# Master Drainage Concept Plan

Harris County Flood Control District (HCFCD)

Texas Department of Transportation (TxDOT)

City of Bellaire (COB)

February 4, 2019

James B Andrews, P.E. City Engineer

TSA June 2001

Flooding in the area is not new…

# Frequent Floods

- Over a 13-month period starting in May 2015, Harris County experienced six significant flood events.
- Each one of these storm events resulted in rainfall totals over eight (8) inches in portions of Harris County. Never, in modern records, has Harris County experienced such frequent back to back flooding events.
- The May 2015 and the Tax Day flood of 2016 affected Bellaire

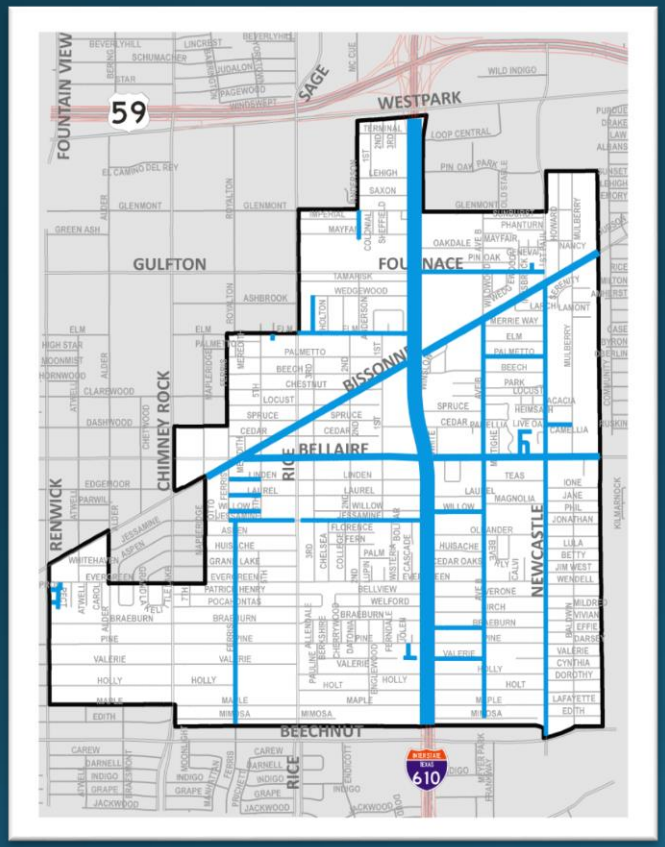
**May 26, 2015**

Newcastle at Holly

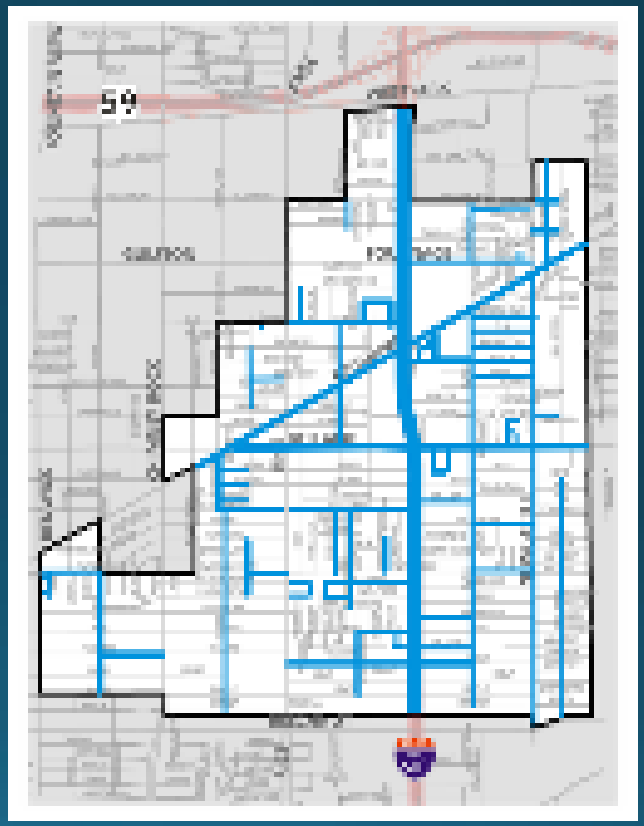
# Drainage work completed to date

- Bellaire Millennium Renewal
- Rebuild Bellaire
- 2016 Drainage Study
- Bonds for a Better Bellaire 2016

