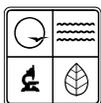


**A PROPOSAL FOR
A WATER QUALITY MONITORING
STRATEGY FOR MISSOURI**

Missouri Department of Natural Resources
Water Pollution Control Program

September 2005



Missouri
Department of
Natural Resources

1. Introduction

This document is a description of the present water quality monitoring program and a proposal for a comprehensive statewide water quality monitoring program for Missouri.

2. Objectives

The overall objective of the monitoring program is to provide data sufficient to allow a water quality assessment of all waters of the state.

Specific objectives of the monitoring program are;

- 2.1** to characterize background or reference water quality conditions
- 2.2** to better understand daily, flow event and seasonal water quality variations and their underlying processes
- 2.3** to characterize aquatic biological communities and habitats and to distinguish between:
 - 2.31** unimpaired biotic communities
 - 2.32** biotic communities impaired by water chemistry
 - 2.33** biotic communities impaired due to habitat quality
- 2.4** to assess time trends in water quality
- 2.5** to characterize the impact of local and regional point and nonpoint source discharges on water quality
- 2.6** to provide water quality information to support these management activities:
 - 2.61** to check for compliance with water quality standards
 - 2.62** to check for compliance with wastewater permit limits
 - 2.63** to develop water quality based permit limits and Total Maximum Daily Load studies
 - 2.64** to develop the state 303(d) list
 - 2.65** to determine the effectiveness of watershed management programs
- 2.7** to support development of strategies to return impaired waters to compliance with water quality standards.

3. Monitoring Design

Three general types of water quality monitoring will be used. These three are fixed stations, intensive surveys and screening level monitoring. A fixed station monitoring program collects a selected group of analytes at predetermined sites on a regular schedule. Fixed station programs typically collect data at given sites for several years. Intensive surveys typically employ several monitoring sites in a small geographic area and sample with greater frequency, often multiple times per day. The duration of most intensive surveys is short, often lasting only one to a few days. These surveys are often repeated multiple times over a one to three year period. Screening level monitoring includes a number of low intensity, short duration monitoring activities. These activities

typically provide smaller amounts of data but have the advantage of monitoring more sites for a given amount of monitoring resources expended.

3.1 Fixed Station Network

The fixed station network is designed to locate water chemistry, sediment, fish tissue and biological monitoring sites equitably among the major physiographic and land use divisions in Missouri.

The fixed station network serves to meet monitoring objectives 2.1, 2.2, 2.3, 2.4, 2.61, 2.63, 2.64 and 2.65 noted above. Biological monitoring and long term fixed station chemical monitoring are considered the most effective ways of documenting the efficacy of nonpoint source control watershed projects. The current fixed station stream network includes 58 sites monitored between six and 12 times annually by the US Geological Survey for a wide variety of physical, chemical and bacteriological constituents and six of these sites are also sampled at less frequent intervals for a wide variety of pesticides. Most of these streams are fifth order or larger. The location of these sites and the constituents analyzed for can be found in the annual Water Resources Data for Missouri Report by the USGS. Stations are identified by the name "Ambient Water Quality Monitoring Network" beneath the station name. Cost of current monitoring program: \$1,010,000.

The Department of Natural Resources, Environmental Services Program monitors water quality at 25 sites three to four times annually for a shorter list of physical and chemical constituents. Most of these streams are fifth order or smaller. Cost of current monitoring program: approximately \$70,000.

The department contracts with the University of Missouri Columbia to monitor approximately 100 lakes in Missouri on a regular basis. At present approximately 60 lakes are monitored four times annually for nutrients, chlorophyll, volatile and non-volatile suspended solids and Secchi depth. Cost of current monitoring: \$60,000

In coordination with USEPA Region VII, MDNR maintains a fish tissue-monitoring program of approximately 14 fixed sites monitored approximately once every two years for whole fish. These sites include a total of four sites on the Missouri and Mississippi Rivers and 10 sites on larger interior rivers. Missouri DNR current cost to collect these samples is approximately \$14,000. Analytical work is done by USEPA Region VII. The Missouri Department of Conservation currently maintains a fish tissue-monitoring program of about 30 sites annually. Samples are typically composites of five or more fish and fillets are analyzed rather than the whole fish. The MDC program does not employ fixed sites. Sites are determined in consultation with regional MDC staff, DNR and the Missouri Department of Health and Senior Services.

The Department of Conservation also runs a Resource Assessment and Monitoring Program (RAM) that monitors approximately 100 stream sites annually. Habitat

assessment and aquatic invertebrate and fish community monitoring are performed on each stream. Each year, 100 samples are divided relatively equally among each of three Ecological Drainage Units. It will take five years to cover the state with this sampling program. Years 6-10 of the program will repeat the work done in years 1-5.



usgsmonitoring_sites.jpg



MDNRmonitoring_sites.jpg

You can view these jpg image maps by right clicking on the image and selecting “Package Object” and “Activate Contents”.

* No fixed schedule, ** Follows National Atmospheric Deposition Program guidelines.

Table 3.12
Overview of Current Monitoring Program and Additional Needs

Note: Monitoring Frequency: # = # of times per year, YR=monitored once per year, 2 YR=monitored every 2nd year, 3YR=

Medium	Aquatic Resource	Size	MDNR sponsored sites	unsponsored sites, data used	Type of Monitoring	# of New Sites Needed	Freq. of Monitoring (#/yr)	Selection Method	Indicators Needed	Rationale
Water	Great Rivers	Miss. 362 Mo. 490 miles	1 1	14 3	Chemical	1 2	4-12	J	WC, SC, B, FT, H, Bac-T	
Water	Large Rivers Non-wade	? rivers ? miles	14	2+	Chemical	7	6-12	A	WC, SC, B, FT, H, Bac-T	2.1,2.2,2.4, 2.5,2.6,2.7
	Medium Rivers wadeable	? ?	34	8+		? w/RAM?	6-12	? P(RAM)	WC, SC, B, FT, H, Bac-T	
	Smaller Class. Streams Int. streams	?	45	33+	Chemical	? +60 screening	4-12	J	WC, SC, B, FT, H	2.5,2.6,2.7
			0	7			? P	? ?		
	Large Lakes Class L2	13	13		Chemical	0	4-12	A	B, SC, H	2.1,2.2,2.4, 2.5,2.6,2.6 4,2.65,2.7
			? 60		Bacteria	? ?	? ?		FT	
	Medium Lakes Class L1,L3	102				? ?			B, SC, H FT	
	Small Lakes Class L1,L3	300+	63		Chemical		4	J	FT	2.2,2.4,2.5, 2.6,2.7
			? 100		Bacteria	? ?	? 12			
					Clarity			A		
Ground-water	Thousands of wells	0		Chemistry	50	1	TBD	WC, WL	2.1,2.4,2.5, 2.6,2.61, 2.65	
		0		Nitrate	50	4				
Water	Wetlands	643,000 acres	0					TBD	WC, SC, B, H	
Fish Tissue	Rivers & Lakes		DNR 12		Chemical (Toxicants)	40	2YR	J		2.1,2.4,2.5, 2.6,2.7
			DNR 5				*	J		
			MDC 30				*	J		
Water	Precipitation	NA	2		Chemical	?	**	**	WC	2.1,2.2,2.4
Water	Full access public beaches	23	23		bacteria	0	? Rec. season	A	Bac-T	
Water	Limited access beaches	10 to 15	0		bacteria	10 to 15	? Rec. season	A	Bac-T	
Biological	Smaller Streams		55		Aq. Inverts. (DNR)	-30	2	J		2.3
			0			30	2	P		
	Smaller Streams		100		Aq. Inverts & Fish (MDC)	0	5YR	P	Refine fish IBI	2.3

monitored every third year, etc.

