Long Term Resource Monitoring Program
Scope of Work–FY2008

Minimum Sustainable Program

Additional Program Element Proposals

Additional Program Element Technical Work

Long Term Resource Monitoring Program
Minimum Sustainable Program

Aquatic Vegetation Component

The objective of the Long Term Resource Monitoring Program (LTRMP) Aquatic Vegetation Component is to collect quantitative data on the distribution and abundance of aquatic vegetation in the UMRS for the purpose of understanding its status, trends, ecological functions, and responses to natural disturbances and anthropogenic activities. Data are collected within three LTRMP study reaches in the UMRS (Pools 4, 8, and 13 on the Upper Mississippi River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols.

Methods

Aquatic vegetation sampling will be conducted following the LTRMP aquatic vegetation standard sampling protocol (Yin et al. 2000). One thousand three hundred and fifty sites will be surveyed in FY07, including 450 in Pool 4, 450 in Pool 8, and 450 in Pool 13 (Table 1). The presence/absence and abundance of aquatic plant species at each site will be measured and recorded. Pool-wide estimates of abundance and percent frequency of occurrence will be derived by pooling data over all strata.

New Product Descriptions

2008A9: Aquatic vegetation in the UMRS

The Mississippi River Research Consortium (MRRC) intends to publish in Hydrobiologia a collection of synthesis papers in association with the MRRC's 40th anniversary. These articles will explore adaptive research and management of the Upper Mississippi River over the past forty years while looking toward the future. Each article will represent a different topic concerning the Mississippi System. This article entitled "Synthesis of Past and Present Upper Mississippi River Vegetation Research, and Suggested Future Research" will focus on floodplain forests, emergent and submersed aquatic vegetation. Our intent is to 1) describe the nature of research and key research findings in vegetation studies for the Mississippi River System; 2) compare and contrast these findings / approaches with work from other great rivers across the world; and 3) attempt to link vegetation research to other subject areas within the full edited volume.

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2008A1	Complete data entry and QA/QC of 2007 data; 1250 observations.		
	a. Data entry completed and submission of data to USGS	Popp, Dukerschein, Bierman	30 November 2007
	b. Data loaded on level 2 browsers	Schlifer	15 December 2007
	c. QA/QC scripts run and data corrections sent to Field Stations	Sauer	28 December 2007
	d. Field Station QA/QC with corrections to USGS	Popp, Dukerschein, Bierman	15 January 2008
	e. Corrections made and data moved to public Web Browser	Sauer, Schlifer, Caucutt	30 January 2008

2008A2	WEB-based annual Aquatic Vegetation Component Update with 2007 data on Public Web Server.		
	a. Develop first draft	Sauer	28 February 2008
	b. Reviews completed	Popp, Dukerschein, Bierman, Sauer, Yin	28 March 2008
	c. Submit final update	Sauer	18 April 2008
	d. Placement on Web with PDF	Sauer, Caucutt	31 July 2008
2008A3	Complete aquatic vegetation sampling for Pools 4, 8, and 13 (Table 1)	Popp, Dukerschein, Bierman	31 August 2008
2008A4	Final draft completion report: Developing submersed aquatic plant bioindicators and biocriteria for the Upper Mississippi River (2007A4)	Dukerschein, Langrehr, Popp, Moore	30 May 2008
2008A7	Web-based: Creating surface distribution maps for aquatic plant species in Pools 4, 8, and 13; 2007 data	Yin	31 July 2008
2008A8	Final draft OFR: LTRMP Aquatic Vegetation Program Review (2007A9)	Heglund, Sauer	30 September 2008
2008A9	Draft manuscript: Aquatic vegetation in the UMRS	Popp, Moore	31 May 2008
2007A9	Draft OFR: LTRMP Aquatic Vegetation Program Review	Heglund	29 February 2008
2007APE1	Draft manuscript: Importance of the Upper Mississippi River Forest Corridor to Neotropical Migratory Birds	Kirsch	30 March 2008
2007APE12	Draft LTRMP Report: Ecological Assessment of High Quality UMRS Floodplain Forests	Chick	29 August 2008

[1]Tracking number sequence: Year, last letter of USGS BASIS task code “BNBLA”, ID number

Literature Cited

Hirst, S. M. 1983. Ecological and institutional bases for long-term monitoring of fish and wildlife populations. Pages 175–178 in John F. Bell and Toby Atterbury, editors. Renewable Resource Inventories for Monitoring Changes and Trends. Proceedings of an International Conference, August 15–19, 1983, Corvallis, Oregon. College of Forestry, Oregon State University. 737 pp.

Ickes, B. S., and R. W. Burkhardt. 2002. Evaluation and proposed refinement of the sampling design for the Long Term Resource Monitoring Program’s fish component. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, October 2002. LTRMP 2002-T001. 17 pp. + Appendixes A–E. CD-ROM included. (NTIS PB2003-500042)

McDonald L., T. McDonald, and D. Robertson. 1998. Review of the Denali National Park and Preserve (DENA) Long-Term Ecological Monitoring Program (LTEM). Report to the Alaska Biological Science Center Biological Resources Division, USGS. WEST Technical Report 98–7. 19 pp.

Strayer, D., Glitzenstein, J. S., Jones, C. G., Kolasoi, J., Likens, G. E., McDonnell, M. J., Parker, G. G. and Pickett, S. T. A. 1986. Longterm ecological studies: an illustrated account of their design, operation, and importance to ecology. Occasional Publication of the Institute of Ecosystem Studies, No.2. Millbrook, New York.

Yin, Y., J. S. Winkelman, and H. A. Langrehr. 2000. Long Term Resource Monitoring Program procedures: Aquatic vegetation monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. April 2000. LTRMP 95-P002-7. 8 pp. + Appendixes A–C.

Personnel

Dr. Yao Yin will be the principal investigator.

Fisheries Component

The objective of the LTRMP Fisheries Component is to collect quantitative data on the distribution and abundance of fish species and communities in the UMRS for the purpose of understanding resource status and trends, ecological functions, and response to natural disturbances and anthropogenic activities. Data are collected within six LTRMP study reaches in the UMRS (Pools 4, 8, 13, and 26 and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Gutreuter et al. 1995; Ickes and Burkhardt 2002).

Methods

Fish sampling will be conducted following the LTRMP study plan and standard protocols (Gutreuter et al. 1995), as modified in 2002 (Ickes and Burkhardt 2002). Species abundance, size structure, and community composition and structure will be measured over time. Between 160 and 270 samples will be collected in each study area (Table 1). Sample allocation will be based on a stratified random design, where strata include contiguous backwaters, main channel borders, main channel wingdams, impounded areas, and secondary channel borders. Tailwaters in the impounded reaches and tributary mouths in the Open River will be sampled under a fixed site design. Sampling effort will be allocated independently and equally across 2 sampling periods (August 1–September 15; September 16–October 31) to minimize risks of annual data loss during flood periods and to characterize seasonal patterns in abundance and habitat use. Pool-wide estimates of abundance will be derived by pooling data over all strata.

New Product Descriptions

2008B5: Assessing habitat use by breeding Great Blue Herons (*Ardea herodias*) on the Upper Mississippi River National Wildlife and Fish Refuge, USA (intended outlet <u>Waterbirds</u> – Ickes and Kirsch)

Great Blue Heron numbers, as monitored by the U.S. Fish and Wildlife Service on Upper Mississippi River System refuges, declined precipitously throughout the 1990's. This study will seek to identify factors associated with this decline using geospatial and observational covariates. Specifically we will investigate hypotheses concerning nest site suitability and limitation, forage availability (fish) and limitation, and colony characteristics. We will assemble and use georeferenced land cover data and fisheries monitoring data from the Long Term Resource Monitoring Program in unison with time series observations of heron abundance to test these hypotheses.

2008B6: River engineering and flooding: Systemwide empirical modeling of the Mississippi and Lower Missouri Rivers (intended outlet <u>Nature</u> – Ickes, Pinter, Jemberie, Remo, Heine)

Rivers are in part a reflection of their geologic history as well as constraints and stresses imposed by centuries of human uses. This study proposes to identify how past river management actions have influenced fundamental hydrologic features of the Mississsippi and Lower Missouri Rivers. We will model the relative contributions of channel engineering (in-channel flow conveyance) and drainage basin (upstream delivery influenced by climate and land use) to observed changes in river stage across the study extent. We will use both historical geospatial data sources and historic hydrologic observations to elucidate whether channel conveyance or basin delivery factors are most associated with observed changes in river stage.

2008B7: Effects of river engineering on flow conveyance and flood stages: Reach-scale empirical modeling of the Mississippi and Lower Missouri Rivers (intended outlet Water Resources and Research – Ickes, Pinter, Jemberie, Remo, Heine)

This study will model the effects of two centuries of river engineering on river stages in the Mississippi and Lower Missouri Rivers. Four regional models (Upper Mississippi River, Middle Mississippi River, Lower Mississippi River, Lower Missouri River) will be developed from time series of historical hydrologic data and time series of engineering features derived from several historic geospatial data sources. We will control for delivery effects by modeling changes in stage at fixed discharges over time. The goal of this research is to identify those engineering features that are most associated with observed changes in stage, irrespective and independent of water delivery mechanisms.

2008B8: Fishes of the Mississippi River System: a 40 year synthesis of research on one of the world's great rivers (intended outlet Hydrobiologia – Ickes, Garvey)

This paper is one of nine topical papers being developed by Mississippi River Research Consortium members as part of this organization's 40th anniversary. Our goal is to synthesize fisheries research over the past 40 years on the Mississippi River, highlight what we have learned, identify areas requiring new / additional work, compare and contrast past findings and approaches with those from other great river systems, and highlight management challenges.

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2008B1	Complete data entry, QA/QC of 2007 fish data; ~1,590 observations		
	a. Data entry completed and submission of data to USGS	Popp, Dukerschein, Bierman, Chick, Sass, Hrabik	31 January 2008
	b. Data loaded on level 2 browsers; QA/QC scripts run and data corrections sent to Field Stations	Schlifer	15 February 2008
	c. Field Station QA/QC with corrections to USGS	Popp, Dukerschein, Bierman, Chick, Sass, Hrabik	15 March 2008
	d. Corrections made and data moved to public Web Browser	Sauer and Schlifer	30 March 2008
2008B2	WEB-based annual Fisheries Component Update with 2007 data on Public Web Server.		
	a. Develop first draft	Sauer, Popp, Dukerschein, Bierman, Chick, O'Hara, Hrabik	30 April 2008
	b. Reviews completed	Sauer, Popp, Dukerschein, Bierman, Chick, O'Hara, Hrabik, Ickes	15 May 2008
	c. Submit final update	Sauer, Popp, Dukerschein, Bierman, Chick, O'Hara, Hrabik	31 May 2008
	d. Placement on Web with PDF	Sauer, Caucutt	31 August 2008
2008B3	Complete fisheries sampling for Pools 4, 8, 13, 26, the Open River, and La Grange Pool (Table 1)	Popp, Dukerschein, Bierman, Chick, O'Hara, Hrabik	31 October 2008
2008B4	USGS Series: Non-native fishes in the Upper Mississippi River System: A Synthesis of Information from the Long Term Resource Monitoring Program (extension of 2005B8	Sass, Irons	30 September 2008

2008B5	Manuscript: Assessing habitat use by breeding Great Blue Herons (*Ardea herodias*) on the Upper Mississippi River National Wildlife and Fish Refuge, USA (intended outlet Waterbirds)	Ickes	30 April 2008
2008B6	Draft Manuscript: River engineering and flooding: Systemwide empirical modeling of the Mississippi and Lower Missouri Rivers (intended outlet Nature)	Ickes	30 April 2008
2008B7	Draft Manuscript: Effects of river engineering on flow conveyance and flood stages: Reach-scale empirical modeling of the Mississippi and Lower Missouri Rivers (intended outlet Water Resources and Research)	Ickes	1 July 2008
2008B8	Draft manuscript: Fishes of the Mississippi River System: a 40 year synthesis of research on one of the world's great rivers (intended outlet Hydrobiologia)	Ickes	30 June 2008
2008B9	Draft manuscript: Standardized CPUE data from multiple gears for community level analysis (re-worked 2006B5).	Chick	27 June 2008
2006B6	Draft manuscript: Spatial structure and temporal variation of fish communities in the Upper Mississippi River. (Dependent on 2008B9 acceptance into journal)	Chick	30 September 2008
2007B5	Draft LTRMP report: Trends in abundance of fish species linked to vegetation	Popp, Delain	30 March 2008
2007B4	Draft manuscript: Proportional biomass contributions of Non-native fish to UMRS fish communities	Ickes	31 May 2008
2007B8	Draft manuscript: Proportional Size Density and Frequency of Occurrence of Flathead Catfish (*Pylodictis olivaris*), Channel Catfish (*Ictalurus punctatus*), and Blue Catfish (*I. furcatus*) in an impounded and unimpounded reach of the Upper Mississippi River. (Expanded work on 2006B12)	Hrabik, McCain, Herzog	30 September 2008
2007APE3	Draft LTRMP report: Testing the Fundamental Assumption underlying the use of LTRMP fish data: Does variation in LTRMP catch-per-unit-effort data reflect variation in the abundance of fishes?	Chick	30 March 2008
2007APE7	Draft completion report: Association between fish assemblage and off-channel area type in the impounded reach of the Upper Mississippi and Illinois rivers: implications for habitat restoration at management-relevant scales	Knights	31 January 2008
2007APE8	A Proposal to restore Specific Monitoring Elements to the LTRMP	Chick	30 April 2008

	Estimated distribution date
Completion report: Habitat-related factors that are potentially limiting backwater fish communities (2006B8; Bartels)	30 May 2008
Completion report: Exploratory Analysis of Index of Biotic Integrity Scores Calculated from Datasets Obtained from Three Different Day Electrofishing Protocols (2006B9; Bartels)	30 July 2008
LTRMP report: Investigate effects of newly completed HREPs (Lake Chautauqua NWR, Banner Marsh State Fish and Wildlife Area) in La Grange Pool (2006APE17b; O'Hara)	30 September 2008
Manuscript: Evaluation of a Catch and Release Regulation for Largemouth Bass in Brown's Lake, Pool 13, Upper Mississippi River (2007B7; Bowler)	30 September 2008
Completion report: LTRMP Fisheries Component collection of six darter species from 1989–2004. (2006B13; Ridings)	30 September 2008

[1]Tracking number sequence: Year, last letter of USGS BASIS task code "BNBLB", ID number

Literature Cited

Gutreuter, S., R. Burkhardt, and K. Lubinski. 1995. Long Term Resource Monitoring Program procedures: Fish monitoring. National Biological Service, Environmental Management Technical Center, Onalaska, Wisconsin, July 1995. LTRMP 95-P002-1. 42 pp. + Appendixes A–J

Ickes, B. S. and R. W. Burkhardt. 2002. Evaluation and proposed refinement of the sampling design for the Long Term Resource Monitoring Program's fish component. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, October 2002. LTRMP 2002-T001. 17 pp. + Appendixes A–E. CD-ROM included. (NTIS #PB2003-500042)

Personnel

Mr. Brian Ickes will be the principal investigator.

