NONPOINT SOURCE PROJECT SUMMARY PAGE

FY 2004 319(h)

1. TITLE OF PROJECT: Project 5 Phase I: Grand Lake (Oklahoma) Watershed Implementation Project.

2. PROJECT GOALS/OBJECTIVES: The ultimate intent of the effort in Grand Lake is to demonstrate the benefits of NPS implementation on the water resources of the Grand Lake Watershed in Oklahoma. Objectives of this project are to:

- educate the citizens of the Oklahoma portion of the Grand Lake Watershed about protection of Grand's water resources,
- begin to demonstrate practices necessary to achieve the nutrient, sediment, and fecal bacteria control needed to protect Grand Lake,
- further refine and delineate sources and areas that need treatment
- promote protection and re-establishment of buffer zones and riparian areas, particularly in near-lake areas,
- promote new partnerships and collaboration among groups in the Grand Lake Watershed to work towards water quality goals, and
- expand current volunteer-based monitoring efforts to address monitoring needs for TMDL development.

3. PROJECT DESCRIPTION

The objective of this project is to initiate the first phase of an in-state, watershed scale effort to reduce NPS loading to eliminate threats and impairments to Grand Lake. In accomplishing this goal, loadings as established in the future TMDL and Water Quality Standards will eventually be met. The education, demonstration, and monitoring activities outlined in this work plan are only the first step in what should be a long-term effort to achieve the objective. Activities of this project will coordinate closely with activities of a proposed Watershed Initiative Project in the watershed. Activities of this project will also coordinate closely with activities in future projects to address water quality problems in the watershed.

4. PROJECT TASKS: See workplan

5. MEASURES OF SUCCESS: See workplan

6. PROJECT TYPE: Statewide ( ) Watershed (x) Demonstration (X)

7. WATERBODY TYPE: River (x) Lake (X) Wetland () Ground Water (X) Other ( )

8. PROJECT LOCATION: The Grand Lake Watershed in Ottawa, Delaware, Craig, and Mayes Counties in northeastern Oklahoma.

9. STREAM REACH CODE:

Oklahoma WBID # OK121600030020

10. NPS MANAGEMENT PROGRAM REFERENCE: : Section II page 14**,** Section IV page 91

11. NPS ASSESSMENT REPORT STATUS: Impaired (X) Impacted ( )
Threatened ( ) NA

12. NPS ASSESSMENT REPORT REFERENCE: Grand Lake, and its eleven of its tributaries are listed on the Oklahoma 2002 Integrated Report Category V list for pathogens, low dissolved oxygen, turbidity, pH, sulfate, TDS, chloride, and unknown causes.

13. PRIMARY CATEGORY OF POLLUTION: Agriculture; Hydromodification, land development, and onsite wastewater systems

14. EXPENDITURE BREAKDOWN FOR MAIN SOURCE CATEGORIES IN PRIMARY CATEGORY OF POLLUTION
1000 Agriculture (40%), 7000 Hydromodification (10%), Land Development (30%), onsite wastewater systems (20%)

15. **SECONDARY CATEGORY OF POLLUTION** Confined Animal Feeding Operations, grazing related sources; removal of riparian vegetation, streambank or shoreline modification/destabilization, channel erosion/incision, other urban runoff

16. NPS FUNCTIONAL CATEGORY: Restoration/Protection, Education, Technical Assistance

17. PRIMARY FUNCTIONAL CATEGORY OF ACTIVITIES 600- Local Education/Information Programs

18. SECONDARY FUNCTIONAL CATEGORY OF ACTIVITIES 200- Technical Assistance to Local Government/Groups

19. BMP IMPLEMENTATION PROJECT (FOR NUTRIENTS, SEDIMENT)
No

20. BEST MANAGEMENT PRACTICES: N/A

21. LOAD REDUCTIONS (NUTRIENTS AND/OR SEDIMENT):
N/A

22. LOAD REDUCTION ESTIMATION METHOD: Monitoring **( )**
Modeling () NA (X)

23. NAME OF MODEL
N/A

24. **WETLANDS/STREAMBANKS/SHORELINES**

Streambank/Shoreline Stabilization will be addressed through this education project and demonstrated and implemented as part of later, complimentary projects.

2**5. LINK TO TMDLS CHECK-OFF**

Will work towards implementing the TMDL, once it is completed.

26. PROJECT COSTS:

State	$846,281.93
Federal	$1,269,423.39
Total	$2,115,705.32

27. PROJECT MANAGEMENT: This project will be managed by the Oklahoma Conservation Commission in cooperation with the Office of the Secretary of Environment.

28. PROJECT PERIOD: The activities for this project will run for four years, between October 2004 and December 2008.

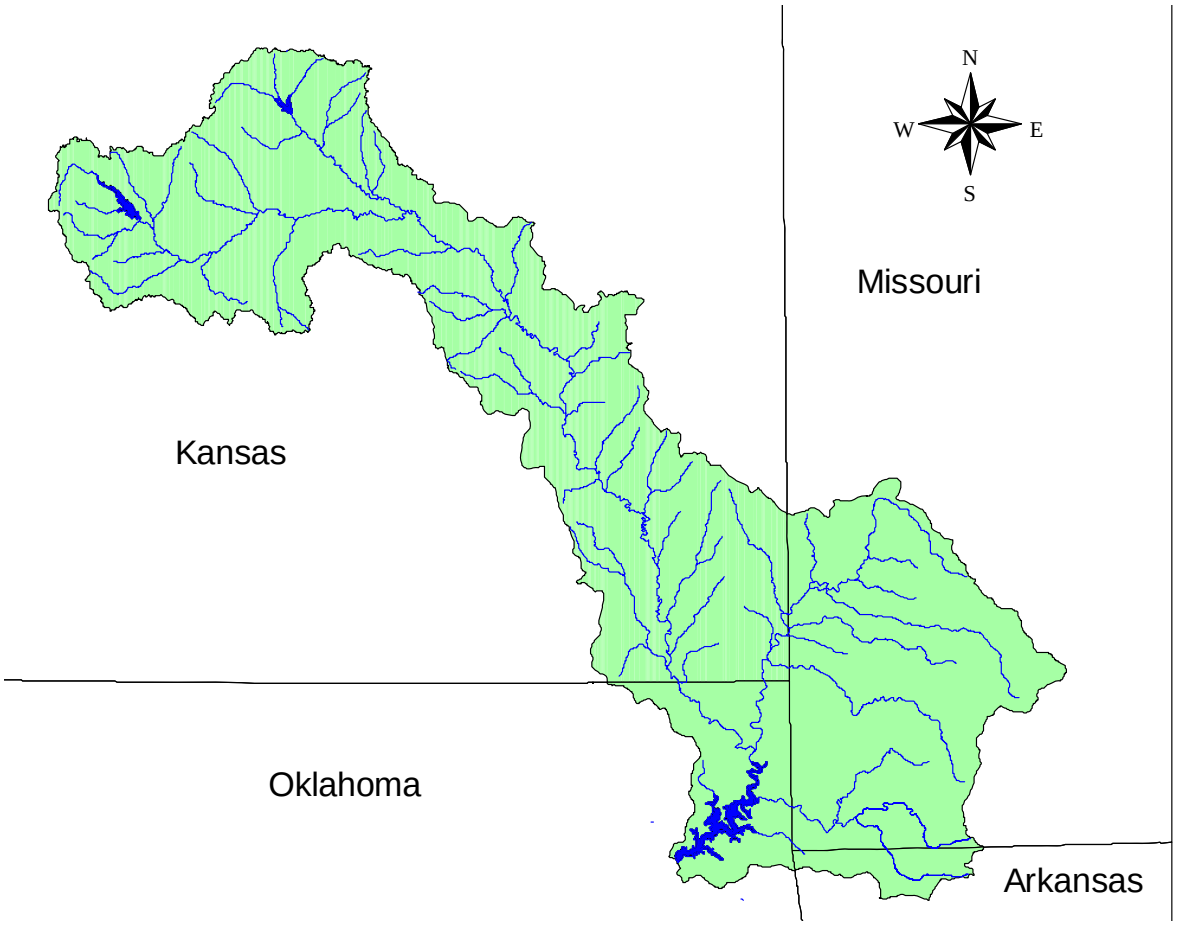
Agency: Oklahoma Conservation Commission

Title: Grand Lake (Oklahoma) Watershed Implementation Project

FY 2004 319(h) Project 5

INTRODUCTION:

Project Location:



The Grand Lake basin encompasses portions of Arkansas, Kansas, Missouri, and Oklahoma, draining a total area of 10,298 square miles. Three major rivers, the Neosho River, the Spring River, and the Elk River drain into the lake. The lake itself covers 46,500 surface acres and holds 1,672,000 acre-feet of water. Grand Lake's designated beneficial uses include public and private water supply, warm water aquatic community, agriculture, municipal and industrial uses, hydroelectric power generation, primary body contact recreation, and aesthetics. The reservoir supports a substantial tourist industry and is one of the few in Oklahoma where landowners can have waterfront homes.

