

## Chapter 1 Administration

### 1.0 COMPLIANCE OVERVIEW:

*In the interest of consistency and to maintain the most efficient oversight of the land subdivision and the land development process, the City of Santa Fe adopts the following Public Works Specification. This specification closely parallels the Galveston County "Rules, Regulations and Requirements Relating to the Approval and Acceptance of Improvements in Subdivisions or Re-Subdivisions" as promulgated by the Galveston County Engineering Department, March 3, 1997 and adopted by the Galveston County Commissioner's Court. It is edited and modified in conformance to the requirements of the Santa Fe Zoning Regulations and various regulations of the Code of the City of Santa Fe.*

*Generally, compliance with county specifications will place a project in compliance with Santa Fe regulations; however because of specific requirements of Santa Fe codes and ordinances and differences between the roles, power and duties of home rule city and county government, it is imperative that the designer, engineer and developer review this specification in detail when applying it to a project within Santa Fe jurisdiction. When a project is proposed in the Santa Fe Extra-territorial Jurisdiction and a conflict arises between the requirements of Santa Fe and the county, it shall be the designer, engineer or developer's responsibility to alert both governments to the conflict and to arrange resolution mutually agreeable to both entities. In general, the more restrictive condition will prevail.*

*When a public works project is proposed within the city limits of Santa Fe full compliance with this specification is mandatory. The staff administrator or City Engineer may modify the technical requirements of this specification when strict adherence compromises good engineering practice or when modifications will result in a project that exceeds in quality that required by the specifications. Modifications to the technical requirements proposed to lower or avoid cost to the developer will be routinely submitted to City Council for approval. At no time will this specification be binding on city funded projects. Such projects will be provided with drawings and specifications appropriate to each project.*

### 1.1 DEFINITION OF TERMS:

**City.** Wherever the term "city" is used throughout this specification it shall mean the City of Santa Fe, Texas.

**City Engineer or Engineer.** Throughout this specification where ever the term "City Engineer" or "Engineer" is used it shall mean the City Engineer of the City of Santa Fe or the individual or firm designated as acting City Engineer by the City Council or it shall mean the Director of Community Services when no City Engineer has been designated.

**FEMA.** Wherever the term "FEMA" is used throughout this specification it shall mean "Federal Emergency Management Agency".

**R.O.W.** Wherever the term "R.O.W." is used throughout this specification it shall mean "right(s)-of-way".

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## 1.2 APPLICATION OF THIS SPECIFICATION

It is the intent of the Planning and Zoning Commission and the City Council of the City of Santa Fe that the standards and restrictions required by this specification shall be applied to all public works and improvements thereto whether on public or private property and whether single or multi-tenant. Specific exception are as follows:

**1.2.1** These specifications are not intended to be applied to private drives giving access to a single family dwelling located on either a pre-existing, conforming or non-conforming, lot or tract of land.

**1.2.2** Nor are they intended to apply to driveways within single tenant commercial and industrial developments when such driveways are not intended for public use

## 1.3 SUBMITTAL OF DESIGN AND CONSTRUCTION DOCUMENTS:

Subdivision documentation shall be submitted in the form and quantity required by the Subdivision and Zoning Ordinances of the city. A minimum of four copies of all other design and engineering documentation must be submitted to the City Engineer for review. This quantity may be reduced to two copies with approval of the Administrator or City Engineer. Additional copies may be required under some circumstances; the designer, engineer or developer will be notified accordingly.

## 1.4 CONSTRUCTION DRAWINGS:

### 1.4.1 Minimum Required Information

Construction drawings for public improvements, private and public rights-of-way improvements and projects intended to be dedicated to public use and intended to be maintained at public expense must be designed to at least these minimum standards. Projects must be approved by the City of Santa Fe. Complete drawings and specifications must be submitted including details, cross-sections, profiles showing line and grade of streets, roads, bridges, sewers, ditches, easements. Also shown must be all existing improvements both sub-surface and above ground including buildings, structures, pipelines, electrical utilities and communications cables. The location and size of all easements and rights-of-way must be shown. Drawings must also include complete detention facility drawings and the engineering and hydrology analysis supporting the design of the drainage and detention system. The design engineer must also provide the proposed location of sewage disposal systems and potable water supply and associated equipment and devices. Information must be provided for the above items both on and within 200 feet of the site.

### 1.4.2 Format

All drawings must be presented on 24" x 36" format unless a different format is approved prior to commencing the project. Deviation from this standard size is discouraged.

### 1.4.3 Reproduction

Check sets and working sets must be blue or black line reproductions. As-built drawings must be black line reproductions; reproducibles shall be non-

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water soluble black line on mylar media.  
**As-builts and final plats shall also be submitted in digital Adobe file format (.pdf).**

### 1.4.4 Design Professional's Seal

Drawings submitted for record must carry the original seal and signature of the responsible design professional. Interim design and check sets need not be sealed. Final approval sets and as-built sets will carry seals.

### 1.4.5 Floodplain Data

All site or location plans within or partially within the 100 year floodplain must carry current flood plain information including the location of the flood plain boundaries and pertinent elevation information.

## 1.5 ADMINISTRATIVE PROCEDURES IN THE REVIEW OF SUBDIVISION PLATS AND CONSTRUCTION DRAWINGS:

**1.5.1 General.** Refer to the City of Santa Fe Subdivision and Zoning Ordinances; these ordinances will control all subdivision and public improvements. No provision of these Public Works specifications will diminish any provision or restriction of such ordinances. If an apparent conflict arises it is the duty of the Professional Engineer to bring it to the attention of the City Engineer. Small subdivisions meeting certain guidelines of the Subdivision Ordinance will be reviewed and approved administratively. Most plats will be reviewed for conformity by the Santa Fe Planning and Zoning Commission. All variances will be referred to the City Council for review and approval.

### 1.5.2 Preliminary plat, preliminary drawings and engineering drawings.

Copies in the number required on the subdivision application must be submitted to the City Engineer; additional copies must be submitted to Galveston County Drainage District #1 for review and recommendations to conform to requirements, *as necessary*. Abutting owners and property lines will be shown; see Subdivision Ordinance for additional information. A table showing the acreage in each tract and total acreage will be shown.

### 1.5.3 Final plat, final drawings and engineering drawings.

Copies shall be submitted complete with drawings and specifications including details, cross-sections and profiles showing line and grade of all streets, roads, bridges, sewers, ditches, utility easements and the course and location of existing pipelines or pipeline easements through such proposed subdivision (five copies). The design engineer shall furnish the proposed location of sewage disposal facilities and the source of water supply.

### 1.5.4 Approval.

Plats and drawings will be reviewed and the drawings either will be approved or recommendations made for further changes.

### 1.5.5 Planning and Zoning Commission Approval.

Upon approval of the plat and drawings by the City Engineer's Office, the final plat pursuant to plat recordation requirements will be submitted to the Planning and Zoning Commission for approval. If approved, the construction and dedication of all public improvements must be completed in one year. Alternatively, the owner of the subdivision may enter into a Subdivision Improvement Agreement by posting a bond or making a financial

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guarantee in lieu of the bond before the plat may be approved by the Planning and Zoning Commission.

### 1.5.6 Permits Required

Before construction begins on the subdivision, the proper development permits will be obtained from the Santa Fe Floodplain Administrator.

### 1.5.7 Storm Water Pollution Prevention

Before construction begins, all development disturbing one or more acres shall provide a Storm Water Pollution Prevention Plan. Provide a copy of the NOI (Notice of Intent) filed with the Texas Commission on Environmental Quality. Use Best Management Practices for erosion and sediment control. Review the Galveston Bay Stormwater...Keep it Clean!! *Stormwater Pollution Prevention for the Construction Industry* Guide available from the City Engineer.

### 1.6 PLAT RECORDATION AND PUBLIC IMPROVEMENTS ACCEPTANCE REQUIREMENTS:

The original plat drawing submitted to the City Engineer prior to approval by Planning and Zoning Commission and recordation in the Galveston County Map Records will be delivered by city personnel to the County Clerk's Office for recording in the Map Records of Galveston County, Texas. The plat will be a maximum size of 24" x 36", be an original mylar signed with black non water soluble ink. No sepias are acceptable. The plat will be recorded by the County Clerk upon receipt of the required fee. All associated fees are the responsibility of the developer.

The following additional information is required to accompany the final plat submittal for recordation:

**1.6.1 Title Report** A title report, statement, or opinion, title policy or certificate or letter from a title company authorized to do business in the State of Texas or an attorney licensed as such in the State of Texas must be provided indicating ownership of the property, all liens against same, and any easements; said title information shall not have been executed more than sixty (60) days prior to the time the plat is received in the Community Development Office.

#### 1.6.2 Tax Certificates

A certificate from each tax collector of a political subdivision in which the property is located showing that all taxes owed to the County, School District, Utility District and/or any other political subdivision have been paid in full to date.

#### 1.6.3 Health Department Permits

A letter to the City Engineer, signed by the County Health Officer, certifying that the subdivision's water and sewage treatment system has been approved in accordance with the requirements of the Texas Department of Health and existing laws.

#### 1.6.4 Subdivision Name Approval

A letter from the County Tax Assessor-Collector certifying that the name of the subdivision to be presented to the Planning and Zoning Commission is not in conflict with any other subdivision previously recorded; this requirement applies to the first section only of multi-section subdivisions and is not applicable to street dedication plats designated by the street name.

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### 1.6.5 Floodplain Disclosure

If a portion of the plat lies within the 100-year floodplain, a letter is required from the developer/owner stating he is aware of the fact and will advise all prospective property owners of the fact. The same will apply to the 100-year floodway.

### 1.6.6 Reserves

Two sets of approved construction drawings are to be on file in the City Engineers Office at the time the plat is submitted to Planning and Zoning Commission for Final Platting; however, in the event a tract of land is being platted to create reserves for the purposes of sale only and there are no immediate plan for construction of improvements on said reserves, then a note shall be placed on the face of the plat stating the following:

"Site drainage drawings for the future development of this reserve must be approved by the applicable Galveston County Drainage District and City Engineer."

### 1.6.7 Easement Crossing

A letter, statement or other instrument from the owner of any privately owned easement or fee strip within the plat boundaries where such easements or fee strips are proposed to be crossed by streets (either public or private) or public utility or drainage easements, stating that the owner of such easement or fee strip approves such crossing of the private easement or fee strip for the purposes intended and depicted upon the plat.

### 1.6.8 Special Easement Annotation

All utility and drainage easements shown on Subdivision plats and Replats shall be clearly annotated in the following manner:

"The obstruction of any portion of this utility easement by the erection or installation of buildings, structures, improvements and landscaping devices is strictly prohibited."

Or

"The obstruction of any portion of this drainage easement by the erection or installation of buildings, structures, improvements, land forms, fill and the placing of landscaping is strictly prohibited."

### 1.6.9 Subdivision Improvement Agreement.

A bond with the owner of the subdivision named as Principal, this bond shall:

1.6.9.1 be made payable to the City of Santa Fe;

1.6.9.2 be in the total amount of paving and appurtenant drainage improvements;

1.6.9.3 be executed with sureties as may be approved by the City Attorney;

1.6.9.4 be executed by a company authorized to do business as a surety in this state; and

1.6.9.5 be conditioned that the roads and streets will be constructed in accordance with the specifications adopted by the City of Santa Fe; in the event that all paving and drainage improvements have not been constructed and accepted within one year from the date of plat approval, the owner of the may request a one year extension.

1.6.9.6 The bond will be reviewed and approved by the City Attorney.

### 1.6.10 Cash or Letter of Credit

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In lieu of a bond an owner may deposit cash or a letter of credit issued by a federally insured financial institution. If a letter of credit is used, it must:

**1.6.10.1** list as the sole beneficiary the City of Santa Fe, and

**1.6.10.2** be conditioned that the owner of the tract of land to be subdivided will construct any roads, streets and drainage in the subdivision:

**1.6.10.3** in accordance with the specifications adopted by the City of Santa Fe; and

**1.6.10.4** within a reasonable time as set by the Planning and Zoning Commission.

### **1.6.11 Supporting Data**

Additional information may be required by the City Engineer to clarify or support any of the aforementioned requirements.