Water Quality Component

The objective of the LTRMP water quality component is to obtain basic limnological information required to (1) increase understanding of the ecological structure and functioning of the UMRS, (2) document the status and trends of ecological conditions in the UMRS, and (3) contribute to the evaluation of management alternatives and actions in the UMRS.

Data are collected within six LTRMP study reaches in the UMRS (Pools 4, 8, 13, 26, and Open River Reach on the Upper Mississippi River and La Grange Pool on the Illinois River). Data entry, quality assurance, data summaries, standard analyses, data serving, and report preparation occur under standardized protocols (Soballe and Fischer 2004).

Methods

Limnological variables (physicochemical characteristics, suspended solids, chlorophyll *a*, phytoplankton [archived], and major plant nutrients) will be monitored at both stratified-random sites (SRS) and at fixed sampling sites (FSS) according to LTRMP protocols.

Fixed site sampling

Fixed site sampling will be conducted as in FY2006 (Table 1).

Stratified random sampling

Stratified random sampling will be conducted at full effort levels (same as FY2006) for fall, winter, spring, and summer episodes (Table 1).

In situ data collection

For both FSS and SRS *in situ* data will be collected on physicochemical characteristics per the standard protocols (Soballe and Fischer 2004).

Laboratory analyses

Samples for chemical analysis (nitrogen (total N, nitrate/nitrite N, ammonia N), phosphorus (Total P, SRP), and silica) will be collected at all fixed sites and at approximately 35% of all stratified random sampling locations as specified in the sampling design. Samples for chlorophyll and suspended solids (total and volatile) will be collected at all SRS and Fixed sites. We will not collect data on major cations and anions in water samples in FY2008. Sampling and laboratory analyses will be performed following LTRMP protocols (Soballe and Fischer 2004) and Standard Methods (American Public Health Association 1992).

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2008D1	Complete calendar year 2007 fixed-site water quality sampling	Houser, Popp, Dukerschein, Bierman, Chick, Sass, Hrabik	31 December 2007
2008D2	Complete laboratory analysis of 2007 fixed site and SRS data; Data loaded to Oracle data base.	Yuan	30 March 2008
2008D3	Complete data entry, QA/QC of calendar year 2006 fixed-site and SRS data.	Rogala. Popp, Dukerschein, Bierman, Chick, Sass, Hrabik	30 May 2008
2008D4	Complete FY 08 fixed site and SRS sampling for Pools 4, 8, 13, 26, Open River, and La Grange Pool (Table 1)	Popp, Dukerschein, Bierman, Chick, Sass, Hrabik	30 September 2008
2008D5	WEB-based annual Water Quality Component Update with 2007 data on Public Web Server.	Rogala	30 June 2008
2008D6	Final draft LTRMP report: Sampling of light regime in support of aquatic vegetation modeling (2007D6)	Dukerschein, Giblin, Hoff	30 August 2008

2008D7	Final draft LTRMP report: Pool 5 water quality, pre- and post-drawdown	Popp, Burdis	30 March 2008
2008D8	Final draft manuscript: Primary production, and dissolved oxygen dynamics in UMRS backwater lakes and main channel. (2007D8)	Houser	30 July 2008
2008D9	Final draft manuscript describing results of analyses of spatial and temporal patterns in UMRS WQ. (2006D5)	Houser	30 August 2008
2006D7	Final draft completion report: Lake Pepin zooplankton and water quality data	Popp, Burdis	31 July 2008
2005D7	Final draft LTRMP report: Main channel/side channel report for the Open River Reach.	Hrabik	30 September 2008
2005APE26	Final draft LTRMP report: retrospective, cross-component analysis for Pool 26	Chick, Johnson	29 February 2008

	Estimated distribution date
Completion report: Evaluation of new Hydrolab Turbidity Probe (2006D6; Hoff))	31 December 2007
LTRMP report: A decade of monitoring on Pool 26 of the Upper Mississippi River: Water quality and fish data with cross component analyses (2005APE27; Chick)	30 September 2008
Completion report: Effectiveness of wetland creation (2006D8; Bierman)	30 September 2008
Completion report: Examining nitrogen and phosphorus ratios N:P in the unimpounded portion of the Upper Mississippi River (2006D9; Crites)	30 September 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLD"; ID number

Literature Cited

American Public Health Association, American Water Works Association, and Water Environment Federation. 1992. Standard methods for the examination of water and wastewater. 18th edition, American Public Health Association, Washington, D.C. 981 pp. + 6 color plates

Soballe, D. M., and J. R. Fischer. 2004. Long Term Resource Monitoring Program Procedures: Water quality monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, March 2004. LTRMP 2004-T002-1 (Ref. 95-P002-5). 73 pp. + Appendixes A-J.

Personnel

Dr. Jeff Houser will be the principal investigator.

Statistical Evaluation

Statistical support for the LTRMP provides guidance for statistical analyses conducted within and among components, for contributions to management decisions, for identifying analyses needed by the Program, for developing Program-wide statistical projects, and for reviewing LTRMP documents that contain statistical content. The ‘Guidance for statistical analyses’ purpose is designed to save money for the LTRMP, at both UMESC and the field stations, by helping LTRMP staff use data and analytical time more efficiently. The statistician is also responsible for ensuring that newly developed statistical methods are evaluated for use by LTRMP. This guidance would include assistance for LTRMP additional program element projects requiring a minor amount of the statistician's time, but projects needing more assistance would build statistical support into that specific scope of work.

Guidance for management includes assistance with modifications to program design, with standardizing general operating procedures, and with estimating power to detect changes and trends. For example, LTRMP's focus on long term rather than on annual changes has important implications for program design. This is because the number of years of sampling is typically more important than the number of samples per year in increasing power to detect long-term trends (given some minimal number of samples per year).

The statistical component will help ensure that potentially useful analyses of data from within and across components are identified, that methods for analysis are appropriate and consistent, and that, when possible, multiple analyses work together to achieve larger program objectives regardless of which group (UMESC, field stations, COE, etc.) conducts analyses. The statistician is also responsible for reviewing LTRMP documents containing statistical components for accuracy and for ensuring that quality of analyses is consistent among products. A primary goal of statistical analyses is to avoid drawing inappropriate conclusions leading to ineffective or even harmful management actions. Within the UMR, there are a variety of confounding factors and conditions that could produce spurious correlations or lead to inappropriate conclusions regarding cause and effect. Appropriate statistical analysis and interpretation is critical to understanding the limitations of LTRMP data. This, in turn, is critical in efforts to distinguish between natural variation and human effects and in evaluating the long-term effects of management actions, such as HREPs, water level manipulations, or increases in navigation.

NEW Product Descriptions

2008E1: Methods of estimating variance components from LTRMP water quality data

The proportions of variation in LTRMP indicators that are associated with spatial (stratum, pool), temporal (season, year) and space-time interactions may be used to identify relative contributors to variation in those indicators. Generating estimates of these variance components, however, is complicated for three reasons: (1) season and strata represent fixed (rather than random) effects with few levels; (2) data generated using LTRMP designs are often substantially unbalanced (e.g., more samples in one stratum than in another); (3) LTRMP sampling weights must be addressed. Methods for addressing these issues will be addressed using water quality data.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2008E1	Draft completion report that describes methods of estimating variance components from LTRMP water quality data	Gray	15 September 2008

	Estimated distribution date
Completion report: "An introduction to the analysis of LTRMP's vegetation rake data"	15 May 2008
Completion report: "Estimating temporal trends in data derived using LTRMP's submersed aquatic vegetation rake sampling design"	15 Jun 2008
Completion report: "Cumulative HREP effects on ecological characteristics of impounded regions of the UMR"	15 Jun 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLE"; ID number

Personnel

Dr. Brian Gray will be the principal investigator.

Data Management

The objective of data management of the LTRMP is to provide for data collection, correction, archive, and distribution of a 90 million dollar database that consists of over 2.2 million records located in 195 tables. The 2.2 million data points currently in the system require regular maintenance and upgrading as technologies change. Also, having a publicly accessible database requires a significant level of security. This is accomplished by having the systems Certified and Accredited by a rigorous, formal process by the USGS Security team.

Methods

Data management tasks include, but are not limited to:

- Review daily logs to ensure data and system integrity and apply application updates.
- Develop and maintain field notebook applications to electronically capture data and begin the initial phase of Quality Control/Quality Assurance (QA/QC).
- Administer and maintain the Oracle LTRMP database.
- Administer and maintain LTRMP hardware, software, and supplies to support LTRMP program needs.
- Administer, maintain, and update the LTRMP public and intranet data browsers to insure access to all LTRMP data within USGS security policy.

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2008M1	Update vegetation, fisheries, and water quality component field data entry and correction applications.	Schlifer	30 May 2008
2008M2	Load 2007 component sampling data into Oracle tables and make data available on Level 2 browsers for field stations to QA/QC.	Schlifer	30 June 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLM"; ID number

Personnel

Mr. Ben Schlifer will be the principal investigator.

Land Cover/Land Use with GIS Support

Although the Long Term Resource Monitoring Program (LTRMP) will not collect data under the minimal sustainable program, the Program will maintain program expertise, manage existing data, and provide limited on-demand Geographic Information System (GIS) technical assistance.

Provide on-demand GIS technical assistance, expertise, and data production to the Environmental Management Program partnership including, but not limited to:

- Aerial photo interpretation
- Interpretation automation into a digital coverage
- Flight planning and acquisition of aerial photography
- Change detection and habitat modeling
- Georeferenced aerial photo mosaics (pool-wide, Habitat Rehabilitation and Enhancement Projects (HREPs), land acquisition areas)
- Georeferenced archival map/plat mosaics (Brown Survey, Mississippi River Commission data, Government Land Office data)
- Produce graphics and summary tables for partnership publications, posters, and presentations
- Conversion of ASCII coordinate data from a GPS to a spatial dataset
- Conversion of all georeferenced data to a common projection and datum for ease of use in a GIS
- Maintain, update, and oversee the aerial photo library of over 50,000 print and digital images.
- Maintain, update, and enhance over 20 million acres of land cover/land use and aquatic areas data spanning the late-1800s through the year 2000. This includes improving existing or developing new crosswalks for comparison of existing datasets, cropping datasets to common extents, and ensuring that all datasets are in a common coordinate system.
- Assist in the maintenance and updating of the USGS-Upper Midwest Environmental Sciences Center's (UMESC) web-based geospatial data repository.

Product Descriptions

Although the primary focus of this component is to provide technical assistance and maintain existing databases, as time allows the following LTRMP projects can be initiated and progress made on:

1. Updating the Aquatic Areas (AA) dataset for the trend pools and Open River North using the 2000 systemic LCU data. These LCU data should be a much better base for the AA since they are hydrologically-based and plant dominance-based. A Deep Marsh polygon from the 2000 LCU will always have standing water (except for drawdowns and extreme droughts) whereas the same cannot be said for the 1989 LCU since neither dominance or hydrology were considered, only genus. The trend pools will allow us to work out an accepted protocol, with input from the Corps of Engineers.

2. Reformat and serve the lower Pool 4 and Pool 5 Light Detection and Ranging (LIDAR) data. These data are currently being served, without restriction, by the Corps of Engineers (http://www.mvp.usace.army.mil/gis/default3.asp?theme_id=18) but is not in "user-friendly" formats. We propose to develop and serve this data in various georeferenced GIS formats such as triangulated irregular networks (TINs), digital elevation models (DEMs), hillshade TIFFs, 2-foot contour shapefiles, and other useful products that can help resource managers assess LIDAR's usefulness to their management efforts.

3. Develop detailed spreadsheet of all LTRMP aerial photography currently housed at UMESC, including date, pool location, format (color infrared, natural color, black-and-white), scan status (yes/no, dots per inch), interpreted status, photo scale, and extent of coverage (partial or complete). This document will be updated as necessary and served via the internet.

