Changing Perspectives for Monitoring Stream Restoration Success
---Sediment---

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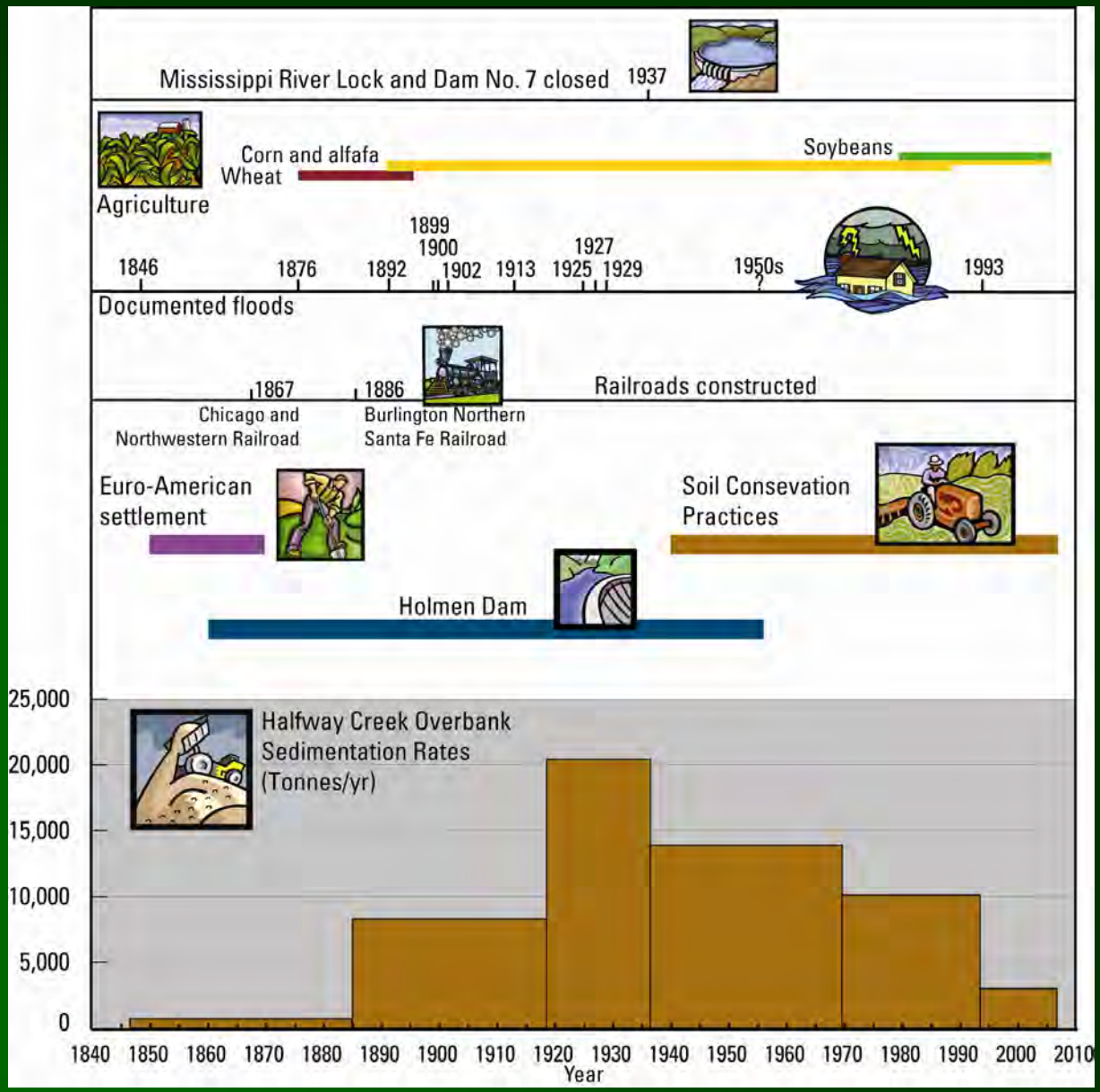
Restoration science issues with monitoring implications:

- Do physical manipulations improve ecological conditions?
- What are the additive effects from multiple projects?
- Do streambank protection projects result in a net decrease in sediment impairments?
- Does habitat heterogeneity = biological diversity?

(Palmer, 2008)

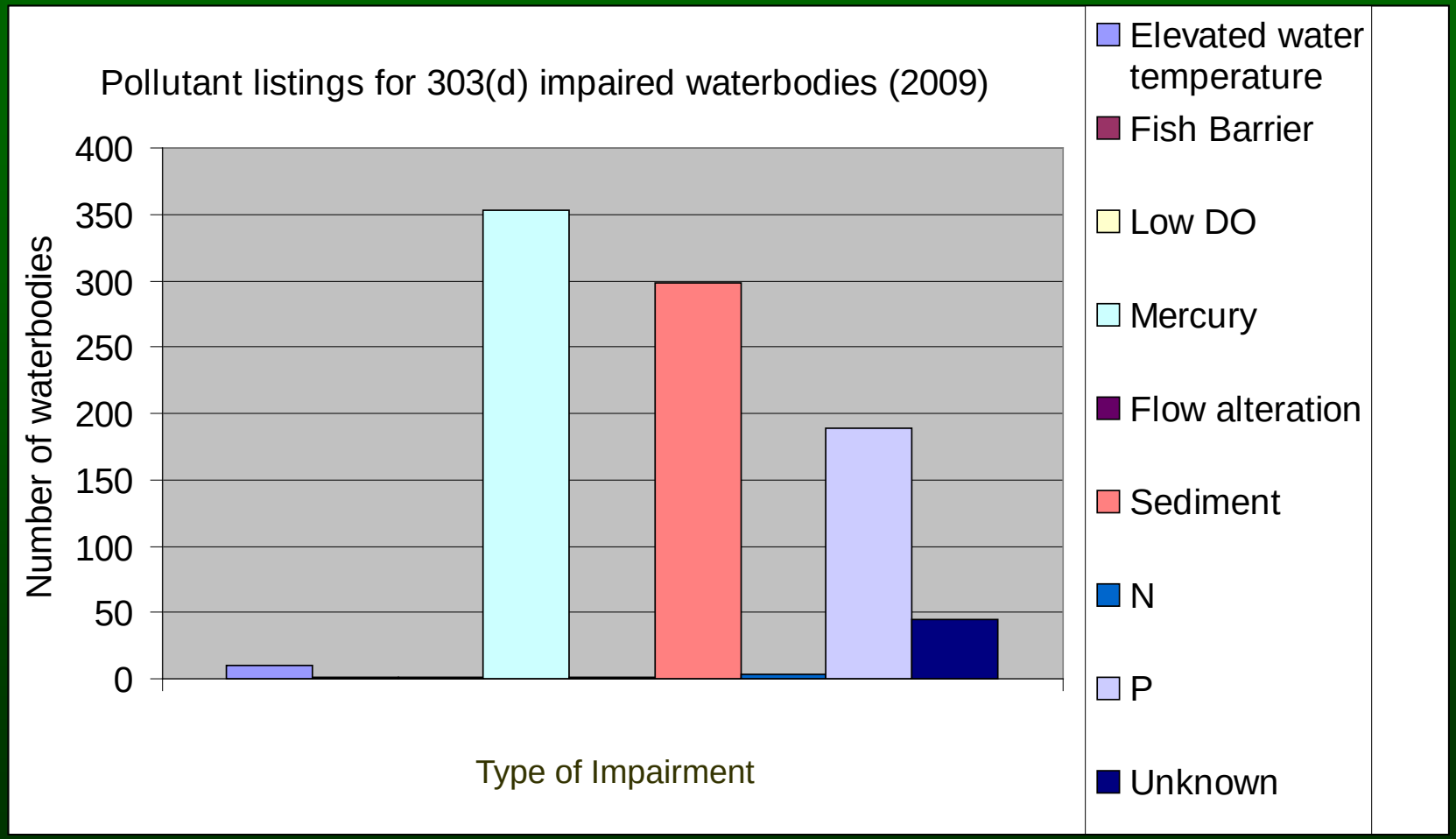
Have changes in historical sediment loads changed the balance between upland and channel sources?

In the WI Driftless area modern sediment loads 2-4x higher than natural rates **but** historical rates were 30x higher



Driftless area example—Halfway Creek (Fitzpatrick et al., 2008)

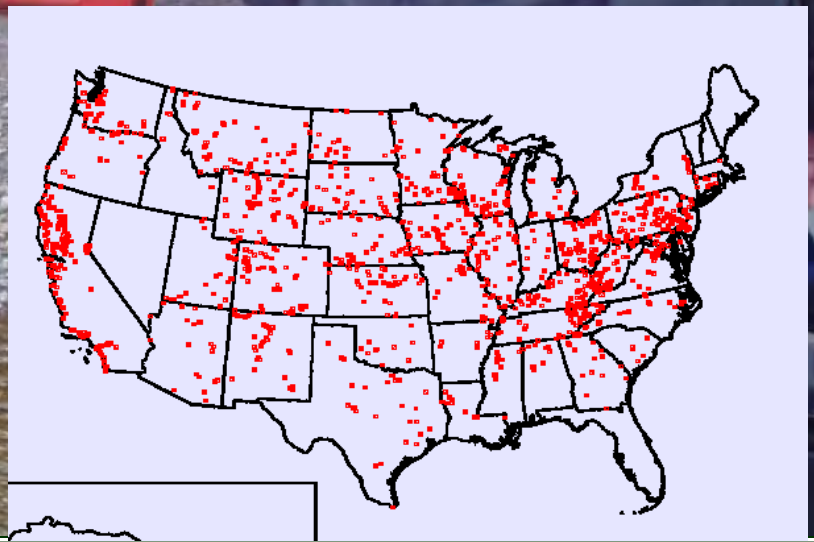
Sediment is the #2 pollutant in Wisconsin water bodies

