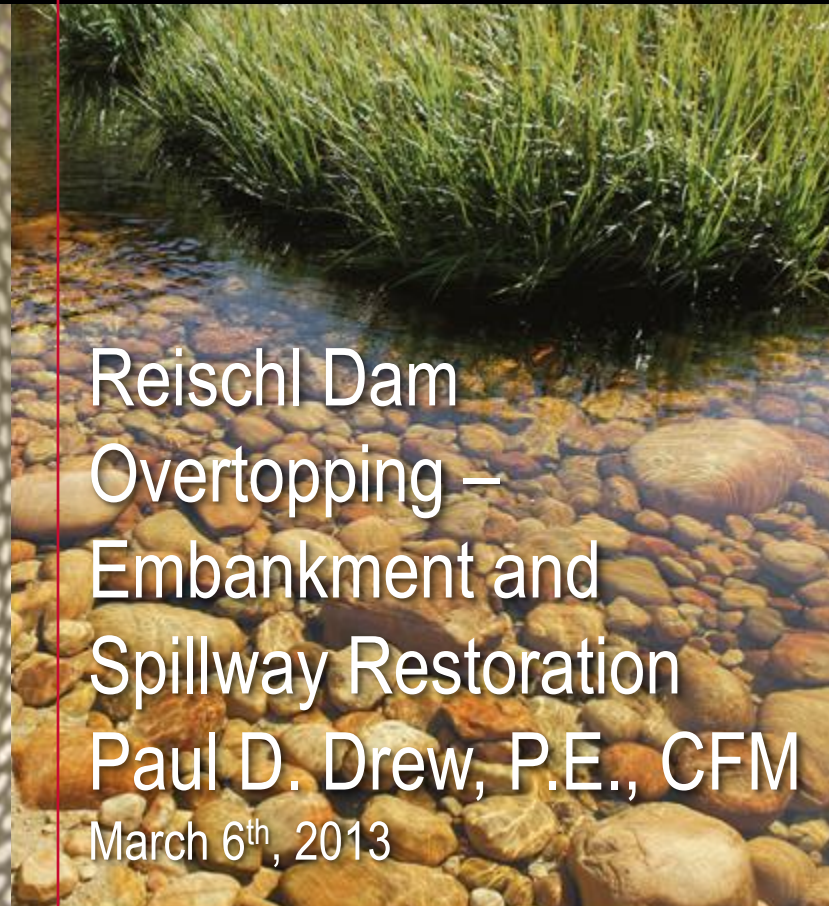
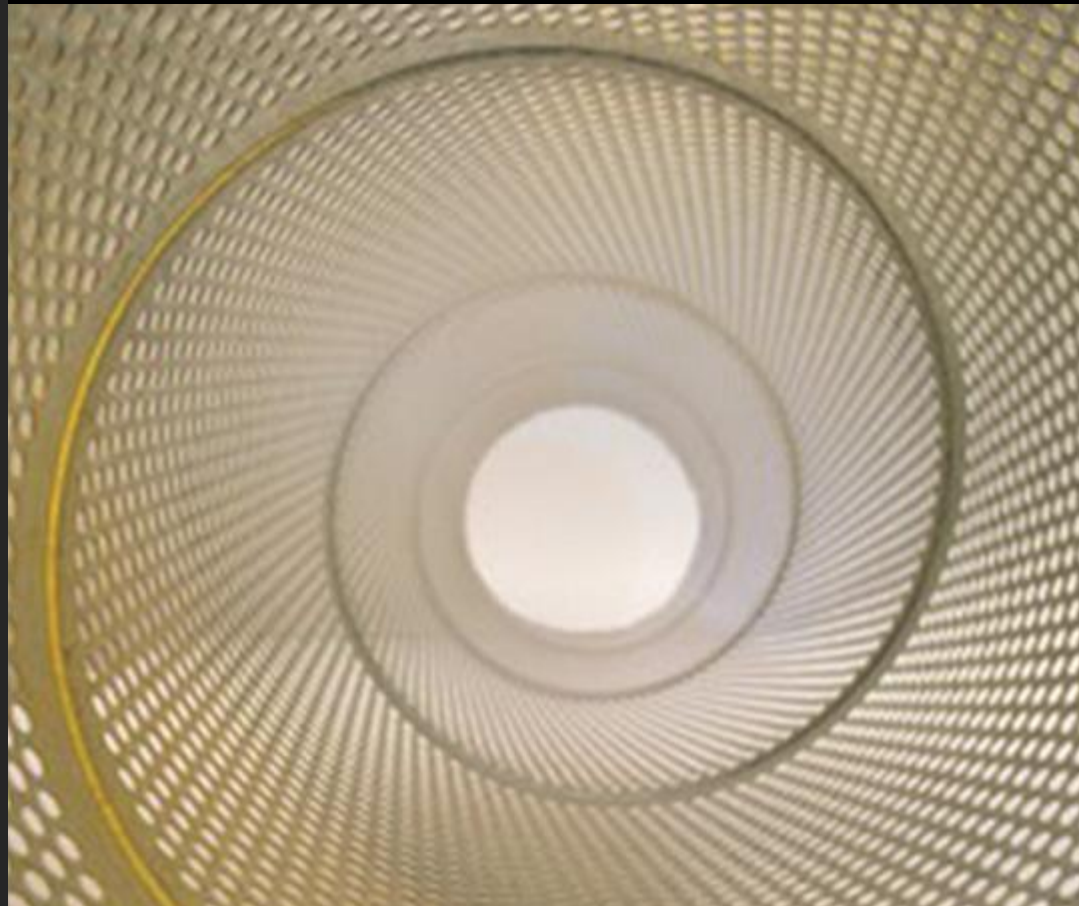


# consulting engineers and scientists

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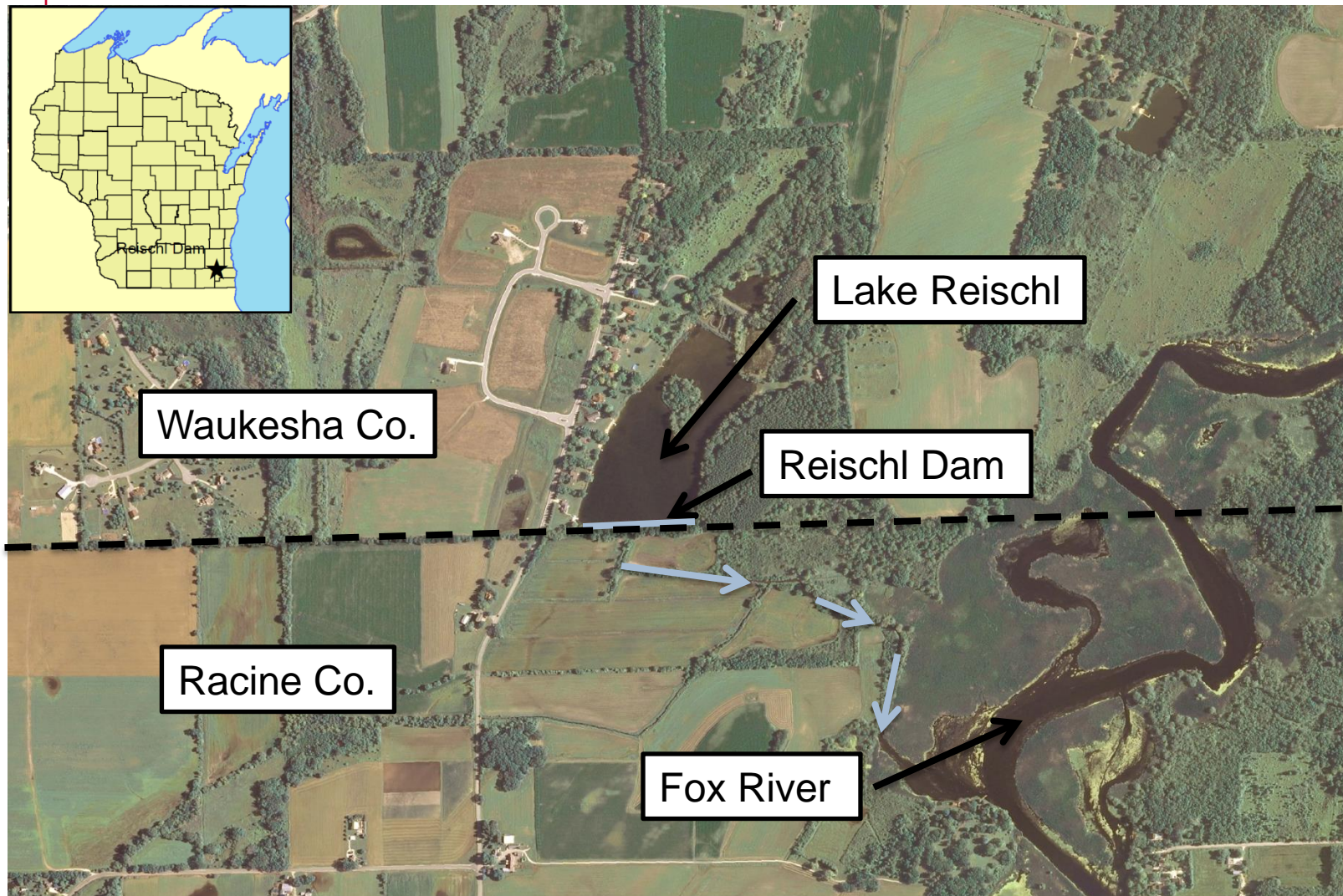


