SYNOPSIS
Determination of Daily Sediment, Nutrient, and Sediment-Associated Chemical Concentrations and Loads for the Conterminous United States

A Proposal to Establish a Long-Term, Base-Funded, Network-Design National Monitoring Network to Generate Sediment, Nutrient, and Sediment-Associated Chemical Concentrations, Loads, Budgets and Temporal Trends

Piloted in the Mississippi River Basin

Prepared by the U.S. Geological Survey and U.S. Army Corps of Engineers

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To obtain an e-version of this synopsis or the full proposal, use windows explorer to access:

ftp://ftpext.usgs.gov/pub/er/va/reston/jrgray/mrb_proposal_mrb_sed_qw_synopsis_1_27_2010
ftp://ftpext.usgs.gov/pub/er/va/reston/jrgray/mrb_proposal_mrb_sed_qw_full_proposal_1_27_2010

EXECUTIVE SUMMARY

A **National Sediment and Water-Quality Monitoring Network**, composed of some 400 to 450 sites is proposed for implementation at an annual estimated cost of **$75-$90 million**. This level of funding will generate a nationally consistent data set that will help address the environmental, engineering, and socioeconomic impacts associated with sediments, nutrients, and sediment-associated chemical constituents. While the cost of this program is not minor, it can be shown to amount to <1% of the current annual estimated costs for dealing with ongoing sediment and water-quality issues. The proposed monitoring program will not only establish a long-term historic record, but will improve the science surrounding sediment and water-quality monitoring, as well management capabilities for maintaining sustainable national water resources. This monitoring program will build on, fill in the gaps, and provide a nationally consistent framework for existing and future programs, and permit the tracking of sediments, nutrients, sediment-associated chemicals, and water quality from headwater streams Hydrologic Benchmark Network, through medium-sized river basins National Water Quality Assessment Program, through major river basins National Stream Quality Accounting Network, and ultimately to coastal outlets.

This proposal describes the need for a national network, but focuses on the thrusts and requirements for initiation of a **Mississippi River Basin (MRB) Pilot Program**. The MRB Program includes some 68 monitoring sites, at a cost of **$18 million in the first year, and about**

$14 million per annum in subsequent years (see Budget and Site Map) and is proposed until it is subsumed by initiation of the National Network.

MAJOR SEDIMENT-RELATED ISSUES

The environmental, engineering, and socioeconomic effects of changes in the annual fluxes of sediments, nutrients, and sediment-associated chemical constituents are well-established and substantial. For example, Louisiana loses an average of 65-100 km^2 of its coastal wetlands annually. Sediment-bound nutrients contribute to eutrophication in a number of economically significant water bodies, including Chesapeake Bay, the northern Gulf of Mexico, and San Francisco Bay. Much of the soil eroded from croplands is captured by and reduces the capacity of water-supply reservoirs, in some cases at rapid rates. Persistent environmental contaminants, such as sediment-bound PCB's in New York's Hudson River, can bioaccumulate and impair the health of aquatic organisms and higher-level consumers.

In North America alone, the physical, chemical, and biological damage attributable to fluvial sediment and sediment-associated chemical constituents has been estimated to range from **$20-$50 billion** annually. Recent information on sediment-related expenditures include:

- The Agricultural Research Service and USGS estimate that the costs associated with sediment damage and remediation on reservoir-storage facilities totals **$2.5 billion annually**.
- The COE estimates that the costs of created wetlands with dredge spoils ranges from about $120-$170 thousand/hectare; hence, using dredged material to backfill areas equal to the annual loss of Louisiana's coastal wetlands would require about **$0.8-$1.1 billion annually**.
- In support of about 490 million tonnes of commerce on the Mississippi and Ohio Rivers in 2007, the COE and contractors dredged 158 million m^3 of material costing about **$1 billion**.
- Since 2006, the COE's annual expenditures on the Missouri River Recovery Program to partly restore various ecological systems have totaled about **$55 million.**
- Since 1986, the COE's annual expenditures on the Upper Mississippi and Illinois Rivers, under the Environmental Management Program, on average, exceeded **$20 million** annually.

