Floodplain Dikes/Berms

Applicability

This summary of recommended Best Management Practices (BMPs) for placing, repairing, or removing floodplain dikes has been developed to support the long-term functionality of the Musselshell River floodplain while protecting infrastructure as necessary. The recommendations are based upon field site reviews and discussions with local stakeholders, and are intended for producers and residents who currently farm or maintain infrastructure in areas prone to flooding. In general however, manipulation of the Musselshell River floodplain is strongly discouraged due to the role of the floodplain in dissipating flood energy and contributing to river stability.

Description

A primary function of a river floodplain is to spread and store floodwaters, thus reducing the energy of flood flows in the adjacent stream channel. Over the past century, the Musselshell River has had much of its natural floodplain area isolated by dikes and berms, with the largest impact being the abandoned Milwaukee Railroad berm. In 2011, floodwaters eroded and overtopped floodplain berms and road prisms, allowing floodwater to re-access the historic floodplain. The flood caused 31 breaches through the Milwaukee Railroad grade between Shawmut and Roundup. Other berms and road prisms were similarly overtopped and breached by floodwaters accessing the historic floodplain. The 2011 Musselshell River flood demonstrates how rivers that have become isolated from their natural floodplains will tend to re-access those areas during high water, and that this process can cause extensive erosion and aggravated flooding where flows can't return to the channel. This BMP is intended to describe considerations and recommendations regarding berm construction and maintenance on the river's floodplain, especially in response to 2011 flood damages.

Figure 1. View to east of railroad dike breached during 2011 flood.

The Floodplain Dike BMP addresses the following issues:

I. ***Berm Construction:*** Considerations for berm construction around buildings on the active river floodplain.
II. ***Repair of Breached Berms:*** Potential impacts of plugging railroad berm breaches with regard to future flood risk.
III. ***Berm Removal:*** Potential benefits of strategic berm breaching or removal.

I. Berm Construction

Berms, dikes, and levees constructed in the floodplain may be built as infrastructure protection, canal/ditch protection, agricultural land protection, or road prisms. Considerations for constructing each type of berm are described below.

Figure 2. Flooding of floodplain structures on Musselshell River during 2011 flood

a. Protection of Infrastructure: Extensive flooding in 2011 resulted in significant property damage due to inundation of residences and outbuildings. Homeowners in the floodplain have expressed an interest in constructing berms to protect their existing homes or outbuildings from future floods. But by building berms, more floodplain becomes isolated, which will reduce the ability of the floodplain to dissipate flood energy in the future. Berms concentrate flows in the channel, which can increase bank erosion rates and drive downcutting or channel widening. Infrastructure-protection berms should therefore have a footprint that is as small as possible to limit the impact on floodplain and channel function. Adjacent to homes, berms can be constructed as topographically subtle, landscape features that are placed close to the buildings of concern. To minimize overall impacts, new construction should be located outside of the river floodplain. Consideration should be given to moving corrals, outbuildings, homes and other structures if possible away from the river's edge and floodplain or to areas higher in the floodplain to eliminate or reduce the size of berm needed to protect the structure. Berms should be placed without the need for riprap.

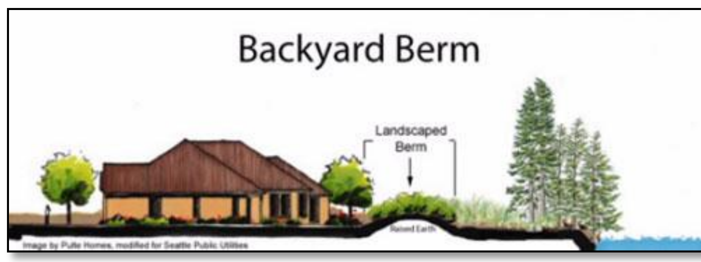

Figure 3. Schematic concept of local flood control berm (www.seattle.gov).

b. Protection of Agricultural Land: Agriculture-related berms constructed as spreader dikes, elevated ditches, or access roads can also affect floodplain access. The 2011 flood showed that in some cases, these floodplain berms caused severe local erosion problems, and exacerbated flooding. Numerous berms served as floodplain dams that backed water upstream, causing floodplain deposition on fields. When the berms were overtopped and breached, flows were focused through the breaches, driving field erosion downstream. Field berms on the floodplain should be constructed as low as possible, to allow floodwaters to continue down valley as shallow

