Corridor Channel Design – Blending Flood Damage Reduction, Stormwater Quality, and Recreation

Carolyn White and Sonny Kaiser

Urban Riparian Symposium

February 12, 2015

Agenda

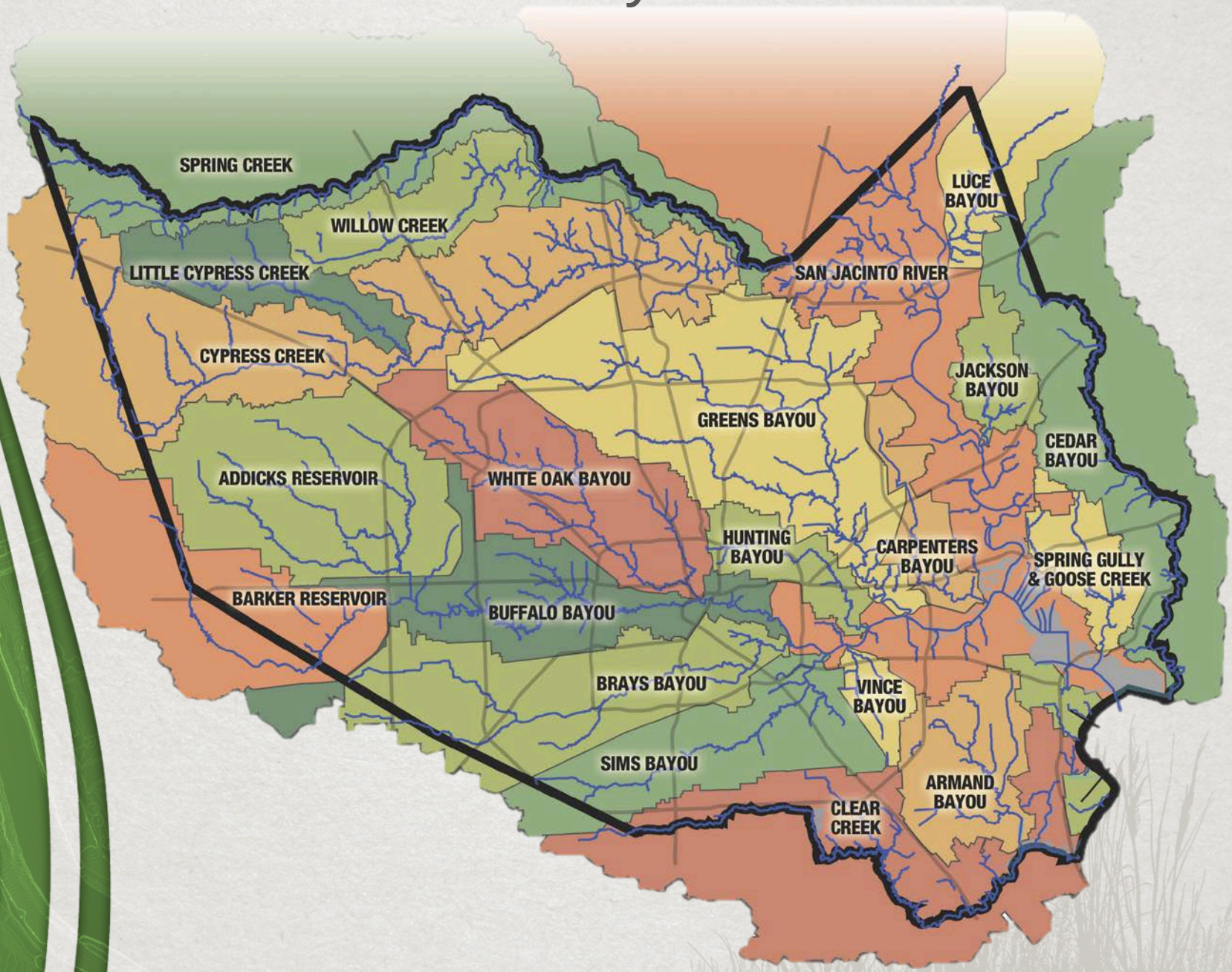
- Harris County Background
- Development & Corridor Channels
- Design Guidelines
- Langham Creek Case Study

Harris County Flood Control District

…to provide flood damage reduction projects that work, with appropriate regard for community and natural values.

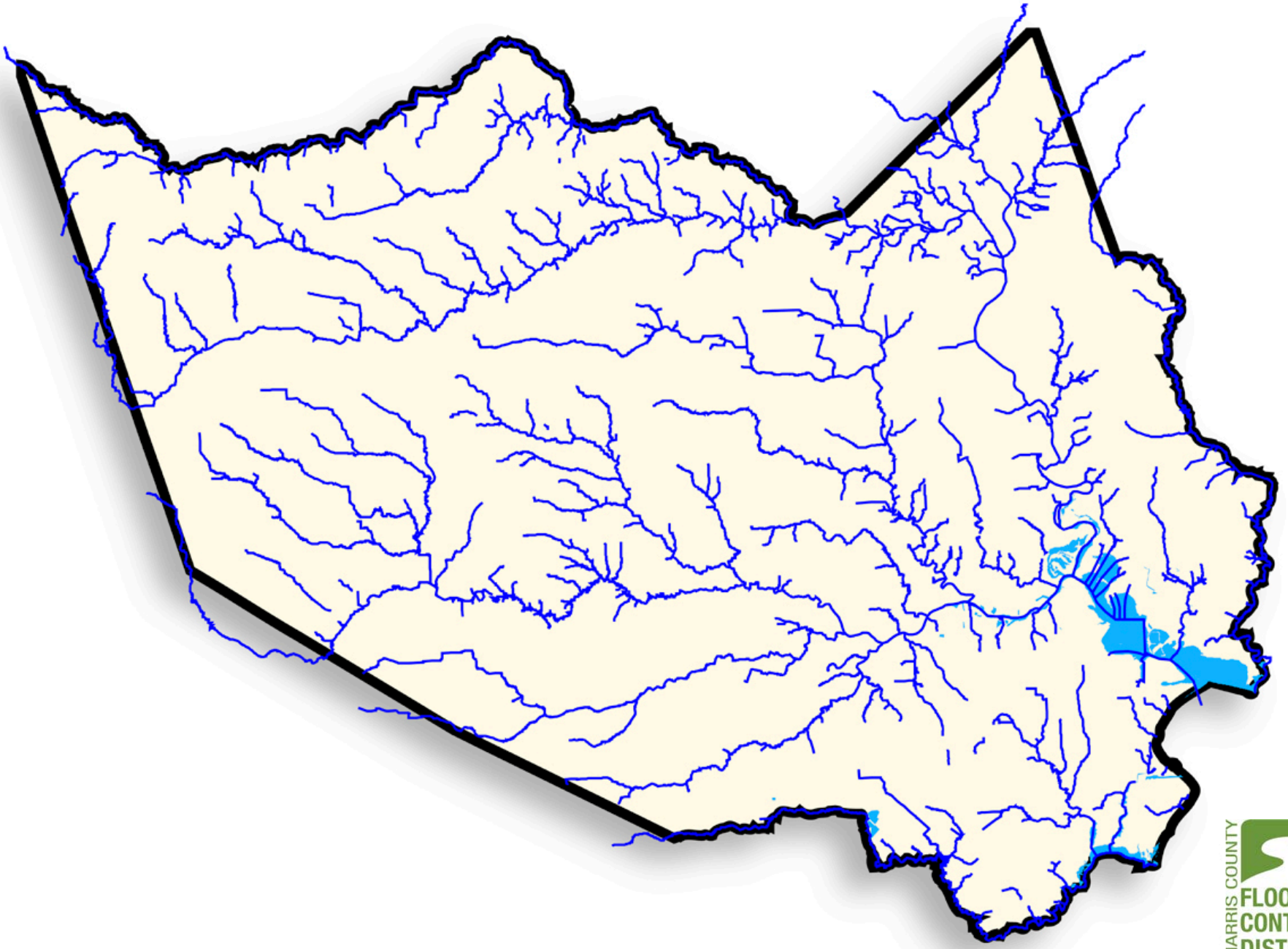
HARRIS COUNTY FLOOD CONTROL DISTRICT

Harris County Watersheds



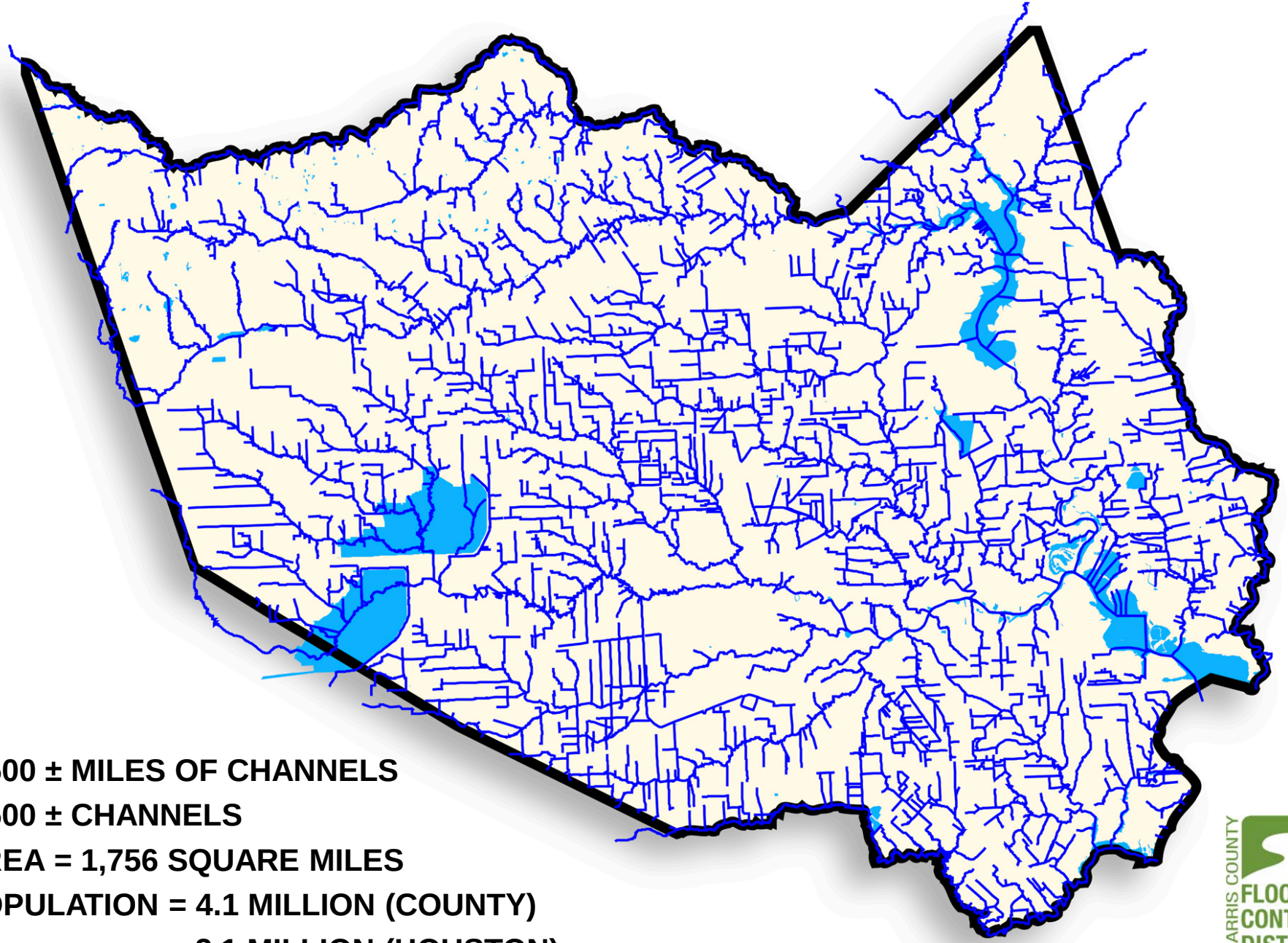
HARRIS COUNTY FLOOD CONTROL DISTRICT

Natural Channels



HARRIS COUNTY FLOOD CONTROL DISTRICT

Open Channel Network



2,500 ± MILES OF CHANNELS

1,500 ± CHANNELS

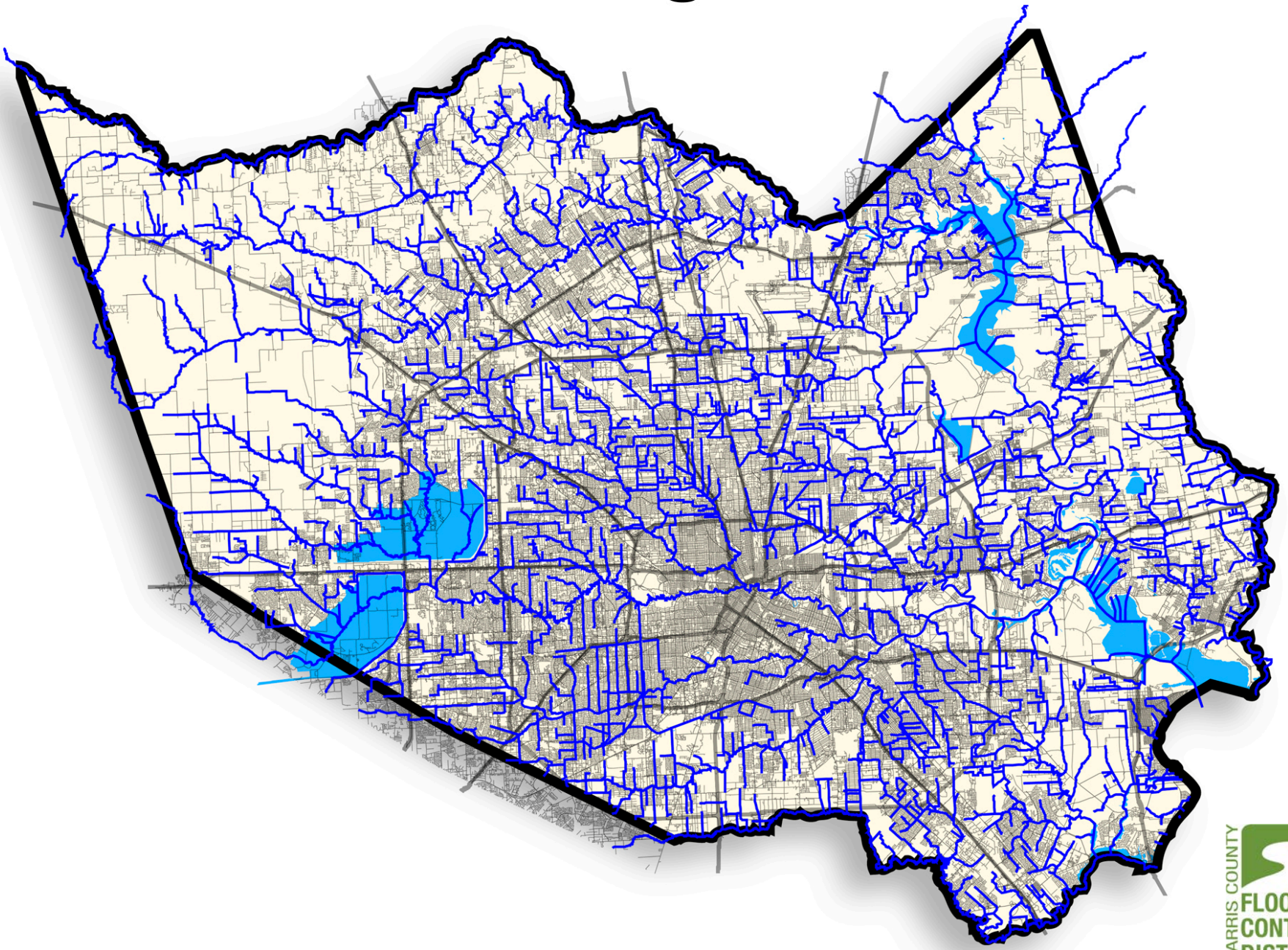
AREA = 1,756 SQUARE MILES

POPULATION = 4.1 MILLION (COUNTY)