# Bellaire Millennium Renewal
# Rebuild Bellaire



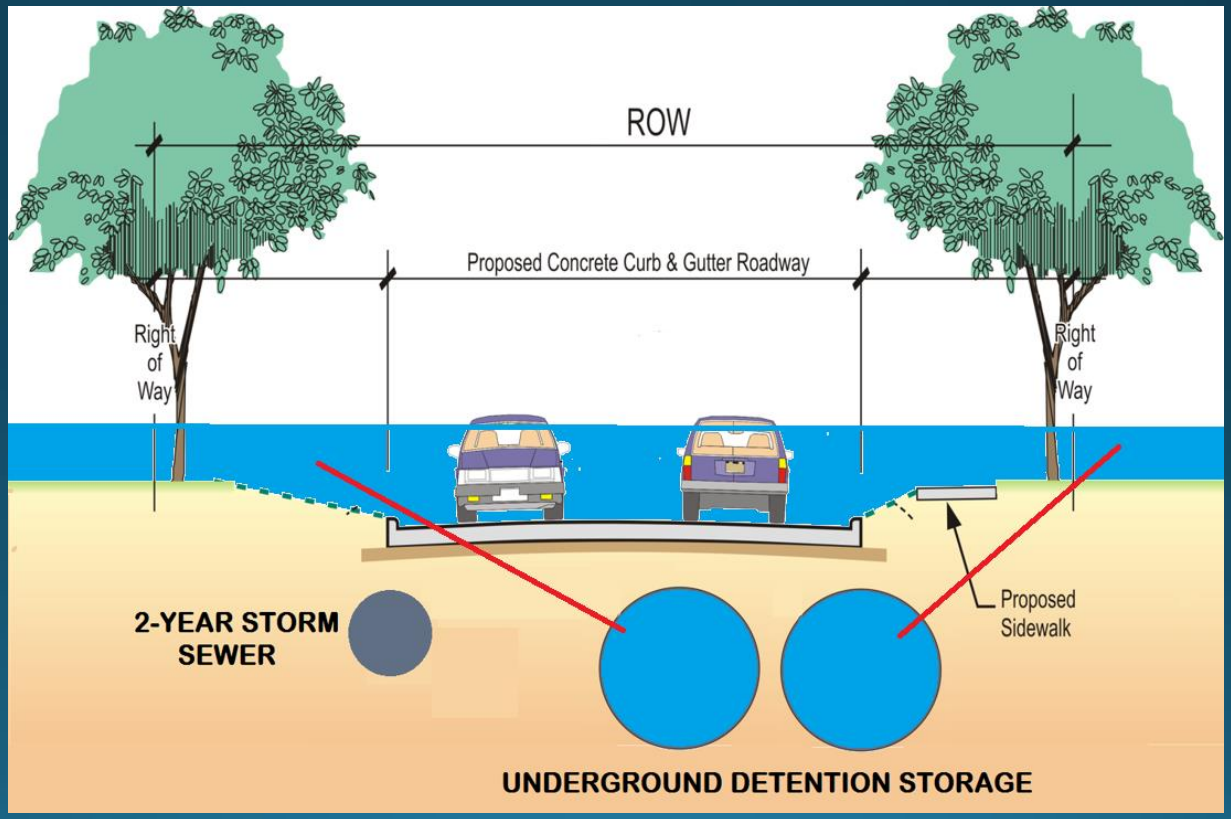

After BMR




After Rebuild

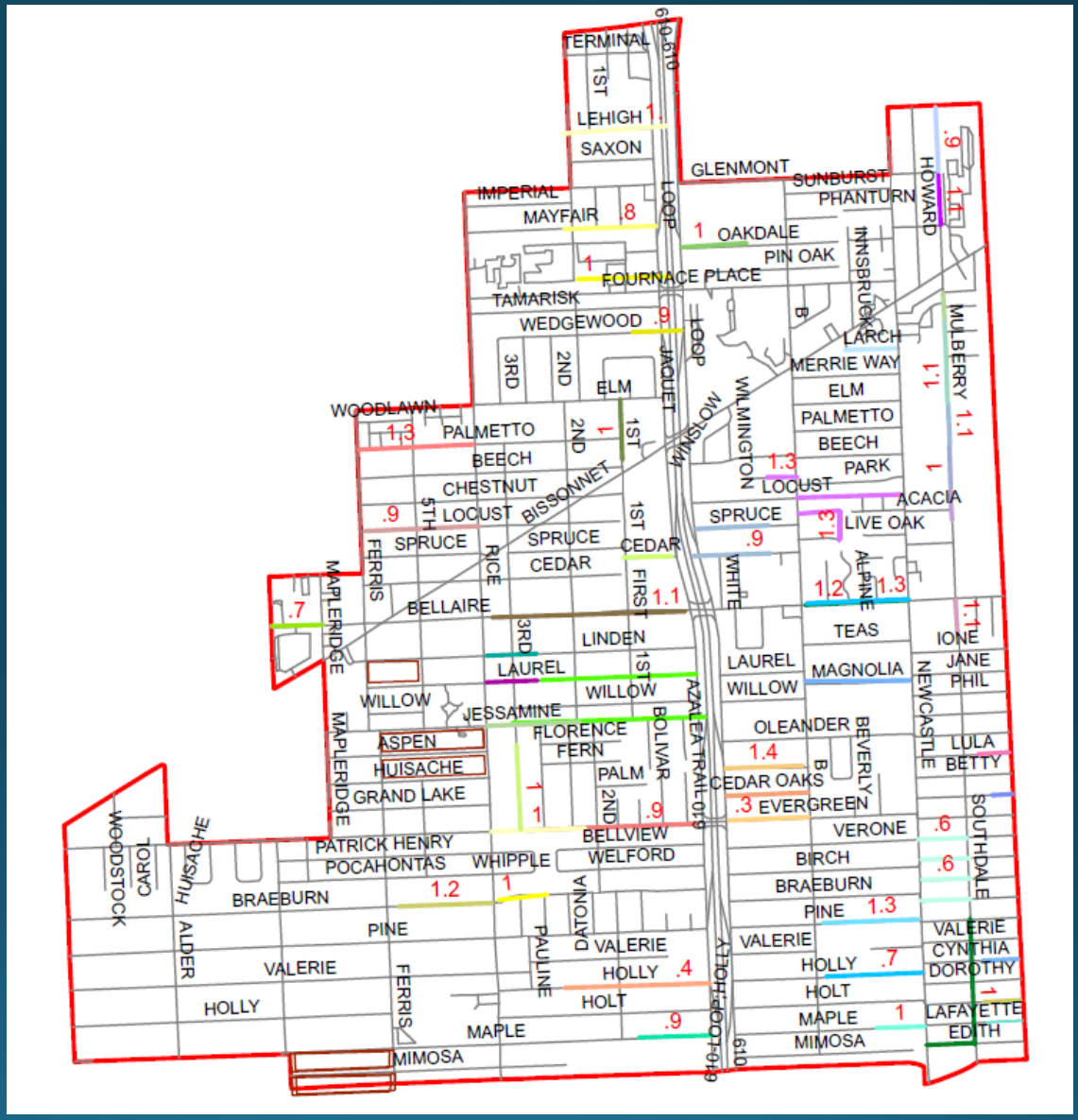
# 2016 Drainage Study Recommendations

- Construct local underground storage systems by increasing the normal two-year design storm sewer system to store the 100-year storm volumes at selected strategic locations.