Selection Method: A= All waters in this group are monitored J=judgmental, P=stratified random selection

Note: A negative number in the Needed Number of Sites column indicates that in the future the current number of sites can be reduced by this number due to increases in other types of monitoring.

* No fixed schedule, ** Follows National Atmospheric Deposition Program guidelines.

MDNR sponsored stream sites includes 58 monitored by USGS and 37 by MDNR (95 total)

Great rivers = 7 - 8 order; large rivers = 5 - 6 order; medium rivers = 4 - 5 order; small = \leq 3rd order

Indicators: WC = water chemistry; B = biology; FT = fish tissue; SC = sediment chemistry; H = habitat; Bacteria = Bac-T; WL = water level

3.2 Intensive Surveys

Intensive surveys tend to be driven by the need for site specific water quality information. This information is used to assist the water quality management process. Examples of these needs would be to develop water quality based NPDES permit limits, to assist in compliance and enforcement activities or to better understand the water quality of an area so that water quality management activities meet the needs of the waters in question. The goal of this monitoring proposal is to develop a system that anticipates the need for intensive surveys and completes all needed intensive surveys in a timely manner.

Current special studies being conducted by the department include:

- Wasteload Allocation Studies for 13 wastewater treatment facilities that will be used to judge compliance with instream water quality standards and if necessary, be used to develop water quality based permit limits.
- Chemical monitoring targeted at coal or heavy metal mining sites or CAFOs. Currently 84 sites on 42 streams are monitored between two and six times annually.
- Dissolved oxygen studies below hydropower dams. Continuous DO monitors are maintained below the dams for 5-7 days. Two such studies are planned for this summer.
- Quantification of sediment deposition below wastewater treatment plants or mining sites. Six streams with multiple sampling points on each stream are being monitored.
- Stream morphology studies characterizing the degree of sinuosity and the degree of heterogeneity of channel width and depth will be done at multiple locations on ten streams.
- Aquatic invertebrate biomonitoring at targeted sites where there are concerns with either point source discharges, discrete nonpoint source areas such as active or abandoned mining sites or concerns related to watershed wide nonpoint source problems. This year 55 sites on 12-14 streams will be monitored twice.
- Chemical monitoring of eight streams to assist in developing an adequate data base for nutrient criteria development.
- Contracted Studies. At any given time, the department typically has two or three contracts for water quality monitoring that are ongoing. Contracts are typically for two to four years, and contractors are typically either the USGS or a person or group associated with a university. Projects typically address one or a few related pollutants in a relatively local geographic area. Beginning in 2005, in anticipation of changes in state water quality standards, the department has contractors conducting Use Attainability Studies for Recreational Use of waters.

Estimate Annual Cost of All Special Studies: \$1,300,000.

3.3 Screening Level Monitoring

Rapid stream assessment protocols that rely on visual evidence and qualitative sampling of aquatic biota are the typical screening level monitoring procedures used by the department. Some additional water chemistry sampling occurs as a result of inspections and complaint investigations. The state volunteer water quality monitoring program is also a significant source of screening level information. In the last few years the department's ability to conduct screening level monitoring has been greatly reduced by the need to increase our intensive surveys. Three Water Protection Program staff in the Monitoring and Assessment unit devote a total of 0.15 FTE to rapid stream assessments. This represents an assessment of approximately 60 streams annually below wastewater discharges, mining areas or landfills.

4. Core Indicators

4.1 Details of Proposed Core and Supplemental Indicators

Table 4.1 Details of Proposed Core and Supplemental Indicators

Protection of Aquatic Life Core Indicators	Recreation Core Indicators	Drinking Water Supply Core Indicators	Fish and Shellfish Consumption Core Indicators
Quantitative Sampling of Aq. Invertebrates Quantitative Sampling of Fish Qualitative Sampling of Invertebrates and Fish Habitat Assessment Flow Water Temperature Dissolved Oxygen PH Conductivity Sulfate Chloride KJN, NH3N,NO2+NO3N total P Diss. Al,Cd,Cu,Fe,Pb,Zn Sediment Toxicity	Fecal Coliform Total N, total P For lakes only: Secchi depth Chlorophyll VSS NVSS	Diss As,Cd,Cu,Pb,Zn NO2+NO3N Dissolved Solids For lakes only: Chlorophyll VSS NVSS Total N, total P	Pesticides PCBs Hg,Pb Dioxins Dibenzo Furans
Supplemental Indicators	Supplemental Indicators	Supplemental Indicators	Supplemental Indicators
Diss. Co, Ni, Cr, Th Bioassay toxicity Pesticides	Hazardous chemicals	Taste and odor causing substances Diss Fe, Mn	Heavy metals, PAHs

5. Quality Assurance

Missouri DNR has an EPA approved quality assurance program in place. All internal water quality monitoring by the two environmental divisions of DNR must be done under a Quality Assurance Project Plan with the DNR laboratory and approved by the Department QA manager. Environmental monitoring contracted to those outside of the department requires the contractor to develop a Quality Assurance Project Plan that must be reviewed and approved by the department.

6. Data Management

The present department plan is to move water quality data from the Environmental Services Program (ESP) Laboratory Information Management System (LIMS) into STORET. Initial discussion between the Water Protection Program staff, information management staff and ESP staff will occur in the spring of 2005.

The Water Protection Program also plans to have water quality data available on the DNR website.

Once the link to STORET is accomplished, the Water Protection Program would continue to manage data internally as it does presently. The present data management system stores water chemistry, sediment chemistry, fish tissue data and toxicity testing results in ACCESS data files. Metadata such as location information, name of sampling organization and measurement units is included with these raw data files. Other metadata including laboratory quality assurance sample results, and detailed information about the sampling organization (contact name, address, fax, phone and email address) and a bibliography of data sources are in separate ACCESS tables. All locational information in our electronic files must include latitude and longitude in decimal degrees to a minimum of four places.

All of the above types of data are entered into electronic data files within six months of receipt and usually within two months. Almost all requests from the public for information from our electronic files are supplied within two working days and almost always by email. Requests for large amounts of electronic data are supplied on compact discs and forwarded by US mail. Requests for data not in our electronic files are handled either by faxing or copying and mailing information if the request is small. For requests for large amounts of non electronic information we will allow the requestor to either pay the WPP to make the copies or we will allow the requestor to visit the files and review them here.

Biological data and aquatic habitat score data is presently stored in the Environmental Services Program (ESP) in ACCESS software. All field notes from biological and habitat assessment are stored in paper form in the files of the ESP. Electronic copies of reports of biological studies are maintained in the ESP and in the files of the WPP. Copies of raw biological and habitat data are available from the ESP and copies of the electronic summary reports are available from the ESP or the WPP.

The department uses an ACCESS software file developed several years ago by USEPA for our assessment file. Last year this file was modified to include data requested in the

new Consolidated Assessment and Listing Methodology (CALM) guidance. The assessment units correspond to the individual stream segments and lakes that are listed in our water quality standards. The department has no plans at present to shift our assessment units to make them conform to the national hydrography dataset. A long-term goal for the department would be to redefine the segments in our water quality standards to make them consistent with the national hydrography dataset.

