"A Quality of Life City"

DESIGN MANUAL

WATER, SANITARY SEWER, STREETS, AND STORM DRAIN

CITY OF HURST
PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
1505 PRECINCT LINE ROAD
HURST, TEXAS 76054
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April 1, 2010

CITY OF HURST, TEXAS

DESIGN MANUAL

PURPOSE

The following document contains the various construction criteria, techniques, and details, which define the Public Improvements required by the City of Hurst. These data are primarily intended for the use of the Developer and his Engineer to enable the applicant to provide the proper design for the public facilities associated with the proposed development. These criteria are not intended to be an exhaustive outline of the construction techniques available. In the event that specific circumstances dictate additional requirements, it shall be the responsibility of the Developer's Engineer to provide the necessary details for construction and those details are to be approved by the Director of Public Works or designated representative.

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

All water, sewer, streets and drainage installations shall be in accordance with the City Standards and Specifications.

SECTION 1-01 CONSTRUCTION PLANS

A. CONSTRUCTION PLAN REQUIREMENTS

Construction plans for proposed public water, sanitary sewer, streets, drainage and traffic improvements shall adhere to the following requirements:

1. Plans are to be designed, signed & sealed, and dated by a professional Civil Engineer registered in the State of Texas and finished in the following format:

   a. Plats and Construction plans require two (2) coordinates tying horizontally and vertically to the City of Hurst benchmarks and monuments - Geodetic Control Points. See our website: http://www.ci.hurst.tx.us/Departments/Publicworks/Engineering/benchmarks.htm

   b. Cover Sheet - The city provides two (2) electronic copies of the cover sheets, one for CIP and the other for private development. See our website: http://www.ci.hurst.tx.us/Departments/Publicworks/Engineering/index.htm

   c. Provide a copy of the filed plat with plans.

   d. Provide a copy of the approved site plan.

   e. Drainage Area Map and calculations with all existing and proposed storm drains and/or other drainage facilities.

   f. Grading Plan demonstrating how the vertical elevation of the proposed improvements will be constructed.

   g. Utility Plan indicating the location and size of all existing and proposed water and sanitary sewer lines and/or services. Show the location of all existing and proposed fire hydrants adjacent to the site and the required radii as outlined in other sections of this manual.

   h. Paving Plan showing plan and profile of any proposed paving.

   i. Erosion Control Plan shall use accepted best management practices to prevent runoff form carrying silt off-site during construction.

   j. Post Construction Erosion Control Plan showing how disturbed areas will be re-established to prevent post construction erosion.

   k. Trench Safety Plan as required by the State for all trenching activity five (5') feet in depth or greater.

   l. Plan and profile sheets are required for streets, sewers, storm sewers, 12-inch and larger water lines, channels, flumes, swales, and at the

discretion of the City Engineer. Stationing shall be generally oriented from left to right.

2. City Standard Details shall not be bound with the construction plans. Only when revisions are proposed and/or a detail is not defined in the standard set. The City Standard Details can be purchased for $5 from the City of Hurst Public Works Department Engineering Division at 1505 Precinct Line Road, Hurst, Texas 76054.

3. Plan and profile sheets shall be twenty-four (24") inches wide by thirty-six (36") inches long.

4. Horizontal scale shall be one (1") inch equals forty (40') feet or larger. Vertical shall be one (1") inch equals four (4') feet or larger.

B. OTHER UTILITIES

The developer shall furnish all easements and ROW necessary for construction of electrical, gas, cable TV, and telephone service to the proposed subdivision. The developer shall be responsible for overseeing the installation of any/all utilities, public or private. The development shall not be accepted until all utilities are installed and the post erosion control measures are in place and established.

SECTION 1-02 WATER SYSTEM

A. WATER SYSTEM EXTENSIONS

1. Water system shall be sufficient size (8-inch minimum-residential areas and 8-inch minimum commercial areas) to furnish adequate domestic service, to provide adequate fire protection to all lots, and to conform to the City's current Master Water Distribution System Plan.

   a. Allowable materials for sizes 6"-12" in diameter include (minimum pressure rating: 150 p.s.i.)

      1 Ductile Iron, Class 51 with polywrap

      2 DR18, Class 150 PVC meeting latest AWWA C900 Standard

   b. Allowable materials for sizes greater than 12" in diameter and less than 36":

      1 Ductile Iron, class 52 with polywrap

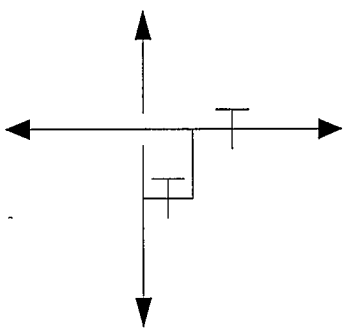
      2 Reinforced Concrete Cylinder Pipe C300

      3 Pre-stressed Concrete Cylinder Pipe C301

      4 Pre-tensioned Concrete Cylinder Pipe C303

      5 PVC class 150, AWWA C905 (size 14" - 16" only)

2. All tee intersections of public water mains shall have a minimum of two gate valves. No cross fittings are allowed. Use of a D-type connection is required when two mains intersect.



3. Minimum depth of cover over water mains shall be as follows: a) 3.5 feet for 6" through 12" in diameter mains, b) five feet for 16" in diameter, c) six feet for 20" in diameter and larger.

4. Where water mains are to be installed in right-of-ways having roads constructed without curb and gutter, a plan and profile sheet shall be submitted with the construction plans showing the existing street grades, preliminary future top-of-curb grades, and the proposed water main profile.

5. Water services shall not be directly connected to water mains sixteen (16") inches in diameter or greater. Smaller parallel water mains are required for water service connections.

6. All water services shall be placed at the center of the lot unless otherwise approved by the Director of Public Works.

   a. Residential: Services shall consist of a one inch (1") service with meter, corporation stop, curb stop (see Standard Details) and meter box (two - three feet (2 -3') behind the back of the curb).

   b. Commercial:

      1 If a one-inch (1") service is requested, then install one-inch (1") meter, corporation stop, curb stop (see Standard Details) and meter box two -three feet (2-3') behind the back of the curb).

      2 If a one and one-half inch (1 1/2") and/or two inch (2") service is requested, then install a two inch (2") tapped tee and two inch (2") gate valve (see Standard Details) then reduce to one and one-half inch (1 1/2") if one and one-half inch (1 1/2") service is requested.

      3 All services larger than two inches (2") shall include a gate valve the same size as the service line.

B. FIRE HYDRANTS

1. All residential lots shall be within five hundred feet (500') of a fire hydrant.

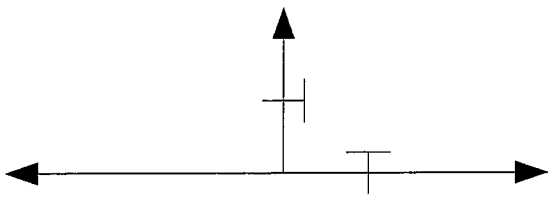
2. All commercial and industrial buildings shall be within three hundred feet (300') of a fire hydrant.

