Environmental Institute of Houston

- *Mission: to help people in the Houston region participate more effectively in environmental improvement.*
- Research, Education and Outreach
- Part of the University of Houston System
- Numerous partnerships
- Located on the UHCL campus

Established in 1993

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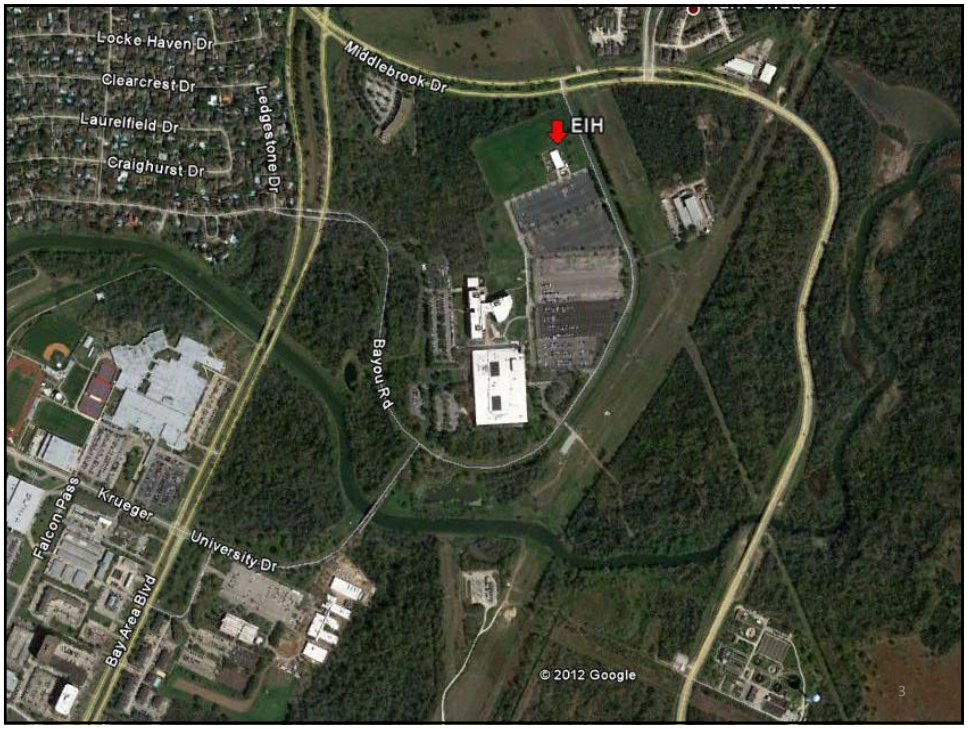
Locke Haven Dr
Clearcrest Dr
Laurelfield Dr
Craighurst Dr
Ledgestone Dr
Middlebrook Dr
EIH
Bayou Rd
Falcon Pass
Krueger
University Dr
Bay Area Blvd
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3


Our Home…..
and other wetland

The Galveston Bay Estuary Program of the Texas Commission on Environmental Quality is charged with implementing *the Galveston Bay Plan*...The second priority described in *the Plan* is to improve water quality by controlling and, where possible, eliminating non-point sources of pollution.

5

Armand Bayou is currently listed as impaired due to elevated levels of bacteria and suppressed levels of dissolved oxygen. The bayou is currently being evaluated to determine if a bacteria TMDL is warranted from an initial listing in 1998.

6

Recent stormwater samples indicate that fecal coliform counts are high in UHCL stormwater runoff.

Additional water quality issues in Horsepen Bayou:

•Dissolved Oxygen (<2 mg/l contribute to fish kills)
•Chlorophyll a (> 20 ug/l considered problematic)
•Turbidity
•Fish Kills

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Outline

- History of the Project
- Project Goals
- Project Timeline Overview
- Source of funding
- Major tasks
  - UHCL support
  - Application Process
  - Contractor Selection
  - Construction
  - Post Project Maintenance
  - Post Project Monitoring & Research
- Results (in progress)
- Lessons Learned

