SEDIMENT ANALYSIS OF A GRADUAL DAM REMOVAL ON BREWSTER CREEK NEAR ST. CHARLES, ILLINOIS

Authors: **Timothy D. Straub, P.E., Hydrologist, U.S. Geological Survey, Urbana, IL, tdstraub@usgs.gov; Donald P. Roseboom, Hydrologist, U.S. Geological Survey, Urbana, IL, roseboom@usgs.gov; Gary P. Johnson, Hydrologist, U.S. Geological Survey, Urbana, IL, gjohnson@usgs.gov; Robert R. Holmes, Jr., PhD, P.E., Hydrologist, U.S. Geological Survey, Urbana, IL, bholmes@usgs.gov; Chester C. Watson, PhD, P.E., Civil Engineer, Colorado State University, Fort Collins, CO, cwatson@engr.colostate.edu; Dave Schrader, Hydrologist, U.S. Geological Survey, Dekalb, IL, dlschrad@usgs.gov**

INTRODUCTION

The Illinois Department of Natural Resources, Office of Water Resources (IDNR-OWR) classified the dam on Brewster Creek near St. Charles, Illinois (figs. 1 and 2) a Class I structure. This classification indicates a high probability for causing loss of life and/or substantial economic loss in the event of a catastrophic failure (Kosky and others, 2004). The dam was built in 1929 and through the years structural deficiencies have developed in the dam. Repairing the dam was cost prohibitive and the owners decided to remove the dam. Possible environmental effects and costs of removing dams, and managing or removing the impounded sediment also can be prohibitive. In Illinois, State regulations require complete sediment containment during any construction project. Project engineers developed a first design for the total removal of Brewster Creek dam that complied with these regulations. The projected construction, oversight, and restoration costs of the dam-removal under this first design were $1.17 million, which exceeded available funds (Kosky and others, 2004).

The Illinois Environmental Protection Agency (IEPA) granted permission for a pilot gradual dam-removal project, consisting of cutting five 12–18 inch notches, over approximately a 9-month period, across the length (or some portion of the length) of the dam. The projected construction, oversight, and restoration cost for the gradual dam removal was $330,000 (Kosky and others, 2004). The benefits of gradually removing the dam at this site using multiple notches included reducing the removal cost and reducing possible effects on downstream sedimentation, upstream erosion, and overall aquatic habitat and water quality by allowing the impounded sediment to slowly move downstream and a stable stream and revegetated flood plain to form upstream.

Effects of gradually removing dams are not well known. In 2002, the U.S. Geological Survey (USGS), in cooperation with the Kane County Division of Environmental Management (KCDEM), the Illinois Environmental Protection Agency (IEPA), and the Northeastern Illinois Planning Commission (NIPC), began a cooperative investigation to monitor, analyze, and interpret environmental conditions before, during, and after gradual removal of a dam on Brewster Creek near St. Charles, Illinois. The USGS monitored and analyzed water-quality, precipitation, streamflow, and sediment data. The USGS and

Colorado State University (CSU) have monitored and analyzed stream-channel evolution and stability, and aquatic habitat. The IDNR and the Shedd Aquarium in Chicago (SAC) monitored and analyzed aquatic organisms. The U.S. Fish and Wildlife Service, Chicago Illinois Field Office (USFWS-CIFO) monitored and analyzed the vegetation in the exposed lake bed and stream riparian area, and IDNR-OWR completed an initial conditions, cross-sectional survey of the lake and stream channel upstream and downstream of the dam. The interpretation of these analyses is being used by the USGS to evaluate the effectiveness of the gradual dam-removal methodology and develop notching criteria for future application on similar watersheds.

This study advances the knowledge and understanding of environmental effects on gradual dam removal on stream systems in northeastern Illinois, with potential application to similar watersheds throughout the Nation. The notching criteria developed in this study may be expanded to other watersheds so that permitting agencies can develop a technical basis for gradually removing dams.

The suspended-sediment data collection and results from June 2002 through September 2005 (pre-notching, notching, and post-notching) on Brewster Creek near St. Charles, Illinois (fig. 1) are presented in the following sections. Data collection will continue through September 2006.

DATA COLLECTION

Suspended-sediment concentrations and loads are being monitored at two stations [one upstream (station number 05551029) and one downstream (station number 05551030) of the dam] (fig. 2 and table 1). Suspended-sediment data are useful in quantifying the sediment yield into and out of Willow Lake on Brewster Creek. Suspended-sediment data are also useful in the analysis of stream-channel evolution and stability, aquatic habitat and organisms, and vegetation.

All suspended-sediment samples were collected following protocols outlined in Edwards and Glysson (1999). Methods used in the computation of sediment records are described in Guy (1970) and Porterfield (1972). During periods of rapidly changing flow, samples are collected more frequently (generally, multiple times on the rising and falling limbs of the storm hydrograph). Stage-weighted event, suspended-sediment samples were collected by electronically connecting the automatic suspended-sediment collector to the streamflow station datalogger. When possible, USGS personnel collected depth-integrated samples using isokinetic samplers to compare and adjust the fixed-point samples to compute the mean suspended-sediment concentration at the cross section.