3. Fire hydrants located on the opposite side of a thoroughfare, i.e., pavement greater than forty-one (41') feet, from a development shall not be considered when determining adequate fire hydrant coverage for a development.

4. Every fire hydrant shall have a valve on the lead.

C. VALVES

1. Valves are usually located at a tee. The valves shall be marked on the lines as follows:



2. Main line valves shall be located between each fire hydrant, allowing the isolation of sections of main without the shutdown of more than one fire hydrant.

3. Valves shall be located such that no more than three valves are required to isolate a section of water main.

4. Valves shall be installed near the end of water mains that will be extended in the future. A minimum of one but no more than two joints of pipe (at least 18' in length each) shall be installed beyond the valve.

D. REQUIRED WATER MAIN EXTENSIONS

All water main constructed within a proposed subdivision shall be extended to the perimeter of the proposed subdivision to allow future extension of the water system into adjacent properties.

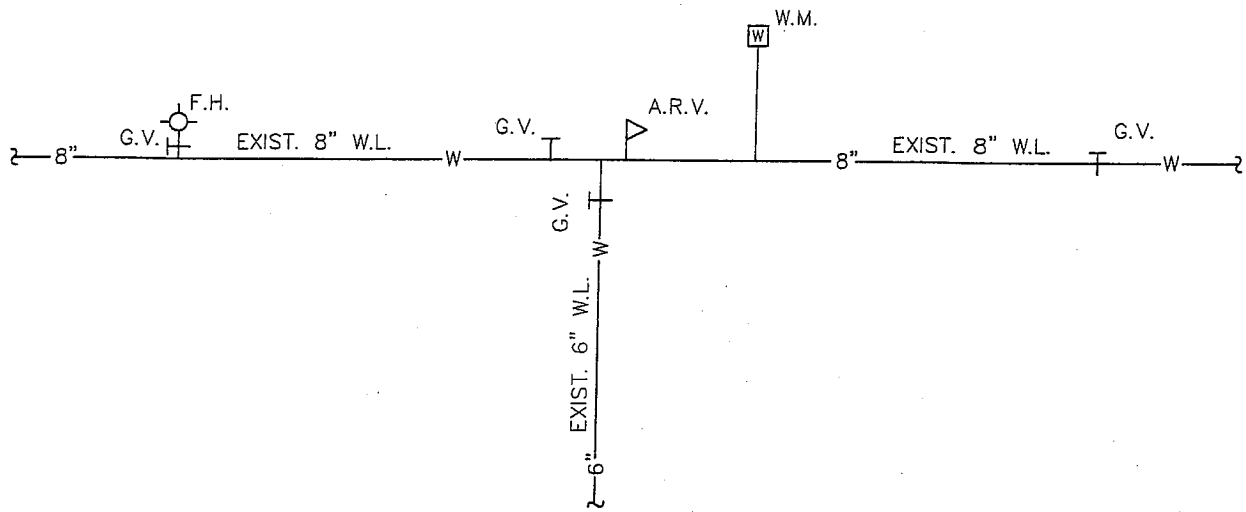
E. MATERIALS AND WORKMANSHIP

All materials and workmanship incorporated in water system extensions shall be in accordance with the currently adopted Construction Specifications in Ordinances No. 256 and No. 628. A copy of the specifications can be purchased for $7.50 from the Engineering Division of the Public Works Department.

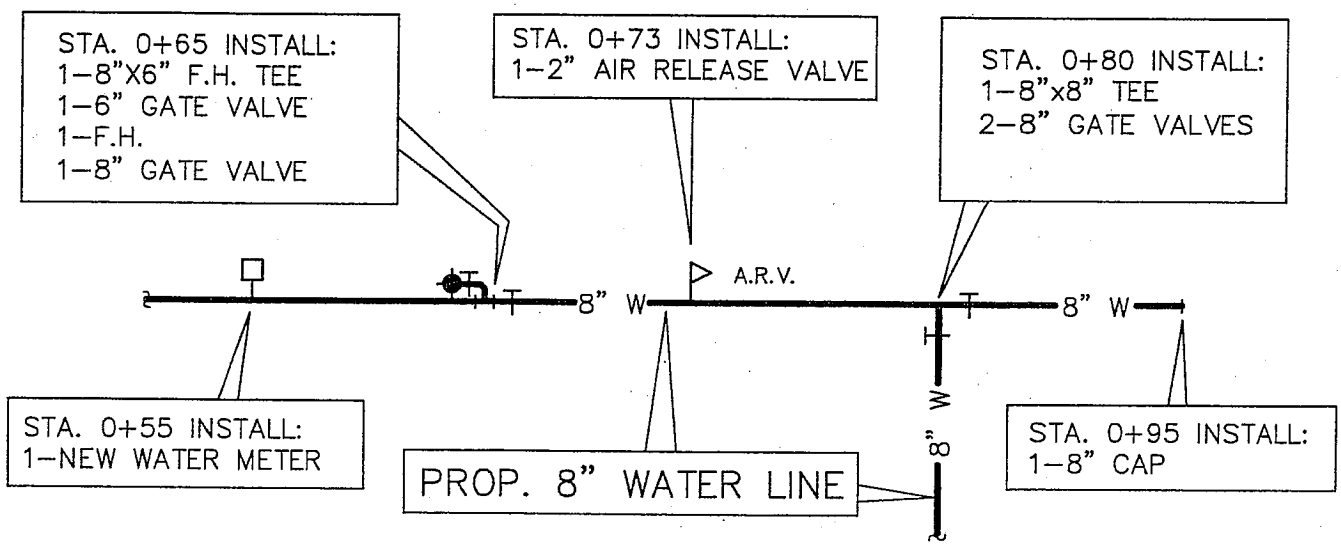
F. TRANSMISSION LINES

The north transmission main line shall be 30 inch minimum and the south pressure main line shall be 24 inch minimum.

EXISTING WATER LINES:



PROPOSED WATER LINES:



WATER

CITY OF HURST TEXAS

"A Quality of Life City"

EXISTING & PROPOSED WATER LINE DESIGNATIONS & CALL OUTS

DEPARTMENT OF PUBLIC WORKS – ENGINEERING

DATE:	DRAWN BY:	APPROVED BY:	REVISION:	SHEET NO.:
5-18-97	R.O.	J.S.	MAY 2007	6A

DWG. NAME: I:\BLKS-DETAILS-ETC\STD DETAILS\WEB\LINE DESIGNATIONS\WATER.DWG

SECTION 1-03 SANITARY SEWER SYSTEM

A. SANITARY SEWER SYSTEM EXTENSIONS

All subdivisions developed subsequent to this ordinance must be served by community sanitary sewer collection, treatment and disposal systems approved by the City. Each lot must be provided with an individual service.