In addition, Grand Lake supports a recreation industry estimated to bring over $28 million dollars in tourism-related revenues to the Grand Lake area (OK Dept. of Tourism and Recreation 1987). Landuse in the watershed includes agricultural fields (cropland including wheat, sorghum, soybeans, and corn;) rangeland, pasture and grassland, forests, rural and urban communities, poultry and dairy operations. The watershed also contains abandoned mining operations. Discharges from seeps and abandoned mineshafts, in this region, release hazardous substances, including toxic metals such as lead, cadmium, zinc, other contaminants, and acidic water. For years, the Tribes, State, and watershed residents have viewed Tar Creek as the nation's top superfund site. Tar Creek drains from Kansas down into Grand Lake. In addition to the negative water quality impacts from Tar Creek, this Superfund site and mining activity within the Tri-State Mining District has also contributed to contaminated soils in several small towns in the area.

Most soils in the upper portions of the watershed are moderately to well-drained dark silts, loams, and clays. Soils closer to the lake are characterized by a high percentage of chert fragments, low fertility, and rapid drainage capacity. The water quality of the reservoir and its tributaries have been of concern for more than a decade and considerable resources have been devoted to studying the system in order to address the water quality problems.

Grand Lake is an exceptional case due to the fact that the Watershed includes portions of four states. Streams and rivers in the watershed are listed on the 303(d) lists of three of those states. Because of the watershed's spread into four different political boundaries and between two different EPA regions, coordination of restoration activities is challenging. In addition, numerous efforts are currently underway or planned for the near future to address water quality issues in the watershed. These include lawsuits, funded infrastructure upgrade projects, TMDLs (both completed, and uncompleted, with various funding statuses), planning efforts, implementation efforts, and monitoring projects. This project (Phase I) will focus on monitoring, planning, demonstration and education efforts that will compliment the efforts already ongoing and those planned for the future. This project will also focus on water quality problems associated with eutrophication including sediment, nutrients, and fecal bacteria. The project will not focus on the problems associated with Acid Mine Drainage and superfund-related efforts in the watershed because these are currently the focus of numerous ongoing efforts. Therefore, this project will not focus on the problems typified in Tar Creek, although we will attempt to include citizens from these areas in the watershed in the education efforts planned as part of this project.

Phase II of the project (funded in subsequent years and perhaps through sources in addition to 319) will include load reduction activities and success monitoring.

Problem Statement

Recently, concerns have arisen that changing land uses within the Grand Lake basin may be contributing to decreased water quality within the basin. In the Oklahoma

portion of the basin, runoff from areas with high concentrations of confined animal operations have been shown to contribute significant quantities of nutrients to receiving streams. Likewise, the human population with its attendant pollution has grown as more recreational users move into the area. Nutrient loading in these streams has reduced their quality as well as that of downstream reservoirs.

A 1995 Oklahoma State University and Oklahoma Water Resources Board (OWRB) Clean Lake Study showed the lake was eutrophic and experiencing nuisance algal blooms in certain areas. The Clean Lakes Study also showed metals contamination in sediments in the upper end of the lake; however, toxic levels were not shown to be released from the sediment under typical lake conditions. A more recent Oklahoma Department of Environmental Quality (ODEQ) study of fish flesh contaminants in fish of the Spring River adjacent to the Tri-State Mining Area did, however, find elevated levels of metals in fish flesh, particularly in the suckers. Various studies have indicated biological, chemical, and habitat degradation within different parts of the Grand Lake Watershed.

Sixteen segments associated with Grand Lake and its watershed are listed as Category V Waters (impaired and in need of a TMDL) in Oklahoma's 2002 Integrated Report as being impaired by low dissolved oxygen, cause unknown, chloride, lead, pathogens, pH, sulfates, TDS, and turbidity(Appendix A). Forty-five segments in the Grand Lake Basin are listed on the 2002 Kansas 303(d) list as being impaired by low dissolved oxygen, eutrophication, fecal coliform, cadmium, zinc, beryllium, sulfate, lead, copper, siltation, and because they failed bioassessments. Multiple segments in the Grand Lake Basin are listed on the Missouri 2002 303(d) list as being impaired by zinc, nutrients, BOD, fecal coliform, algae, sediment, and ammonia.

Objective:

A Watershed Based Plan (WBP) has been drafted and Total Maximum Daily Loads (TMDLs) for portions/pollutants in the watershed are scheduled for 2004, 2005, and 2009 in Oklahoma (Appendix A). These may further define the water quality problems and identify additional measures needed to achieve water quality improvements in the Oklahoma portion of the Grand Lake Watershed. This project will focus on the nonpoint source (NPS) water quality problems identified to date. Although agricultural activities appear to be the major NPS impact in the majority of the basin, in Oklahoma, near-lake development is believed to have a significant impact on water quality. This near-lake development is a primary concern for Oklahoma citizens in the watershed and therefore this program will focus on these activities. The activities in this work program will include major components of the Watershed-Based Plan, which will be revisited at the conclusion of this project and/or once the TMDL is complete.

Based on the knowledge gained through similar projects in the region, the objective of the overall project is to initiate, within Oklahoma, a watershed scale effort to reduce NPS loading to eliminate threats and impairments to the Grand Lake Watershed. In accomplishing this goal, loadings as established in the TMDL and Water Quality

Standards will be met. The education, demonstration, and monitoring activities outlined in this work plan are only the first step in what will be a long term effort to achieve the objective. Future projects will include wide-spread BMP implementation efforts that build upon the education/demonstration efforts established in this project.

Overview:

This project will be managed by the OCC with oversight from the Office of the Secretary of Environment. Gayle Bartholomew, OCC's Environmental Project Coordinator will be the overall Project Manager although completion of individual tasks will be the responsibility of various individuals as detailed later. The project activities will be conducted within a four year period, beginning in October, 2004 and ending in December 2008. Certain activities will be contracted out to insure completion of a quality product in a timely, cost effective manner. Further discussion of the project overview is detailed under each project task.

Project Tasks:

Task 5.1. Targeting Nonpoint Source Pollution

Task Description: The Oklahoma portion of the Grand Lake Watershed covers over 1000 square miles in northeastern Oklahoma. Past studies have identified causes of impairment and suggested possible sources, but little has been done to pinpoint the location or concentration of those sources or to verify whether or not certain land uses and potential sources actually contribute to the problem.

Available resources will probably be inadequate to blanket the entire watershed with best management practices to reduce NPS pollution from all sources. Therefore, the upcoming proposed implementation phase of the program (funded through future projects) will focus practices, selecting areas where they are needed the most and where the environmental benefit will be maximized. Hotspots in the watersheds of the sixteen segments from the 2002 Oklahoma Integrated Report Category V list will be identified through a scientifically-based targeting mechanism so that when implementation does occur, we will achieve the greatest pollution reduction for dollars spent.

Task Objective: The objective of this task is to define the method used to target resources at the most significant sources and in the most cost-effective manner.

Task Activities: The targeting effort will involve a three component process. For the first component, a landuse database will be developed for the watershed, based on satellite-imagery. In the second component, this data will be modeled at the subwatershed level to estimate nutrient loading from various areas of the watershed. For the third component, a subpixel classification using the satellite data will be performed to provide more detailed information, which will be used to target implementation of BMPs. The preliminary results will then be ground-truthed by the

Project Coordinator. Results of the ground-truth exercises will be incorporated into the final product. The result of these activities will be detailed maps of areas in the watershed mostly likely producing the greatest nutrient loads as well as calculations of those loading estimates.

These results will further be analyzed to recommend a series of practices and associated load reductions that might be utilized to reach ultimate TMDL goals in the watershed. In effect, a suite of BMPs will be recommended to consider both the economic and water quality impacts of load reductions in various portions of the watershed.

These maps can then be utilized to target landowners to participate in Phase II efforts, funded under a subsequent project(s). These maps will be distributed to local conservation districts for their use in developing long-range plans, implementing the locally-led State Cost-share Program, and other conservation planning purposes. In addition, they will be distributed to FSA and NRCS at both the local and state level to assist with their conservation programs. Finally, these maps will be shared with other States for their information. In addition, other States will be consulted during development of the landuse classifications, particularly for purposes of ground-truthing.

The targeting effort will incorporate the Grand Lake Watershed in Oklahoma, as well as the entire Honey Creek Watershed in Oklahoma, Missouri, and Arkansas and will be contracted out to an organization with previous experience conducting similar exercises.

Due to the growing human population in the watershed and the Karst geology, septic tanks are suspected to contribute a significant portion of the near-lake loading. A demographic analysis, similar to the one used to estimate maximum septic tank loading in the Clean Lakes Study, will be completed to estimate the maximum loading attributable to septic tanks in the near-lake area.

Completion of this task will help address several aspects of the watershed-based plan. The targeting will provide a more robust estimation of loading relative to land uses and areas of the watershed. In turn, the State will be better able to estimate the load reductions possible from implementation of BMPs. In addition, it will be a tool all four states can use to target implementation, particularly in those portions of the watershed where TMDLs have not yet been developed. The targeting will also allow for a better estimation of the funding needed for implementation. Repeated use of the targeting mechanism throughout implementation of the WBP can also be used to suggest potential load reductions that have been achieved through implementation prior to the time they are detectable with water quality monitoring. A continued lack of improvement in water quality data when compared to repeated targeting that suggest load reductions should be occurring is also a tool that can be used to redirect implementation efforts. The estimate of the maximum loading attributable to septic tanks in the area will help justify the allocation of potential load-reducing funds either devoted towards this potential source, or towards other significant sources.

The Environmental Project Coordinator (Gayle Bartholomew, funded annually under the implementation task of OCC Implementation of NPS Management Program Projects such as FY 2004 Project 2) will be responsible for insuring that the targeting contractors remain on schedule and that reports and tasks are completed in a timely manner.

