Technical Bulletin

High-Water Bypass

Version 1.0 3/21/06

High Water Bypass: A flat, low-lying section of road that serves as an emergency spillway to allow water to flow over the road with minimal damage during extreme flow events.

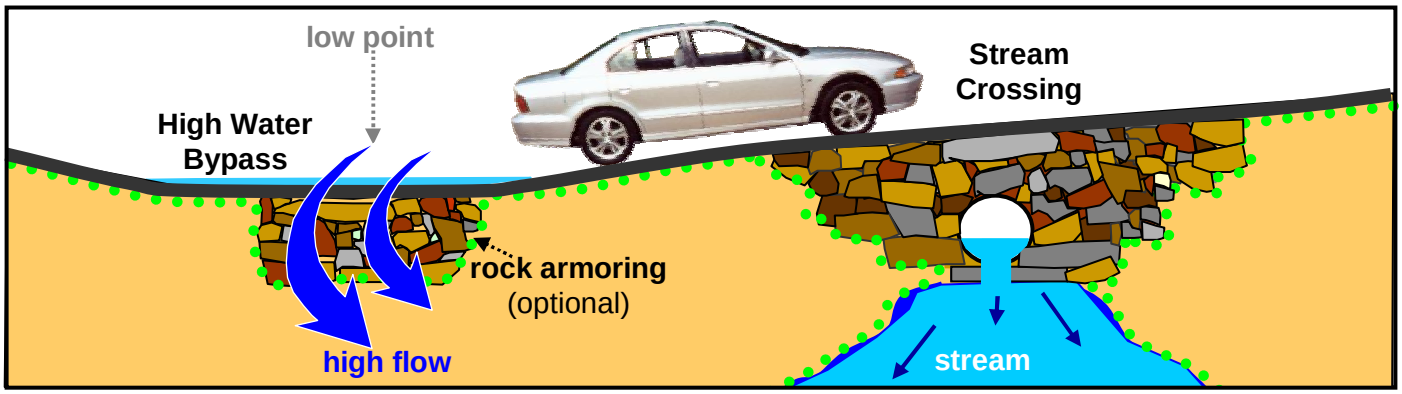

Figure 1: Stream Crossing with a high-water bypass

Purpose

A high-water bypass provides a stable overflow area to minimize road failure and bridge/culvert damage during extreme flow events. It is impractical to design bridges and culverts to adequately handle all possible storm events. On streams crossings that frequently overtop, a high-water bypass controls the path of the flood water, reducing the potential for erosion on the road or failure at the stream crossing.

Benefits of a high-water bypass

- Reduces risk of failures at stream crossings by directing extreme flows across road at a stable location;
- Minimizes erosion of costly road material and damage to drainage structures;
- Reduces emergency maintenance needed to make roads passable after damage by high water flow;
- Allows for effective management of storm flows beyond the design capacity of bridges and culverts;
- Reduces "firehose effect" of confining flood flows to main stream channel; and
- Connects floodplains on opposite sides of a road.

Considerations

- Make bypass wide and flat to encourage sheet flow.
- In locations where space is limited, or large road banks exist, it may be necessary to reinforce the bypass area to minimize the potential for erosion.
- In areas where space is limited, a bypass may be constructed directly over a stream crossing.
- These structures are intended for extreme events, not as regular flow channels for frequent events.

Where to use a high-water bypass

- Where flow historically overtops a bridge or culvert.
- On lower traffic volume roads where sheet flow of water over road is more acceptable.
- Where it is desirable to connect the floodplains on either side of the road instead of concentrating all of the stream's flow at the crossing structure.

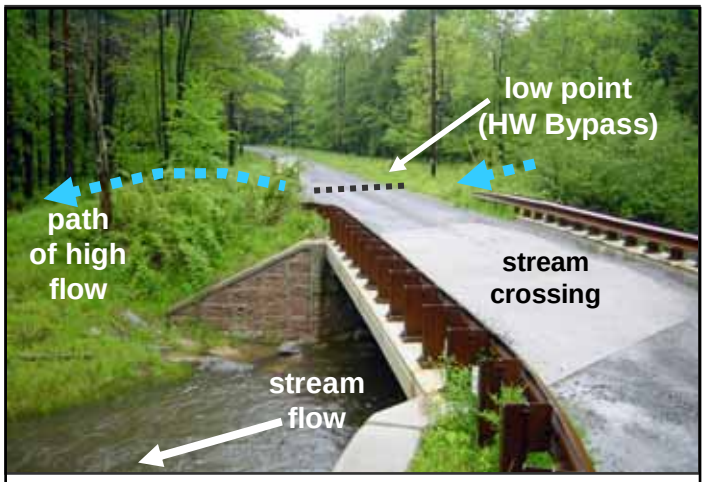

Photo 1: The low point in the above site is away from the stream. Little reinforcement was needed at this site because of the relatively flat terrain.

