

Jefferson County Drainage District No. 6
Jefferson County, Texas

*A Plan Related to Drainage and Flood
Damage Reduction*



December 2006

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Executive Summary

Jefferson County Drainage District No. 6 undertook preparation of this document to examine how development is reviewed and to lay the groundwork required by statute so that the District can develop, adopt, implement, and enforce regulations relating to its review and approval of development proposals. The statute requires a drainage district to adopt a master drainage plan prior to adopting such rules; this plan constitutes the District's master drainage plan.

The Plan was prepared with guidance by an advisory committee appointed by the District's Board of Directors and composed of staff representatives from the District, Jefferson County, the City of Beaumont, and representatives of development, engineering, and surveying communities. A representative the Texas Water Development Board (TWDB) attended the planning meetings and offered guidance throughout the process.

In addition to the development of regulations governing the District's review of drainage reports and plans, this Plan calls for the District to identify priorities for future watershed studies, to coordinate local involvement in the revision of flood maps by the Federal Emergency Management Agency, to formalize how flood conditions are documented, to develop in-house capabilities for using geographic information system technology, and to develop a drainage design criteria manual.

The final draft of the Plan was made available for comment on the District's web site, in District facilities, and in public libraries. The final Plan was presented and adopted at a public meeting of the District's Board of Directors on February 27, 2007. It is available for review at the District Office's located at 6550 Walden Rd, Beaumont, TX 77707.

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THE COUNTY OF JEFFERSON

JEFFERSON COUNTY DRAINAGE DISTRICT NO. 6

Agenda Item 4

RESOLUTION

BE IT REMEMBERED that at a meeting of the Board of Directors of Jefferson County Drainage District No. 6, of Jefferson County, Texas, at which a quorum was present, held after proper notice according to law on the 27th day of February, 2007, on a motion made by Joshua Allen, Sr. and seconded by Samuel Laday, the following Resolution was duly adopted by vote of Board Members present and voting as follows:

Director Sam O. Smith	<u>Aye</u>
Director William F. Miranda	<u>Aye</u>
Director Joshua W. Allen, Sr.	<u>Aye</u>
Director Samuel P. Laday	<u>Aye</u>
Director James D. McNicholas	<u>Absent</u>

WHEREAS some portions of Jefferson County, Texas, and the incorporated municipalities that are supported by Jefferson County Drainage District No. 6 have drainage inadequacies and flooding problems; and

WHEREAS, future development may exacerbate those problems if not adequately coordinated with the drainage activities and the drainage system and facilities of the District;

WHEREAS, Section 49.211 of the Texas Water Code authorizes a drainage district to adopt rules governing approval of drainage reports if the district adopts a master drainage plan;

WHEREAS, the *Hazard Mitigation Plan (2004)* was adopted by the Board of Directors in January 2005; this plan identifies actions that, over time, will help minimize and reduce public safety threats and damage to private property, including Action #5, "Develop and adopt a master drainage plan in order for the District to exercise the authority granted to drainage districts under Chapter 49.211 of the Texas Water Code."

WHEREAS, the Texas Water Development Board provided funds to support development of the master drainage plan, the drainage regulations, and the drainage criteria manual;

WHEREAS, the public was provided two opportunities to learn about the master drainage plan and the actions proposed in the plan, and to review the draft prior to adoption;

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of Jefferson County Drainage District No. 6 (DD6) that the *Plan Related to Drainage and Flood Damage Reduction* (December 2006), which constitutes the District's master drainage plan, is hereby adopted as an official plan of the District.

ADOPTED this 27th day of February, 2007.

ATTEST:


President

Secretary/Acting Secretary

1. Introduction

1.1 Overview of the District

Jefferson County Drainage District No. Six (DD6) is a conservation and reclamation district and a political subdivision of the State of Texas located in the southeast corner of the state. DD6 was established January 21, 1920, after favorable vote on January 10, 1920. It was created primarily to provide drainage of overflow lands within DD6, including the construction and maintenance of drains, ditches and levees, and other improvements of the District. The District is governed by a five member Board of Directors that is appointed by the County Commissioners Court of Jefferson County, Texas.



The District was extended and enlarged according to the authority of the 57th Legislature, Chapter 349, and Chapter 7, Title 128, Revised Civil Statutes of Texas, Art. 8129. This enlargement came about in 1961, through legislation (HB 1063), which also established the District as a Conservation and Reclamation District under Section 59, Article XVI, Texas Constitution. Containing approximately 486 square miles, DD6 lies wholly within and comprises approximately half of Jefferson County, including the cities of Beaumont, Bevil Oaks, China, and Nome.

1.2 Statutory Authorities

Chapter 56 of the Texas Water Code authorizes the creation and operation of regional districts for water, sanitary sewer, drainage, and municipal solid waste disposal. Specific sections address authorities granted to drainage districts. For the purposes of this plan related to drainage and flood damage reduction, certain authorities of particular interest are those that address activities undertaken by entities other than the District, including private property owners, developers, and local governments (see text box on page 1-2).



Texas Water Code: Chapter 56. Drainage Districts

Subchapter D. Powers and Duties

[Excerpts pertinent to activities by Entities other than DD6]

56.140. Public and Private Improvements

(b) A person who owns land in the district may drain into one or more of the public drains, and at his own expense, the landowner may make drains according to the natural slope of the land through other lands intervening between his land and the nearest public drain or watercourse or along any public highway.

(c) Before constructing any drains, the landowner shall notify the board of his intention to construct a drain through another person's land or along a public highway, and the directors shall go on the premises and acting as a jury of view shall determine the place for constructing the drain.

§ 56.141. Outside Drains

(a) Before a person artificially drains adjacent land located outside the district into the canals, drains, or ditches of the district, the person must submit a written application to the board, and the board must grant permission to make the connections. The application shall include the width, depth, and length of the connecting drains and ditches.

§ 56.142. Enlargement of Canals, Drains, and Other Outlets

(a) If the engineer's report indicates that the capacity of the canals, drains, or outlets of the district are insufficient to carry the excess water that would be discharged into them by connecting drains or that the additional discharge of water will endanger the canals and drains or the lands and property adjacent to them, the board may give the applicant permission to construct connecting drains and secure the desired outlet on condition that the applicant make necessary enlargements of the canals and drains of the district at the applicant's own expense. The increased capacity of the canals of the district shall be sufficient to carry any increase of water caused by the connection without danger to canals and drains or lands adjacent to them.

[as of December 31, 2004]

Additional powers and duties of drainage districts are enumerated in Section 49.211 of the Texas Water Code (see text box on page 1-3). Specifically, a district that is established to engage in drainage or flood control activities may adopt a master drainage plan and require district approval of a drainage report for subdivision plats as part of the approval process administered by municipalities and counties.

**Texas Water Code: Chapter 49. Provisions Applicable to All Districts
Subchapter H. Powers and Duties**

§ 49.211. Powers

(a) A district shall have the functions, powers, authority, rights, and duties that will permit accomplishment of the purposes for which it was created or the purposes authorized by the constitution, this code, or any other law.

(b) A district is authorized to purchase, construct, acquire, own, operate, maintain, repair, improve, or extend inside and outside its boundaries any and all land, works, improvements, facilities, plants, equipment, and appliances necessary to accomplish the purposes of its creation or the purposes authorized by this code or any other law.

(c) A district that is authorized by law to engage in drainage or flood control activities may adopt:

(1) a Master Drainage Plan, including rules relating to the plan and design criteria for drainage channels, facilities, and flood control improvements;

(2) rules for construction activity to be conducted within the district that:

(A) reasonably relate to providing adequate drainage or flood control; and

(B) use generally accepted engineering criteria; and

(3) reasonable procedures to enforce rules adopted by the district under this subsection.

d) If a district adopts a Master Drainage Plan under Subsection (c)(1), the district may adopt rules relating to review and approval of proposed drainage plans submitted by property developers. The district, by rule, may require that a property developer who proposes to subdivide land located in the district, and who is otherwise required to obtain approval of the plat of the proposed subdivision from a municipality or county, submit for district approval a drainage report for the subdivision. The drainage report must include a map containing a description of the land to be subdivided. The map must show an accurate representation of:

(1) any existing drainage features, including drainage channels, streams, flood control improvements, and other facilities;

(2) any additional drainage facilities or connections to existing drainage facilities proposed by the property developer's plan for the subdivision; and

(3) any other parts of the property developer's plan for the subdivision that may affect drainage

(e) The district shall review each drainage report submitted to the district under this section and shall approve a report if it shows compliance with:

(1) the requirements of this section;

(2) the district's Master Drainage Plan adopted under subsection (c)(1); and

(3) the rules adopted by the district under Subsections (c)(2) and (d).

(f) On or before the 30th day after the date a drainage report is received, the district shall send notice of the district's approval or disapproval of the drainage report to:

(1) the property developer; and

(2) each municipal or county authority with responsibility for approving the plat of the proposed subdivision.

(g) If the district disapproves a drainage report, the district shall include in the notice of disapproval a written statement:

(1) explaining the reasons for the rejection; and

(2) recommending changes, if possible, that would make a revised version of the drainage report acceptable for approval.

[as of December 31, 2004]



1.3 Overview of the Plan

This plan provides a concise summary of the following:

- **Chapter 1 Introduction.** The statutory authorities summarized are those under which DD6 operates and which call for a master drainage plan as a requirement for adoption of drainage regulations.
- **Chapter 2 Goals.** The goals established in the District's *Hazard Mitigation Plan* are summarized; this plan was identified in that document as a high priority action. The primary purpose for its development is to allow DD6 to develop, adopt and implement rules relating to its review of drainage plans.
- **Chapter 3 Jefferson County Drainage District No. 6.** This brief description of the District and the region includes information the major watersheds and the population. A small increase in population is anticipated, a factor that influences the amount of development anticipated.
- **Chapter 4. The Planning Process.** An established process was followed to develop this document. A committee representing various interests was formed and a series of meetings was held. The public was given the opportunity to comment at the outset and prior to adoption.
- **Chapter 5, How Development is Managed (as of 2005).** This chapter summarizes how Jefferson County and the City of Beaumont process their reviews of drainage plans for subdivision proposals. Both jurisdictions (and the cities of Bevil Oaks, China and Nome) require that developers obtain DD6 review – DD6's typical review process also is summarized.
- **Chapter 6 Flood and Drainage Conditions.** A summary of the types of drainage and flooding problems is presented to illustrate the wide range of problems that are taken into consideration as the District implements its responsibilities and that are important in the consideration of drainage and flood-damage reduction measures to be addressed in development proposals.

-
- **Chapter 7 Factors Influencing Future Problems.** Factors that contribute to drainage and flooding problems are described, including new development and increased runoff, new construction in flood-prone areas, and the District's drainage system improvements and ongoing maintenance program.
 - **Chapter 8 Meeting the Goals: Actions.** Six actions are identified to help the District meet stated goal related to facilitating development reviews to recognize existing stormwater and flooding problems while avoiding creating new problems or worsening existing problems. The actions include:
 - A. Develop and implement drainage regulations
 - B. Identify watershed study needs
 - C. Coordinate flood map revisions
 - D. Document flood conditions
 - E. Develop GIS capabilities
 - F. Develop drainage design criteria manual

1.4 Acknowledgements

DD6 acknowledges the support and contributions of the Texas Water Development Board (TWDB). In 2004, DD6 received a Flood Protection Planning Grant from the TWDB to support development of this plan related to drainage and flood damage reduction (master drainage plan). In addition, TWDB funds were provided to support the watershed study of an unstudied portion of the Hillebrandt Bayou watershed that was DD6's top priority due to the extent of prior flooding and the limited solutions based on currently available engineering data. This study will examine a range of cost-effective alternatives to improve drainage and reduce flood damage.

2. Goals: Managing Drainage, Protecting Lives and Property

Runoff of excessive rainfall, drainage, and flooding are inextricably linked processes. The purpose of both natural and manmade drainage and stormwater management systems is to convey runoff; when the capacity of those drainage systems is exceeded, normally dry lands are inundated by floodwater. Manmade stormwater and drainage works usually are designed to handle runoff from frequent rainfall events such as the 5-year or 10-year frequency storm¹. Some drainage systems are designed to convey less frequent floods, such as the 1%-annual chance flood (commonly called the 100-year flood)². Some key concepts in stormwater management and floodplain management are explained in Appendix A.

DD6 implements its authority to manage drainage in order to protect lives and property from the adverse effects of uncontrolled drainage and flooding. The District was created primarily to provide drainage of overflow lands, including the construction and maintenance of drains, ditches and levees, and other improvements of the District.

In January 2005, DD6 adopted a *Hazard Mitigation Plan (2004)* that was prepared according to the planning process outlined by the Federal Emergency Management Agency. As part of that process, the District formulated four mitigation goals:

1. To protect public health, safety, and welfare;
2. To reduce losses due to hazards by identifying hazards, minimizing exposure of citizens and property to hazards, and increasing public awareness and involvement;
3. To facilitate the development review and approval process to accommodate growth in a practical way that recognizes existing stormwater and floodplain problems while avoiding creating new problems or worsening existing problems; and
4. To seek solutions to existing problems.

¹ A “5-year frequency storm” has a 20% probability of occurring in any given year and a “10-year frequency storm” has a 10% probability of occurring in any given year.

² A “100-year flood” has a 1% probability of occurring in any given year.



The *Hazard Mitigation Plan (2004)* also sets forth an action agenda for the period 2005-2010. One of the high priority actions is:

Action # 5. Develop and adopt a master drainage plan [plan related to drainage and flood damage reduction] in order for DD6 to exercise the authority granted to drainage districts under Chapter 49.211 of the Texas Water Code. Chapter 49.211 requires districts to adopt master drainage plans before adopting rules relating to the review and approval of proposed development drainage plans.

Coordinating reviews of drainage improvements with DD6 is part of the subdivision review process undertaken by Jefferson County and the City of Beaumont. Although the District does not have formal rules, the regulations adopted by the County and City do contain provisions that link approval of subdivisions to the District's review.