2.1 MILLION (HOUSTON)

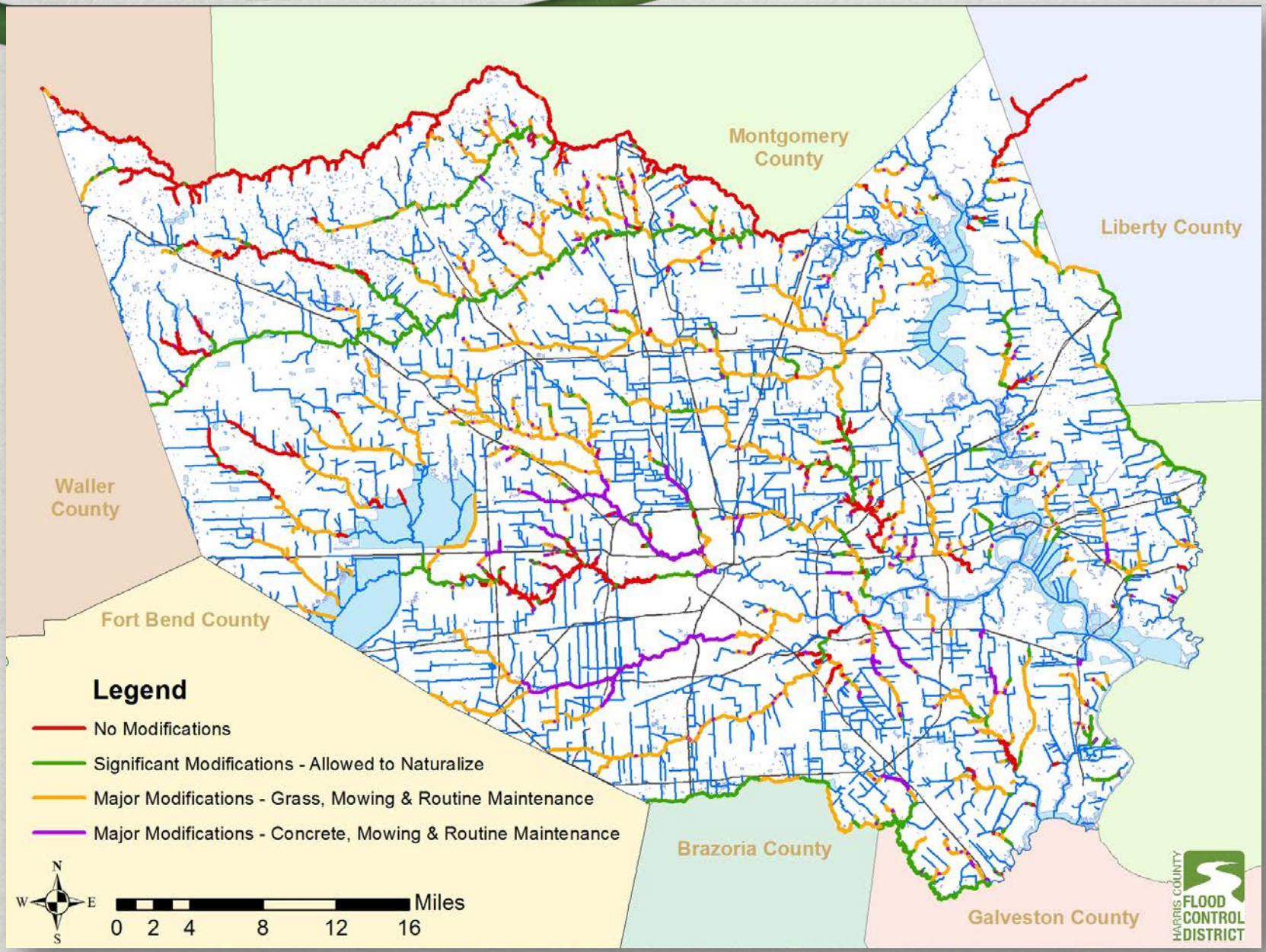
HARRIS COUNTY FLOOD CONTROL DISTRICT

Total Drainage Network

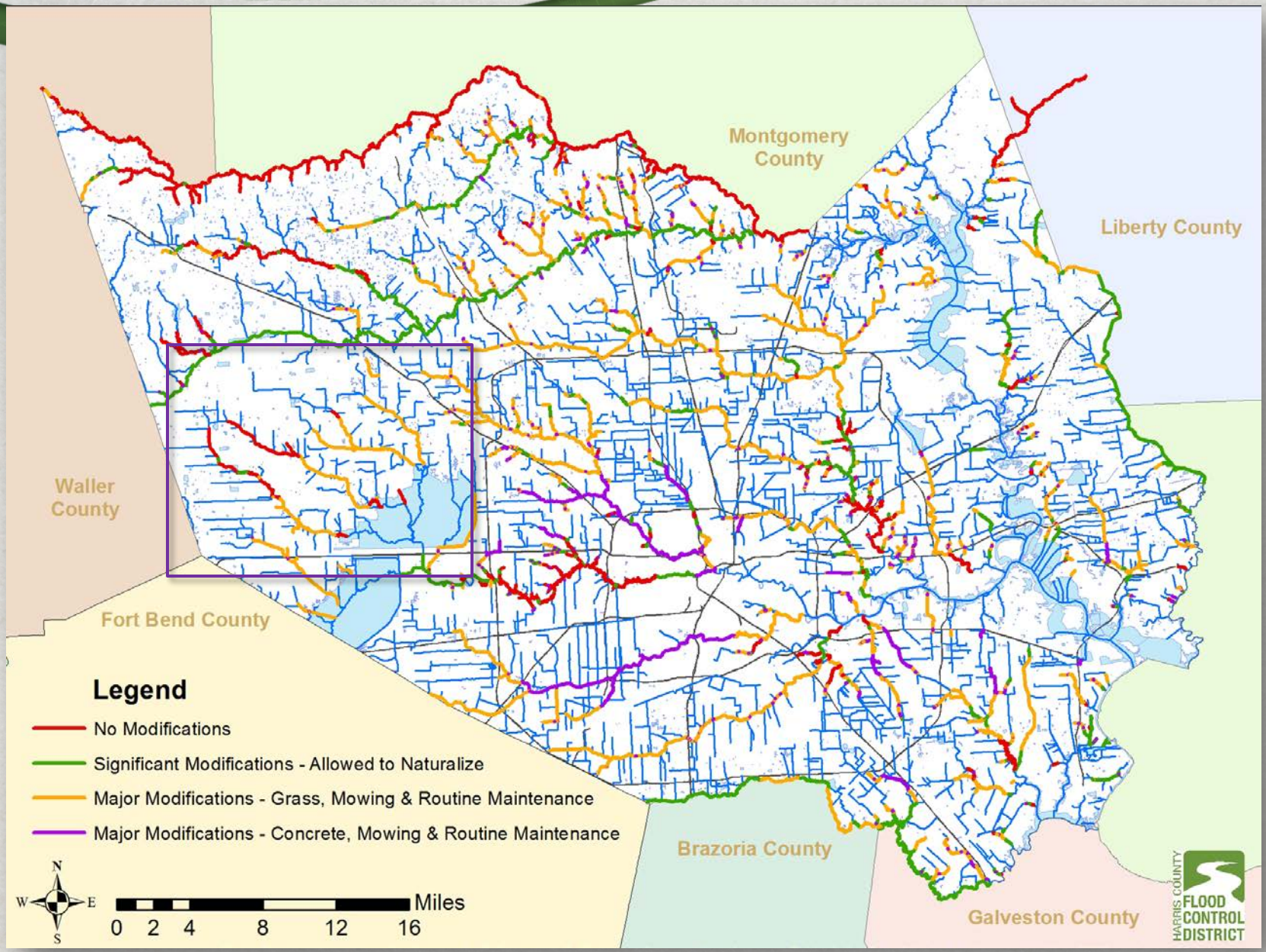


HARRIS COUNTY FLOOD CONTROL DISTRICT

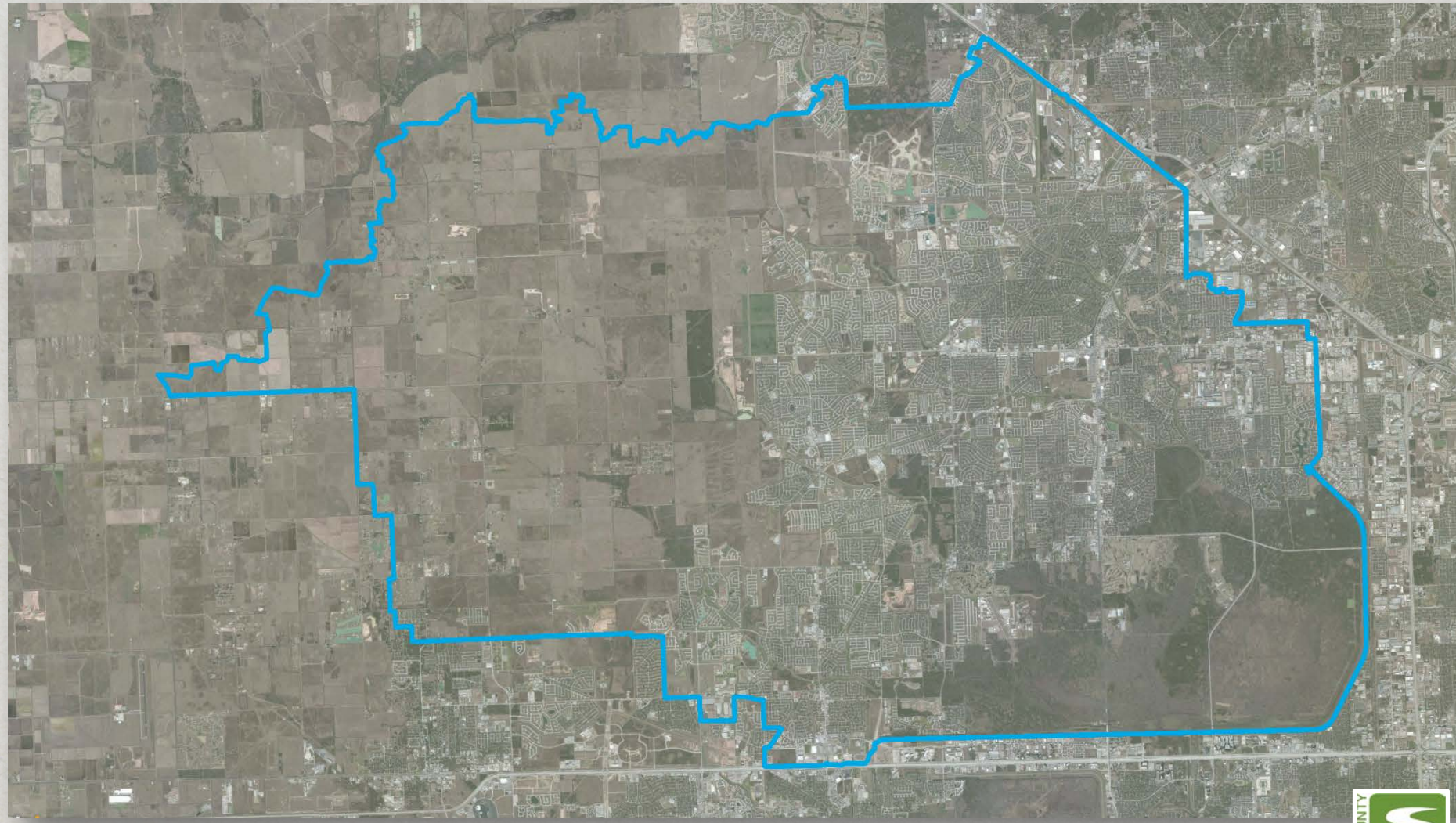
Channel Modifications



Channel Modifications

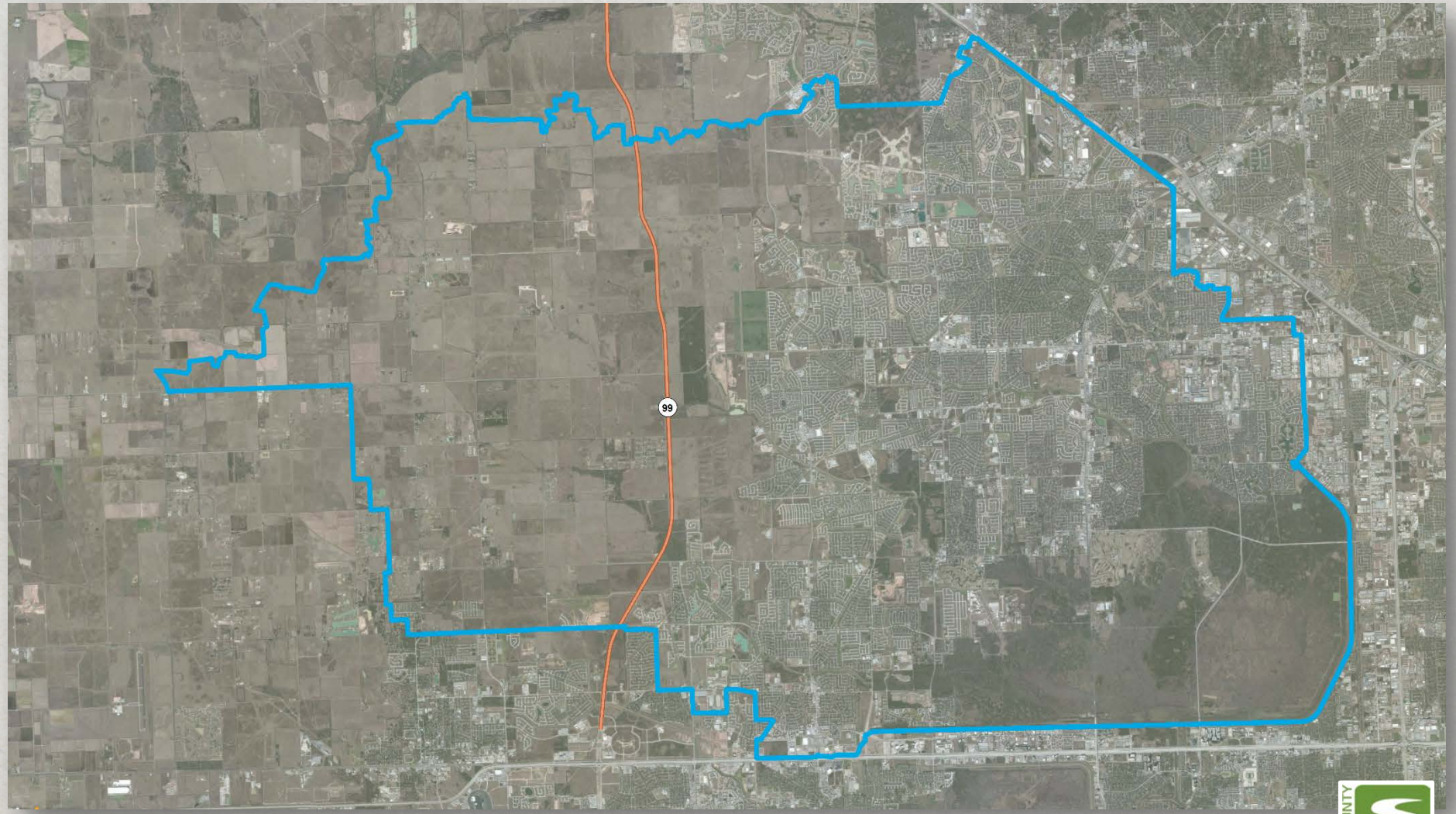


Addicks Watershed



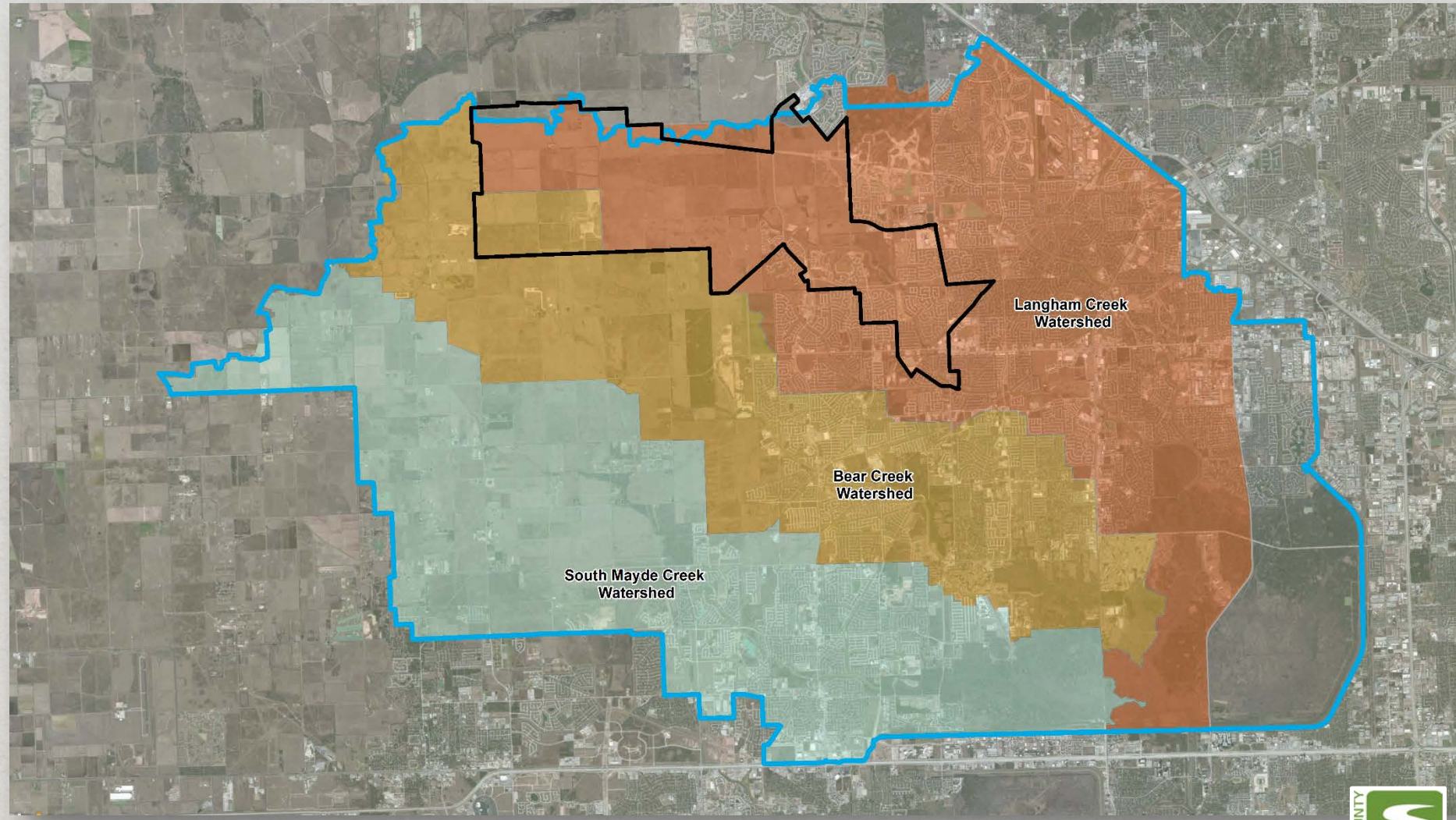
HARRIS COUNTY FLOOD CONTROL DISTRICT

Addicks Watershed



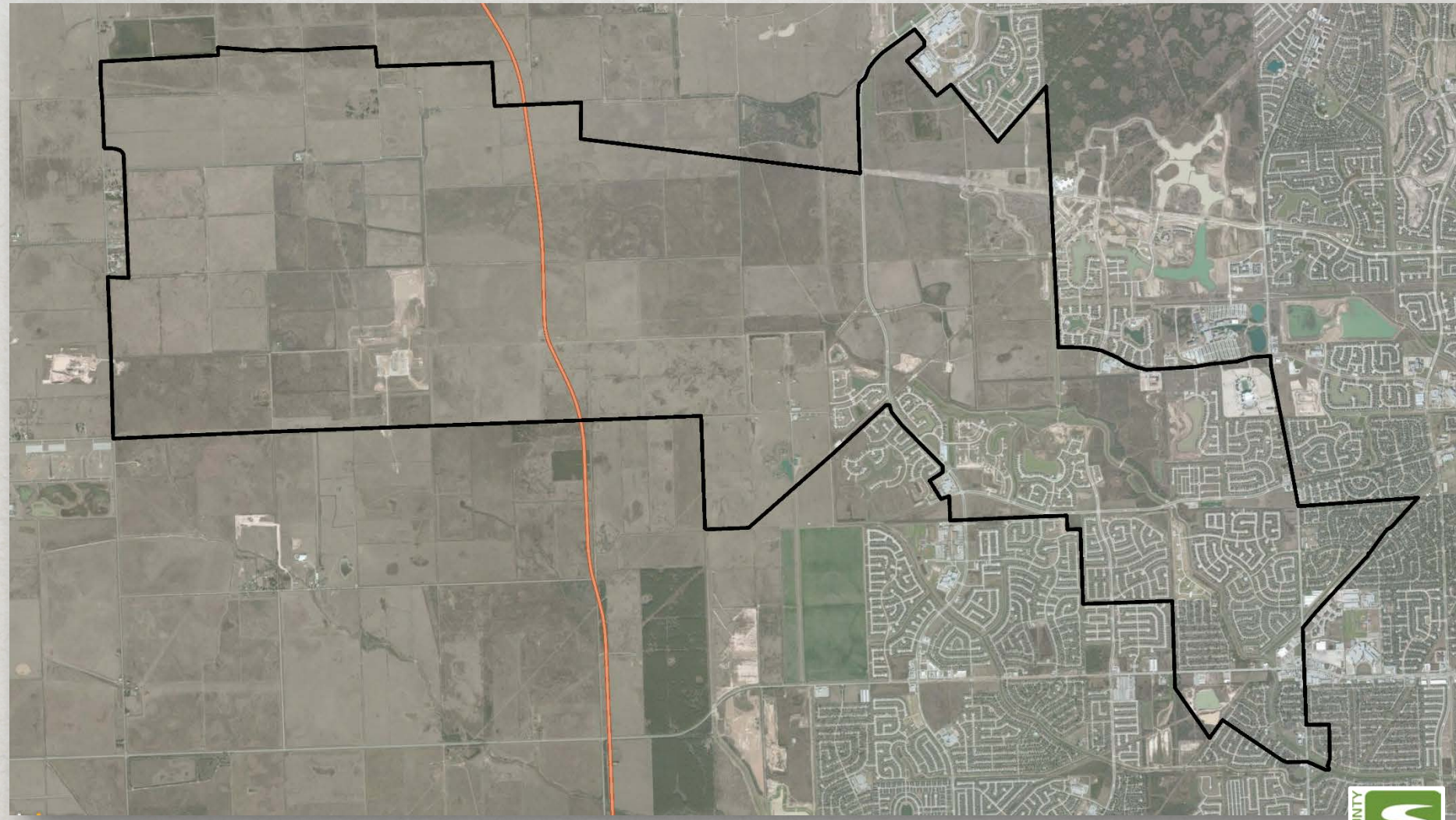
HARRIS COUNTY FLOOD CONTROL DISTRICT

Upper Langham Creek



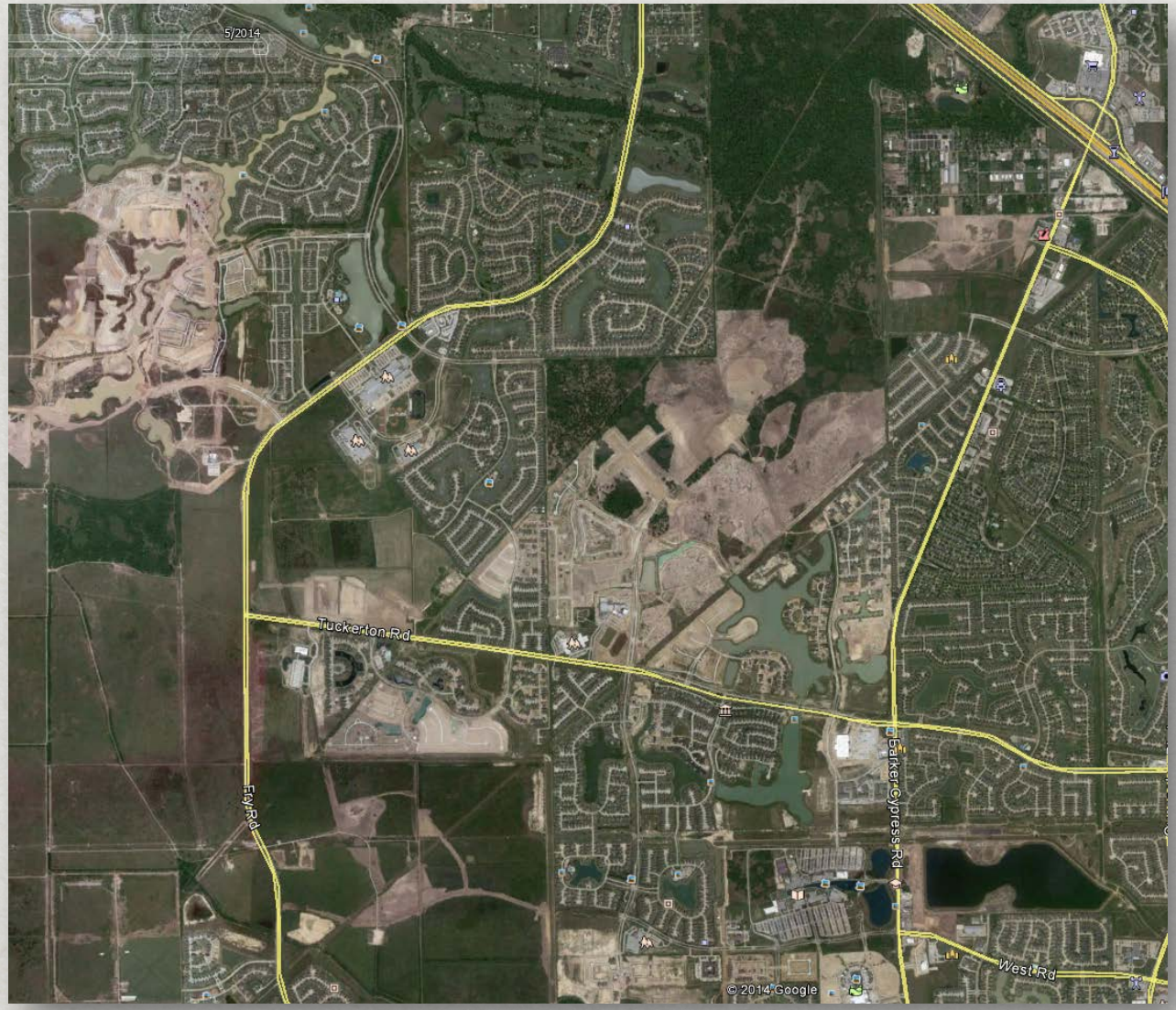