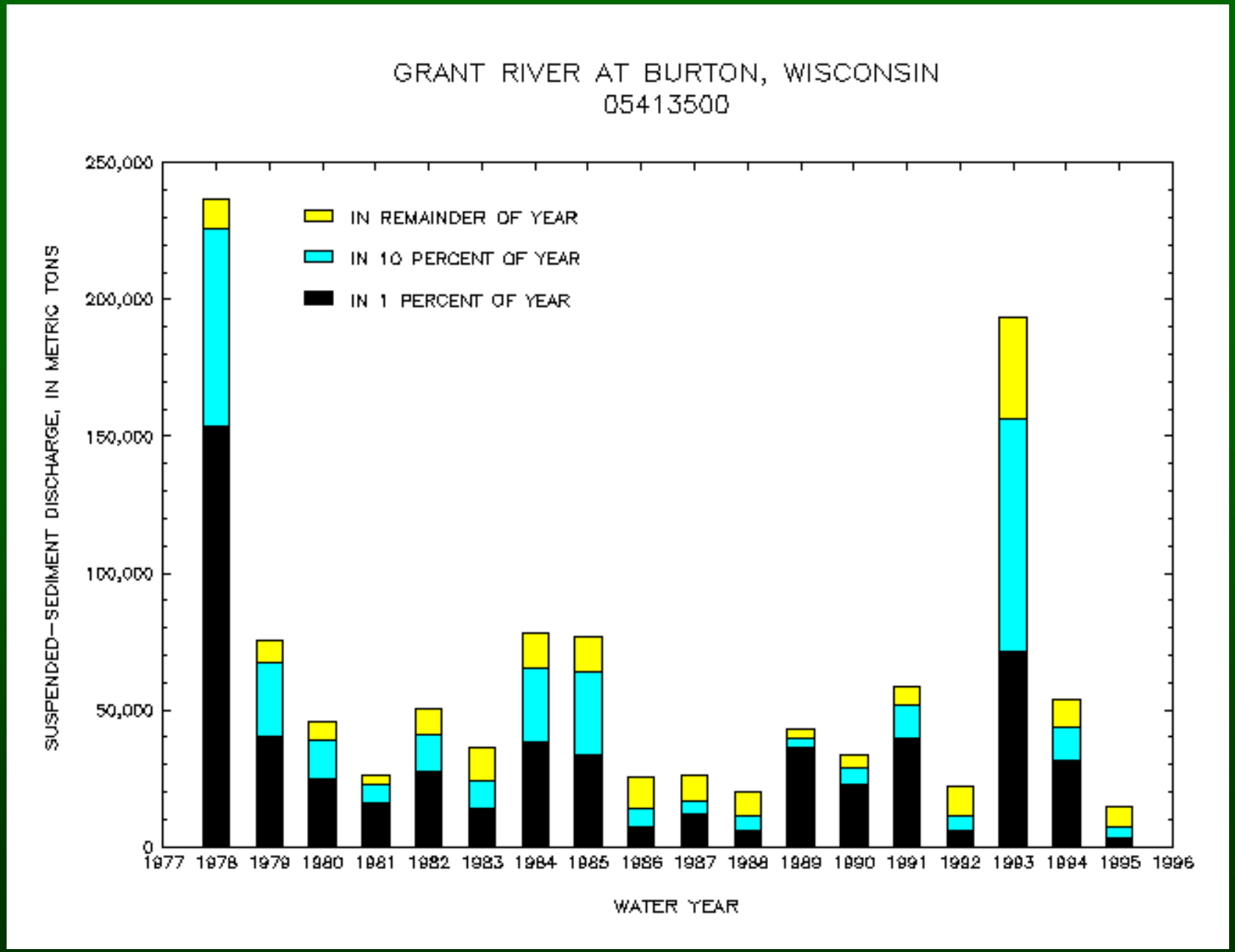


SIDE NOTE….

The last long-term sediment station in the WI USGS was discontinued in the mid 1990s (Grant River)

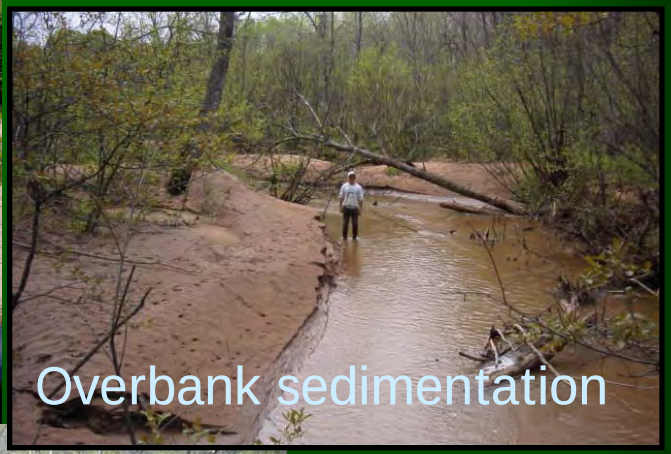
USGS streamgages with historical suspended sediment loads

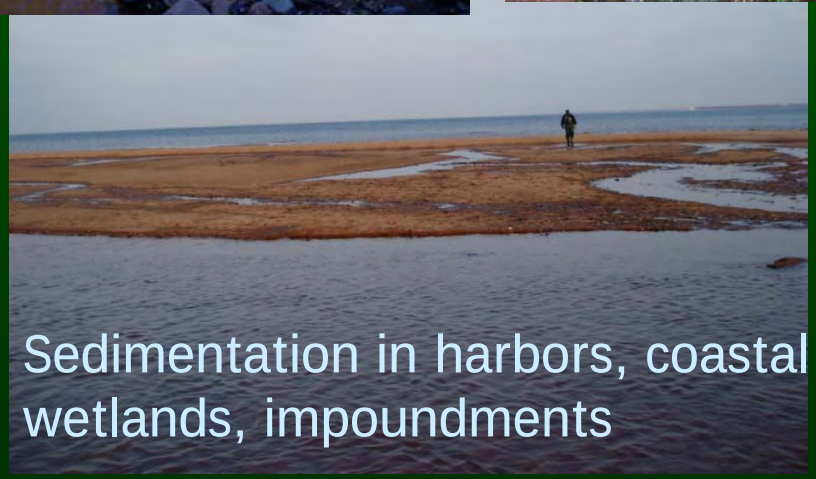


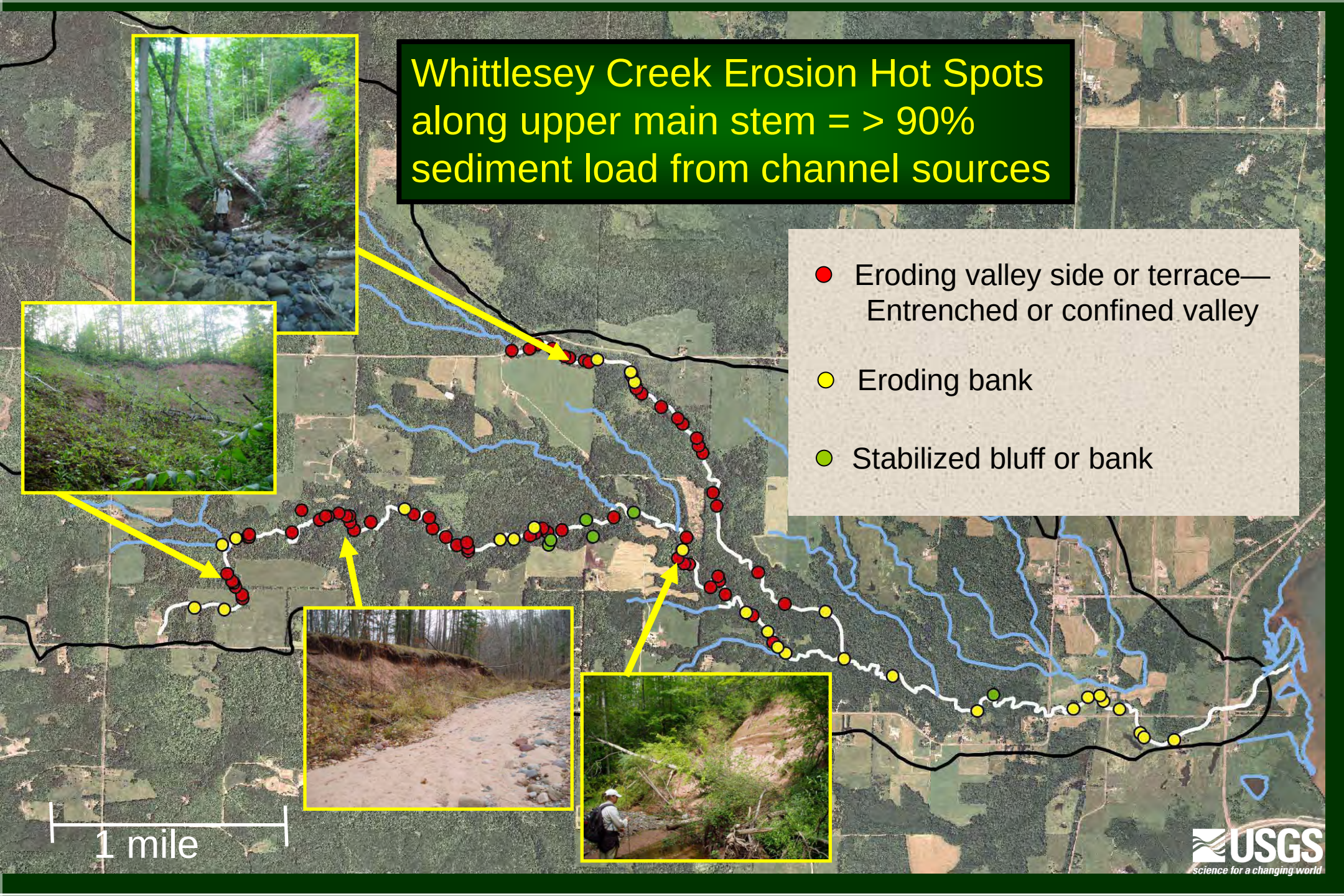

GRANT RIVER AT BURTON, WISCONSIN
05413500
IN REMAINDER OF YEAR
IN 10 PERCENT OF YEAR
IN 1 PERCENT OF YEAR
SUSPENDED-SEDIMENT DISCHARGE, IN METRIC TONS
250,000
200,000
150,000
100,000
50,000
0
1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996
WATER YEAR

Why do we still have a sediment problem?

