

# Storm Damage – Floating Culverts & Other Inlet Issues

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# What causes a culvert to float?

1. Accumulation of debris at inlet.
2. Water then evacuates the culvert.
3. Water then ponds at the inlet submerging it.
4. Buoyancy force then results, lifting the culvert.
5. Depending on depth of fill, the culvert may pop through the fill, or it may have its end bent upwards.



# Signs to look for

1. Pipe has upwards deformation.
2. Anchor is damaged or gone.
3. Embankment is disturbed.
4. Trail of fill material at outlet.
5. Bottom of pipe may be severely distorted, or suffer other damage.
6. Stream typically has floating debris.



# DEBRIS ACCUMULATION EXAMPLES







**SR 56 Dubois @ RP 54.2**  
**April 2015**

Debris at inlet.



## SR 26 Tippecanoe Co. @ RP 28.10

**March 2012**

Debris accumulation on collector and on top of structures.





## CO Rd 550 E Gibson Co @ Pigeon Creek May 2011

This 60 ft. bridge is immediately upstream of I-69 Bridge and was plugged by debris, mainly branches and corn stalks. A local farmer unplugged it using a tractor with a backhoe attachment.



**CO Rd 550 E Gibson Co @ Pigeon Creek**  
**May 2011**

Note the branches and corn stalks.





**CO Rd 550 E Gibson Co @ Pigeon Creek**  
**May 2011**

Note the corn stalks jammed in between the beams.



## CO Rd 550 E Gibson Co @ Pigeon Creek May 2011

More of the corn stalks and branches in the beams. Note the corn stalks on the bank upstream of the bridge.





**CO Rd 550 E Gibson Co @ Pigeon Creek**  
**May 2011**

Up stream view of the bridge.



**CO Rd 550 E Gibson Co @ Pigeon Creek**  
**May 2011**

Up stream view of the bridge and I-69 bridge down stream.





## CO Rd 550 E Gibson Co @ Pigeon Creek May 2011

Looking N from bridge. Note the stains on the County Road due to overtopping, as well as the corn stalks. Also, note how the I-69 bridge extends far onto the flood plain. Br is > 1,300 ft long.

# Back to the presentation on floating culverts



# **SR-60 July 2006 Clark County**

**11.40 ft x 7.24 ft  
Structural Plate Pipe Arch  
(SPPA)**





**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**  
**7-16-2006**

Items to observe: 1. Culvert bottom was in poor shape prior to event. 2. Note upwards bending of culvert (looking in inlet direction).





**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**

**7-26-2006**

Residual debris in culvert (looking towards inlet)



**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**  
**7-16-2006**

Looking down at culvert inlet from upper limit of embankment disturbance.





**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**  
**7-26-2006**

Disturbed embankment at inlet. Again note the upwards bend of the culvert.



**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**  
**8-4-2006**

Interior bottom damage to culvert near inlet. Again, note the bending of the culvert and debris.





**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**

**8-4-2006**

Culvert bottom damage.



**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**

**7-26-2006**

Flooding impacts, drying out.





**SR-60, Clark Co., July 2006, 11.40 x 7.24 SPPA**

**7-26-2006**

Flooding impacts, drying out.

# A short diversion to discuss multiple pipe issues





## Multiple culvert problems

Note that one culvert tends to become the streams choice, and the other may experience sediment accumulation. And, the one the stream chooses to use, also collects floating debris.





56-19-54.2 7-22-15

## Multiple culvert problems

Accumulating sediment



## Multiple culvert problems

Double culverts with one set higher to avoid sediment accumulation.





## Multiple culvert problems

At the higher culvert outlet sediment and debris accumulation is visible, as well as a tree starting to grow.





## Multiple culvert problems

Double culvert where the stream has shifted and abandoned the other culvert, which now has a ridge of soil with trees growing immediately upstream of the inlet.





159 - 84 27.03 Inlet

## Multiple culvert problems

Close-up of the same culverts showing how water has to be very deep to get into the second culvert.





159 - 84 27.03 Outlet

## Multiple culvert problems

At the outlets it is apparent that the other culvert has been abandoned by the stream.





## Multiple culvert problems

Another view of the outlets further downstream.

