

**CITY OF ANGLETON**  
**MASTER DRAINAGE PLAN**  
**PHASE I EVALUATION & PRELIMINARY REPORT**

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**1.0 Summary**

This report presents the findings and recommendations of an evaluation of the City of Angleton storm water drainage system and existing flooding problems. This evaluation was undertaken to provide the City of Angleton with a professional opinion regarding the appropriateness and adequacy of the City's storm water drainage system.

Review of the City's existing storm water drainage policies indicates that adequate drainage policy has been undertaken and pursued by the City of Angleton. The existing storm water detention policy, which requires onsite detention facilities so that downstream flows are not increased as a result of property development, is considered useful and effective. The recently enhanced maintenance of City storm water drainage facilities indicates the City is pursuing proactive policies to improve storm water drainage.

Review of documentation for storm water drainage improvement projects within the past 10 years indicates there has been steady, ongoing activity relating to analysis, planning, design, and construction of storm water drainage improvements within Angleton by the City, the Angleton Drainage District and TxDOT.

Consultation with local drainage professionals with the City of Angleton, the Angleton Drainage District, Brazoria County Engineer's office, TxDOT and local engineering consultants indicate that competent professionals are engaged in the evaluation of drainage and flooding problems in Angleton and in the planning, design and construction of storm water drainage improvements.

Based on preliminary evaluation of the City's existing storm water drainage system, replacement of

drainage structures by the City of Angleton and channel improvements by the Angleton Drainage District along Brushy Bayou may be effective in reducing 100-year flood levels along Brushy Bayou. These improvements should be further investigated in Phase II of the Master Drainage Plan. Channel improvements by the Angleton Drainage District to the Ditch A, Ditch 1 and Ditch 7 systems also appear to be effective in reducing 100-year flood levels within Angleton and should be further investigated in Phase II of the Master Drainage Plan.

It is believed that house flooding in Angleton can be significantly reduced by improving the system of minor drainage ditches which are owned and maintained by the City of Angleton. The efficacy of improvements to the minor drainage ditches should be investigated in further detail in Phase II of the Master Drainage Plan.

The City of Angleton and the Angleton Drainage District have several regional storm water detention facilities under investigation. These regional detention facilities will improve storm water drainage by reducing downstream flows and should continue to be pursued.

Based on the findings contained herein of our evaluation of the City of Angleton storm water drainage system and flooding problems, the following recommendations are made:

- Continue to allow development within Angleton in accordance with the current City requirement for onsite storm water detention facilities.
- Continue to pursue implementation of regional storm water detention facilities by the City and by the Angleton Drainage District.
- Continue the recently enhanced regular maintenance of the City's storm water drainage facilities.
- Continue to work with FEMA to insure certification of the Angleton Protection Levee.
- Undertake Phase II of the Angleton Master Drainage Plan to provide the City with adequate

preliminary engineering of needed storm water drainage improvements to alleviate existing house flooding in Angleton.

## **2.0 Purpose & Scope**

The purpose of this evaluation of the City of Angleton storm water drainage system is to provide the City with a professional opinion of the appropriateness and adequacy of the City's existing storm water drainage system. The evaluation includes a review of recent projects undertaken by the City and other pertinent entities (Angleton Drainage District, TxDOT, FEMA) responsible for storm water drainage within Angleton. This evaluation is the first phase of a two phase project to provide the City of Angleton with a Master Drainage Plan which will identify specific projects which should be undertaken to improve storm water drainage within the City.

This scope-of-work of this evaluation, as approved by the City of Angleton under Stokes & Associates, Inc. Work Order No. 750-0727 is as follows:

1. Meet with City Manager and Staff to review storm water drainage problems in Angleton.  
The meeting will include site inspections of recently flooded areas and currently contemplated drainage improvements.
2. Obtain and review existing documentation relating to flooding conditions and storm water drainage within Angleton including: 1) the Brazoria County Master Drainage Plan, 2) the FEMA Flood Insurance Study (the currently effective FIS as well as available information on the FIS Update expected to be released in 2008), 3) planning studies and reports for storm drainage facilities (ditches, detention ponds, levees, new culverts/bridges, etc.) and 4) City Ordinances and other City requirements relating to drainage and floodplain management.
3. Consult with local drainage professionals (Angleton Drainage District No. 1, Brazoria

County Engineer, local engineering consultants, TxDOT, etc.) who are familiar with drainage and flooding issues in Angleton and Brazoria County to obtain their general opinions regarding these issues.