B. SANITARY SEWER IMPROVEMENTS DESIGN CRITERIA

1. Sanitary sewer facilities shall be provided to adequately service each lot or tract of the subdivision, and shall conform to the City's current Master Sanitary Sewer System Plan. The size and grade of the proposed sanitary sewer shall be evaluated by the use of the Manning equation:

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

Where:
- V — Velocity, measured in feet per second
- R — Hydraulic radius measured in feet
- S — Slope of the energy grade line measured in feet per feet
- n — Manning's coefficient of roughness

Proposed sanitary sewer mains shall be designed at a slope such that the resulting velocity, when the line is flowing less than full, will be between 2.0 feet/second and 6 feet/second with n = 0.013.

2. No sanitary sewer main shall be less than eight inches (8") in diameter. A design should demonstrate desirable grades. Desirable grades are between 0.8% and 2.8%. Minimum grade is 0.40% for eight-inch (8") sewer line; 0.30% minimum grade preferable for all other sewer lines. All designs shall maintain a minimum velocity of 2 feet/second. All sewers shall be designed with consideration for serving the full drainage area subject to collection of the sewer in question. Exceptions to this requirement may be made only at the direction of the Director of Public Works.

3. All sewer services shall be located ten feet (10') from the centerline of the lot nearest the point of the lower sanitary sewer main grade.

4. Pipe Material: The following types of material apply to sanitary sewer pipe materials specified on the design plans:

Pipe Material (PVC)	Range of Pipe Diameter
SDR35	8" - 15"
ASTM F679	18" - 27"
ASTM F794	18" - 48"
Non-Reinforced Concrete	18" - 24"
Reinforced Concrete	27" and larger

Note: If PVC SDR-35 shall not be installed in areas greater then 8' in depth, SDR-26 shall be used up to 15 feet in depth with the appropriate embedment material.

5. An 8" sewer line shall have a minimum 200' centerline radius; 10" a 250' radius; 12" a 300' radius; all others shall be designed.

6. Governing City Ordinances are No. 333-Water and Sanitary Sewer Regulations and No. 256-Water and/or Sewer Main Extensions.

C. LATERALS AND MAINS

All laterals and sewer mains installed within a subdivision must extend to the borders of the subdivision as required for future extensions of the collection system regardless of whether or not such extensions are required for service within the subdivision.

D. SANITARY SEWER MANHOLE SIZES

Manholes to be constructed on existing or proposed sanitary sewer mains shall be sized as follows:

Pipe Diameter	Manhole Diameter
8" - 15"	4.0 feet
18" - 27"	5.0 feet
30" - 36"	6.0 feet

Special manholes shall be designed for mains larger than thirty-six (36") inches in diameter and for mains in extremely deep cuts. Sealed manholes with bolt down lids shall be

provided in creek beds and in flood plains. Manholes in a floodplain below the 100-year WSEL must have a watertight bolt down lid.

E. MANHOLE LOCATIONS

Manholes shall be provided at the following locations to facilitate maintenance, cleaning, and inspection:

1. At the location of lateral connections 6-inches in diameter or larger.
2. At the locations of lateral connections to a main 24-inches in diameter or larger.
3. At any location where the vertical grade changes.
4. At 500 foot intervals on mains 12-inches in diameter or smaller, 700 to 900 foot intervals on mains 15-inches in diameter thru 24-inches in diameter, and 900 to 1100 foot intervals on mains 27-inches and larger.
5. At all locations where the size of the pipe diameter changes.
6. At horizontal or vertical points of intersections in excess of 22.5 degrees on mains 24-inches in diameter or smaller.
7. At the center of horizontally curved sections of pipe where the included angle equals or exceeds 45 degrees.
8. At the intersections of mains, except large trunk mains in creeks where the manhole would be subject to long periods of submergence or in locations of difficult access. In these situations a manhole should be provided on the side main at the high bank or first accessible location.
9. At the end of all mains.

F. LOCATION OF SANITARY SEWER MAINS

Proposed sanitary sewer mains shall be located in the right of way area 3.5 feet off the property line. Mains located within an apartment complex or commercial development shall be designed within the proposed drive lanes and shall be located a minimum of 8 feet from the edge of existing or proposed structures.

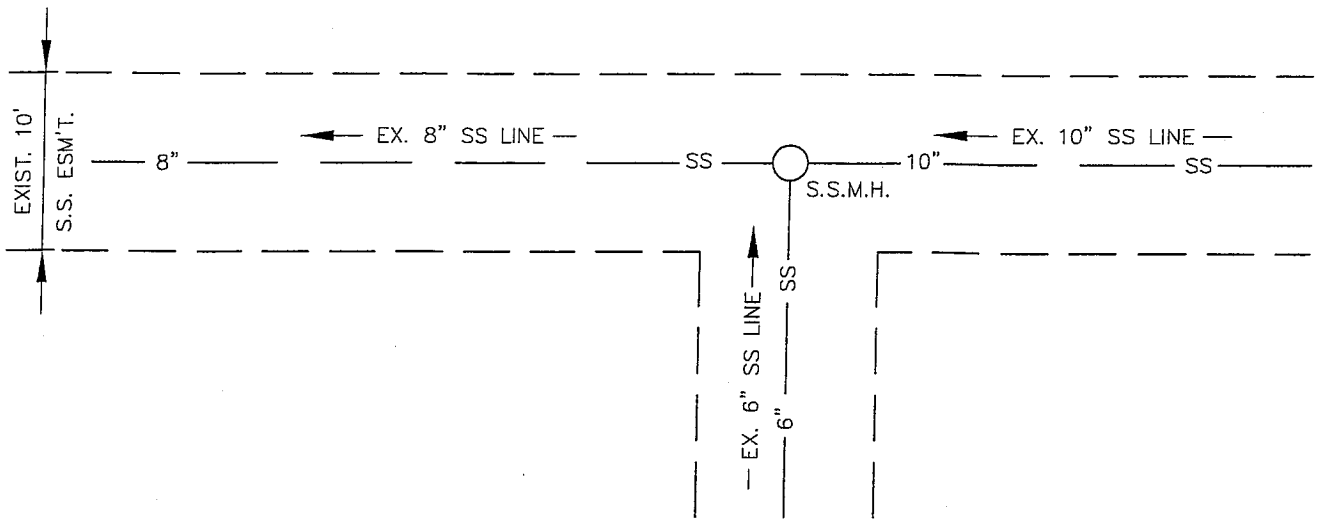
G. LIFT STATIONS OR SEPARATE TREATMENT FACILITIES

The provisions for lift stations or separate treatment facilities will not be permitted unless there is no feasible alternative in order to provide the necessary service to the proposed subdivision.

