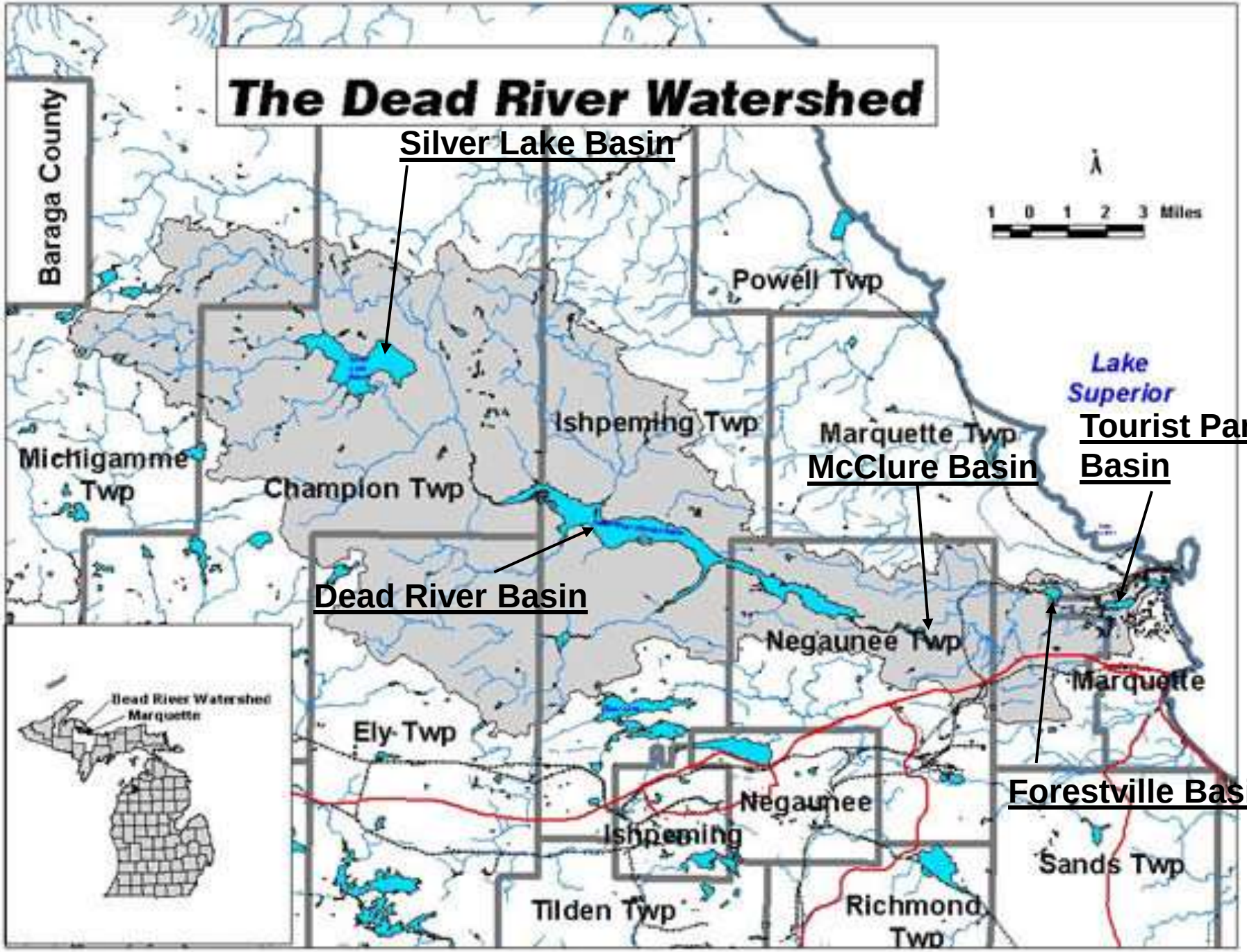

PEPSI
DUTCHS OLD BAR
04/30/2013


9/25/2000
CR AAO Bridge
Dead River Flood & Natural Channel Design
Mitch Koetje
Water Resources Division
UP District