7. Data Analysis and Assessment

All of the department's data analysis and assessment procedures are given in the most current version of the Section 303(d) Listing Methodology document. This document is revised for each 303(d) listing cycle through a public participation process and is located on the department website.

8. Reporting

8.1 Clean Water Act Reporting

Missouri will continue to provide Section 319 nonpoint source water quality assessments and Section 314 Lake water quality assessments as part of its Section 305(b) reporting requirements. Electronic assessment file updates are forwarded to USEPA annual by April 1. Text reports are required in even numbered years and will be submitted as soon as they are completed. Section 303(d) listing schedules are presently unrealistic due to the long review times required in the development of the list by Missouri and its review and approval by USEPA. The department is now required to develop the 303(d) list as a state rule, a process that will add almost a full year to the listing process.

8.2 Other Reports

Other water quality related reports include Total Maximum Daily Load Studies, Water Quality Basin Plans, Water Quality Review Sheets developed in association with calculation of appropriate NPDES permit limits, and miscellaneous data summary reports associated with water quality data review and assessments. These reports are available either on the DNR website or are available for public viewing in the departments files.

9. Program Evaluation

As part of the PPA/PPG process, Missouri DNR and USEPA Region VII will review the department's monitoring strategy. This review would include: (1) an update of the current program description biennially, (2) update the GAPS analysis biennially, and (3) identify monitoring strategy GAPS to be addressed in the next PPA/PPG cycle (annually).

10. General Support and Infrastructure Planning

The table below summarizes the estimated funds necessary to implement the expansion of the current monitoring program to address the GAPS.

Item	Prior-ity	Administrative	Equipment	DNR Personnel	Contractu al	Total
Large Streams –Chemistry	4	3,000			297,000	300,000
Large Streams - Biological	4	4,000			376,000	380,000
Small Streams-Chemistry	4	12,000	60,000	600,000		672,000
Fish Community Monitoring-Data Interp.	3	1,000*			49,000*	50,000
Improving Volunteer Mon. Data collection/submission	4			2,000		2,000
Expansion of Low Flow Survey Program	2	1,600	20,000	108,400**		130,000
Census of Lakes and their Bacterial Mon. Pgrms.	3	600		5,400		6,000
Item	Prior-ity	Administrative	Equipment	Personnel	Contractu al	Total
Biological Monitoring of Lakes-Criteria development	6	1,000*			79,000*	80,000
Lake Biomonitoring Pgrm.	6	5,000		45,000		50,000
Expansion of Volunteer Mon. Program on Lakes	6	5,000	5,000	40,000		50,000
Wetlands Inventory	6	1,000*			49,000*	50,000
Wetlands Monitoring Pgrm	6	5,000	15,000	80,000		100,000
Expansion of PDWP Chem. Analysis of Groundwaters, Data Mngt by WPCB	3		2,000	23,000		25,000
Develop UAA and WQRS QAPPs and monitoring needs document	2	1,000		9,000		10,000
WQ Monitoring for UAA or WQRS Purposes	2	?	?	?	?	
Total for Prionites 2 & 3		4,200	22,000	145,800	49,000	221,000
Total for Priority 4		19,000	60,000	602,000	673,000	1,354,000
Total for Priority 6		17,000	20,000	165,000	128,000	330,000
Grand Total		40,200	102,000	912,800	850,000	1,905,000

* This is a one time cost. ** this line item is the sum of the targeted and non-targeted sites and includes addition of 2 FTEs.

Appendix A: Gaps Analysis

FIXED STATION NETWORK

GAP 1. Great Rivers (The Missouri and Mississippi Rivers).

GAP 1.1 Water Chemistry Monitoring. The Missouri River has adequate chemical monitoring upstream of Kansas City. The Army Corps of Engineers currently operates eight stations between Yankton, South Dakota and Rulo, Nebraska. The USGS monitors at St. Joseph. Between Kansas City and the mouth there is currently only one monitoring site at Hermann about 60 miles upstream from the St. Louis area. Two additional monitoring sites are needed on the river, one site immediately downstream of the KC metro area and one near the mouth in the St. Louis area. There are currently at least chemical monitoring sites on the Mississippi River between the Des Moines and Ohio Rivers. There are currently no fixed station monitoring points on the portion of the Mississippi bordering Missouri downstream of the Ohio River. The addition of one site in this segment of the river is recommended.

Recommendation: Since the collection of water quality samples (and measurement of flow) on very large rivers requires specialized equipment, it is recommended that the three additional stations be added via an extension of Missouri DNR's existing joint funding agreement for ambient monitoring with the US Geological Survey. Estimated annual cost: \$80,000. [\$0 Fees]
Priority Level 4.

GAP 1.2 Biological and Habitat Monitoring. There are no biological criteria for the great rivers. One research project completed last year has initiated the attempt to characterize aquatic invertebrate communities of the Missouri River and discussed the possibilities for defining "reference conditions". More research on fish and invertebrate communities in the great rivers is needed that will lead to the development and refinement of biological criteria..

Recommendation: The department needs to give higher priority to the use of existing monitoring funds for research leading to the development of biocriteria for great rivers. The department also needs to explore the use of the Great Rivers EMAP program toward this end. Once such criteria are developed, a regular program of biological monitoring for these rivers would be needed. Approximately ten sites each would be monitored on the Missouri and the Mississippi over a four-year period. Approximately five sites would be monitored annually for fish, invertebrates, and physical habitat characteristics. Some sites or specific habitats would also be monitored for water and sediment chemistry. Research needs are projected to require ten years at an annual level of funding of \$100,000. Implementation of the monitoring program (5 sites annually) estimated annual costs: \$80,000. Priority Level 3. [\$0 Fees]

GAP 2. Large Rivers (the larger interior rivers of the state, not including the Missouri or the Mississippi rivers).

GAP 2.1 Water Chemistry Monitoring. Missouri currently has 32 fixed station monitoring sites monitored between 6 and 12 times annually on large rivers (excluding the Missouri and Mississippi rivers). This network covers all but seven of the streams in this size category. The seven streams presently without fixed station monitoring are: Wyaconda River, North Fabius River, Middle Fabius River, Nishnabotna River, Warm Fork of the Spring River, Spring River and Shoal Creek.

Recommendation: These seven streams should be included in the fixed station monitoring network. Based upon the number of beneficial uses supported, dissimilarity to similar sized rivers already monitored and the percent of the watershed within the State of Missouri, the priority order for adding these to our network should be: Shoal Creek, Spring River, Warm Fork Spring River, North Fabius River, Middle Fabius River, Wyaconda River, Nishnabotna River.

These stations should be added to the fixed station network either by amendment of the joint funding agreement with USGS for monitoring of ambient waters or by modification of the existing Quality Assurance Project Plan for ambient monitoring by the DNR Environmental Services Program. Estimated annual cost: \$120,000. Priority Level 4. [\[\\$0 Fees\]](#)

GAP 2.2 Biological and Habitat Monitoring. There are no biological criteria for the large rivers. More research on fish and invertebrate communities in the large rivers is needed that will lead to the development and refinement of biological criteria..

