GUIDE TO (Revised February,2005)

STREAM CROSSINGS

CULVERTS, BRIDGES, AND FORDS

Culverts, bridges, and fords are all methods used to cross-streams. Culverts are the most common stream crossing structure.

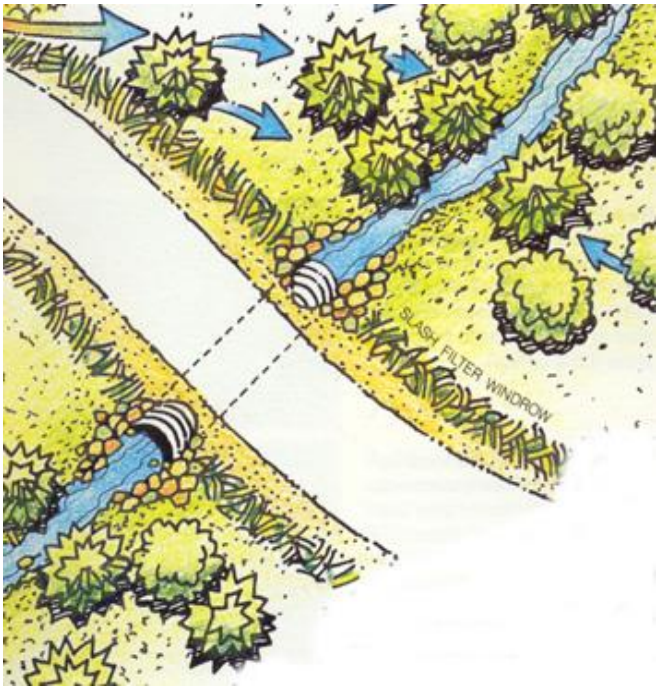
Bridges are best for large streams with high gradients and areas plagued with floatable debris problems. Bridges also have less effect on fisheries than other methods. For this reason, bridges may be required at certain sites if it is determined that a culvert will significantly impair or prevent fish passage.

Fords are less desirable because of continued disturbance to the streambed. A wrong choice of stream crossing method can result in major damage to the immediate site as well as downstream areas.

All private landowners considering temporary or permanent stream crossings on perennial streams must obtain a 310 permit. Consult with your local Conservation District Office about any stream crossings. If a floodplain has been designated for the stream, a permit must also be obtained from the designated local city/county floodplain manager.

DESIGN AND INSTALLATION CONSIDERATIONS

Select a location that has firm banks and fairly level approaches. Design stream crossings to handle peak runoff and floodwaters, and for adequate fish passage.



Install stream crossing at right angles to the channel whenever possible.

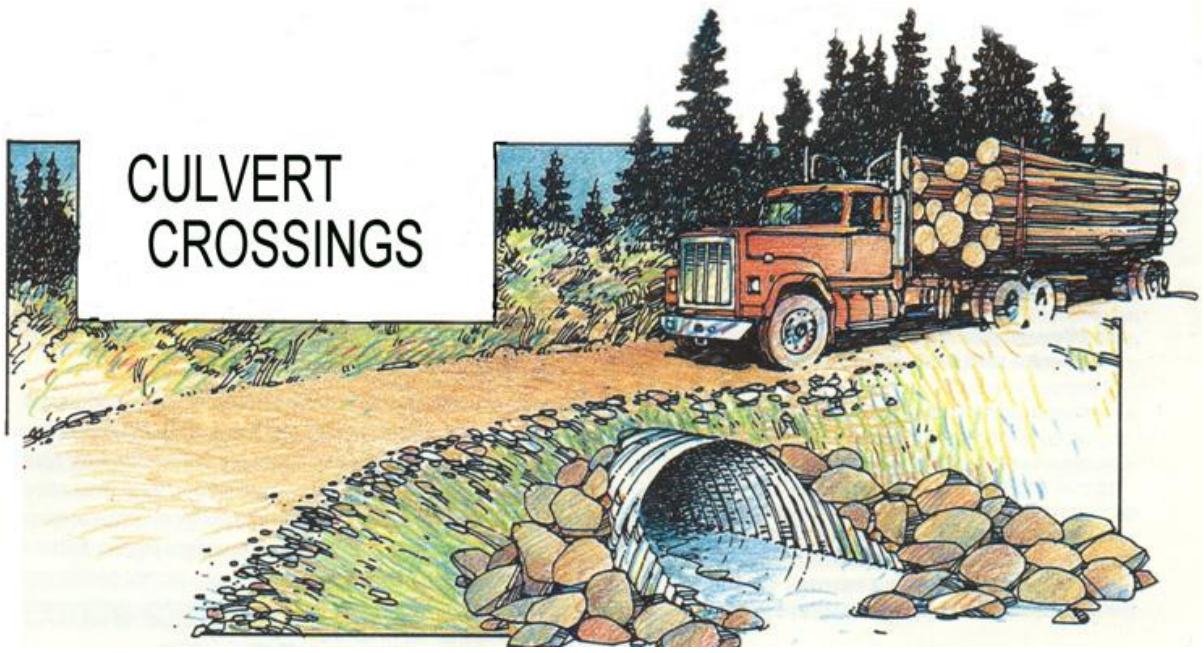
Adjust the road grade to reduce the concentration of water carried by drainage ditches to stream crossings. Direct ditch flows away from the stream-crossing site or into an adequate filter.

