

CITY OF PLANO, TEXAS



ENGINEERING DEPARTMENT

MANUAL

**FOR THE DESIGN OF
WATER & SANITARY SEWER LINES**

JANUARY, 1997

CITY OF PLANO

**MANUAL FOR THE DESIGN OF
WATER AND SANITARY SEWER LINES**

SECTION A - NOTES TO ENGINEERS

This manual is intended to aid and assist private engineers in the layout and design of sanitary sewers and water lines to definite standards and to obtain uniformity in the plans. It is recognized that each addition has its individual problems and that no fixed rules will apply to all cases; therefore, final approval of all or any part of any plans rests with the City Engineer.

1. Submittal: On completion of the plan and engineering of a subdivision, it will be to your advantage to bring or send two copies along with a contour map and preliminary water and sewer layout to this office, whereby a check can be made as to the general layout and availability of water and sewer. If problems arise as to the availability of water and sewer, it may be necessary to have a meeting with the developer and discuss the problems.
2. Preliminary Check: When the engineering plans are complete, send in five sets of good, legible blue line prints. We will try to review plans within two weeks if they have no peculiar problems.
3. Final Check: When the plans are returned to you after preliminary check, and if the corrections were few, the final plans may be brought in with the marked up set. If there were many corrections, then one or more sets of prints should be submitted again.
4. Final Approval of Plans: Before you request approval of the plans, check the following:
 - a. The plans must be complete and correct.
 - b. The approved plat must have been submitted.
 - c. The street grades and storm sewer plans must have been submitted and approved.
 - d. The plans must be signed and sealed by the Registered Professional Engineer who is responsible for the design.
 - e. All fees and other monies due must be paid in full.

- f. Contractor's insurance must be in correct form.
 - g. Four sets of complete engineering plans are required for city use. There should be additional approved plans available for Contractors and Engineering Consultants use during construction of the improvements. Only those plans with the "approved" stamp will be recognized by the Construction Inspector.
 - h. If all of the preceding have been done, the plans are ready for approval by the Engineering Division.
- 5. Specifications are the Standard Specifications for Public Work Construction, North Central Texas.
 - 6. Special Provisions are City of Plano Special Provisions to the Specifications.
 - 7. Standard Details are City of Plano Standard Construction Details.

SECTION B - WATER MAINS

In general, water mains are placed on the north and west sides of a street, at a distance of ten feet from the centerline of the street, or otherwise as directed by the Engineering Division. See Exhibit "B" for details of locations. Where applicable, line sizes will comply with the Water Distribution System Master Plan dated September 1987, or subsequent revisions.

- 1. For mains over 1,200 feet in length or mains supplying more than one fire hydrant, 8-inch pipe will be required in residential districts. For mains over 600 feet in length in commercial and manufacturing districts, 12-inch pipe may be required.
- 2. For mains less than 1,200 feet in length in residential districts and supplying not more than one fire hydrant, 6-inch pipe will be required. Deadend mains shall not exceed 600 feet in length, and a water meter service in a meter box will be required, at the end of the main.
- 3. In non-residential developments, minimum 8-inch mains will be required. Water mains must be of adequate size to provide for the building total fire flow.
- 4. No water main shall be located nearer than five feet from any tree or structure.
- 5. Water Main Material:
 - a. All water mains 12-inch in diameter and under shall be ductile iron or AWWA C900 PVC, mechanical joint, or a joint of the type which provides a recession in the bell for the employment of a single rubber gasket to be placed before the insertion of the succeeding spigot. Joint material for PVC shall conform to ASTM F477. Tracer wire shall be installed over all PVC mains.

- b. All water mains 14-inch in diameter and larger shall be Reinforced Concrete, Pretensioned Reinforcement (Steel Cylinder Type)", complying with American Water Works Association Specifications C-303. Profile elevations shall be provided for mains 14-inch in diameter and larger.
 - c. All mains supplying fire sprinkler systems outside of utility easements shall be minimum 200 PSI working pressure and U.L. listed.
6. Valves 12-inch and under shall be placed on or near street property lines not over 800 feet apart in residential, duplex and apartment districts and not over 500 feet apart in all other districts; and in such a manner as to require preferably two, but not more than three valves to shut down each City block, or as may be required to prevent shutting off more than one fire hydrant. On cross-feed mains without services, a maximum of four valves shall be used to shut down each block. Also, valves shall be placed at or near the ends of mains in such manner that a shut down can be made for a future main extension without causing loss of service on the existing main. The location of valves larger than 12-inch will be as approved by the Engineering Division. Valves 12-inch and under will be Resilient Seat Gate Valves (RSGV). Valves over 12-inch will be Butterfly Valves.

7. Fire Hydrants

Section 1. Number and Locations

A sufficient number of fire hydrants shall be installed to provide hose stream protection for every point on the exterior wall of the building with the lengths of hose normally attached to the hydrants. There shall be sufficient hydrants to concentrate the required fire flow, as recommended by the publication "GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOW" published by the Insurance Service Office, around any building with no hose line exceeding the distances hereinafter established and with an adequate flow available from the water system to meet this required flow. In addition, the following guidelines shall be met or exceeded:

- a. Single Family and Duplex Residential - As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections at a maximum spacing of 500 feet between fire hydrants as measured along the route that fire hose is laid by a fire vehicle.
- b. Multi-Family Residential - As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections at a maximum spacing of 400 feet as measured along the length of the centerline of the roadway, and the front of any structure at grade shall be no further than 500 feet from a minimum of two fire hydrants as measured along the route that a fire hose is laid by a fire vehicle.

- c. Other Districts - As the property is developed, fire hydrants shall be located at all intersecting streets and at intermediate locations between intersections at a maximum spacing of 300 feet as measured along the length of the centerline of the roadway, and the front of any building at grade shall be no farther than 300 feet from a minimum of two fire hydrants as measured along the route that the fire hose is laid by a fire vehicle.
- d. Protected Properties - Fire hydrants required to provide a supplemental water supply for automatic fire protection systems shall be within 100 feet of the Fire Department connection for such system.
- e. Buildings Fire Sprinkled - An 8-inch fire line stub-out with valve shall be provided for all buildings to be sprinkled. A smaller stub-out can only be used with Fire Department approval.
- f. Fire hydrants shall be installed along all fire lane areas as follows:
 - 1. Non-Residential Property or Use
 - A. Within 150 feet of the main entrance.
 - B. Within 100 feet of any Fire Department connection.
 - C. At a maximum intermediate spacing of 300 feet as measured along the length of the fire lane.
 - 2. Apartment, Townhouse, or Cluster Residential Property or Use
 - A. Within 100 feet of any Fire Department connection.
 - B. At maximum intermediate spacing of 400 feet as measured along the length of the fire lane.
- g. Generally, no fire hydrant shall be located closer than fifty (50) feet to a non-residential building or structure unless approved by the Engineering Division and the Fire Department.
- h. In instances where access between the fire hydrant and the building which it is intended to serve may be blocked, extra fire hydrants shall be provided to improve the fire protection. Railroads, divided thoroughfares, expressways, blocks which are subject to buildings restricting movement, and other man-made or natural obstacles are considered as barriers.

Section 2. Restrictions

- a. All required fire hydrants shall be of the national standard three (3) way break-away type no less than five and one-fourth (5 ¼) inches in size and shall conform to the provisions of the latest A.W.W.A. specifications C-502 and shall be placed upon water mains of no less than six (6) inches in size. Fire hydrants shall be as specified in the Specifications and/or Special Provisions. Fire hydrants shall have a bury depth of five feet.
- b. Valves shall be placed on all fire hydrants leads.
- c. Required fire hydrants shall be installed so the break away point will be no less than two (2) inches, and no greater than six (6) inches above the grade surface.
- d. Fire hydrants shall be located a minimum of two (2) feet and a maximum of six (6) feet behind the curb line, based on the location of the sidewalk. The fire hydrant shall not be in the sidewalk.
- e. All required fire hydrants placed on private property shall be adequately protected by either curb stops or concrete posts or other methods as approved by the Engineering Division and the Fire Department and shall be in easements. Such stops or posts to be the responsibility of the land owner on which the said fire hydrant is placed.
- f. All required fire hydrants shall be installed so that the steamer connection will face the fire lane or street, or as directed by the Fire Department.
- g. Fire hydrants, when placed at intersections or access drives to parking lots, when practical, shall be placed so that no part of the fire truck will block the intersection or parking lot access when connections to the fire hydrant are made.
- h. Fire hydrants, required by this article, and located on private property, shall be accessible to the Fire Department at all times.
- i. Fire hydrants shall be located at street or fire lane intersections, when feasible.
- j. A Blue Stimsonite, Fire-Lite reflector (or approved equal) shall be placed in the center of the street opposite fire hydrants.
- k. In non-residential developments an 8-inch lead will be required on all fire hydrants that are located more than 50 feet from the looped main.

- I. Fire hydrant bonnet shall be painted according to the main size to which it is attached. See chart below. The remainder of the hydrant above ground shall be painted aluminum.

<u>Water Main Size</u>	<u>Color</u>
4"	Red
6"	Silver
8"	Blue
10" & larger	Yellow

- 8. Four-inch mains used for hydrant supply shall be replaced and dead-ends eliminated where practical. Six-inch lines shall be connected so that not more than one hydrant will be between intersecting lines and not more than two hydrants on an eight-inch main between intersecting lines.
- 9. The minimum cover to the top of the pipe must vary with the valve stem. In general, the minimum cover below the top of the street subgrade should be as follows: 6-inch and smaller, 3.5 feet; 8-inch, 4.0 feet; 12-inch, 4.5 feet to 5 feet; and 16-inch, 5.0 feet to 5.5 feet. Lines larger than 16-inch shall have a minimum of six feet of cover which is sufficient to allow water and sewer and other utilities to go over the large main. For water lines to be constructed along county-type roads commonly built with a high crown about the surrounding property, increase the cover as required to allow for future paving grade changes.
- 10. A service with a meter box is constructed from the main to a point just behind the curb line, usually in advance of paving. The location of the meter box is at or near the center of the front of the lot to be served. On multiple apartments and business properties, the desired size and location is usually specified by the owners or architect. Minimum requirements for water service sizes are:
 - a. One-inch copper services are required to serve all residential lots including townhouse lots and patio homes. One-inch copper services are required to serve lots zoned Duplex. Separate services shall be provided for each of the family units.
 - b. The size of apartment, condominium, or multi-family services will depend on the number of units served with a minimum of one meter per building.
 - c. All services on existing water mains that are 2" or smaller should be made by Utility Operations.
 - d. Bullheads may be used for retrofit only, where the water main is under the pavement.
- 11. A domestic service connection shall not be allowed on fire hydrant leads except as authorized by the Engineering Division.

SECTION C - SANITARY SEWERS

INTRODUCTION

The City of Plano has been authorized by the Texas Natural Resource Conservation Commission to review all plans for proposed sanitary sewers within the city. To comply with this authorization the city has adopted a policy that all sewers will be designed in accordance with Chapter 30 Texas Administrative Code Chapter 317 -- "Design Criteria For Sanitary Sewage Systems." Further, all Engineers submitting designs to the City are required to complete the Administrative and Technical Review Questionnaire found in Appendix A of this manual. The Engineer will be required to keep the questionnaire, and all associated calculations and data, on file for a period of one-year from the date of final acceptance of the completed project. When requested in writing the Engineer will furnish, within in five working days of receiving the notice, to the City of Plano copies of the questionnaire.

As a minimum, the Engineer shall keep on file copies of submittal documents, correspondence related to the review and approval of the project, construction inspection reports, and testing results.

PROCEDURE FOR VARIANCES

When, in the course of completing the questionnaire, any question is answered "no" a variance from the design criteria set forth in Chapter 317 must be requested. To obtain a variance the Engineer must complete question T-113 of the questionnaire.

SANITARY SEWERS

1. Sizes and grades for sanitary sewer shall be as required by the Engineering Division, and consideration shall be given as to possible extensions for future development. No sanitary sewers, other than laterals and force mains, shall be less than 6-inches in diameter. If feasible, sewers shall be placed in streets. Sewers are usually located in the center of the street. Each addition has its individual problems, therefore, no fixed rules will apply to all cases. See Exhibit "B" for details of locations.
2. Railroad, State Highway and creek crossings, etc., shall be as approved by the Engineering Division.
3. The Engineer shall include on the design plans a summary of pipe sizes, pipe materials, and joint materials.
4. Minimum cover shall be 3.5 feet; exceptions authorized by the Engineering Division shall have concrete protection. In general, the minimum depth for sewer to serve given property with a 4-inch lateral shall be 3-feet plus 2% times the length of the house lateral (the distance from the sewer to the center of the house). Thus, for a house 135 feet from the sewer, the depth would be 3-feet plus 2% x 135 feet = 3.0

plus 2.7 = 5.7 feet. The depth of the flow line of the sewer should then be at least 5.7 feet below the elevation of the ground at the point where the service enters the house. Profiles of the ground line 20-feet past the building line will be required to verify that this criteria is met. On lines deeper than 12 feet, a parallel sewer line will be required when laterals are to be attached. This requirement should be discussed with the Engineer.