Task Schedule:

Subtask #	Milestone Description	Completion Date
5.1.1	Secure workplan and contracts for first stage of targeting from contractor	July 2006
5.1.1.a	QAPP for first stage for use of secondary data	August 2006
5.1.2	Receive results of first stage from contractor in report form	September 2006
5.1.3	Meet with Conservation District/NRCS/FSA to discuss results of first stage	September 2006
5.1.3.a	Revision of the Watershed Plan to incorporate input from Arkansas, Kansas, Missouri, and Region 7.	January 2007
5.1.3.b	Revision of the Watershed Plan to incorporate results of the targeting mechanism.	January 2007
5.1.5	Update estimates of potential loading from near-lake septic systems to ascertain whether significant investment in infrastructure upgrades are warranted	January 2007
5.1.6	Load Reduction Estimates from NRCS, FSA and supporting programs in the watershed.	with semi-annual reports

Deliverables:

Subtask #	Deliverable	Due Date
5.1.1.a	Secondary data QAPP	August 2006
5.1.2	Targeting Results + Recommended suite of practices based on associated load reductions and economic-based effectiveness	July 2006
5.1.3.a	Revision of the Watershed Plan to incorporate results of the targeting mechanism.	January 2007
5.1.5	Update estimates of potential loading from near-lake septic systems to ascertain	January 2007

	whether significant investment in infrastructure upgrades are warranted	

Targeting Methodology Budget:

Federal	State	Total
$157,305*	$104,870**	$262,175

*****total payable to contractor
**match provided by contractor

Task 5.2. Project Local Management.

Task Description: A Project Education Coordinator will be hired to coordinate the education efforts, and assist, as necessary on water quality issues in the Grand Lake Watershed with local conservation districts. The coordinator will be located at a conservation district office but will report to the OSU Water Quality Program and OCC. The coordinator will hold regular meetings of partners to update educational targets and accomplishments and coordinate efforts among with the various groups in the watershed to reduce duplication of efforts.
The coordinator, with appropriate assistance from OSU and OCC will be responsible for the tasks listed below.

- Develop a cooperative agreement among agencies indicating individual objectives, willingness to meet and devote effort to common goals.
- Coordinate implementation of the bioretention cell demonstration and education programs. The coordinator will visit with commercial and residential entities to interest them in the bioretention cell technology and arrange contracts for implementation. Actual contracts will be negotiated and funded through the Conservation District. Bioretention cell designs will be published by OSU for commercial and residential application. The target will be to install ten working bioretention cells, with a monitoring program to evaluate their performance.
- Coordinate education of public on nutrient management and water quality through the Master Gardener Programs of Delaware and Ottawa Counties. Master Gardeners will be educated on water quality issues and technologies. They will participate in the bioretention cell program by helping to evaluate the performance of vegetation in the rain gardens, and by explaining their performance to the public. The Master Gardeners will also conduct demonstrations for the public at visible locations and at public functions like the County Fair and other events.
- Work with task managers from tasks 5.3 – 5.7 to ensure that volunteers from each program also participate in additional programs associated with this project. Coordinator will actively participate in these programs, attending trainings and qualifying for certifications as a volunteer monitor, etc.
- Coordinate the education of professionals and the public on improved design of private domestic waste treatment systems. There are serious problems with the

perc tests that are currently required for approval of septic tank-drain field systems. As currently designed, they may fail due to clogging or water logging, or they may drain too rapidly and provide subsurface contamination of the lake. In either case there is likely to be a water quality problem. These problems can be largely avoided by evaluating the soil profile for proper drainage properties either in place of or in support of a standard perc test. This task will educate the professionals about how to evaluate soil profiles and it will educate realtors, bankers, developers, and homeowners to help them understand the importance of soil profile analysis to assure good performance.

- The coordinator will also represent the project interests at Conservation District Board Meetings, cooperate with NRCS and FSA to keep them informed of project activities, compile photographs of demonstration sites, before and after implementation, as well as project education programs, and other duties as necessary to ensure that the project activities are completed. The coordinator will be responsible for insuring that all four Conservation Districts participate in the program, and for involving the three other watershed States in the project, as possible. The Education Project Coordinator will also represent project Phase I activities to groups such as the local Watershed Advisory Group and will coordinate with implementation efforts (to be funded through future projects, both through 319 and otherwise).
- The coordinator will maintain an electronic log or journal of daily activities, conversations, etc. Coordinators perform countless efforts that are never detailed because they are difficult to report on. A brief journal of activities will help document the tremendous efforts undertaken by the coordinator in order for project activities to be completed.

The Coordinator's position is a full time position, with a duration of four years from January 2005 through December 2008.

The County Conservation District(s) will provide substantial support for the implementation of this project. The District(s) will provide clerical support for the demonstration program and participate in the educational activities. The District(s) will also provide office and telephone service for the project staff. Support will be provided to the participating district(s) to help offset the office space, telephone, and clerical workload costs. Conservation Districts will also provide support for the various education efforts ongoing in the watershed, most notably providing invaluable assistance with bringing watershed residents to the project events and activities.

A project kick-off meeting will be held in the watershed to introduce the Oklahoma watershed citizens to the activities and goals of the program, including both short and long-term goals. Representatives from the other three states will be invited to attend and participate, as well as the representatives from the four Conservation Districts, the Grand Lake Association, and other important partners in the watershed. Many of these groups will be consulted prior to the meeting as to additional recommendations regarding potential partners who should be included in the meeting. Participation in and review of project activities will be invited at this meeting. Depending on the success of

this meeting as far as increasing participation from partners currently outside of the project, additional meetings may be held throughout the project to further the sharing of information and ideas.

The OCC Project Coordinator, Dr. Kevin Gustavson, will coordinate this task of the project and assure it is on track for water quality objectives. The Project Coordinator and OCC staff will coordinate the management and reporting aspects of the project. OSU Cooperative Extension Service Staff, including the NE District Water Quality Specialist, will provide technical water quality expertise to the project through in-service training and direct involvement.

Task Objective: The objective of this task is to insure localized project input and management.

Completion of this task will help address some of the public outreach components of the watershed based plan and some of the strategies identified as necessary to address water quality problems.

Task Schedule:

Subtask #	Description	Milestones
5.2.1	Establish district support agreements and MOUs among agencies and NGOs	December 2004
5.2.2	Hire Project Coordinator	January 2005
5.2.3	Conduct monthly meetings with public reports on program	Monthly
5.2.3.a	Project Kick-off meeting	January 2006
5.2.4	Semi-annual reports	Semi-annually, April and October

Task 5.2 Deliverables

Subtask #	Description	Due Date
5.2.1	Journal of project activities, conversations, etc.	December 2008
5.2.2	Meeting Minutes and Agendas (Conservation District Board meetings, etc.)	Semi-annually, April and October
5.2.4	Semi-annual reports	Semi-annually, April and October

Measures of Success:

In addition to the measures of success outlined under later tasks, completion of this task will insure that major stakeholders in the watershed are informed about and involved with project activities. The Grand Lake Association, Grand River Dam Authority (GRDA), OCC, and OSU Extension will work together to identify all of the groups that need to be involved in the project and the Project Coordinator will insure, at

a minimum that all groups receive regular updates of project activities (through newsletters, media coverage, phone calls, and meetings) and that at least seventy five percent of these groups actively participate in the program.

Involvement will be evaluated with semi-annual reports and steps planned to insure adequate involvement will be planned and specified with these reports.

Task 5.2 Budget:

Position	Salary + Fringe	Travel	Contractual	Supplies	Total
On-site Coordinator*	$210,000	$6,000		$17,000	
OSU Support Staff			$81,666.67		
District support agreements			$45,000		
Project local support- volunteer time, etc.			$90,000		
Total	$210,000	$6,000	$216,666.67	$17,000	$449,667
State	$0	$0	$171,666.67		$171,666.67
Federal	$210,000	$6,000	$45,000	$17,000	$275,000

* Positions not included nor funded in FY 2004 319(h) Projects 2 -4.

Task 5.3. Biorentention Cell Design, Evaluation, and Technology Demonstration

Non-point source pollution urban runoff is the major concern in many watersheds. Nutrients, heavy metals, and organic chemicals contained in NPS pollution, while at low concentrations, negatively impact water quality due to the large volumes and widespread nature of the flow. There are few cost effective ways to bring treatment to individual urban sites that contribute to NPS pollution, particularly after the site is developed. Bioretention cells can be retrofit into areas that were not designed with NPS pollution in mind and treat water before leaving the site.

Bioretention cells, also called rain gardens, act as a storage location, physical filter, chemical reactor, and biological degradation system for stormwater or wastewater. Water from the first flush event is held in the media of the cell allowing water to be removed through evapotranspiration, deep percolation or timed release to take place. As the cell is filling, pollutants come in contact with the media and are sorbed onto inorganic and organic matter. Once sorbed, microorganisms decompose and degrade the degradable contaminants into benign materials, while non-degradable contaminants are strongly bound and accumulate in the cell. The first flush event is just the initial runoff from a surface. This initial runoff has been shown to have higher concentrations of pollutants because they are not strongly held to surfaces like parking lots so are easily removed once rain begins. The sources of pollutant buildup on these surfaces are regular use and atmospheric deposition. Figure 1 shows two applications of

bioretention cells at work in the United States. The picture on the left shows an application in an urban setting in Landover, Maryland with a typical parking lot draining into it. The curb cut allows water to fill the cell and lets the excess flow into the stormwater drain. The picture on the right shows rain gardens in use in a residential area located in Seattle, Washington. Stormwater runoff flows into these cells reducing the amount of water, thus pollutants, flowing to the stormwater drain.