4. Evaluate options for obtaining new aerial topographic mapping of the City and its Extra-Territorial Jurisdiction (ETJ) area for use in planning and preliminary design of storm water drainage improvements under Phase 2 of this proposal. This evaluation will include consideration of the aerial mapping being developed by FEMA (2-foot elevation contours using LIDAR technology) as well as conventional aerial photogrammetric mapping options.
5. Using preliminary design data in existing planning studies, evaluate the hydraulic adequacy of existing major drainage facilities and determine the feasibility of improving existing City drainage facilities to mitigate flooding problems.
6. Develop a scope of services for Phase 2 of this project - the development of a Master Drainage Plan for the City of Angleton. The Master Drainage Plan will incorporate existing available data as determined from documents reviewed under Task 2 above.
7. Provide a written report of the findings and recommendations of the Phase I services including our professional opinion of the appropriateness and adequacy of the City's storm drainage system.

### 3.0 Review of Existing Documentation

In order to assess activity associated with storm water drainage and flooding issues within Angleton, the following documents were obtained and reviewed:

- City of Angleton Subdivision Ordinance (Centurion Consulting Group, 1994)
- City of Angleton Comprehensive Plan Update (City of Angleton, 2003)
- Angleton Drainage District and City of Angleton Ditch Maintenance Inventory Map (Baker & Lawson, Inc., 2007)
- Angleton Drainage District Rules, Regulations, Guidelines and Flood Protection Plan (Angleton Drainage District, 2004)
- Brazoria County Master Drainage Plan Report (Klotz Associates, Inc., 2002)
- Brazoria County Drainage Criteria Manual (Klotz Associates, Inc., 2003)
- Flood Insurance Study of Brazoria County, Texas and Incorporated Areas (FEMA, 1989)
- Preliminary Drainage Mitigation Analysis for Phase 1 Costa Clemente Development (Lentz Engineers, L.C., 2007)
- Report to the Angleton Drainage District – The Angleton Protection Levee (Baker & Lawson, Inc., 2006)
- Drainage Impact Analysis for SH 35 (TxDOT, 2006)
- Shanks Road Preliminary Engineering Report (Baker & Lawson, Inc., 2005)
- Recommendations for Mitigating the Impacts of Development in the Ditch 9 Watershed (Baker & Lawson, Inc., 2003)
- Master Planning Study – Ditch 7, Ditch 10 and Ditch 21 (Baker & Lawson, Inc., 2000)
- Hydrologic and Hydraulic Analysis of Galaznik Road Street Improvements (Baker & Lawson, Inc., 2000)

- Hydrologic and Hydraulic Analysis of the Ditch 7 Watershed (Baker & Lawson, Inc., 1998)
- Drainage Impact Analysis for Buchta Road and Hospital Drive (Baker & Lawson, Inc., 1998)
- Drainage Impact Analysis for Wilkins Street (Baker & Lawson, Inc., 1997)

Review of the above existing documentation indicates that adequate drainage policy has been undertaken and pursued by the City of Angleton. The City's existing storm water detention policy, whereby proposed development projects are required to provide onsite detention to limit post-development flows to no greater than pre-development conditions, is particularly suitable for Angleton considering existing flooding problems within Angleton. This policy is widely used by municipalities with flooding problems and is usually accepted by the development community since it lessens the developer's liability should future downstream flooding occur. The City has also demonstrated a proactive policy relating to maintenance of its storm water drainage system by the recent addition of two City employees who are assigned to maintenance of the storm water drainage system.

The documentation review also indicates there has been steady, ongoing activity relating to analysis, planning, design and construction of storm water drainage improvements within Angleton by the City, the Angleton Drainage District and TxDOT.

The City maintains a database of house flooding problems which shows a total of 79 homes being flooded during the November 16-17, 2006 and the May 28, 2007 storms. The attached Exhibit 1 shows the locations of these house flooding problems.