Reischl Dam  
Overtopping –  
Embankment and  
Spillway Restoration  
Paul D. Drew, P.E., CFM  
March 6<sup>th</sup>, 2013

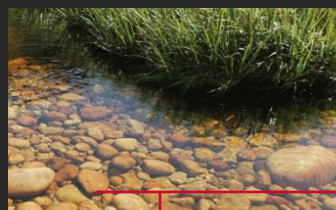




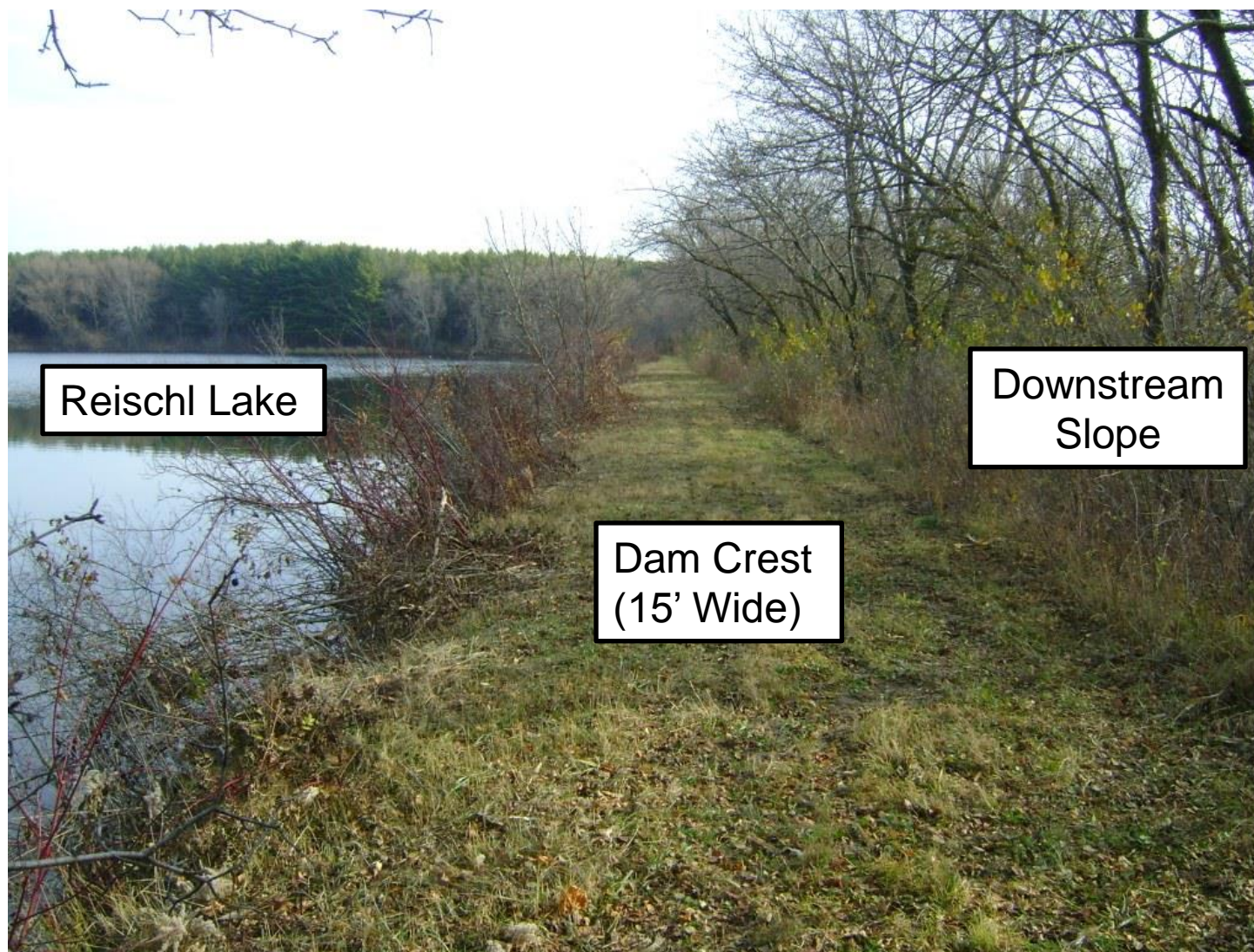
# Project Location







# Reischl Dam – October 2012





# Dam Description

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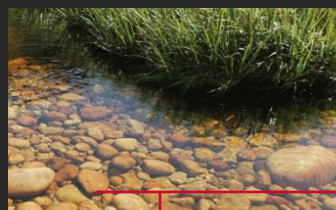
- Dam Type: 1,000 LF Earthen Embankment
- Location: Town of Vernon, Waukesha Co.
- Structural Height of Dam: 14.5 feet
- WDNR Classification: Large Dam
- Spillway: 12" drop inlet
- Hazard Rating: Low
  - Minimum Principal Spillway Capacity for  $Q_{10}$
  - Minimum Total Spillway Capacity for  $Q_{100}$
- Owned and Operated by: Norris Adolescent Center