This Plan is prepared and adopted in order to allow DD6 to develop, adopt and implement rules relating to that review and to formalize the process of approval of proposed drainage plans submitted by property developers so that there are defined requirements and an orderly review and approval process.

3. Jefferson County Drainage District No. 6

The area covered by the Jefferson County Drainage District No. 6 is located in southeast Texas (Figure 3-1). Jefferson County is bounded on the north by the Neches River and Pine Island Bayou, which form the border with Hardin and Orange Counties; on the east by Sabine Lake, which forms the border with Cameron Parish, Louisiana; on the South by the Gulf of Mexico; and on the west by Liberty and Chambers Counties. The City of Beaumont is the County seat and the largest city in Jefferson County. Beaumont is situated approximately 85 miles east of Houston, approximately 70 miles northeast of Galveston, and 275 miles southeast of Dallas.

The District implements and maintains drainage projects throughout the District's 486 square mile area of responsibility which lies wholly within Jefferson County and includes the cities of Beaumont, Bevil Oaks, China and Nome, and much of Jefferson County. Figure 3-2 delineates the major watersheds that are within or flow through the District.

Among its other duties, DD6 works with the other jurisdictions to identify flood-prone areas, to encourage inclusion of flood-damage avoidance measures in land development, and to implement cost-effective flood mitigation projects. Chapter 6 includes additional information regarding flood hazards.

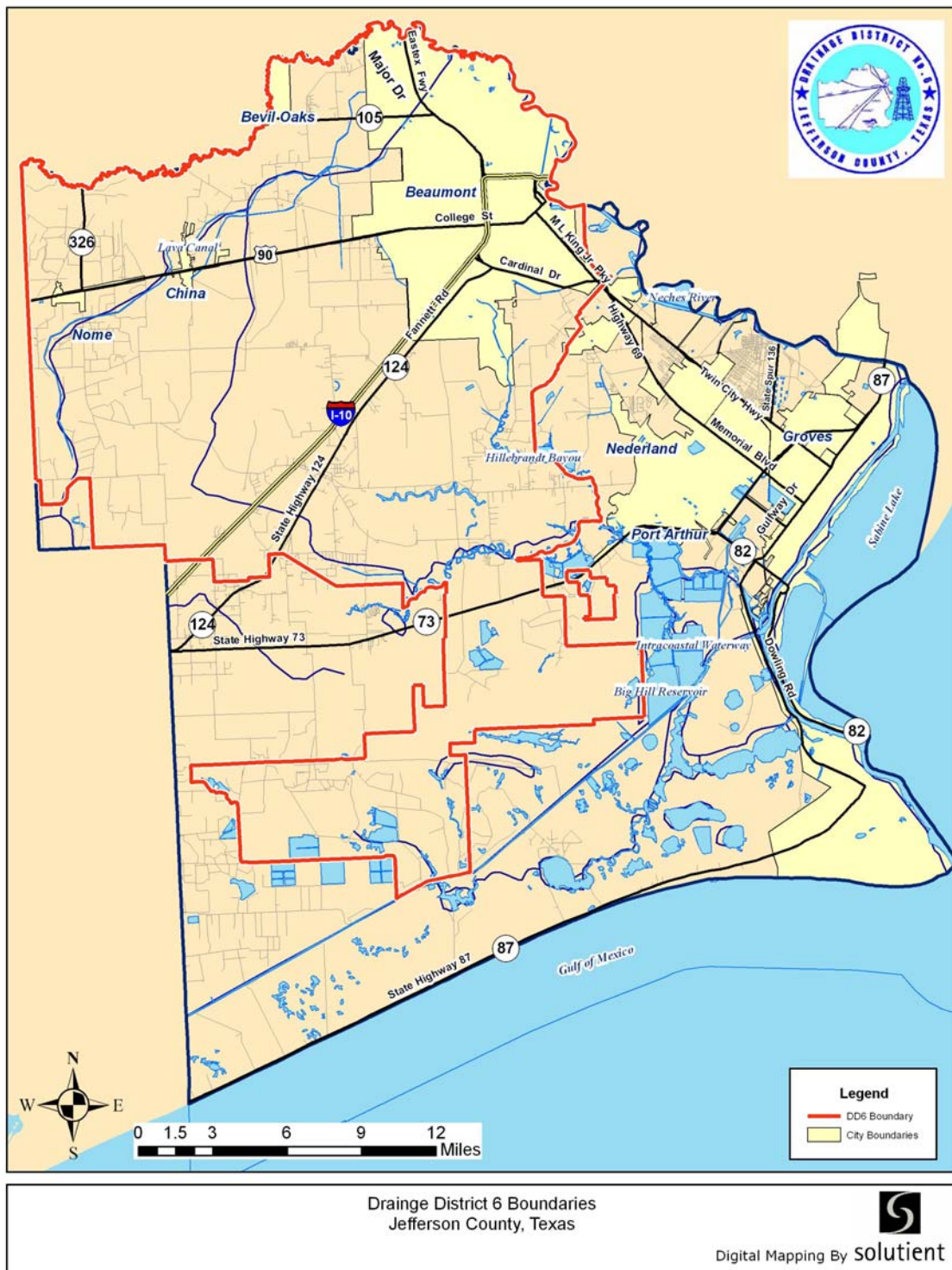


Figure 3-1 Jefferson County Drainage District No. 6

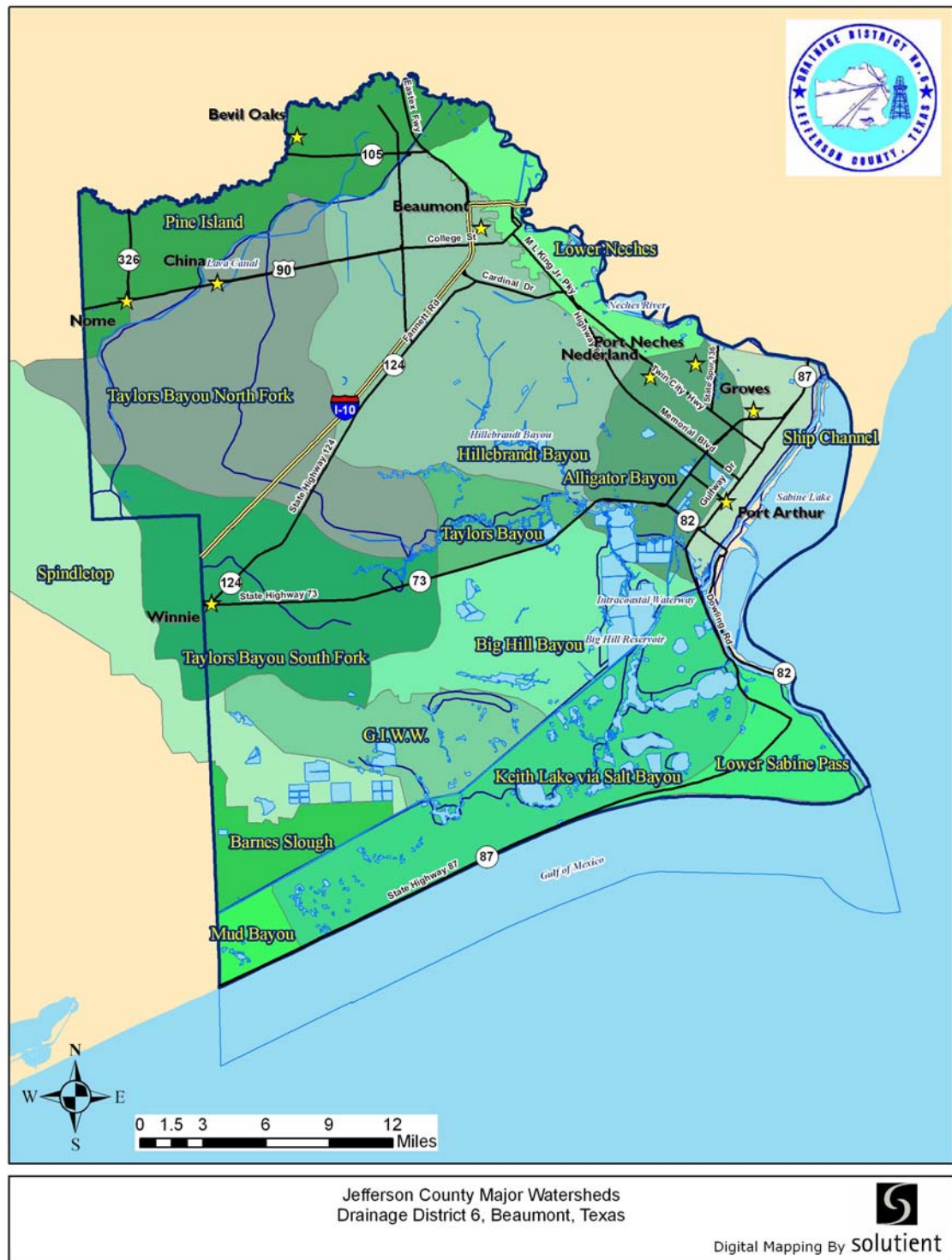


Figure 3-2 Drainage District No. 6 and Major Watersheds



Southeast Texas is characterized by gently sloping or nearly flat topography. Ground surface elevations across the District vary from 37 feet to 3 feet above mean sea level. The geologic structure is nearly flat strata, with bedrock types comprised of deltaic sands and muds. Data from the Bureau of Economic Geology at the University of Texas at Austin, identifies the land as “expansive clay and mud – locally silty, locally calcareous, flat to low; hilly prairie; commonly tilled”.

The climate of the region is humid subtropical, with warm summers and moderate winters. Rainfall is abundant and, on average, is fairly evenly distributed throughout the year. The heaviest rains usually occur during the hurricane season, which extends from June through October. Average annual precipitation is approximately 56 inches and the average annual temperature is about 69° F.

Jefferson County, including the incorporated municipalities, has a total population of 252,051 (2000 Census). The population density per square mile is 279 (statewide average is 79.6 persons per square mile). The population of unincorporated Jefferson County totals 30,701; Table 3-1 shows the population distribution of the remaining 221,250 people. According to the State Demographer, the population projection for Jefferson County for 2005 is 256,052 (1.6% increase). As indicated by this 2005 population estimate, growth within the District is relatively stagnant. The area’s labor force in is 108,633, and the top three industries are education, health, and social services with 23,338 workers (21.5%); manufacturing with 13,798 (13.8%); and retail trade with 12,736 workers (12.8%).

Table 3-1. Population (2000 Census)

Jurisdiction	Population
Beaumont	113,866
Bevil Oaks	1,346
China	1,112
Nome	515
Total for cities	221,350
Unincorporated County	30,701
Total	252,051

The City of Beaumont has a population of 113,866 (2000 Census). The population density per square mile is 1,339.4 (statewide average is 79.6 persons per square mile). The population of the labor force is 52,051. According to the Texas State Data Center and Office of the State, the top five employers are: Beaumont Independent School District (2,927 employees); Christus St. Elizabeth Hospital (2,600 employees); the US Postal Encoding Center (2,023 employees); Lamar University (1,700 employees); and Memorial Hermann Baptist Hospital (1,500 employees). Beaumont is also home to Exxon-Mobil Oil, E.I. DuPont, and the Goodyear Tire and Rubber Company, which maintain significant operations.

4. The Planning Process

4.1 Advisory Committee

To guide the development of this Plan, DD6 created an Advisory Committee and identified and invited several members of the public to participate. The City of Beaumont and Jefferson County were also represented. Table 4-1 lists the Advisory Committee membership.

Table 4-1. Advisory Committee Members

Name	Organization
Betty Holman	Drainage District No. 6
Jim Broussard	Drainage District No. 6
Doug Canant	Drainage District No. 6
Thad Heartfield	Counsel to DD6
Adina Abshire	City of Beaumont
Tom Warner	City of Beaumont
Don Rao	Jefferson County
Jim Dishman	Developer
Richard Worthey	Wortech Land Surveyors
Sam Parigi, Jr	Parigi Property Management
Howard Nichols	Developer
Richard Guseman	Developer

4.2 Planning Process

DD6 followed a well-established planning process to develop this Plan. The Advisory Committee met four times (meeting agendas and minutes are on file with DD6). The following summarize the sessions:

- **April 22, 2004.** Presented an overview of the planning process, the role of the Advisory Committee, and background on Texas Water Development Board (TWDB) grant, including the scope of the watershed study and development of the Plan. Discussed the authority set forth in Section 49.211 of the Texas Water Code, and modifications made by passage of HB 919. Presented and discussed the subdivision review and approval processes of the City of Beaumont and Jefferson County and how DD6's current review and comment process is coordinated.
- **November 30, 2004.** Summarized the presentation from the public meeting. Reviewed the Draft plan outline, the draft regulations



outline, the flow charts of the subdivision review and approval processes in Jefferson County and the City of Beaumont, and discussed key concepts to be captured in the Plan.

- **May 10, 2006.** Discussed member comments on the draft plan, with particular attention to the section that outlines the approach to working with developers to examine alternatives to address drainage, and the anticipated content of the drainage regulations.
- **November 15, 2006.** Reviewed the actions called for, including progress on drafting drainage regulations and the Hillebrandt Bayou watershed study. The Plan will be presented to the Board of Directors for adoption.

4.3 Public Involvement

Jefferson County Drainage District No. 6 recognized the importance of keeping the public informed as it developed this Plan and the recommendations that will affect how drainage is handled in the development processes of the County and cities. Public involvement is required as a condition of the TWDB grant. In addition to the open meetings of the Advisory Committee, two public meetings were held:

- **November 29, 2004.** As advertised twice in the local paper (Appendix B), the purpose of this public meeting was to present overviews of preparation of the Plan and the engineering study of Hillebrandt Bayou.
- **November 15, 2006.** As advertised in the local paper (Appendix B), the purpose of this meeting was to present the Plan, summarize the actions that are called for, provide an update of the Hillebrandt Bayou study, outline the drainage regulations that are under development, and alert the public that drainage regulations will be made available for public comment in the near future.

