Western Kentucky University
Technical Assistance Center for Water Quality
Center for Water Resource Studies

"Supporting Small Water Systems in Meeting the Goal of Public Health Protection"

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Introduction

Western Kentucky University was awarded a grant by the Environmental Protection Agency (#X826659-01-0) to establish a Technical Assistance Center (the Center) for Water Quality for small public water systems. This program focuses resources and expertise toward assisting small water systems in achieving and maintaining capacity development, and meeting the primary goal of public health protection. The capacity development framework provides a forum within which this Center is working with other similar programs, federal and state regulatory agencies, and small drinking water systems. Through the Center's assistance, we are working to help small systems acquire and maintain technical, financial and managerial capacity. These capacities are needed to provide safe drinking water and achieve the public health protection goals of the EPA Safe Drinking Water Act. Likewise, the goal of public health protection is promoted through additional tasks of the Center that include a small systems circuit rider, the Utility Management Institute (UMI), Source Water Protection Program, and Information Technology.

Western Kentucky University has developed this Center with long-range goals, and a "regional" focus of projects that have a national perspective. The work plan for this Center is organized into tasks that have multi-year projects. These tasks are distinct in nature, but mutually supportive of small water systems and the provision of public health. **Administration** provides support for all other tasks, administers the grant, and works to advance capacity development of small systems; **Task 1** addresses managerial training for capacity development; **Task 2** provides for technical capacity development and identification of needs in a "circuit rider" approach; **Task 3** is a source water protection program consisting of field studies and assistance to create models, provide application of water quality tools, address unique contamination problems in karst regions, and create a forum for advancing best management practices (BMPs) for source water protection of small drinking water systems; **Task 4** is a database management system and development of information tools to receive, organize, integrate and distribute project information.

Executive Summary

Introduction. Western Kentucky University has established a Technical Assistance Center for Water Quality for small water systems. The underlying goal of the Center is to assist small water systems in the protection of public health and the provision of safe drinking water. Assistance is provided to small water systems through the Utility Management Institute, a small systems circuit rider, a source water protection program, and information technology. All aspects of the Center are focused on capacity development of small water systems through the enhancement of managerial, technical and financial capabilities. Information presented in this report represents efforts during the second quarter of year five (FY02) of this grant.

Synopsis. This second quarter, fifth contract year report depicts progress in each of the aforementioned tasks, with task activities that are focusing on the ultimate goal of improved public health through the provision of safe drinking water. The Technical Assistance Center for Water Quality's efforts continue in developing and delivering management training courses for small systems; in working with Western Kentucky University to provide technical oversight for online course development and delivery in water utility management; conducting on-site technical assistance for small system compliance; providing technical assistance to develop and promote source water protection, through source water assessments, field investigations, on-site source water assistance and community relations; and developing and distributing information and information tools.

Administration. The primary focus of the Director in this second quarter of the fifth year has been to continue to promote safe drinking water at the local, regional and national scales. The groups of team members that make up the Center at WKU have been working at these various scales to provide unique assistance as part of the Technical Assistance Centers Network (TACNET). This network comprises a total of eight University based TACs, including the Center at WKU, that each promote public health by assisting small water systems throughout the United States. The Director has completed the following this quarter: an invited presentation at the AWWA Source Water Protection Conference BMP Workshop in Albuquerque, NM, on January 19, 2003 (Development of Agricultural Partnerships for Source Water Protection in Kentucky); a meeting with farmers in the Spa Lake Watershed, Lewisburg, Kentucky to discuss source water protection issues to reduce atrazine contamination of the Lewisburg water supply; participated in a Karst Source Water Protection Workshop for small system operators; worked with the Kentucky Pesticide Workgroup to increase agricultural partnerships for source water protection; worked with the American Water Works Association (AWWA) as the Chairman of the Small Systems Committee for the

Tennessee/Kentucky Section of AWWA; presented results for the TACWQ source water program to the EPA Project Officer, EPA Project Technical Advisor, and the Acting Chief of the Prevention Branch and other EPA staff; identified additional opportunities for productive work that fits within the mission of the Technical Assistance Center for Water Quality and the Center for Water Resource Studies at Western Kentucky University; provided oversight to a project to test new Global Positioning Systems in small water systems management; took part in the tuition free Utility Management Institute courses; and assisted in development of a Crisis Communications Plan for small water systems. The Director has had a major focus of conducting work within rural communities to assist in source water protection, developing viable models for small systems to utilize GIS, and promoting a consortium of scientists, state primacy agency personnel, local extension providers, state agriculture personnel and other assistance providers to address pesticide nonpoint source pollution and the impacts on small rural water systems in the state of Kentucky. The consortium previously mentioned is the Kentucky Pesticide Workgroup. This Workgroup is receiving national attention as a state model to address the impacts of nonpoint source agricultural contamination of source waters that impact small water systems.

The director and TACWQ staff are working with small systems in the task of source water protection and planning. We are now working with McCreary County Water District, the City of Lewisburg and farmers in the Spa Lake Basin, West McCracken Water District, the City of Marion, and working to impact small systems in the region and nation. We have completed the susceptibility analysis of the McCreary County Water District's new intake on the South Fork of the Cumberland River utilizing the Kentucky Division of Water methods. This project will be expanded to the interstate watershed scale in 2004 to include small systems in Tennessee. The hope is that we can work to create an interstate small water utility-based model for source water protection. In this manner, our goal is to refine the methods for developing a source water protection plan at the interstate level, and provide results that could be used under a national framework that would provide more consistent and detailed analyses from state to state. This work will be beneficial on both a regional and national level, as it will be used to produce a source water protection how-to-guide for small systems in the next project year. Lastly, this work will help the Center develop a web toolbox for source water protection that can be accessed by water systems throughout the nation.

Task 1: Utility Management Institute. The Utility Management Institute now claims a total of one hundred twenty-four (124) students. Fourteen (14) of our students have now completed all six of the courses in the UMI Series and have been awarded the Utility Management Professional designation. Course assessments completed throughout the history of the courses show a high level of satisfaction with the courses and the UMI. Over 73% of the respondents have given the courses their highest ranking of "very beneficial." Another 26% rated the courses at the second highest ranking of "beneficial." Only one of one hundred fourteen (114) respondents rated an individual course as being "slightly beneficial" and no respondents have rated the course at the lowest level of "not beneficial."

Task 2: Small Systems Circuit Rider. During the 1st Quarter of 2003-2004, the Circuit Rider position logged over 590 hours. Of that time 38.2% of the total time was spent directly assisting systems or their personnel including 70 hours on-site working with systems, 120 hours developing wellhead plans and other compliance documents, 37 hours providing formal training including a presentation for a third grade class. Also, 22 systems were assisted on-site and 10 assisted off site by compliance documentation (i.e. wellhead protection plans and groundwater protection plans).

Much of this quarter was spent contacting water systems and state primacy agencies to determine what types of assistance are needed. Two main categories identified were; compliance assistance and technical assistance. Compliance assistance included monitoring and reporting, consumer confidence reports, and security. Technical assistance included system mapping, computer support and training, source water protection, and leak detection. A specific request was made to develop a monitoring and reporting database that would accept electronically generated lab results in order to track analysis fees, trend water quality parameters and generate sample pick-up schedules.

Task 3: Source Water Protection. Work on the Source Water Protection Initiative's three major existing projects, the Source Water Protection Education Project, the Demonstration Watershed Study, and the Trihalomethane Study, each achieved scheduled progress. We continued special emphasis on the pesticide problems, in this quarter particularly at Lewisburg and Marion, which we have identified as our most serious source water concern for small suppliers. We also continued to work closely with the Kentucky Department of Agriculture, Division of Pesticides regarding this work, and continued fieldwork in the agricultural Upper Iowa River watershed, Iowa, in collaboration with the Upper Iowa River Watershed Alliance. We have extended our work there to study serious agricultural

impairment of water quality in karst aquifers that supply water to a number or small rural communities. Work continues on two new sampling and analysis programs, in cooperation with the Western Kentucky University Departments of Chemistry and Agriculture, to examine transport behavior of the herbicide atrazine on sediments and in rainfall, to better understand potential threats to drinking water sources by this toxic and widespread chemical. Within the Trihalomethane Study work continued during the quarter on Manipulative Experiments, the Large River Survey, the Taylorsville Lake Study, and analysis of the Implications for THM Model Development and Water Management.

We continued to develop the Source Water Protection Education Project, and the initiation of the first two modules. We gave our first education workshop, *Impacts of Karst in Source Water Protection*, to a group of 35 water treatment operators on February 26, 2003, at the request of the Kentucky Rural Water Association. Results of these projects are described in the body of this work.