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2008V1	Provide biannual updates to LTRMP management	Robinson	Biannual
2007APE13	Assessment of high-resolution digital imagery for UMRS vegetation mapping and software-based vegetation classification	Robinson	30 March 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLV"; ID number

Personnel

Mr. Larry Robinson will be the principal investigator.

Bathymetry Component

The overall goal of the LTRMP Bathymetry Component is to complete a system-wide GIS coverage of UMRS bathymetry used to quantitatively and qualitatively assess the suitability of essential aquatic habitats. Presently, eight pools (Pools 4, 7, 8, 9, 13, 21, 26, and La Grange Pool) are complete and nine pools (Pools 5, 5A, 10, 11, 15, 17, 18, 20, and Peoria Pool) are over 50% complete (some over 80% complete). In addition, the Middle Mississippi Reach is about 90% complete. Although LTRMP will not collect data under the minimal sustainable program, the Program will maintain some level of expertise to provide basic assistance with using the existing LTRMP data.

Provide on-demand technical assistance related to the bathymetric database to the EMP partnership including, but not limited to:

- Deliver data in non-standard formats, such as raw point data in GIS or text files.
- Adjust bathymetry data to selected water surface conditions (presently only available at "flat-pool" conditions)
- Calculate summary statistics (e.g., hypsographic curves and volume) for geographical subsets of the data
- Advise partner agencies on data collection methods and locations that meet LTRMP needs
- Assist in spatial modeling using the bathymetric data

Work on this component in FY08 will focus on the development of a multi-year bathymetric data acquisition plan outlining a process and financial needs to complete the system-wide bathymetry dataset. The USACOE and USGS will jointly develop a comprehensive plan to collect the remaining bathymetric data for the Upper Mississippi River System. This plan will be distributed to the partnership in FY08 for review and approval and will be implemented if FY09 contingent upon available funding.

The bathymetric data acquisition plan will cover several topics including: the current status of UMRS bathymetric data coverage, identifying priority areas for data collection, appropriately sized acquisition areas, data standards, data collection through contracting, short-term and long-term acquisition plans and funding requirements.

UMESC POC: Jim Rogala (jrogola@usgs.gov)

USACE POC: Hank DeHaan (henry.c.dehaan@usace.army.mil)

Products and Milestones

Tracking number[1]	Products	Lead	Milestones
2008T1	Provide biannual updates to LTRMP management	Rogala	Biannual
2008T2	Draft UMRS Bathymetric Data Acquisition Plan	DeHaan	1 August 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLV"; ID number

Personnel

Mr. Jim Rogala will be the principal investigator.

Macroinvertebrate Component Wrap-up

Following guidance from the A-Team and EMP-CC, the macroinvertebrate component has been dropped from the LTRMP. Potential work to address issues of interest to the Partnership may be proposed as Additional Program Elements.

Product Descriptions

2005C2: Open River Macroinvertebrates

Although the target organisms selected historically for monitoring under the LTRMP are ecologically important, the physicochemical nature of the Open River Reach (ORR) is unique from the five other LTRMP study areas. As a result, relative abundance of these organisms is often low and restricted by the availability of preferred habitats in the ORR. The purpose of this study was to evaluate several macroinvertebrate capture methods in an unimpounded reach of the Mississippi River to determine the most effective way to characterize macroinvertebrate community structure.

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2005C2	Draft LTRMP Report: Open River macroinvertebrates	Hrabik	30 September 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code "BNBLC"; ID number

LTRMP Summary Report

Communication is a cornerstone of the LTRMP. We must communicate the accomplishments of the program to partners, customers, decision makers, politicians, and the general public in a way that is simple and effective, and that makes the program relevant to their needs. Each LTRMP project communicates its results in some form, which yields a variety of products available through various outlets. The program needs a single product that summarizes and highlights its accomplishments annually in a format that is easy to read and widely available.

Methods

A Web-based report will be produced that summarizes, synthesizes, and highlights the accomplishments of the LTRMP for FY05 and shows how these accomplishments are important to river management. Types of information that may be included are monitoring efforts, applied research results, analyses, GIS tools and products, data syntheses and interpretations, unusual or newsworthy events, lessons learned, efficiencies gained, substantive changes in operation/organization, updates to long-term ecological trends, and examples of how LTRMP information is making a difference. The aim will be to report accomplishments in an informative manner that relates science to management. The report will concentrate primarily on system-level information, although noteworthy accomplishments at smaller scales will be included. The report will build on previous annual summary reports, the LTRMP Report to Congress, and the USGS Status and Trends report (USGS 1999) and will become the basis for contributions to the next Report to Congress.

Products and Milestones

Tracking number[1]	Products	Staff	Milestones
2007S1	2005 LTRMP Web-based summary report on-line	Johnson, Houser, Ickes, Yin,	30 June 2008

[1]Tracking number sequence: Year; last letter of USGS BASIS task code “BNBLV”; ID number

Literature Cited

U.S. Geological Survey. 1999. Ecological status and trends of the Upper Mississippi River System 1998: A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. April 1999. LTRMP 99-T001. 236 pp.

Report Definitions

Draft: A draft that has been reviewed by the LTRMP Science Leader or his designee which is ready for review by USGS, COE, A-Team, or blind review, as needed.

Final draft: The report is completely through the USGS review/revision process and is ready to go to the USGS editorial group for production.

Reports not identified as drafts: (e.g., LTRMP report titled: Multi-year Synthesis of the Macroinvertebrate Component from 1992–2002 for the Long Term Resource Monitoring Program's) indicates a final printed version or Web-based report is on-line. For other products (i.e., manuscripts) this indicates submission to a journal.

Table 1. LTRMP sample collection for FY08.

	Study Area					
Component	**4**	**8**	**13**	**26**	**La Grange**	**Open River**
Vegetation	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	450 stratified random sample sites over growing season.	—	—	—
Fisheries	~160 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~200 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~180 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~270 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.	~165 samples; 2 periods: Aug. 1–Oct. 30, 6 sampling gears. Mix of stratified random and fixed sample sites.
Water Quality	135 stratified random sites done in each episode (winter, spring, summer, and fall); 14 fixed sites	150 stratified random sites done in each episode (winter, spring, summer, and fall); 13 fixed sites	150 stratified random sites done in each episode (winter, spring, summer, and fall); 12 fixed sites	121 stratified random sites done in each episode (winter, spring, summer, and fall); 9 fixed sites	135 stratified random sites done in each episode (winter, spring, summer, and fall); 11 fixed sites	150 stratified random sites done in each episode (winter, spring, summer, and fall); 9 fixed sites

2008 Additional Program Elements

2008APE1: Developing an empirical framework for reconstructing and modeling UMRS floodplain disturbance histories

FY08 LTRMP Theme Area: Connectivity

Name of Principal Investigator: Brian S. Ickes

Collaborators: Kenneth Lubinski, Jeff Houser, J.C. Nelson, John Chick, Valerie Barko, Bob Hrabik, Greg Sass, Richard Sparks

Introduction/Background

Connectivity, as defined by Pringle (2003), is the water-mediated transfer of energy, materials, and organisms across a hydrologic landscape. Connectivity is presently viewed as operating in up to four dimensions (Ward 1989) and represents a key force in disturbance and succession dynamics that maintain diverse landforms and ecological integrity in river systems (Ward et al., 1999). Thus connectivity is a central concept in prevailing theories that seek to predict functional attributes of river systems (e.g., Vannote et al., 1980; Ward and Stanford 1983; Thorpe and Delong 1994; Junk et al. 1989). However, large river systems such as the Upper Mississippi River System (UMRS) continue to present significant challenges to prevailing river theories. Correspondingly, no single theory appears to apply adequately to large river systems and we still lack a mechanistic and predictive understanding of how large rivers function to inform rehabilitation efforts (Johnson et al., 1995).

Impoundment, channel training, and floodplain levees have contributed notably to changes in connectivity among UMRS environments. Some of these modifications produced immediate effects while others took time to manifest as fluvial processes responded to engineering activities in the basin. For example, impoundment resulted in immediate inundation of vast areas that were formerly floodplain and many argue that these areas are now over-connected. Levees restrict seasonal interactions between channel and floodplain environments. Like impoundment, levees had a rather immediate effect; however, the result is largely described as under-connected, and increasingly so as levees are raised over time in response to flood risks in the basin. Fluvial responses to channel training have been cumulative over time and have contributed significantly to fundamental changes in the relationship between discharge and stage in areas of the system (Pinter et al 2006; Pinter et al. in review). For example, water-surface elevations at relatively low discharges (60,000 cfs) have dropped about 2.4 m (8.0 ft) over the record 133-year period at St. Louis, Missouri, 0.5 m (1.5 ft) over the 52-year record at Chester, Illinois, and 1.5 m (5.0 ft) over the 60-year record at Thebes, Illinois. Conversely, water-surface elevations at relatively high discharges (780,000 cfs), have risen about 2.7 m (9 ft) over the record period at St. Louis, 1.5 m (5.0 ft) at Chester, and 1.1 m (3.6 ft) at Thebes. Such changes in the fundamental hydrology and geomorphology of the system have profound implications for connectivity in the basin.

Attempts to rehabilitate UMRS ecosystems must take into account how anthropogenic impacts have altered connectivity probabilities as it moves forward. Rehabilitation cannot be simply about reconstructing past UMRS landforms, but rather must account for ever-changing hydrologic and geomorphic realities. We do not argue past and present rehabilitation is simply about reconstructing past landforms, but we also do not argue that rehabilitation proceeds with the benefit of a functional understanding of how river environments have evolved to past human uses of the system and how that may constrain/enable future rehabilitation efforts.

We feel that concepts of connectivity still hold the best promise for forging mechanistic linkages to predict and understand large river function and offer the greatest hope of aiding management efforts in the basin. However, rather than taking a theoretical approach to the issue, we propose an empirical one.

We propose the development of a spatially-explicit empirical model that uses historical and contemporary data sources (circa 1890 to present), a basin-wide hydrological database (> 6 million daily stage observations and > 2 million daily discharge estimates), and retro-modeling principles (Remo and Pinter 2007; Jacobsen and Galat 2006) to reconstruct metrics of connectivity for select reaches of the UMRS. We will select three study areas that collectively traverse the previously described geomorphic and anthropogenic impact gradient that defines the contemporary UMRS (USGS 1999; Koel 2001). We will develop spatially explicit models for each study area and for each of three time periods (late 1800s, mid 20th century, contemporary), adjusting over time for fluvial and hydrological changes associated with cumulative system engineering (Pinter et al., in review). Connectivity within and among discrete model cells (elements of a grid) will be indexed as the frequency, duration, and magnitude of inundation (stage) and velocity (flow) from 2-dimensional hydraulic models. Connectivity indices within each study area and for each time period will be described statistically (probabilistically) by season and annually and spatially mapped. Spatial patterns in connectivity probabilities will be tested for changes over time within each study area, and patterns among study areas within each time period will be compared.

Long Term Research Goal
Long term goals of this research are to (1) integrate and synthesize historical geospatial data and historical hydrological data into an empirical modeling framework; (2) map and analyze spatial patterns in connectivity probabilities along a geomorphic and human impact gradient within the UMRS; and (3) determine whether spatial patterns in connectivity probabilities relate to faunal and floral patterns observed by the Long Term Resource Monitoring Program and other data sources.

This study plan focuses on addressing three major questions:
1. How has connectivity probabilities changed over time in the UMRS in response to system engineering activities?
2. Are there non-random associations between connectivity frequencies and floral and faunal patterns in the UMRS (e.g., are faunal and floral patterns predictable from hydrologic disturbance patterns)?
3. What is the extent of change over time in connectivity, what is its spatial signature, and how can such information help to inform rehabilitation activities?

Relevance of research to UMRS/LTRMP: The proposed research will test the generalized hypothesis that changes in connectivity over time, owing to river engineering activities, have altered basic and higher order ecological processes within the Mississippi basin. The primary objective is to develop a spatially-explicit model of connectivity frequency using probabilistic statistical methods. This model will incorporate historic and contemporary data sources (circa 1890 to present) on floodplain elevation, channel bathymetry, river engineering structures, river stage, and discharge compiled under a recent National Science Foundation grant (N. Pinter, Southern Illinois University). Historic data sources will be integrated into a GIS and linked to hydraulic models to estimate spatially explicit probabilities of the frequency, magnitude and timing of connectivity, critical for biogeochemical processing (e.g., denitrification) and higher-order ecosystem functions (e.g., faunal diversity patterns). A series of model outputs will be produced that describe the frequency, magnitude and timing of connectivity at several discharge conditions over the past 120 years in the Mississippi River basin. Spatial patterns in connectivity probabilities will be tested for changes over time for each study area, compared among study areas, and correlated to independent ecological databases (US Geological Survey, Upper Midwest Environmental Sciences Center) using multivariate statistical models. These models will test hypotheses concerning the relationships between connectivity frequencies and ecological structure and function in the Mississippi River basin.

Thus, this study proposes to integrate and model historic and contemporary (e.g., LTRMP) data sources to reconstruct an evolutionary history of hydrological and ecological change in the basin, as well as to develop a predictive framework for ecosystem rehabilitation. As such, it will be integrative and synthetic. We feel such a framework will be critical and necessary for identifying and targeting viable rehabilitation targets in the basin.

Methods:

Task 1: Compile historic geospatial data sources on the Mississippi River
Historic geospatial data sources containing information on channel hydrographic surveys, engineering structures (e.g., wing dikes, levees, weirs, and bridges), floodplain topography, land use, and river discharge and stage will be assembled, digitized, and rectified to a common reference frame using GIS. Data are available from at least 1890 to present and were previously compiled under a NSF grant at Southern Illinois University.