Recommendation: The department needs to give higher priority to the use of existing monitoring funds for research leading to the development of biocriteria for large rivers. Once such criteria are developed, a regular program of biological monitoring for these rivers would be needed. Approximately 38 sites, one on each of the larger rivers would be sampled once every five years. Thus seven to eight sites would be monitored annually for fish, invertebrates, and physical habitat characteristics. Some sites or specific habitats would also be monitored for water and sediment chemistry Research needs are projected to require ten years at an annual level of funding of \$100,000. Implementation of the monitoring program estimated annual costs: \$100,000. Priority Level 3. [\[\\$0 Fees\]](#)

GAP 3. Small (Wadeable) Streams

GAP 3.1 Water Chemistry Monitoring. For every large (non-wadeable) river in the state there are typically 10-20 smaller wadeable classified streams tributary to it. Thus there are an estimated 380 to 760 smaller streams that have been recognized as having multiple beneficial uses. Currently 20 of these streams are monitored 6 to 12 times annually by the USGS and the DNR Environmental Services Program monitors 25 three times annually. Thus the current fixed station network is sampling only about 6-12% of this type of stream.

About one-third of these 45 sites are targeted to assess water quality impacts related to specific point source or discrete nonpoint source areas and the remaining two-thirds are sites believed to be representative of regional water quality. The present coverage is inadequate for statewide assessment of Wadeable streams.

Recommendation: The Wadeable streams fixed network needs to double the total number of targeted sites to 30 and to have a system of randomly selected (stratified by physiographic province/land use class) network of sites that achieves 5% coverage by “benchmark stations” and 10% coverage by less frequent monitoring sites. This would require an expansion of our existing network by an additional 73 monitoring sites (39 targeted or benchmark sites monitoring 6 to 12 times annually, and 34 sites monitored at less frequent intervals).

These stations should be added to the fixed station network either by amendment of the joint funding agreement with USGS for monitoring of ambient waters or by modification of the existing Quality Assurance Project Plan for ambient monitoring by the DNR Environmental Services Program. The department should look at our present use of Section 319 funds (up to 20% can be used for water quality monitoring) and also look at the present Special Area Land Treatment (SALT) program administered by the department Soil and Water Program. Watershed that receive multiple SALT grants would seem to be good candidates to have some of those funds dedicated to a fixed station water quality monitoring site within the watershed. Estimated annual cost: \$672,000. Priority Level 4. [\[add 15 targeted sites to Fees expansion: cost \\$114,000\]](#).

GAP 3.2 Biological Monitoring

The Department of Natural Resources, Environmental Services Program currently monitors aquatic invertebrates at 55 sites twice annually, collecting physical habitat data and some water chemistry at these sites. The current program is composed mainly of targeted sites supporting the department’s TMDL program. The Department of Conservation currently collects fish, aquatic invertebrates at approximately 100 sites annually. This sampling also includes collection of physical habitat data. All sampling in a given year occurs within three of the 16 Ecological Drainage Units (EDUs) in the state and the entire state is therefore sampled in about five years. Together, these two programs represent adequate fixed station biological monitoring coverage for Wadeable streams.

Both aquatic invertebrate monitoring efforts use the sampling and enumeration protocols developed by the Department of Natural Resources. These protocols include scoring of metrics that allows determining if waters do or do not meet the protection of aquatic life beneficial use. No such metrics or scoring procedures exist for the large amount of fish community data this is being collected and this data now has limited utility for water quality assessment.

It is recommended that the Department of Natural Resources/ Dept. of Conservation hire a qualified contractor to review the fish community data and develop metrics that will allow evaluation of fish data for compliance with the protection of aquatic life beneficial use. This contract is expected to require two years. Estimated total cost: \$50,000. Priority Level 3. (High PPA/PPG priority?) [[\\$0 Fees](#)]

GAP 4. Intermittent (unclassified) Streams

GAP 4.1 Screening Level Stream Surveys.

There are an estimated 84,000 miles of unclassified streams in Missouri apportioned among an estimated 20,000 to 30,000 individual streams. These waters are covered by the narrative criteria within the state water quality standards and are required to be free from aesthetic problems related to odor, color, objectionable bottom deposits or floating materials. These streams must also be free from conditions harmful to aquatic life.

The department currently uses a visual and qualitative aquatic invertebrate stream survey protocol to screen unclassified streams for compliance with narrative criteria. Only 60-70 such surveys are conducted annually by the Water Pollution Control Branch. In addition, there are about 50 sites that are routinely monitored by state trained volunteers using a protocol similar to the one used by department staff. With each survey covering an average of about 2 miles of stream, the present annual coverage of this type of stream is less than three-tenths of one percent of all the unclassified stream miles in the state. All of the surveys currently done by the department are targeted at specific point sources or discrete nonpoint source areas. This data is used in the water quality review sheet process.

Recommendation One: The current percentage of all trained volunteers that submit either chemical or aquatic invertebrate data on a regular basis for a given stream is small. The volunteer program should encourage more of its trained volunteers to submit data regularly. Estimate cost: \$2000. Priority Level 4. [[\\$0 Fees](#)]

Site	Site Name
1288/1.5	Trib. M. Fk. Tebo Cr. 0.1mi.bl. AML

This expansion of the screening level stream survey program would require the addition or re-allocation of one FTE. It is recommended that the majority of this expansion or re-allocation occur in the regional offices and that the central office staff and/or the Environmental Services Program staff provide training to the regional office staff in screening survey protocols. Estimated annual costs \$18,000 for training and transportation, plus any costs associated with hiring additional personnel. Priority Level 4. (top recommendation for PPA/PPG?)

GAP 5. Reservoirs

Large GAP 5.1 Multi-Purpose Reservoirs.

GAP 5.1.1 Bacterial Monitoring at Public Use Areas. There are 14 large multi-purpose reservoirs in Missouri. Thirteen are operated by the US Army Corps of Engineers and one, Lake of the Ozarks, by AmerenUE. Many public access swimming areas are not regularly monitored for bacteria.

Recommendation: The department needs to make a census of these public swimming areas and investigate what organizations are conducting bacterial sampling at these sites, at what frequency and what testing methods are being used. Following this census, the department needs to make a recommendation for any additional bacterial sampling needs and how to meet them. Estimated cost for census \$ 1000. Priority Level 3. (PPA/PPG item?)

GAP 5.1.2 Biological Monitoring. There are currently no biocriteria available to assess the biological health of reservoirs. Research is needed to develop such criteria.

Recommendation: The department should fund research leading to the development of biological criteria for reservoirs and lakes. Once biocriteria are in place, reservoir-monitoring programs should be amended to include biomonitoring. Estimated costs of research \$80,000. Estimated cost of biomonitoring of lakes: unknown. Priority Level 6.

GAP 5.2 Smaller Reservoirs and Lakes

GAP 5.2.1 Water Clarity and Bacterial Monitoring at Public Use Areas. There are 442 smaller reservoirs and lakes that are classified within Missouri's water quality standards. Approximately ten of these are natural lakes occurring in the floodplains of the great rivers and the others are reservoirs. Approximately 100 of these are currently monitored four times during the summer on a rotating schedule that visits about 40 reservoirs or lakes per year. This monitoring is for nutrients, suspended solids, chlorophyll and water clarity. The remaining 300+ reservoirs are not regularly monitored as part of a statewide monitoring effort

Little is known about human recreational uses or bacterial monitoring programs on most of these smaller lakes.