HARRIS COUNTY FLOOD CONTROL DISTRICT

Upper Langham Creek



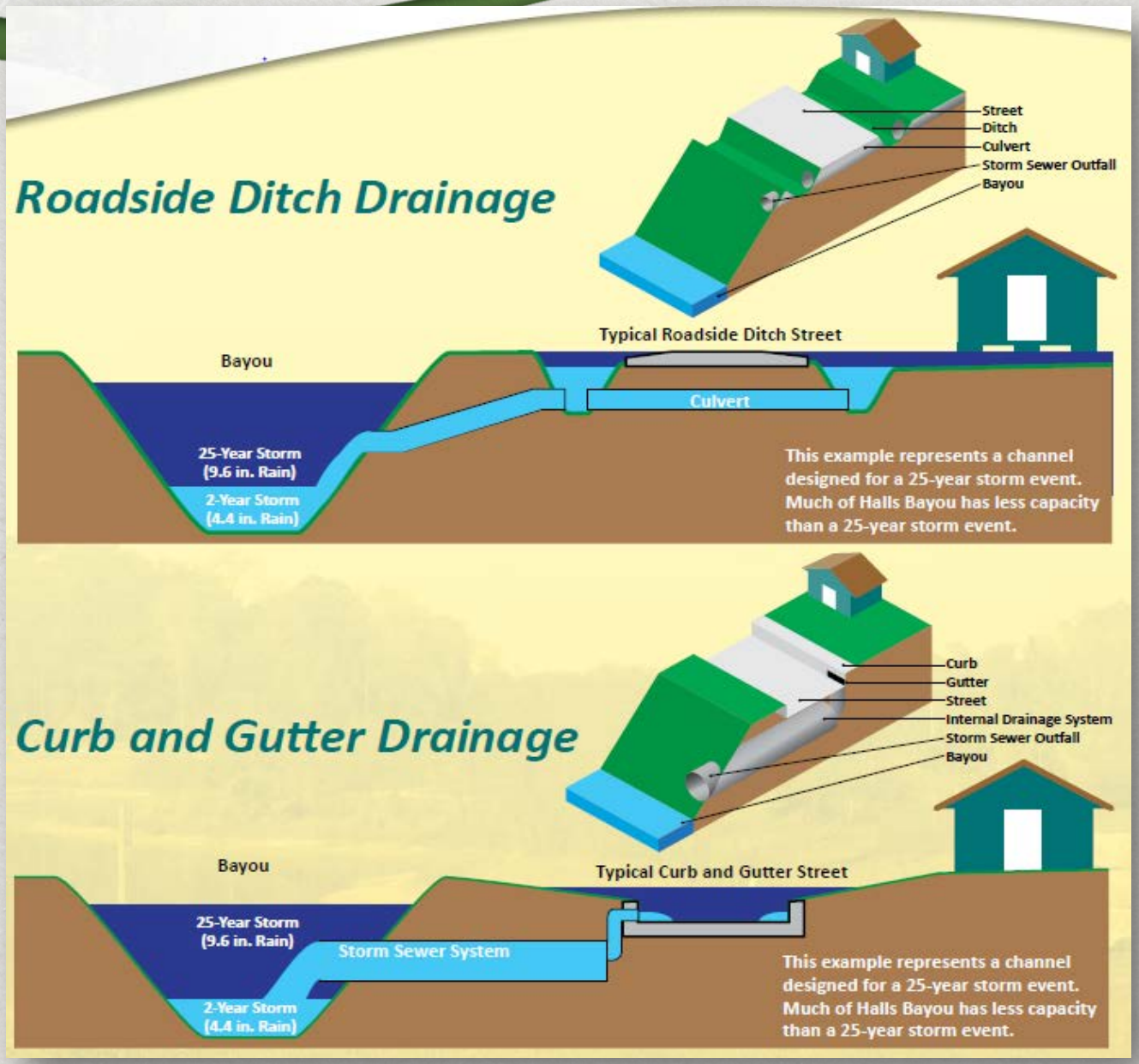
HARRIS COUNTY FLOOD CONTROL DISTRICT

Developing Landscape



HARRIS COUNTY FLOOD CONTROL DISTRICT

Stormwater Systems



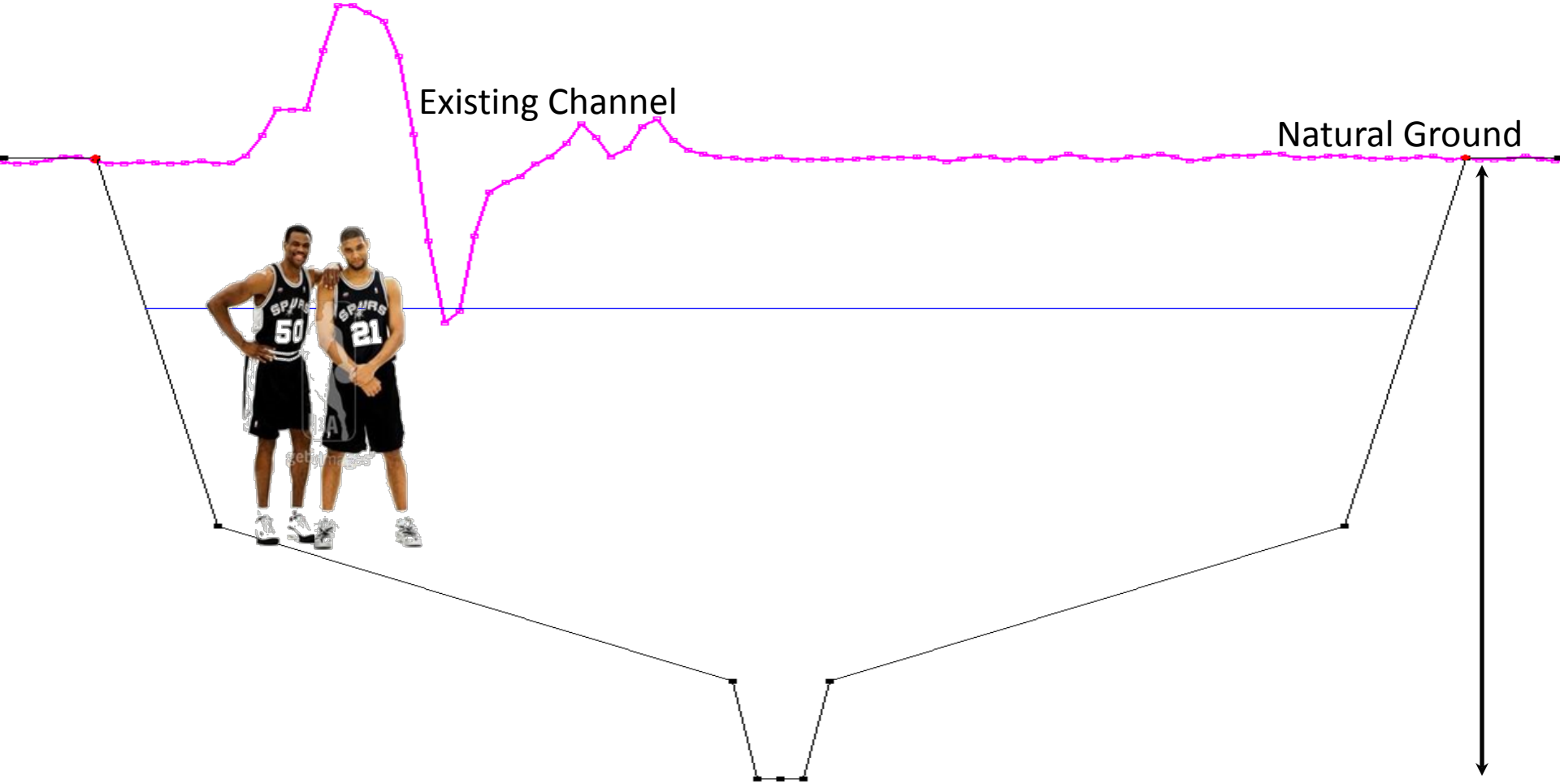
HARRIS COUNTY FLOOD CONTROL DISTRICT

Drainage Options

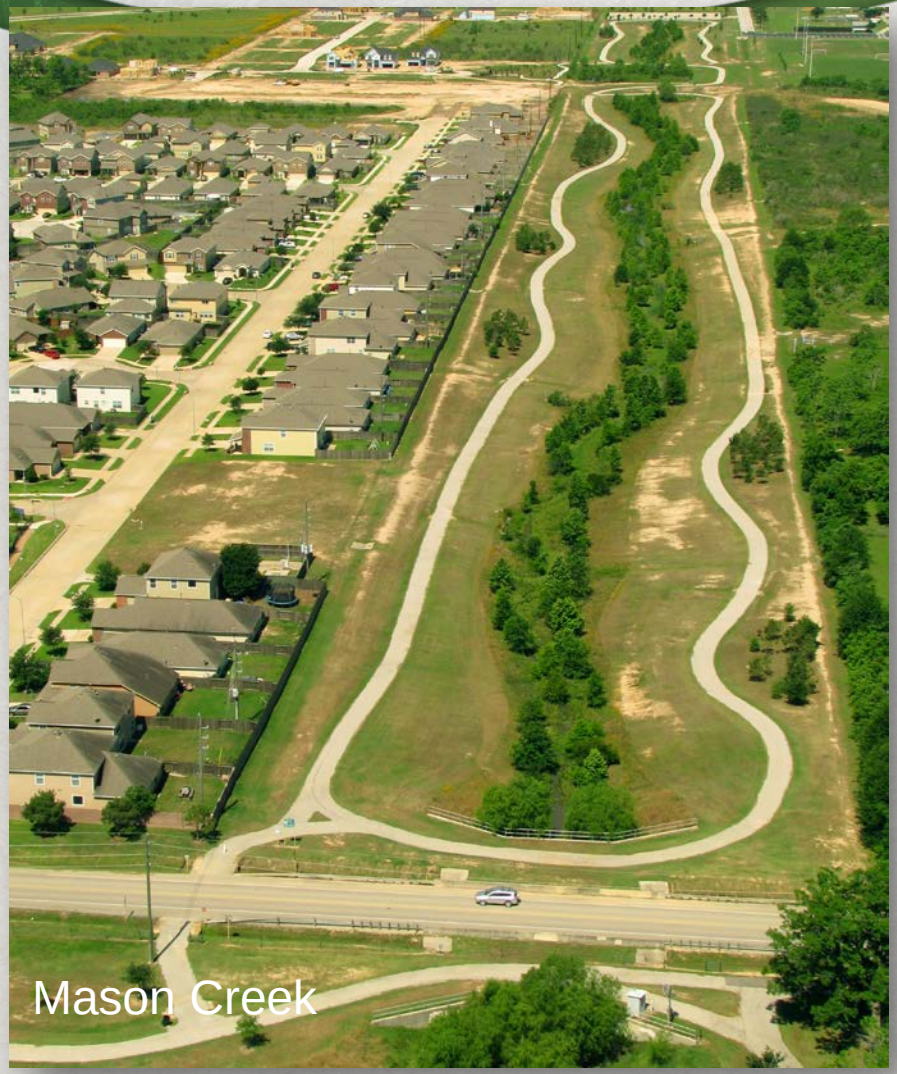
- Natural Drainage
  - Leave creek intact
  - Manage drainage
  - Runoff released as natural flows
- Bypass Channel
  - Leave creek intact
  - Drainage routed to man-made channel
  - Flows split to sustain natural creek
- Corridor Channel
  - Natural creek recreated at depth