5. No sewer line shall be located nearer than five feet from any tree or structure.
6. No sanitary sewer in alleys unless approved by the Engineering Division.

7. Curved Sewers

No vertical curves will be allowed.

Horizontal curvature may be by joint deflection or pipe flexure but not both. The Engineer must specify on the plans the method of deflection allowed and the allowable radius or joint deflection for each pipe size.

When pipe flexure is used, the minimum radius of curvature shall be equal to that recommended by the pipe manufacturer or $300 \cdot D_o$, where D_o is the average outside diameter of the pipe in inches, which ever is greater. The Engineer shall note on the plans that, when using pipe flexure, all joints are to remain fully seated.

If joint deflection will be used to provide horizontal curvature, the allowable deflection shall be 5° or 80% of the Manufacturer's recommended maximum joint deflection, or 80% of the National Reference Standard maximum recommended joint deflection, which ever is less. When joint deflection is used the Engineer must specify the size of mandrel used for deflection testing. The mandrel shall be sized to verify that the maximum joint deflection has not been exceeded.

Horizontal curves shall match change in street direction as near as possible, but will not be allowed across residential single family and duplex lots.

Slopes on curved sewers shall be a minimum of 3% greater than the corresponding minimum slope of sewers on a straight line.

Manholes on curved sewers shall be located at the P.C. and P.T. of the curve and a maximum spacing of 300 feet along the curve. Sewage flow shall be computed in accordance with Exhibit "A", with the exceptions, as required by the Engineering

Division. The minimum acceptable "n" factor for use in design of sanitary sewers shall be 0.013. Pipes should be placed on such a grade that the velocity when flowing full is not less than two feet or more than ten feet per second. Minimum grades based on n = 0.013 shall be as follows:

Size of Pipe in IN. I.D.	Minimum Slope in Percent	Maximum Slope in Percent
6	0.50	12.35
8	0.33	8.40
10	0.25	6.23
12	0.20	4.88
15	0.15	3.62
18	0.11	2.83
21	0.09	2.30
24	0.08	1.93
27	0.06	1.65
30	0.055	1.43
33	0.05	1.26
36	0.045	1.12
39	0.04	1.01
> 39	*	*

* For lines larger than 39-inches in diameter, the slope shall be determined using Manning's equation to maintain a minimum velocity of 2 feet per second when flowing full and a maximum velocity of 10 feet per second when flowing full.

$$V = \frac{1.49}{n} * R^{2/3} \sqrt{S}$$

Where V = velocity (ft/sec)
n = Manning's Roughness Coefficient (0.013)
R = Hydraulic Radius (ft)
S = Slope (ft/ft)

8. All grades shall be shown to the nearest 0.01 foot.

9. The sizes and locations of manholes, wyes, bends, tap connections, cleanouts, etc., shall be designated by the Engineering Division. In general, manholes shall be placed at all four-way connections and three-way connections, changes in grade and direction, and the maximum spacing 500 feet.
10. The diameter of a manhole constructed over the center of a sewer should vary with the size of the sewer. For 6", 8", and 10" sewers, the manhole shall be 4.0 foot minimum diameter; for 12", 15", 18", 21", 24" and 27" - 5.0 foot minimum diameter; 30" and 36" - 6 foot minimum diameter.
11. In Flood Plains, sealed manholes "Type S" shall be used to prevent the entrance of storm water. Where more than three manholes in sequence are to be bolted and gasketed, every third manhole shall be vented above the 100-year floodplain elevation. The Engineer shall provide the elevation of the 100-year flood. Sealed manholes shall also be used in all areas subject to carrying drainage flow or in drainage ways.
12. Clean-outs shall be placed on the ends of all lines. Drop manholes shall be required when the inflow elevation is more than 18-inches above the outflow elevation. All drops shall be located outside the manhole. Construct manholes at each end of lines that are installed by other than open cut and at each end of aerial crossing lines.
13. Where unequal size pipes enter a manhole, the crown of the pipes should be set at the same elevation.
14. In order to provide access for sewer lines for cleaning, manholes and/or cleanouts shall be so located that 250 feet of sewer rod can reach any point in the line. This means that spacing between a manhole and an upstream cleanout shall be limited to 400 feet. Cleanouts may be located at the end of the line only.

LATERALS:

1. The sizes and locations of laterals shall be as designated by the Engineering Division. In general, for single family dwellings, the lateral size shall be 4" minimum; for multiple units, apartments, local retail and commercial - 6" minimum; for manufacturing and industrial, the size should be 8" or larger as required. House laterals usually come out 10 feet downstream from the center of the lot and shall have a 10-foot lateral separation from the water service. Manholes will be required on 6-inch and larger laterals where they connect to the main line. Laterals will not be attached to sewer mains that are deeper than 12 feet. A minimum of one lateral per building shall be required. Also, a minimum of one lateral per residential lot shall be required. Duplexes shall have two laterals.

2. Construction Staking - Line and grade stakes for construction shall be furnished by the developer's Engineer. All property lines and corners must be properly staked to insure correct alignment. The City will not be liable for improper alignment or delay of any kind caused by improper or inadequate surveys by the developer or by interference of other utilities.
3. Materials for Sewer Lines:

The material used for the sanitary sewer shall be designed for a minimum structural life cycle of 50 years. If the pipe material will deteriorate when subjected to corrosive conditions, the Engineer shall provide for an acceptable corrosion resistant liner or provide calculation and data that demonstrated that the design and operational characteristics will provide for the minimum life cycle.

Rigid Pipe - For this manual, rigid pipe shall include reinforced concrete pipe and ductile iron pipe. If the proposed project contains the option for use of rigid pipe, the Engineer shall perform an engineering analysis which shows that pipe is adequate to withstand the designed loads. The Engineer shall, as a minimum consider trench, depth of cover, effect of water table, etc. when analyzing the pipe. Copies of the analysis must be provided to the City of Plano within five days of written request from the city.

Flexible Pipe -- The Engineer shall include in his analysis the following:

Method of defining the modulus of subgrade reaction, E' ;

For the bedding material, E'_b ; and;

For the natural soil, E'_n or other specific information that is necessary to quantify of the in situ material on the effective modulus, E'_e ;

Included within the analysis are calculations for the effective modulus, prism loads, live loads, long-term deflection, strain, bending strain, buckling, and wall crushing. Copies of the analysis must be provided to the City of Plano within five days of written request from the city.

- a. All sewer pipe shall be PVC complying with ASTM 3034 or F794 with a cell classification of 12454b or c.

Reinforced Concrete Pipe is allowed only on a case by case basis and then only, on lines larger than 30 inches in diameter. The City of Plano will issue written approval for use of RCP on those projects where it must be used.

Vitrified clay pipe will not be allowed in the City of Plano.

- b. Sewer pipe shall conform to the Specifications and/or Special Provisions.
- c. Sewer pipe joint materials shall have resilient properties, conforming to the Specifications and/or Special Provisions.

SECTION D - FORM OF PLANS

1. IF IN DOUBT, CHECK WITH THE ENGINEERING DIVISION BEFORE PROCEEDING.
2. Plans shall be clear, legible, and neatly drawn on bordered sheets, size 24" x 36". Each sheet shall clearly display the Texas Professional Engineer's seal of the Engineer under whose direction the plans were designed. A title block in the lower right-hand corner shall be filled in to include: (1) project name; (2) Engineer's name, address, and telephone number.
3. The plan sheet should be drawn so that the north arrow points to the top or to the left side of the sheet. It is important that the plan show sufficient surrounding streets, lots, and property lines so the existing water and sewer may be adequately shown and so that proper consideration may be given to future extensions. Proposed water and sewer lines shall be stubbed out to the addition extremities in order that future extensions may be made with a minimum of expense and inconvenience. Unless it would make the plan very difficult to read, both water and sewer lines should be shown on the same sheet. The lines on the profile sheet shall be drawn in the same direction as on the plan. Lettering shall be oriented to be read upward or to the left.
4. On large additions or layouts requiring the use of more than six sheets (total of plan & profile), key sheets may be required on a scale of 1" = 400' or 1" = 1000', as designated by the Engineering Division. They shall show the overall layout with the specific project clearly indicated with reference to individual sheets.
5. The use of "off-standard" scales will not be permitted. A plan shall be drawn to scales of 1" = 100', or 1" = 40'. Plans for water and sewer that do not involve great detail should be drawn on a scale of 1" = 100'. These may be on plan-profile sheets or the "plan" may be drawn with the profiles on full ruled profile cloth. (If required for clarity, a separate sheet on 1" = 40' scale may be used to show details.) Plans in and along creeks, heavily wooded sections, streets with numerous utilities, or as may be required to produce a clean and legible drawing, shall be drawn on plan-profile sheets or separate plan and profile sheets on a scale 1" = 40'. If the plan is in an extremely congested area, a scale of 1" = 20' may be necessary and will be permitted. All profiles shall be drawn on a vertical scale as required for clarity, and the horizontal scale shall be the same as for the plan unless otherwise directed by the Engineering Division.

SECTION E - DATA TO BE INCLUDED

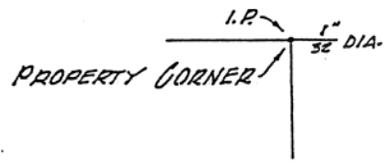
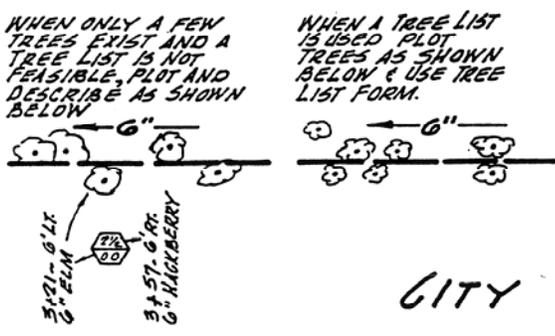
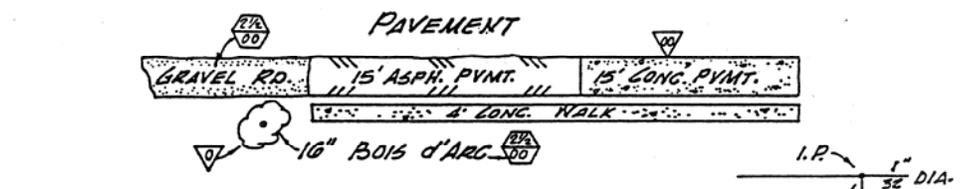
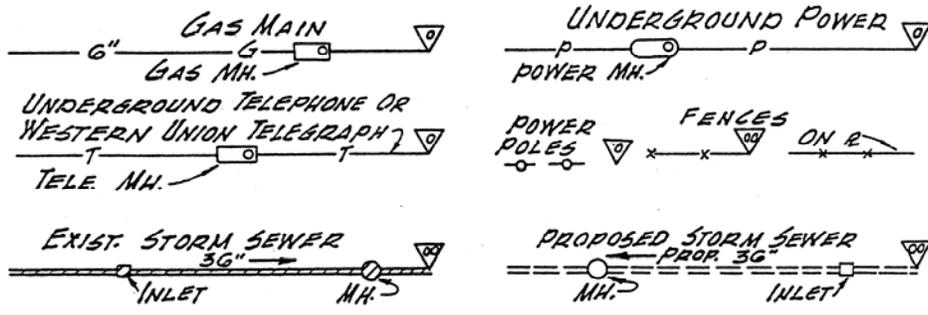
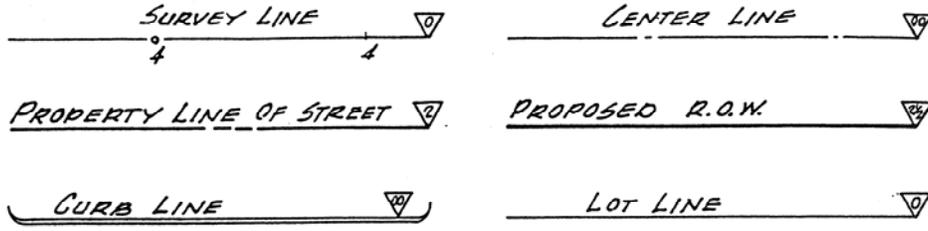
1. Sewer Data to be included on Plan Sheet: The plan shall show the existing and proposed water and sewer lines and all appurtenances thereto. The plan should also have the storm sewer system dashed in. All lines shall be numbered, lettered or otherwise designated on both plan and profile sheets. All lines shall show sizes and direction of flow on both plan and profile sheets. Stationing shall be shown to the nearest 0.1 foot and each new line shall begin at 0+00 at the outlet and increase up the sewer. Station pluses at all junctions of sewers, horizontal P.C.'s, and P.T.'s, bends, angle points, wyes, cleanouts, manholes, the centerlines of all cross streets and railroads, and all crossing utilities, etc., shall be shown on both plan and profile. The degree of angles and horizontal curve data shall be shown on the plan only. Minimum Radius for sanitary sewer mains is 200 feet. Sewer laterals shall be shown at a location most convenient to serve the property. Sewer laterals will usually be near the center of the lot, either at the street or alley. If the lateral is to be adjacent to the water service, then show the lateral 10 feet downstream. The location shall be designated on the plans.
2. Sewer Data to be included on the Profile Sheet: The data for the profile sheet shall be obtained by running a line of levels along the actual route and by taking any other necessary observations. Profiles shall show the elevations to the nearest 0.1 foot of the ground at the centerline of the sewer, and to the right and left of the centerline of the sewer at the location of the approximate center of the proposed houses or buildings to be served, and the approved street or alley grade. Profiles shall also show the sewer pipe, manholes, cleanouts, etc. The size of the sewer, the direction of the flow, and the grade to the nearest 0.01 foot shall be indicated just over the "pipe" and the total linear footage of line, size, kind of pipe, and type of embedment or encasement shown below the "pipe". All of the information pertaining to the horizontal data, station pluses, appurtenances to be built, etc., is usually shown just above the ground line, whereas, the flow line (invert) elevations are shown below the pipe. Elevations of crossing and parallel utilities shall be shown. All invert elevations shall be shown to the nearest 0.01 foot. Invert elevations shall be recorded at all junctions (all lines-in and out), at grade breaks, the ends of lines, or other points as requested by the Engineering Division. Bench marks used shall also be clearly shown, giving the descriptive locations and elevations. Elevations must be from sea level datum, not assumed. Bench level circuits should begin at a USGS monument and bench mark of second order accuracy established at least every one-half mile through the project. All existing water, sewer, gas, storm sewer, telephone, power, and other utilities parallel to or crossing the proposed sewer or water line shall be adequately designated as to size, type, and location. Drainage area maps and capacity calculations for mains 10" and larger will be required.
3. Data to be Included for Water Plan and Profile: For water lines in new subdivisions, very little data need to be included. Indicate the location of any existing valves required for shut-down purposes and of any tees, ends, etc., to be tied into. Indicate clearly the sizes of the lines to be installed, and all proposed valves, fire