5. How Development is Managed (as of 2005)

In general, a number of factors have varying influence over where development occurs. With the area's population increasing at what appears to be less than 2 percent in the past five years, and some population shifting from Beaumont into Jefferson County, the pressure for development is not driving rapid construction and subdivision of land. The most likely factors taken into consideration by developers are land price, school zoning, convenience of existing amenities (shopping and recreation), and proximity to employment opportunities.

Although no analysis was performed, DD6 staff reports that the presence of mapped floodplain areas on a parcel of land does not appear to significantly influence decisions to purchase or to develop. The exceptions to this are most likely to occur in areas that have flooded frequently or recently (even if such areas are not shown on official maps) and areas where flooding is predicted to be deep (which affects construction costs).

5.1 Jefferson County

Jefferson County, Texas, has land use and permit authority over the unincorporated land within its boundaries and exercises this authority through issuance of permits and approvals for certain types of development proposals. The County's requirements for drainage within subdivisions are set forth in the Rules, Regulations and Requirement Relating to the Approval and Acceptance of Improvements in Subdivisions or Resubdivisions; requirements for single-lot development do not explicitly include provisions for drainage. The County shares jurisdiction for subdivisions that are proposed in the Extraterritorial Jurisdiction (ETJ) areas of the cities. Table 5-1 summarizes permits and approvals issued in 2002, 2003 and 2004.



**Table 5-1. Jefferson County: Approvals & Permits
(2002–2004)**

Subdivision Approvals	2002	2003	2004
Residential Subdivisions	3	2	1
Nonresidential Subdivisions	0	0	0
Subdivision Totals	3	2	1
Permit Type	2002	2003	2004
New Home Construction	138	122	108
+Mobile Home	85	70	48
Businesses	26	22	28
Not new home, moved onto property	12	7	7
Storage	24	27	42
Barn	14	17	17
Improvement > 50% of home value (Remodeling, Mold, Flood)	6	12	8
Other	0	2	0
Permit Totals	305	279	258

Notes on selected provisions of Jefferson County’s subdivision requirements that pertain to flood hazard areas and storm drainage are found in Appendix C-1. Of particular interest are the following:

- Article 1.0(n) sets forth the general requirement that “The Developer is required to obtain approval of [the] drainage plan from applicable Drainage District and submit approval with plat, said plan must comply with the Jefferson County Floodplain Order.”
- Article 3.0 outlines steps in the approval process and standards for subdivisions. Section A(9) notes that drainage improvements are to meet minimum standards to be accepted by the County for maintenance, including “ditches must have a discharge factor of 1.3 cfs per acre and may not have substantial ponding.”
- Article 3.0, Section D, outlines requirements for subdivision layout, including drainage easements which “shall be dedicated as

required by Jefferson County Drainage Districts, or the County Engineer if the subdivision is outside a Drainage District, for major drainage channels and ditches, and of sufficient width to provide for maintenance and ample room for spoil banks and berm, if spoil is left in place after excavation. In addition, 40 feet, 20 feet on each side of centerline of drainage way, shall be dedicated for all minor drainage ways.”

- Article 3.0, Section G, outlines requirements for storm drainage, including:
 - “For areas inside the subdivision a discharge factor of 1.3 cfs per acre shall be used.”
 - “For discharge originating outside the subdivision, a discharge factor of 1.3 cfs per acre, or such factor of runoff as may be determined by study of the drainage area shall be used, discharge factor must be approved by Drainage District.”
 - “Storm sewers shall be designed to carry the discharges from factors listed above, but must have a design velocity of not less than 3.0 feet per second.”
 - “Outfalls from sewers and ditches into drainage ways or natural navigable waterways shall enter at the grade of the drainage channel. If necessary, rip-rap and/or drop type outfall structures shall be used to prevent erosion.”

To minimize the effects of flooding and to make federal flood insurance available to its citizens, the County administers a floodplain management ordinance within mapped special flood hazard areas. The ordinance and the County’s administrative procedures are in compliance with the requirements of the National Flood Insurance Program.

**Floodplain Management in
Jefferson County**

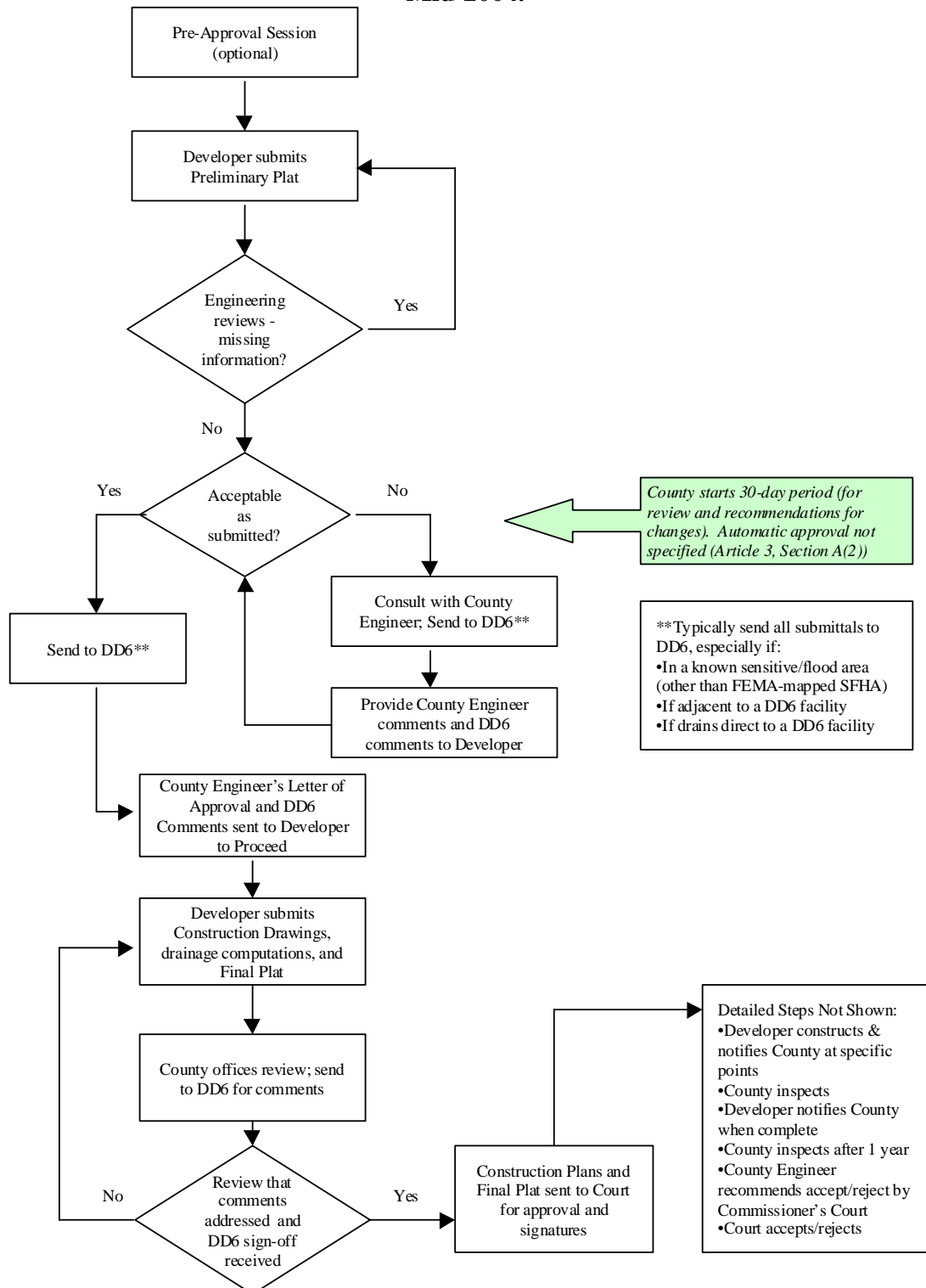
*Joined the National Flood Insurance
Program on June 1, 1983*

*Current Flood Insurance Rate
Map is dated August 6, 2002*

The County’s subdivision review and approval process is outlined in Figure 5-1. The County Engineer is empowered to approve subdivision proposals that conform to the requirements. Developers are required to



Figure 5-1. Jefferson Subdivision Review (Preliminary Plat) As of Mid-2004.



obtain DD6 approval of drainage plans, although this process is managed by the County. The County sends submitted reports and materials to DD6 for review at two times during the approval process. The Commissioner's Court approves the construction plans and final plat prior to construction.

The County requires that at least one-year elapse between completion of the subdivision streets and drainage and submission of the "as-built" plans prior to acceptance (or rejection) by the Commissioner's Court.

5.2 City of Beaumont

The City of Beaumont regulates development within its corporate boundaries through administration of various ordinances (land use, building code, subdivision). The City and Jefferson County share jurisdiction and issue joint subdivision approvals in the City's ETJ, which extends five miles into the County from the City boundary. Table 5-2 summarizes permits and approvals issued in 2002, 2003 and 2004, including those approved in the ETJ.

**Table 5-2. City of Beaumont: Approvals & Permits
(2002–2004)**

Subdivision Approvals	2002	2003	2004
Residential Subdivisions	2	6	13
Commercial Subdivisions	0	0	3
Subdivision Totals	2	6	16
Permit Type	2002	2003	2004
New Residential Construction	260	264	251
Residential Accessory	81	107	103
New Commercial Construction	110	62	64
Commercial Accessory	24	18	24
Permit Totals	475	451	442

Notes on selected provisions of Beaumont's Subdivision Regulations that pertain to flood hazard areas and storm drainage are found in Appendix C-2. The Subdivision Regulations do not identify specific design criteria



for drainage systems and drainage easements, although the City Engineer's approval is required. Of note:

- As part of the submission of the preliminary plat, Sec. 24-8(a)(10) requires that the location of existing and proposed storm drainage easements and improvements be shown and states that "A copy of all design computations shall be submitted along with the plans." (The City Engineer reports that the Texas Department of Transportation drainage requirements are used as the basis for review.)
- Section 24-16(b) states that "Minimum drainage easements shall be required when a subdivision is traversed by a watercourse, drainage channel, stream or underground conduits. Minimum easements shall be adequate to provide for the drainage requirements as determined by the City Engineer or any local drainage districts."
- Section 24-23 states, in part, that "The subdivider shall provide for all storm water easements and improvements in accordance with the plans approved by the City Engineer."

To minimize the effects of flooding and to make federal flood insurance available to its citizens, the City administers a floodplain management ordinance within in mapped special flood hazard areas. The ordinance and the City's administrative procedures are in compliance with the requirements of the National Flood Insurance Program.

**Floodplain Management in
Beaumont**

*Joined the National Flood Insurance
Program on October 30, 1970*

*Current Flood Insurance Rate Map is
dated August 6, 2002*

The City administers a phased approval process for subdivision proposals. The process involves submission of the preliminary plat, which operationally triggers a 30-day period within which preliminary plats are to be approved. As shown in Figure 5-2:

-
- The developer is notified when the Planning & Zoning Commission has approved the preliminary plat which is followed by submission of construction plans and drainage calculations (among other materials).
 - DD6 is provided material for review and returns written comments. The City conveys the comments to the developer.
 - Upon approval of the construction plans, the developer proceeds with construction and the City performs periodic inspections.
 - When construction is complete, the City performs a final inspection and the developer applies for approval of the final plat and as-builts, and requests the City's acceptance of the infrastructure.

**Revisions to Beaumont's
Regulations in Preparation**

The description of the City's regulations and review process reflects what is in effect as of late November 2006. The City is drafting changes.

The City processes proposals for subdivisions in the ETJ through the same phased approval process shown in Figure 5-3. Once approved, the City submits the applicant's submittal to the County for review and approval, after which the City issues the final approval.

5.3 Cities of Bevil Oaks, China, and Nome

DD6 maintains some drainage ditches in the cities of Bevil Oaks, China and Nome. Unlike Beaumont and Jefferson County, little development occurs within these communities. However, DD6 is available to review and advise the cities should proposals for subdivisions and large single lot developments be received.



