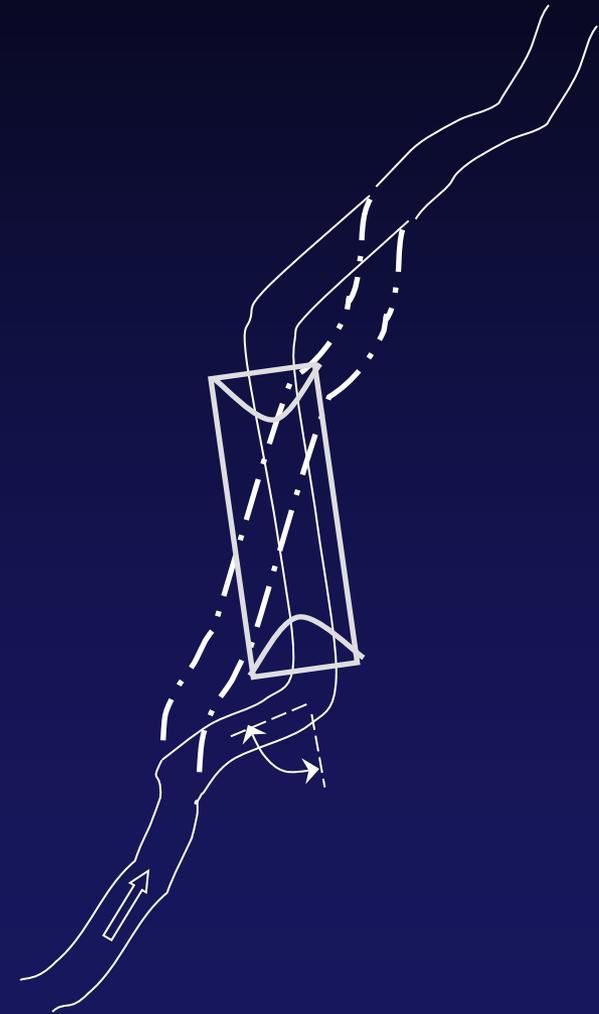
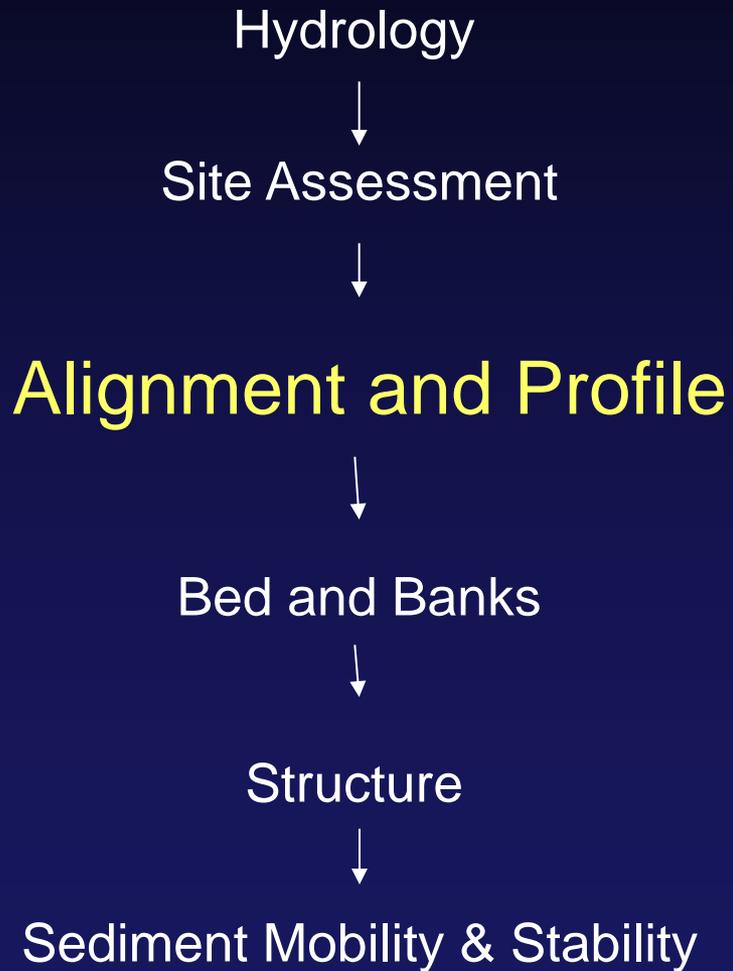


