AN EVALUATION OF THE VARIABILITY OF TRINITY RIVER SEDIMENT AND NUTRIENT LOADS INTO GALVESTON BAY, TEXAS, DURING HIGH FLOW EVENTS

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Abstract Galveston Bay is a shallow estuary in southeastern Texas with contributing areas that include the San Jacinto River and Trinity River watersheds, as well as numerous local bayous. The sediment and nutrient loads that flow into the bay from these sources are important to the biogeochemistry of this estuarine ecosystem. The Trinity River watershed extends from Galveston Bay northwestward to the Dallas/Fort Worth area, and the river is regulated by several reservoirs, the largest being Lake Livingston in southeast Texas. Annual discharge of the Trinity River is the largest of all Texas Rivers and contributes more than 50 percent of the average total inflow to Galveston Bay. Sediment concentration in the Trinity River can vary appreciably upstream from Galveston Bay on the basis of an average instantaneous discharge that can range from 100 cubic feet per second at low flow to more than 100,000 cubic feet per second during major floods.

The U.S. Geological Survey (USGS), in cooperation with the Texas Water Development Board, is evaluating the variability of sediment and nutrient loads in the lower reaches of the Trinity River during a variety of hydrologic conditions to understand how natural processes, such as high flow events, affect the transport of sediment and nutrients into Galveston Bay and to provide insight into best practices for managing the health and living resources of the ecosystem.

To minimize tidal influence on the river discharge, the USGS commenced collecting sediment and nutrient samples at USGS gaging station Trinity River at Wallisville, Tex. upon exceedance of a minimum flow criterion of 10,000 cubic feet per second at the gaging station at Trinity River at Liberty, Tex. Field measurements (water temperature, specific conductance, pH, dissolved oxygen, and turbidity) were made using a water-quality multi-probe instrument and discharge measurements of the stream were made using an acoustic Doppler current profiler (ADCP). The samples were collected using USGS methods for an equal discharge increment as defined by the USGS National Field Manual and analyzed for sediment (total suspended and size fractionation) and nutrients (total and fractions of nitrogen/phosphorus and ammonia) concentrations. During the high flow event, samples were collected at multiple intervals during varying discharge magnitudes and over a period of time that adequately characterized the variation in sediment and nutrient loads entering Galveston Bay throughout the event.

Two example high flow events are evaluated to demonstrate the variability of sediment and nutrient loading caused by differences in flood-discharge magnitude and duration and origin of initial floodwater runoff into the Trinity River system. One high flow event occurred downstream of the regulated reservoirs along the Trinity River, with a maximum discharge of approximately 16,500 cubic feet per second and lasting less than one week. The second high flow event originated upstream of regulated reservoirs controlling the flow with a maximum discharge of approximately 22,000 cubic feet per second and lasting in excess of a month.

Preliminary results from these high flow events have shown that the sampling approach utilized is effective in evaluating the changes in sediment and nutrient loads and demonstrate the considerable differences in the characteristics of flood discharge scenarios and comparability of sediment and nutrient loading into Galveston Bay.