hydrants, tees, crosses, bends, reducers, plugs, sleeves, wet connections, tap connections, creek, railroad or highway crossings, tunnels, meter boxes, valve vaults, and other appurtenances at each intersection or as required. Where the pipe is to be laid around a curve, the curve data on the plat is usually sufficient unless otherwise requested. The size and type of services and the material, type of joint, and class of pipe may be indicated by adequate notation in the lower left or right hand corners of the plan sheet. Water services and meter boxes shall be indicated and shall be located at or near the center of the front of each lot. If a water line requires a profile, then follow the general procedures as outlined for sewers, except that the grades and elevations of the proposed water line usually need not be shown closer than the nearest 0.1 foot.

SECTION F - SYMBOLS

All plans drawn for the city by engineers shall be as nearly alike as possible; therefore, standard symbols and lines will be on all plans. (See the attached Table)

SYMBOLS FOR WATER & SANITARY SEWER PLANS

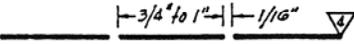


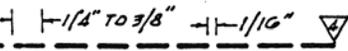
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SYMBOLS FOR WATER & SANITARY SEWER PLANS

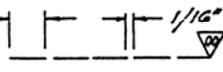
PROPOSED WATER MAINS

8" OR LARGER 

6" 

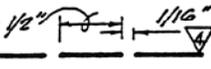
4" 

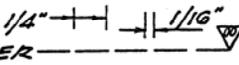
2" OR SMALLER 

FUTURE WATER 

FIRE HYDRANT ● 5/32" DIA.

PROPOSED SANITARY SEWER

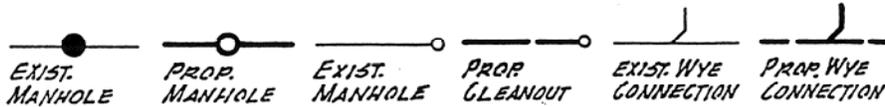
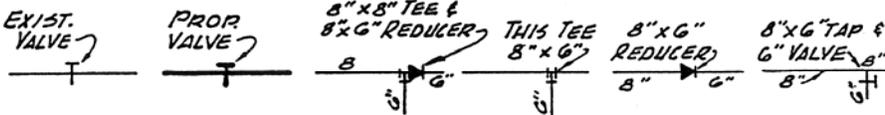
ALL SEWERS 

FUTURE SEWER 

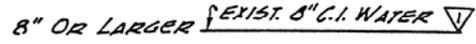
MANHOLE ○ 11/64" DIA. ▽

CLEANOUT ○ 3/32 DIA. ▽

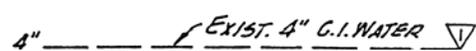
RAPIDOGRAPH PEN SIZE INDICATED IN TRIANGLE ▽

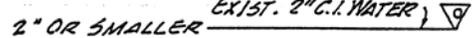


EXISTING WATER MAINS

8" OR LARGER 

6" 

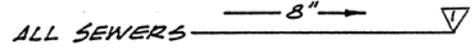
4" 

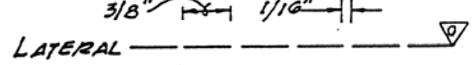
2" OR SMALLER 

FIRE HYDRANT ○ 5/32" DIA. ▽

WATER METER ○ 5/64" DIA. ▽
FOR PROPOSED WATER & SANI. SEW. MAINS REFERENCED ON SHEET A14-17

EXISTING SANITARY SEWER

ALL SEWERS 

LATERAL 

MANHOLE ● 5/32" DIA. ▽

CLEANOUT ○ 5/64" DIA. ▽

CITY OF PLANO

SANITARY SEWER DAILY FLOW CALCULATIONS

Apartment Sanitary Sewer Flow

95 gal. x .75 = 71.25 gal. per day per person

22 units per acre with 3 persons per unit

Calculations (71.25) (22) (3) = 4,702 or 4,700 gallons per day per acre.

Office Sanitary Sewer Flow

3100 parking spaces for 34.7 acres

One person per parking space

20 gallons per person per day

$\frac{3100}{34.7 \text{ acres}} = 89.33 \text{ persons per acre (20 gal)} = 1,786.7 \text{ or } \underline{1,790} \text{ gal. per day per acre.}$