Recommendation: The department has investigated the possibility of expanding the present Lakes of Missouri Volunteer Monitoring Program to include substantially more than the 40-50 lakes presently in the program. The University of Missouri has been expanding the number of lakes in this program over the past several years. However, the department would like to extend volunteer monitoring of lakes to a majority of lakes in the state. It is proposed that the Department of Natural Resources and the Department of Conservation expand the current volunteer program for streams to include a volunteer program for monitoring water clarity in small public lakes. . Estimated annual cost for expansion of volunteer monitoring program: \$50,000. Priority Level 6.

The department also needs to make a census of public swimming areas on these smaller reservoirs and investigate what organizations are conducting bacterial sampling, what testing methods are used and at what frequency. Following this census, the department needs to make a recommendation for any additional bacterial sampling needs and how to meet them. Estimated cost for census of beaches and current bacterial monitoring: \$5,000. Priority Level 3. (PPA/PPG item?) [[\\$5,000 Fees expansion](#)]

GAP 5.2.2 Biological Monitoring. There are currently no biocriteria available to assess the biological health of reservoirs. Research is needed to develop such criteria.

The department should fund research leading to the development of biological criteria for reservoirs and lakes. Once biocriteria are in place, reservoir monitoring programs should be amended to include biomonitoring. Estimated cost of research: see Section 5.1.2. Estimated cost of biomonitoring of small lakes: unknown. Priority Level 6. [[\\$0 Fees](#)]

GAP 6. Wetlands

The state will work with EPA Region VII, ORD and the EPA National Wetlands Monitoring Work Group and other Region VII states via the Regional Wetlands Monitoring Workgroup to develop a state-wide wetland protection plan and an implementation strategy for protection of public and private wetlands. The protection plan will include goals and a methodology to document net losses or gains in wetlands within the state. The plan will include: (1) a wetlands inventory (by type of wetland), (2) a monitoring and assessment program, (3) information on actual and potential mitigation sites, (4) establishment of wetland restoration and protection partnerships, (5) outreach and education.

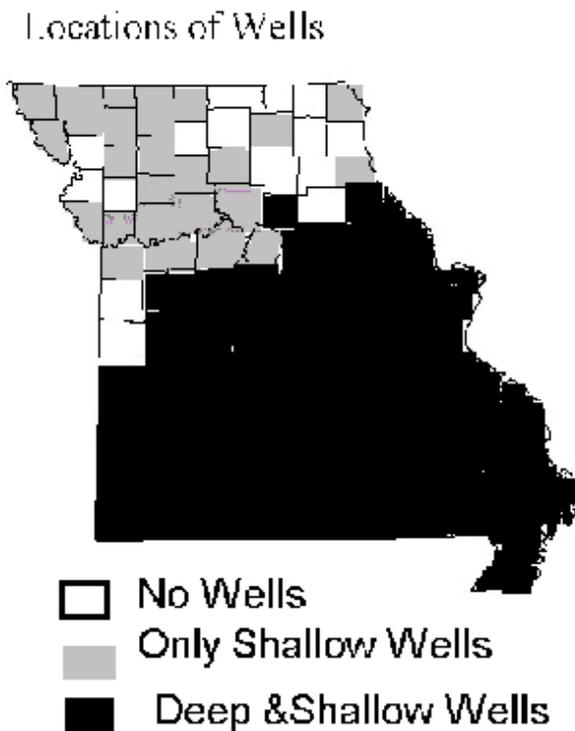
Milestones for the wetland program will include: (1) a wetlands inventory by type of wetland, (2) establishment of a wetlands technical advisory committee to help determine appropriate monitoring and assessment protocols, (3) a pilot project for wetlands monitoring to assess baseline biological and chemical conditions, (4) a wetlands biological indicator development project, (5) a project to develop a set of rapid assessment methods for determining wetland conditions, (6) a reference site development program.

When completed the above activities will allow the following actions to take place: (1) an improvement in reporting the status of wetlands in the state 305(b) report, (2) listing of specific wetlands within state water quality standards, (3) development of chemical and or biological criteria for wetlands and inclusion of these within the state water quality standards, and (4) judging the success of state wetland mitigation efforts.

GAP 7. Groundwater

Many areas of the state use groundwater as a public drinking water supply source. The Safe Drinking Water Act requires annual monitoring for nitrate and monitoring every three years for a fifteen inorganic chemicals (Sb, Asbestos, As, Ba, Be, Cd, Cr, Cu, CN, F, Pb, Hg., NO₂, Se and Tl) , 53 organic chemicals including several pesticides, PCBs, PAHs, phthalates and volatile hydrocarbons, and radionuclides (alpha and beta particles, Ra 226 and 228 and Uranium).

There are three potential concerns with the SDWA monitoring program serving as a statewide groundwater monitoring program. One, is the list of analytes sufficient? Two, is the frequency of sampling sufficient? Three, is the spatial distribution of wells sampled adequate to characterize the spatial variation in groundwater quality?



The list of analytes does not address aesthetic issues such as levels of manganese, iron and total dissolved solids. Since overpumping of aquifers and saltwater intrusion is an issue in certain areas of the state, total dissolved solids is an important analyte. It is unknown if the current frequency of analysis is adequate to accurately characterize water quality in the various aquifers. The distribution of public drinking water wells is shown in the figure to the left. This map indicates that in the portion of the state north of the Missouri River most public drinking water wells are shallow. These wells draw water only from alluvial or shallow unconsolidated aquifers. In northeastern Missouri many areas do not have public drinking water wells. Thus addition wells may be needed in northern Missouri.

Recommendation: Dissolved iron, dissolved manganese, total dissolved solids, sulfates and chloride should be added to the list of analytes monitored. The adequacy of the frequency of monitoring should be addressed by an analysis of water chemistry data at selected wells in different areas of the state. This analysis should determine if sample sizes are adequate to characterize water quality with respect to drinking water standards with a high degree of statistical confidence. Additional wells into the deep aquifer should be added to the groundwater monitoring network in at several locations in northern Missouri and at least two wells into shallow potentially potable aquifers should be added in Schulyer and Monroe counties in northeastern Missouri.

GAP 8. Precipitation

Currently there are two National Atmospheric Deposition Program (NADP) monitoring sites that analyze precipitation for a wide variety of chemicals in Missouri. One site is in the southeastern corner of Missouri and the other is in the center of the state near Ashland. These two sites measure a wide variety of physical and chemical attributes of water on a frequent basis but it is currently unknown if these two sites provide precipitation data that is representative in all parts of the state. There are many sites, well spaced state-wide, that measure amount of precipitation but not precipitation chemistry. Watershed models require information on precipitation quality and quantity. The department needs to ascertain whether or not the present network of precipitation monitoring is adequate for water quality modelling.

Recommendation: The department should review all the water quality models now in use by the agency or its contractors or models that may be used in the next several years. The precipitation data needs of these models and the overall importance of precipitation data to the accuracy of the model need to be evaluated (sensitivity analysis). Based on this evaluation, the department should make recommendations concerning the need for additional precipitation monitoring sites.

