

# Current Activities of the Texas Instream Flow Program in the Middle and Lower Brazos River Basin



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April 26, 2011

Texas Commission on Environmental Quality  
Resource Protection Team



# Senate Bill 2

The Texas Legislature directed:



- Establish a data collection and evaluation program = Texas Instream Flow Program
- Determine flow regime necessary to support a **sound ecological environment** in Texas rivers and streams
- Complete priority studies by Dec 31, 2016

# Program Purpose

**For the first time state agencies and the public will collaborate on scientific studies to determine how much water should flow in rivers for a healthy environment.**



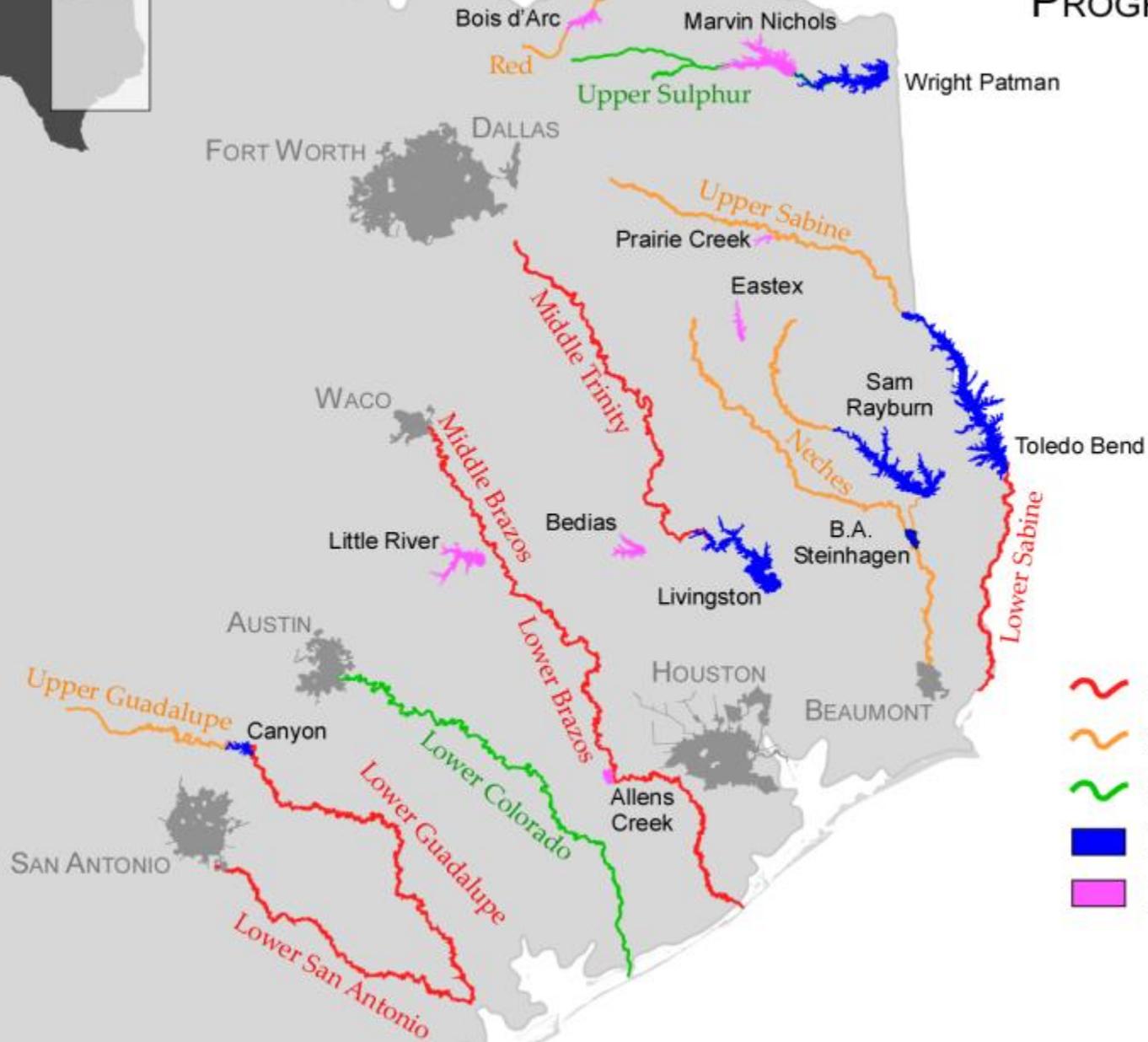
# What does SB2 do?

- Establishes a program to study River Basins in the state and make flow recommendations based on those studies.
- Serves as the Best Available Science for use in the SB3 processes:
  - Initial flow recommendations phase
  - Reevaluation phase to evaluate “improvements in science related to environmental flows.”

# What SB2 doesn't do?

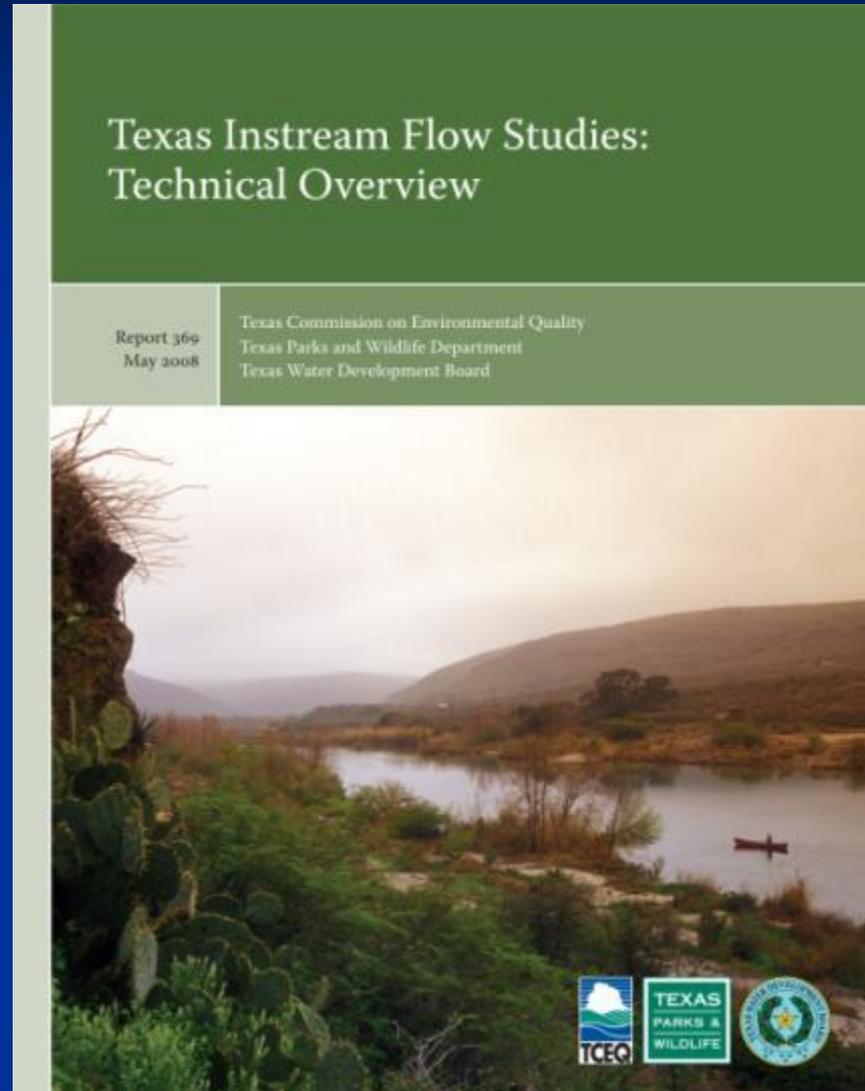
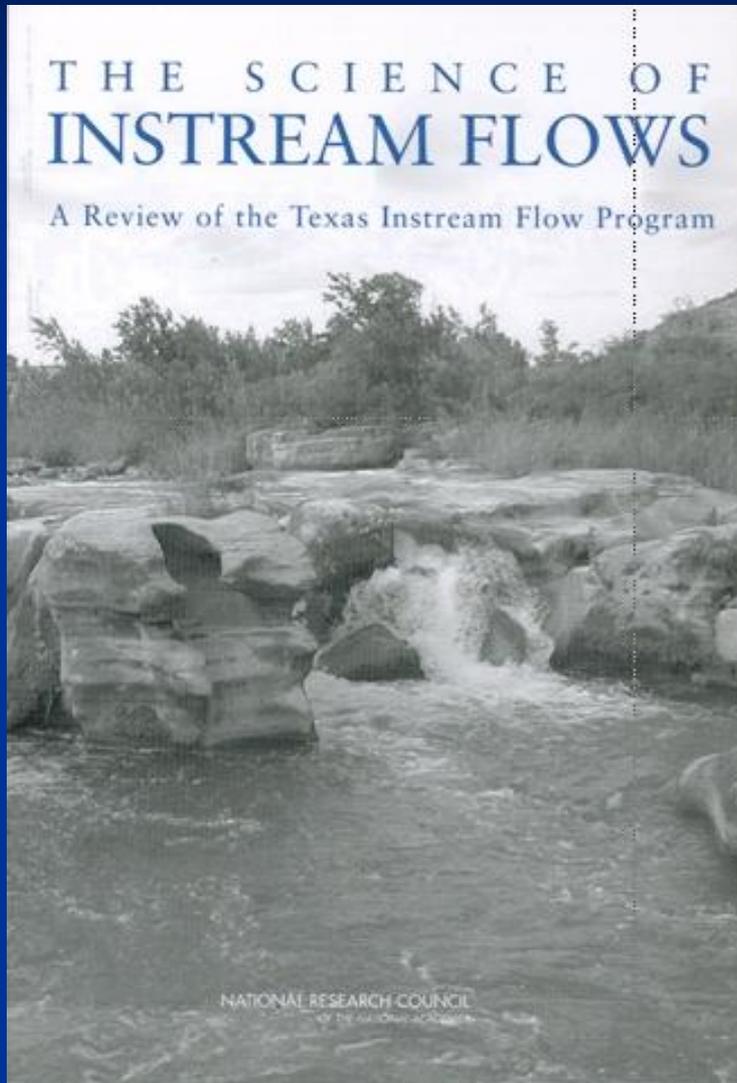
- Doesn't provide flow recommendations for areas outside of the study area.
- Doesn't provide flow recommendations for consideration by the BBEST/BBASC.
- Doesn't provide flow recommendations that will be adopted by the TCEQ in Environmental Flow Standards Rule Making.
- Doesn't provide a "Silver Bullet" for instream flows.

# TEXAS INSTREAM FLOW PROGRAM STUDIES

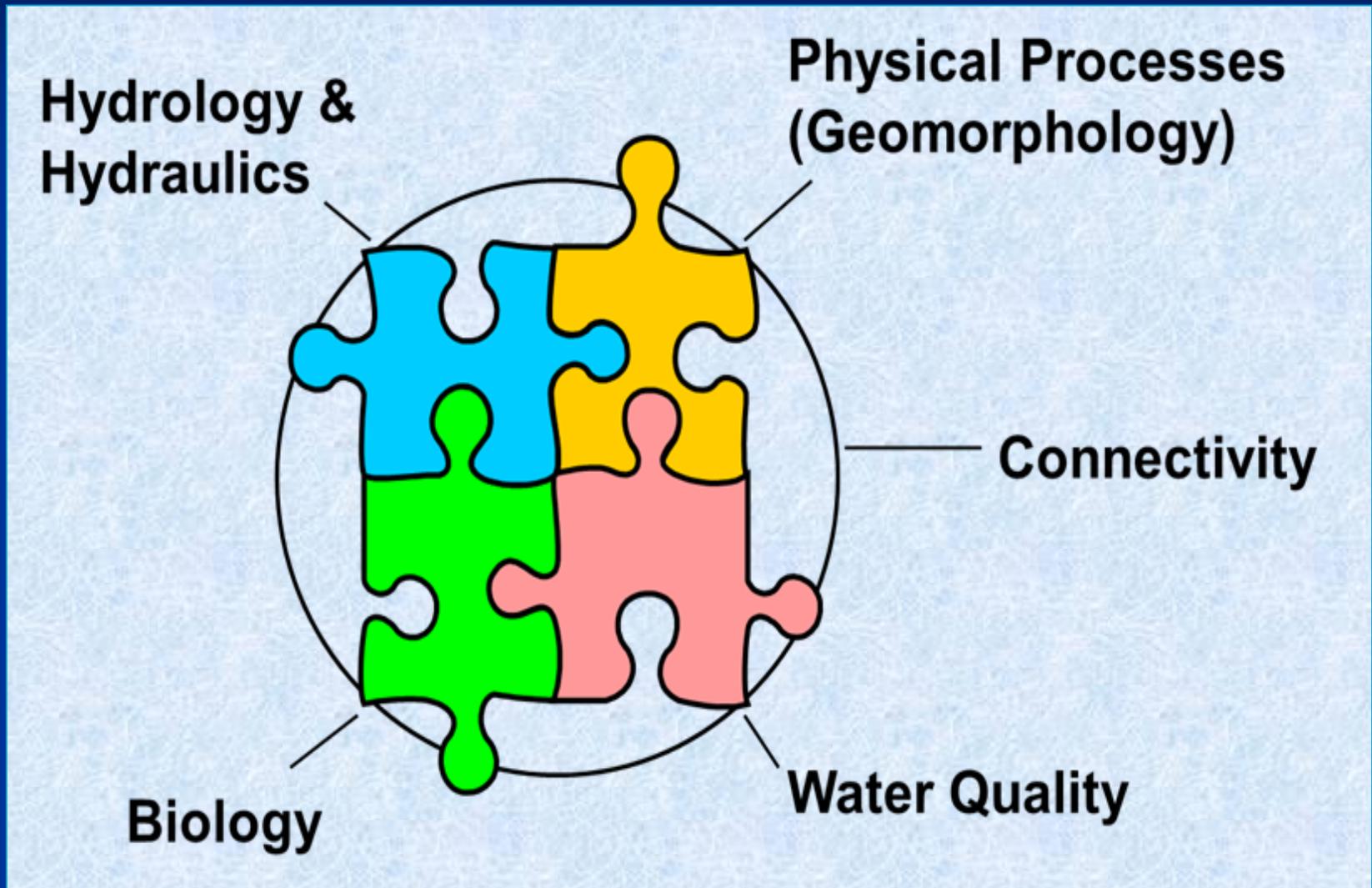


- Priority Study
- 2<sup>nd</sup> Tier
- Special Study
- Existing Reservoir
- Proposed Reservoir