Residential Sanitary Sewer Flow

95 gallons per person per day

4 units per acre

3.5 persons per unit

(95) (4) (3.5) = 1330 gallons per acre per day

Hospital Sanitary Sewer Flow

200 beds - Plano General Hospital

200 gallons per day per bed

200 x 200 = 40,000 gallons per day

Nursing Home Sanitary Sewer Flow

150 beds - Heritage Manor

90 gallons per day per bed

90 x 150 = 13,500 gallons per day

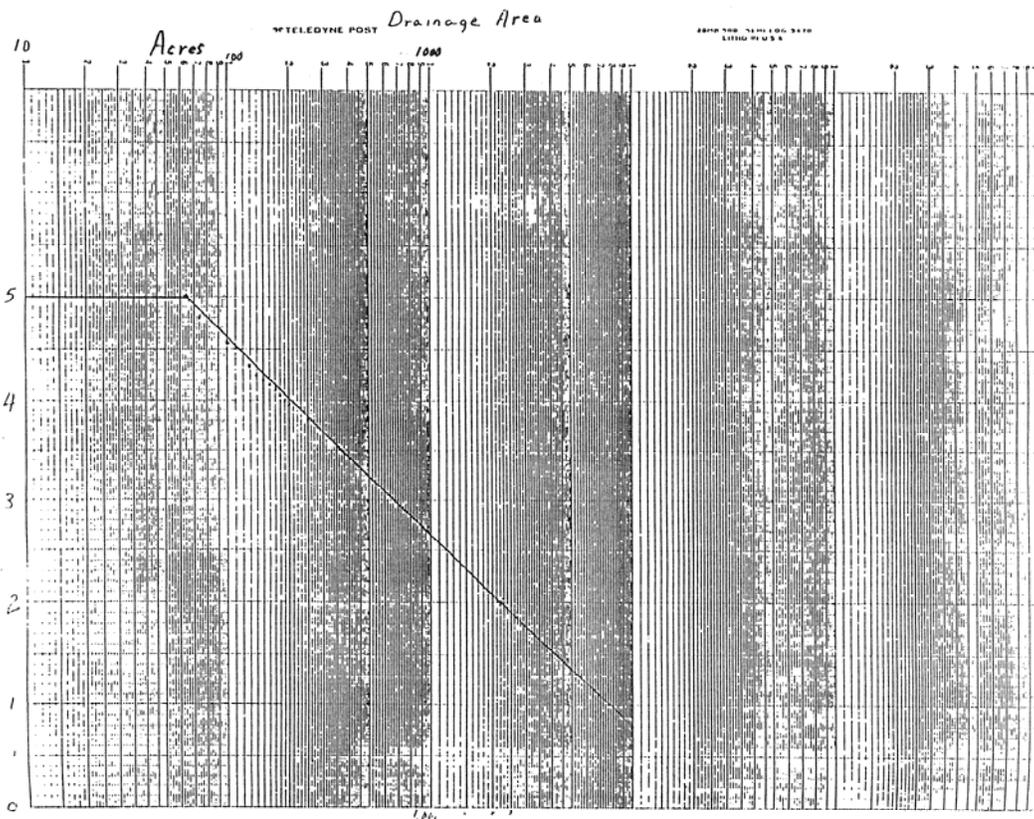
Patio Home Sanitary Sewer Flow

95 gallons per person per day

10 units per acre

3.5 persons per unit

$(95) (10) (3.5) = 3,325$ gallons per day/acre

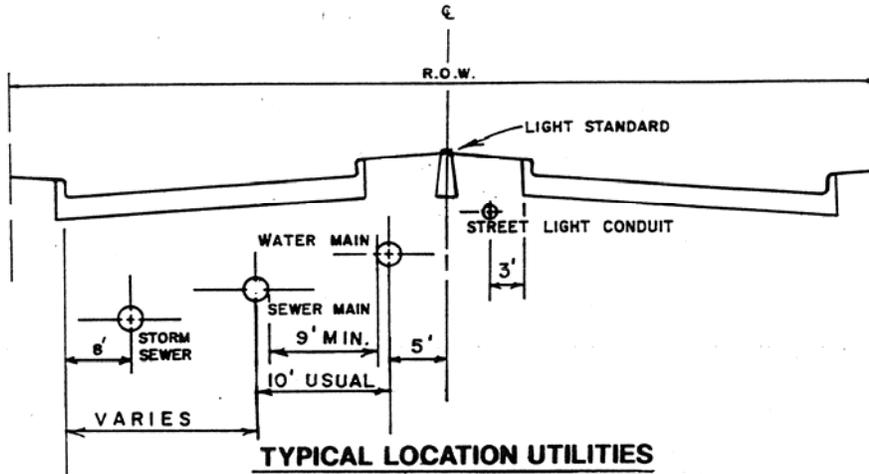


Sanitary Sewer Drainage

EXHIBIT A

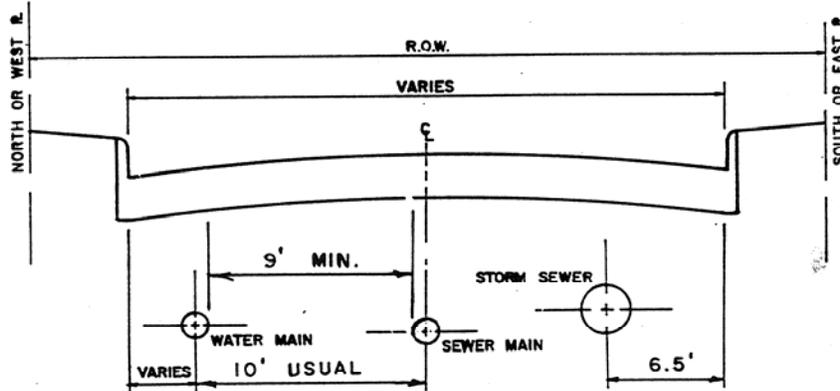
DRAINAGE AREA IN ACRES	DOMESTIC FLOW	DOMESTIC DRAINAGE FACTOR	MAX. DOMESTIC FLOW (LESS INFILTRATION)	INFILTRATION (DOMESTIC ONLY) 750 GAL./AC.	DAILY MAX. DOMESTIC FLOW IN GAL./DAY	DAILY COMMERCIAL FLOW IN GAL./DAY	DAILY INDUSTRIAL FLOW IN GAL./DAY	MAX. APARTMENT FLOW IN GAL./DAY	DAILY APARTMENT FLOW IN GAL./DAY	MAX. PATIO BOKE FLOW GAL./DAY	DAILY PATIO BOKE FLOW IN GAL./DAY
1.1	133	5.0	465	75	740	300	250	2,350	2,425	1,462.5	1,737.5
1.2	166	"	1,330	250	1,480	1,000	500	4,150	4,150	4,887.5	5,112.5
1.3	399	"	1,395	500	1,960	1,000	1,000	4,700	4,700	6,250	6,250
1.4	331	"	3,325	375	3,700	2,300	1,150	11,750	11,750	15,112.5	15,112.5
1.5	442	"	2,290	325	2,440	1,440	1,000	4,100	4,100	5,112.5	5,112.5
1.6	394	"	2,290	325	2,440	1,440	1,000	4,100	4,100	5,112.5	5,112.5
1.7	591	"	5,520	400	5,920	4,000	2,000	16,800	16,800	23,200	23,200
1.8	1,084	"	5,985	475	6,460	4,300	2,150	21,150	21,150	28,487.5	28,487.5
1.9	1,197	"	6,450	550	7,000	5,000	2,500	23,500	23,500	31,000	31,000
2.0	1,300	"	6,915	625	7,540	5,500	2,750	25,750	25,750	33,500	33,500
2.1	1,403	"	7,380	700	8,080	6,000	3,000	28,000	28,000	36,000	36,000
2.2	1,506	"	7,845	775	8,620	6,500	3,250	30,250	30,250	38,500	38,500
2.3	1,609	"	8,310	850	9,160	7,000	3,500	32,500	32,500	41,000	41,000
2.4	1,712	"	8,775	925	9,700	7,500	3,750	34,750	34,750	43,500	43,500
2.5	1,815	"	9,240	1,000	10,240	8,000	4,000	37,000	37,000	46,000	46,000
2.6	1,918	"	9,705	1,075	10,780	8,500	4,250	39,250	39,250	48,500	48,500
2.7	2,021	"	10,170	1,150	11,320	9,000	4,500	41,500	41,500	51,000	51,000
2.8	2,124	"	10,635	1,225	11,860	9,500	4,750	43,750	43,750	53,500	53,500
2.9	2,227	"	11,100	1,300	12,400	10,000	5,000	46,000	46,000	56,000	56,000
3.0	2,330	"	11,565	1,375	12,940	10,500	5,250	48,250	48,250	58,500	58,500
3.1	2,433	"	12,030	1,450	13,480	11,000	5,500	50,500	50,500	61,000	61,000
3.2	2,536	"	12,495	1,525	14,020	11,500	5,750	52,750	52,750	63,500	63,500
3.3	2,639	"	12,960	1,600	14,560	12,000	6,000	55,000	55,000	66,000	66,000
3.4	2,742	"	13,425	1,675	15,100	12,500	6,250	57,250	57,250	68,500	68,500
3.5	2,845	"	13,890	1,750	15,640	13,000	6,500	59,500	59,500	71,000	71,000
3.6	2,948	"	14,355	1,825	16,180	13,500	6,750	61,750	61,750	73,500	73,500
3.7	3,051	"	14,820	1,900	16,720	14,000	7,000	64,000	64,000	76,000	76,000
3.8	3,154	"	15,285	1,975	17,260	14,500	7,250	66,250	66,250	78,500	78,500
3.9	3,257	"	15,750	2,050	17,800	15,000	7,500	68,500	68,500	81,000	81,000
4.0	3,360	"	16,215	2,125	18,340	15,500	7,750	70,750	70,750	83,500	83,500
4.1	3,463	"	16,680	2,200	18,880	16,000	8,000	73,000	73,000	86,000	86,000
4.2	3,566	"	17,145	2,275	19,420	16,500	8,250	75,250	75,250	88,500	88,500
4.3	3,669	"	17,610	2,350	19,960	17,000	8,500	77,500	77,500	91,000	91,000
4.4	3,772	"	18,075	2,425	20,500	17,500	8,750	79,750	79,750	93,500	93,500
4.5	3,875	"	18,540	2,500	21,040	18,000	9,000	82,000	82,000	96,000	96,000
4.6	3,978	"	19,005	2,575	21,580	18,500	9,250	84,250	84,250	98,500	98,500
4.7	4,081	"	19,470	2,650	22,120	19,000	9,500	86,500	86,500	101,000	101,000
4.8	4,184	"	19,935	2,725	22,660	19,500	9,750	88,750	88,750	103,500	103,500
4.9	4,287	"	20,400	2,800	23,200	20,000	10,000	91,000	91,000	106,000	106,000
5.0	4,390	"	20,865	2,875	23,740	20,500	10,250	93,250	93,250	108,500	108,500
5.1	4,493	"	21,330	2,950	24,280	21,000	10,500	95,500	95,500	111,000	111,000
5.2	4,596	"	21,795	3,025	24,820	21,500	10,750	97,750	97,750	113,500	113,500
5.3	4,699	"	22,260	3,100	25,360	22,000	11,000	100,000	100,000	116,000	116,000
5.4	4,802	"	22,725	3,175	25,900	22,500	11,250	102,250	102,250	118,500	118,500
5.5	4,905	"	23,190	3,250	26,440	23,000	11,500	104,500	104,500	121,000	121,000
5.6	5,008	"	23,655	3,325	26,980	23,500	11,750	106,750	106,750	123,500	123,500
5.7	5,111	"	24,120	3,400	27,520	24,000	12,000	109,000	109,000	126,000	126,000
5.8	5,214	"	24,585	3,475	28,060	24,500	12,250	111,250	111,250	128,500	128,500
5.9	5,317	"	25,050	3,550	28,600	25,000	12,500	113,500	113,500	131,000	131,000
6.0	5,420	"	25,515	3,625	29,140	25,500	12,750	115,750	115,750	133,500	133,500
6.1	5,523	"	25,980	3,700	29,680	26,000	13,000	118,000	118,000	136,000	136,000
6.2	5,626	"	26,445	3,775	30,220	26,500	13,250	120,250	120,250	138,500	138,500
6.3	5,729	"	26,910	3,850	30,760	27,000	13,500	122,500	122,500	141,000	141,000
6.4	5,832	"	27,375	3,925	31,300	27,500	13,750	124,750	124,750	143,500	143,500
6.5	5,935	"	27,840	4,000	31,840	28,000	14,000	127,000	127,000	146,000	146,000
6.6	6,038	"	28,305	4,075	32,380	28,500	14,250	129,250	129,250	148,500	148,500
6.7	6,141	"	28,770	4,150	32,920	29,000	14,500	131,500	131,500	151,000	151,000
6.8	6,244	"	29,235	4,225	33,460	29,500	14,750	133,750	133,750	153,500	153,500
6.9	6,347	"	29,700	4,300	34,000	30,000	15,000	136,000	136,000	156,000	156,000
7.0	6,450	"	30,165	4,375	34,540	30,500	15,250	138,250	138,250	158,500	158,500
7.1	6,553	"	30,630	4,450	35,080	31,000	15,500	140,500	140,500	161,000	161,000
7.2	6,656	"	31,095	4,525	35,620	31,500	15,750	142,750	142,750	163,500	163,500
7.3	6,759	"	31,560	4,600	36,160	32,000	16,000	145,000	145,000	166,000	166,000
7.4	6,862	"	32,025	4,675	36,700	32,500	16,250	147,250	147,250	168,500	168,500
7.5	6,965	"	32,490	4,750	37,240	33,000	16,500	149,500	149,500	171,000	171,000
7.6	7,068	"	32,955	4,825	37,780	33,500	16,750	151,750	151,750	173,500	173,500
7.7	7,171	"	33,420	4,900	38,320	34,000	17,000	154,000	154,000	176,000	176,000
7.8	7,274	"	33,885	4,975	38,860	34,500	17,250	156,250	156,250	178,500	178,500
7.9	7,377	"	34,350	5,050	39,400	35,000	17,500	158,500	158,500	181,000	181,000
8.0	7,480	"	34,815	5,125	39,940	35,500	17,750	160,750	160,750	183,500	183,500
8.1	7,583	"	35,280	5,200	40,480	36,000	18,000	163,000	163,000	186,000	186,000
8.2	7,686	"	35,745	5,275	41,020	36,500	18,250	165,250	165,250	188,500	188,500
8.3	7,789	"	36,210	5,350	41,560	37,000	18,500	167,500	167,500	191,000	191,000
8.4	7,892	"	36,675	5,425	42,100	37,500	18,750	169,750	169,750	193,500	193,500
8.5	7,995	"	37,140	5,500	42,640	38,000	19,000	172,000	172,000	196,000	196,000
8.6	8,098	"	37,605	5,575	43,180	38,500	19,250	174,250	174,250	198,500	198,500
8.7	8,201	"	38,070	5,650	43,720	39,000	19,500	176,500	176,500	201,000	201,000
8.8	8,304	"	38,535	5,725	44,260	39,500	19,750	178,750	178,750	203,500	203,500
8.9	8,407	"	39,000	5,800	44,800	40,000	20,000	181,000	181,000	206,000	206,000
9.0	8,510	"	39,465	5,875	45,340	40,500	20,250	183,250	183,250	208,500	208,500
9.1	8,613	"	39,930	5,950	45,880	41,000	20,500	185,500	185,500	211,000	211,000
9.2	8,716	"	40,395	6,025	46,420	41,500	20,750	187,750	187,750	213,500	213,500
9.3	8,819	"	40,860	6,100	46,960	42,000	21,000	190,000	190,000	216,000	216,000
9.4	8,922	"	41,325	6,175	47,500	42,500	21,250	192,250	192,250	218,500	218,500
9.5	9,025	"	41,790	6,250	48,040	43,000	21,500	194,500	194,500	221,000	221,000
9.6	9,128	"	42,255	6,325	48,580	43,500	21,750	196,750	196,750	223,500	223,500
9.7	9,231	"	42,720	6,400	49,120	44,000	22,000	199,000	199,000	226,000	226,000
9.8	9,334	"	43,185	6,475	49,660	44,500	22,250	201,250	201,250	228,500	228,500
9.9	9,437	"	43,650	6,550	50,200	45,000	22,500	203,500	203,500	231,000	231,000
10.0	9,540	"	44,115	6,625	50,740	45,500	22,750	205,750	205,750	233,500	233,500
10.1	9,643	"	44,580	6,700	51,280	46,000	23,000	208,000	208,000	236,000	236,000
10.2	9,746	"	45,045	6,775	51,820	46,500	23,250	210,250	210,250	238,500	238,500
10.3	9,849	"	45,510	6,850	52,360	47,000	23,500	212,500	212,500	241,000	241,000
10.4	9,952	"	45,975	6,925	52,900	47,500	23,750	214,750	214,750	243,500	243,500
10.5	10,055	"	46,440	7,000	53,440	48,000	24,000	217,000	217,000	246,	

EXHIBIT "B"



TYPICAL LOCATION UTILITIES

STRAIGHT CROWN STREETS



TYPICAL LOCATION UTILITIES

PARABOLIC CROWN STREETS

APPENDIX A

**TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
SEWAGE COLLECTION SYSTEM SUBMITTAL APPLICATION
FOR PLANS AND SPECIFICATIONS REVIEW**

This application is intended as an aid in fulfilling the review requirements of 30 TAC Chapter 317, titled *Design Criteria for Sewerage Systems*, sections 317.1 and 317.2. This application may be submitted in lieu of a separate engineering report. This form will only be accepted for review if all the pages of this application, including any attachments, are permanently bound together, and the application is signed, sealed and dated on the final page by a professional engineer registered in the State of Texas, or if each page of attachments and each page of this application have the signed and dated seal of a Professional Engineer registered in the State of Texas. Use of the application form is not mandatory. The intent of this application is to expedite Texas Natural Resource Conservation Commission (TNRCC) plan review by providing a format which ensures that the information required to complete a TNRCC review of the project is included in the submittal materials, and to assist the reviewer in locating this information. Please note that the determination of whether or not the information submitted by the applicant is sufficient to obtain TNRCC approval will be made by the TNRCC reviewer and that additional information regarding the project design may be required before the TNRCC will approve construction of the project. Except as exempted in question A23 of this application, in addition to this application, each submittal must include one set of the project specifications, permanently bound, with the signed and dated seal of a Professional Engineer registered in the State of Texas on the cover of the specifications and one set of plans, with each plan sheet containing the signed and dated seal of a Professional Engineer registered in the State of Texas. The submittal of the plans, specifications and application need to be made to the following address:

TNRCC
Wastewater Permits Section
MC 148
P.O. Box 13087
Austin, Texas 78711-3087

For answers to questions relating to wastewater plan review contact:

Louis C. Herrin, III, P.E.
Phone No. (512) 239-4552

ADMINISTRATIVE REVIEW

TNRCC review is intended to provide both a technical review and a historical record of wastewater construction projects. The following information is required for administrative review purposes.