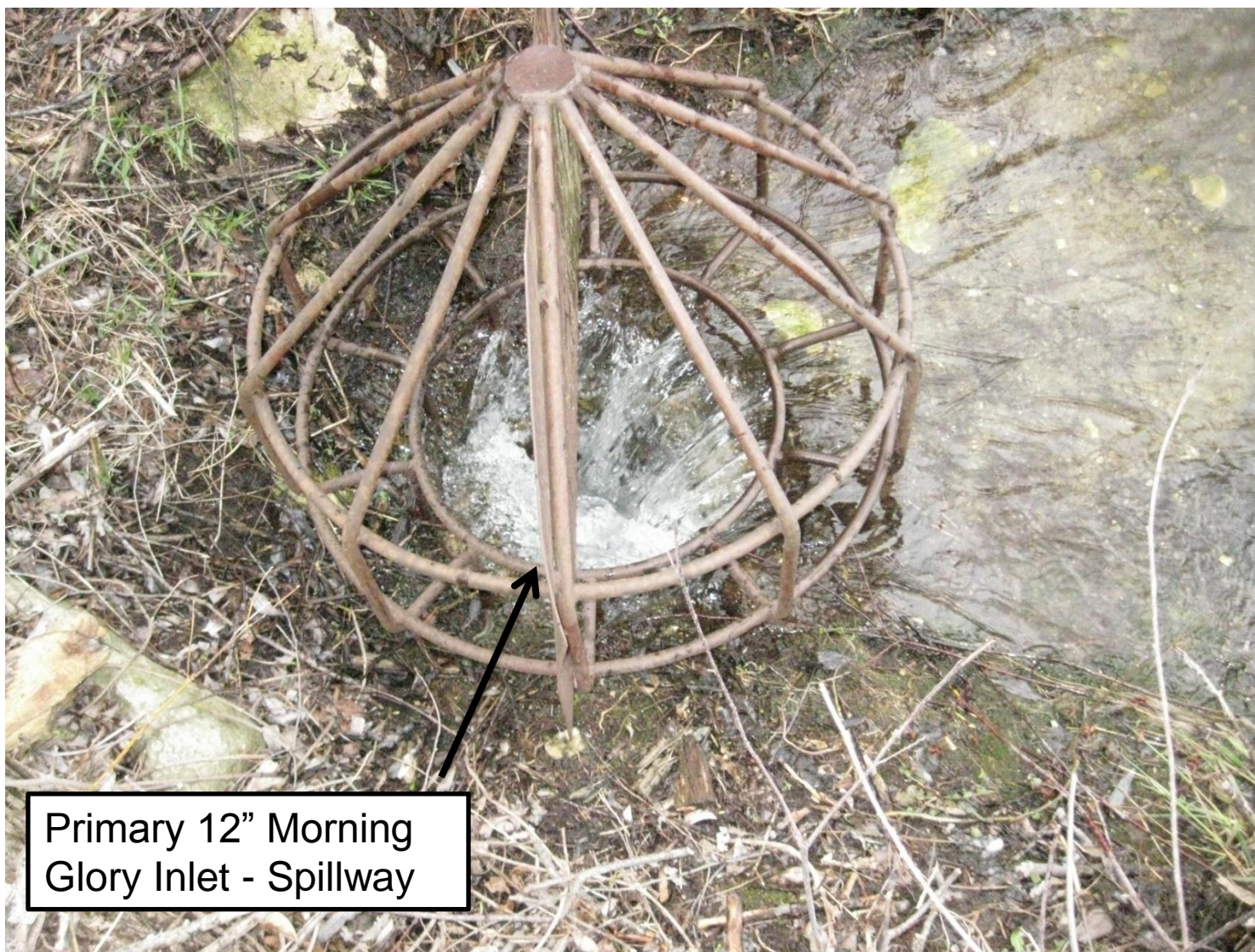
# Project Purpose

- Wisconsin Department of Natural Resources (WDNR) performed site inspection.
- Identified the following **actions**:
  - **Hire consultant to inspect condition of dam**
  - **Prepare Interim Emergency Action Plan (EAP)**
  - **Prepare Inspection, Operation and Maintenance Plan (IOM)**
  - **Prepare a Dam Failure Analysis (DFA)**



