

In cooperation with the National Park Service

# Geomorphic Assessment of Bank Instability, Missouri National Recreational River

The Missouri National Recreational River (MNRR) includes two relatively unchannelized segments of the Missouri River on the border between Nebraska and South Dakota. The 39-mile upstream segment extends from Fort Randall Dam downstream to the headwaters of Lewis and Clark Lake and the 59-mile downstream segment extends from Gavins Point Dam to Ponca State Park, Nebraska (fig. 1). These river segments are characterized by multiple, intersecting channels, sandbars, islands, and eroding banks - features common in the historic Missouri River before it was altered by reservoir inundation, channelization, and flow regime regulation at the dams (fig. 1). The flow regimes of these segments are highly affected by flow regulation by dams and trapping of sediment behind Fort Randall and Gavins Point dams has caused channel degradation, or erosion downstream of the dams and sediment deposition in the headwaters of Lewis and Clark Lake.

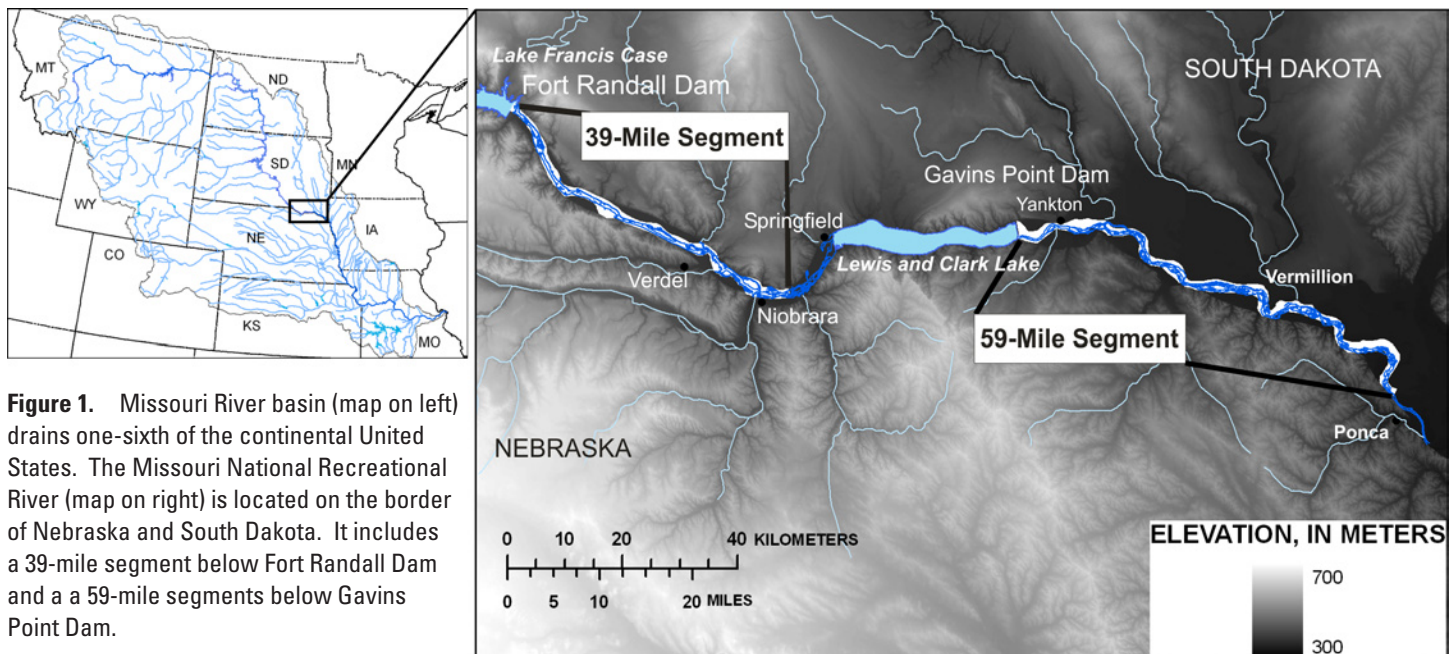
Designation of these segments as a National Recreational River within the Wild and Scenic River system in 1978 mandated the National Park Service to preserve the Missouri River's free flowing condition. The MNRR is also subject to management actions by multiple agencies, including stabilization of banks, maintenance of habitats for threatened and endangered species, and improvement of recreational opportunities. The geomorphic classification can provide a basis for coordination and prioritization of these activities.

## Research Objective

River classification provides a method to improve understanding of causes and rates of bank instability (fig. 2). This study is producing a geomorphic classification of the MNRR based on variations in channel pattern and morphology. The ability of the classification to predict areas of bank instability is being tested by comparing the locations and rates of bank erosion over the last 10 years. River classification aids managers in targeting habitat restoration strategies, stratifying sampling design for monitoring programs, and improving understanding of the spatial distribution and rates of bank erosion.

## Research Strategy

To develop a geomorphic classification system, research scientists use high-resolution digital aerial photographs acquired over the past decade to create a series of digital map layers for the river. These images allow for the mapping of channel patterns and morphological characteristics, such as bankfull width, braiding index, sinuosity, valley-wall constraints, and sandbar and island locations. Using a Geographic Information System (GIS), researchers measure and analyze changes in these river attributes (fig. 3).



**Figure 1.** Missouri River basin (map on left) drains one-sixth of the continental United States. The Missouri National Recreational River (map on right) is located on the border of Nebraska and South Dakota. It includes a 39-mile segment below Fort Randall Dam and a 59-mile segments below Gavins Point Dam.