### **1.6.12 Street Lighting**

A letter from the developer stating that when street lighting is installed he is aware that he will have to pay the installation, maintenance, and monthly usage costs for at least three years; see the Subdivision Ordinance for details.

### **1.6.13 Sidewalks and Landscaping**

A letter from the developer stating that if sidewalks and landscape berms or medians are installed, he is aware that he will have to pay the installation and maintenance costs for at least one year.

### **1.6.14 Responsibility to Federal State and Local Agencies**

A letter from the developer stating he is aware that all other requirements and permits are his responsibility including, but not limited to, U.S. Army Corps of

Engineers permits for work in wetlands or navigable waters, U.S. Environmental Protection Agency, U.S. Federal Emergency Management Administration, Texas General Land Office, Texas Attorney General, Texas Commission on Environmental Quality, United States Postal Service, and local and state health agencies.

### **1.6.15 Extension of Existing R.O.W.s**

If any portion of a proposed or planned street, collector or thoroughfare traverses any part of the land being subdivided, that portion of the street at the proposed R.O.W. width shall be incorporated into the subdivision plan and shall be dedicated to the appropriate governmental entity.

### **1.6.16 Extension of Existing Drainage**

If any portion of a proposed ditch, channel or drainage improvement traverses any part of the land being subdivided, that portion of the ditch, channel or drainage improvement as planned, at the proposed R.O.W. width, shall be incorporated into the subdivision plan and shall be dedicated or conveyed to the appropriate governmental entity.

### **1.6.17 FIRM Remapping**

If the proposed subdivision necessitates the need for a FEMA FIRM or Floodway map amendment or revision, the developer shall provide the engineering and all costs for these. The amendment or revision shall be completed and approved by FEMA before the subdivision can be approved.

### **1.6.18 FEMA Compliance**

All development shall conform to FEMA's National Flood Insurance Program and Related Regulations which have been adopted by the City of Santa Fe as a

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requirement to participate in the National Flood Insurance Program.

### 1.6.19 Professional Engineer

State of Texas Engineering Practice Act should be reviewed in conjunction with these regulations.

### 1.6.20 Professional Land Surveyor

The State of Texas Professional Land Surveying Practices Act should be reviewed in conjunction with these regulations.

### 1.6.21 Permits Only Upon Completion.

No building permits will be issued in any subdivision until the road and drainage have been constructed per the approved plans and specifications and inspected and accepted by the city for compliance with the same.

### 1.6.22 Bond.

A bond in the amount of all improvements (streets, drainage, grading) shall be submitted with the request to accept the improvements. The bond will be in effect for one year after acceptance.

## 1.7 PLAT FORMAT:

The standard format and standardized statements required on each plat will be in conformance to those set out in the Santa Fe Zoning Subdivision Ordinance.

## 1.8 SPECIFIC IMPROVEMENTS, DEVELOPMENT REQUIREMENTS:

### 1.8.1 Landscaping

Landscaping on right-of-way must be approved by the city. Installation costs are at developer's expense. Maintenance and utility expenses remain the responsibility

of the developer until after final acceptance of the streets and improvements for one year.

### 1.8.2 Signs and Identification Structures

Entry, subdivision and project signs must conform with the sign regulations of the city and must be placed on private property or on dedicated easement or reserves outside of rights-of-way.



## **Chapter 2 DRAWING REQUIREMENTS**

### **2.1 GENERAL**

The Professional Engineer, registered in the State of Texas, is required to seal, date and sign each sheet of the drawings in accordance with rules set forth by the Texas State Board of Registration for Professional Engineers. The seal must reproduce on all sheets.

### **2.2 CONSTRUCTION PLANS**

#### **2.2.1 Elevation Data.**

All projects shall be tied to National Geodetic Survey (NGS) Datum adjustment which matches the Federal Emergency Management Agency (FEMA) rate maps or the most current NGVD which matches the FEMA rate maps. In the event GPS surveying is used to establish bench marks, at least two references to bench marks relating to the FEMA rate maps must be identified. Equations may be used to translate other datum adjustments to the required adjustment.

#### **2.2.2 Dimensions.**

Indicate right-of-way widths, pavement widths and thickness, type of roadway materials, curbs, intersection radii, curve data, stationing, existing and proposed utilities - type, location, etc. on each plan sheet.

#### **2.2.3 Stations.**

Stationing must run from left to right except for short streets or lines originating from a major intersection where the full length can be shown on one sheet.

#### **2.2.4 North Arrow.**

A North arrow is required on all sheets and should be generally oriented either upward or to the right.

#### **2.2.5 Adjoining Properties.**

Identify all adjacent property and owners, show all lot lines, property lines and rights-of-way lines, etc.

#### **2.2.6 Cover Sheet.**

A cover sheet shall be required for all projects involving three or more plan and profile sheets. All plan sheet numbers should be included on the cover sheet or area map. A vicinity map should always be included to show the project location.

#### **2.2.7 Existing Roadway information.**

If a roadway exists where drawings are being prepared to improve or construct new pavement or to construct a utility, this roadway should be labeled as to its existing width, type of surfacing and base thickness if available without destruction of pavement.

#### **2.2.8 Final Plat in Engineering Drawings.**

A copy of the final plat should be included with the final drawings when the design drawings are submitted for final approval.

#### **2.2.9 Mylar Media.**

Drawings submitted for City Engineer's approval shall be on mylar or linen.

#### **2.2.10 Match Lines.**

Do not place match lines in intersections.

#### **2.2.11 Plan and Profile View.**

All utility lines four inches (4") in diameter or larger within the right-of-way or construction easement should be shown in the profile view. All utility lines, regardless of size, should be shown in the plan view.



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Resolve all known conflicts of proposed utilities with existing utilities.

**2.2.12 Flow lines.**

Show flow line elevations and direction of flow of all existing ditches.

**2.2.13 Profiles.**

Show natural ground profiles at each right-of-way or easement line. Center line profiles of natural ground will be satisfactory for rights-of-way or easements except where there is a difference of 0.50 feet or more from one right-of-way or easement line to the other; in which case, dual profiles will be required.

**2.2.14 Drawing Size.**

Drawings for street and/or public improvements shall be standard 24"x 36" overall dimensions for all design in rights-of-way or easements.

**2.2.15 Uniformity of Scales.**

Details of special structures not covered by approved standard drawings, such as stream and gully crossings, special manholes, etc., should be drawn with the horizontal and vertical scales equal to each other.

**2.2.16 Scale.**

Drawings shall be drawn to accurate scale, showing proposed pavement typical cross sections and details, lines and grades, and all existing topography within the street rights-of-way; and at intersections, the cross street shall be shown at sufficient distance in each direction along the cross street for designing adequate street crossings.

**2.2.17 Grades.**

Grades should be labeled for the top of the curb except at railroad crossings. Gutter elevation shall be shown at Railroad

Crossings. Center line elevations are acceptable only on streets without curb and gutters.

**2.2.18 Curb Return Elevations.**

Curb return elevations for turnouts shall be shown in the profile.

**2.2.19 Station Locations.**

Station all esplanade noses, both existing and proposed.

**2.2.20 Esplanade.**

The design of both roadways is required on all pavement sections with an esplanade.

**2.2.21 Station Locations.**

Station all PC's P.T.'s, radius returns and grade change P.I.'s in the plan view. Station all radius returns and grade change P.I.'s in the profile with their respective elevations.

**2.2.22 Standard Scales.**

The standard scales permitted for plans and profiles of paving and utility drawings are as follows:

**2.2.22.1 Major thoroughfares or special intersections/ situations:**

1" = 2' Vertical; 1" = 20' Horizontal

**2.2.22.2 Minor streets:**

1" = 5' Vertical; 1" = 50' Horizontal

or

1" = 4' Vertical; 1" = 40' Horizontal

(for reconstruction on minor streets, a larger scale may be required to show detail)

**2.2.23 Detail Scales.**

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The above scales of paragraph 2.2.22.1 are the minimum, and larger scales may be used to show details of construction.

### **2.2.24 Scale Deviations.**

Deviations to these scales can only be allowed with the specific approval of the City Engineer.

### **2.2.25 Key and Index.**

In addition to the plan and profile sheets described above, where applicable, each set of construction drawings shall contain a separate key paving and drainage drawing and a key utility drawing indexing specific plan and profile sheets.

### **2.2.26 Key Drawing.**

It is preferable that key overall layouts be drawn at a scale of 1" = 100' or 1" = 200'. Smaller scale may be used where appropriate for the project with prior approval.

### **2.2.27 Drafting Conventions.**

Drafting principals, conventions, techniques shall be those generally recognized in contemporary literature, and in common practice in the engineering practice.

### **2.2.28 Graphic Standards.**

Graphic standards shall be in accordance with those currently used in common engineering practice.



## **CHAPTER 3 General Standards**

### **3.1 Street Right-of-Way Standards.**

#### **3.1.1 Right-of-Way Width.**

The minimum right-of-way width is sixty (60) feet. Minimum width for feeders and arterials are as otherwise specified herein or set out in the Santa Fe Subdivision Ordinance, whichever is greater.

#### **3.1.2 Cul-de-sac Right-of-Way Length.**

The maximum cul-de-sac right-of-way length is 1000' in single family residential zones and 800' in all other zones. Cul-de-sacs traversing both a single family residential zone and any other zone are limited to a maximum right-of-way length of 800'.

#### **3.1.3 Minimum Existing Street Width Correction.**

When a proposed subdivision adjoins an existing non-conforming width right-of-way the non-conforming right-of-way width must be corrected by dedication of proposed subdivision's share of the non-conforming width shortfall.

#### **3.1.4 Dead-end and Cul-de-sac Policy.**

It is the general policy of the City of Santa Fe to discourage the use of dead-end and cul-de-sac streets. The following reasons are given for this position: the efficiency and effectiveness of police patrol on cul-de-sac and dead-end streets is restricted and therefore often gives the community a false sense of security. Such streets are subject to blockage during emergency access or evacuation, and by their nature restrict emergency access under ordinary

conditions. Utilities are also limited by the single source nature of dead-end lines.

### **3.2 UTILITY APPROVAL AND ACCEPTANCE PROCESS**

#### **3.2.1 Utility Easements Required.**

When dead end streets, cul-de-sacs, character of adjoining property, adjoining development or potential development, indicates that easements are required for future utility lines, such easements must be provided at locations, and in widths, as determined by the City Engineer. A remotely future time for installation of such utilities is not justification to eliminate such easements.

#### **3.2.2 Utility Oversight.**

To assist in the preparation for future utilities, copies of all drawings must be submitted to the local Water Control and Improvement District. District requirements for the development should be viewed as requirements of the City and an approval of design work by the District will be required by the City Engineer. Development within the District jurisdiction will require full compliance with District standards and specifications. The Professional Engineer must obtain copies of the District acceptance of improvements and submit same to the City Engineer at each stage of the approval and acceptance process.

#### **3.2.3 Utility Drawings Submitted to City.**

A copy of all utility drawings and specifications associated with development must be submitted to the City Engineer for reference.

#### **3.2.4 As-built Drawing Distribution.**

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Copies of all “As-built” drawings and specs must be distributed to both the District and the City.



## Chapter 4 DRAINAGE DESIGN REQUIREMENTS

### 4.1 GENERAL:

#### 4.1.1 Reference.

All storm sewers and appurtenant construction shall conform to the ~~City of Houston Department of Public Works and Engineering Standard Construction Details for Wastewater Collection, Water Lines, Storm Drainage and Street Paving (See section 4.6.2)~~ Galveston County drainage District #1 Drainage Criteria Manual, January 2020 edition and all subsequent revisions. Where specifications may differ, the more stringent shall apply.

