CONTINUOUS IN-STREAM MONITORING TO ESTIMATE WATER-QUALITY CHARACTERISTICS AND SEDIMENT SOURCES IN THE LITTLE ARKANSAS RIVER, KANSAS

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Abstract: A continuous, in-stream water-quality monitoring system developed by the U.S. Geological Survey in Kansas provides real-time estimates of constituent concentrations and loads for sediment, major ions, selected nutrients and metals, atrazine, and indicator bacteria, and uncertainty and probability of exceeding criteria that improve the characterization of water quality compared to more traditional approaches (http://ks.water.usgs.gov/Kansas/rtqw/). Regression models are developed to relate constituent concentrations in laboratory-analyzed discrete samples to in-stream sensor measurements. An example from two sites in the Little Arkansas River, south-central Kansas, is presented comparing traditional and alternative approaches for estimation of sediment and sediment-associated constituents.

Comparisons of regression models for streamflow- and turbidity-estimated suspended-sediment concentrations and loads indicate that continuous turbidity measurement provides better defined estimates of concentrations and loads than those models developed using traditional streamflow-estimation techniques. From 1999-2004, annual suspended-sediment loads estimated using streamflow were 7 to 31 percent larger than those estimated using turbidity. Monthly suspended-sediment loads estimated using turbidity were larger than those estimated using streamflow during some spring and summer months.

Clockwise hysteresis has been demonstrated by other researchers to be related to depletion of available sediment from the streambed, channel, or areas near the channel. Clockwise hysteresis is a decrease in concentrations of suspended sediment corresponding with an increase in streamflow. Counterclockwise hysteresis is an increase in sediment concentrations corresponding to a decrease in streamflow. Counterclockwise hysteresis probably occurs when sediment is derived from sources that are more distant from the stream (overland flow, tributaries, or channel wasting). In the Little Arkansas River, examples of clockwise and counter-clockwise hysteresis of streamflow and turbidity are examined to infer sediment sources.

Despite implementation of practices to control sediment transport, an historical comparison in the Little Arkansas River Basin using streamflow-estimated concentrations and loads indicates that sediment transport and yield has changed little in the past 40 years considering the uncertainty in the estimation technique. Hysteresis variability of turbidity-estimated sediment concentrations with streamflow indicates that sources of sediment during storms are variable. Because of this variability, management of transport of sediment and sediment-associated constituents, such as nutrients and bacteria, may prove difficult given that the concentrations for some of these constituents frequently exceed their corresponding water-quality criteria even during the smallest of hydrologic events.