- A1) Does the project include any potable water distribution or water treatment related construction?
_____ If yes, a separate review by the TNRCC Water Utilities Division may be required. Please contact Joe Strouse, PE, at (512) 239-6960 for this determination.

- A2) Name and mailing address of entity submitting project for review: _____

- A3) Name of design engineer: _____ Phone No. : _____

- A4) County in which the project is located: _____

- A5) Name of project (include subdivision name, contract numbers, or any other identifying information which is relevant to this project):

- A6) Entity which will own and maintain the sanitary sewer collection system described in this application: _____

- A7) Identify the wastewater treatment plant (WWTP) which will receive and treat flows from the project.
TNRCC Permit No. : _____ Permittee: _____
Facility or plant name if different from permittee: _____

- A8) If this WWTP is not under enforcement skip to A10. If this WWTP is currently under a TNRCC enforcement order, please provide the name and phone number of the TNRCC enforcement coordinator and the TNRCC Region Office wastewater inspector assigned to the enforcement case.
Name: _____ Phone No. : _____
Name: _____ Phone No. : _____

A9) Describe the nature of the enforcement case. If the WWTP which will receive flow from this project is under enforcement due to flow exceedance, the description should include the permitted average daily flow, information regarding average daily flows currently measured at the WWTP during both dry and wet weather conditions, and any other information which would help describe the flow exceedance problems:

A10) If any portion of the project is within the Edwards Aquifer Recharge Zone, **STOP**. The project must be reviewed by the appropriate TNRCC Region Office as required by 30 TAC Chapter 313. For information on the submittal requirements for projects located over the Edwards Aquifer Recharge Zone contact the appropriate Region Office for details: Are all portions of this project outside the Edwards Aquifer Recharge Zone? _____

A11) If the project is publicly funded, identify the source of funding. Please include the name and phone number of a contact person at the funding entity.

Source of Funding: _____

Name: _____ Phone No. : _____

A12) Identify entities other than TNRCC which will review the project. Please include the name and phone number of a contact person for each entity other than the TNRCC which will review this project.

Entity: _____	Name: _____	Phone No. : _____
Entity: _____	Name: _____	Phone No. : _____
Entity: _____	Name: _____	Phone No. : _____
Entity: _____	Name: _____	Phone No. : _____

- A13) If this project proposes any sewage collection system (gravity sewer pipe, lift station or force main) installation or construction which would not be considered maintenance and rehabilitation work, skip to page 7 of this application and complete the applicable portions of the technical review section of this application starting with T1 on page 7. If a project consists solely of maintenance and repair of an existing sanitary sewer collection system, a waiver of review may be granted on a case by case basis in accordance with Section 317.1(a)(7) of the Design Criteria. Section 317.1(a)(7) states, "Waiver of submittal or review requirements. When minor upgrade, rehabilitation, or maintenance work is planned for existing systems a waiver of submittal or review may be granted at the discretion of the executive director...If a waiver of submittal or review is desired, written notification to the commission...shall be made and shall include sufficient information to describe the significance of such modifications. If a waiver of submittal or review is requested, it shall be submitted by a professional engineer registered in Texas, and shall include the signed and dated seal of the engineer submitting the waiver request. The executive director...will determine whether a submittal or review of engineering plans and specifications will be required following this initial notification of the extent of the planned modifications. Replacement of equipment, piping or materials with like equipment, piping, or materials for purposes of maintenance and repair only, will not routinely require a submittal or a technical review by the executive director, and also will not routinely require a request for a waiver of submittal or a request for a waiver of review." If this project only proposes collection system maintenance and rehabilitation work, state whether the project consists of sewage collection piping rehabilitation work, lift station rehabilitation work, or both sewage collection system piping and lift station rehabilitation work: _____

If this project only consists of sewage collection piping maintenance and rehabilitation work, answer items A14 through A18.

If this project only consists of maintenance and rehabilitation work for one or more lift stations, answer items A19 through A22 and continue on with A23.

If this project proposes both sewage collection system piping rehabilitation and maintenance and rehabilitation of one or more sanitary sewer lift station, answer items A14 through A22 and continue on with A23.

- A14) Detail the scope of the sewer collection pipe rehabilitation project. Include details regarding linear feet of pipe which will be rehabilitated, types of pipe rehabilitation technologies which are proposed, pipe, pipe joint and pipe bedding materials which are proposed for the maintenance and rehabilitation work and any other information which may be necessary to show that the proposed project will be accomplished utilizing standard acceptable engineering practices:

- A15) Are all proposed lines to be constructed in the same trench as existing lines? _____
- A16) Are all proposed lines the same diameter as existing lines? _____
- A17) Are all slopes the same as or greater than existing lines? _____
- A18) Will flows and connections be equal to or less than current flows and connections? _____ If no lift station rehabilitation work is planned, skip to A23.
- A19) Detail the scope of the maintenance and rehabilitation work proposed for the lift station(s). Include the number of lift stations which will be rehabilitated, information regarding structural maintenance which is to be performed on each lift station proposed for rehabilitation, the size of any pumps which are to be replaced in each lift station, the size of any pumps which currently exist in each lift station, the size of any pumps which are not proposed to be replaced and will remain in each lift station, details regarding any force main rehabilitation which is intended for the sewage system and any other information which may be necessary to show that the proposed project will be accomplished utilizing standard acceptable engineering practices:

- A20) Will the operating characteristics of the rehabilitated lift station(s) be equivalent to the operating characteristics of the existing lift station(s) regarding pumping capacity versus total dynamic head? _____
- A21) Will the force main piping either remain unchanged, or, be replaced at the same alignment and with the same diameter pipe as the existing force main piping? (yes or no) _____
- A22) Will the lift station(s) and force main(s) include, at a minimum, an arrangement of valves and appurtenances which ensures that the lift station(s) operation will be equivalent to or superior to that of the lift station(s) and force main(s) being upgraded or replaced? _____
- A23) **If you answered no to any of the items in A15, A16, A17, A18, A20, A21, or A22, skip to A24. If you answered yes to all the items in A15, A16, A17, A18, A20, A21, or A22, which are relevant to the project, STOP. This project meets the criteria which must be met to allow the TNRCC to grant a general waiver of review and to allow an exemption from the requirement to submit plans and specifications to the TNRCC. Submit pages 1 through 6 of this application, and any attachments associated with pages 1 through 6 of this application to the TNRCC for record keeping purposes. The submitted pages shall be properly bound and the final page shall include the signed and dated seal of a Professional Engineer registered in the State of Texas. The pages can be stapled or left loose if each page of the submittal has the signed and dated seal of a Professional Engineer registered in the State of Texas.**
- A24) **If you answered no to any of the items in A15, A16, A17, A18, A20, A21, or A22, but believe that the project constitutes routine maintenance of an existing system, please provide engineering justification why TNRCC review should not be required. Please detail in what ways the rehabilitation project differs from the existing system with regard to the items in A15, A16, A17, A18, A20, A21 or A22. Submit all attachments and pages 1 through 6 of this application to the TNRCC for a determination of whether review is required for this project. The pages of the submittal shall be properly bound and the final page shall include the signed and dated seal of a Professional Engineer registered in the State of Texas. The pages can be stapled or left loose if each page of the submittal has the signed and dated seal of a Professional Engineer registered in the State of Texas. Please be aware that review may be required at the discretion of the Executive Director. If it is determined that the proposed maintenance and rehabilitation work will be reviewed by the TNRCC, in addition to pages 1 through 6 of this application, the applicant will need to submit one set of the project specifications, permanently bound, with the signed and dated seal of a Professional Engineer registered in the State of Texas on the cover of the specifications, an engineering report, permanently bound, with the signed and dated seal of a Professional Engineer registered in the State of Texas on the cover of the engineering report (For collection system submittals which contain no lift stations or force mains, this application form may substitute for the engineering report, provided the application is properly completed) and one set of plans, with each plan sheet containing the signed and dated seal of a Professional Engineer registered in the State of Texas.**

TECHNICAL REVIEW

T1) Please provide a brief summary of the project scope:

T2) If a conflict exists between the various submitted documents (engineering calculations, project specifications, project plans, addendums, etc.), which document takes precedent? For instance do plans govern over specifications or do specifications govern over plans? Do special conditions govern over technical specifications or plans? etc. Where in the submitted materials is the prioritization of documents specified? Provide answers to these items below. Please be aware that the TNRCC may require any identified discrepancies between plans and specifications to be corrected or clarified:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T3) This application form is intended to function as a document, which when completed properly, constitutes full compliance with Sections 317.1 and 317.2 of the TNRCC's rules. All the requirements in these Sections of Chapter 317 have been restated in this application in a format which is intended to clarify what is needed to show compliance with Sections 317.1 and 317.2. *If during the course of completing this application it is determined that the project does not comply with specific portions of the requirements in Chapter 317, as indicated by "no" answers to the items in the application, the applicant must request a variance from the rules for these items. The specifics of what requirements must be met to obtain a variance can be found on page 35 of this application. Page 35 is also the appropriate places to provide the details needed to justify any variance requests.*

Part I of the technical review portion of this application covers gravity sewer collection piping only. Part II of this application has not yet been developed. Part II, when developed, will cover lift stations and force main piping only. If this project contains gravity collection piping complete the items in Part I, beginning with T4 on page 8 of this application. Until Part II is finalized, if this project contains lift stations and force main piping, which need a TNRCC review, a separate engineering report which shows full compliance with Section 317.3 of the TNRCC's rules titled Design Criteria for Sewerage Systems, must be submitted to the TNRCC for the lift station and force main portions of the project. Conceptually similar Chapter 317 requirements have been grouped together under their relevant citations in Part I of this application. For more detailed information on these requirements, please consult the relevant rules.

PART I - GRAVITY SANITARY SEWER PIPING

Capacity Design

Flow and Capacity Analysis: 30 TAC, Sections 317.2.(a)(1), 317.2.(b)(1), 317.2.(b)(2), 317.2.(b)(3), 317.4.(a)

T4) Basis for average flow used for design of collection system (check one or more):

Per Capita Contributions: ___ Service Connections: ___ Land Area and Use: ___ Fixture Analysis: ___

T5) Peaking factor used for design: ___ A peaking factor of at least 4 is required for minor lines. A peaking factor greater than 4 must be used if needed to convey peak flows. Has a peaking factor greater than or equal to 4 been used in the design? _____

T6) Provide flow/capacity analysis. The capacity analysis must derive the average and peak flows to be carried by each line. Additionally, the analysis must verify that the diameters and slopes for each reach of collection line (or for the minimum capacity reach of each line) provide a capacity adequate to carry the anticipated peak flow. The analysis must include consideration of all existing upstream flow contributions, and the impact of the project on the downstream collection system. The stated design flow must be justified on the basis of future population to be served, and must include any anticipated industrial, commercial, or institutional flow contributions. Please note that capacities must be determined using Manning's equation for pipes flowing full with an "n" value of 0.013:

General Structural Components

The Design Criteria outlined in Section 317.2 of the TNRCC's rules states, "The collection system design shall provide a minimum structural life cycle of 50 years." Section 317.2 also states, "The collection system design shall provide for the minimization of anaerobic conditions." These two TNRCC requirements can be assumed to have been met for the purposes of Plans and Specifications approval provided that the items in T7 through T104, detailed below, are met:

Materials Used and ASTM Standards Adhered To: 30 TAC 317.2(a)(2), 317.2(a)(3), 317.2(a)(5), 317.2(c)(5)(A)

T7) List all the pipe diameters proposed for this project. Specify the total linear feet of pipe proposed for each listed diameter, the pipe material proposed for each diameter, the national standard specifications (ASTM, AWWA, ANSI, etc...) which govern each proposed pipe material and the appropriate national standard specifications for joints which correspond to each of these proposed materials:

	Linear Feet	Pipe Material	National Standard Specification for Pipe Material	National Standard for Pipe Joints
Pipe Diameter 1				
Pipe Diameter 2				
Pipe Diameter 3				
Pipe Diameter 4				
Pipe Diameter 5				
Pipe Diameter 6				

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Note: Section 317.2.(c)(1) requires a minimum pipe diameter of 6 inches for all sanitary sewer collection system piping except service laterals. The TNRCC does not currently review service laterals. The design, installation and testing of service laterals is regulated by municipal and county codes. Compliance with these codes is considered sufficient to satisfy the TNRCC.