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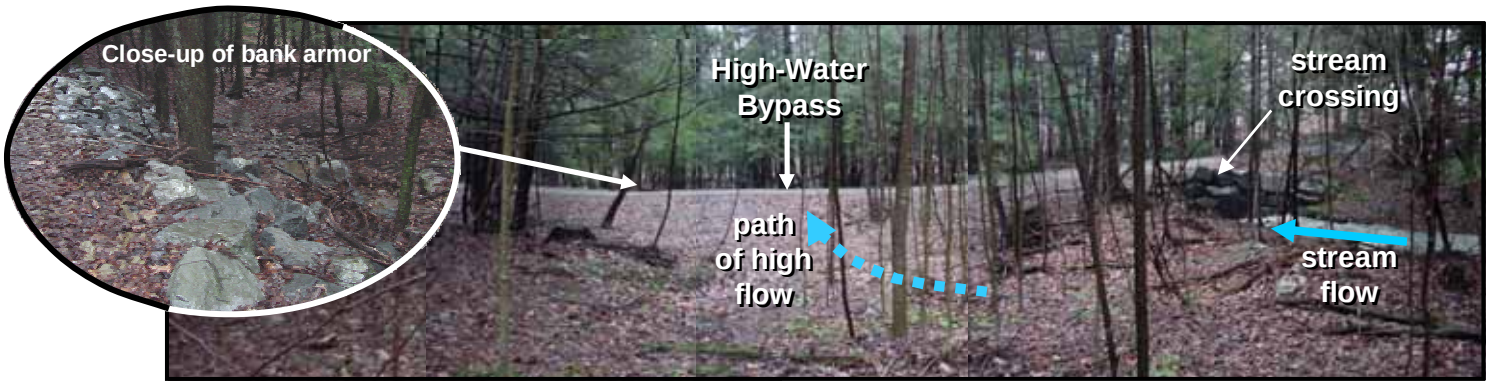

Photo 2: Geo-synthetic and rock reinforcement was used on the bypass due to width limitations and a steep drop-off on the downslope side of the road. When stream flow exceeds pipe capacity at the crossing, water will flow over the bypass.

To reinforce or not to reinforce? Bypasses may need to be reinforced in locations where width is limited or where steep road banks exist. The need for road reinforcement can be avoided by making bypasses as flat and wide as possible.

Road Reinforcement: In areas where bypass width is limited, or more frequent flows are expected, it may be necessary to armor the roadway itself as in the example to the right. 3-dimensional geogrid (***photo 4***) adds additional strength and helps to tie the surface together. #3* stones provide traffic support while resisting erosion.

Bank Reinforcement: If a drop-off exists on the side of the road, it should be armored with rock to prevent erosion as water flows across the road. The bypass in ***Photo 2*** above is armored with R7* rip-rap.

Construction Sequence – *(see **photos 3-5**)*

This location was reinforced due to high overflow frequency.

1. **Excavation:** Dig into the road to create room for surface reinforcement. Depth will depend on size of geogrid, size of stone, and elevation of road. A 10" excavation depth is shown in example here. ***(photo 3)***
2. **Geotextiles:** Place fabric, then geogrid in excavated area. Geogrid is secured with pins. ***(photo 4)***
3. **Rock:** Fill geogrid with rock, #3* as shown. ***(photo 4)***
4. **Surface:** After an additional layer of fabric over the stone, the bypass is ready for aggregate. ***(photo 5)***

Construction Considerations

- **Size:** Sizes vary greatly depending on available space and stream size. Make the bypass as wide as possible to spread the water out and encourage sheet flow.
- **Elevation:** Use leveling equipment to be sure that the finished surface of the bypass will be the lowest section of road in the floodplain.
- **Shape:** Flat and wide! The finished bypass surface should be as flat and wide as possible to insure even sheet flow and minimize erosive forces.

Photo 3: Excavation of bypass.

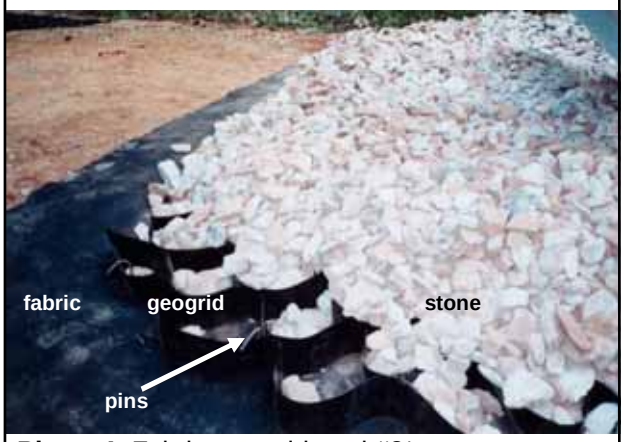

Photo 4: Fabric, geogrid, and #3* stone.

Photo 5: Finished bypass blends into rest of road.

*****#3 and R7 rock sizes refer to PA Department of Transportation Section 408 Specifications.

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