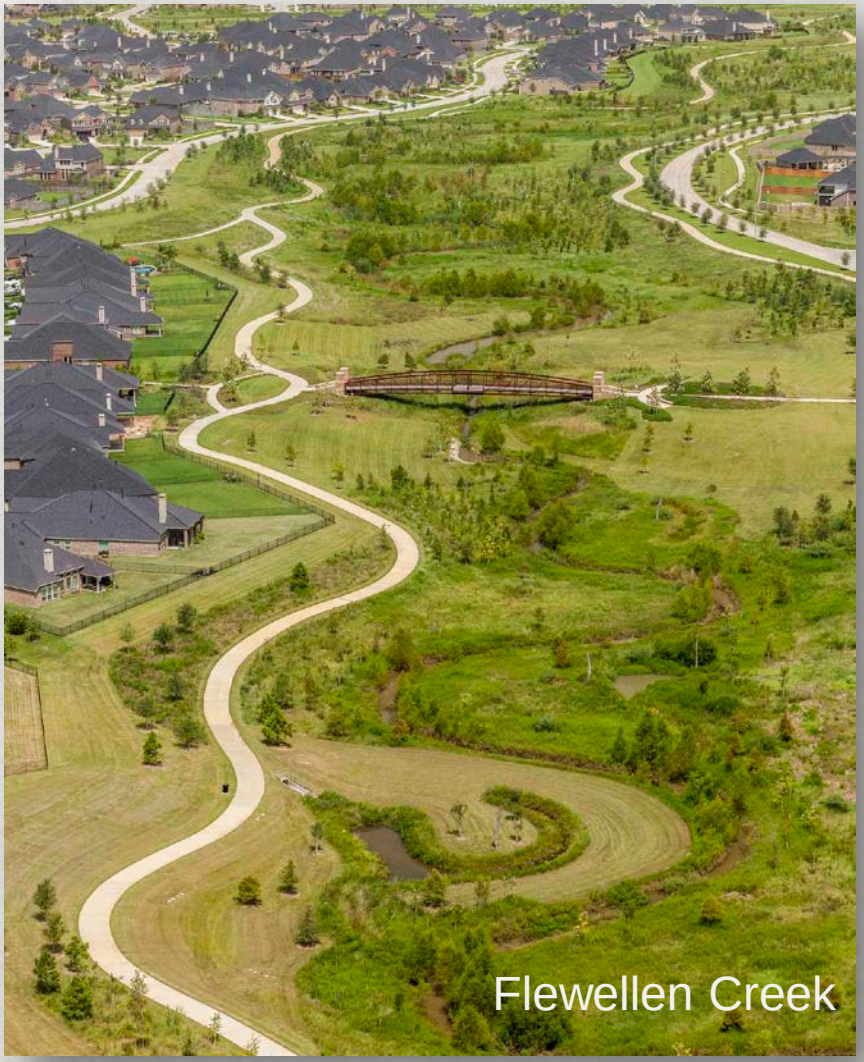
HARRIS COUNTY FLOOD CONTROL DISTRICT

Development: Channel Depths



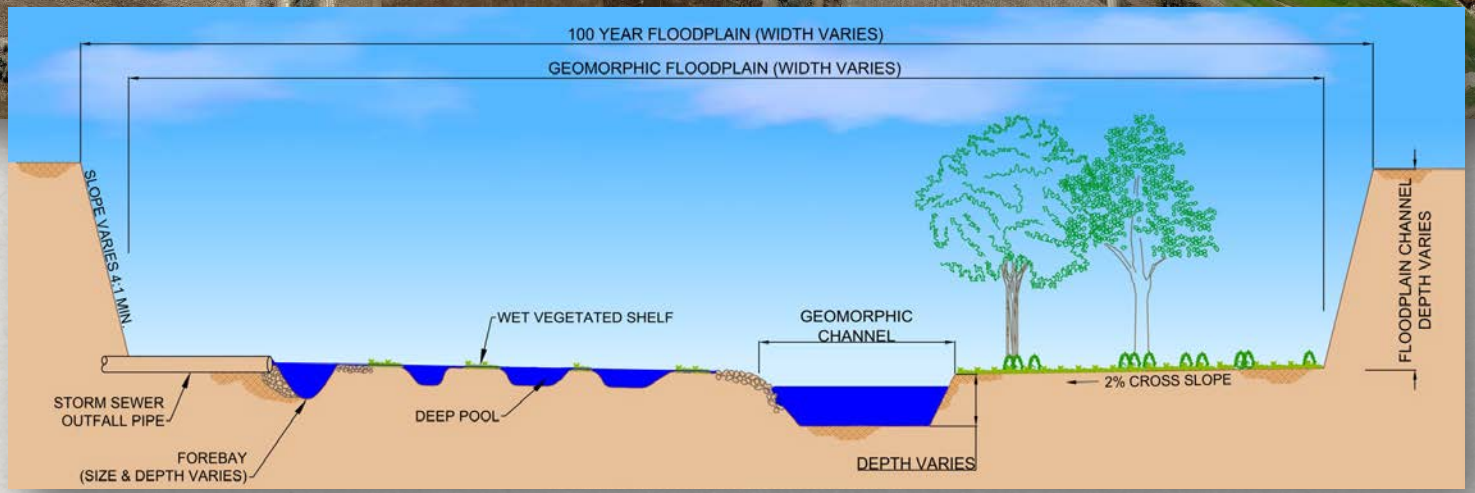
Corridor Channels





HARRIS COUNTY FLOOD CONTROL DISTRICT

Regional Opportunities



HARRIS COUNTY FLOOD CONTROL DISTRICT

Frontier Program Objectives

- Anticipate and Accommodate Future Development
  - Fully developed 1% storm conditions
  - Detention and Floodplain Mitigation
  - Developer and HCFCD Cost Savings
- Satisfy Environmental Requirements
  - Regional Stormwater Quality Features
  - Wetland Mitigation
- Facilitate Multi-Objective Uses
  - Recreational and Aesthetic Improvements
  - Habitat Enhancement

HARRIS COUNTY FLOOD CONTROL DISTRICT

Corridor Channel Design

- Appropriate for “Frontier Areas”
- Flood Damage Reduction – contains 100-year storm event
- In-line detention facility
- Stable bankfull channels with geomorphic floodplain
- BMPs for stormwater treatment
- Riparian recreational areas

HARRIS COUNTY FLOOD CONTROL DISTRICT

Corridor Design Manual

- Design process for perennial and ephemeral corridor channels.
- Stream plan, profile, and dimensions.
- Stormwater interceptor wetland system sizing and configuration.
- Step-by-step guidance to determine best methods to apply to project-specific scenarios.
- Case Study to demonstrate use of Manual for a Langham Creek reach.

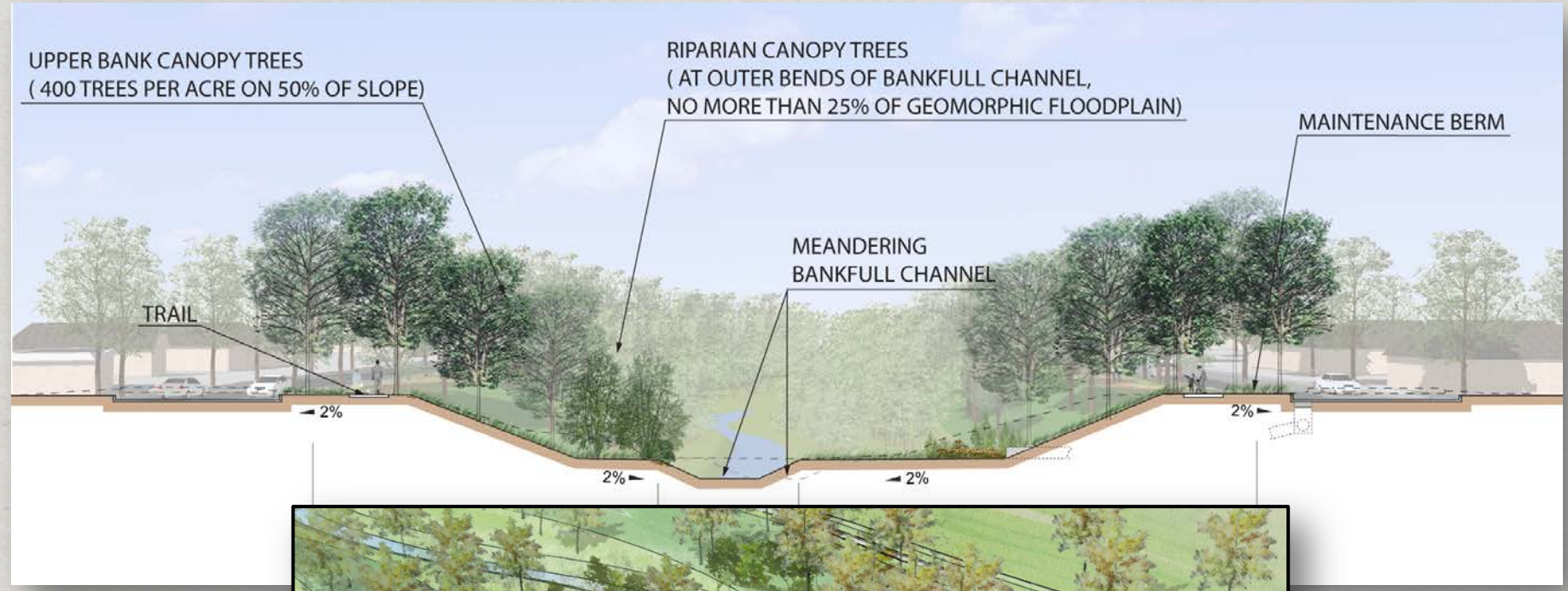
HARRIS COUNTY FLOOD CONTROL DISTRICT

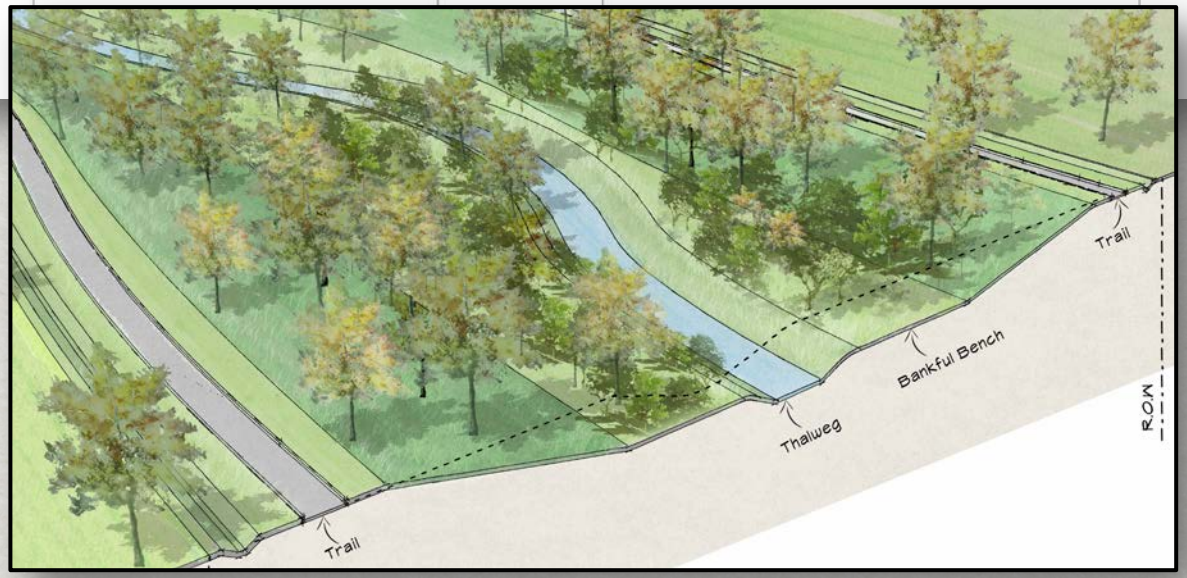
Corridor Design Manual

- Provides engineers with guidance for natural channel design, stormwater wetlands, and plunge pools within the corridor channel.
- Provide designs to improve the natural functionality of the stream corridor
  - Enhance water quality - decrease sedimentation; instream structures increase dissolved oxygen; riparian vegetation for stability and shading
  - Provide habitat – riparian and instream
  - Provide recreation – floodplain trails; multi-use benches

HARRIS COUNTY FLOOD CONTROL DISTRICT

Conceptual Design





HARRIS COUNTY FLOOD CONTROL DISTRICT

Streams will be Streams

HARRIS COUNTY FLOOD CONTROL DISTRICT

Natural Channel Design

Application of a geomorphologic approach to stream restoration, or reconstruction of an unstable channel, based on properties of a natural, stable channel, including:

- Valley type
- Watershed conditions
- Channel dimension, pattern, and profile
- Hydrology
- Sediment transport

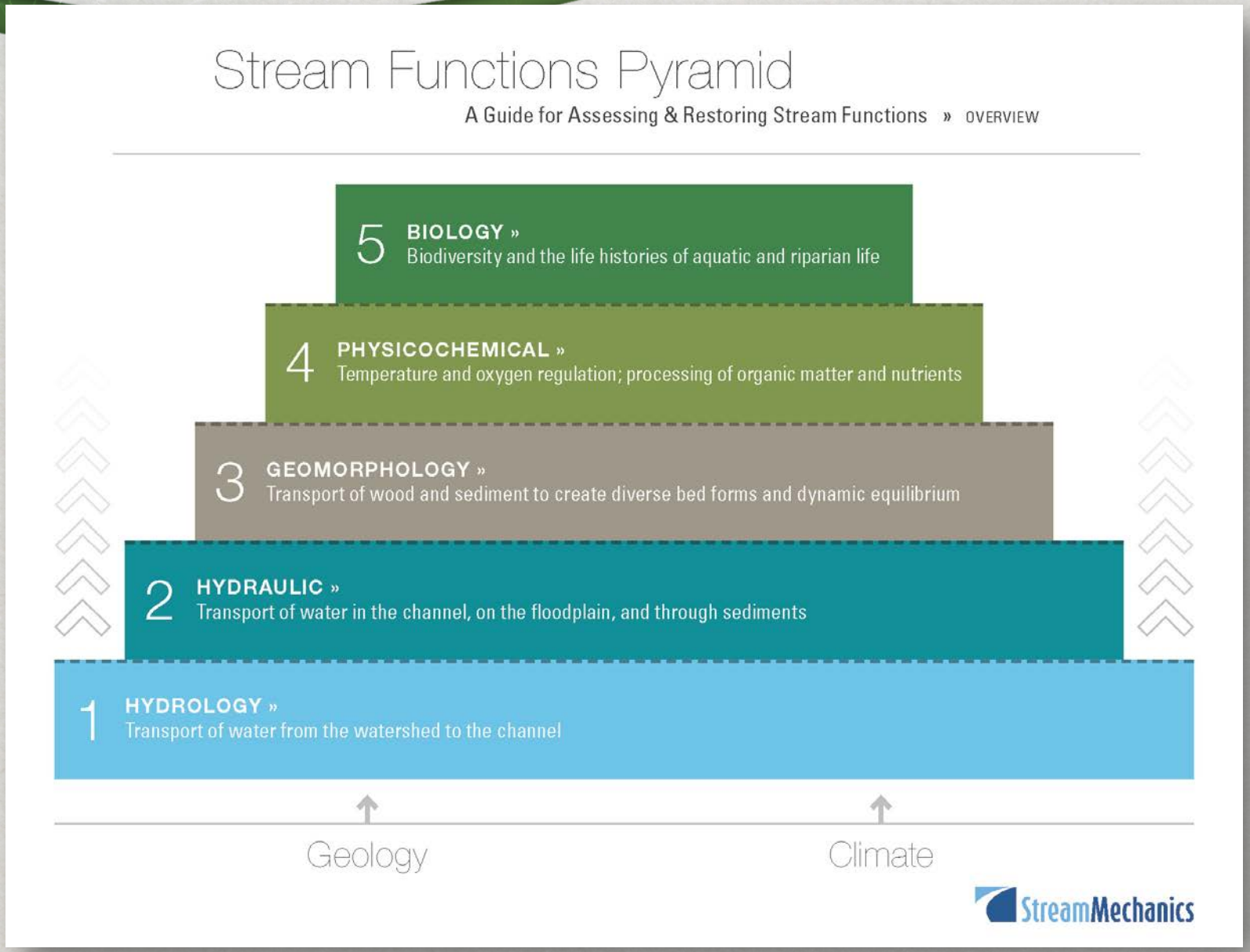
HARRIS COUNTY FLOOD CONTROL DISTRICT

Design Goals

- Carry the water and sediment delivered by the watershed, so that over time, the channel does not aggrade or degrade.
- Create a channel form that maximizes functions, given project constraints.
- Provide areas to treat stormwater through chemical and biological processes prior to entering the main channel.
- Accommodate multi-objective uses.