# Culvert Design Process



## Interpret longitudinal profile & alignment

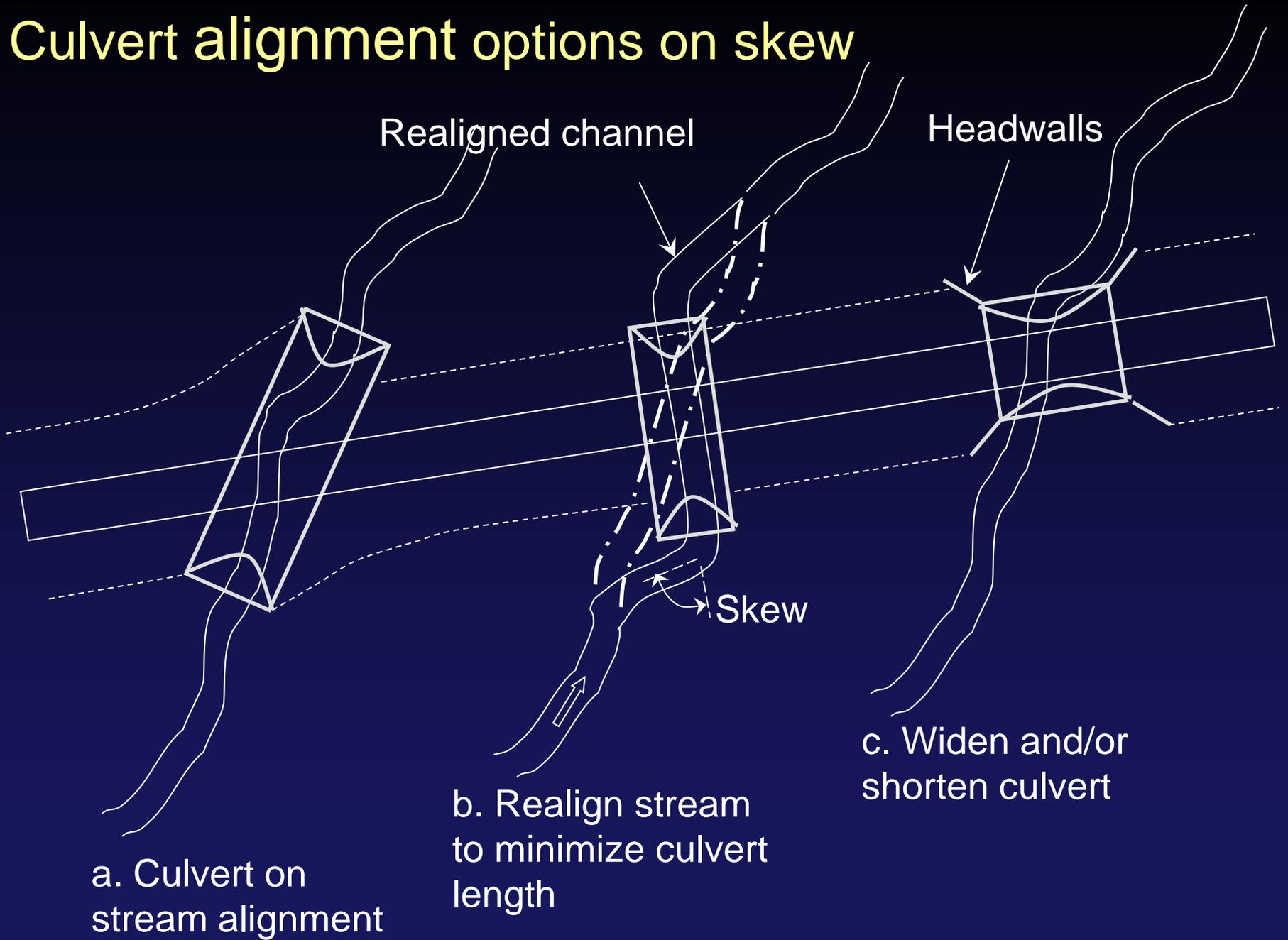
- Scour, incision or aggrading due to existing structure
- Channel effects to removal of existing pipe—head-cut potential
- Natural variability of bed elevation
- Channel restoration extent & feasibility

# Alignment

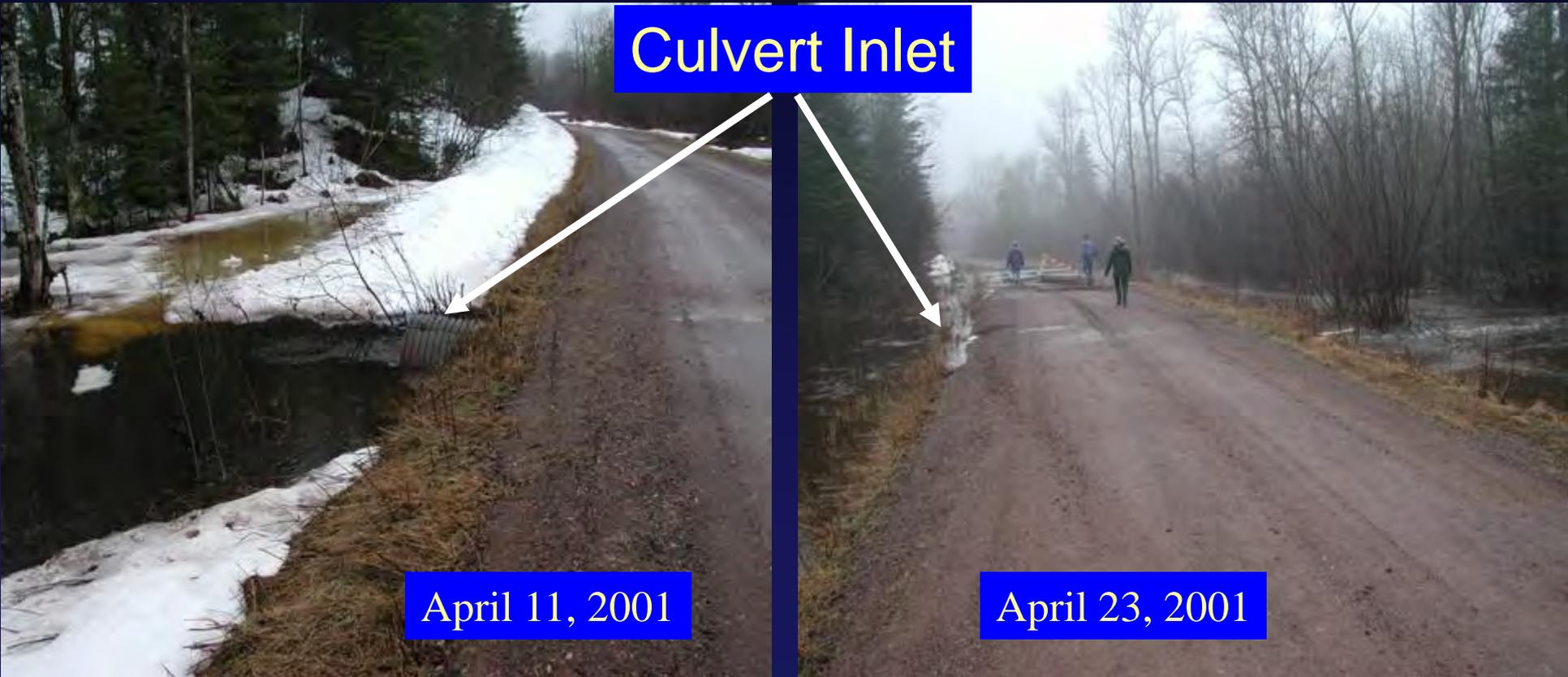
- Design alignment concurrently with profile
- Culvert skew affects length
- Culvert length may affect stream profile
- Important factor for debris blockage and failure
- Choose reasonable alignment for existing and **future** stream channel.
- Disturbance, stability, length, cost are often a compromise.