Figure 5-2. Beaumont's Subdivision Review Process for Preliminary Plats as of Mid-2004 *(Not for subdivisions that are processed as Minor Plats)*

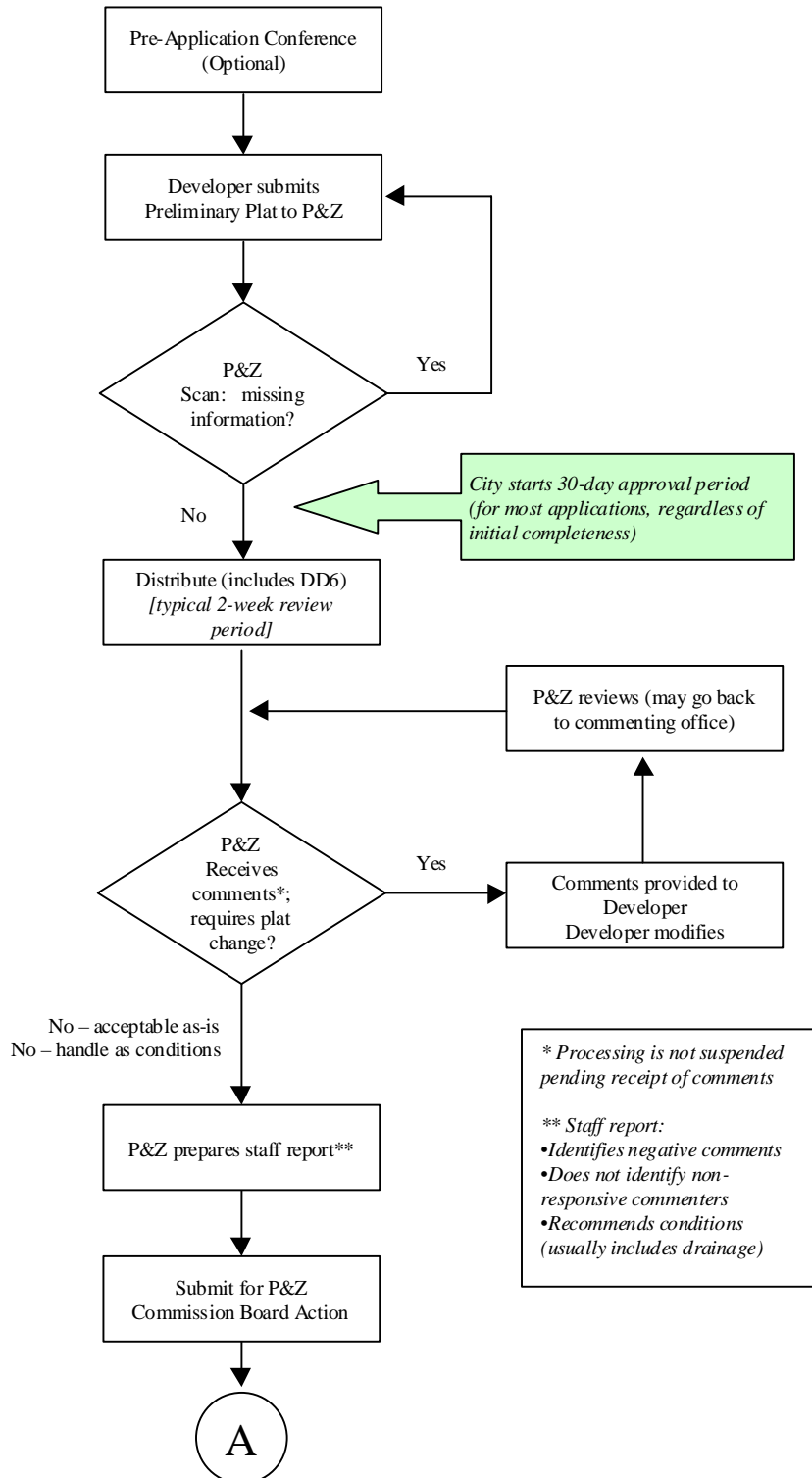


Figure 5-2. Beaumont's Subdivision Review Process for Preliminary Plats as of Mid-2004, continued

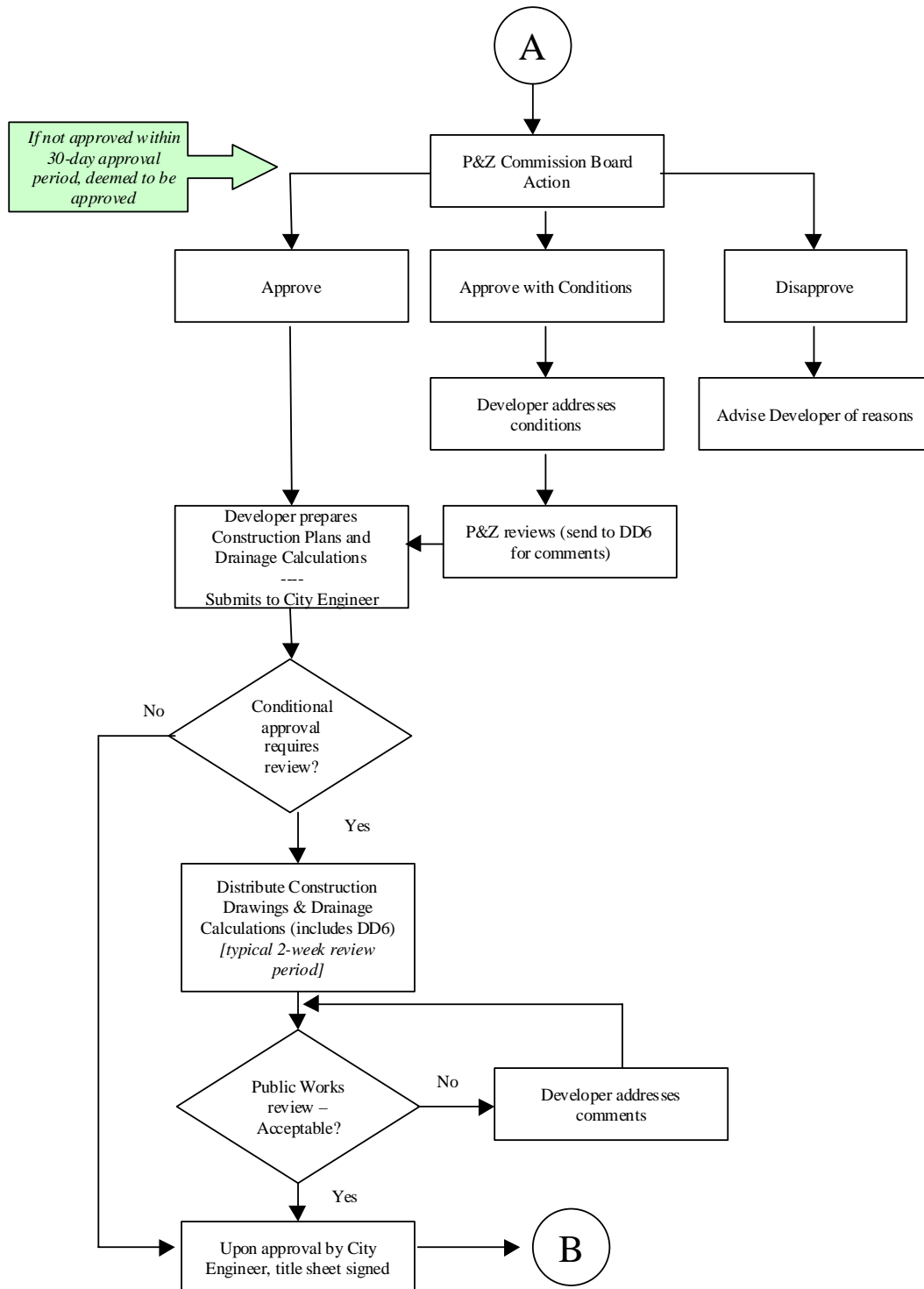
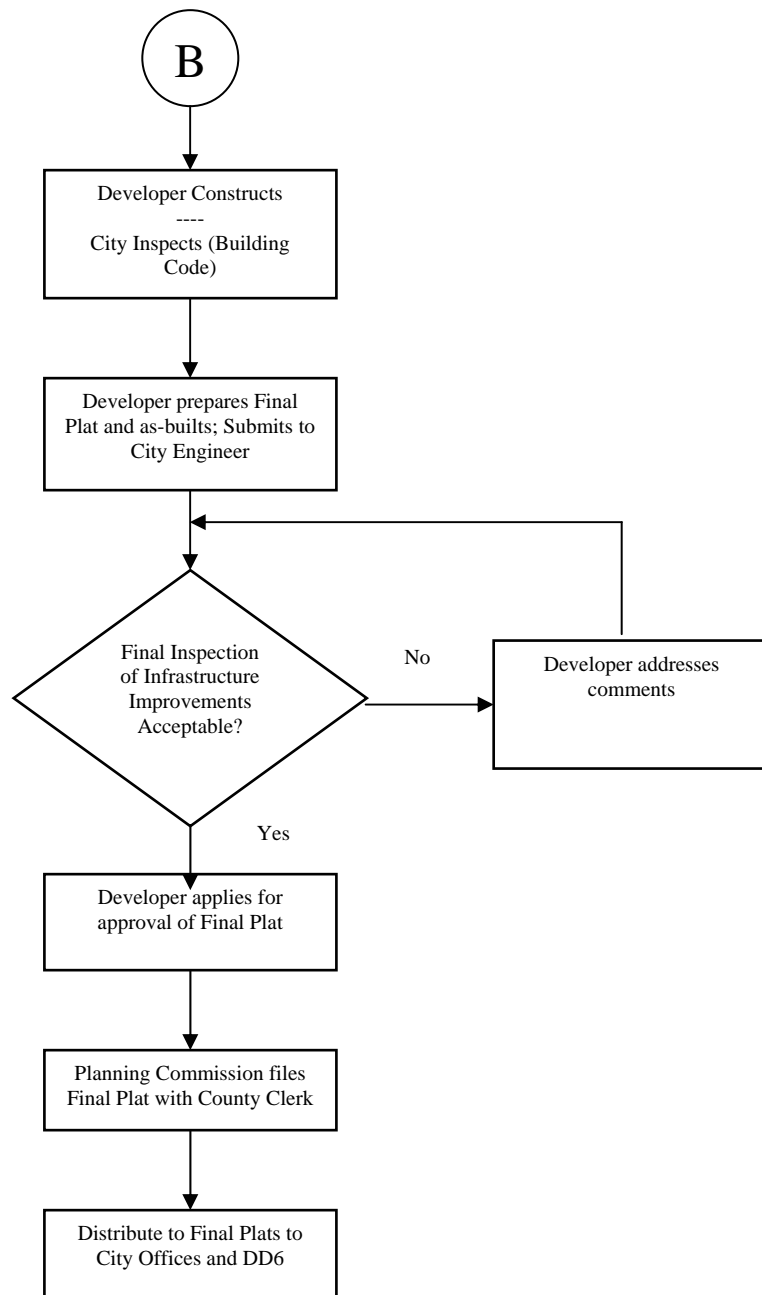




Figure 5-2 Beaumont's Subdivision Review Process for Preliminary Plats as of Mid-2004, continued



5.4 Jefferson County Drainage District No. 6

The District is organized in three departments:

- Administration – personnel, finance, and general management of the District,
- Operations – general maintenance of District equipment, facilities, and infrastructure, and construction of new infrastructure
- Engineering – flood studies of problem areas, identification and engineering of mitigation alternatives, review of development proposals, and coordination with maintenance and new construction.

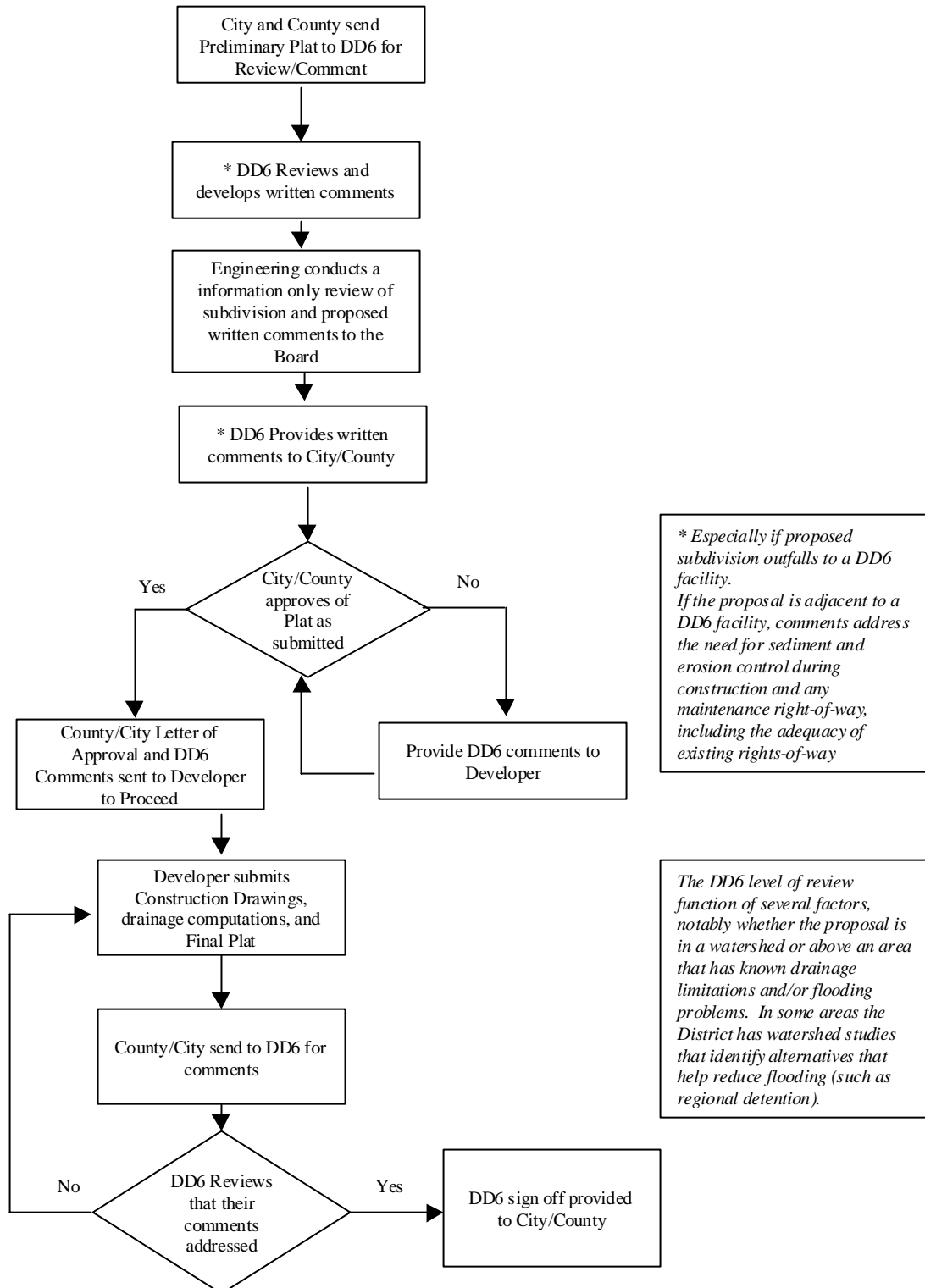
The District participates in the development review processes of Jefferson County and the City of Beaumont through review of subdivision drainage plans and some single-lot development proposals (typically those over one-acre in size). Figure 5-3 outlines the review steps performed by DD6 Engineering. The County and Beaumont provide copies of subdivision proposals (preliminary plats in the City) and drainage plans to DD6 for review. In addition to development proposal reviews:

- The County requests DD6 comments on all applications for building permits in flood-prone areas.
- Beaumont requests DD6 comments on proposals for lots that are one-acre or larger in size and on proposals for lots that are adjacent to DD6 ditches.