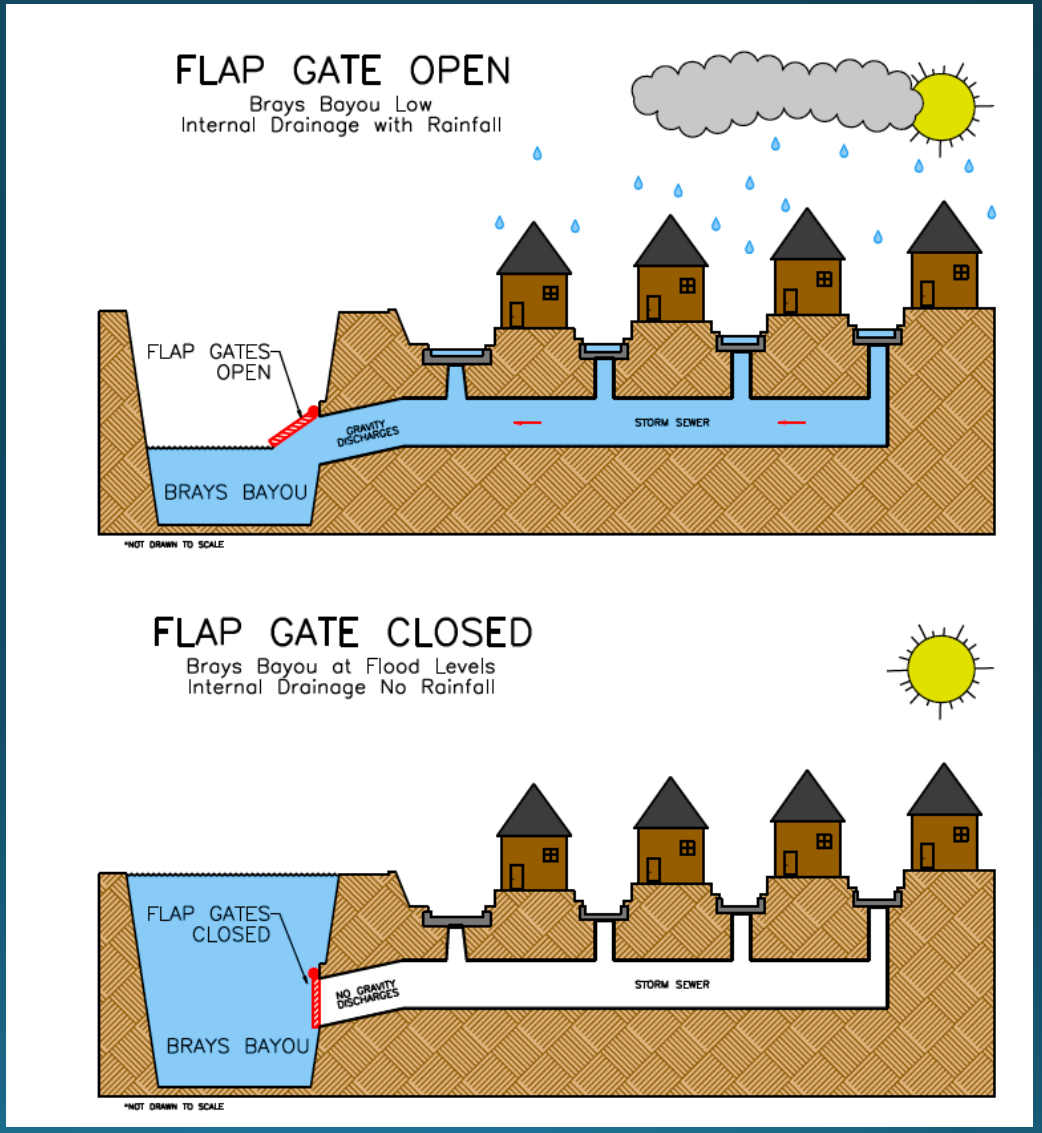


# Bonds for a Better Bellaire 2016

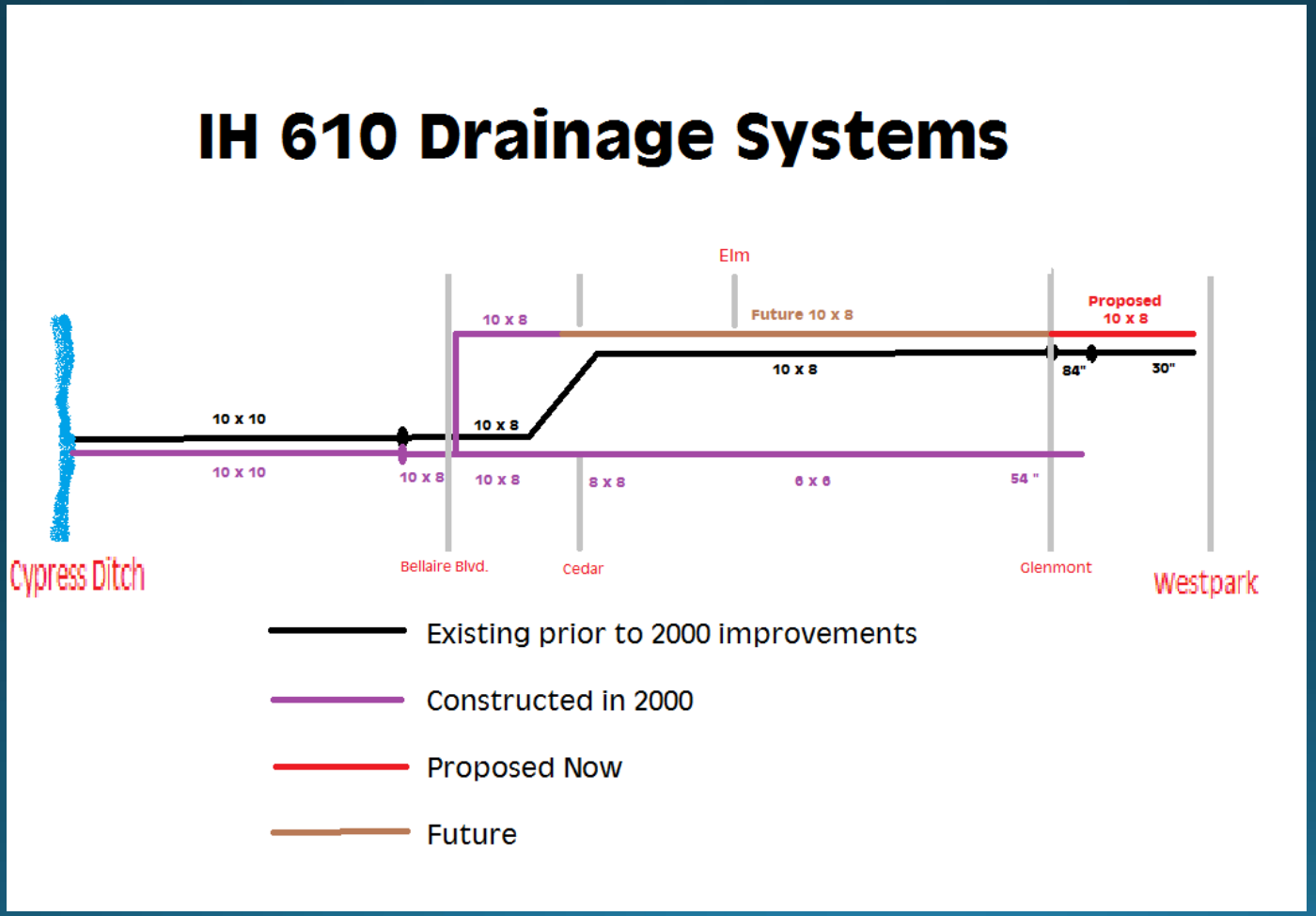
Reduction in 100 year water surface



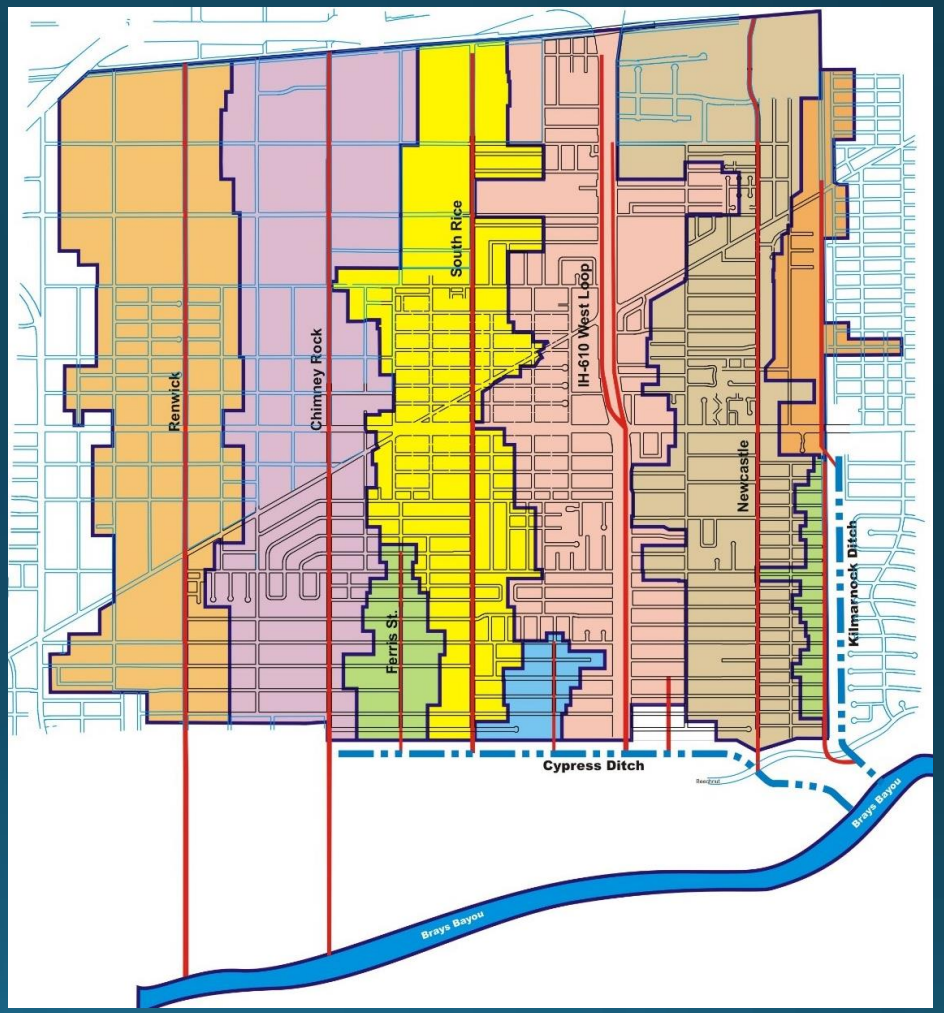
- Construct backflow prevention systems at several of the major drainage system outfalls to prevent back water flow from Brays Bayou from backing up into these systems during high water flood stages.



# Request improvements to the TxDOT system directly adjacent to the proposed improvements associated with the US69/IH610 interchange improvements



Work with TxDOT, HCFCD, City of Houston and others to improve the North/South major drainage arterials and Cypress Ditch.