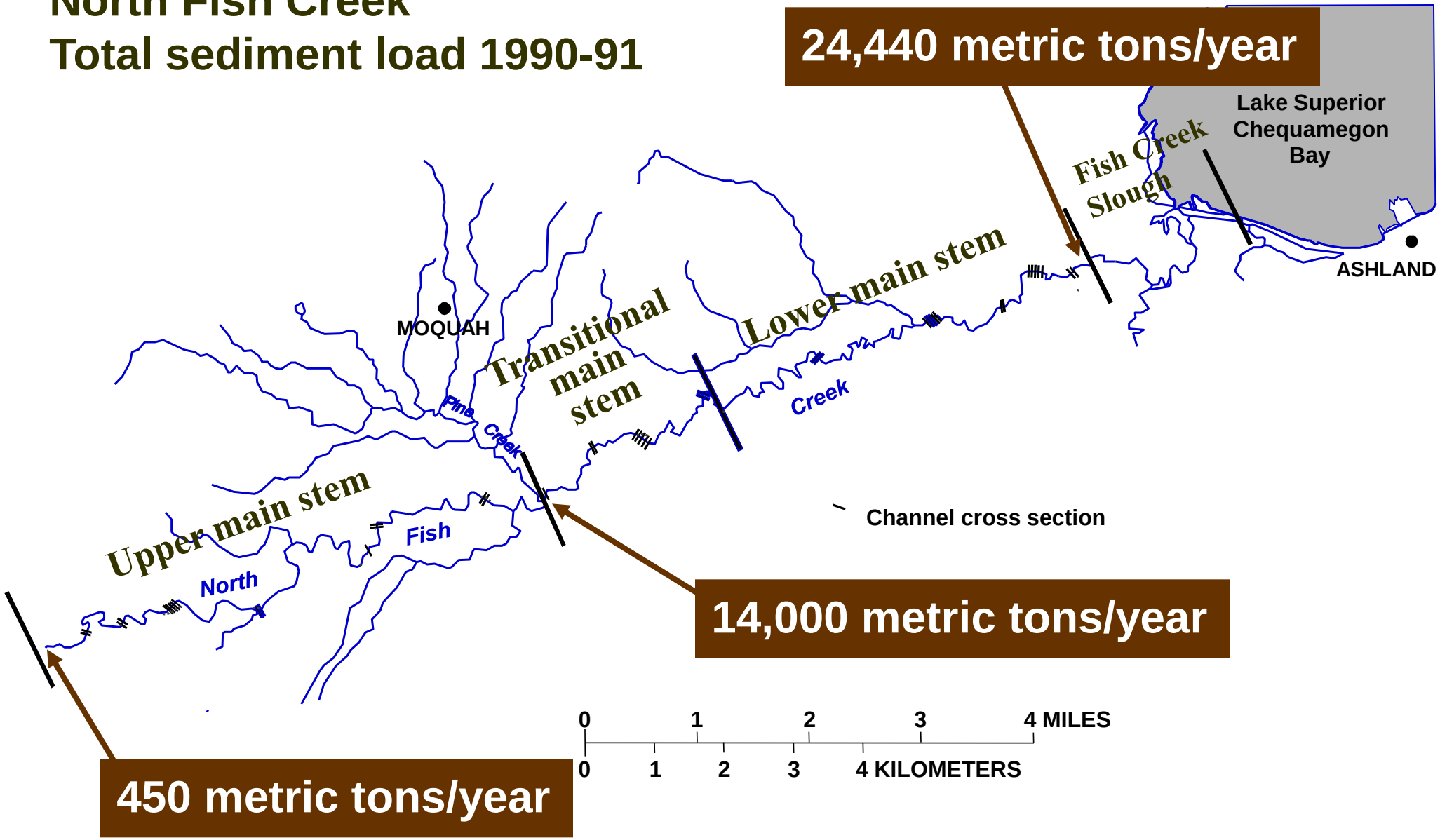
- *Left over instream storage from legacy upland soil erosion?*
- *Modern channel adjustments to extreme floods?*
- *Channel feedback processes related to excess floodplain sediment storage?*





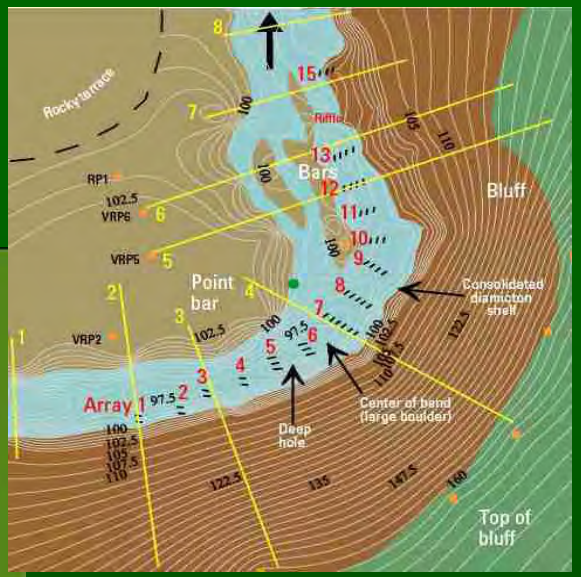

Whittlesey Creek Erosion Hot Spots along upper main stem = > 90% sediment load from channel sources
Eroding valley side or terrace—Entrenched or confined valley
Eroding bank
Stabilized bluff or bank
1 mile
USGS
science for a changing world

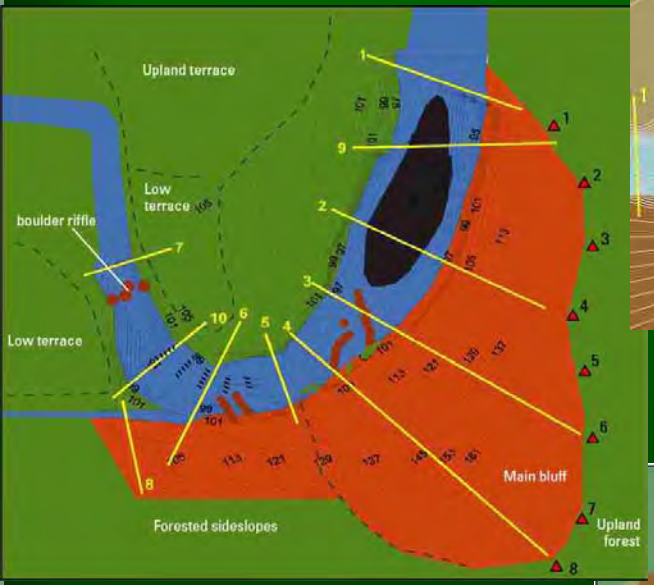
North Fish Creek
Total sediment load 1990-91



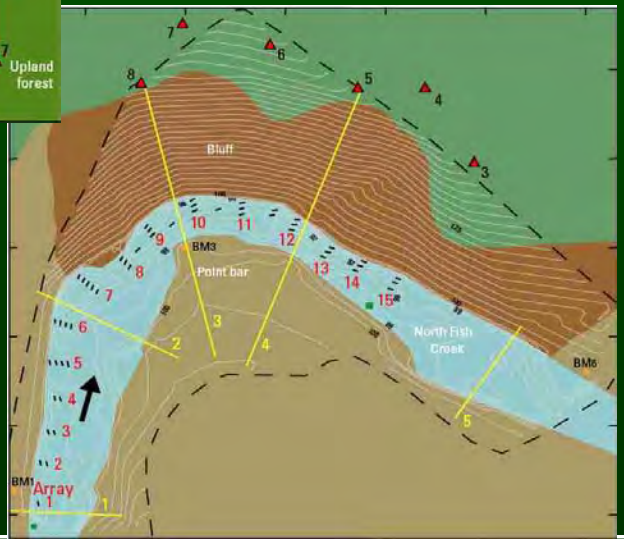
North Fish Creek bluff stabilization (2000-2010)
Repeat cross section surveys