Task 4: Database Management and Information Tools During this quarter, efforts by the Database Management and Information Tools group have resulted in significant accomplishments. These include further distribution of the ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. We are working to update our ArcExplorer map layers for Kentucky small water providers, and hope to make these available to water systems next quarter. We have made additional distributions of the stand-alone Water Loss Calculator for free use by small water systems, and are working on a new Tools CD to be distributed to water systems beginning next quarter. We are also working on putting together a Tools CD that will include only nationally useful tools for distribution to water providers outside Kentucky. These products will be of direct utility to water systems and water resource managers both within and beyond Kentucky.

Last quarter we presented an initial series of 42 maps, beginning with data from the calendar year 2000, from the EPA Safe Drinking Water Information System (SDWIS) site describing drinking water Maximum Contaminant Level (MCL) violations. Additional mapping and statistical analysis is underway and will take some time to complete; we are also in the process of preparing a manuscript for publication that features these maps and analyses. We feel strongly that the national picture of water system problems that is developing will allow us to target problems and solutions more efficiently. We have also made some final modifications to the internet interface we developed for querying our database. We are now using this database interface to structure and facilitate cooperation with other researchers, institutions, and agencies on specific projects.

We have continued to participate actively in significant education and outreach opportunities, provide science advisory services, and work cooperatively with a variety of agencies and organizations concerned with water quality; these are efforts with a potentially broad impact. Dr. Meier cooperated with teachers at a public school to obtain a grant to schools to develop curriculum focusing specifically on the relationships between karst hydrology and drinking water. Under this grant, Dr. Meier will conduct professional development workshops for teachers on this issue, highlighting the particular vulnerabilities of aquatic systems located in karst hydrogeologic environments particular to this region and similar karst regions in the US.

Administration (Second Quarter 03)

I. Work Status

Administrative activities included technical oversight for all tasks, management of personnel, planning, budgeting, grant cost accounting, and tracking accounts for the EPA grant for the WKU TAC. Administrative responsibilities further included meetings and interaction with officials in the U.S. EPA headquarters, Region 4, and Region 6, the Kentucky Division of Water, the Kentucky Rural Water Association, the Tennessee/Kentucky Section of the American Water Works Association, the Association of State Drinking Water Administrators, the Barren River Area Development District, the U.S. Department of Agriculture, other Technical Assistance (TA) providers, and local communities. Administrative activities assessed task efforts to insure accordance with the primary goal of protection of public health through capacity development of small water systems. The Director also gave guidance to the Task Managers in order that activities were in accordance with the grant technical proposal and milestone schedules. Additionally, the Director worked with the EPA Project Officer, Small Systems Program (Deborah McCray) and Source Water Protection (Steve Ainsworth), to find avenues for presenting our source water protection results.

A. Work Progress. We spoke at EPA headquarters to describe our work in the arena of source water protection. Within that meeting we described our progress in preparation of our materials for source water protection in karst regions and presented our successful results working with McCreary County Water District, the City of Marion, and the City of Lewisburg and local farmers. These are all examples of successful implementation of this grant and the results that can be used on a national level to promote source water protection in urban, rural and agricultural basins.

McCreary County Source Water Protection Planning: We are working now working with the water district to develop a interstate watershed source water protection plan. We will be working in the near future to gain the support of small water systems in Tennessee and develop a basin-wide protection plan. A key element of the plan will be the participation stakeholders such as Eastern Kentucky Power, the National Forest Service, and the Big South Fork National Recreation Area. These stakeholders manage land and landuses that are included within the watershed. Currently, these key stakeholders are at the table and have participated in the Source Water Assessment for the District.

On-line UMI Courses: Western Kentucky University (WKU) has approved all six UMI courses, developed under this grant, and Utility Management 101 is being offered as a course for water utility managers this semester. As part of an Associates Degree in Business Technology with a concentration in Water Utility Management, these courses will continue to be developed for online distribution and access. In this manner we hope to work with the University to promote capacity development at the national scale. Although the TACWQ will not receive program income, the TACWQ staff will serve as advisors to guide how the UMI materials can be translated to online courses. A Community College faculty member funded by a WKU education grant, Dr. Dawn Bolton, is working with Phillip East, the KRWA Education Director, to teach the on-line course. This program of study will allow TA providers, trainers, utility managers, office managers, operators and others to obtain a degree with a concentration in Water Utility Management from WKU. Our primary purpose for promoting this within the University was to establish a program that could increase the managerial capacity of small systems by allowing managers to complete a degree. The TACWQ will continue to offer tuition free courses through the UMI. The UMI has continued to provide for managerial capacity development of small systems. Lastly, we have graduated seventeen utility managers through the program of tuition free UMI courses and these graduates have earned a Utility Management Professional Designation from the TACWQ.

West McCracken Water District GIS: We have completed data collection, development of the GIS, and implementation of the system for management of the District's infrastructure. We have worked with the District to assess the personnel, financial, managerial and technological resources necessary to implement a GIS for a small water system. The outcome of this project will be to provide "A Guide to GPS and GIS for Small Water Systems" that will assist other small water systems in determining how to acquire the capacities to develop and utilize a GIS for management of their infrastructures. In the interim, we have written a paper to be published in the Waterproof journal that goes out to rural water systems in Kentucky and are looking to avenues to publish the work at the national scale.

B. Difficulties Encountered. No Difficulties Encountered.

C. Preliminary Data Results. We are continuing the work in progress. A paper regarding the GIS work will be presented in the next report as well as a paper regarding the UMI.

D. Anticipated Activities. Work will continue to assist other states in Region 4 in developing training to increase managerial capacity. The Director will continue all administrative duties and work to increase capacity development within the state of Kentucky, the Region, and the nation. To that end, the Director will be advising the WKU Community College as they will be putting all of the UMI courses into an on-line format that will allow water utility management courses to be taken remotely from throughout the United States. Finally, we will be working to become a leader in providing technical assistance for source water protection, including planning, assessment, best management practices development, and education. This is indicated by our recent involvement in the AWWA Source Water Conference, BMP Workshop on January 19, 2003.

II. Discussion of Expenditures

During the 2nd quarter of FY03, expenditures for Administration were $89,200 with Year-to-Date expenditures of $137,901.

III. Changes in Key Personnel

There were no changes in key administrative personnel for this period.

Task 1: Utility Management Institute – UMI (Second Quarter 03)

I. Work Status

The goal of the UMI is to develop and deliver a series of courses to be included in a "Utility Management Professional" certification program. This program is available to system managers, operators, and office managers of water systems serving rural areas and small municipalities with populations under 10,000.

A. Work Progress. The course entitled "Human Resource Management for Utilities" was presented at The Center for Rural Development in Somerset, Kentucky on March 19-20, 2003. There were twenty-seven (27) students participating in this course. Copies of the Course Assessments, filled out by the students, are included with this quarterly report.

B. Difficulties Encountered. No unanticipated difficulties were encountered.

C. Preliminary Data Results. The Utility Management Institute now claims a total of one hundred twenty-four (124) students. Fourteen (14) of our students have now completed all six of the courses in the UMI Series and have been awarded the Utility Management Professional designation. Course assessments completed throughout the history of the courses show a high level of satisfaction with the courses and the UMI. Over 73% of the respondents have given the courses their highest ranking of "very beneficial." Another 26% rated the courses at the second highest ranking of "beneficial." Only one of one hundred fourteen (114) respondents rated an individual course as being "slightly beneficial" and no respondents have rated the course at the lowest level of "not beneficial."

D. Anticipated Activities. During the third quarter, the UMI course entitled "Utility Organization, Regulation & Law" will be presented in Owensboro, Kentucky on April 16-17, 2003 at the Executive Inn Rivermont. In addition, The Internet course presentation of "Utility Management 101" is being taught during the Spring Semester of 2003. We anticipate developing one more course for Internet availability in the Fall of 2003.

II. Discussion of Expenditures

During the 2nd quarter of FY03, expenditures for Task 1 were $35,061 with Year-to-Date expenditures of $39,970.

III. Key Personnel Changes

There were no personnel changes during this quarter.

Task 2: Circuit Rider Program (Second Quarter 03)

I. Work Status

The "Circuit Rider" approach to providing a combination of on-site technical assistance and training is nationally recognized as the most effective method of assisting small public water systems to comply with state and federal environmental regulations. The Circuit Rider program works in partnership with Kentucky Division of Water (DOW) to target the public water systems serving populations under 3,300, with particular emphasis on systems serving less than 500 people. Our "Circuit Rider" approach works to target those small systems experiencing profound difficulties in complying with SDWA provisions in order to enhance protection of public health.

A. Work Progress. During the 1st Quarter of 2003-2004, the Circuit Rider position logged over 590 hours. Of that time 38.2% of the total time was spent directly assisting systems or their personnel including 70 hours on-site working with systems, 120 hours developing wellhead plans and other compliance documents, 37 hours providing formal training including a presentation for a third grade class. Also, 22 systems were assisted on-site and 10 assisted off site by compliance documentation (i.e. wellhead protection plans and groundwater protection plans).