Old County Road AAO Bridge



Map courtesy of Marquette County

Actively Draining Silver Lake

Look Downstream
From Silver Lake
Through Fuse Plug

Fuse Plug Area –
30 foot deep erosion trench


JUL 18 2006


29 9:51 AM

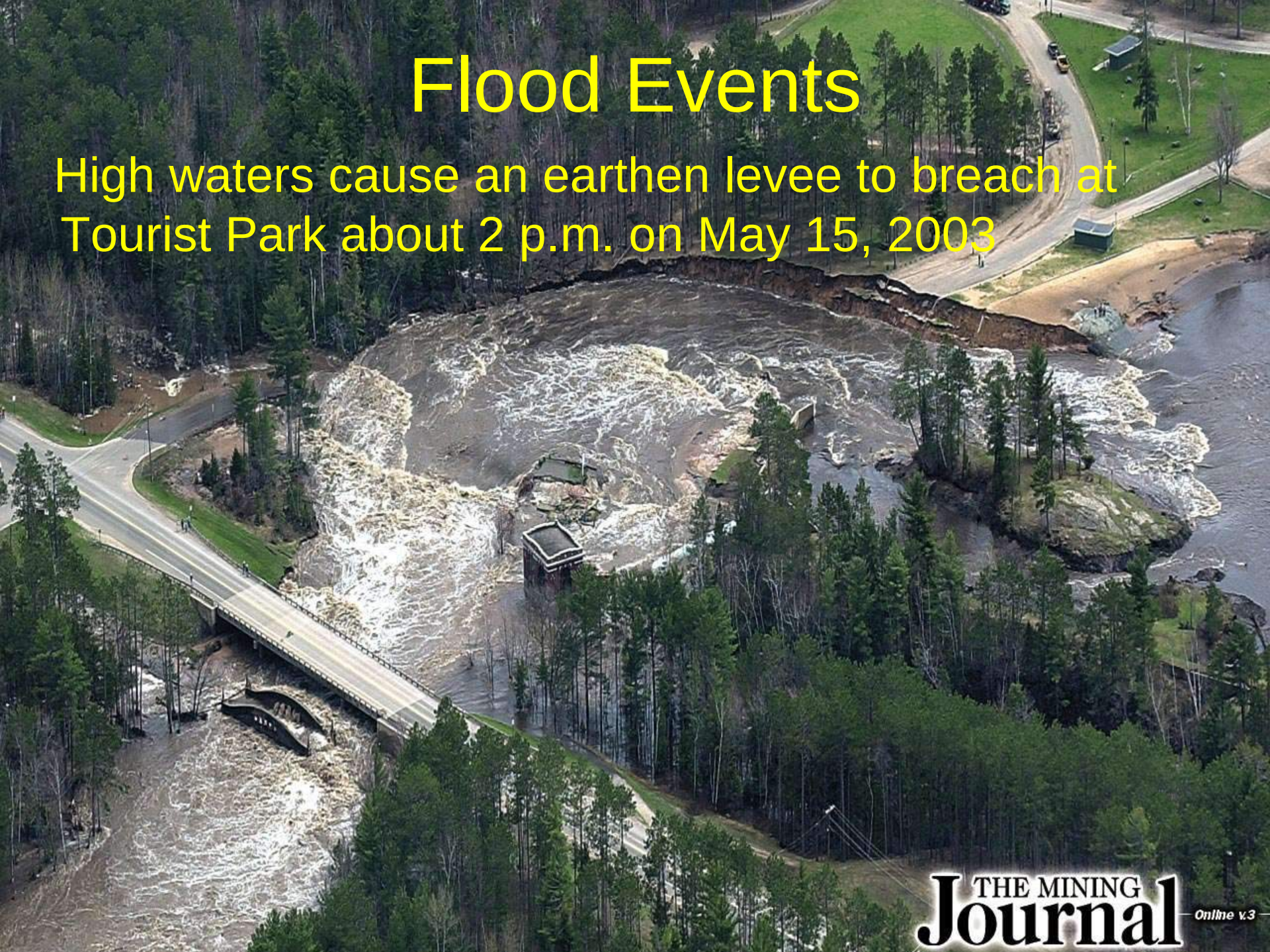

Start of Connors Creek Area/Reach B -
Looking Upstream on 7-15-04


Once forested, there are now several sand plains left from the flood damage downstream of the fuse plug failure at Silver Lake Basin. (Connors Ck. Area 10/15/03)
Dead River
Look Downstream


Dead River Basin
Sand Delta
in May 2004
Photo courtesy of Central Lake Superior
Watershed Partnership, 5/2004

Flood Events

High waters cause an earthen levee to breach at Tourist Park about 2 p.m. on May 15, 2003



Tourist Park Basin Looking Upstream - Right after the Event on 5/16/03

Old CR 550 Bike Path Bridge

THE MINING Journal Online v.3


Is this it? Get off your rear ends
and get something done would ya!

So… Restoration Planning

- **Collaborative Effort**
- **Two Phased Watershed Approach**
- **Natural Channel Design**
- **Studies**

- Riverine Habitat (Rosgen)

- Revegetative Stabilization Techniques

- Wetlands/Floodplains

- Fish, Mussels, Macroinvertebrates

- $8.7 Million in Assessment & Recovery (without lower river)
- $1.3 Million in Mitigation
- Silver Lake Rebuild estimated at $10 M

Sand Plug of the Mulligan Creek Mouth


Sand Trap area looking US to
Mulligan Mouth 7-15-04

4/23/04 – Mulligan Creek Confluence

Clay Banks Interim Restoration Project 2003

Post Construction: Clay Banks Interim Project Completed 11/03 Photo on 7/15/04


5-4-05
Riprap Bank


5-4-05


Same spot 6/3/10
4 years post construction

$1.7M total from Flood Control and Costal Emergency funding was utilized by USACE

80,000 yd3 of debris removed

Woody Debris Mulch Pile

Photo Courtesy of Central Lake Superior Watershed Partnership


29 10:23AM

Channel Stability

The ability of a stream, over time, to maintain its pattern, dimension and profile such that, the channel neither aggrades or degrades and is able to transport the flow and sediment from it's watershed without adverse impact.

These physical channel features are described as a function of the bankfull elevation.

Reference Reach

A **reference reach** is a channel segment that is stable, -neither aggrading nor degrading, and of the same morphological type as the channel being assessed. The reference reach should also have the same potential valley type, flow regime, sediment regime, streambank type and riparian community as that of the assessment reach.

The reference reach is used as the standard against which the assessment reach is being judged. To account for differences in drainage area and discharge between a reference site and an assessment site, data on channel characteristics (dimension, pattern, and profile) in the form of dimensionless ratios are developed for the reference reach.

NCD Measurements Used for the Design Process

There are 67 variables that are measured or studied. These variables are used in dimensionless rations for the channel design.

