

Dirt Gravel and Low  
Volume Road Program

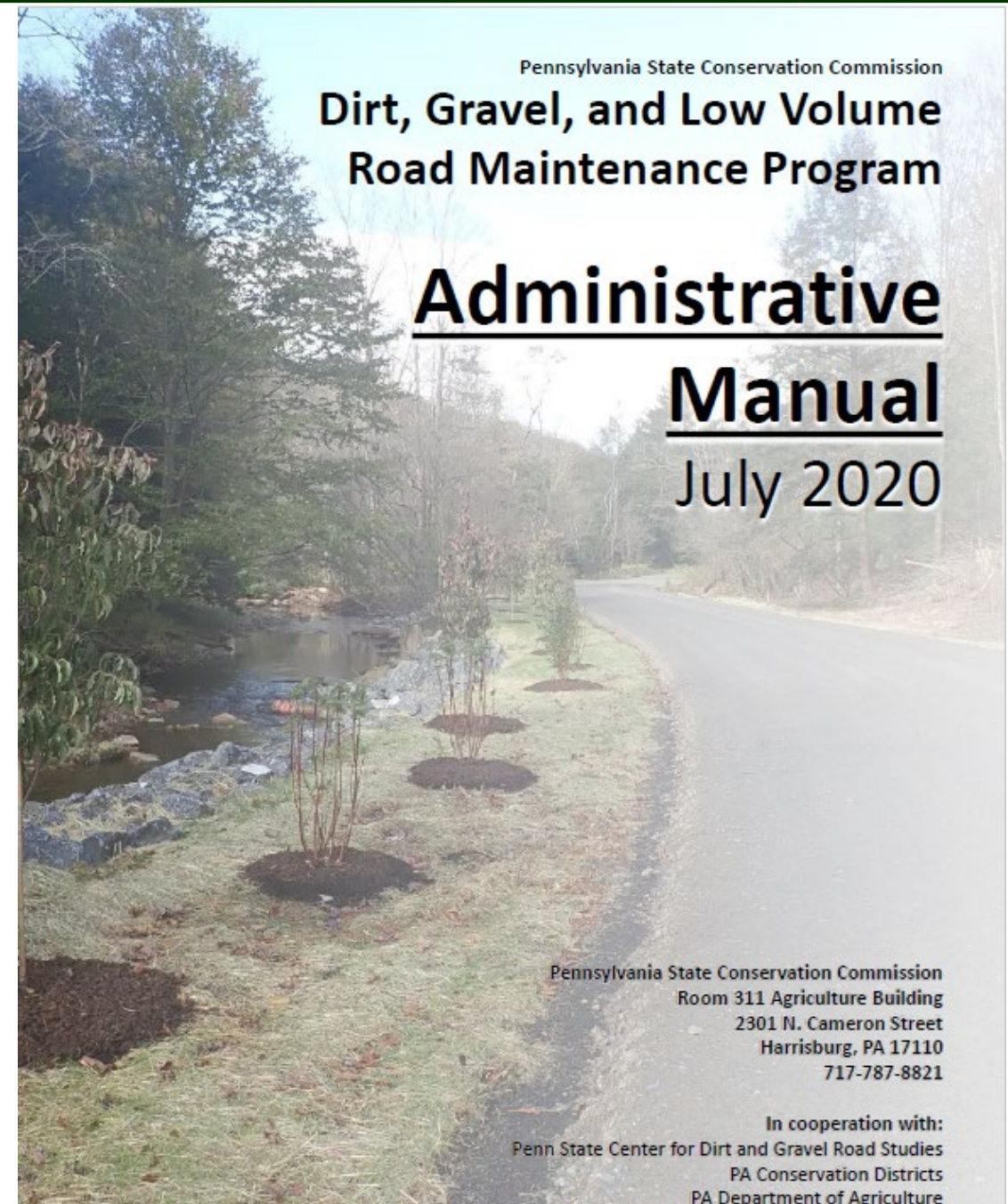
# Stream Crossing Project Examples

WEBINAR

2/11/21 Starts at 9am

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- **7.1 Stream Crossing Replacement Policy**



Pennsylvania State Conservation Commission  
Dirt, Gravel, and Low Volume  
Road Maintenance Program

**Administrative**  
**Manual**  
July 2020

Pennsylvania State Conservation Commission  
Room 311 Agriculture Building  
2301 N. Cameron Street  
Harrisburg, PA 17110  
717-787-8821

In cooperation with:  
Penn State Center for Dirt and Gravel Road Studies  
PA Conservation Districts  
PA Department of Agriculture

## Stream crossings with existing structures OVER 12.5 ft<sup>2</sup> opening (4' diameter)

**In order to be eligible for replacement, EXISTING structures must:**

1. Have a structure to bankfull width ratio of 75 % or less.
2. Show signs of streambank erosion.
3. Show signs of streambed erosion/aggradation.

**The NEW REPLACEMENT structure must *(all four)*:**

1. Have a structure width at least equal to bankfull width (100% ratio).
2. Be properly aligned with the channel.
3. Consider additional floodplain connectivity when possible.
4. Be designed and constructed to accommodate the passage of aquatic organisms through the structure.

## Stream crossings with existing structures UNDER 12.5 ft<sup>2</sup> opening (4' diameter)

~~In order to be eligible for replacement, EXISTING structures must:~~

- ~~1. Have a structure to bankfull width ratio of 75% or less.~~
- ~~2. Show signs of streambank erosion.~~
- ~~3. Show signs of streambed erosion/aggradation.~~

**The NEW REPLACEMENT structure must (all four):**

1. Have a structure width at least equal to bankfull width (100% ratio).
2. Be properly aligned with the channel.
3. Consider additional floodplain connectivity when possible.
4. Be designed and constructed to accommodate the passage of aquatic organisms through the structure.



## Other policies that pertain to stream crossings

- Round pipes over 36” are not permitted for use in DGLVR funded stream crossings.
  - Oval or squash pipes are acceptable
- Structures that do not meet replacement criteria (as listed above) are not eligible for replacement with program funds. (materials, equipment, and labor)
- Replacement structures must be single span openings. Multiple opening structures are not permitted
- Existing crossings consisting of multiple “side by side” pipes are eligible for replacement regardless of bankfull width ratio

## Policy Application to small streams and Routine Maintenance

- Stream crossing policy applied to situation where streams, including intermittent channels, with identified bed and banks are flowing into the road or uphill ditch. Contact the SCC in questionable circumstances. In order for policy exemptions of “questionable streams” channels, Districts must obtain written approval from the SCC prior to contracting the project.
- The Program has never paid for “routine or regular maintenance” such as grading roads. Similarly, regular maintenance of stream crossing structures is not eligible for funding. This includes items such as culvert lining, extending undersized stream crossings, bridge deck repair, etc. that provide minimal environmental improvements.