Much of this quarter was spent contacting water systems and state primacy agencies to determine what types of assistance are needed. Two main categories identified were; compliance assistance and technical assistance. Compliance assistance included monitoring and reporting, consumer confidence reports, and security. Technical assistance included system mapping, computer support and training, source water protection, and leak detection. A specific request was made to develop a monitoring and reporting database that would accept electronically generated lab results in order to track analysis fees, trend water quality parameters and generate sample pick-up schedules.

Significant Contacts. The Lynnville Water System located in Graves County serves approximately 20 connections from a single well. It is a loosely run operation having no actual responsible party in charge. The system began over twenty years ago out of the generosity of local resident who had a highly productive well and wanted to share the water with the community. She even went as far as to deed the well to the community for as long as the system was in use. Over the years a few people have tried to run the system and become certified, but none has succeeded. Fortunately chlorination is the only treatment needed for this system and it is maintained by the current homeowner. Due to compliance issues and financial burden the system has remained a significant non-complier. Financial problems arise from everyone agreeing to pay a fixed amount each month, but without meters or valves there is no recourse when someone does not pay their fair share which happens often.

The Circuit Rider has been working in a liaison capacity between Lynnville and a water district to extend water to the community. The water district is beginning a line extension project that will end within a mile of Lynnville. One of the problems to overcome is convincing the community that they will be better served and pay less money than operating the community system in compliance. After analyzing the system expenses and factoring in the cost of future compliance the circuit rider calculated that the water rates should be $42/month as compared to the current $20 that not everyone is paying. The reason for this exercise is to convince the community to sign a water service agreement which will allow the water district to request additional funding.

The Trimble County Water District serves 1,300 connections from four wells drilled into the Ohio River Alluvium. The district had concerns over the expansion of a sand mining operation possibly affecting water quality and quantity. The mining company had filed for a permit to deepen the excavation and increase their water withdrawal. The district upon notification from the state of the intent to expand the mining operation filed a complaint. In the meantime the district needed to obtain static and pumping water level elevations prior to a temporary permit being issued. The circuit rider was able to install and maintain water level recorders at a significant savings to the district. In addition to the installation the data retrieved from the dataloggers along with river stage data from the U.S. COE was processed into spreadsheets for graphical comparison. The information complied from the monitoring is helping the district to negotiate with the mining company for some monitoring wells and periodic water quality analysis.

B. Difficulties Encountered. No unanticipated difficulties were encountered.

C. Preliminary Data Results. See Work Progress above.

D. Anticipated Activities. During the next quarter, the WKU Small System Circuit Rider will continue to assist systems with operational and management problems. An increasing amount of the Circuit Rider's time is expected to be spent on-site demonstrating and training system personnel to use GPS technology to map and manage their utility. The Circuit Rider will continue to create educational opportunities for the communities we serve. Educational activities will focus on elementary, middle, and high school children and will emphasize the role small utilities play and the importance of good source water quality. This work will be coordinated with efforts within the WKU Center for Water Resource Studies.

II. Discussion of Expenditures

During the 2nd quarter of FY03, expenditures for Task 2 were $3,663 with Year-to-Date expenditures of $8,001.

III. Key Personnel Changes

There were no personnel changes during this quarter.

Task 3: Source Water Protection Initiative (Second Quarter 03)

A. Work Progress

Work on the Source Water Protection Initiative's three major projects, the Source Water Protection Education Project, the Demonstration Watershed Study and the Trihalomethane Study, each achieved scheduled progress.

a. Demonstration Watershed Study

Sampling at the Kentucky Demonstration Watersheds
The Demonstration Watershed Study currently uses two interrelated programs to characterize each study site's source-water catchments: 1) water sampling and water analysis, 2) Geographic Information System (GIS) land use analysis. We made significant progress during the quarter, and results are outlined below.

Work has continued on our quarterly sampling program at the Demonstration Watersheds (Auburn, Cadiz, Marion), in order to characterize and monitor the sites' source water issues. We continue to focus on the most significant source water problems that we have identified: pesticides and bacteria. Detailed work on pesticide contamination at Lewisburg (Spa Lake) continues at Lewisburg with sampling by Joey Wilcox and VJ Golla. Task 3 groundwater dye traces are now nearing completion in the watershed. We continued our basin-wide sampling for atrazine at Lewisburg to a monthly interval. Work at both Spa Lake and Marion is ongoing with cooperation of the Kentucky Pesticide Work Group (consisting of Western Kentucky University, Kentucky Division of Pesticides, Kentucky Division of Water, Kentucky Department of Conservation, Kentucky Corn Growers Association, Kentucky Rural Water Association, the U.S. Geological Survey, U.S. Natural Resources Conservation Service, and the Syngenta Corporation). Dr. Taylor prepared a presentation on the status of the atrazine work at Lewisburg and Spa Lake for the Kentucky Pesticide Work Group, which he will present at the group's next meeting in Frankfort, Kentucky, in April.

Work at Logsdon and Hawkins River (Diamond Caverns) continues with emphasis on analysis of data on the role of sediment in the transport of pesticides through karst aquifers. raduate student Mike Anderson is completing a manuscript on this work will be that submitted to at least one refereed journal in 2003. Task 3 will continue quarterly sampling at the Logsdon and Diamond Wells with cooperation of the National Park Service in order to continue developing source-water protection techniques and monitor effects of the newly implemented Conservation Reserve Enhancement Program (CREP).

Data from the quarterly sampling program are reported in the data section below.

Agricultural Contamination of Karst Water Sources in Northeast Iowa
During the quarter Graduate student Pat Kambesis continued field and analytical work to investigate methods for identification and characterization of karst groundwater contamination by agricultural land use in the Coldwater Creek Basin of the Upper Iowa River Watershed in northeast Iowa. This work is being undertaken in cooperation with the Upper Iowa River Watershed Alliance (UIRWA), a consortium of citizen's groups, state government scientists from Iowa and Minnesota, university scientists, and others interested in the water quality of the basin. Our participation in the program has been an outreach of our source water protection experience in karst areas, at the request of the UIRWA.

Water sampling for a range of water quality parameters, including the herbicide atrazine and its metabolites, as well as dye tracing to better delineate groundwater catchment areas. Two trips were made to Iowa during the quarter to initiate dye traces, and normal monthly water sampling continued. Data were gathered from temperature data loggers to quantify groundwater response to surface water inputs at four locations (three groundwater and one surface water) and found to both be operating correctly to and to accurately reflect dynamic hydrologic conditions.

During the quarter two dye traces were initiated in the Coldwater Basin, each with one of the common water tracing dyes (fluorescein, Rhodamine WT) to help delineate the recharge area of the main spring whose impact from agricultural contamination is being studied. Two new springs, which had been identified during the previous quarter, were added to the list of those monitored. The traces that had been attempted in the previous quarter

(freezing conditions during the entire December visit meant that no liquid water was flowing at input points on the surface and thus dye could not be injected) were initiated, one with an in-cave injection point in February, to ensure flowing water into which to inject the dye, and a surface injection in March.

Ms. Kambesis also made progress in GIS development.

Program on Sediment Transport of Atrazine
During the quarter we continued an effort to better understand the transport of the pesticide atrazine by sediments within the Lewisburg (Spa Lake) Watershed. Previous efforts on the grant have shown a relationship between sediment transport by storm waters at the Hawkins River (Diamond Caverns) site, although the results have also shown that only certain fractions of the sediment appear to contribute to this transport. In cooperation with the WKU Departments of Chemistry and Agriculture, we planned detailed experiments with sediment from the Spa Lake, Hawkins River (Diamond Caverns Campground), and Logsdon River sites that will enhance our understanding of these processes. Understanding how atrazine is transported within this watershed is a key component to understanding what land use practices can be undertaken in order to ameliorate related problems here and elsewhere. The project has been undertaken as a closely supervised master's thesis research project by Mr. Tony Oakes, supervised by Dr. Eric Conte of the Department of Chemistry, along with Ritchie Taylor and Chris Groves. During the quarter we designed the sampling plan, and sediments for analysis will be collected during the next quarter, during the primary atrazine application period, from four locations (Two non-karst sites at Spa Lake, as well as karst sites at Hawkins River (Diamond Caverns Campground) and Logsdon River. The experiments are designed to better understand the role of sediment in the transport of atrazine and its metabolites to drinking water sources, by separating the sediment into three size fractions, as well as separating organic carbon. Atrazine and its metabolites (breakdown products) will be extracted from the surfaces of these sediments to determine which sizes and sediment types contain the highest concentrations of these chemicals. In turn, this information may be helpful in pinpointed specific strategies for pesticide best management practices that focus on retaining the specific sediment types on the field where application has occurred.