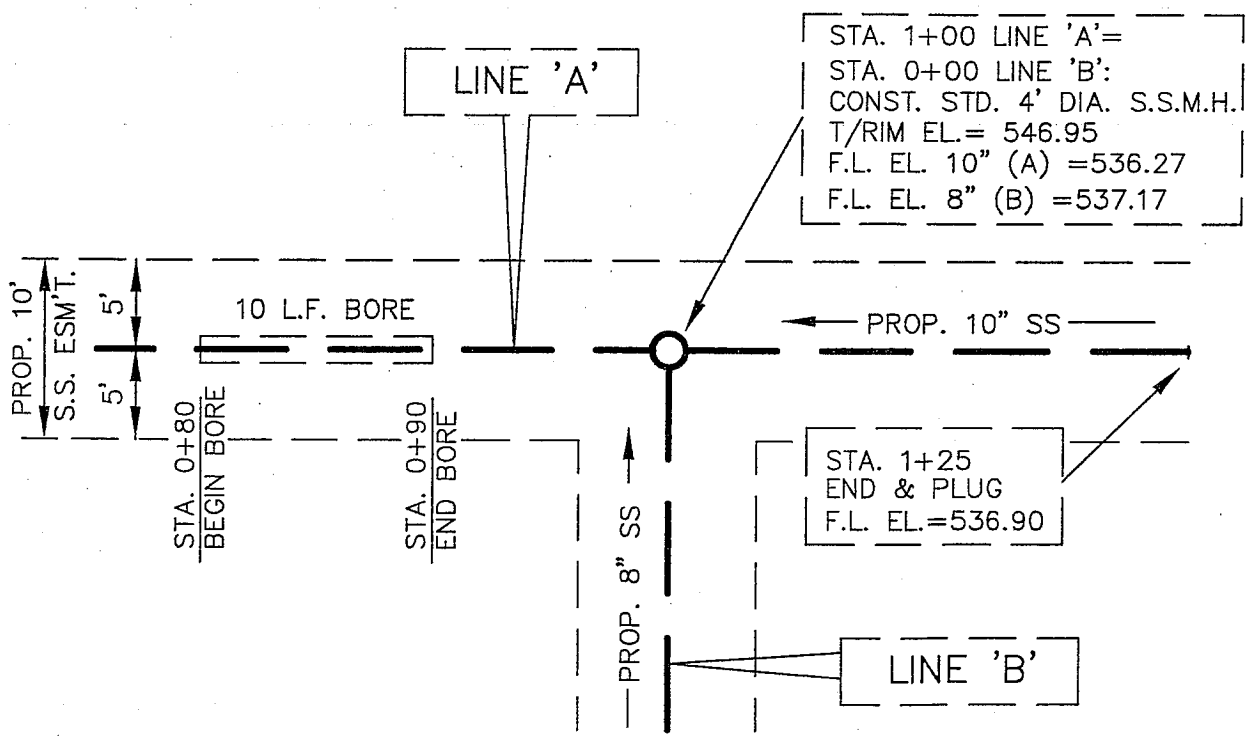
H. CONNECTIONS

No connection shall be made to any sanitary sewer within the City which will permit the entrance of surface water or waste which has other than domestic sewage characteristics.

EXISTING SANITARY SEWER LINES:



PROPOSED SANITARY SWER LINES:



SAN. SEWER

CITY OF HURST TEXAS

"A Quality of Life City"

EXISTING & PROPOSED SAN. SEWER LINE DESIGNATIONS & CALL OUTS

DEPARTMENT OF PUBLIC WORKS – ENGINEERING

DATE:	DRAWN BY:	APPROVED BY:	REVISION:	SHEET NO.:
5-18-98	R.O.	J.S.	MAY 2007	10A

DWG. NAME: I:\BLKS-DETAILS-ETC\STD DETAILS\LINE DESIGNATIONS\SAN. SEWER.DWG

SECTION 1-04 STREETS

A. STREETS REQUIRED

All streets constructed within the City shall be constructed with curb and gutters. The required widths of all streets within the City shall be determined by the "Functional Classification" of the streets as contained in the most current revision of the Master Thoroughfare Plan for the City of Hurst. Residential streets shall be a minimum of 31 feet wide measured from back of curb to back of curb.

B. STREET DESIGN CRITERIA

1. All streets within or abutting the proposed subdivision shall be paved, with curb and gutters installed, in accordance with the most current revision of the City's Standards Details and Specifications. All paving shall be the width specified on the Master Thoroughfare Plan and shall be constructed under the inspection of the Public Works Department. The construction cost of all street improvements shall be borne by the Developer unless participation by the City has been approved.

2. All underground utilities required in the subdivision shall be placed under or across all streets after rough grades are cut, but prior to the paving being placed. Paving operations will not be allowed to start until all utility work is completed and approved by the City.

3. Street grades shall be designed such that excessive sand disposition from too low a water velocity or pavement scouring from too high a velocity is avoided. The minimum street grade permitted shall be 0.80%. The maximum street grade shall not exceed 8.0%. Any deviation from this range of permissible grades shall require written approval of the Public Works Director.

4. Standard roadway widths from back of curb to back of curb are thirty-one (31') feet in a fifty (50') foot ROW, thirty-seven (37') feet or forty-one (41') feet in a sixty (60') foot ROW, sixty-one (61') feet in an eighty (80') foot ROW, and two (2) thirty-nine (39') foot pavement sections with a twenty (20') foot median in a one-hundred and twenty (120') foot ROW. Standard roadway widths for state owned facilities will vary from these city standards.

5. The minimum classified width of a proposed street may be enlarged under the following conditions:

    a. Adjacent to commercial or multi-family land uses where, in the opinion of the Public Works Department, additional width is indicated for proper access and circulation.

b. Where, in the opinion of the City or in the opinion, of the Developer with the concurrence of the City, the esthetics value achieved from extra width is dictated by special conditions.

6. No street shall be more than one thousand (1,000') feet in length without an intersection with another street, which will provide some degree of flexibility in traffic patterns and public convenience.

7. No street can be designed as a dead-end without the installation of a cul-de-sac. All cul-de-sacs require a forty-one (41') foot radius to the back of curb in a fifty (50') foot radius right-of-way. No cul-de-sac street may exceed five hundred (500') feet in length, as measured along the street centerline from the projected curb intersection to the farthest curb location.

8. Standard reinforced concrete curb height and width is six (6") inches with a twenty-four (24") inch integral gutter section, measured from the back of curb. Any deviation from this section will require the approval of the Director of Public Works.

9. The minimum pavement and sub-grade thickness for various street widths shall be constructed in accordance with the most current revision of the City's Standard Specification for Paving.

