

Quantifying Stored Sediment in Southwest Wisconsin Stream Channels

Robert Hansis
Faith Fitzpatrick

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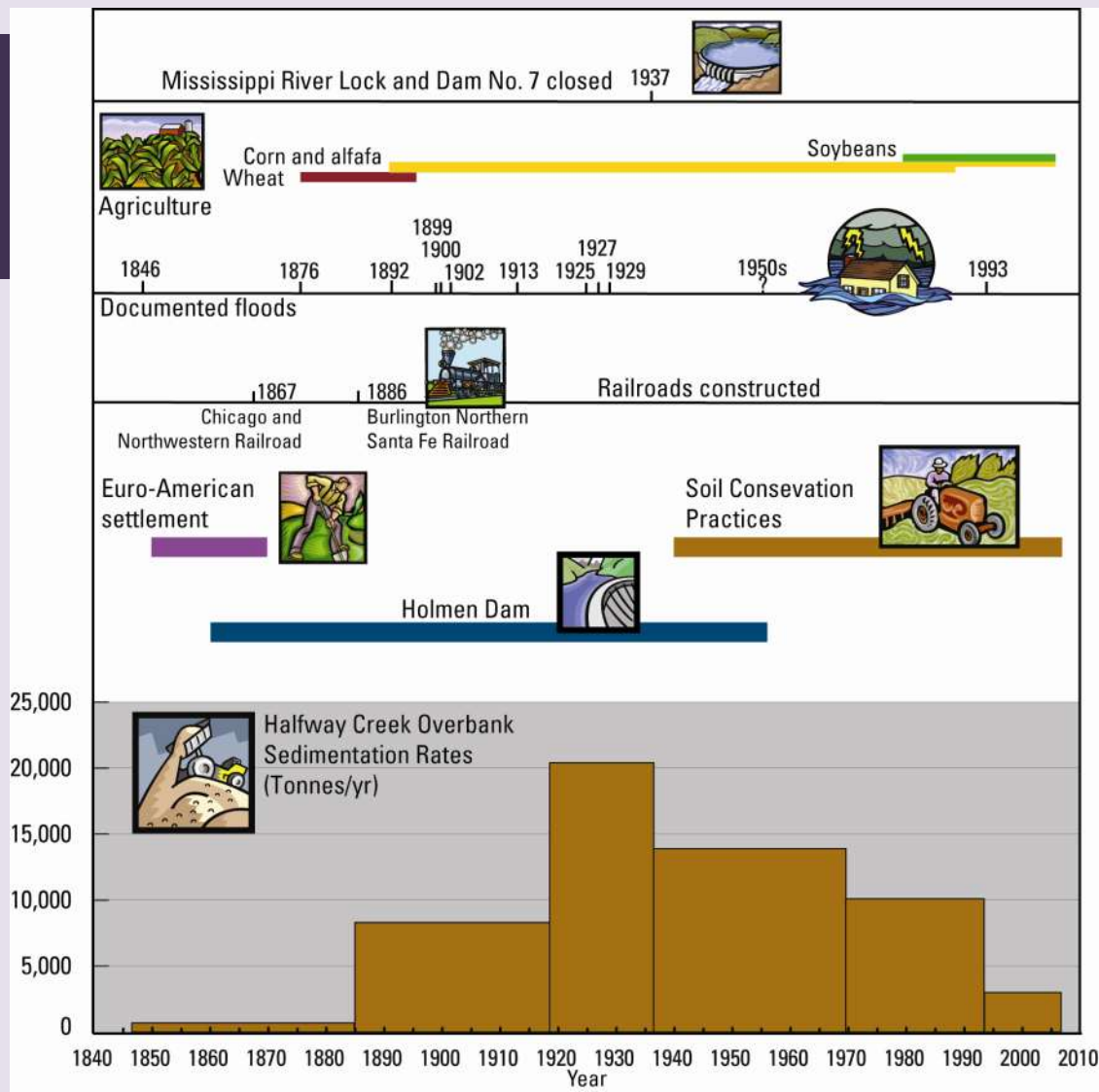
Minneapolis, MN



Historical sedimentation (and erosion) rates have decreased by an order of magnitude over the last 75 years because of widespread adoption of soil conservation practices