# **Stream Crossing Project Examples**

**“The Good, The Bad, and The  
In-Between”**

**Project Site Visits from 2018-  
2020 QAQC’s**

# **Projects that exceed expectations**

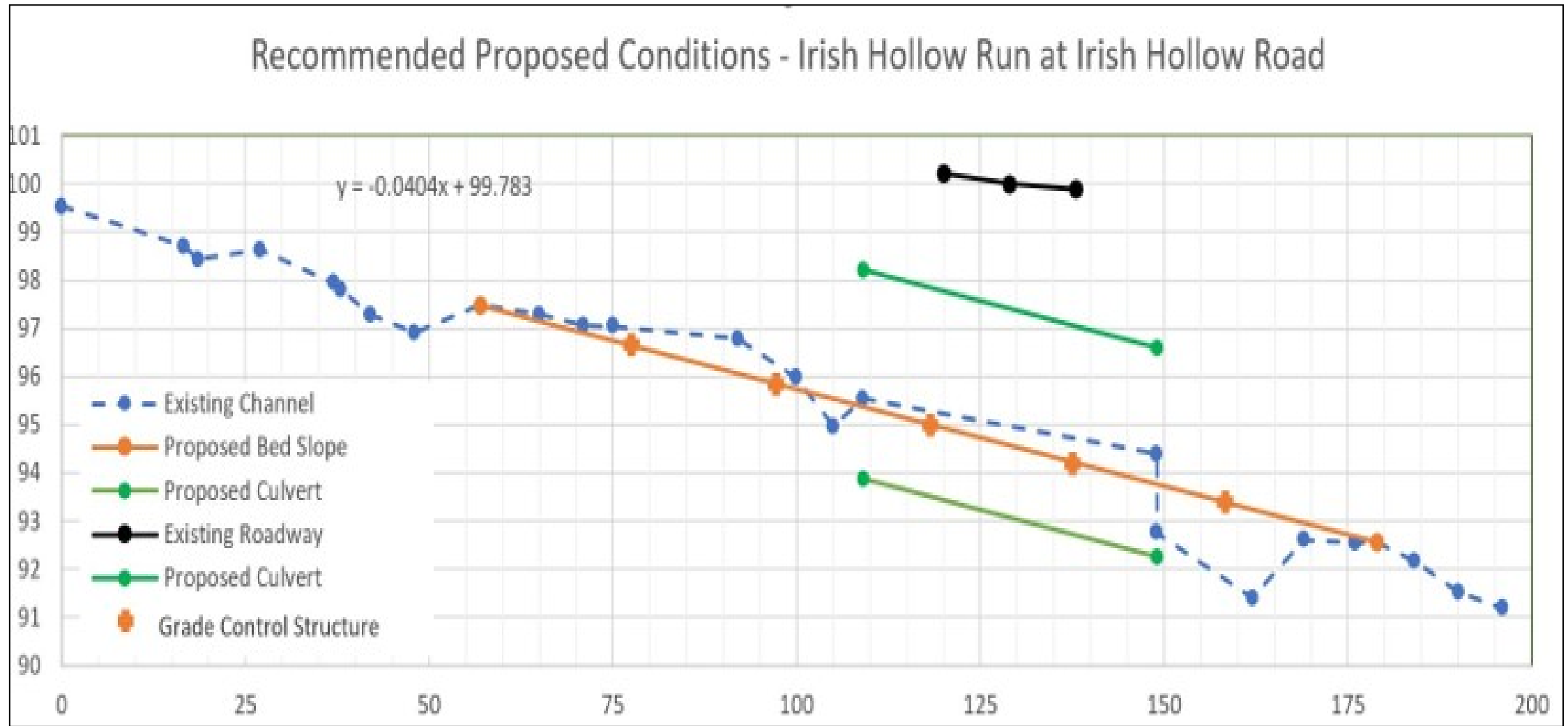
**“The Good”**



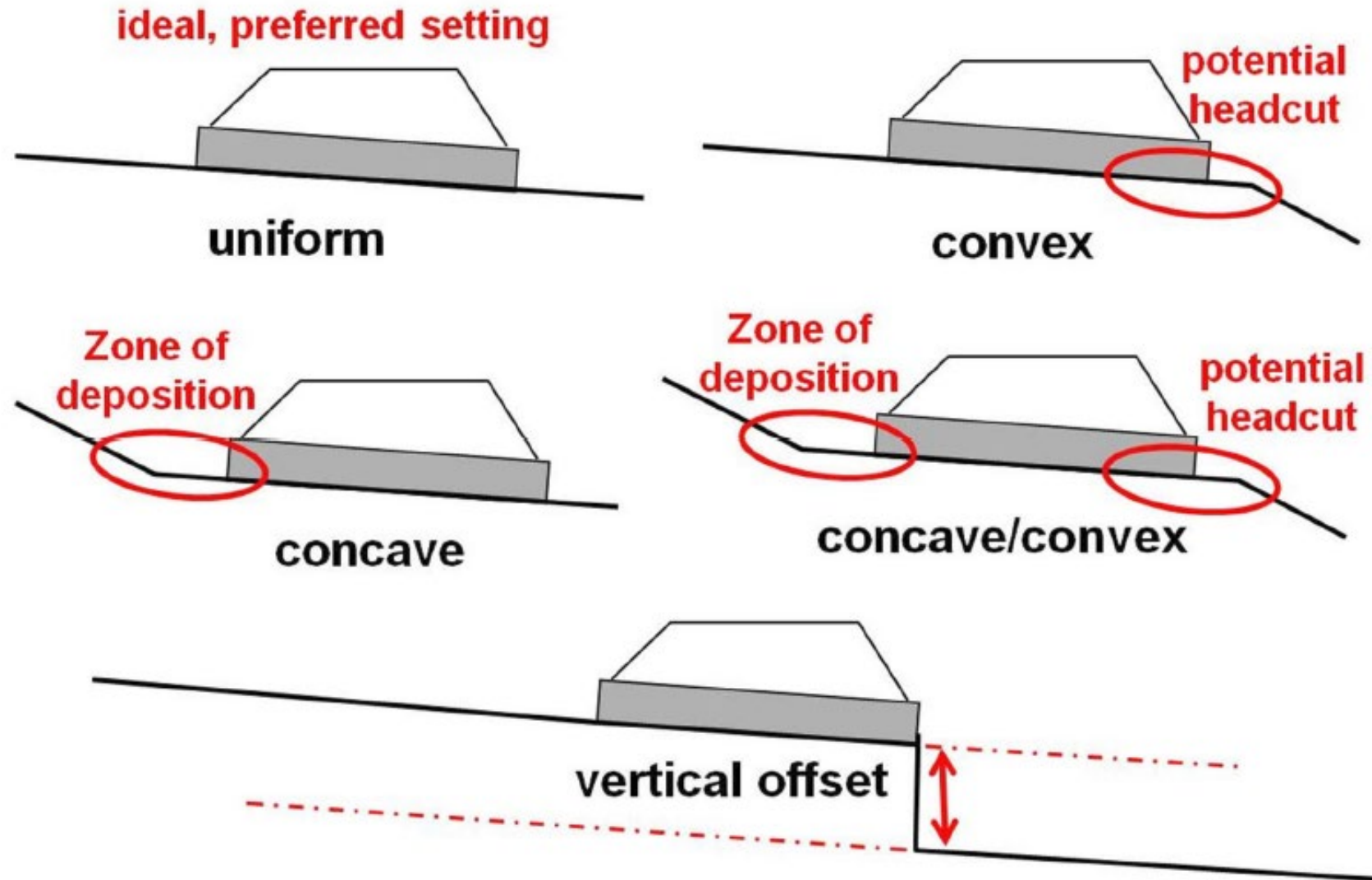
# What makes a good stream crossing?

1. Wider than bankfull width structure at the bankfull elevation
2. Low Flow Channel
3. Stable Bank Margins
4. Properly spaced grade controls & proper stream slope
5. Structure properly aligned with the channel
6. Considers floodplain connectivity
7. Hydraulic opening sufficient for at least the 100 year storm event
8. Sufficient structure height to accommodate waves of debris or bedload movement and constructability of streambed
9. Full Aquatic Organism passage (AOP)
10. Stream Continuity = items 1 through 9

# Example of a longitudinal profile showing new culvert and proposed streambed



# Interpreting Longitudinal Profile Shapes at Road-Stream Crossings: Slope Transitions and Geomorphic Processes





# Greater than bankfull width structure with Full AOP



Over bankfull width Structure  
@ the bankfull elevation

Structure properly aligned with channel

Stable Bank Margins

Low Flow Channel

Stable Streambed through  
structure, no bare metal  
showing,



# Greater than bankfull width structure with Full AOP





# Greater than bankfull width structure with Full AOP



# **Examples of Projects that do not meet expectations / unacceptable**

**“The Bad”**

# What makes a stream crossing not meet expectations?

1. Structure that is less than the bankfull width of the channel
2. Lack of streambed through the structure
3. Structure not properly aligned with the channel
4. No grade controls
5. No aquatic organism passage