Site 16.4





Site 14.4



Site 12.2

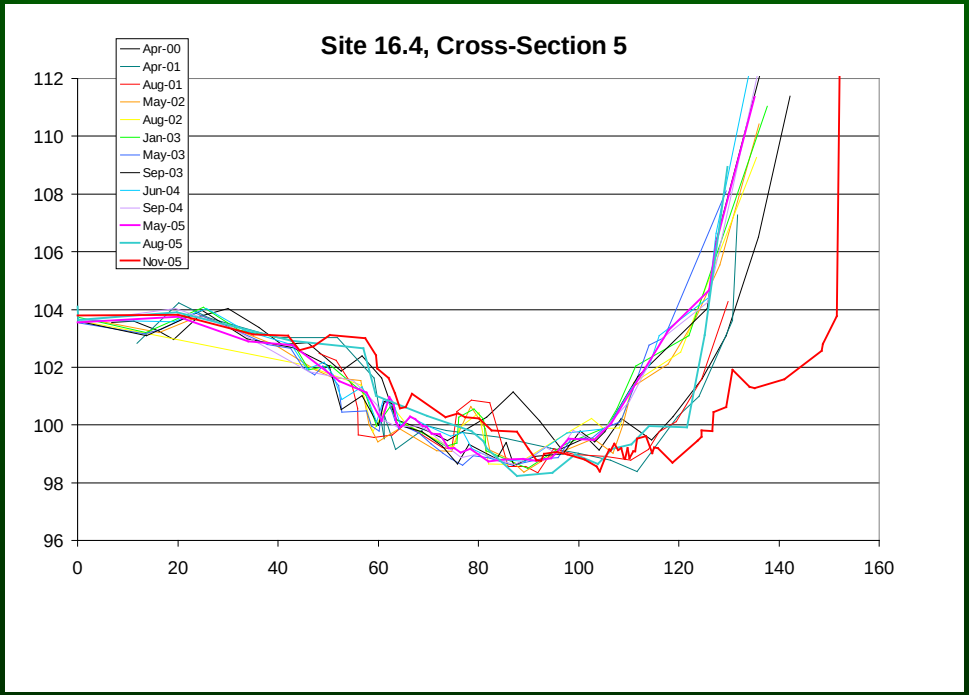
North Fish Creek bluff stabilization

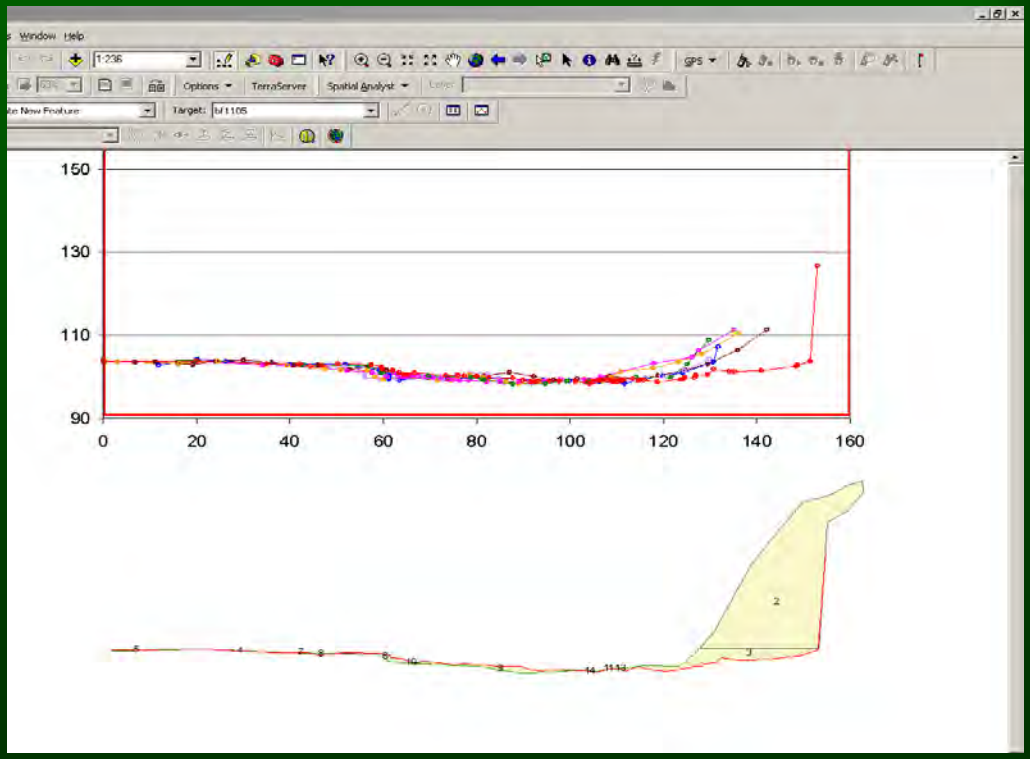
Photo points are qualitative but convey powerful message of success or failure

Site 16.4

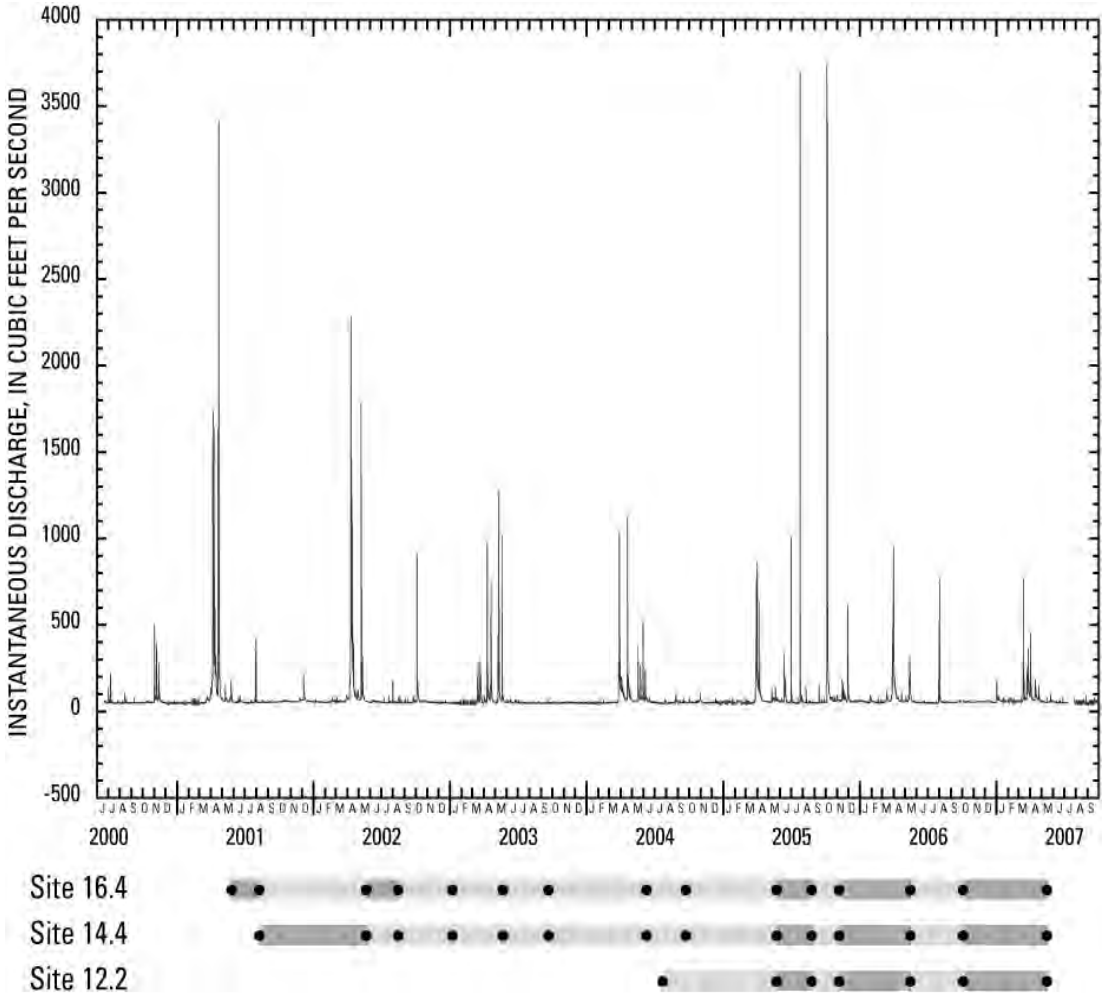
Calculating sediment volume changes

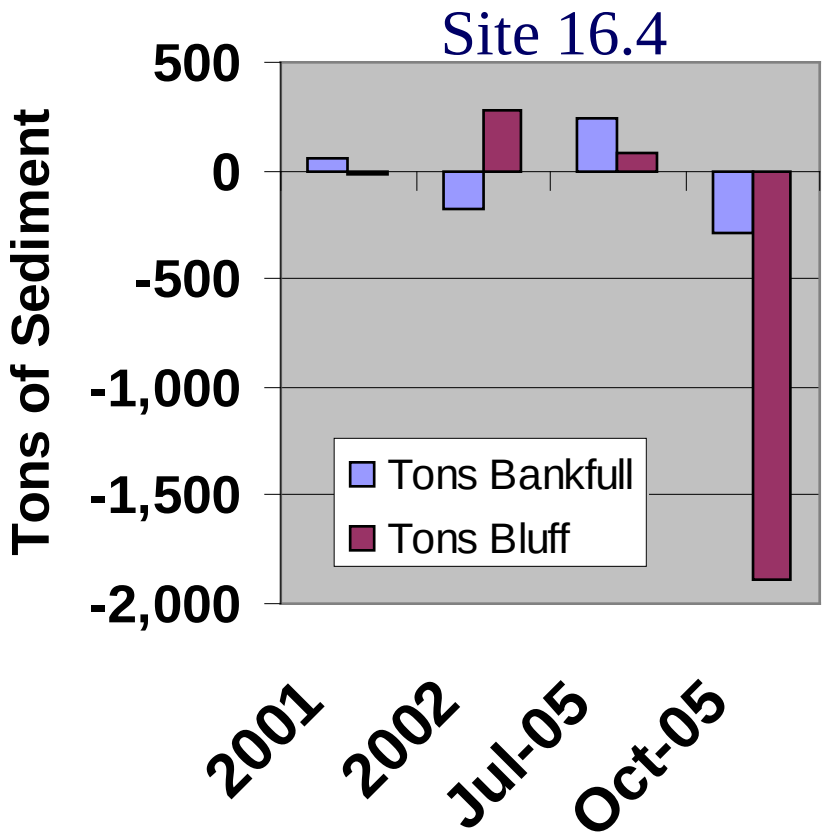
* frequent, repeated, benchmark cross sections
* track areas of change along banks and bed
* cross sectional area changes are digitized in a GIS
* area changes are applied along lengths between cross sections