#### 4.1.2 Bedding and Backfill.

Any storm sewers and sanitary sewers which are located underneath or within one (1) foot of the paving section shall be bedded and backfilled with cement stabilized sand which meets or exceeds minimum 100 psi and contains not less than 1-1/2 sack cement per ton of sand. Backfill with cement sand to within one (1) foot of subgrade. Water lines to be bedded and backfilled in accordance with City of Houston Technical Specifications.

#### 4.1.3 Trenching.

Trench excavation shall comply with all provisions contained in Article 1015Q (Texas Civil Statutes, Annotated).

$$i = \frac{b}{(d + TC)^e}$$

### 4.2 REQUIREMENTS UNIQUE TO MAJOR THOROUGHFARES

4.2.1 The high point of top of curb should be at or not more than 3" below finished grade and the gutter to slope to inlet on minimum 0.25% grade.

4.2.2 Paving elevations, grades and storm sewer design shall be such that not more than one traffic lane of water shall pond in the low gutter of curbed sections during a 25 year event rainfall.

4.2.3 Storm sewers shall be designed from the following criteria:

A minimum 150' wide strip each side of and adjacent to the proposed road right-of-way shall be considered an impervious surface contributing runoff to the storm sewer and an in depth study of runoff and characteristics shall be made of all land areas contributing runoff to the roadway. The contributing runoff from all areas outside the two 150' wide strips shall be computed according to section C below.

### 4.3 GENERAL DESIGN REQUIREMENTS

#### 4.3.1 Design Rainfall Intensities

4.3.1.1 The 2-year storm, as derived from the National Weather Service Technical Paper 40 and Hydrometeorological Report 35 publications, shall be used for storm sewer and roadside ditch design in Santa Fe. The 2-year rainfall intensity may be computed using the following equation:

Where I =rainfall intensity (inches per hour)

TC = Time of Concentration (minutes)

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$$b = 75.01; d = 16.2; e = 0.8315$$

For example, the rainfall intensity for an area that has a TC of 25 minutes would be 3.42 inches per hour.

### 4.3.1.2 Determination of Time of Concentration

Time of concentration can be calculated from the following formula:

$$TC = 10a^{0.1761} + 15$$

Where: TC = Time of Concentration (minutes)

a = the sub-area in acres

For example, the Time of Concentration for a 2-acre sub-area would be 26.3 minutes.

### 4.3.1.3 Rational Method

The Rational method calculates the peak runoff for a storm drain system using the following equation for runoff:

$$Q = \text{Sum}(CA)i$$

C = Runoff Coefficient

Where:

A = Area (acres)

i = Rainfall Intensity (inches per hour)

The rational method will be used for design on all storm sewered areas up to 600 acres in size. The Rational Method will be considered applicable for all storm sewered areas up to 1,200 acres and for areas served by roadside ditches to 500 acres in size.

### 4.3.1.4 Calculation of Runoff Coefficient

The runoff coefficient "C" values in the Rational Method formula will vary based on the land use. Land use types and "C" values which can be used are as follow:

**See Table 1 for values of "C" for various land use types.**

**Table 1**

Land Use Type	Runoff Coefficient
<b>Residential Districts</b>	
Lots more than 1/2 acre	0.35
Lots 1/4 to 1/2 acre	0.45
Lots less than 1/2 acre	0.55
<b>Multi-Family Areas</b>	
Less than 20 DU/AC	0.65
20 DU/AC or greater	0.80
<b>Business Districts</b>	0.80
<b>Industrial Districts</b>	
Light Areas	0.65
Heavy Areas	0.75
Railroad yard areas	0.30
Parks/Open Areas	0.18

Alternatively, the runoff coefficient "C" in the Rational Method formula can be calculated from the equation:

$$C = 0.6I_a + 0.2$$

C = watershed coefficient

Where:

I<sub>a</sub> = percent impervious area.

For example, if the percent impervious is 0.9, then the runoff coefficient would be 0.74.

If this alternate equation is used rather than the values tabulated above, the details of the computation of C are to be provided as part of the drainage calculations.

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Runoff originating outside the development's limit, but entering the development's system, shall be designed at 1 cfs/acre or at a rate determined by complete study of the area using the Harris County Flood Control District Site Runoff Curves for a 25-year storm event (Figure 1). In the event a swale ditch is needed to intercept runoff and direct it to the proper storm sewer system or drainage outfall ditch utilize the following guidelines:

**4.3.2.1** Provide Contour Map showing area to be drained along with calculations to support ditch size and grades.

**4.3.2.2** Locate in an easement sufficient in width to allow for proper maintenance operations. See drainage standard drawings.

**4.3.3 Mapping Requirements:**

Provide a Contour Map and Drainage Area Map for all areas which are to be drained by the proposed drainage system.

**4.3.4 Drainage Calculations and Roughness Coefficients:**

Submit drainage calculations to support line sizes and slopes. The "n" coefficient in Manning's Formula shall be 0.013 for concrete pipe and 0.024 for corrugated metal pipe.

**4.3.5 Hydraulic Grade Line:**

A graphical plot and calculations of the hydraulic gradient shall be furnished by the design engineer. The hydraulic gradient shall be calculated assuming the top of the outfall pipe as the starting water surface. At drops in pipe invert, should the upstream pipe be higher than the hydraulic grade line, then the hydraulic grade line shall be recalculated assuming the starting water surface to be at the top of pipe at that point.

For the design storm, the hydraulic gradient shall at all times be below the gutter line for all newly developed areas. For approved streets with ditch sections, the hydraulic gradient shall be 0.5' below the edge of pavement or natural ground elevation, whichever is lower.

**4.3.6 Storm Sewer Pipe Sizes:**

The minimum size for storm sewers and inlet leads shall be twenty-four inches (24") inside diameter pipe or equivalent cross section area. Box culverts shall be at least 2' by 2'.

**4.3.7 Storm Sewer Flow Velocities:**

Storm sewers shall be designed to have a minimum velocity of three feet per second (3'/sec) when flowing full. Storm sewers should be constructed to flow in subcritical hydraulic conditions if possible. Maximum velocities should not exceed 8 feet per second without use of energy dissipation downstream. Maximum velocities should not exceed 12 feet per second.

**4.3.8 Storm Sewer Junctions:**

Larger pipes upstream should not flow into smaller pipes downstream unless construction constraints prohibit the use of a larger pipe downstream, or the improvement are outfalling into an existing system, or the upstream system is intended for use in detention. Match crowns of pipe at any size change unless severe depth constraints prohibit.

**4.3.9 Soil Borings and Bedding:**

For all storm sewers having a cross sectional area equivalent to a forty-two inch (42") inside diameter pipe or larger, soil borings with logs shall be made along the alignment of the storm sewer at intervals not to exceed five-hundred feet (500') and to a depth not less than three feet (3') below the flowline of the sewer. The

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required bedding of the storm sewer as determined from these soil borings shall be shown in the profile of each respective storm sewer. When the trench is opened, if in the judgement of the Design Engineer, conditions differ from the design bases, he may authorize changes in the bedding indicated on the drawings. Such changes shall be shown on the record drawings.

### 4.3.10 Roadside Ditches:

**4.3.10.1 Design Flows:** The rainfall runoff criteria shall be determined based on the projected land use, and the rational method as described above. The design storm event for the roadside ditches shall be a 2-year rainfall. Design capacity for a roadside ditch shall be to 0.5 feet below the edge of pavement or the natural ground at the right-of-way line, whichever is lower. The design must include and extreme event analysis to indicate that structures will not be flooded.

**4.3.10.2 Slide Slopes:** The minimum preferred unlined or unimproved roadside ditch section should have a side slope no steeper than three (3) horizontal to one (1) vertical configuration. Steeper slopes will be allowed when the existing right of way is limited or other construction features dictate the design. The steepest slope shall not exceed two (2) horizontal to one (1) vertical.

**4.3.10.3 Bottom widths:** The minimum bottom width for roadside ditches should be two feet (2') unless design hydraulics will support a narrower or vee ditch configuration.

**4.3.10.4 Roughness Coefficients:** The "n" coefficient in Manning's Formula for ditch calculations shall be based on the surface treatment of the completed channel

section with 0.040 as the minimum coefficient for unlined dirt ditches and 0.025 for ditches with paved inverts.

**4.3.10.5 Flowline Slope:** The minimum grade or slope of roadside ditches shall be 0.10 percent (0.1 foot per 100 feet). For grass lined sections, the maximum design velocity shall be 3.0 feet per second during the design event.

**4.3.10.6 Allowable Depth:** The minimum depth of roadside ditches shall be eighteen inches (18") from the top of the pavement, and the maximum depth shall be not more than four feet (4'). Extreme conditions may warrant a deeper ditch, specific approval of which must be obtained from the City Engineer.

**4.3.10.7 Culvert Capacity:** Culverts will be placed at all driveway and roadway crossings, and other locations where appropriate. A graphic plot and calculations of the hydraulic gradient employing culvert design parameters shall be shown for each drainage ditch section and shall be 0.50' below the edge of pavement or natural ground elevation, whichever is lower. Head losses in culverts shall conform to TxDOT Hydraulic Manual, Chapter 4-Culverts, or equivalent. Culverts will be designed assuming inlet control.

**4.3.10.8 Culvert Size:** The minimum size culvert shall have a cross section area equal to or greater than an eighteen-inch (18") inside diameter pipe. Roadside culverts are to be sized based on drainage area. Calculations are to be provided for each block based on drainage calculations. Pipe culverts shall conform to ASTM Specifications C-76, Class III, for reinforced concrete pipe. All proposed and reasonably expected future culverts shall be included in the hydraulic profile. The



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size of culvert used shall not create an additional head loss of more than 0.20' greater than the normal water surface profile prior to placement of the culvert. All driveways to have culverts; no paved dips for driveways.

**4.3.10.9 Erosion Protection:** Erosion control methods acceptable to the City Engineer shall be utilized in ditch designs where the velocities of flow are calculated to be greater than five feet (5') per second or where soil conditions indicate their need. All ditches and channels require seeding, fertilizing, hydromulching with a short and long term grass in accordance with section **4.11** of this chapter. Ditch invert protection will be used at the upstream and downstream ends of all culverts.

**4.3.10.10 Outfalls:** Outfalls from storm sewers and ditches shall enter at the grade of the outfall ditch or in a manner acceptable to the applicable Galveston County Drainage District and City Engineer. If necessary, drop type outfall structures shall be used to prevent erosion.

**4.3.10.11 Shoulder Width:** The shoulder widths for roadways shall be a minimum of 6 feet (6') from the edge of pavement to the adjacent edge of ditch bank.

**4.3.10.12 Right-of-way:** The minimum distance between the right-of-way line and adjacent edge of the bank of ditch shall be two feet (2').

**4.3.10.13 Storm Sewer Inlets:** Storm water discharging from a ditch into a storm sewer system must be received by use of an approved structure (i.e., stubs with ring grate or type "E" Manholes. The capacity of type "E" inlet is 20 cfs.).

**4.3.10.14 Lot Drainage:** All side lot or back lot drainage facilities shall be underground storm sewers constructed in accordance with the specifications herein. Individual lot drainage shall be exempted from this requirement.

### **4.3.11 Major Channels**

Major drainage ways through a subdivision shall be designed and constructed to accommodate the 100-year peak rate of runoff, in the manner prescribed by the applicable Galveston County Drainage District and the City Engineer. For channels with drainage areas of 300 acres or less, the site runoff curves (Figure 2) may be used. For larger drainage areas, a more detailed hydrologic analysis should be performed. A minimum of 20' to 30' maintenance berm is required on each side and must be seeded, mulched, and fertilized. If topsoil is needed to obtain a successful stand of grass, it shall be provided. Water surface elevation shall be calculated using Manning's Equation and the continuity equation. For the design storm event, the water surface should be calculated to remain within banks.