Avoid unimproved stream crossings (drive-throughs or "fords"). Remove stockpiled material from high water zones.

To protect fisheries and water quality, complete work as quickly as possible during low flows. Installation should not be done in frozen ground.

The time trout spawn and the length of time eggs incubate varies with the species present and the water temperature characteristics of the stream.

Consult with your area fishery biologist to determine times when in-stream construction activities can occur without interfering with fish spawning or egg incubation.



CULVERT SIZE

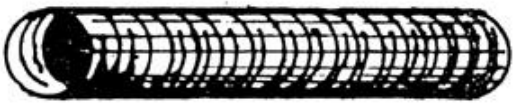
Size of culvert required depends on:
- the size of the drainage above the culvert site,
- average stream width, depth, and gradient (slope) at the crossing site,
- amount of debris loading anticipated,
- the permanence of the crossing.

The culvert must be sufficient size to handle peak runoff, a minimum 25-year frequency runoff. A minimum diameter of 18 inches is recommended for permanent stream crossings. They require less maintenance and protect both the stream and road investment.

CULVERT SHAPE

Culverts come in a variety of shapes. Round culverts are used for medium and high stream banks. Pipe-arch or "squash" pipes are used for low clearance large waterway openings, and aesthetics. This arch shape can have hydraulic and fisheries advantages at low flows, and requires less road fill. However, a squash pipe has approximately 8 percent less capacity, than the equivalent-size round pipe.

Round Pipe



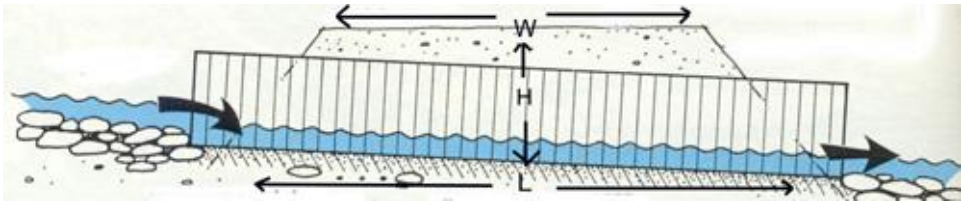
Pipe-Arch or Squash Pipe

CULVERT LENGTH

The length of culvert needed will depend on the desired width of the road top, the height of the culvert, and the average depth of the road fill over the culvert. A minimum of 1 foot of culvert should extend beyond the toe of the road fill on each end.

For most road material (well-graded sand and gravel), the side slopes of the fill should be no steeper than 1:1 (1 feet wide for every 1 foot in height). However, on steep gradient streams, or for road fill consisting of fine sand or silt, side slopes of roadfill should be no steeper than 1 1/2:1.

To prevent crushing by traffic, use 1- 2 foot minimum cover for culverts 18 to 36 inches in diameter, and a cover of 1/3 to 1/2 the culvert diameter for larger culverts.