Variable Categories:

- Streamflow Regime
- Sediment Regime
- Valley Morphology, Bed & Bank Materials, Roughness, & Riparian Veg.
- Channel Feature Dimensions: Riffle, Run, Pool, Glide, (step) & Floodplain
- Channel Pattern: Sinuosity, Meander Length, Radius of Curvature, Pool Length and Spacing
- Channel Profile: Water Surface & Bed Feature Slopes and Depths

Bankfull Definitions

Bankfull discharge:

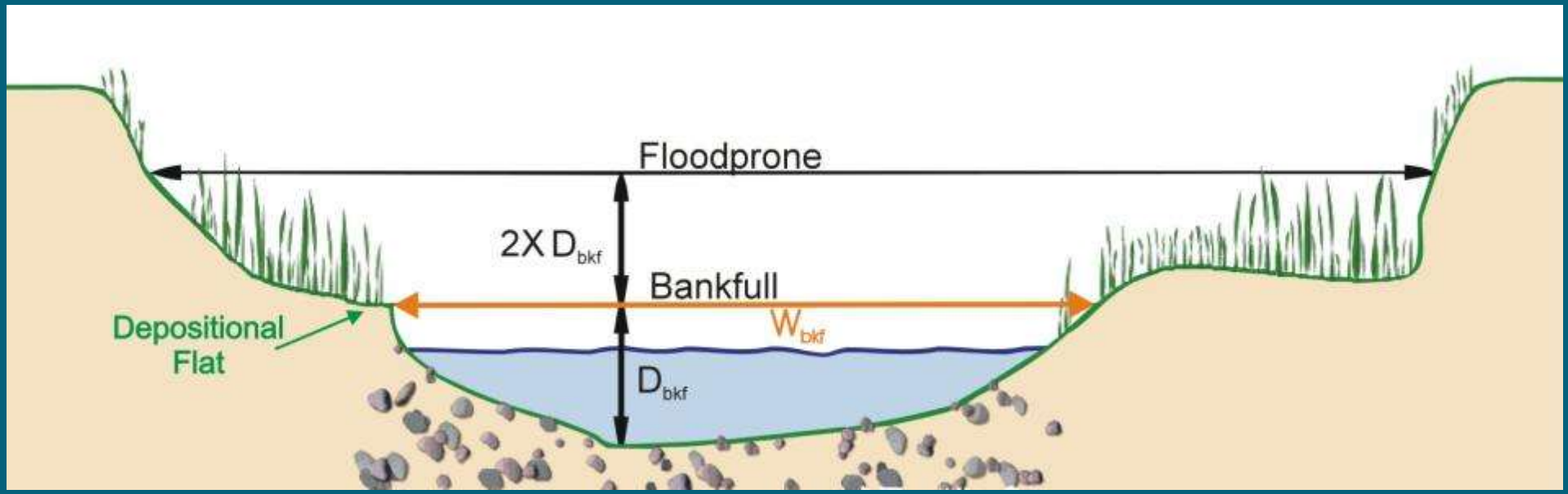
- The momentary maximum flow associated with the bankfull elevation.

- Is the discharge which reoccurs every 1 or 2 years; approximately 1.5 years on average.

- Is the discharge which "performs most of the work" – transports most of the sediment, determines channel dimensions, forms or removes bars and meanders, etc.