# The City had a solid plan…

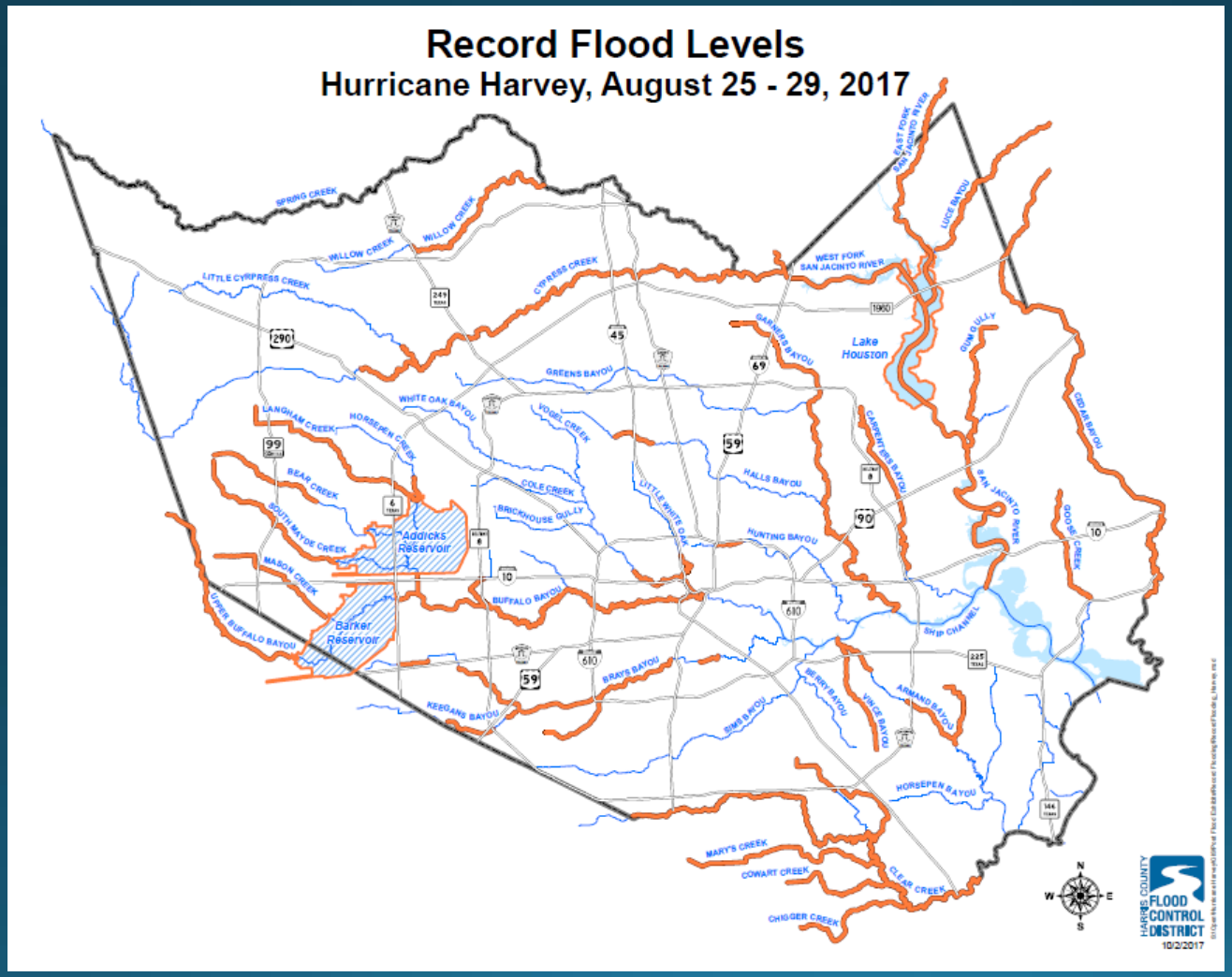
Bond election was passed

Bonds for a Better Bellaire 2016 program begins

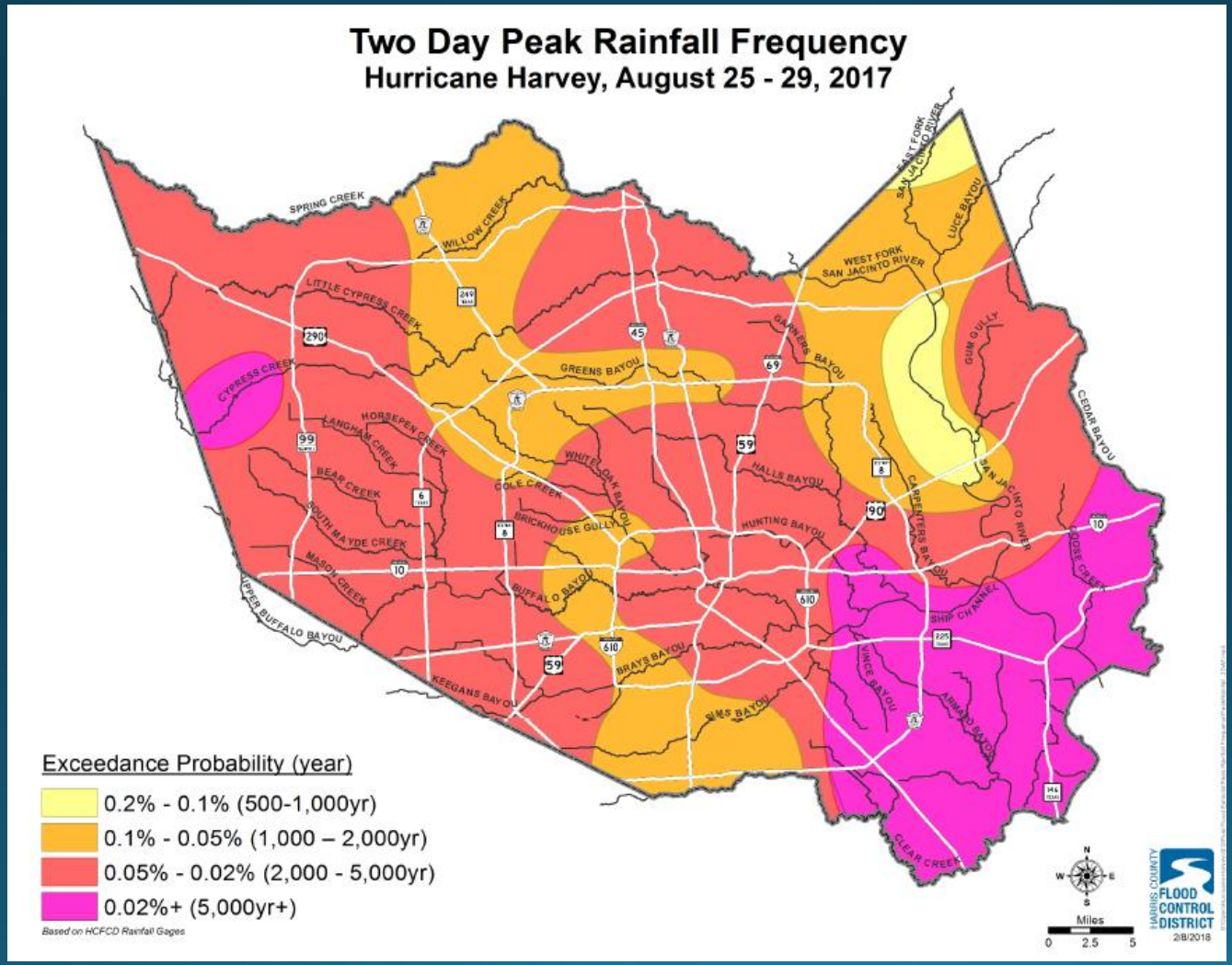
Improvements recommended in 2016 Drainage Study start