# Framework of the TIFP



# Multidisciplinary Studies



# Physical Processes (Geomorphology)

- Assess bed, banks and floodplains
- Examine active floodplains and channels
- Assess channel adjusting and overbank flow behavior
- Develop sediment budgets
- Identify habitat features

## Evaluations

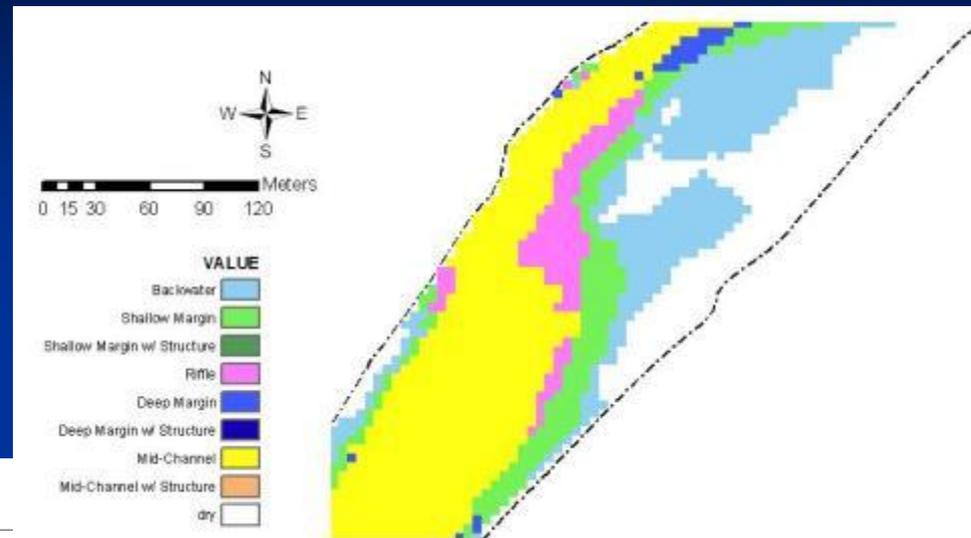
Hydrology  
Hydraulics

Physical  
Processes

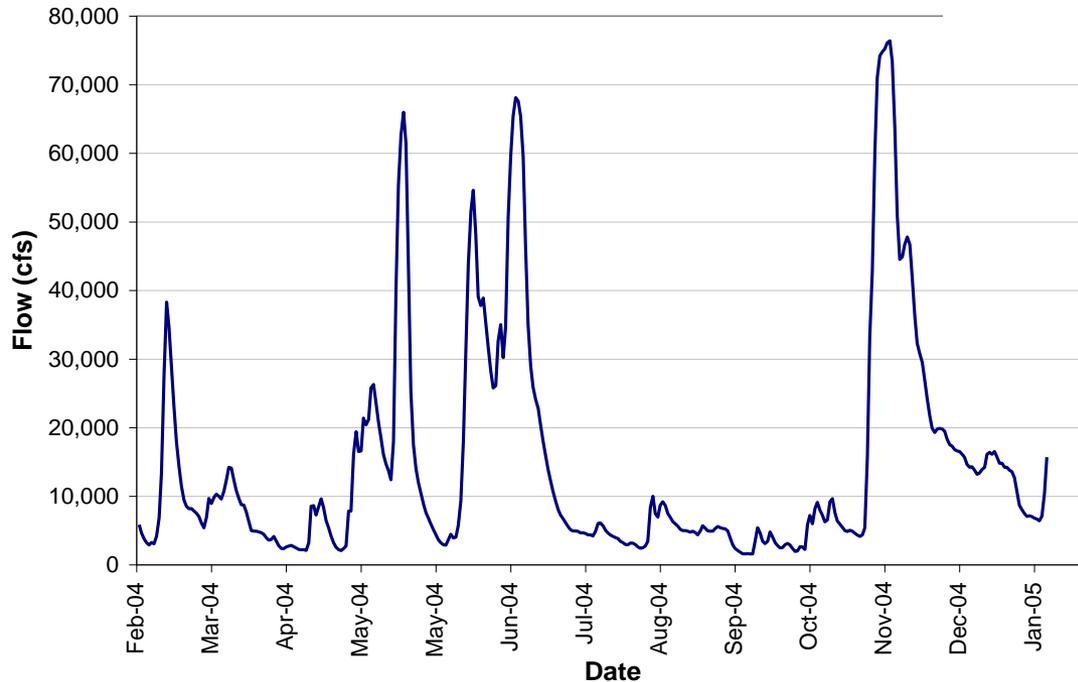
Water  
Quality

Biology

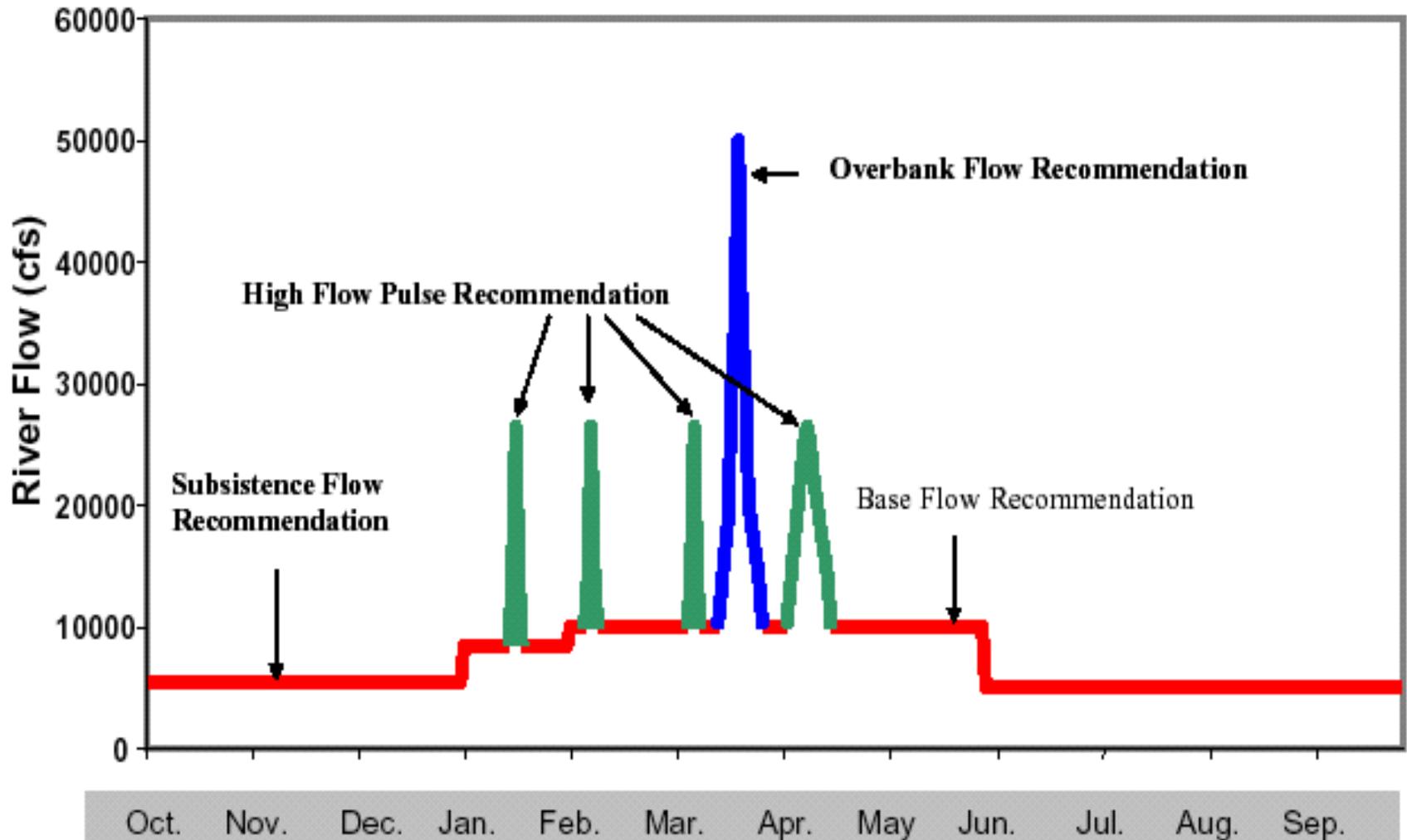
# Hydrology and Hydraulics



Brazos River at Richmond 08114000



# Environmental Flow Regime



## Evaluations

Hydrology  
Hydraulics

Physical  
Processes

Water  
Quality

Biology

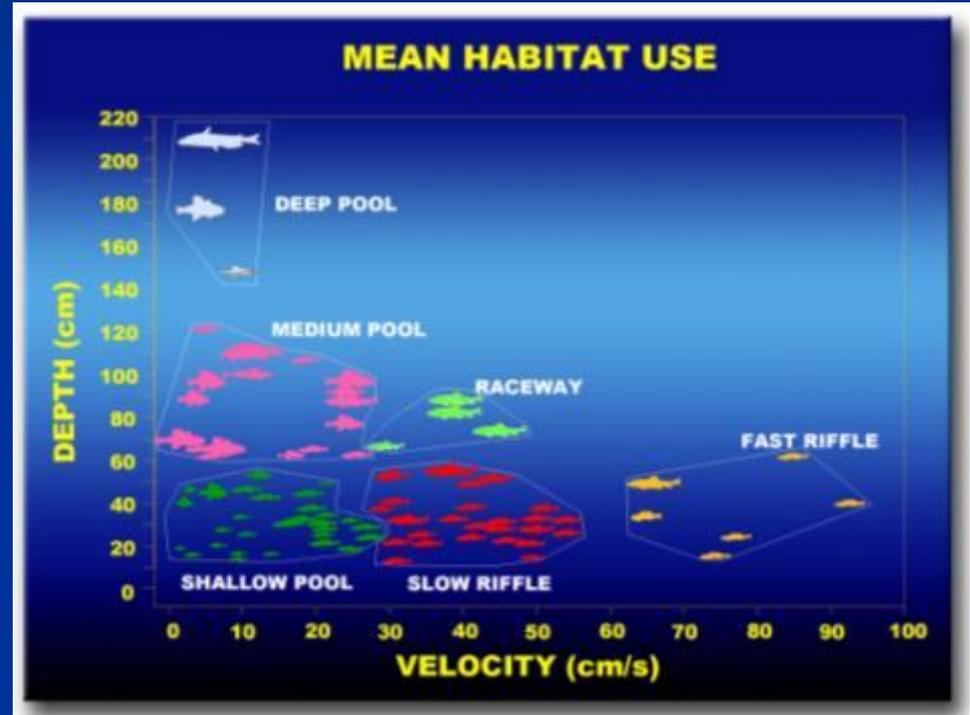
# Biology

## Habitat Diversity

## Biodiversity



Photo by Clint Robertson



## Evaluations

Hydrology  
Hydraulics

Physical  
Processes

Water  
Quality

Biology

# Water Quality

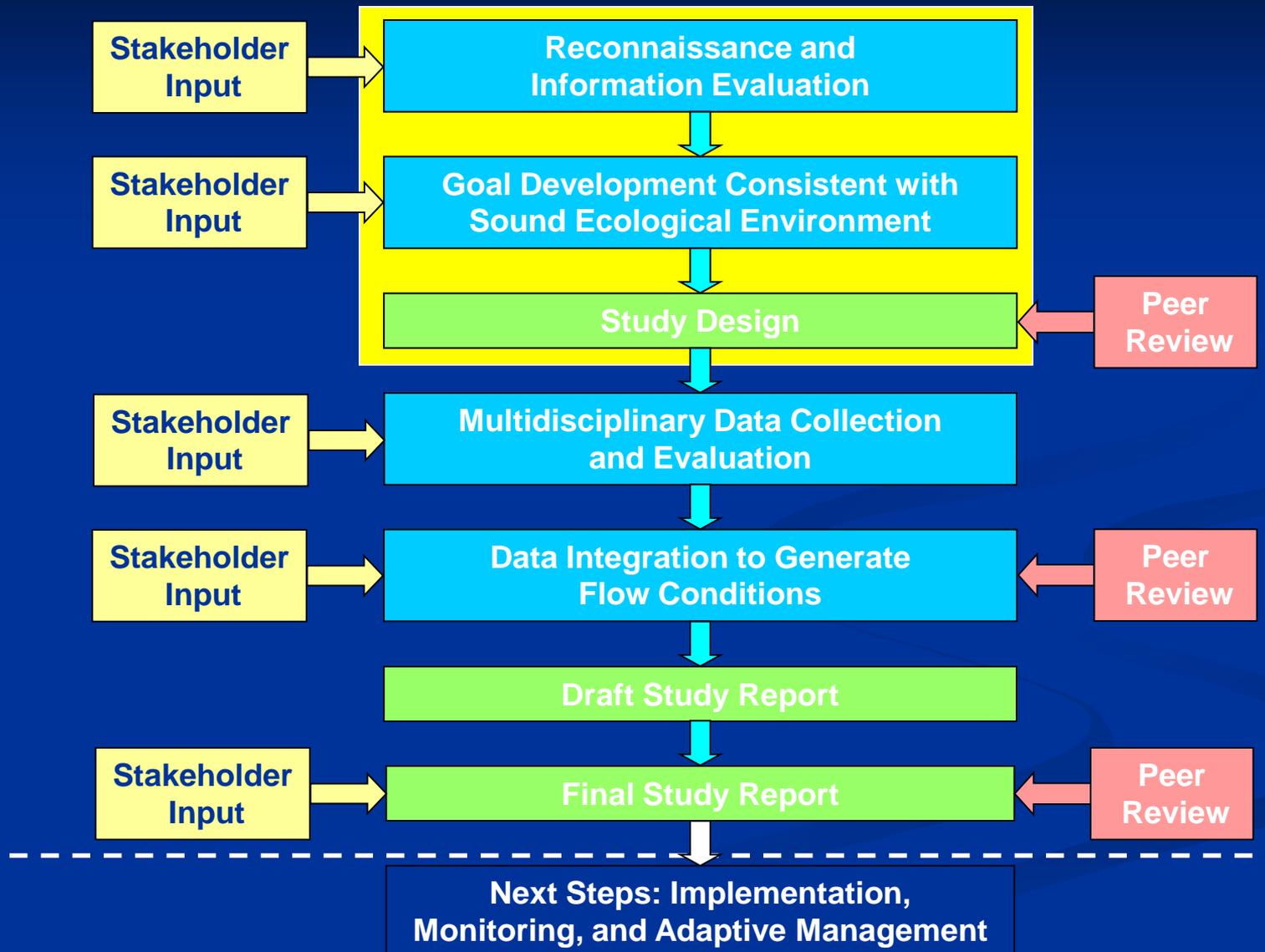
## Water Quality Indicators

Dissolved Oxygen, Temperature, Bacteria, Water Clarity,  
Salinity, Nutrients.

## Technical Studies

WQ Evaluation from existing programs – CRP, TPDES, TMDL  
Extended deployment of WQ Data Sondes  