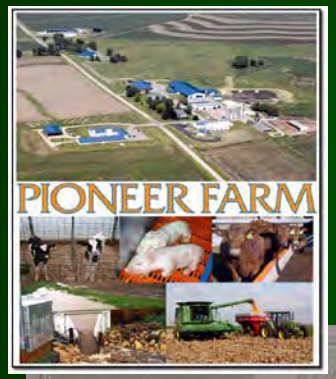


North Fish Creek streamflow and sediment loads



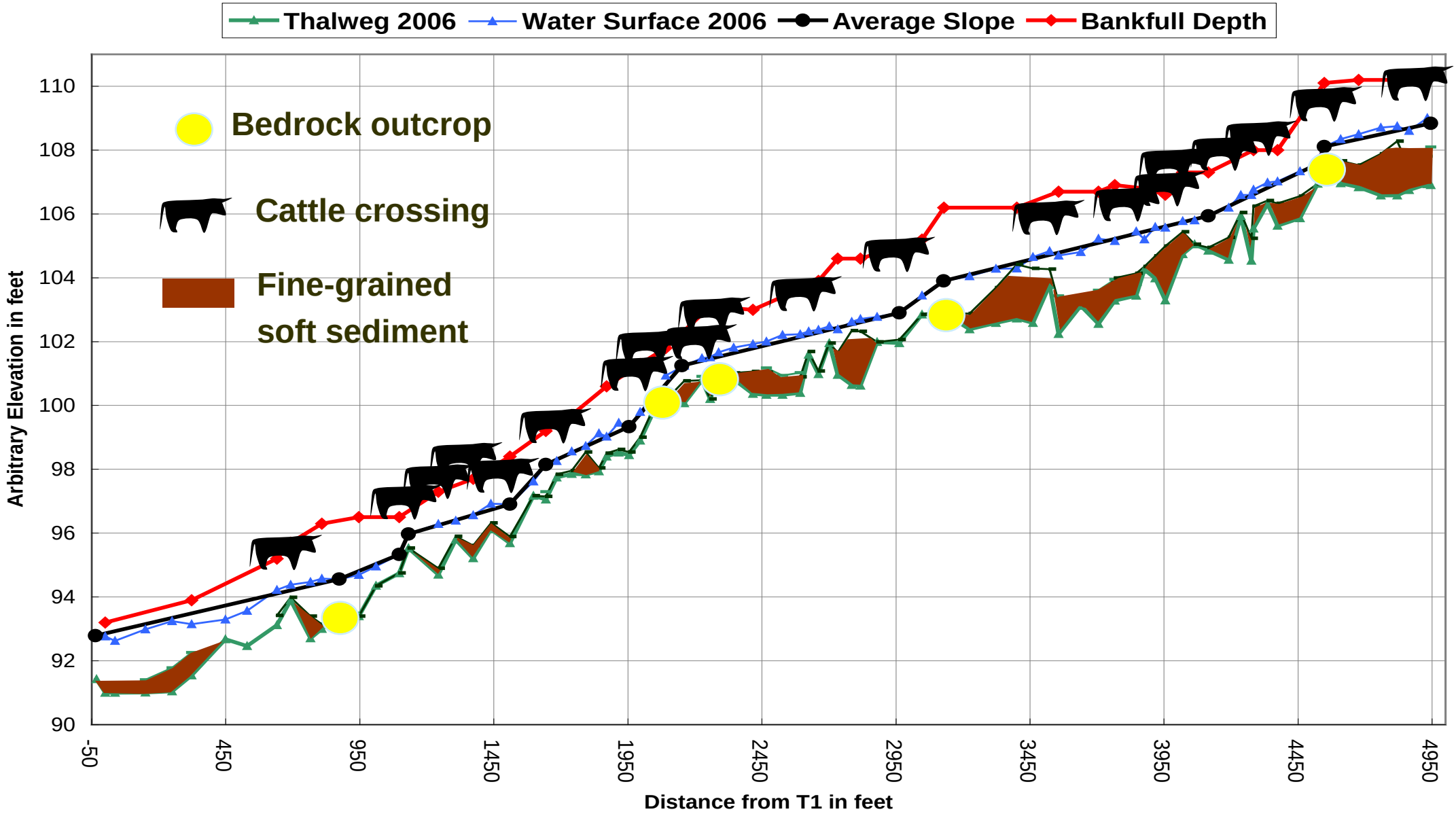


Riparian Rotational Grazing Study (2003-07)



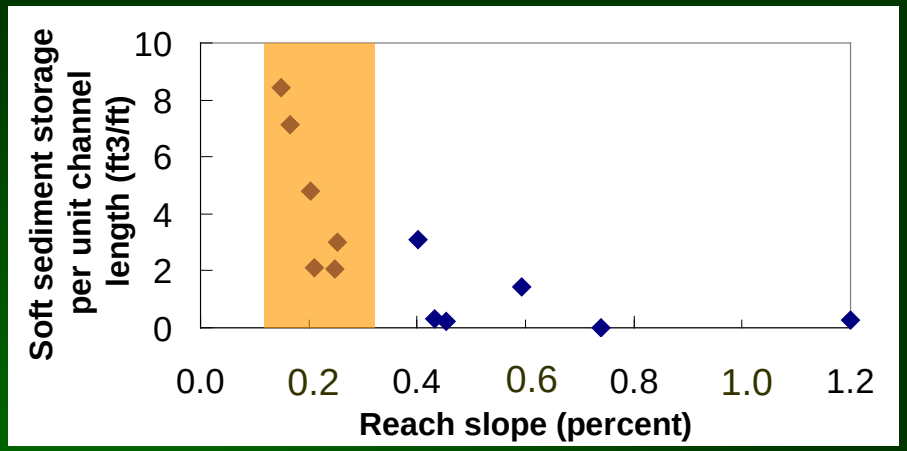
- 0.8 mi stream miles along the Fever River
- 7 paddocks (31 acres)
- 4 constructed crossings
- Herd size average 40 beef cows and heifers, 25 calves, and 1 bull
- Nonsystematic rotation based on forage quality, shade, animal performance

Longitudinal Profile and Sediment Survey from Pioneer Farm, Fever River



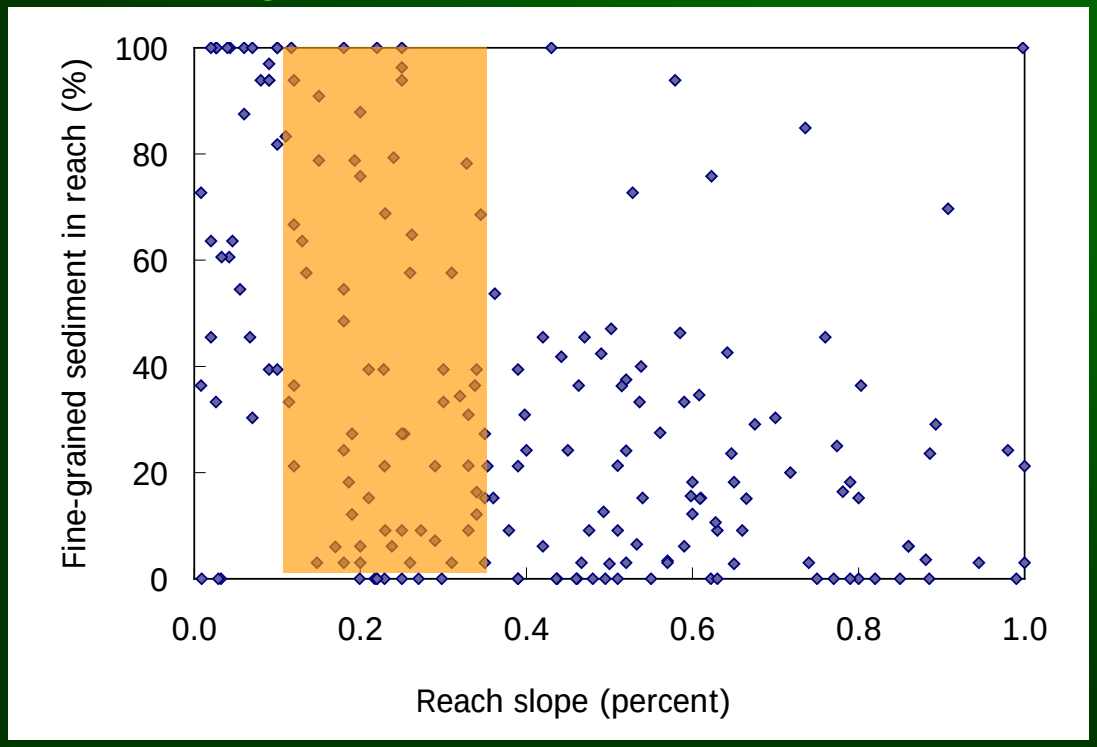
Snapshot of physical conditions

- Highly dependent on slope
- Need geomorphic context
- Nested sites are helpful



Fever River, Pioneer Farm, Wis.
Grazed riparian reach

245 forested, agricultural, and urban streams across the U.S.