# Then…Hurricane Harvey Hits

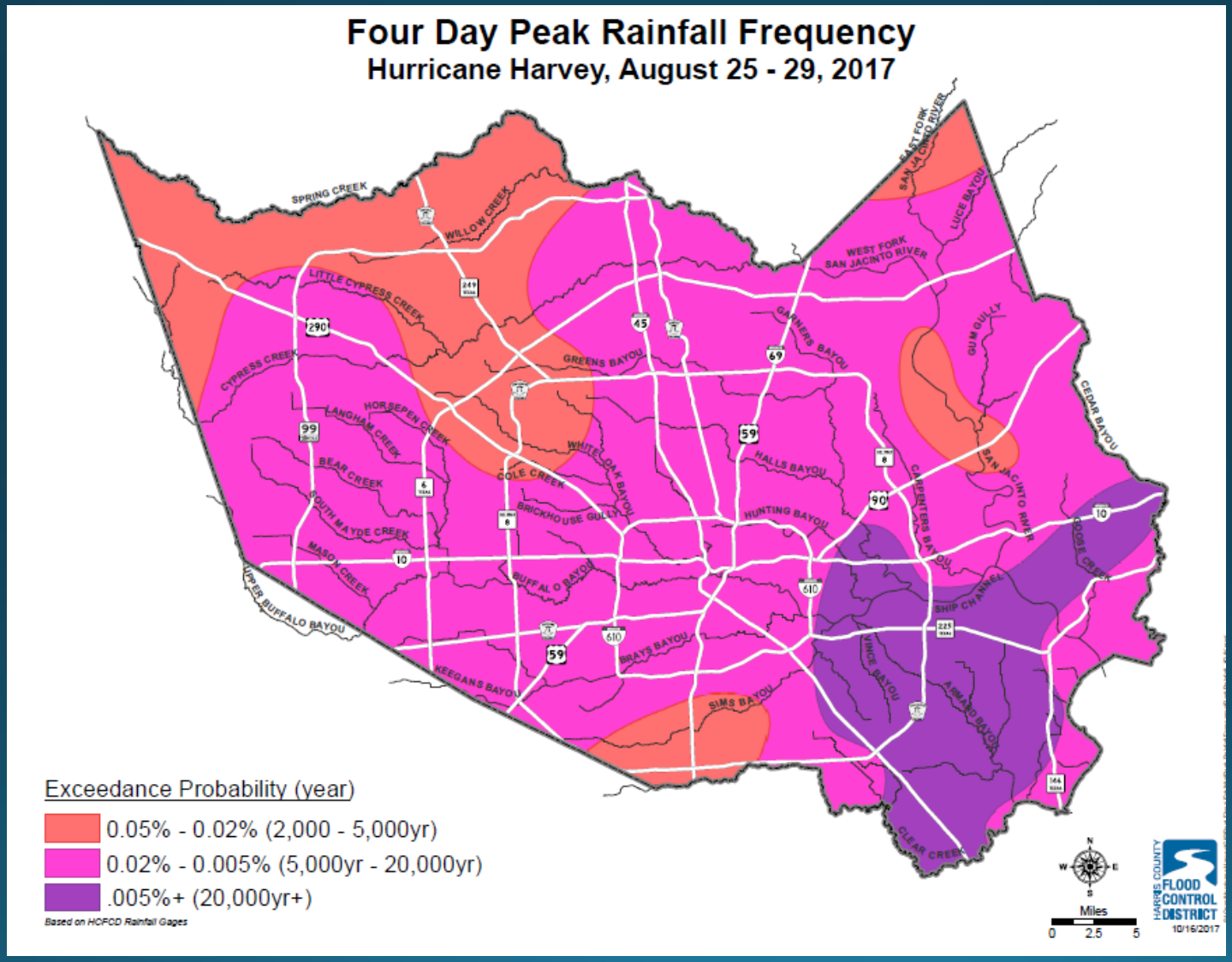
# Record Flood Levels during Harvey



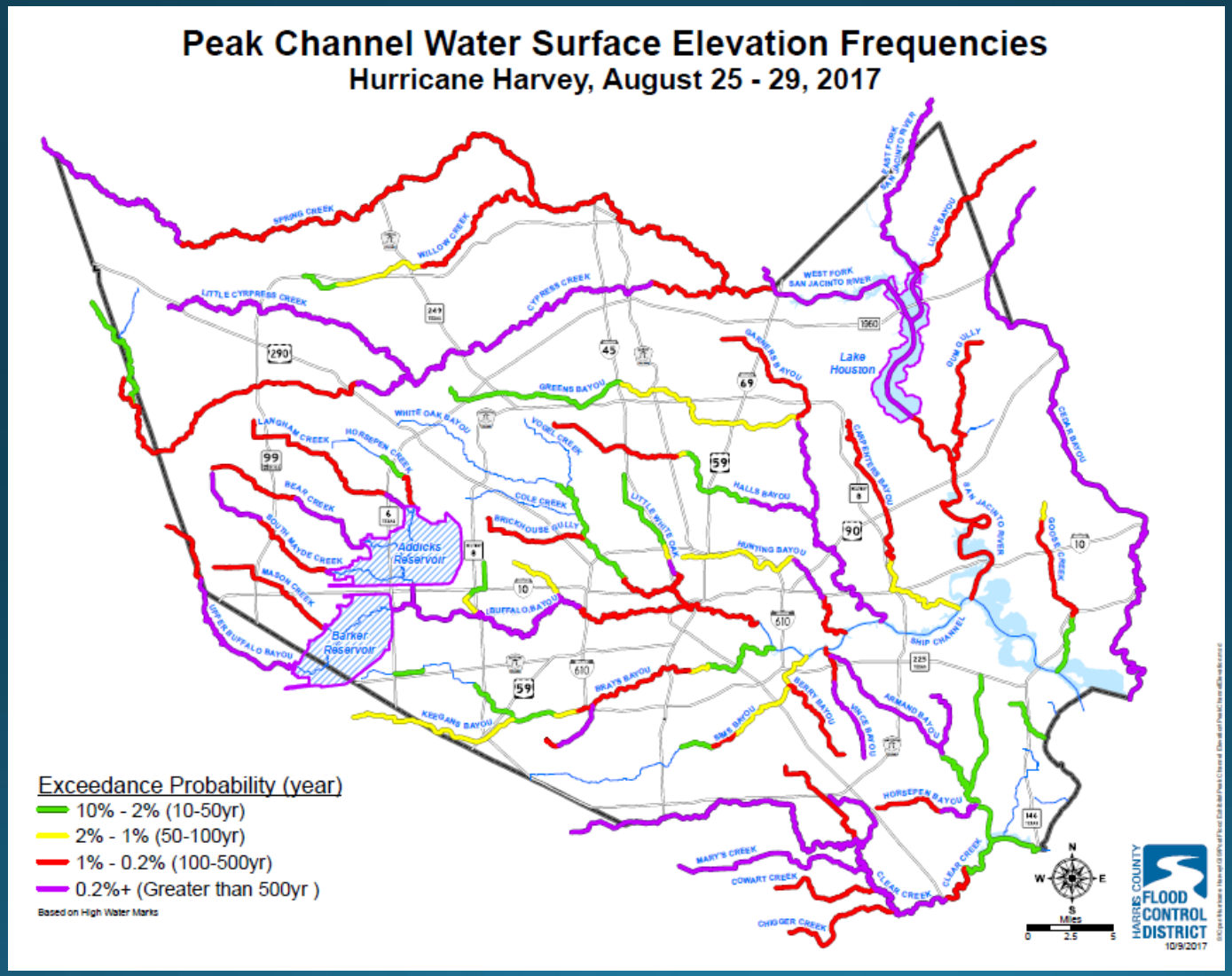
# 2000 year event for 2 day peak



# 5000 to 20,000 year event for 4 day peak



# Brays Bayou overbanks



# 23,810 homes flooded in Brays Bayou watershed

**SUMMARY**

| Description | | Existing Homes | May 2015 Flood | | August 2017 Flood | | Flooded in Both Storms |
|---|---|---|---|---|---|---|---|
| | | | Structural Flooding | % Flooded Homes | Structural Flooding | % Homes w/Structural Flooding | |
| Tier I | Pre 1980 | 2313 | 122 | 5% | 1039 | 45% | 80 |
| Tier II | 1980-1993 | 1087 | 32 | 3% | 291 | 27% | 12 |
| Tier III | 1994-2007 | 2348 | 56 | 2% | 554 | 24% | 30 |
| Tier IV | 2008-Present | 739 | 16 | 2% | 47 | 6% | 5 |
| | Year Build Unknown | 201 | 2 | 1% | 5 | 2% | 0 |
| | ***TOTAL*** | ***6688*** | ***228*** | ***3%*** | ***1936*** | ***29%*** | ***127*** |

# Newer homes built above the Base Flood faired well.

# Flood Mitigation Task Force

- Community Rating System (CRS) credit program through FEMA.

- The Task Force developed a Flood Hazard Mitigation Plan with 32 Action Items.

- Most notable:
  - Continue the upsizing of the storm sewers for detention
  - Continue the elevated finished floor policy
  - Develop a regional plan for flood control
  - Seek Regional Partnerships

# Master Drainage Concept Plan

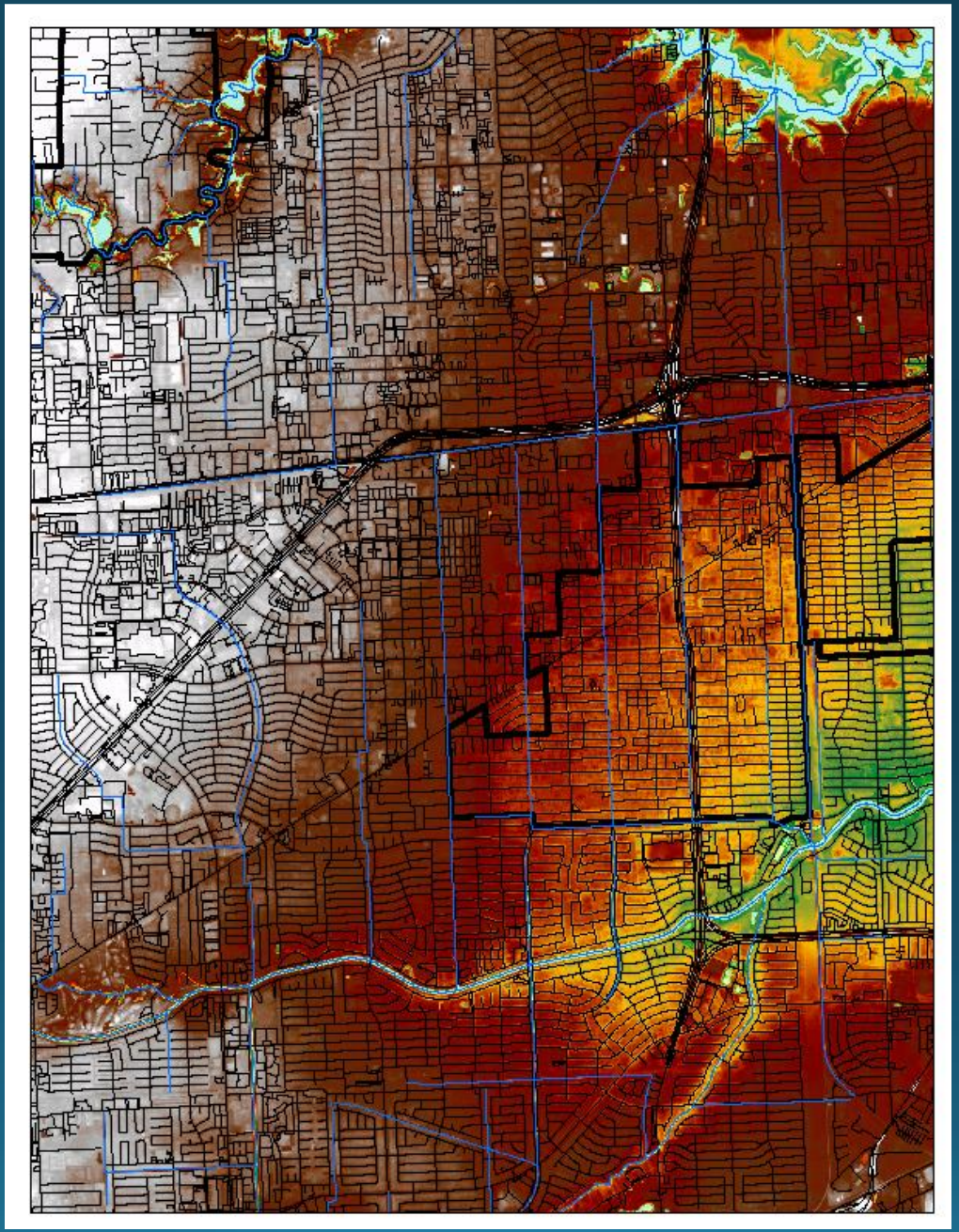
The Master Drainage Concept Plan will evaluate drainage system capacity, existing flooding issues and investigate solutions and improvements for the major drainage systems that serve the City.

