

WEST FORK SAN JACINTO MOUTH BAR DEPOSITION FROM HURRICANE HARVEY

SUMMARY:

Approximately 283,000 CY of sediment was likely deposited during Hurricane Harvey in the vicinity of the mouth bar at the West Fork San Jacinto River at the upstream side of Lake Houston. This is based on an estimation of the sediment yield based on measured data, an approximation based on a sediment transport relationship, and elevation differences between surveys in 2011 and 2018.

OVERVIEW:

There is an emergent mouth bar at the interface between the West Fork San Jacinto (WFSJ) River and Lake Houston. The requested analysis was to identify what volume of sedimentation in the vicinity of the mouth bar was associated with Hurricane Harvey (August 2017).

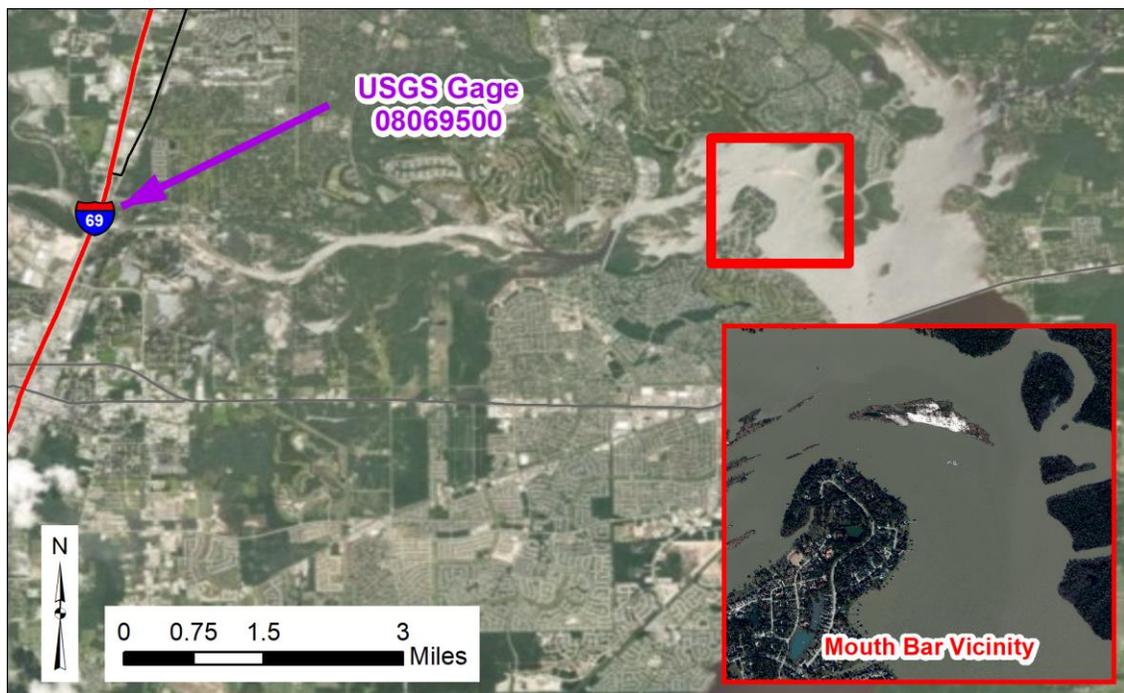


Figure 1: Project vicinity

DATA COLLECTION AND ANALYSIS:

The primary data used in this analysis was a survey from 2011, a survey from 2018, data from USGS gage 08069500 (West Fork San Jacinto River at US-59), and a HEC-RAS model developed previously for this project. The volumetric difference between the 2011 survey and 2018 survey in the region of the mouth bar indicated that an estimated 753,000 CY of net deposition between 2011 and 2018.

The flow history during the period between surveys at gage 08069500 is shown in figure 1. Data is largely stage only during that period though was converted to discharge using the rating curve available from the NWIS database. That rating curve did not extend to capture the extreme high and low ends and was supplemented with the rating curve associated with the one-dimensional HEC-RAS model (fig. 2A).