10. Minimum horizontal curvature radii for design of street centerline shall be as follows:

Classification	Horizontal Radius
Arterial	800 feet
Collector	400 feet
Residential	200 feet

11. In order to maintain an adequate sight distance, the minimum "K" values for the computation of vertical curves in the formula L=KA, where L is the length of the vertical curve in feet, and A is the algebraic difference of the street grades in percent (%) are listed below:

Design Speed MPH	Crest Vertical Curve "K" Value	Sag Vertical Curve "K" Value
30	28	35
40	60	60
50	110	90

12. The minimum radius for curb returns at intersections shall be twenty-five (25') feet to the back of the curb for residential streets with a thirty-one (31') in width, and thirty (30') feet to back of curb for all others.

13. A tangent of at least one hundred (100') feet long shall be introduced between reverse curves on arterial and collector streets. A tangent of at least one hundred-fifty (150') shall be introduced at all intersections, as measured from the intersection of the centerline.

14. At all street intersections, there shall be provided a minimum ten (10') foot by ten (10') foot corner clip sidewalk and utility easement diagonal to the street ROW lines for residential streets with a thirty-one (31') feet to back of curb, and a fifteen (15') foot by fifteen (15') foot for all others.

15. Reinforced concrete valley gutters shall be required at all asphalt street intersections where gutter flow lines cross another street or at low points where water flow crosses the street.

16. Median openings shall be spaced a minimum of 600 feet center to center or 500 feet curb-to-curb, which ever is greater.

17. A minimum ten (10') foot by sixty (60') foot visibility easement shall be required for residential streets (30 mph) and a ten (10') foot by one-hundred (100') foot for all others.

C. SIDEWALKS

1. Sidewalks and access ramps shall be installed on all streets classified as Collector Street or larger and along streets that are within fifteen hundred (1,500') feet of a school.

2. Sidewalks shall be constructed of four (4") inch thick, three thousand (3,000) psi compressive strength concrete reinforced with #3 steel bars laid on maximum of twenty-four (24") inch centers.

3. Sidewalks shall be a minimum of four (4') feet in width. The sidewalk shall be located on the City parkway one and one-half (1-1/2') feet off the private property line in most cases i.e., four (4') feet from the back of curb. If conditions dictate and the sidewalk has to be constructed adjacent to the curb, the sidewalk shall be six (6') feet in width. Sidewalks shall be graded such that the parkway has a 2% cross slope.

D. CITY PARTICIPATION

Where a street is designated as a Collector or Arterial street on the City of Hurst Thoroughfare Plan, the City will participate in the construction cost of that thoroughfare in conventional single-family residential areas only. The City's participation is limited to not more than ten (10%) percent of the paving cost on streets wider than thirty-one (31') feet for

back to back of curb, up to thirty-seven (37') feet from back to back of curb and not exceeding twenty-five (25%) percent of the paving cost for streets wider than thirty-seven (37') feet from back to back of curb. A written contract for City participation will be a condition prior to any payment of City funds. For medians required by the City for traffic separation and extra traffic lanes required by the City for turning movements onto public streets, the City shall not pay more then the cost of such construction. The City may require, but shall not pay for, medians or extra lanes required to provide safe ingress or egress for the sub-divider's property.

Where a street is required to be constructed with extra width or special conditions by the City for esthetics value or special circumstances, the City will participate on the same basis as thoroughfare considerations. Where the over-sizing of the street is at the discretion of the Developer for esthetics purposes or special considerations, no participation is required.

In all areas other than conventional single-family residential areas when existing development would require additional strength design or additional width of pavement to accommodate expected traffic use, no City participation is allowed.

E. DRIVEWAY STANDARDS

For the requirements and design of driveways see Ordinance No. 1306, "Driveway Access and Design Manual", adopted November 27, 1990.

SECTION 1-05 STORM DRAINAGE IMPROVEMENTS

A. GENERAL

The criteria herein provided shall govern the design of storm drainage improvements within the City of Hurst. Improvements shall include streets, alleys, storm sewers, channels, culverts, bridges, swales, flumes and any other facility through which storm water flows. All drainage improvements shall be constructed in accordance with City of Hurst Specifications and Ordinances and be in dedicated Right-Of-Way, drainage easement or floodway easement. The Developer shall provide all the necessary easement and ROW required for drainage structures, including storm sewers and open channels with access ramps. Easement width for storm sewer pipe shall be not less than fifteen (15') feet, and easement width for open channels shall be at least forty (40') feet wider than the top of the channel with twenty (20') feet on each side to serve as access ways for maintenance purposes.

The Developer shall be required to install at his own expense all storm sewers and drainage structures. This policy is applicable to facilities including the main channels and tributaries of Walker Branch, Calloway Branch, Lorean Branch, Valley View Branch, Little Bear Creek, and Sulphur Branch. The Developer shall be responsible for excavation and construction of the type channel required in any given area as shown in the publication "A Storm Drainage Study of Major Streams in Hurst, Texas" dated November 1983, by Albert Halff and Associates. The Developer shall be responsible for improvements based on the fully urbanized one hundred (100) year frequency discharge for the channel, unless otherwise approved by the City Council.

B. BASIS OF DESIGN

1. General - The design of storm drainage improvements in the City of Hurst, where the area is less than 160 acres, shall be based on discharges determined from the Rational Formula. The formula for calculating storm flows in this manner is as follows:

$$Q = C I A$$

Where:

- Q — Discharge, measured in cubic feet per second
- C — runoff coefficient (ratio of the maximum rate of runoff to the average rate of rainfall)
- I — average intensity of rainfall for the calculated time of concentration of the design point, measured in inches per hour
- A — drainage area, measured in acres

For areas greater than 160 acres a unit hydrograph shall be required to calculate runoff.

2. Quantity of Storm Water - The quantity of storm water runoff shall be determined for each inlet, bridge, culvert or other designated design point by using the following standards in application of the Rational Formula.

a. Runoff Coefficient - The runoff coefficient shall be determined for each drainage area from the current Land Use Plan of the City of Hurst. The runoff coefficient for land uses shall be as follows:

Areas	C
Business	0.95
Industrial	0.90
Residential	0.60
Park	0.40

Composite runoff coefficients will be determined by direct proportion when more than one land use exists within a drainage area.

b. Rainfall Intensity - Frequency - rainfall intensity - frequency curves complied by the U.S. Weather Bureau, Department of Commerce in Technical Paper No. 40 shall be used in computing rainfall intensity. The intensity, I in the Rational Formula shall be determined from the time of concentration and design storm frequency.

1 Time of Concentration - The time of concentration shall be calculated for all inlets and pipe junctions in a proposed storm sewer system or other points of analysis. The time of concentration shall consist of sheet flow, swale flow, street flow, inlet time and time of flow in the sewer and the basis of design shall be the longest time concentration applicable to the point of analysis.

For drainage areas of one acre or less the time of concentration need not be calculated and storm duration of ten minutes may be used as a basis of design.