**Flooding Sources**

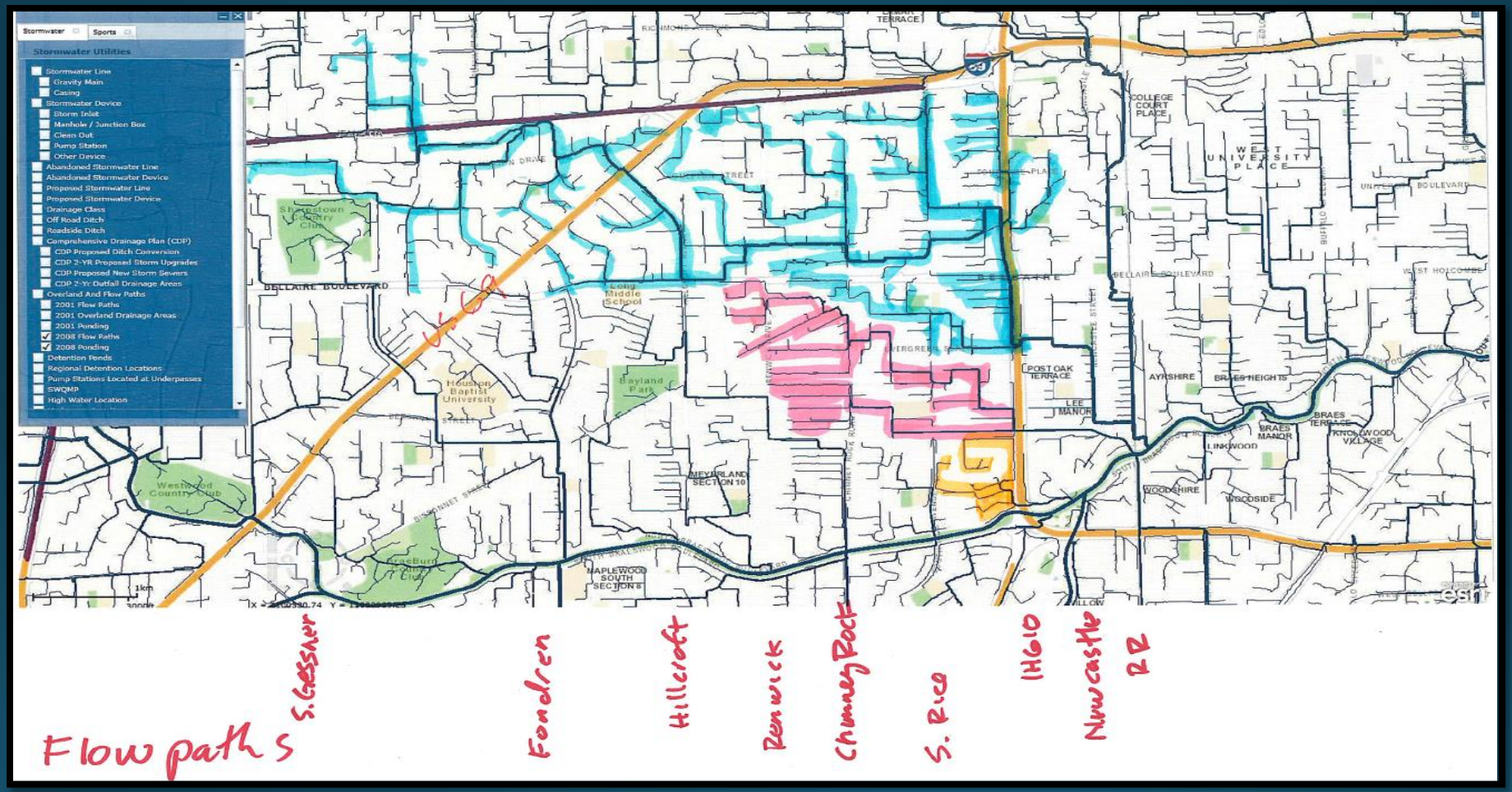
Brays Bayou
Sheet Flow Issues
Major Drainage Systems
Local Drainage Systems