- This is considered the effective or channel forming flow

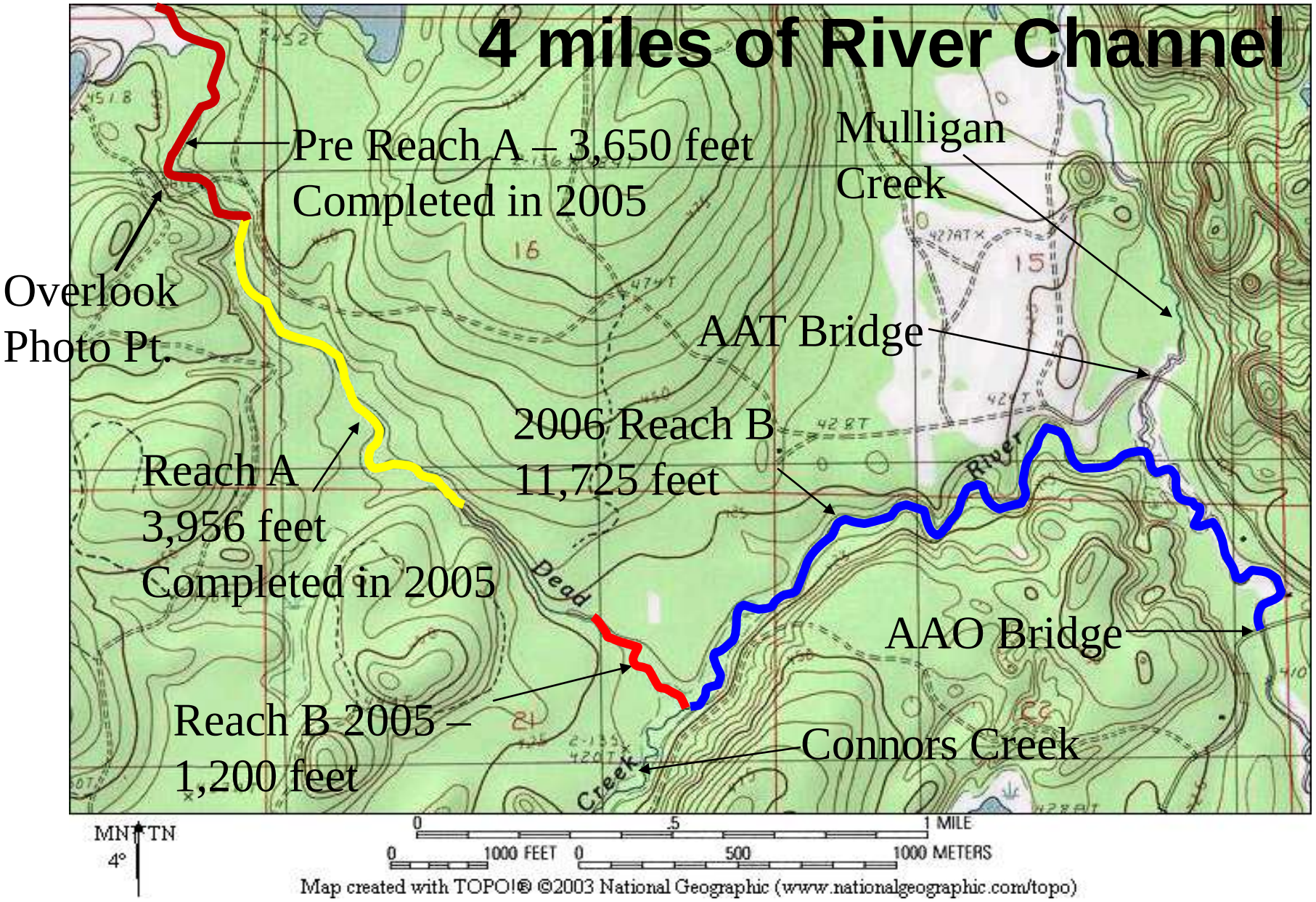
Bankfull Elevation




Once forested, there are now several sand plains left from the flood damage downstream of the fuse plug failure at Silver Lake Basin. (Connors Ck. Area 10/15/03)
Dead River
Look Downstream


h Eagle Eye
Dead River/Conner's Creek
5/17/2011 9:05:07 AM
Southwest View
Conner's Creek
Dead River


Jeremiah Eagle Eye
Dead River/Conner's Creek
Northeast View
5/17/2011
Flow
Dead River
Flow
Dead River
Connors Creek


4 miles of River Channel
Pre Reach A – 3,650 feet
Completed in 2005
Mulligan
Creek
Overlook
Photo Pt.
AAT Bridge
2006 Reach B
11,725 feet
Reach A
3,956 feet
Completed in 2005
Dead
River
AAO Bridge
Reach B 2005 –
1,200 feet
Connors Creek
Creek
MN
TN
4°
0
.5
1 MILE
0
1000 FEET
0
500
1000 METERS
Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)


Sand Plug of Original Silver Lake Dam Outlet Channel
Reference Point for Following Photos
7-14-04 Look Upstream at Channel Restoration Photo Monitoring Point Downstream of Fuse Plug
Photo Point