Streams across the U.S. that have slopes 0.1-0.3 % have the most potential for variation in fine sediment

Soft fine-grained sediment “savings and loan”

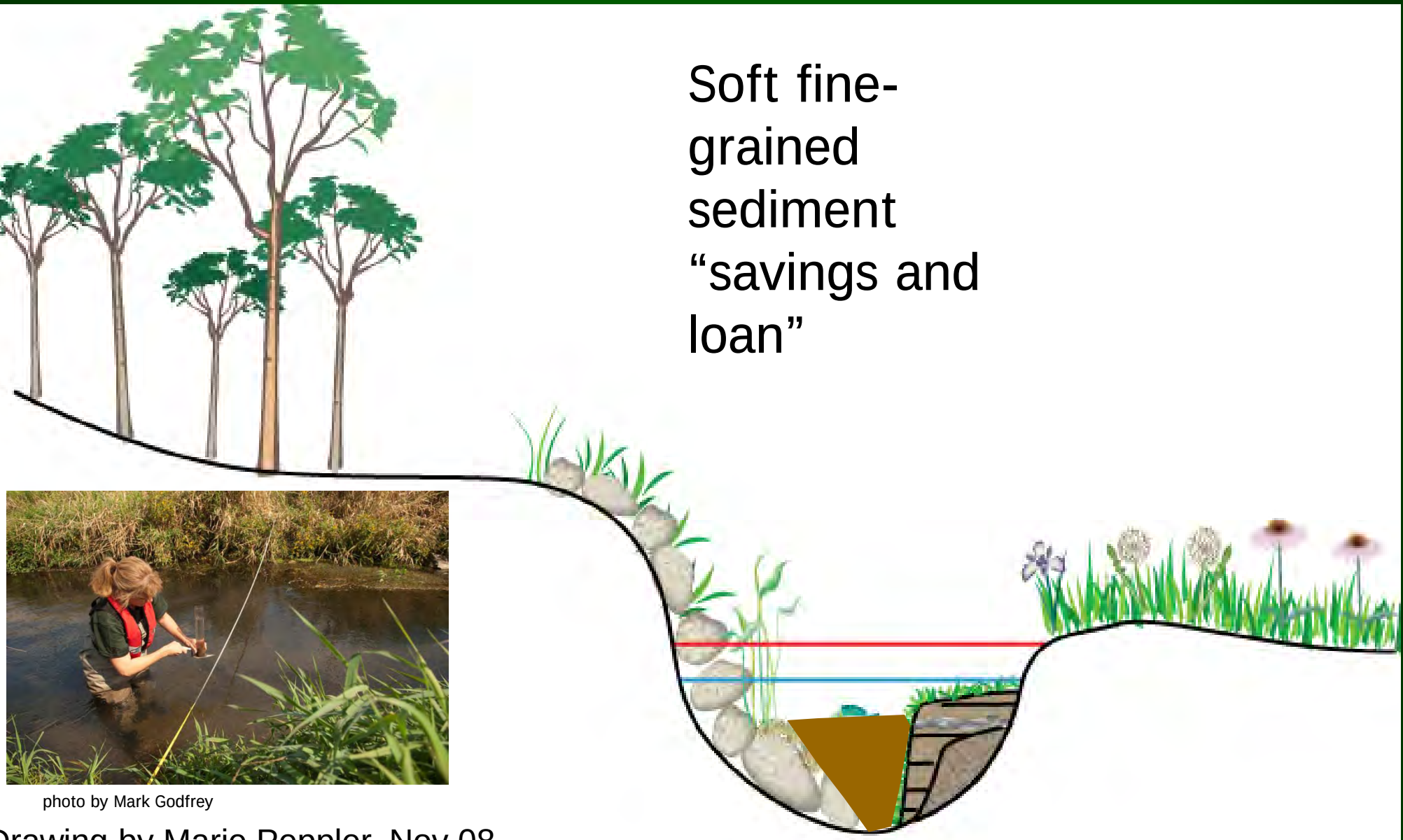
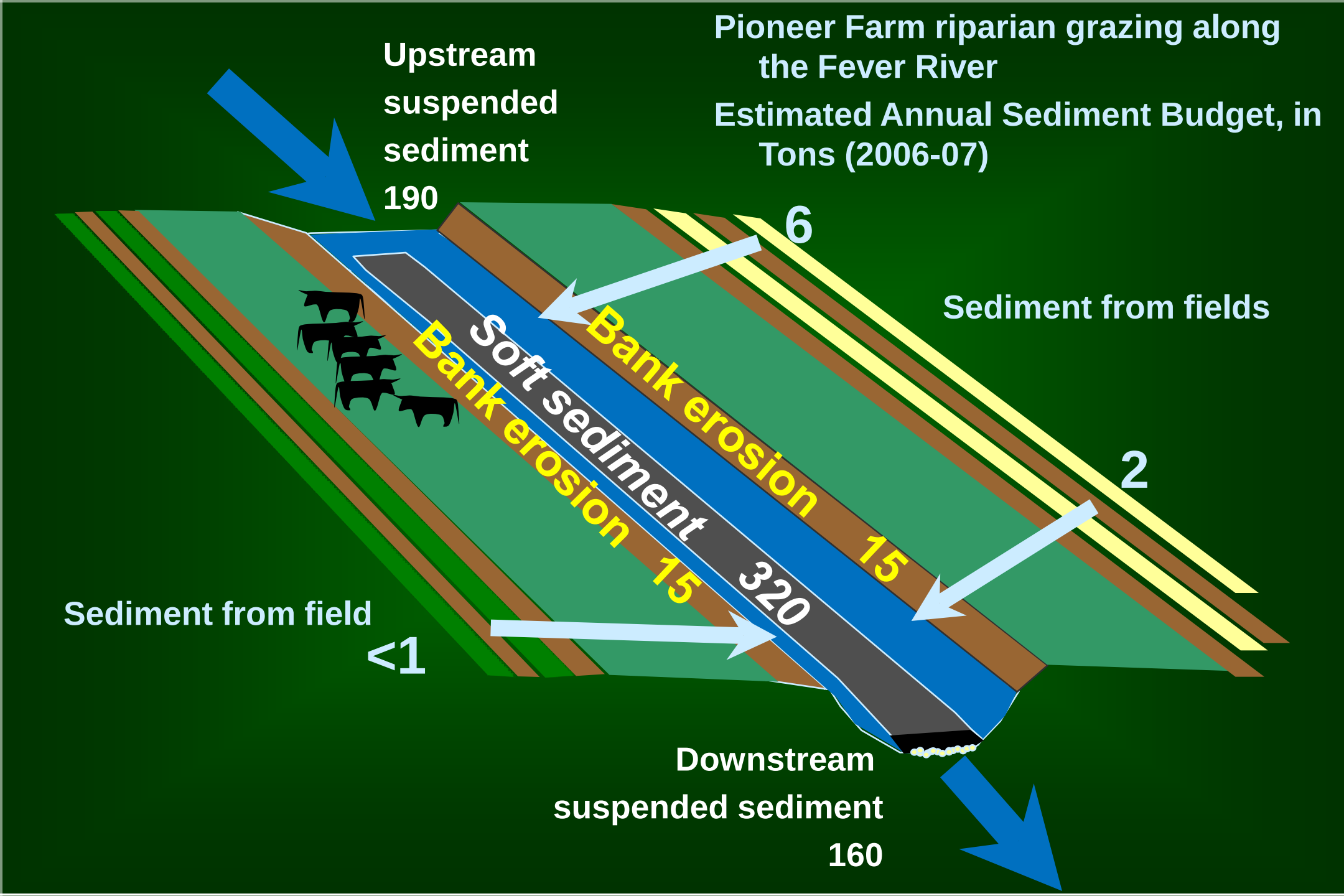
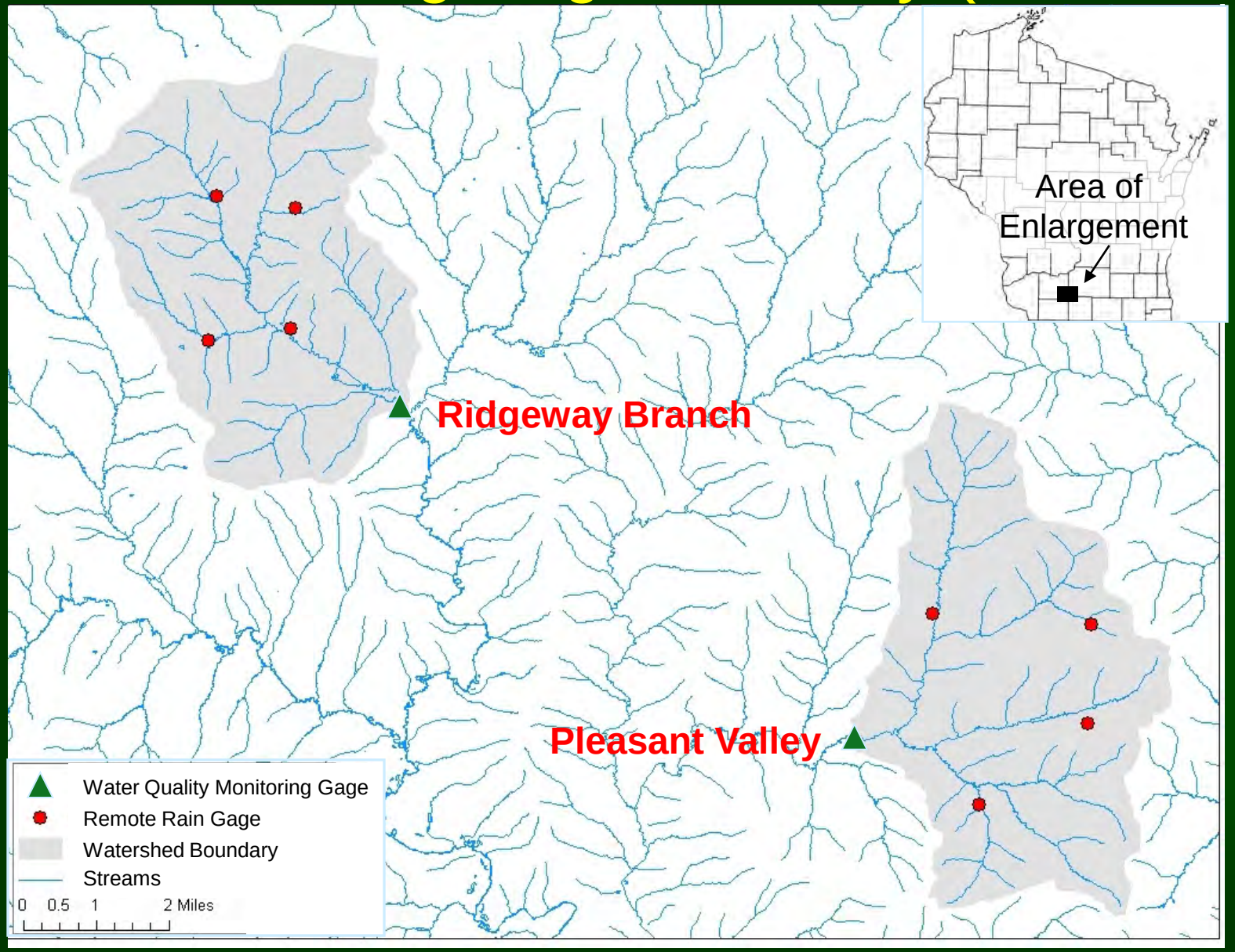