# Sheet Flow

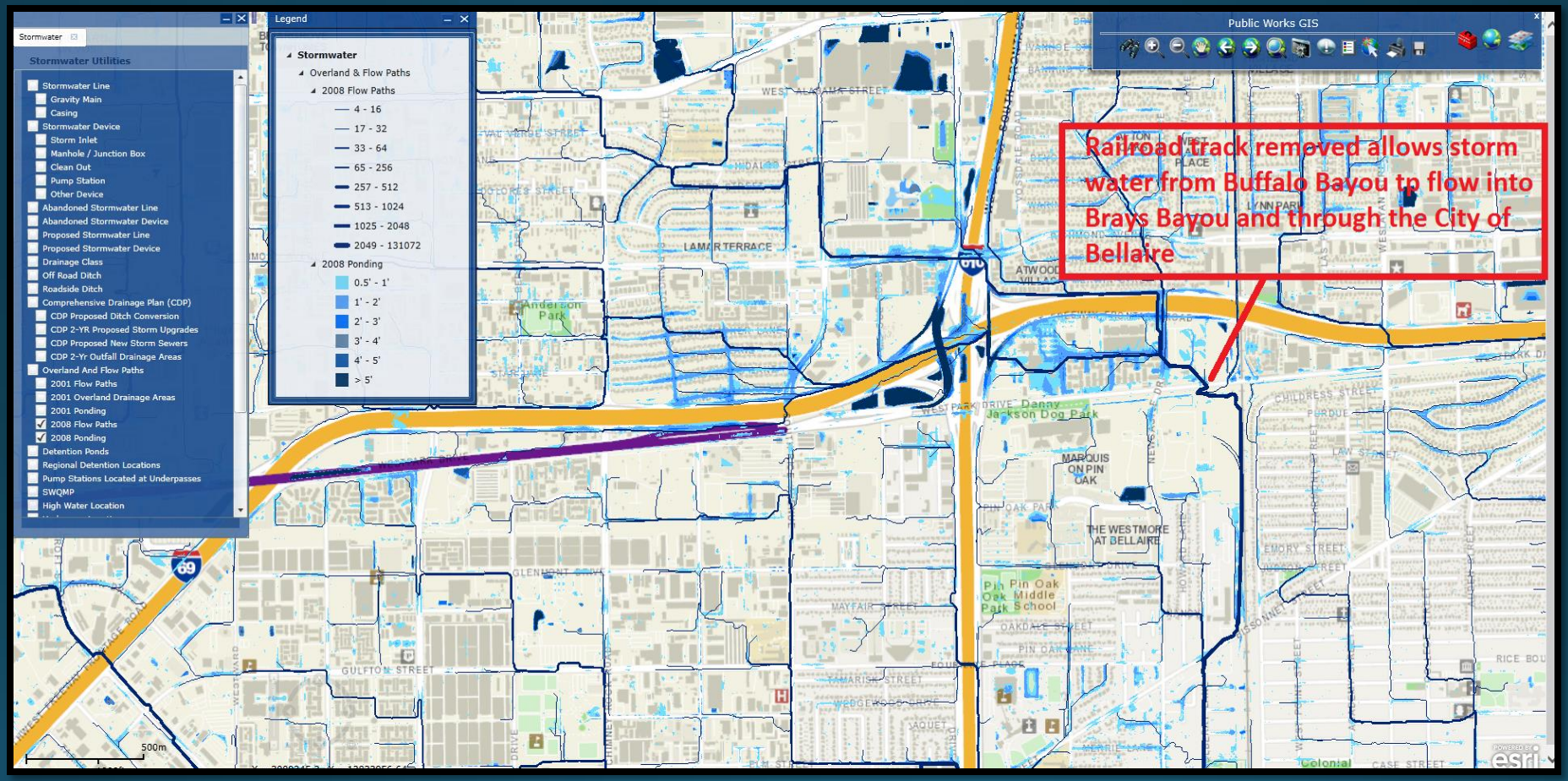
## Northwest to Southeast



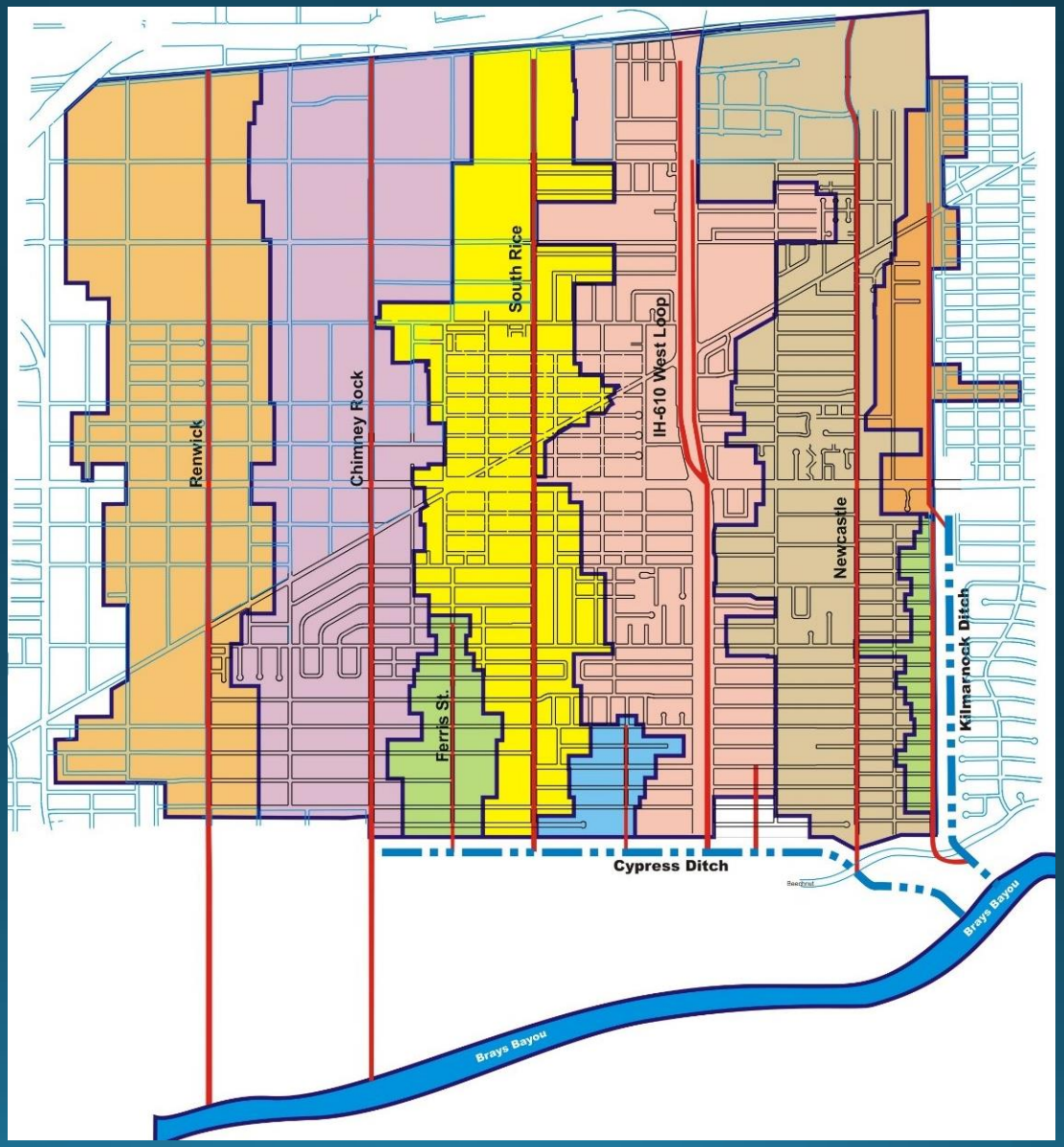
# Overland Flow



# Study Overview



# Major Drainage Systems



# Possible Improvement Alternatives

The hydraulic model will be utilized to evaluate improvement alternatives. Improvement alternatives that will be investigated will consist of:

•Enlarge main storm sewer systems to improve conveyance capacity

•Intermittent detention ponds to collect and reduce flows to the existing storm sewer system

•Flood control channels to capture sheet flow and convey it to Cypress Ditch and Brays Bayou

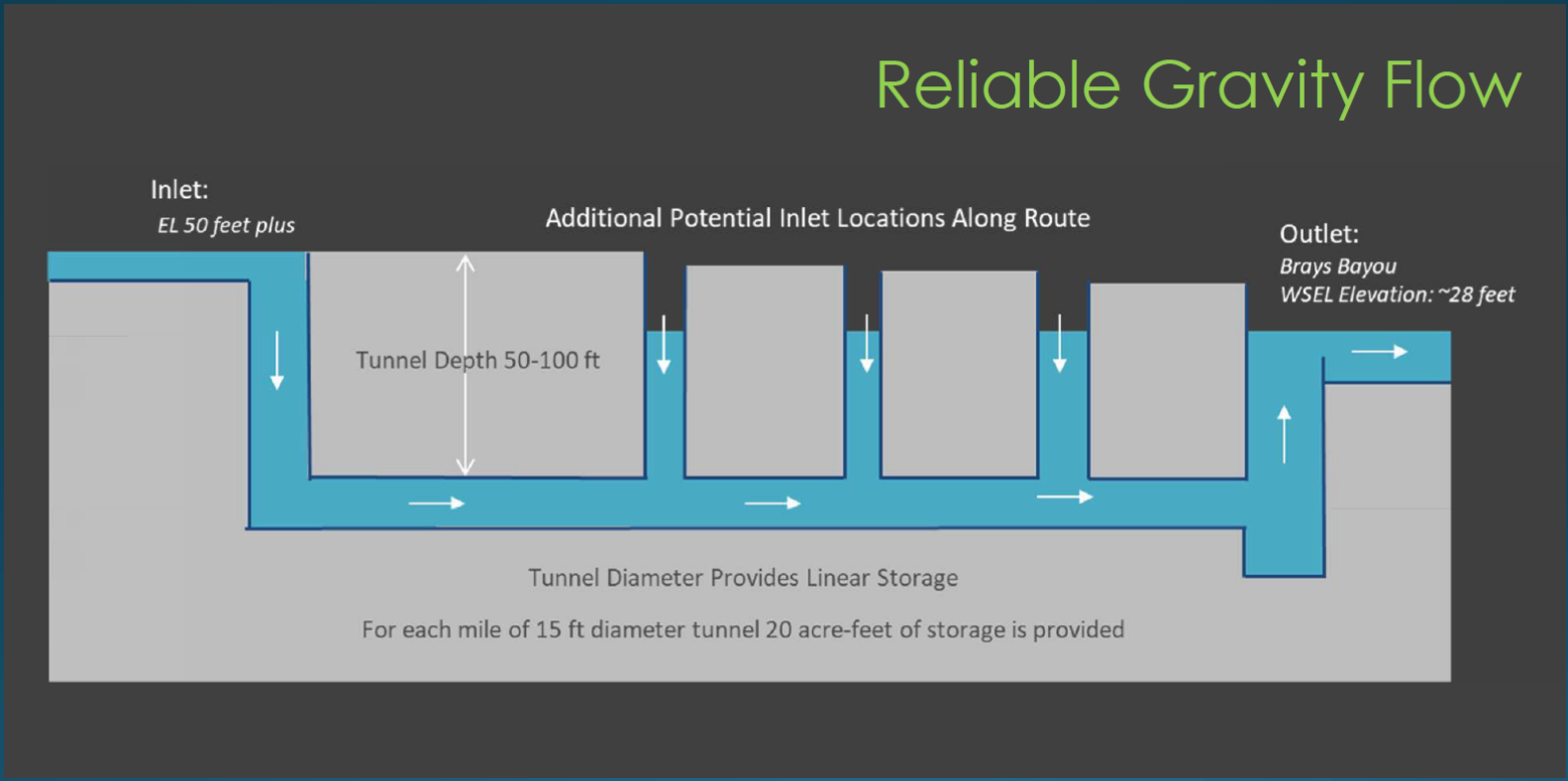
•Relief structures through IH 610 and the railroad track to better utilize Kilmarnock Ditch

•Oversized storm sewers, with supplemental pump stations, to increase conveyance and reduce peak water surface elevations by providing inline detention within the drainage system.