Use of existing WQ models in use by TCEQ  
Development of Statewide Water Quality modeling approach

# Steps in TIFP Studies



# Study Design

- Summary of available data and reconnaissance surveys
- Conceptual model of river systems
- Goals, objectives and indicators for the study
- Proposed study sites, methods and tools
- Public participation process
- Peer Review Process (USGS)



# Study Design

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## **Instream Flow Study of the Middle and Lower Brazos River**

### **Draft Study Design**

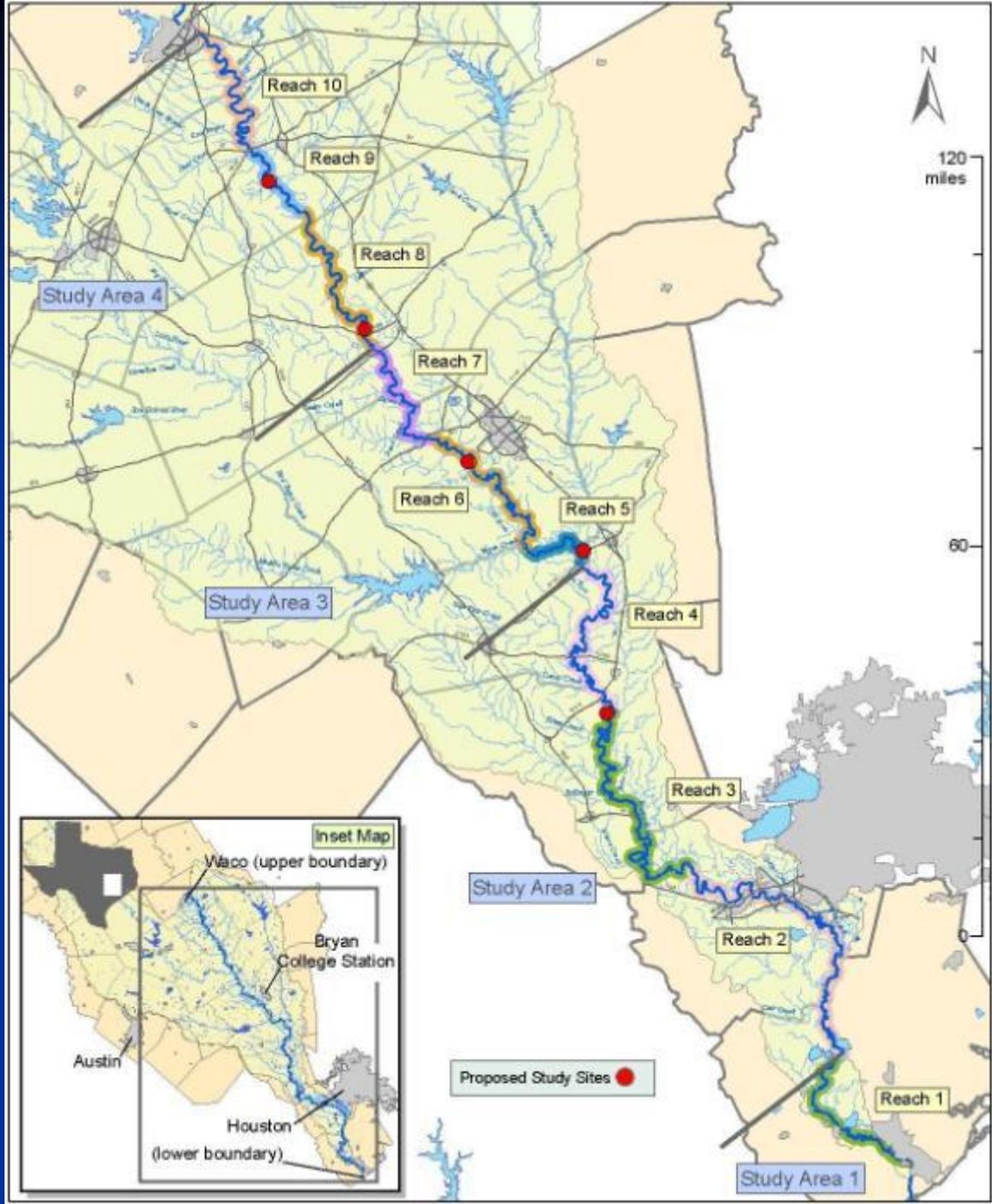


Prepared for  
Middle and Lower Brazos River Sub-Basin Study Design  
Workgroup

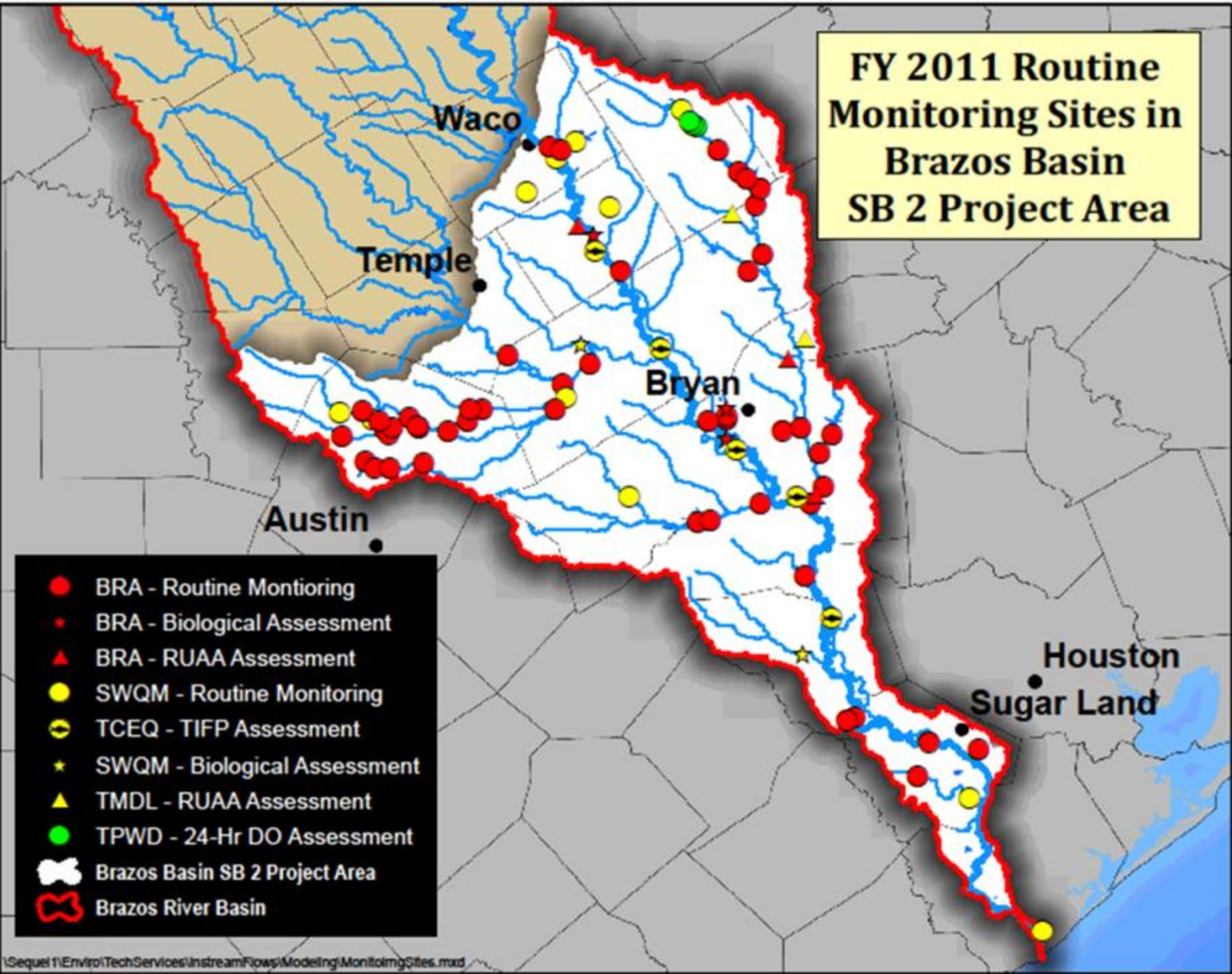
Prepared by  
**TEXAS INSTREAM FLOW PROGRAM  
AND BRAZOS RIVER AUTHORITY**

MARCH 2010

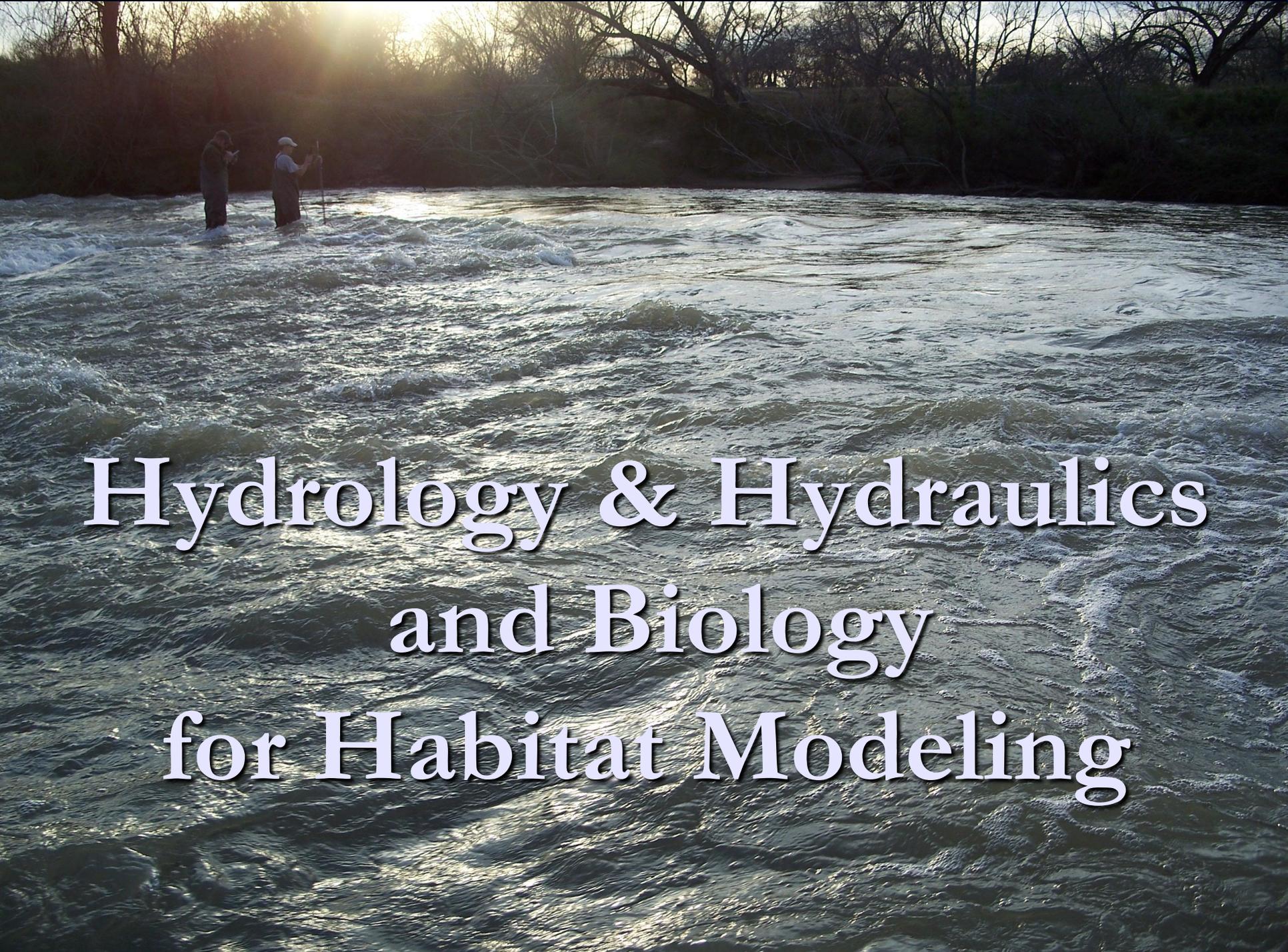




**FY 2011 Routine  
Monitoring Sites in  
Brazos Basin  
SB 2 Project Area**



- BRA - Routine Monitoring
- BRA - Biological Assessment
- ▲ BRA - RUAA Assessment
- SWQM - Routine Monitoring
- ◐ TCEQ - TIFP Assessment
- ★ SWQM - Biological Assessment
- ▲ TMDL - RUAA Assessment
- TPWD - 24-Hr DO Assessment
- ◌ Brazos Basin SB 2 Project Area
- ◌ Brazos River Basin