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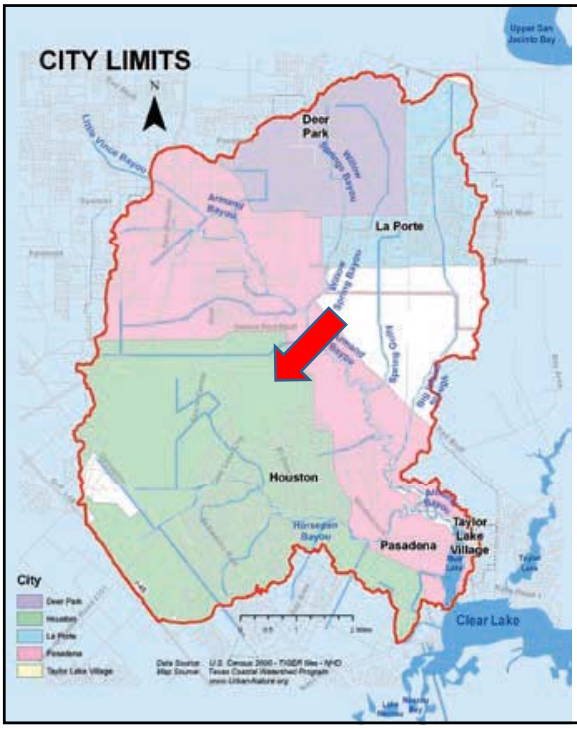

Armand Bayou Watershed

- Project Location: Horsepen Bayou
  - largest tributary
  - 33% of AB watershed
- Impaired waterbody:
  - Elevated bacteria
  - Depressed D.O.
  - TMDL

Armand Bayou Watershed size: 59.1 sq miles (37,822 ac)
From Armand Bayou Watershed Plan Phase I

Project Goals

- Improve water quality in Armand Bayou watershed
  - Stormwater treatment from UHCL campus
  - Target pollutants: bacteria, nutrients & suspended solids
- Evaluation of alternative technology – solar pump
- Habitat for fish and wildlife
- Research opportunities
- Educational resource
- Aesthetically pleasing outdoor area




To address these problems, the project has implemented two structural best management practices (BMPs):

1) constructed wetland to treat stormwater, and
2) feasibility study – use a solar pump to treat water withdrawn from impaired water body

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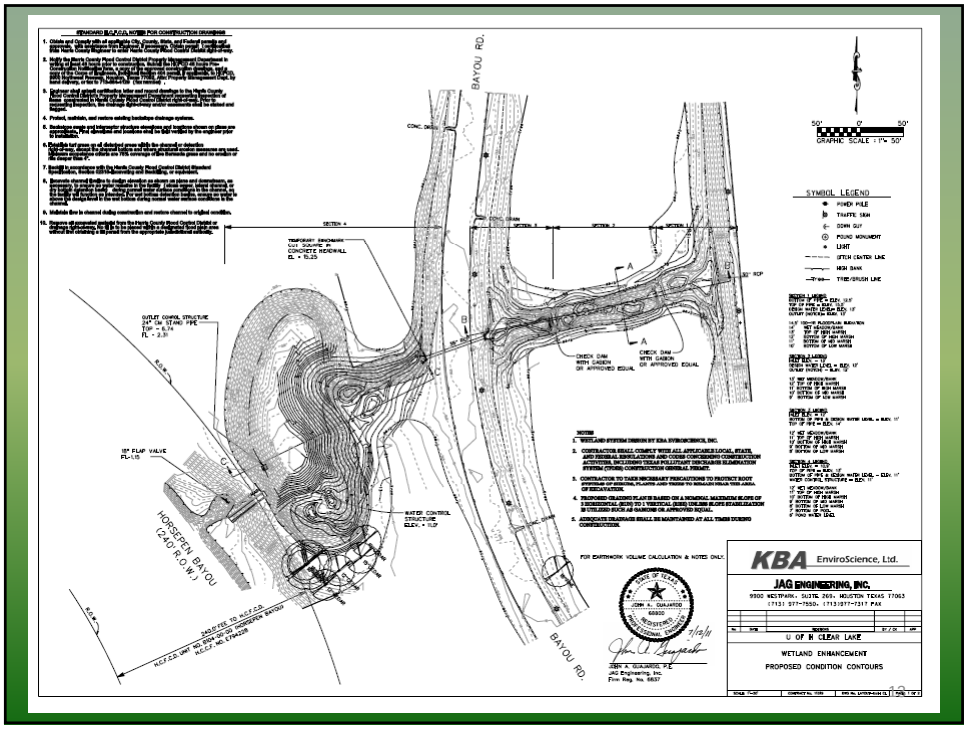
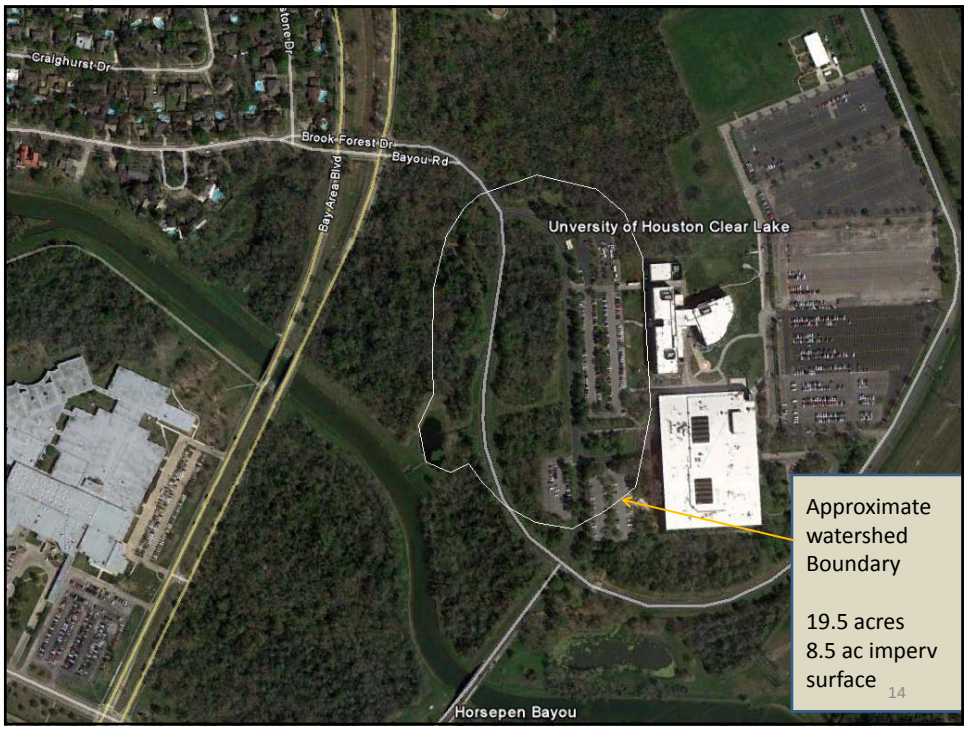
CONCEPTUAL DESIGN