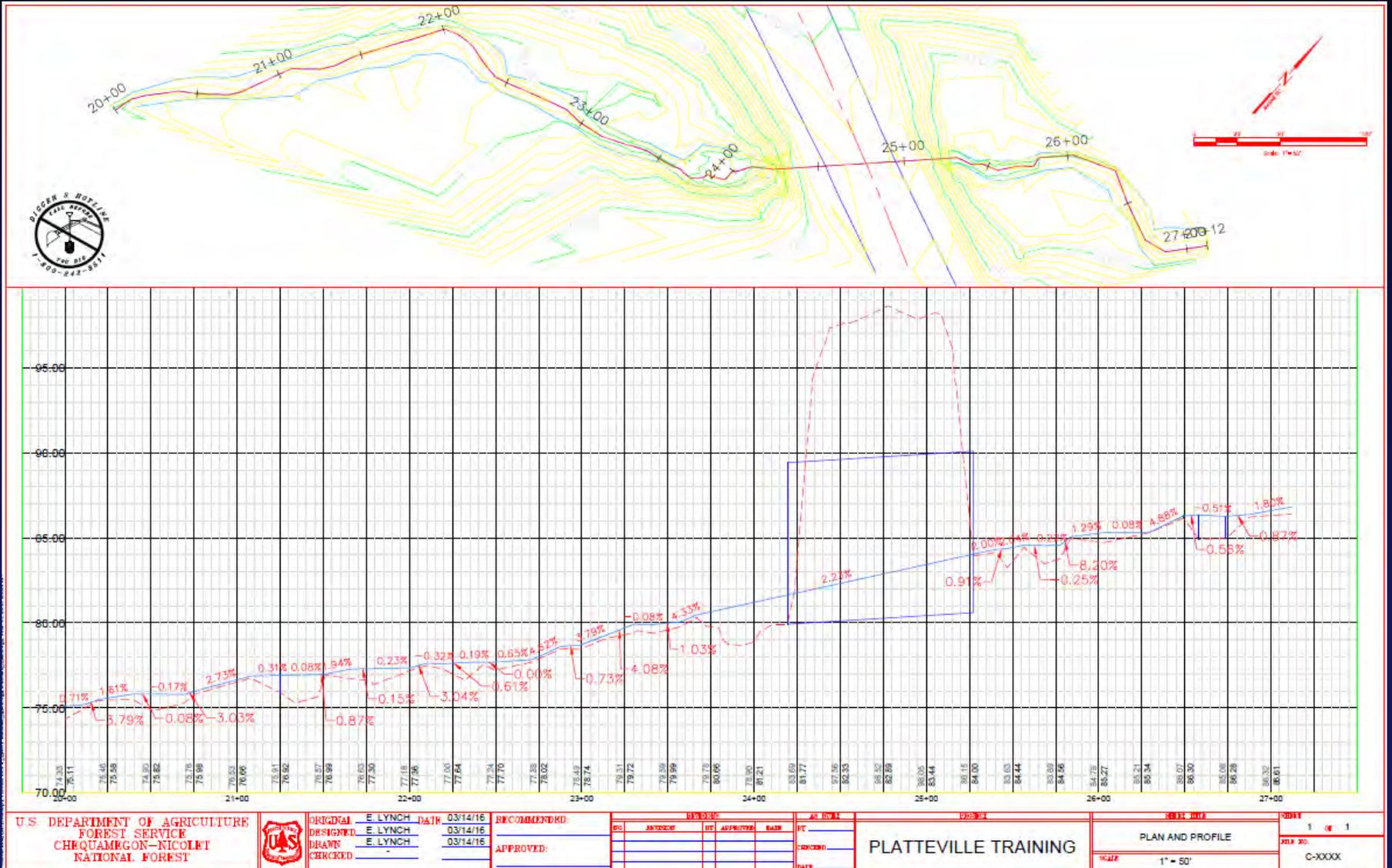
# Culvert alignment options on skew



# Problems with a realigned channel



# Plan and profile, Rountree Trib.



U.S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
CHEQUAMEGON-NICOLET  
NATIONAL FOREST



DESIGNED: E. LYNCH DATE: 03/14/16  
 DRAWN: E. LYNCH DATE: 03/14/16  
 CHECKED: \_\_\_\_\_

RECOMMENDED: \_\_\_\_\_  
 APPROVED: \_\_\_\_\_

REVISIONS				AN. NO. 1	
NO.	DATE	BY	APPROVED	DATE	BY

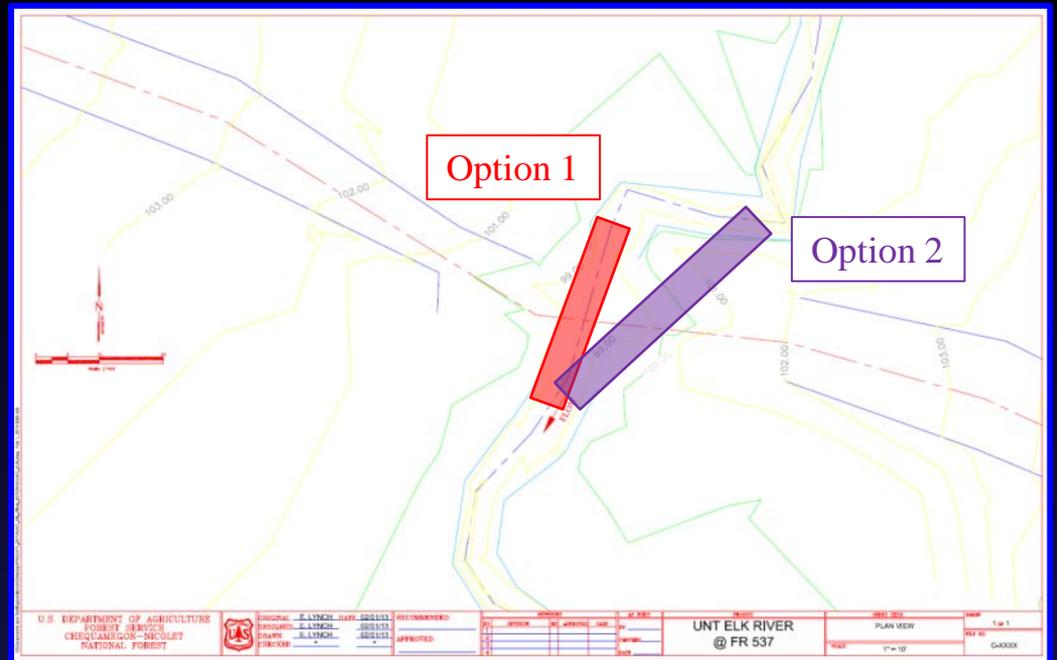
PROJECT: PLATTEVILLE TRAINING

SHEET TITLE: PLAN AND PROFILE  
 SCALE: 1" = 50'