Program to Evaluate Atrazine Distribution Distant from Application Sites
During the quarter we continued design work on a new program to analyze atrazine concentrations of surface, groundwater, and rainfall during the in and around Mammoth Cave National Park to evaluate transport away from application areas. The Park land area provides 23,000 hectares over which atrazine is not applied, and so to the extent that these samples are positive, atrazine is being transported away from application areas through a variety of potential pathways. We are working with Mr. Joe Meiman, hydrologist with the National Park Service to coordinate monitoring within the park, and to obtain addition atrazine data collected by his staff with National Park Service funding.

A graduate student, Mr. Jason Kuykendahl, designed, built, and installed 15 rainfall monitoring and sample collection devices, throughout south central Kentucky over a 50 mile range, including within the Hawkins River (Diamond Caverns Campground) and Logsdon River demonstration watersheds, as well as Mammoth Cave National Park. This is designed to better understand rainfall transport of atrazine, and whether this might pose a risk to drinking source water areas in catchments where atrazine is not being applied directly within the catchments. We will initiate sampling in the next quarter during the regular atrazine application season.

b. Trihalomethane Project (Dr. Jeffrey Jack, University of Louisville)
Work continued during the quarter on Manipulative Experiments, the Large River Survey, the Taylorsville Lake Study, and THM Model Development. Results are discussed in the data section, below.

B. Difficulties encountered
No significant difficulties were encountered.

C. Data Results

Source Water Demonstration Watershed Study
Quarterly sampling for demonstration watershed project occurred at Marion, Hawkins River (Diamond Caverns Campground), and Logsdon River on March 18 and 19, and the data are given below in Appendix 3-1. All three sites showed positive results for the pesticides metribuzin and triflualin, although in low concentrations that would

not appear to pose a significant health threat. Atrazine and the other nine pesticides in our sampling program were negative at all locations.

Metribuzin is a triazine-class herbicide that inhibits photosynthesis of susceptible plant species. It is used for control of annual grasses and weeds in field and vegetable crops and in turfgrass. A maximum contaminant level (MCL) for drinking water has not been established by the EPA, and it has a lifetime health advisory (HA) level (developed from data describing non-carcinogenic end-points of toxicity) of 0.2 mg/L. This HA level is 50 times higher than the highest concentration of metribuzin than we found at our demonstration watersheds during the quarter.

Trifluralin is a selective, pre-emergence dinitroaniline herbicide used to control many annual grasses and broadleaf weeds in a large variety of crops. An MCL for drinking water has not been established by the EPA, and Trifluralin has a lifetime health advisory (HA) level of 0.005 mg/L, which is roughly five times higher than the levels found at our demonstration watersheds during the quarter.

Summary of Lewisburg (Spa Lake) Atrazine Basin Sampling
Data from weekly sampling at Lewsiburg (Spa Lake) are given in Table 3-1.

Sample Date	Raw Water Atrazine (ppb)	Finished Water Atrazine (ppb)
1/6/2003	0.18	0.13
1/13/2003	0.17	0.11
1/20/2003	0.09	0.02
1/27/2003	0.07	
2/3/2003		0.04
2/10/2003		
2/17/2003		0.07
2/24/2003		0.08
3/3/2003	0.10	0.06
3/10/2003	0.07	0.12
3/17/2003	0.13	0.13
3/24/2003	0.14	0.12
3/31/2003	0.31	0.20
4/7/2003	0.75	0.63

Table 3-1. Atrazine data from Lewisburg (Spa Lake) Kentucky.

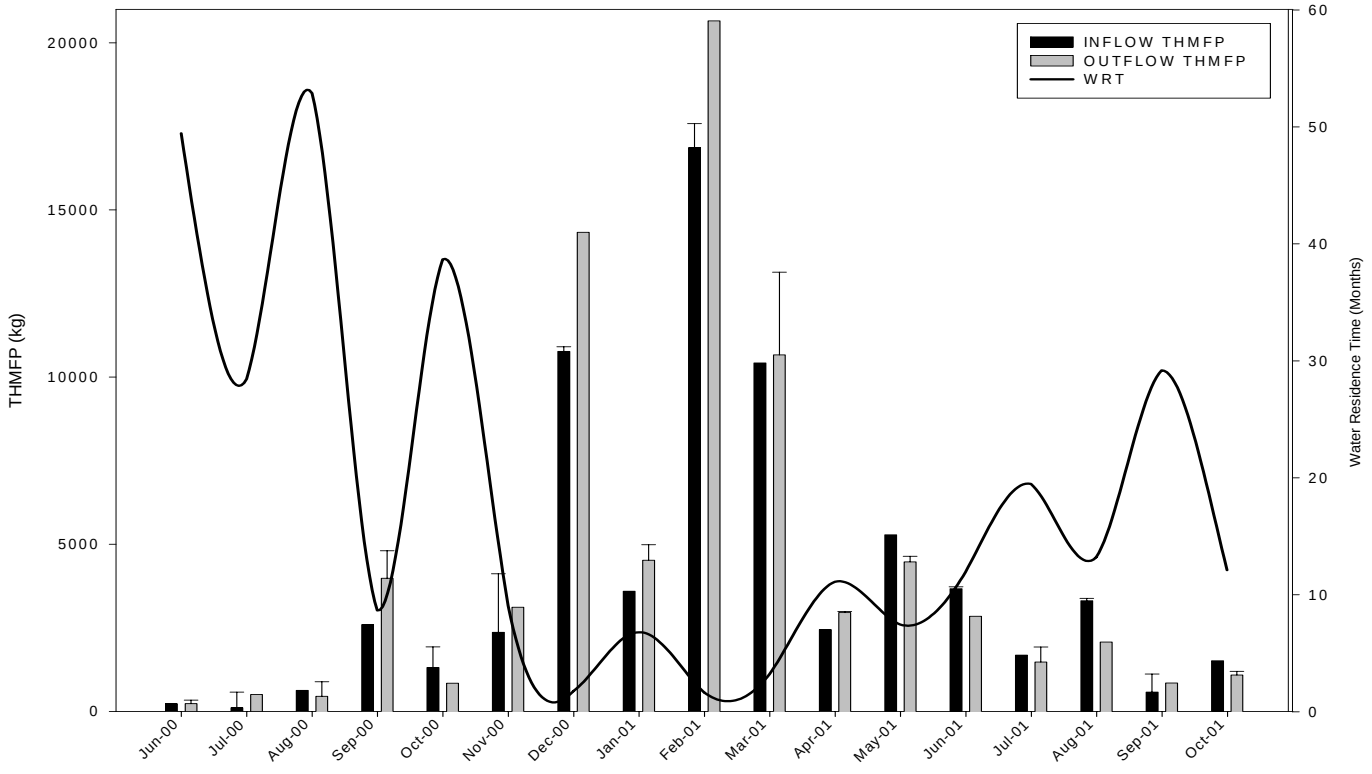
Trihalomethane Project (Dr. Jeffrey Jack, University of Louisville)

Work Status
The work performed during this period included the following items.

Data collection is now nearly complete for the project; we have one more winter pool sample to collect in Taylorsville Lake. The preliminary model for Taylorsville Lake suggests that while the lake is in balance for THMFP on an annualized basis, the lake is a source of THMFP during the winter months.

Data collection is complete for Ohio River survey. We have just received the water year data from the USGS necessary to develop the mass balance model for the main stem and the tributaries.

Implications for THM Model Development and Water Management
The Taylorsville Lake data monitoring and mass balance work indicates that reservoirs may be important sources of THMFP during the winter months when allochthonous loading into these systems is high. In contrast to rivers, autochthonous production does not appear to be a major factor driving higher THMFP. In our annualized budget however, the reservoir we studied seems to be nearly in balance with respect to THMFP inputs and outputs. Water systems using reservoirs as drinking water sources should examine their operations during the winter months to minimize the production of THMFP in disinfection.



Dissemination of Results

We have begun work on two more manuscripts to be submitted this spring. One will include the monitoring and experimental results of our work at Taylorsville Lake and will be submitted to the *Journal of the North American Lake Management Society*. We have selected this journal because it is widely read by the water management community. We are considering sending our mass balance budget work to the *Journal of the American Water Works Association*, which is another journal widely read by the management community and which would maximize the impact of the work, if our manuscript is accepted.

Source Water Protection Education Project

Work continued on the Source Water Protection Education Project, and the first two modules, 1) *Impacts of Karst in Source Water Protection* and 2) *Developing Participant Networks in Source Water Protection Programs*. These modules communicate information about aspects of source water quality, both technical issues and the development of source water plans. These modules are being designed for dissemination in three different formats: 1) through the Internet, 2) as written and computer disk materials, such as powerpoint presentation, and 3) as site visit workshops.