SPECIAL STUDIES

GAP 9. Wasteload Allocation Studies and other Intensive Studies

The current program is adequate for assessing chemical impacts of localized nonpoint source areas such as active and abandoned mining sites, closed landfills and other areas where drainage from disposed materials may affect water quality. The current program is not adequate to provide the data necessary to meet the needs of the Water Quality Review Sheet (WQRS) process for reissuance of wastewater discharge permits nor is it adequate to assess the success of the implementation plans based on TMDL studies, particularly phased TMDLs. Nor is the present special studies program adequate for statewide monitoring for more extensive nonpoint sources such as row crop agriculture or pastures, for development/revision of water quality standards, use attainability analyses or determination of stream classification. The current biomonitoring programs of the Department of Natural Resources and the Department of Conservation RAM program would meet this need, pending completion of contractual studies discussed in Gap 3.2. Estimate cost: see Gap 3.2. Priority Level 3.

Recommendation One: The department needs to formalize its plan for obtaining the data necessary to meet the requirements of the WQRS process, for Use Attainability Analyses and for studies to determine stream classification. The plan should describe in detail what kind and amount of data would be required and how much of these data needs are to be met by monitoring done by the department. A Quality Assurance Project Plan (QAPP) for each of these types of studies should be developed and used to conduct these

studies. Estimated cost: \$10,000. Priority Level 2. [An annual expansion of WLAs and similar monitoring on larger point source discharges 13 studies or about 80 sites is recommended and proposed for the Fees expansion: cost \$200,000].

Recommendation Two: All other special study needs should be addressed through the existing annual monitoring needs identification process.

GAP 10. Targeted Screening Level Stream Surveys

In the last few years the department's ability to conduct screening level monitoring has been greatly reduced by the need to increase our intensive surveys. Three Water Protection Program staff in the Monitoring and Assessment unit devote a total of 0.15 FTE to rapid stream assessments. This represents assessment of approximately 60-70 streams annually below wastewater discharges, mining areas or landfills. Approximately 1,000 permits to discharge wastewater are re-issued annually by the department. It is estimated that the WQRS process for 80% of these would benefit from a screening survey of the receiving stream prior to re-issuance of the permit.

Recommendation: The targeted screening survey program should be increased so that it has the capacity to conduct 750-800 stream surveys annually, and be used to support the Water Quality Review Sheet process. The goal of this portion of our monitoring program is to provide relatively current screening level information on all point and discrete nonpoint source sites where this type of monitoring is appropriate. The objective is to monitor the receiving waters of each of these point source facilities or sites at least once every five years, preferably within 18 months of permit reissuance. Approximately one FTE would be required. It is further recommended that most of the manpower allocated to this work come from the regional offices and that central office provide training to regional office staff as needed in Screening Level Stream Survey protocols. Estimated cost: \$12,000 for training and transportation plus any cost associated with hiring or re-allocating of one FTE. Priority Level 2. (top PPG/PPA priority?) Note: the department may wish to consider using this monitoring program to screen relatively large numbers of recently designated recreational waters. Costs for this type of monitoring are not included here. [included under Fees expansion: cost \$62,000].

DATA MANAGEMENT

GAP 11. Entering Data into STORET. The department needs to identify and implement a system of loading data generated by the department into STORET. In addition, data generated by outside organizations under contract to the department must have a system for entry into STORET.

Recommendation: Department MIS and ESP staff make a recommendation to WPP for entry of LIMS data into STORET. WPP and MIS staff also need to discuss and recommend a method for moving data generated under contract to the department into STORET.

DATA ANALYSIS AND ASSESSMENT

GAP 12. The current EPA CALM Guidance five category system results in a de facto requirement for the same (relatively high level) of data assurance be used for the 305(b) report as for the 303(d) list. Missouri has traditionally used a wide range of data for making statewide assessments in the 305(b) reporting, including a lot of data that does not meet the minimum data quality standards for 303(d) listing. Our present inability to use this kind of data will result in fewer waters being assessed and an underestimate of impaired waters.

Recommendation. EPA should review its guidance requiring a consolidated listing and decide if the benefits of a consolidated listing outweigh the restrictions it imposes on the completeness and accuracy of the 305(b) report.

REPORTING

GAP 13. Missouri presently uses 10 CSR 20-7.031 Table H waters as the reporting units in our water quality assessment file used to generate impaired waters for section 305(b) and 303(d) purposes. This is inconsistent with the EPA guidance requesting all states use the National Hydrography Dataset (NHD) list of waterbody segments as the reporting units. Since it is a national system, use of NHD segments by all states would improve the consistency of 305(b) reports.

Recommendation: The department, as part of its water quality standards revision process, should amend Table H to correspond to the NHD segments. Once this amendment to the state rules has been promulgated, the department's water quality assessment database should be amended to use the NHD segments as the reporting units.

Appendix B. Priorities for Water Quality Monitoring

- **Priority Level One:** Monitoring required to meet court orders or other legally binding agreements.
- **Priority Level Two:** Monitoring for time critical department/program information needs. This would include TMDLs, WQRS, enforcement actions, special investigations related to human health or other environmental emergencies.
- **Priority Level Three:** Development of aquatic biological criteria for streams and research on the linkage of the health of aquatic biological communities to physical and chemical characteristics of the watershed. Problem identification and compliance monitoring for human health related water quality standards.
- **Priority Level Four:** Problem identification and compliance monitoring for non-human health related water quality standards. Development of chemical and physical water quality standards.
- **Priority Level Five:** Statewide water quality assessment and reporting requirements (Sec. 305b requirement to assess all of the state's waters).
- **Priority Level Six:** Development of biological criteria for lakes. Assessment of trophic conditions in lakes. Development of water quality criteria for wetlands. Assessment of condition of wetlands.

Appendix C Fixed Station Chemical Monitoring Sites

Fixed Station Monitoring Sites in Missouri Sites Supported Partially or Wholly by Mo. DNR

Site Name	Size	Type	Org	Freq	HUC 8
Fox R. at Wayland	M	CL	GS	6	7110001
S. Fabius R. nr Taylor	M	CL	GS	12	7110003
Cuivre R. nr Troy	M	CL	GS	6	7110008
Mississippi R. nr. Grafton, Ill.	G	CL	GS	12	7110009
Nodaway R. nr Graham	L	CL	GS	6	10240010