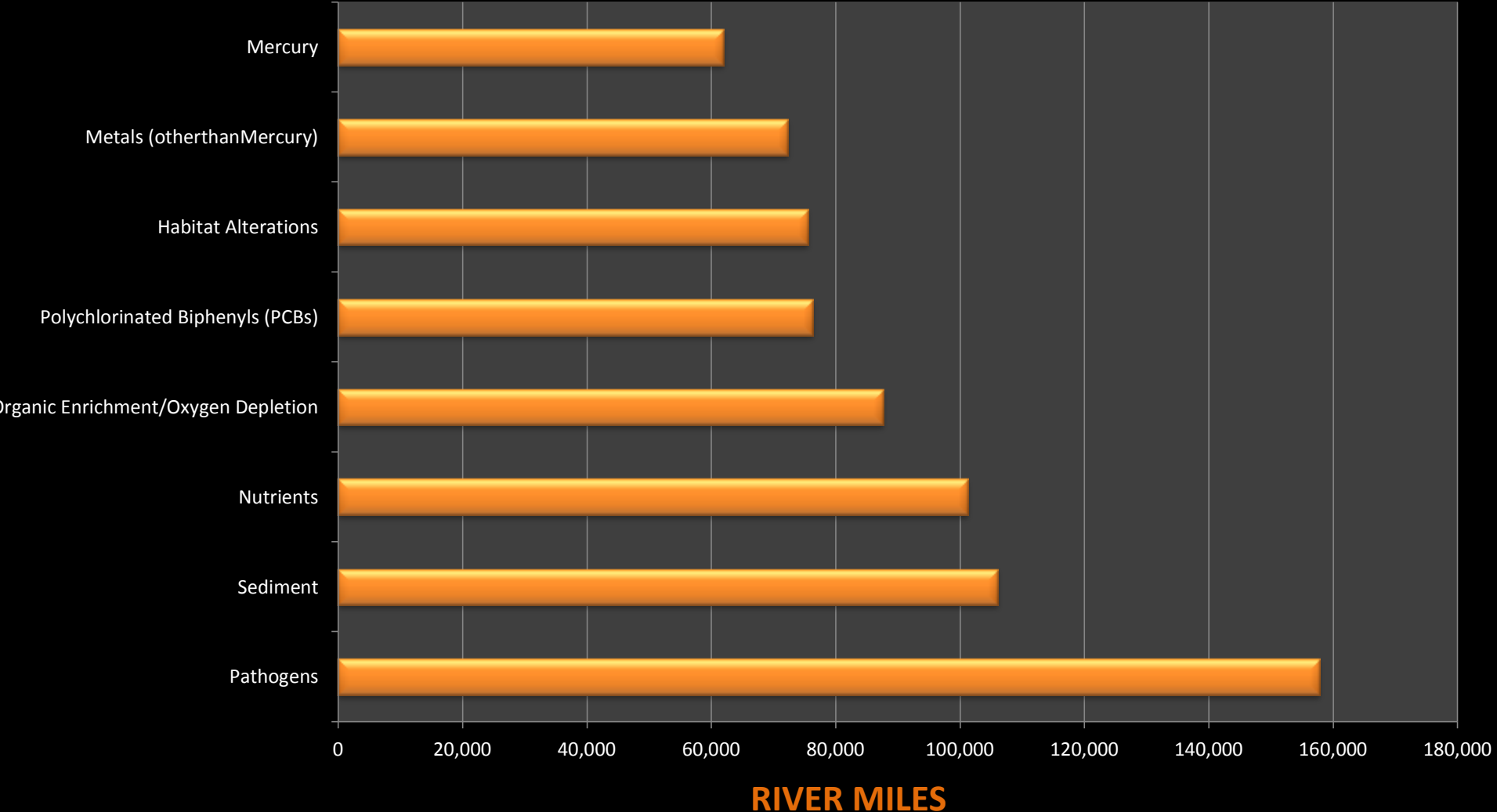


**WI Driftless Area
Upper Mississippi River
Halfway Creek
(Fitzpatrick, et al. 2009)**



Fluvial sediment is a national and global challenge

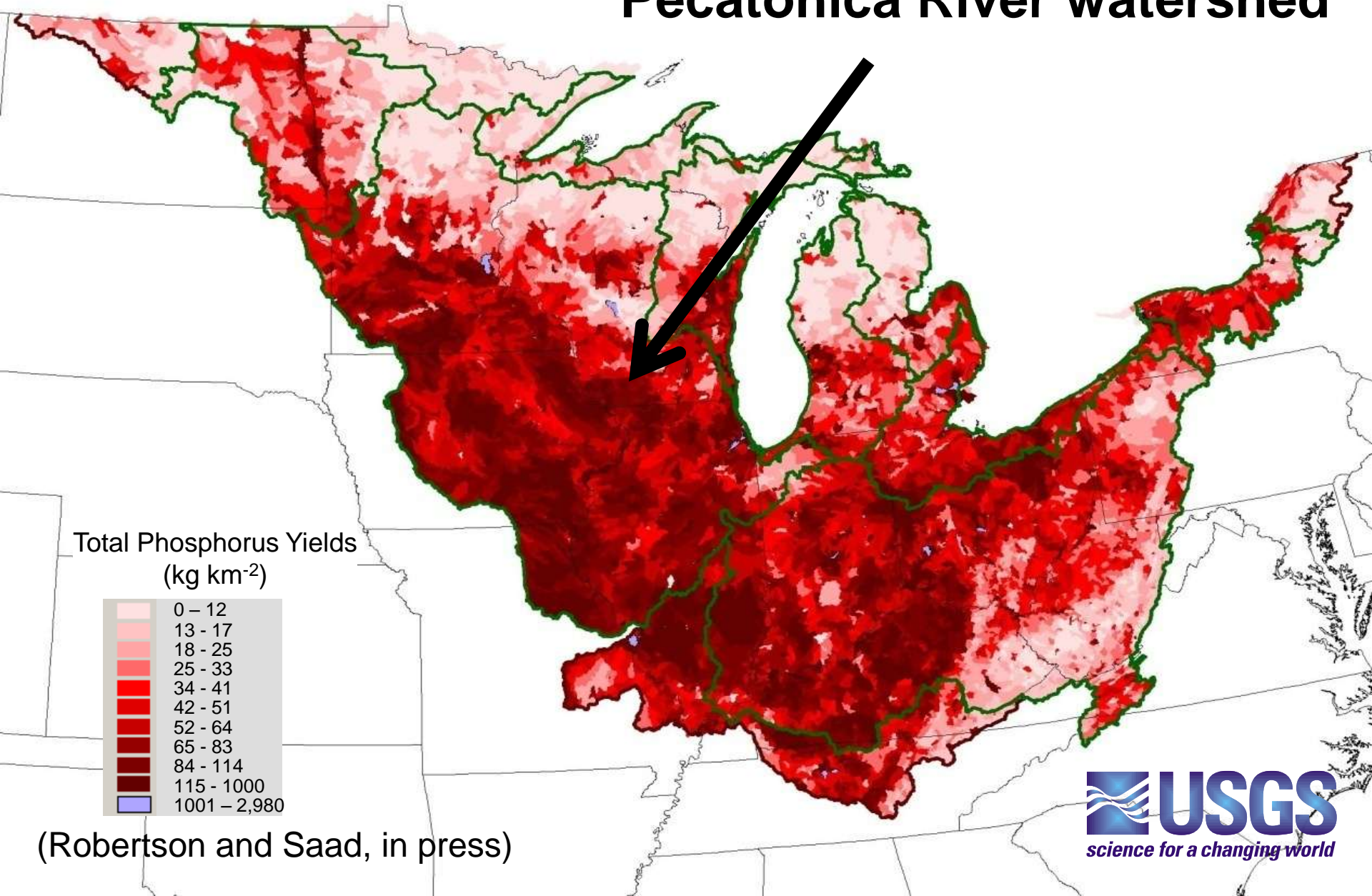
NATIONWIDE IMPAIRED WATERS CAUSES—USEPA 2010