Although not available for review, the updated FEMA Flood Insurance Study for Brazoria County and Incorporated Areas (including the City of Angleton) is scheduled for release in 2008 and represents effort by FEMA to provide updated flood hazard data for use by the City. The updated FEMA data is limited to floodplain mapping only using the LIDAR topography and will not include updated hydrology or hydraulics. Based on comparison of flows and flood elevations in the Brazoria County Master Drainage Plan, there are significant differences between FEMA hydrology/hydraulics and updated hydrology/hydraulics.

FEMA has shown a willingness to work with the City, County and the Angleton Drainage District to have the Angleton Protection Levee certified as a flood protection levee which protects Angleton from 100-year overflow flooding by the Brazos River. This has very important implications for the 100-year floodplain in Angleton. The City, County and Angleton Drainage District are currently undertaking necessary roadway crossing improvements at the levee to insure that the levee will be certified by FEMA as a flood protection levee.

#### **4.0 Consultation with Local Drainage Professionals**

Local drainage professionals were consulted to obtain their general opinions regarding storm water drainage issues affecting Angleton. Meetings and discussions were held with representatives of the following organizations:

- City of Angleton
- Angleton Drainage District
- Brazoria County Engineer's Office
- Texas Department of Transportation

- Baker & Lawson, Inc. consulting engineers
- Klotz Associates, Inc. consulting engineers

The meetings and discussions with the local drainage professionals indicate that competent professionals are engaged in the evaluation of drainage and flooding problems in Angleton and in the planning, design and construction of storm water drainage improvements. These local drainage professionals exhibited a knowledge and understanding of standard engineering considerations, methods and procedures associated with storm water drainage issues such as the necessity of adequate major outfall drainage ditches, the use of storm water detention facilities, identification of inadequate components of the storm water drainage system, analysis of flood hazards using up-to-date engineering methods and the importance of adequate maintenance of storm water drainage facilities. Most of the existing documentation reviewed under Section 3.0 of this report was prepared by the local drainage professionals.

## **5.0 Options for Obtaining New Aerial Photography**

New aerial topographic mapping of Angleton and its immediate surrounding area is required to perform adequate planning and preliminary engineering design of Phase II of the City's Master Drainage Plan. The LIDAR mapping being developed by FEMA (with a 2-foot contour interval) will provide much improved topographic mapping and is expected to be available in 2008. Due to the relatively low ground slopes prevalent in coastal areas such as Angleton, more accurate topographic mapping with a 1-foot contour interval is desirable for planning and preliminary engineering design of storm water drainage facilities. Based on discussions with aerial mapping companies, the cost of new 1-foot contour interval topographic mapping of Angleton and its immediate surrounding area will be approximately \$90,000.

## 6.0 Preliminary Evaluation of Existing Storm Water Drainage System

Using existing available data, a preliminary evaluation of the City's existing storm water drainage system was conducted. The existing FEMA flood profiles for Bastrop Bayou, Bastrop Bayou East Tributary and Brushy Bayou were examined to ascertain if there is significant head loss at any roadway crossing structure which could be reduced by structure replacement. Two structures on Brushy Bayou were identified as candidates for replacement and further investigation in Phase II of the Master Drainage Plan:

- County Road 443 (Hospital Road) where the FEMA 100-year head loss is approximately 1.2 feet
- County Road 428 (Buchta Road) where the FEMA 100-year head loss is approximately 1.5 feet – this structure was recommended for enlargement in 1998 and was subsequently replaced by the City of Angleton

Brushy Bayou drains the northern portion of Angleton. The FEMA 100-year flood elevations of Brushy Bayou vary from approximately 23.5 feet at the Union Pacific Railroad crossing at the east corporate limits of Angleton to approximately 31.7 feet at the County Road 341 (Henderson Road) crossing near the west corporate limits of Angleton. The 8.2 feet difference in 100-year flood elevation over a stream distance of approximately 3.4 miles indicates that this reach of Brushy Bayou may be a candidate for channel improvements which would lower the 100-year flood elevations along Brushy Bayou. Channel improvements of Brushy Bayou would be undertaken by the Angleton Drainage District and should be further investigated in Phase II of the Master Drainage Plan.