### **4.3.12 Major Channel Structures:**

If the developer proposes to construct major structures, such as box culverts or bridges across drainage channels, such structures shall conform to drawings and specifications of TxDOT as well as the City Engineer. See Section V.A-1, Structures. Head losses in culverts shall conform to TxDOT Hydraulic Manual, Chapter 4-Culverts, or equivalent. Generally, corrugated metal pipe will not be approved for permanent installation of culverts in Santa Fe right-of-way except at railroad crossings.

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### 4.4 FLOOD PLAIN DEVELOPMENT GUIDELINES AND PROCEDURES

#### 4.4.1 Requirements within 100 year Floodplain.

The following requirements shall apply to all developments planned within the 100-year flood plain:

4.4.1.1 Any construction and/or fill that would obstruct flow and cause any increase in flood levels must be fully offset with conveyance improvements.

4.4.1.2 Flood plain storage volumes shall not be reduced by way of fill. Where flood plain fill is proposed and is demonstrated not to adversely affect conveyance, compensatory storage equal in volume and effect shall be excavated.

#### 4.4.2 Procedures for Development within 100 year Floodplain.

Specific procedures to be followed for analysis of development proposed within the flood plain are outlined below:

4.4.2.1 The existing designated 100-year flood plain and floodway should be plotted on a map of the proposed development. The designated flood levels and floodway may be obtained from the Santa Fe Floodplain Administrator or the appropriate Galveston County Drainage District.

4.4.2.2 A hydraulic profile should be developed utilizing the HEC-2 computer program or other acceptable hydraulic modeling technique which provides a reasonable comparison with the designated flood levels and floodway.

4.4.2.3 The effect of the proposed development and the encroachment into

the flood plain area should be incorporated into the hydraulic model and the resulting flood plain determined. Careful consideration should be given to providing an accurate modeling of effective flow areas taking into account the expansion and contraction of the flow.

4.4.2.4 The required channel improvements or other means of off-setting increases in flood plain elevations should then be incorporated into the hydraulic model. The resulting flood levels should be determined to verify that the improvements sufficiently offset the encroachment.

4.4.2.5 Once it has been determined that the proposed improvements adequately offset the encroachment, a revised floodway for the stream must be computed and delineated.

4.4.2.6 All hydraulic model data should be submitted with appropriate supporting information and computations to the City Engineer and/or the appropriate Galveston County Drainage District for review.

### 4.5 DOWNSTREAM IMPACT ANALYSIS

The following paragraphs describe general procedures to be used to determine the effect a proposed development has on downstream flood conditions.

#### 4.5.1 General Criteria

The task of determining what downstream areas may be impacted by a proposed development is not an easy one. Varying rainfall patterns over a watershed and changing land-use conditions in other areas of the watershed may affect the extent and area of impact due to a proposed development. Also,

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developments of a similar nature located in different parts of a watershed may have different downstream impacts. Because of these various factors and uncertainties, the criteria outlined below are general in nature. Specific projects should be closely coordinated with the City Engineer and/or the appropriate Galveston County Drainage District from their inception in order to avoid costly revisions and delays in project completion. The following are generally recommended criteria and procedures to be followed:

**4.5.1.1** The location of the proposed project should be submitted by the project engineer to the City Engineer and/or the appropriate Galveston County Drainage District for comment.

**4.5.1.2** The City Engineer and/or the appropriate Galveston County Drainage District will indicate the downstream areas which are considered to be of concern with respect to the potential impact of the proposed project.

**4.5.1.3** The project engineer will then determine the impact on the areas of concern and present data to satisfy the City Engineer and/or the appropriate Galveston County Drainage District that no adverse impact will result

### **4.5.2 Courses of Action.**

To satisfy the City Engineer and/or the appropriate Galveston County Drainage District that no adverse impact will result, three potential courses of action may be followed:

**4.5.2.1** Provide channel improvements through the area of concern which fully offset the increased flow rates caused by the proposed development, or;

**4.5.2.2** A detention basin or other acceptable detention system may be designed to eliminate any increase in peak flow rates to the receiving stream, or;

**4.5.2.3** A flood routing study may be performed which shows that the proposed project will not increase peak flow rates through the critical area under reasonable assumptions regarding rainfall distribution and land use within the watershed.

### **4.5.2.4 Combination of solutions.**

These three alternative courses of action are not intended to be mutually exclusive. A combination of solutions involving these approaches may be obtained. For example, a combination of some downstream channel improvements and detention storage may be used. A detailed routing study may show that the proposed development may increase downstream flow rates to a minor extent which may be compensated for by minor channel improvements or a small detention system. However, in lieu of a detailed routing study; the design of offsetting channel improvements or detention will be based on the assumption that the peak runoff rate from the proposed development occurs at the same time as the peak runoff rate for the receiving stream through the critical reach. The design of improvements under items (1) and (2) above shall follow the procedures in common engineering practice at that time.

### **4.5.3 Guidelines.**

Regarding routine studies to evaluate the impact on downstream critical reaches, the following general guidelines shall be followed:

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**4.5.3.1** Rainfall distribution over the watershed shall be in accordance with the HEC-1 default triangular distribution. However, the City Engineer and/or the appropriate Galveston County Drainage District may require additional analyses under different rainfall assumptions if it feels such analyses are warranted.

**4.5.3.2** Channel improvements planned to be completed within a two-year period may be considered in the routine procedures.

**4.5.3.3** Future land-use conditions within the watershed to be used in the routing study shall be defined by the City Engineer and/or appropriate Galveston County Drainage District.

**4.5.3.4** Unless an alternative method is specifically approved by the City Engineer and/or the appropriate Galveston County Drainage District, the Corps of Engineers' HEC-1 program shall be used for performing the routing analysis. Optional routing methodologies should be reviewed with the City Engineer and/or the appropriate Galveston County Drainage District. Sub-area runoff computations and associated routing shall be performed on sub-areas which are of a size that allow reasonable determination of the timing of flows from the development in comparison with the overall timing of flood flows from the watershed. The sub-area breakdown, hydrograph coefficients, routing methodology, etc. should be submitted to the City Engineer and/or the appropriate Galveston County Drainage District for approval prior to performing detailed calculations.

### **4.6 MATERIALS:**

#### **4.6.1 Storm Sewers.**

All storm sewers shall be constructed with reinforced concrete pipe, either precast pipe, box conduits or cast in place pipe. The use of corrugated galvanized metal pipe, or other approved equal, may be used only at the storm sewer outfall into unlined channels. The length of the outfall shall be determined on an individual basis as dictated by the construction requirements.

#### **4.6.2 Reference to City of Houston Specification.**

All storm sewer construction shall conform to the City of Houston, Department of Public Works and Engineering "Storm Sewer Standard Details Date 1996", City of Houston Drawings 02081-01 through 02081-10, 02084-02 through 02084-09, 02317-03 through 02317-07, 02317-09, 02362-01 through 02362-10, 02633-01, 06333-02, 02641-01, 02642-01 and all subsequent revisions.

### **4.7 STORM SEWER ALIGNMENTS**

#### **4.7.1 Horizontal Alignment.**

All cast in place concrete storm sewers shall follow the alignment of the right-of-way or easement.

#### **4.7.2 Vertical Alignment.**

All precast concrete pipe storm sewers should be designed in a straight line and tops of pipes should be matched at all pipe sized changes.

#### **4.7.3 Leads.**

All storm sewer inlet leads shall be designed in a straight line.

#### **4.7.4 Back Lot Easements Discouraged.**

Storm sewers shall be located in public street rights-of-way or in approved

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easements. Back lot easements are discouraged.

**4.7.5 Centering and Bedding.**

In all easements restricted to storm sewers, the pipe shall be centered within the limits of the easement. Minimum width of easement shall be 20 feet (20'). In the event of extreme depth and/or large sewers, additional width will be required to allow for proper maintenance operations. Bedding shall be provided in accordance with City of Houston requirements stated previously.

**4.7.6 Minimum Widths.**

For storm sewers located in easements adjacent to public street rights-of-way, the minimum width of the easement shall be ten feet (10'). The minimum width shall be increased for larger pipe or conduit with the requirement that a minimum distance of five feet (5') shall be maintained from the easement line to the outside edge of the sewer, and a minimum distance of two feet (2') shall be maintained from the right-of-way line to the outside edge of the sewer pipe or conduit.

**4.8 MANHOLES SHALL BE LOCATED AT:****4.8.1 Size Changes.**

All pipe size or cross section changes. Tops of pipe should be matched.

**4.8.2 Intersections.**

All pipe sewer intersections or P.I.'s.

**4.8.3 Grade Changes.**

All pipe sewer grade changes (precast pipe only).

**4.8.4 Intersections.** All street intersections.

**4.8.5 Maximum Interval.**

A maximum of seven-hundred feet (700') measured along the center line of the pipe sewer. Manholes are not required where inlet leads intersect a monolithic concrete storm sewer; however, manholes may be required as necessary to provide access for adequate maintenance of lead lines.

**4.8.6 Inlet Lead and Conduit Intersections.**

All inlet lead and conduit intersections with the pipe sewer where precast concrete pipe sewers are designed. Manholes are not required where inlet leads intersect a monolithic concrete storm sewer; however, manholes may be required as necessary to provide access for adequate maintenance of lead lines.

**4.9 INLETS:****4.9.1 Low Points Locations.**

Shall be located at all low points on gutter gradient.

**4.9.2 Inlet Spacing.**

Inlets must be spaced to serve the runoff calculated using the Rational Method as applied according to Section 4.3 of this document. Curb inlets shall be spaced so that the maximum travel distance of water in the gutter will not exceed seven-hundred feet (700') one way for residential streets and three-hundred feet (300') one way on major thoroughfares and streets within commercial developments. It is preferable that curb inlets be located on intersecting side streets instead of major thoroughfares on all original designs or developments. Do not place inlets in circular portion of cul-de-sac streets unless special conditions warrant otherwise. Place inlets at the end

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of proposed pavement, if drainage will enter or leave pavement. Do not locate inlets adjacent to esplanade openings. Special conditions warranting other locations of curb inlets shall be determined on a case by case basis by the City Engineer.

### 4.9.3 Construction Type.

Standard Inlet Type and Construction: Type "BB" Inlet or equal is to be used as a curb inlet on curbed streets. The capacity of a Type "BB" Inlet is 5 cfs and valley gutters are not permitted on public streets (public alleys exempted) on all original designs or developments. All inlets are to be constructed of brick masonry, cast concrete in place, or may be precast as approved by the City Engineer. Minimum lead size is 24".

### 4.9.4 Other Inlet Types

Certain instances may bring about the need for utilization of inlet types other than the standard "BB" and will be used only after receiving approval of the City Engineer. Do not use "Beehive" grate inlets or other "specialty" inlets. Do not use grate top inlets in unlined roadside ditch.

## 4.10 CONSIDERATION OF OVERLAND FLOW

### 4.10.1 Design Frequency.

The design frequencies for consideration of overland sheet flow will consider extreme storm events which exceed the capacity of the underground storm sewer system resulting in ponding and overland sheet flow through the development to the primary outlet.

**4.10.2 Relationship of Structures to Street.** All structures will be higher than the highest level of ponding anticipated resulting from the extreme event analysis.

### 4.10.3 Calculation of Flow

**4.10.3.1** Streets will be designed so that consecutive high points in the street will provide for a gravity flow of drainage to the ultimate outlet.

**4.10.3.2** The maximum depth of ponding at high points will be six inches above top of curb.

**4.10.3.3** The maximum depth of ponding at low points will be 18 inches above top of curb.

**4.10.3.4** Sheet flow between lots can be provided only through a defined drainage easement.

**4.10.3.5** A map shall be provided to delineate extreme event flow direction through a proposed development and how this flow is discharged to the primary drainage outlet.