•Increase retention time of stormwater by enlarging ponded areas
•Create a minimum of 0.09 ac of wetland w/ample shallow wetland

Created 0.56 ac of wetland – impacted 0.25 ac of borrow pond and ditch


BAYOU RD.
HORSEPEN BAYOU
(240' R.O.W.)
BAYOU RD.
SYMBOL LEGEND
KBA EnviroScience, Ltd.
JAG ENGINEERING, INC.
WETLAND ENHANCEMENT
PROPOSED CONDITION CONTOURS


Craighurst Dr
Stone Dr
Brook Forest Dr
Bayou Rd
Bay Area Blvd
Unversity of Houston Clear Lake
Horsepen Bayou
Approximate watershed Boundary
19.5 acres
8.5 ac imperv surface

Project Timeline

- Initial proposal submitted: October, 2007
- Contract executed: August, 2009
  - Total Budget ~$500,000
    - Total Match: ~$110,000
- Design, permitting, & pre-monitoring: 2010
- Construction began: August, 2011
- Ribbon-Cutting ceremony: September, 2011
- Post-Construction monitoring: to Present

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Funding Sources

- GBEP – facilitated funding
- 320 federal funding – EPA
- State GBEP funds
- Match
  - UHCL land
  - UHCL resources
    - Water
    - Volunteers

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Major Tasks

- UHCL Support
- Application process
- Contractor selection
- Construction
- Site Maintenance
- Post-project monitoring and research

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UHCL Support

- Support from administration
  - President
  - Facilities
  - Dean
- Explain function of wetland
- Availability of land to modify?
- Ability to provide long-term support?

University of Houston Clear Lake

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Application Process

- Guidance provided by GBEP
- Internal Support
  - Office of Sponsored Programs
    - legal contractual matters
- UHCL Facilities
  - legal land descriptions
  - background and history of site
  - Underground utilities

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Contractor Selection

- State of Texas/UHCL process followed
- Technical qualifications defined
- Expert panel formed to review applications
- Issues regarding need for engineer:
  - State Bd. of Engineers: variances granted to state Universities for research projects
- Qualified contractor selection instrumental!

KBA EnviroScience, Ltd.
planning, consulting, and restoration

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Permits Obtained

Section 404 COE permit:
•Nationwide Permit 27

HCFCD notification
•Net gain of flood storage below 100-yr floodplain

City of Pasadena notification
•Net gain of flood storage

TCEQ Water Rights Permit
•Pending approval

TCEQ Temporary Water Rights Permit
•Obtained for solar pump

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Construction

- Time-Line
- Drain existing pond
- Minimize environmental impact
- Rely heavily on expertise of contractor
- Required modification post-construction


top of project
drainage ditch
borrow pond
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Upper ditch May 2011
Lower drainage ditch
Alligator Pond May 2011
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Phase 1 or Primary Wetland Construction

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Phase 2 or Secondary Wetland Construction

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Volunteer Community Planting Day (8/27/2011)

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Educational Sign Design

Sign Topics

1) Title Sign
2) How Wetlands Improve Water Quality
3) What is a Wetland
4) Types of Wetland Plants
5) Wetland Wildlife

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Ribbon-Cutting Ceremony at the Created Wetland Site (9/23/2011).

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Post-Construction Maintenance

- Watering
- Weeding
  - Chinese Tallow
  - Johnson Grass
- Supplemental Planting
- Cleaning
  - Solar Panel
  - Boardwalk
  - Signs
- Pump Maintenance
- Lawn Service
- Wear and Tear

Post-Project Monitoring and Research

- Water Quality
  - Nutrients
  - Bacteria
  - Suspended Solids
- Pre vs Post Monitoring
- Site Selection
- Wet vs Dry
  - Grab Samples
  - First Flush Samplers

Matrix	Parameter	Method
Water	TSS	SM 2540 D
	VSS	EPA 160.4
	TDS	SM 2540C
	Sulfate	ASTM D516
	Chloride	SM 4500 Cl⁻ C
	Alkalinity	SM 2320 B
	Chlorophyll-a	EPA 446.0
	E. coli IDEXX	SM 9223-B
	Enterococcus IDEXX	ASTM D-6503-99
	TKN	SM 4500 C
	Ammonia N, Total	SM 4500 NH3-G
	Nitrate, Nitrite Total	SM 4500-NO3 F
	Total P	SM 4500-P E
	O-Phosphate-P, field filtered	SM 4500-P E
	CBOD (Matching BOD done at UHCL) -3	SM 5210B
	TOC	SM 5310 C
Sediment	Total Organic Carbon	EPA 9060
	Grain Size	Standard sieve
	Nitrate, Nitrite Total	EPA 300.0
	Total Phosphorus	EPA 365.2
	TKN	EPA 351.2
	Total Mercury	SW846 7471
	Total Lead	SW846 6010
	Total Cadmium	SW846 6010
Rainfall and Dry Deposition	Ammonia N, Total	SM 4500 NH3-G
	Nitrate, Nitrite Total	SM 4500-NO3 F
	Sulfate	ASTM D516
Plant Tissue	Total Mercury	EPA 6020A
	Total Lead	EPA 6020A
	Total Cadmium	EPA 6020A

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Post-Project Monitoring and Research Cont.

- Determine feasibility of solar pump
  - Intake and Debris
  - Horsepen Bayou Salinity
    - 3 year average ~2000µS
  - Pump Capacity (1 in PVC)
    - Flow rates ~ 0.5 cfm
    - Solar intensity
    - Battery storage

- Encourage additional research projects

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Additional Research Projects

- Biological Assessment
- Vegetation Surveys

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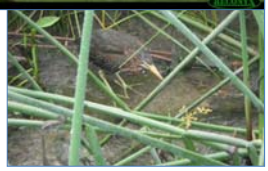
Additional Research Projects

- Biological Assessment
- Vegetation Surveys



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Additional Research Projects

- Residence Time Study
- Grey Water Study
- Biological Assessment
- Vegetation Surveys
- Topographic Mapping
- GIS Modeling

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Results

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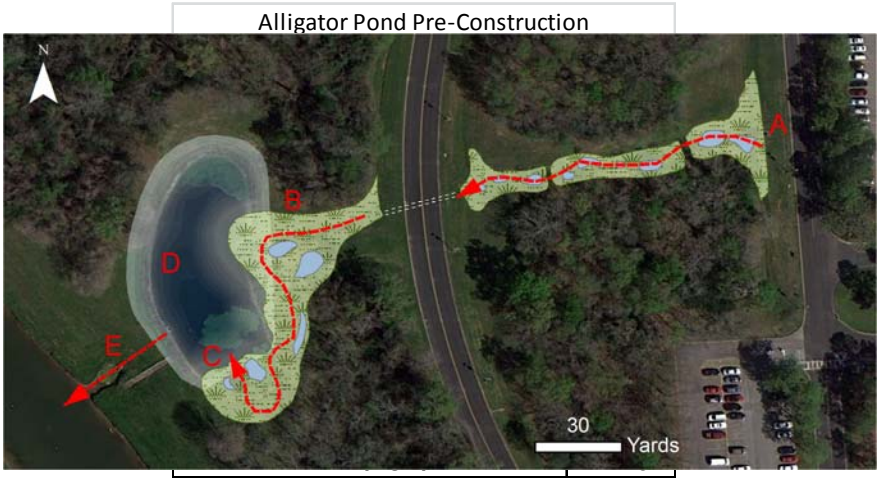
Results Monitoring Pre-Construction



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Results Residence Time Study

Site #	Site Description	Time Dye Detected	Date	Interval (hrs)	Example time
1	Spicket	9:30	3/26/2012	0.00	12:00
2	Outfall of Primary Wetland	13:01	3/26/2012	3.50	15:30
3	Outfall of Secondary Wetland	15:31	3/26/2012	6.00	18:00

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Results Grey Water Study

Site	Site Description	Nitrate+Nitrite (mg/L)	Ortho Phosphate (mg/L)	TKN (mg/L)	Ammonia (mg/L)	Total Phosphorus (mg/L)
1	Spicket	13.15	2.64	3.57	2.44	3.88
2	Outfall of Primary Wetland	0.72	0.38	2.70	0.15	0.57
3	Outfall of Secondary Wetland	0.14	0.23	2.27	0.12	0.35

- Three Events
  - n=9
- Decreasing Trend
- Factors of Influence
  - Dilution factor
  - Holding Time
  - Sedimentation

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Human Use – Dec 2011-March 2013 Arbor Camera

As of 3/20/13	Number of Users with Bike	Number of Users with Dog (s)	Number of Adults	Number of Children	Total User Count
Total Number	396	179	2253	828	3081
Percent of total users	12.9	5.8	73.1	26.9	

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Lessons Learned & Things to Remember

- Partnerships, partnerships!
- Marketing - buy in and support by community
- Timing

Application + bureaucracy of your organization + bureaucracy of the funding agency + permitting = many delays!!!

- Contractor
  - experience
  - flexibility
  - conditions spelled out for unexpected set backs
- Monitoring
- Recognize your partners and congratulate them!!

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Final Steps

- Preparing final report
- Document
  - Changes in wetland vegetation
  - Logistical and design issues
  - Improvements in water quality
  - Performance of solar pump system
  - Fish and wildlife use
  - Recommendations – future sites, lessons learned

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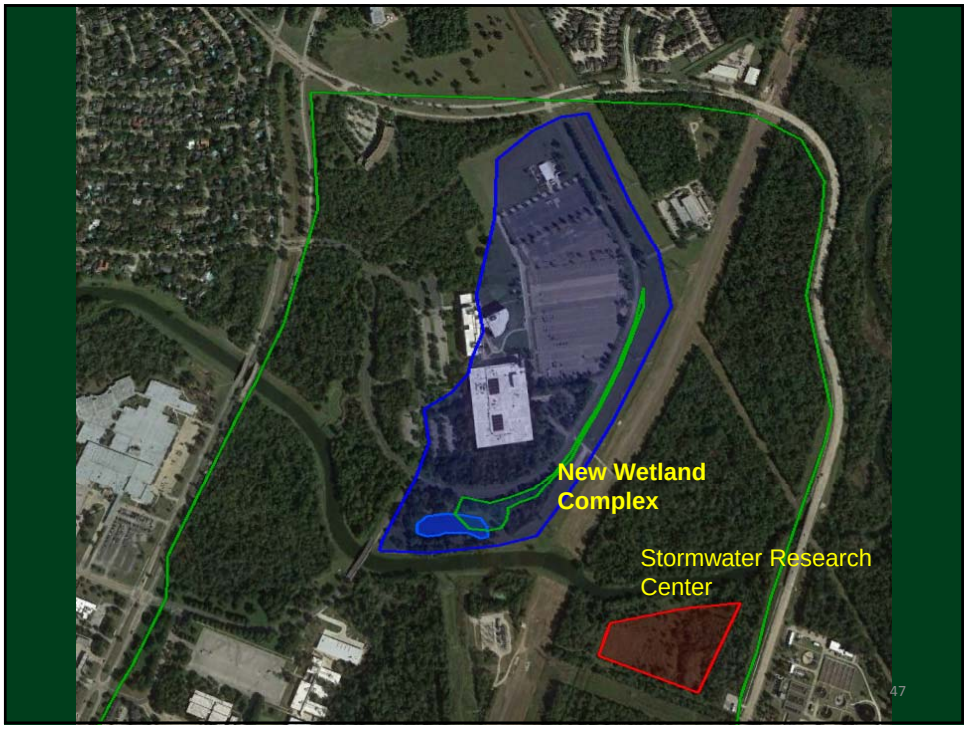

Finding Solutions Together

- Wetland Assessments
- Terrestrial and Aquatic Monitoring
- Sampling technique training
- Mapping and Modeling
- Watershed Assessments

Questions?

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