SPARROW Total Phosphorus Yields

Pecatonica River watershed



(Robertson and Saad, in press)

Siltation causes biological impairments

45% of stream impairments are habitat losses due to sedimentation



Wisconsin 2010 Consolidated Assessment and Listing Methodology (WisCALM)
Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting

Wisconsin Department of Natural Resources
Last Revised 11/30/2009

Wisconsin Department of Natural Resources
101 S. Webster Street • PO Box 7921 • Madison, Wisconsin 53707-7921
608-266-2021

Wisconsin Water Quality Report to Congress 2010

Table 38. Rivers and Streams - Impairment and their Source

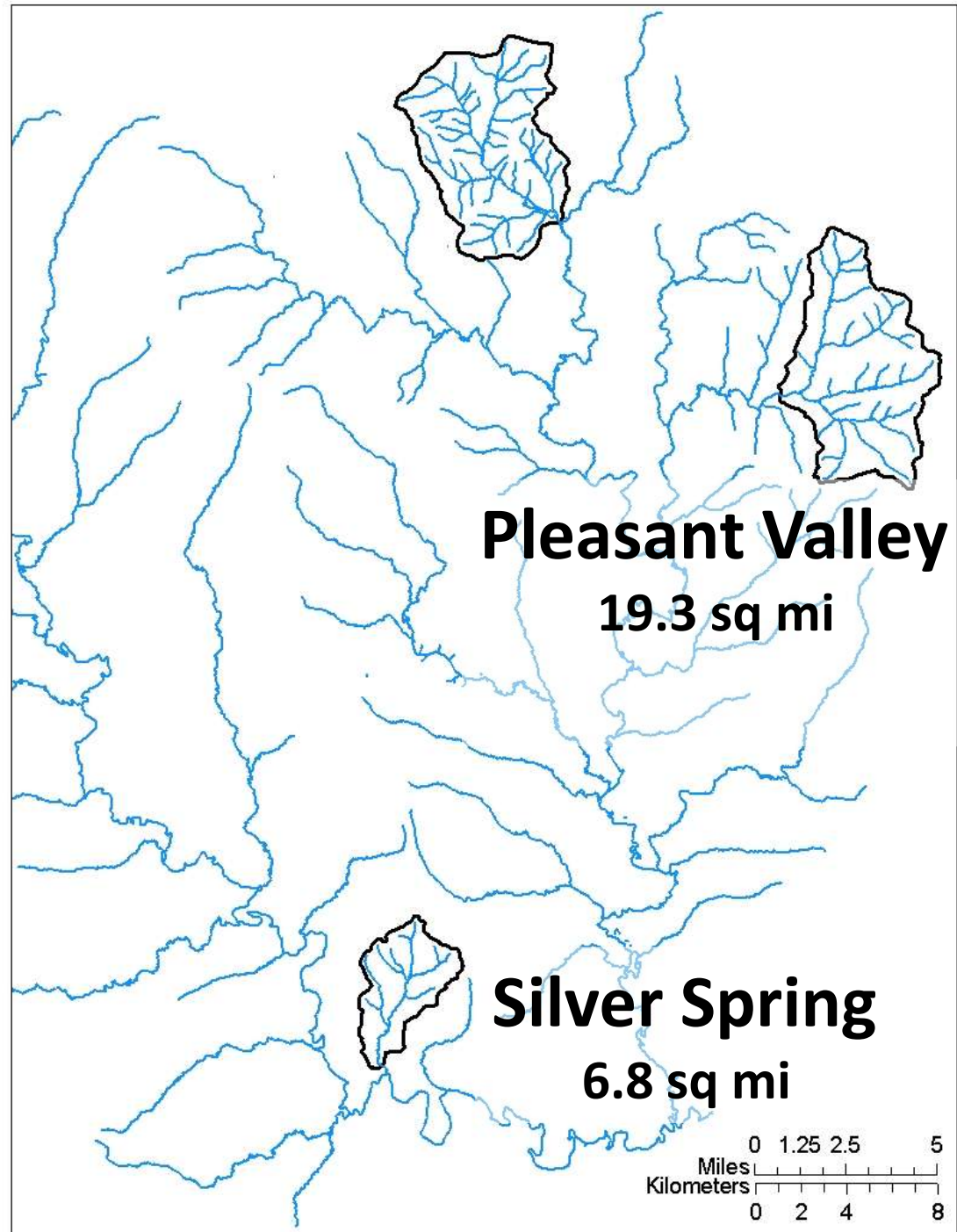
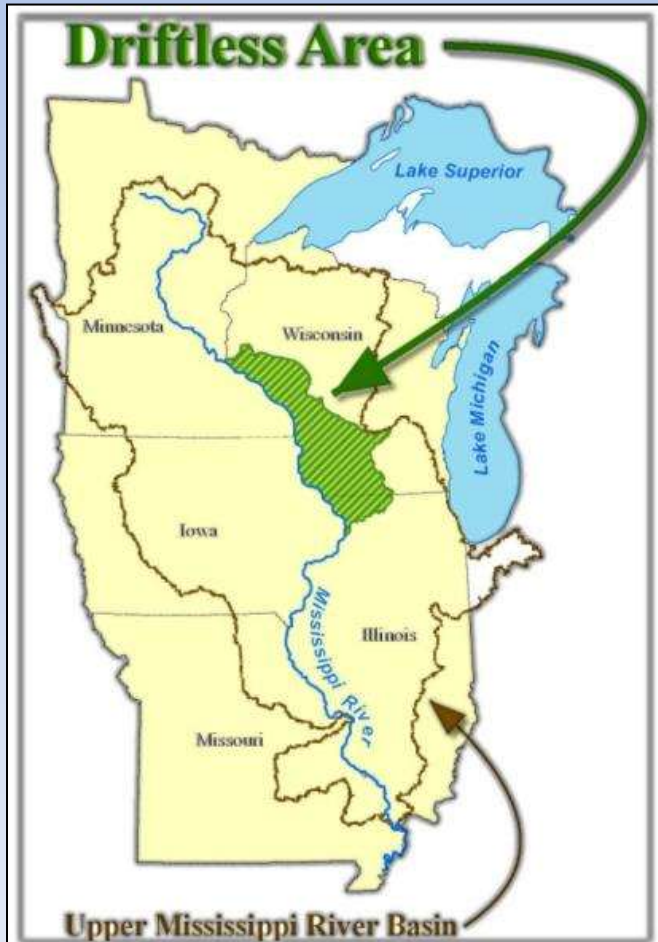
USE CATEGORIZATION	Total Sites (APRCS)	Percentage (%)	USE CATEGORIZATION	Total Sites (APRCS)	Percentage (%)
FISH & RECREATION USES			FISH & RECREATION USES		
Impaired Habitat	1413	45%	Excessive Nutrient Levels/Algal	501	24%
Low DO	308	21%	Livestock (Grazing or Feeding Operations)	464	8%
Elevated Water Temperature	238	17%	Discharges from Municipal Separate Storm Sewer Systems (MS4s)	438	7%
Contaminated Sediments	100	8%	Worming/soil Crop Production	318	8%
Chronic Aquatic Toxicity	117	8%	Contaminated Sediments	208	8%
Contaminated Fish Tissue	184	2%	Loss of Riparian Habitat	248	4%
Eutrophication	80	2%	Historic Point Sources - Legacy Pollutants	213	4%
Detrital Submerged Aquatic Vegetation (SAAV)	45	1%	Impacts from Hydrostructure Flow Regulation/Flotation	162	2%
Excessive Algal Growth	28	1%	Animal Feeding Operations (AFOs)	128	2%
Acute Aquatic Toxicity	28	1%	Site Clearance Land Development or Redevelopment	122	2%
Sediment Total Suspended Solids	18	0.3%	Channelization	118	2%