DD6's concerns are largely focused the impacts of receiving additional runoff into its existing drainage system, the availability of adequate easements for maintenance access, the areas affected when subdivision drainage system capacity is exceeded, and on downstream flooding impacts, especially in areas already known to flood frequently. The District's interest in management of development in flood-prone areas is directly related to the demand for drainage improvement and investments in flood control and flood mitigation projects.



Figure 5-3. DD6 Review (Preliminary Plat) As of Mid-2005



DD6 Engineering prepares written comments to document its review, especially if drainage from a proposed subdivision outfalls directly to a DD6 facility. In general, DD6 Engineering does not confirm the computations of the volume of discharge proposed to flow into a DD6 ditch. The likely path of overland flow is checked to see where water will flow when the designed drainage capacity is exceeded. If the proposal is adjacent to a DD6 facility, the District's comments address the need for sediment and erosion control during construction and any maintenance right-of-way, including the adequacy of existing rights-of-way.

It is common for DD6 Engineering to meet with developers and engineers to discuss drainage needs and to negotiate mutually beneficial alternatives. Alternatives have included redirecting runoff, increased easement widths, and joint stormwater management or drainage improvement projects, such as increasing the hydraulic capacity of drainage structures, installing detention structures, and others.

The District also provides information about past flooding and drainage limitations and problems in the vicinity of proposed developments, with particular attention to whether downstream impacts on flooding need to be examined. DD6 reinforces the importance of floodplain management requirements (especially elevation above the Base Flood Elevation or height above grade where BFEs are not available) and recommends floor heights above grade in areas prone to flooding that are not shown on the Flood Insurance Rate Maps.

The District's review comments and recommendation to approve or disapprove proposals are returned to the County or City, and copied to the developer's engineer. An explanation is provided if disapproval is recommended.

To keep the DD6 Board informed of development activity, DD6 Engineering provides an overview of proposed subdivisions and its technical comments during the Board's work sessions. Because of their familiarity with the area, Board members often provide insight or additional comments. These presentations are informational only and do not involve approval by the Board.



DD6 is not involved in inspection of private construction sites; Jefferson County and the cities are responsible for determining whether construction conforms to the approved plans.

6. Flood and Drainage Conditions

The January 2005 *Hazard Mitigation Plan (2004)* adopted by DD6 includes an overview of past flood events and the nature of flood damage sustained in the area. Since 1965, twelve major Federal disaster declarations have been declared due to storms and flooding in the area. Flooding that does not prompt a disaster declaration occurs more frequently in some areas.

As described in Chapter 2, DD6 implements its authority to manage drainage in order to protect lives and property from the adverse effects of uncontrolled drainage and flooding. This chapter briefly describes the different flood and drainage conditions that occur in the area and that can be exacerbated by increases in impervious area in some watersheds.

Rainfall amounts associated with storms that are expected to occur with given frequencies are used for design of drainage works and flood control/mitigation projects, and for evaluation of the impacts of proposed development. For the region of Texas that includes Jefferson County, the event level (frequency) and rainfall amounts used are shown in Table 6-1.

Table 6-1. Rainfall Frequency

24 hour rainfall/event	
Event Level	Inches of Rain
2-year	5.5"
5-year	7.5"
10-year	8.8"
25-year	10.2"
100-year	13.0"

6.1 Available Data

Flood and drainage problems are generally categorized in two ways: (1) flooding along waterways (ditches and streams), and (2) inadequate drainage (ponding in low areas and street flooding). DD6 has a number of sources of information that identify problem areas and examine potential projects, including some engineering studies and reports



prepared in the past 20 years. The value of information in these sources varies considerably, in part because of age, the level of detail, and subsequent analyses. The District reserves the right to provide data from the following sources based on its determination of the quality and usefulness of the data for specific uses:

- 1986 areawide engineering analyses and consideration of alternatives, referred to as the “Bernard Johnson Master Drainage Plan” and the “2001 Taylor’s Bayou Watershed Study”
- 2006 Upper Hillebrandt Watershed Study
- Various studies and analyses of smaller areas

The Flood Insurance Studies and Flood Insurance Rate Maps (FIRMs) prepared by the National Flood Insurance Program (NFIP) for Jefferson County and the cities show some areas that have been determined to be subject to flooding by the 1%-annual chance flood (commonly called the 100-year flood). The maps show some flood-prone areas that were not determined using current detailed engineering methodologies (called ‘unnumbered A Zones’) and some FIRM panels are more than 15 years old.

The District operates an automated system to collect rainfall and stream data as part of the ALERT flood warning system. The data collection system stores historic data which are used in a number of ways to support DD6 functions. One notable use is to identify areas that flood but that are not shown on FEMA flood maps. In these areas, the District regularly recommends that buildings be elevated above grade in order to minimize the likelihood of future flood damage. Some flooding and high water records are recorded in survey field books and some have been noted on maps.

Together these sources of information may prove useful for DD6, the cities, landowners, and developers to plan projects and to evaluate alternatives to reduce problems.

6.2 Ditch and Creek Flooding

Many DD6 ditches are sized to carry floodwaters, but many ditches pre-date current design considerations. In those areas, flooding of drainage ditches and creeks is characterized by floodwaters that exceed the capacity of the waterways. When capacity is exceeded, adjacent lands are affected. Some of these flood-prone adjacent lands are shown on the FIRMs. It is known, however, and confirmed by recent experience, that the FIRMs do not show all flood-prone areas along ditches and waterways.

To provide optimum drainage function, DD6 performs routine maintenance of the drainage ditch system. Maintenance of drainage ditches involves mowing rights-of-way, cutting vegetation on ditch side slopes, removing excessive accumulations of sediment, repairing erosion and slumps, and repair of areas eroded during high water events. Erosion control measures include application of concrete, rock, timber bulkheads, installing pipe outfalls, and vegetative measures (sod or grass seeding).

6.3 Localized Ponding and Street Flooding

Areas where water collects or flows slowly that are not directly associated with a waterway are described as subject to ‘localized’ ponding or flooding. These areas may simply be flat or shallow depressions with limited or poor drainage in which rainfall-runoff collects faster than it can drain away or infiltrate into the ground.

Local drainage problems contribute to the frequency of flooding, increase ditch maintenance costs, and are perceived to adversely affect property values and the quality of life in some neighborhoods.

In areas where streets are constructed with curbs and flat local topography limits drainage options, rainfall-runoff collects in streets and may become too deep for vehicle access. Many areas of local ponding and street flooding are not shown on the Flood Insurance Rate Maps and thus are not regulated as flood hazard areas. Damage to buildings is evident due to the large number of NFIP flood insurance claims in areas that are not shown on the FIRMs (see Section 6.5).



Although DD6 maintains some records of areas subject to localized ponding and street flooding, a comprehensive map is not available.

6.4 Storm Drainage

Drainage is an important component of subdivision and site design. As described in Appendix A, storm drainage networks generally are designed for more frequent storms (e.g., the 5-year or 10-year rainfall) and, therefore, are not expected to convey significant intense or prolonged storms. Sections 5.1 and 5.2 describe requirements administered by Jefferson County and the City of Beaumont.

Many older developments were built prior to adoption of the current minimum requirements. Local storm drainage flooding causes problems in some of those subdivisions, even during frequent rainstorms. This type of flooding occurs when elements of the drainage network are undersized, when they are overwhelmed by increased runoff from new impervious surfaces, or if they are compromised by lack of maintenance by property owners or homeowners associations. Elements of the drainage network include swales, subsurface stormdrains, inlets, pipes, culverts, and basins.

6.5 Flood-Prone Buildings

In many locations throughout the area buildings are subject to flooding, regardless of whether the source of water is ditch or creek flooding or localized ponding and street flooding. The County and cities require that new buildings and certain improvements to existing buildings comply with ordinances that contain the minimum flood-damage resistant provisions outlined by the National Flood Insurance Program.

As part of the Jefferson County Drainage District No. 6 *Hazard Mitigation Plan (2004)*, an estimate was prepared of the number of flood-prone buildings located in the District (Table 6-2). Using Geographic Information System (GIS) capabilities at the County and historical knowledge, it is estimated that about 4,600 residential buildings and nearly 400 non-residential structures are located in the flood-prone areas of the District. Therefore, approximately 10.5% of all buildings in the

District are prone to some degree of flooding. It should be noted that, due to limited GIS capabilities, a more precise identification of flood-prone structures within the FEMA-mapped floodplain is not feasible.

Table 6-2. Flood-Prone Buildings in DD6 (2004)

	Residential	Non-Residential
Total number of buildings	43,895	3,629
Number of est. flood-prone buildings*	4,600	400

*Estimate of flood-prone buildings is derived from actual historical building claims plus an estimate of number of buildings experiencing prior non-insured losses

The most telling evidence of flood-prone buildings is found in the records of the National Flood Insurance Program. Table 6-3 summarizes the program's recent flood insurance policy and claims data for the area. For the most part, two factors prompt people to purchase flood insurance – when mortgage lenders require it because a building is located in a mapped floodplain and when actual flood damage makes it clear that buildings are, indeed, located in flood-prone areas. Thus, the number and distribution of flood insurance policies is one way to characterize flood-prone areas throughout the District.

Table 6-3. NFIP Insurance Policies & Claims in DD6*

	Policies	Claims Paid**
Jefferson County (unincorporated)	1,554	439
Beaumont	6,822	3,232
Bevil Oaks	336	125
Nome	14	4

* As of December 31, 2004, online at <http://www.fema.gov/nfip/pcstat.shtm>

** Many buildings have received multiple claims

Past claims for flood damage can be used to identify areas where buildings are affected by flooding, especially in areas that are not shown



on the NFIP's maps. Figure 6-1 shows the locations of properties identified as having received multiple flood insurance claims: 523 properties have received payments totaling over \$24 million (includes payments for building damage and contents damage). Mitigation projects undertaken by the District in recent years are focused specifically on these repetitive loss structures. When these projects are completed, many of the repetitive loss properties will be protected from future damage associated with the 1%-annual chance flood (100-year).

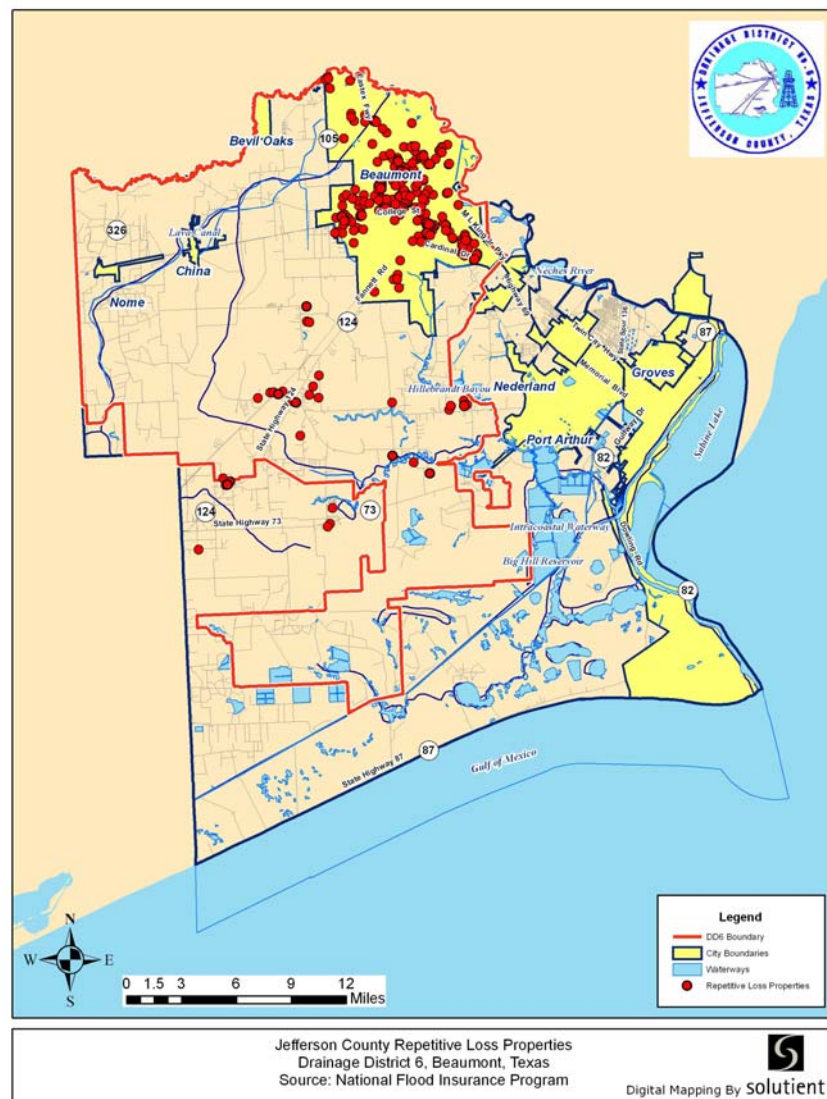


Figure 6-1 Locations of NFIP-Insured Repetitive Loss Properties

7. Factors Influencing Future Problems

A brief overview of the types of flood and drainage conditions is described in Section 6, highlighting that problems may be associated with:

- Flooding when runoff exceeds the capacity of existing ditches and creeks,
- Localized ponding and flooding of streets,
- Exceeding the capacity of existing storm drains, swales, ponds and inlets, and
- Flooding that impacts buildings.

This section briefly describes factors that contribute to those problems and that may exacerbate existing problems or that may lead to future problems. These factors are considered to be the more significant influences, but other factors may come into play in different areas of the District's jurisdiction. The factors described include:

- Pattern of development as indicated by where permits have been issued in the past few years,
- The impact of new development on runoff and flooding,
- New development in areas that are known to experience periodic flooding, and
- The District's program for drainage improvements and on-going maintenance.