T8) Watertight, size on size resilient connectors conforming to ASTM C-923 must be specified for connecting pipe to manholes. Have such connectors been specified? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T9) For purposes of TNRCC review, rigid pipe materials include, but are not limited to, concrete, vitrified clay or ductile iron pipe. If the design does not include rigid pipe, skip to T11. If the design includes rigid pipe, the specified bedding must comply with ASTM C-12 class A, B, or C for materials and densification. A minimum of 4 inches of bedding is required for all pipe. Will the proposed project comply with these requirements? _____

T10) Specify the bedding class proposed for each diameter of rigid pipe and each rigid pipe material:

Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T11) For purposes of TNRCC review, flexible materials include, but are not limited to, plastics, PVC, ABS, fiberglass, and, polyethylene. If the design does not include flexible pipe, skip to T13. If the design includes flexible pipe materials, the specified bedding must comply with ASTM D-2321 class IA, IB, II or III for materials and densification. A minimum of 4 inches of bedding is required for all pipe. Will the proposed project comply with these requirements? _____

T12) Specify the bedding class proposed for each diameter of flexible pipe and each flexible pipe material:

Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____
Pipe Diameter: _____	Pipe Material: _____	Bedding Class: _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Note: For TNRCC review, cement stabilized bedding materials are considered to comply with ASTM D-2321 if the base material and compaction meet the minimum requirements of ASTM D-2321, class IA, IB, II or III.

T13) Brick manhole construction is not allowed. Use of brick for adjusting manhole covers to grade is also prohibited. Do the project plans and/or specifications prohibit the use of brick manholes and the use of brick to adjust manholes to grade? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T14) Are materials specified for manhole construction limited to monolithic cast in place concrete, fiberglass, precast concrete or HDPE? _____ List all materials specified for manhole construction:

1) _____ 2) _____ 3) _____ 4) _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Minimum and Maximum Slopes: 30 TAC 317.2(c)(2), 317.2(c)(3)

T15) All pipe must be designed with a slope that will provide a velocity of at least 2 ft/s flowing full, as calculated using Manning's equation with an "n" value of 0.013. Additionally, the collection system must be designed to ensure that, with pipes flowing full, the velocities will be less than 10 feet per second. For each diameter of pipe, indicate the minimum and maximum collection line slopes which will exist in this project (see 317.2(c)(2) of the TNRCC's rules for a table of maximum and minimum slopes allowed for each diameter of pipe):

Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____
Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____
Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____
Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____
Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____
Pipe Diameter: _____	Min. Slope: _____	Max. Slope: _____

T16) Do these proposed slopes ensure a velocity greater than or equal to 2 feet per second and less than or equal to 10 feet per second? _____

General Trenching and Backfill: 30 TAC 317.2.(a)(5), 317.2.(a)(9), 317.2.(a)(10), 317.2.(c)(3)

T17) Describe any known soil, geologic, or hydrologic conditions on the site which may pose difficulties for construction or compromise the structural integrity of the collection system. These include but are not limited to high water table; low soil strength; high plasticity index; active faults; zones of active subsidence; and; caves, solution caverns or sinkholes. If no such conditions are known to exist in the proposed project location, skip to T19.

T18) Describe the measures which will be taken to provide for the structural integrity of the collection line and for construction safety where pipe must be installed in conditions described in T17:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T19) **If faults, caverns, or subsidence are discovered during construction, construction should be halted to allow the features to be inspected by the design engineer or a geological or geotechnical professional.** For active faults, localized subsidence zones, or caverns, the system must be laid out to minimize the number of crossings through, and construction within, the unfavorable features. Where crossings through faults or subsidence zones are unavoidable, the design must allow for deflection due to differential settlement. Manholes should be provided on each side of such features to allow pumping in case of sewer failures. Service connections within 50 feet of such features should be avoided. These design features should be detailed in the project specifications. Will these requirements be met? _____
Please provide appropriate details:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T20) The trench width must be minimized while still allowing adequate width for proper compaction of backfill, and while still ensuring that at least 4 inches of backfill exists on each side of the pipe. Will this be accomplished? _____

T21) For each diameter of pipe, indicate minimum and maximum trench width:

Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____
Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____
Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____
Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____
Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____
Pipe Diameter: _____ Min. Trench Width: _____ Max. Trench Width: _____

T22) Will the trench walls be vertical to at least one foot above the pipe? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T23) Will the backfill be free of stones greater than 6 inches in diameter and free of organic or any other unstable material? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Corrosion Prevention:

T24) List any proposed collection system components (pipes, manholes, etc...) that will be susceptible to deterioration through the corrosive effects of an anaerobic sewage environment. If the collection system does not contain any components which are susceptible to deterioration through the corrosive effects of an anaerobic sewage environment, skip to T26:

T25) If the proposed wastewater collection system contains components susceptible to corrosive attack, provisions to protect these components from corrosive attack, such as coatings, liners, high alkalinity concrete, etc, are needed. If steps have been taken to protect the wastewater collection system from corrosive attack, detail these corrosion prevention measures below. Indicate that these measures are sufficient to protect the gravity sanitary sewer piping from corrosive attack for a design life of 50 years and indicate where in the plans and specifications these measures are required. If the proposed wastewater collection system contains components susceptible to corrosive attack, and if corrosion prevention measures will not be taken for this project, provide an engineering analysis demonstrating that the collection system will adequately resist corrosive attack through the 50 year design life of the project. This analysis must consider the potential for anaerobic conditions both under startup conditions and at ultimate buildout. (Refer to ASCE Manual and Reports on Engineering Practice-No. 69, Sulfide in Wastewater Collection and Treatment Systems). Have these specifics been addressed? _____

Analysis:

Manholes - General: 30 TAC Section 317.2(c)

T26) Are manholes provided at all changes in size, grade or alignment of pipe? _____

T27) Are manholes or cleanouts provided at the end of all lines? _____

T28) The maximum manhole spacings allowed by the TNRCC are as follows:

Pipe Diameter (in)	Maximum Manhole Spacing (ft)
6 - 15	500
18 - 30	800
36 - 48	1000
54 or larger	2000

Indicate what the maximum spacing in this project will be for each proposed diameter of pipe.

Pipe Diameter: _____ Max. Spacing: _____ Pipe Diameter: _____ Max. Spacing: _____
 Pipe Diameter: _____ Max. Spacing: _____ Pipe Diameter: _____ Max. Spacing: _____
 Pipe Diameter: _____ Max. Spacing: _____ Pipe Diameter: _____ Max. Spacing: _____

T29) Do the maximum spacings for this project comply with the TNRCC's maximum manhole spacing requirements? _____

Manholes - Ventilation: 30 TAC 317.2.(c)(5)(C)

T30) Provide the 100-year flood plain elevation for the project area(s): _____

T31) On what basis was the 100-year flood plain elevation determined?

T32) Manhole covers which lie within a 100 year flood plain must be sealed and gasketed or otherwise provided with adequate protection against inflow. Such measures should also be provided to any manholes lying in drainageways or streets subject to carrying drainage flows. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

- T33) If this project does not contain any sections of line with more than three manholes in sequence which are bolted and gasketed, or protected against inflow in some other fashion, skip to T34. Where more than three manholes in sequence are to be bolted and gasketed, every third manhole (or a maximum of every 1,500 feet) must be vented to a point above the 100 year flood plain elevation in a way that prevents stormwater inflow. Additionally, the plans should identify the nearest known flood plain elevation and indicate any manhole covers which are required to be sealed. Will these requirements be met? _____
Does this project solely protect against inflow with bolted and gasketed manholes? _____ Describe ventilation provisions:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Manholes - Minimizing Turbulence: 30 TAC 317.2.(c)(5)(E)

- T34) Where unequal sized pipes enter a manhole, the crowns of the pipes should be at equal elevation where feasible and the manhole channel should slope evenly between pipe inverts. If relevant, have these principles been incorporated into the design (If not relevant to this project skip to T35)? _____
- T35) Drop inlets must be provided for pipes entering a manhole at an elevation greater than 30 inches above the manhole invert. This requirement is especially important where force mains or inverted siphons discharge into the gravity collection system. Any required drops should be detailed in the project plan sheets. If relevant, have these requirements been specified (If not relevant skip to T36)? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

- T36) Where sewer lines enter the manhole higher than 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe should be provided for a sewer entering a manhole more than 30 inches above the invert. Any required fillets should be indicated in the project plans or profile drawings. If relevant, have these features been incorporated into the design (If not relevant skip to T37)? _____
- T37) A U-shaped channel must be provided through the manhole base. For pipes less than 15 inches diameter, channel depth must be at least half the pipe diameter. For pipes greater than 15 inches but less than 24 inches diameter, channel depth must be at least 3/4 the pipe diameter. For pipes greater than 24 inches diameter, channel depth must be at least equal to the pipe diameter. Has this principle been followed in the design? _____
- T38) The manhole bench (base area outside the flow channel) must be sloped at least 0.5 inches per foot. Has this principle been followed in the design? _____

Inverted Siphons: 30 TAC 317.2.(c)(6)

- T39) Inverted Siphons (sag pipes) can be a major source of corrosive activity due to anaerobic conditions. If the project does not include any sag pipes skip to T40. If the project includes sag pipes, have they been designed in accordance with section 317.2.(c)(6) of the Design Criteria? _____ Provide design assumptions and calculations which justify the design of the sag pipes and show that 317.2(c)(6) of the TNRCC's rules has been complied with:

Trenchless Technology: 30 TAC 317.2(a)(2)(A)

- T40) If the project propose any trenchless installation of pipe (e.g. slip-lining; boring and jacking; or, microtunneling), please provide a brief description of the type of installation, design basis, and engineering justification of why the proposed method is appropriate for this project. If the project does not propose trenchless installation of pipe skip to T41:

Vertical Curvature: 30 TAC 317.2(c)(4)

- T41) Vertical curvature between manholes is not allowed in gravity collection systems. Has this project been designed without the use of vertically curved gravity collection piping between manholes? _____

Horizontal Curvature: 30 TAC 317.2(c)(4)

- T42) If this project does not contain any portions which include horizontally curved gravity sanitary sewer piping, skip to T57. Chapter 317 of the TNRCC's rules states "Sewers shall be laid in straight alignment with uniform grade between manholes unless slight deviations from straight alignment and uniform grade are justified to the satisfaction of the Executive Director." To clarify what constitutes justification to the satisfaction of the Executive Director, the TNRCC developed a horizontal curvature policy. The specifics of this horizontal curvature policy are detailed in T43 through T56. If this project includes horizontally curved gravity sanitary sewer piping, complete the relevant portions of T43 through T56, then continue with T57. Has the amount of horizontal curvature which will be used in this design been minimized? _____

T43) Horizontal curvature must be either by joint deflection or pipe flexure, but not both. Indicate the method utilized: _____ If horizontal curve will be provided by joint deflection skip to T46. If horizontal curvature will be provided by pipe flexure, for each type and size of pipe to be installed using pipe flexure, calculate the minimum radius of curvature which is proposed in this project and calculate a value for $300 * D_o$, where D_o is the average outside diameter of the pipe in inches.

T44) For each type of pipe material and for each pipe diameter, report the minimum radius of curvature recommended by the manufacturer, the minimum radius of curvature recommended by a national reference standard (if available), the minimum radius of curvature calculated in T43 and the value for $300 * D_o$ calculated in T43:

	Pipe Material	Minimum Radius of Curvature Recommended by Manufacturer	Minimum Radius of Curvature Recommended by National Reference Standard (N/A if none)	Calculated Minimum Radius of Curvature	Value for $300 * D_o$
Pipe Diameter 1					
Pipe Diameter 2					
Pipe Diameter 3					
Pipe Diameter 4					
Pipe Diameter 5					
Pipe Diameter 6					

T45) If curvature will be provided by pipe flexure, all joints must be installed fully seated. The specifications must describe how installation will be performed for curved sections. The minimum radius of curvature calculated cannot be less than the minimum radius of curvature recommended by the manufacturer or the minimum radius of curvature recommended by any applicable national reference standards. The minimum radius of curvature also should not be less than $300 \cdot D_o$. Will these requirements be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T46) If the horizontal curvature in this project will not be provided by joint deflection, skip to T52. If the horizontal curvature in this project will be provided by joint deflection, calculate the joint deflection proposed for each pipe diameter:

T47) Report the maximum proposed joint deflection for each pipe diameter:

Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____
Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____
Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____
Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____
Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____
Pipe Diameter: _____	Maximum Proposed Joint Deflection: _____

T48) Indicate manufacturer's maximum recommended joint deflection for pipe to be used and/or indicate maximum joint deflection recommended by the appropriate national reference standard (ASTM, AWWA, ANSI etc...) for pipe to be used:

a) Manufacturer's maximum recommended joint deflection (degrees):

Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____
Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____
Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____

b) National Reference Standard maximum recommended joint deflection (degrees):

Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____
Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____
Pipe Diameter: _____ Deflection: _____ Pipe Diameter: _____ Joint Deflection: _____

T49) The maximum allowable joint deflection allowed by the TNRCC's horizontal curvature policy is equal to the lesser of 5 degrees, or 80% of T48(a) or 80% of T48(b). Indicate the maximum allowable joint deflection for each pipe diameter:

Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____
Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____
Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____
Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____
Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____
Pipe Diameter: _____ Max. Allowable Joint Deflection: _____ Max. Joint Deflection for Project: _____

T50) If the proposed joint deflection, for any individual portion of pipe, as calculated in T46 is greater than the maximum allowable joint deflection as determined in T49 for that same portion of pipe, the proposed curvature will not be approved by TNRCC. Does the proposed horizontal curvature comply with TNRCC policy as outlined in T43 through T49 above? _____

T51) Curved lines constructed using joint deflection must be tested for deflection with a mandrel sized to verify that the design maximum joint deflection is not exceeded. Has this test been specified? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T52) For each size of pipe which will be installed with horizontal curvature, indicate the minimum slope.