HARRIS COUNTY FLOOD CONTROL DISTRICT

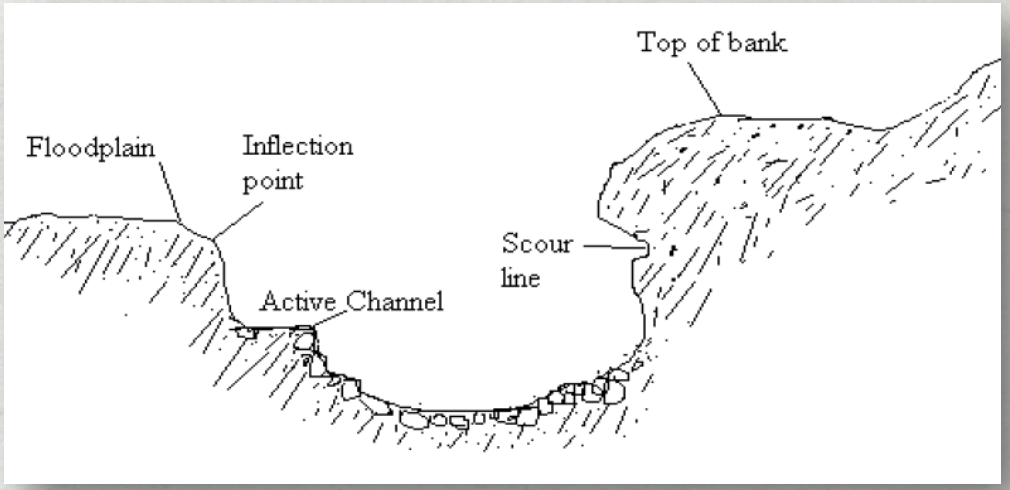
Stream Function Pyramid

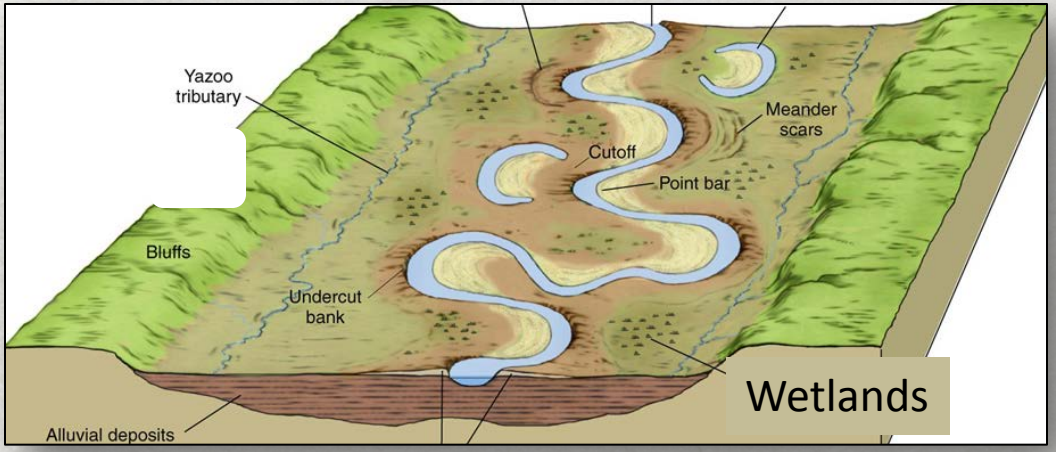


HARRIS COUNTY FLOOD CONTROL DISTRICT

Corridor Design

- Importance of sizing the 1-2 year channel
- Effective sediment transport; efficient discharge of channel forming flows (bankfull)
- Access to broad floodplain; natural levees; meander evolution





