Field Restoration – Erosion and Sedimentation

Figure 1. Fields affected by sediment may require several years to return to full production but don't have long-term impacts to productivity.

Applicability

This summary of recommended field restoration strategies has been developed to support the sustained productivity of crop fields on the Musselshell River, considering issues of sediment deposition by floodwater, the depth and texture of such deposits, the magnitude and location of field erosion features, weed control, and restoration costs. The information presented here is based on the field evaluation of multiple flood affected sites and discussions with producers. The information is intended for use by land managers in the river corridor who have experienced field damage from deposition of sediment, scour, and/or soil erosion.

Description

The Field Restoration BMP addresses the following issues:

I. ***Sedimentation:*** Consideration of sediment characteristics when planning field restoration.
II. ***Field Erosion and Scour:*** Consideration of erosion or scour depth and location.
III. ***Weed Control:*** Noxious weed control needs.
IV. ***Economics:*** Estimated costs of field restoration practices.

I. Sedimentation

Rivers move a tremendous amount of sediment, especially during floods. Flood-deposited sediment built the present floodplain where the majority of the irrigated cropland along the Musselshell River occurs. The sources of this sediment include eroded banks and beds of old and freshly cut river channels. This sediment is really just more of the same parent material for these deep, fertile soils and so generally doesn't threaten the long-term productivity of the land. During the 2011 flood, hundreds of acres of productive fields in the Musselshell River corridor were buried with up to several feet of sediment, which destroyed established crops and buried the pre-flood soil surface. Several factors affect how to go about restoring the productivity of sediment-affected fields in the short-term.

Figure 2. 2011 flood deposited sediment on alfalfa field. Photo Credit: Tom Pick

Figure 3. Same field in 2013 planted to a small grain crop. Photo Credit: Tom Pick

a. **Sediment depth** –Shallow depths (< 2 inches depth) of flood deposited sediment can usually be harrowed or cultivated with common tillage equipment to incorporate the sediment and smooth the field. If inundation by water didn't persist long enough to kill the previous crop, perennial crops such as alfalfa and grass will typically come back up through the shallow sediment once the field is treated (harrow or light tillage) and irrigated. Deeper deposits of sediment (>2 inches depth) and/or longer inundation will usually require more aggressive treatment such as re-shaping with a land leveling machine or in more severe cases (and in particular for flood irrigated border dikes) laser leveling prior to reseeding (see below). Very deep deposits of a foot or better will usually require heavy shaping prior to final leveling to remove(push off or haul) sediment from the field in order to restore proper irrigation grades.

b. **Soil texture** - The nature of basic soil texture (sand, silt, or clay) will affect the restoration approach. Sand and gravel deposits can more adversely affect future productivity than fine textured sediment, but in general, such coarse deposits are not common in the lower Musselshell River. Sand and gravel over several inches deep will usually require removal from the field. Thinner sand and gravel deposits can be worked into the soil to prevent thin lenses of contrasting texture causing problems in irrigation percolation (water moving freely into and down through the soil). Silt or clay is the most common soil texture found in flood deposited sediment on the lower Musselshell River. Clay tends to deposit in the areas with very flat topography or where water was ponded. While both of these soils will crack deeply on initial drying and appear to be damaged or severely altered, once vegetation begins to grow and the soils go through several freeze and thaw cycles, the cracks will be eliminated. Silt and clay can usually be incorporated into the native soil depending on the depth of the deposit, as described above.

Figure 4. Silt and clay deposits crack deeply after initial drying but cracks won't persist. Photo Credit: Tom Pick

c. **Crop cycle** – Fresh sediment deposits are nearly pure mineral particles without benefit of air pore spaces, organic matter, or other attributes of a mature soil that provide water and nutrient holding capacity. To be productive, the soil needs to develop micro organisms and soil aggregates to effectively function as a living, breathing medium for plant growth. To help this process along, it is recommended to smooth out the field first to allow planting and harvesting, then grow one or two dryland crops of warm- or cool-season, annual, small grain or a cover crop mix. The crop will help to incorporate organic matter into the soil and build up a normal component of microfauna which will help facilitate nutrient and mineral cycling and the final, precision leveling process. Wheat, hay barley, millet, sudan-sorghum hybrid, oats or a cover crop mix can be harvested as hay, feed grain, or grazed by livestock. The longer-term perennial crop, typically alfalfa, can then be seeded once the field has been precision leveled and the irrigation system is in place.