2 Storm Frequency - Storm Frequencies for the storm drainage improvements in the City of Hurst are as follows:

Type of Facility	Design Frequency (Years)
For calculated storm sewer pipe sizes:	
27" and smaller	10
30" - 48"	50
54" and larger	100
Culverts, Bridges, Channels and Creeks	100

NOTE: When storm drainage facilities are designed to capture less than the 100 year event, positive overflow must be routed to convey any storm flow not captured in the 100 year event. The city engineer must set all building elevations adjacent to the overflow such that the lowest floor elevation is a minimum of 1 foot above the routed water surface elevation.

c. Area - The area used in determining flows by the Rational Formula shall be calculated by subdividing a map into drainage areas within the basin contributing storm water runoff to the system.

3. Storm Drainage Design - Before the construction or reconstruction of any street so as and before the construction of any building or other structure on a site of three or more acres, an engineering evaluation shall be made to determine the necessity of on-site or off-site storm drainage facilities to meet the requirements of Ordinance No. 595, "Streets and Storm Sewers" adopted January 28, 1975.

a. Surface Drainage on Streets - Storm drainage inlets shall be located and designed so as to limit the depth of water at the face of curb on any street to five inches and to permit no more than ten (10) cubic feet per second of storm water to cross an intersection.

b. Surface Drainage on Private Property - On lots or tracts of one acre or more, storm water runoff shall not be permitted to drain onto adjacent property except in existing creeks, channels or storm sewer system.

c. Storm Sewers - Storm water runoff in excess of that permitted to be carried on the surface shall be collected and transported in a storm sewer system. Such storm sewer systems shall be designed using Manning's equation for pipe and channel capacity:

$$Q = \frac{1.486\ A\ R^{2/3}\ S^{1/2}}{n}$$

Where:

Q	Discharge, measured in cubic feet per second
A	Cross sectional area of flow, measured in square feet
R	Hydraulic radius, measured in feet
S	Slope of the hydraulic gradient, measured in feet per foot
n	Manning's coefficient of roughness

Storm Sewer Type	n
Concrete Pipe	0.013
Concrete Lined Channel	0.015
Corrugated Metal Pipe	0.024
Earth Channel (Maintained)	0.035
Earth Channel	0.050

Storm sewer pipes shall be designed so that the average velocity of flow shall be not less than three (3) feet per second and not more than fifteen (15) feet per second. The minimum size of storm sewers shall be eighteen (18") inches in diameter or equivalent cross-section area.

In the design of a storm sewer system, the elevation of the hydraulic gradient of the storm sewer shall be a minimum of two (2) feet below the elevation of the adjacent street gutter and account for all head losses. In any system, the junction of pipes of different diameter shall be made with prefabricated fittings, junction boxes or manholes so that the crowns of the pipes are at the same elevation. Access to the main shall be provided every 400 feet.

d. Open Channels - When the calculated pipe size for a storm drain system exceeds seventy-two (72") inches in diameter, storm water runoff may be transported in open channels. Open channels may be fully lined, partly lined or unlined. Unlined channels will be permitted only in areas designated by the City Council and, in addition to other requirements, must be bordered by a minimum of one hundred feet of open space on each side of the floodway or top of the bank whichever is greater. Maximum earth slopes for unlined or partially lined channels shall not exceed 4:1. Partially lined channels shall consist of a concrete paved bottom and either earth slopes or concrete lined slopes to a height less than the design depth of water. Fully lined channels shall consist of concrete lined bottom and slopes extending at least one foot above the design water depth. Maximum side slopes for lined portions of a channel shall be 2:1.

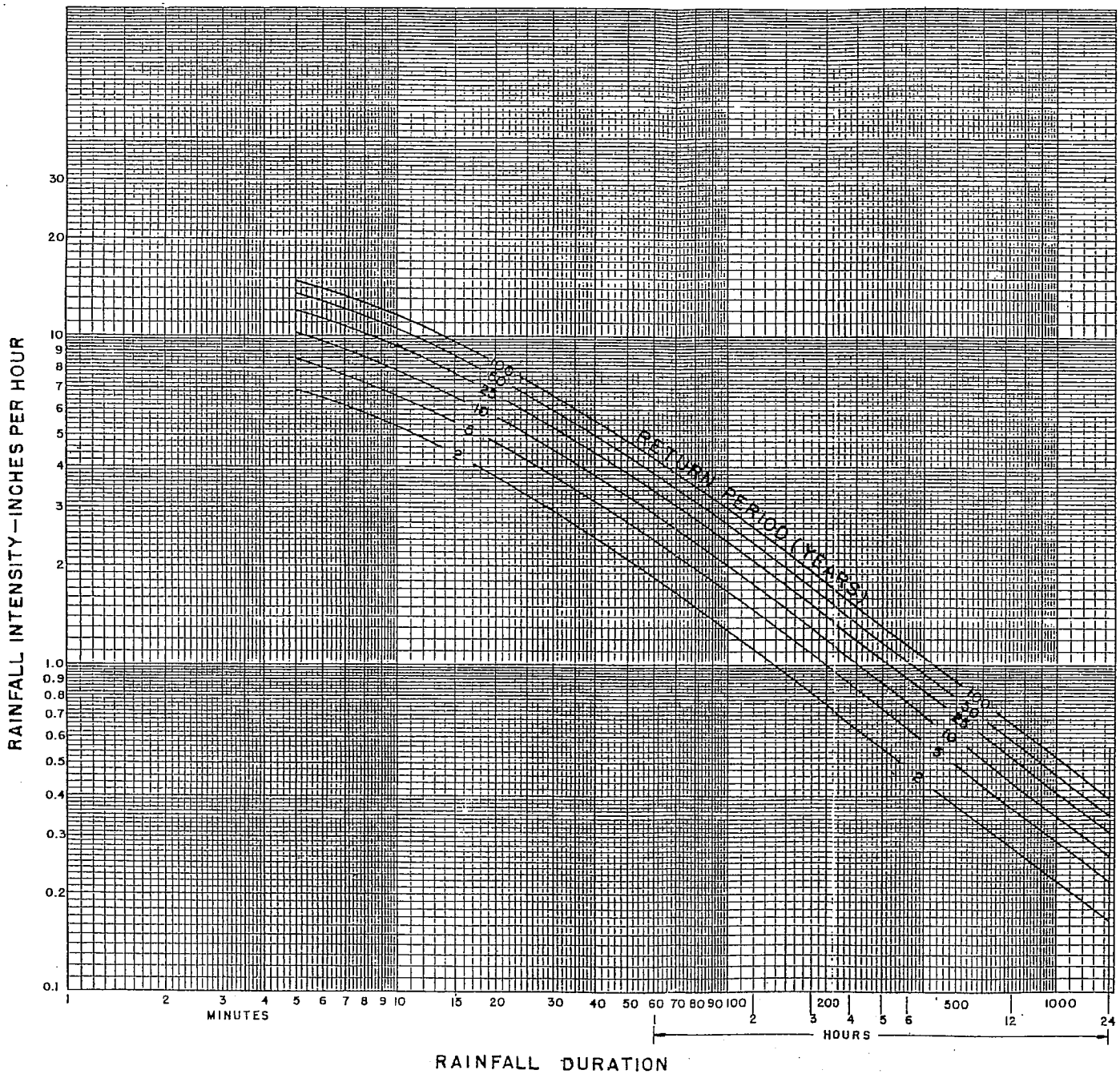
e. Bridge and Culverts - In addition to satisfying capacity requirements resulting from the application of Manning's Formula, bridges and culverts constructed to provide crossings of streams and open channels