**4' Round Pipe  
in 8' Bankfull**

**No streambed  
material in  
structure**

**Significant  
drop at outfall  
of structure**

**Round pipes  
over 3'**



**<100%  
bankfull width  
Not Designed  
and  
Constructed to  
accommodate  
AOP**

**No bank  
margins, low  
flow channel,  
or grade  
controls**

**Structure set  
too high**

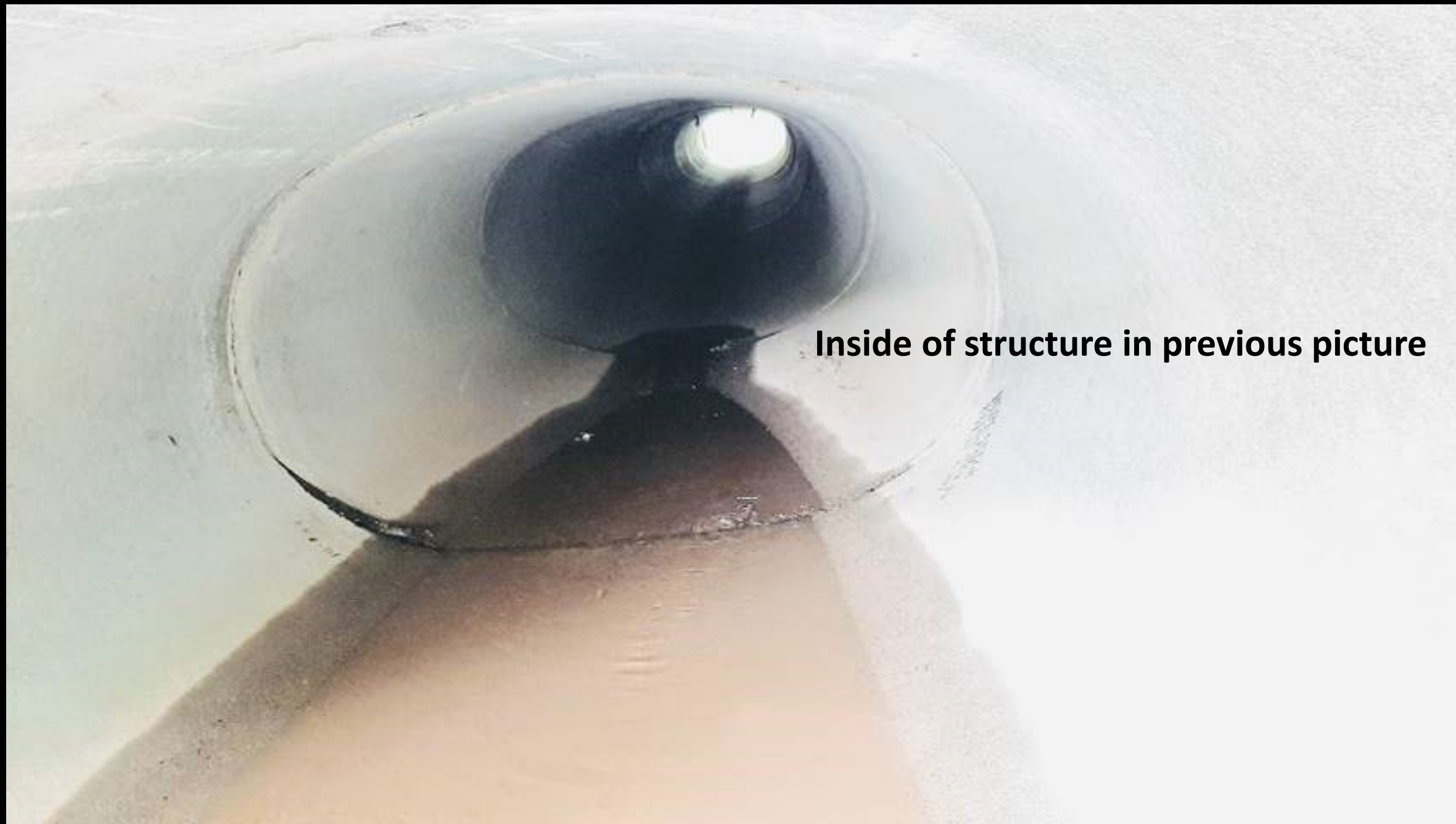


**6' Pipe in 15' bankfull**

**Not designed and constructed to accommodate AOP  
No bank margins, low flow channel, or streambed material**

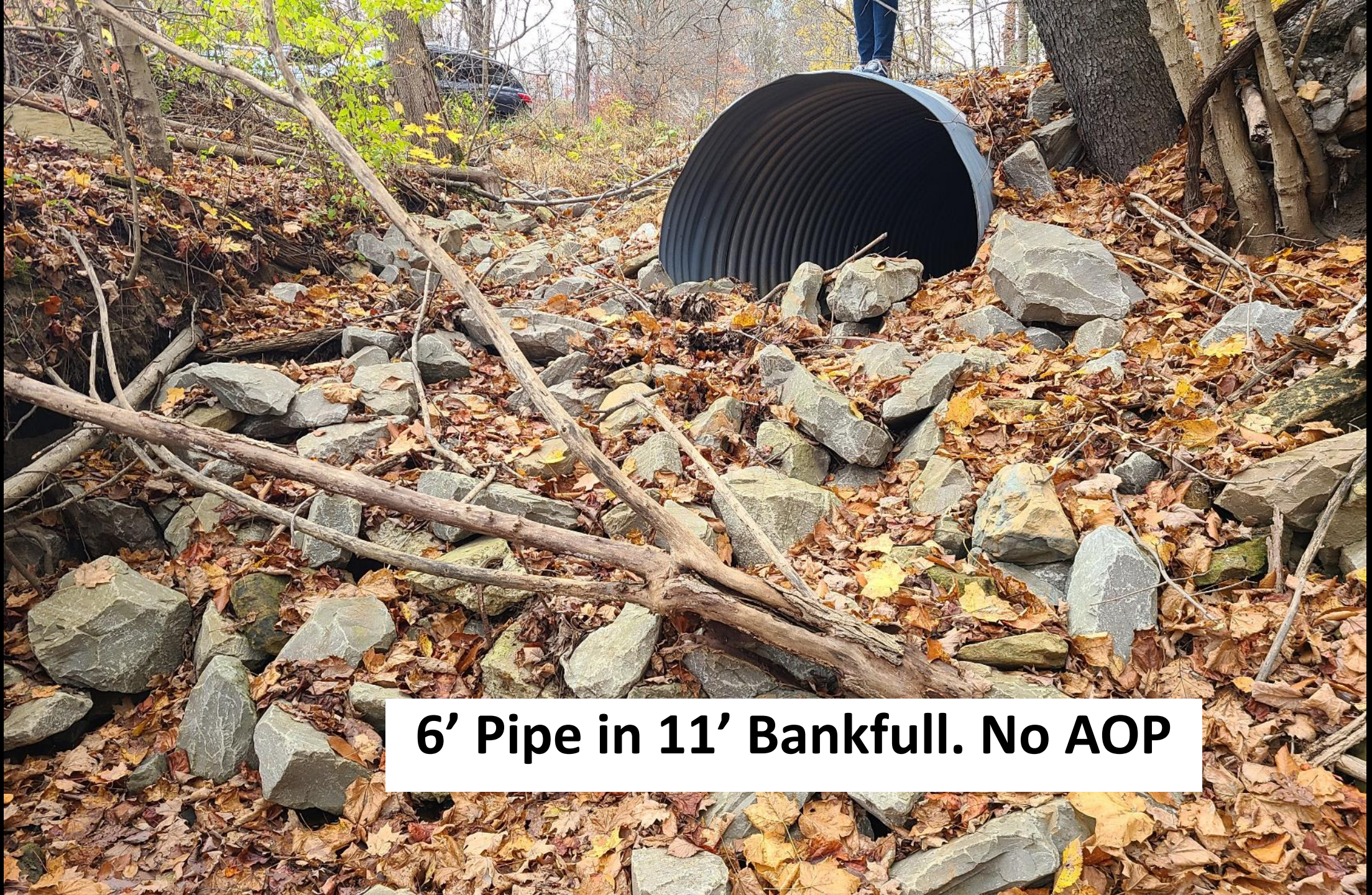






**Inside of structure in previous picture**





**6' Pipe in 11' Bankfull. No AOP**



**Inside of structure in previous picture**





**4' pipe in a 7' bankfull, No AOP**





Structure is under bankfull and lacks AOP





This structure is bankfull width, but lacks AOP





Inside of structure in previous picture





Downstream of structure in previous picture





**This structure is bankfull width, but lacks AOP**

**Shows typical issues with  
low profile arch**





# Bankfull width structure, No AOP

Structure will  
rust much  
faster without  
streambed  
material





# Streambed material is NOT just for AOP





# **Examples of Projects That Meet Expectations, but could use improvement**

**“The In-Between”**



# **Common issues with stream crossings**

- **Lack of bank margins and low flow channels**
- **Structure installed too high or too low**
- **Slope of structure and streambed issues**
- **Depth of streambed material**