Additionally, proposed projects to address sediment/water quality-related issues include:

- Flow diversions for at least 20 sites along the Mississippi River to build wetlands in Louisiana; if only 3-5 diversions actually are constructed, the cost would be **$1.5-$2.5 billion**.
- Low-water water-supply infrastructure upgrades and Federal levee repairs in the Missouri River, Kansas City, MO, are expected to cost **$625 million**.

The benefits of the proposed long-term monitoring network will be substantial, if only in improving how sediment and water-quality issues are addressed. Lack of an adequate monitoring network now requires the development of many project proposals and dredging works without a clear understanding of sedimentary system dynamics. This can, and has resulted in some projects, such as diversion structures, being mis-located, or has led to unintended and undesirable consequences associated with the structures. With Federal, state, and local resources inadequate to address these issues, expending funds and resources on these projects, without the requisite basic resource and process information on which reliable predictions of benefits are predicated, would be imprudent at best.

PROGRAMMATIC OBJECTIVES

Effective sediment, nutrient, and particulate-chemical management in the U.S. requires a clear understanding of the sources, sinks, pathways, and fluxes of these constituents. This only can be achieved through data collection and analyses that describe the concentrations and loads, in conjunction with an understanding of the fundamental transport processes of these materials and from models that use those data to simulate/predict responses to potential management options.

Technological advances, coupled with manual measurements and analyses, provide the capacity to continuously monitor the daily transport of sediments, nutrients, and sediment-associated chemical constituents in a reliable and cost-effective manner at hundreds of key sites in the U.S., as part of a comprehensive National Monitoring Network. The implementation of a monitoring program of this magnitude would benefit from an initial piloting exercise to finalize the requisite instrumentation, sampling, processing, and analytical protocols, and data-management tools to be used in a nationally consistent program. Because the MRB represents a microcosm of most of the sediment, nutrient, and sediment-associated chemical issues facing the Nation as a whole, as well as representing a variety of fluvial environments, it is an ideal area for a pilot program prior to full implementation of a National Monitoring Program.

MISSISSIPPI RIVER BASIN (MRB) PILOT PROGRAM

A MRB Pilot Program will address two major objectives:

1. Establish a sediment, nutrient, and sediment-associated chemical monitoring program for the Mississippi, Missouri, and Ohio Rivers, and their major tributaries, that can be used to compute accurate sediment, nutrient, and sediment-associated chemical budgets, at critical spatial and temporal scales, within acceptable and quantifiable error limits, and

2. Using the data collected and budgets computed in Objective 1, along with available historic data, determine the availability of sediment for various uses; trends in suspended-sediment concentrations (SSC), sediment character/grain size, nutrients, sediment-associated chemistry; and the impacts of spatial and temporal trends in these constituents on various economic, ecologic, and restoration activities and characteristics in the MRB.

Detailed goals, the approach, benefits, costs, monitoring locations, constituents to be monitored, and related information are contained in the main proposal at:

ftp://ftpext.usgs.gov/pub/er/va/reston/jrgray/mrb_proposal_mrb_sed_qw_full_proposal_1_27_2010