Missouri R. nr. St. Joseph	G	CL	GS	12	10240011
Platte R. at Sharps Station	L	CL	GS	6	10240012
Middle Fork Grand R. nr Grant City	S	CL	GS	6	10280101
Thompson R. nr Mt. Moriah	M	CL	GS	6	10280102
Weldon R. at Princeton	M	CL	GS	6	10280102
No Creek near Dunlop	S	CL	GS	12	10280102
E. Fk. Medicine Cr. nr Harris	S	CL	GS	12	10280103
W. Fk. Medicine Cr. nr Harris	S	CL	GS	12	10280103
Locust Creek nr Unionville	S	CL	GS	12	10280103
Grand R. nr. Sumner	L	CL	GS	12	10280103
Chariton R. nr. Prairie Hill	L	CL	GS	6	10280202
Mussel Fork nr Mystic	S	CL	GS	12	10280202
E. Fk. Chariton R. nr Huntsville	M	CL	GS	6	10280203
Lamine R. nr Pilot Grove	M	CL	GS	9	10300103
Osage R. nr Schell City	L	CL	GS	6	10290105
L. Sac R. nr Walnut Grove	M	CL	GS	12	10290106
Pomme de Terre R. nr Polk	M	CL	GS	6	10290107
S. Grand R. bl. Freeman	S	CL	GS	6	10290108
Niangua R. bl. Bennett Spring	M	CL	GS	6	10290110
Osage R. bl. St. Thomas	L	CL	GS	6	10290111
Roubidoux Spring bl. Waynesville	M	CL	GS	6	10290201
Big Piney R. at Devil's Elbow	M	CL	GS	6	10290202
Gasconade R. at Jerome	L	CL	GS	12	10290203
Huzzah Cr. nr. Steelville	M	CL	GS	6	7140102
Courtois Creek nr. Berryman	M	CL	GS	6	7140102
Meramec R. nr. Sullivan	L	CL	GS	12	7140102
Bourbeuse R. nr. Union	M	CL	GS	6	7140103
Big R. nr Richwoods	M	CL	GS	6	7140104
Meramec R. at Paulina Hills	L	CL	GS	12	7140102
Castor R. at Zalma	M	CL	GS	6	7140107
St. Francis R. nr Saco	M	CL	GS	6	8020202
Big Creek at Sam Baker State Park	M	CL	GS	6	8020202
St. John's Ditch at Henderson Mound	M	CL	GS	6	8020201
Little River ditches nr Rives	L	CL	GS	12	8020204
Roaring River nr Cassville	M	CL	GS	6	11010001
Wilson's Cr. nr Brookline	S	CL	GS	12	11010002
James R. at Boaz	M	CL	GS	6	11010002
James R. at Galena	M	CL	GS	12	11010002
Flat Cr. at Flat Creek	M	CL	GS	12	11010002
Lake Taneycomo at Branson	L	CL	GS	6	11010003
Swan Creek nr Swan	S	CL	GS	6	11010003
North Fork R. nr Tecumseh	L	CL	GS	6	11010006
Bryant Cr. bl. Evans	M	CL	GS	6	11010006
Black R. bl. Annapolis	M	CL	GS	6	11010007
Jacks Fk. above Two Rivers	M	CL	GS	6	11010008
Big Spring at Van Buren	M	CL	GS	4	11010008
Current R. at Doniphan	L	CL	GS	12	11010008
L. Black R. below Fairdealing	M	CL	GS	6	11010008
Eleven Point R. nr. Bardley	M	CL	GS	6	11010011
Center Creek nr Smithfield	M	CL	GS	9	11070207
Turkey Creek nr Joplin	S	CL	GS	9	11070207
Elk River at Tiff City	L	CL	GS	12	11070208

Buffalo Creek at Tiff City	M	CL	GS	12	11070208
Honey Cr. at Hwy 6	S	CM	DNR	4	10280102
W. Locust Cr. at Hwy 6	S	CM	DNR	4	10280103
E. Locust Cr. at Hwy 6	S	CM	DNR	4	10280103
Marrowbone Cr. Daviess Co.	S	CM	DNR	4	10280101
N. Blackbird Cr. at Hwy 136	S	CM	DNR	4	10280201
Shoal Cr. at Hwy 136	S	CM	DNR	4	10280201
Grindstone Cr. @Hwy E, Daviess Co.	S	CM	DNR	4	10280101
Big Cr. in Shannon Co.	S	CM	DNR	3	11010008
L. Black R. in Ripley Co.	S	CM	DNR	3	11010008
Mill Cr. in Phelps Co.	S	CM	DNR	3	10290203
W. Piney Cr. in Texas Co.	S	CM	DNR	3	10290202
Huzzah Cr. in Dent Co.	S	CM	DNR	3	7140102
Meramec R. in Dent Co.	S	CM	DNR	3	7140102
Loutre R. in Montgomery Co.	M	CM	DNR	3	10300200
Moniteau Cr. in Cooper Co.	S	CM	DNR	3	10300102
River aux Vases in Ste. Genevieve Co	S	CM	DNR	3	7140101
Saline Cr. in Ste. Genevieve Co.	S	CM	DNR	3	7140105
Castor R. in Madison Co.	S	CM	DNR	3	7140107
Marble Cr. in Madison Co.	S	CM	DNR	3	8020202
Bryant Cr. in Douglas Co.	S	CM	DNR	3	11010006
Bull Cr. in Christian Co.	S	CM	DNR	3	11010003
E. Fk. Crooked Cr. in Ray Co.	S	CM	DNR	3	10300101
Heaths Cr. in Pettis Co.	S	CM	DNR	3	10300103
L. Drywood Cr. in Vernon Co.	S	CM	DNR	3	10290104
Jones Cr. in Jasper Co.	S	CM	DNR	3	11070207
Mike's Cr. in McDonald Co.	S	CM	DNR	3	11070208
E. Fk. Grand R. nr Allendale	S	CM	DNR	3	10280101
Honey Cr. in Nodaway Co.	S	CM	DNR	3	10240013
White Cloud Cr. in Nodaway Co.	S	CM	DNR	3	10240010
L. Fox R. in Clark Co.	S	CM	DNR	3	7110001
M. Fabius R. in Lewis Co.	M	CM	DNR	3	7110002
Spring Cr. in Adair Co.	S	CM	DNR	3	10280202
Sugar Cr. in Cuivre River State Park	S	CM	DNR	3	7110008
E. Drywood Cr. in Prairie State Park	S	CM	DNR	3	10290104
Pickle Cr. in Hawn State Park	S	CM	DNR	3	7140105
Ketchum Hollow in Roaring River State Park	S	CM	DNR	3	11010001
Coakley Hollow in Lake Ozark State Park	S	CM	DNR	3	10290109

size: G=great river(7-8 order), L=large interior river(5-6 order), M=medium sized river (order 405)

S=small river or creek (Order 3-4), IB= itty bitty creek (order 1-2)

type: CL=chemical monitoring,more than 20 analytes,CM=chemical 10-19 analytes, CS= chemical <10 analytes

Org= sampling organization: GS=USGS, DNR=Missouri DNR

Freq= number of samples per year

Fixed Station Chemical Monitoring Sites Not Sponsored by DNR						
Site Name	Size	Type	Org	Freq	HUC 8	Comment
Missouri R. at Hermann	G	CL	GS	12	10300200	