photo by Mark Godfrey

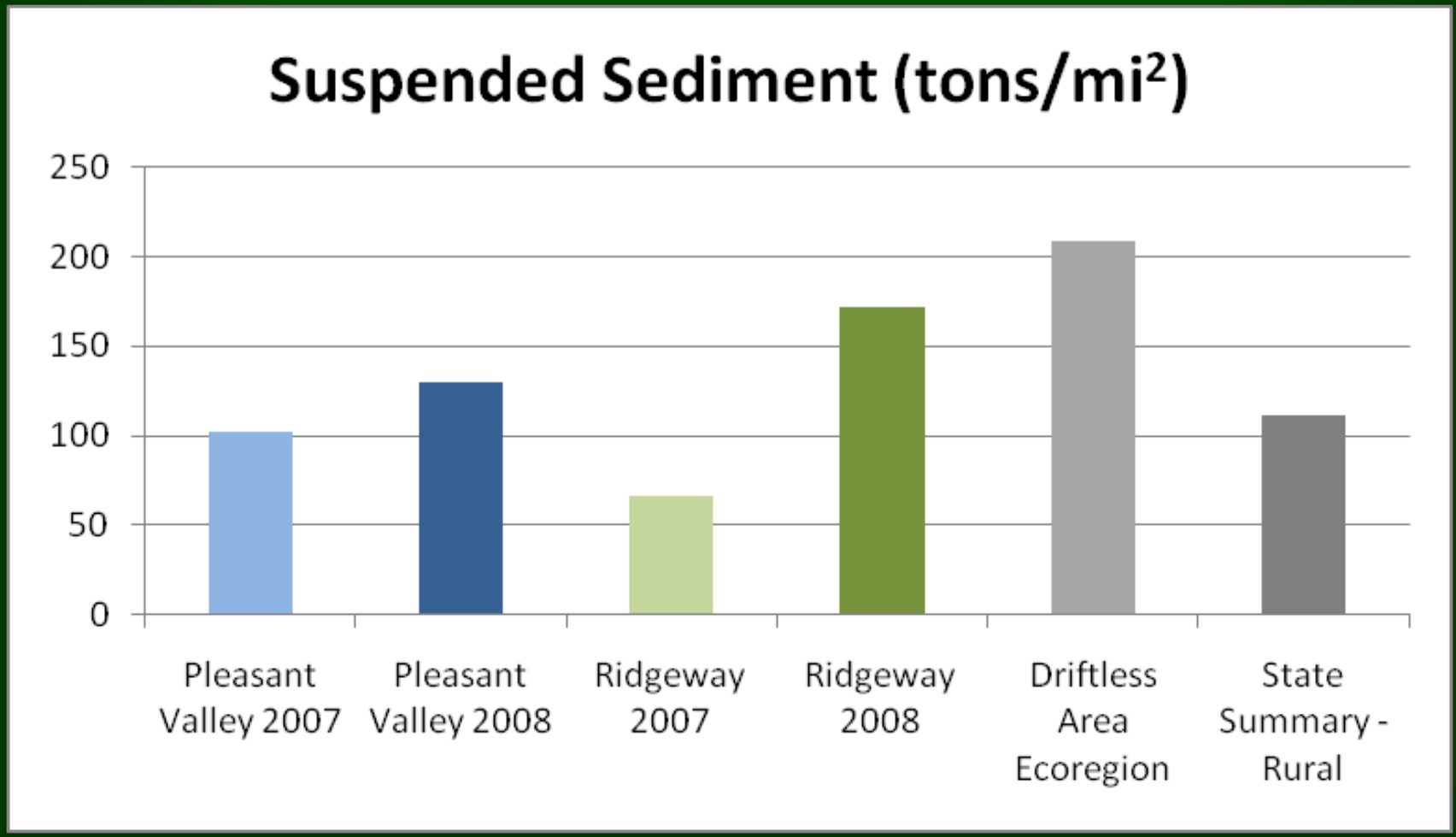
Drawing by Marie Peppler, Nov 08


Pioneer Farm riparian grazing along the Fever River
Estimated Annual Sediment Budget, in Tons (2006-07)
Upstream suspended sediment 190
6
Sediment from fields
Bank erosion 15
Soft sediment 320
Bank erosion 15
2
Sediment from field <1
Downstream suspended sediment 160

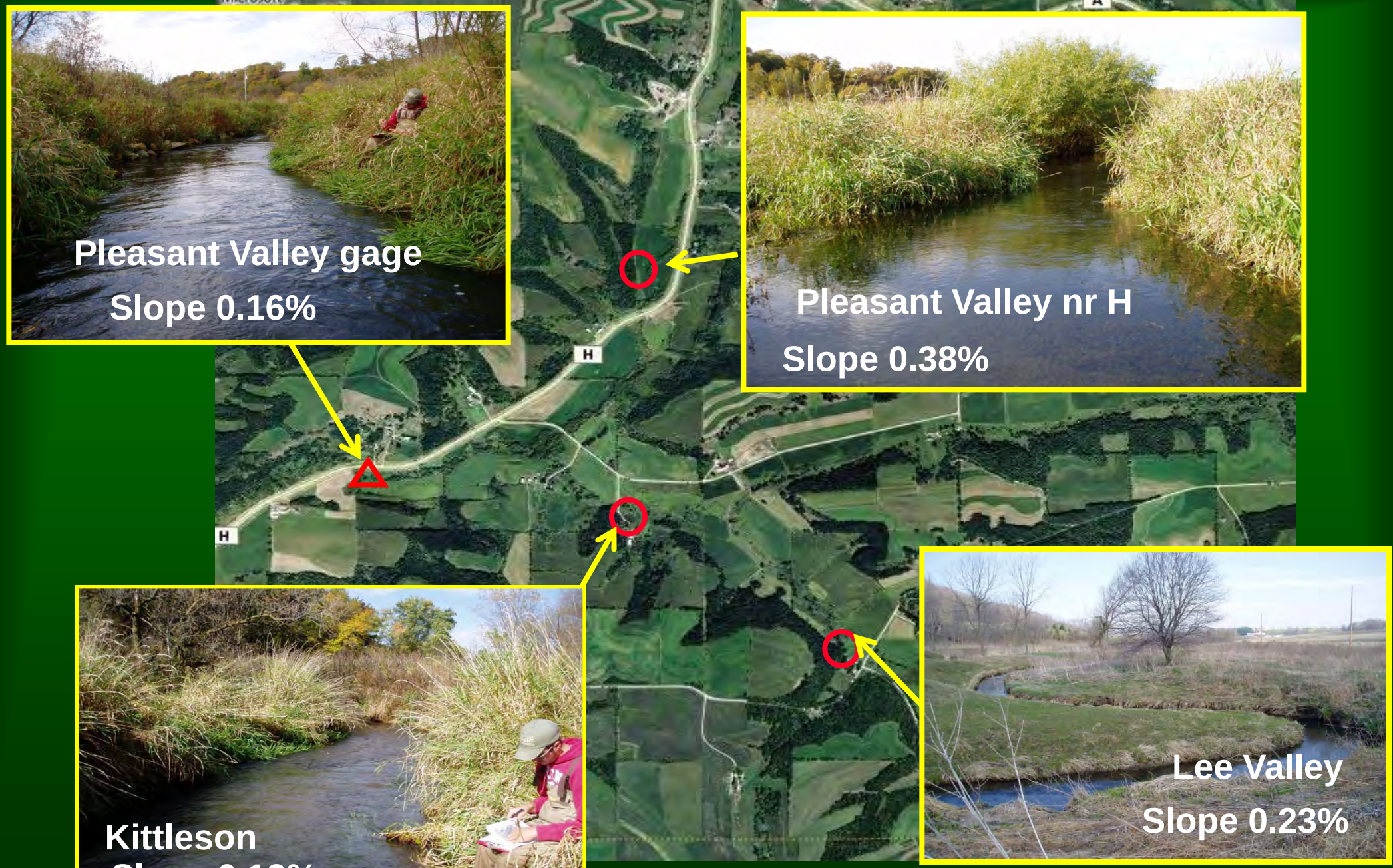
Pecatonica R. Targeting BMP study (2009-2012)