Task 2: Integrate historical data into a GIS for site selection
Historical data from Task 1 will be integrated into a GIS using ArcMap 9.0 software. Historical data sources will be linked to elevation models. Three reaches of river with sufficiently dense data from three time periods representative of river engineering changes between 1890 and the present will be identified and extracted for detailed hydrological modeling and later ecological analyses. Selected study areas will be discretized into finite element cells for spatial modeling. Our intent is for the three selected reached to traverse the full geomorphic and anthropogenic impact gradient that has been previously defined for the UMRS (e.g., USGS 1999; Koel 2001).

Task 3: Develop and calibrate hydraulic models
Hydraulic models will be developed and calibrated for each study reach selected from Task 2 above. Geospatial data compiled in Task 2 will be used to define boundary conditions and to parameterize the models. River discharge data used to drive the models will be adjusted to reflect changes in stage to discharge relationships using the specific-gauge approach. This approach allows one to model the effect of empirically observed changes in hydrology resulting from river engineering activities (Pinter et al., 2002). To develop models for each time step, we will apply recent advances in hydraulic modeling known as retro-modeling (Remo 2007; Jacobson and Galat 2006). Each model will be run across a broad range of discharge conditions. Water surface profiles and velocity estimates from each model simulation will be integrated back into a GIS for visualization and analysis.

Task 4: Estimate and map water surface elevation and velocity probabilities
Hydraulic model results from Task 3 will be used to estimate the probability occurrence of several different water surface elevation (magnitude, duration, timing) and velocity (hydraulic residence) states for each finite model cell. These probabilities will be surfaced using spatial Kriging algorithms and visualized using GIS.

Task 5: Compare and contrast changes in probability profiles over time
Probability surfaces for each study reach will be compared for changes in the spatial distribution of connectivity states. We will statistically test for spatial differences in water surface elevation and velocity probability states over time using autocorrelation tests.

Task 6: Test contemporary associations between disturbance frequencies and ecological diversity
Spatial associations between various ecological outcomes (e.g., community composition, community structure, and diversity) and modeled connectivity probabilities will be tested using multivariate modeling methods known as canonical correspondence analysis and non-metric

multidimensional scaling. Candidate ecological outcomes include floodplain forest community metrics, LTRMP aquatic vegetation metrics, LTRMP fisheries metrics, and LTRMP limnological metrics. We will test the general hypothesis that modeled spatial patterns in connectivity indices (elevation magnitude, duration, and timing) are associated with spatial patterns in faunal and floral diversity, community composition, and structure.

Products and Milestones

Tracking number	Products	Staff	Milestones
2008APE1a	Draft completion report (geospatial synthesis and data extraction)	Ickes	30 September 2008

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2008APE2: Setting quantitative fish management targets for LTRMP monitoring

FY08 LTRMP Theme Area: Setting Management Objectives:

Name of Principal Investigator: Greg Sass

Collaborators: John Chick and Brian Ickes

Introduction/Background

Our overall focus for this project will be to decide on quantitative goals (i.e., target levels) for the fish indicators reported on in the most recent Status and Trends Report (STR). We may broaden our list of fish indicators beyond those reported in the STR if there is clear evidence for the utility of new indicators. A basic assumption behind our approach is that ultimately, target indicator levels are an expression of values. As such, science by itself can not generate these levels. Science can be used to provide the range of indicator levels that might be achievable given various assumptions about past conditions and the management of the ecosystem, but managers need to be the decision makers as to what levels are adopted. Therefore, best professional judgment must be the tool that sets the target indicator levels. We will attempt to identify both upper target levels (i.e, best obtainable levels), and lower target levels that would be useful as indicators of serious resource degradation. Thanks to relatively recent history, developing these lower target thresholds should prove less troublesome than developing the upper target levels. For example, prior to the Clean Water Act, major portions of the Illinois River were seriously degraded from municipal pollution. Because the Long-term Illinois River Electrofishing Database encompasses this time period, we can examine this issue empirically. Additionally, with an eleven year database (1994-2004) of consistent LTRMP data, we are in a strong position to define long-term averages with upper and lower bounds.

For identifying upper target levels, we will start with the assumption that we are looking for best attainable levels, rather than estimating a pre-disturbance (i.e., pre-navigation or pre-European) level. This likely will be more difficult to derive and will require far more assumptions (e.g., different levels for different reaches). The critical questions to ask are: 1) are we satisfied with what we have?; 2) is there room for improvement?; and 3) what is a realistic/obtainable level of improvement to set as a goal? It is important to view this effort with a long-term perspective. The upper targets we set today should not be viewed as written in stone; rather, they should be revisited and refined where necessary on a regular basis (e.g., every five years).

Participation by each of the five UMRS states, along with the federal LTRMP partners, will be a key to the success of this project. We feel Illinois is in a rather unique position of having several long-term data sets to draw inferences from, particularly for the Illinois River. This will be particularly useful because the La Grange Reach often had the greatest levels for fish indicators in the STR. Nevertheless, we need to draw on information from all five states and we need the judgment of managers and researchers from all five UMRS states and the federal LTRMP partners. We will coordinate our meetings with A-team meetings, and vet our findings to the larger management communities.

Relevance of research to UMRS/LTRMP:
We are developing target levels for a key natural resource monitored by LTRMP. These targets will be extremely useful in evaluating the condition of the UMRS in future Status and Trends reports and other analyses, reports, and publications of LTRMP data.

***Methods**:*
Our approach will be divided into three phases:

First, we will identify historic data bases that can yield useful information and analyze these data sets to gain an historic perspective on indicator levels. The Long-term Illinois River Electrofishing program will certainly be one of the databases we use. Additionally, we will mine information from commercial fish catches (see Schramm 2004), UMRCC resources, museum records, and EMAP. Finally we will contact state agencies in each of the five UMRS states to identify further data sets that may be useful and available.

Second, we will host meetings with resource managers to present data from the STR and historic data bases. The goal of these meetings is to identify potential target levels for indicators. Because we need feedback from all LTRMP state and federal partners, we will attempt to organize most of these meetings to coincide with A-team meetings. Two meetings will focus on presentation of historic and LTRMP data, with draft upper and lower limits expected to be completed at the end of the second meeting.

Third, we will seek feedback on the proposed target levels from the broader management community and refine the target levels accordingly. The draft limits developed in the second meeting will be vetted with the broader management community. Feed back will be presented at a third and final meeting, when final target levels will be agreed on.

Products and Milestones

Tracking number	Products	Staff	Milestones
2008APE2	Draft LTRMP technical report	Sass	30 March 2009

Literature Cited

Schramm, H.L. Jr. 2004. Status and management of Mississippi River fisheries. *In Welcomme, R.L. (ed.); Petr, T. (ed.)* Proceedings of the second international symposium on the management of large rivers for fisheries (Volume I). RAP Publication 2004/16, Food and Agriculture Organization Of The United Nations & The Mekong River Commission.

2008APE3: Development of survey methods to spatially map mussel assemblages in the UMRS.

FY08 LTRMP Theme Area: Native Mussels:

Name of Principal Investigator: Jim Rogala

Collaborators: Travis Moore; Matt Combe; Mike Davis; Dean Corgiat; Teresa Newton; Brian Gray

Introduction/Background:

Resource managers need information on mussel abundance and how they are distributed in the UMRS. Nested within this question are specific information needs at many levels. At the coarsest level, pool-wide estimates of total mussel abundance across species are needed. At a finer level, abundance estimates are often needed at smaller spatial scales, or estimates of community composition are needed. Even more detailed information is often needed regarding spatial patterns at smaller scales (e.g., project sites). At a very fine level, estimates of rare species are often needed at a project site.

Previous studies conducted in 2006 and 2007 evaluated potential sampling designs that may provide estimates that meet the needs of resource managers. In 2006, a systematic survey design used in Pool 5 produced acceptable levels of relative precision for pool-wide population estimates. The pool-wide design used in Pool 5 was subsequently used for pool-wide mussel surveys in Pools 6 and 18 in 2007. However, the design used in Pool 5 was unsuccessful at attaining the desired relative precision for abundance estimates in the shallow water zone representing the area that might be impacted by the drawdown.

Two additional sampling designs were deployed in Pool 6 in 2007. We tested the use of a double sampling design to address the inability to estimate shallow-water zone mussel abundance with the pool-wide systematic sampling design that didn't use double sampling. A double sampling design utilizes a more rapid method of mussel detection that is subsequently adjusted for detection errors. The percentage of mussels not detected using the rapid method (i.e., detection probability) is obtained from paired quantitative/semi-quantitative samples. The second design, adaptive sampling) was tested in deep water to increase the number of collected mussels. Collecting more mussels can lead to better estimates for species that are less common and provide better species lists. Adaptive sampling collects more mussels by increasing sampling frequency where mussels are found.

This proposed research will continue to use experimental sampling methods and evaluate the use of such methods to provide information on mussels in the UMR. Some of these methods have already been used by resource managers, but have gone untested (e.g., no detection probabilities were estimated). Specifically, the methods tested here will focus on mussel bed determination and characterizing the mussel assemblage within selected beds.

Relevance of research to UMRS/LTRMP:

The overall objective of this proposal is to further evaluate study designs that may be suitable for obtaining mussel assemblage information at small to intermediate spatial scales. There are two distinct projects under this proposal: 1) a study to determine detection probabilities (e.g., double sampling) for mussel bed surveys in Pools 22 and 24 and 2) a study to evaluate an adaptive double sampling design in Pools 3 and 4. These studies will provide new information on double sampling surveys in deep water, and an adaptive double sampling design.

Pools 22 and 24 double sampling
This project will provide new information on double sampling. Methods differ somewhat from the previous work using double sampling in Pool 6, thus providing needed information on the use of semi-quantitative sampling methods. This is a deep water survey in the lower part of the UMR. The rapid assessment will include a less quantitative method than the design used in Pool 6, and it will focus on selected mussel beds (e.g., areas of higher overall density than pool-wide density). The estimation of detection probabilities will provide a means of assessing the validity in comparing past data from primarily quantitative surveys to recent data using rapid qualitative assessments. In particular, the abundance of several selected species that are thought to be in decline will be better estimated, thus a better assessment of their status will be a product of this survey.

Pools 3 and 4 adaptive double sampling
The proposed study will use an adaptive double sampling design to characterize a selected number of mussel beds. Development of these methods and the evaluation of these methods will lead towards more robust sample estimates. The use of an adaptive design will address the need to allocate samples efficiently when sampling populations that have high spatial heterogeneity.

All data collected during this APE project will be available to researchers developing habitat associations for mussels.

Methods:

Pools 22 and 24 double sampling
We propose to sample two mussel beds where deertoe (*Truncilla truncata*) mussels were previously found to be common amongst distinct large beds in Pools 22 and 24. Transects traversing the beds will be established, with transect length estimated by determining endpoints based on mussel density observed during the survey. We will deploy semi-quantitative and quantitative sampling techniques. The entire length of each transect will be surveyed by visual/tactile surface methods (semi-quantitative) on the downstream side of the established transect line. Each transect will also be surveyed by ¼ m^2 quadrat samples (quantitative) placed on the upstream side of each transect line. The distance between quadrats will be selected to achieve a desired sample size for accurate estimates of detection probabilities. The quadrat will be double sampled, with visual/tactile surface samples collected prior to excavation of the sediments. The two distinct samples will be used to determine detection probabilities. Sampling will be conducted by diving. Information on sampling effort required to complete the various techniques (i.e., surface samples and excavated quadrats) will be recorded.

Pools 3 and 4 adaptive double sampling
We propose to sample two or more known mussel beds: one off-channel bed in Pool 3 and one main channel bed in Pool 4. Sampling will radiate out from the selected starting points within the bed until criteria for a mussel bed, as predefined, are not met. Methods will include qualitative sampling along transects to “trigger” semi-quantitative sampling if mussel density criteria are met. A subset of the semi-quantitative sites will be surveyed quantitatively for the purpose of obtaining detection probability values. This approach accommodates the clustered nature of mussel distributions (i.e., mussel beds) by rapidly surveying areas with few or no mussels. The use of such a design will not only begin to provide information on mussel bed characteristics, but also provide insight into the utility of such a design for surveying HREP sites and other project areas. Sampling will be conducted by diving. Information on sampling effort required to complete the various techniques (i.e., qualitative, semi-quantitative, and quantitative) will be recorded.

Timeline:
Latest date for beginning of project: April 2008
Expected completion date: One year from funding date

Products and Milestones

Tracking number	Products	Staff	Milestones
2008APE3	Draft completion report: Evaluation of two double sampling designs for sampling mussel beds in the UMRS	Rogala	30 March 2009

Additional Information: There will likely be two additional reports, but these will be products of co-investigators and will not be funded through APE funds. The additional reports would cover mussel bed characteristics in the two respective study areas (i.e., the two lower pools and one upper pool).

2008APE4: Analysis and support of aquatic vegetation sampling data in Pools 6, 9, 18, and 19

FY08 LTRMP Theme Area: Aquatic vegetation

Name of Principal Investigator: Yao Yin

Collaborators: joseph.s.lundh@usace.army.mil

Introduction/Background

The importance of aquatic vegetation for water quality, fish, and migrating waterfowl is well known. Understanding the distribution and drivers of vegetation to enable better management for wildlife has been pursued by many agencies, researchers, and individuals. Prior to the LTRMP surveying key pools starting in 1991, studies were mainly restricted to individual surveys on smaller disparate areas. Current LTRMP field studies in key pools provide detailed documentation of species abundance and distribution in Pools 4, 8, 13, and 26 on the Mississippi River.