**4.10.3.6** In areas where ponding occurs and no sheet flow path exists, then a calculation showing that runoff from the 100-year event can be conveyed and remain in compliance with the other terms of this section must be provided.

## 4.11 SEEDING AND FERTILIZING FOR EROSION CONTROL

### 4.11.1 Description.

This item shall consist of preparing ground, providing and hydromulching seeds and fertilizer, rolling and other management practices along and across such areas that are required to be reseeded as designated as on the plans and in accordance with these specifications. A complete uniform and mowable stand of grass must result or

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the area will be immediately re-seeded until such is the result.

**4.11.2 Materials.**

**4.11.2.1 Seed:** All seed must meet the requirements of the Texas Seed Law Including the labeling requirements for showing pure live seed (PLS=purity + germination) name and type of seed. Seed furnished shall be of previous season's crop and the date of analysis shown on each bag shall be within nine months of the time of use on the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Engineer. Seeding shall be a combination of Bermuda grass (hulled) at 15 lbs/acre and Rye grass 25 lbs/acre for a total of 40 lbs/acre.

**4.11.2.2 Fertilizer:** Fertilizer shall be delivered in bags or containers clearly labeled showing the analysis. The fertilizer is subject to testing In accordance with the Texas Fertilizer Law. Fertilizer that is powdered or caked will be rejected. A pelleted or granulated fertilizer which has an analysis of 12-12-12, (percent of nitrogen, phosphoric acid, and potash nutrients) shall be uniformly applied at a rate of 830 lbs/acre. In the event it is necessary to substitute a fertilizer of different analysis, the total amount of nutrients furnished and applied per acre shall equal that specified for each nutrient. Any such substitutions shall be approved in advance by the Engineer.

**4.11.2.3 Mulch:** Mulch for use with hydraulic application of grass seed and fertilizer shall consist of specially prepared wood cellulose fiber or shredded paper fiber. It shall be processed in such a

manner that it will not contain germination or growth inhibiting factors. It shall be dyed green to allow visual metering of its application. The fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water, and allows infiltration to the underlying soil. Weight specifications from suppliers, and for all applications, shall refer only to air dry weight of the fiber, a standard equivalent to 10 percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds, and shall be marked by the manufacturer to show the air dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements.

**4.11.2.4 Topsoil:**

**4.11.2.4.A** As needed 3" in depth spread and rolled on exposed slopes and other exposed areas. The topsoil shall be fertile loam, easily cultivated and free from objectionable material, and shall have a relatively high erosion resistance and be readily able to support the growth of the planting, seeding or sodding specified. The City Engineer shall be notified at least 2 weeks in advance of obtaining topsoil from any material source to permit inspection and to prepare for a necessary checking and measurement.

**4.11.2.4.B** Trash, wood, brush, stumps and other objectionable materials encountered shall be removed and disposed of as directed by the Engineer prior to beginning of work required by this item.

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**4.11.2.4.C** Material may be stockpiled in the designated areas only. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of use. Trash, wood, brush, stumps and other objectionable materials must not be allowed to contaminate the stockpiled topsoil so the site must be cleared and cleaned by the Contractor prior to stockpiling the topsoil and kept clean while the job is in progress.

**4.11.2.4 D** The selected topsoil material shall be used to improve designated areas for planting and seeding purposes.

**4.11.2.4E** The spreading of the topsoil shall be undertaken as soon as the grading operations have been completed. Topsoil shall be spread, so as to form a uniform cover 3 inches thick prior to rolling. After topsoil has been placed, shaped, and rolled it shall be seeded within 48 hours. The stockpile areas shall be cleaned, re-graded to preconstruction condition, and seeded at that time.

**4.11.3 Seeding.**

All exposed topsoil shall be seeded.

**4.11.3.1** All areas to be seeded shall be cultivated to a depth of 4 inches. The seed bed shall be firmed with a roller not exceeding 90 pounds for each foot of roller width and then cultivated sufficiently to reduce the soil to a state of good tilth when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deep for optimum germination. The proper cross-section shall be maintained throughout the process of cultivation and any necessary reshaping shall be done prior to any planting of seed.

**4.11.3.2** Seeding and fertilizing shall be accomplished by hydromulching only.

**4.11.3.3** The application of the mulch slurry shall be made with hydraulic equipment, which has a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix slurry. The slurry distribution lines shall be large enough to prevent stoppage and shall be equipped with hydraulic spray nozzles which provide even distribution of the slurry on the slopes to be seeded. The fiber mulch shall be applied at the rate of 2,000 pounds per acre in combination with water, fertilizer, and seed, and shall be sprayed over the soil in a uniform coat. The mulch shall be kept moist by daily application of water if necessary, until the seeds in the mulch have germinated and rooted in the soil and are visible growing above the soil surface.

**4.11.4 Sprinkle Irrigation.**

All seeded areas must be irrigated.

**4.11.4.1** Description. This item shall consist of providing and properly applying water on all seeded areas, and any other area as directed by the Engineer and as herein specified.

**4.11.4.2** Materials. Water shall be clean and free of industrial wastes and other substances harmful to the growth of grass.

**4.11.4.3** Construction Methods. This works shall be done within 24 hours after rolling the seed bed or as directed by the Engineer. The developer will furnish and operate sprinklers, nozzles, or other approved equipment which will insure the distribution of water in a uniform and controllable rate of application. The developer shall apply the water as necessary to cause the seed to germinate



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and sprout and without causing erosion or displacement of the topsoil.

### 4.11.5 Acceptance.

Seeding shall not be accepted until the planted seed has germinated, rooted in the soil, and is visibly growing above the surface of the topsoil. The developer shall be responsible for the establishment and proper care of a stand of grass over the entire seeded area. It is the intent of these specifications to have a good, thick, mowable stand over the entire project and before final acceptance of same.

## 4.12 STRUCTURAL DESIGN CRITERIA

### 4.12.1 GENERAL.

The structural design of flood control facilities encompasses all aspects of the design of modifications to existing channels and streams or new channels, from the selection of side slopes for earthen channels to major structures, such as bridges, culverts, drop structures, and retaining walls. Hydraulic structures should convey stormwater safely, control erosion, be cost effective, require minimal maintenance, and add safety and esthetics to the drainage system. The intent of this section is to present recommended standard structural details and to outline the criteria and calculations required for approval of non-standard structures. Discussed in the sections to follow is the structural design of drainage channels (both lined and unlined), culverts, bridges, drop structures, closed conduits, backslope drains, sheet flow interceptors, and storm sewer outlets.

### 4.12.2 DESIGN CONSIDERATION.

The structural design of any non-standard drainage structure will require an independent structural analysis in accordance with the recommendations of a

geotechnical study. The construction drawings should include a scaled drawing of sufficient size of the particular structure with appropriate typical sections, dimensions, and construction specifications and notes.

4.12.2.1 In the design of such structures, the following effects should be considered as minimum:

4.12.2.1.A Lateral earth pressures.

4.12.2.1.B Buoyant forces.

4.12.2.1.C Bank stability, including channel bottom rotational stability, when designing vertical drop structures.

4.12.2.1.D Scour and erosion forces.

4.12.2.1.E Dead loads, live loads, and impact loads.

4.12.2.1.F Wheel loadings in accordance with HS20-44.

4.12.2.1.G Bearing capacity of soils.

4.12.2.1.H Backfill effects, especially when expansive soils are involved.

4.12.2.1.I Negative pressure at drop structure overflow nappe.

4.12.2.1.J Fault lines.

4.12.2.1.K Construction loadings

4.12.2.2 The latest applicable standards should always be used in the design of hydraulic structures.

4.12.2.3 Structures should generally be able to be built by local contractors using common construction techniques in the

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Santa Fe area. Construction techniques not common to the area or patented building materials and processes should be avoided. Structures should also be designed so contract bidding will be competitive.

### 4.12.3 SOILS CONSIDERATIONS.

#### General Geotechnical Requirements

**4.12.3.1** A subsurface soils investigation should be an integral part of improvement projects in Galveston County, Texas. A detailed subsurface investigation should be made by taking soil samples and analyzing the samples for various conditions that will affect the structural integrity of proposed structures. The field effort should define soil stratifications and groundwater conditions. Soil borings will be required at a minimum of every 1,000 feet along a channel in which improvements are proposed as well as at all proposed major structures.

**4.12.3.2** Each boring should be a minimum of 1.5 times the proposed channel depth or conduit invert.

**4.12.3.3** Soils in the area of Santa Fe tend to be clayey with areas of sandy clay. The clay soils tend to be very expansive and can generate large soil pressures on structures.

**4.12.3.4** Channel Side Slope Stability. Laboratory test should be conducted to measure the undrained and drained shear strengths of appropriate soil strata and evaluate the grain size, permeability and competence of cohesionless zones. Index testing can be utilized along with specific test results to select proper soil parameters. All tests should be performed in accordance with American Society for

Testing and Materials (ASTM) procedures where appropriate.

**4.12.3.5** Slope stability should be analyzed for the design cases as follows:

**4.12.3.5A** End of Construction Case, which models the initial undrained condition of the soil.

**4.12.3.5.B** Long Term Design Case, which represents steady state piezometric and stress conditions. When a ditch slope is excavated, altered stress conditions create pore pressure changes within the slope and the undrained strength of the bank soils is mobilized. With time, the soil pore pressures adjust to the imposed stress and piezometric conditions, and the bank soils rely on their available strength for long term stability.

**4.12.3.5.C.** Rapid Dragdown Case, which models the condition where high flood waters saturate and piezometrically "load" a ditch slope, and then quickly recede leaving a large unbalance of piezometric head in the bank slope.

### 4.12.4 CHANNEL DESIGNS

**4.12.4.1** General. Flood control channels vary widely in make-up from totally earthen channels where adequate right-of-way exists to totally concrete lined where right-of way is very limited. In some instances, the channel section is a combination of these two extremes. This section defines the parameters for the design of these various channel sections.

**4.12.4.2** Earthen Channels. The most common flood control channel in Santa Fe is a totally earthen channel. This is generally the most economical design except in the already developed areas

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where land costs are extremely high. The initial construction cost for a concrete lined channel is generally three to four times that of an earthen channel.

**4.12.4.3** In the design of an earthen channel, consideration of long term maintenance has a very strong influence on design parameters. The following are minimum requirements to be used in the design of all earthen channels: Refer to Exhibit D-5-1.

**4.12.4.3A** Maximum earthen side slopes should be 3 (horizontal) to 1 (vertical). Slopes flatter than 3 to 1 may be necessary in some areas due to local soil conditions.

**4.12.4.3B** Minimum bottom width is six (6) feet.

**4.12.4.3.C** A minimum maintenance berm is required on either side of the channel of between 20 to 30 feet depending on channel size. For top widths less than 60 feet, 20-foot berms are acceptable and for top widths more than 60 feet, 30-foot berms are required.

**4.12.4.3.D** Backslope drains or interceptor structures are necessary at a minimum of 1,000 feet intervals to prevent sheet flow over the ditch slopes. A standard detail is presented in Exhibit D-5-2.

**4.12.4.3.E** Channel slopes must be re-vegetated immediately after construction to minimize bank erosion.

**4.12.4.3.F** Flow from roadside ditches must be conveyed to the channel through a roadside ditch interceptor structure and pipe (Exhibit D-5-3).

**4.12.4.4** Concrete-Lined Trapezoidal Channels. In instances where flow velocities are excessive, channel confluences create a significant erosion potential, or right-of-way is limited, fully or partially concrete lined channels may be necessary. The degree of structural analysis required varies significantly depending on the intended purpose and the steepness of the slope on which paving is being placed.

**4.12.4.5** Presented below are minimum requirements for partially and fully concrete lined trapezoidal channels (Exhibit D-5-4):

**4.12.4.5.A** All slope paving should include a minimum 18-inch toe wall at the top and sides and a 24-inch toe wall across or along the channel bottom for clay soils. In sandy soils, a 36-inch toe wall is recommended across the channel bottom.