**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP**

**-No Bank Margins**

**-No Low Flow Channel**

**-Potential for scour along  
footers**





**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP**

**-No Bank Margins or Low  
Flow Channel can cause  
deposition inside  
structure**

**-Streamflow directed at  
footer**

**Stream flow directed at  
edge of structure.**





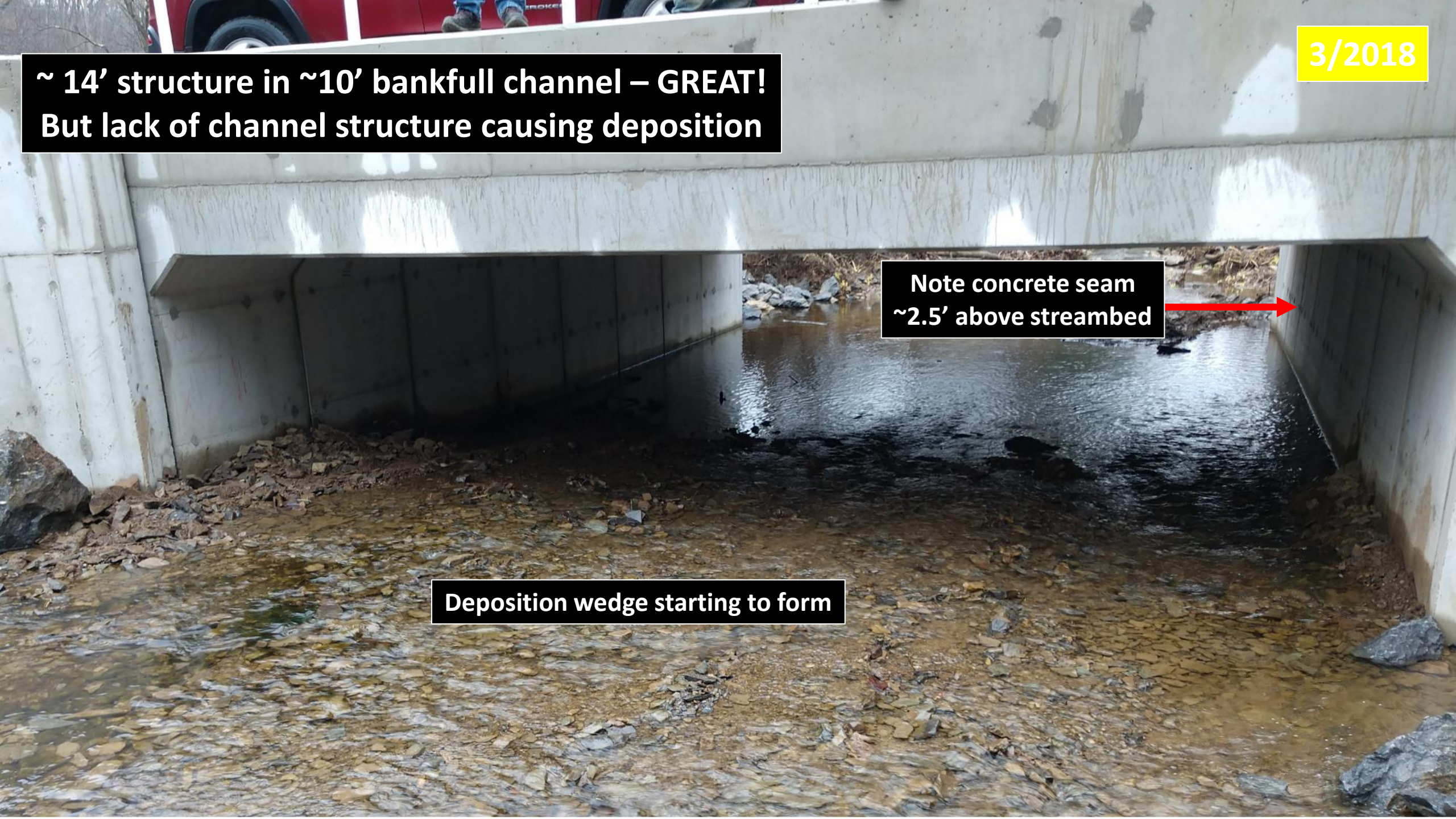
3/2018

**~ 14' structure in ~10' bankfull channel – GREAT!  
But lack of channel structure causing deposition**

**Note concrete seam  
~2.5' above streambed**

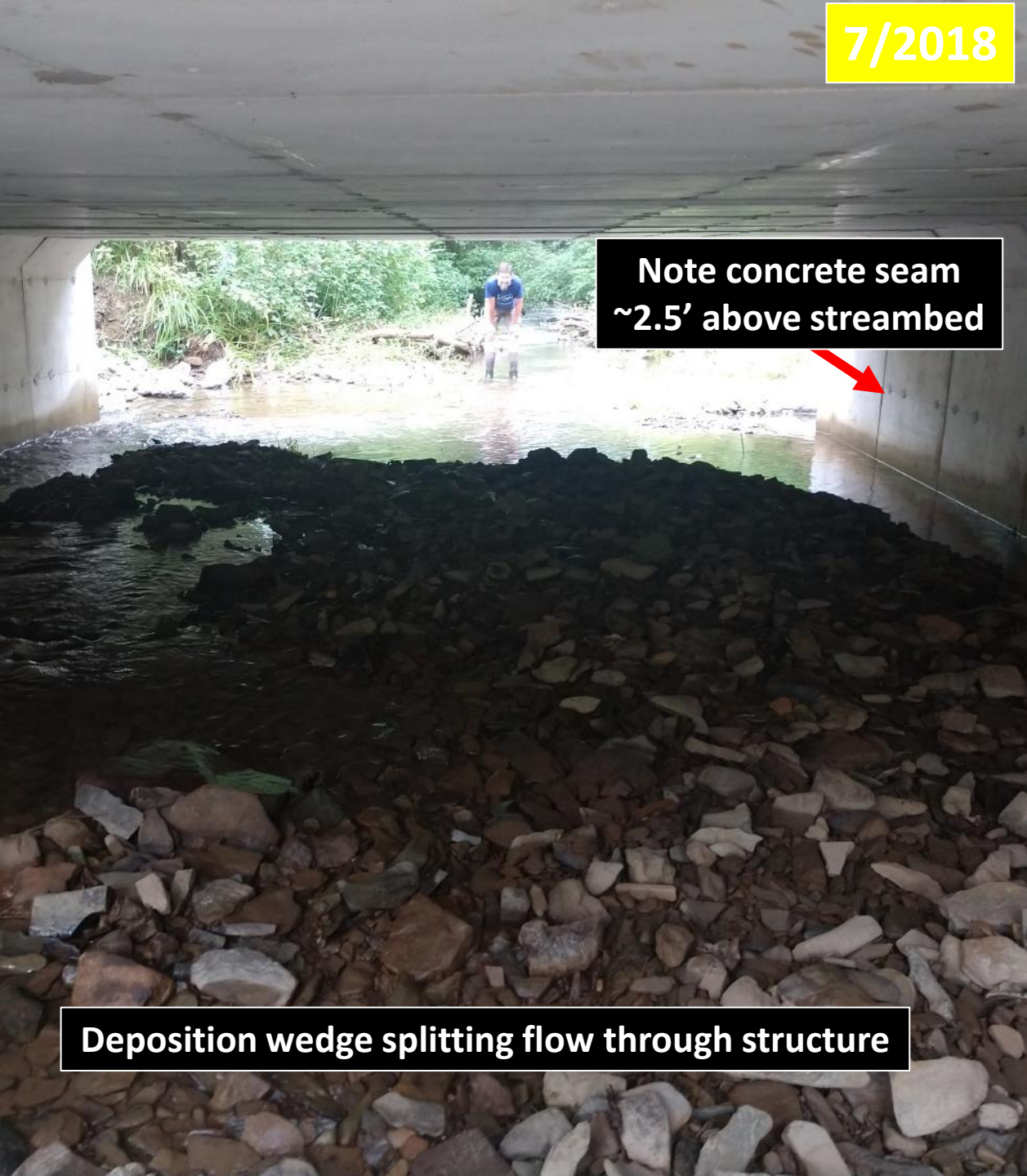


**Deposition wedge starting to form**





7/2018



8/2020





# **Common issues with stream crossings**

- **Lack of bank margins and low flow channels**
- **Structure installed too high or too low**
- **Slope of structure and streambed issues**
- **Depth of streambed material**

