

Real People. Real Solutions.

Beyond The Right-Of-Way: Avoiding Drainage Missteps

Bill Douglass, P.E., Water Resources Group Manager Tony Rotchadl, P.E., Project Engineer December 5, 2017 – AMC Conference St. Cloud, MN

Overview of Presentation

- Typical Culvert Replacements What to look out for
- New Roadway Expansion Considerations
- Culvert Lining Technologies Applications/Pitfalls
- Inter-Agency Coordination Case Study
- Erosion Control at Steep Culverts
- Questions/Discussion

Straightforward Box Culvert Replacement



After Panning Back



Basement Floor, Near 998.0







2017 Estimated Market Value = \$340,0001,200 SF Walkout Basement



Rural Roadway Expansion

Where there no existing roadway, the general drainage patterns are defined by sheet flow, not channelized

Where there are existing roadways, the road profiles are low and have minimal culverts; frequent overtopping, low capacity

Rural Roadway Expansion

Portions of corridor in areas where no roads currently exist 12 major culvert crossings proposed, plus 2 bridges Converts agricultural sheet flow to concentrated flow crossing the roadway

Culvert Example

186 acre drainage area Existing 18" pipe, roadway at 1018.9 feet

Q100 = 690 cfs Overtops Existing Roadway by 1'

Culvert Inundation Limits

24" RCP vs 48" RCP Roadway above 24" elevation Ponding limits similar for 24" or 48" Culvert Size DURATION of ponding largely influenced

K Flow Rates Impounded by Roadway Embankr

Impacts to Peak Discharge



Flooding Duration is Critical



Roadway Expansion Takeaways

- Consider ponding limits AND durations during culvert analysis for possible easement acquisition
- Converting sheet flow (existing) to point source (proposed culvert apron) may require additional coordination downstream (grassed swales, easements, etc.)

Culvert Replacement on County Ditch



Considerations

- ade Raise at low point
- rvey adjacent farmstead shed floors AND sement openings
- jacent Farmstead: B2B 0-yr Analysis
- unty Ditch System eration only (no increase in draulic capacity without gering county ditch oceedings)
- place culvert at legal ditch



Culvert Lining – C.I.P.P. or Slip Lining?



C.I.P.P. or Slip Lining?

- ner option serves roadway design ameters
- lining increases headwater elevations, ndating more cropland
- lining increases flood durations nificantly for large and small events
- P.P. liner chosen to minimize flood ation, flood stage increases
- oding location 1.5 miles outside of right-of-
- badway detour is planned, open cut lacement of large culverts is more cost active



Inter-Agency Coordination Beyond the ROW



- Partners:
 - Roadway agency
 - MnDNR
 - Railroad
 - Downstream landowner

Roadway Agency

- vo-lane expansion of roadway
- II into DNR protected water
- Il over existing lake outlet ructure
- gnificant DNR permitting quired
- mit future exposure of DNR awdown operations to adway agency



MnDNR Permit Requirements

- Provide DNR with the ability to draw down the lake for fish management
- Protect oak trees adjacent to construction
- Provide saturated buffer outlets at adjacent stormwater treatment BMPS



Railroad Permit Requirements

- Jack and auger 36" RC @ 0.2% under railroad and existing roadway
- No disturbance of failing RR inslope
- Accommodate drainage in railroad and roadway ditch
- Fill and abandon existing pipe



Downstream Landowner

- Previously constructed private containment berm to manage lake outflows across ag. field
- Existing containment berm expanded and key elevations maintained
- Lake outlet structure designed to provide no change for storm events
- Lake drawdown is a new (changed) condition!



Lake Drawdown

- IR required 4' drawdown of lake
- fs maximum drawdown flow = 45 y +/- drawdown duration
- ntainment berm breached during awdown, requiring overland flow alysis (2D)
- gotiations ongoing regarding sement size and/or tile upsizing
- sign and coordination for right-ofy design was the easy part!



Limiting Downstream Velocities



Tumbling Ring Alternative

- Benefits to roadway corridor (maintenance)
- Benefits to receiving waters (sediment)
- Tumbling rings should be considered if site conditions are right



Why Tumbling Rings?

- e in steep culverts with extreme ocities (very erosive when > 16 fps)
- sipates energy within culvert for nonsive outlet velocities (V< 12 fps)
- f-the-shelf" technology
- sy installation
- nventional riprap stilling basin will uire additional R/W in most cases
- orap basins require ongoing intenance on sites where access is a allenge



Tumbling Ring Performance





Tumbling Ring Performance





Conclusions

- Drainage related issues are manifested after rainfall events, sometimes well after project completion. It's too late!
- Drainage considerations often affect ROW needs
- Identify key drainage considerations early in project development when ROW acquisition is being considered.
- Always look beyond the Right-Of-Way. Looking at the planning stage can save money and headaches later!

Questions???

- Thanks!
- Presenter Contact Information:
 - Bill Douglass, P.E. 507-625-4171 (<u>billdo@bolton-menk.com</u>)
 - Tony Rotchadl, P.E., 507-625-4171 (<u>tonyro@bolton-menk.com</u>)