7.1 New Development and Runoff

New development that changes the surface of the land alters existing drainage by changing how much water runs off the land and by changing the timing of that runoff. New development increases runoff because impervious areas are increased by the construction of buildings, roads, and parking lots.

Whether increases in runoff due to new development create drainage problems and downstream flooding problems is a function of where in the watershed the development takes place, the capacity of existing ditches



conditions, the planned drainage work, the potential future drainage work, and whether downstream flooding will be made worse. Combinations of these factors will vary from location to location.

To determine how new developments change runoff, drainage reports can be prepared for proposed new subdivisions and large single lot developments. As described in Section 5.1 and 5.2, Beaumont and Jefferson County largely focus on the adequacy of drainage that is interior to a proposed subdivision. Although it is not explicit in their regulations, their interests are to assure that the drainage system provided by a developer will handle frequent rainfall-runoff events, generally the 5-year storm (see Table 6-1).

For DD6, the focus of a review of proposed drainage system designs is two-fold: (1) adequacy of the flow path when the provided drainageways are exceeded so that improved properties are not adversely impacted; and (2) the impact of the additional drainage to the District's overall system and how it impacts downstream flooding. Drainage reports should include:

- Computations of runoff for the site before development,
- Computations of how runoff will change if the site is developed,
- Flow path when the capacity of the proposed drainage system is exceeded,
- Determinations of the adequacy of downstream drainage channels and the impact of the additional runoff,
- Determination of whether, and to what degree, downstream flooding is affected, and
- Preliminary assessment of alternatives to address the increased runoff.

7.2 New Development in Flood Hazard Areas

In both Beaumont and portions of Jefferson County, flooding that impacts homes and businesses occurs with considerable frequency. Figure 7-1

shows the extent of mapped special flood hazard areas as shown on the Flood Insurance Rate Maps prepared by FEMA. The map also shows the locations where flood insurance claims have been paid due to flood damage that occurred outside of those mapped areas

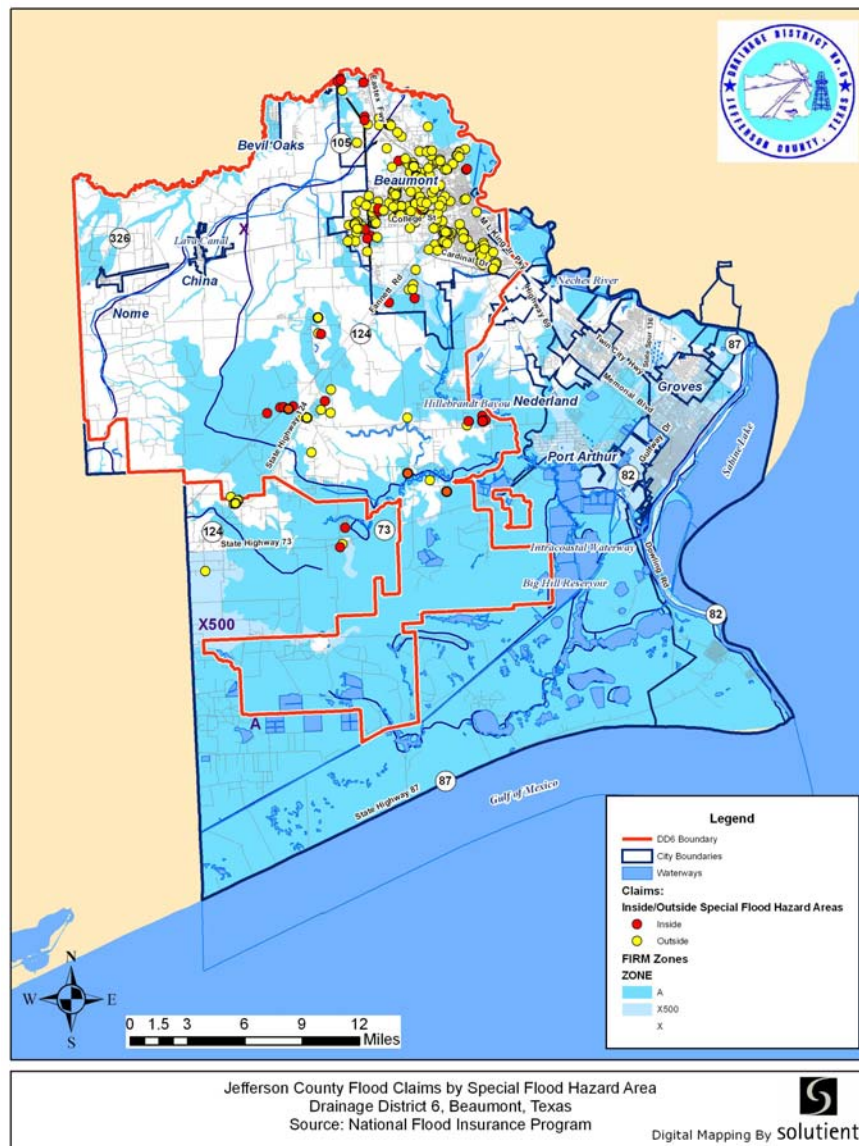


Figure 7-1 NFIP Claims (In and Out of Mapped Flood Hazard Areas)



Development in flood hazard areas that are shown on the FIRMs is regulated by ordinances adopted by the County and the cities. The most notable requirement is that the lowest floor must be elevated above the Base Flood Elevation (which is the elevation of the 1%-annual chance flood, commonly called the “100-year” flood). It is important to emphasize that floodplain management requirements are imposed in areas shown on the FIRMs as special flood hazard areas. Regardless of actual flood experience, areas not mapped as special flood hazard areas are not subject to the minimum flood-damage reduction requirements established by the NFIP, unless a community adopts a specific requirement to that effect.

The requirement that new buildings be elevated above the Base Flood Elevation does not address the impacts of the development on the flow of water during flooding conditions. Earthen fill that is used to elevate buildings reduces available floodwater storage and can alter local drainage pattern. Developments that increase runoff due to added impervious area can contribute to downstream flooding either by making existing flooding worse (deeper and/or more frequent) or by creating flood problems where none existed.

When homes and businesses are damaged by floods, and when traffic circulation is impaired due to street flooding, there is increased demand for DD6 to improve drainage, to manage runoff, to construct flood control projects, and to undertake other flood mitigation projects.

7.3 DD6 Improvements and Maintenance

Jefferson County Drainage District No. 6 has a long history of improving the drainage system and, importantly, a history of maintaining the improved system.

Drainage Improvements. Relieving and reducing known flooding of residential areas is given the highest priority in the District’s capital improvement project planning. Priorities are identified by examining several sources of information, including reports from citizens, questionnaires distributed by the District, location of NFIP flood

insurance claims, and the personal experiences of the DD6 staff and board. When a priority area is identified, the cause of flooding is analyzed and how the drainage in the area relates to a DD6 outfall, lack of an outfall, or the inadequacies of an existing outfall. Some cooperative projects are undertaken with the City of Beaumont and Jefferson County to make improvements where the problems include street flooding, inadequate inlets from the streets, and inadequate outfall pipes.

When new development is proposed, the impact of the increased runoff on downstream flows is considered. If the increased runoff occurs in areas with known flooding and drainage problems, improvements at culverts and bridges, or channel improvements, may provide sufficient capacity to handle the increases.

Examining the cost effectiveness of an improvement is part of the District's process to identify where improvements will be made. Existing watershed and floodplain studies are examined to determine if sufficient information is available to both identify the problem and evaluate alternatives. In general, channel improvements are more economical than detention and, unless there are specific environmental concerns, the channel improvements are undertaken. Some known problem areas require study to ascertain feasible solutions in order to determine costs and benefits. As of the end of 2005, the District's project list includes work that may take 10 years to complete, and the list continues to grow.

Detention Improvements. Detention is a relatively more expensive approach than ditch improvements when addressing downstream flooding problems. The District initially examines other approaches before considering detention, especially in areas where some reaches of the downstream ditch system have sufficient capacity to handle added runoff from anticipated development which suggests that additional ditch improvement may be feasible. If the downstream capacity is inadequate, detention is considered when an appropriate site that is available at reasonable cost also meets the hydrologic requirements for the detention capacity.



The concept of detention is to hold water in a constructed ponding area while, below the pond (or basin), the existing drainage infrastructure moves the water which flows directly to it. The detention basin handles the runoff from the drainage area above it which would otherwise increase the flows through the downstream drainage system. The District carefully balances detention outflows with the downstream channel capacities.

When the intent is to reduce downstream flooding, detention basins are not effective in some locations. For example, because so much of the land area that drains to the Neches River and Pine Island Bayou watersheds is upstream of Jefferson County, a detention basin designed to hold back increased runoff from a development in Jefferson County will not change the peak flows of the large waterways.

Maintenance of the Drainage System. The District recognizes that periodic maintenance of its 1,200 miles of drainage is required in order to maintain its performance. The superintendent and general field supervisor are responsible for scheduling the approximately 50 employees that perform maintenance work on a daily basis. The District also constructs many capital improvement projects. Some maintenance work and some capital work is contracted with the private sector. Most ditches are mowed once each year, although some problem areas are mowed twice each year.

The District's area of jurisdiction is toured and examined routinely by the superintendent and the general field supervisor; other District personnel report concerns noted as they travel the area. Property owners in the area also are a source of information about problem areas; their phone calls and visits are logged and are given significant weight when determining maintenance priorities. When a citizen reports a concern, a DD6 representative is dispatched to assess the area and to evaluate the priority for work. Problems that are deemed more important, such as a major blockage of a culvert or major build-up of debris under a bridge, are addressed as soon as possible, usually within a couple of days. Minor problems are addressed sequentially.

Before and during heavy rain events, most DD6 crews are assigned to specific bridges or culverts to perform what is known as “running drift.” The crews remove debris as it washes downstream or catches at crossing in order to keep ditches open and free-flowing and to minimize blockage which can exacerbate flooding.

8. Meeting the Goals: Actions

With the guidance of the Advisory Committee DD6 has determined that the actions identified in Table 8-1 and described in the following subsections will meet the goal described in Section 2 and set forth in the *Hazard Mitigation Plan (2004)*. Specifically, these actions will “facilitate the development review and approval process to accommodate growth in a practical way that recognizes existing stormwater and floodplain problems while avoiding creating new problems or worsening existing problems.”

Table 8-1. Summary of Actions

A. Develop and Implement Drainage Regulations
B. Identify Watershed Study Needs
C. Coordinate Flood Map Revisions
D. Document Flood Conditions
E. Develop GIS Capabilities
F. Develop Drainage Design Criteria Manual

8.1 Coordinate Regulations & Development Reviews

As authorized in Section 49.211 of the Texas Water Code, a master drainage plan may include rules relating to the planning and design criteria for drainage channels, facilities, and flood control improvements. These regulations will form the basis of DD6’s review and approval of the drainage reports for proposed development that occurs within its jurisdiction in Jefferson County, the City of Beaumont, and the cities of Bevil Oaks, China, and Nome.

ACTION A: Develop and Implement Drainage Regulations. DD6 will develop regulations to implement the authority to review and approve drainage reports for proposed developments. The regulations will be subject to public review prior to adoption and are expected to address:



- The types of developments and construction activities that are subject to the requirements set forth in regulations, as well as those activities that are exempt.
- The District's review process and coordination with the County and cities.
- A requirement for pre-design meetings and encouragement for negotiations with the District to address site-specific, ditch-specific and watershed-specific needs.
- The contents of drainage reports and drainage plans.
- Availability of engineering studies and data; conditions under which new studies or contributions to studies may be required.
- The performance requirements for adequacy of post-development drainage and alternatives that may be considered to address runoff and flooding.
- Standards for drainage and flood hazard reduction to address runoff and flooding, including but not limited to: cooperative projects with DD6; land or other contributions for new DD6 ditches or regional detention facilities; new or increased easements along drainage ditches to be maintained by DD6; design for replacement, upgraded, or new drainage pipes and culverts that carry drainage to DD6 ditches; design for upgraded or new erosion protection at outfalls; and on-site detention of increases in runoff.
- Procedures to enforce rules adopted by the District.

DD6 will develop application forms and a formal approval instrument. To implement the regulations in a manner that meets the stated goal, DD6 will work with Jefferson County and the cities to coordinate development processes and timelines, and to improve regulatory consistency. DD6 may suggest modifications to the regulations and procedures of the County and the cities.

To facilitate compliance and understanding by the development community, DD6 will prepare a review checklist.

8.2 Watershed Studies & Revised Flood Hazard Maps

DD6 has a number of engineering studies and reports that were prepared for portions of some watersheds that are within its jurisdiction (see Section 6.1). The District has determined that some of the information in these available sources may be useful and makes it available to others. However, some information is not of sufficient quality to meet today's standards. In addition, older reports do not reflect subsequent projects and improvements, nor do they cover all areas where development is occurring.

The Flood Insurance Rate Maps prepared by the National Flood Insurance Program delineate special flood hazard areas within which floodplain management regulations apply. As described in Section 6, these maps do not delineate all areas that experience drainage problems and flooding. In recognition of the fact that many FIRMs are out-of-date, the Federal Emergency Management Agency (FEMA), which administers the NFIP, has embarked on a multi-year effort to modernize and revise the maps. As of June 2005, Jefferson County is projected to have the map revision process initiated in Federal Fiscal Year 2006 with completion some time in FFY2008. The initial planning meeting took place in early 2006.

During the map revision cycle FEMA actively encourages partnerships with local entities such as DD6. Local contributions may take a number of forms, such as providing digital base mapping, watershed studies that show current areas subject to flooding by the 1%-annual chance flood, records that demonstrate areas prone to flooding that are not shown on the FIRMs, and funding.