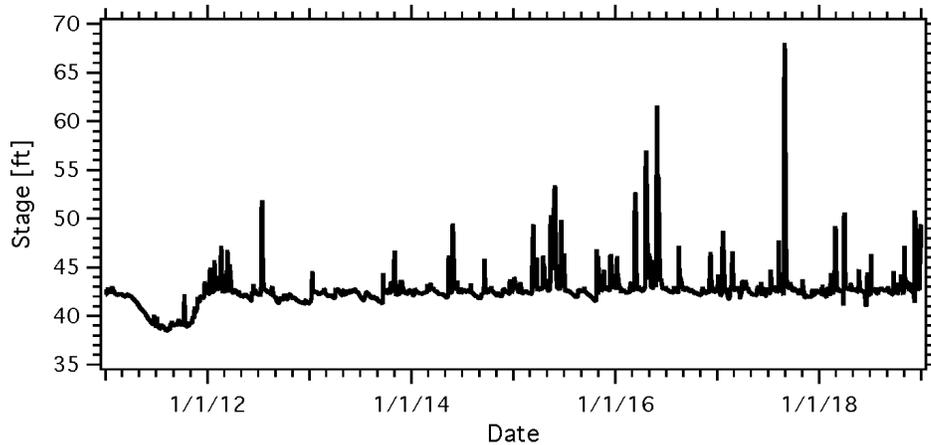


Figure 2: Stage Hydrograph at USGS 08069500 2011-2018

Measured suspended sediment data was collected 87 times since 2010 at USGS gage 08069500. Suspended sediment concentration (SSC) data was converted to a bed material load transport rate (tons/day excluding wash load where wash load is identified as sediment below 63 microns). A number of measurements were excluded for a variety of reasons including very low SSC values and absent wash load percentage data. After removing those data points, twenty were left. Wash load percentages were estimated in some circumstances based on reported measured values. Excluding these measurements is not overly problematic given many are at low flow with low suspended sediment concentrations. Additionally, where wash load percentage was reported under those flow and transport conditions the percentage of fines meeting the wash load criteria approached 100%. The rating curve between discharge and suspended bed material load based on measured data is in figure 2B.

A power-law relationship has fit to the measured data and would likely work well within the range of measured data, however there are no measurements above 45,000 cfs. Extrapolating to project suspended bed material load at higher flows produced sediment loads far beyond a reasonable range. In lieu of the measured data relationship, sediment rating curves were developed for the WFSJ upstream of Lake Houston using HEC-RAS cross-section data.

There is no shortage of total-load sediment transport equations; Ackers-White, Engelund-Hansen, Laursen (Copeland), and Yang were used to develop total bed material load rating curves (fig. 2C). The Engelund-Hansen (EH) relationship was selected for the sediment rating curve. This relationship is generally applied to sand-bed rivers with high suspended sediment transport (as is the case in the WFSJ). As a check on the reasonableness of the relationship, both the measured data rating curve and the EH rating curve were used on the flow history during the time period of interest excluding the high flows. The high flows were excluded to prevent the extrapolation issues noted above. The sediment yield from measurements (outside of high flows) was approximately 393,000 tons/year. That of the rating curve developed (outside of high flows) is approximately 422,000 tons/year. This is considered reasonably similar for the purposes of this analysis.