shall provide a clear waterway having a least the same width as the downstream channel and shall have a clear height of one foot above the calculated upstream water depth for the fully urbanized 100 year storm unless otherwise approved by the Director of Public Works. Bridges shall have concrete lined bottoms and slopes. Bridges and culverts shall have upstream and downstream protection in the form of abutments, headwalls, or wingwalls.

f. Access Ramps - Reinforced concrete ramps shall be provided at all intersections of the channels with public streets. Access ramps shall be a minimum of twelve (12") feet wide with a maximum slope of sixteen (16%) percent.

g. Lot Grading - Lot grading shall be conducted in a manner in which will not allow runoff to cross more than two (2) lots (including the lot on which the drainage originates). If this is not possible, then a drainage easement must be provided and any necessary facilities shall be constructed and installed by the Developer.

Finished floor elevations shall be set a minimum of one (1') foot plus 2% from curb to structure above the top of curb at the centerline of the lot or one (1') foot above the fully urbanized, fully encroached, one hundred (100) year frequency storm water surface elevation, whichever is the higher. A lot and block grading plan sheet shall be required for all development plans.



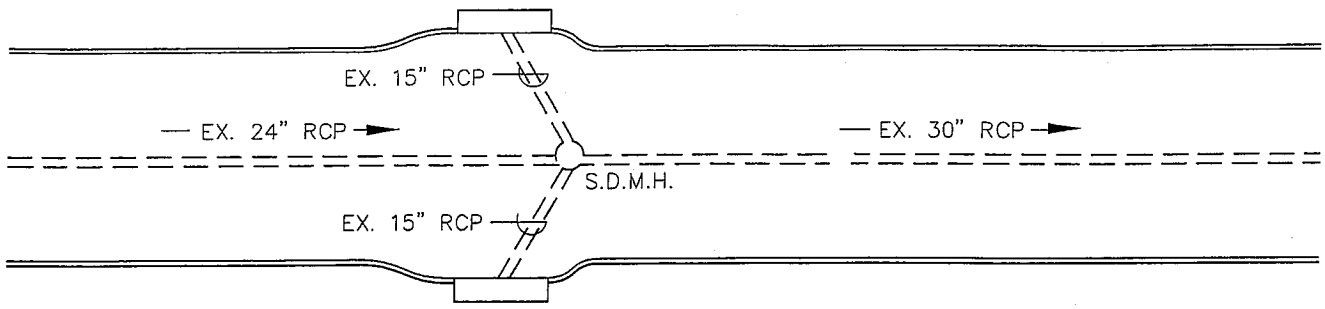
DEVELOPED FROM U.S. WEATHER BUREAU RAINFALL FREQUENCY DATA PRESENTED IN TECHNICAL PAPER № 40, DATED MAY, 1961.

RAINFALL INTENSITY VS. DURATION & FREQUENCY

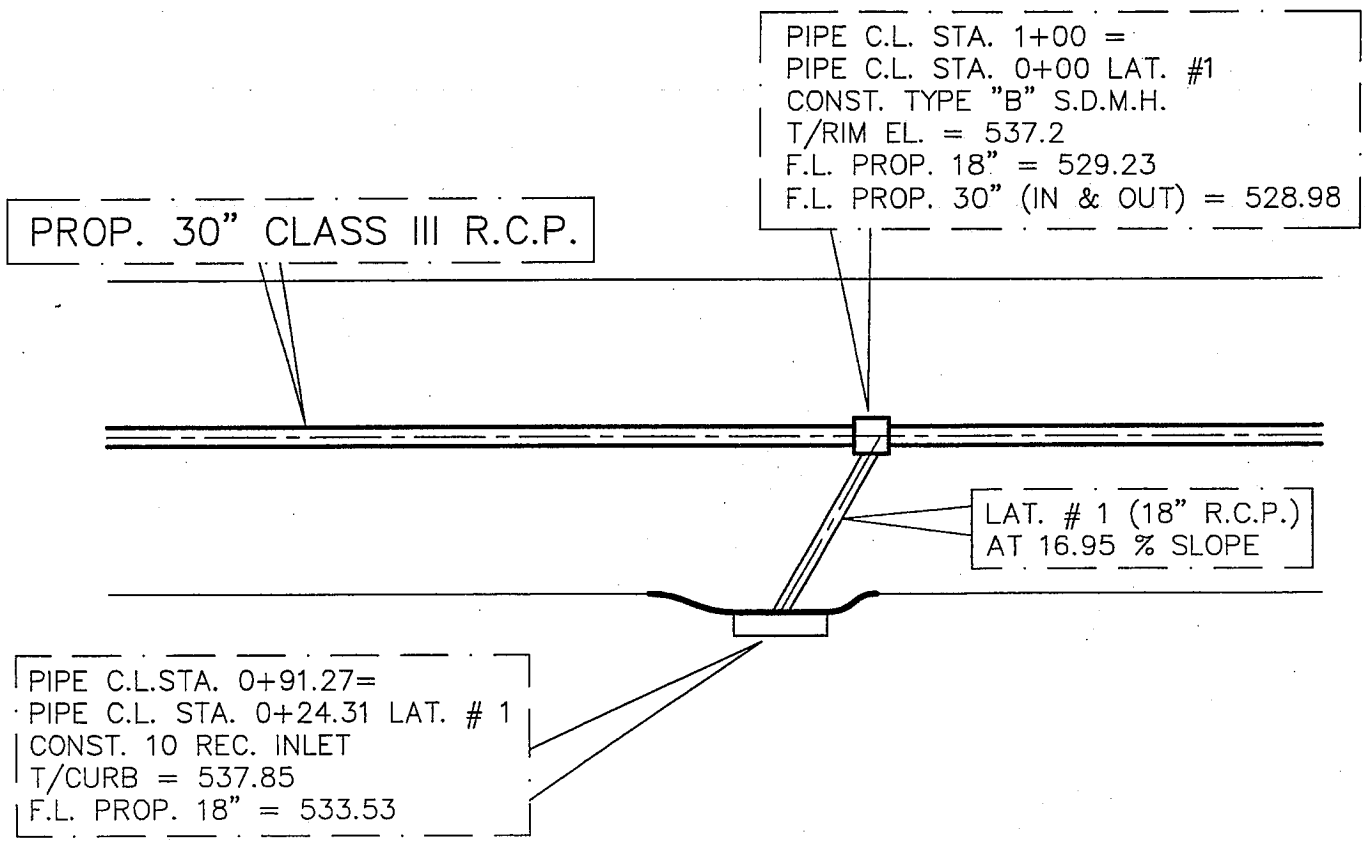
FOR

CITY OF HURST, TEXAS

EXISTING STORM DRAIN LINES:



PROPOSED STORM DRAIN LINES:



DWG. NAME: L:\USER\ROBERTO\ACAD\STANDARDS\STORM DRAIN LINE.DWG

STORM DRAIN

CITY OF HURST TEXAS

"A Quality of Life City"

EXISTING & PROPOSED STORM DRAIN LINE DESIGNATIONS & CALL OUTS

DEPARTMENT OF PUBLIC WORKS – ENGINEERING

DATE:	DRAWN BY:	APPROVED BY:	REVISION:	SHEET NO.:
5-18-98	R.O.	J.S.	MAY 2007	19B

Detention and Retention Facilities

Runoff rates shall be limited to the rates that would be produced from single-family residential areas. Detention/retention facilities shall be designed for the 100-year design flood according to the following criteria.

1. The minimum amount of storage volume of the detention basin shall be that volume required to reduce runoff rate to a single-family rate. Dedicated detention/retention basins shall also include an additional one foot of freeboard and two feet of sediment storage. The volume of runoff storage for drainage areas greater than 160 acres shall be computed using unit hydrograph procedures. Acceptable unit hydrograph procedures include the Soil Conservation Service Dimensionless Unit Hydrograph and Snyder's Unit Hydrograph. Manual methods or use of the computer programs TR20, HEC-1, and NUDALLAS are allowed for runoff hydrograph computation and flood routings.

   For drainage areas less than 160 acres, the above methods are recommended; however, an approximate routing method based on the rational formula is allowable, as outlined in Figure 1.

2. Detention areas in parking lots shall not be:

   a. In required parking spaces but in extra spaces.

   b. Behind speed bumps unless the speed bumps are made with reinforced concrete.

   c. Deeper than six inches unless warning signs are posted.

3. Drainage easement shall be provided for all regional detention/retention facilities and for other detention/retention facilities where two or more owners are involved.

4. Detention/retention facilities shall be designed to empty in less than 24 hours, unless it is also serving as an erosion control facility.

5. Detention/retention facilities shall not be counted as an erosion control technique unless (1) the basins are designed to empty a minimum of 24 hours from the storm event and (2) adequate sediment storage areas in the basin have been set aside and are maintained.

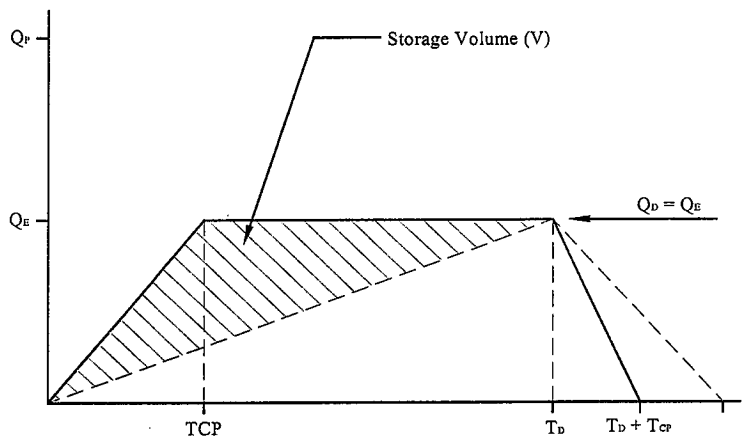
6. Detention/retention facilities shall be maintained by the owner unless the facilities and a drainage easement are dedicated to the City of Hurst. Typically, Hurst will not accept maintenance responsibilities of a detention/retention facility unless the bottom is concrete.

7. A steel elevation rod shall be installed in all grass-bottomed detention/retention facilities. The owner will be responsible for removing the sediment when the two-foot storage is met.

FIGURE 1

Approximate Routing Method for Watersheds < 160 Acres

STORAGE VOLUME (V)



TIME (MINUTES)

$$V = \frac{60}{43{,}560}\left[Q_D T_D - Q_E\left(\frac{T_D + T_{CP}}{2}\right)\right]$$

Where:

V	Detention volume, measured in acre-feet.
Q_P	Peak discharge for developed watershed using storm duration equal to T_{CP}, measured in cubic feet per second
Q_E	Peak discharge for existing watershed, assuming full residential development and corresponding T_C, measured in cubic feet per second
T_{CP}	Time of concentration for proposed development, measured in minutes
T_D	Storm duration corresponding to I_D, measured in minutes

$$I_D = \frac{Q_D}{C_P A}$$

Where:

I_D	Rainfall intensity for a storm duration that produces Q_D, measured in inches per hour
Q_D	Peak discharge for developed watershed, based on a storm duration that yields the existing discharge for C_P and A, measured in cubic feet per second
C_P	Rational runoff coefficient for developed condition
A	Drainage area, measured in acres

Detention Basin Example

Development Data for the 100-Year Storm:

Drainage Area: $A = 160 \text{ acres}$

Residential:

$C_R = 0.60$

$T_{CR} = 15 \text{ min} \quad \Rightarrow \quad I_R = 9.60 \frac{\text{in}}{\text{hour}}$ (from Technical Paper #40)

Developed:

$C_P = 0.90$

$T_{CP} = 10 \text{ min} \quad \Rightarrow \quad I_P = 11.60 \frac{\text{in}}{\text{hour}}$

$$Q_E = Q_D = C_R \, I_R \, A = (0.60)(9.60)(160) = 921.6 \text{ cfs}$$

$$Q_P = C_P \, I_P \, A = (0.90)(11.60)(160) = 1670.4 \text{ cfs}$$

$$I_D = \frac{Q_D}{C_P \, A} = \frac{921.6}{(0.9)(160)} = 6.4 \frac{\text{in}}{\text{hour}}$$

$T_D = 32 \text{ min}$ (from Technical Paper #40)

Volume of Detention:

$$V = \frac{60}{43{,}560}\left[Q_D \, T_D - Q_D \left(\frac{T_D + T_{CP}}{2}\right)\right]$$

$$V = \frac{60 \, Q_D}{43{,}560}\left[T_D - \frac{T_D + T_{CR}}{2}\right]$$

$$V = \frac{60 \cdot 921.6}{43{,}560}\left[32 - \frac{32 + 10}{2}\right]$$

$$V = 13.96 \text{ acre - feet}$$