THE MIGHTY BRAZOS RIVER – RECREATING A RECORD
TEXAS FLOODPLAIN MANAGEMENT ASSOCIATION
SPRING CONFERENCE 2017
APRIL 27, 2017

Study Location
Regulated drainage area below 7 USACE Reservoirs from Waco to the Gulf of Mexico

Flood Protection Planning Grant
Study Partners
- Brazos River Authority (BRA)
- Texas Water Development Board (TWDB)
- Data Providers: Fort Bend Co.
- Stakeholders
  - Brazoria County
  - Waller County
  - Lake Jackson
  - Sandy Point
  - Sugar Land
  - Washington County
  - Velasco Drainage District
  - Pecan Grove MUD
Reasons for the Study

- One of the fastest growing areas in the country
- Hydrologic and hydraulic models/data are dated outside of Fort Bend County
- Need for consistent modeling methodology across county boundaries
- Need to assess lower Brazos watershed from a comprehensive basinwide perspective (existing conditions and alternatives)
- 10,000 square miles of uncontrolled drainage area

Goals of the Study

- Quantify existing flooding issues and flood damage reduction alternatives
- Update hydrologic and hydraulic data for the lower Brazos River (above Hempstead gauge to mouth across 5 counties)
- Calibrate new models to historical events and provide flood volumes, flood depths, and flood durations
- Facilitate land use planning, emergency response, and sound floodplain management

Field Surveys

- Locations – Field Recon and aerials
- 15 cross sections and 7 bridges
- Right-of-Entry – public and private
- Survey Methods – Topography and Bathymetry
**Field Surveys**
- Datum – NAD 83 and NAVD 88
- Established Control
- FEMA Data Capture Standards
- Ties in with LiDAR data

**USGS Collection Methods**
- Streamflow is physically measured
  - Computed using 2 variables
    - Velocity
    - Area
  - Streamflow = (velocity x area)
- USGS measures and then totals the stream velocities and areas, in a river cross section, to compute stream flow

**2016 Richmond USGS Measurements**
Hydrograph at Richmond Gage (USGS 08114000 Brazos Rv at Richmond, TX)

Hydrology Study Location
- Base HEC-HMS Model
  - 9,766 sq. mi. below 7 USACE reservoirs
  - 154 sub-basins (63 sq. mi. avg. size)
  - 114 routing reaches (over 1,240 river miles modeled)
- Extensive Calibration
  - 17 Calibration Zones
  - 8 Calibration Storms
  - UH and Routing Parameters
Hydraulic Study Location
- Study Area – Waller/Grimes Co Line to Gulf of Mexico
- 220 miles of Detailed Unsteady HEC-RAS Modeling
- 4 USGS Gages

Calibrated Historical Floods
- 4 Low Flow Events (within the channel banks)
  - October 17, 1998 to November 1, 1998
  - June 19, 2007 to July 31, 2007 (HW Marks at 8 Locations)
  - September 1, 2010 to October 9, 2010
  - October 12, 2013 to November 21, 2013
- 3 High Flow Events (spill out of the main channel banks)
  - December 21, 1991 to January 15, 1992
  - May 25, 2015 to June 14, 2015
  - May 26, 2016 to June 6, 2016

May-June 2016 Flood
- Amid deadly floods, Texas Brazos River crests at record 54 feet
- Texas residents brace for more flooding after torrential rains kill six
May/June 2016 HMS Model Rainfall

May-June 2016 Gage Discharge Timeline

- **May 27**
  - 14:00 Hempstead Gage Peaks at 156,000 cfs
  - 21:00 Mill Creek Gage Peaks at 89,000 cfs

- **May 28**
  - 18:00 San Felipe Gage Peaks at 143,000 cfs

- **June 1**
  - 11:00 Richmond Gage Peaks at 102,000 cfs

- **June 4**
  - 13:00 Rosharon Gage Peaks at 112,000 cfs

May-June 2016 Calibration

- High Water Mark Survey
- Georeferenced Flood Photos
- Fort Bend County Sheriffs Office
- Fort Bend County
- Velasco Drainage District
- Twitter
- Photos from Space Station
- YouTube Videos
- Drone Flights
- Facebook Photos

Source: NASA Space Station Photo Posted on Twitter 5/28/2016 Waller/Austin Co.
Halff made several field visits to document the May/June 2016 flood event
- 18 High Water Mark Survey points
- 850 Flood Photos of the Brazos River
- Georeferenced location of photos
- Time Stamp with Date and Time

Brazos Rv Nr Hempstead,Tx
- Waller County, TX
- Located on US Hwy 290
- Gage Datum = 107.90 NGVD29
- Period of Record – 1938 through Current Date
- 79 Years of Record

Hempstead Flood Photos
- SH 159 – June 3, 2016
- FM 519 – June 3, 2016
Brazos Rv at San Felipe, TX

- Austin County, TX
- Located on FM 1458
- Gage Datum = 0 feet above NGVD88
- Period of Record – August 2013 through Current Date
  - 4 Years of Record

June 3, 2016 – FM 1458

San Felipe Flow Calibration

Date

Flow (cfs)

Flow Calibration

Observed Flow
SAN FELIPE STAGE CALIBRATION

DATE

STAGE (FEET)

SAN FELIPE STAGE CALIBRATION

Brazos Rv at Richmond, TX

- Fort Bend County, TX
- Located on Highway 90A
- Gage Datum = 27.94 feet above NGVD29
- Period of Record – 1922 through Current Date
- 95 Years of Record

May 31, 2016 – US-90A

US 90 - Looking Upstream Along the Brazos Rv
Brazos Rv at Rosharon, TX

- Brazoria County, TX
- Located at FM 1462
- Gage Datum = 0 feet above NGVD29
- Period of Record – 1967 through Current Date
- 49 Years of Record

June 1, 2016-Rosharon Gage

USGS Gage Elevation on 6/6/2016: 50.7-51.7 feet (46.6 feet with Datum Adjustment)

Drone footage along FM 1462 west of the Brazos River

June 6, 2016-Rosharon Gage

Along FM 1462 East of Brazos River near Majestic Oak Dr.
Picture taken on 6/6/2016 @ 15:00
Gage Elevation on 6/6/2016: 52.5 feet (46.25 feet with Datum Adjustment)
Next Steps

- Finalize Hydrology, Hydraulics, and Floodplain Mapping – June 2017
- Alternatives Formulation – August 2017
- Flood Damage Analysis Modeling – November 2017
- Environmental Constraints Analysis – January 2018
- Draft Report – January 2018
- Final Report – March 2018

Hydrologic Model

- Calibration Methodology
  - Data Collection
    - Stream Flow
    - Reservoir Releases
    - Rainfall – Gridded & Gauged

- Calibration Methodology Cont.
  - 17 calibration zones
  - 7 calibration storms
    - 6 from MPE era
    - 1 from ground gauges
  - Reset using observed data
  - Parameter Adjustment
    - Loss and Unit Hydrograph Parameters
    - Routing
    - 10% Rule and eyeball test

NWS MPE Rainfall Data