A photograph of a river with rapids. Two people are standing in the water, one holding a long pole. The sun is low in the sky, creating a bright glow and long shadows. The water is turbulent and white with foam. The background shows a dense line of trees.

Hydrology & Hydraulics  
and Biology  
for Habitat Modeling

# Hydrology

## Gage Location and 7Q2 values

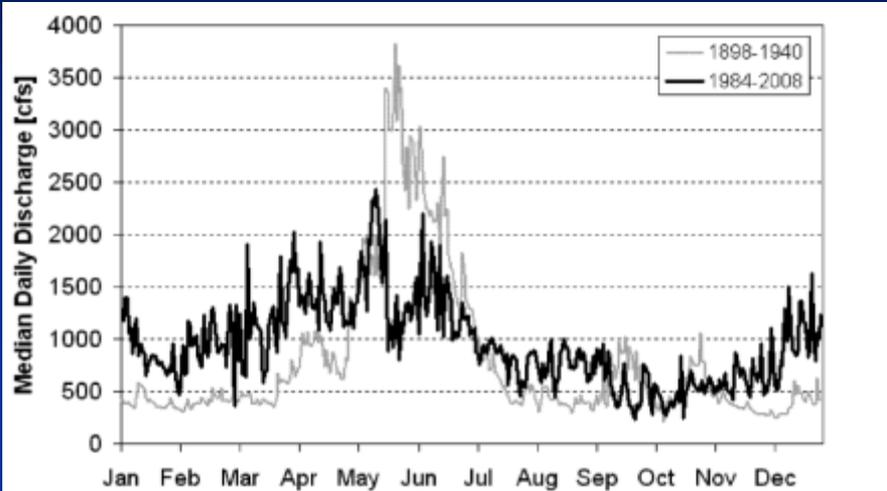


Figure 2. Median of daily streamflow values for USGS gage 08096500, Brazos River at Waco.

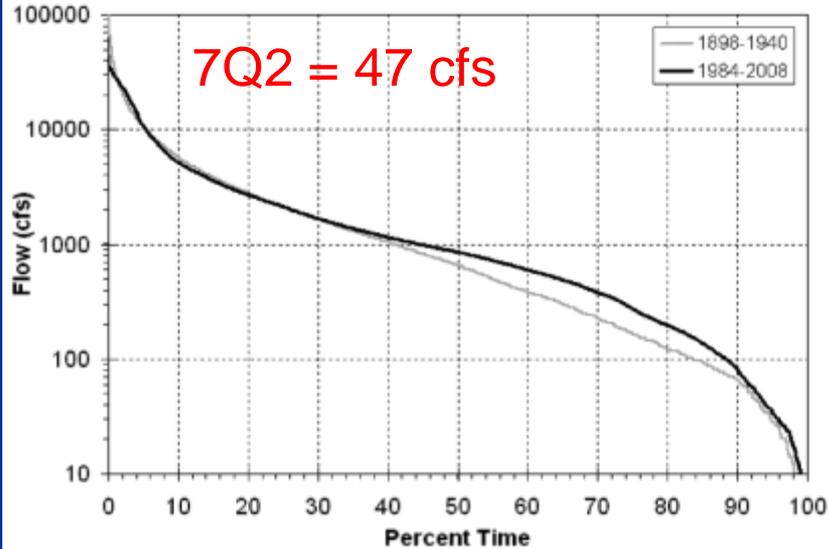


Figure 3. Flow duration curves for daily average flow at USGS gage 08096500, Brazos River at Waco.

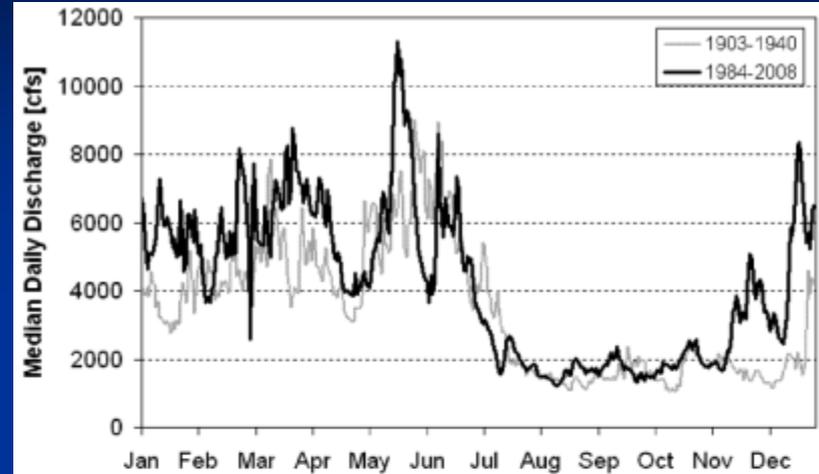


Figure 4. Median of daily streamflow values for USGS gage 0811400, Brazos River at Richmond.

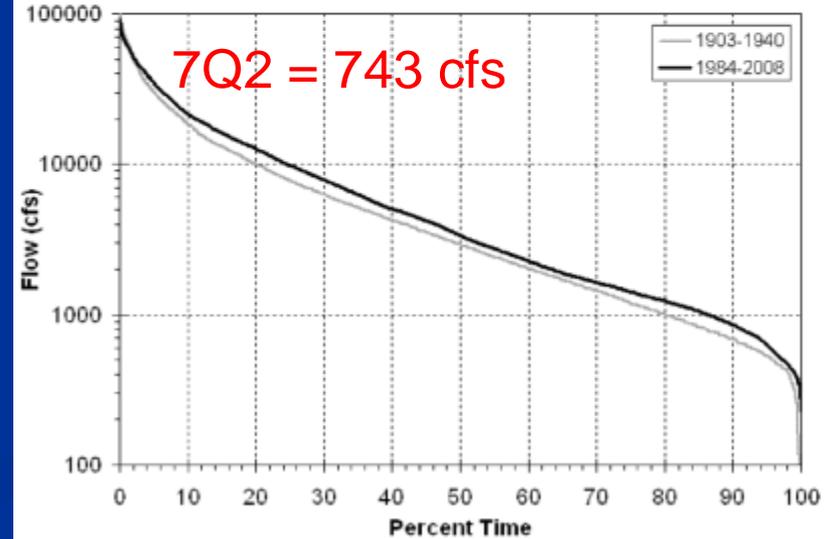


Figure 5. Flow duration curves for daily average flow at USGS gage 0811400, Brazos River at Richmond.

# What Flows to Sample?

Station	High BF (35-50%)	Medium BF (15-35%)	Low BF (5-15%)
Waco	400-800 cfs	135-400 cfs	35-135 cfs
Highbank	650-975	275-650	100-275
Bryan	1025-1475	550-1025	275-550
Hempstead	1550-2500	850-1550	450-850
Richmond	1700-2900	900-1700	500-900

# H&H Topics

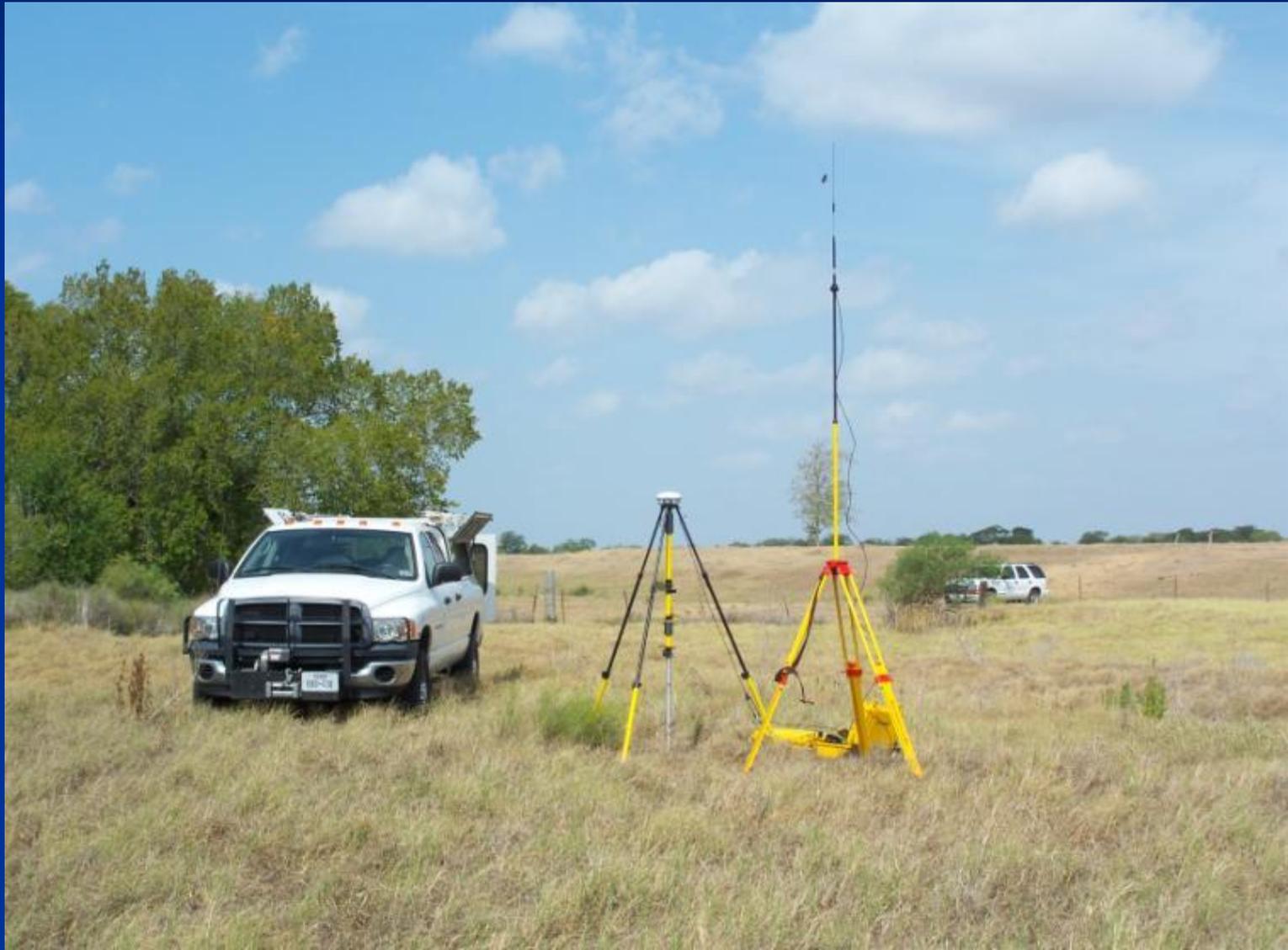
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- Elevation reference points -  
Benchmarks
- Hydraulic model calibration/validation
- 2D habitat modeling
- 1D overbanking/riparian modeling