**4.12.4.5.B** Fully lined cross-sections should have a minimum bottom width of eight (8) feet.

**4.12.4.5.C** Concrete slope protection placed on 3:1 slopes should have a minimum thickness of 4 inches and 6 x 6 x W 2.9 x W2.9 welded wire fabric or equivalent reinforcing.

**4.12.4.5.D** Concrete slope protection placed on 2:1 slopes should have a minimum thickness of 4-inches and 6 x 6 x W4.5 x W10 welded wire fabric or equivalent reinforcing.

**4.12.4.5.E** Concrete slope protection placed on 1.5:1 slopes should have a minimum thickness of 5-inches and 4 x 4 x W4 x W10 reinforcement or equivalent. Poured in place concrete side slopes should not be steeper than 1.5:1.

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**4.12.4.5.F** In instances where the channel is fully lined, no backslope drainage structures are required. Partially lined channels will require backslope drainage structures as outlined.

**4.12.4.5.G** Weep holes should be used to relieve hydrostatic head behind lined channel sections. Refer to Exhibit D-5-5.

**4.12.4.5.H** Where construction is to take place under conditions of mud and/or standing water, a seal of slab of Class C concrete should be placed in channel bottom prior to placement of concrete slope paving. Refer to Exhibit D-5-4.

**4.12.4.5.I** For bottom widths of twenty (20) feet and greater, transverse grade beams shall be installed at twenty (20) feet spacing on center. Grade beams shall be one foot wide, one foot-six inches deep, and run the width of the channel bottom. Refer to Exhibit D-5-4.



## Chapter 5 PAVING REQUIREMENTS

### 5.1 GENERAL:

**5.1.1** Both concrete pavement, flexible base pavement and the subgrade for both shall be designed and constructed in accordance with applicable "TxDOT Standard Specifications for the Construction of Roads and Bridges" (1993). Where conflicts occur, the requirements set forth in these guidelines shall supersede. Flex base shall be TxDOT Item 247 TyA, Grl.

**5.1.2** Treatment of the subgrade shall be determined by a certified geotechnical engineer, accredited by the American Association for Laboratory Accreditation (A2LA). Recommendations(s) of the certified geotechnical engineer shall be adhered to unless the specified treatment is not consistent with conditions found during construction, at which time the geotechnical engineer will be required to make adjustments, as needed.

**5.1.3** The following design requirements are applicable to all pavement within the City of Santa Fe's jurisdiction that is to be constructed by the development community.

### 5.2 TYPICAL SECTIONS

#### 5.2.1 Reference.

Roadway cross sections, curb and gutter streets, shall conform to "~~Geometric Design Guidelines for Subdivision Streets, Harris County and City of Houston~~" Galveston County Rules, Regulations and requiremnets relating to the approval and acceptance of improvements in

Subdivision or Resubdivision, March 3, 1997 and any subsequent revisions thereto.

#### 5.2.2 Roadway cross sections .

Roadway cross sections for streets with ditches:

**5.2.2.1** Major thoroughfares shall be two (2) divided traffic lanes of twenty-four (24') edge to edge for each lane with minimum six foot (6') shoulder on each side.

Minimum width of the paving section for low density single family developments shall be twenty four feet (24') with a six foot (6') shoulder on each side. Thickness, cement content and reinforcement requirements, see 5.3 (below). All other roadways shall be designed in such a manner that the combined width of the paving and the shoulders is equal to or greater than the width requirements for a curb and gutter street with identical land use being planned for adjacent property. Thickness and reinforcement for such streets shall be seven inches (7") thick and reinforced with #4 (1/2") bars 18" on center each way. In no case shall minimum width of roadway be less than 28 feet (28') edge to edge of paving in any development with the exception of Low Density Single Family Residential Subdivisions. The city shall determine which subdivisions are low density single family type.

### 5.3 MINIMUM THICKNESS AND REINFORCEMENT REQUIREMENTS FOR CONCRETE PAVEMENT WITH CURBS

#### 5.3.1 Minor Street Pavement.

For pavement less than thirty feet (30') F/F of curb, including subdivisions of low density single family type with concrete

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streets shall require a minimum of twenty-eight feet (28') from face to face of curb. The concrete pavement is to be a minimum of six inch (6") uniform thickness, 5.0 sacks of Portland Cement per cubic yard, reinforced with #4 (1/2") deformed steel reinforcing bars spaced a maximum of 18" center to center each way.

### 5.3.2 Thoroughfare Pavement.

Pavement thickness and reinforcement for major thoroughfare streets shall be designed in accordance with item 5, below, and shall have minimum width of twenty-four feet (24') F/F of curb for each one-half of the roadway section. The concrete pavement shall be a minimum of 8" uniform thickness, 5.0 sacks of Portland Cement, reinforced with #4 (1/2") deformed steel reinforcing bars spaced a maximum of 18" center to center each way.

### 5.3.3 Other Pavement.

For all other curb and gutter streets, the concrete pavement shall be a minimum of 7" uniform thickness, 5.0 sacks of Portland Cement, reinforced with #4 (1/2") deformed steel reinforcing bars spaced 18" center to center each way.

### 5.3.4 Reinforcing Steel.

All reinforcing steel shall conform to TxDOT Specifications Item 440, Reinforcing Steel.

### 5.3.5 Special Conditions.

In the event special circumstances and engineering analysis indicate the need of a stronger pavement than those listed above, pavement thickness and reinforcement shall be supported by design analysis. Design method and loading requirements shall conform to current TxDOT or AASHTO Methods.

## 5.4 FLEXIBLE BASE PAVEMENT WITH DITCHES (VARIANCE REQUIRED)

Pavement of public or private streets in the City of Santa Fe requires the use of reinforced concrete. Flexible base pavement may only be used with a subdivision variance approved by the City Council with a recommendation from the Planning and Zoning Commission.

**5.4.1 Minimum Thicknesses** are as follows:

**5.4.1.1** 6" subgrade as specified in the applicable TxDOT Item 260 or Item 275.

**5.4.1.2** 8" of compacted base; crushed limestone, or approved equal(s). TxDOT Item 247, TyA, Grl.

**5.4.1.3** 1-1/2" of Hot Mix Hot Laid Asphaltic Concrete Pavement. TxDOT Item 340, TyD.

### 5.4.2 GEOTECHNICAL CONSULTANT.

Flexible Base Pavement for all developments other than Low Density Single Family residential shall be supported by design analysis conducted by a certified geotechnical engineer. Recommendation of the geotechnical engineer shall be strictly followed. Design method and loading requirements shall conform to current TxDOT or AASHTO Methods.

### 5.4.3 PAVEMENT WIDTH:

**5.4.3.1** Minimum shall be ~~twenty-two feet (22')~~ twenty-four feet (24') edge to edge of paving with a six foot (6') shoulder on each side. (Low Density Single Family Residential).

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**5.4.3.2** Roadway widths shall be designed in accordance with criteria set forth in "Roadway Cross Sections for Streets with Ditches". See Section 5.2.

**5.4.3.3** Ditch sections will follow requirements given under drainage.

### 5.5 GRADE DESIGN REQUIREMENTS

#### 5.5.1 Curb and Gutter Sections:

**5.5.1.1** Minimum gradient on gutter shall be 0.25 percent.

**5.5.1.2** Maximum drop of grade tangents from opposite directions to a common inlet shall be 1.5 feet.

**5.5.1.3** The maximum allowable curb run to an inlet shall be seven hundred feet (700') one way for residential streets and three hundred feet (300') one way for major thoroughfares or streets within commercial developments.

**5.5.1.4** Maximum cut from finished grade at property line to top of curb shall be 1.75 feet.

**5.5.1.5** Minimum one percent (1%) fall around intersection turnout for a minimum radius of twenty-five feet (25'). Grade for larger radius shall be determined on an individual basis.

**5.5.1.6** Vertical curves shall be installed when algebraic difference in grades exceeds one percent (1%). Elevations shall be shown at ten-foot (10') intervals through vertical curves.

**5.5.1.7** Radius of cul-de-sac pavement:

**5.5.1.7.A** Residential shall be a minimum of forty-two feet (42') to face of curb.

**5.5.1.7.B** Commercial shall be a minimum of fifty feet (50') to face of curb.

**5.5.1.8** When a curb and gutter intersects a drainage ditch, the grade of gutter shall be above the designed water surface of the ditch in accordance with requirements of the city and the applicable Galveston County Drainage District.

**5.5.1.9** Minimum grade for cul-de-sac shall be 0.60 percent along gutter.

**5.5.1.10** Major thoroughfares shall be super elevated in accordance with sound engineering practice whenever the center line radius of lanes or rights-of-way are less than 2,000 feet.

**5.5.1.11** For boulevard sections, the amount of cross slope over the pavement section should be shown on the drawings. The usual cross slope is one-fourth inch (1/4") per foot from curb line to curb line, and one-eighth-inch (1/8") per foot for left turn lanes and esplanade crossovers. For streets with single paving sections, the amount of cross slope over the pavement section shall be 1/4" per foot from center to edge of pavement.

**5.5.1.12** A minimum gradient of 0.40 percent around the longest radius is required on an L-type street intersection.

**5.5.1.13** When meeting an existing curbed street, top-of-curb grades should be laid to meet an elevation six inches (6") above the existing gutter, except at inlets.

**5.5.1.14** Grades should be laid to match the top of the curb of an existing inlet.

**5.5.1.15** Vertical curves should be labeled every ten feet (10'). Maintain

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minimum of 0.03 feet on ten-foot (10') intervals by altering the calculated elevations.

**5.5.1.16** When the curb grades are not laid below the natural ground, fill lines shall be shown on the drawings and shall be of a sufficient height to insure a minimum of three-eighths-inch (3/8") per foot transverse slope toward the curb from the property line between a point two feet (2') outside right-of-way and top of the curb. If this type fill is required and the pavement is adjacent to a non-participating property owner, fill easements from this property owner shall be obtained, filed, and a copy of the easements shall accompany the final drawings.

**5.5.1.17** Grades should be labeled for all top of curbs except at railroad crossings. Center line grades are acceptable for approved streets with ditch sections only.

**5.5.1.18** Gutter elevations are required for vertical curves where a railroad track is being crossed.

**5.5.1.19** The gradient for tangents to vertical curves at railroad crossings shall be a maximum of 3.5 percent and 4.0 percent at bridges, box culverts and pedestrian tunnels.

**5.5.1.20** Where railroad crossings are not at right angles to the pavement slab, vertical curves should be calculated for each curb line and should be posted at ten-foot (10') intervals in the profile.

**5.5.1.21** Valley Gutters are not permitted.

**5.5.2 Roadway Sections with Ditches:**

**5.5.2.1** Minimum grade on ditches - 0.10 percent

**5.5.2.2** Ditch design to handle runoff as determined in Section 4.3.10 "Roadside Design Requirements".

**5.5.2.3** Side slopes of ditch not steeper than 3:1 for unimproved ditches. Steeper slopes may be allowed when existing right-of-way is limited or other construction features dictate the design.

**5.5.2.4** Culverts shall be designed to carry ditch discharge, but not less than eighteen-inch (18") pipe and all driveways shall have culverts or bridges; no paved dips for driveways.

**5.6 INLETS:****5.6.1 Inlets Types.**

Type "BB" inlets or equal shall be used on all curb and gutter sections unless certain conditions exist which warrant the use of other standard inlets. See Section 4.

**5.6.2 Inlet Location.**

Inlets at all low points on gutter gradient.

**5.6.3 Inlets at Intersections.**

Inlets should be placed away from the major thoroughfare and on the side streets at street intersections.

**5.6.4 No Inlets at Critical Locations.**

Attempt to keep the proposed inlets away from the esplanade openings and out of major thoroughfare intersections. Also attempt to keep inlets out of future driveways.