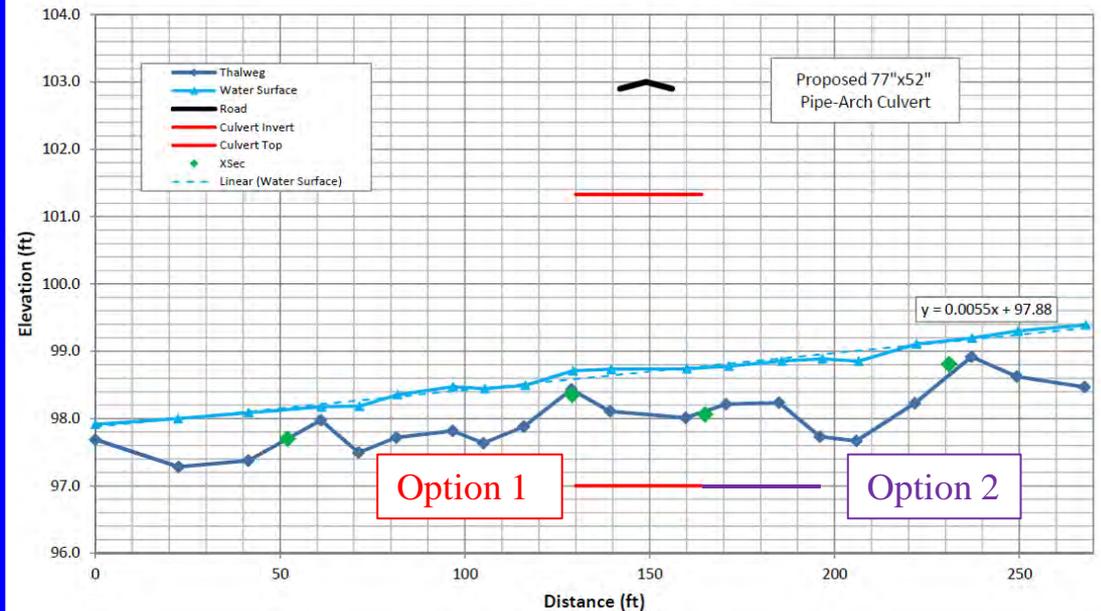
SHEET NO.: 1 of 1  
 DATE: C-XXXX



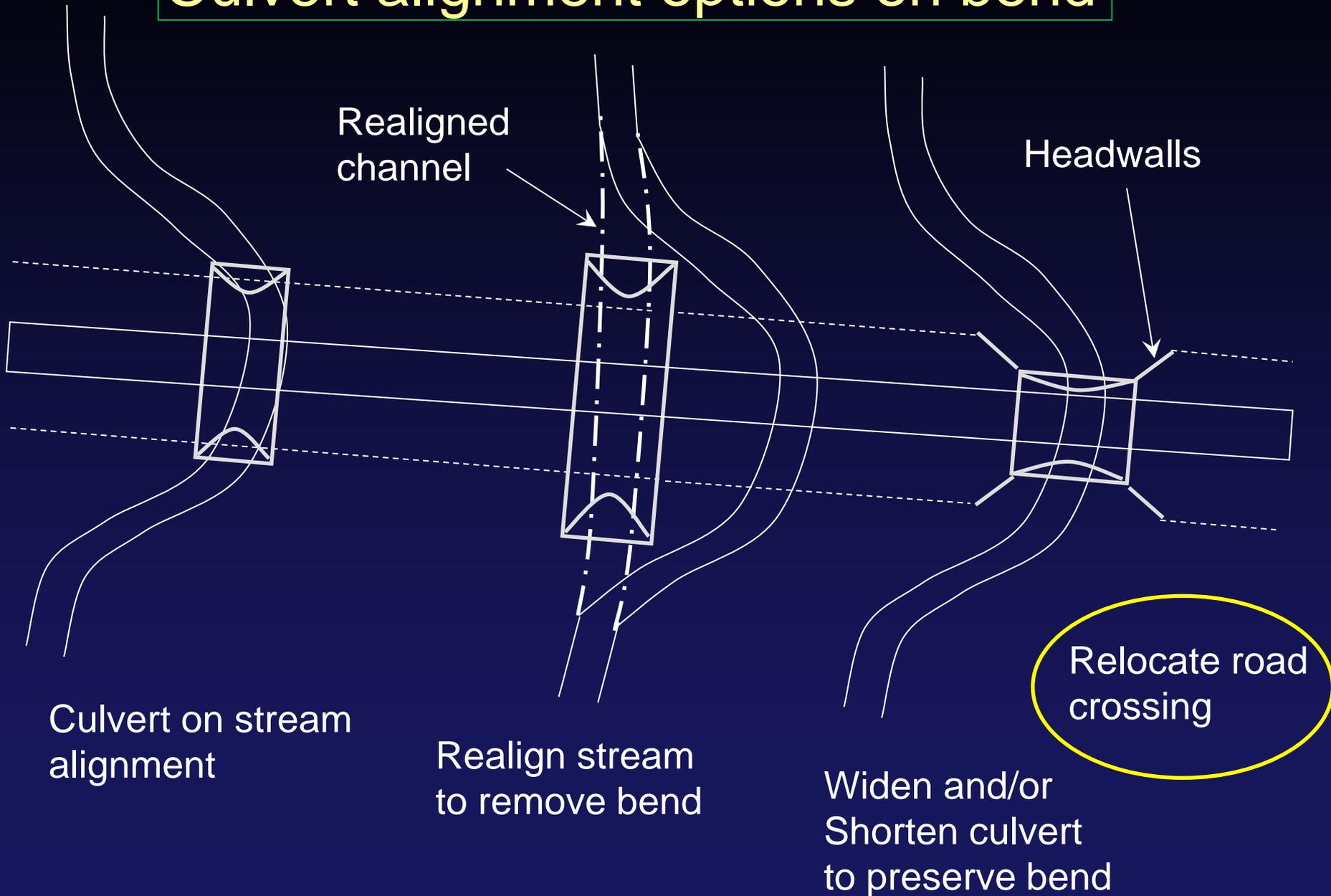
# Culvert skew, length and stream profile