**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP**

**-Structure set too deep  
causing stream to neck  
down**



**-Lacks sufficient height  
to pass bedload and  
stormflow**

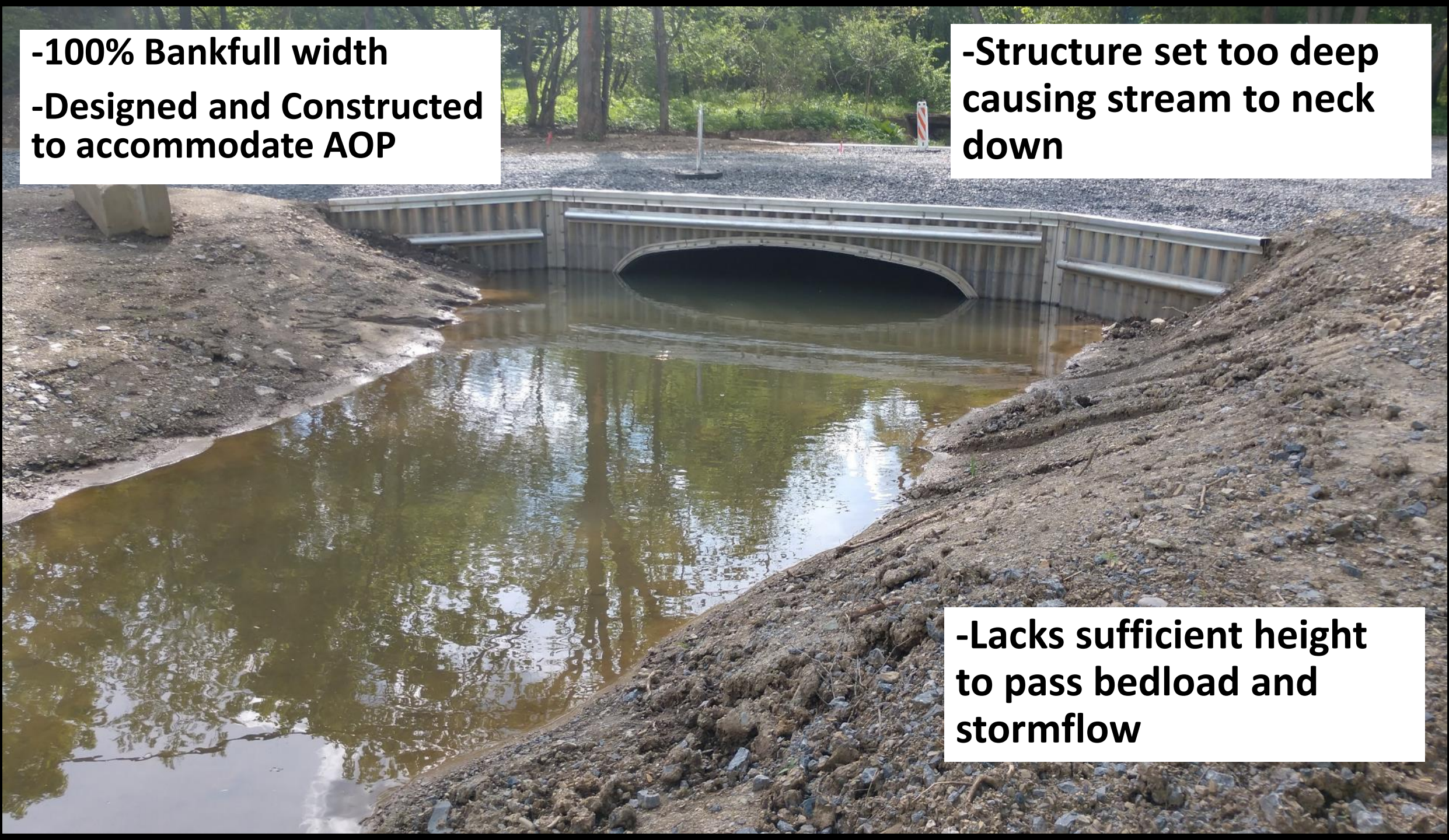


**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP**

**-Structure set too deep  
causing stream to neck  
down**

**-Lacks sufficient height  
to pass bedload and  
stormflow**





**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP??**



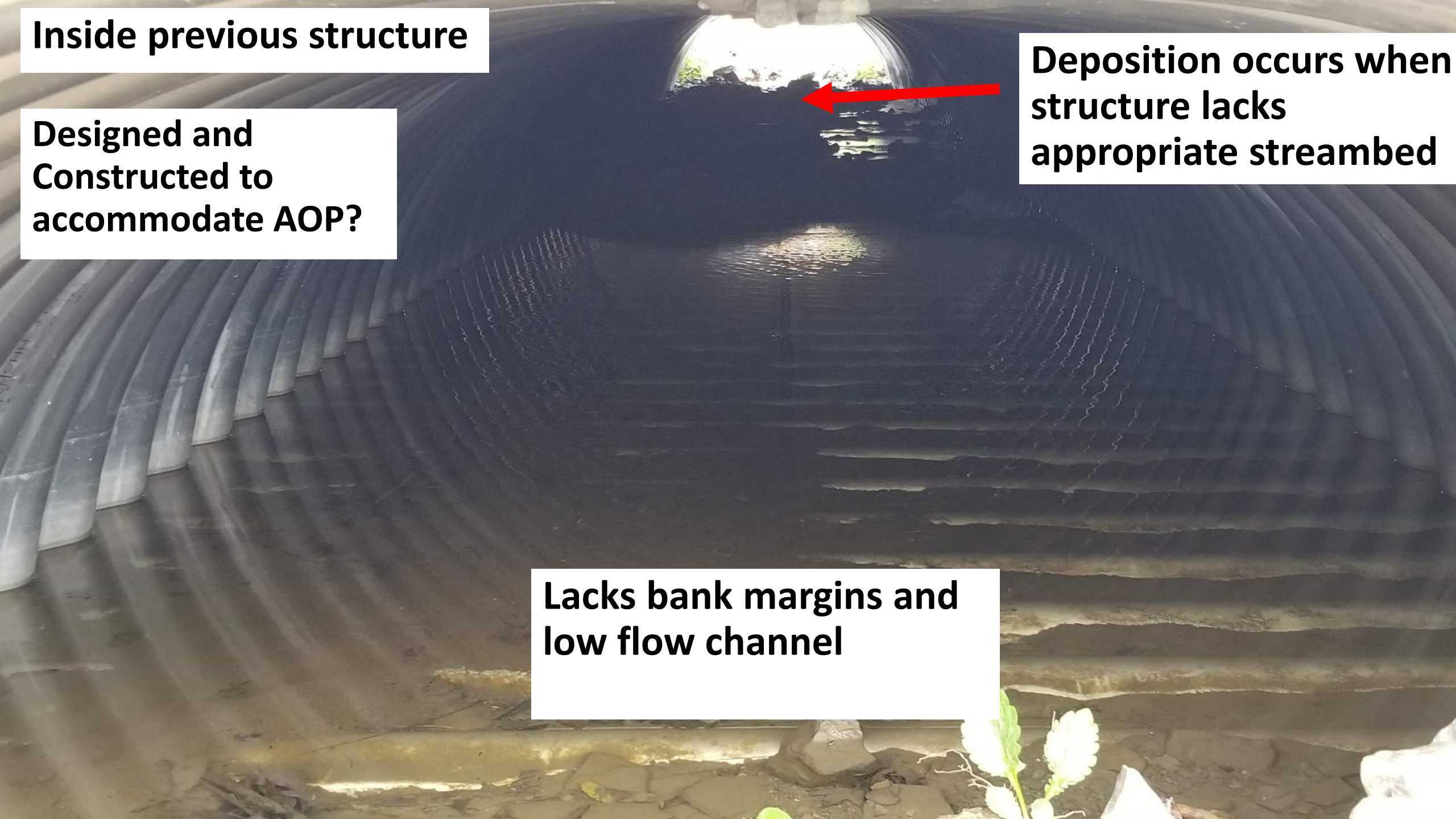


**Inside previous structure**

**Designed and  
Constructed to  
accommodate AOP?**

**Deposition occurs when  
structure lacks  
appropriate streambed**

**Lacks bank margins and  
low flow channel**





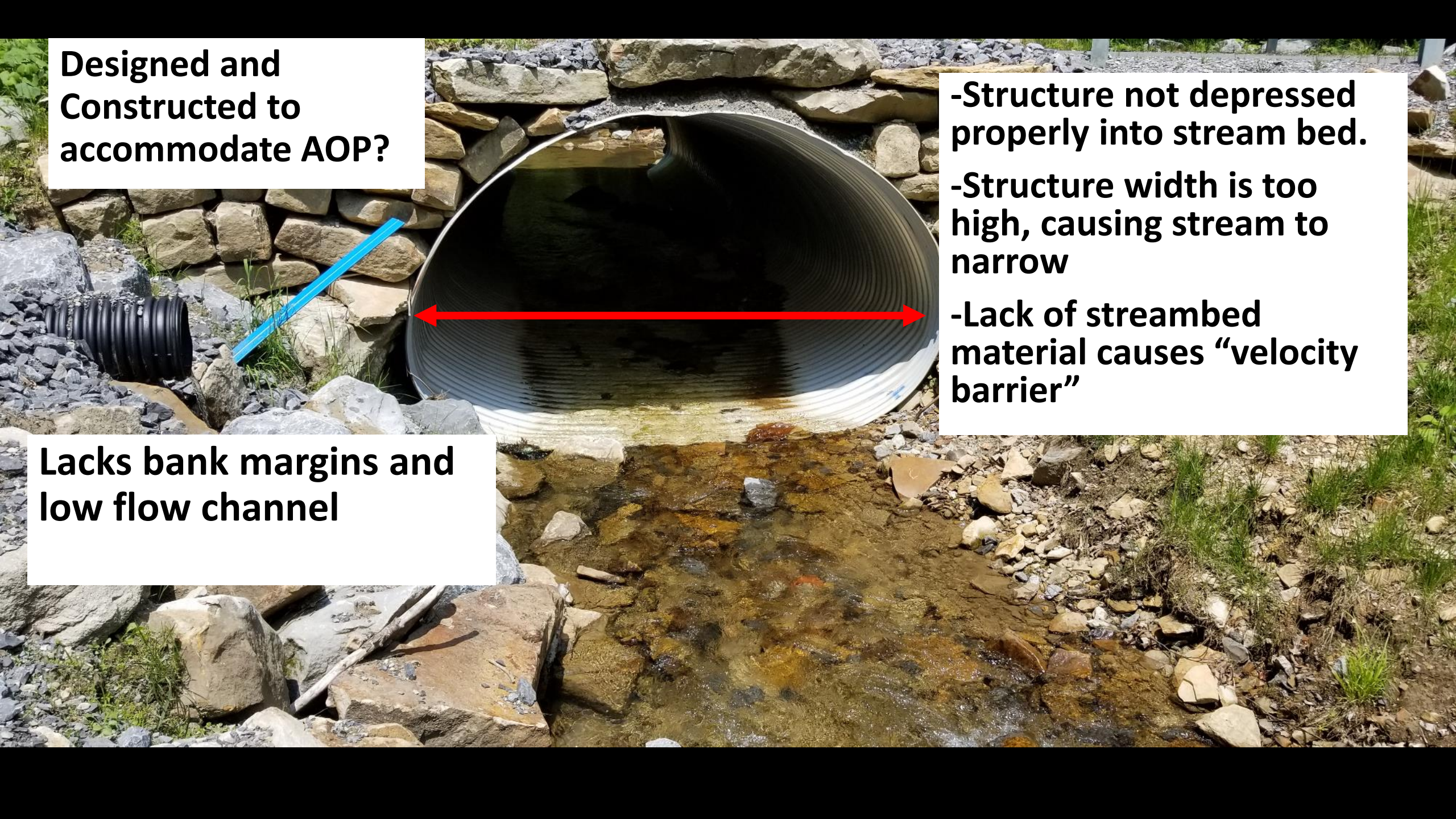