# Surveying Water surface elevation (WSE)



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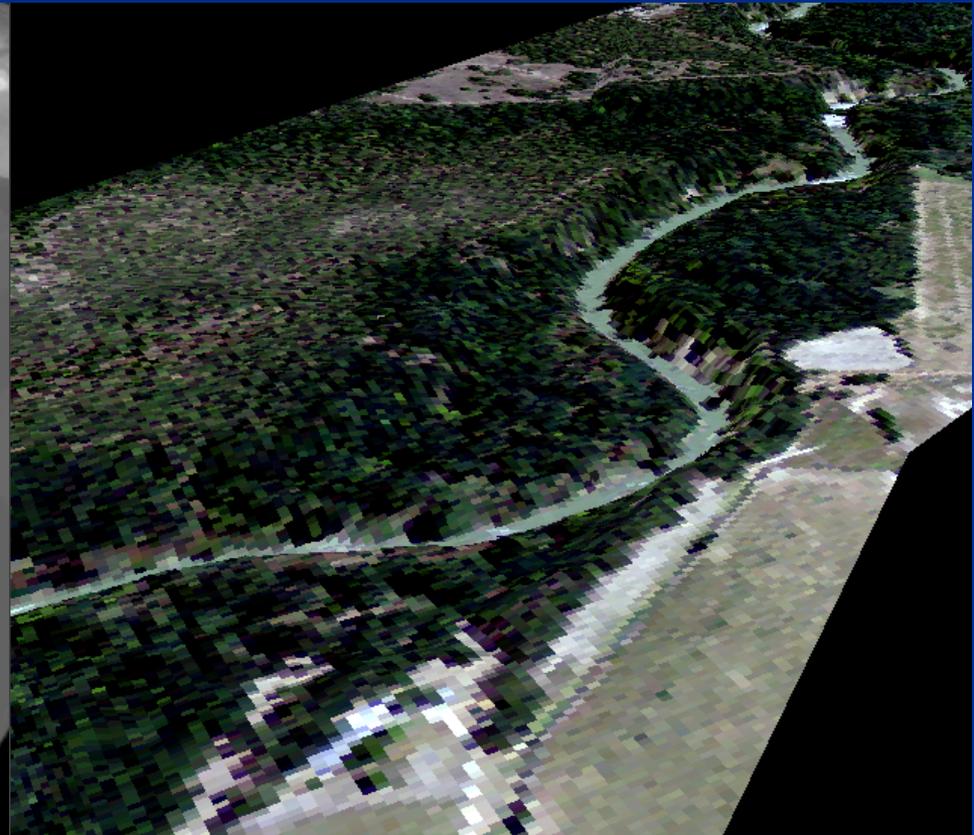
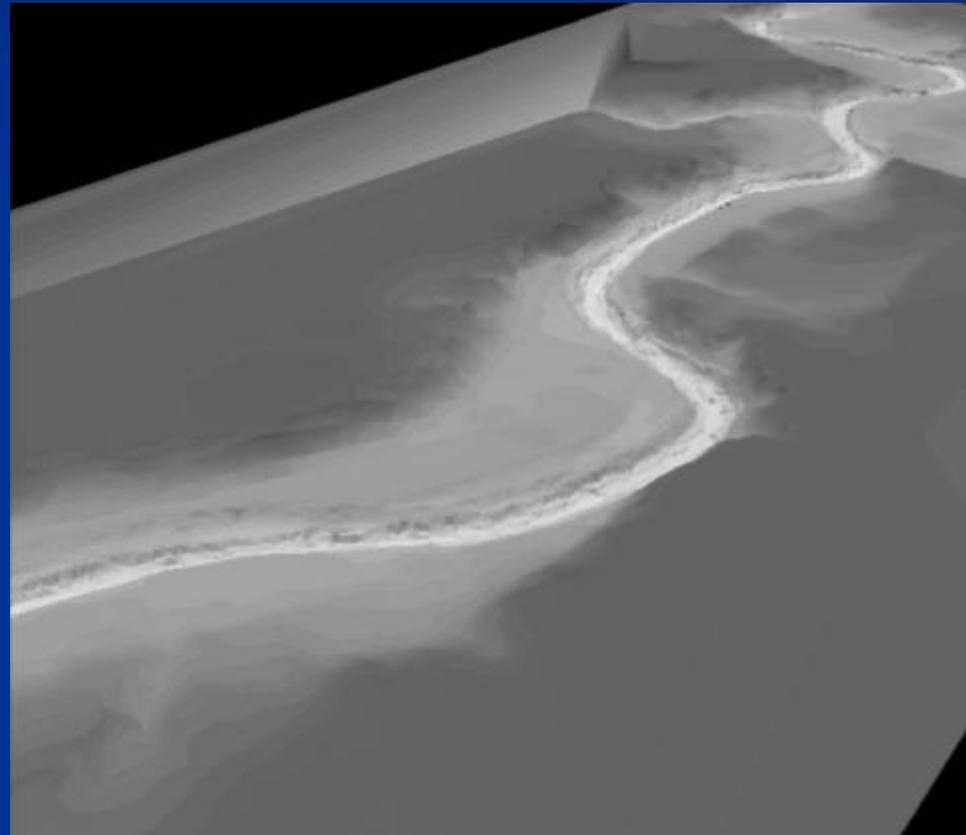


# Bathymetry

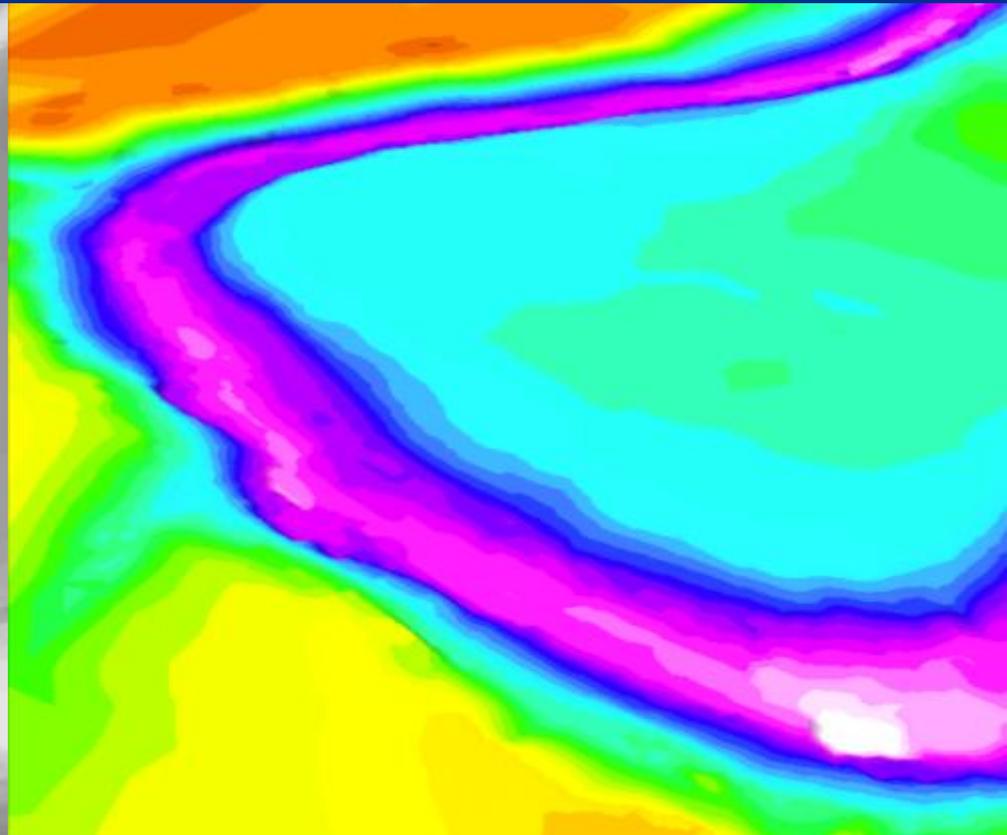
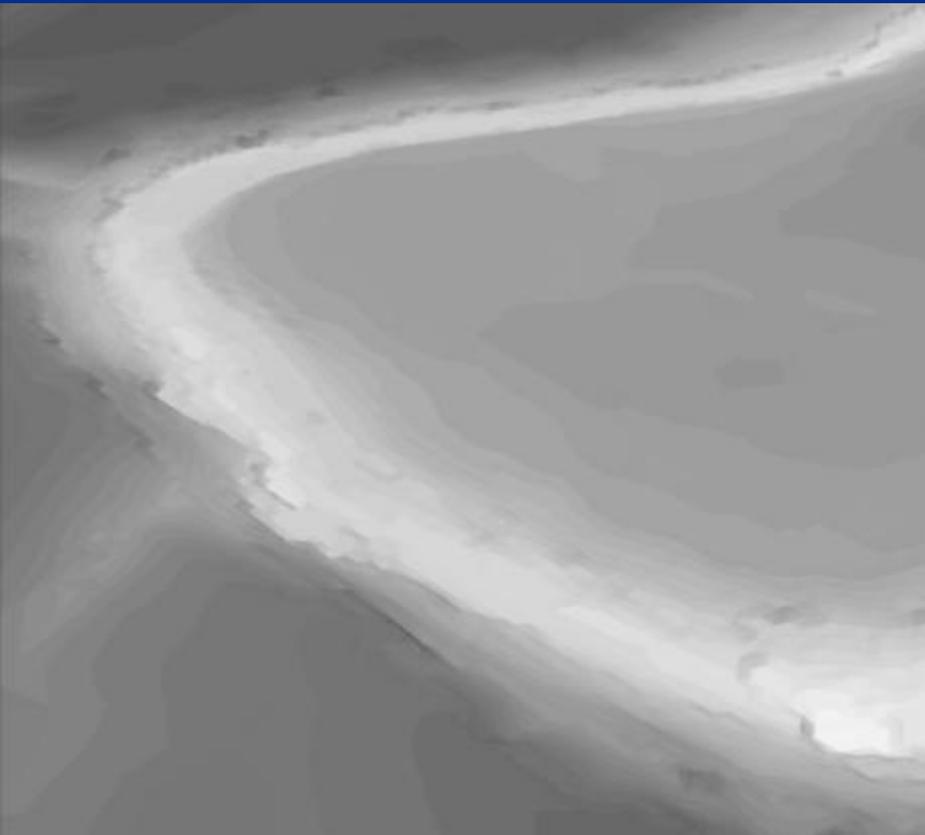
- Echosounder
  - Boat mounted:
    - RTKGPS + echosounder
- RTKGPS
  - Roving unit on range pole
    - point measurements
- Total station
- Laser



# Digital Terrain Model



# Digital Terrain Model



# Habitat and Substrate Mapping

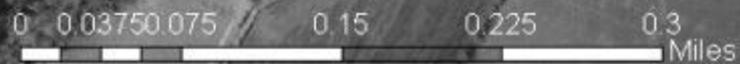
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- Mesohabitat mapping
  - Runs, riffles, pools, backwater
- Substrate mapping
  - Clay, silt, sand, cobble, rubble, boulder, bedrock
- Large woody debris