Determining Length of Culvert: *

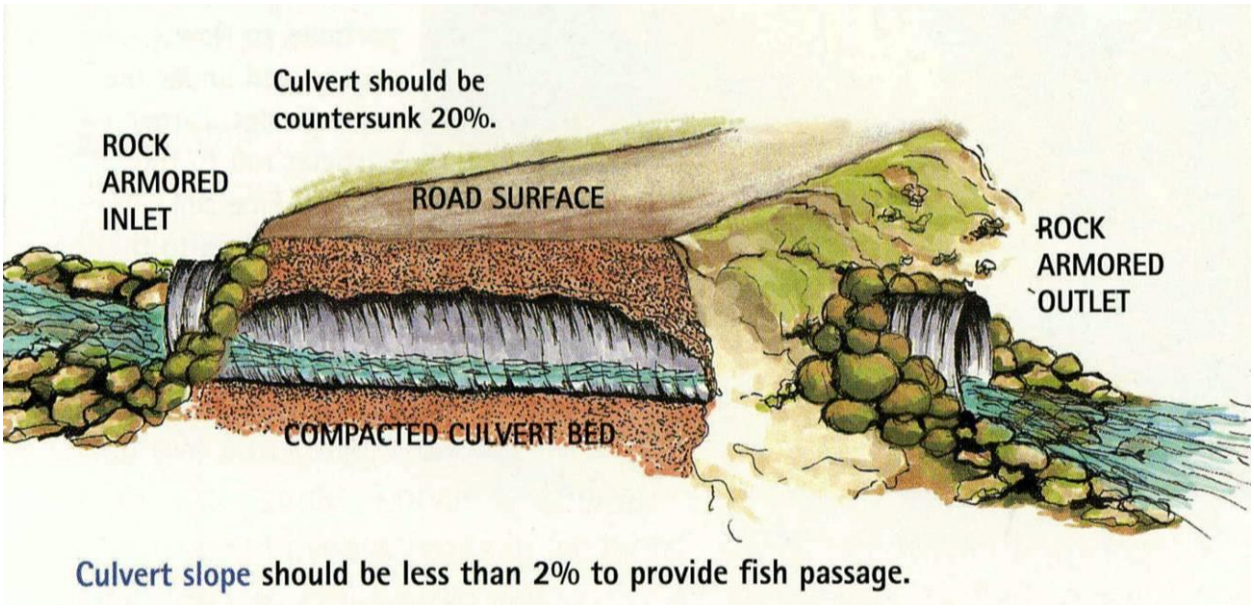
L = W + 2H + 2 (for 1:1 side slopes); or
L = W + 3H + 2 (for 1 1/2 :1 side slopes)

L = Length of Culvert
W = Width of Road Top Desired
2 (Constant) Angles of Side Slopes 2(1:1); or
3 (Constant) Angles of Side Slopes 3(1 1/2:1)
H = Height of Culvert + Ave. Depth of Road Fill
2 (Constant) One Foot Pipe Extension Beyond Fill Ends

Example: Length of culvert needed for a 12 foot road top, 24" (2 foot) diameter pipe, 2 foot average road fill, 1:1 slopes, 1 foot pipe extended beyond fill:
L = 12'road top + 2(2'culvert + 2'fill) + 2'extension
L = 22 feet

***Remember a culvert set at an angle to the road will require a greater length than one set at 90 degrees to the road centerline.**

CULVERT INSTALLATION



Consider dewatering stream-crossing sites during culvert installation where practical. Use erosion fabric to reduce sedimentation.