II. Field Erosion and Scour

Floodwaters passing over crop fields sometimes erode the surface and occasionally create scour holes where water velocity is high. (Chris picture insert). Fields that are either cultivated or in a grain crop with little surface residue at the time of a flood are more susceptible to erosion and scour. Surface erosion is typically considered sheet erosion and usually can be restored with standard tillage and leveling practices unless the surface scour is over three to four inches deep. Deeper scour will likely require heavy leveling to restore field grade and smoothness.

Figure 4. Field scour at edge of field adjacent to river may require added protection in addition to fill material where water enters or leaves the field. Photo Credit: Tom Pick

Scour holes caused by water turbulence should be filled with local soil and compacted and/or overfilled to compensate for settling. Several years may be required for settling to stabilize. This isn't usually a problem for small scour holes within a field but when holes occur at the edge of a field, more care should be provided to protect the field edge from headcuts during the next flood event. If the scour hole is on a fairly low surface that is prone to flooding, a rock ramp or other non-erosive material combined with planting suitable vegetation may be needed to prevent gully erosion from forming a headcut as flood or irrigation water enters or leaves the field via the hole. Holes usually occur in fields also affected to some degree by erosion or sediment deposition so the same recommendations will apply for leveling and preparation for the next crop. Untreated field holes and scour may make an avulsion more likely in future floods.

Figure 5. Plains cottonwood (*Populus deltoides*) colonizes the fresh sediment after the 2011 flooding on the Musselshell. Landowners must decide whether to remove unwanted vegetation and return to crop production or to let them grow. Photo Credit: Tom Pick

III. Weed Control

In addition to sediment, floodwater deposits debris, plant parts, and the seeds of undesirable plants. Some of these seeds or plant parts may be from noxious weeds, that is, those weeds that have been designated noxious by the State of Montana or the local county government. See the Musselshell BMPs Noxious Weed Control. Noxious weeds are generally perennial and harder to kill than annual weeds. In most cases, fields that are allowed to lie fallow after a flood causes noxious weeds to become more prevalent.

The need to control noxious weeds prior to planting a perennial hay crop or pasture is another reason to grow an annual grain crop for more than one season. The added growth cycle provides more opportunity to control the noxious weed. Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis),* leafy spurge (*Euphorbia esula*), and spotted knapweed (*Centaurea spp.)* are noxious weeds often found in cropland fields affected by sediment deposition. Failure to control these species prior to seeding perennial hay or pasture crops will likely lead to lower crop yields and limited options for weed control in the future. Consult your county weed control plan or Weed Control Coordinator (**http://www.mtweed.org/find-weed-coordinator/**) for specific noxious weed treatment recommendations.

Common annual weeds such as kochia (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and redroot pigweed (*Amaranthus retroflexus*) are usually short-lived and are more easily controlled by standard farming practices (tillage, clipping, and/or chemical control) in cropland. Unless very severe , annual weed growth doesn't typically present a problem since they usually only persist for a short period following the disturbance and are relatively easily outcompeted by permanent vegetation.

IV. Economics

The estimated costs of removing sediment from fields generally is dependent on the volume of material to be moved per acre and the precision of leveling performed. Smoothing and light land shaping ranges from $50 to $100 per acre. Moving larger volumes of sediment and precision land (laser) leveling can cost $450 to $650 per acre ($1.50 to $3.00 per yard). Heavy shaping and fill required on fields damaged by erosion may cost as much as $1,500 per acre treated.