Unnamed Tributary to Elk R at FR 537



# Culvert alignment options on bend



# Culvert bend example short, wide box culvert w/HW

Waupee Cr at FR 2308

- Culvert Length/BF Width
- Drainage Area = 27 sq mi
- BFW = 34 ft (est eq)
- Culvert Length = 34 ft
- CL/BFW = 1.0



# Culvert elevation

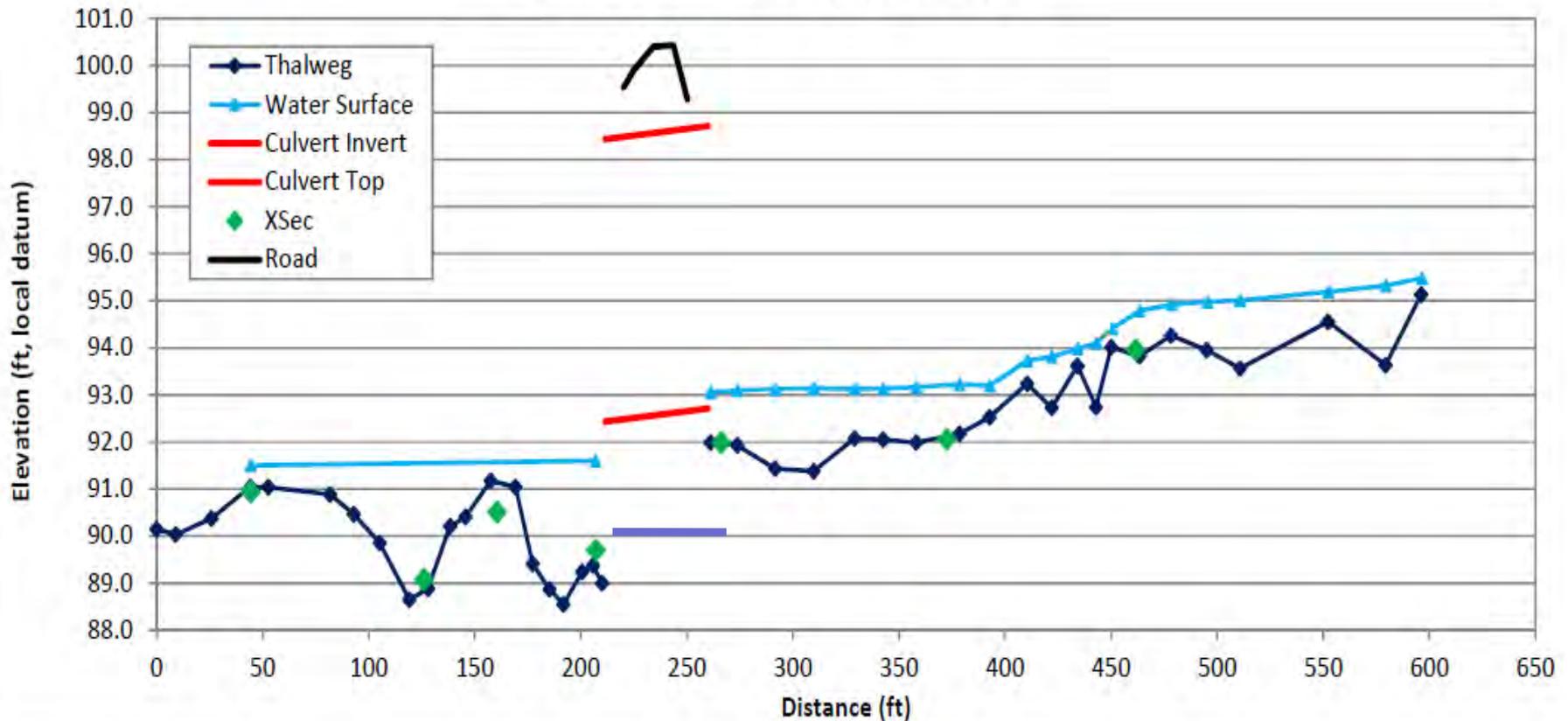
Bankfull width – Tailwater control

- Set flat (on low gradient streams, except...)
- Check profile for channel morphology impacts
- Consider channel adjustment and restoration
- Consider plunge pool and tailwater longevity
- Ensure tailwater will provide good depth and low velocity in culvert
- Consider pool/run lengths relative to culvert length