The south portion of Angleton is drained by Ditch A, Ditch 1 and Ditch 7, all of which drain into Bastrop Bayou near FEMA river mile 15. The FEMA 100-year flood elevation of Bastrop Bayou near river mile 15 is approximately elevation 9.0 feet. There appears little to be gained by channel improvements to

Bastrop Bayou. However, channel improvements to Ditch A, Ditch 1 and Ditch 7 may achieve significant reductions in 100-year flood elevations within Angleton since the ground elevations in south Angleton are as high as approximately 25 feet. Channel improvements of Ditch A, Ditch 1 and Ditch 7 would be undertaken by the Angleton Drainage District and should be further investigated in Phase II of the Master Drainage Plan.

The southwest portion of Angleton is drained by Bastrop Bayou East Tributary which drains into Bastrop Bayou near FEMA river mile 21.5. The FEMA 100-year flood elevation of Bastrop Bayou near river mile 21.5 is approximately 17.8 feet. The FEMA 100-year flood elevation of Bastrop Bayou East Tributary at the Union Pacific Railroad crossing is 24.1 feet. The 6.3 feet difference in 100-year flood elevations over a stream distance of approximately 4.7 miles indicates there is probably little to be gained by channel improvements to Bastrop Bayou East Tributary.

The consensus opinion of the local drainage professionals is that house flooding in Angleton can be significantly reduced by improvements to the system of minor drainage ditches which are owned and maintained by the City of Angleton (as opposed to the major drainage ditches owned and maintained by the Angleton Drainage District). The efficacy of improvements to the minor drainage ditches should be further investigated in Phase II of the Master Drainage Plan.

The City of Angleton and the Angleton Drainage District have several regional storm water detention facilities under investigation. These regional detention facilities will improve storm water drainage by reducing downstream flows and should continue to be pursued. The regional detention ponds under construction at Peach Street and Anchor Road should be completed and put in service as soon as possible. Other projects currently being considered such as the Freedom Park detention pond and the Rancho Ditch relief culverts should be undertaken as soon as possible.

## **7.0 Scope-of-Work for Phase II of Master Drainage Plan**

The following tentative scope-of-work is recommended for the Phase II – Master Drainage Plan for the City of Angleton:

- Prepare technical specifications for new 1-foot contour aerial topographic mapping of Angleton and its immediate surrounding area. Obtain and evaluate proposals for the work from qualified aerial mapping specialists. Award contract to allow aerial photography during winter months.
- Conduct necessary field surveys to support development of the new aerial topographic mapping and to provide elevation data for existing drainage structures (to be used in development of hydraulic computer models).
- Using new aerial topographic mapping, delineate drainage areas and prepare hydrologic computer models for computation of 2, 5, 10, 25, 50 and 100-year flood flows for existing conditions and for fully developed watershed conditions.
- Using new aerial topographic mapping and results of hydrologic computer models, prepare hydraulic computer models for computation of 2, 5, 10, 25, 50 and 100-year flood profiles of major and minor drainage facilities for existing conditions and for fully developed watershed conditions.

- Based on results of the hydraulic models and known historic house flooding problems, perform preliminary engineering for storm water drainage improvements to alleviate existing house flooding problems. Develop preliminary cost estimates of storm water drainage improvements.
- Identify and develop alternative solutions (with cost estimates) for existing house flooding problems. Alternatives generally include storm water detention, property purchase and floodproofing. Recommend the preferred option for each house flooding problem.
- Identify storm water drainage improvements needed to accommodate future development. This will generally be based on the use of onsite storm water detention facilities in accordance with the City's current policy or the implementation of a regional storm water detention facility where sites are available.
- Prioritize recommended storm water drainage improvements.
- Identify funding options for recommended storm water drainage improvements.

## **8.0 Recommendations**

Based on the findings contained herein of our evaluation of the City of Angleton storm water drainage system and flooding problems, the following recommendations are made:

- Continue to allow development within Angleton in accordance with the current City requirement for onsite storm water detention facilities.
- Continue to pursue implementation of regional storm water detention facilities by the City and by the Angleton Drainage District.
- Continue the recently enhanced regular maintenance of the City's storm water drainage facilities.
- Continue to work with FEMA to insure certification of the Angleton Protection Levee.
- Undertake Phase II of the Angleton Master Drainage Plan to provide the City with adequate preliminary engineering of needed storm water drainage improvements to alleviate existing house flooding in Angleton.