Toxicity	18	0.3%	Slip Paved/Asphalt (Clear Lanes or Dry Lanes)	111	2%
Excessive Algal Growth	8	0.3%	Industrial Point Source Discharge	87	2%
Fish Barriers (Fish Passage)	7	0.2%	Real Estate/Industrial Erosion and Spill Prevention	88	1%
Low Flow Alterations	8	0.2%	Permitted Non-Point Run Carried Animal Feeding Operations (LAPFOs)	78	1%
Recreational Restrictions - Patrollers	2	0.1%	Channel (Channel Mile Factor Areas)	52	1%
			Source Unknown	34	0.9%
			Municipal (Urbanized High Density Area)	53	0.9%
			Sediment Resuspension (Clean Sediment)	44	0.7%
			Highways, Roads, Bridges, Infrastructure (New Construction)	39	0.6%
			Highways, Roads, Bridges, Infrastructure (New Construction)	38	0.6%
			Fluvial or Major Flooding	31	0.6%
			Upstream Source	28	0.6%
			Drainage or Riparian or Shoreline Zones	28	0.6%
			If other sources exist list them 3%	244	3%
				0.2% each	
RECREATION USES			RECREATION USES		
Recreational Restrictions - Patrollers	118	10%	Livestock (Grazing or Feeding Operations)	8	2%
			Backflow Source	3	2%
FISH CONSUMPTION USES			Permitted Non-Point Run Carried Animal Feeding Operations (LAPFOs)	4	1%
Contaminated Fish Tissue	184	9%	Source Unknown	3	1%
Contaminated Sediment	115	1%	Channel (Channel Mile Factor Areas)	3	1%
Acute Aquatic Toxicity	23	0.1%	FISH CONSUMPTION USES		
PUBLIC HEALTH & WELFARE USES			Contaminated Sediments	140	43%
None			Atmospheric Deposition - Toxics	86	24%
GENERAL USES			Sludge Underflow	83	24%
Water Quality Use Restrictions	251	100%	Historic Point Sources - Legacy Pollutants	58	2%
			Upstream Source	28	1%
			Industrial Point Source Discharge	3	0.1%
			Non-Point Source	3	0.1%
			PUBLIC HEALTH & WELFARE USES		
			None		
			GENERAL USES		
			Historic Point Sources - Legacy Pollutants	31	100%