**Designed and  
Constructed to  
accommodate AOP?**

**-Structure not depressed  
properly into stream bed.**

**-Structure width is too  
high, causing stream to  
narrow**

**-Lack of streambed  
material causes “velocity  
barrier”**

**Lacks bank margins and  
low flow channel**







- Structure not depressed properly into stream bed.
- Structure installed too high, causing stream to narrow
- Lack of streambed material causes “velocity barrier”
- Lifespan of crossing that lacks material?





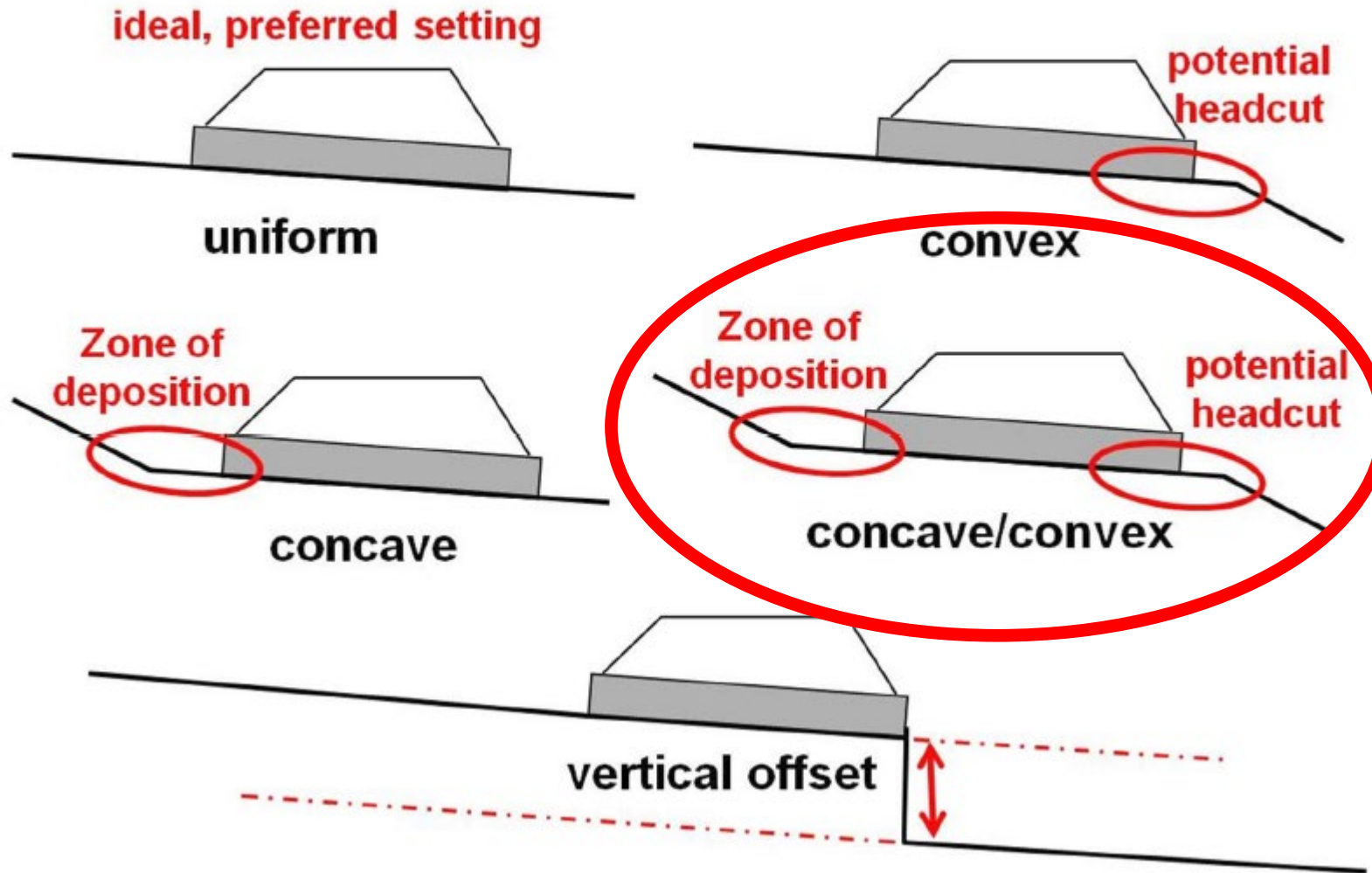


# **Common issues with stream crossings**

- **Lack of bank margins and low flow channels**
- **Structure installed too high or too low**
- **Slope of structure and streambed issues**
- **Depth of streambed material**