Figure 1. Working Bioretention cells in an urban, left, and residential, right, application. (Source: Michael Clar, P.E, Ecosite, Inc., Ellicott City, Maryland)

Oklahoma State University is currently developing a numerically based procedure to design bioretention cells. It will provide a simple process for developers and/or regulatory agencies to size bioretention cells for a given application. The existing procedure, while based on established theory, has three weaknesses. First the performance of many potential cell materials is poorly defined. Many organic and inorganic materials may be used. Some are relatively expensive, such as commercial zeolite, which is also selective in pollutant removal. Others, such as common straw, may be very inexpensive, but lack effectiveness. Second, existing performance data for bioretention cells is entirely taken from humid regions. How these cells would perform in Oklahoma, where the climate ranges from sub-humid to semi-arid, is not at all apparent. Third, there are no known applications of biorentention cells in the region. Thus, they are a largely unknown concept to most citizens. Education can bring knowledge of this technology to the public.

The ten demonstration bioretention cells will contribute to the development of the proposed Center for Enhancing the Value of Urbanizing Stream Corridors through Oklahoma State University. This group will also be involved in the technology transfer and public education goals of this project by disseminating the information and results. This will give the PIs more opportunity to speak with large groups about the technology being implemented in the state of Oklahoma. This proposed center has brought well-

known speakers in to OSU to teach students, staff, and faculty about new and innovative stormwater technology and stream bank restoration.

Task Objective: A two-phased approach is proposed for this task. The first phase will be the construction and monitoring of ten bioretention cells. Oklahoma State has received approval and support from the Oklahoma Technology Research Park in Stillwater, Oklahoma to install a bioretention cell on their campus. Due to the location of this technology park, the project will be highly visible and open to public education as well as a source of recognition for the program. The other cells will be installed in urban and residential areas adjacent to Grand Lake.

The second phase will be technology transfer and education. This will consist of bringing the county extension agent in for training on how the system works and the main processes behind the technology. Then the extension agents can present the information to the Chamber of Commerce of Stillwater and Grove. The three extension agents around Grand Lake, the Master Gardeners, and the Grand Lake Association will also be involved in technology transfer at the local level. This will involve signs and education programs at the bioretention cell locations and possibly a bench-scale or hangable bioretention cell model.

Completion of this task is recommended in the Watershed Based Plan under component F of the Water Quality Goals and Recommended Actions section which indicates that education programs will be necessary to promote water quality improvements, particularly those that are based on voluntary implementation. Ultimately, this will help reduce sediment and nutrients in runoff from developed areas. Certain developers in the watershed already employ some of the more traditional pollution reduction strategies such as detention ponds. However, those ponds frequently have problems with algae blooms and even fish kills, due to their sediment and nutrient capturing functions. Bioretention cells offer an alternative to those traditional methods that can be implemented at a variety of scales, ranging from a single yard to a group of homes in a development to an entire subdivision or a parking lot.

Task Schedule:

Subtask #	Milestone Description	Due Date	Total Cost
5.3.1.	Develop a Quality Assurance Project Plan (QAPP) for the project. This plan will include procedures to prepare, take, and transport water samples.	August 2006	$3500
5.3.2	Demonstrate a suitable media for phosphorus, nitrogen, metal, and oil removal from influent. Bench testing will be preformed in the Groundwater Laboratory, Biosystems and Agricultural Engineering Department, while water	April 2007	$45,000

	analysis will be will be done in the Soil, Water, Forage Analytical Laboratory, Plant and Soil Science Department, OSU.		
5.3.3	Oklahoma State University will install ten bioretention cells for phosphorus removal in the state of Oklahoma. This process will take approximately 6 months. The 9 locations near Grand Lake, Oklahoma will most likely deal with residential area and commercial areas, while the cell in Stillwater will collect runoff from a parking lot. A core will be taken of the media before the system is working and after the project is over to determine the pollutant concentrations actually sorbed. This will be done to double check the accuracy of our water samples. Steps will be taken through design and/or monitoring to ensure that bioretention cells are not merely a direct conduit to groundwater in a Karst environment such as Grand.	September 2006 – October 2007	$190,287.88
5.3.4	A series of public education session(s) at the bioretention cell in the Grand Lake Watershed explaining how it works and how it will help make drinking water free of pollutants. At least 6 sessions will be held, including volunteers from other project tasks (5.4 – 5.7) plus extension agents, developers, district personnel, county commissioners, and other appropriate individuals.	October 2007	$200
5.3.5	Monitor and collect data from the working bioretention cells. This will require a cooperator in the Grand Lake area to sample when it rains. Influent and effluent will be collected and analyzed to determine the efficiency of the cell. Samples will be shipped back to Oklahoma State University where they will be analyzed. The cells will be designed to handle the first flush from a runoff event. Approximately 30 runoff events per year will be processed from the residential Grand Lake site and 60 from the urban Stillwater site. This will give a total of 360 samples for the two years of monitoring (4 samplers, 2 composite samples per sampler for each runoff event). Testing for nitrate, total dissolved phosphorus, lead, cadmium, and zinc approximately $15 per sample if completed by the Soil, Water, Forage Analytical Laboratory, Plant and Soil Science	QAPP approval 2006 – April 2008	$35,000

	Department at OSU. Samples will also be evaluated for reductions in sediment loading.		
5.3.6	Data Analysis and Final Reporting	November 2007 to September 2008	$30,000

Deliverables:

Subtask #	Description	Due Date
5.3.1.	QAPP	August 2006
5.3.2	Letter report describing demonstration of media suitable for use in the prototype bioretention cells and an evaluation of the media places in the cells	April 2007
5.3.3.	Publish designs for bioretention cells in commercial and residential areas	November 2006
5.3.3	Identify cooperators and write contracts for ten bioretention cells (at least 9 in the Grand Lake Watershed)	August 2006
5.3.4	Report documenting the public learning session(s)- documentation will include a measure of the volunteer-time devoted to these learning sessions and other volunteer time related to the project.	To be included in final report
5.3.5	Water quality analysis of cell influent and effluent and seepage to groundwater	September 2008
5.3.6	Final Report	September 2008

Task Budget:

	State	Federal	Total
Personnel	$19,151	$114,533	$133,684
Fringe	$6,686	$41,280	$47,966
Supplies	$0	$12,000	$12,000
Travel	$0	$9,500	$9,500
Equipment	$0	$30,000	$30,000
Contractual	$0	$42,000	$42,000
Indirect Costs	$140,371	$0	$140,371
Total	$206,220.26	$249,313	$415,521*

*- total payable to contractor

Measures of Success: success will be demonstrated by at least a thirty percent load reduction in nitrate, phosphorus, and sediment from monitored sites with bioretention

cells established. Cursory data evaluations will be completed as part of the semi-annual reporting process once monitoring has been initiated to evaluate the success of the structures. Secondary success will be planned or actual implementation of bioretention cells in at least three other sites to occur within two years of the project conclusion.

Task 5.4 Reducing Nutrient Loss from Lawn, Garden, Parks, and Golf Courses in the Grand Lake Watershed

Fertilizers are widely used by homeowners, public parks and golf courses to maintain and improve landscape beauty and quality. Both nitrogen (N) and phosphorus (P) are needed by all plants for vigorous growth. Continuous use and misuse in some cases of various fertilizers have caused concern about pollution of lakes and groundwater since runoff from the landscape contains soluble and particulate P as well as N. However, no information is available as to the nutrients lost from lawn and gardens in the Grand Lake Watershed. The average soil test phosphorus (STP) level of lawn and garden soils in Oklahoma are several times higher than that required by plants. Some soil samples from the Grand Lake region had STP as high as 760 (65 is considered adequate for plant growth). This suggests too much P fertilizer and/or incorrect fertilizer formula may be used for those areas. Studies have shown that dissolved reactive P (which is linked to algae bloom directly) in the runoff from lawn and golf courses increases as STP and fertilizer rates increase. Although an individual lawn or garden or golf course seems small, the total area of grassed area and gardens in the watershed many be significant especially with the rapid development. Some properties and recreational facilities are built on the lake front with little or no buffer zone between fertilized area and the water. Proper fertilizer use (timing, rates, formula, etc.) and improved soil nutrient management can keep the grass green and the water clean. However, many urban and other non-agricultural audiences are unaware of the impact of nutrients on water quality and unfamiliar with many proven strategies of nutrient management around the houses and golf courses.

Task Objective: The overall objective is to increase water quality awareness among non-agricultural audiences and to reduce nutrients (especially N and P), chemicals, grass clippings and sediment input to Grand Lake by improving lawn, garden and golf course management. This project will teach homeowners, lawn care professionals, park and golf course caretakers the basics of plant nutrient needs, soil nutrient availability and transport process, the impact of fertilizers and soil nutrients on water quality, the strategies of proper fertilization, and available best management practices (BMPs) to minimize pollution. Many of the planed activities will be implemented through local Master Gardener programs. Master Gardeners will be trained to understand and provide information and recommendations on lawn, garden and golf-course management geared towards NPS pollution reduction.