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STUDY LOCATION



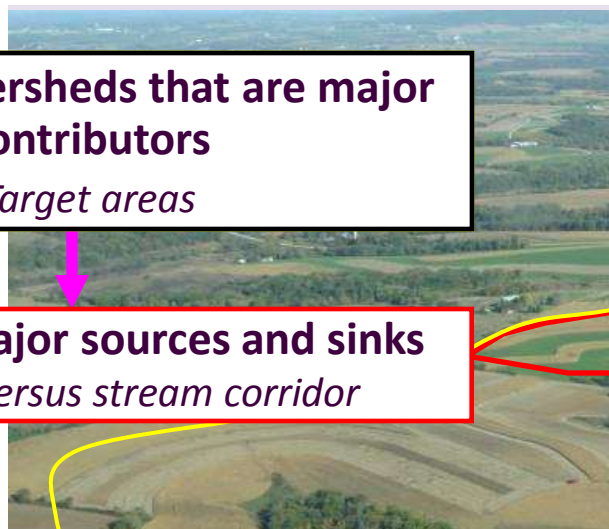
Connecting Field to Stream Transport of Sediment

Identify watersheds that are major contributors

Target areas

Inventory major sources and sinks

Upland versus stream corridor



Connecting Field to Stream Transport of Sediment

Identify watersheds that are major contributors

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Inventory major sources and sinks

Upland versus stream corridor



Target best management practices in areas with high losses

Stream corridor rehabilitation

Soil conservation



LAG TIME?

Evaluate effectiveness

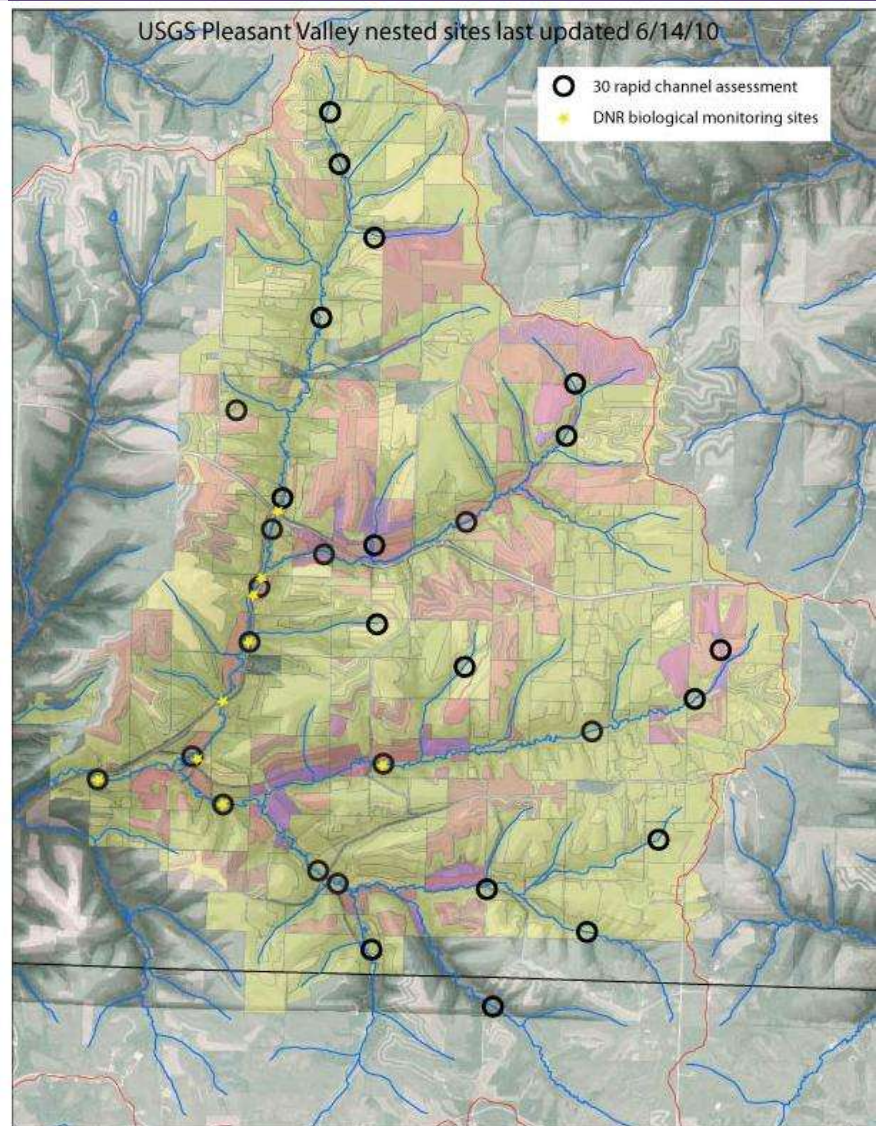
geomorphology, water chemistry, habitat, biological response



Photo Credits: Rebecca Carvin (top), Mark Godfrey (middle), WDNR (bottom)

Upper Pecatonica Pleasant Valley Nested Design Baseline Assessment and Monitoring

