Channel Response Assessment for the Upper Blackfoot
Executive Summary

by

Denine Schmitz
Land Resources and Environmental Science
Montana State University

Jessica Mason
Department of Civil Engineering
Montana State University

Matt Blank
Western Transportation Institute and Department of Civil Engineering
Montana State University

Joel Cahoon
Department of Civil Engineering
Montana State University

Executive Summary prepared for the

Montana Department of Natural Resources and Conservation

December 1, 2010

EXECUTIVE SUMMARY

This report presents research activities and results for a study performed on Mike Horse Dam (MHD) and nearby streams and watersheds in Western Montana (see Figure 1). Streams included in the study were Mike Horse Creek, Beartrap Creek, Anaconda Creek, and the Upper Blackfoot River. The study began with field data collection in 2007. Data collection continued through 2008. Data analyses and report preparation were completed in 2009 and 2010.

The purpose of the research was to investigate the response of vegetation, stream channels, and watershed characteristics to pre-dam mining activities, dam construction (erected in 1941), dam operation, dam failure flood (breach) event in 1975, and the post-breach period. Reclamation activities, largely focusing on removal of contaminated soils and sediments, are currently underway at the dam and in adversely affected stream channels and are anticipated to continue for at least the next decade.

MHD is located 24 kilometers east of Lincoln, Montana, in the Upper Blackfoot Mining Complex (also known as the Heddleston Mining District). Mike Horse Dam creates an impoundment on Beartrap Creek, a headwater tributary to the Upper Blackfoot River. This portion of the Upper Blackfoot River watershed is heavily forested, mountainous terrain 1,600–2,300 meters above sea level. Average annual precipitation is roughly 46 centimeters, most of which falls as snow. The Upper Blackfoot River is a water source to residents in the greater Lincoln area and the watershed is a resource to anglers, hunters, and other recreationists.

We estimated the breach flood event using three independent approaches—1) modeled flow using paleohydrology and step-backwater techniques, 2) empirically derived regional estimates of peak annual discharge, and 3) hydrograph records. Using these techniques, we estimated a flood flow of 11.5 m^3/s for Mike Horse Creek and Beartrap Creek, 15.2 m^3/s for Anaconda Creek, and 26.7 m^3/s for the Upper Blackfoot downstream of the confluence of Beartrap and Anaconda creeks. These estimates are very similar to the 100-year flow estimated using regional regression equations.
We acquired aerial photos of the study area for 1938, 1964, 1978, 1995, and 2005 to analyze changes in channel form and vegetation. We georeferenced and mosaiced the 1938, 1964 and 1978 photos using the 1995 images as the target layers. We identified floodplain extent using the modeled flood path, changes in riparian vegetation extent, and changes in upland vegetation density and horizontal structure. We limited our interpretation to canopy vegetation because it was visible on all aerial photos and indicative of major changes to the riparian landscape. Watershed characteristics were developed for each site using terrain analyses of 10 m digital elevation models (DEMs).

We stratified the vegetation data into three reaches. The Anaconda reach extended from the upstream-most transect on Anaconda Creek to the Anaconda–Beartrap confluence. The Beartrap reach extended from the MHD to the Anaconda–Beartrap confluence. The Upper Blackfoot reach extended from the Anaconda–Beartrap confluence to the downstream-most transect. We analyzed the point observation data in a regression environment to detect relationships between riparian canopy type distribution and watershed characteristics related to hillslope hydrology and network organization. We used Generalized Linear Regression because it is nonparametric, suitable for binomial data (presence/absence), accommodates categorical data, and has adequate goodness of fit measures.

We saw the largest change in canopy distribution on Beartrap and Upper Blackfoot in 1978, three years after the dam failure flood. Our data from 1995 and 2005, in addition to ground surveys in 2007, indicate little recovery has taken place in the 32 years since the flood. However, we provided evidence of active relationships to watershed-scale processes in the Beartrap and Upper Blackfoot reaches. The response of the Beartrap and Upper Blackfoot reaches to dam construction and mining-related activities indicated increased bare ground and fragmentation of riparian vegetation following the lifting of MHD in 1941 and its failure in 1975. The response of the Beartrap and Upper Blackfoot reaches to the dam failure flood was catastrophic. Similar responses were observed following the Pattengail Dam failure flood in 1927. In Pattengail Creek, 90 years later, riparian vegetation has not returned due to marked channel downcutting and coarse substrate resulting from the breach. The Mike Horse study area will likely experience a similar fate without ongoing active restoration. It should be pointed out that active removal of contaminated sediments and restoration of natural channel and floodplain processes is currently being implemented.

A companion study, performed by Jess Mason, was also completed during this project. This study modeled the effect of discharge events, including the 10-, 25- and 100-year recurrence intervals, to assess the potential for sediment transport from the mine-impacted wetland in the Upper Blackfoot Mining Complex. There has been substantial work to assess and remediate the impact of the Upper Blackfoot Mining Complex on aquatic resources by Helena National Forest, Montana Department of Environmental Quality, and the mining company, ASARCO. Until recently, however, the wetland complex has largely been omitted from environmental assessments. This companion study is included as Appendix A.