Recovery Efforts 2005

Photo courtesy of UPPCO

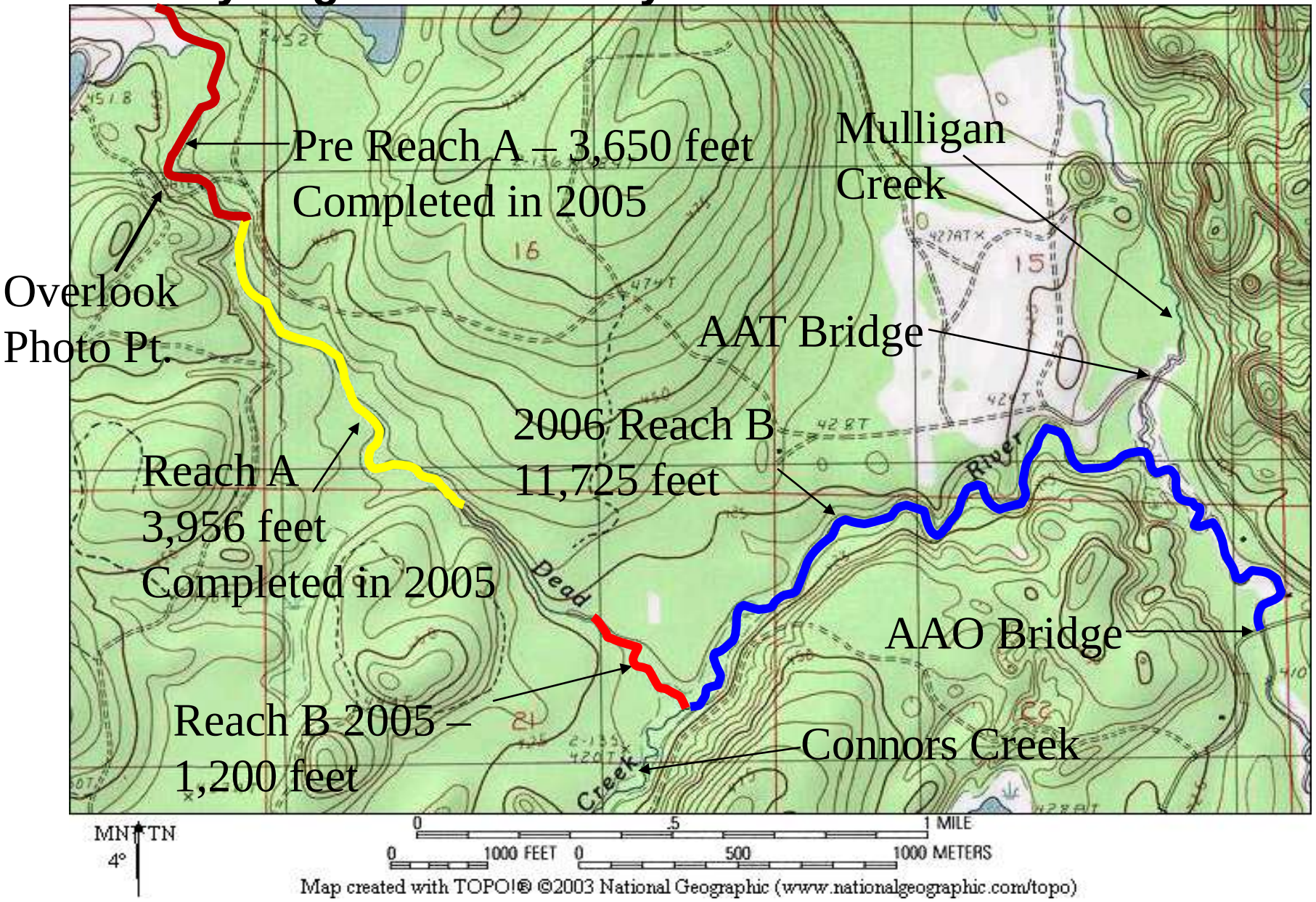

GB-1367
Recovery Efforts 2006- Pre-Reach A
Start of Year 1
Old Channel and Future Wetland
New Channel
New Wetland
Photo courtesy of UPPCO