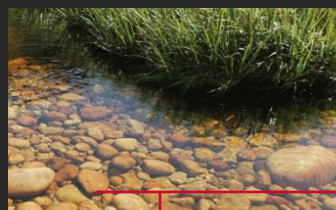


# Existing Spillway



Primary 12" Morning  
Glory Inlet - Spillway



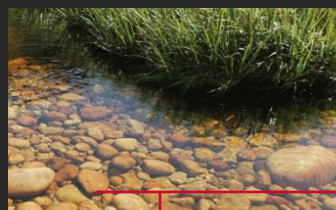


# Existing Spillway

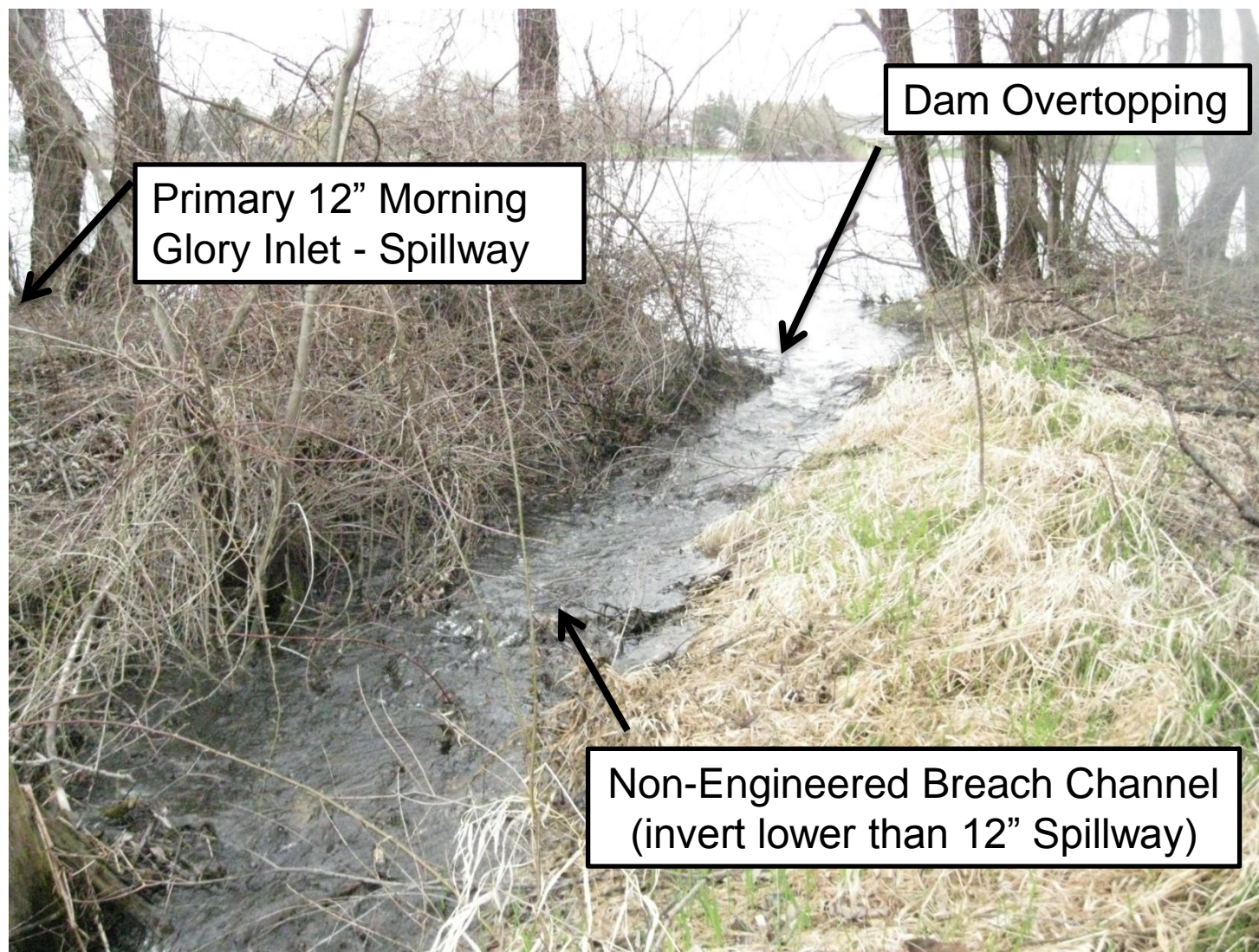


Corroded Drop Inlet CMP

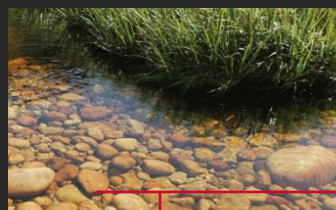




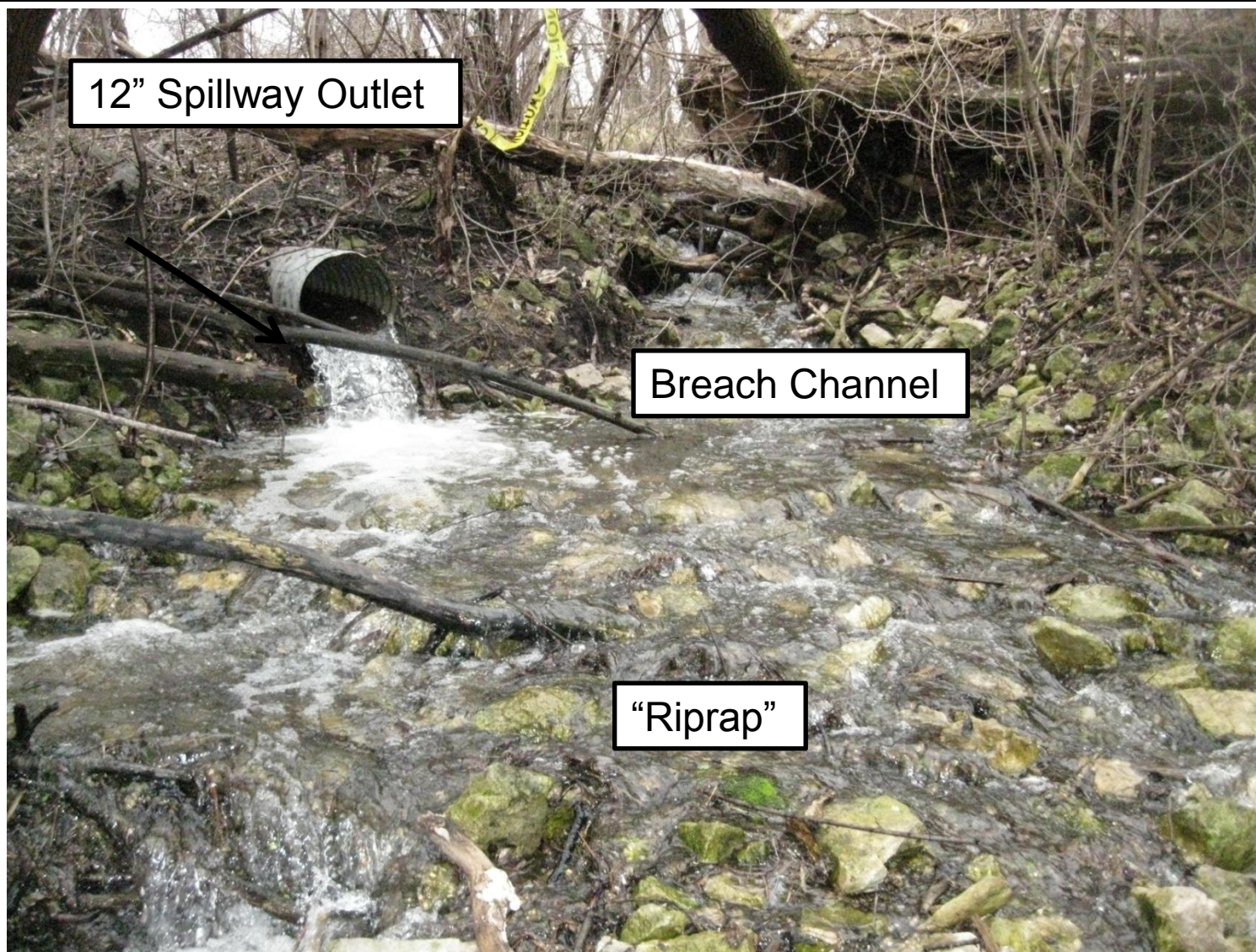
# Existing Spillway



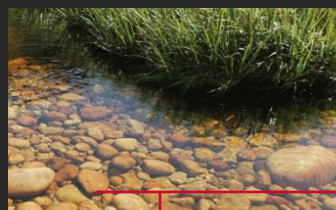




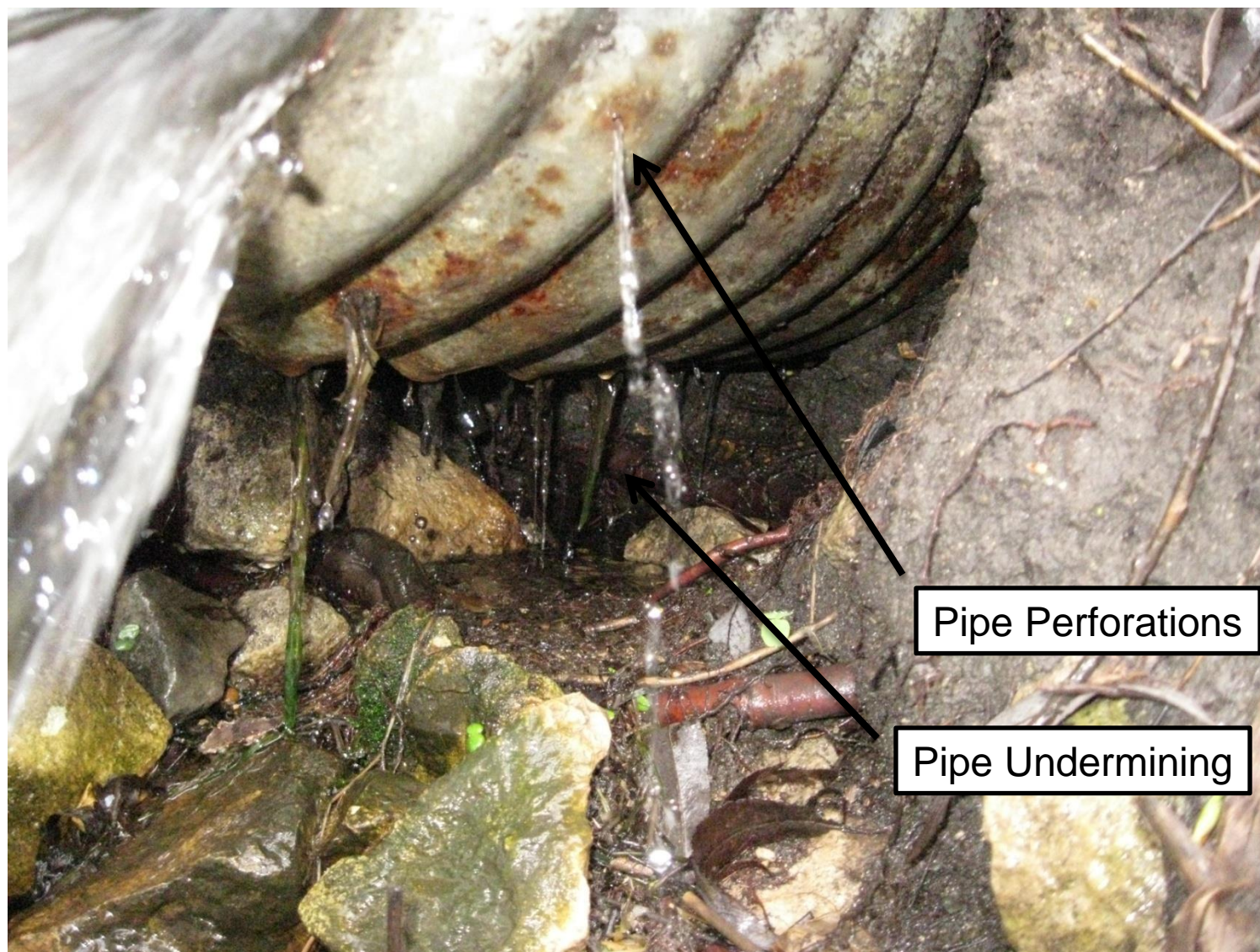
# Existing Spillway Outlet



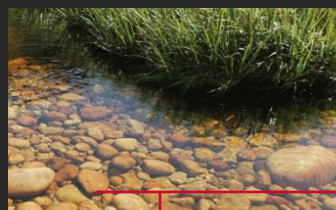




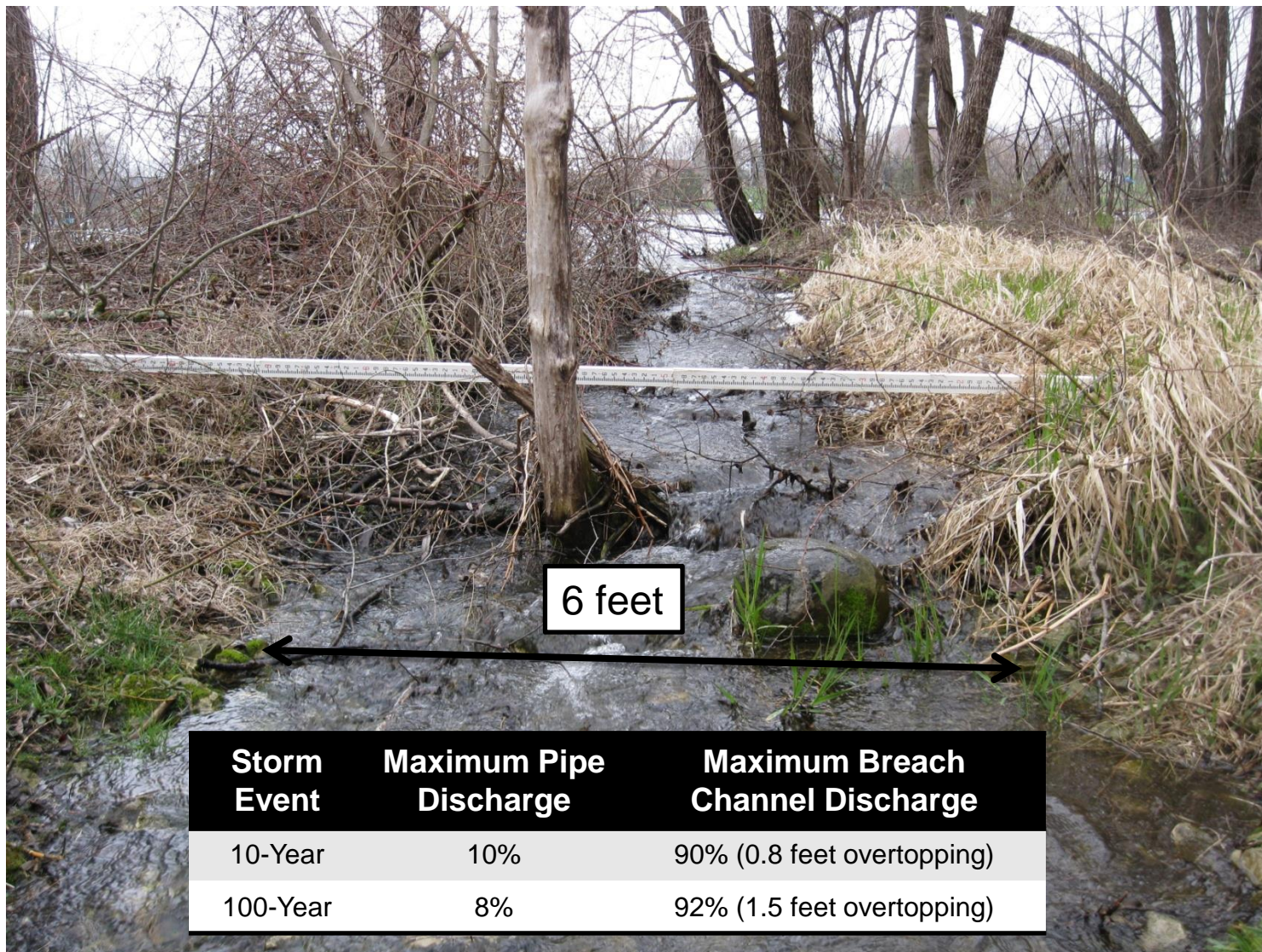
# Existing Spillway Outlet





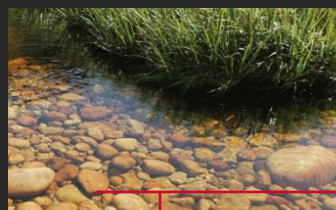