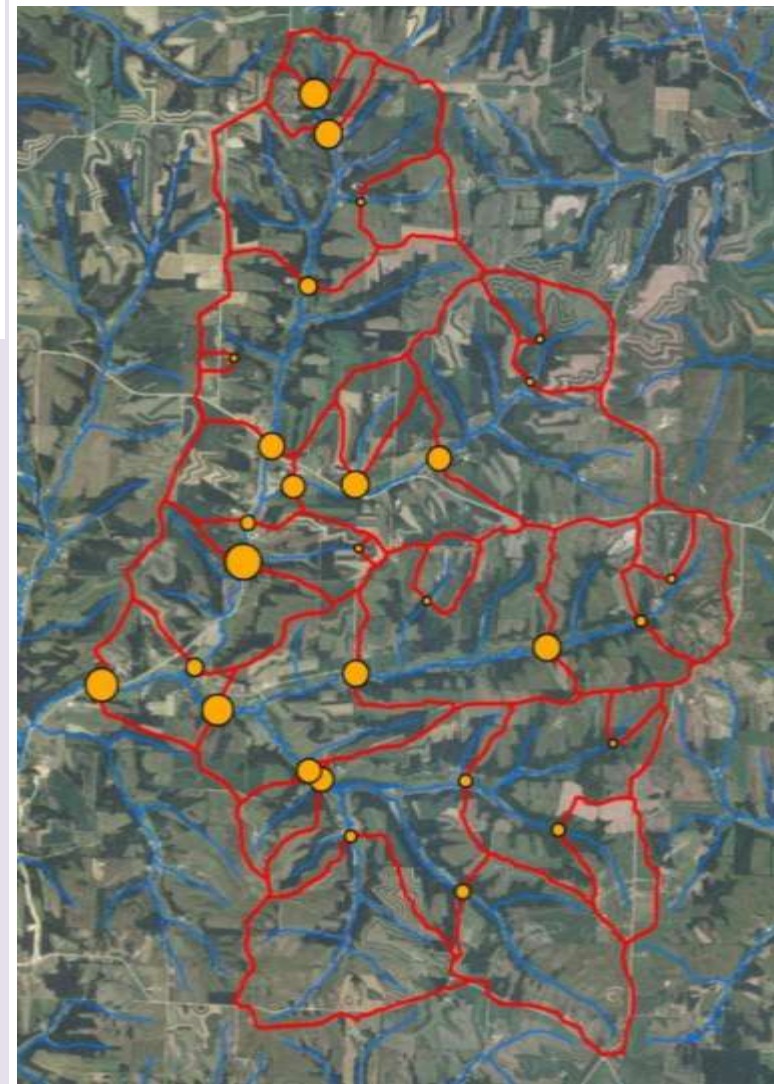
- 30 total sites (2009)
 - Ephemeral and perennial throughout watershed
 - Rapid channel/sediment stability assessment
 - Quantitative measurements of eroding banks and fine sediment deposition**
 - Low-flow discharge measurements
- 15 nested sites (2009-11)
 - Modified pebble counts
 - Bank, streambed, and soil samples for particle size, total P, organic matter, and radioisotopes
- 10 nested sites
 - Channel cross sections (2010-11)
 - Historical macroinvertebrate, fish, and habitat surveys (2008-10)
 - Resurveys of fine sediment deposition using updated mapping techniques (2011)
- 6 nested sites (2010+)
 - Walling suspended sediment tube samplers for event based sediment fingerprinting
- 1 streamgage at outlet (2006+)
 - discharge, total P and suspended sediment loads



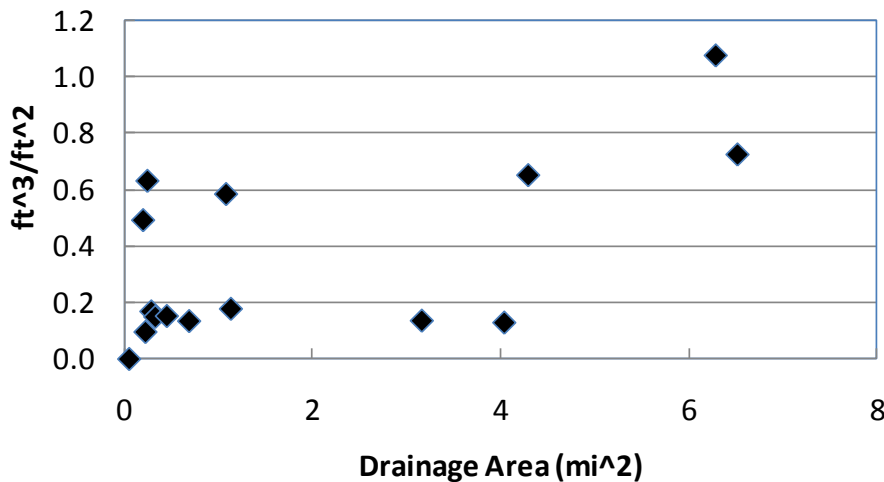
Fine Sediment Deposition

Highly variable within watersheds

PLEASANT VALLEY
 Rapid Channel Assessment
 2009
 Fine Sediment Deposition
 (Average = 0 to 0.54 ft³/ft²)