Nutrient status in non-agricultural fertilized soils of the watershed will be documented through intensive soil sampling and the rates, types and frequency of fertilizer use before and at the end of the project will also be surveyed.

Completion of this task is recommended in the Watershed Based Plan under component F of the Water Quality Goals and Recommended Actions section which indicates that education programs will be necessary to promote water quality improvements, particularly those that are based on voluntary implementation. Ultimately, this will help reduce sediment, nutrients, and pesticides in runoff from developed areas. The participation of the Master Gardeners in the other programs associated with the project will insure that more of the citizens in the watershed are better informed about many of the watershed issues, ranging from septic tank loadings to the value of volunteer water quality monitoring programs to NPS pollution in general. Rather than having general just a general knowledge that proper lawn and garden management can reduce pollution, Master Gardeners will have more specific information about the consequences of that pollution and share their knowledge more effectively with average citizens in the watershed.

Master Gardeners: The Master Gardener program is a volunteer training program conducted by University Extension designed to help county extension offices meet the demands for consumer horticulture information. Master Gardeners take classroom training coordinated by local extension staff with the assistance of state extension specialists located at Oklahoma State University. Trainees participate in an 8-12 week course receiving 35-56 hours of course work involving basic plant science, pest problems, soils and nutrient management, turf management, fruit & nut trees, ornamentals, houseplants, and vegetable gardens. Upon completion of the course work all participants are required to pass an exam on materials and topics covered. They are then certified and awarded the title of Oklahoma Master Gardener. In return, certified trainees agree to donate between 40-56 hours of volunteer time to the Horticulture Program. Master Gardener volunteer activities include speaking at club or civic meetings; assisting with horticulture tours; maintaining horticultural community gardens; manning educational exhibits; teaching horticulture activities at nursing homes or assisted living centers; judging horticulture exhibits at fairs, etc. Yearly re-certification requires a minimum of 20 hours by donating time to the program, attending educational seminars and other activities.

Master Gardeners have become a vital part of Extension's ability to provide consumers with up-to-date, research-based information. Master Gardener program in the Grand Lake Watershed offers a great opportunity to implement many nutrient loss prevention strategies. There are over 100 certified Master Gardeners current in Delaware and Ottawa counties. More will become Master Gardeners in the next four years.

This task will expand the repertoire of the Master Gardeners' expertise in the Grand Lake Watershed to include NPS pollution concerns, and BMPs to address these concerns such that they can recommend programs that not only focus on plant needs, etc, but present their recommendations in a context that protects water quality as a primary goal.

Task Schedule:

Subtask #	Milestone Description	Due Date	Total Cost
5.4.1	Identifying Demonstration and Developing QAPP- With the assistance of Delaware and Ottawa County Extension personnel and local Master Gardener Organization, The demonstration lawn and garden site close to a meeting facility will be selected and a MOU will be signed with the land owner. QAPP will be developed before project initiation.	August 2006	$5,000
5.4.2	At the designated site in the watershed (Task 1), a demonstration lawn and garden will be established and maintained for the duration of the project (4 years). Half of the lawn and garden will be fertilized according to soil test recommendations and managed to minimize nutrient inputs and therefore losses and the other half will be fertilized the way commonly practiced by homeowners, lawn care professionals or golf courses. Comparisons of soil nutrient levels and plant growth conditions will be made every season. A mini-composting facility will also be established to convert all organic residues produced on site into fertilizers so that commercial fertilizer usage can be reduced. This site will be used for demonstrating tips of proper fertilizer application and management, recycling nutrients through composting, and nutrient losses using portable rainfall simulator. Signs will be posted at the site for public visitation.	August2006	$65,000
5.4.3	Educate homeowners, local landscapers and lawn care professionals, public park caretakers, and golf course superintendents. A six-hour training session will be conducted every year as part of the Master Gardener program (a minimum of three annual training sessions), and similar trainings will be offered to past Master Gardeners, lawn care professionals and other people who are not participating in the Master Gardener program. This task will address the concern of nutrients and other chemicals from lawn, garden and golf courses on plant growth and water quality, tips of how to keep the plants green and water clean. The course will be taught by nutrient management specialist, turf grass specialist and extension educators. A nutrient management manual will be developed and used for the training. New and existing factsheets will also be available to all participants and the general public. Signs will be posted on all areas in the watershed where the best nutrient management practices are used by volunteers.	April 2006 – May 2008	$45,000
5.4.4	Demonstrate nutrient and sediment losses from both lawn and garden plots using a portable rainfall simulator during the second year of the project and repeated in the future if necessary. Runoff simulation will be conducted following protocol established by the National Phosphorus Project. Runoff will be collected and analyzed on site for nutrients and		$27,000

	sediments using test kits. Demonstrate proper fertilizer use techniques, and management strategies to minimize nutrient and chemical losses to water bodies. Participants will collect soil samples using different tools following standard protocol. A selected group of participants will manage the demonstration site and implement available BMPs. Factsheets and other appropriate educational materials will be prepared/provided to participants showing typical runoff phosphorus values from different urban, agricultural, and natural settings.		
5.4.5	Assess nutrient status in the area through extensive soil sampling and testing. Samples will be taken from certain number of lawns, gardens, parks and golf courses within the watershed using standard operating procedures. A summary of soil pH and plant available nutrient status will be made. This database can be used for any modeling effort to quantify nutrient input to the lake from the above mentioned areas.		$25,000
5.4.6	Evaluate the effectiveness of this Education Program. Participants will be polled at the beginning and the end of the project. Polling questions will be made by the project team and analyzed statistically. Changes in the amount, time and frequency of fertilization will be monitored. Soil test phosphorous level will also be monitored. Findings will be available to the public through extension publications.	December 2008	$10,000
5.4.7	Semiannual and Final Reports	December 2008	$22,537

Deliverables:

Subtask #	Description	Due Date
5.4.1.a	QAPP-	August 2006
5.4.1.b	MOU/Contract with demonstration site landowner	August 2006
5.4.3	Three copies of all education material produced during the project will be forwarded to EPA	As generated
5.4.6	Set of polling questions for documenting participant behavioral and attitude changes	January 2007
5.4.7.a	Semi-annual Reports	April and October throughout project
5.4.7.b	Final Report- to include task results plus documentation of the time and associated match contributed to the task efforts by volunteers	December 2008

Measures of Success

Determination of the success of this task is based on the adaptation of the proper fertilizer use and nutrient management skills for lawn, garden and golf courses. Soil nutrient test levels will be closely monitored in the watershed to document any changes. Reduction of nutrient losses will be evaluated based on changes of fertilizer use and soil test levels, which will be evaluated annually, at a minimum. Polling at the beginning and end of the project will be used to document the amount, type and frequency of fertilizer uses by all participants. The task goal will be that 70% of the polled participants will apply fertilizer more appropriately. Summaries of soil test levels will be made from samples submitted by all participants, and from samples submitted to OSU Soil, Water and Forage Analytical Laboratories. A goal for soil test values will be no net gain in high phosphorus soils. An additional goal will be that at least 30% of the participants involved in these education efforts are not associated with the Master Gardeners program, but are rather general citizens and landowners in the area.

Task Budget:

	Salary	Fringe	Contracts	Supplies	Total
Nutrient Management			$199,537	$0	$199,537

Task 5.5. Whole Soil Evaluation for Accurate On-Site Residential Septic System Design

Over the past 25 years on-site residential waste water treatment has improved nation-wide by the application of whole soil evaluation. This nation-wide trend utilizes the vast knowledge of our soil resource developed by the NRCS (formerly the Soil Conservation Service SCS)-USDA and emphasizes an appreciation of our natural resources.

Since the early part of the 20th century the NRCS-USDA has methodically collected detailed whole soil information across Oklahoma. This soil geographic information is available, free-of-charge, and includes Delaware, Ottawa, Craig, and Mayes Counties in Oklahoma. During the past five years the Environmental Complaints and Legal Services (ECLS) Division of the Oklahoma Department of Environmental Quality (DEQ) has promoted the use of whole soil evaluation (soil profiling) for on-site septic system sizing and design. The ECLS-DEQ has cooperated with the Oklahoma State University Division of Agricultural Sciences and Natural Resources to train and certify public and private sector individuals for whole soil evaluation for on-site residential waste water treatment. Training and education has not reached all critical areas across Oklahoma because of a large demand and limited educational resources. The Grand Lake Watershed contains unique soil types not found in other parts of the state. The interaction of septic system use, unique soil types especially formed from cherty limestone, and vital water resources in the Grand Lake Watershed points to a critical need for education concerning on-site residential waste water treatment.

Objective:

This task contains two major objectives; 1) provide whole soil evaluation training to appropriate state and federal professionals (educators, NRCS, Conservation District personnel, etc.) and professional private sector individuals involved with on-site evaluation for septic systems and 2) provide educational seminars, workshops, and displays for emphasizing improved waste water treatment by whole soil evaluation (developers, county and city planners, and special interest groups) in the Grand Lake Watershed.

Completion of this task is recommended in the Watershed Based Plan under component F of the Water Quality Goals and Recommended Actions section which indicates that education programs will be necessary to promote water quality improvements, particularly those that are based on voluntary implementation. Ultimately, this will help reduce nutrients and fecal bacteria loading in the watershed. Once developers, bank loan officers, and septic system installers have been informed about the value of whole soil profiles compared to perc. tests, ODEQ believes they can begin to require them for septic tank installation. This task will also address component J of the same section and reduce phosphorus and bacteria loading from onsite septic systems.