Missouri R. at Kansas City	G	CM	KCMO	50+	10240011	City of KC
Missouri R. nr. St. Charles	G	CM	MAWC	50+	10300200	Mo. American Water Co.
Mississippi R. nr Thebes, Ill.	G	CL	GS	12	7140101	
Des Moines R.at St. Francisville,Mo.	L	CL	IDNR	12	7100009	Iowa DNR
Mississippi R. nr. Quincy, Ill	G	CL	IEPA	4	7110004	Illinois EPA
Mississippi R. at Keokuk, Ia.	G	CL	IEPA	6		Illinois EPA
Mississippi R. at L&D 21	G	CL	IEPA	4	7110004	Illinois EPA
Mississippi R. at Clarksville, Mo.	G	CL	IEPA	4	7110004	Illinois EPA
Mississippi R. just ab. Cuivre R.	G	CM	LTRMP	12	7110004	USGS Long Term Resource Mon. Prgm.
Dardenne Cr. at Hwy B	S	CM	LTRMP	12	7110009	USGS Long Term Resource Mon. Prgm.
Mississippi R. at Hartford, Ill	G	CM	LTRMP	12	7110009	USGS Long Term Resource Mon. Prgm.
Peruque Cr. nr mouth	S	CM	LTRMP	12	7110009	USGS Long Term Resource Mon. Prgm.
Mississippi R. just ab. Meramec R.	G	CL	IEPA	4	7140101	Illinois EPA
Watkins Cr. nr mouth	S	CL	GS	4	7140101	USGS for StL MSD
Maline Cr. nr mouth	S	CL	GS	4	7140101	USGS for StL MSD
River des Peres at Harlan Park	S	CL	GS	4	7140101	USGS for StL MSD
River des Peres at St. Louis	S	CL	GS	4	7140101	USGS for StL MSD
Black Cr. at Brentwood	S	CL	GS	4	7140101	USGS for StL MSD
Deer Cr. at Maplewood	S	CL	GS	4	7140101	USGS for StL MSD
Deer Cr. at LaDue	S	CL	GS	4	7140101	USGS for StL MSD
Engelholm Cr. at Wellston	S	CL	GS	4	7140101	USGS for StL MSD
Gravois Cr. at Green Park Rd.	S	CL	GS	4	7140101	USGS for StL MSD
Grand Glaize Cr. at Valley Park	S	CL	GS	4	7140101	USGS for StL MSD
Fishpot Cr. at Valley Park	S	CL	GS	4	7140101	USGS for StL MSD
Kiefer Cr. nr. Ballwin	S	CL	GS	4	7140101	USGS for StL MSD
Williams Cr. nr Peerless Park	S	CL	GS	4	7140101	USGS for StL MSD
Fenton Cr. at Hwy 141	S	CL	GS	4	7140101	USGS for StL MSD
Matesse Cr. at Ringer Road	S	CL	GS	4	7140101	USGS for StL MSD
Mississippi R. at Chester, Ill.	G	CM	IEPA	4	7140105	Illinois EPA
Mississippi R. 3 mi.abl. Cape Girardeau	G	CM	LTRMP	12	7140105	USGS Long Term Resource Mon. Prgm.
Mississippi R. 6 mi.ab. Cape Girardeau	G	CM	LTRMP	12	7140105	USGS Long Term Resource Mon. Prgm.
Mississippi R. nr. Trail of Tears State Park	G	CM	LTRMP	12	7140105	USGS Long Term Resource Mon. Prgm.
Mississippi R. nr. Neely's Landing	G	CM	LTRMP	12	7140105	USGS Long Term Resource Mon. Prgm.
Mississippi R. nr. Whittenburg	G	CM	LTRMP	12	7140105	USGS Long Term Resource Mon. Prgm.
9 sites in Fellows,McDaniel,Stockon Res.+tribs		CM	CU	50	10290106	City Utilities of Springfield
2 sites on Osage R. below Bagnell Dam	L	CS	UE	50+	10290111	AmerenUE
Indian Cr. at State Line Bridge	S	CL	KDHE	6	10300101	Kansas Dept. of Health & Environ.
Blue River nr Stanley	S	CL	KDHE	6	10300101	USGS
Brush Cr. at Rockhill Rd.-KC	IB	CS	GS	100+	10300101	USGS
Brush Cr. at Wornell Rd.-KC	S	CL	GS	6	10300101	USGS
Brush Cr. nr state line	IB	CL	GS	6	10300101	USGS
Marais des Cygnes R. at Hwy 69	S	CL	KDHE	6	10290102	Kansas Dept. of Health & Environ.
L. Osage R. nr Fulton, KS	S	CL	KDHE	6	10290103	Kansas Dept. of Health & Environ.
Marmaton R. nr. Ft. Scott, KS	S	CL	KDHE	6	10290104	Kansas Dept. of Health & Environ.
Cowmire Cr. -SL	IB	CL	GS	4	10300200	USGS for StL MSD
Caulk's Cr. at Chesterfield	IB	CL	GS	4	10300200	USGS for StL MSD
Bonhomme Cr. at Hwy CC	S	CL	GS	4	10300200	USGS for StL MSD
Creve Coeur Cr. at Hwy 340	IB	CL	GS	5	10300200	USGS for StL MSD
Fee Fee Cr. at McKelvey Rd.	IB	CL	GS	6	10300200	USGS for StL MSD
Coldwater Cr. nr. Jamestown	S	CL	GS	7	10300200	USGS for StL MSD
Kings R. n. of Berryville,Ark.	M	CL	ADEQ	12	11010001	Arkansas DEQ
Long Cr. nr. Denver, Ark.	S	CL	ADEQ	12	11010001	Arkansas DEQ

James R. at Hootentown Access	M	CM	SPW	6	11010002 Springfield Dept. of Public Works
James R. at Nelson Mill Bridge	M	CM	SPW	6	11010002 Springfield Dept. of Public Works
James R. at Galena	M	CM	SPW	6	11010002 Springfield Dept. of Public Works
James R. at Delaware Access	M	CM	SPW	6	11010002 Springfield Dept. of Public Works
Finley Creek nr. Mouth	S	CM	SPW	6	11010002 Springfield Dept. of Public Works
5 locations on Wilson's Cr.	S	CM	SPW	6	11010002 Springfield Dept. of Public Works
Terrell Cr. nr. Mouth	S	CM	SPW	6	11010002 Springfield Dept. of Public Works
Schuler Cr. nr. Mouth	S	CM	SPW	6	11010002 Springfield Dept. of Public Works
Table Rock Lake at McCords Bend		CM	SPW	6	11010002 Springfield Dept. of Public Works
31 sites on Current, Jacks Fk and tribs	S-L	CS	NPS	6	11010008 National Park Service
9 sites on Current R.	M-L	CM	GS	2	11010008 USGS for Nat. Park Service
Warm Fork nr. Thayer, Mo.	M	CM	ADEQ	12	11010010 Arkansas DEQ
Cave Spring Br. At state line	IB	CM	OKDE	12	11070206 Oklahoma DEQ
2 sites on Cave Spg.Br. Just over state line	S	CM	OKDE Q	12	11070206 Oklahoma DEQ
Center Cr. nr. Smithfield, Mo.	M	CL	KDHE	6	11070207 Kansas Dept. of Health & Environ.
Turkey Cr. at Hwy P	S	CL	KDHE	6	11070207 Kansas Dept. of Health & Environ.

site located outside Missouri

Note: FY08 \$200,000 GR for monitoring. Possible projects.

1. High flow monitoring of James R. at Galena, Finley Creek at Riverdale: water temp, pH, d.o., conductivity, nitrate N, total N, total P, total suspended solids, chloride.
2. High flow monitoring of Elk River at Tiff City, L. Sugar Creek at Pineville (and maintain flow gage station on L. Sugar at Pineville).
3. E. coli monitoring of public swimming areas on large reservoirs (Table Rock, Stockton, Pomme de Terre, Truman, Mark Twain and smaller suburban lakes with developed shorelines. This would not include Lake of the Ozarks which already has funding for a 5 year bacterial study).
4. Multi-year fixed station monitoring of Shoal Creek in Newton County and Spring River in Jasper County (expansion of JFA with USGS: \$24K if monitoring 6/yr, \$48K for 12/yr). This option not recommended if GR funding is for one year only.
5. Multi-year fixed station monitoring on smaller streams: work done by DNR/ESP at cost of approx. \$6K-10K per station/yr depending on frequency and analyte list. This option not recommended if GR funding is for one year only.
6. Standards development studies. Tiered aquatic life criteria for dissolved oxygen. Continue contracted studies of summer low flow dissolved oxygen levels in "reference streams".