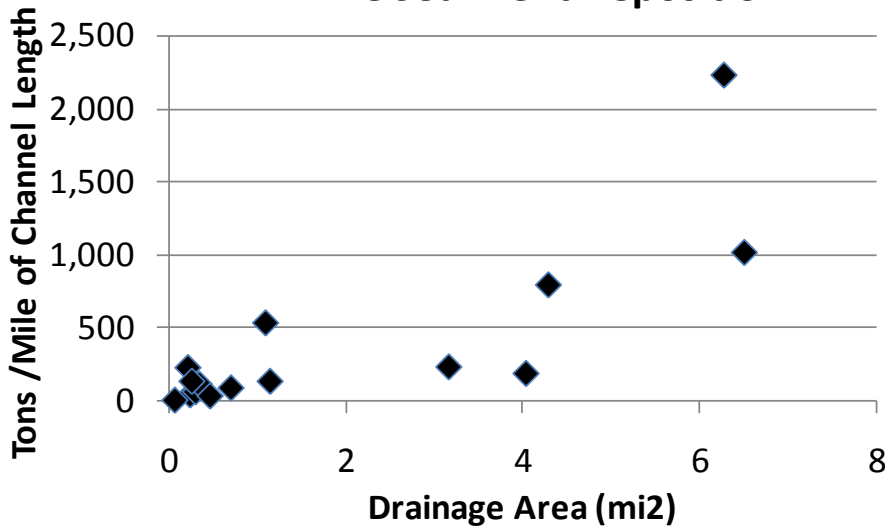


SILVER SPRING CREEK
 2010 Fine Sediment Deposition



Fine Sediment Depositional Areas Sediment and Phosphorus “Savings and Loan”

**Silver Spring Creek
Fine Sediment Deposition**



RUSLE2 SOIL LOSS

SS	PV
1.5	1.1
TONS/AC/YR	

WATERSHED EXPORT

SS	PV
0.20	0.15
TONS/AC/YR	

BANK EROSION

SS	PV
0.22	0.06
TONS/AC/YR	

SEDIMENT BUDGETS FROM FIELDS TO WATERSHED OUTLETS

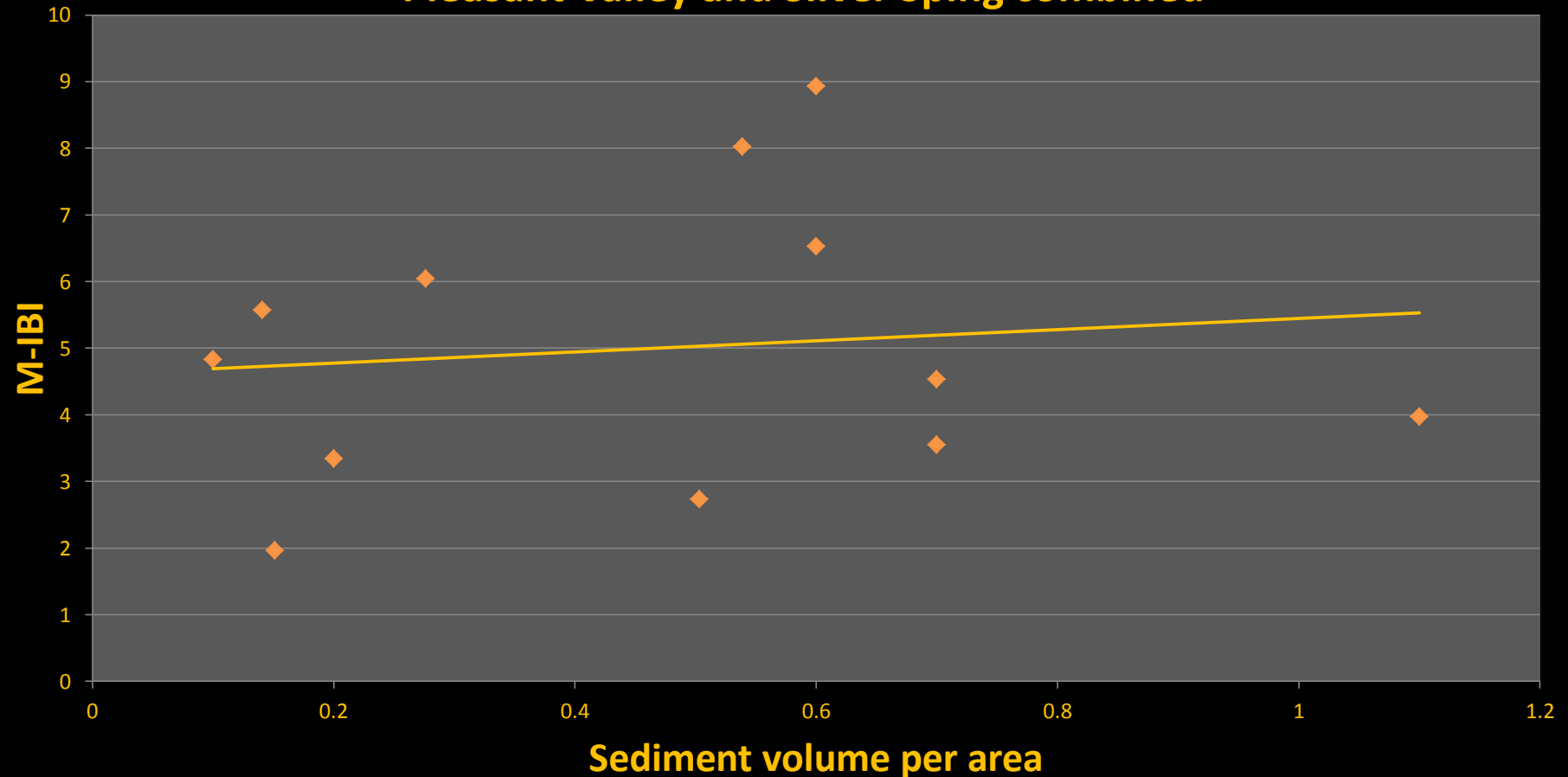
SS = Silver Spring Creek
PV = Pleasant Valley
2007-2010 data