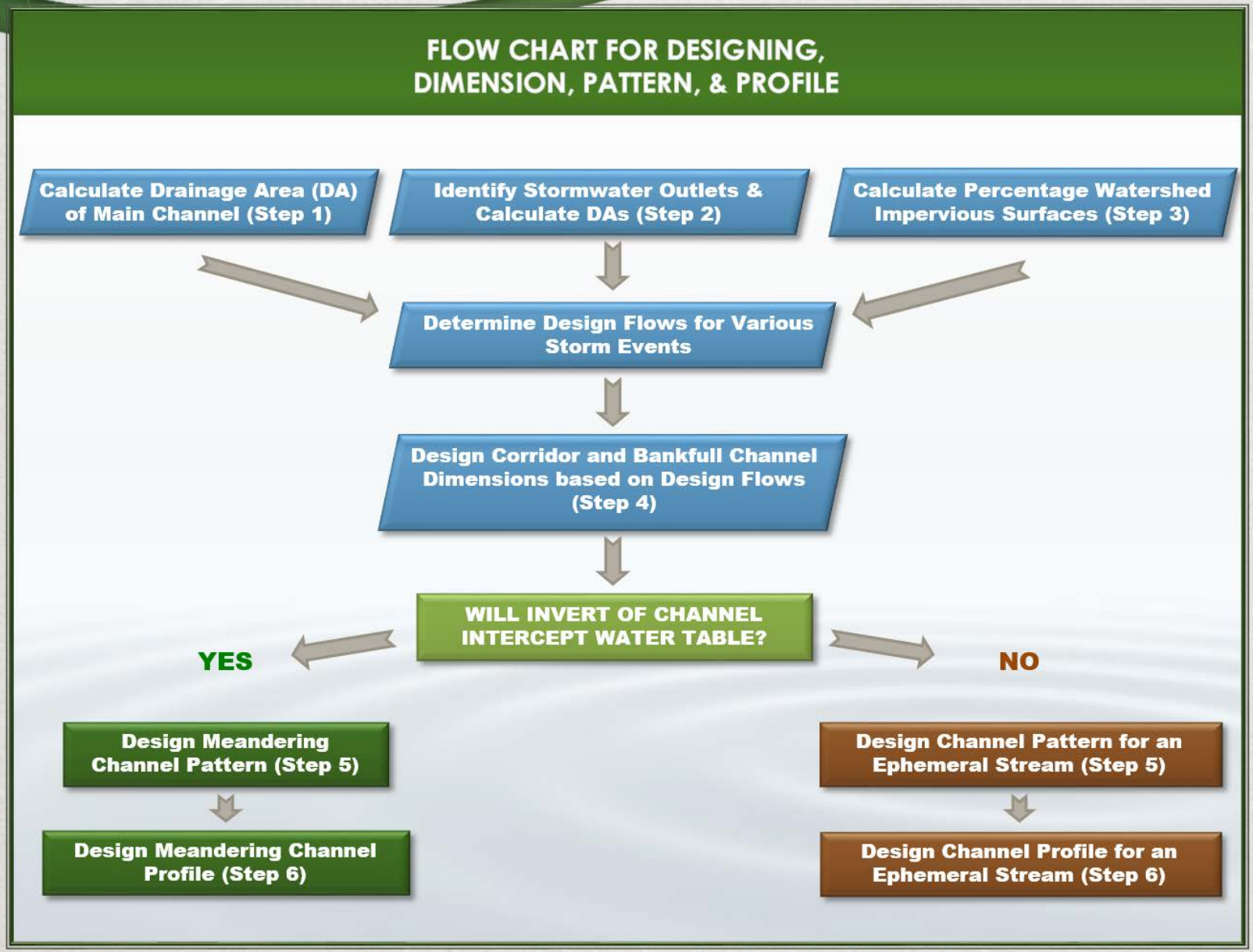
HARRIS COUNTY FLOOD CONTROL DISTRICT

Langham Creek Concept

Meandering Stream within Straight Flood Control Channel

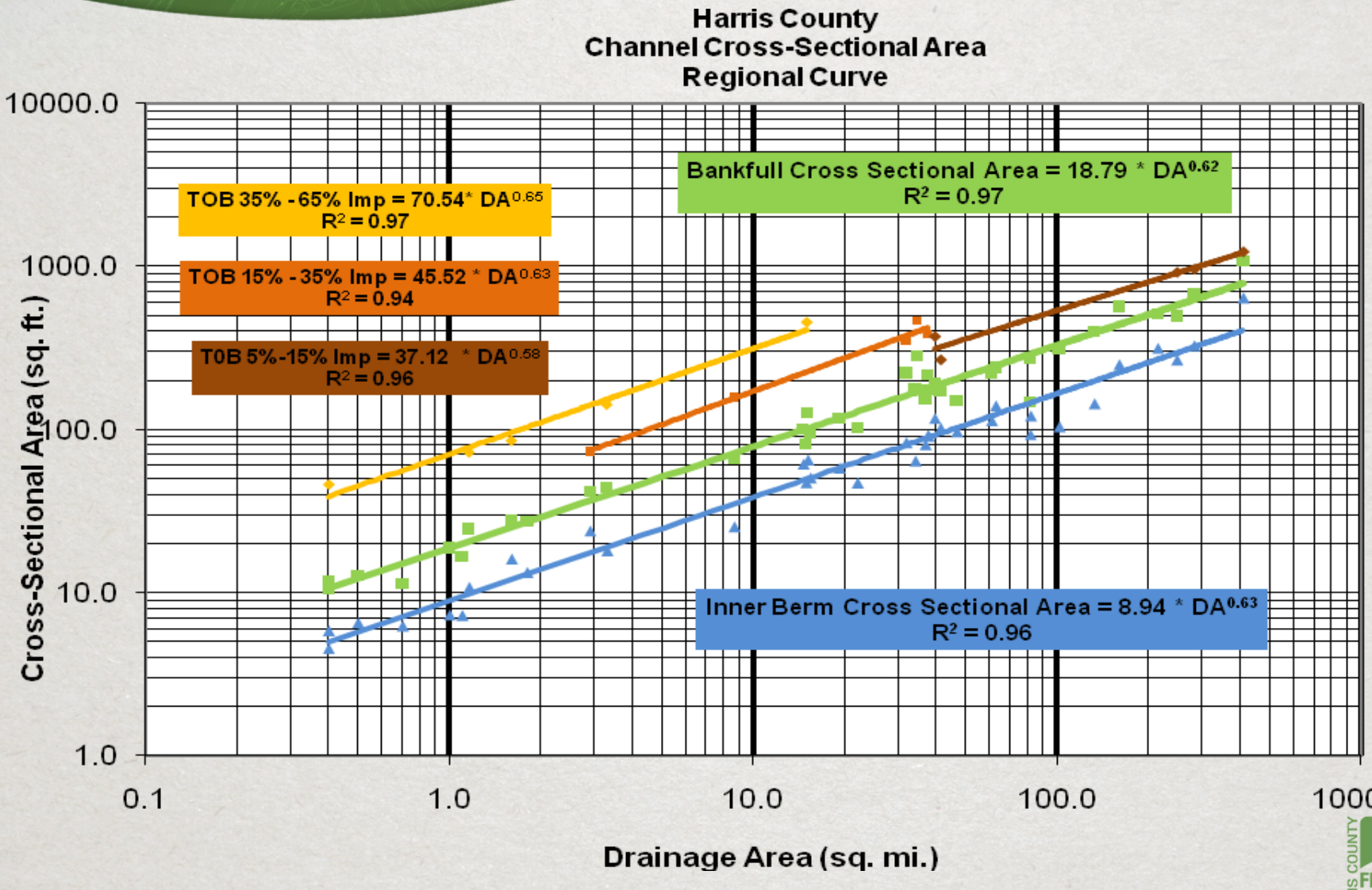
HARRIS COUNTY FLOOD CONTROL DISTRICT

Channel Design



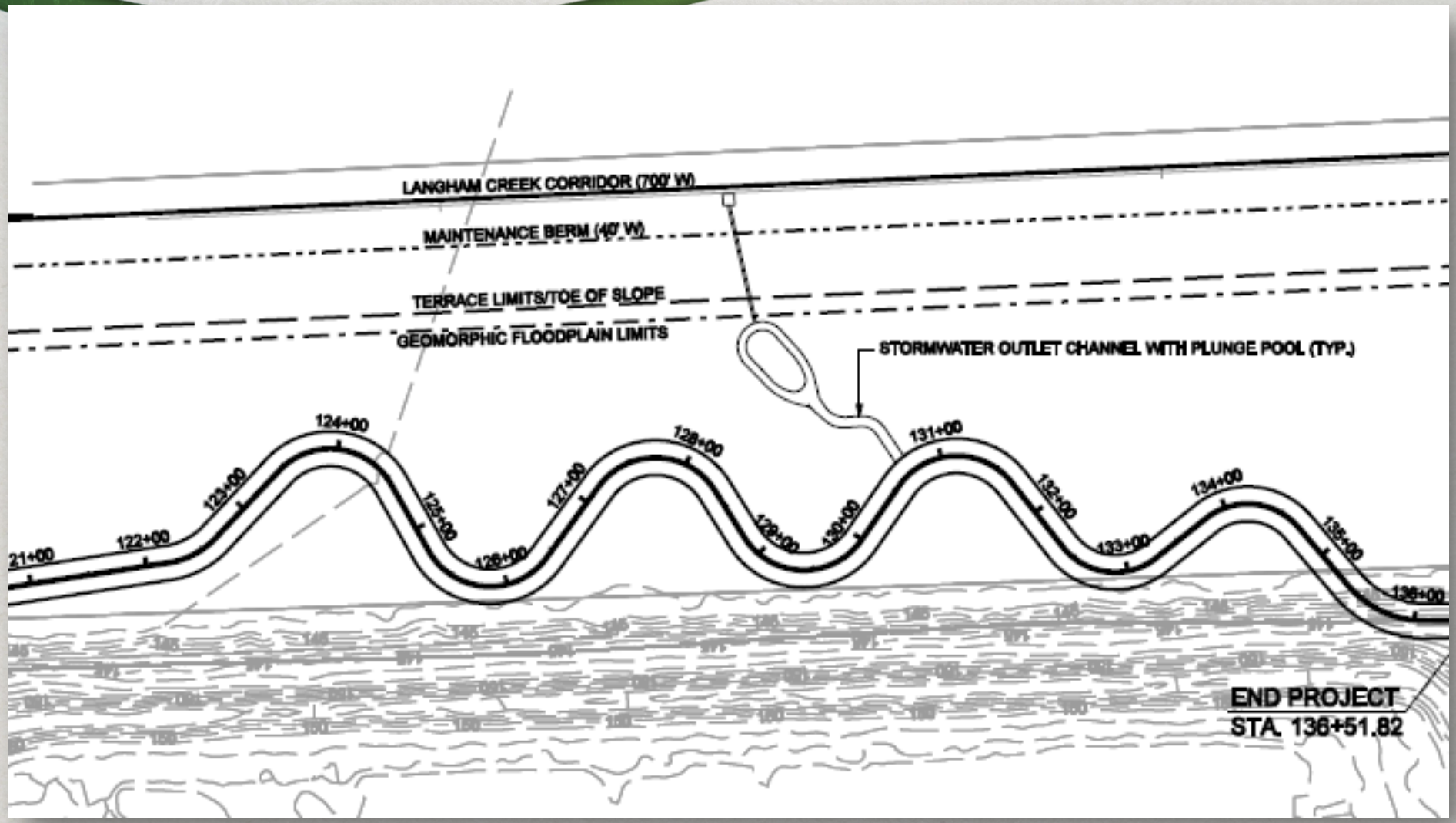
HARRIS COUNTY FLOOD CONTROL DISTRICT

Regional Curves



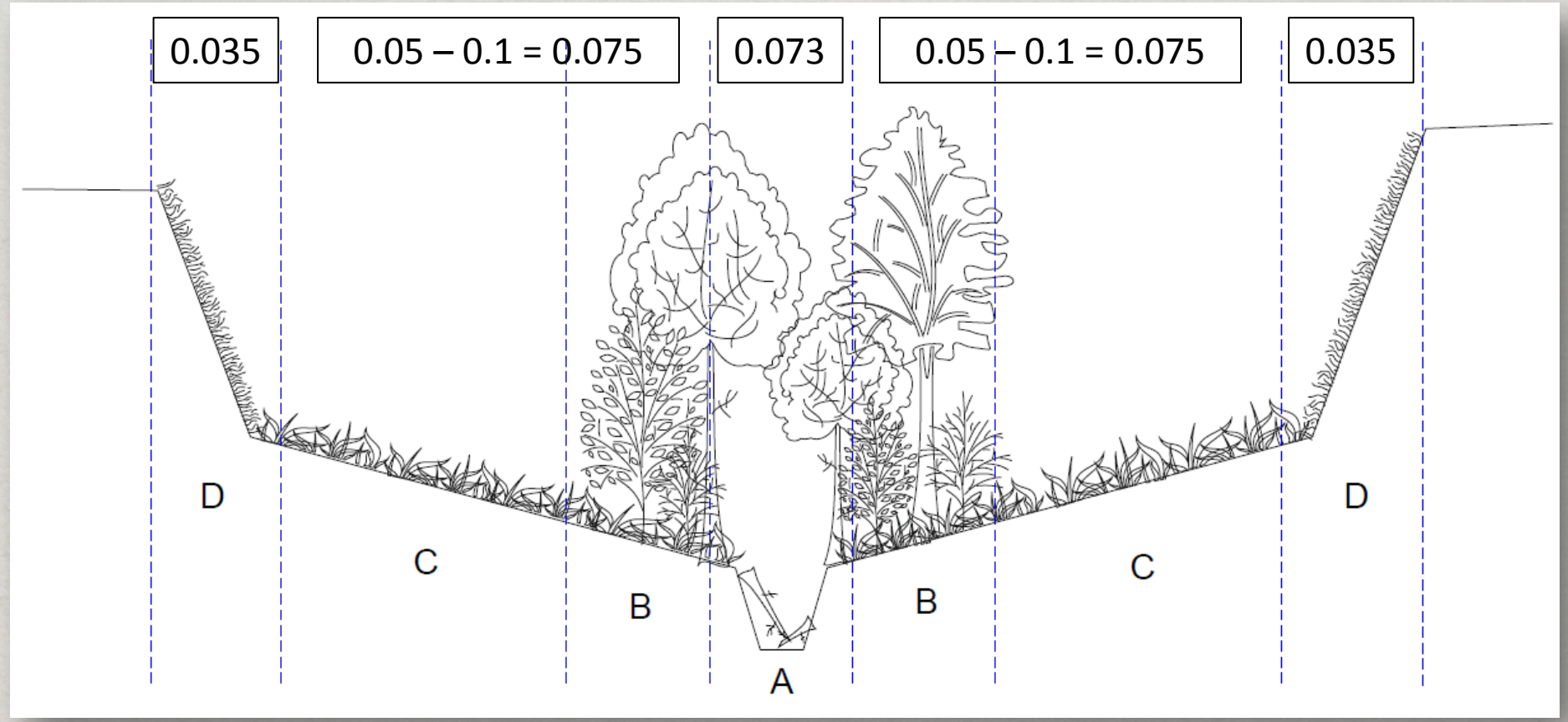
HARRIS COUNTY FLOOD CONTROL DISTRICT

Channel Design



HARRIS COUNTY FLOOD CONTROL DISTRICT

Channel Roughness



HARRIS COUNTY FLOOD CONTROL DISTRICT

Interceptor Wetlands

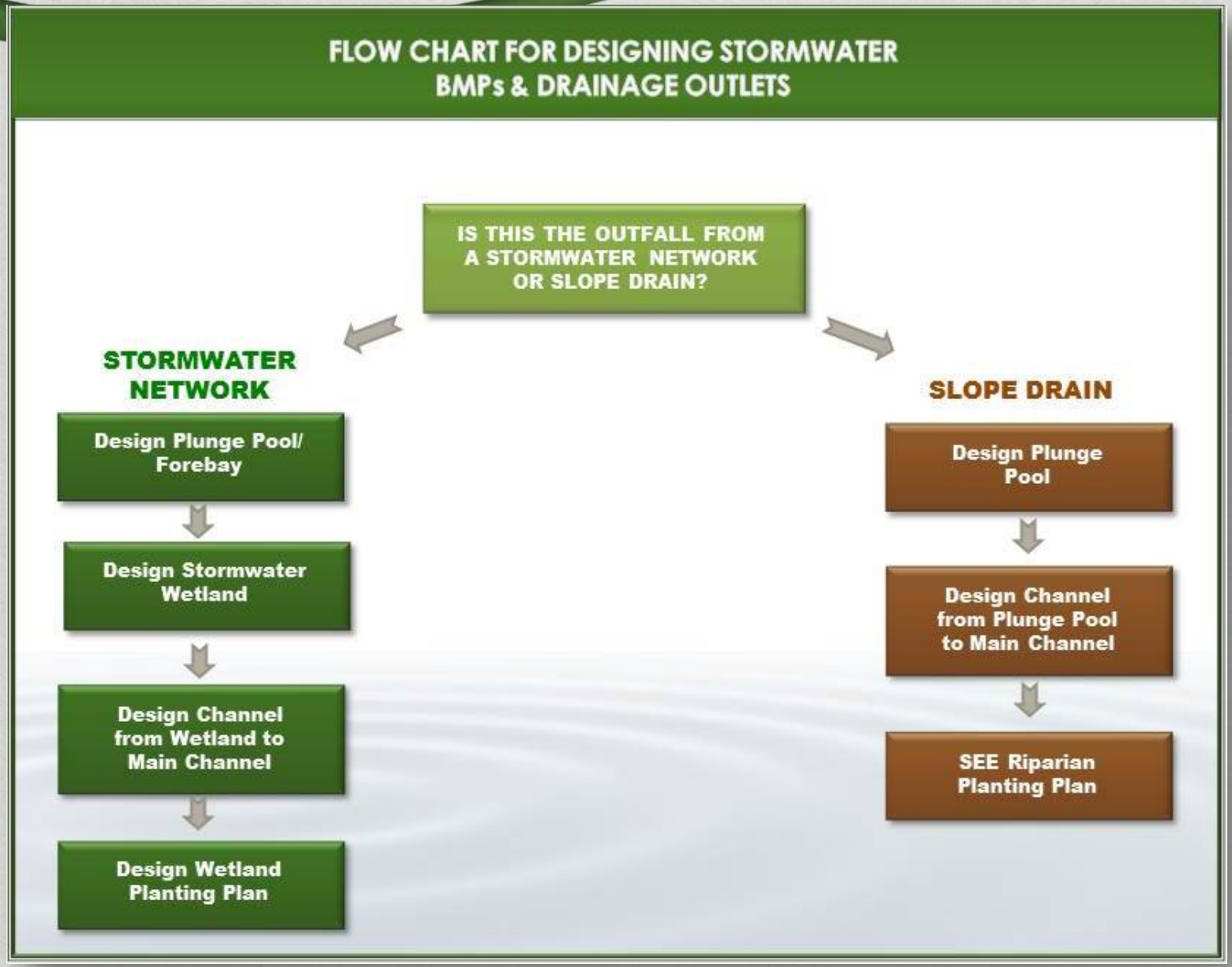
Freshwater Marsh at Brays Bayou

HARRIS COUNTY FLOOD CONTROL DISTRICT

Interceptor Wetlands

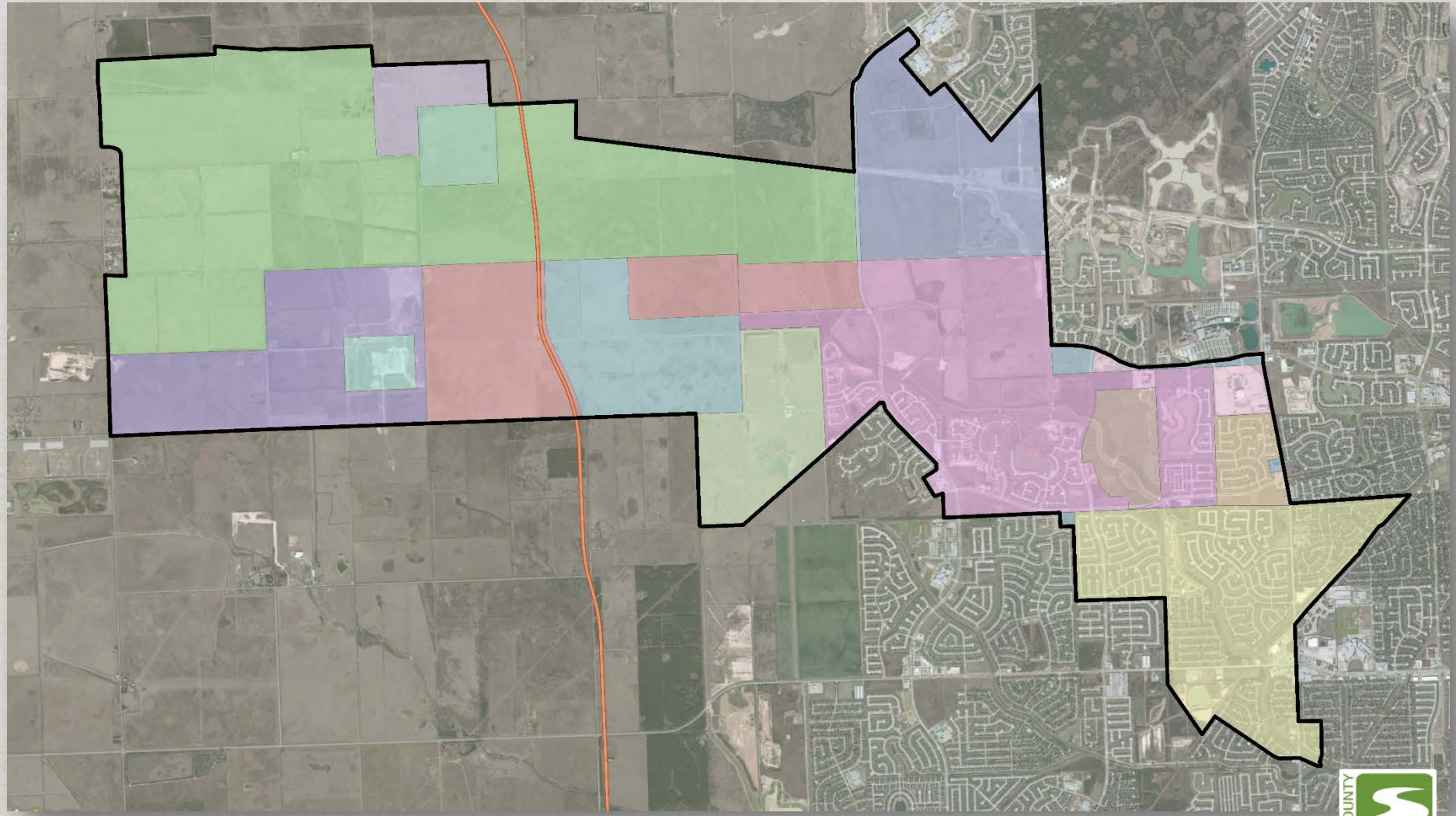
HARRIS COUNTY FLOOD CONTROL DISTRICT

Wetland Design



HARRIS COUNTY FLOOD CONTROL DISTRICT

Multiple Landowners



HARRIS COUNTY FLOOD CONTROL DISTRICT

Technical Reports

TECHNICAL MEMORANDUM

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

10497 Town and Country Way, Suite 600 • Houston, Texas 77024 • 713-600-6800 • Fax 713-600-6801 www.freese.com

TO: Jonathan Holley

FROM Stephanie Coffman, G.I.T. and David Coffman

SUBJECT: Analysis and Conceptual Design of Proposed Water Quality Best Management Practices for the Upper Langham Creek Frontier Program