# Back to the presentation on floating culverts



# **I-74      June 2008**

## **Putnam County**

**Twin 9.5 ft x 6.0 ft**  
**Structural Plate Pipe Arch**  
**(SPPA)**





## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

**6-18-2008**

Culvert inlets. Closest one was blocked and floated, popping up through the pavement of westbound I-70.





## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-16-2008

East pipe inlet. Note large dent and debris, including a tree.





**I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA**

**6-16-2008**

Dent on eastern side of east culvert inlet.



**I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA**

**6-16-2008**

Dent on western side of east culvert inlet.



## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-18-2008

East pipe, bottom damage, looking towards inlet. Note upwards bend in culvert top.





## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

East pipe, bottom damage, looking towards inlet



## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Looking upstream at inlets. Note debris deposits above culverts. And stream has chosen one culvert and abandoned the other resulting in sediment is collecting in the abandoned one.





## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Temporary patching where culvert popped up through the westbound lane of I-70.





## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Culvert Outlets, east culvert (one that floated) barely visible in the shade. Note the embankment material that was transported through the culvert when it was floated.



## I-70, Putnam Co., June 2008, Twin 9.5 x 6.0 SPPA

6-12-2008

Culvert Outlets, east culvert in shade. I-70 embankment material.

# **SR-26 Event Date Unknown Tippecanoe County**

**Twin 7 ft x 7 ft  
Precast Reinforced Concrete Box**







## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

**Photo taken 2/10/2012**

Culvert inlets with debris collected at deflector and tree lodged between separated sections visible on left. Embankment issues.



## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Culvert inlets with separated section and timber lodged in gap.





## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Culvert inlets with separated section and timber lodged in gap.

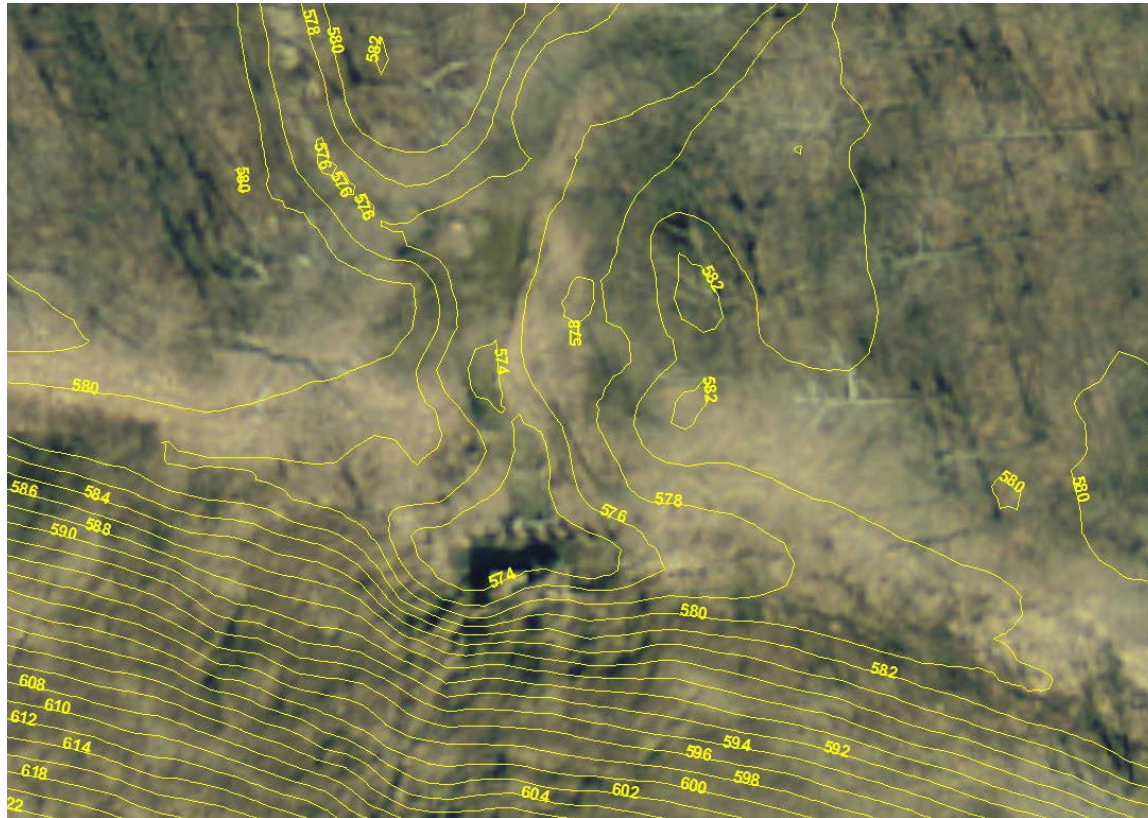




## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs

Photo taken 2/10/2012

Slope sloughing on inlet side. Possibly due to embankment disturbance.



## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs Contours – 2011-13 Indiana Map

Note that the stream is contained and depth at the inlet can easily reach 8 feet.





## SR-26 RP 28.10 Twin 7 ft x 7 ft Precast RCBs Embankment Damage 2005 Aerial Photo

With ponding at inlet due to blockage, rapid drawdown can result.





## **Embankment damage due to rapid drawdown Borman Expressway, 2008**

Ponding in interchange due to clogged levee flapgate.



## **Embankment damage due to rapid drawdown Borman Expressway, 2008**

Ponding in interchange due to clogged levee flapgate.

# **SR-46      Event Date Unknown Brown County**

**8'-2" x 5'-9"**

**Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek**





**Reported to Hydraulics as possibly  
in failure mode due to pipe  
deformation and bottom of culvert  
gone. Anchor was also gone.**

**8'-2" x 5'-9"**

**Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek**





**SR-46 RP 80.14 8'-2" x 5'-9"**

**Photo taken mid-2015**

Culvert inlet, invert gone.



## SR-46 RP 80.14 8'-2" x 5'-9"

Photo taken mid-2015

Culvert inlet, invert gone.





**SR-46 RP 80.14 8'-2" x 5'-9"**

**Photo taken 2-27-2015**

Culvert inlet.

Note that pipe is in good shape, but is bent upwards at the inlet.

# Final Determination

Upwards bend at culvert inlet suggests blockage and buoyancy force occurred in the past.

8'-2" x 5'-9"

Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek



# Final Determination

Sharp edge on missing floor of culvert suggests that it was manually removed.

8'-2" x 5'-9"

Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek





# Final Determination

Both factors suggest event occurred when culvert was new and was structurally sound, especially the bottom which didn't deform as seen in older pipes.

8'-2" x 5'-9"

Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek



# Final Determination

The bottom at the inlet was likely tilted upwards when the culvert was new, the bottom was cut out to allow the creek to flow through.

8'-2" x 5'-9"

Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek



# Final Determination

**Recommendation: pave the invert,  
construct a headwall with wingwalls,  
and protect the outlet from scour  
with riprap.**

**8'-2" x 5'-9"**

**Structural Plate Pipe Arch  
RP 80.14 – Henderson Creek**







**SR-46 RP 80.14 8'-2" x 5'-9"**

**Photo taken 2-27-2015**

Culvert inlet. Note driveway adjacent. Resident said it is difficult to mow around the inlet. A headwall with wingwalls will satisfy backwater requirements, plus make it easier to mow the grass.



**SR-46 RP 80.14 8'-2" x 5'-9"**

**Photo taken 2-27-2015**

Upstream. Garage and basement require no increase in backwater necessitating both a paved invert and headwall.





**SR-46 RP 80.14 8'-2" x 5'-9"**

**Photo taken 2-27-2015**

Downstream. Paved invert will increase outlet velocity requiring riprap to protect channel from scour at the outlet.



# Quiz





## I-70 Morgan Co. RP 55.02 6'-6" x 4'-6" SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.



## I-70 Morgan Co. RP 55.02 6'-6" x 4'-6" SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.





## I-70 Morgan Co. RP 55.02 6'-6" x 4'-6" SPPA

Photo taken 11-10-2015

Damaged inlet. Bottom distorted. Anchor damaged. Embankment disturbed.

# Diagnosis?





## **I-65 RP 27+15**

**Photo taken 3-1-2016**

Bottom distorted. Pipe has upwards bend.





**I-65 RP 27+15**

**Photo taken 3-1-2016**

Bottom distorted. Pipe has upwards bend.

# Diagnosis?





**The End**  
**Any Questions?**