# Breach Channel

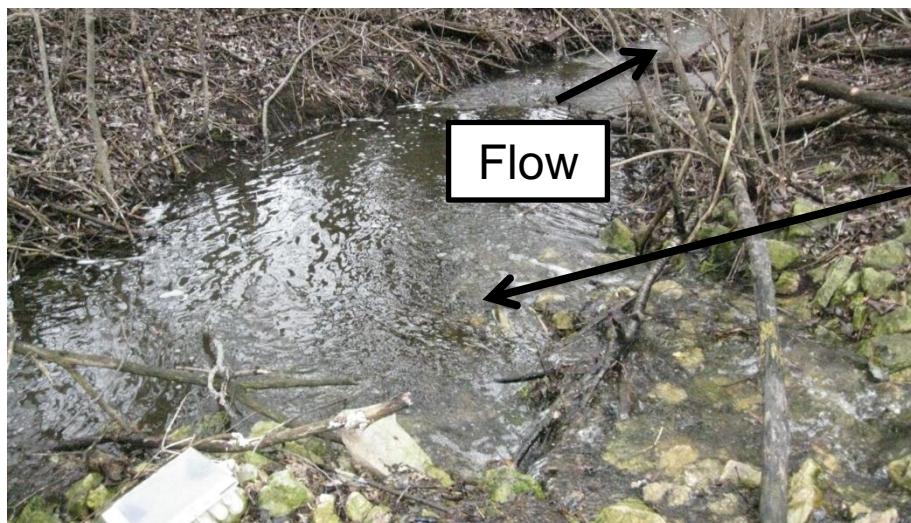


Storm Event	Maximum Pipe Discharge	Maximum Breach Channel Discharge
10-Year	10%	90% (0.8 feet overtopping)
100-Year	8%	92% (1.5 feet overtopping)



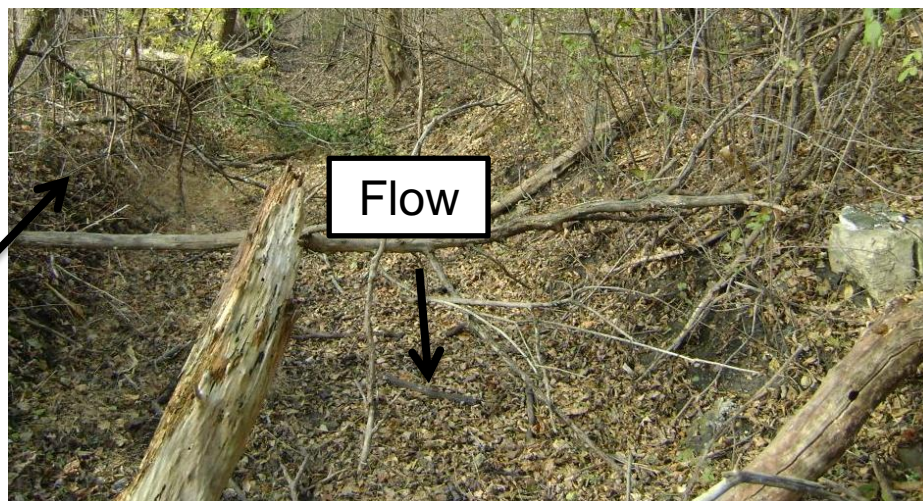


# Existing Spillway Outlet



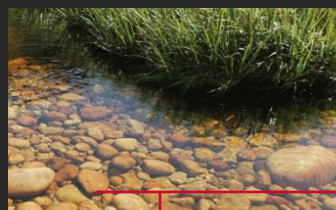
Downstream of Outlet

Embankment Toe



Toe of Dam





# Existing Embankment



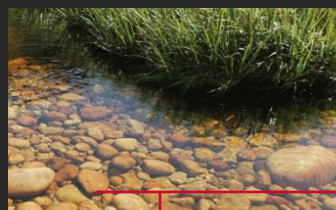
- Embankment covered with trees and woody vegetation
- No ground cover
- Steep Slopes (1.5:1 max, 2:1 min.)
- Non-Engineered Channel at toe of embankment