**5.6.5 Inlets at Ends of Pavement.**



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Inlets shall be placed at the end of pavement in order to eliminate drainage from the pavement gutter into a ditch when the drainage is toward the end of the pavement or from the ditch to the pavement gutter.

**5.6.6 Approved Sewer to Ditch Interface.** When meeting a ditch, storm water must be received by use of an approved structure. See Section 4.3.

**5.7 CURBS, SIDEWALKS AND DRIVEWAYS****5.7.1 Curbs:**

**5.7.1.1** Standard curb height is six inches (6"), constructed in accordance with Santa Fe Subdivision Standards.

**5.7.1.2** Curbs are to be decreased from six inches (6") to zero inches (0") in ten feet (10') when approaching railroad tracks or existing roadway without curbs.

**5.7.2 Sidewalks and Driveways**

**5.7.2.1** All sidewalks and driveways shall conform to handicap requirements of the state and with the ADA. Minimum sidewalk width is five feet (5').

**5.7.2.2** Sidewalk Construction in Esplanade: When concrete sidewalks are constructed in esplanades, they shall be six inches (6") thick.

**5.8 REQUIREMENTS FOR INTERSECTIONS, TURNOUTS, TRANSITIONS AND THOROUGHFARES****5.8.1 Termination, New Street to Old at Intersection.**

At a "T" intersection with a street that has not been improved to its ultimate width, concrete pavement should be stopped either at the right-of-way line or the end of the curb return, whichever would require less concrete removal at a future date.

**5.8.2 Location of Transitions.**

When roadway turnouts are placed where an existing cross street intersects, the turnout should be sized to fit the ultimate pavement width and then transitioned to the existing roadway utilizing same materials as exist on the existing road/street. Length of transition shall conform to "Geometric Guidelines for Subdivision Streets, Harris County and City of Houston", and any subsequent revisions thereto.

**5.8.3 Half Thoroughfare Paving.**

When paving only one (1) roadway of a proposed two (2) roadway thoroughfare, all left turn lanes and esplanade crossovers in the one half (1/2) of the right-of-way where the roadway is being paved shall be paved to center line of the street right-of-way.

**5.8.4 Termination of New Street at Existing Concrete Street.**

When meeting an existing concrete street at right angles, the existing street shall be saw cut in a V-shape extending from the curb returns to a point where the centerline of the proposed pavement intersects the quarter point of the existing street in order to create a crowned intersection. In the event that this construction causes excessively rough riding condition making

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adequate control of the vehicle difficult, a special design will be considered to eliminate this condition.

### 5.8.5 Traffic Signage Specifications.

All traffic signs, striping, channelization devices, etc. must comply with the Manual on Uniform Traffic Control Devices

## 5.9 MISCELLANEOUS PAVING REQUIREMENTS

### 5.9.1 Integral Driveway Entrances.

If driveways are to be constructed with the paving project, show locations on the drawings and post a center line for the driveway at the property line with elevation for each drive.

### 5.9.2 Private Street Intersections.

Private streets should be treated as if they were driveways, and the sidewalk area should be honored with no curb extending through this area.

### 5.9.3 Paving Headers.

Standard paving headers shall be placed at the end of all concrete slabs.

### 5.9.4 Concrete Demolition Edge Conditions.

All concrete to be removed shall be removed either to an existing joint or a sawed joint.

### 5.9.5 Vertical Crest Curves Speed Criteria.

A thirty (30) mph minimum sight distance shall be used on all crest vertical curves. Forty (40) mph minimum for major thoroughfares.

### 5.9.6 Barricades.

Standard City of Houston Type III barricades shall be placed at the end of all dead-end streets not terminating in a cul-

de-sac and other locations where applicable.

### 5.9.7 Responsibility for Signage.

Traffic Signs and Street Name Signs: Prior to final acceptance of the improvements, the owner of the development must furnish and install the traffic signs and street name signs for all intersections. The street name signs shall be standard City of Houston type. The traffic signs shall be the standard TxDOT type for small roadway signs. Further, all traffic signage is to be provided and installed by the developer following consultation and approval of the Streets Superintendent.

### 5.9.8 Approval of All Agencies.

Approval of all affected agencies must be obtained prior to approval of City Engineer.

### 5.9.9 Transmission Pipeline Crossings.

A letter of agreement approving the construction plan crossing is required when paving is placed over a transmission pipeline.

### 5.9.10 Doweling New to Old Concrete.

Horizontal dowels are required when meeting concrete pavement that has no exposed steel.

5.9.10.1 Dowels should be #6 bars, twenty four (24") long, twenty-four inches (18") center to center, embedded twelve inches (12") and epoxied.

5.9.10.2 As an alternate to 10.1 above, saw cut and remove existing concrete to expose a minimum of twelve inches (12") of steel (longitudinal to the new construction) with an equivalent cross section area of steel equal to the proposed pavement steel.

**Engineering Design Specifications****Chapters 1 - 12****5.9.11 Termination of Uncompleted Paving.**

Dead-end streets designed to be extended in the future shall have fifteen inches (15") of reinforcing steel exposed beyond the pavement, coated with asphalt and wrapped with burlap for future pavement tie.

02754-01,02754-02, 02763-01, 02763-02,  
02775-01, 02775-02, 02902-01.

**5.9.12 Uniform Traffic Control Devices.**

Guidelines set forth in the Manual on Uniform Traffic Control Devices shall be strictly followed.

**5.9.13 "Cold" Concrete Joints.**

"Cold" joints are not allowed.

**5.9.14 Streets Over Existing Pipelines.**

When any of the roads or streets of a subdivision or re-subdivision are constructed over, across or along any existing oil, gas, sulfur, chemical or other pipeline running through the subdivision or re-subdivision, such pipeline shall be lowered and cased in such a manner as to meet the minimum requirements of the pipeline company and the City of Santa Fe.

**5.9.15 Right-of-Way Staking.**

Road rights-of-way shall be staked with three fourths inch (3/4") iron rods at all P.C.'s, P.T.'s, block corners and dead end streets prior to acceptance of the improvements. Lot corners may be staked with minimum five eighths inch (5/8") iron rods (or other suitable metal pipes).

**5.9.16 Reference Specifications.**

The following City of Houston, Department of Public Works and Engineering Standard Construction Details for Street Paving, dated September 1996 are adopted as part of these subdivision regulations: 02632-11,

## **Chapter 6 STRUCTURES**

### **6.1 BRIDGES AND CROSSINGS REQUIRED.**

Bridges or other ditch type crossings may be required in order to maintain a smooth flow of vehicular traffic through any given area. In the event uncertainty exists concerning whether or not a bridge will be required, it is advisable to contact the City Engineer regarding same so that the issue can be resolved while the project is in the planning stage.

### **6.2 BRIDGE STANDARDS.**

All bridges and box culverts to be designed to minimum H20 or HS-20 as applicable load design.

### **6.3 BRIDGE WIDTHS:**

**6.3.1** Where there are no curbs on approach pavement, the width of bridge face to face of curbs to be out to out distance of approach road pavement edges plus two feet (2') each side, plus walk or walks.

**6.3.2** Where curbs are on approach pavement, the width of bridge face to face of curbs to same as the distance between curb faces on the approach road.

**6.3.3** Individual one way traffic bridges on esplanade boulevards shall have one walk on the outside and two way traffic bridges shall have a walk on each side.

**6.3.4** Bridges of widths covered by condition (1) above are to have four feet (4') clear width sidewalks.

**6.3.5** Bridges of widths covered by condition (2) above are to have six feet (6') clear width sidewalks.

### **6.4 BRIDGE MATERIAL.**

All bridges to be of reinforced concrete design unless specific application require other materials and then only at the approval of the City Engineer.

### **6.5 BRIDGE RAILINGS.**

Bridge railings to be of galvanized or stainless steel on reinforced concrete parapet wall.

### **6.6 GUARD RAILS.**

Galvanized Flex Beam Guard Rails shall be designed and constructed in accordance with the TxDOT Item for this item.

### **6.7 BRIDGE DESIGN.**

Design and construction shall be in conformance with TxDOT Item 420, "Concrete Structures".

### **6.8 CULVERT HEADWALLS.**

Where culverts are used, the headwall shall be of sufficient height to allow construction of the guardrail and sidewalk at the elevation of the roadway.



## **Chapter 7 INSPECTION**

**7.1** Developer or his/her engineer will notify the Community Services Director and the applicable Galveston County Drainage District by letter seven (7) days prior to when construction of improvements is to begin. Contractor shall provide a minimum of twenty-four (24) hours advance notice to City Engineer, of each day's construction. Failure to do so may result in rejection, by the City, for acceptance and maintenance. Inspections shall be scheduled during normal city business hours, Monday through Friday.

**7.1.1** To insure conformance with the final subdivision plat and drawings as approved by the Planning and Zoning Commission, a representative of the City Engineer will inspect the subdivision during construction and after construction is completed. The applicable Galveston County Drainage District may monitor construction related to their jurisdiction.

**7.1.2** The Inspectors, under the direct supervision of the applicable Galveston County Drainage District and the City Engineer will report their findings and note variations from the approved drawings. If the developer fails to correct these variations, the subdivision may not be accepted by the City Council or the Drainage District.

**7.2** Construction of improvements by a developer shall be conducted under the observation of a Professional Engineer to insure that the work is performed in accordance with the approved drawings. Work will also be monitored by the following:

**7.2.1** A qualified resident Inspector furnished by the Professional Engineer,

**7.2.2** A recognized laboratory, acceptable to the City of Santa Fe, employed by the Professional Engineer, whose representative(s) and technicians shall be NICET certified, Level II minimum.

**7.2.3** An Inspector representing the City of Santa Fe.



## Chapter 8 TESTING REQUIREMENTS

*Note: A recognized laboratory, referenced throughout these specifications, means that the laboratory must be accredited by the American Association for Laboratory Accreditation (A2LA) in the field of construction materials testing.*

### 8.1 General

#### 8.1.1 Materials Testing.

Construction materials and operations shall be under controlled testing and inspection by a recognized laboratory in accordance with provisions set forth herein as well as all other applicable TxDOT Specification Items and ASTM Standards. All laboratory personnel shall be NICET approved and certified, Level II minimum.

#### 8.1.2 Certification Required.

Upon completion of the work and prior to acceptance of the work by the city, the recognized laboratory shall submit, to the City Engineer, a written, certification sealed by a Professional Engineer registered in the state of Texas, that all construction materials and operations as specified above were under controlled testing and inspection by the laboratory and same complies with all specifications applicable to the project.

#### 8.1.3. Backfill Testing.

Testing of materials used for bedding and backfill of storm sewers as well as other utilities, when located underneath or within one (1) foot of subgrade shall be conducted to insure compliance with other provisions contained in Section III "Drainage Design Requirements" (General).

## 8.2 TESTING REQUIREMENTS FOR FLEXIBLE BASE PAVEMENT

### 8.2.1 Reference.

Thickness of flexible base pavement shall conform to requirements given in Section 5.4 .

### 8.2.2 Subgrade

8.2.2.1 Densities shall be made on each three hundred linear feet or less as conditions may require. Preparation shall be in accordance with procedures and methods specified in the applicable TxDOT Specification item. 95% Standard Proctor density (ASTM D698) shall be uniformly achieved.

8.2.2.2 In the event of rainwater standing on the subgrade after densities are made, or other conditions beyond contractor's control, additional densities as specified above will be required prior to progressing with the work.

8.2.2.3 In no case shall there be less than three (3) density tests made for each day's activity and there shall be a minimum of three (3) density tests made for each street, unless approved otherwise by resident inspector.

8.2.2.4 The Contractor is required to have subgrade density test reports in his/her possession at the construction site at the time of placement of base material. Date of same shall be clearly marked.

### 8.2.3 Base Materials.

Approved base material shall be spread and uniformly compacted to 95% Standard Proctor density (ASTM D698) prior to commencing surfacing. Quantity of test(s) in accordance with above.