We gave the first workshop, *Impacts of Karst in Source Water Protection*, to a group of water plant operators in coordination with the Kentucky Rural Water Association (KRWA), at Barren River State Park. This workshop was presented from 8:30-12:00 on February 26, 2003 as part of a larger training workshop held by the KRWA. The conference was designed for water systems operators in rural Kentucky and focused on water regulations, treatment processes, and operations and maintenance of water treatment systems. Our audience thus consisted of 35 water

treatment specialists. The overall aim of our workshop was to educate water systems operators about the particular impacts of karst on source water protection.

Topics of the workshop were presented in the following order:
1. Concepts of Source Water Protection, by Dr. John All
2. Partnerships for Source Water Protection: Kentucky Case Studies, by Dr. Ritchie Taylor
3. Karst Landscapes and Aquifers, by Dr. Chris Groves
4. Karst Related Environmental Problems, by Alan Glennon
5. Source Water Protection in Karst: Land Use/Best Management Practices, by Pat Kambesis
6. Source Water Protection in Karst: Geographic Information Systems, by Mark Graham

Presenters created a power point slide with a combination of text and images to best convey important concepts to the audience. The average time for each topic was thirty minutes with questions.

Concepts of Source Water Protection analyzed the sources and types of pollutants entering our groundwater. Common contaminants include automobile petrochemicals, sediment, high volume run-off, nitrates, pesticides, and herbicides. Sources include roadways, railways, construction, increased impervious surface area, livestock and other farming.

Partnerships for Source Water Protection emphasized a watershed approach to source water protection, with particular attention to the partnerships that can be formed within a watershed to create an integrated approach to source water protection. Dr. Ritchie proposed a "Multiple Barriers Approach" to watershed protection, listing risk prevention, risk management, monitoring and compliance, and individual action as an umbrella through which we can safeguard our drinking water supplies. Highlighted alliances were agricultural partnerships and community partnerships. For a community partnership, establishing a Source Water Protection Council was listed as essential for the following steps: contaminant source inventory, source water susceptibility analysis, source water assessment, and dissemination of results.

Karst Landscapes and Aquifers characterized the nature of aquifers in regions dominated by karst. Karst landscapes are generally characterized by caves, sinkholes, sinking streams (that then flow underground), large springs, and thin soils. Karst aquifers are easily contaminated because there is little to no natural filtration within them. The issue is further complicated because of the relative invisibility of water in the karst landscape.

Karst Related Environmental Problems expanded on the previous topic, listing sinkholes, cave entrances, cracks and crevices, filtration through soil, and soil macropores as pathways for pollution. Urban pollution of groundwater can include sewage, pavement runoff, trash, domestic and industrial chemicals, while rural pollution of groundwater often comes from sewage, fertilizers, pesticides, herbicides, dead livestock, and trash. Flooding in a karst system can lead to catastrophic collapse, creating construction problems in karst areas. Karst can be an impediment to developing further water supplies due to a lack of either quality or quantity. Environmental health issues associated with karst include radon and acute contaminant exposure. Mr. Glennon also took the audience on a tour of a sinking stream, demonstrating the unseen and difficult to predict quality of karst aquifers.

Best Management Practices (BMPs) for Source Water Protection in Karst defined BMPs as a combination of structural, management and cultural practices that federal, state, and local governments, agricultural scientists, and environmental planning agencies determine to be effective measures in controlling or minimizing human effects on the environment. Individual BMPs include storm water retention basins, silt fences, no till cultivation, contour tilling, sediment retention basins, riparian strips, educating the public, and using less or less-toxic and biodegradable pesticides and herbicides. Furthermore, the combination of several BMPs is more effective than use of individual BMPs.

Source Water Protection in Karst: GIS demonstrated the effectiveness of Geographic Information Systems (GIS) at interpreting and visualizing complex or vast sets of data. GIS was defined as a computer technology that allows the user to analyze and display data relative to geographic location. Raw data can be analyzed, spatial patterns viewed and future trends modeled. These capabilities can be of great advantage to those interested in watershed monitoring. For example, using GIS one could map analysis sites and results as well as water migration and flow patterns.

Attendees of the workshop were given a binder including the power point presentation slides, Appendix A: *EPA Delineation of Source-water Protection Areas in Karst Aquifers of the Ridge and Valley and Appalachian Plateaus Physiographic Province: Rules of Thumb for Estimating the Capture Zones of Springs and Wells*, Appendix B: World Wide Web Links: Further Information About Source Water Protection and Karst Aquifers, and an insert titled *Living With Karst – A Fragile Foundation*, part of the AGI Environmental Awareness Series. A copy of the materials are provided in this quarterly report.

Overall, the workshop was well received and quite informative for anyone who lives on or works with karst landscapes. And, as Dr. Groves mentioned in his presentation, about 15% of the land area of the earth is karst, and an estimated one-quarter of the world's residents are estimated to get their drinking water form karst sources. This therefore will be a relevant workshop to many in the future.

II. Discussion of Expenditures

Task 3 expenditures for the 2nd quarter of FY03 were $11,533 with Year-to-Date expenditures of $19,061. We are approximately on schedule within Task 3.

III. Changes in Key Personnel

Dr. Charlotte MacAlister has taken another job and has left the program. Graduate students Jason Kuykendal and Elizabeth Robb have joined the project. Mr. Kuykendal is coordinating atrazine rainfall sampling, and Ms. Robb joins the project as an Environmental Education Specialist on the Source Water Education project.

Task 4: Database Management and Information Tools (Second Quarter 03)

I. Work Status

It is the responsibility of the Database Management component of this Task to provide appropriate methods and structures for reporting data and metadata to facilitate: reporting of information by other Tasks, appropriate capture and storage of data and metadata, and access to information and materials by end users. The Information Tools function of our Task works to put technology, information, and the tools to create information capacity and capability directly into the hands of water providers, and to make that technology and information as accessible as possible in order to promote the protection of public health.

A. Work progress.

During this quarter, efforts by the Database Management and Information Tools group have resulted in significant accomplishments. These include further distribution of the ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. We have also made additional distributions of the stand-alone Water Loss Calculator for free use by small water systems. We have developed additional U.S.- wide maps of geographic and water quality information pertaining to water systems and Maximum Contaminant Level Violations from the EPA Safe Drinking Water Information System database. Some of these additional distributions as well as software demonstrations were made at the Kentucky Rural Water Association conference on 12 February 2003 where the TACWQ set up an exhibitor's booth; many useful contacts and discussions with water system managers were made at the conference, as we usually do. We have made some final adjustments to the internet interface we developed for querying our database. We have also continued to participate actively in significant education and outreach opportunities, provide science advisory services, and work cooperatively with agencies, groups, and the public.

It is worth noting that the consistency of the funding obtained by the TACWQ through EPA has been instrumental in leveraging infrastructure funds that include housing for part of the TACWQ. A $20 million building on the WKU campus that will house Engineering and Biology research space is currently under construction and will be completed in approximately one year. The building includes a generous space and furnishings for the Center for Water Resource Studies, specifically for the Database and Information Tools section of the TACWQ. No TACWQ funds have been used in its construction or furnishings, but the active involvement and consistent funding of the TACWQ have made us a fortunate recipient of this space and building allocation.

(1) Mapping Tools for Water Systems. We are continuing to distribute our ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. Many water systems were able to view for the first time the data that they and their Area Development Districts submitted to the Commonwealth of Kentucky about their water systems, including a road survey for water lines. This 2-CD set is being distributed directly to water systems that request the information. For our latest distribution, we were able to update a number of these data layers so that the mapping tool can be distributed to water systems with the latest information available.

(2) Software and Information Tools for Water Providers. We have distributed additional copies of our stand-alone Water Loss Calculator. The program calculates the volume, rate, and subsequent dollar losses due to undetected leaks, and can chart monthly production, distribution, water loss, and dollar loss values so the user can easily examine trends over time. This final, nationally distributable version includes modifications to the Water Loss Calculator's installation program so that it installs correctly and easily to a broad range of computer operating systems. A copy of the final version of this program can be downloaded from our website, http://water.wku.edu . A copy of the CD with this software was submitted in an earlier report.

(3) Internet-Accessible Data Upload and Query Capability.