•Potential flood tunnels and associated siphons and pump stations, to move floodwaters to Brays Bayou

# Tunnel Drivers

# Storm Water Tunnels



The MDCP projected project cost breakdown for each entity is as follows:

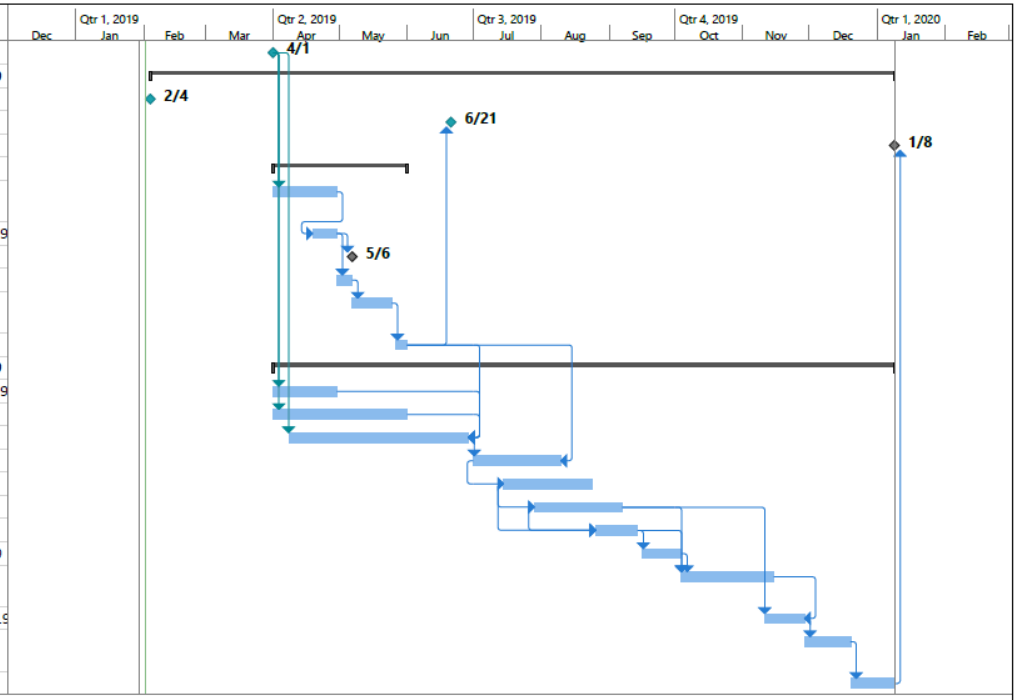
| | | | |
|---|---|---|---|
| Bellaire | 18% | or | $126,360 |
| TxDOT | 18.4% | or | $129,250 |
| HCFCD | 63.6% | or | $446,390 |
| | Total | | $702,000 |

Working on inter local agreements with TxDOT and HCFCD

Harris County Commissioner's Court must approve participation level

# MDCP Schedule… about 10 months

| ID | Task Mode | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|
| 1 | | Notice to Proceed | 0 days | Mon 4/1/19 | Mon 4/1/19 |
| 2 | | **Stakeholder Coordination** | **243 days** | **Mon 2/4/19** | **Wed 1/8/20** |
| 3 | | City of Bellaire Public Meeting No. 1 | 0 days | Mon 2/4/19 | Mon 2/4/19 |
| 4 | | City of Bellaire Public Meeting No. 2 | 0 days | Fri 6/21/19 | Fri 6/21/19 |
| 5 | | City of Bellaire Public Meeting No. 3 | 0 days | Wed 1/8/20 | Wed 1/8/20 |
| 6 | | **Concept Development** | **45 days** | **Mon 4/1/19** | **Fri 5/31/19** |
| 7 | | Preliminary Hydrologic & Hydarulic Evaluation | 21 days | Mon 4/1/19 | Mon 4/29/19 |
| 8 | | Project Concept Development | 7 days | Fri 4/19/19 | Mon 4/29/19 |
| 9 | | Initial Screening Workshop | 0 days | Mon 5/6/19 | Mon 5/6/19 |
| 10 | | Concept Design Memo - DRAFT | 5 days | Tue 4/30/19 | Mon 5/6/19 |
| 11 | | Review of Memo by Stakeholders (estimated) | 14 days | Tue 5/7/19 | Fri 5/24/19 |
| 12 | | Concept Design Memo-FINAL | 5 days | Mon 5/27/19 | Fri 5/31/19 |
| 13 | | **Master Drainage Concept Plan** | **203 days** | **Mon 4/1/19** | **Wed 1/8/20** |
| 14 | | Data Collection | 21 days | Mon 4/1/19 | Mon 4/29/19 |
| 15 | | Topographic Surveying | 45 days | Mon 4/1/19 | Fri 5/31/19 |
| 16 | | Existing Condition H&H Analysis | 60 days | Mon 4/8/19 | Fri 6/28/19 |
| 17 | | Improvement Alternatives Development | 30 days | Mon 7/1/19 | Fri 8/9/19 |
| 18 | | Proposed Condition H&H Analysis | 30 days | Mon 7/15/19 | Fri 8/23/19 |
| 19 | | Alternatives Analysis | 30 days | Mon 7/29/19 | Fri 9/6/19 |
| 20 | | Schematic Layouts of Alternatives | 15 days | Mon 8/26/19 | Fri 9/13/19 |
| 21 | | Cost Estimates | 14 days | Mon 9/16/19 | Thu 10/3/19 |
| 22 | | Develop Phasing Plan of Preferred Alternative | 30 days | Fri 10/4/19 | Thu 11/14/19 |
| 23 | | Prepare Technical Report | 14 days | Mon 11/11/1 | Thu 11/28/19 |
| 24 | | Review of Report by City of Bellaire, HCFCD, and TxDOT | 15 days | Fri 11/29/19 | Thu 12/19/19 |
| 25 | | Finalize Technical Report | 14 days | Fri 12/20/19 | Wed 1/8/20 |




Project: MDCP-Schedule
Date: Sat 2/2/19

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

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# Hazard Mitigation Grant Program

**Hazard Mitigation Grant Program**

The purpose of Hazard Mitigation Grant Program (HMGP) is to help communities implement hazard mitigation measures following a Presidential Major Disaster Declaration in the areas of the state, tribe, or territory requested by the Governor or Tribal Executive. The key purpose of this grant program is to enact mitigation measures that reduce the risk of loss of life and property from future disasters. FEMA provides up to 75 percent of the funds for mitigation projects.

Types of Project Considered for Funding:

- Property acquisition and structure demolition
- Structure elevation
- Mitigation reconstruction
- Dry flood-proofing for non-residential and historic residential structures
- Localized and non-localized flood risk reduction projects
- Infrastructure retrofits
- Community safe room construction
- Wind retrofit projects
- Post-disaster code enforcement projects
- Soil stabilization projects.

**Benefit Cost Analysis**

The Hazard Mitigation Grant Program (HMGP) applications require the preparation of a benefit cost analysis (BCA) to determine the cost effectiveness of a proposed mitigation project. The BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The end result is a benefit cost ration (BCR) which is the project's total net benefits divided by its total project cost. A project is considered to be cost effective when the BCR is 1.0 or greater.

FEMA has developed a software with a suite of tools to analyze the cost effectiveness of a project. This software analyzes mitigation project using a damage frequency assessment (DFA) module. The DFA module analyzes proposed mitigation projects based on damages (either historical or expected) and future damages avoided. Information required for analysis are as follows:

- Detailed scope of work
- Detailed cost estimate for the project
- Annual maintenance cost for the project
- Life expectancy for the project
- Historical Damage Costs (minimum of 3 flooding events)
- Expected Damages Costs
- Recurrence Intervals for all flooding events analyzed
- Depth of flood water in structures
- Square footage of each structure flooded
- Building Replacement Value (BRV) for each structure flooded

Items that the BCA tool does not consider when determining the cost benefit of a project is as follows:

- Existing street condition
- Excessive ponding in the street
- Existing storm sewer capacity