Figure 2. Breached berm and eroded field.

sheet flow, rather than concentrated channelized flow that will erode new channels and potentially capture the main river.

c. ***Road Prisms:*** Similar to agricultural berms, road prisms serve or function as floodplain dikes that commonly impound water on the floodplain and focus erosive flows through breaches. Since roads also provide access, road prism design requires balancing access during high water and floodplain function. At Harvey Road for example, the reconstructed road approach is pierced by high flow culverts that will reduce the damming effect of the road prism. Constructing roads that minimize the impoundment of water on the floodplain will allow water to drain down-valley and reduce the severity and duration of flooding, while also reducing the depth and velocity of water flowing down the main river channel.

Figure 3. Breached road prism and upstream erosion.

Figure 4. Road prism forming floodplain dike/dam during 2011 flood.

Figure 5. View downstream of Harvey Road Bridge site showing newly constructed high flow culverts to left of channel.

II. *Repairing Breached Berms/Dikes*

Many producers have plugged or reconstructed damaged berms to restore the function of the berm, be it road access, flood control, or irrigation management. With most low berms on agricultural fields, the hydrologic impact of these repairs is low. However, with larger berms, road crossings, or especially the railroad berm, repairs will re-isolate large floodplain areas. Whether or not the breaches are plugged should consider the overall need for the project, other breach locations and floodplain drainage patterns. Where berms overtopped from the landward side for example, flows were returning to the stream corridor over the berm because there was no better relief valve. In these areas especially, maintaining an overflow return point through the breach will reduce the risk of overbank flows becoming trapped on the floodplain and possibly damaging areas normally outside of the floodplain. These breaches can be reinforced as swales that still allow transportation access, and can be hardened as necessary to prevent erosion or headcutting.

Figure 8. View down-valley of multiple breaches; downstream breach serves as return flow point.

Figure 9. Railroad berm breach where flows overtopped from the backside of the berm.

III. Berm Removal

Levee setback and berm removal projects have become common around the country where levee systems have resulted in channel destabilization, habitat loss, high maintenance costs, and increased flood hazards within and downstream of the confined areas. In areas of dense floodplain development, levee removals or setbacks are extremely expensive, yet they are still being pursued because of the long-term net gain in restoring floodplain access. On the Musselshell River, the Milwaukee rail grade is an un-maintained, discontinuous floodplain berm that runs largely parallel to the river corridor upstream of Melstone. As the berm continues to naturally breach and decay, it will become an increasingly severe liability to corridor residents and agricultural producers. Relying on an unmaintained, locally breached berm as a de-facto flood protection measure is a poor long-term prospect for river corridor management. The berm is likely to remain a serious problem during future floods, with continued failures, floodwater ponding, and channel destabilization. It would be therefore appropriate to consider developing a restoration strategy for selective berm removal that would re-connect the Musselshell River to its historic floodplain and prevent a reoccurrence of some of the problems that occurred in 2011.

IV. Permitting

If any property owners are pursuing construction work in what might be a floodplain, it is critical that they contact their local county floodplain administrator before starting that work. Local floodplain administrators for Musselshell River corridor counties are listed below. Neither Garfield County or Petroleum County are currently participating in the National Flood Insurance Program (NFIP), hence they do not have floodplain administrators. In these counties, please check in with your local conservation district prior to constructing a floodplain project.

Wheatland County, Golden Valley County:

PAGE DRINGMAN
PO BOX 1256 BIG TIMBER MT 59011
sgplanning@cablemt.net
Phone: (406) 932-5470

Musselshell County:

MONTE SEALEY
PO BOX 660
ROUNDUP MT 59072
cmrcd@midrivers.com
Phone: (406) 323-2804

Rosebud County:

JOHN MARKS
ROSEBUD COUNTY DEPT. PLANNING/GRANTS
PO BOX 47
FORSYTH MT 59327
jmarks@rosebudcountymt.com
Phone: (406) 346-6135

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