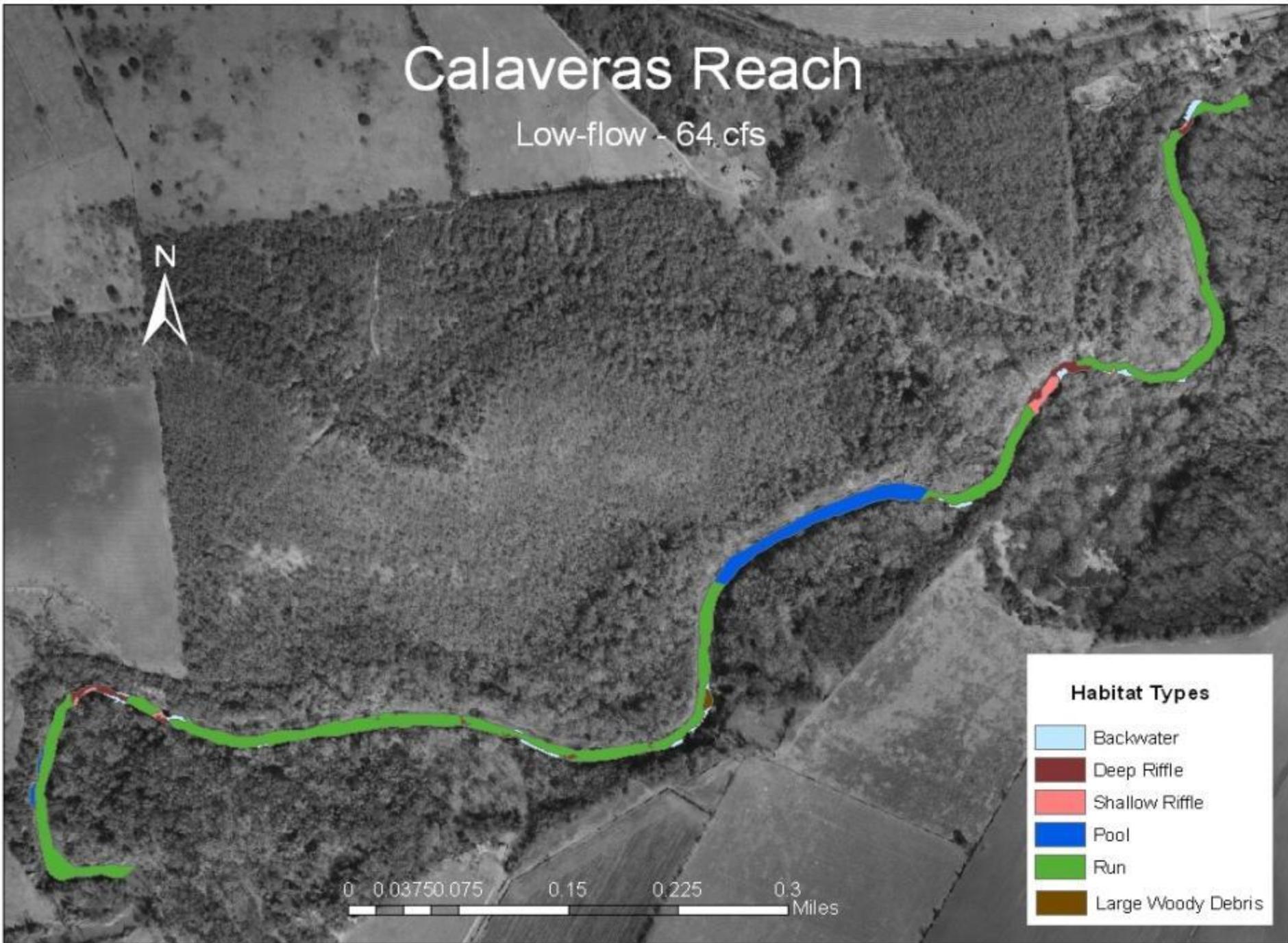
# Calaveras Reach

Low-flow - 64 cfs



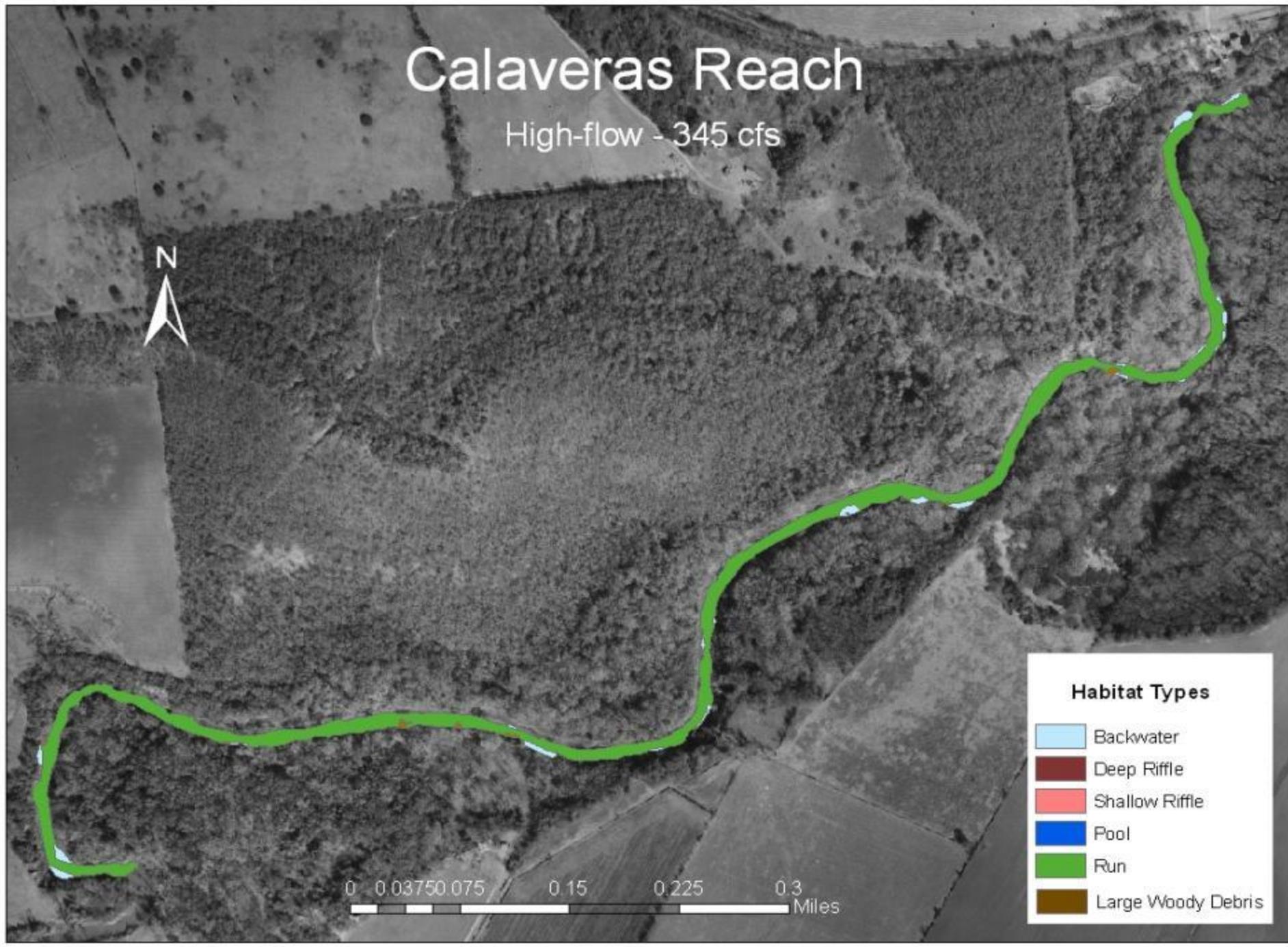
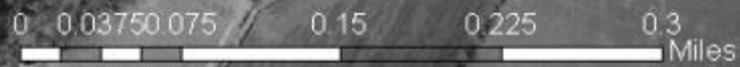
## Habitat Types

-  Backwater
-  Deep Riffle
-  Shallow Riffle
-  Pool
-  Run
-  Large Woody Debris