Submersed aquatic vegetation (SAV) is not distributed evenly throughout the Upper Mississippi River system and is affected by difference in water clarity/quality, velocity, and depth (USGS 1999). Most SAV occurs between Pools 4 and13 (Lubinski 1993). Though the LTRMP sampling confirms these findings on the pool scale for areas surveyed and on the system scale, vegetation distribution between key pools has not been well documented using on the ground surveys. For example, between key Pools 13 and 26, the conditions change from abundant vegetation to a nearly depauperate status. Pool 19 is the furthest downstream pool with significant aquatic vegetation on the Mississippi River. Vegetative conditions are also reduced in Pool 6 as compared to key Pools 4 and 8. More detailed studies of areas using LTRMP methodologies outside the key pools will provide additional understanding of the current vegetative conditions on the river.

Apart from a general understanding of out-pools, there are specific reasons for better documenting certain pools including those with significant wildlife usage and documenting potential drawdown effects. Pools 9 and 19 qualify under significant wildlife usage and are major stop-over sites for diving duck migration. Pool 19 is the most important Pool on the Lower Impounded reach and it sees the majority of lesser scaup migrating though the Mississippi flyway. The good food resources lengthen the stop-over time allowing birds to refuel during their migration. Pool 9 along with Pools 6 and 18 are also potentially slated for draw downs. Collecting pre drawdown data will help document vegetative response in those pools.

Relevance of research to UMRS/LTRMP:

This APE would relate directly to these aquatic vegetation secondary and tertiary focus areas:

- *What is the potential standing stock and annual production of SAV in different parts the UMRS given existing abiotic conditions?*
- *How can we create conditions that will establish SAV below Pool 13?*

This out-pool sampling data in Pools 6, 9, 18, and 19 would provide additional information on the abundance, diversity, and distribution of aquatic vegetation thus addressing the first Aquatic Vegetation Focus Area directly. Methodologies used are intended to be comparable to the key pools to provide a relevant reference. Future sampling efforts in FY 08 may target other non-key pools as well.

This out-pool sampling also provides important data on SAV below Pool 13 by directly sampling Pools 18 and 19. Records include depth and substrate information along with vegetation. Compiling and analyzing this existing data set will provide data on the distribution and abundance of SAV in these two pools.

Pool 19 is also the furthest downstream Pool with any significant SAV even though Pool 18 has very little. The use of this data along with future studies looking at what conditions change from

Pool 18 to 19 that allow for vegetation would be very interesting. Especially interesting as virtually the initial water quality entering 19 is the same as exiting 18.

One tool for changing conditions for aquatic vegetation is that of using draw downs. Pool 18 is potentially slated for a draw down under NESP. The data collected from Pool 18 would provide excellent preliminary data for later comparison of draw down affects. Perhaps this will provide insight into promoting SAV in the lower impounded reach. Additionally, draw downs are also slated for two other areas studied: Pools 6 and 9.

Methods:

Aquatic vegetation data has been collected in 2005 and 2006 in Pools 9 and 19 along with Pools 6 and 18 in 2007 through a cooperative volunteer effort of the Upper Mississippi River Conservation Committee and others. The data was collected during UMRCC "Field Days" in late July/early August of 2005 and 2006 in Pools 9 and 19. The field days comprised a day to day and a half of sampling using the LTRMP aquatic vegetation standard sampling protocol (Yin et al. 2000). The effort combined boat and personnel resources of the Minnesota DNR, Iowa DNR, Illinois DNR, Wisconsin DNR, US Army Corps of Engineers, UMESC, Fish and Wildlife Service, NGOs, volunteers, and many others. As part of the cooperative effort, UMESC provided the random sampling points and map support.

Unlike standard LTRMP protocol for aquatic vegetation in the key pools, these surveys utilized less sampling points to facilitate a one to two day effort w/ available people. The sample points were organized in clusters of 15 to 20 points per cluster. Clusters were then assigned to one boat or multiple clusters were assigned to a group of boats.

The 2005 and 2006 data has already been quality checked and entered into a database. Efforts under this APE are detailed in the product section below but include QA/QC of 2007 data, computer entry of data, point generation for 2008 sites, map support for 2008, and analysis of 2005-2007 data. The analysis will be similar to LTRMP reporting for key Pools but also include distribution and abundance of key species as well. Comparisons will be made to other key pools and if possible determine if there are any comparable trends.

Special needs/considerations

Since the data is collected though a cooperative volunteer effort by multiple agencies and groups, it will require additional consideration during the analysis phase. Some complications from these one-day sampling efforts include dealing multiple observers and inaccessible or missed data points. The total number of surveyed points is also less than what is normally collected during work in the key pools. Other specific adjustments to the standard LTRMP protocol included reduced sampling in upper Pool 19 above Fort Madison due to the limited likelihood of finding vegetation and not sampling some backwater areas in Pool 18 including Keithsburg Refuge and Boston Bay to cite two examples. The budget submitted includes additional time to parse out these inconsistencies to provide a summary that is as comparable as possible to the other key pools.

As this effort is ongoing, this summary includes additional support for 2008 field work and 2007 data entry. Future surveys through cooperative effort post draw down in Pools 6, 9, and 18 are also planned. Currently collected data in those pools will then be available for comparison through future APE submittals.

This APE does not include budget items for data collection as it has been and will be done through cooperative efforts of agencies, NGOs, and volunteers. Survey locations for FY08 will be finalized during the spring UMRCC meeting.

Products and Milestones

Tracking number	Products		Staff		Milestones
2008APE4a	Draft completion report: FY05-07 data		Yin		30 December 2008
2008APE4b	Data entry and data quality checking of the 2008 data		Yin		30 March 2009

Additional information:

- Completion report for FY05-07 data and posting of data to website.
    - Data analysis providing: abundance, diversity, and distribution of aquatic vegetation for key species and species groups in Pools 9 and 19 from 2005 and 2006.
    - Data analysis providing: abundance, diversity, and distribution of aquatic vegetation for key species and species groups in Pools 6 and 18 from 2007.
    - GIS data layers of surveyed points with tabular summary information.
    - Comparison of Pools 6, 9, 18, and 19 to nearby key pools.
- Data entry and data quality checking of the 2007 data. (June 1, 2008)
- Map, point generation, and general support of the 2008 cooperative data collection. (July 15, 2008)
- Data entry and data quality checking of the 2008 data (two pools of sampling yet to be determined). (September 30, 2008)

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2008APE5: Experimental and Comparative Approaches to Determine Factors Supporting or Limiting Submersed Aquatic Vegetation in the Illinois River and its Backwaters

FY08 LTRMP Theme Area: Aquatic Vegetation

Name of Principal Investigator: Greg G. Sass

Collaborators: Thad R. Cook, Timothy M. O'Hara, Kevin S. Irons, Michael A. McClelland, Nerissa N. Michaels, John H. Chick, Chad R. Dolan, Robert J. Cosgriff, Yao Yin, and Clinton A. Beckert

Introduction/Background:

Historically, submersed aquatic vegetation (SAV) flourished within the Upper Mississippi River System (UMRS). At present, SAV distributions are spatially heterogeneous within the UMRS and generally lacking below pool 13. Distinct longitudinal changes in SAV over the past 100 years have been documented on the Illinois River. For example, SAV flourished throughout the Illinois River in the early 20th century, was only present in the lower reaches in the mid-20th century, and most recently (late 20th century to present) SAV has flourished in the upper reaches (Dresden, Marseilles, Starved Rock) and has been lost in lower reaches (Alton, La Grange) (Havera et al. 2003, Cook and McClelland 2007). As a consequence of budget constraints and the lack of vegetation present in the Alton and La Grange reaches of the Illinois River, the LTRMP vegetation monitoring component was dropped from each reach in 2005. A combination of anthropogenic, abiotic, and biotic factors may be responsible for the spatial heterogeneity observed in SAV abundances among reaches of the Illinois River and in the UMRS.

Little is known regarding interacting factors that may limit or promote SAV growth in large rivers, however seed bank viability, turbidity (< 40 NTU), herbivory (red-eared slider *Trachemys scripta elegans*, grass carp *Ctenopharyngodon idella*), and sediment resuspension (common carp *Cyprinus carpio*) may be important. Lessons learned from the studies of shallow lakes may inform SAV management in large rivers, in that large rivers generally maintain a continual state of mixis and backwater lakes are similar to many well-studied shallow lakes. Shallow lakes generally exist in one of two stable states; clear-water or turbid (Scheffer 1997, Jeppesen et al. 1998, Carpenter 2003). Change from one stable state to another is known as a regime shift (Carpenter 2003). The clear-water state is dominated by the presence of primary producers such as aquatic macrophytes, periphyton, and epiphyton. Phytoplankton concentrations are low and recycling of phosphorus to phytoplankton is slow because macrophytes stabilize sediments and sequester nutrients during the growing season. Herbivory by zooplankton may also limit phytoplankton production in the clear-water state. Alternatively, the turbid state is dominated by phytoplankton, which may shade aquatic macrophytes and destabilize sediments. In the turbid state, phosphorus recycling may be rapid due to wave action. Bottom feeding fishes, such as common carp, may also uproot macrophytes, directly consume (e.g. grass carp) plant matter, and/or disturb sediments preventing SAV colonization and persistence. Ultimately, a regime shift from a clear-water to turbid state results in a series of negative feedback loops such that the pathway to the turbid state may not be the same as the recovery pathway back to the clear-water state due to hysteresis and irreversibility (Carpenter 2003). Lessons learned from the turbid state of shallow lakes (i.e. potentially analogous to the mainstem Illinois River and its backwater lakes) suggest that seed bank viability, nutrient loading, light limitation (e.g. turbiditity, phytoplankton shading), water level fluctuations, sediment resuspension (e.g. wave action, bottom-feeding fishes) and herbivory (e.g. grass carp, red-eared slider) may constitute individual or interacting factors limiting SAV growth in the UMRS.

Ecosystem science methodology provides a deductive framework to test for factors influencing key attributes of aquatic ecosystems. For example, theoretical (e.g. modeling), comparative, experimental, and long-term studies provide the cornerstones for ecosystem science (Carpenter 1998). At present, the LTRMP has been able to model factors influencing SAV and has documented changes in SAV through long-term monitoring. However, comparative and experimental studies to test for factors limiting or supporting SAV establishment or growth are lacking. Comparative and replicated ecosystem experiments may be critical to understanding why SAV is limited and spatially heterogeneous in the UMRS and may provide insights for management to reestablish and rehabilitate SAV.

Relevance of research to UMRS/LTRMP:

Our objectives are twofold: 1) to replicate and add to the Chick et al. experimental mesocosm study (2av) in the Swan Lake, lower Illinois River HREP with an experimental mesocosm study in the Lake Chautauqua, middle Illinois River HREP to determine factors limiting the establishment of SAV and to determine if augmented SAV beds can persist when exclosure from predation and sediment disturbance are removed. In addition to the Chick et al. methodology, we will also address light limitation and water-level fluctuation effects by creating exclosures at various bottom depths; and 2) to conduct a comparative field study throughout the Illinois River to test for factors limiting or supporting SAV under current Illinois River conditions. We will also mine historic data (other than from the LTRMP) to enable us to better understand past and present river conditions. Whole-ecosystem experiments conducted at appropriate spatial scales for management, such as the mesocosm study presented here, are often criticized for lack of replication (Carpenter 1998). Replication of the (2av) study will overcome this criticism and provide information about factors limiting SAV growth and persistence in different reaches of the Illinois River.

Our proposed research directly answers the question, “What factors control the abundance, diversity, and distribution of aquatic vegetation in the UMRS?”, for the Illinois River. Because SAV in the Illinois River is likely the most depauperate of any habitat in the UMRS, our results will be informative to other portions of the UMRS that do not have SAV and may have a greater chance of reestablishing SAV due to less degraded conditions. Our goal is to gain a better understanding of SAV dynamics through experimental and comparative approaches on the Illinois River. Our results may guide future HREP’s and alternative restoration projects in order to promote the re-establishment of SAV in the Illinois River and the UMRS. Further, this research could be a first step in designing large-scale and cost-effective methods to achieve desired vegetation responses, such as creating conditions that allow the persistence of SAV given current river disturbance regimes.

Ultimately, our collaborative experimental and comparative studies may provide insights into factors limiting or promoting SAV growth in large rivers, why SAV distributions are heterogeneous in the UMRS, and guide future restoration efforts to re-establish or promote SAV growth in the UMRS, whether it be through HREP’s or other means. Our collaborative and replicated effort, coupled with previously established modeling results and long-term monitoring observations, should complete our deductive ecosystem science strategy to determine factors influencing the key attribute of SAV in the UMRS. Collaboration will be limited to the Illinois River and (2av) in this study because the Illinois River is likely the most degraded system in the UMRS. Therefore, our findings from the highly disturbed and degraded Illinois River should be directly pertinent to SAV management in the rest of the UMRS.