DD6 has collected many records of high water from past flooding events, including flooding in areas not shown on the FIRMs. Some data are recorded in survey field books and some have been noted on maps. The rainfall and stream data collection system for the ALERT flood warning system stores historic data. These are used in a number of ways to support DD6 functions. One notable use is, in areas not shown on FEMA



flood maps, to recommend that buildings be elevated above grade in order to minimize the likelihood of future flood damage.

ACTION B: Identify Watershed Study Needs. DD6 will develop a prioritized list of watersheds and subwatersheds for which new engineering studies are needed in the next 5 to 10 years to help guide the District's consideration of capital projects and the review of development proposals.

ACTION C: Coordinate Flood Map Revisions. DD6 will coordinate the participation and contributions of the County and cities in FEMA's Map Modernization effort to revise and update the Flood Insurance Rate Maps for that portion of Jefferson County that is within its jurisdiction.

ACTION D: Document Flood Conditions. DD6 will continue to survey and collect high water data, especially in areas that are not shown as mapped floodplain on the FIRMs. Data collection tools should be standardized and data should be collected, displayed on a map, and stored so that information can be retrieved readily to support recommendations for development in areas susceptible to flooding and drainage problems.

8.3 Geographic Information System Capabilities

Geographic Information Systems (GIS) is a computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface. Typically, a GIS is used for handling maps and other data that can be displayed spatially. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image on a map and a record in an attribute table. GIS can relate otherwise disparate data on the basis of common geography, revealing hidden patterns, relationships, and trends that are not readily apparent in spreadsheets or statistical packages, often creating new information from existing data resources.

With GIS, spatial elements of data can be displayed, such as flood-prone areas, drainage ditch locations, drainage structure locations, easements, etc. At present, DD6 does a number of manual tasks that could be performed more efficiently and accurately once the base maps and baseline features of the District's system are created in GIS format, including:

- An in-house program is used for the ditch inventory, easement dimensions, maintenance tracking, and preparing reports required for water quality compliance purposes;
- Development of grant applications for mitigation funds, including manually plotting historical claims information and flood hazard information for repetitively-flooded homes; and
- Prepare and use maps of areas for which studies have been undertaken and will be undertaken, including the study of a portion of Hillebrandt Bayou that is underway (as of mid-2005).

Section 8.2 (Action C) calls for DD6 to take a leadership role to coordinate with FEMA for revision of the Flood Insurance Rate Maps for the area. Because FEMA's initiative is entirely GIS-based, the District will be better prepared to fulfill this action with in-house GIS capabilities.

ACTION E: Develop GIS Capabilities. DD6 will develop GIS capabilities. This action will include the purchase of GIS software, the development of various layers of data, and staff training. Data relevant to the following are expected to be developed or converted: ditch inventory (dimensions, easements, etc.); drainage structure inventory (type, size, capacity, etc.); statistics on homes in flood-damage areas (addresses, building characteristics, property values, etc.); historical flood losses (flood insurance claims and uninsured losses); prior flood depths, and others.

8.4 Prepare a Drainage Design Criteria Manual

With the adoption of regulations for drainage reports and DD6's review of development proposals, it will be helpful for the development



community to have a manual that outlines the appropriate design criteria. The manual will address drainage and flooding conditions experienced in the area, including ditch and creek flooding, localized ponding and street flooding, storm drainage, and development in flood-prone areas.

ACTION F: Develop Drainage Design Criteria Manual. DD6 will develop a Drainage Design Criteria Manual. The manual will be based on manuals from other jurisdictions but tailored to the conditions of the area and DD6. The manual is expected to include design methods and criteria that are specific to DD6 and that have been successfully applied in the region. The manual will be subject to public review and comment.

8.5 Capital Projects: Drainage & Flood Mitigation

DD6 implements its authority to manage drainage in order to protect lives and property from the adverse effects of uncontrolled drainage and flooding. The District was created primarily to provide drainage of overflow lands, including the construction and maintenance of drains, ditches and levees, and other improvements of the District.

ACTION G: Drainage & Flood Mitigation Projects. DD6 will continue to identify effective drainage improvement projects and flood mitigation measures, and continue to pursue state and federal grant funding for those projects that are eligible and cost-effective.

Appendix A. Key Concepts in Stormwater and Floodplain Management

When property owners are affected by water, it usually is not important to them whether the water is considered “stormwater” or “floodwater.” Although the problems are both related to water, the approaches taken to deal with the problems are different. To understand those differences, a few key concepts are important.

What is a Watershed?

A watershed is the area of land that drains runoff to a point on a waterway, sometimes it is called the drainage basin. Figure A-1 shows a simple watershed. The size and shape of a watershed depends on the shape of the land. Every river, creek, stream and ditch has a watershed. Many small watersheds, or subwatersheds, combine to make large watersheds. The Mississippi River watershed covers almost 1.25 million square miles.

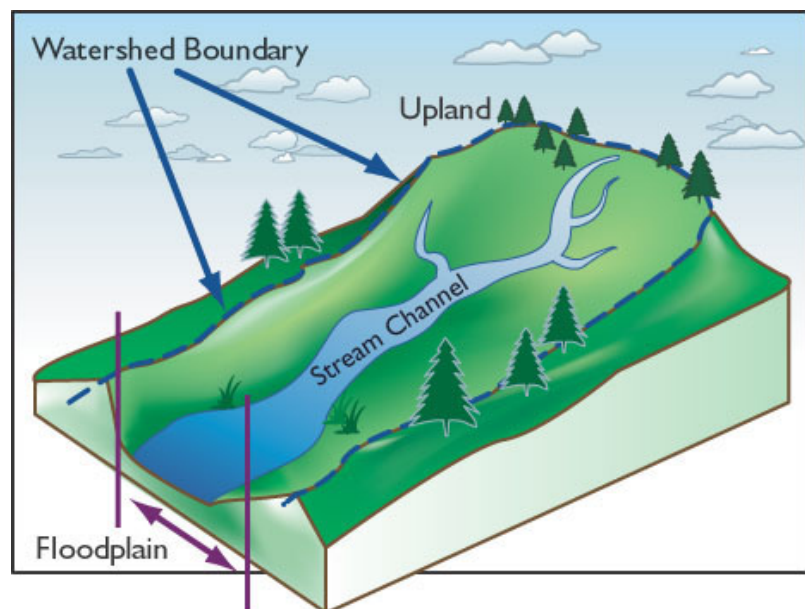


Figure A-1. Simple watershed

What is Hydrology?

Hydrology is the study of water and how it moves through the hydrologic cycle (Figure A-2). Hydrology involves understanding what influences the distribution and circulation of water, including surface water (runoff) and groundwater. When it rains, many things affect how much water runs off the land and how quickly it collects in streams and drainage channels.

How people use the land is a significant factor in runoff. Figure A-3 shows how “discharge” or the volume of water running off the land, changes with time for different amounts of development.



Heavily developed areas, with large areas covered by buildings, parking lots, and roads, have the most runoff which usually collects very quickly because of drainage ditches. Forested areas absorb a lot of rainfall and so less water collects in the rivers and streams. Detailed engineering studies are done to understand the runoff from each watershed and to estimate how much water will collect during different types of rain storms.

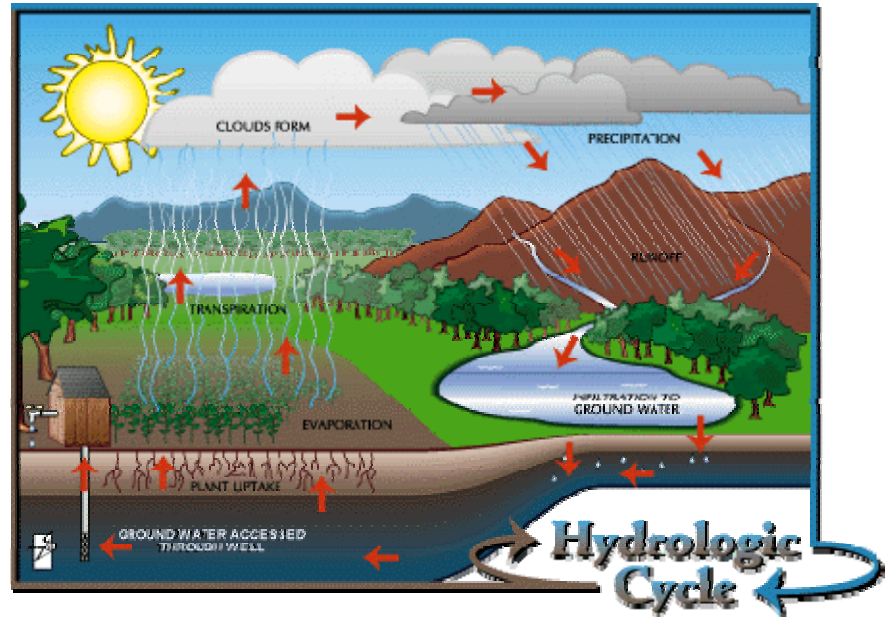


Figure A-2. Hydrologic cycle

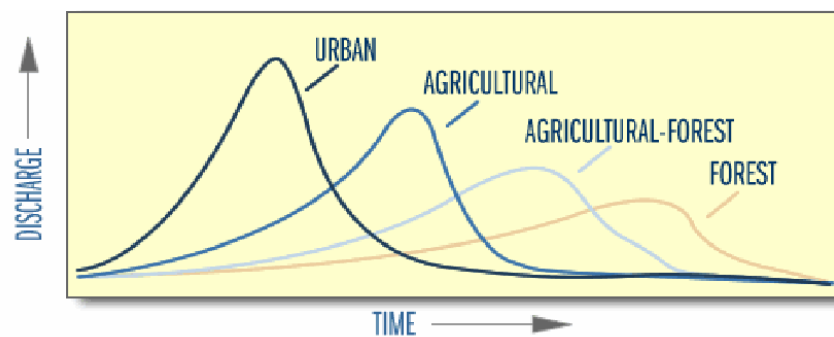


Figure A-3. How land use changes discharge (runoff)

What is Hydraulics?

Hydraulics is the study of how the water that runs off the land flows through the river, stream or ditch. Engineering studies are done to understand how fast the water will flow and how high it will rise. Many factors come into play, including the flatness of the landscape, the shape of the stream valleys, whether there are bridges and culverts that block flow, the size and shape of drainage channels, and others. A common product of these studies is a floodplain map, shown below.

What is Stormwater Management?

Rainfall runs off of all land. But when land is developed with buildings and pavement, more water runs off than before it was developed. Stormwater management refers to measures that control – or manage – the increases in runoff. Usually developers are required to estimate how much more water will runoff during different storms or different amounts of rainfall. The amount of rainfall for different storms is determined by long-term studies by the U.S. Geological Survey and the Natural Resources Conservation Service.

For southeast Texas, studies indicate that:

- The 2-year, 24-hours storm (that has a 50% chance of occurring in any year) will drop 5.5 inches of rain
- The 10-year storm, 24-hour storm, will drop 8.8 inches of rain
- The 100-year storm, 24-hour storm, will drop 13.0 inches of rain

When stormwater management is required for a proposed development project, engineers first estimate how much water will run off of the project site assuming no development occurs. Then the changes to the land are taken into consideration and new estimates are made. The difference between the two estimates is the amount of increased runoff that the developer must manage.

Increases in stormwater runoff can increase downstream flooding and cause more erosion of streams and drainageways. This is why developers are required to account for the increases that their projects create. Management options include building small ponds as part of the development to capture the increased runoff. Sometimes drainage channels can be improved or enlarged to handle the additional water. And sometimes a “regional” approach is found to be best. In a regional approach, a larger pond or detention facility is built and developers contribute funding or land.

In Jefferson DD6, the Dishman Road Soccer Field (Detention Basin B) is a regional detention pond. It is designed to capture and manage increased runoff due to upstream development. It is not designed to prevent all downstream flooding.



What is Floodplain Management?

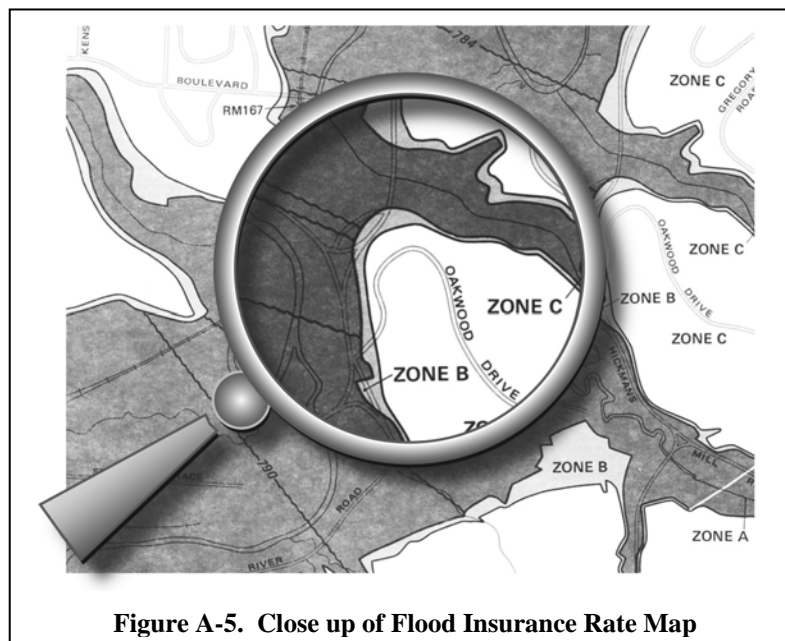
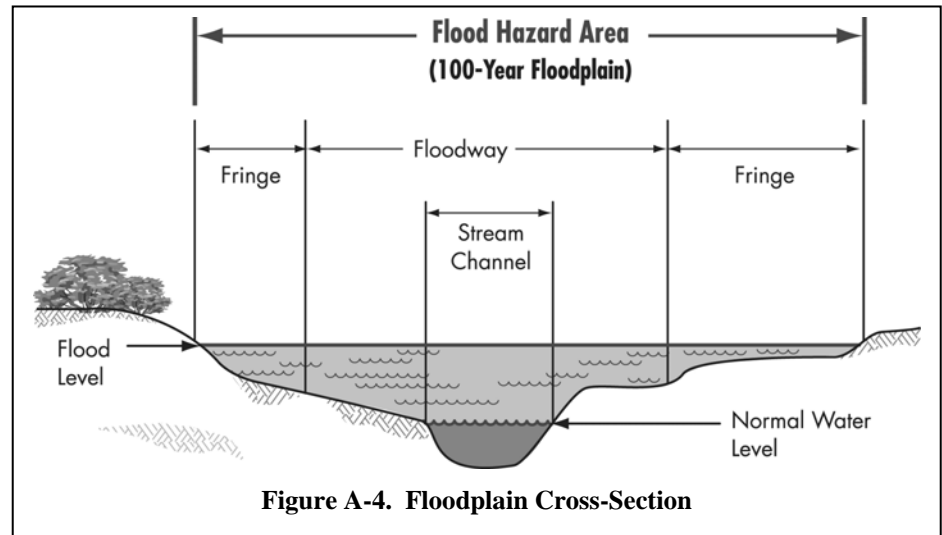
Floodplain management is an overall program of corrective and preventive measures taken to reduce flood damage. Such measures generally are of two types:

- Preventive measures include managing areas that are prone to flooding to guide development away from problem areas or to require construction in ways that reduce damage; and
- Corrective measures such as flood control projects to help reduce flooding of areas that are already developed.