# Specify invert elevation

Bankfull width – Tailwater control

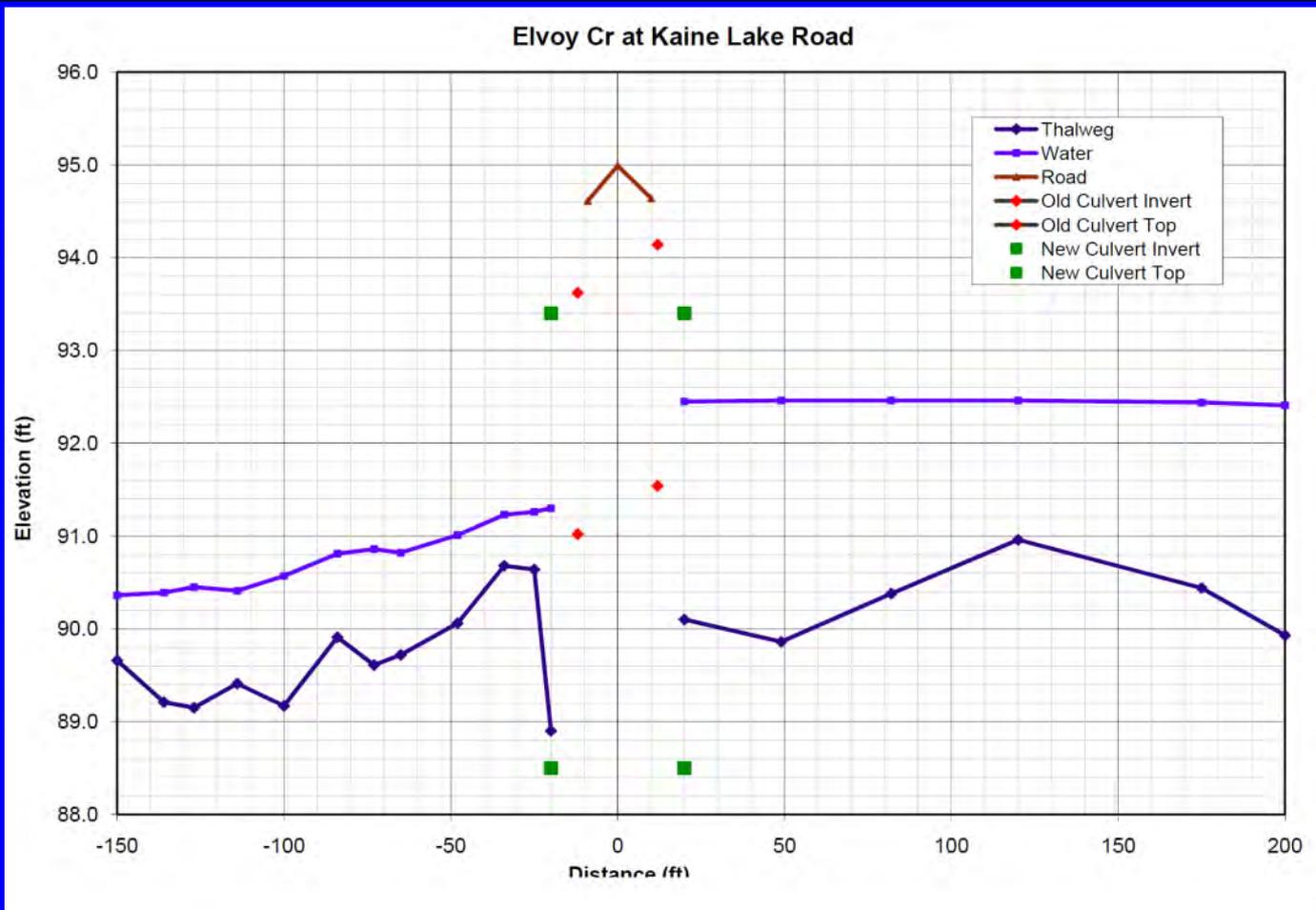
## Snowden Trib at Rock Road





# Specify culvert elevation

## Low gradient culvert design



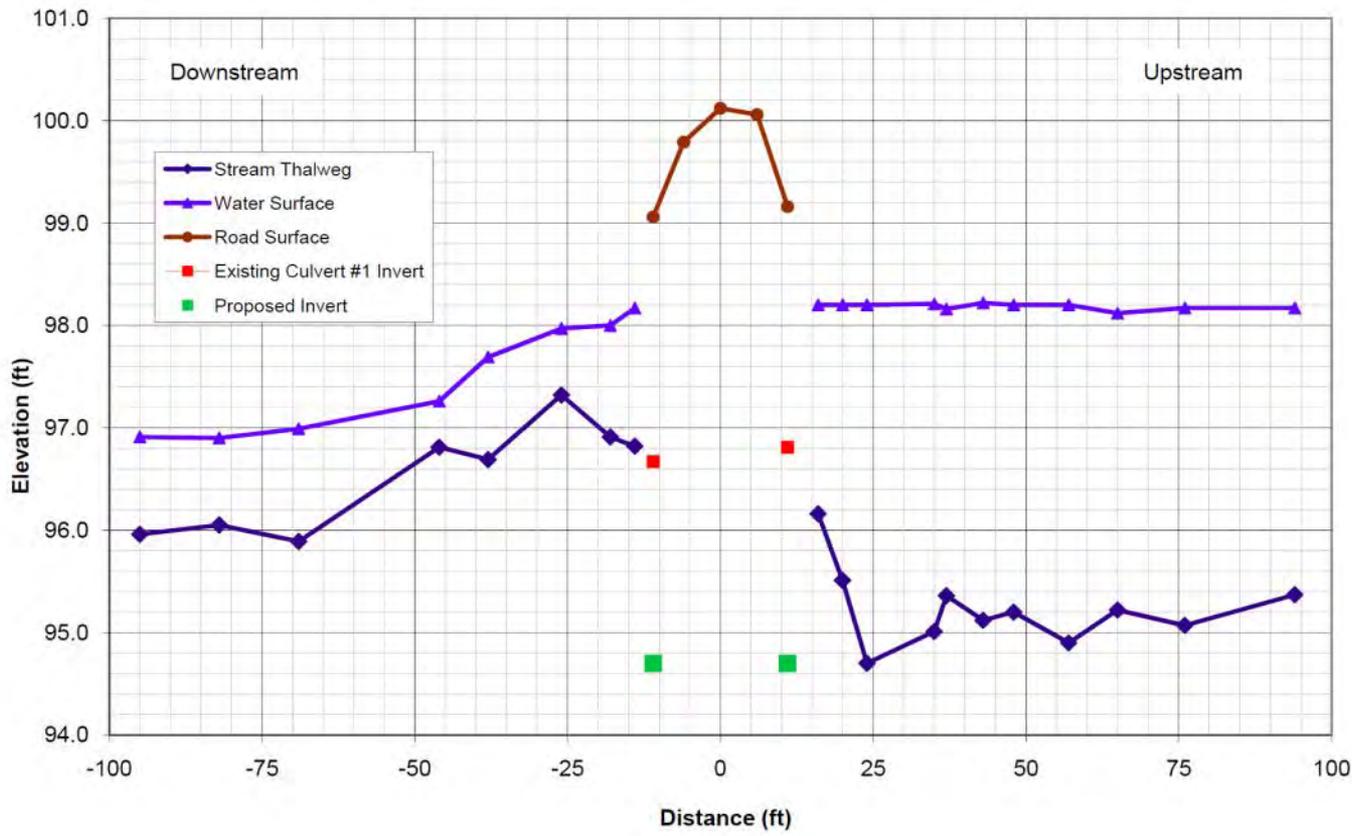


# Specify culvert elevation

## Low gradient culvert design



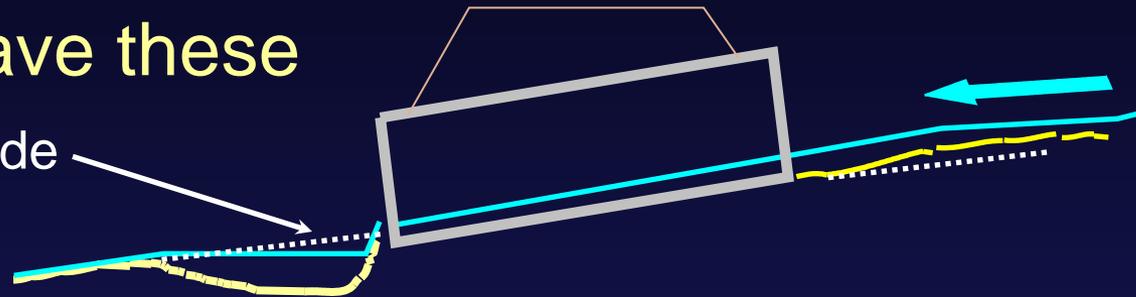
N Otter 4th Crossing Below Spring Ponds  
Just Upstream from Chequamegon-Nicolet NF, WI