Methods:

We propose to create 36, 3x3 m mesocosm exclosures in the north pool of Lake Chautauqua to test for the influences of seed bank viability, light limitation and water-level fluctuation, sediment resuspension, and herbivory on the establishment and persistence of SAV. Each exclosure will be anchored by four posts and enclosed by plastic netting and metal flashing to prevent fish entrance through swimming and red-eared slider entrance through burrowing, respectively. Two groups of 12 exclosures will be subject to ambient wind and wave conditions, while one group of 12 exclosures will be subject to reduced wind and wave action. In each group of 12 exclosures, 4 will be in 0.5 m of water, 4 in 1.0 m of water, and 4 in 1.5 m of water to simulate differences in light penetration and water level fluctuations. Twelve control plots will also be created at each of the three locations. Initially, we will use sediment coring to determine whether the viability of a seed bank may be limiting SAV growth in Lake Chautauqua. Following the determination of seed bank viability, 20 bags with 3 sago pondweed *Stuckenia pectinata* tubers in each bag will be planted in each exclosure. All red-eared sliders, common carp, and grass carp will be removed from the exclosures continually throughout the experiment to control for the effects of sediment resuspension and herbivory. Each exclosure and control plot will be sampled weekly for turbidity, wind speed, and wave height during the study. Submersed aquatic vegetation stem density and biomass per unit area will be sampled monthly by taking three, 0.25 m diameter cores in each exclosure and control plot. One month following tuber planting or when sago pondweed has become established in the exclosures, three exclosures in each of the three groups (one at each depth level) will be removed. The former exclosures will be sampled weekly to determine SAV persistence following establishment. Red-eared slider, common carp, and grass carp ambient relative abundances will be assessed monthly by pulsed-DC electrofishing and fyke netting and compared to abundances of each species at Swan Lake to test for threshold density effects on SAV. Our additional exclosure experiments will provide replication of the Swan Lake experiment and may provide additional spatial and water-level factors limiting SAV growth among reaches in the Illinois River. A one-way Analysis of Variance (ANOVA) will be used to test for differences in sago pondweed stem densities and biomass among treatments and among controls and treatments with the null hypothesis of no difference ($\alpha = 0.05$).

Within the past one hundred years, SAV abundances in the Illinois River have undergone three distinct spatial phases: 1) high abundances of SAV throughout the river; 2) devoid of SAV in upper reaches and high abundances in lower reaches; and 3) SAV in the upper reaches and no SAV in the lower reaches. Factors lending to the current spatial distribution of SAV in the Illinois River are mostly unknown. We propose to conduct a comparative field study among six reaches of the Illinois River (Alton, La Grange, Peoria, Starved Rock, Marseilles, Dresden) to test for abiotic and biotic factors limiting or supporting SAV growth. We propose a stratified-random sampling approach among reaches using LTRMP vegetation protocols to determine presence/absence, species composition, and percent cover of SAV. At each site, we will also measure pertinent abiotic (e.g. substrate composition by penetrometer, turbidity, Secchi depth, flow velocity, light penetration) and biotic variables (e.g. common and grass carp catch-per-unit-effort) that may influence SAV establishment or growth. Common and grass carp CPUE will be determined by a 15 minute pulsed-DC electrofishing run beginning 100 m upstream of the vegetation sample site and proceeding downstream. All fishes stunned during the electrofishing run will be collected, identified, and counted to test for patterns among the presence/absence of SAV, abiotic habitat conditions, and fish species community composition. We will use best-subsets, multiple regression analysis to test for significant predictors of SAV percent cover among reaches. Mallow's Cp statistic (i.e. penalization for insignificant model parameters) and maximum adjusted r2 values will be used to choose the best, statistically-significant models. All interaction terms will be tested and removed from model consideration if $p > 0.05$ (Draper and Smith 1998). We will use Classification and Regression Tree (CART) analysis to determine abiotic and biotic thresholds to SAV presence/absence (Breiman et al. 1984, Ripley 1996). Multiple logistic regression will be used to determine significant predictors and probabilities of SAV presence/absence in the six reaches of the Illinois River.

Products and Milestones

Tracking number	Products	Staff	Milestones
2008APE5	Draft LTRMP Technical Report	Sass	30 March 2009

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2008APE6: Hydrologic connectivity between off channel areas and the main channel: an empirical test of an important driver of potential HREP effects on biological production and organism health

FY08 LTRMP Theme Area: Connectivity

Name of Principal Investigator: William Richardson

Collaborators: Jeff Houser, M. Bartsch, L. Bartsch, B. Knights, A. Bartels, S. Giblin, G. Sass, J. Chick, T. Dukershein, J. Hendrickson.

Introduction/Background

Nutrient loading and hydraulic retention time (HRT) are two primary controllers of riverine productivity and biological diversity. Nutrient loading to the river as a whole is largely a function of basin land use and is difficult to change on short time scales. However hydraulic retention time and thus input, retention, and cycling of nutrients in a particular off channel area can be directly manipulated by management actions. Habitat restoration and enhancement projects (HREPs) in the Upper Mississippi River System (UMRS) often include such manipulations with the expectation that they will enhance physicochemical and biological conditions for fish and fowl (e.g., Finger Lakes of Nav. Pool 5; the Stoddard Island project, Reno Bottoms project, Peoria Lake Islands, Lake Chautauqua). Biotic productivity in these areas is expected to respond to the changes in hydraulic retention time and nutrient input and export resulting from HREP construction, but the mechanisms driving these expected responses are not well understood.

One mechanism through which connectivity to the main channel and HRT may affect productivity and biological diversity in off channel areas (OCAs) is by affecting food quality and quantity in OCAs. Because of high rates of denitrification and low rates of exchange with the main channel, backwater areas that are poorly connected to the main channel often exhibit very low nitrogen (N) concentrations in the water column in these OCAs during the summer growing season. However, phosphorus (P) concentrations in the water column often remain relatively high (Houser 2005). Conditions of high P concentration and low N concentration in the water column are expected to increase the probability of blue green algae dominating the phytoplankton community (Reynolds 1984, Scheffer et al. 1997). Recent taxonomic analysis of Long Term Resource Monitoring Program phytoplankton samples (Smith & Wehr, Calder Biological Research Center, Fordham University, unpublished data) shows species composition of OCAs is diverse in the spring, but dominated by cyanobacteria, a bluegreen alga in late summer. Because bluegreen algae are a poor food resource (Ahlgren et al. 1990, Goulden et al. 1999, Brett et al. 2006) higher levels of the food web may be affected. For example, tissue from zooplanktivorous fish (young of year bluegill, Lepomis macrochirus) and unionid and zebra mussels (Dreissena polymorpha) from OCAs have been shown to contain significantly lower concentrations of essential fatty acids (EFAs—an indicator of fish health) than do those from channels (Bartsch et al. 2007) and this difference is likely related to greater abundance of high quality algae in channels (e.g., diatoms and green algae) and abundance of lower quality algae (bluegreens) in backwaters. Channel areas also experience higher loading rates (replenishment) of high quality food particles than backwaters with low connectivity to channels. Hence, we hypothesize that the connectivity of a given aquatic area to the main channel affects both rates of productivity, food quality, and biotic diversity.

We propose the following specific hypotheses:

1. Isolated off-channel areas (OCAs) will exhibit low N:P ratios due to nitrogen depletion, particularly in late summer; connected OCAs and channels will exhibit higher N:P ratios due to N inputs from the channel.

2. Connection between channels and backwaters strongly affect phytoplankton community structure: isolated OCAs will be more frequently dominated by blue-green algae (low food value)

than moderately or highly connected areas. Phytoplankton in channels and connected backwaters will be dominated by species of higher food quality.

Because blue-green algae are a poor food source, the higher levels of the food web (e.g., selected macroinvertebrates and fishes) in isolated OCAs will exhibit lower tissue levels of EFA and total lipids indicating poorer body condition and health, than those in moderately and highly connected areas.

4. Total ecosystem productivity (primary productivity, macro- and microinvertebrate standing stock and fish standing stock) will be highest in OCAs of moderate connectivity because of the combination of steady nutrient inputs and moderately long HRT.

5. Constructed islands that create areas of reduced water velocity and increased hydraulic retention time will increase ecosystem productivity.

The effects of connectivity on productivity and lipid dynamics do not differ among regions of the UMR (up-river, down-river comparison).

We propose to test these hypotheses, and the function of HREP projects, by measuring rates of ecosystem productivity and organism health (lipid and EFA content) in organisms at a set of sites across a gradient of connectivity to the main channel. This project will also contrast HREP and connectivity effects in upper and lower reaches of the UMR and in the Illinois River.
This project builds on base-funded USGS research on lipids as biomarkers in river foodwebs (e.g., Bartsch et al. 2007), as well as 2 years of APE funded research on factors controlling primary production and ecosystem metabolism in channels and backwaters of the UMR (e.g., Houser et al. 2005, 2006), and will also rely on LTRMP data and collaboration with field staff to plan and complete this research. We will also collaborate with the APE project proposed by Kreiling et al. that will evaluate factors important for the growth of aquatic vegetation at the Stoddard Island HREP, sharing data, coordinating sampling, and collaborating on analyses and interpretation of results.

Relevance of research to UMRS/LTRMP: By measuring the quantity and quality of food (e.g., phytoplankton), and rates of production at multiple levels in the food web, in main channel areas, off channel areas, and HREP projects, the proposed research will substantially improve our understanding of the role of connectivity on the production and diversity of river biota and the effects of HREPs on these processes. Such an understanding should provide immediately useful information for the design and implementation of future HREPs and in management of off channel areas within the UMRS. The results of this project will further provide information needed to build and manage HREPS for enhanced production of “healthier” (i.e., greater high-quality lipid content, more productive) foodwebs containing high-quality (lipid-rich) phytoplankton that better support fish and wildlife.

Methods:
Approach: At field sites located across a gradient of connectedness to the main channel, we will measure factors known to control primary production and ecosystem metabolism (nutrients, light, phytoplankton, and zooplankton density), and macroinvertebrate and fish standing stock. We will use the stable isotope of sulfur (34S) as an indicator of the residency of these organisms in channels or backwaters (as determined by the redox signature imparted in oxidizing [channel] or reducing [backwater] habitats). Further, we will use lipid biomarkers (fatty acid methyl esters) as an indication of food source and relative health of fish and macroinvertebrates. Lipid analysis and sulfur isotopic analysis of seston (transported organic matter), combined with counts of phytoplankton, will provide a clear picture of planktonic food sources and nutritional value to higher consumers. In addition, we will work with a hydrologist from the Army Corps of Engineers (Jon Hendrickson), to relate hydraulic retention times and velocity profiles (indicators of river

connectivity) modeled (TAB model) over 3 river stages, to our metrics of productivity and organism health at each of these sites. Finally, comparisons between up-river and down-river conditions will provide insight into the effects of gradients in latitude, nutrient load/concentration, light regime, and river geomorphology (floodplain area and connectivity) on river productivity and food quality.

2008 sites (Navigation Pool 8): This year of sampling will focus on contrasts within Pool 8. High connectivity: Main channel at RM 693. Ecosystem productivity and nutrient dynamics has been measured at this site by Houser et al. for two years.
Intermediate connectivity: Round Lake (ecosystem productivity and nutrient dynamics has been measured at this site by Houser et al. for two years), Pool 7 Islands (1 site inside, 1 site outside the velocity shadow) and Pool 8 Phase II Islands (1 site inside, 1 site outside the complex; ecosystem productivity and nutrient dynamics have been measured by Houser et al. for 2 years at this site).
Low connectivity: 1 site in Lawrence Lake (ecosystem metabolism and productivity has been measured at this site by Houser et al. for two years).

2009 sites (Navigation Pools 8 and 26 and Illinois River): This year of sampling will focus on contrasts w/in Pool 26 and La Grange Pool as well as contrasts between Pools 8, 26, and La Grange. We will select 2 HREP sites and 1 main channel site in the La Grange reach of the Illinois River, and 2 HREP sites and 1 MC site in Pool 26 in consultation with the LTRMP field station staff familiar with those pools. The HREP sites will be selected based on their effect on river connectivity (preferably low to intermediate connectivity). We will also continue sampling at the main channel site in Pool 8 used in 2008 as a point of reference for the down river measurements.

Sampling: The proposed research includes two growing seasons of sampling. To determine the relationship between river stage, connectivity, and limnological and organism health we will sample all sites biweekly from May through late September (growing season:10 dates) during Year 1, and 5 dates (triweekly) during Year 2.
Nutrients, TSS, and chlorophyll a: Water samples for nutrient, total suspended solids, and chlorophyll a analysis will be collected from a depth of 0.2 m. Nutrient samples will be analyzed for total nitrogen (TN), total phosphorus (TP), soluble reactive phosphorus (SRP), and nitrate/nitrite-N (NO3-N), and ammonia (NH4+). All nutrient analyses will be conducted at the USGS Upper Midwest Environmental Sciences Water Quality Lab according to the methods used by the Long Term Resources Monitoring Program (Soballe and Fischer 2004; APHA 1998).
Ecosystem primary production: Ecosystem primary production will be measured in all sites throughout the study period. Primary production and respiration will be calculated from open water dissolved oxygen measurements using single station diel oxygen curve analysis (Odum 1956) as modified in Owens and Crumpton (1995). A small monitoring station will be deployed to record wind velocity, solar irradiance (above the surface and at two different depths in the water column in order to determine light extinction rates), and dissolved oxygen (at 0.5 m) at regular intervals (e.g., every 15 minutes). Regular trips to these stations will be needed for station maintenance. Dissolved oxygen data collected at short time intervals will be used to estimate ecosystem primary production. Maximum and minimum DO for each day will also be extracted from the DO data set and will provide information on the frequency at which hypoxia occurs.
Water column primary production: Water column primary production (and respiration) will be measured using the light/dark bottle method on 5 – 10 dates at all sites (Strickland and Parsons 1972; Parsons et al. 1993). Comparison of water column primary production with ecosystem primary production will indicate the proportion of primary production that occurs in the water column versus macrophytes and sediments.

Water velocity and direction: Point measurements (5 - 10) of water velocity and dominant flow direction will be taken in the vicinity (within 10 m) of each sample site. These snapshots will be used to help calibrate TAB model runs.