FINE SEDIMENT SAVINGS AND LOAN

SS	PV
1.2	1.2
TONS/AC	

Factors other than fine sediment influence stream biological health

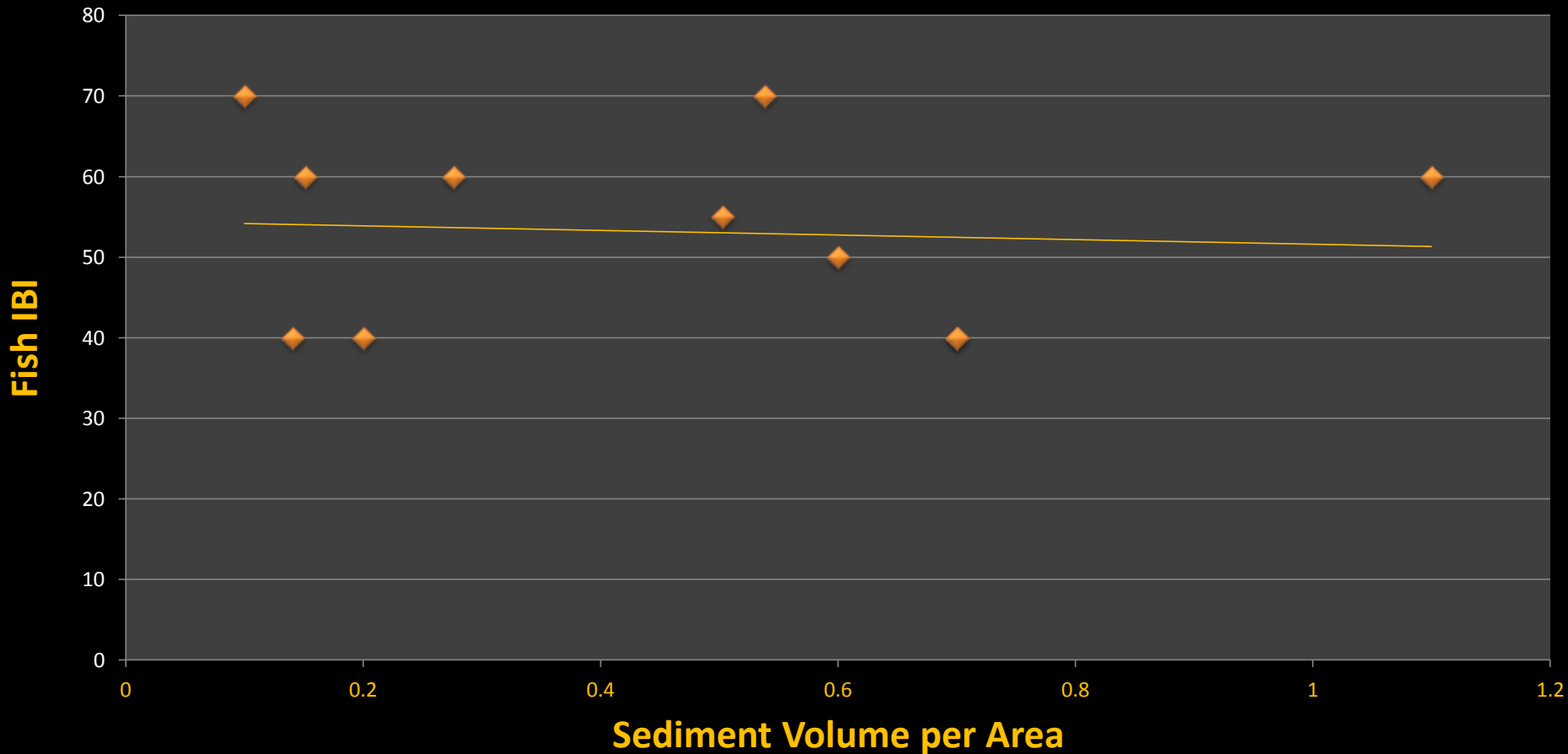
Sediment vs Macro-invertebrate IBI Pleasant Valley and Silver Spring combined



Factors other than fine sediment influence stream biological health

Sediment vs Fish-IBI

Pleasant Valley and Silver Spring combined



IS TRAPPING A SOLUTION?











Conclusions

- Fine sediment deposition in channels is an important source of sediment and nutrients in Driftless Area streams and should be included in sediment budgets
- Bank erosion is also a significant contributor to sediment and nutrients, but its importance varies from site to site
- Quantification of in-place sediment along with bank erosion (and overbank sedimentation) helps managers partition resources between upland practices and stream restoration techniques
- Quantification of channel sources and sinks help determine the lag effects from field-scale best management practices to improvements in aquatic biological integrity





STUDY PARTNERS AND FUNDING

Dane County, Land Conservation Division

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Iowa County Land Conservation Department

Green County Land Conservation Department

University of Wisconsin-Madison

Biological Systems Engineering

Soil Science

Nelson Institute of Environmental Studies

Agricultural and Applied Economics

Civil and Environmental Engineering

University of Wisconsin-Extension

U.S. Geological Survey

Natural Resource Conservation Service

Wisconsin DNR

Wisconsin DATCP

The Nature Conservancy

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McKnight Foundation

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Robert Hansis
Madison, WI
rhansis@tds.net
[608] 957-6440

Faith Fitzpatrick
USGS Wisconsin Science Center
fafitzpa@usgs.gov
[608] 831-3818