Pipe Diameter: _____ Min. Slope: _____ Pipe Diameter: _____ Min. Slope: _____
Pipe Diameter: _____ Min. Slope: _____ Pipe Diameter: _____ Min. Slope: _____
Pipe Diameter: _____ Min. Slope: _____ Pipe Diameter: _____ Min. Slope: _____

- T53) All curved sections of gravity line must be installed at a minimum slope at least 3% greater than the corresponding minimum slope for straight lines. Do the slopes in T52 comply with this requirement?

- T54) Maximum allowable manhole spacing for sections of pipe with horizontal curvature is 300 feet. Has this requirement been met in the design? _____
- T55) Manholes should be provided at PC and PT of horizontal curves. Does the design include such provisions? _____
- T56) Trench excavation must match the radius of curvature of the installed pipe, with the pipe laid in the center of the trench. Has this requirement been incorporated into the design and detailed in the specifications?

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Reduction of Inflow: 30 TAC 317.2(a)(8)

- T57) TNRCC rules do not allow combined sewers. Has the project been designed to preclude or eliminate any connections of storm drains, roof drains, etc... to the sanitary sewer? _____
- T58) If storm drainage facilities are proposed for construction in conjunction with this project, were these designed to prevent storm water from entering the sanitary sewer? _____
- T59) Please indicate the design storm return period for the storm sewer, if applicable: _____

Rigid Pipe Design

General Requirements: 30 TAC 317.2(a)(2)(B)

- T60) If the project does not specify an option to use rigid pipe, skip to T61. If the project specifies an option to use rigid pipe, please provide an engineering analysis which shows that the rigid pipe design will be adequate to withstand the applied loads expected from the proposed installation. Consideration should be given to trench width, depth of cover, effect of water table elevation on the rigid pipe, etc. Please indicate the maximum burial depth or applied load for each diameter and type of pipe material and the corresponding minimum strength properties or allowable depth of installation as specified in the appropriate national reference standard, or as specified by the pipe manufacturer.

Flexible Pipe Design

T61) If the project specifies an option to use flexible pipe materials, complete T62 through T87. If the project does not specify an option to use flexible pipe materials, skip to T89.

Live Load Analysis: 30 TAC 317.2(a)(2)(A)

T62) For the purposes of this application, the minimum depth of burial for gravity sanitary sewer pipe, from the ground surface to the crown of the pipe (H) is 2 feet. Does the submitted design comply with this minimum H? _____

T63) If all pipe proposed for this project will be installed at a burial depth of greater than or equal to 3.0 feet and the pipe will not be subjected to live loads greater than 18 kip axle, assume that the pressure due to live load (L_1) = 0 and skip to T68. If a value of H greater than or equal to 2 feet and less than 3 feet is proposed for any portions of the gravity sanitary sewer pipeline or if the pipe will be subjected to live loads greater than 18 kip axle, calculations which quantify what the L_1 on the pipe will be must be provided:

T64) Indicate minimum H: _____

T65) Indicate maximum anticipated L_1 as determined in T63: _____

T66) Are all proposed flexible pipe materials capable of supporting this L_1 ? _____

T67) Indicate source of maximum L_1 : _____

Buckling Analysis: 30 TAC 317.2(a)(2)(A)

T68) Calculate allowable and predicted buckling pressure. Predicted and allowable buckling pressures must be calculated for each size of pipe and type of flexible pipe material. For the purposes of this application form, the buckling analysis must be performed using the method outlined below. The method of calculating allowable buckling pressure provided below is only valid for lines which are installed at depths of $2 \text{ ft} \leq H \leq 80 \text{ feet}$.

- a) Calculate allowable buckling pressure as follows:

$$q_a = 0.4 * \sqrt{32 * R_w * B' * E_b * (E * I / D^3)} \quad \text{Equation (1)}$$

$$R_w = 1 - 0.33 * (h_w / h) \quad \text{Equation (2)}$$

$$B' = \frac{1}{1 + 4 * e^{-0.065H}} \quad \text{Equation (3)}$$

$$I = (t^3 / 12) * (\text{inches}^4 / \text{Linch}) \quad \text{Equation (4)}$$

- q_a = allowable buckling pressure, pounds per square inch (psi)
- h = height of soil surface above top of pipe in inches (in)
- h_w = height of water surface above top of pipe in inches (in) (groundwater elevation)
- R_w = Water buoyancy factor. If $h_w = 0$, $R_w = 1$. If $0 \leq h_w \leq h$ (groundwater elevation is between the top of the pipe and the ground surface), calculate R_w with Equation 2
- H = Depth of burial in feet (ft) from ground surface to crown of pipe.
- B' = Empirical coefficient of elastic support
- E_b = modulus of soil reaction for the bedding material (psi)
- E = modulus of elasticity of the pipe material (psi)
- I = moment of inertia of the pipe wall cross section per linear inch of pipe, $\text{inch}^4 / \text{lineal inch} = \text{inch}^3$. For solid wall pipe, I can be calculated with equation 4. If the pipe used is not solid wall pipe (for example a pipe with a ribbed cross section), the proper moment of inertia formula must be obtained from the manufacturer.
- t = pipe structural wall thickness (in)
- D = mean pipe diameter (in)

b) Calculate pressure applied to pipe under installed conditions:

$$q_p = \gamma_w * h_w + R_w * (W_c / D) + L_1 \quad \text{Equation (5)}$$

$$W_c = \gamma_s * H * (D + t) / 144 \quad \text{Equation (6)}$$

- q_p = pressure applied to pipe under installed conditions (psi)
-
- γ_w = 0.0361 pounds per cubic inch (pci), specific weight of water
- γ_s = specific weight of soil in pounds per cubic foot (pcf)
- W_c = vertical soil load on the pipe per unit length in pounds per linear inch (lb/in)
- L_1 = Live load as determined in T63

T69) Report q_a and q_p for each pipe diameter proposed and for each type of pipe material proposed:

Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____
Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____
Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____
Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____
Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____
Pipe Diameter: _____	Pipe Material: _____	q_a : _____	q_p : _____

T70) If $q_a \geq q_p$, specified pipe is acceptable for the proposed installation. If $q_a < q_p$, the wall thickness of the pipe must be increased and/or a pipe with a larger modulus of elasticity (E) must be used. Make the appropriate modifications and repeat the buckling analysis, showing that for the upgraded pipe, $q_a \geq q_p$. Does all the pipe proposed for this project meet these requirements? _____

Wall Crushing: 30 TAC 317.2(a)(2)(A)

T71) If no concrete encased flexible pipe is proposed for the submitted project, skip to T73. If any flexible pipe will be installed in rigid encasement (e.g. concrete), calculate the maximum depth that the pipe can be buried before wall crushing (or failure by ring compression) will occur using the method outlined below. It should be noted that cement stabilized sand or soil is not considered a rigid encasement for purposes of TNRC review:

$$H = (24 * P_c * A) / (\gamma_s * D_o) \quad \text{Equation (7)}$$

-
- D_o = outside pipe diameter, in.
 - P_c = compressive stress or hydrostatic design basis (HDB). For typical PVC pipe assume 4,000 psi. For any other pipe material the HDB must be supplied by the pipe manufacturer.
 - A = surface area of the pipe wall, in.²/ft
 - γ_s = specific weight of soil in pounds per cubic foot (pcf)
 - H = Depth of burial in feet (ft) from ground surface to crown of pipe.
 - 24 = conversions and coefficients

T72) Will all pipe installations proposed for this project have an H less than or equal to the maximum allowable H calculated in T71 and greater than or equal to 2 feet? _____ Report maximum allowable H, (H_a), and the maximum H which is proposed, (H_p), for each proposed pipe diameter and each type of flexible pipe material.

Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____
Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____
Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____
Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____
Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____
Pipe Diameter: _____	Pipe Material: _____	H _a : _____	H _p : _____

Installation Temperature Effects: 30 TAC 317.2(a)(2)(A)

T73) If flexible pipe will be installed under favorable ambient temperature conditions, skip to T74. If flexible pipe will be installed under very high or low ambient temperature conditions, please indicate provisions for handling which will protect the pipe and ensure an adequate installation:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Tensile Strength: 30 TAC Sections 317.2.(a)(2)(A), 317.2.(a)(5)

T74) The project specifications need to indicate minimum allowable tensile strength in psi for each flexible pipe material. If PVC pipe is proposed, specify cell class:

Pipe Material: _____	Tensile Strength: _____	Cell Class (PVC only): _____
Pipe Material: _____	Tensile Strength: _____	Cell Class (PVC only): _____
Pipe Material: _____	Tensile Strength: _____	Cell Class (PVC only): _____
Pipe Material: _____	Tensile Strength: _____	Cell Class (PVC only): _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Strain: TAC 30 Section 317.2.(a)(2)(A)

T75) Are the conditions of this installation such that strain-related failure will not be a problem? _____ If any proposed flexible pipe material is considered to be susceptible to strain-related failure at less than 5% long-term deflection provide analysis for predicted strain due to hoop stress and bending strain. If strain-related failure will not be a problem for the pipe installation proposed in this project, skip to T76.:

Deflection Analysis: 30 TAC 317.2(a)(2)(A)

T76) Indicate E_b (modulus of soil reaction for the bedding material) in psi. If E_b is greater than 750 psi, justification must be provided.: _____

How was E_b determined or estimated?

T77) Indicate E'_n (modulus of soil reaction for the in-situ soil) in psi: _____

How was E'_n determined or estimated?

T78) Based on T76 and T77, above, calculate the ratio of bedding modulus to soil modulus:

$$E_b/E'_n = \underline{\hspace{2cm}}$$

If this ratio is greater than 1.25, a zeta factor must be calculated by completing T79 and T80, where zeta is a factor which corrects for the effect of in-situ soil on pipe stability. If the ratio of bedding modulus to soil modulus is less than or equal to 1.25, assume zeta = 1.0 and skip to T80.

T79) Where native soil is significantly weaker than bedding material, or where predicted deflection approaches 5%, the effect of native soil must be quantified using Leonhardt's Zeta factor. Zeta must be determined for each diameter of pipe and corresponding trench width. Zeta may be estimated graphically or calculated directly. If zeta is estimated graphically, identify the source for tables, figures, etc...(including page numbers and table numbers or figure numbers for each source) which were used to estimate zeta. To calculate zeta directly use the formulas in T79(b), below. The calculations which are done to determine the zeta factors for the different pipe diameters must be included with this submittal.

(a) Sources:

(b) Calculations:

$$\text{zeta} = \frac{1.44}{f + (1.44 - f) * (E_b / E'_n)}$$

Equation (8)

$$f = \frac{b/d_a - 1}{1.154 + 0.444 * (b/d_a - 1)}$$

Equation (9)

- f = pipe/trench width coefficient
- b = trench width
- d_a = pipe diameter
- E_b = modulus of soil reaction for the bedding material (psi)
- E'_n = modulus of soil reaction for the in-situ soil (psi)

T80) For each size of pipe, report zeta factor determined in T78 or T79:

Pipe Diameter: _____	Trench Width: _____	Zeta: _____
Pipe Diameter: _____	Trench Width: _____	Zeta: _____
Pipe Diameter: _____	Trench Width: _____	Zeta: _____
Pipe Diameter: _____	Trench Width: _____	Zeta: _____
Pipe Diameter: _____	Trench Width: _____	Zeta: _____
Pipe Diameter: _____	Trench Width: _____	Zeta: _____

T81) Determine pipe stiffness (P_s) in psi. P_s can be determined either by parallel plate test at 5% deflection, based on manufacturer's data or national reference standards; or, calculated using either equation 10 or equation 11. As an example, the minimum pipe stiffness at 5% deflection for PVC pipe less than 15 inches in diameter meeting ASTM D 3034, is 46 psi for SDR-35 and 115 psi for SDR 26. If equation 11 is used, the ring stiffness constant (RSC) is provided by the pipe manufacturer. Show calculations, or provide proper references, for each size of pipe and for each flexible pipe material.

$$P_s = \frac{EI}{0.149 * r^3} \quad \text{Equation (10)}$$

or

$$P_s = 0.80 * RSC * (8.337/D) \quad \text{Equation (11)}$$

E = modulus of elasticity of the pipe material (psi)

I = moment of inertia of the pipe wall cross section per linear inch of pipe, $\text{inch}^4/\text{lineal inch} = \text{inch}^3$. For solid wall pipe, I can be calculated with equation 4. If the pipe used is not solid wall pipe (for example a pipe with a ribbed cross section), the proper moment of inertia formula must be obtained from the manufacturer.

D = mean pipe diameter (in)

r = mean radius (in)

T82) Report P_s for each pipe size and each type of flexible pipe material as determined in T81.