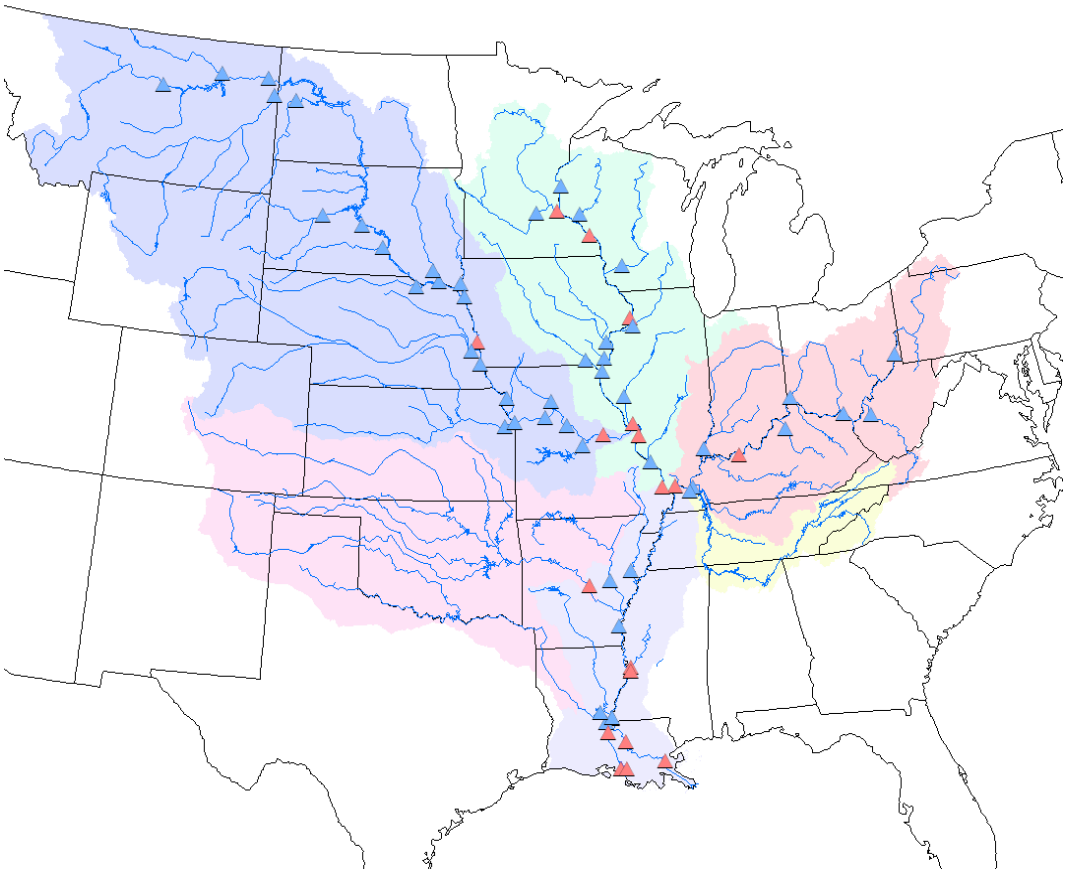

Figure 1: Map showing locations of 68 proposed monitoring sites for the MRB Pilot Program designated as Priority 1 (red) and Priority 2 gage locations.

BUDGET, MISSISSIPPI RIVER BASIN PILOT PROJECT

BUDGET, MISSISSIPPI RIVER This 11-category, 2-page budget is based on operating 68 continuous-monitoring sites for measuring suspended-sediment, nutrient, and particulate-chemical concentrations and fluxes, and for monitoring bedload at 6 of them. Costs for continuous streamflow at each site are borne by the USGS and are not included. The costs presuppose that all sites are monitored throughout each year.

