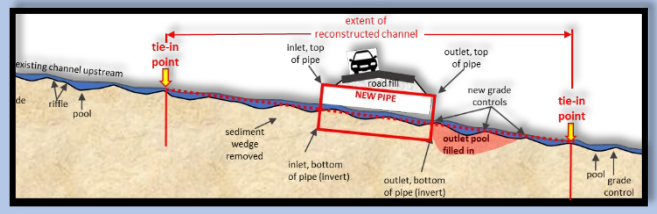
What is “Stream Continuity”?

<u>Continuity</u> simply means:
“uninterrupted connection”

Stream continuity means that the stream is very similar in character upstream, downstream, <u>and through</u> the road crossing. This includes features such as slope, streambed material, channel width and shape, pool/riffle sequencing, and connectivity to its floodplain.



Continuity is a wholistic approach that looks at the entire reach of stream, not just the crossing.

Stream Connectivity in PA

Designing stream crossings for continuity is catching on in PA. A variety of organizations such as the PA State Conservation Commission (SCC), PA Department of Environmental Protection, PA Fish and Boat Commission, PA Game Commission, Trout Unlimited, PA Bureau of Forestry, Western PA Conservancy, and others are actively trying to spread the message of stream continuity. While other standards exist nationally, the documents described on the back are the only PA standard, and only apply for PA DGLVR projects.

More information:

Efforts to design stream crossings for connectivity extend beyond PA. Several states in the Northwest and New England provide standards for stream continuity. The most comprehensive guidance is from the US Forest Service and their “Stream Simulation” approach. More information at:
https://www.fs.usda.gov/biology/education/workshops/aop/index.html
(or search USFS Stream Simulation)

PA Dirt, Gravel, and Low Volume Road Maintenance Program

The PA DGLVR Program provides $28 million annually in grant funding for environmental and road improvement projects on publicly-owned roads. The PA State Conservation Commission (SCC) administers the program at the state level. County conservation districts administer the program within each county. Local public road owning entities, largely townships, apply to their district for funding. www.dirtandgravelroads.org.

The DGLVR Program funds a variety of other practices, but typically installs about 60 stream crossing replacements annually. In July of 2022, the SCC, working in collaboration with the Penn State Center for Dirt and Gravel Road Studies and others, approved a comprehensive set of stream crossing documents for program use:

<u>Policy</u>: Requires use of standard and outlines other trainings, reviews, and inspection requirements.

<u>Standard</u>: Design and installation standard for new stream crossings. Provides requirements and information for engineers on project design, construction inspection, and more.

<u>Technical Manual</u>: Comprehensive guidance document in support of the Policy and Standard above. Most of the manual is written for conservation district staff administering projects through the PA DGLVR Program, with chapter 12 being dedicated to design engineers.

<u>Documents</u>:
https://dirtandgravel.psu.edu/general-resources/stream-crossing-replacements/
(or search “DGLVR stream crossings”)

The above documents are only required for projects funded by the PA DGLVR Program. The documents are publicly available for others interested in stream continuity projects.

Designing Stream Crossings for Connectivity, Continuity, and Storm Resiliency in Pennsylvania

5/2023

Document provided by PSU Center for Dirt and Gravel Road Studies and PA State Conservation Commission

PENNSTATE
Center for Dirt and Gravel Road Studies
Pennsylvania SCC State Conservation Commission

Streams pass more than water, but traditional culvert design is based on hydraulics only, like a stormwater pipe, and crossings are often undersized.

Problems with Traditional Design and Undersized Stream Crossings:

Backwatering and Gravel Bars: At high flows, undersized pipes often back up water like a dam, causing material that streams naturally carry to drop out above the pipe inlet. This "gravel bar" is a constant source of maintenance for road owners as it requires constant cleanout after each storm.

Clogging: Undersized pipes are prone to clogging during large flow events due to debris jams and gravel deposition.

Aquatic Barriers: Undersized pipes can fragment habitat by creating barriers that prevent organisms, ranging from fish to frogs to invertebrates, from passing through the structure.

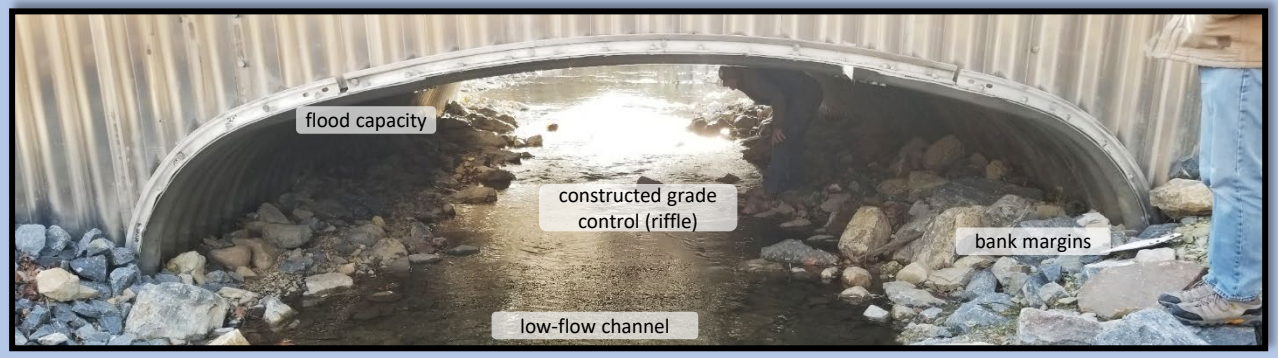
Erosion and aquatic barrier at undersized pipe outlet

A clogged pipe inlet led to a complete road washout.

Channel and Road Erosion: Undersized pipes flowing full can act like a fire hose to erode banks and scour streambed for hundreds of feet downstream.

Complete Failure: With increased storm frequency and severity, more undersized crossings eventually experience a total washout or failure due to the concerns outlined above.

A Different Approach: *Let the stream be a stream, even through the road.*



A newly installed structure with 24"+ of streambed, and continuity of slope, shape, and grade control.

Wider Structures: Structures must be wide enough not only to accommodate water flow, but to maintain channel shape while passing debris and maintaining channel stability through the road.

Consistent Slope: Maintaining a natural channel slope is critical, as an increase in slope can lead to erosion, and a decrease in slope can lead to gravel deposition. Establishing slope continuity often requires doing work further upstream and/or downstream to correct legacy stream impacts from the undersized structure.

Grade Control: As the name implies, grade controls are essentially immobile objects that set the elevation of the streambed. In most PA streams, grade control consists of large rock clusters. Reestablishing the spacing, type, and sizing of natural grade controls will help to promote long term channel stability.

Streambed: Maintaining streambed through the structure is key for long term stability. Bottomless structures are encouraged, especially on steeper channels. Structures with inverts (bottoms) should be buried sufficiently to maintain streambed. The streambed mix composition should mimic natural conditions.

Channel Shape: Typical streams have a low-flow channel, bank margins, and a floodplain. Stream continuity mimics these features as best as possible through the structure as shown in the picture above.

Aquatic Organism Passage: Aquatic Organism Passage (AOP) means that both aquatic and terrestrial animals can move naturally up and down the stream through the road corridor. Creating a stream with continuous slope and streambed features through the road will ensure AOP is also achieved.

What About Cost? Yes, larger structures and additional in-channel work can mean more up-front costs. However, it is important to consider the 75–100-year lifetime costs of structures, especially when severe storms are becoming more frequent. Several studies have shown long-term cost savings from these larger, more stable structures when accounting for reduced erosion, maintenance, and the potential for failure.