PROJECT: HCF12353 - Upper Langham Creek Frontier Program

DATE: October 25, 2013

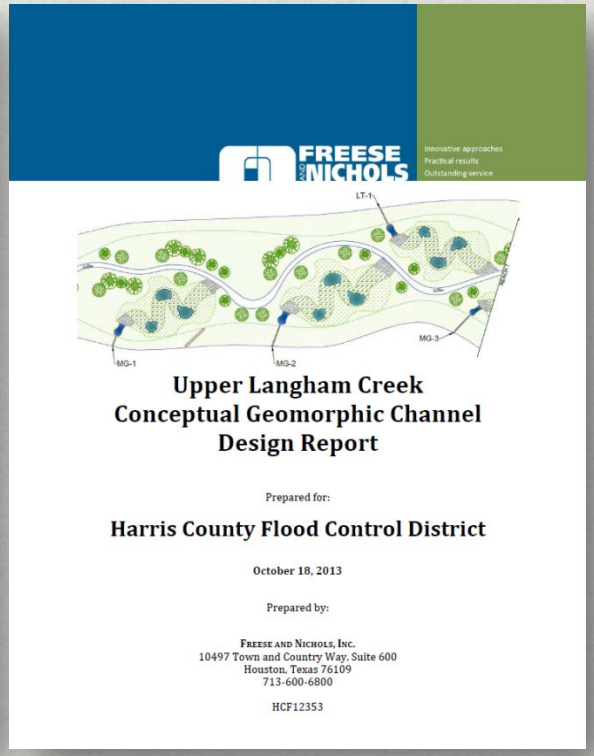
INTRODUCTION

The purpose of this technical memorandum is to document the methodology and criteria to be used by future development to size stormwater quality best management practice features (stormwater wetland BMPs) for the Harris County Flood Control District (HCFCD) Upper Langham Creek Frontier Program (ULC Program). The conceptual BMPs described in this technical memorandum will, in combination with the conceptual natural channel design of the ULC Program corridor, result in a comprehensive system design which will address the needs of the ultimately developed Upper Langham Creek Service Area. In addition to the potential water quality and erosion reduction benefits provided by these features, they will also help the HCFCD and ULC developers satisfy the requirements of HCFCD's future Upper Langham Creek Regional Stormwater Quality Permit.

Freese and Nichols, Inc. (FNI) sized stormwater wetland BMPs for 26 proposed storm sewer outfalls using the criteria outlined in the draft HCFCD Natural Channel and Best Management Practices Design Guidelines for Corridor Channels Final Draft (HCFCD, December 2012 Draft). The resulting conceptual BMP dimensions are listed on page 9 of this technical memorandum.