Phytoplankton: Whole water samples for phytoplankton counts will be sampled at all sites following LTRMP protocols. Samples preserved in lugols fixative will be counted to lowest possible taxa by a consultant (J. Wehr, Calder Ecological Research Center, Fordham University, NY).

Zooplankton: Vertical hauls (depth recorded) of a 0.25 m dia. plankton net (20 um mesh) will be collected at each site on the same dates as nutrient samples. Samples will be identified to lowest possible level and density estimated.

Macroinvertebrates: Duplicate artificial substrates (Hester-Dendy plates) will be placed at all sites in June (descending limb of hydrograph) and August (base flow, peak biomass), and allowed to colonize for 30 d. Subsamples of invertebrates will be counted. Prior to preservation, individuals of the dominant species will be processed for lipid analysis (methods below). Benthic samples will be taken at each site (where depth and velocity allow) using a vacuum sampler (0.25 m dia.). Subsamples will be counted and prior to preservation, individuals of the dominant species will be processed for lipid analysis (methods below).

Fish: Fish density (catch per unit effort) and species will be estimated at each site by the LTRMP fisheries crew using standard collection methods. Sampling will occur in June and August. Young of the year and adult bluegill (3 -5 individuals) will be subsampled from the total catch and processed for lipids. This species is selected because it is abundant, is one of the few species found in both flowing and quiescent waters, and we have lipid data on them from previous studies.

Seston: Whole water samples (metered volume) will be pumped from mid-depth, through nested sieves (mesh 20, 100, 250 um). The captured material will be processed for total lipids and fatty acid methyl esters (methods below).

Lipid and EFA content will be measured in a subset of organisms (with an emphasis on common organisms of the river foodweb: centrarchid fishes, hydropsychid caddisflies and Hexagenia mayflies, and seston). Fatty acids will be analyzed in tissues and seston following Hebert et al. (2006). Briefly, fatty acid methyl esters (FAME) will be obtained in a three-step process which includes extraction, derivatization, and quantification on a gas chromatograph (GC). The collected material will be preserved in the field in liquid nitrogen and freeze-dried in the lab. Freeze-dried samples will be extracted in chloroform:methanol solution and centrifuged to remove nonlipid material. A known aliquot will be removed, dried, and weighed to obtain quantitative the total lipid content. The remaining sample will then be suspended in hexane and derivatized with BF_3-methanol. The methylated lipid extract will then be analyzed by gas chromatography (Agilent model 6890, Wilmington, DE) using a Supelco 2560 capillary column (100 m, 0.25 mm inner diameter and a 0.2 μm film thickness) and measured by a flame ionization detector. Fatty acid methyl esters will be identified by comparison of their retention time with known standards (37-component FAME mix, Supelco 47885-U) and quantified with reference calibration curves. This analysis will be conducted at UMESC.

Connectivity: We will work with Jon Hendrickson to use existing TABS models and develop new models (e.g., Pool 7) to provide quantitative estimates of connectivity. If necessary, other empirical methods may be employed (e.g., tracer studies of selected off channel areas).

Material source: We will determine isotopic signature of the stable isotope of sulfur (34S) as an indicator of the residency of these organisms in channels or backwaters (as determined by the redox signature imparted in oxidizing [channel] or reducing [backwater] habitats). Samples of seston, macroinvertebrates, YOY and adult bluegill will be processed and sent to the Plateau Isotopic Analysis Laboratory (Northern Arizona University) for isotopic analysis. Past research (Richardson et al. unpublished) has shown 34S to be an excellent indicator of backwater residency in fish and macroinvertebrates.

Field work plan and staffing needs:
Based on our previous experience the time required for sampling, metabolism, water quality, organism sampling, and associated lab work is such that three people can conduct a full sampling event at about one station per day, four days a week. This will require three field employees full time for the entire summer. The lipid analysis is labor intensive and requires a high level of expertise; our current senior staff is well experienced in the procedure and will direct summer staff in portions of the procedure when they are not engaged in field work. We have the in-house expertise to conduct the micro- and macroinvertebrate identification but will require temporary staff for sorting and sample processing. For this task we have requested funding one technician for 6 months, in addition to a number of pay periods for senior staff. We do not have in-house expertise for phytoplankton identification and request funding for this contract with Fordham University. Further, we have requested funding for LTRMP staff in both La Crosse (2008 and 2009) and Illinois River/Pool 26 field stations (2009) in support of the fisheries sampling (2008, 2009) and water quality sampling, YSI probe, and light meter maintenance (2009). Finally, we request funding in support of the hydraulic modeling to be conducted by Jon Hendrickson.

Substantial portions of the data analysis and writing by Bill Richardson and Lynn Bartsch will be supported by USGS base funds. Jeff Houser's contributions to the project, including planning, analysis, and writing will be supported through LTRMP MSP.

Timeline:
Latest date for beginning of project: June 2008. To begin the project on this date will require a commitment of funds by mid-March at the latest. The lead time is necessary for appropriate hiring, purchasing, and planning to be conducted in a timely manner.

Products and Milestones

Tracking number	Products		Staff		Milestones
2008APE6	Data set for 2008 field season		Richardson		30 March 2009

Additional Information:

First year of sampling: completed Sept 2008;
Second year of sampling: completed Sept 2009
All sample analysis completed August 2010 (analysis conducted after FY2009 will be in-kind effort supported by USGS base funds);
Final report January 2011 (Writing and analysis conducted after FY 2009 will be in-kind effort supported by USGS base funds and LTRMP MSP funds (Jeff Houser)).

9/2008

1. Data set for 2008 field season consisting of in-situ measurements (e.g., dissolved oxygen, temperature, nutrients, solar irradiance) from all sampling sites as well as selected lab measurements (e.g., chlorophyll *a*, TSS). Exact content of this data set will be pending processing times in the water quality lab.

2. Full set of 2008 samples of biota (phytoplankton, zooplankton, macroinvertebrates, and fish) will have been collected and properly stored for processing in FY 2009.

8/2009

3. Manuscript/interim report: "Connectivity as a driver of river metabolism in the Upper Mississippi River", to in-house review.

9/2009

4. Data set for 2009 field season consisting of in-situ measurements (e.g., dissolved oxygen, temperature, nutrients, solar irradiance) from all sampling sites as well as selected lab measurements (e.g., chlorophyll a, TSS). Exact content of this data set will be pending processing times in the water quality lab.

5. Full set of 2009 samples of biota (phytoplankton, zooplankton, macroinvertebrates, and fish) will have been collected and properly stored for processing in FY 2010.

10/2009

6. Manuscript/interim report: "Riverine foodwebs along a connectivity gradient in the UMR: a quantitative analysis of essential fatty acids", submitted for in-house review.

01/2011

7. Final report/manuscript: "Effects of habitat restoration and connectivity on trophic interactions and ecosystem metabolism in the Upper Mississippi River and Lower Illinois River", submitted for in-house review.

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2008APE7: A Proposal to Restore Specific Monitoring Elements to the LTRMP

Submitted By:
LTRMP A-team

Committee:
John Chick – Illinois Natural History Survey
James Fischer – Wisconsin Department of Natural Resources
Robert Maher – Illinois Department of Natural Resources

We propose the following monitoring activities be restored for fiscal year 2008:

1. First time period of fish monitoring will be conducted at Pool 13, Pool 26, the La Grange Reach and the Open River Reach.

2. Fixed site water quality monitoring will be restored to Pool 4 and Pool 8 as outlined below.

Objectives

We believe that restoration of the monitoring activities described above will yield multiple benefits to the program, the most important of which likely will be realized in extensive analyses for monitoring program data from the early 1990's to 2009 (when MSP is set to expire). For the purposes of this proposal, however, we will focus on questions and products that can be realized on an annual time frame in accordance with the APE format. For fish monitoring, we will examine the dominant species, defined as the group of species that accounting for the majority (75%) of individuals captured across all four field stations, to address whether strong year-classes were produced. To assess the status of young-of-the-year production for each of the dominant species, a length interval corresponding to YOY will be defined based on comparisons of length data among time periods and mean CPUE and standard error intervals for this YOY length interval in period 1 will be compared to previous years (1994 to 2004) to assess the status of year classes strength (strong - higher mean, non-overlapping standard error; weak – lower mean, non-overlapping standard error, or average – overlapping standard error).

For the water quality component, we will focus on the UMRCC light criteria recommendation, and examine differences in the assessment of this criteria based on monthly versus biweekly monitoring. The effect of monthly versus biweekly monitoring on the outcome of the criteria is unknown and should be evaluated, along with the management recommendations that would arise from application of the UMRCC light criteria. Assessment of underwater light conditions will be made based on secchi disk depth, suspended solids, and turbidity at fixed stations for the growing season (May 15-Sept 15) based on (1) biweekly sampling data and (2) monthly data by dropping the extra sampling events from analyses. A historical analysis of underwater light conditions will be made for select sites to evaluate changes in light penetration through time.

The following fixed-sites are therefore proposed for restoration at two of the LTRMP field stations:

Field Station 1 (Lake City):

1. Restore bi-weekly, fixed-site water quality monitoring in Pool 4 during the summer period by adding 4 more days of sampling (two 2-day sampling episodes – one in July and one in August), resulting in bi-weekly coverage from April through August.

2. Restore monitoring to 6 historical sites in Pool 5 from April through August. This would not result in any additional field days, as the sites would be sampled on the same trips as for the existing sites.

Field Station 2 (La Crosse):

1. Restore bi-weekly, fixed-site water quality monitoring in Pool 8 during the summer period by adding 4 more days of sampling (two 2-day sampling episodes – one in July and one in August), resulting in bi-weekly coverage from April through August.

2. Restore bi-weekly monitoring to 4 historical fixed-sites in Pools 8 and 9 from April through August. This would not result in any additional field days, as the sites would be sampled on the same trips as for the existing sites.

Site details, including rationale and some of the specific intended uses of the data are listed in Table 2.

Table 2. Specific locations and rationale for restored monitoring

Field Station	**Pool**	**Location**	**Rationale and Specific uses of the data**
Lake City	4	Existing sites	Bi-weekly sampling June-August to capture low-flow periods. Fish kills and nuisance algal blooms have occurred during a drought period.
Lake City	5	Inlet & Outlet to Weaver Bottoms	A large degraded backwater area that has had restoration projects implemented. Input/output to the area is important to understanding internal processes. Pool 5 has undergone two years of drawdown, and response monitoring during out-years will provide key feed-back on this experimental management tool.
Lake City	5	Whitewater River	Sediment-laden tributary that empties to Weaver Bottoms.
Lake City	5	LD 5 Transect sites (3)	Output from Pool 5 where several HREP projects are completed, and have undergone two years of drawdown. Response monitoring during out-years will provide key feed-back on response to management efforts
La Crosse	8	Coon Creek	High sediment concentrations input to Pool 8 from a watershed with historic management efforts. Output above Pool 8 HREP phase III, stage 1.
La Crosse	9	Bad Axe River	Tributary to Pool 9 where several HREP projects are in planning stages. Pool 9 has also been selected by the Water Level Management Task Force for drawdown
La Crosse	9	Upper Iowa River	Tributary to Pool 9. The Upper Iowa River delta has been selected by the FWWG for an HREP project, and several others within Pool 9 are in planning stages. The Water Level Management Task Force has also selected Pool 9 for future drawdown
La Crosse	9	Reno Spillway	Output for Pool 8/Input to Pool 9. Embankment projects are in planning stages (NESP or other) that will affect Reno Bottoms in Pool 9. Water quality reflects the impounded portion of Pool 8 where the Pool 8 HREP Phase III islands will be built immediately upstream of this site, changing the sediment re-suspension dynamics. Site is also influenced by the sediment-rich Root River and HREP islands may change associated sediment movements

Products and Milestones

Tracking number	Products		Staff		Milestones
2008APE7	Draft Completion Report		Chick		30 March 2009

Additional Information:

I. Monitoring data will be added to the LTRMP online database.

II. Project completion report containing:

A. First period fish:

1. Basic catch information
2. List of any species captured only in first time period
3. Assessment of status of young-of-the-year production for dominant species

B. WQ fixed sites:

1. Basic parameter information available for future management assessments and questions
2. Assess the affect of monthly vs. biweekly sampling on the outcomes and potential management recommendations derived from application of the UMRCC water quality light criteria
3. Evaluate effects of additional monitoring on overall variability of the data

LTRMP Field Equipment Refreshment

Investment in equipment refreshment over the past several years has been sporadic due to limited annual budgets. Equipment refreshment was identified by the partnership as a priority under the completed 5-year planning effort, with a minimum investment of $ 57,000 annually. In FY2004, an initial effort began to develop an equipment refreshment needs plan, prioritizing items as High, Medium, or Low need. That effort was expanded to include both short and long-term field equipment needs for refreshment. This tool will provide the program a better vision to accommodate program needs related to safety, obsolete, and unserviceable equipment. A well-planned strategy offers significant program benefits such as reliability, availability and readiness.