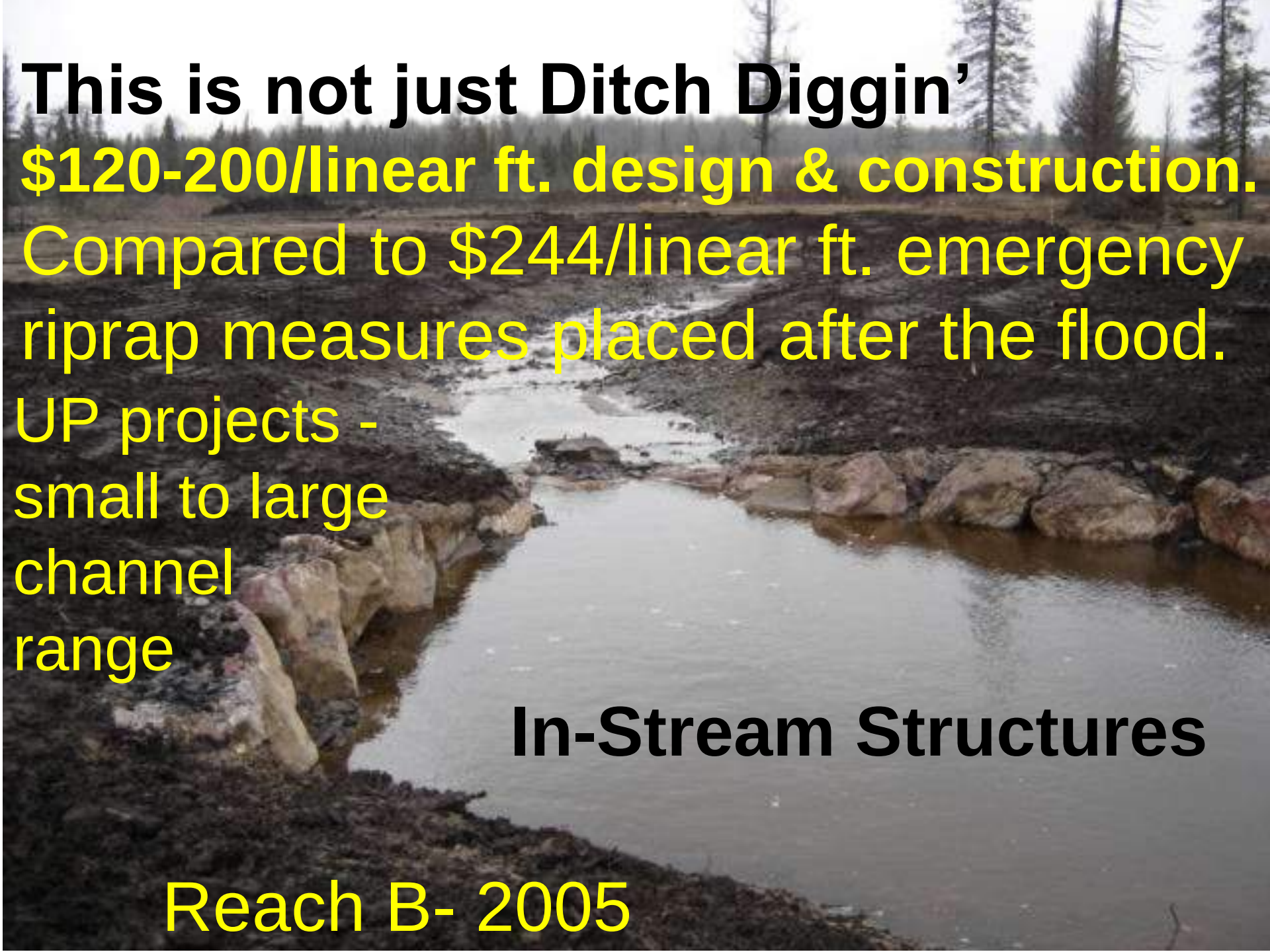
Same Area on August 2, 2007
Year 2

Same Area on 6-9-09
Year 4


6/3/10
Start of Year 5
New Channel
Old Channel and Future Wetland
New Wetland

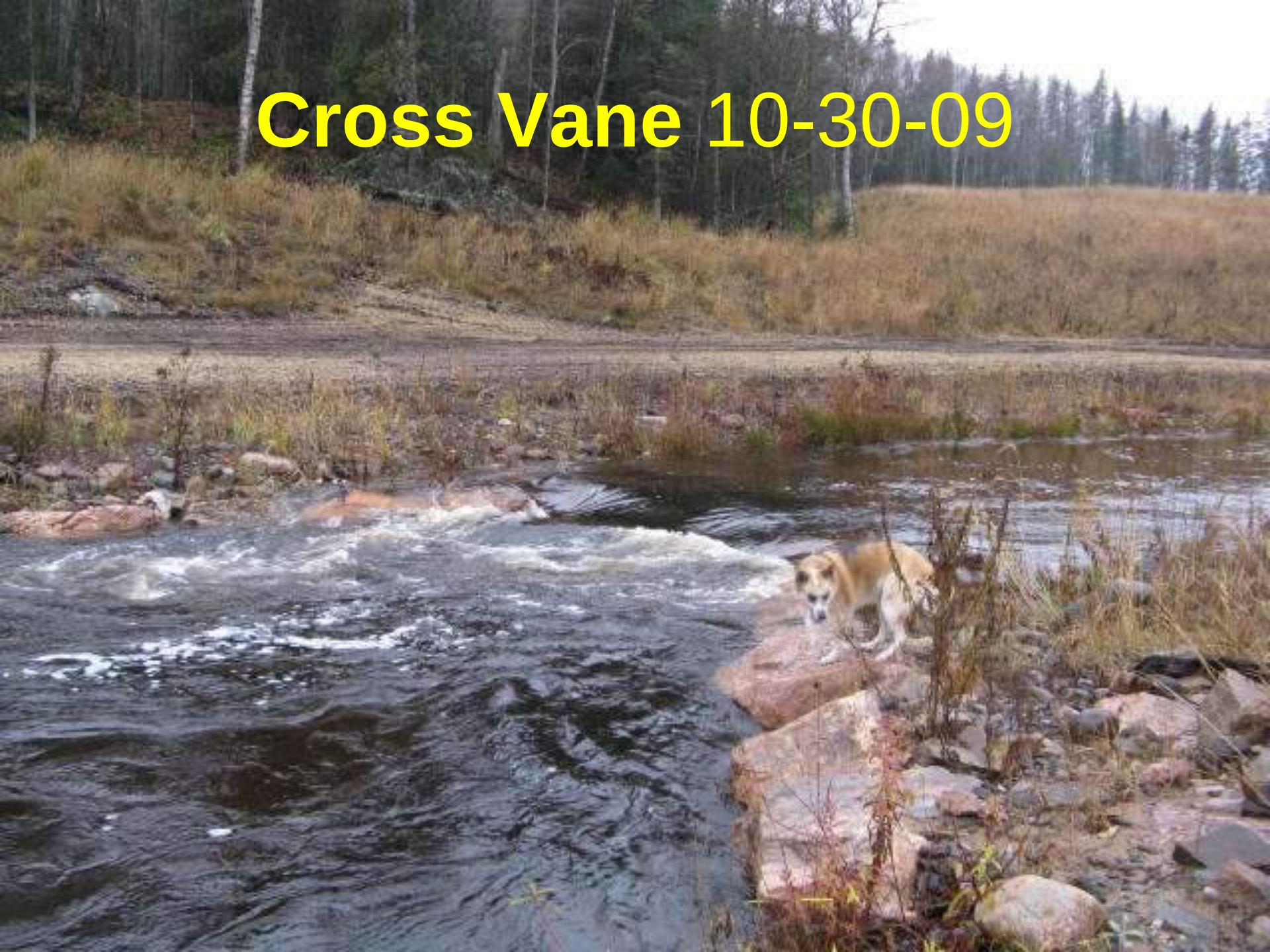
How do you get this stability on 4 miles of River Channel?