We have very recently completed a major renovation of our website at http://water.wku.edu in order to make it more attractive, user-friendly, and accessible to small water systems. Many of our renovations are based on direct feedback from users, including a website user survey. Similarly, many of our software tools and innovations are initiated following direct contact with water system managers and visits to small water systems, and from information obtained from KRWA. We make a point of engaging representatives of water systems directly, including at industry conferences, so that we better understand their needs and problems and how we can assist them with information and technology transfer. Included in our website is a new section of links devoted to information about source water protection, including background, problems, and resources. One of the primary missions of Task 4 is to facilitate information retrieval of a voluminous amount of water quality data. We receive data from other tasks as well as researchers working outside of Western Kentucky University. We wanted to make it easier for researchers to access their own data for query and analysis, and for our GIS personnel to pull down for mapping, so we have been developing an internet interface for uploading and querying data generated and collected by the project. In previous quarters we performed initial development and testing, and subsequent redevelopment and retesting. During this quarter, we have made some final modifications of the internet access interface. Our database is being stored in SQL Server, and the web interface crafted by Seth M. Johnson for use with this database has made it much easier for cooperating researchers to query and analyze their own data tables and additional data tables to which they may be given access, while still protecting database integrity and administrator control over the database. We are now using this database interface to structure and facilitate cooperation with other researchers, institutions, and agencies on specific projects.

(4) Analysis and Synthesis of Data for Publication. Last quarter we presented an initial series of 42 maps using calendar year 2000 data from the EPA Safe Drinking Water Information System (SDWIS) site describing drinking water Maximum Contaminant Level (MCL) violations. Additional mapping and statistical analysis is underway and will take some time to complete. Task 4 has also worked to map and analyze water quality data collected this spring, summer, and fall at monitoring sites throughout the Green River / Tradewater Basin of Kentucky; this analysis was presented at a citizens' monitoring conference in November 2002. This quarter we have begun a more detailed mapping and analysis effort to elucidate patterns of national problems.

(5) Education Outreach and Science Advisory Duties.
Public health and small rural water systems benefit from the presence of an informed public, skilled citizens' groups who care about source water protection, and sympathetic and knowledgeable state and regional agencies. When feasible, we take advantage of opportunities to participate in educational programs, outreach events, and science advisory service to agencies and groups entrusted with protecting the streams and rivers that serve as the source water for small water systems. Dr. Meier has continued to work with a variety of agencies and organizations, including the Kentucky Division of Water's sponsored Green River Basin Management Team, the Kentucky Waterways Alliance, Watershed Watch, a multi-agency the Green River Conservation Reserve Enhancement Program – Monitoring Oversight Committee, and are working to create an Upper Green River Biological Preserve along the banks of the Green River upstream from Mammoth Cave National Park.

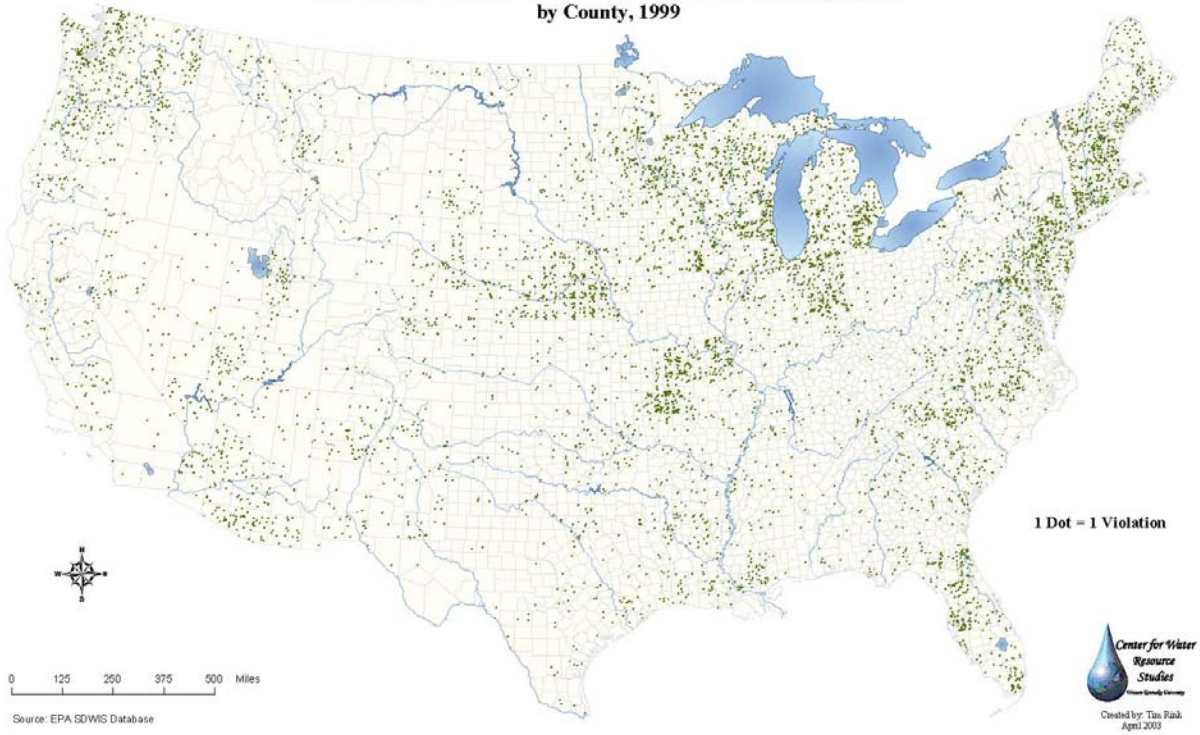
Public education and advocacy for safe drinking water and source water protection have been important components of efforts with a broader impact as well. As a model within a local public school, Dr. Meier and other faculty members in the Biology Dept. at WKU are implementing the second year of development of a hands-on science curriculum through weekly science labs that 350 elementary school children attend with their teachers. Many of the labs developed feature the properties of water, human treatment and use of water, public health, the ecology of aquatic systems, and the importance of informed stewardship in protecting our essential water resources. Based on teacher feedback and consultation with other educators, we are refining the curriculum to publish as a model that can be adopted and adapted by other schools. Dr. Meier also cooperated with teachers at that public school to obtain a $7,000 EPA grant to schools to develop curriculum focusing specifically on the relationships between karst hydrology and drinking water. Under this grant, Dr. Meier conducted professional development workshops for teachers on this issue, highlighting the particular vulnerabilities of aquatic systems located in karst hydrogeologic environments particular to this region and similar karst regions in the US.

We have also continued to participate actively in significant education and outreach opportunities, to provide science advisory services, and to work cooperatively with a large number of state and federal agencies, citizens' and community groups, and the public. For example, we have worked with Watershed Watch in Kentucky to train citizens in water quality monitoring and to map water quality data throughout the region. Some recent recruits have included regional health department employees, a number of whom are continuing their water quality monitoring on a completely off-time basis, and a county judge-executive and county magistrate who are using their leadership to protect the quality of their water resources and promote thoughtful land use practices. In another effort, we have obtained a small grant in partnership with a local school, W.R. McNeill Elementary, to improve teacher training specifically in understanding and communicating the relationships between groundwater, wastewater, and drinking water in a karst environment. The grant paid for equipment and materials for the school, compensation for the teachers during the professional development training we provided, and funding for instructional field trips by students this year to Lost River Cave, the American Cave Museum at Hidden River Cave, Mammoth Cave National Park, Kentucky Caverns, and the Cumberland Science Museum. A complete, year-long and hands-on science curriculum is being developed at McNeill with teacher and student feedback for implementation in a science lab setting; the TACWQ has contributed some of Dr. Meier's time in developing portions that deal with water-related topics. We hope that after further testing, the curriculum can be distributed broadly. In other outreach efforts, we have served on the Kentucky Division of Water's broadly based Green River Basin Management Team, served as basin coordinator for the Kentucky Waterways Alliance, worked to purchase 705 acres for a Green River Biological Preserve, and recently helped organize a Watershed Ecology seminar series that included employees of the Kentucky Division of Conservation, Mammoth Cave National Park, and The Nature Conservancy.