Item	Gross Dollar	Field Station
90 hp Outboard Motor	$ 6,901	Lake City
Shocker Control Box refurbish	$ 515	La Crosse
Generator	$ 1,236	La Crosse
Electrofishing Boat Booms	$ 515	La Crosse
Outboard Motor 115 HP	$ 6,695	La Crosse
Ruggedized Field Laptop Computer	$ 7,837	La Crosse
Peristaltic pump #2	$ 606	La Crosse
Mustang PFD field suits	$ 556	La Crosse
Electric Trolling Motor	$ 258	La Crosse
Field Laptop Computer	$ 7,837	Bellevue
Minisonde multi-probe WQ meter	$ 6,180	Bellevue
GPS/depth meter (Fish)	$ 412	Great River
GPS/depth meter (Fish)	$ 412	Great River
GPS/depth meter (WQ)	$ 412	Great River
Minisonde multi-probe WQ meter	$ 5,356	Great River
Hydrolab Surveyor4A	$ 1,803	Open River
GPS3	$ 515	Open River
Garmin 168 Mapsounder	$ 1,545	Open River
Ruggedized Field Laptop Computer	$ 7,837	Open River
Generator	$ 2,575	La Grange

LTRMP Strategic Planning Process

Develop a 5-year strategic and tactical plan to guide LTRMP implementation from FY2010–2014. The strategic portion of the plan will identify what the program is going to do and the tactical section will explain how in general overarching terms. The tactical portion of the plan will not replace the detailed implementation plans the partnership will need to develop in response to this plan. At the end of the planning process, the objective is to have a five-year plan endorsed by all of the EMP program partner agencies.

DURATION of the PLANNING PROCESS: Discussion begins in February 2007 and the planning process and 5-year LTRMP Strategic/Tactical Plan is anticipated to be completed by July 2008. Report out to EMP-CC in August, presenting the strategic/tactical plan and seeking endorsement from the partnership. Make final changes to the plan (if needed) by September 2008 leaving approximately 12 months to prepare for implementation before FY 2010 commences in October 2009. It is acknowledged that this is an aggressive schedule that will require considerable commitment from all participants and may necessitate some shifts in resources and priorities. However, a relatively short, focused effort will be more efficient, ensure completion in time for partners to make necessary transitions, and leave room for schedule adjustments if warranted during the process.

Data Visualization Tools

1. Maintenance of LTRMP Graphical Browsers

Because the LTRMP databases are relatively complex, the utility of serving raw data is often less than satisfactory for river managers not familiar with LTRMP data structure and the statistical sampling design of the program. To assist managers access the data more easily, data is synthesized in an intuitive graphical interface–the Graphical Browsers. Effort is needed annually to add and maintain sampling data the Oracle tables that the LTRMP Graphical Browsers query.

Also, currently synthesized fisheries information is generated using complex SAS code that is unwieldy to edit and to add new code for generation of additional data requested. We will rewrite the current code using more efficient SQL code which is the code currently used to generate synthesized data for the Vegetation Graphical Browser.

Products and Milestones

Tracking number	Products	Lead	Milestones
2008VT1	Maintenance of LTRMP Graphical Browsers	Schlifer, Caucutt	30 September 2008
2008VT2	Beta-version SQL code: rewrite of current fish SAS code used to generate synthesized fisheries information	Schlifer, Bartels	30 September 2008

2. Develop a plan to rewrite the Water Quality Application.

The WQ application (field and laboratory) has slowly been moving toward being obsolete. A plan on how to replace the WQ application over the next few years will be developed. Due to the size of the WQ application and the resources available, this plan would more than likely suggest a multi-year strategy where pieces of the old application are replaced one at a time and actually work with the other pieces of the old system. The goal of the new system would be to write it in code that is easily updated and maintained; a side benefit would be to add in any new features the water quality laboratory needs.

Tracking number	Products	Lead	Milestones
2008VT3	Develop a plan to rewrite the Water Quality Application	Schlifer	30 September 2008

3. LIDAR and LCU Processing

To establish itself as a leader in the LIDAR and LCU processing realm, UMESC is prepared to enhance it’s capabilities to do such work. The entire LIDAR process will help with LCU development using Feature Analyst and will create usable and servable LIDAR packets of the area of the Upper Mississippi River from Pool 8 to Pool 15. This LIDAR was obtained by partnering with the State of Iowa (See LTRMP 2007 Scope of Work).

Tracking number	Products	Lead	Milestones
2008VT4	Servable LIDAR data of Pools 8–15	Robinson, Dieck, Nelson, Olsen	30 September 2008

LTRMP Field Meeting

To foster communication between USGS UMESC and state field station staff, a joint meeting of all staff will be held in FY2008. Topics covered will include introduction of staff (new and old alike), highlight of work activities, review of sampling procedures, and collection of a suite of monitoring data. To be held first week in June in Muscatine, Iowa.

Appendix A: FY08 Budget Summary

LTRMP FY 2008 BUDGET SUMMARY

		FEDERAL	NON-FEDERAL	COE	TOTAL
Minimum Sustainable Program	Aquatic Vegetation Sampling	$ 284,829	$ 248,592	$ -	$ 533,421
	Fisheries Sampling	$ 254,820	$ 927,218	$ -	$ 1,182,038
	Water Quality Sampling	$ 562,038	$ 859,294	$ -	$ 1,421,332
	Statistical Evaluation	$ 136,948	$ -	$ -	$ 136,948
	Data Management	$ 462,466	$ -	$ -	$ 462,466
	Science Management Support	$ 222,413	$ -	$ -	$ 222,413
	Bathymetric Component	$ 20,118	$ -	$ -	$ 20,118
	Land Cover/Use	$ 135,710	$ -	$ -	$ 135,710
			$ -	$ -	$ -
		$ 2,079,342	**$ 2,035,104**	**$ -**	**$ 4,114,446**
Additional Program Elements	APE1 - Floodplain Connectivity	$ 208,861			$ 208,861
	APE2 - Setting Fish Mgmt Targets for LTRMP		$ 46,956		$ 46,956
	APE3 - Develop Survey Methods to Map Mussels	$ 15,707	$ 31,059		$ 46,766
	APE4 - Submersed Aquatic Vegetation	$ 89,402		$ 3,559	$ 92,961
	APE5 - Determine Factors Aquatic Veg Illinois River		$ 108,945		$ 108,945
	APE6 - Hydraulic Connectivity HREP Effects	$ 141,652	$ 4,931	$ 5,000	$ 151,583
					$ -
					$ -
		$ 455,622	**$ 191,891**	**$ 8,559**	**$ 656,072**
APE7 Restored Monitoring		$ 23,211	$ 50,742	$ -	**$ 73,953**
COE Support to LTRMP			$ -	$ 20,000	**$ 20,000**
Equipment Refreshment		$ 23,510	$ 36,491	$ -	**$ 60,001**
APE Management		$ 41,000	$ -	$ -	**$ 41,000**
Strategic Planning		$ 100,000	$ 6,000	$ 50,000	**$ 156,000**
Publication Hub		$ 5,000	$ -		**$ 5,000**
Annual Fld Sta Meeting		$ 7,372	$ 7,956		**$ 15,328**
GIS Visualization Tools		$ 62,560		$ -	**$ 62,560**
HREP/LTRMP Coord		$ 28,000		$ -	**$ 28,000**
TOTAL EMP LTRMP		**$ 2,825,617**	**$ 2,328,184**	**$ 78,559**	**$ 5,232,360**
FY07 Carryover		**$ -**	$ 70,000		**$ 70,000**
GRAND TOTAL		**$ 2,825,617**	**$ 2,258,184**	**$ 78,559**	**$ 5,162,360**

Appendix B: Minimum Sustainable Program Condensed Budget. Includes full cost accounting.

AQUATIC VEGETATION SAMPLING

Salaries	FTE	Total
UMESC	1.51	$ 243.1
Field Stations	2.88	$ 231.1
Total salaries	**4.39**	**$ 474.2**
Travel/Ops		
UMESC		$ 41.7
States		$ 17.4
Total travel/ops		**$ 59.1**
COMPONENT TOTAL	**4.39**	**$ 533.4**

FISHERIES SAMPLING

Salaries	FTE	Total
UMESC	1.47	$ 198.1
Field Stations	9.37	$ 849.2
Total salary	**10.84**	**$ 1,047.3**
Travel/Ops		
UMESC		$ 56.7
States		$ 78.0
Total travel/ops		**$ 134.7**
COMPONENT TOTAL	**10.84**	**$ 1,182.0**

WATER QUALITY SAMPLING

Salaries	FTE	Total
UMESC	3.72	$ 428.7
Field Stations	9.47	$ 767.9
Total salaries	**13.19**	**$ 1,196.6**
Travel/Ops		
UMESC		$ 133.4
States		$ 91.4
Total travel/ops		**$ 224.8**
COMPONENT TOTAL	**13.19**	**$ 1,421.4**

STATISTICAL EVAL MONITORING DATA

Salaries	FTE	Total
UMESC	**0.65**	**$ 115.6**
Travel/Ops		$ 21.3
Component Total	**0.65**	**$ 136.9**

BATHYMETRIC COMPONENT

Salaries	FTE	Total
UMESC	**0.14**	**$ 20.1**
Travel/Ops		$ 0.0
Component Total	**0.14**	**$ 20.1**

LAND COVER/USE

Salaries	FTE	Total
UMESC	**1.11**	**$ 112.7**
Travel/Ops		$ 23.0
Component Total	**1.11**	**$ 135.7**

DATA MANAGEMENT

Salaries	FTE	Total
UMESC	**3.05**	**$ 333.3**
Travel/Ops		$ 129.2
Component Total	**3.05**	**$ 462.5**

SCIENCE MANAGEMENT SUPPORT

Salaries	FTE	Total
UMESC	**1.39**	**$ 206.3**
Travel/Ops		$ 16.1
Component total	**1.39**	**$ 222.4**

TOTAL MSP	**34.76**	**$ 4,114.4**

Appendix C: Additional Program Elements Includes full cost accounting. (Thousands)

APE 1: Developing an empirical framework for reconstructing and modeling UMRS floodplain disturbance histories

Salaries	**FTE**	**Total**
UMESC	**1.42**	**$ 183.0**
Travel/Ops		
UMESC		$ 25.9
Sub-total travel		**$ 21.2**
COMPONENT TOTAL	**1.42**	**$ 208.9**

APE 2: Setting quantitative fish management targets for LTRMP monitoring

Salaries	**FTE**	**Total**
		$ -
States	**0.00**	**$ 12.4**
Travel/Ops		
States		$ 34.6
Sub-total travel		**$ 34.6**
COMPONENT TOTAL	**0.00**	**$ 47.0**

APE 3: Development of survey methods to spatially map mussel assemblages in the UMRS

Salaries	**FTE**	**Total**
UMESC		$ 12.0
States		$ 7.5
Sub-total salary	**0.07**	**$ 19.5**
Travel/Ops		
UMESC		$ 3.7
States		$ 23.6
Sub-total travel		**$ 27.2**
COMPONENT TOTAL	**0.07**	**$ 46.8**

Appendix C: Continued

APE 4: Analysis and support of aquatic vegetation sampling data in Pools 6, 9, 18, and 19

Salaries	**FTE**		**Total**
UMESC		$	14.3
COE		$	3.6
Sub-total salary	**0.48**	**$**	**17.9**
Travel/Ops			
UMESC		$	75.1
States			
Sub-total travel		**$**	**75.1**
COMPONENT TOTAL	**0.48**	**$**	**93.0**

APE 5: Experimental and Comparative Approaches to Determine Factors Supporting or Limiting Submersed Aquatic Vegetation in the Illinois River and its Backwaters

Salaries	**FTE**		**Total**
States		$	55.6
Sub-total salary	**0.00**	**$**	**55.6**
Travel/Ops			
UMESC			
States		$	53.3
Sub-total travel		**$**	**53.3**
COMPONENT TOTAL	**0.00**	**$**	**108.9**

APE 6: Hydrologic connectivity between off channel areas and the main channel: an empirical test of an important driver of potential HREP effects on biological production and organism health

Salaries	**FTE**		**Total**
UMESC		$	100.3
States		$	4.1
COE		$	5.0
Sub-total salary	**1.66**	**$**	**109.4**
Travel/Ops			
UMESC		$	43.8
States		$	0.8
Sub-total travel		**$**	**44.6**
COMPONENT TOTAL	**1.66**	**$**	**153.9**

TOTAL APE	**3.63**	**$**	**658.4**

Appendix C: Continued

RESTORED MONITORING

	FTE	Total
UMESC		$ 23.2
States		$ 50.7
COMPONENT TOTAL		**$ 74.0**

COE SUPPORT TO LTRMP

	FTE	Total
COE		$ 20.0
COMPONENT TOTAL		**$ 20.0**

EQUIPMENT REFRESHMENT

	FTE	Total
UMESC (Field Laptops)		$ 23.5
States		$ 36.5
COMPONENT TOTAL	**0.00**	**$ 60.0**

APE MANAGEMENT

	FTE	Total
UMESC		**$ 41.0**

LTRMP/HREP COORDINATION

	FTE	Total
UMESC	**0.00**	**$ 28.0**
COMPONENT TOTAL		**$ 28.0**

STRATEGIC PLANNING

Salaries	FTE	Total
UMESC		$ 100.0
States (Facilitators)		$ 6.0
COE		$ 50
COMPONENT TOTAL	**0.44**	**$ 156.0**

PUBLICATIONS

	FTE	Total
UMESC		$ 5.0
COMPONENT TOTAL		**$ 5.0**

Appendix C: Continued

LTRMP FIELD MEETING

	FTE	Total	
Travel/Ops			
UMESC		$	5.0
States		$	8.0
COMPONENT TOTAL		**$**	**13.0**

VISUALIZATION TOOLS

	FTE	Net Cost	
UMESC	**0.22**	**$**	**62.6**

TOTAL OTHER	**0.66**	**$**	**459.6**

FY 2007 CARRYOVER		**$**	**70.0**

TOTAL MSP, APE, & OTHER PROGRAM ELEMENTS	**39.1**	**$**	**5,162.4**