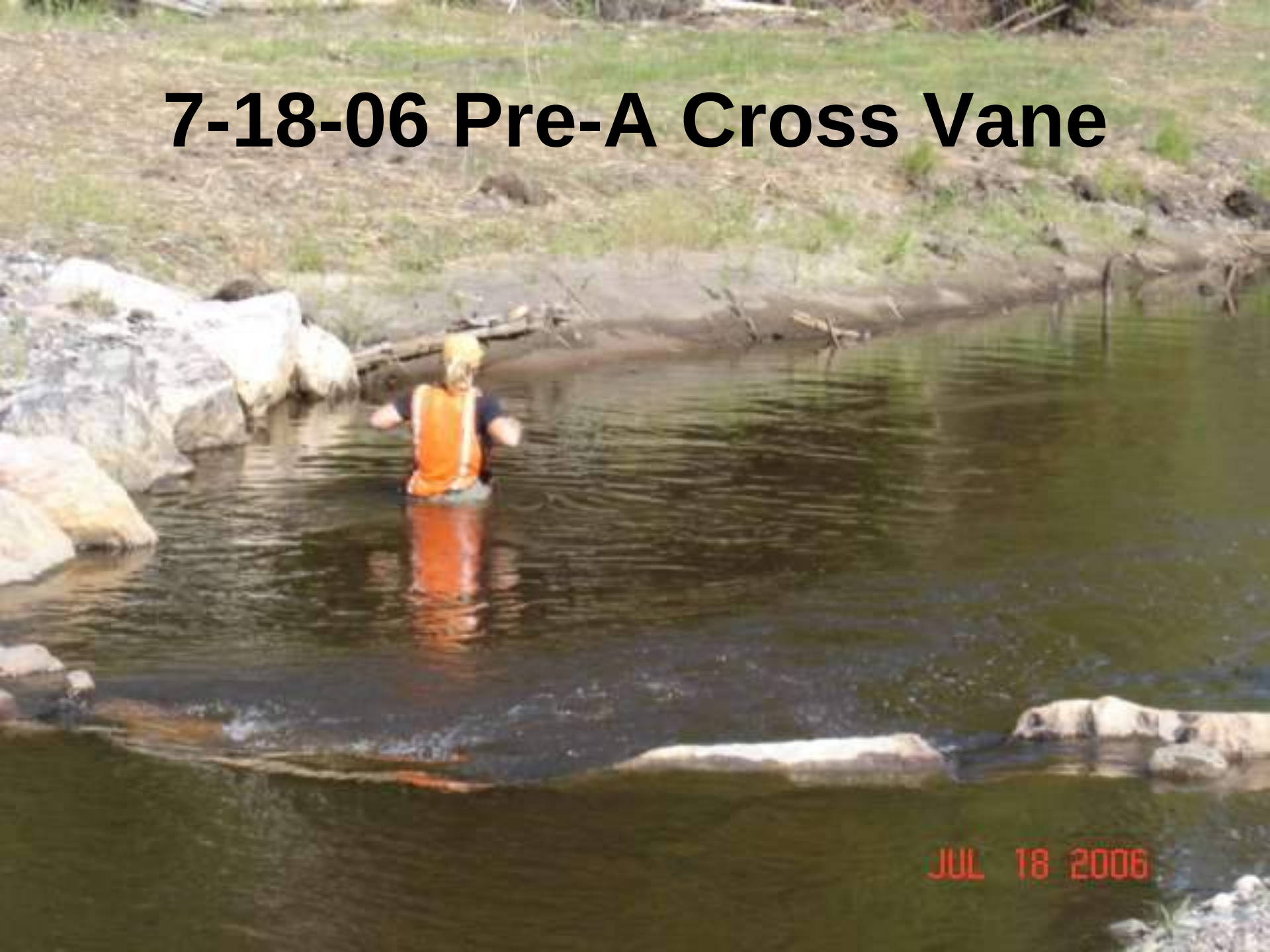



This is not just Ditch Diggin’
$120-200/linear ft. design & construction.
Compared to $244/linear ft. emergency riprap measures placed after the flood.
UP projects - small to large channel range
In-Stream Structures
Reach B- 2005


