# *Pipeline Crossings*

## Applicability

Pipeline Crossings are pipelines carrying water or petroleum products laid beneath the river bottom. This Best Management Practice (BMP) focuses primarily on irrigation water pipelines, but does include some criteria on permitting oil/gas pipeline crossings. On-site observations of irrigation pipeline crossings and discussions with Musselshell River water users are the basis for much of the information that follows.

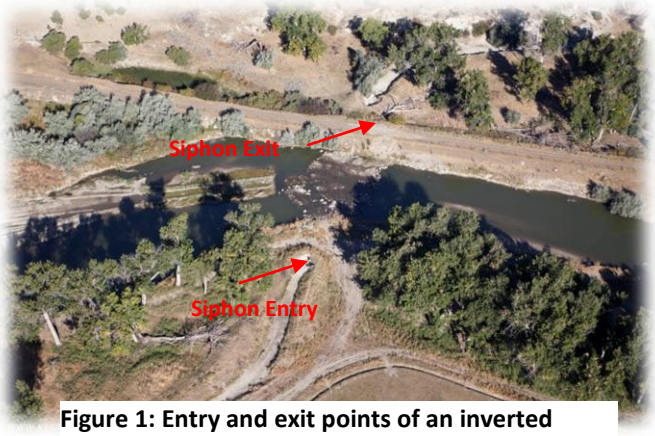


**Figure 1: Entry and exit points of an inverted siphon on the Musselshell River.**
**Photo Credit: Kestrel Aerial Services, Inc.**

## Description

This Pipeline Crossings BMP addresses the following items:

I. ***Irrigation Pipeline Crossings:*** Most irrigation pipeline crossings on the Musselshell River are gravity-based, inverted siphons installed beneath the river bottom.

II. ***Alternatives to Irrigation Pipeline Crossings:*** Alternative means of delivering irrigation water across the river.

III. ***Oil/Gas Pipeline and Cable Crossings:*** General considerations for permitting new or replacement of oil/gas pipeline and cable crossings.

IV. ***Domestic Water Pipelines:*** Design considerations for small diameter domestic water pipelines.

V. ***Permitting:*** Permits needed for pipeline crossing installation or maintenance.

## I. Irrigation Pipeline Crossings

The irrigation pipeline crossings on the Musselshell River are primarily inverted siphons. Inverted siphons are steel, pre-cast concrete, or PVC pipelines that carry irrigation water under the bed of the river. Water is carried through the pipeline by gravity by having the siphon entry point higher in elevation than the exit point (Figure 1). The pipelines are usually buried less than 5 feet below the river bed, trenched into the river bed with heavy equipment. If an irrigation pipeline (inverted siphon) is not buried deep enough and/or is located in a channel section subject to scouring, it may become exposed during a high water or ice event. Once exposed, the likelihood of the pipeline becoming severely damaged by debris is high.

**Figure 2: 2011 flood scoured the river bed, exposing the irrigation inverted siphon on the Musselshell River.**
**Photo Credit: Kestrel Aerial Services**

*Irrigation Inverted Siphons:* The construction of an irrigation inverted siphon requires a detailed design and layout by a qualified engineer. The amount of water to be conveyed across the river will be determined by such factors as feeder canal capacity, pipe diameter, pipe type, pipe length, and the elevational head between the siphon's entry and exit points. General design considerations include:

- If possible, locate the siphon on a straight section of river that is stable and has not moved laterally or vertically over the last 30 years. Avoid meander bends and braided channels.
- Place bank armoring on both sides of the river to protect the inlet and outlet sections of buried pipeline from flanking or scouring, when necessary.
- Have a geomorphic analysis completed at the proposed buried siphon location to determine the potential for future channel scour or degradation.
- Bury the pipeline as deep as possible under the river bed. If the river bed does not have sufficient natural armoring, carefully construct a graded rock apron that extends far enough upstream and downstream from the buried siphon to assure the channel bed over the siphon fits the overall river channel gradient.