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### 8.2.4 Surfacing.

Surfacing shall be in accordance with Section 5 "Paving Requirements".

### 8.2.5 Paving Design.

Roadway section shall conform to provisions contained in Section 5 "Paving Requirements". All applicable portions of 8.2. contained in this section shall be strictly followed without exception.

## 8.3 TESTING REQUIREMENTS FOR CONCRETE PAVEMENT

### 8.3.1 Subgrade

8.3.1.1 Densities shall be made on each three hundred (300) linear feet or less as conditions may require. Preparation of the subgrade shall be in accordance with applicable city and TxDOT specification item. A minimum of 95% Standard Proctor density (ASTM D698) shall be uniformly achieved.

8.3.1.2 In the event of excessive rain water standing on the subgrade after densities are made and before concrete is placed on the prepared subgrade, or other conditions beyond Contractor's control, additional densities as specified above will be required prior to placement of the concrete.

8.3.1.3 In no case shall there be less than three (3) density tests made for each day's activity and there shall be a minimum of three (3) density tests made for each street, unless otherwise approved by the resident inspector.

8.3.1.4 The Contractor is required to have density test reports in his/her possession at the construction site prior to placement of concrete. Date of same shall be clearly marked.

### 8.3.2 Concrete Test Requirements (General)

8.3.2.1 The testing laboratory shall review the mix design for each project utilizing criteria regarding cement content set forth in Section 5 "Paving Requirements". Proportioning of concrete shall be in accordance with all applicable portions of the TxDOT Item "Concrete Pavement" Item 360.

8.3.2.2 Unless otherwise permitted, the concrete mix design shall be proportioned to provide a slump of 4.50 1/2-inch, when tested in accordance with ASTM C143, ± "Slump Test". A slump test will be made for each new concrete load or when consistency of the mix changes, at the point of discharge.

8.3.2.3 The laboratory shall inspect and confirm batch design proportions at the plant site each day prior to placement of that day's concrete.

8.3.2.4 Pavement mix designs shall meet flexural strength requirements of five hundred (500) psi at seven (7) days for 5.0 sack concrete in accordance with ASTM C293.

### 8.3.3 Testing Requirements (Concrete Beams)

8.3.3.1 A minimum of four (4) test beams shall be made for each seven hundred fifty (750) square yards, or less, of pavement placed each day. Samples to be taken in accordance with ASTM C172 and molded and cured in accordance with ASTM C31. Any deviations from these requirements shall be recorded on the test report.

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**8.3.3.2** Test specimens in accordance with "Standard Test Method for Flexural Strength of Concrete" (ASTM C293).

**8.3.3.2.A** Two specimens shall be tested at 7 days and two shall be tested at 28 days. The acceptance test results shall be the average of the strengths of the two specimens tested at 7 or 28 days.

**8.3.3.2.B** If one specimen in a test manifests evidence of improper sampling, handling, molding or testing, it shall be discarded and the strength of the remaining specimens shall be considered the test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded and beams sawed from the area in question may be required by the City Engineer in accordance with "Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" (ASTM C42).

**8.3.3.2.C** If the average seven day break and the twenty eight (28) day breaks do not meet minimum requirement, even though evidence of improper procedures as outlined above are not apparent, the City Engineer may, again, require sawed beams from area in question in accordance with ASTM C42.

**8.3.3.3** In the event low strength concrete is confirmed, pavement in the area in question will not be accepted.

**8.3.3.4** Additional beams may be required due to concrete placing conditions, or for adequately determining the strength of concrete when the early opening of the pavement to traffic is necessary and/or desirable. See TxDOT specification item 360, "Concrete Pavement".

### 8.3.4 Concrete Test Requirements (Cores)

**8.3.4.1** After the pavement has been in place for a minimum of fourteen days, one (1) core shall be taken for each 1000 square yards of pavement, or portions thereof, except that not less than one (1) core shall be taken on each street. Cores shall be taken alternately in each one-half section of the pavement in order to obtain a representative sample for thickness. Location of cores shall be selected by the Resident Inspector.

**8.3.4.2** Paving Thickness: Pavement thicknesses contained herein and in the Pavement Design Section (**5.3** Minimum Thickness and Reinforcement Requirements For Concrete Pavement ) are minimums. Therefore, there should not be a need for any tolerance for pavement that is too thin, or less than plan requirements. However, in the event pavement the thickness of which is less than plan requirements is determined, the following shall apply:

**8.3.4.3** The thickness of individual cores shall be determined in accordance with ASTM C174 by averaging no less than three (3) such measurements. Any core, the thickness of which is equal to or greater than one-quarter-inch (1/4") less than the thickness shown on the approved drawings shall be considered one of deficient thickness. Cores drilled for thickness measurements shall be a minimum of four inches (4") in diameter.

**8.3.4.4** If a core is determined to be deficient in thickness, additional cores shall be taken at ten-foot (10') intervals on either side of the deficient core to establish the length of the deficient section. The length of the deficient section shall be the



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distance between the nearest cores of satisfactory thickness, and the width shall be the entire width of the pavement. That pavement shall be removed and replaced with concrete that meets or exceeds requirements. This shall be done at no cost to the City of Santa Fe.

**8.3.4.5** Other testing requirements and procedures will be given under the Section titled "Testing Requirements".

**8.3.4.6** Defective Concrete. Any defective concrete discovered, after the forms have been removed, shall be removed immediately and replaced. If the surface of the concrete is bulged, uneven or shows excessive honeycombing or form marks, which in the opinion of the Engineer and the City Engineer cannot be repaired satisfactorily, the entire section shall be removed or renewed in a manner which is satisfactory to the City of Santa Fe.

**8.3.4.7** Cores shall be broken at 28 days in accordance with ASTM C42. A minimum compressive strength of 3000 psi for 5.0 sack concrete is required. Thickness shall conform to minimum requirements contained in Section **5.3** "Minimum Thickness and Reinforcement Requirements For Concrete Pavement".

**8.3.4.8** If a core fails to meet minimum strength requirements, additional cores may be required by the City Engineer and tested in accordance with procedures outlined above (ASTM C42). In the event low strength concrete is confirmed, pavement in the area in question will not be accepted. In the event minimum thickness is not attained, pavement will not be accepted.

### **8.4 TESTING REQUIREMENTS (STRUCTURES)**

Bridges and box culvert testing shall be in accordance with TxDOT Specification Item 421 "Portland Cement Concrete", and others as they apply.

### **8.5 TEST REPORTS REQUIRED.**

Copies of all test reports to be submitted to the City Engineer in an expeditious manner



**CHAPTER 9  
ACCEPTANCE OF  
IMPROVEMENTS WITHIN  
SUBDIVISIONS**

**9.1 DOCUMENTATION FOR ACCEPTANCE.**

At the time pavement and drainage facilities have been completed, the following documents shall be submitted to the City Engineer on behalf of the owner/developer by the Professional Engineer who received City Engineer approval of drawings for construction of the improvements.

**9.1.1 Acceptance Letter.**

A letter from the Professional Engineer requesting acceptance of the improvements.

**9.1.2 Mylar Reproducibles and Prints.**

One reproducible mylar set and 2 prints of complete "as-built" construction drawings shall be provided and shall become a part of the permanent file to be maintained by the City Engineer and the applicable Drainage District. The following information shall be added to the original drawings approved by the City Engineer.

**9.1.2.1** Crown and gutter line elevations of the roadway, flow line elevations and grade of all inlets and storm sewers shall be shown. Each drawing shall be stamped as "As-Built Drawing".

EXAMPLE

Drawings, as approved As-Built drawings

prior to construction	subsequent to construction
T.C. = 101.50	T.C. = 101.50 101.49 G 100.89
Flowline = 94.50	Flowline = 94.50 94.52

**9.1.2.2** Top elevations of storm sewer manholes as well as all crude oil, gas and product pipelines shall be shown. Technique shall be similar to that prescribed above.

**9.1.3 Grades and Elevations Certifications.**

A letter signed and sealed by the Professional Engineer certifying that the elevations and grades were taken by an on-site survey on a certain date and that all pavement, inlets, manholes and appurtenances are constructed to grade as shown on the drawings and in compliance with the Approved plans & specifications. The letter shall also certify that all trunk storm sewers, and leads are of the proper size and that all improvements are capable of performance as designed and approved. Any deviations from the approved construction drawings to actual construction shall be noted for evaluation by the City Engineer.

**9.1.4 Drainage District Approval Letter.**

A letter from the applicable Galveston County Drainage District stating that the drainage facilities are constructed in accordance with the approved plans and specifications and are acceptable to them.

**9.1.5 Testing Laboratory Certification Letter.**

Certification letter from the recognized laboratory as described in Section 8.1.2

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"Testing Requirements", as well as copies of testing results as specified in Section 8.3.

### 9.1.6 Construction Costs.

Construction costs for the pavement and drainage improvements.

## 9.2 REVIEW AND ON-SITE INSPECTION.

Upon receipt of the above listed documentation, the City Engineer or designated representative(s) shall complete review of the material and an on-site inspection shall be scheduled.

### 9.2.1 Deficiencies and Re-inspection.

At the time of inspection, should any deficiencies be found, the City Engineer shall notify the applicant, in writing, of the deficiencies requiring correction. Re-inspection by the City Engineer will be made following receipt of a letter from the Professional Engineer stating that all noted deficiencies have been corrected. If more than three months have passed since the date of the first deficiency report released by the City Engineer, the project is subject to a complete re-inspection and all noted deficiencies found at that time shall be identified and reported to the Professional Engineer for correction.

### 9.2.2 City Engineer's Certification.

At the time all corrective work is completed and the City Engineer has found the streets and drainage improvements have been constructed in accordance with the approved plans and specifications, the City Engineer shall certify to such.

## 9.3 BOND

### 9.3.1 One Year Inspection.

At the request of the developer's engineer, the City Engineer or designated

representative(s) shall re-inspect these road, street and drainage improvements on or after one (1) year after the date of certification stated in 9.2.2 above.

### 9.3.2 Deficiencies and Re-inspection.

At the time of re-inspection, should any deficiencies be found, the City Engineer shall notify the owner/developer as principal on the bond, in writing, of the deficiencies requiring correction. Re-inspection by the City Engineer will be made following receipt of a letter from the Professional Engineer stating that all noted deficiencies have been corrected. If more than three months have passed since the date of the first deficiency report released by the City Engineer, the project is subject to a complete re-inspection and all noted deficiencies found at that time shall be identified and reported to the Professional Engineer for correction.

### 9.3.3 Final Inspection and Bond Termination.

At the time all corrective work is completed and the City Engineer has found the streets and drainage improvements are in compliance with the approved plans and specifications, the City Engineer shall recommend to the City Council that the bond be terminated. Upon action Council, the City Engineer, by letter, will transmit a copy of the Order terminating the bond to all concerned parties.

### 9.3.4 City Maintenance Begins.

The city Street Department shall place the roads and drainage on the road maintenance system following termination of the bond.



**CHAPTER 10 PAVING &  
DRAINAGE STANDARD  
DRAWINGS**

See Appendix 1



## **CHAPTER 11 POTABLE WATER AND WATER DISTRIBUTION SYSTEMS**



### **11.1 W.C.I.D. No. 8**

Refer to the specifications as adopted by W.C.I.D. No. 8.

### **11.2 Galveston County Health Department**

Galveston County Health Department or individual water wells and systems refer to the regulations of the Galveston County Health Department. Licensing and approval of all wells and water systems is under Health Department authority.



## **Chapter 12 Sanitary Sewer and Waste Disposal**

### **12.1 W.C.I.D. No. 8**

Refer to the specifications as adopted by W.C.I.D. No. 8.

### **12.2 Galveston County Health Department**

For individual sewage treatment systems and septic systems refer to the regulations of the Galveston County Health Department. Licensing and approval of all sewage treatment systems and septic systems is under Health Department authority

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