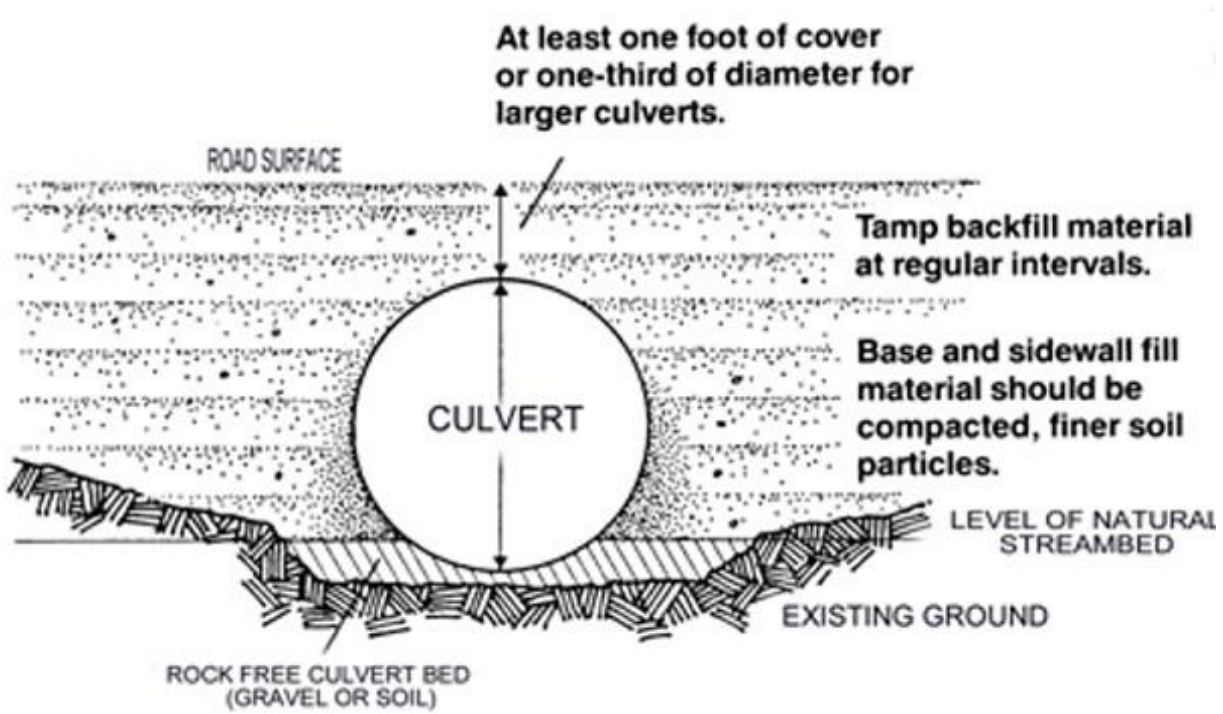
The culvert foundation and trench walls must be free of logs, stumps, limbs, or rocks that could damage the pipe. The bed should be either rock-free soil or gravel. Bedding should provide even distribution of the load over the length of the pipe.

Alignment within the stream channel is critical for the culvert to function properly. Culverts set at an angle to the channel can cause bank erosion and can develop debris problems. Culvert alignment must fit the natural stream channel.

Place culverts slightly below normal stream grade (20%) to reduce water velocity, allow gravel to deposit in the bottom, and conform to the natural streambed and slope. Water should drop slightly as it enters the culvert. Improper culvert placement can:

- **Restrict flows,**
- **Increase the risk of plugging,**
- **Cause undercutting of the culvert,**
- **Form a barrier to fish migration.**

There should be no frozen soil in the fill material, as it reduces the ability to compact. Backfill must be free of limbs, rocks, and other debris that could dent the pipe or allow water to seep around the culvert.



Tamping fill material in layers (lifts) throughout the entire backfill process is important. The base and sidewall material should be compacted first. This reduces seepage into the fill.

Both the culvert inlet and outlet should be armored with rock to protect these locations against erosion.

All disturbed areas and road fill should be reseeded to a sod-forming grass mix immediately following completion of the culvert installation to prevent erosion and sedimentation of the stream.

MULTIPLE CULVERTS

Use of multiple culverts at a crossing site placed side-by-side is not recommended. A stream that is too wide or too large for a single culvert, is better suited to a bridge crossing. To install multiple culverts properly, each culvert must be spaced sufficiently apart to adequately compact the road fill between them. This fill must be well armored at each end, to prevent the stream from washing out, or "piping" between the culverts.

BRIDGE CROSSINGS

Bridges are best for large stream and those plagued with floatable debris or ice jam problems. Bridges have the least impact on fish.