# Summary of Deficiencies

- Phase I inspection of the dam
- Summary Dam Deficiencies from 2011 GEI Inspection:
  - **Existing Spillway undersized** / corroded and dam is currently **overtopping** through non-engineered breach channel.
  - **Trees and vegetation** cover dam crest and downstream slope. Trees can lead to seepage and piping issues / progressive slope failure.
  - **Steep downstream slopes** with no ground cover. (Does not meet WDNR stability requirements)





# GEI Recommendations

- Summary of GEI Recommendations / Design:
  - **Remove Trees** and Woody brush on embankment
  - **Remove Existing Spillway and construct new spillway** in accordance with WDNR Dam Safety Regulations. Move spillway to center of dam embankment inline with downstream tributary
  - **Raise left embankment** to prevent overtopping and provide freeboard during normal pool conditions and 100 year flood events.
  - **Re-grade the downstream** slope with stable slopes per WDNR stability criteria. Re-establish ground cover.



# Permitting

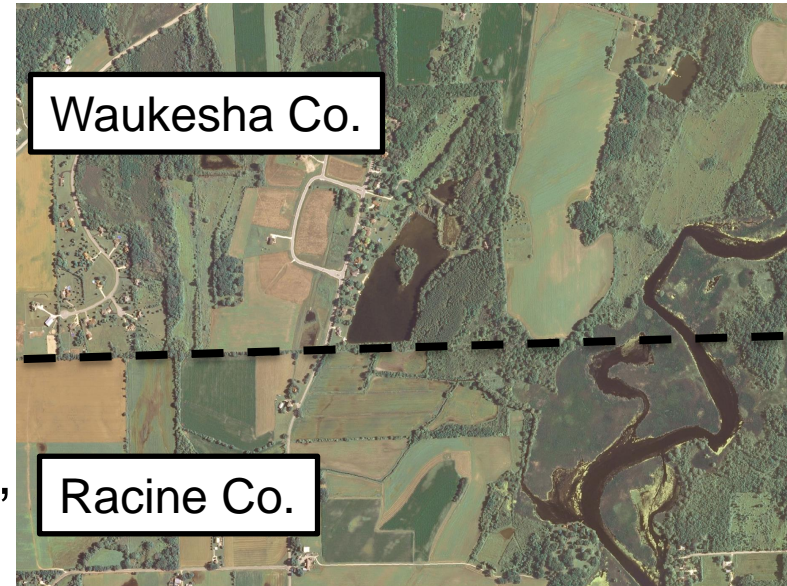
- WDNR / USACE Permitting:
  - All rehabilitation work was designed in accordance with the requirements of NR 333.05 and NR 333.07.
  - **NR 333.05:** Hydraulic, Hydrologic and Stability Analyses
  - **NR 333.07:** Hydraulic design and safety requirements
  - **NR 333 Chapter 140 & 116.07:** Dam Failure Analysis and Inundation Mapping
  - **Submitted May 2012, Approved June 2012**





# Permitting

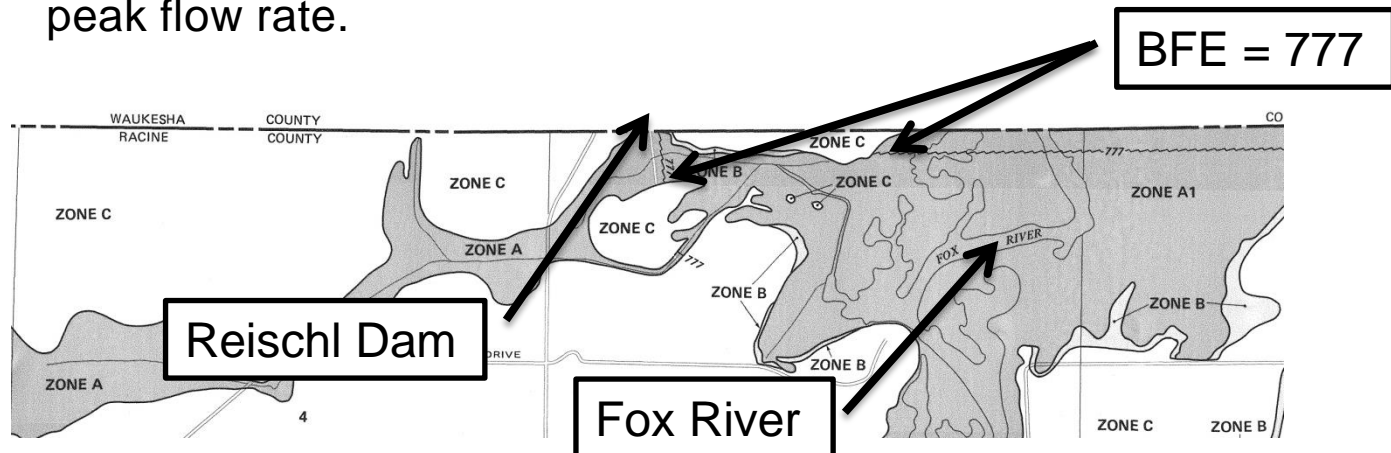
- Waukesha / Racine County:
  - Waukesha County
    - Floodplain Development
    - Conditional Use (Building Permit)
    - “No Downstream Impacts”
  - Racine County
    - Zoning of DFA
    - Adopt “Low Hazard” Classification



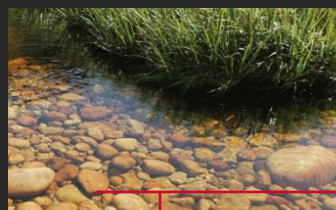


# Permitting – Conflicting Regulations?

- Waukesha County's Focus: "Downstream Impact"
  - Increase in Regional Flood Flows
  - Increase in non-flood flows
  - Increase Base Flood Elevation
- WDNR Focus: Dam Safety
  - Increase Existing Spillway Capacity to **Safely** pass at least  $Q_{100}$
  - Increase in Spillway Capacity creates negligible rise because of Tailwater from Fox River
  - No residences or buildings would be inundated during existing and proposed condition
  - Operating Lake at same normal WL, same volume of flow, but at higher peak flow rate.







# Permitting

- Ways to achieve “No Downstream Impact” as defined by Waukesha County:
  - Replace Spillway in Kind (**Does not Meet WDNR Dam Safety Regulations**)
  - Increase Storage Capacity of Lake (**Would have to flood the property of Shoreline residents**)
  - Operate the Lake at a lower elevation (**Shoreline Residents, Town, WDNR objected**)
  - Remove the DAM.