Task Schedule:

Task #	Milestone Description	Due Date
Task 5.5. 1	Implement a whole soil-septic system educational training course for 1) state and federal professionals (especially DEQ-Environmental Specialists, Cooperative Extension County Educators and Specialists, and USDA-Conservationists and Land Resource Specialists) and 2) environmental planners and land developers (especially bankers, county commissioners, and realtors). These professionals, developers, and planners will help disseminate new information to people in the area and support new development techniques. The purpose of the course will be to develop and deliver up-to-date soil and septic system information to environmental and conservation specialists in the Grand Lake Watershed. Digital soil spatial and attribute data are available for Mayes County and soon will be available for Delaware County. Craig and Ottawa counties currently have only hard-copy soil resource information. Both field and classroom techniques will be utilized to demonstrate whole soil evaluation and on-site residential waste water systems. Site specific information will be linked to the county soil survey database through digital electronic media for Mayes and Delaware Counties. Specialists will be taught site specific techniques as well as subdivision, city, and county-wide planning strategies involving soil types, waste water renovation, and	May 2005 December 2008

	water quality. A minimum of two courses per year will be offered. The project coordinator (Task 2) will work with Dr. Carter, ODEQ, Conservation Districts, and the Grand Lake Association to set up these training sessions.	
Task 5.5.2	Implement a whole soil evaluation and septic system training and certification program for private sector individuals. These individuals will provide on-site soil evaluation for septic system sizing and design for the Grand Lake Watershed. This training and certification program will be implemented in cooperation with DEQ. The program will increase the number of private sector individuals qualified for on-site residential waste water treatment and design evaluation. Training for site evaluation will include 1) preliminary identification of soil types and their proximity to surface and ground water resources by utilizing county soil surveys (either hard-copy for Ottawa and Craig Counties or digital electronic form in Mayes and Delaware Counties), 2) acquiring field soil profiling techniques used for site specific evaluation for each system installed, and 3) learning environmental codes and regulations covering types of on-site residential waste water treatment systems and design specifications. A minimum of two trainings will be held per year, in coordination with DEQ.	May 2005 – December 2008
Task 5.5.3	Provide an educational seminar series highlighting soil as a natural resource and a vital living filter to renovate waste water. This educational seminar series will promote a proactive stance which emphasizes knowing, before you develop an area, the capabilities and limitations of your soil resource. An increase in soil resource education, especially related to water resources for people living and developing the Grand Lake Watershed is important for long-term environmental quality improvement. Soil forming processes and morphology of key soil types will be presented. The spatial distribution of soil types and their association with geologic formations, topography, and plant and animal communities will be discussed. Also, major chemical, physical, and mineralogical properties used for land-use decisions will be emphasized and discussed. Dr. Carter and the project Education coordinator will work with the GLA, Conservation Districts, and other groups as necessary to ensure that at least one of these programs is held annually during the project period.	May 2005 – December 2008

Task 5.5.4	Develop and construct a permanent soil educational display which emphasizes the soil as a living filter. This display will highlight key soil factors and processes which determine the fate and renovation of septic system effluent. The display will be housed adjacent to Grand Lake (easily accessible to many people) and will provide key information for planned development, and environmental quality. This display will include photographs, soil monoliths, short videos, and written presentation. The theme of the display will focus on maintaining water quality through proper effluent treatment and renovation. Also, soil as a natural resource component of planned development will be highlighted.	June 2007

Deliverables:

Subtask #	Description	Due Date
5.5.1	Three copies of all education materials generated during project will be forwarded to EPA	As generated
5.5.1.a	Secondary Data QAPP	September 2006
5.5.2	Semi-annual Reports	April and October
5.5.3	Final Report- - to include task results plus documentation of the time and associated match contributed to the task efforts by volunteers	December 2008

Measures of Success:

Success of Task 5 activities will be based upon 85% of the appropriate state and federal staff and 20% of the environmental planners and land developers who are active in the watershed attending the whole septic system educational training course. GLA, ODEQ, and other appropriate groups will help identify appropriate individuals to be targeted by the program. At least twenty percent of those identified will need to be involved in the education events during each year of the project. Attendance will be evaluated in the semi-annual reporting cycles and corrective measures identified to address attendance, if necessary. Attendance at the on-site wastewater system training and certification program will result in a fifty percent increase in the number of individuals using proper site evaluation for design and installation of septic systems in the watershed. The use of whole-soil profiles instead of perc. tests will be considered annually throughout the project period with assistance from ODEQ.

Task Budget:

Subtask #	Personnel	Supplies	Travel	Contractual	Equipment	Waived Indirect	Total
5.5.	$79,070	$28,000	$12,000	$14,000	$23,000	$68,930	$225,000*

*****total payable to contractor

Task 6. Develop and Implement Total Phosphorus and Chlorophyll-a Monitoring Utilizing Volunteers from the Grand Lake Association, the Wyandotte Nation, and the Seneca-Cayuga Tribe.

The Grand Lake Association (GLA) Oklahoma Water Watch Chapter was initiated in 1992. Since then, more than 90 volunteer monitors have invested over 10,000 person hours testing for water quality throughout the Grand Lake basin (GLA Water Watch Data Report, 2002). Over the years, monitors have been testing for pH, dissolved oxygen, water clarity using a Secchi disk, ammonia nitrogen, nitrate nitrogen, orthophosphate, watercolor, and other characteristics such as water and air temperature, amount of precipitation, and aquatic macrophytes at 75 different sites throughout the basin. Currently, the GLA OWW chapter has 48 active sites. Thirteen sites are in-lake and correspond with sites being monitored by the OWRB's Beneficial Use Monitoring Program, which collects at these sites quarterly, every other year. The usefulness of volunteer collected data at the same location and within the basin, on a consistent basis, is extremely beneficial for the OWRB, the State of Oklahoma, and local lake managers, by providing data that can be used to fill in gaps and develop baseline trends.

The level of involvement of the lake residents with the GLA Chapter of OWW illustrates how successful state and local organizations can work together for the enhancement and protection of our water resources. Citizens not only collect monthly water quality data, they attend regularly scheduled Quality Control sessions, host an annual Water Monitor Appreciation Dinner, operate booths at various community events, and work with teachers and students within the basin both in the classroom and assist with Science Fair projects.

The volunteers go through rigorous training, with continued oversight by local and state trainers to ensure their data meets the OWW Program's data quality objectives. Volunteers use state of the art equipment for all their monitoring including Hydrolab Multiprobe Water Monitoring Instruments, IDEXX Bacteria Testing equipment, HACH Turbidimeter, and a HACH Colorimeter. The Grand Lake Association volunteers operate under the EPA approved Quality Assurance Project Plan for OWW. Additionally, two tribes, the Seneca-Cayuga and Wyandotte Nation monitor for OWW. The tribes operate under their own EPA approved QAPP's, maintain their own equipment, and attend OWW scheduled QCA sessions. The tribes will partner with OWW to fulfill the requirements of this project.

This task will expand the level of education the volunteers receive by the development and implementation of a watershed and landuse component to the training protocols of OWW. Additionally the proposal will expand monitoring efforts by developing and implementing total phosphorus and chlorophyll-a monitoring in the Grand Lake basin. Watershed education and the data generated will empower the local citizens with tools

to better understand their lake and its watershed therefore be more active in its protection.

Objective:
This task will allow OWW to further educate the established network of volunteers in the Grand Lake Basin on watershed and landuse impacts on water quality. It will also allow for the research and development of protocols for implementing volunteer-collected total phosphorus and chlorophyll-a monitoring at in-lake, shoreline, and river sites. Small stream monitoring will be investigated, however the focus will be large rivers feeding into the lake and established in-lake sites. Volunteers conducting stream monitoring will be dually certified as OWW/Blue Thumb volunteers (Task 5.7).

Blue Thumb is a nonpoint source education-based program which includes a volunteer monitoring component, primarily focused in streams. This volunteer training/monitoring program includes training in sampling methodology, data interpretation, stream ecology, and nonpoint source pollution. In order to standardize sampling methodology and insure that data collected from both groups is comparable, OWW stream sampling volunteers will participate in BT training. Conversely, in order to educate BT volunteers about lake ecology and lake sampling methodology, BT volunteers will attend OWW trainings.

Total phosphorus samples will be collected and packaged by volunteers, and analyzed by the state environmental laboratory. Chlorophyll samples will be collected, filtered, and packaged by volunteers, OWRB staff will extract chlorophyll and the state environmental laboratory will analyze the results. Volunteers who participate will devote an additional level of commitment to protecting their resource. They will be educated on watershed impacts, outcomes of the reported data, and self-data interpretation. OWRB field staff will work closely with volunteers, further educating them on professional sampling techniques and quality assurance. Sample collection frequency will be implemented ten out of twelve months per year to provide a consistent, large data set that could not conceivably be collected by State Staff. If necessary to achieve the data quality objectives set forth in the QAPP, monitoring may occur during all 12 months of the year. The OWW QAPP will be modified to include total phosphorus sample collection and packaging. Chlorophyll-a sample collection is currently in the OWW QAPP, however this will be updated to reflect the Grand Lake project. Turbidity samples will also be measured using a HACH 2100P Turbidimeter.