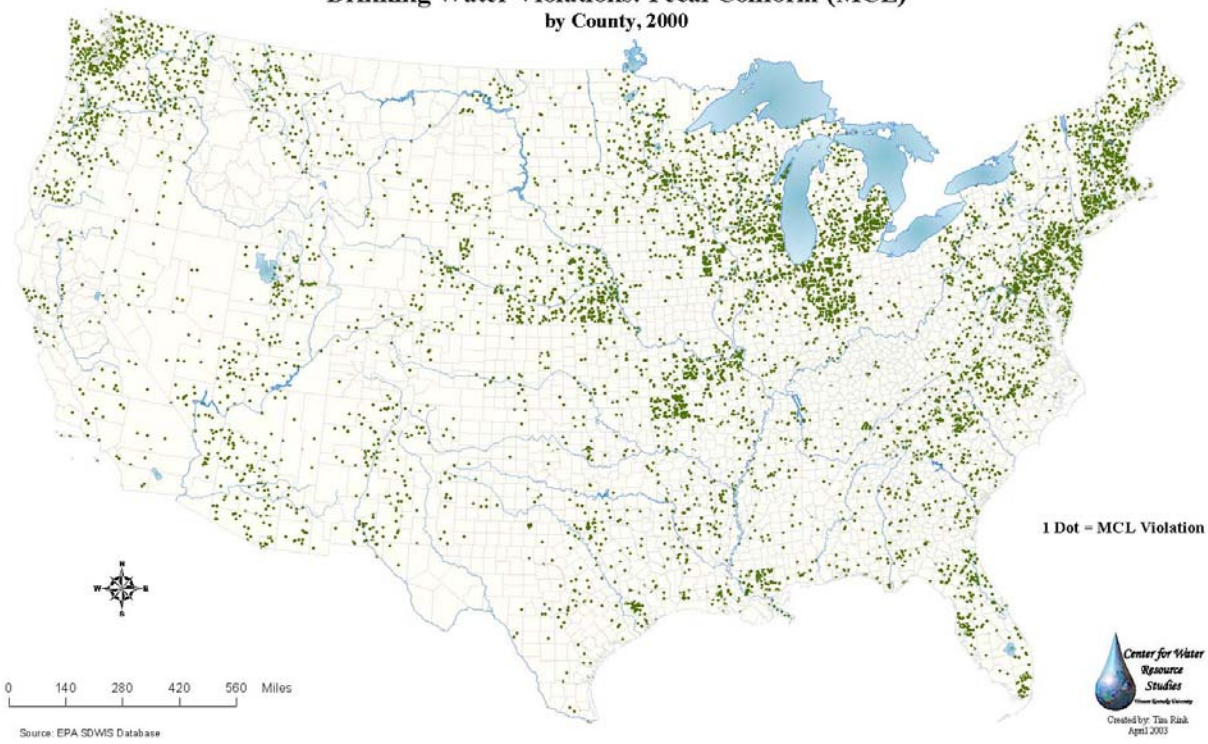
B. Difficulties encountered. No insurmountable difficulties have been encountered.

C. Preliminary data results. Last quarter we presented a set of 42 US maps that represent a national picture of drinking water quality that, to our knowledge, has never before been available. The maps are a culmination of work spent retrieving, organizing, querying, and mapping data by our team. We have been able to take advantage of the very valuable EPA Safe Drinking Water Information System (SDWIS) database in this effort. We are now conducting further analyses to interpret the data more extensively, and are also focusing on preparing a manuscript for publication that features these maps and analyses. It is through defining problems clearly that one is able to target solutions as well; that philosophy is certainly of strategic interest in elucidating the problems and potential solutions to them for drinking water systems throughout our country.

Drinking Water Violations: Fecal Coliform (MCL)
by County, 1999



Drinking Water Violations: Fecal Coliform (MCL)
by County, 2000



D. Anticipated activities. We are working to update our ArcExplorer map layers for Kentucky small water providers, and hope to make these available to water systems next quarter. We are also working on a new Tools CD to be distributed to water systems beginning next quarter. We are also working on putting together a Tools CD with only nationally useful tools for distribution to water providers outside Kentucky. Other anticipated activities for the next quarter include analysis, synthesis, and publication of spatially distributed information and water quality data sets; use of our internet query interface with the databases; and a new website renovation. These products will be of direct utility to water systems and water resource managers both within and beyond Kentucky.

II. Discussion of Expenditures

Task 4 expenditures for the 2nd quarter of FY03 were $19,920 with Year-to-Date expenditures of $48,703.

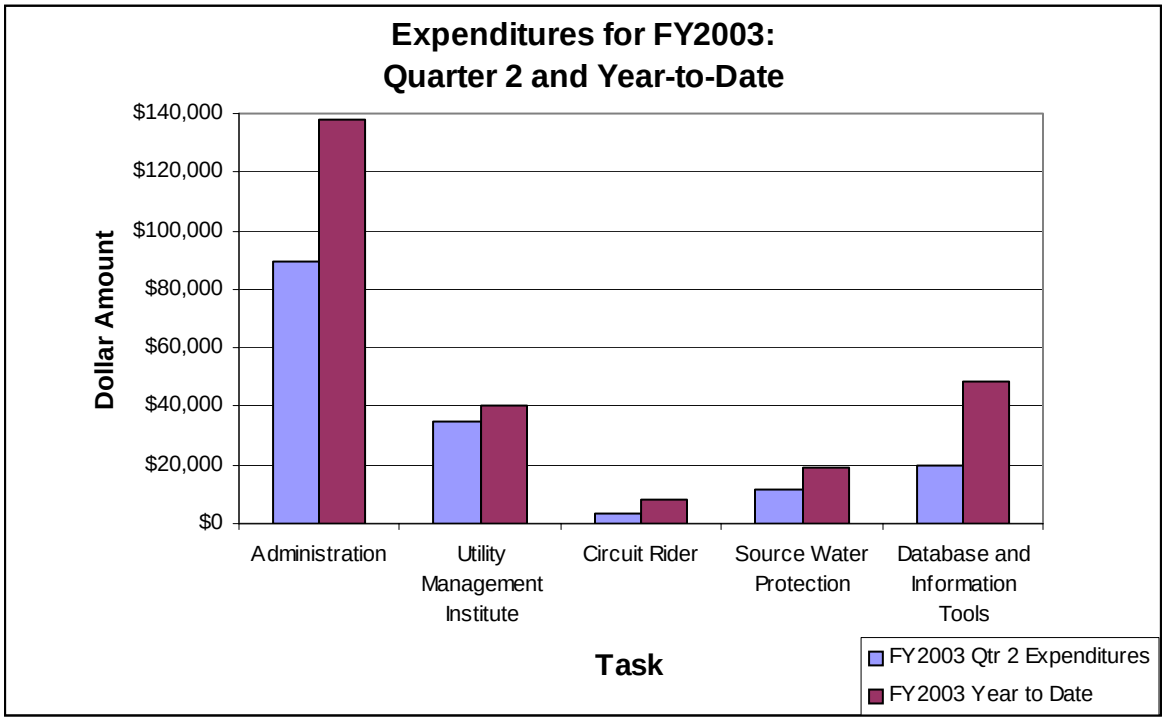
III. Key Personnel Changes

There have been no changes in key personnel within Task 4 during this quarter.

As always, we are grateful to our team of bright, talented undergraduate students who assist with the work in Task 4. Mr. Harish Pratapani, a computer science graduate student, has joined our group and is making great contributions in web design and database querying. Mr. Tim Rink, a geosciences student and GIS specialist, is helping us streamline our map production. Also, Ms. Jenna Harbaugh, a graduate student in geosciences, and Dr. Jaga Anmala, a hydrologic modeler, though working primarily on other projects within the Center, have contributed much to the cooperative efforts of the TACWQ. The Center is very grateful for the dedicated and skillful efforts of each of these individuals. It is a goal of the Center to help educate students through applied research and to help "grow" scientists that are mindful of the issues facing drinking water systems and public health protection.

Appendix A. Expenditures:

FY 2003 Quarter 2 and Year-to-Date.



Appendix 3-1

Source Water Protection Initiative
Demonstration Sites:
Quarterly Water Sampling Results, March 2003