**Figure 3: Rock apron placed over a buried inverted siphon on the Musselshell River.**
**Photo Credit: Tom Pick**

- Develop 100 year Channel Migration Zone (CMZ) boundaries for the Musselshell River. If possible, locate all inlet and outlet structures outside the CMZ boundary.

## II. Alternatives to Irrigation Pipeline Crossings

*Cross-Channel Flumes:* These are irrigation structures that cross over the river channel. They can be either a closed pipeline or an open flume. Most surface flumes have been replaced with inverted siphons over the last 50 years. If a flume is to be built or replaced, the following design criteria should be considered:

- Locate the flume on a straight section of river that is stable and has not moved laterally or vertically over the last 30 years.
- Elevate the flume above the 100 year flood elevation as a minimum.

- Due to the channel width of the Musselshell River and the weight of the flume when fully charged with water, flume supports in the bankfull channel may be necessary. Consider using a suspension system to minimize the number of supports.

*Irrigation Pumps:* Inverted siphons and flumes are expensive and require continual maintenance. In certain situations, the use of an irrigation pump may be more efficient and economical than installing a pipeline crossing. Refer to the Irrigation Pump BMP for additional information.

## III. Oil/Gas Pipeline and Communications Cable Crossings

There are some oil/gas pipelines and cables that cross the Musselshell River. Many are buried beneath the river bed although some smaller pipelines or cables may be attached to bridges. The Pipeline and Hazardous Materials Administration (PHMSA) enforces the safety rules for all oil/gas/hazardous waste pipeline crossings. The 310 law may not apply to many new or replacement oil/gas pipeline and cable crossings if they are directional drilled without surface disturbance of the river bank or channel bed.

**Figure 4: Diagram showing directional drilling commonly used to avoid disturbance to the river channel and banks.**

The following considerations are for Conservation Districts who may have 310 permitting authority over certain oil/gas pipeline and cable crossings, if they are not directionally drilled:

- Encourage the pipeline or cable company to directionally drill new and replacement oil or gas pipelines and cables under the river rather than trenching them in.
- When directionally drilled, maintain a minimum of 20 vertical feet between the river bed and the pipeline or cable.
- Develop 100 year Channel Migration Zone (CMZ) boundaries for the Musselshell River. Locate the entry and exit points of the pipeline or cable outside the CMZ boundary.

**Figure5: Exposed oil pipeline on Beaver Creek near Helena.**
**( http://ravallirepublic.com)**

## IV. Domestic Water Lines

Domestic or livestock water pipeline crossings should follow the oil/gas pipeline design considerations with a few exceptions:

- Encourage the landowner to have their domestic water pipeline directionally drilled under the river rather than trenching it in.
- When directionally drilled, maintain a minimum of 10 feet between the river bed and the pipeline. Depth is not as critical for water pipelines as for oil/gas pipelines due to the lower hazard to water quality. It is still advisable to bury the pipeline as deep as possible to minimize the likelihood of it becoming exposed and needing to be replaced.
- Develop 100 year Channel Migration Zone (CMZ) boundaries for the Musselshell River. Locate the entry and exit points of the water pipeline outside the CMZ boundary.
- If the pipeline is trenched in, follow all the same considerations outlined under Section II Irrigation Pipeline Crossings.

## V. Permit Requirements

Prior to beginning any activity that physically alters or modifies the bed or banks of a perennially flowing stream, producers should use the joint application http://dnrc.mt.gov/Permits/StreamPermitting/JointApplication.asp to apply to the local Conservation District (CD) for a Natural Streambed and Land Preservation Act (310 Permit). This joint permit also serves to apply for a Federal Clean Water Act Dredge and Fill Permit (404 Permit)from the US Army Corps of Engineers , as well as various other permits potentially needed from Montana Fish, Wildlife & Parks, and Montana Department of Environmental Quality. For more information on all permits needed to work in and near streams in Montana see “A Guide to Stream Permitting in Montana” which is available at the local CD office or online at: http://dnrc.mt.gov/Permits/StreamPermitting/Guide.asp.