BRIDGE LENGTH

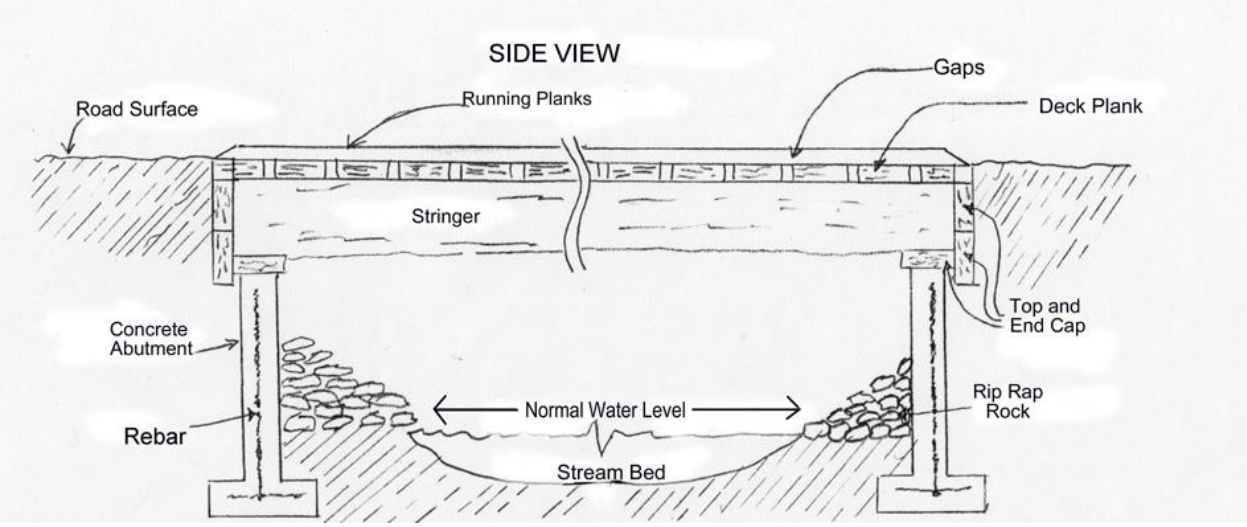
The length of the bridge span should exceed the width of the stream at the crossing site. Otherwise, the abutments will encroach into the stream channel and constrict flows.

BRIDGE MATERIALS

Acceptable bridge materials for permanent crossings are:
-railroad flat cars
-treated wood, concrete, steel, or log stringers
-treated wood, concrete, or steel pilings

BRIDGE HEIGHT

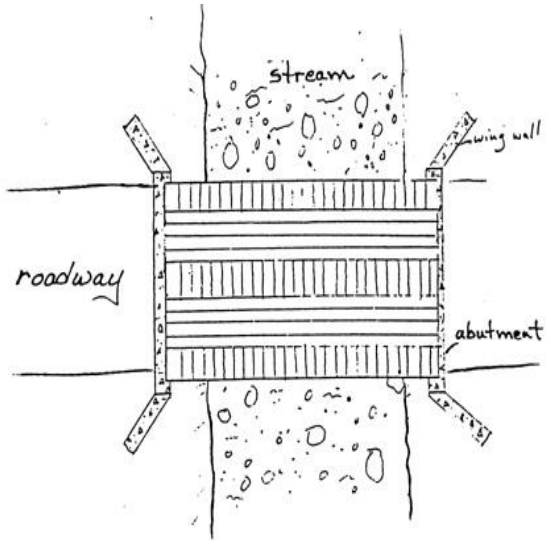
The height of the bridge should be adequate to pass high water, debris, and ice jams. Too low of a bridge becomes a constant maintenance problem to the landowner and restricts stream flows.



BRIDGE ABUTMENTS AND WINGWALLS

Abutments and wingwalls are recommended for all permanent bridge installations. Abutments should be positioned at or beyond the high water mark of the channel, whenever possible, to prevent restriction of water flows.

Abutments should be buried a minimum of 3 feet below ground surface. If placed on the stream bank, abutments should be buried at least 3 feet below the scour depth, to prevent undercutting. Acceptable abutment materials are concrete, steel, or treated wood.



Wingwalls should be of sufficient height and length to prevent any roadfill from entering the stream. Acceptable wingwall materials are concrete, steel, treated wood or rock riprap.

Armor both abutments and wingwalls with rock on the streamside to prevent scouring underneath.

BRIDGE INSTALLATION

Avoid crossing the stream with equipment and materials if possible during installation of the abutments, wingwalls and bridge itself. If this is not possible, limit the number of crossings to the minimum necessary.