Marion Demonstration Site, March 18, 2003

Analyte	Results	Units	Lab Name	Analytical Method
Conductivity	126.6	microSiemens	field	meter
pH	7.15	pH_units	field	meter
Temperature	13°C	degC	field	meter
Aluminum	0.112	mg/L	WKU MCC	ICP-TOFMS
Antimony	0.002	mg/L	WKU MCC	ICP-TOFMS
Arsenic	.000726	mg/L	WKU MCC	ICP-TOFMS
Barium	0.021	mg/L	WKU MCC	ICP-TOFMS
Beryllium	.00102	mg/L	WKU MCC	ICP-TOFMS
Boron	0.053	mg/L	WKU MCC	ICP-TOFMS
Cadmium	.000215	mg/L	WKU MCC	ICP-TOFMS
Calcium	12.13	mg/L	WKU MCC	AA-3100
Chromium	0.004	mg/L	WKU MCC	ICP-TOFMS
Cobalt	0.036	mg/L	WKU MCC	ICP-TOFMS
Copper	0.008	mg/L	WKU MCC	ICP-TOFMS
Iron	0.156	mg/L	WKU MCC	ICP-TOFMS
Lead	.00137	mg/L	WKU MCC	ICP-TOFMS
Lithium	0.002	mg/L	WKU MCC	ICP-TOFMS
Magnesium	3.099	mg/L	WKU MCC	ICP-TOFMS
Manganese	0.032	mg/L	WKU MCC	ICP-TOFMS
Nickel	0.005	mg/L	WKU MCC	ICP-TOFMS
Phosphorus	<.0417	mg/L	WKU MCC	ICP-TOFMS
Potassium	2.610	mg/L	WKU MCC	ICP-TOFMS
Selenium	0.004	mg/L	WKU MCC	ICP-TOFMS
Silicon	2.702	mg/L	WKU MCC	ICP-TOFMS
Silver	<.0000306	mg/L	WKU MCC	ICP-TOFMS
Sodium	3.758	mg/L	WKU MCC	ICP-TOFMS
Strontium	0.049	mg/L	WKU MCC	ICP-TOFMS
Sulfur	60	mg/L	WKU MCC	SC-432
Thallium	.0000764	mg/L	WKU MCC	ICP-TOFMS
Tin	0.001	mg/L	WKU MCC	ICP-TOFMS
Vanadium	.000563	mg/L	WKU MCC	ICP-TOFMS
Zinc	0.059	mg/L	WKU MCC	ICP-TOFMS
Acetochlor	<0.00021	mg/L	WKU TraceOrg	GC-MS
Alachlor	<0.00009	mg/L	WKU TraceOrg	GC-MS
Atrazine	<0.00004	mg/L	WKU TraceOrg	GC-MS
Chloroneb	<0.00014	mg/L	WKU TraceOrg	GC-MS
Linuron	<0.0001	mg/L	WKU TraceOrg	GC-MS
Metolachlor	<0.00004	mg/L	WKU TraceOrg	GC-MS
Metribuzin	0.00485	mg/L	WKU TraceOrg	GC-MS
Pendimethalin	<0.0001	mg/L	WKU TraceOrg	GC-MS
Propachlor	<0.00014	mg/L	WKU TraceOrg	GC-MS
Propazine	<0.0002	mg/L	WKU TraceOrg	GC-MS
Simazine	<0.00011	mg/L	WKU TraceOrg	GC-MS
Trifluralin	0.00093	mg/L	WKU TraceOrg	GC-MS

Hawkins River Demonstration Site, March 19, 2003

Analyte	Results	Units	Lab Name	Analytical Method
Conductivity	-	microSiemens	field	meter
pH	7.62	pH_units	field	meter
Temperature	15.5°C	degC	field	meter
Aluminum	0.027	mg/L	WKU MCC	ICP-TOFMS
Antimony	0.002	mg/L	WKU MCC	ICP-TOFMS
Arsenic	.00127	mg/L	WKU MCC	ICP-TOFMS
Barium	0.028	mg/L	WKU MCC	ICP-TOFMS
Beryllium	<.00102	mg/L	WKU MCC	ICP-TOFMS
Boron	0.014	mg/L	WKU MCC	ICP-TOFMS
Cadmium	.000697	mg/L	WKU MCC	ICP-TOFMS
Calcium	62.36	mg/L	WKU MCC	AA-3100
Chromium	0.008	mg/L	WKU MCC	ICP-TOFMS
Cobalt	0.137	mg/L	WKU MCC	ICP-TOFMS
Copper	0.043	mg/L	WKU MCC	ICP-TOFMS
Iron	0.237	mg/L	WKU MCC	ICP-TOFMS
Lead	.00297	mg/L	WKU MCC	ICP-TOFMS
Lithium	0.004	mg/L	WKU MCC	ICP-TOFMS
Magnesium	8.651	mg/L	WKU MCC	ICP-TOFMS
Manganese	0.001	mg/L	WKU MCC	ICP-TOFMS
Nickel	0.008	mg/L	WKU MCC	ICP-TOFMS
Phosphorus	0.052	mg/L	WKU MCC	ICP-TOFMS
Potassium	1.334	mg/L	WKU MCC	ICP-TOFMS
Selenium	0.019	mg/L	WKU MCC	ICP-TOFMS
Silicon	3.902	mg/L	WKU MCC	ICP-TOFMS
Silver	<.0000306	mg/L	WKU MCC	ICP-TOFMS
Sodium	2.465	mg/L	WKU MCC	ICP-TOFMS
Strontium	0.147	mg/L	WKU MCC	ICP-TOFMS
Sulfur	63	mg/L	WKU MCC	SC-432
Thallium	.000166	mg/L	WKU MCC	ICP-TOFMS
Tin	0.001	mg/L	WKU MCC	ICP-TOFMS
Vanadium	.000989	mg/L	WKU MCC	ICP-TOFMS
Zinc	0.087	mg/L	WKU MCC	ICP-TOFMS
Acetochlor	<0.00021	mg/L	WKU TraceOrg	GC-MS
Alachlor	<0.00009	mg/L	WKU TraceOrg	GC-MS
Atrazine	<0.00004	mg/L	WKU TraceOrg	GC-MS
Chloroneb	<0.00014	mg/L	WKU TraceOrg	GC-MS
Linuron	<0.0001	mg/L	WKU TraceOrg	GC-MS
Metolachlor	<0.00004	mg/L	WKU TraceOrg	GC-MS
Metribuzin	0.00212	mg/L	WKU TraceOrg	GC-MS
Pendimethalin	<0.0001	mg/L	WKU TraceOrg	GC-MS
Propachlor	<0.00014	mg/L	WKU TraceOrg	GC-MS
Propazine	<0.0002	mg/L	WKU TraceOrg	GC-MS
Simazine	<0.00011	mg/L	WKU TraceOrg	GC-MS
Trifluralin	0.00124	mg/L	WKU TraceOrg	GC-MS

Logsdon River Demonstration Site, March 19, 2003

Analyte	Results	Units	Lab Name	Analytical Method
Conductivity	-	microSiemens	field	meter
pH	7.94	pH_units	field	meter
Temperature	15.5°C	degC	field	meter
Aluminum	0.143	mg/L	WKU MCC	ICP-TOFMS
Antimony	0.003	mg/L	WKU MCC	ICP-TOFMS
Arsenic	.000838	mg/L	WKU MCC	ICP-TOFMS
Barium	0.026	mg/L	WKU MCC	ICP-TOFMS
Beryllium	<.00102	mg/L	WKU MCC	ICP-TOFMS
Boron	0.045	mg/L	WKU MCC	ICP-TOFMS
Cadmium	.000753	mg/L	WKU MCC	ICP-TOFMS
Calcium	49.34	mg/L	WKU MCC	AA-3100
Chromium	0.006	mg/L	WKU MCC	ICP-TOFMS
Cobalt	0.144	mg/L	WKU MCC	ICP-TOFMS
Copper	0.038	mg/L	WKU MCC	ICP-TOFMS
Iron	0.257	mg/L	WKU MCC	ICP-TOFMS
Lead	.00584	mg/L	WKU MCC	ICP-TOFMS
Lithium	0.003	mg/L	WKU MCC	ICP-TOFMS
Magnesium	5.816	mg/L	WKU MCC	ICP-TOFMS
Manganese	0.004	mg/L	WKU MCC	ICP-TOFMS
Nickel	0.007	mg/L	WKU MCC	ICP-TOFMS
Phosphorus	0.048	mg/L	WKU MCC	ICP-TOFMS
Potassium	0.931	mg/L	WKU MCC	ICP-TOFMS
Selenium	0.006	mg/L	WKU MCC	ICP-TOFMS
Silicon	3.631	mg/L	WKU MCC	ICP-TOFMS
Silver	<.0000306	mg/L	WKU MCC	ICP-TOFMS
Sodium	3.475	mg/L	WKU MCC	ICP-TOFMS
Strontium	0.100	mg/L	WKU MCC	ICP-TOFMS
Sulfur	75	mg/L	WKU MCC	SC-432
Thallium	.000140	mg/L	WKU MCC	ICP-TOFMS
Tin	0.002	mg/L	WKU MCC	ICP-TOFMS
Vanadium	.000580	mg/L	WKU MCC	ICP-TOFMS
Zinc	0.097	mg/L	WKU MCC	ICP-TOFMS
Acetochlor	<0.00021	mg/L	WKU TraceOrg	GC-MS
Alachlor	<0.00009	mg/L	WKU TraceOrg	GC-MS
Atrazine	<0.00004	mg/L	WKU TraceOrg	GC-MS
Chloroneb	<0.00014	mg/L	WKU TraceOrg	GC-MS
Linuron	<0.0001	mg/L	WKU TraceOrg	GC-MS
Metolachlor	<0.00004	mg/L	WKU TraceOrg	GC-MS
Metribuzin	0.00197	mg/L	WKU TraceOrg	GC-MS
Pendimethalin	<0.0001	mg/L	WKU TraceOrg	GC-MS
Propachlor	<0.00014	mg/L	WKU TraceOrg	GC-MS
Propazine	<0.0002	mg/L	WKU TraceOrg	GC-MS
Simazine	<0.00011	mg/L	WKU TraceOrg	GC-MS
Trifluralin	0.00149	mg/L	WKU TraceOrg	GC-MS