Tasks/Numbers/Cost (inc. 3% inflation factor)	# of Sites	# of Samples per Site	Cost per sample X $1,000	2012 X $1,000	2013 X $1,000	2014 X $1,000	2015 X $1,000	2016 X $1,000	Assumes 3% inflation/year
1a. Collection of sediment and water quality samples at each site; drop to 12 samples/year after 3rd year.	20	20	$4.50	$1,800	$1,854	$1,910	$1,210	$1,246	
1b. Collection of sediment and water quality samples at each site.	48	12	$4.50	$2,592	$2,670	$2,750	$2,832	$2,917	
2a. Routine analysis for constituents in appendix 3 -Priority 1 Sites; drop to 12 samples/year after 3rd year.	20	20	$2.50	$1,000	$1,030	$1,061	$672	$692	
2b. Routine full grain-size analysis for Priority 1 Sites.	20	20	$0.15	$60	$62	$64	$40	$41	
2c. Routine analysis for constituents in appendix 3 -Priority 2 Sites.	48	12	$2.50	$1,440	$1,483	$1,528	$1,574	$1,621	
2d. Routine full grain-size analysis for Priority 2 Sites.	48	12	$0.15	$86	$89	$92	$95	$98	
3. Non routine analysis for constituents in appendix 3--sampled annually.	68	2	$4.00	$544	$560	$577	$594	$612	
4. Installation and purchase of water-quality monitors equipped with temperature, specific conductance, turbidity, and dissolved oxygen, and dual-frequency side-looking acoustic backscatter meters (all equipment purchased).	68	1	$40	$2,720	$0	$0	$0	$0	
5. Operation and maintenance and real-time record working finalized every 3 months for temperature, specific conductance, turbidity, dissolved oxygen, and ABS sediment.	68	1	$56	$3,808	$3,922	$4,040	$4,161	$4,286	

6. Installation and purchase of UV nitrate sensor	**68**	**1**	**$20**	**$1,360**	**$0**	**$0**	**$0**	**$0**
7. Additional cost for operation and maintenance of UV nitrate sensor.	**68**	**1**	**$12**	**$816**	**$840**	**$866**	**$892**	**$918**
8. Network management and quality assurance, fact sheet publication, and additional publications (e.g., concentration and load computation, SSC and nutrient model development).				**$500**	**$750**	**$773**	**$796**	**$820**
9. Enhancement of existing NRTWQ web page to display all continuous and discrete sample data as an interface to NWIS for all newly collected data for all Mississippi River Basin sites.				**$100**	**$100**	**$0**	**$0**	**$0**
10. Assembly of historic data from Corps and USGS, entry into NWIS, and Retrospective analysis resulting in publication of reports.				**$300**	**$500**	**$250**	**$0**	**$0**
11. Installation, operation, maintenance, and development of methods to measure the phase distribution of sediment transport using enhanced optic, acoustic and laser technology at 6 sites. Sites will include 3 Mississippi River and 3 tributaries (2 in the Missouri River). Operation starts in 2012. Evaluation will be completed and published in 2014.	**6**	**6**	**$13.50**	**$486**	**$501**	**$0**	**$0**	**$0**
				$17,612	**$14,362**	**$13,909**	**$12,865**	**$13,251**
Totals ($thousands)								
Annual cost per site for 68 sites ($thousands)	**68**			**$259**	**$211**	**$205**	**$189**	**$195**

MISSISSIPPI RIVER BASIN PILOT PROGRAM

Constituent List

Filtered Water (Routine)

1) Sulfate
2) Chloride
3) Ammonia
4) Nitrate plus Nitrite
5) Nitrite
6) Total Nitrogen
7) Orthophosphate
8) Total Phosphorus
9) Silica
10) Major ions (Na, K, Ca, Mg)
11) Alkalinity
12) Trace Elements
13) Pesticides
14) Dissolved Organic Carbon
15) pH
16) Conductance
17) Turbidity

Suspended Sediment (Routine)

1) Concentration
2) Full grain-size analyses
3) Surface Area
4) Nutrients (N, P, C)
5) Trace Elements
6) Transport Rates by size class

Suspended Sediments (Non-Routine, Twice/Year)

1) Point Concentration vs Continuous Concentration
2) Full Grain-Size Analysis
3) PAHs
4) PCBs
5) Persistent Organic Pollutants [e.g., pesticides (DDT, DDE, DDD)]

Bed Sediments (Non-Routine. Twice/Year)

1) Full Grain-Size Analysis
2) Surface Area
3) Nutrients (N, P, C)
4) Trace Elements
5) PAHs
6) PCBs
7) Persistent Organic Pollutants [e.g., pesticides (DDT, DDE, DDD)]

Bedload (Non-Routine)

1) Full Grain-Size Analysis
2) Transport rates
3) Percentage of total sediment transport