BACKGROUND

The project area is located in Harris County, TX, northwest of the City of Houston (Figure 1). HCFCD provided FNI with the locations of 26 proposed future outfalls based on conceptual plans from developers with the understanding that the locations are subject to change. FNI estimated drainage areas for each of the outfalls based on their proposed locations. Table 1 contains the pertinent data for each outfall including: developer, drainage area and 10-year peak discharge from Upper Langham Creek Hydrologic (HEC-HMS) model subbasins (FNI, 2013). The developers for the project area include BGM



FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Upper Langham Creek Conceptual Geomorphic Channel Design Report

Prepared for:

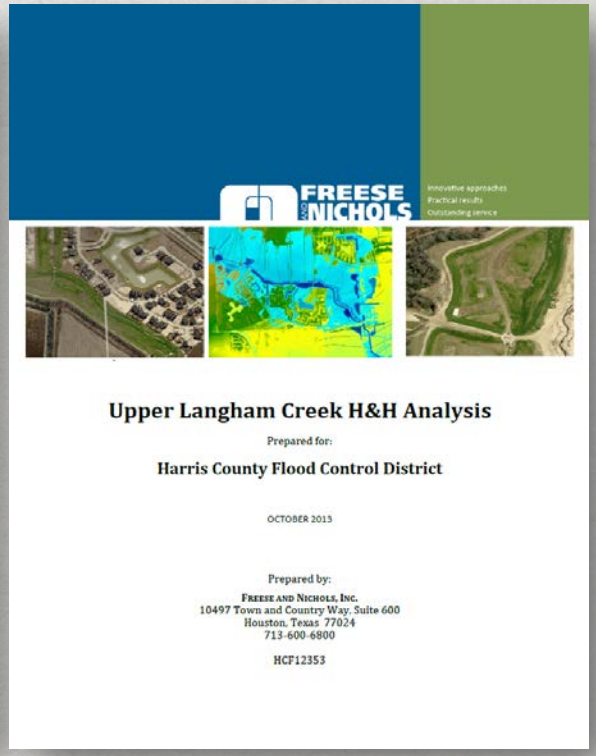
Harris County Flood Control District

October 18, 2013

Prepared by:

FREESE AND NICHOLS, INC.
10497 Town and Country Way, Suite 600
Houston, Texas 76109
713-600-6800

HCF12353



FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service

Upper Langham Creek H&H Analysis

Prepared for:

Harris County Flood Control District

OCTOBER 2013

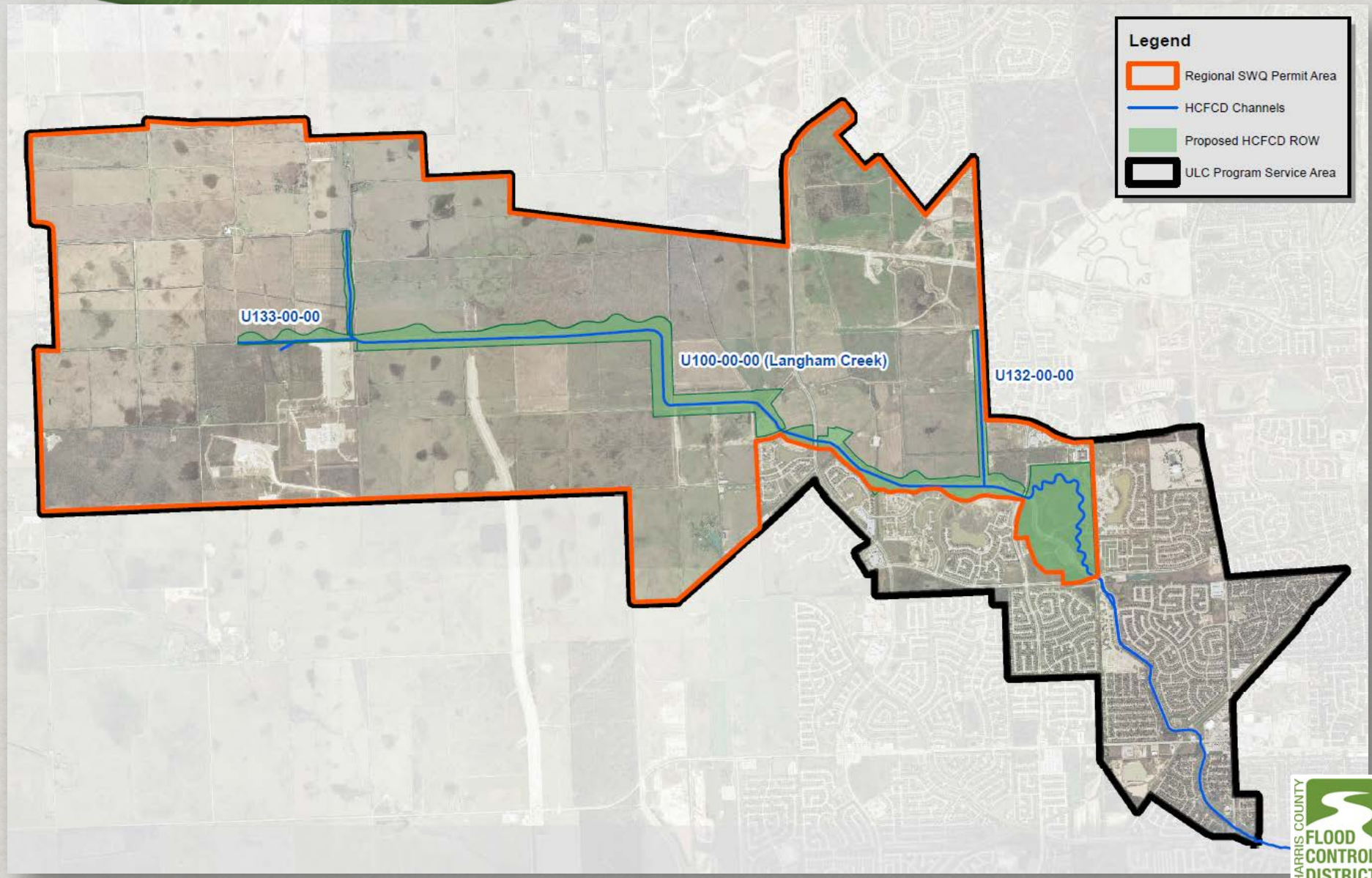
Prepared by:

FREESE AND NICHOLS, INC.
10497 Town and Country Way, Suite 600
Houston, Texas 77024
713-600-6800

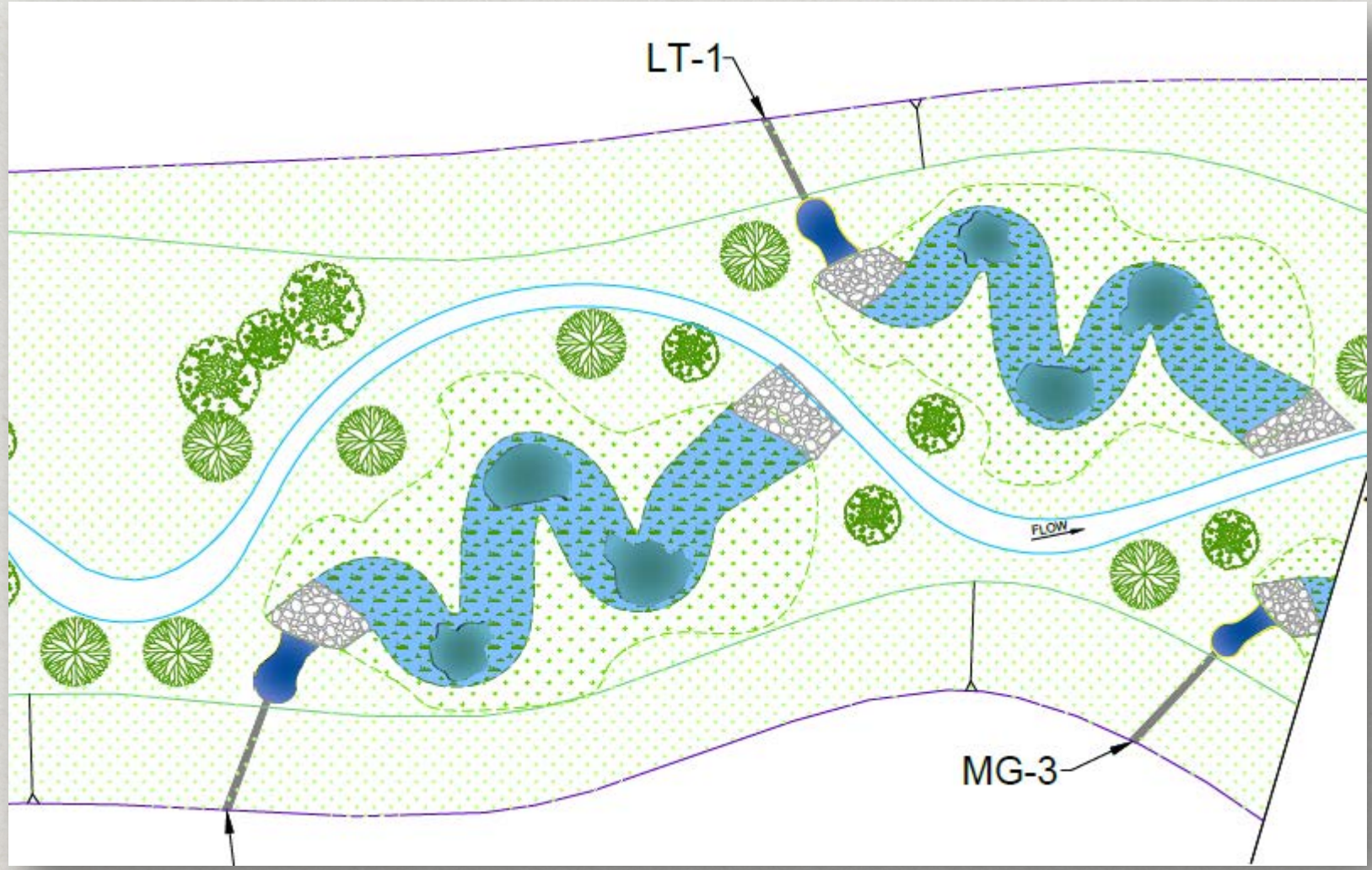
HCF12353

HARRIS COUNTY FLOOD CONTROL DISTRICT

Stormwater Quality



Stormwater Quality

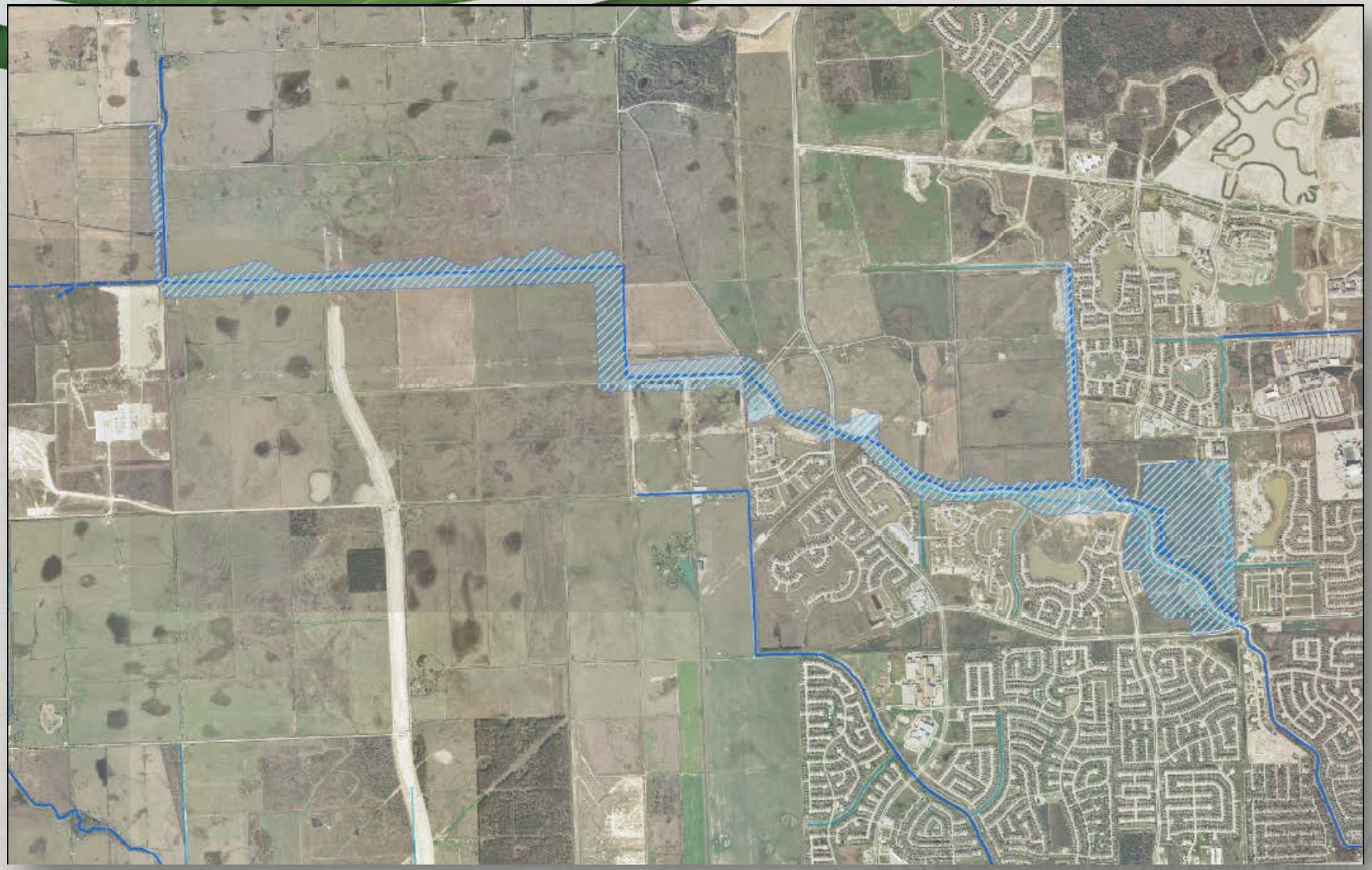


HARRIS COUNTY FLOOD CONTROL DISTRICT

Stormwater Quality

HARRIS COUNTY FLOOD CONTROL DISTRICT

HARRIS COUNTY FLOOD CONTROL DISTRICT



Questions?

Carolyn White
Harris County Flood Control District
carolyn.white@hcfcd.org
713-684-4128

Sonny Kaiser
Ecosystem Planning and Restoration
skaiser@eprusa.net
832-399-3400