# Scour pool vs. incised channel

Outlet Scour – Most projects have these

Original Channel Grade

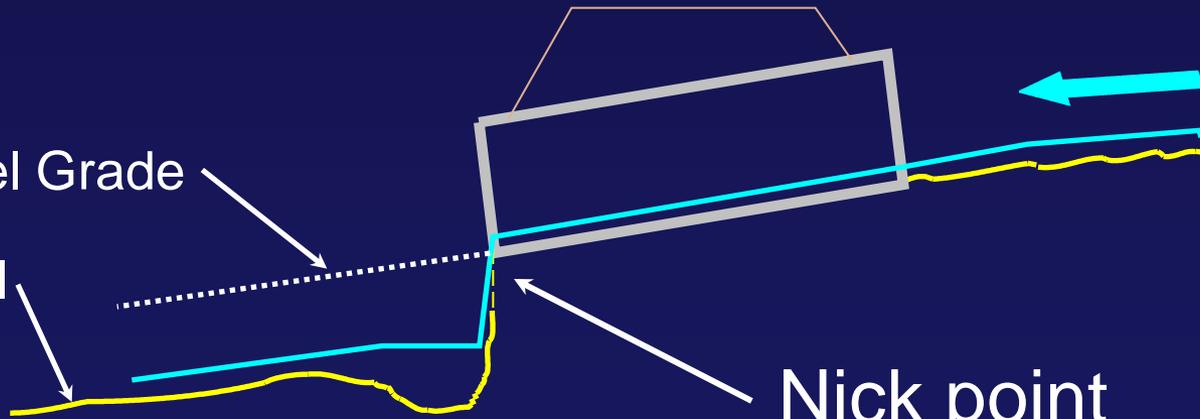


Incised Channel – Some Channels

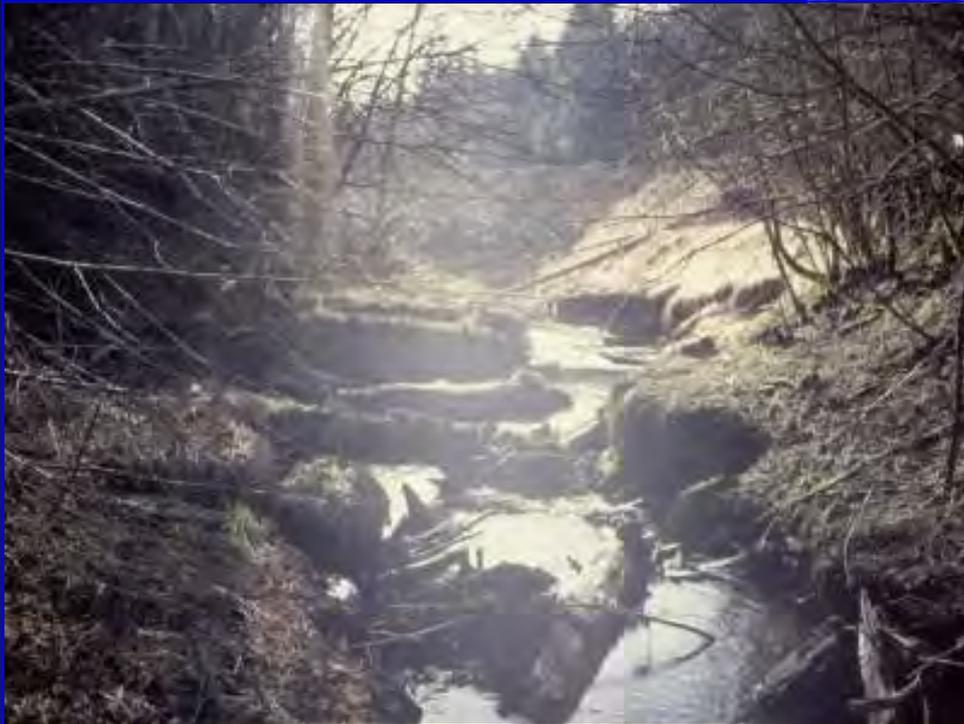
Original Channel Grade

Incised Channel Grade

Nick point



# Example of a head-cut causing instability upstream

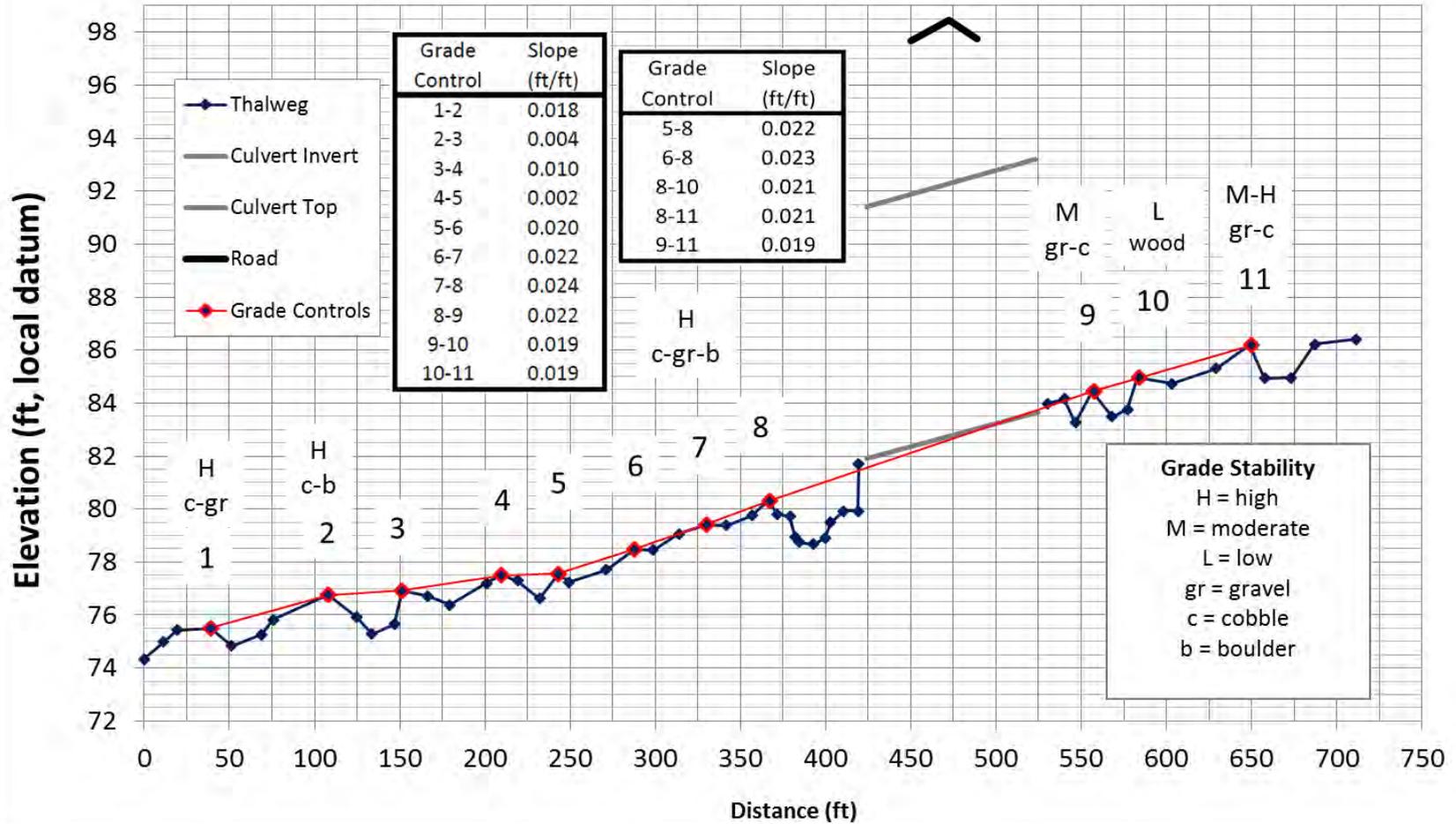