# Interpreting Longitudinal Profile Shapes at Road-Stream Crossings: Slope Transitions and Geomorphic Processes





**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP??**



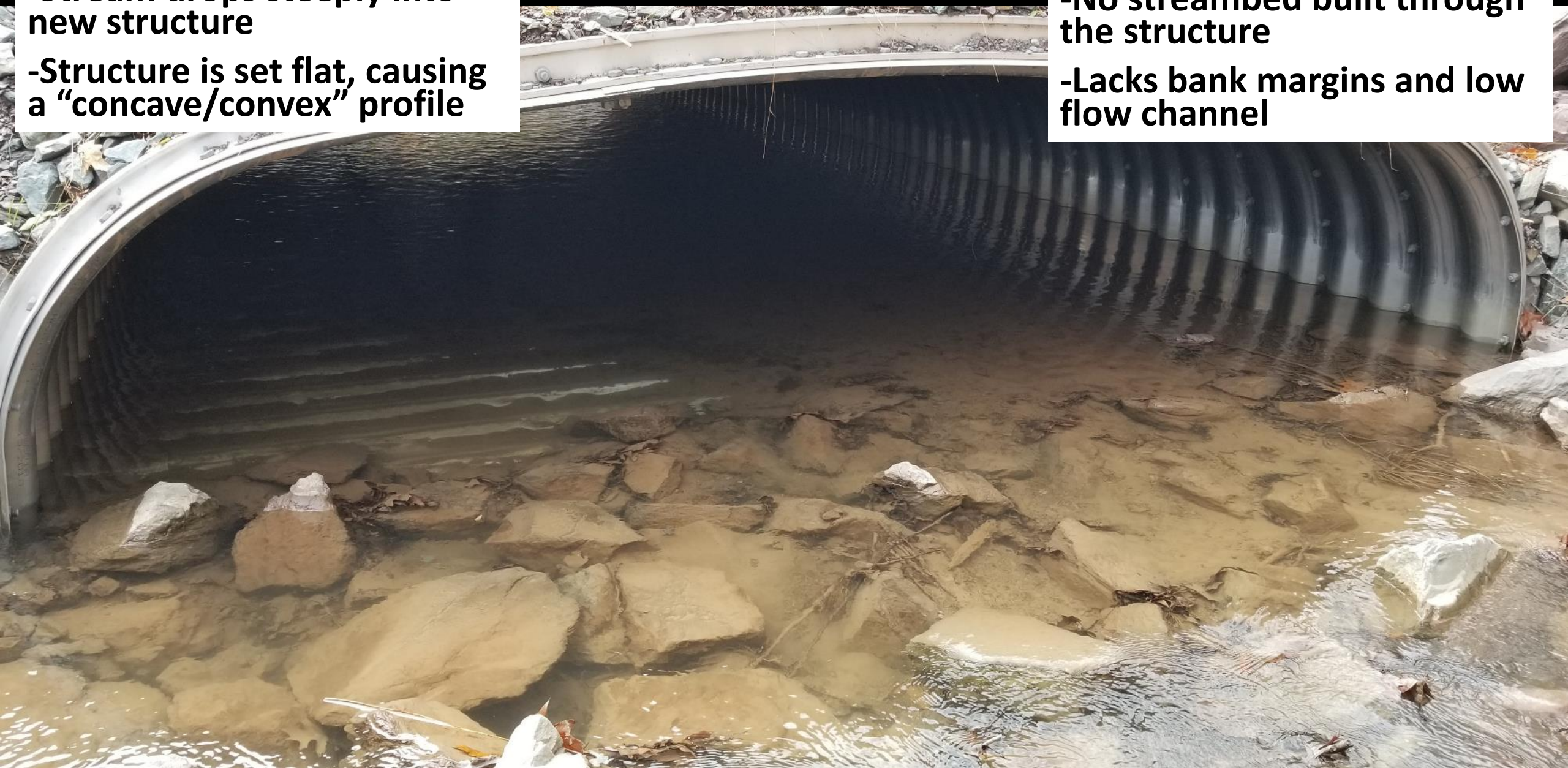


**-Stream drops steeply into  
new structure**

**-Structure is set flat, causing  
a “concave/convex” profile**

**-No streambed built through  
the structure**

**-Lacks bank margins and low  
flow channel**





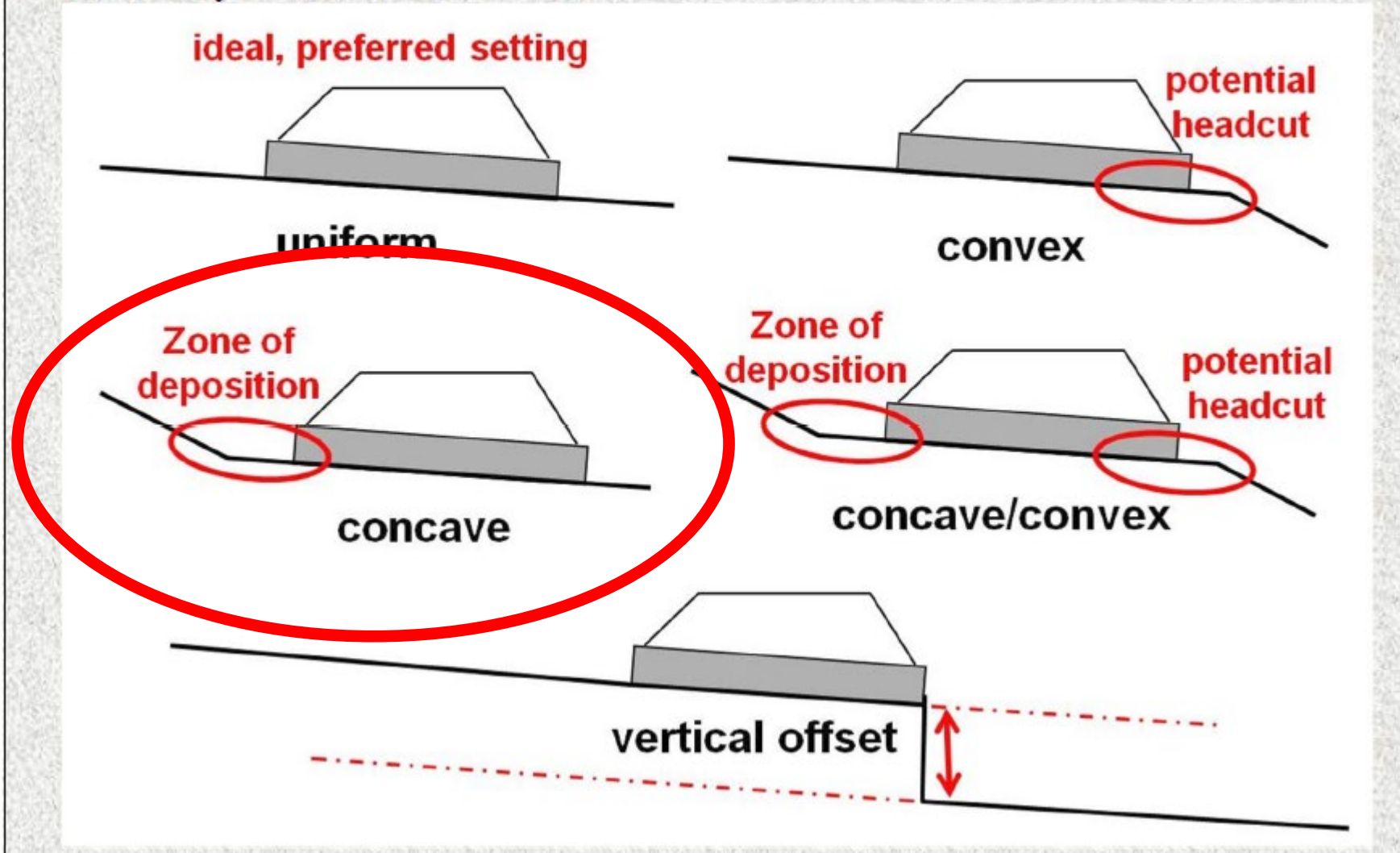


- Stream drops steeply into new structure
- Stream is flat through structure
- Stream drops again leaving the structure
- Structure is set flat, causing a “concave/convex” profile

- No streambed built through the structure
- Lacks bank margins and low flow channel
- AOP barrier downstream
- Potential for head cut



# Interpreting Longitudinal Profile Shapes at Road-Stream Crossings: Slope Transitions and Geomorphic Processes





**- example of a “concave”  
installation**

**-Shows typical deposition  
and split of stream**







- example of a “concave” installation
- Shows typical deposition and split of stream



**-Stream drops steeply into  
new structure**

**-Structure is set flat**





**-100% Bankfull width**

**-Designed and Constructed  
to accommodate AOP??**





# **Common issues with stream crossings**

- **Lack of bank margins and low flow channels**
- **Structure installed too high to too low**
- **Slope of structure and streambed issues**
- **Depth of streambed material**





**-Lacks sufficient streambed material**

**-No bank margins and low flow channels**

**-Scour is greater than depth of streambed material**





**-Lacks sufficient streambed material**

**-No bank margins and low flow channels**

**-Scour is greater than depth of streambed material**



**-Large grade controls like these will cause more scour on the downstream**

**-Lacks sufficient streambed material**  
**-No bank margins and low flow channels**  
**-Scour is greater than depth of streambed material**