## Research Strategy (continued)

For each time period, researchers map the top of the river's bank to monitor the spatial and temporal trends in bank erosion. The top of the bank is a geomorphic indicator that can be mapped independent of discharge, thereby allowing comparison among multiple years regardless of flow conditions when the image was acquired. An address system organizes longitudinal measurements of morphological characteristics. This information is analyzed statistically to identify discrete reaches and dominant physical processes in the MNRR. This information is analyzed statistically to identify discrete reaches and dominant physical processes in the MNRR. An understanding developed through compilation of this information will be complemented with additional existing information, including flow records and channel cross sections monitored by the U. S. Army Corps of Engineers.

The ability of the river classification to predict persistence of geomorphic processes, including bank erosion, channel instability, and sandbar formation, is evaluated by analyzing how rates of change vary by classified reach. Based on preliminary analysis, we anticipate that the classification will define persistent reaches that show consistent geomorphic processes and rates over time. Once identified, these process domains may be useful to guide different management approaches.

The project is scheduled to be completed in Fall 2006. A final U.S. Geological Survey Scientific Investigations Report will document methods and results, and GIS data files will be distributed through the Internet.

*For information, contact:*

Caroline Elliott, Hydrologist

U.S. Geological Survey

Columbia Environmental Research Center

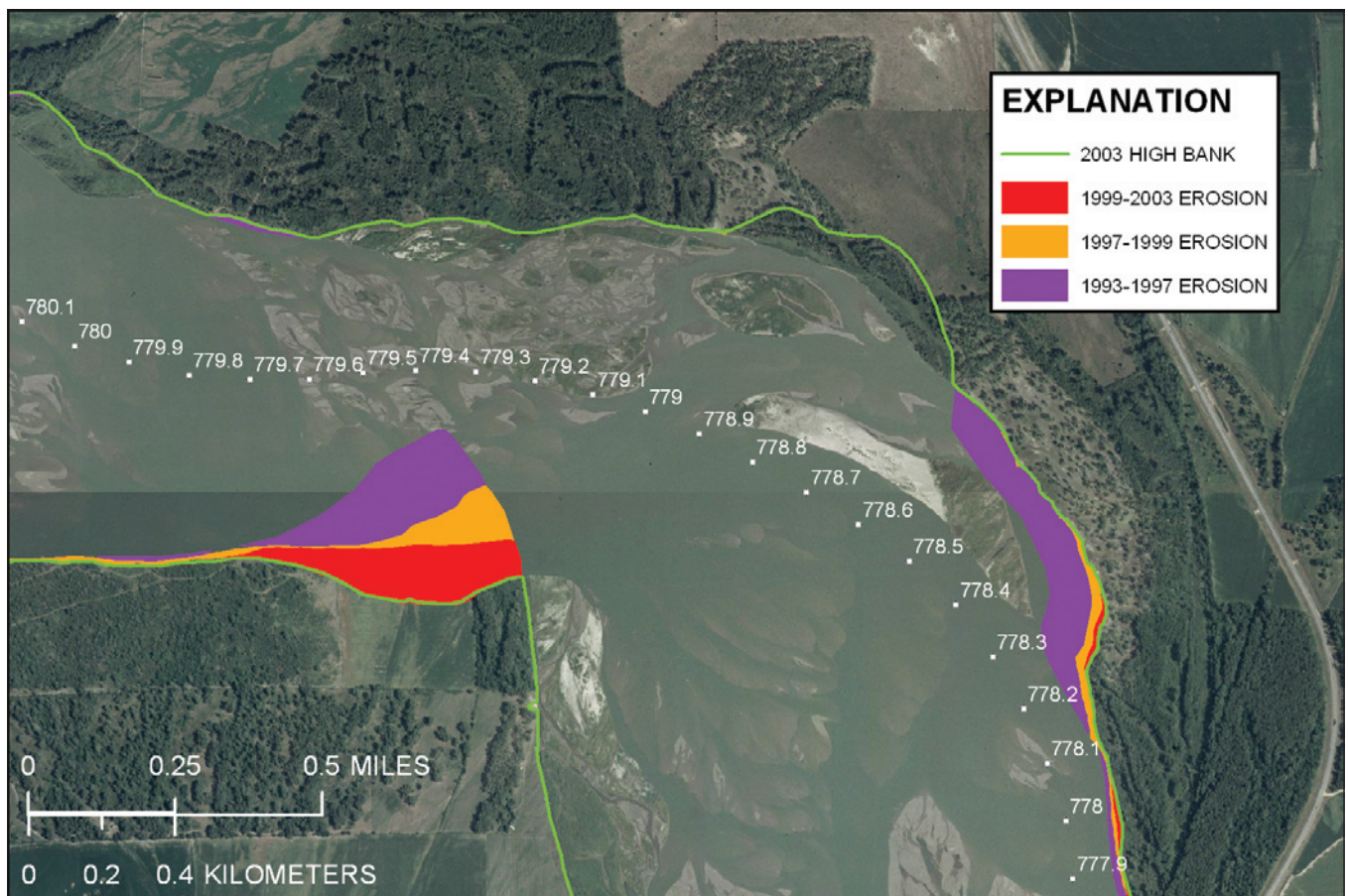
4200 New Haven Road, Columbia, MO 65201

573-441-2951; celliott@usgs.gov

<http://infolink.cr.usgs.gov/RSB/Hab/index.htm>



**Figure 2:** A geomorphic classification system will aid in understanding why and where bank instability occurs in the Missouri National Recreational River.



**Figure 3:** Spatial trends in bank erosion from 1993-2003 for a reach of the Missouri National Recreational river demonstrate how geomorphologic transitions occur over time.