# Permitting

- Solution
  - Waukesha County:
    - Agreed that the Dam needed to be restored and not removed.
    - Safety concerns of Dam are primary
  - Racine County
    - Didn't want to be downstream of a non-compliant Dam.
    - Rather mitigate “downstream impacts” than potential dam failure.
  - 4 Month Permitting Process





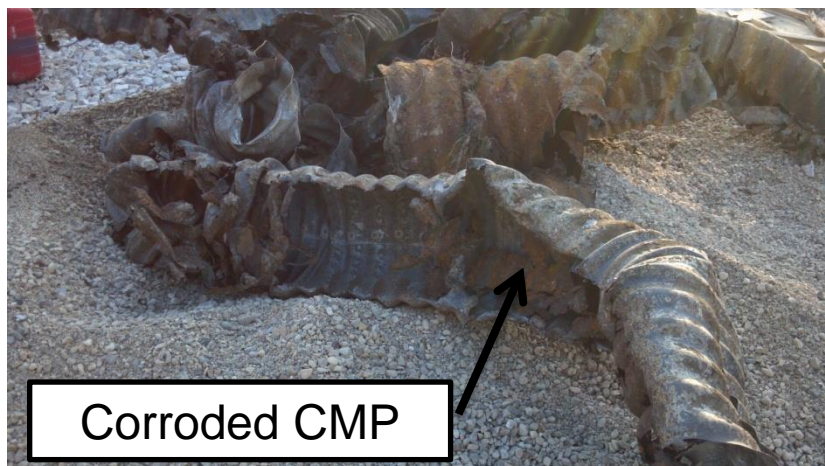
# Embankment and Spillway Restoration



- Removed Tree Cover and woody brush along 1,000 feet of embankment.
- Stripped 4-6 inches of existing topsoil.
- Tree removal / clearing completed in 2 days.



# Embankment and Spillway Restoration

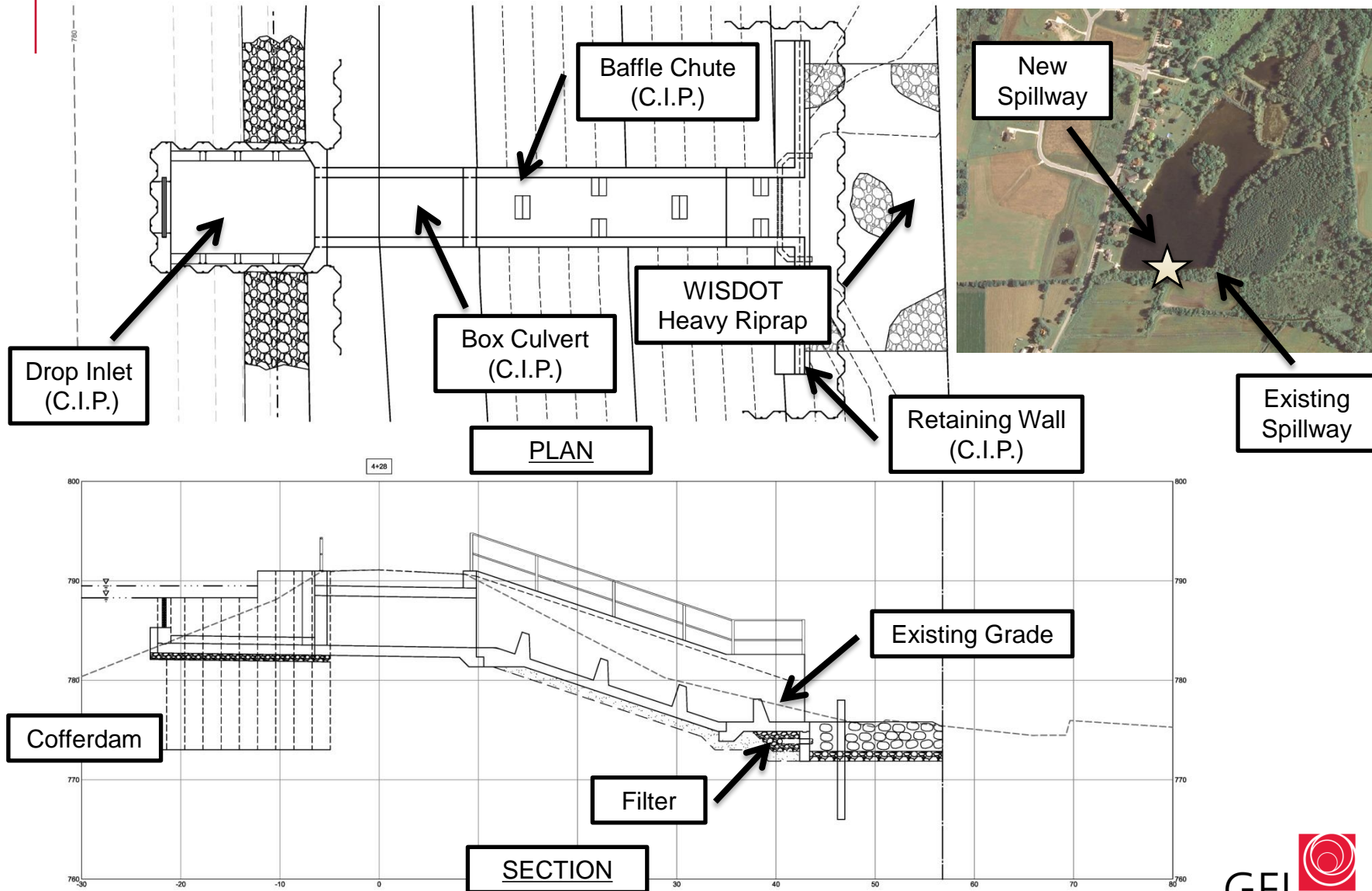


- Removed Corroded CMP
- No lake drawdown was required because of low lake level from dry 2012.
- Existing breach channel to be used as emergency drawdown channel if needed during construction.
- Channel stayed dry during duration of construction.



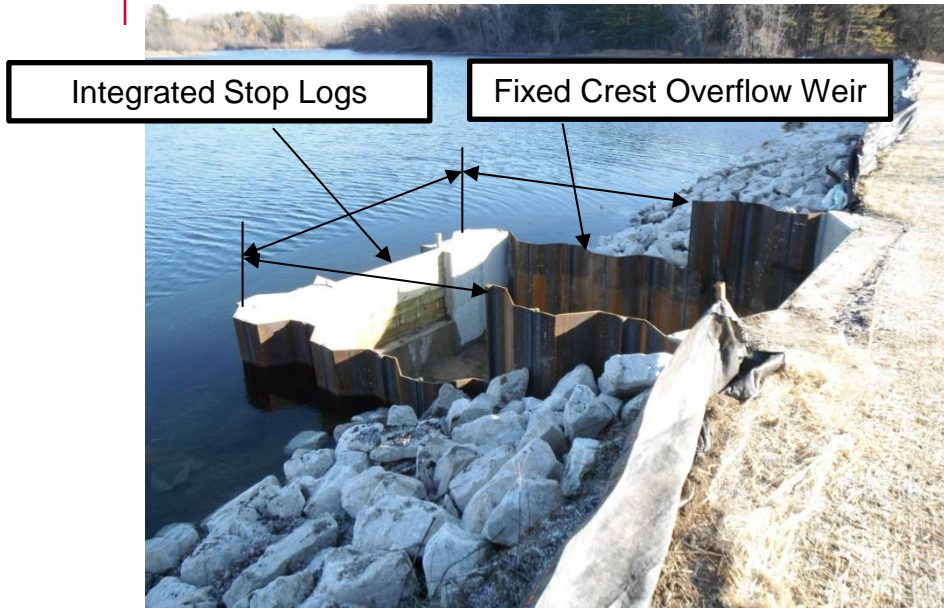


# Embankment and Spillway Restoration



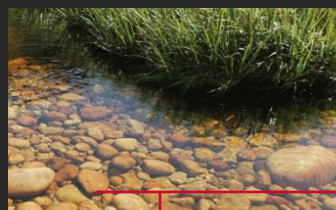


# Embankment and Spillway Restoration



- Spillway Type: Cast in Place Drop Inlet.
- Effective Weir Length: Approximately 30 feet.
- Low Level Outlet Capacity: 3 feet – Stop Logs.
- 100-Year Flood Capacity with 1 foot Lake Freeboard.
- Constructed in PZ-22 cofferdam.
- Designed in Accordance with Bureau of Reclamation “Design of Small Dams”.