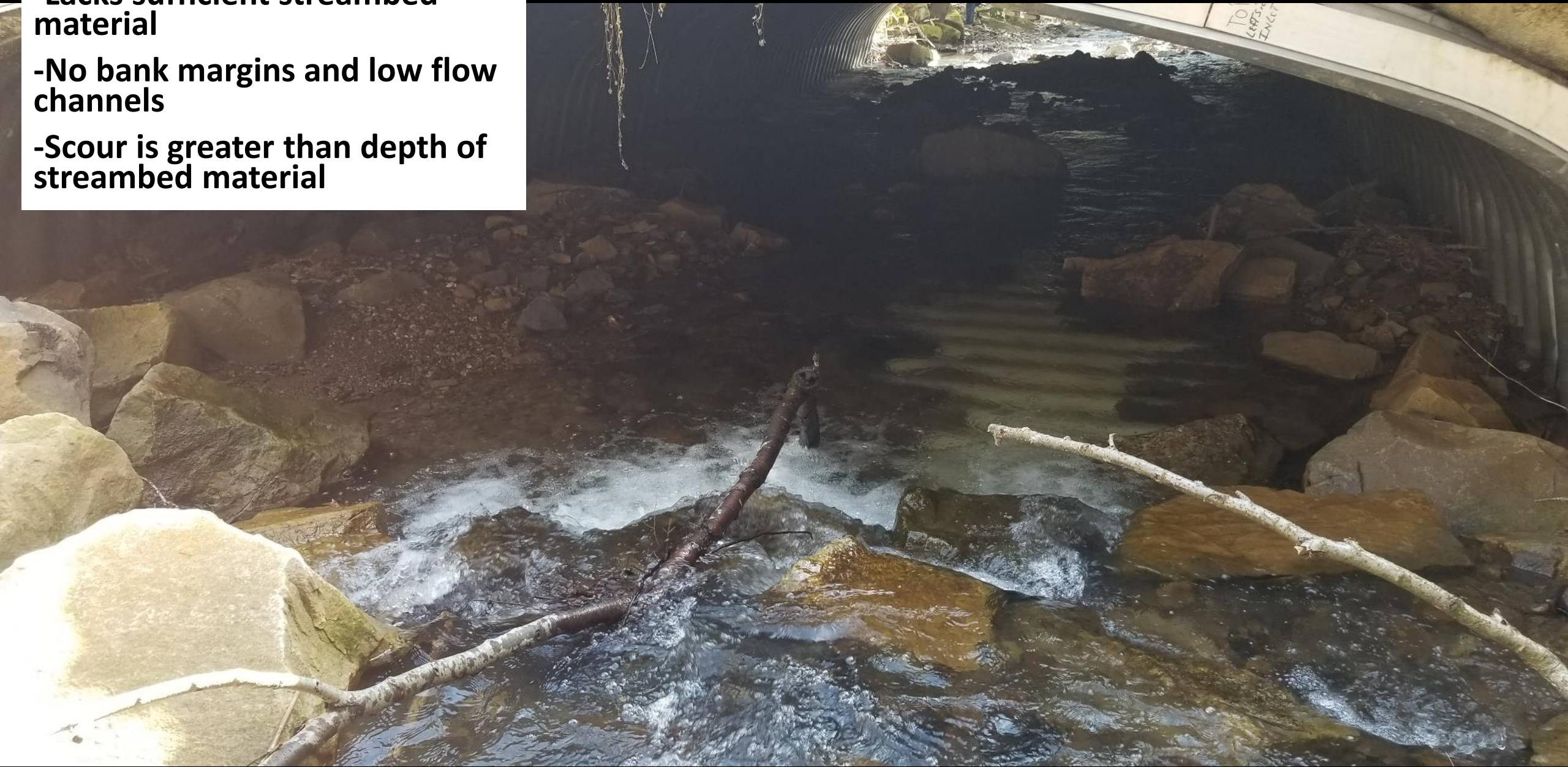




**-Lacks sufficient streambed material**

**-No bank margins and low flow channels**

**-Scour is greater than depth of streambed material**





**-Lacks sufficient streambed material**

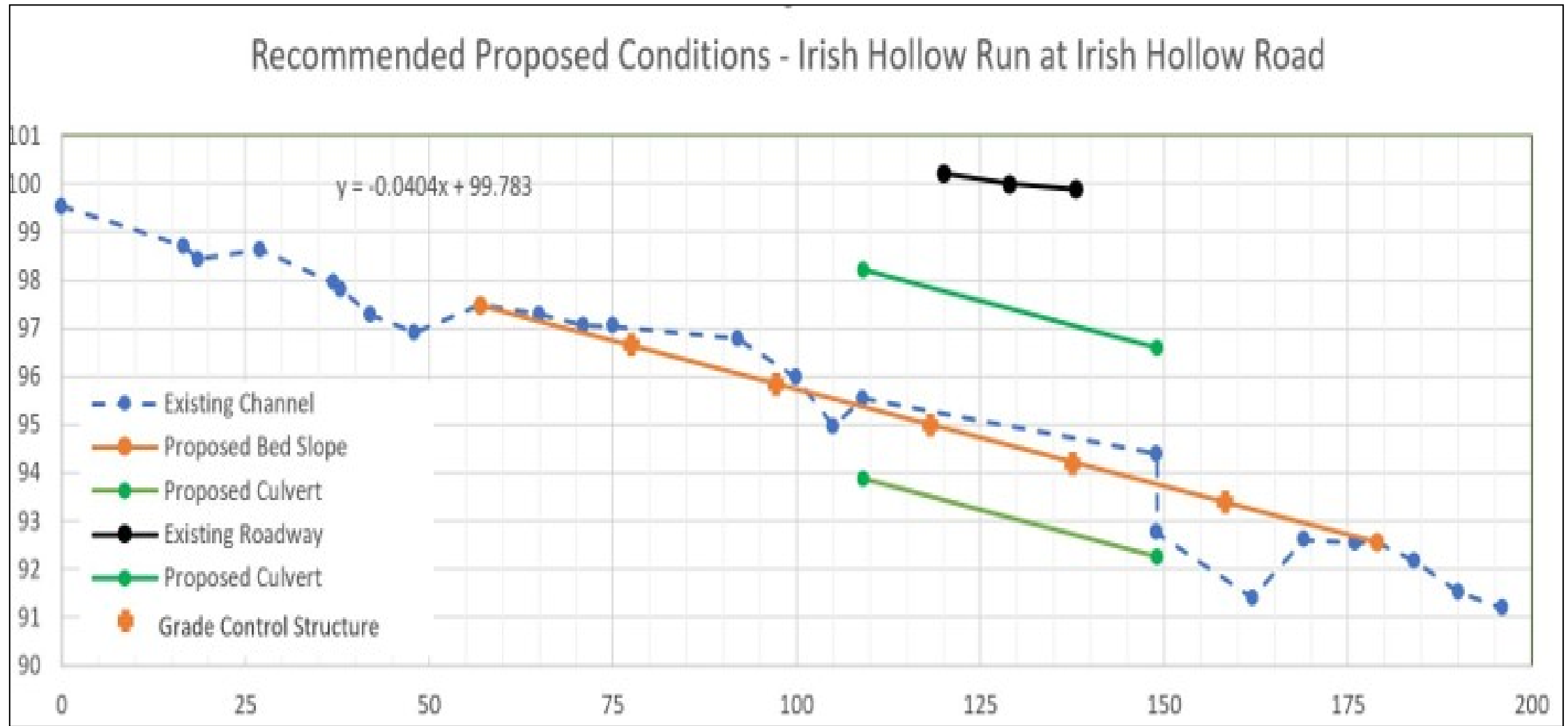
**-No bank margins and low flow channels**

**-Scour is greater than depth of streambed material**





# Example of a longitudinal profile showing new culvert and proposed streambed





# **Lessons we have learned**

- **The Program needs to provide more guidance and better define policy expectations**
- **Stream continuity is the key to ensuring a successful project**
- **100% Bankfull structure is typically not wide enough to construct the crossing properly**
- **100% Bankfull width structure with no material or “AOP” will greatly decrease life span of structure**
- **Long pro’s are very important for stream bed slope continuity**



# **Lessons we have learned**

- **Bury depth is very important and should be determined using a long pro and potential scour**
- **Low profile structures need careful consideration for constructability of streambed within the structure**
- **There is often a cost increase with installing appropriate streambed material that is not planned during the application phase**
- **Projects should give extra consideration to using bottomless structures (where appropriate)**



# Where do we go from here?

- Developing stream crossing technical manual
- Reference guides for engineering services
- Additional training and education opportunities
- Updating policy where appropriate
- The Center's website has about 6 hours of recorded stream crossing boot camp classroom session!