Pipe Diameter: _____ Pipe Material: _____ P_s : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s : _____

T83) Because the terms in the denominator of the modified Iowa formula (Equation 13) are added, it is theoretically possible to have zero pipe stiffness ($P_s=0$) and still predict flexible pipe deflections less than 5%. In order to ensure that the stiffness being provided to the installation has a reasonable contribution from pipe stiffness, and does not rely solely on the stiffness provided by the soil stiffness factor (SSF), the ratio of P_s/SSF must be calculated. If $P_s/SSF < 0.15$, T81 and T82 must be repeated such that a higher stiffness pipe is chosen for each portion of the project where $P_s/SSF < 0.15$. The P_s/SSF ratio(s) must then be recalculated for the new higher stiffness pipe. This process must be repeated until $P_s/SSF \geq 0.15$ exists for all proposed pipe sizes and for all types of flexible pipe materials.

$$\frac{P_s}{SSF} = \frac{P_s}{0.061 * zeta * E_s} \geq 0.15 \quad \text{Equation (12)}$$

P_s = Pipe stiffness (psi) [from T82]

E_s = modulus of soil reaction for the bedding material (psi) [from T76]

zeta = 1.0, or a value calculated with the method in T79

SSF = soil stiffness factor ($0.061 * zeta * E_s$)

T84) Indicate the final values calculated for P_s/SSF for each diameter of pipe and for each pipe material:

Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____
 Pipe Diameter: _____ Pipe Material: _____ P_s/SSF : _____

- T85) Do all proposed pipe sizes and flexible pipe materials have a pipe stiffness to soil stiffness factor ratio of greater than or equal to 0.15? _____
- T86) Calculate and report predicted deflection. Predicted deflection must be calculated for each size of pipe and type of flexible pipe material. For the purposes of this application form, predicted deflection must be calculated using the method outlined below. Show calculations and report calculated maximum deflection for each size of pipe and type of flexible pipe material. Maximum allowable deflection in installed lines is 5%, as determined by the deflection analysis and verified by a mandrel test conforming to T89. Some conservatism should be employed in determining allowable predicted deflections. This conservatism is necessary to allow for variability in the quality of installation.

$$\Delta Y/D(\%) = \frac{K (L_p + L_f) * 100}{(0.149 * P_p) + (0.061 * zeta * E_p)} \quad \text{Equation (13)}$$

$$L_p = \frac{\gamma_s * H}{144} \quad \text{Equation (14)}$$

- %ΔY/D = Predicted % vertical deflection under load.
- ΔY = Change in vertical pipe diameter under load
- D = Undeformed mean pipe diameter (in)
- K = Bedding angle constant. Assumed to be 0.110 unless otherwise justified.
- γ_s = Unit weight of soil (pcf). γ_s less than 120 pcf must be justified.
- H = Depth of burial (ft) from ground surface to crown of pipe.
- L_p = Prism load (psi). If prism load is calculated using Marston's load formula, or other formulas less conservative than the one provided above, the load should be multiplied by a deflection lag factor D_L = 1.5 to account for long-term deflection of the pipe as the bedding consolidates.

(P, from T82; zeta from T80; and E_p from T76)

- ★ If the predicted $\% \Delta Y/D$ for any proposed pipe size or material is over 5%, the proposed flexible pipe design cannot be approved by the TNRCC. Appropriate design modifications must be made and the analysis must be repeated until a deflection of less than or equal to 5% is predicted.
- ★ If a zeta value of 1.0 was assumed as a result of T78, and the predicted deflection for any size or type of pipe is determined to be between 4% and 5%, the deflection analysis must be repeated. Repeat the deflection analysis by performing all the same calculations. The difference will be that instead of using an assumed zeta factor of 1.0, the zeta factor must be calculated as outlined in T79. If the predicted deflection is determined to be above 5% after the deflection analysis is repeated, this flexible pipe design cannot be approved by the TNRCC. Appropriate design modifications must be made and the analysis must be repeated until a deflection of less than or equal to 5% is predicted.
- ★ If the predicted deflection, for a particular pipe, using the deflection analysis method detailed above, is less than or equal to 4%, and a zeta factor of 1.0 was assumed as a result of T78, that particular pipe is assumed to comply with the TNRCC's requirements for deflection analysis and can therefore be approved.
- ★ If the predicted deflection, for a particular pipe, using the deflection analysis method detailed above, is between 4% and 5%, and the zeta factor which was used in the analysis was determined using the method in T79, that particular pipe is assumed to comply with the TNRCC's requirements for deflection analysis and can therefore be approved.

T87) Report the final pipe diameters, types of pipe material proposed for each diameter, type of pipe material, pipe stiffness for each pipe material (P_s), zeta factors assumed or calculated for each pipe diameter, modulus of the pipe bedding material (E_b) and % deflection predicted for each pipe size and type of pipe material.

	Type of Pipe Material	P_s (psi) [T82]	Zeta Factor Assumed or Calculated [T80]	E_b (psi) [T76]	% Deflection [T86]
Pipe Diameter 1					
Pipe Diameter 2					
Pipe Diameter 3					
Pipe Diameter 4					
Pipe Diameter 5					
Pipe Diameter 6					

T88) Do all pipes proposed for this project have a maximum predicted deflection of 5.0%? _____

Miscellaneous Requirements

Testing, Inspection, and Certification: 30 TAC Sections 317.2.(a)(1), 317.2.(a)(4)(A)&(B), 317.2(a)(4)(C), 317.2.(c)(5)(H)

T89) All gravity lines utilizing flexible pipe must be tested for deflection by pulling a rigid mandrel through the installed pipe. The test must be conducted at least 30 days after placement and compaction of final backfill. No pipe shall exceed a deflection of 5%. A rigid mandrel shall be used to measure deflection. The test must be performed without mechanical pulling devices. The mandrel's minimum outside diameter is 95% of the pipe inside diameter. The mandrel must have an odd number of runners, totaling nine or more. The barrel section of the mandrel must have a length at least 75% of the pipe inside diameter. A TV test cannot substitute for the deflection test. Will these requirements be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T90) A professional engineer registered in the State of Texas must certify that the entire installation passed the required deflection test. This certification may be made in conjunction with the notice of completion required in section 317.1.(e)(1). Will these requirements be met? _____

T91) A leakage test is required for all gravity lines. For line that is not horizontally curved, a hydrostatic test and/or a low pressure air test must be performed on all proposed gravity sanitary sewer collection piping. These tests must comply with Section 317.2(a)(4) of the TNRCC's rules. All sections of horizontally curved line must be subjected to a hydrostatic leakage test conforming to the requirements of Section 317.2.(a)(4)(A) of the Design Criteria, with a maximum allowable leakage of 10 gallons/inch diameter/mile/day. Do all leakage tests proposed for this project comply with these leakage test requirements of 317.2(a)(4)? _____ Which leakage test will be used? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T92) Manholes must be tested for leakage. If manholes will be tested with a hydrostatic test, answer T93, then skip to T102. If manholes will be tested with a vacuum test, answer T94 through T101 and continue with T102. If project specifications allow either a hydrostatic test and/or a vacuum test, answer T93 through T101 and continue with T102. How will manholes be tested? _____

T93) Does the hydrostatic manhole test proposed for the manholes in this project comply with the test requirements detailed in Section 317.2(c)(5)(H) of the TNRCC's rules? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T94) Each manhole shall be tested immediately after assembly and prior to backfilling. Manholes which have been backfilled shall either be excavated to expose the entire exterior prior to vacuum testing or the manhole shall be tested for leakage by means of a hydrostatic test. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T95) All lift holes and exterior joints shall be plugged with an approved non-shrink grout. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T96) No grout shall be placed in horizontal joints before testing. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T97) All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T98) Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T99) A minimum 60-inch/lb torque wrench shall be used to tighten the external clamps that secure the test cover to the top of the manhole. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T100) The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation. Will this requirement be met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T101) A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time is greater than 2 minutes. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. If the manhole fails a second time, repairs should again be made and the manhole shall be tested by means of a hydrostatic test which complies with Section 317.2(c)(5)(H) of the TNRCC's rules. If any manhole fails the hydrostatic test, after failing the vacuum test twice, the contractor should consider replacing that manhole. If the contractor chooses to attempt to repair that manhole, the manhole must be retested by means of the hydrostatic test outlined in Section 317.2(c)(5)(H) of the TNRCC's rules, until it passes. Will these requirements be satisfied? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T102) Inspection must be provided during critical phases of construction by a qualified inspector under the direction of a P.E. Critical phases of construction are deemed at a minimum to include testing of pipe and manholes for leakage, and testing of flexible pipe for installed deflection. Do the project plans or specifications define the scope of inspection, and indicate who (owner, design engineer, project manager, etc...) will assume this responsibility? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T103) TNRCC approval letters for plans and specifications review contain the requirement that once the project is completed, a P.E. registered in the state of Texas must certify that the construction was performed substantially in accordance with the approved plans and specifications. If flexible pipe was installed, a P.E. must also certify that all pipe was subjected to and passed the required deflection test. Will these requirements be met? _____

T104) Indicate who (owner, design engineer, project manager, etc...) will certify the installation:

Name: _____ Project Relation: _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

Occupational Safety, Public Health, and Environmental Protection: TAC 30 317.2.(a)(7), 317.13, 317.2.(a)(8) 317.2.(c)(5)(D), 317.2(c)(5)(E), 317.2(c)(F)

T105) The project plans and specifications must ensure that the pipe installation will adhere to the minimum separation distances allowed by 317.13, Appendix E of the TNRCC's rules. Additionally, the project plans or specifications should include language (preferably an exact reproduction of the separation distance wording detailed in Section 317.13 (Appendix E) of the Design Criteria) which ensures that the separation distance between any unknown water lines which are discovered during the installation phase of the project, and, the gravity sanitary sewer pipe which will be installed, will be sufficient to comply with the minimum separation distances allowed by 317.13, Appendix E, of the TNRCC's rules. Will the requirements of 317.13, Appendix E, been met? _____

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

T106) Briefly describe provisions to control erosion or sedimentation due to runoff during construction of the project. Additional information may be required by the TNRCC on a case by case basis:

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

- T107) If the project site does not contain any water wells, springs, surface water sources of potable water, or potable water storage facilities, skip to T108. If the project site does contain any water wells, springs, surface water sources of potable water, or potable water storage facilities, does the design conform to and include any applicable sections of 30 TAC Chapter 290, Rules and Regulations for Public Water Systems? _____
- T108) If an air gap is required for the project, is the project designed with a minimum 18 inch air gap between the elevation of all potable water outlets and the maximum water surface elevation of any nearby sewer appurtenances? _____ If no air gap is required for this project, skip to T109.

Occupational Safety: 30 TAC Sections

- T109) Are all manhole base sections at least 48 inches in diameter? _____
- T110) Are all manhole covers at least 24 inches nominal diameter? _____
- T111) For purposes of this application, **the use of manhole steps to access manholes for maintenance purposes will not be approved by the TNRCC!** Please indicate how manholes will be accessed if a manhole is in need of maintenance.

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

- T112) Personal gas detectors are required for wear by all personnel whose jobs require entering enclosed spaces (such as manholes and lift stations) capable of having accumulations of hydrogen sulfide or other harmful gases. Please indicate who is responsible for ensuring that these detectors are provided to the appropriate personnel.

Location in submittal: Plan sheet _____ Specifications page _____ Item No. _____

- T113) If you answered no to any of the items in this application you may need to obtain a variance from those items in accordance with Section 317.1(f) of the TNRCC's rules. Section 317.1(f) of the TNRCC's rules states, "Variance. A variance from the design criteria herein may be granted by the commission if the variance would not result in an unreasonable risk to treatment plant performance, public health or the waters in the state. Requests for variances must be submitted in writing by the design engineer and must, for each affected item, include a detailed engineering justification." List each item to which you answered no below. For each item which had a no answer, provide an engineering justification which addresses the requirements of 317.1(f). The TNRCC review engineer will determine whether or not a variance is needed. If a variance is needed, the TNRCC review engineer will determine whether or not sufficient engineering justification to comply with 317.1(f) has been provided to warrant granting a variance.

In order for this document to be valid, the professional engineer responsible for the completion of this application form must certify that all the information provided in this application and in the accompanying set of plans and specifications show full compliance with the requirements of Chapter 317 of the TNRCC's rules, unless a variance from Chapter 317 is being requested, and the professional engineer responsible for this application form provides the needed justification for the variance. Additionally, the professional engineer responsible for completing this application must certify that all portions of the application, which were relevant to the project, were filled out as completely as possible, and that all supporting calculations and engineering analyses requested in this application were performed. These calculations shall show that the proposed design complies with Chapter 317. By affixing a Texas registered professional engineer's seal to this document, below, that professional engineer certifies the compliance requirements described in this item (item T113) have been met.

Signature, Seal and Date of the Texas Professional Engineer who is certifying that item T113 has been complied with:
