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The Future Is Now: Flood Forecasting in Harris County, Texas

Andy Yung, P.E., CFM, D.WRE, Walter P Moore and Associates

Ataul Hannan, P.E., CFM, Harris County Flood Control District

Justin Terry, P.E., CFM, Harris County Flood Control District

Jeff Lindner, Harris County Flood Control District

Jeremy Justice, Harris County Flood Control District

Partnership



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Objectives & Definition

- Objective
 - To provide a flood forecasting system capable of estimating a **peak elevation** and a **time-to-peak**
- Purpose
 - A support tool for HCFCF during flood emergency operations
 - It will be a tool—it is not to be a replacement for human judgement/interaction



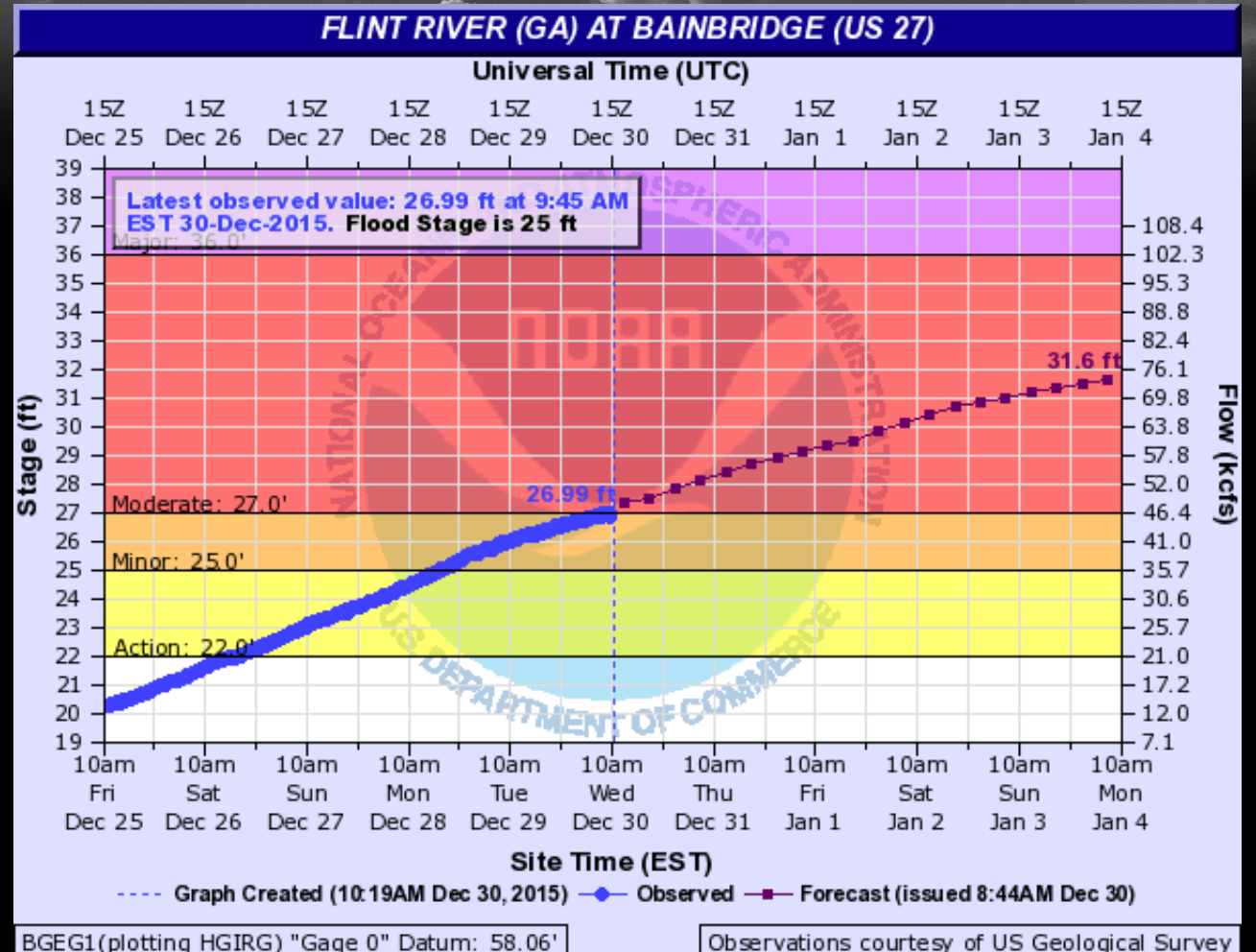
Objectives & Definition

- Definition of “Flood Forecasting”
 - Differs from Monitoring or Warning
 - Monitoring—observing rainfall and flooding events through instrumentation without utilizing data to mobilize emergency operations
 - Warning—observing rainfall and flooding events with the intent to utilize data to better coordinate with emergency personnel to begin evacuations, issue shelter-in-place orders, and/or to close roadways, etc.



Objectives & Definition

- Definition of “Flood Forecasting”
 - **Forecasting** is utilizing as much hydrologic response data as possible to project flooding issues at certain locations with the goal of providing adequate/additional lead time to emergency coordinators and first responders



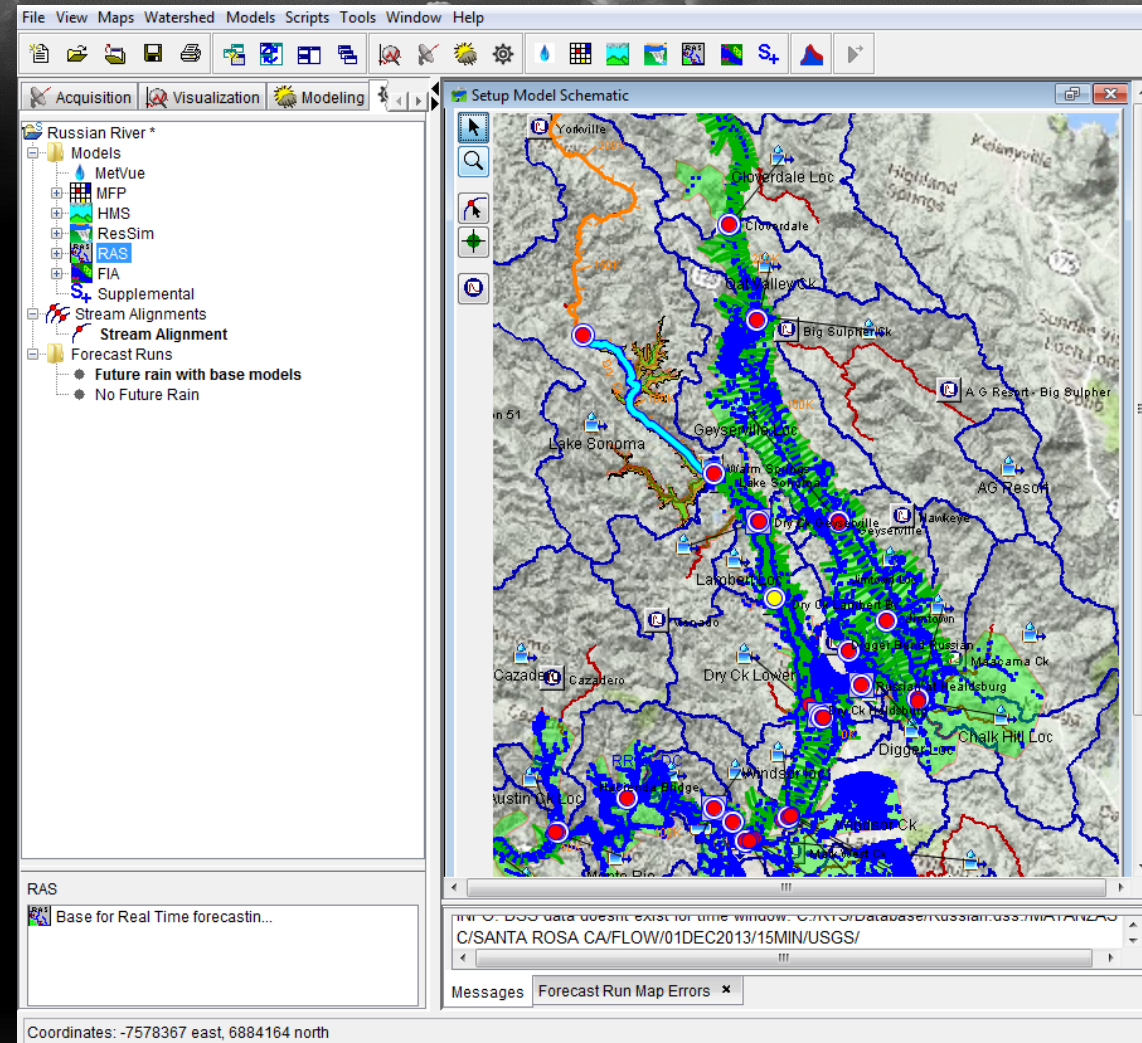
Evaluation Overview

- Task
 - Gathered information on existing flood warning/forecast systems
 - Evaluated how each system arrives at an elevation in time
 - Web Survey
 - Sent to 13 agencies



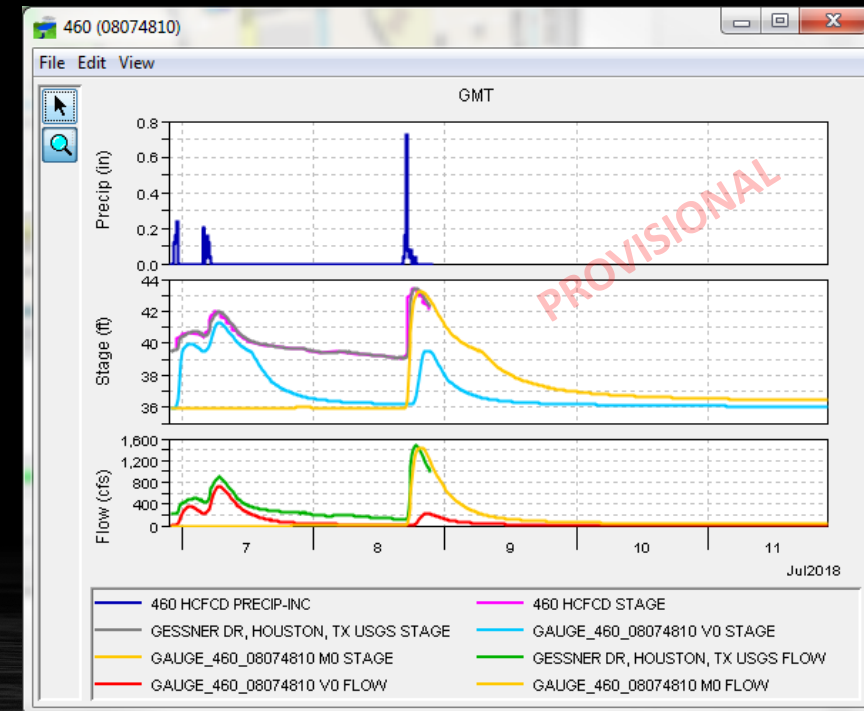
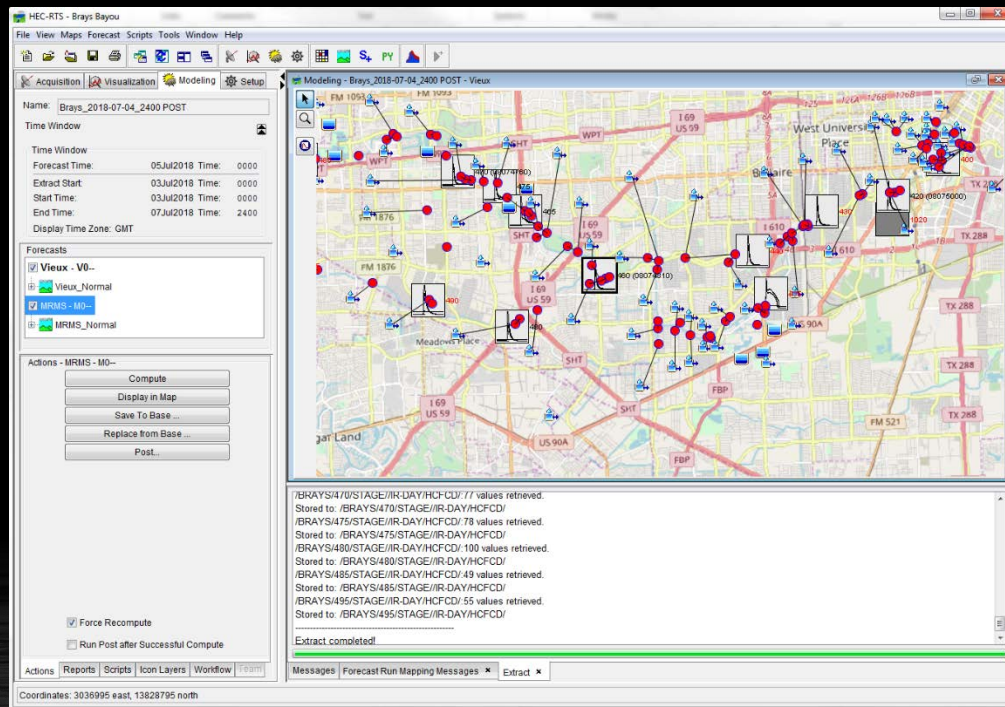
Evaluation Overview

- Task
 - Face-to-face interviews
 - Rice University/Texas Medical Center
 - University of Texas at Arlington
 - West Gulf River Forecast Center
 - City of Austin
 - Vieux & Associates
 - San Antonio River Authority
 - Hydrologic Engineering Center
 - David Ford Consulting



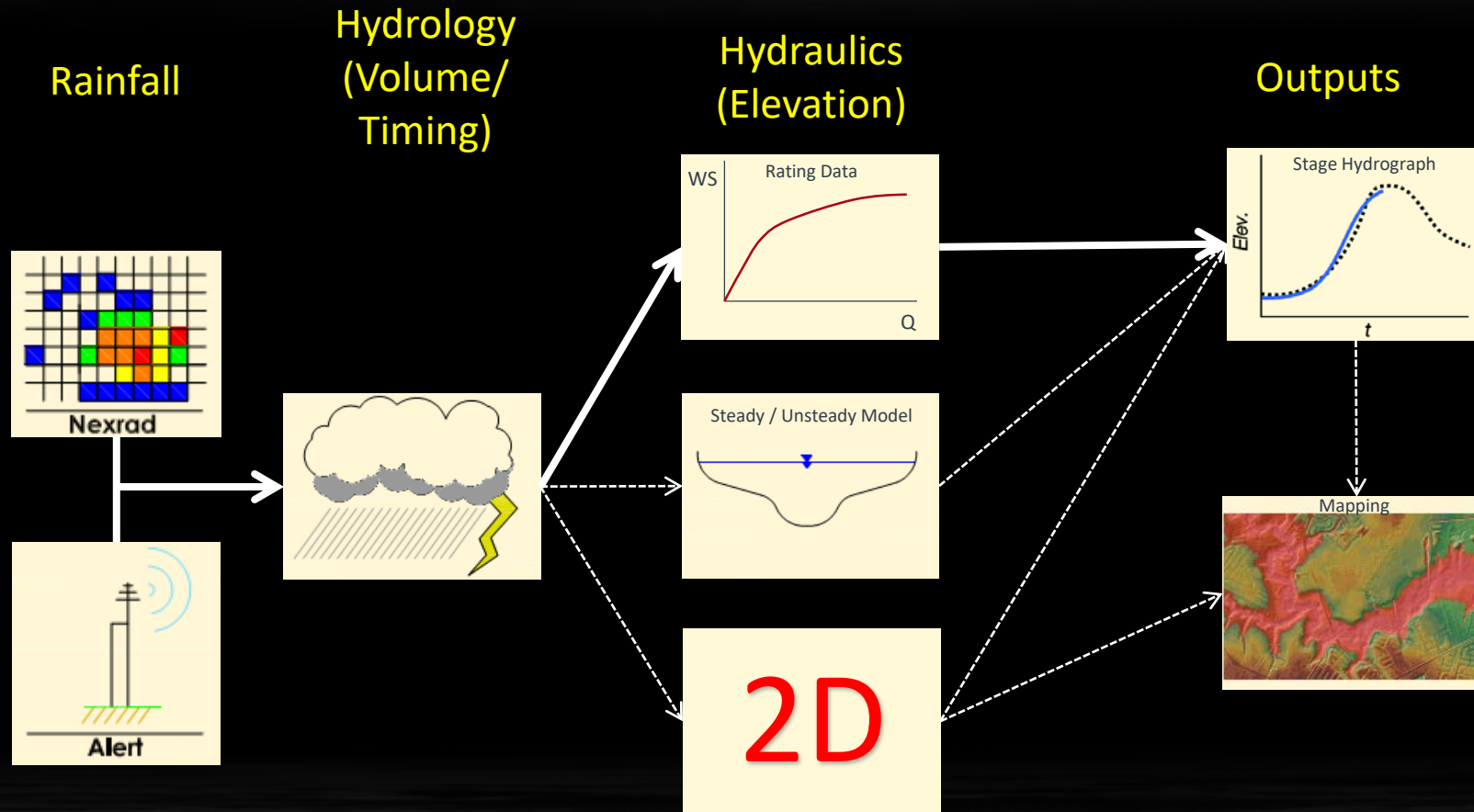
HEC-RTS Overview

- Forecast and Operational Interface
- Handles communication between HEC Software
- Provides Customization (scripting)
- Support from HEC



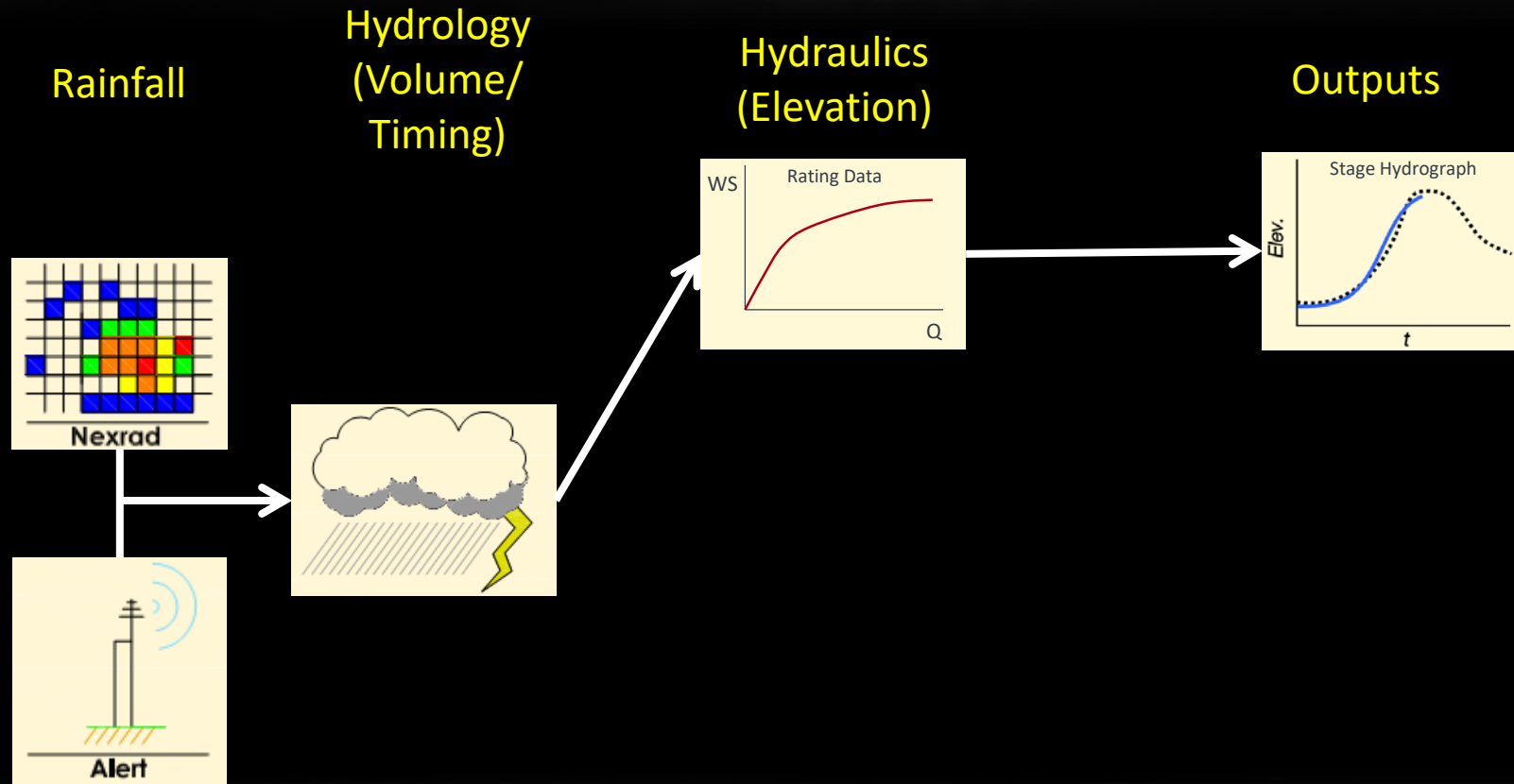
Forecasting Methodology

- Simplified Process Diagram



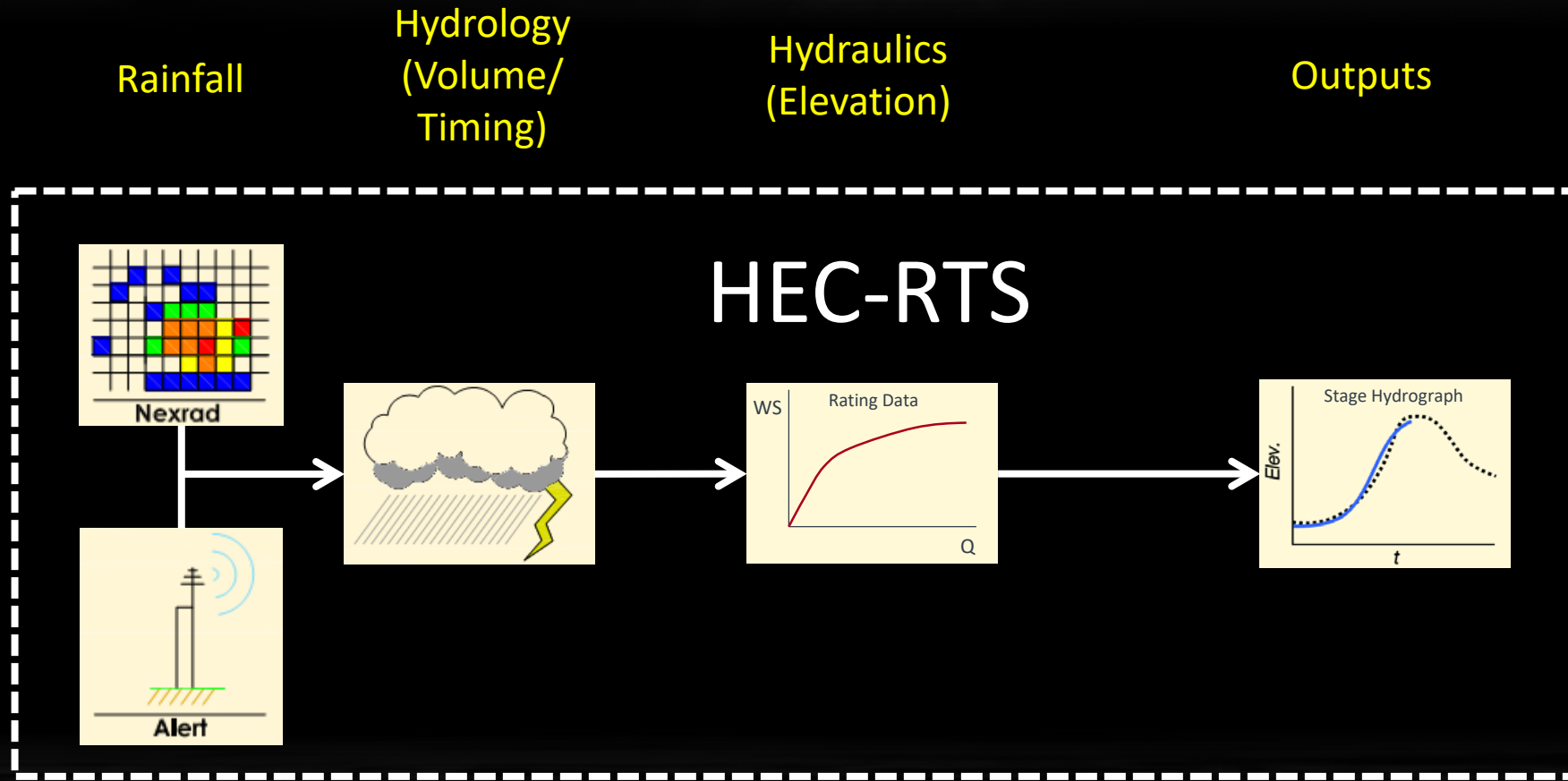
Forecasting Methodology

- Simplified Process Diagram



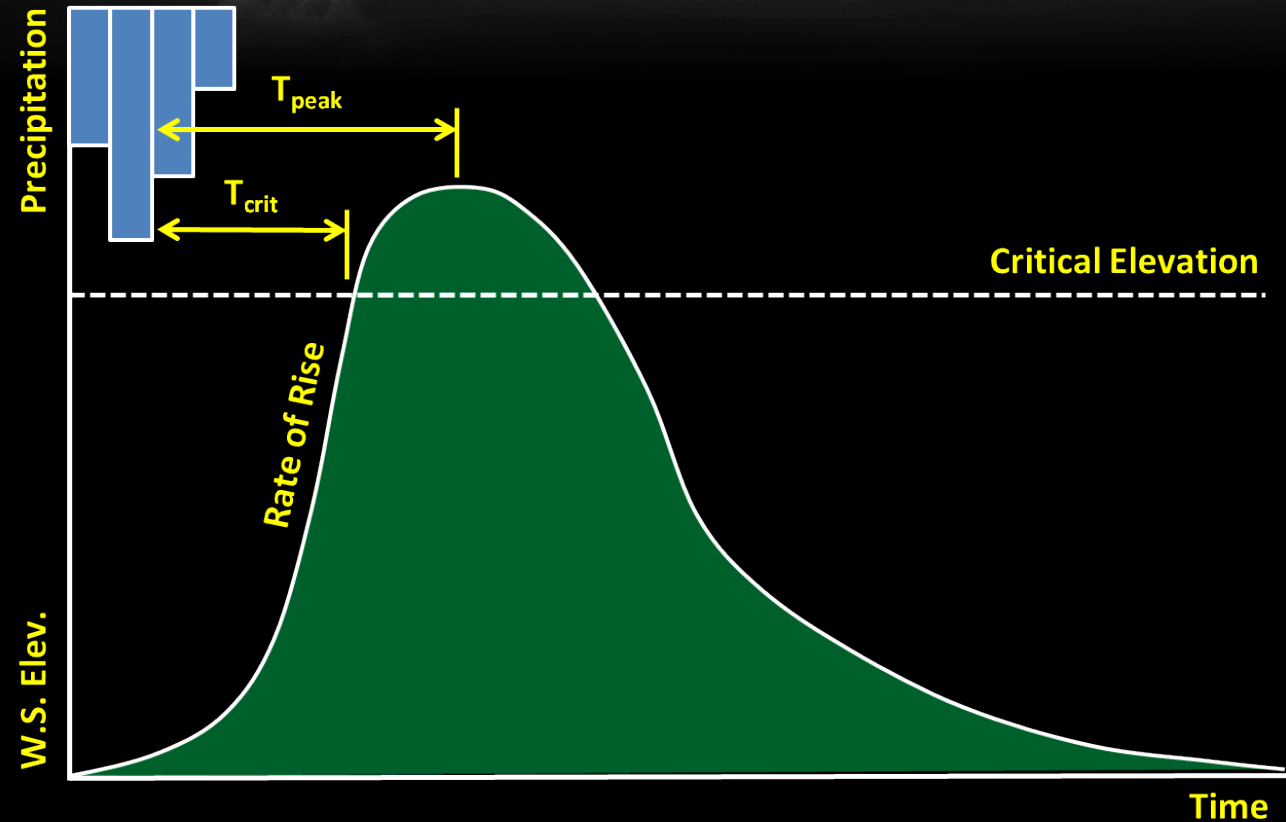
Forecasting Methodology

- Simplified Process Diagram



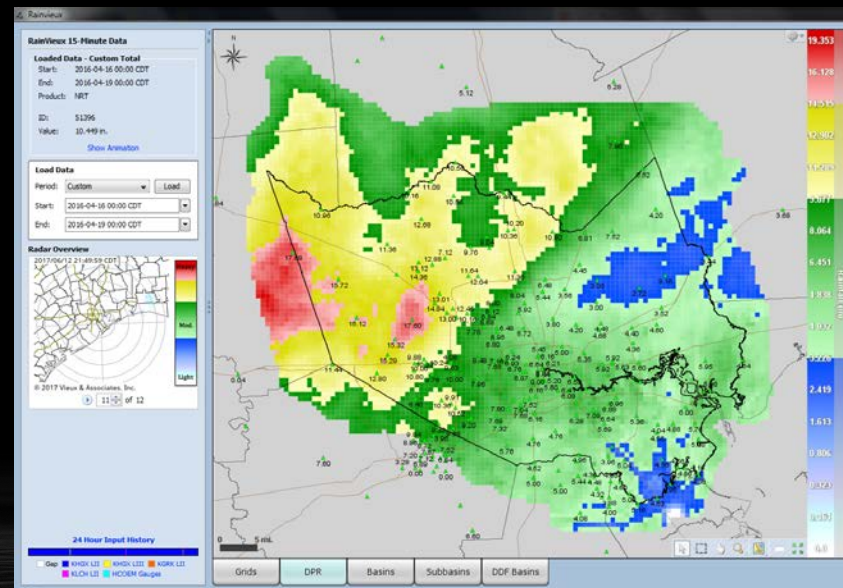
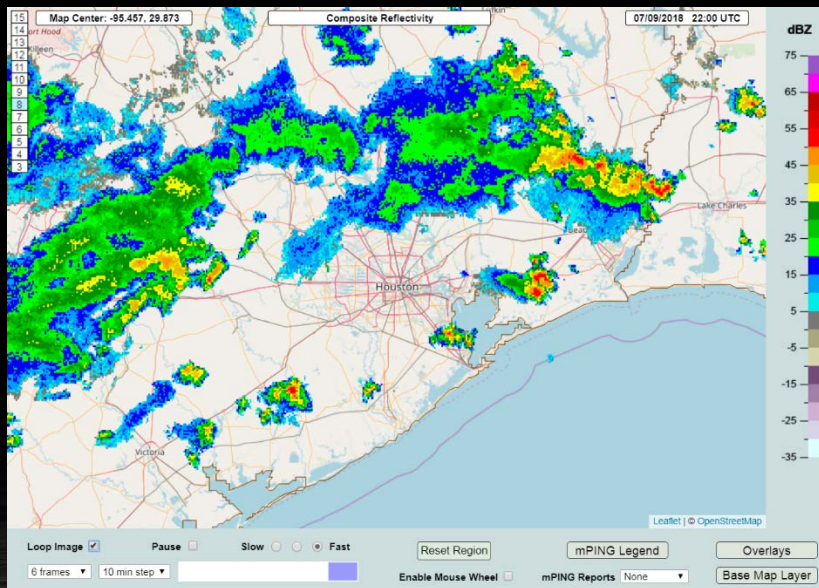
Forecasting Methodology

- Considerations
 - Rainfall Data
 - Base Models
 - Loss Methods
 - Soil Moisture/Antecedent Conditions
 - Routing
 - Rating Data
 - Observed Data
 - Calibration of 8 storms
 - Accuracy
 - Lead Time



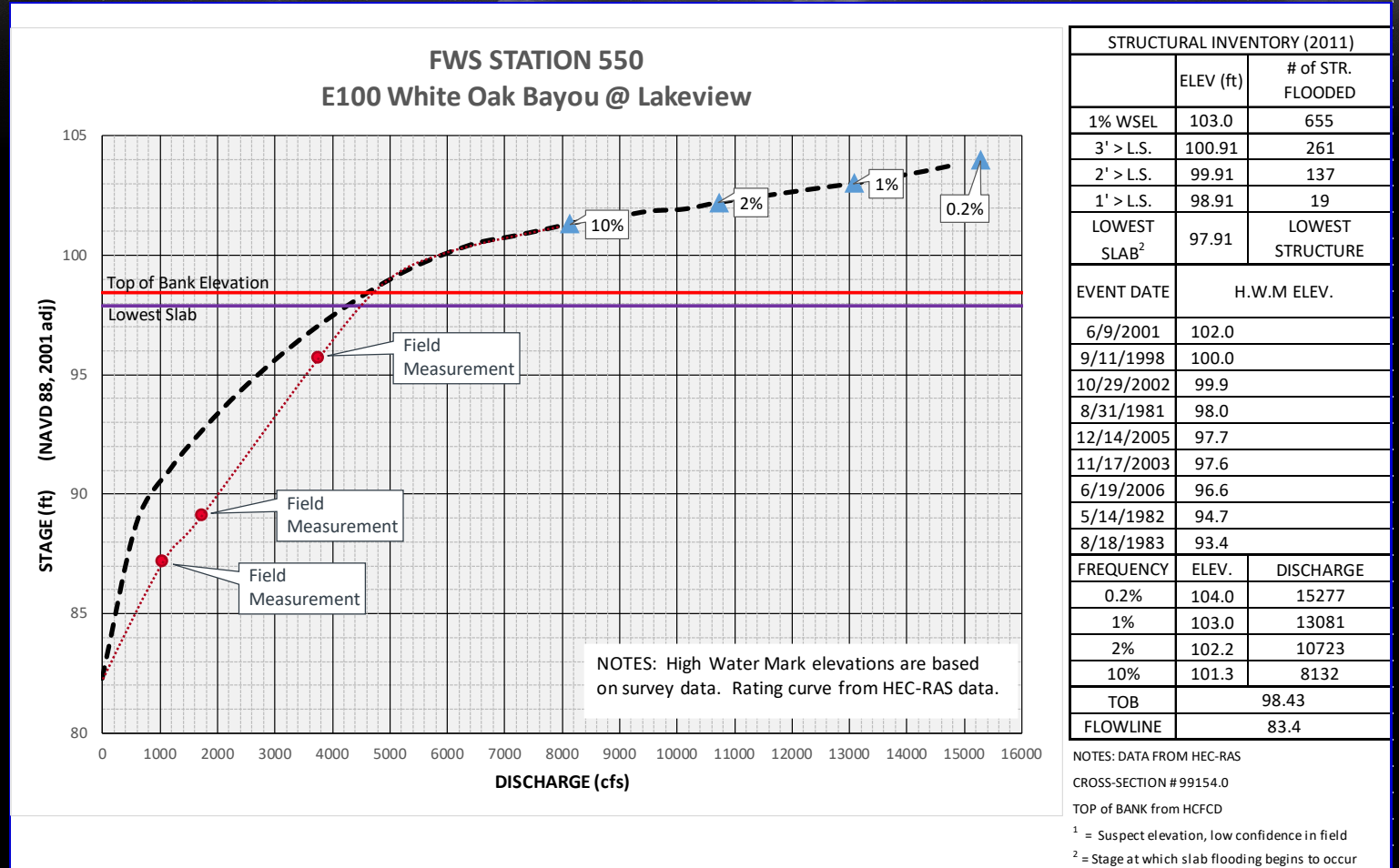
Forecasting Methodology

- Rainfall Data Requirements (Ensemble Model Scenarios)
 - Multi-Radar Multi-Sensor (NWS – MRMS)
 - Gage-Adjusted Radar-Rainfall (Vieux & Associates – GARR)
 - Gage-only data (HCFCD)
 - Forecast

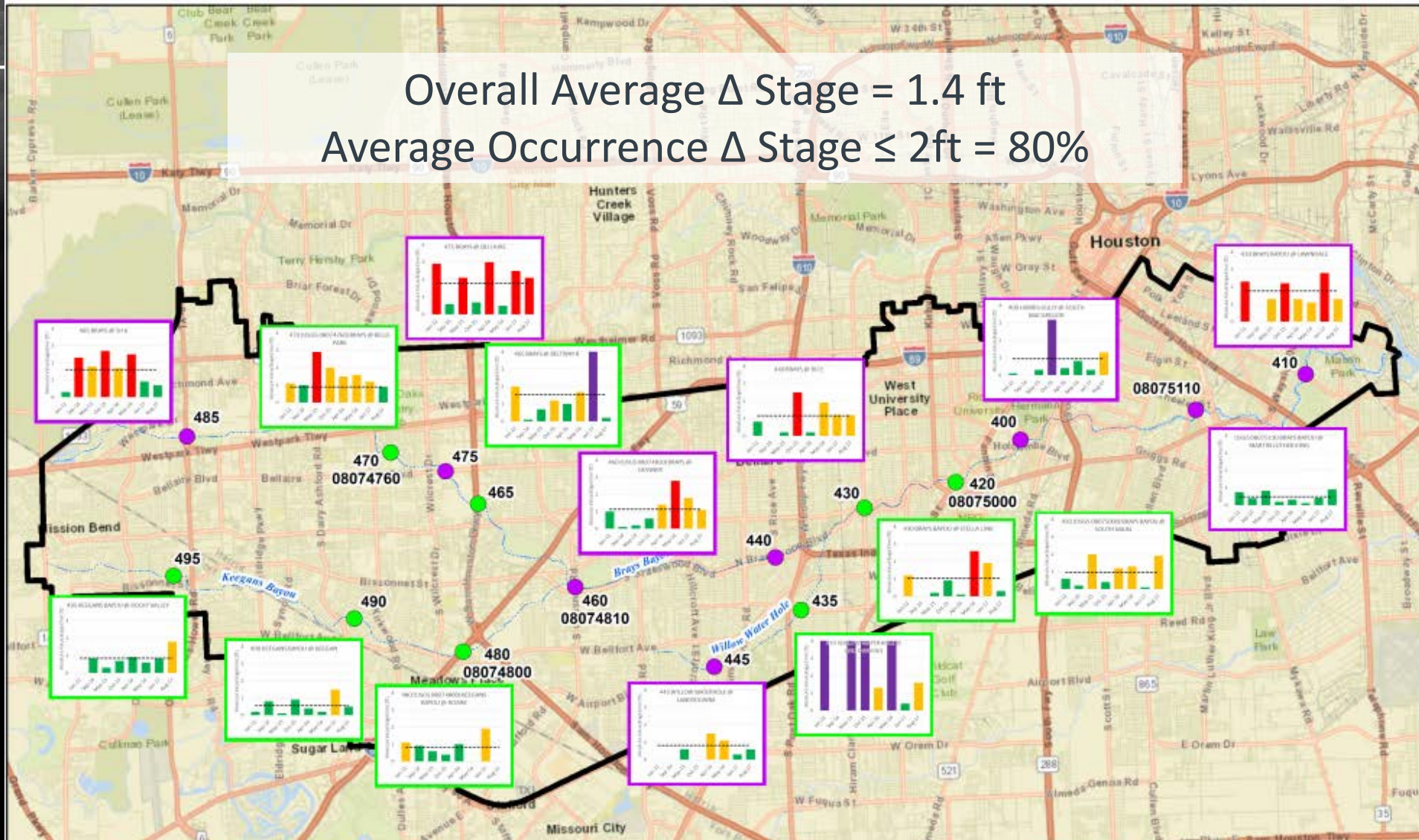


Forecasting Methodology

- Rating Curve Data
 - Base Hydraulic Models
 - Steady Flow
 - USGS Ratings
 - Field Measurements



Overall Average Δ Stage = 1.4 ft
 Average Occurrence Δ Stage ≤ 2 ft = 80%



Legend

● Calibration	■ Obs. vs Calc. Stage ≤ 1.00 ft
● Validation	■ " " " " 1.01-2.00 ft
	■ " " " " 2.01-3.00 ft
	■ " " " " > 3.00 ft

Overall Gauge Map

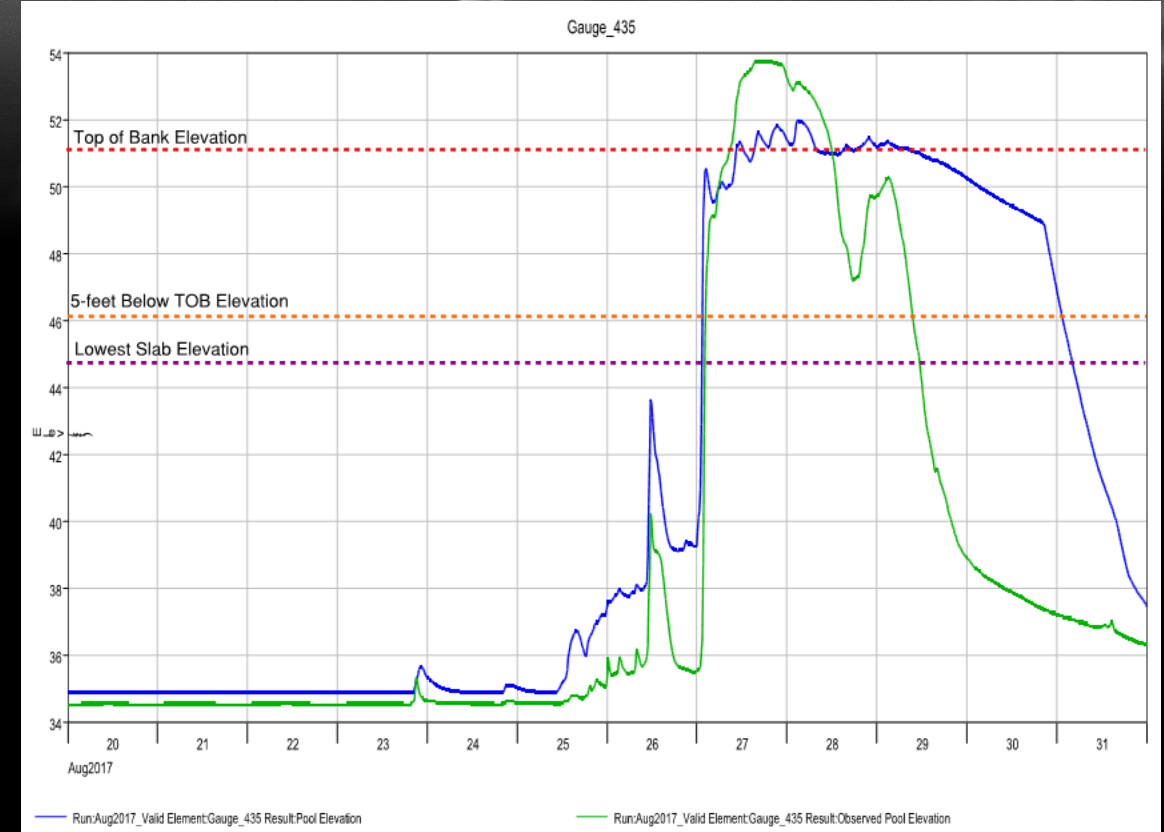
Initial Calibration and Testing

- Issues

- Clay Soils/Antecedent Moisture
- Inaccurate Model Data (Offline Detention)
- Historic vs. Recent Storms (Development)
- Rating Data (USGS vs. Model)
- Shapes of Hydrographs

- Solutions

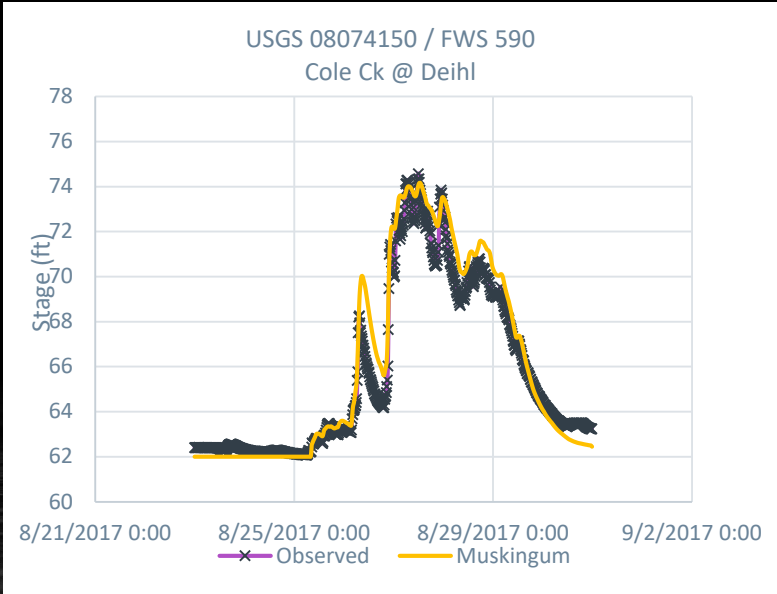
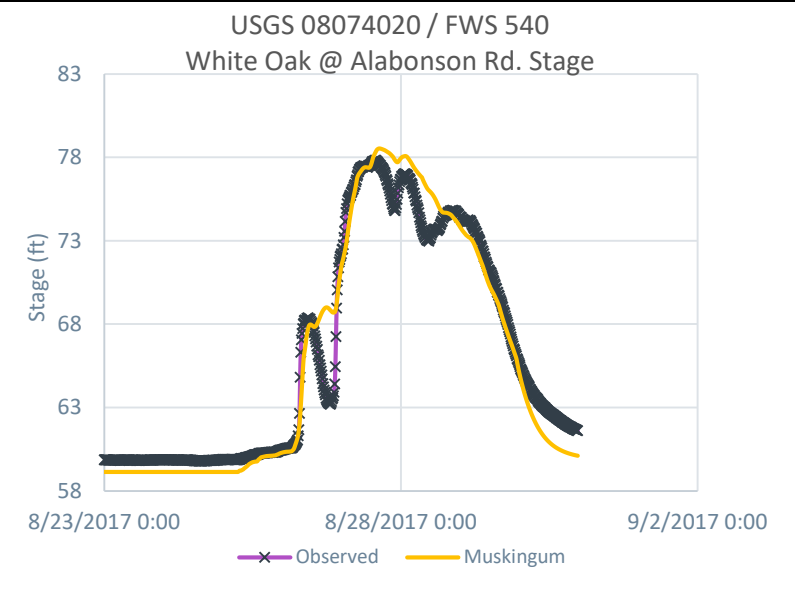
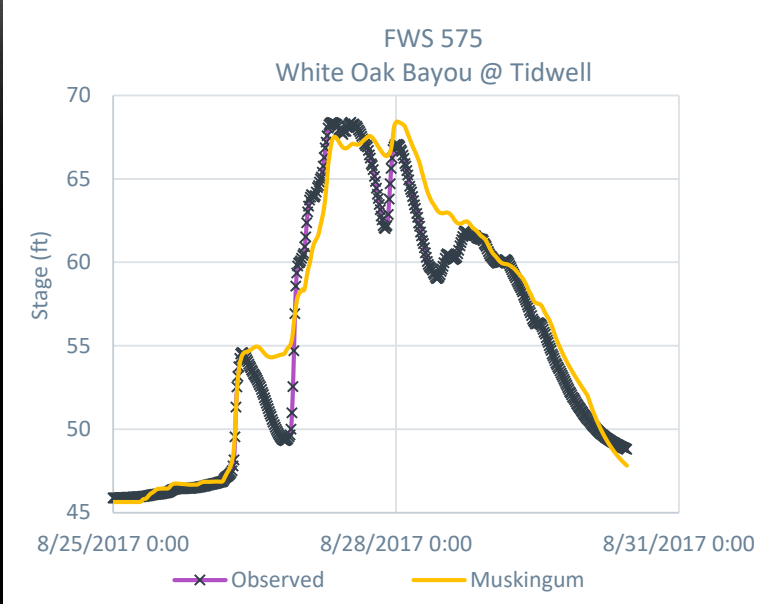
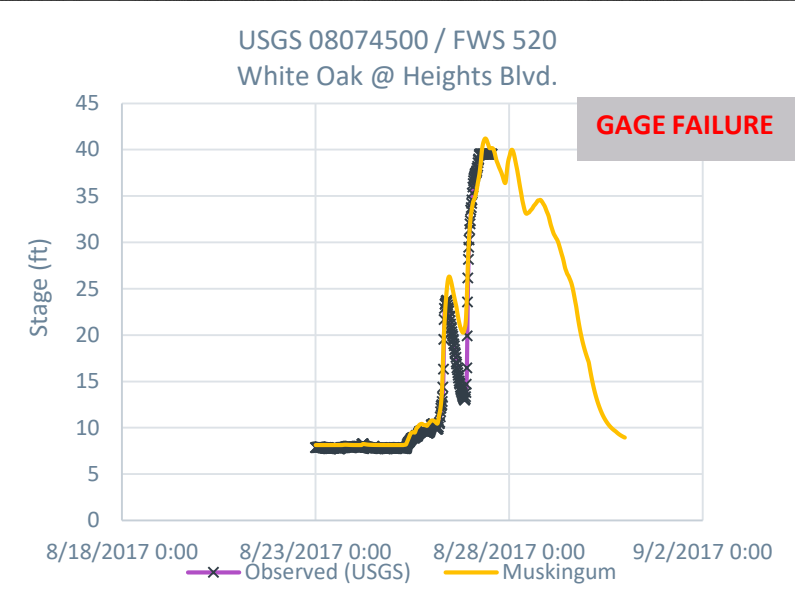
- Soils: Not much need for calibration
- Model: Adjust original modeling
- Storms: 3 recent (calibration), 5 historic (verification)
- Ratings: Combine field measurements (in-bank) with model (out-of-bank)
- Routing: Muskingum vs. Modified Puls



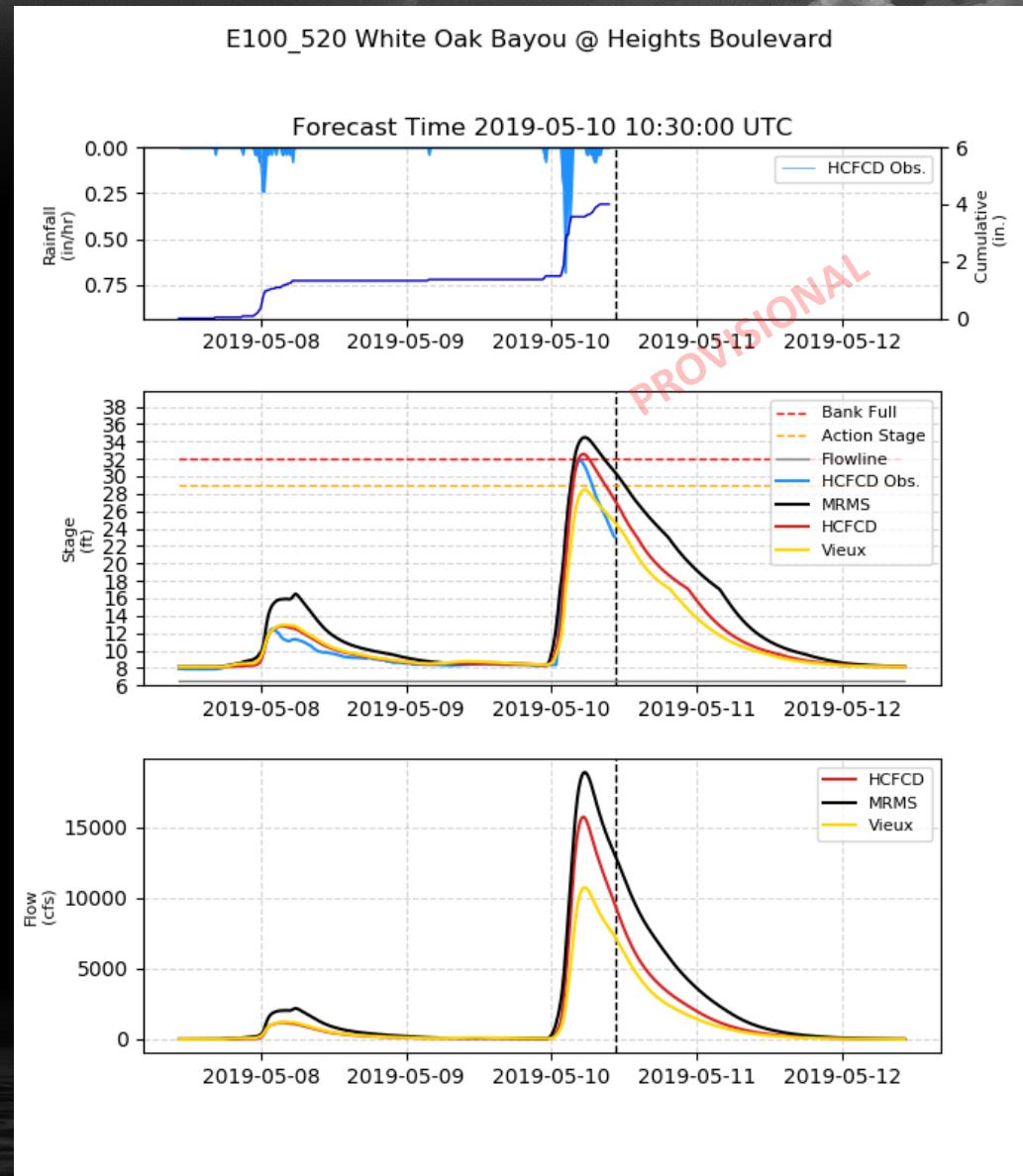
Stage Comparison Summary Table (Calibration Procedure)

Peak Stage Delta										
Gage Name	Gage Location	Storm								
		May-14	May-15	Oct-15	Apr-16	May-16	Jan-17	Aug-17	Harvey 2017	Comments
555	White Oak at Jones Rd.	0.98	0.88	0.09	0.64	-0.33	0.12	-0.08	0.52	
550	White Oak at Lakeview	0.39	-0.01	2.53	0.28	-0.75	-0.20	0.11	0.18	
545	White Oak Fairbanks at N. Houston	1.56	-0.21	3.75	-0.50	0.36	0.00	0.66	0.60	
Gage_540_8074020	White Oak on Alabonson	0.50	-1.30	0.17	2.34	-0.43	-0.76	-0.26	0.92	
575	White Oak Bayou at Tidwell	1.10	-3.17	0.89	-0.10	-0.82	-0.66		-0.37	
535	White Oak at Pinemont	0.95		0.24	0.00	-0.98	-0.44	-0.53	-0.21	
Gage_520_8074500	White Oak at Heights	1.18	0.65	0.97	-0.44	-0.79	-0.61	0.70	-4.38	*Backwater effect during Harvey
Gage_590_8074150	Cole Ck at Deihl	-0.71	-0.80	0.79	-0.86	-0.03	0.34	-0.14	-0.43	
Gage_580_8074250	Brickhouse Gully at Costa Rica	-1.13	-1.20	0.66	0.14	0.34	0.84	-0.11	-2.42	*Backwater effect during Harvey
Gage_560_8074540	Little White Oak at Trimble	-1.01	-1.45	1.45	0.55	-0.50	-0.53	1.60	-1.86	*Backwater effect during Harvey
595	Vogel Creek at Gulf Bank	0.72	-0.94	1.29	-0.68	-0.69	-0.05	0.14	-0.28	
585	Vogel Creek at Victory	-	-0.75	0.31	-1.98	-1.09	0.66	-0.02	-1.96	*Backwater effect during Harvey
570	Little White Oak at Tidwell	-0.05	-0.93	1.25	1.51	-0.30	-0.18	1.21	0.20	
Within 0.5'	41%									
Within 1'	76%									
Within 2'	94%									
Greater than 2'										

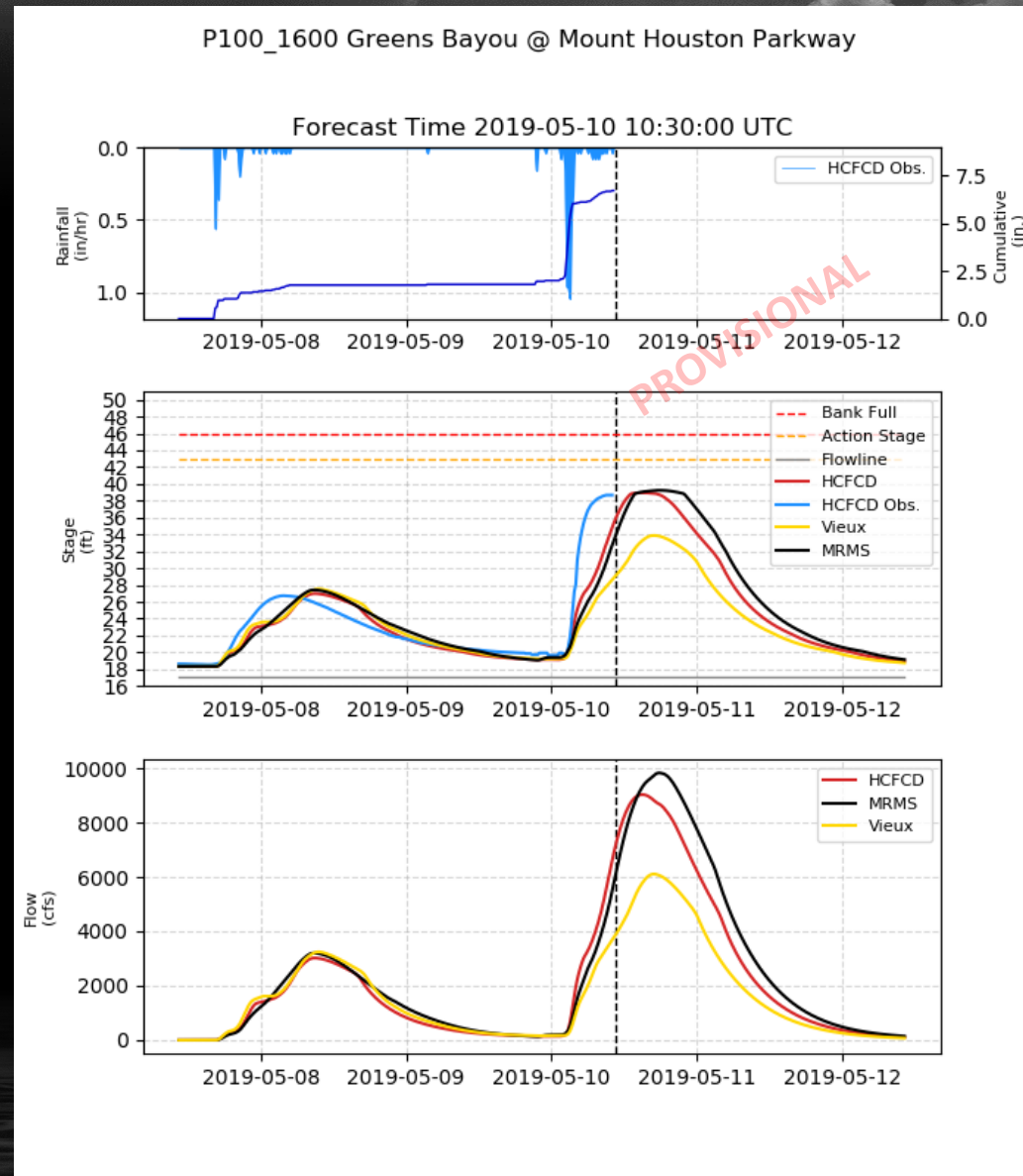
Hurricane Harvey Stage Hydrograph Comparisons



May 10th, 2019 Test – White Oak Bayou at Heights Boulevard



May 10th, 2019 Test – Greens Bayou at Ley Road





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Questions???

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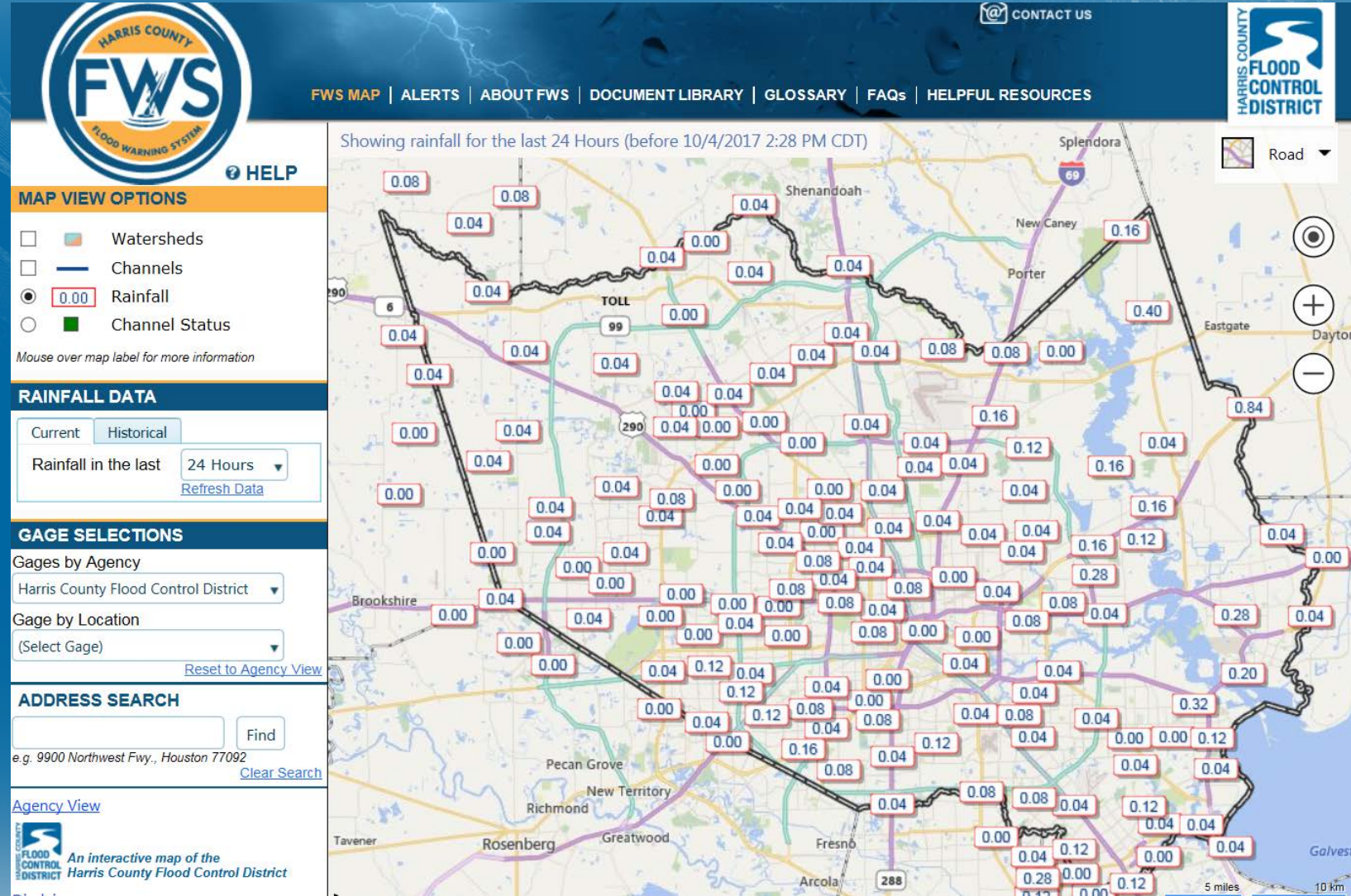
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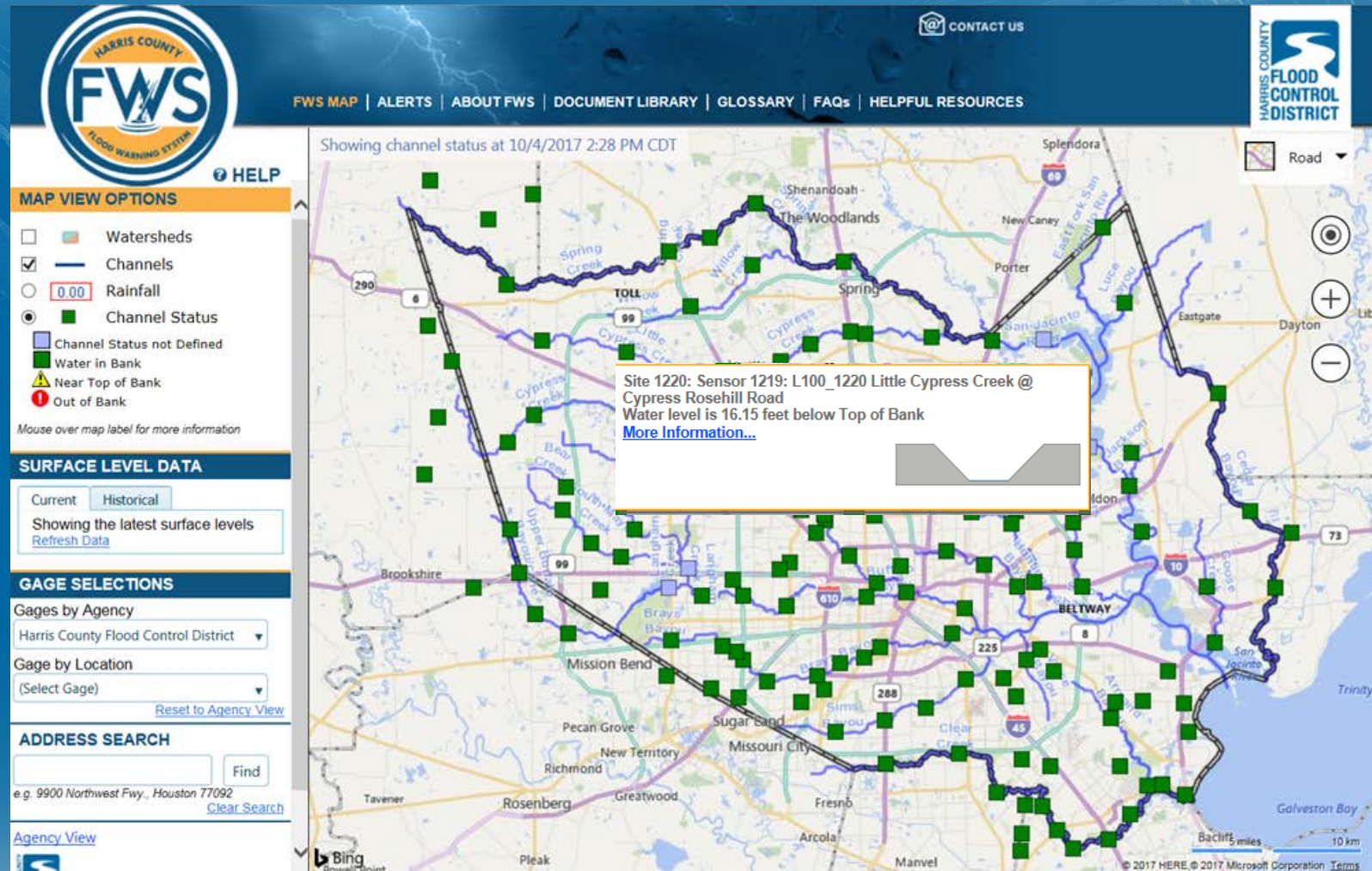
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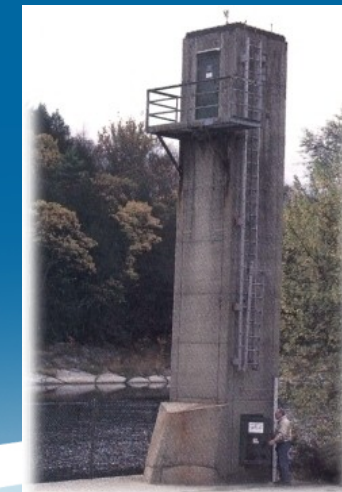
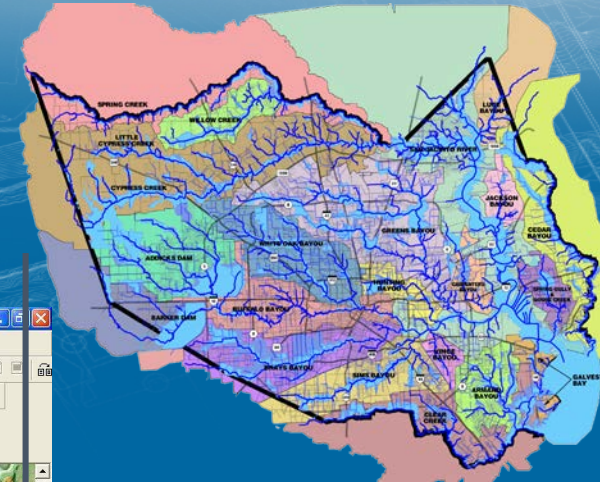
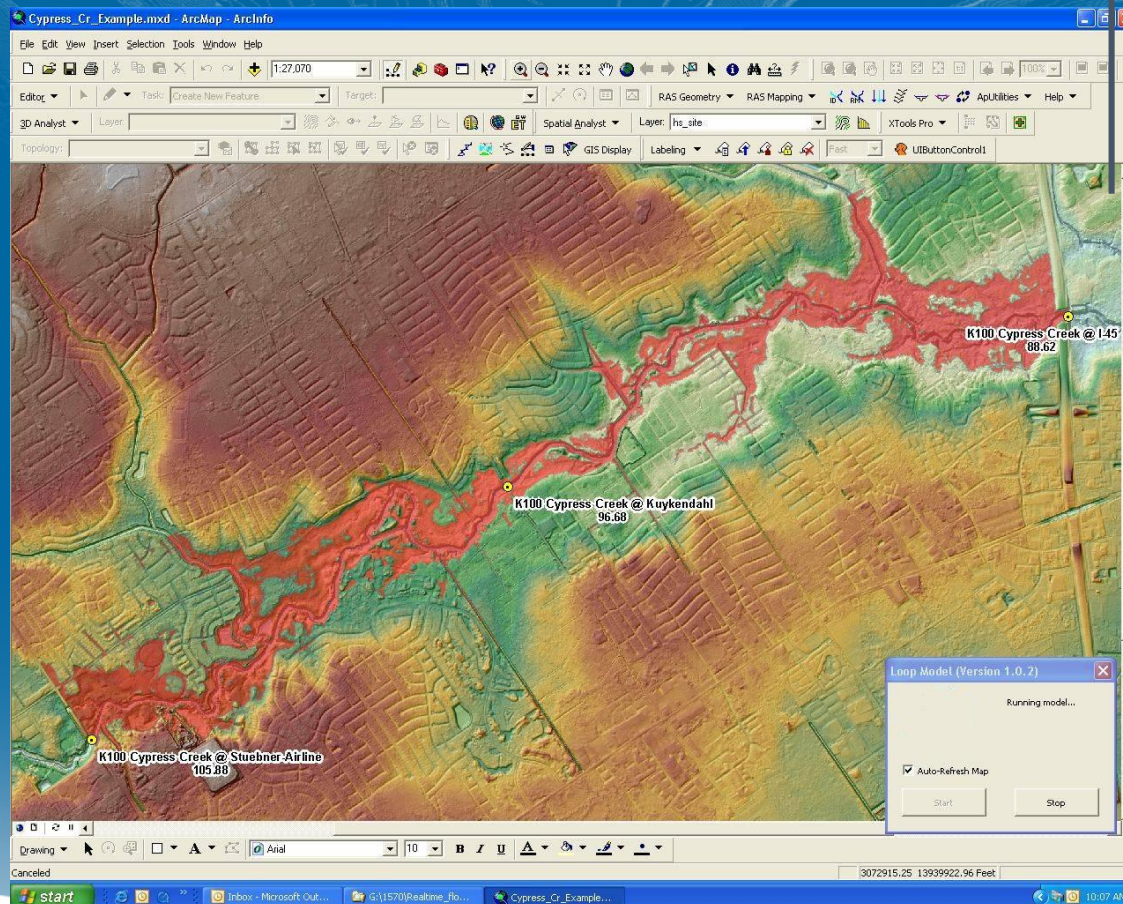
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HCFCDD

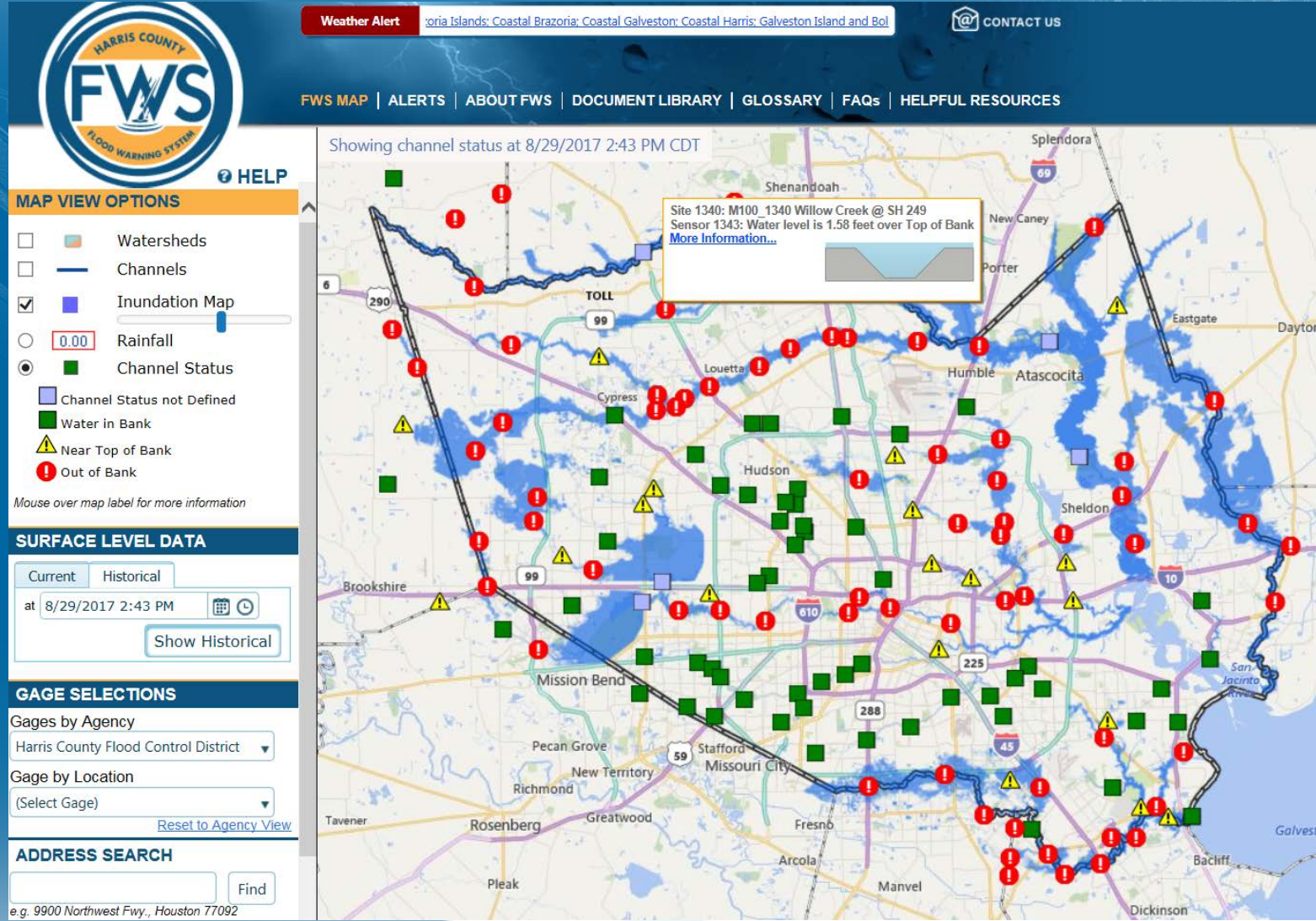


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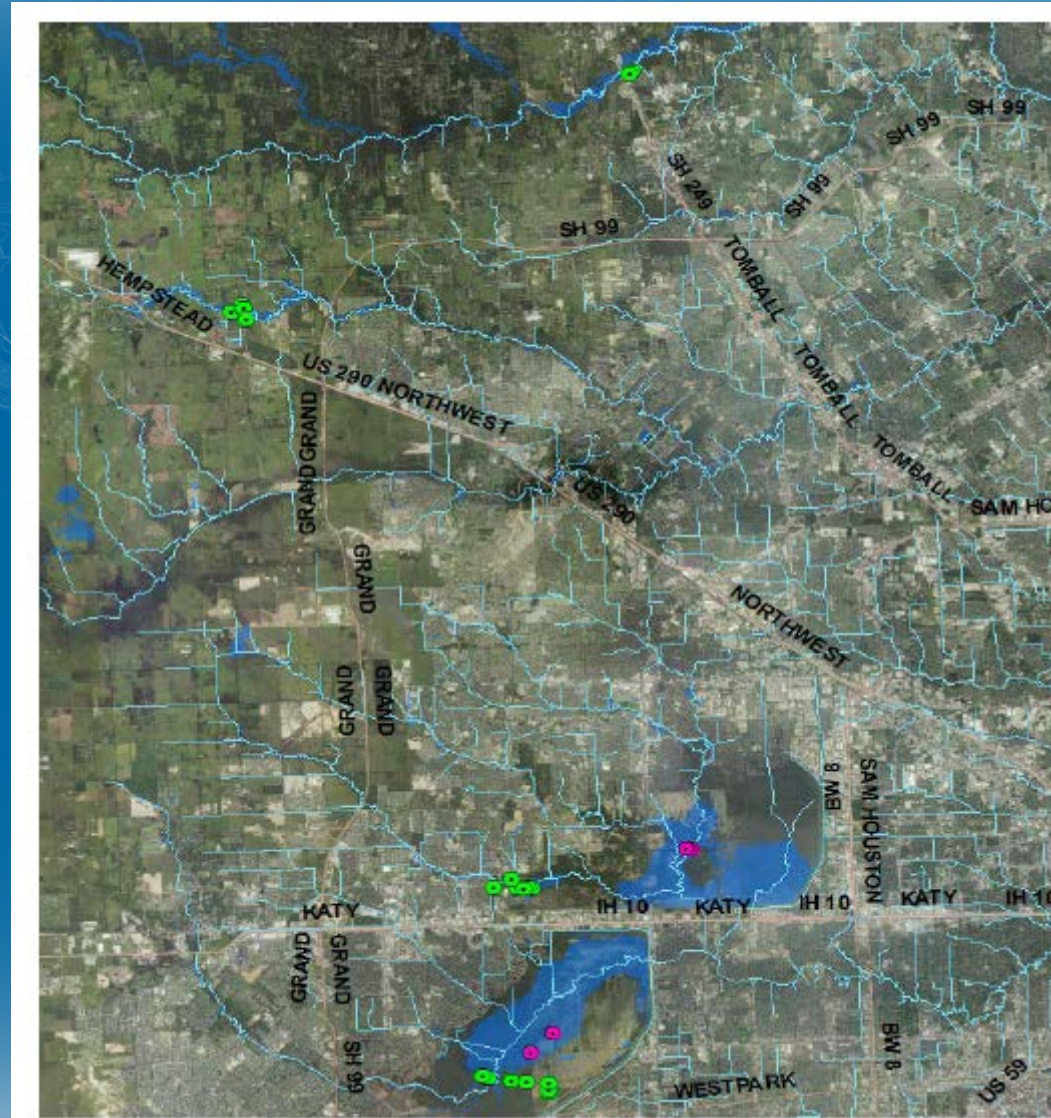




HCFCD



Validation



Validation



Validation



Validation