Live Stake Shrubs
on all Banks


June 2010

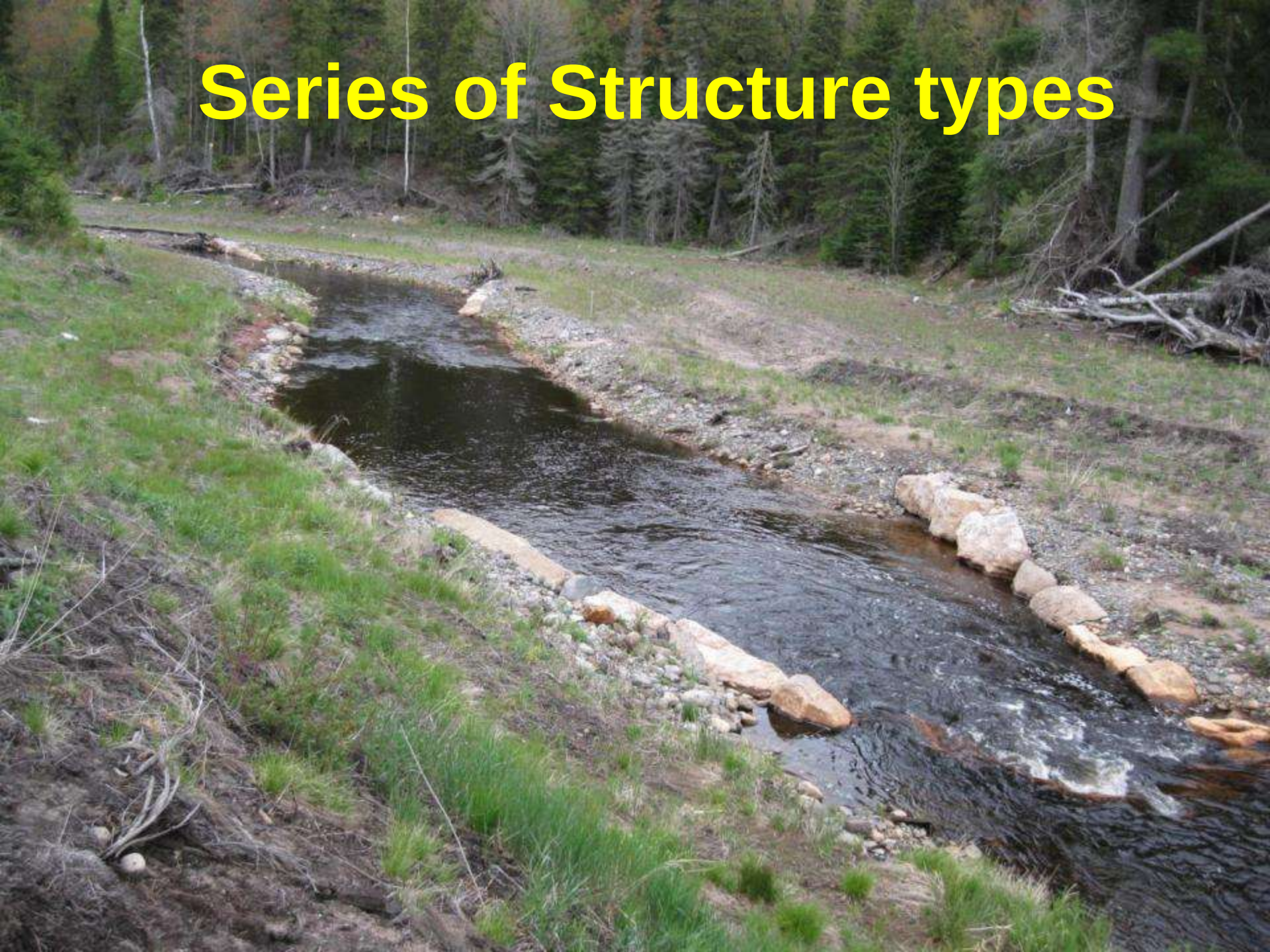

Cross Vane 10-30-09


7-18-06 Pre-A Cross Vane
JUL 18 2006


J-Hook 5-15-07


Riffle 6-9-09

Root Wads

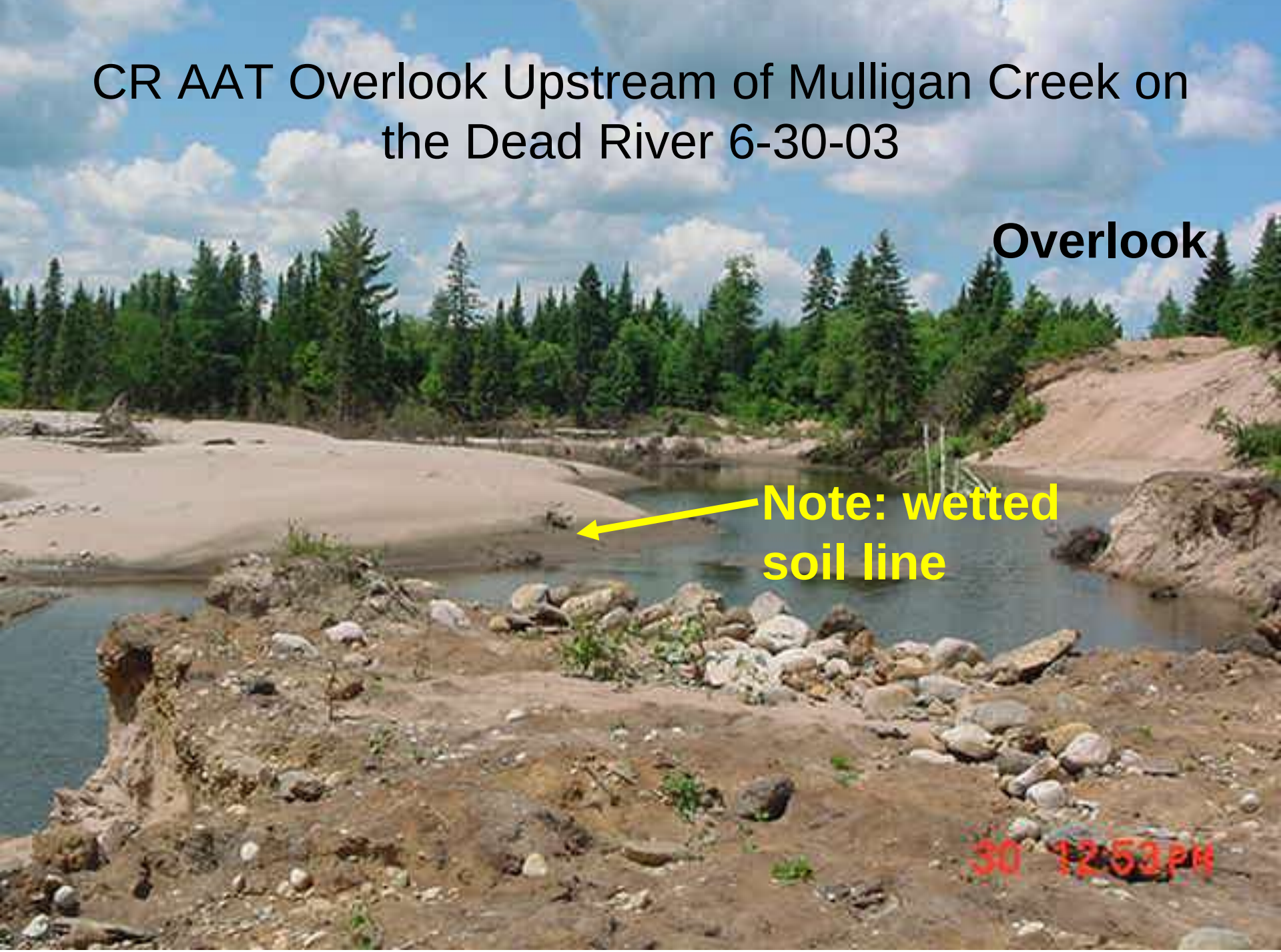

Series of Structure types


6/9/09
Reach A
Stabilized Channel Forever?

Top of Pre-Reach A


6/3/10 4.5 years post construction
Post-Event Water Line
and "white" tree

CR AAT Overlook Upstream of Mulligan Creek on the Dead River 6-30-03



County Road AAT Overlook on 8-1-06 (3 years later)


6/9/03


6/9/03


6/9/03


View of previous photo – Look Upstream from the Road Overlook on 7-9-09 **6 years after the event**
Less than 3 years after construction

5-10-13

8-21-13

CR 550 to Superior Recovery 2011

- **57 foot wide channel**
- **Riffles – 3 to 4.5 ft deep**
- **Pools – Max. of 7.5 ft deep with 20ft bottom**


THE END