# Specify culvert elevation

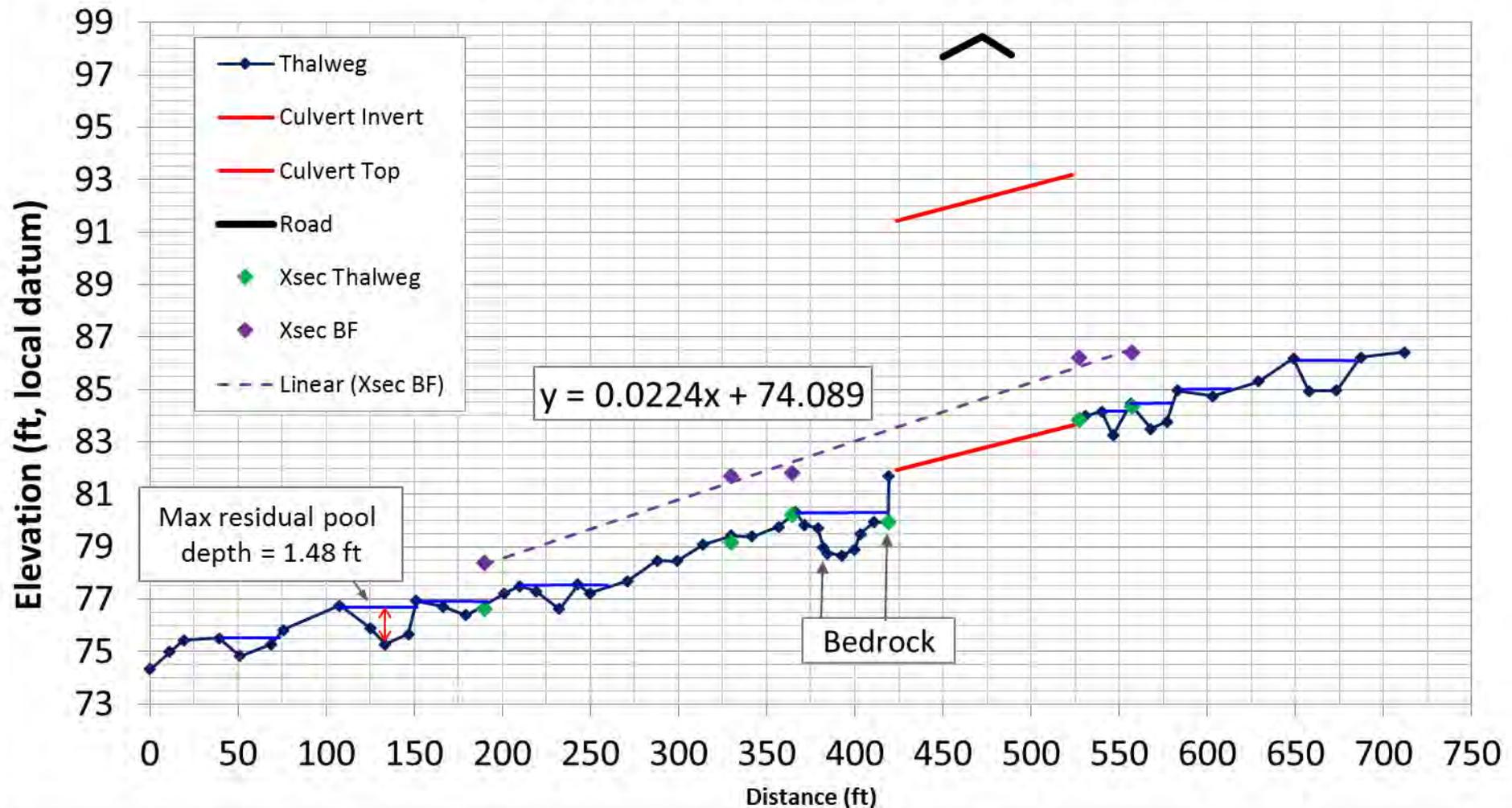


### Rountree Tributary at W Main Street, Platteville, WI



# Vertical adjustment potential

## Rountree Tributary at W Main Street, Platteville, WI



# Vertical Adjustment Potential (VAP), alignment and culvert elevation exercise