Evaluating the variability of sediment and nutrient loading into San Antonio Bay
U.S. Geological Survey

Progress Summary: April 6, 2017

Overview

This study continues ongoing efforts to analyze river discharge and sediment and nutrient concentrations entering San Antonio Bay from the San Antonio and Guadalupe River system and will support analysis of historic flow data from stations in the Guadalupe River and San Antonio River below Victoria, Texas in order to determine the magnitude of unaccounted flow that might be entering the estuary through canals and wetlands instead of the main channel. Recent studies by the USGS on the Guadalupe River have provided continuous discharge data to enable the development of a predictive relationship for sediment and nutrient loadings using surrogate models based on the attenuation/backscatter signal data recorded by an automated index velocity meter (an acoustic Doppler current profiler). This study will further this effort by allowing for additional sediment and nutrient data collection over a range of hydrologic conditions and for the development and validation of a quantitative relationship between flow and sediment and nutrient loadings at the U.S. Geological Survey gage 08188800 located on the Guadalupe River at SH 35 near Tivoli, Texas. Also, it contributes to a Tier 1 recommendation to improve streamflow gaging and water quality monitoring as well as a Tier 3 recommendation to evaluate sediment transport affecting the Guadalupe Estuary delta as identified by the Guadalupe, San Antonio Basin and Bay Area Stakeholder Committee in the Guadalupe, San Antonio basin and bay area work plan.

Progress by Task

Task A

Operate and maintain an index-velocity gage at USGS station 08188800, Guadalupe River near Tivoli, Texas. This will include the collection of additional discharge measurements for validation and documentation of possible changes over time. USGS will continue operation and maintenance of the index-velocity gage through support from the Guadalupe-Blanco River Authority. Additionally for this task, periodic water quality samples will be collected at this site to determine sediment and nutrient concentrations entering San Antonio Bay from the main channel of the Guadalupe River.

- Ten discharge measurements have been completed. Measurement dates are as follows: 3/10/16, 5/4/16, 6/9/16, 6/13/16, 7/6/16, 9/8/16, 10/26/16, 1/3/17, 2/22/17, 3/16/17
- Four water quality samples have been collected. Sample dates are as follows: 5/26/17, 6/9/16, 6/14/16, 2/27/17
- Additional water quality samples needed to verify results of tasks B and C.
Task B
Perform acoustic and in situ surrogate analysis to estimate suspended sediment concentrations using the backscatter signal from the acoustic Doppler velocity meter at USGS station 08188810 Guadalupe River at SH 35 near Tivoli, Texas. This includes a regression analysis to determine the relationship between measured suspended sediment concentration and acoustic backscatter. Nutrient correlations also may be explored. Backscatter data will be processed to correct for beam spreading and attenuation using the Surrogate Analysis and Index Developer Tool.

- Regression analysis for suspended-sediment concentrations has been completed and is currently under USGS colleague review and approval. The preliminary model results are shown below:
- After model is approved, the process to upload model to real-time webpage will be started. 
An example is shown below:
- Preliminary models for nutrients using backscatter are being explored, with the potential of a regression for total phosphorus using acoustic backscatter. A preliminary plot of total phosphorus and backscatter is shown below:
Task C

Continue development of the relationship between measures of optical turbidity and acoustic backscatter to support monitoring of sediment and nutrient loads to estuaries on a continuous basis. Upon developing an equation to estimate suspended sediment concentrations based on acoustic backscatter data, suspended sediment concentrations and loads will be calculated for the period of gage operation.

- Suspended-sediment loading for the duration of the gage operation will be computed with streamflow and regression model data after approval of model.

Task D

Evaluate historic flow data for the Guadalupe River and San Antonio River below Victoria, Texas to determine the magnitude of unaccounted flow that might be entering the estuary through canals and wetlands instead of the main channel. This task may also help define priority locations for conducting high flow measurements in ungauged portions of the watershed.

- This task is currently being worked on while the surrogate model is undergoing review and approval. A time series comparison of the discharge at 08188810 Guadalupe River at SH 35 near Tivoli, Texas will be compared to USGS gages further upstream to gain insight to hydrologic variability within the system.

Deliverables

Summary of findings including:

- results of the surrogate analysis for the development of an acoustic backscatter/sediment model,
- a preliminary evaluation of the continuous record of Guadalupe River discharge in the lower reach for the time period of the index velocity gage operation,
- results of sediment and nutrient analyses at Guadalupe River at SH 35 gaging station,
- an examination of the acoustic methods for measurement of sediment and nutrient concentrations.

A continuous record of suspended sediment concentration at Guadalupe River at SH 35 will be provided based on the developed acoustic surrogate model through the National Real-Time Water-Quality webpage.

Deliverables were originally due August 31, 2017. Due to limited rainfall events to capture validation samples for the surrogate model during period of study and to allow more time for model review and approval, a no cost extension has been requested. New final deliverable date to be determined once the extension is in place. It is anticipated that real time discharge and sediment data will be available on the USGS National Real Time Water Quality website prior to the final Summary of Findings.