If the stream must be forded during installation, restore the stream banks and vegetation to their previous condition following construction.

All disturbed areas and road fill should be reseeded to a sod-forming grass mix immediately following completion of the bridge installation.

A silt fence, straw bales, or slash filter windrow should be placed at the toe of the banks to prevent sediment from entering the stream while bank vegetation is reestablishing.

USE OF CENTER PIERS

Avoid center piers whenever possible on a stream crossing. They obstruct stream flows and catch floating debris.

FORD CROSSINGS

A ford is a stream crossing option for low service level roads that are private, gated and have infrequent use. Access control is important to avoid damage to the ford approaches when they are vulnerable to erosion. Fords seldom have year-long access.

Generally, fords (or drive-throughs/unimproved crossings) are not acceptable permanent stream crossing due to sedimentation of the stream and damage to the banks.

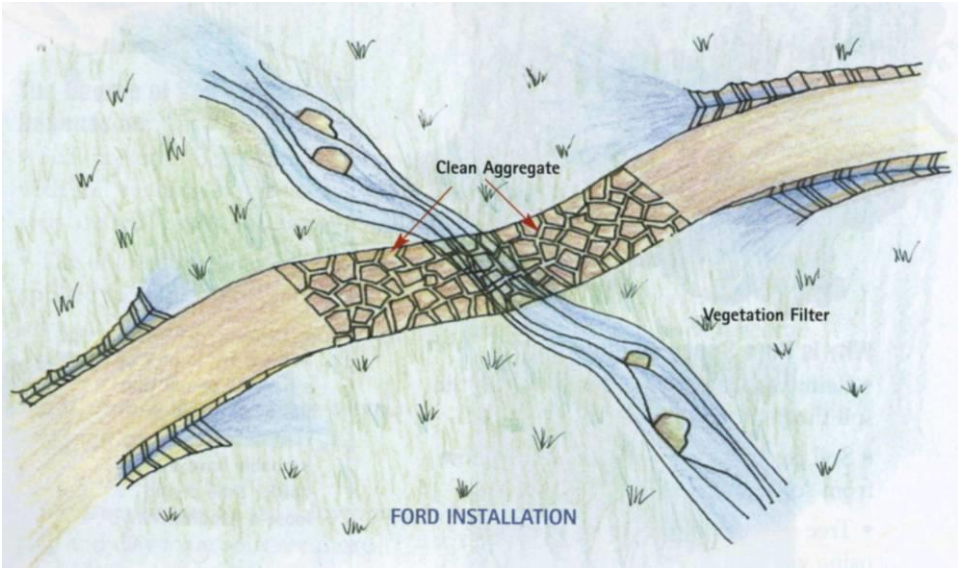
For temporary use, or private on-farm occasional use, a ford crossing may not cause damage to the stream. Avoid unimproved stream crossings. When a culvert or bridge is not feasible, locate drive-throughs on a stable, rocky portion of the stream channel.

Factors to consider in choosing a ford crossing of a stream are:

- whether this is an existing, historic ford crossing;
- stability and natural rock armoring of stream bed and banks;
- number of crossings planned, with what type of vehicles;
- time of year crossing planned;
- permanence of the crossing site.
A bedrock stream bottom is ideal for a ford location. Otherwise, the bottom should be armored.

Armoring the streambed and banks with rock, or concrete planks fastened together can provide an improved ford crossing.

The size and shape of in-stream rock can indicate the minimum size of armor rock required to resist downstream movement. It should be bigger than what you see in your stream bottom. Angular rock is preferred, because it resists movement by interlocking. Don't restrict fish passage.



Gently sloping, stable streambank approaches are preferred. Approaches should be rocked to minimize erosion when driving in and out of the ford. Where practical, approaches should be at right angles to the stream. Approaches should dip into and out of the stream, creating a concave shape that ensures the stream cannot be diverted out of its natural channel and down the road.

CREDITS

***Prepared by*:**

Tara Comfort, Resource Conservationist,
Missoula Conservation District, Missoula, Montana

***Technical Review Provided by*:**

Missoula Conservation District
USDA, Natural Resources and Conservation Service
Montana Fish, Wildlife and Parks
Montana Department of Natural Resources and Conservation
Plum Creek Timber Company

***References and Illustrations*:**

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