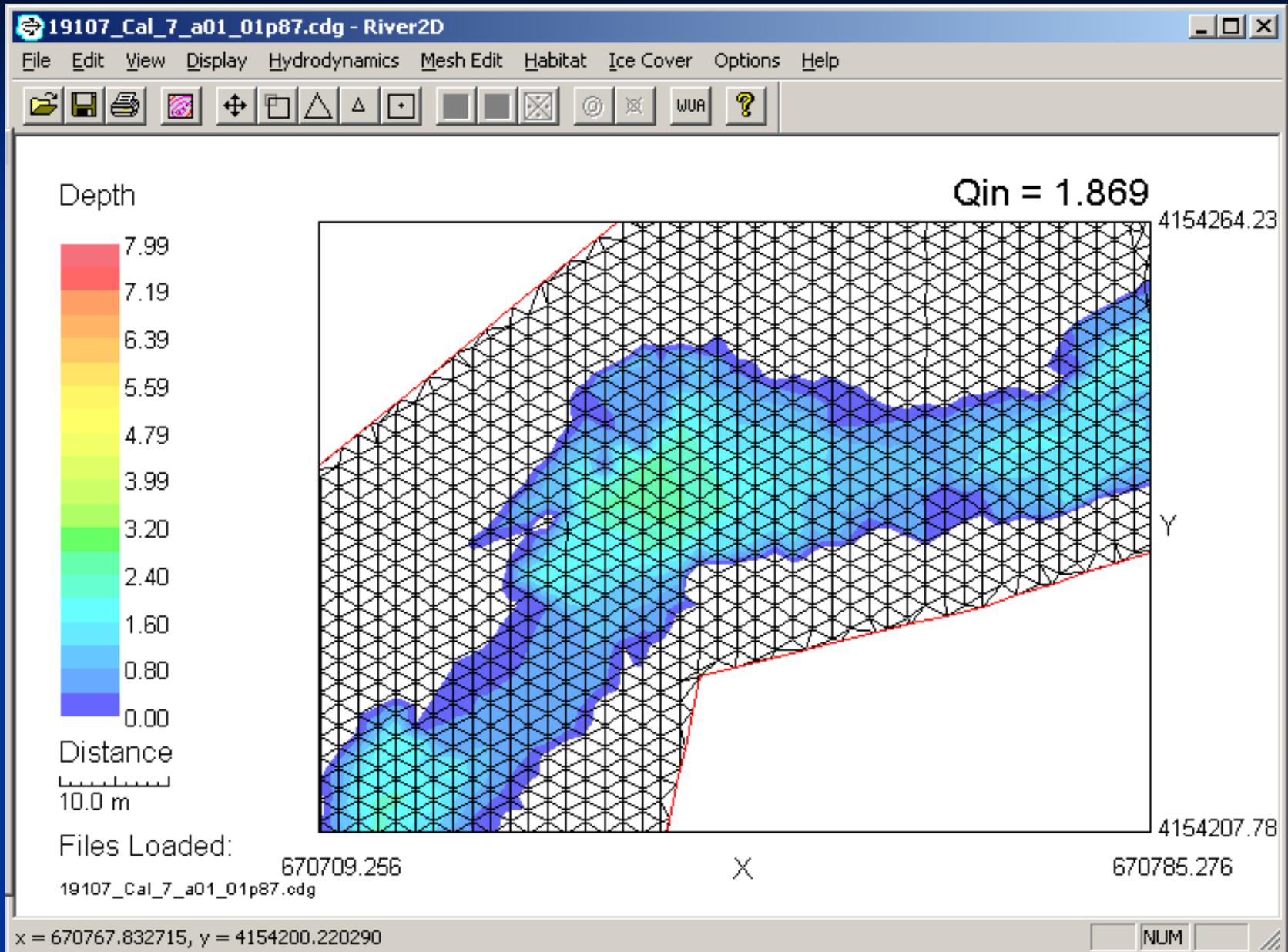


# Calaveras Reach

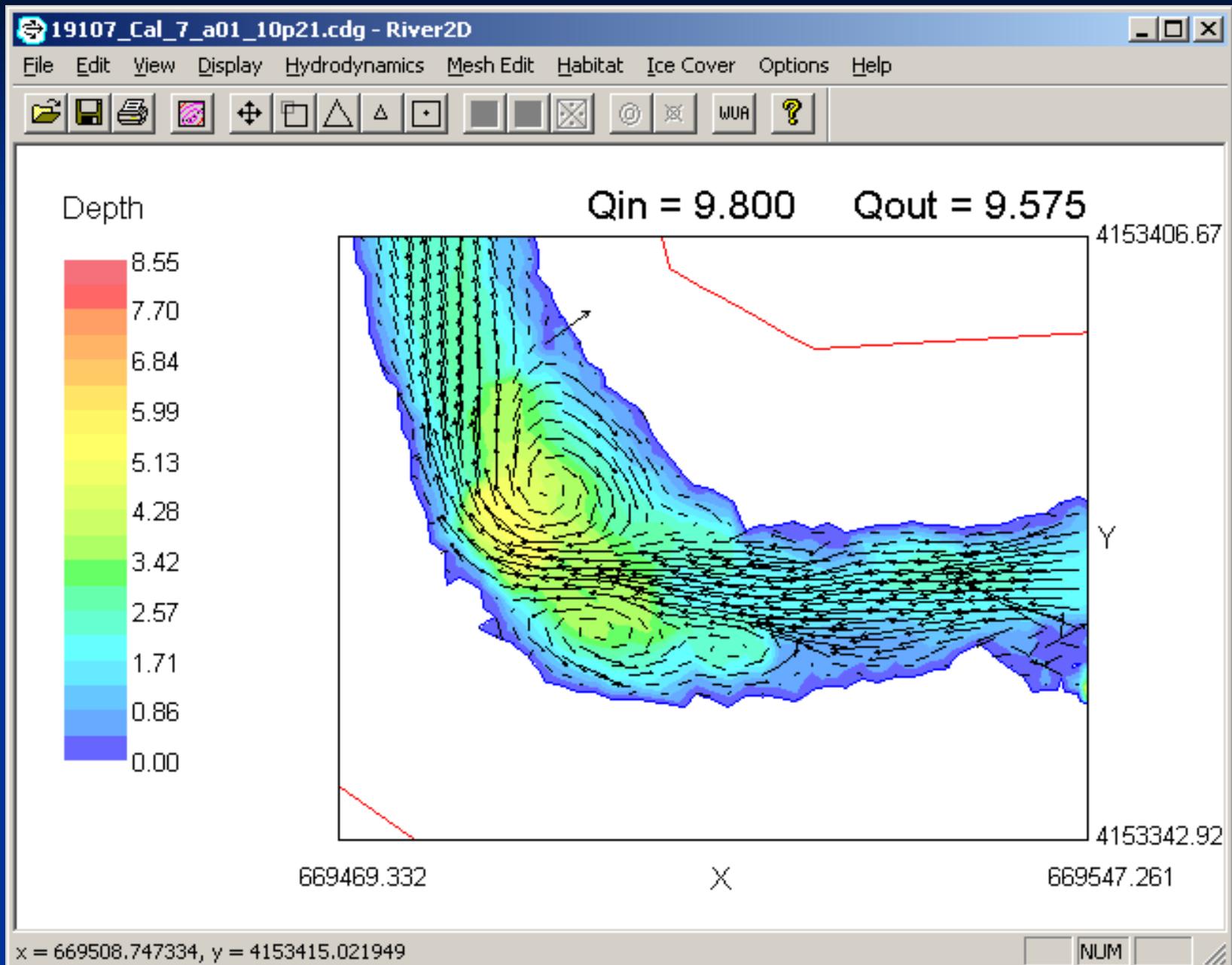
High-flow - 345 cfs



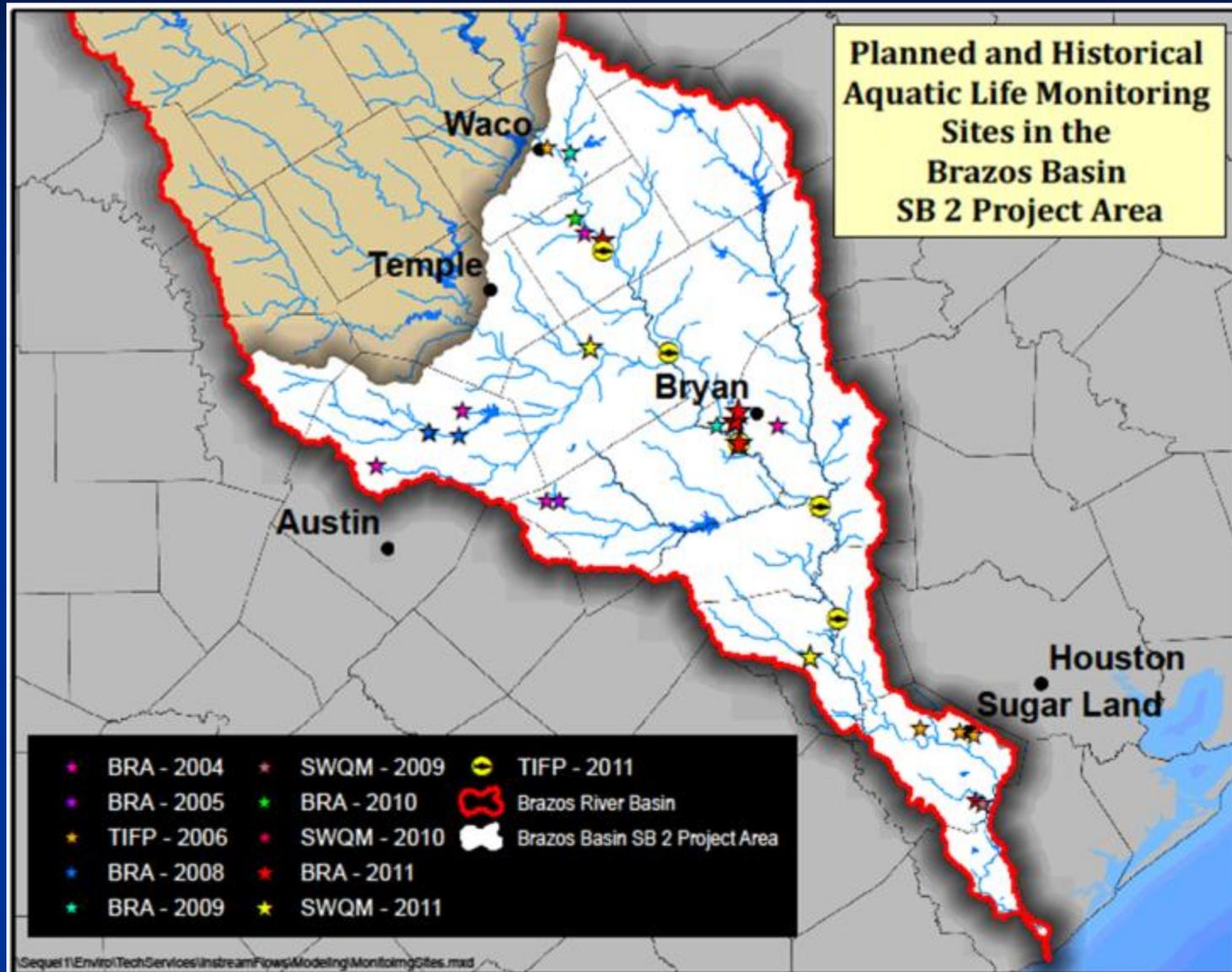
# River2D model



# River2D model



# Biological Sampling Events



# Habitat Suitability Criteria (HSC) Development

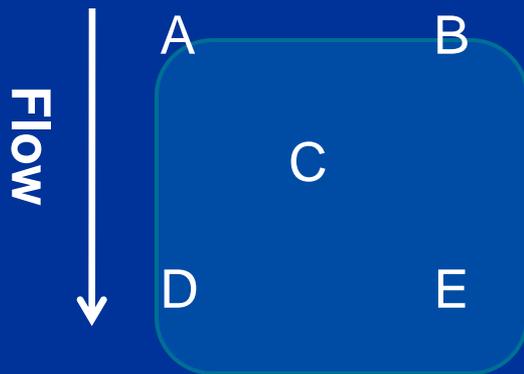
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- Overlay habitat and substrate maps
- Randomly pick sites within each habitat/substrate category
- Sample with appropriate gear
  - Seines
  - Boat electrofishing
  - Barge-style electrofishing



# Mesohabitat Characterization

- Record habitat type
- Take depth, velocity, substrate, and GPS waypoint at 5 locations
- Note coverage of LWD, aquatic veg, undercut bank, etc.

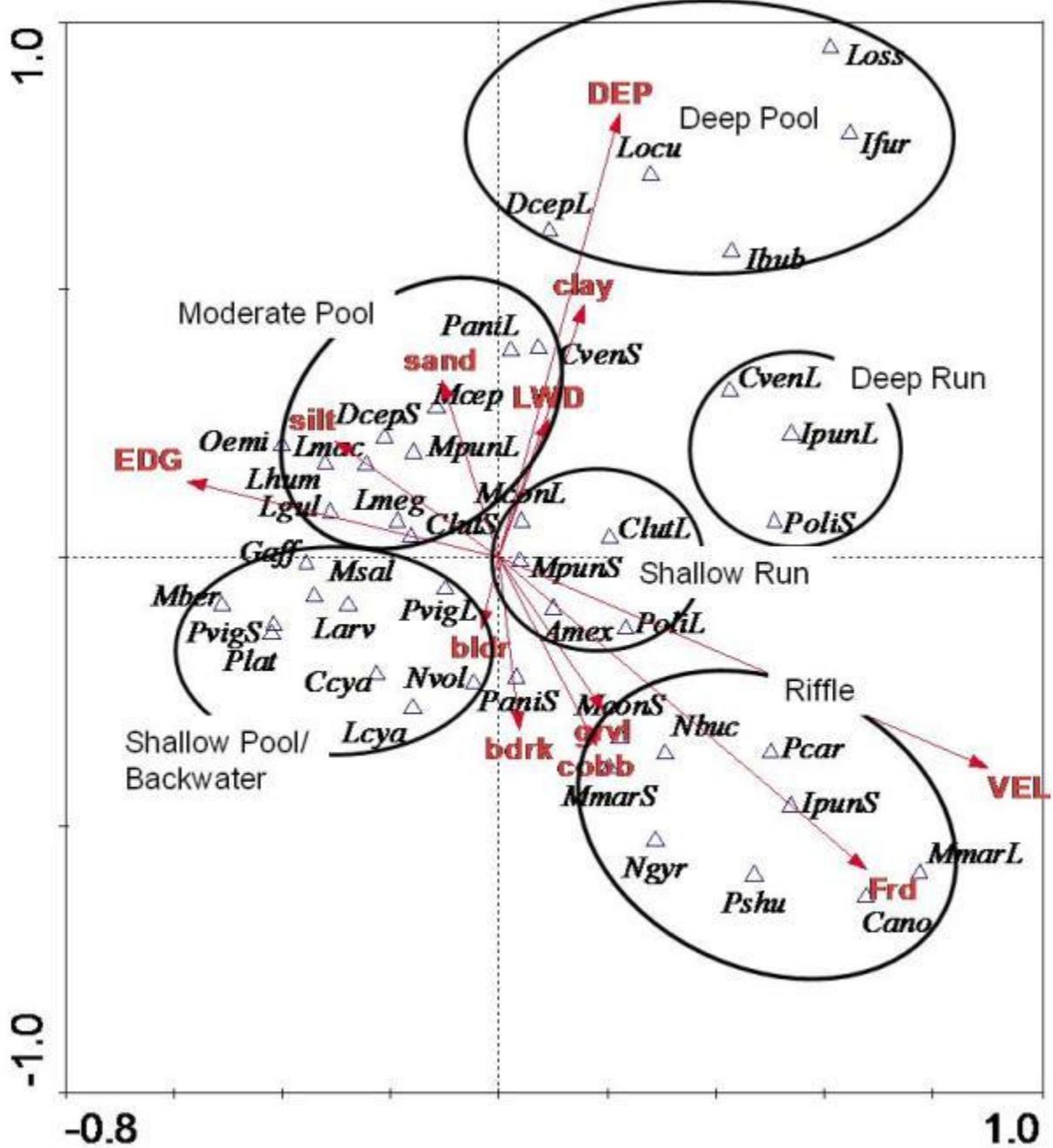


# Data Analysis

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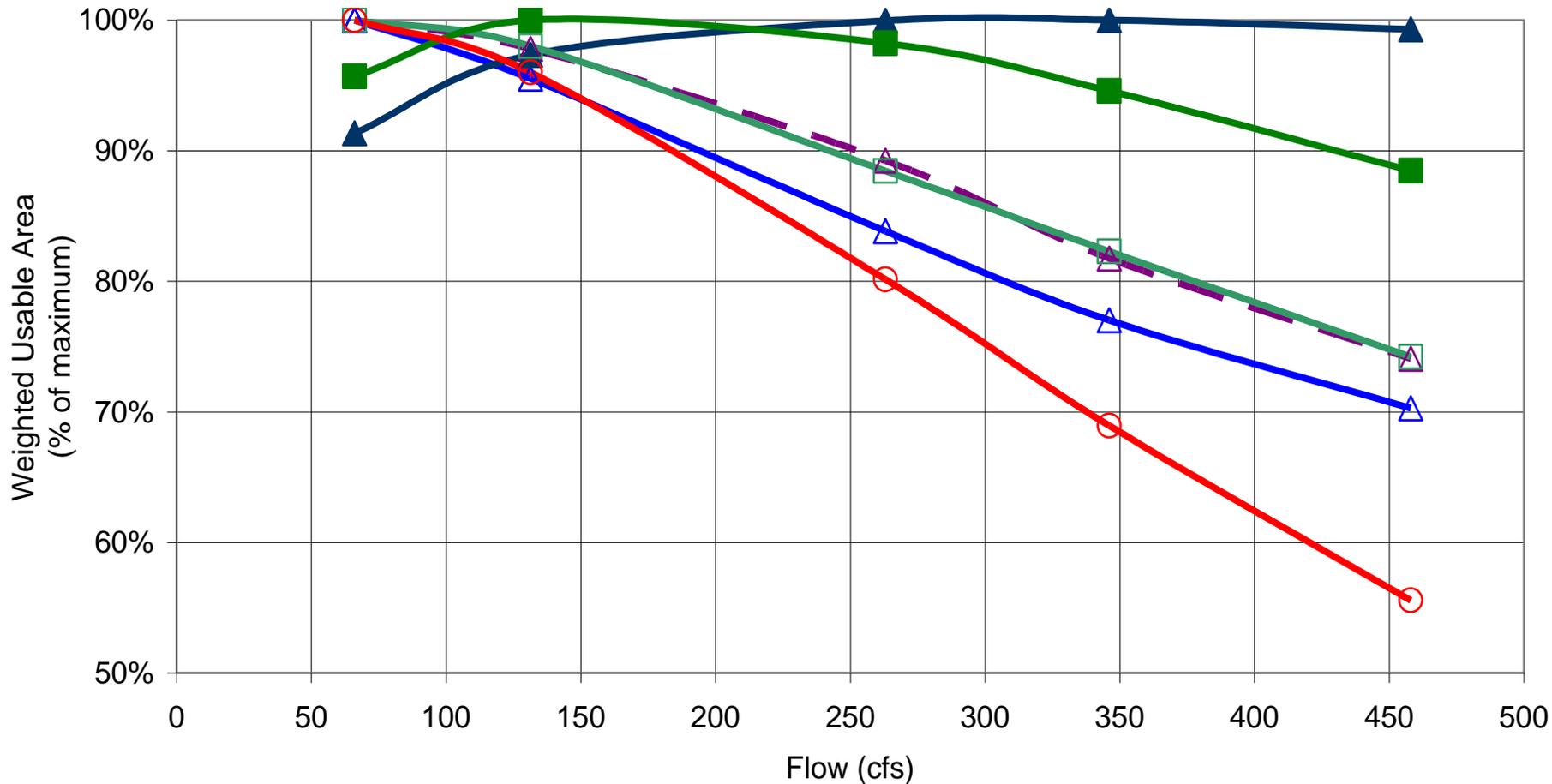
- Examine habitat use of various life-stages
- Develop habitat guilds using Canonical Correspondence Analysis (CCA)
- Establish Habitat Suitability Criteria (HSC) for each guild
  - Depth
  - Velocity
  - Substrate

# CCA



# Habitat Modeling Results

DRAFT  
LSAR Instream Flow Study  
San Antonio River 19107\_Calaveras  
WUA vs Flow