The intent of this task is to: 1) develop new methodologies to improve the existing Volunteer Monitoring activities resulting in better data generated and more educated lake citizens. Once methodologies have been developed and implemented, it is the intent for OWW and the GLA to continue implementation beyond budget and project period at no additional cost to the federal government, and 2) collect data that will be useful for the upcoming TMDLs scheduled for Grand Lake.

Because TMDL data requirements can be quite specific regarding time, location, and parameters for sample collection, ODEQ will be included as a signatory to the QAPP and will participate throughout its development.

Completion of this task will address numerous components of the Watershed Based Plan, ranging from public outreach by further involving one of the most powerful existing groups in the watershed (Grand Lake Association) in all project activities. One outcome will be that the GLA is better informed about the wide-range of problems and potential solutions in the watershed. Secondly, water quality data will be collected that will help fill in the gaps left by existing programs for TMDL development. Also, involvement of the other States in the monitoring program development will keep them informed as to the monitoring effort ongoing in this state. In addition, completion of this task will specifically address components D, F, L, and K of the Strategies section of the Watershed Based Plan, at a minimum.

Task Schedule:

Task #	Milestone Description	Due Date
Task 5.6.1	Research and develop total phosphorus sample collection.	August 2005 – December 2005
Task 5.6.2	Modify existing OWW QAPP to include total phosphorus sample collection. Meet with ODEQ, OCC, and other appropriate agencies during sampling design and throughout QAPP development to ensure that data collection is optimized to meet data needs. Kansas, Arkansas, and Missouri will also be involved in the development of this QAPP.	July 2006
Task 5.6.3	Train volunteers on new methodologies, including workshops on watershed and landuse impacts, and self-data interpretation. Will coordinate with Project Coordinator (Task 1) to include volunteers in additional education programs ongoing as part of this project. Will also coordinate with OCC Blue Thumb program (Task 5.7) to utilize developed Water Quality Primer related program to watershed and landuse impacts, and, as necessary, self-data interpretation. In addition, any volunteers that complete stream sampling will also become BT certified and become Earth Team Volunteers associated with the Conservation District.	January 2006 – January 2008
Task 5.6.4	Implement sample collection and quality control sessions for the implementation phase	August 2006 – May 2008
Task 5.6.5	Semi-annual progress reports and draft Final Report- Reporting will be coordinated with BT Program (Task 5.7) to document volunteer monitoring efforts completed as part of this effort. Final report will also include documentation of the time and associated match contributed to the task efforts by volunteers	October 2008

Deliverables:

Subtask #	Description	Due Date
5.6.1	OWW Handbook Addendum to include Total Phosphorus	March 2006
5.6.2	Modified OWW QAPP with Project Addendum	July 2006
5.6.3	Revised Training Protocols including educational workshops	Included in Final Report October 2008
5.6.4	Data summary/Results- included with final report	October 2008
5.6.4.a	Semi-annual reports	October 2005 – July 2008
5.6.4.b	Final Report	October 2008

Measures of Success:
Volunteers will be provided with evaluation forms to evaluate their knowledge base prior to and following trainings with OWW/ OWRB/ OCC staff. A more difficult to measure measurement of success will be the overall education the citizens will receive. The volunteers will provide an informed and educated, local citizen base to the peers in the Grand Lake basin. To have local citizenry support for government efforts should not go unnoticed in measuring the successful benefits of such a project. The number of samples collected and delivered to the laboratory for analysis, and likewise the data output will also measure success of the project. Additionally results of the quality control assessment will measure success of the ability of the volunteer to collect data equitable to professional staff. The current reputation of the GLA OWW Chapter has helped them receive numerous grants, donations from private industry, and awards to assist them in their efforts. They have an exceptional public image within the Grand Lake basin. The GLA currently funds the OWW monitoring program in the Grand Lake almost completely. GLA is very interested in continuing the additional total phosphorus and chlorophyll monitoring developed with this task beyond the life of the project at their own expense. This will be an additional measure of success of the task.

Through their interaction with other portions of the program, OWW volunteers will be expected to participate in a number of watershed-wide (primarily within the Oklahoma portion of the watershed) education activities. Ninety-five percent of)OWW volunteers will participate in at least two of these additional activities (funded through task 5.2 – 5.5 and 5.7) during the project period. In addition, thirty-five percent of the volunteers will contribute additional products, beyond water quality data, to the education effort such as articles to local newspaper, time spent at a county fair booth, volunteer time installing demonstration sites (associated with tasks 5.2 – 5.5), etc. Progress towards meeting these measures of success will be evaluated with the semi-annual reporting cycle.

Task Budget:

Subtask #	Personnel	Supplies	Travel	Contractual	Total
5.6.	$108,086	$4,962	$5,904	$73,147	$192,099*

***total payable to contractor**

Task 5.7. Support and Expand Blue Thumb Activities in the Grand Lake Watershed.

The Blue Thumb (BT) Program in the Grand Lake Watershed currently consists of two or three groups that monitor watershed streams. The BT program will work with Conservation Districts and other groups associated with the project (Tasks 5.2 – 5.6) to add new sites and volunteers as necessary.

Particularly important will be coordination between ODEQ, OWW, and OCC to insure that volunteer data collection be optimized, as possible to collect data that will be useful for TMDL development. Additionally important, will be the addition of total phosphorus

data to the suite of parameters monitored. OCC will work with OWW to develop a protocol for total phosphorus analysis in the Grand Lake Basin as a trial run for incorporation into other BT programs, particularly those in areas where phosphorus is of concern.

An additionally important function of this Blue Thumb effort will be to develop new BT partners in the Watershed. Working with the Grand Lake Association, the Conservation Districts, and County Extension will introduce the Blue Thumb Program to other agencies. The ultimate intent is to generate a BT program that operates relatively independently in the watershed, sponsored by Conservation Districts and other groups in the watershed.

Objective:
This task will allow the Blue Thumb program to expand and develop in the Grand Lake Watershed to help address NPS education needs and to explore the addition of new parameters such as total phosphorus and chlorophyll a to the Blue Thumb monitoring program. This task will also allow the BT program to help educate other volunteer programs about NPS pollution and water quality.

Blue Thumb volunteers will continue to monitor their existing sites, and, through new recruitment and BT certification, will expand to monitor stream sites in Oklahoma as identified through QAPP development with ODEQ and OWW/OWRB. BT volunteers will also participate in other educational programs ongoing as part of this project (Tasks 5.2 –5.6).

Water Quality sample collection frequency will be implemented monthly, fish will be collected once at each sampling site during the project period (BT fish collections occur once every three years), and Benthic Macroinvertebrates will be collected at least once annually at each site. The BT QAPP will be modified to include total phosphorus sample collection, and additional analyses, parameters, and methodologies, as appropriate. In addition, the Blue Thumb website will be maintained to allow volunteers to remotely enter their data. This remote access will allow more immediate data sharing and quality assurance analysis.

In addition, the Blue Thumb Program and Delaware Conservation District will work with the Cleora School in NW Delaware County to improve an outdoor classroom. The school (grades 1 – 8) owns over 80 acres of land, currently used as an outdoor classroom, with established trails and a meeting area. The school has a very active conservation/water quality education program, which it is interested in expanding. The large amount of surface water and the importance of wetlands in maintaining water quality in this area make wetland education an important aspect in this watershed. The school will promote a Blue Thumb program on the established site, in addition to the wetland education program. The site will be open to area schools and education programs as a regional outdoor classroom.

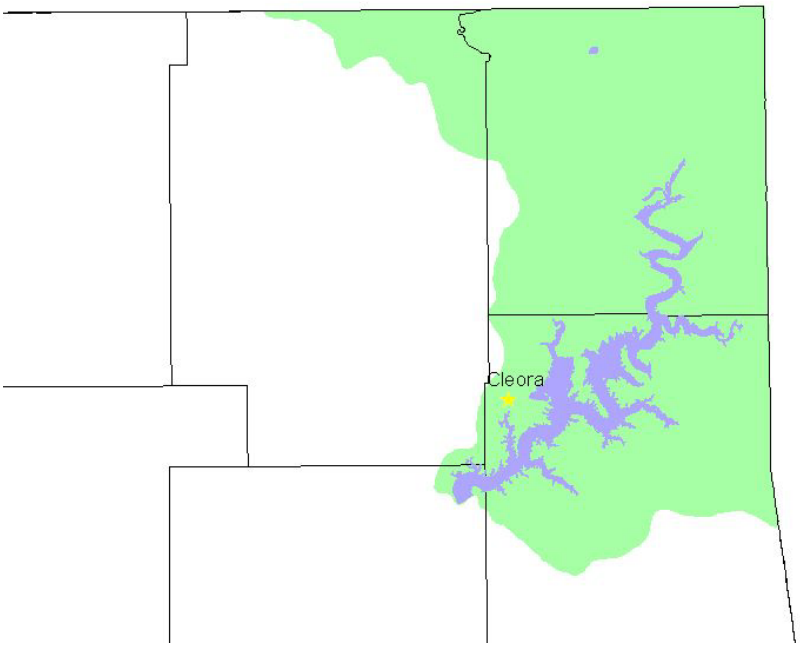


Figure 1. Location of Outdoor Classroom.

Finally, the BT program will coordinate to meet at least quarterly with other volunteer monitoring programs, and with the ODEQ to help meet monitoring and education needs in the watershed.