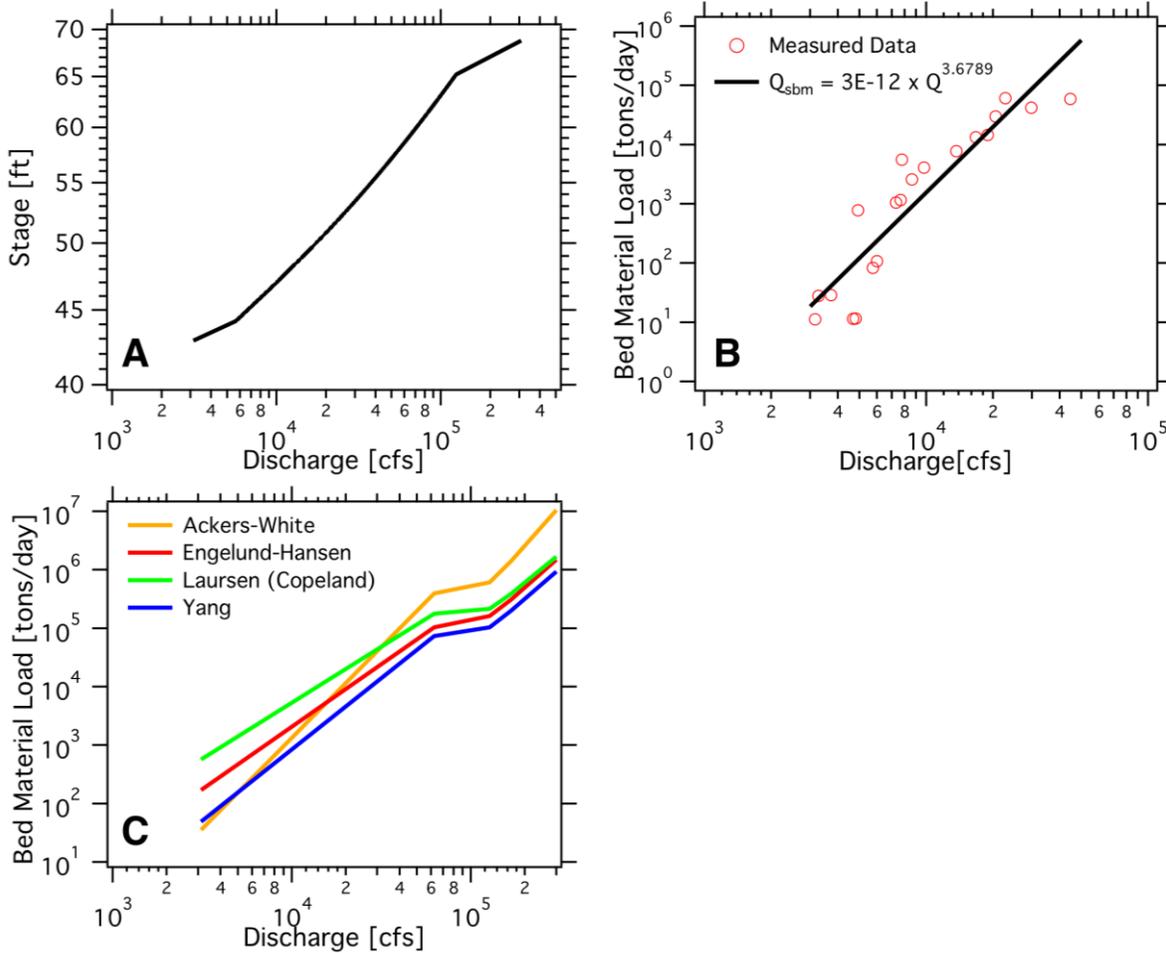


Figure 3: Data analysis for this report: (A) stage discharge hydrograph at USGS gage 08069500, (B) measured suspended sediment and power-law regression, and (C) bed material load rating curves coinciding with USGS gage 08069500

The sediment yield was then estimated using flow history for the entire period between surveys to get 5.4M tons (3.9MCY). Approximately 20% of the sediment delivered between surveys was deposited in the mouth bar region (753,000 is approximately 20% of the 3.9MCY). The sedimentation associated with Hurricane Harvey in the area near the mouth bar was estimated based on the fractional sedimentation between surveys. Hurricane Harvey is estimated to have delivered 2.0M tons (1.4MCY) of sediment. Assuming that approximately the same fraction of sediment is deposited at the mouth bar as the whole inter-survey period, the deposition at the mouth bar would be approximately 283,000 CY during Hurricane Harvey.

CONSTRUCTION CONSIDERATIONS:

This analysis and the associated estimations were limited by data availability in the area of the mouth bar and as a result the quantities included for the mouth bar (shown above) are only including emergent volumes above the normal water level of Lake Houston (41.8 ft NAVD88). In order to dredge these areas the contractor performing the work will have to obtain approximately 4 feet of water for dredge plant floatation. The limited hydrographic survey information in the area of the mouth bar by the TWDB in 2011 shows, that there was between 5.3 and 1.0 ft of deposition in the southeastern portion of the point bar. Based on the new emergent area resulting from Harvey

deposition it was estimated at 23 acres that has to be dredged to a depth of 4 ft, adding approximately 150,000 CY of additional dredging requisite. This provides a total estimated volume of dredging in the study area of 433,000 CY, with a standard over/underrun volume of 15% the planning/budgetary volume should be 497,950 CY.

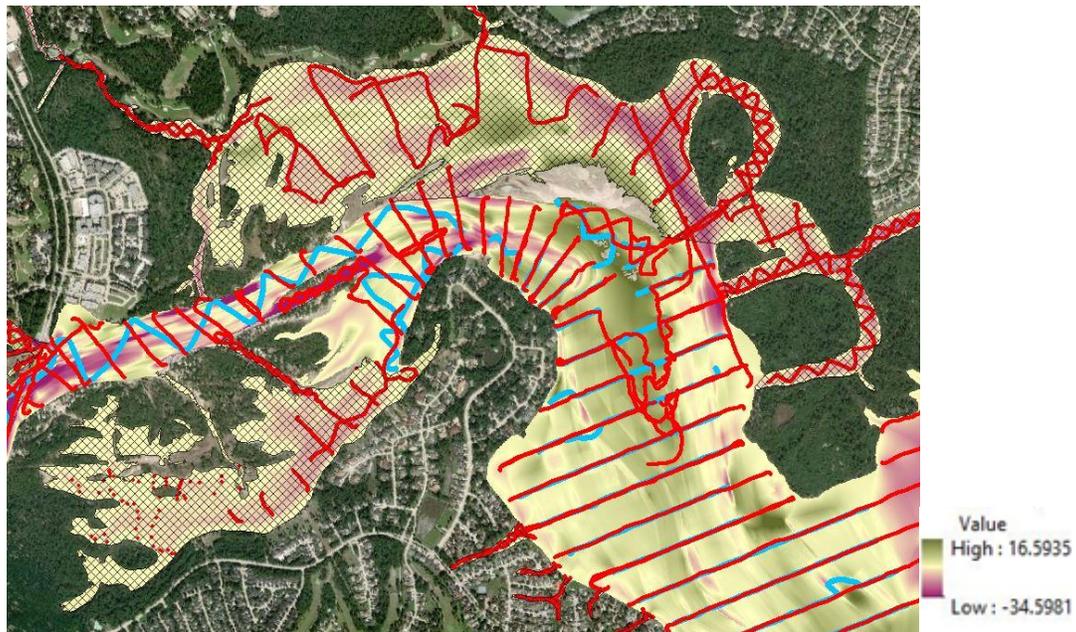


Figure 4. TWDB survey lines 2018 (red) and 2011 (blue) overlaid on difference surface in feet over the project area, cross hatching is interpolated data provided by the TWDB.