The basis for floodplain management is a map that shows areas that are predicted to flood during what is commonly called the “100-year flood.” A more precise term is the “1% annual chance flood.” It is the flood that has only 1 chance in 100 of occurring in any given year. While that may seem like a low probability, it has been shown that a home in the 100-year floodplain is 5 times more likely to be damaged by a flood than to sustain damage from a major fire.

Jefferson County, the City of Beaumont and the other incorporated towns in the County all have adopted floodplain management regulations and participate in the National Flood Insurance Program. By administering those regulations they help protect people and property, while also making federal flood insurance available to all citizens. The County, Beaumont and the other incorporated towns all have flood maps that were prepared by the National Flood Insurance Program. Many of those map panels do not show all areas that are known to be prone to flooding. In addition, because many of the map panels are more than 20 years old they do not take into account increases in runoff due to more recent land development. FEMA's published schedule for revising and modernizing the maps anticipates that new maps for Jefferson County and its incorporated municipalities will be completed in 2008.

Figure A-4 shows a cross-section across a natural floodplain, where the water is deepest in the channel and gets shallower toward the edge as the land rises up from the stream. (Drainage channels that are built and maintained generally are intended to confine within the channel the waters of most flow conditions, often up to and including the 1% annual chance flood.) Figure A-5 is a sample of what a flood map looks like. It shows many streets, roads and streams, and the area shaded gray is the mapped flood hazard area. Development in the shaded gray areas must comply with the floodplain management regulations.



Appendix B

Public Involvement Materials

Publishers Affidavit

Acct #051972001 Job #154695701
Name JEFFERSON CO. DRAINAGE #6

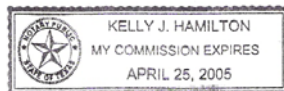
Tear Sheet Attached
4098421818 B23978957

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY PERSONALLY APPEAR
WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE/SHE IS THE CLERK
OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER REGULARLY PUBLISHED
CIRCULATED IN JEFFERSON, HARDIN, TYLER, NEWTON, ORANGE, JASPER, LEE,
SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY(COUNTIES), TEXAS; THAT
IN SAID NEWSPAPER ON THE FOLLOWING DATE(S), TO WIT:

11-14-04 11-21-04

SWORN AND SUBSCRIBED TO BEFORE ME, THIS 22ND DAY OF NOVEMBER 2004,
TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.



Kelly J. Hamilton
NOTARY PUBLIC IN AND FOR
THE STATE OF TEXAS

Kelly J. Hamilton
PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES 4-25-05

PUBLIC MEETING ON
JEFFERSON COUNTY
DRAINAGE DISTRICT NO.
6 MASTER DRAINAGE
PLAN AND
HILLEBRANDT
BAYOU WATERSHED
ENGINEERING STUDY

A public meeting will be held November 23, 2004, at 6 p.m. to present an overview of the on-going Master Drainage Plan development process and an overview of the Engineering Study. The meeting will be held at Jefferson County Drainage District No. 6 offices located at 6550 Walden Road. The plan development and study will lead to the following:

- * Improved control of drainage and runoff that contributes to flooding; and
- * Identified cost effective ways to reduce or eliminate future flooding in Hillebrandt Bayou.

Attendees will be asked to comment on the above. Comments will be received until December 15, 2004.

When the documents are ready, they will be available for public review; and another public meeting will be scheduled before then to present recommendations and to request comments from interested citizens. The final Master Drainage Plan and the final Engineering Study report will be presented to the District's Board of Directors when complete.

Questions regarding the above should be directed to Betty Holman at (409)842-1818 or Jeffrey S. Ward at (540)668-6945.

Betty S. Holman
Asst. General Manager-Adm

TATIVE

COUNTY

AMBERS,

OTICE



Publishers Affidavit

Acct #051972001 Job =168231401
Name JEFFERSON CO. DRAINAGE #6

Tear Sheet Attached
4098421818 B24077957

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY PERSONALLY APPEARED N
WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE SHE IS THE CLASSIFIED R
OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER REGULARLY PUBLISHED IN JEFF
CIRCULATED IN JEFFERSON, HARDIN, TYLER, NEWTON, ORANGE, JASPER, LIBERTY, SAB
SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY(COUNTIES), TEXAS; THAT THE ATTAC
IN SAID NEWSPAPER ON THE FOLLOWING DATE(S), TO WIT:

10 31 06 11-12-06

SWORN AND SUBSCRIBED TO BEFORE ME, THIS 13TH DAY OF NOVEMBER 2006
TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.

NOTARY PUBLIC IN AND FOR
THE STATE OF TEXAS

Lynda Jo Casteel
PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES 2008 April 13

PUBLIC MEETING
on the
Jefferson County Drainage
District No. 6 Master
Drainage Plan and
Hillebrandt Bayou Water-
shed Engineering Study

A public meeting will be held November 15, 2006, at 6 p.m. to present the final draft of the Master Drainage Plan, to introduce concepts under consideration for stormwater regulations, and to provide status on the Engineering Study. The meeting will be held at Jefferson County Drainage District No. 6 offices located at 6550 Walden Road, Beaumont, Texas. The plan and study will lead to the following:

- Regulations to address stormwater runoff from new developments;
- Improved control of drainage and runoff that contribute to flooding; and
- Identified cost-effective ways to reduce or eliminate future flooding in Hillebrandt Bayou Watershed.

The final draft of the Master Drainage Plan is available for public review at the following locations:

DD6 offices at 6550 Walden Road
City of Beaumont, City Hall, Room 205
Jefferson County Engineering Office, 5th Floor

Attendees will be asked to comment on the above. Comments will be received until November 30, 2006.

The final Master Drainage Plan and the final Engineering Study report will be presented to the District's Board of Directors when complete.

Questions regarding the above should be directed to Betty Holman at (409)842-1818 or Jeffrey S. Ward at (540)668-6945 or by e-mail

ward@crstarmail.com.

L. Betty Holman
Not. Asst. Gen. Mgr. - Adm.

April 13, 2008



Appendix C. Notes on Drainage Requirements – Subdivision Rules & Ordinances

C-1. Jefferson County

RULES, REGULATIONS AND REQUIREMENTS RELATING TO THE APPROVAL AND ACCEPTANCE OF IMPROVEMENTS IN SUBDIVISIONS OR RE-SUBDIVISIONS. Revised March 28, 1994

Article 1(b): Approval and acceptance of streets, roads, storm sewers, drainage ditches and drainage easements, fresh water supply and sanitary sewage disposal and setback lines of a subdivision or re-subdivision is contingent upon compliance.

Article 1(b): Compliance is required in the extraterritorial jurisdiction of any incorporated city, town or village; in the case of conflict, the regulations of the city, town or village shall prevail. The width of the ETJ varies as a function of the population of the municipality.

Article 1(k): Developer required to submit elevations of each lot.

Article 1(n): Developer required to obtain approval of drainage plan from applicable Drainage District and shall submit approval with plat, said plan must comply with the Jefferson County Floodplain Order.

Article 1(q): Requires compliance with State requirements for on-site sewage facilities; planning materials that must be submitted include the “100-year floodplain map.” As part of this requirement, states that “A comprehensive drainage and 100-year floodplain impact plan must also be included in this planning material.

Article 3.0, Section A(9) notes that drainage improvements are to meet minimum standards to be accepted by the County for maintenance, including “ditches must have a discharge factor of 1.3 cfs per acre and may not have substantial ponding.”

Article 3.0, Section D, outlines requirements for subdivision layout, including drainage easements which “shall be dedicated as required by Jefferson County Drainage Districts, or the County Engineer if the subdivision is outside a Drainage District, for major drainage channels and ditches, and of sufficient width to provide for maintenance and ample room for spoil banks and berm, if spoil is left in place after excavation. In addition, 40 feet, 20 feet on each side of centerline of drainage way, shall be dedicated for all minor drainage ways.”



Article 3.0, Section G, outlines requirements for storm drainage, including:

- For areas inside the subdivision a discharge factor of 1.3 cfs per acre shall be used.
- For discharge originating outside the subdivision, a discharge factor of 1.3 cfs per acre, or such factor of runoff as may be determined by study of the drainage area shall be used, discharge factor must be approved by Drainage District.
- Storm sewers shall be designed to carry the discharges from factors listed above, but must have a design velocity of not less than 3.0 feet per second.
- Outfalls from sewers and ditches into drainage ways or natural navigable waterways shall enter at the grade of the drainage channel. If necessary, rip-rap and/or drop type outfall structures shall be used to prevent erosion.

C-2. City of Beaumont

SUBDIVISION ORDINANCE (Ordinance No. 83-95; Chapter 24, September, 1983, as amended).

Sec. 24-2. Applies to the planning and recording of subdivisions and additions to subdivisions within the corporate limits of the City and within five (5) miles (the ExtraTerritorial Jurisdictional area).

Sec. 24-3. Purpose. Provides for, among other things, open space and, drainage. Among the goals is “to secure safety from fire, flood, and other danger”; “to assure the adequacy of drainage facilities”; “to encourage the wise use and management of natural resources”; and “to ensure that street, utilities, and drainage improvements needed by the subdivision are actually installed.”

Sec. 24-5. The regulations are to supplement and facilitate enforcement of provisions in “the building and housing codes, Zoning Ordinance, Comprehensive Plan, Official Street and Highway Plan and other official plans of the City.” Given the magnitude of flood hazard areas, explicit inclusion of the Flood Damage Prevention Ordinance would be reasonable.

Sec. 24-7. Pre-application conference. In the final sentence, include “floodplain management regulations” among the list of things that are required to be shown in sufficient detail to allow for review of the proposed development for general compliance.

Sec. 24-8. Preliminary plat.

- (a)(10): refers to submission of design computations [no specific standards, City Engineer refers to TXDOT].
- (a)(11): topography is not generally required.
- (b): Establishes timeline for action by the Planning Commission, which must act “upon an application completed in accordance with the requirements of this ordinance” within 30 days. The Commission’s approval constitutes conditional approval of the final plat, subject to the approval by the City Engineer. [City does not formally notify the applicant when the application is complete, but “starts the clock” when the plat is received.]
- (d)(1): before construction begins, final construction plans must be submitted, including features related to drainage, which are subject to acceptance by the City Engineer. Reference is made to the “official standard requirements of the City” which are conveyed as comments.

Sec. 24-9. Final plat.

- By requiring that the “final plat must comply in all respects with the approved preliminary plat” drainage should be shown.
- (a)(8): Permanent survey reference monuments are to be shown. [If the City maintains a database that is accessible to surveyors and engineers, could qualify for CRS]
- (a)(13): Final plat must show flood zones, boundaries and elevations. [For disclosure to future buyers, most effective if the information shown also includes the date of the map and reference to the City’s floodplain regulations.]

Sec. 24-11. Acceptance of Dedication Offers. Applies to utilities, not drainage easements.

Sec. 24-12. General Design Principles.

- (b) Physical conditions. Provides that land found by the Planning Commission to be unsuitable for subdivision shall not be subdivided or developed unless adequate methods to solve the problems are formulated by the developer and approved by the



Commission. Among possible conditions of unsuitability are flooding and improper drainage.

- (c): only very general design requirements related to drainage are listed, including the “logical extension of abutting and proposed utilities and drainage easements and improvements in order to provide for system continuity and to promote future development of adjacent areas.”

Sec. 24-13. Streets. In (c), (d), (e) and (f), provision is made for the City to assume some costs associated with “larger storm sewer pipes than adequate for a particular subdivision” are required.

Sec. 24-16. Easements.

- (b): “Minimum drainage easements shall be required when a subdivision is traversed by a watercourse, drainage channel, stream or underground conduits. Minimum easements shall be adequate to provide for the drainage requirements as determined by the City Engineer or any local drainage districts.” [This is key link to DD6.]

Sec. 24-18. Lots. Despite purposes in Sec. 24-3, there are no explicit lot layout requirements related to natural areas (e.g., avoidance first, minimization of impacts, setbacks, etc.).

Sec. 24-23. Drainage and storm sewers. Requires the subdivider to provide for stormwater easements and improvements in accordance with plans approved by the City Engineer.

Sec. 24-30. Variances, exceptions and appeals.

- (b)(1): subdivisions that qualify do not get reviewed for adequacy of drainage, streets, etc.
- (b)(2): Exemptions from preliminary plat requirements allowed if final plats are accompanied by written evidence that all drainage and utility easements and improvements are satisfactory.