# Calaveras – Riffle Habitat Guild

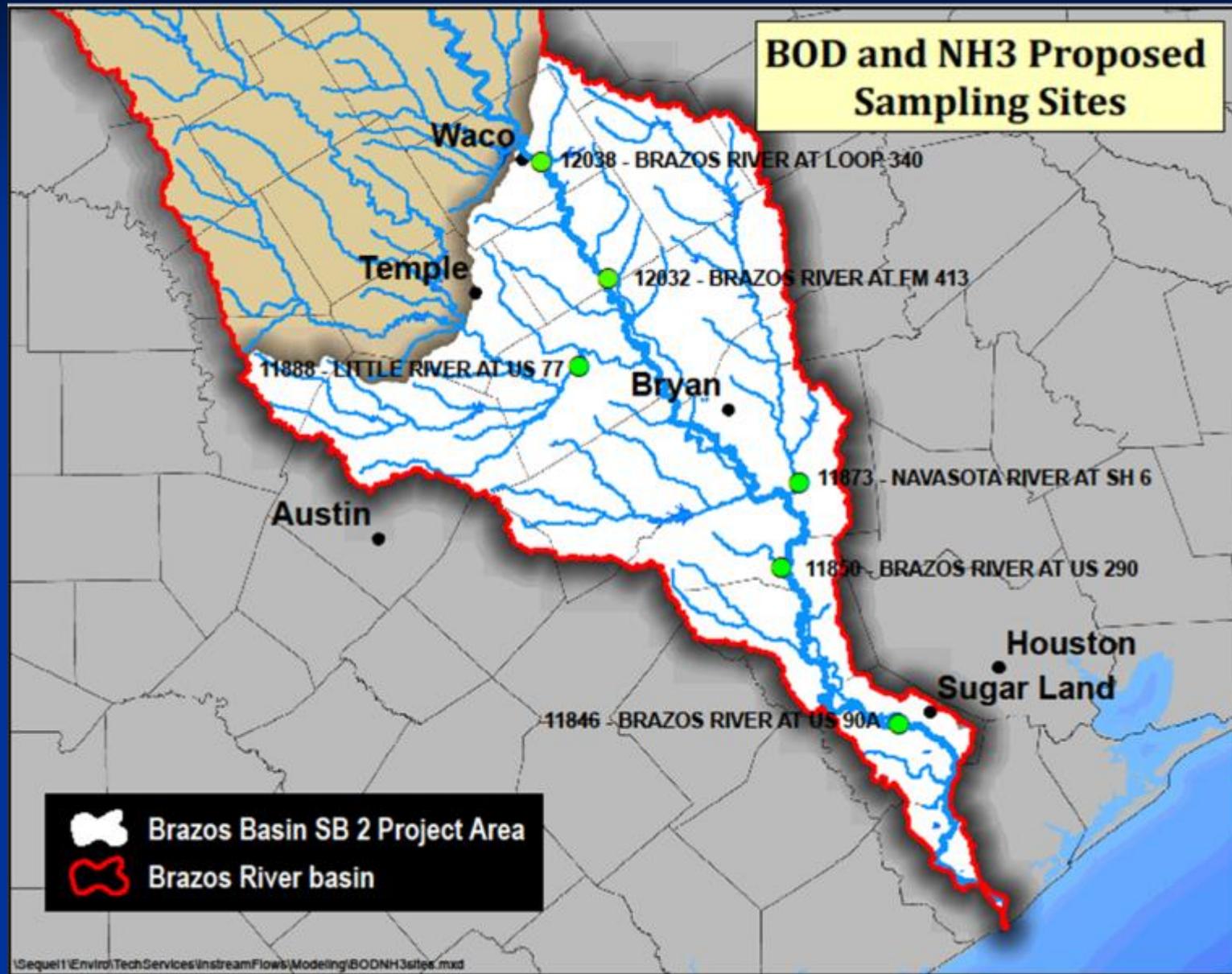


# Water Quality

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- Approach outlined in Study Design
  - Summarize Available Information
  - Assess Current Conditions
    - Current Flow
    - Water Quality Data
  - Identify Water Quality Goals, Objectives, and Identify Needs
  - Conduct Studies and Apply Models if needed
  - Integration into Flow Recommendations

# Water Quality Sampling Events



# Summary of Available Information

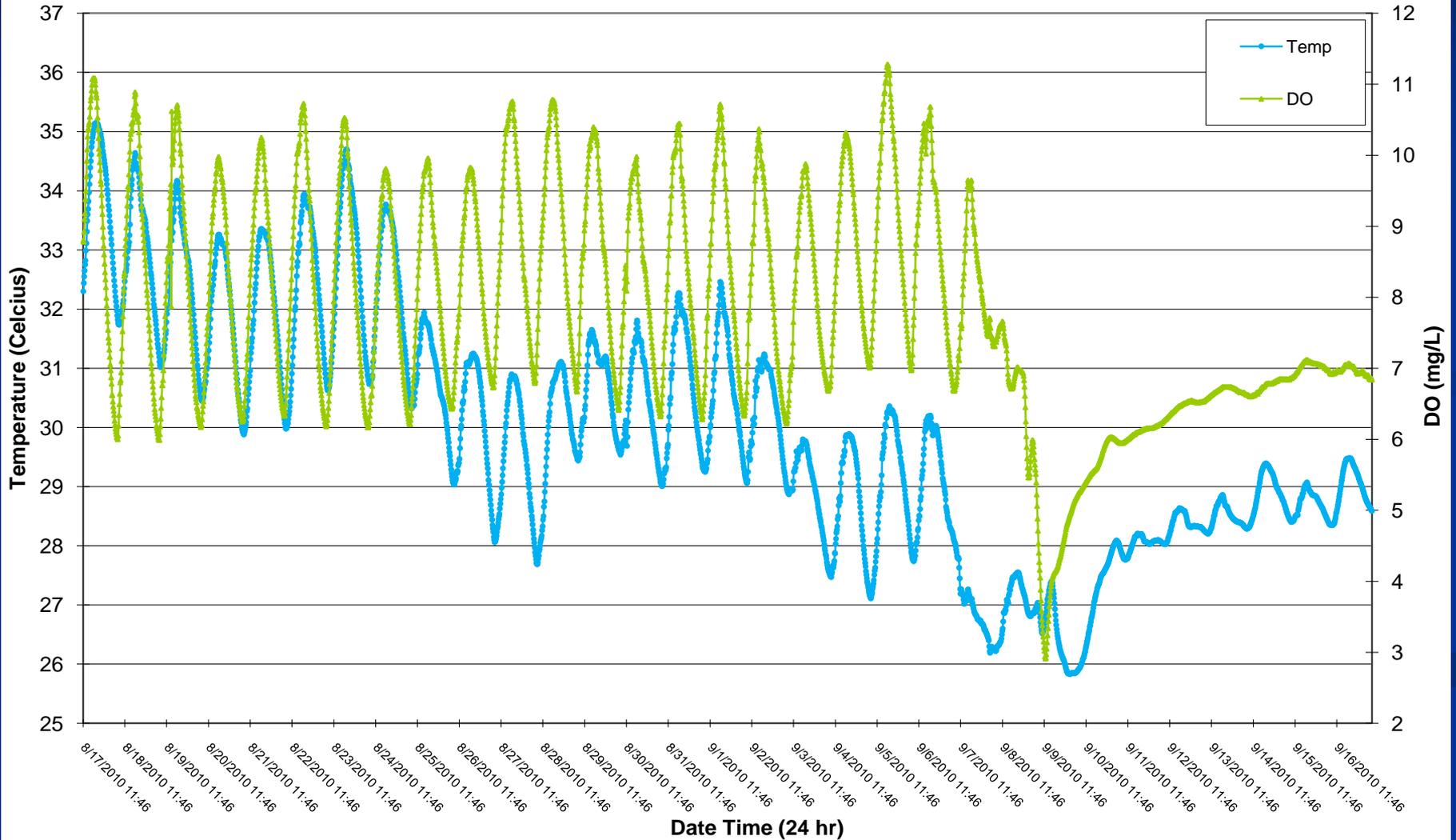
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- Clean Rivers Program – BRA/TCEQ  
Historical Water Quality Trends
- Other Sources of WQ Data
  - SWQM Stations
  - USGS
  - TCEQ – UAAs, RWAs, TMDL Implementation

Note: All needs of TIFP WQ analysis are NOT addressed by existing programs.

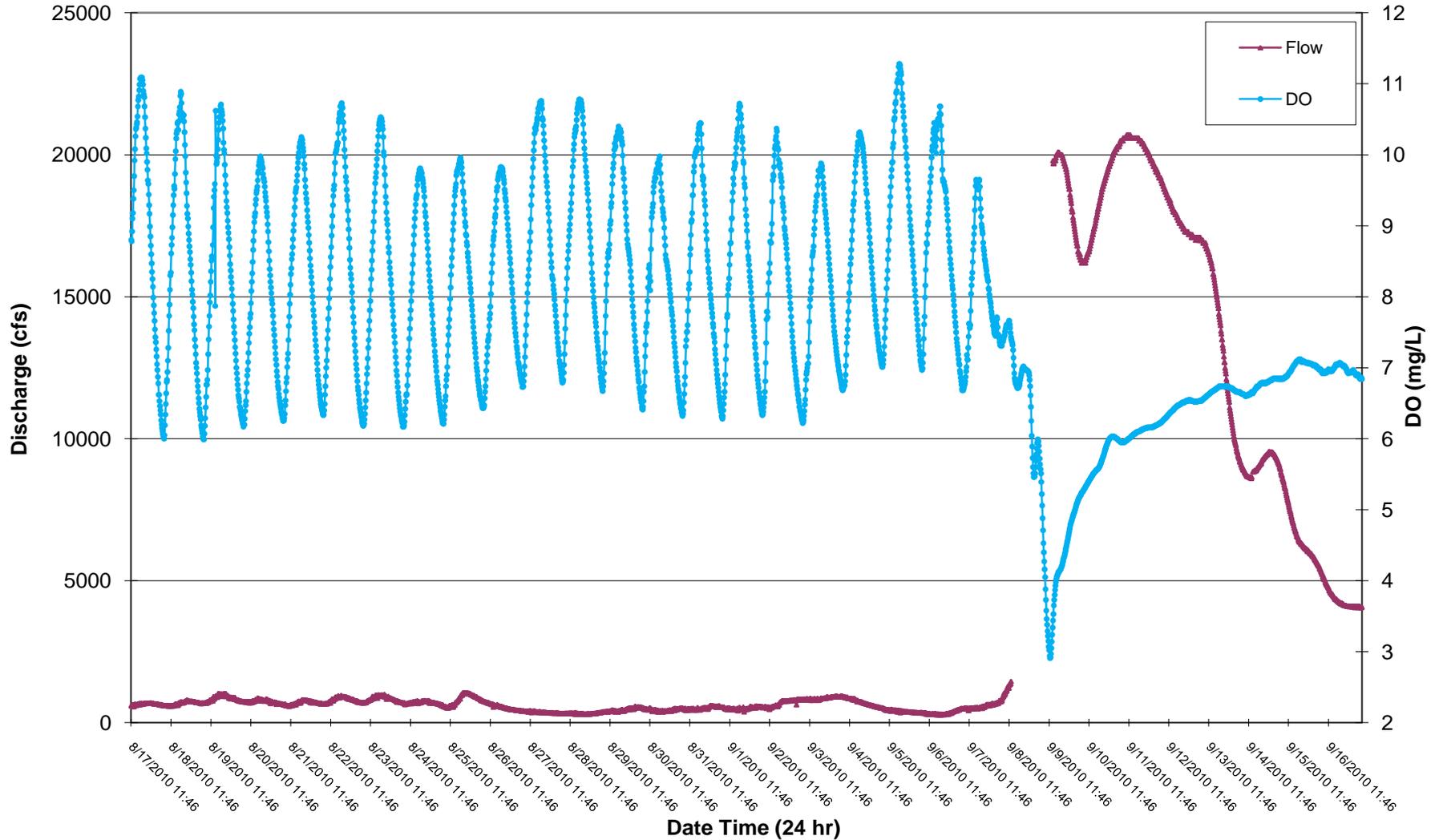
# Sonde Long-term Water Quality

12080 Brazos River near Hearne, Texas  
Sonde Temp and DO Data



# Sonde Long-term Water Quality and Flow

12080 Brazos River near Hearne, Texas  
Sonde Flow and DO Data



# Additional Study Efforts

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- ❖ TCEQ/BRA Water Quality Study
- ❖ TPWD SWG Riparian Assessment/Flow Analysis
- ❖ TWDB Research and Planning Contracts
  - ❖ TPWD Mussel and Benthic Invertebrate
  - ❖ TAMU Fish Habitat Utilization
  - ❖ TSU UAV Flyover

# Integration of Flow Components

Overbank Flows	<p><b>4,000-10,000 cfs</b> for 2-3 days Once every 3-5 years Channel Maintenance Riparian Connectivity, Seed dispersal Floodplain habitat</p>				<p>Wet year Average year Dry year</p>
High Flow Pulses	<p><b>700-1500 cfs</b> for 2-3 days 2-3 X per year every year Sediment transport Lateral connectivity Fish spawning</p>		<p><b>1800 cfs</b> for 2 days 1 X per yr every other year "Big River fish" spawning between Jul 15 - Aug 15</p>		
Base Flows	<p><b>300-450 cfs</b> maintain biodiversity and longitudinal connectivity</p>				
	<p><b>100-150 cfs</b> Fish habitat</p>	<p><b>150-300 cfs</b> Spring spawning</p>	<p><b>40-50 cfs</b> Fish habitat</p>	<p><b>90-100 cfs</b> Fish habitat</p>	
Subsistence	<p><b>35 - 55 cfs</b> Maintain water quality (35 cfs) and key habitats in May (55 cfs)</p>				

# Instream Flow Program Results

- An essential database for conservation of fish and wildlife resources in Texas
- Considered in the State's water rights permitting process, and
- Incorporated into future regional and state water plans

# Linking SB2 and SB3

- SB3 Objective: develop recommendations to protect instream flows and freshwater inflows” (TWC § 11.0235 d-6).
- BBEST utilize “best available science” to generate flow recommendations to meet the needs of the environment (TWC § 11.02362 m). SB2 studies currently underway in the Middle and Lower Brazos River Basin may be considered "best science available."
- BBEST recommendations are then considered “in conjunction with other factors, including the present and future needs for water for other uses related to water supply planning,” by BBASC (TWC §11.02362 o).
- TCEQ considers recommendations of both the expert science team and area stakeholder committee, human and other competing water needs, and other factors (TWC §11.1471 b).
- Adaptive Mgmt component requires flow recommendations to be reviewed at a minimum every 10 years by BBEST/BBASC (TWC §11.02362 p).



# Information

Texas Instream Flow Program Website

[www.twdb.state.tx.us/Instreamflows/](http://www.twdb.state.tx.us/Instreamflows/)

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Questions???