Pecatonica Targeting BMP study



Graph courtesy David Graczyk


Pleasant Valley gage
Slope 0.16%
Pleasant Valley nr H
Slope 0.38%
Kittleson
Slope 0.12%
Lee Valley
Slope 0.23%
H
H
A

WISCONSIN REGIONAL BANKFULL CURVES FIELD SHEET

Developed by Marie Peppler (USGS), 2007

SECTION 4 - Pebble Counts

Pebble counts

RIVER KITTLESON VA. STATION ID DA

LOCATION TRUMAN RD. / ABOVE CTH RD. H USGS GUAGE (ON BACK) TIM

FIELD CREW FAITH FITZPATRICK, RYAN KURTZ DNR

WEATHER (Clear) → Partly Coudy Cloudy Rain Snow Windy

RIVER STAGE (Stable, normal) Peak Falling Rising Stable, low

PROTOCOL SUMMARY:

Size in mm will be recorded for 100 pebbles chosen at random from the channel bed from 10 transects

If the sample is covered in an organic fluff layer, MARK sample in box.

Sand or finer particles will be hand textured with the aid of a sand guage:

For <2 mm, record as follows:

VCS - very coarse sand	FS - fine sand	CL - clay
CS - coarse sand	VFS - very fine sand	OR - organic detritus
MS - medium sand	SI - silt	M - MACROPHYTES

If channel bed is more than 50% sand, see protocol for QA sampling method.

If channel bed is 100% sand, see protocol for sampling method.

PC1 - PEBBLE COUNT - Note location on Reach Map

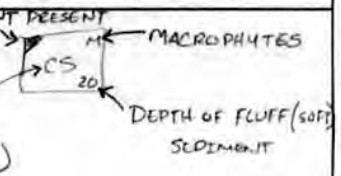
RIFFLE at Transect Number _____

measurements in mm

Notes:

ON BOTTOM GRID

BOTTOM SUBSTRATE (WIDTH)(PEBBLE SIZE)



FS 30	FS M 0	FS M 0	150 M 40	400 M 25	35 M 80	25 0	210 0	110 0	200 0	10
	CS 10	11 0	FS M 0	MS M 0	150 M 0	400 M 0	65 M 0	20 M 40	510 0	9
9 0	VCS M 0	FS M 0	95 M 0	H2 M 0	14 M 0	15 0	130 0	350 0		8
		MS 0	3 0	MS M 0	MS M 0	CS M 0	20 M 40	150 M 0	32 0	7
15 0	110 0	FS M 0	50 M 20	25 M 10	40 0	250 0				6
			FS M 0	60 M 0	20 M 0	60 M 0	40 M 0	80 M 0	160 0	5
MS M 0	FS M 0	160 M 0	VFS M 0	16 M 0	300 0	70 0	250 0			4
		SI 120	MS 0	MS M 0	MS M 0	VFS M 0	FS M 0	125 0	25 0	3
FS 20	40 0	80 0	75 M 0	CS 0	FS M 0	25 0	68 0			2
SI 50	SI 0	FS 0	10 0	70 0	MS 0	15 0	40 0	15 0	CS 30	1

↑ DOWNSTREAM START

PC2 - PEBBLE COUNT - Note location on Reach Map

RIFFLE at Transect Number _____

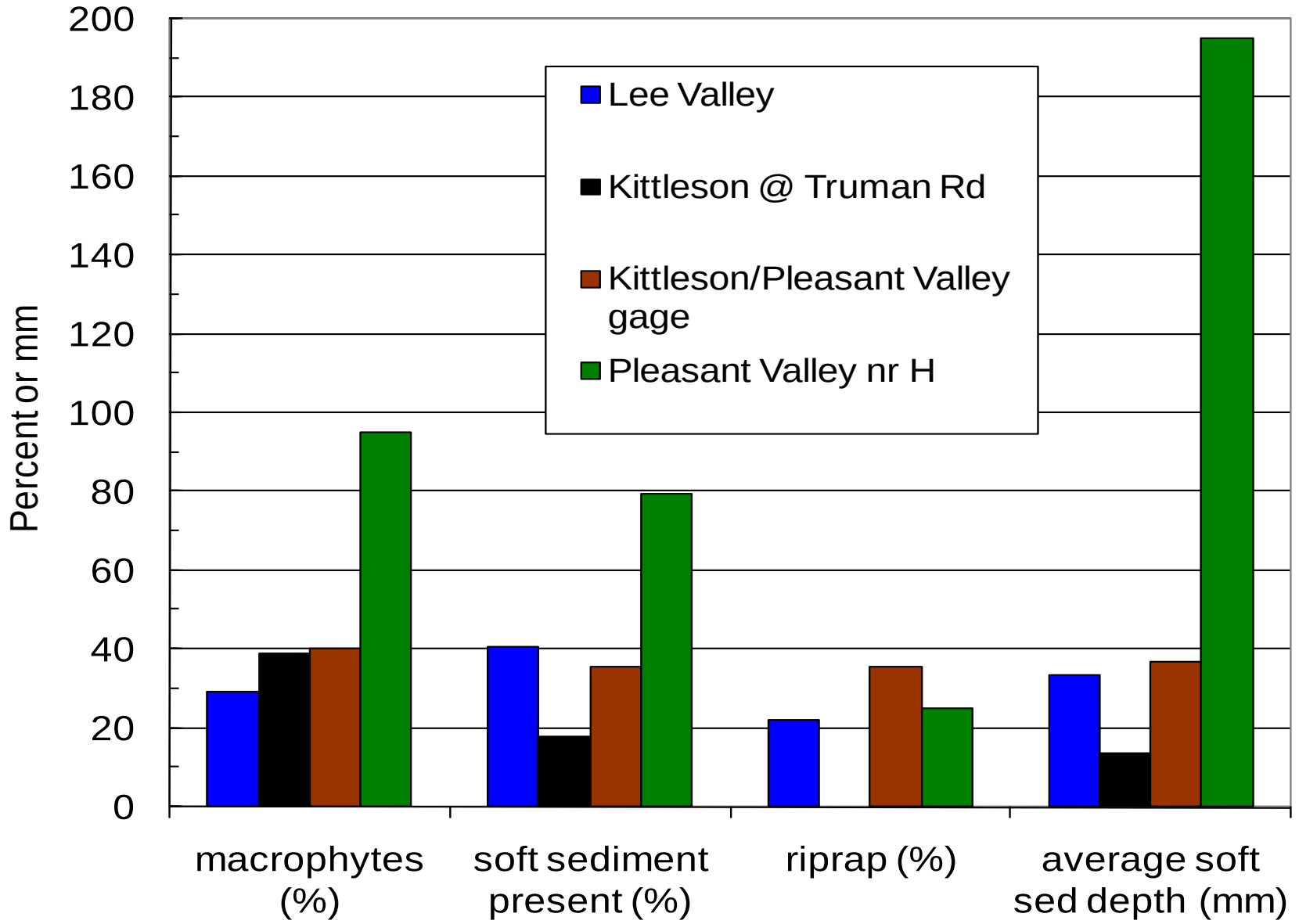
measurements in mm

Notes: BASE FLOW IS HIGH
STREAM SEEMS STABLE

FS 70	10 0	25 M 170	40 M 140	120 M 20	40 M 60	25 M 0	70 0	62 0	85 0	11
FS 100	34 0	45 M 130	18 M 60	115 M 60	15 0	55 0	35 0	44 0		12

most u/s transect

Pebble counts Fall 2008



Pecatonica Nested Design

- 30 total sites
  - Ephemeral and perennial throughout the 19 mi^2 watershed
  - Rapid channel/sediment stability assessment
  - Quantitative measurements of eroding banks and soft sediment deposition
  - Low-flow discharge measurements
- 15 nested sites
  - Modified pebble counts
  - Bank and streambed samples for particle size, total P, organic matter, and radioisotopes for sediment fingerprinting
- 10 nested sites
  - Repeat channel cross sections
  - macroinvertebrate, fish, and habitat surveys
- 6 nested sites
  - Walling sediment tube samplers – event based sediment fingerprinting
- 1 streamgage at watershed outlet with continuous streamflow, nutrients, and suspended sediment load

Successful Monitoring:

- Need understanding of causes for channel instability – baseline conditions
- Qualitative and quantitative measures specific to sediment processes and rates are needed
- Multiple lines of evidence are needed that span multiple spatial and temporal scales
- Geomorphic measurements + ecological endpoints complimentary
- Need quality assurance, context and understanding of sensitivity of results
- Awareness of climate change and nonstationarity issues with restoration monitoring
- Need time!

Role of the USGS in restoration?

- Traditional role is monitoring and assessment
- Archiving monitoring/evaluation data?
  - currently no common agency-supported data base for geomorphic data
- Dissemination of evaluation results?
  - USGS standard reports or web site?
  - Publication in journals or trade magazines?
  - Internet?
- Testing/evaluation of new strategies within the science?

http://wi.water.usgs.gov/surface-water/geomorph.html

http://wi.water.usgs.gov/professional-pages/fitzpatrick.html