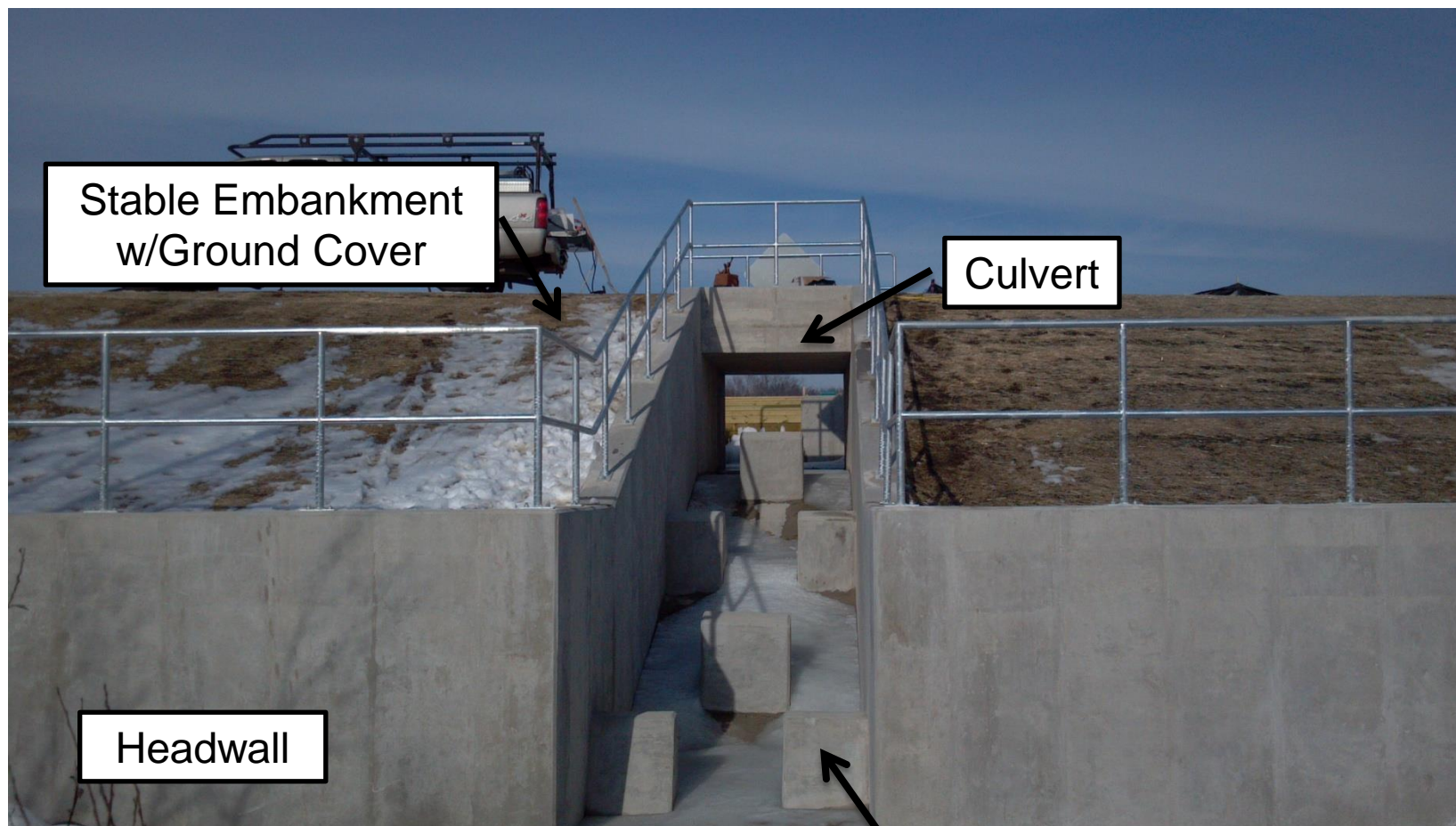
# Embankment and Spillway Restoration



- Box Culvert: 6' Wide x 5' High 16' Long
- Cast in place concrete headwall
- Discharges to cast in place concrete baffle chute.
- Hand Railings
- Dam Warning Sign



# Embankment and Spillway Restoration



Stable Embankment  
w/Ground Cover

Culvert

Headwall

WIS DOT RIPRAP  
(Installed Spring 2013)

Baffles





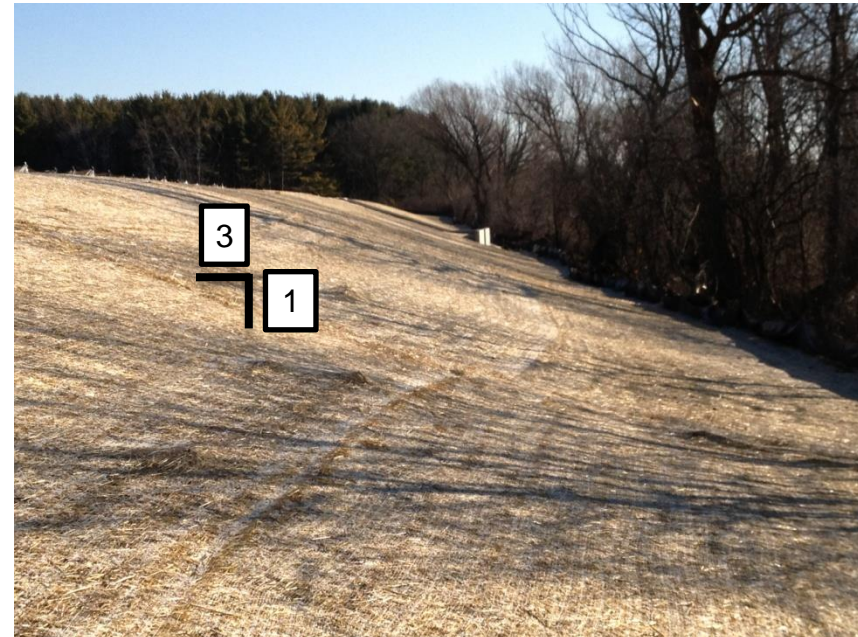
# Embankment and Spillway Restoration



- Removed woody vegetation from US slope.
- Placed WISDOT “Medium Riprap” below normal WL.

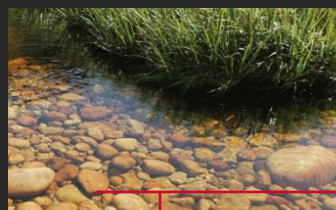


# Embankment and Spillway Restoration



- Existing embankment fill consists of a mixture of silty sand (SM), sandy clay (CL) and silty clay (CL).
- The new embankment fill consists of low plasticity clayey material and have a USCS classification of CL, CL-ML or SC.
- Re-graded embankment to meet WDNR stability requirements and establish ground cover.





# Embankment and Spillway Restoration



- Removed existing CMP and backfilled excavation and breach channel with new embankment fill.
- Raised left embankment approximately 2 feet.
- Provided 1 foot of lake freeboard during the 100-year flood event.



# Acknowledgements

- **Owner:** Don Harris – Norris Adolescent Center
- **GEI Staff:**
  - Rick Anderson, P.E. – Senior Consultant
  - Matt Emrick, P.E. – Project Manager
  - Paul Drew, P.E., CFM – Project Engineer
- **WDNR Staff:**
  - Bill Sturtevant, P.E.
  - Michelle Hase, P.E.
- **Waukesha County:**
  - Amy Barrows
- **Contractor:** Staab Construction
- **Surveyor:** Oneida Total Integrated Enterprises (OTIE)





# Questions?

**Paul D. Drew, P.E., CFM**

Project Engineer

**GEI Consultants, Inc.**

*Geotechnical, Water Resources, Environmental*