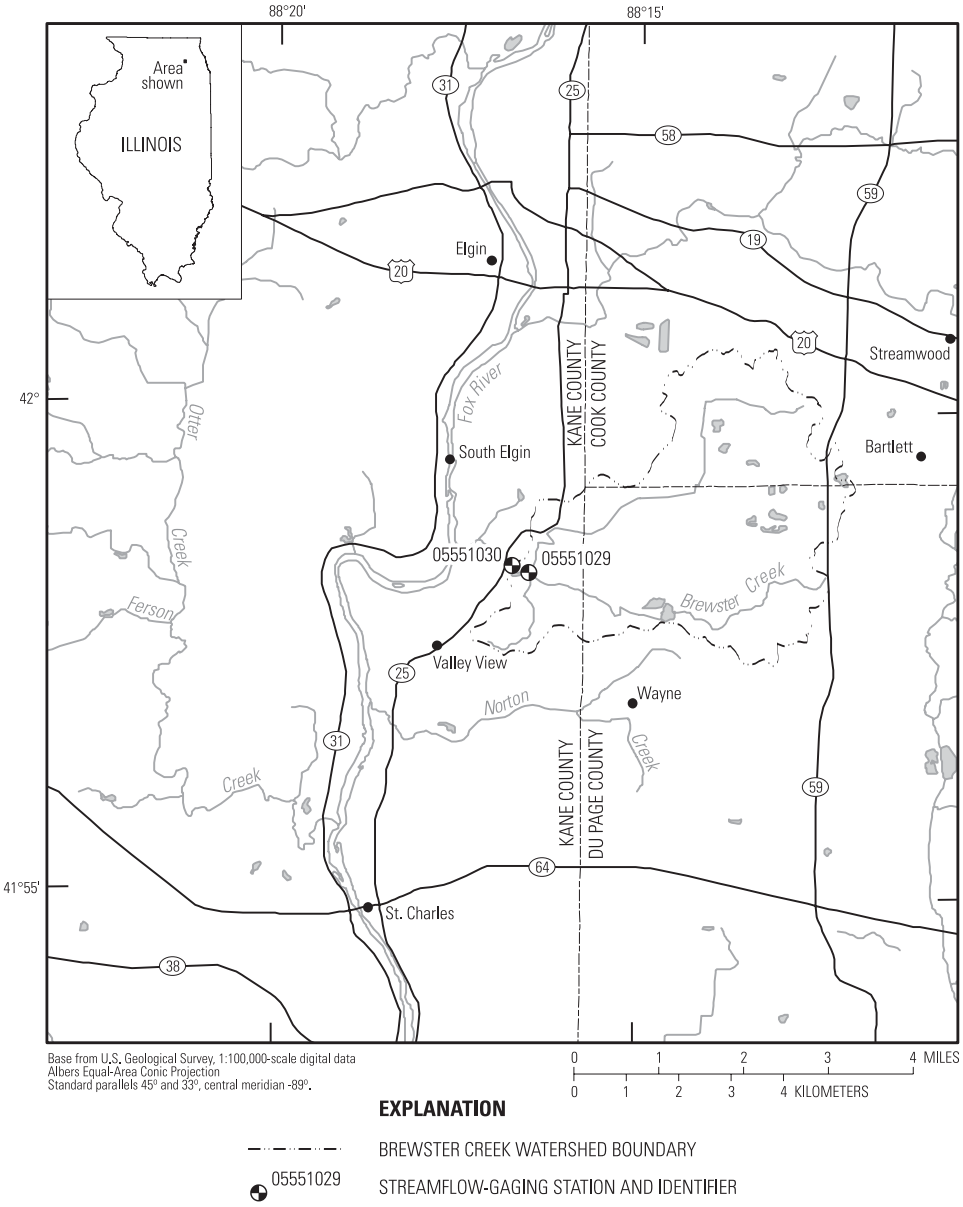

Figure 1. Location of Brewster Creek watershed and the U.S. Geological Survey streamflow and suspended-sediment stations near St. Charles, Illinois.

Figure 2. Location of the study area including Brewster Creek dam on Willow Lake and the U.S. Geological Survey streamflow and suspended-sediment stations on Brewster Creek near St. Charles, Illinois.

Table 1. Streamflow and suspended-sediment stations used in the study and corresponding drainage areas, Brewster Creek near St. Charles, Illinois. [mi^2, square miles]

Station	Station Number (fig. 2)	Drainage Area (mi^2)
Upstream	05551029	13.88
Downstream	05551030	14.00

SUSPENDED-SEDIMENT LOADS

Suspended-sediment loads for two discrete time periods: pre-notching (June 15, 2002, through June 14, 2003), and both the notching and post-notching (June 15, 2003, through September 30, 2005) are presented in the following paragraphs. The last notch was completed in February 2004.

During the pre-notching time period, the total suspended-sediment load at the downstream station (397 tons) is less than the upstream statoin (459 tons). The backwater effects from the dam (slowing the water and allowing for settling of sediment particles) trapped sediment in the pre-notching time period.

The total suspended-sediment load for the combined notching and post-notching time periods equals 2,293 tons at the downstream station as compared to 1,236 tons at the upstream-gaging station. The difference in the two loads (1,057 tons) is a result of streamflow eroding the sediment to form a channel through the old lakebed (fig. 3).

Once the stream channel becomes more stable the downstream load would be expected to be similar to the upstream load. The suspended-sediment load (at the upstream and downstream stations) did not exceed the expected regional estimate of annual suspended-sediment load for a similar sized watershed, thus limiting downstream impacts.

Figure 3. Top Left: Notching procedure during the fourth notch (November 2003). Top Middle: Dewatering of lake and channel formation after first notch (June 2003). Top Right and Bottom Left: Channel formation and headcut progression (May 2004). Bottom Right: Vegetated channel and riparian area (August 2005).

REFERENCES

Kosky, K. M., Straub, T. D., Roseboom, D. P., and Johnson, G. P., 2004, Preliminary Results of a Dam-Removal Analysis on Brewster Creek near St. Charles, Illinois, 2002-2004, Proceedings of the American Society of Agricultural Engineers, Self-Sustaining Solutions for Streams, Wetlands & Watersheds Conference, St. Paul, Minnesota, http://asae.frymulti.com/ (last accessed in October 2005)