Completion of this task will address numerous components of the Watershed Based Plan, ranging from public outreach by further involving one of the most powerful existing groups in the watershed (Grand Lake Association) in all project activities. One outcome will be that the GLA is better informed about the wide-range of problems and potential solutions in the watershed. Secondly, water quality data will be collected that will help fill in the gaps left by existing programs for TMDL development. Also, involvement of the other States in the monitoring program development will keep them informed as to the monitoring effort ongoing in this state. In addition, completion of this task will specifically address components D, F, L, and K of the Strategies section of the Watershed Based Plan, at a minimum.

Task Schedule:

Task #	Milestone Description	Due Date
Task 5.7.1	Research and develop total phosphorus and chlorophyll-a sample collection in Coordination with OWW/OWRB.	August 2005 – December 2005
Task 5.7.2	Modify existing BT QAPP to include total phosphorus sample collection and other methodologies, as appropriate. Coordinate with ODEQ, OWRB, and other appropriate agencies during sampling design and throughout QAPP development to ensure that data collection is optimized to meet data needs.	September 2005 – August 2006
Task	BT Volunteer trainings (a minimum of two during project	October 2005 –

5.7.3	period). Will also coordinate with Project Coordinator (Task 1) to include volunteers in additional education programs (Task 5.2 – 5.6) as part of OCC program to utilize developed Water Quality Primer related program to for NPS education related to watershed and landuse impacts. In addition, any volunteers that complete stream sampling as a portion of this project (Task 5.2 – 5.7) will also become BT certified and become Earth Team Volunteers associated with the Conservation District. BT volunteers will also participate in additional education programs as part of this project (Tasks 5.2 – 5.6) in order to become more aware of the issues in the Grand Lake Watershed. In particular, BT volunteers will attend OWW trainings to learn about lake ecology and sampling methodology. Through this activity, they will be encouraged to do their part to educate watershed citizens about the issues in Grand Lake	October 2008
Task 5.7.4	Sample collection and quarterly quality control sessions	Following QAPP approval and volunteer training – October 2008
Task 5.7.5	Semi-annual progress reports and draft Final Report- Reporting will be coordinated with OWW Program (Task 5.6) to document volunteer monitoring efforts completed as part of this effort.	October 2004 – March 2008
Task 5.7.6	Outdoor classroom- design and construct outdoor classroom	November 2006 – December 2007
Task 5.7.7	At least monthly education events will be held using the outdoor classroom during the project period. In addition, a minimum of 6 events annually during the project period will involve groups outside of the Cleora school district	December 2007 – October 2008

Deliverables:

Subtask #	Description	Due Date
5.7.1	BT SOPs for new parameters	August 2006
5.7.2	Modified BT QAPP	August 2006
5.7.3	A minimum of two BT trainings (or as many as are necessary to include volunteers from other project tasks).	October 2008
5.7.4	Data summary/Results- included with final report	October 2008
5.7.4.a	Semi-annual reports	March and October of the project period
5.7.4.b	Final Report- to include task results plus	December 2008

	documentation of the time and associated match contributed to the task efforts by volunteers. Minutes of all interagency coordination meetings will be included in the final report.	

Measures of Success:
The BT Program in Grand Lake will expand by at least forty percent to include more sites and volunteers. BT volunteers in the Grand Lake Watershed will evaluate whether or not it is effective for volunteers to collect water quality samples for Total Phosphorus and chlorophyll-a analysis. The BT program will educate local citizens about NPS pollution and water quality issues in the Grand Lake Watershed. Through their interaction with other portions of the program (Tasks 5.2 – 5.6), BT volunteers will be expected to participate in a number of watershed-wide (primarily within the Oklahoma portion of the watershed) education activities. Ninety-five percent of BT volunteers will participate in at least two of these additional activities (funded through task 5.2 – 5.6) during the project period. In addition, thirty-five percent of the volunteers will contribute additional products, beyond water quality data, to the education effort such as articles to local newspaper, time spent at a county fair booth, volunteer time installing demonstration sites (associated with tasks 5.2 – 5.5), etc. Volunteers will present project activities and/or water quality data at least twice during the project period to meetings such as the Oklahoma Clean Lakes and Watershed Association. The idea of recruiting volunteers whose duties center around education rather than monitoring will also be investigated. Progress towards meeting these measures of success will be evaluated with the semi-annual reporting cycle and corrective measures will be identified as necessary at that time.

Task Budget:

Subtask #	Personnel	Supplies	Travel	Equipment	Contractual	Total
5.7.	*	$18,400	$6,000	$14,000	$20,000	$58,400

***BT** staffing supplied through OCC workplans such as FY 2005 Project 4.

Task 5.8: Demonstration of Practices Specific to Grand Lake

This project serves as the first stage in a larger effort to address NPS issues and other water quality problems in the Grand Lake Watershed. The purpose of this task is to provide funding to support demonstration of practices that will be included in later Grand Lake area projects such as the Honey Creek FY 2006 319 project. A demonstration farm has been established in the Spavinaw Creek Watershed as part of an FY 2003 project which can also serve the Grand Lake Area; however, as a larger area with additional landuses not seen in Spavinaw Creek, Grand Lake efforts have need of additional demonstration sites to showcase urban/residential practices as well as practices associated with traditional, row-crop agriculture.

Practices to be demonstrated may include alternative septic systems (sand-filter septic systems, for example), bioretention cells on commercial and residential properties, no-till farming, shoreline vegetative plantings, or other practices identified as needed.

The OCC will develop an implementation plan, detailing the practices to be installed, location in the watershed, and justification for choosing those locations. The final report will include an estimate of load reduction due to installation of those practices. Education programs associated with the project will include visits to demonstration sites and/or photographic documentation of the sites.

Task Schedule

Task #	Description	Due Date
5.8.1	Project Coordinator will work with project partners to locate suitable sites for demonstration of practices	Throughout project period
5.8.2	Project Coordinator and OCC Tech Writers will draft Implementation Plan	October 2006
5.8.3	Installation of demonstration sites	December 2005 – September 2008
5.8.4	Tours/Education Programs utilizing demonstration sites	Throughout project period
5.8.5	Summarize demonstration site activities and estimate load reduction from implementation	Final Report

Task Deliverables:

Task #	Description	Due Date
5.8.2	Implementation Plan	November 2006
5.8.4	Update photodocumentation QAPP	September 2006
	Final Report	December 2008

Task Budget:

Subtask #	Other	State	Federal	Total
5.7.	$313,306.65	206,220.26	107,086.39	$313,306.65

Total Project Outputs:

Task #	Description	Person Responsible	Due Date
5.1.1.a	Secondary data QAPP	Contractor	August 2006
5.1.2	Targeting Results+ Recommended suite of practices based on associated load reductions and economic-based effectiveness	Contractor	September 2006

5.1.3.a	Revision of the Watershed Plan to incorporate input from Arkansas, Kansas, Missouri, and Region 7.	OCC	January 2007
5.1.3.b	Revision of the Watershed Plan to incorporate results of the targeting mechanism.	OCC	January 2007
5.1.5	Update estimates of potential loading from near-lake septic systems to ascertain whether significant investment in infrastructure upgrades are warranted	Contractor	January 2007
5.1.6	Load Reduction Estimates from NRCS, FSA and supporting programs in the watershed.	OCC	with semi-annual reports
5.2.1	Journal of project activities, conversations, etc.	Project Coordinator	December 2008
5.2.2	Meeting Minutes and Agendas (Conservation District Board meetings, etc.)	Project Coordinator	Semi-annually, April and October
5.2.4	Semi-annual reports	Project Coordinator	Semi-annually, April and October
5.3.1.	QAPP	Contractor- Brown et. al.	August 2006
5.3.2	Letter report describing demonstration of media suitable for use in the prototype bioretention cells and an evaluation of the media places in the cells	Contractor- Brown et. al	April 2007
5.3.3.	Publish designs for bioretention cells in commercial and residential areas	Contractor- Brown et. al	November 2006
5.3.3	Identify cooperators and write contracts for ten bioretention cells (at least 9 in the Grand Lake Watershed)	Contractor- Brown et. al/ Project Coordinator	August 2006
5.3.4	Report documenting the public learning session(s)- documentation will include a measure of the volunteer-time devoted to these learning	Contractor- Brown et. al	To be included in final report

	sessions and other volunteer time related to the project..		
5.3.5	Water quality analysis of cell influent and effluent and seepage to groundwater	Contractor- Brown et. al	September 2008
5.3.6	Final Report	Contractor- Brown et. al	September 2008
5.4.1.a	QAPP-	Contractor- Zhang et. al	August 2006
5.4.1.b	MOU with demonstration site landowner	Contractor- Zhang et. al	August 2006
5.4.3	Three copies of all education material produced during the project will be forwarded to EPA	Contractor- Zhang et. al	As generated
5.4.6	Set of polling questions for documenting participant behavioral and attitude changes	Contractor- Zhang et. al	January 2007
5.4.7.a	Semi-annual Reports	Contractor- Zhang et. al	April and October throughout project
5.4.7.b	Final Report- to include task results plus documentation of the time and associated match contributed to the task efforts by volunteers	Contractor- Zhang et. al	December 2008
5.5.1	Three copies of all education materials generated during project will be forwarded to EPA	Contractor- Carter et. al	As generated
5.5.1.a	Secondary Data QAPP	Contractor- Carter et. al	September 2006
5.5.2	Semi-annual Reports	Contractor- Carter et. al	April and October
5.5.3	Final Report- - to include task results plus documentation of the time and associated match contributed to the task efforts by volunteers	Contractor- Carter et. al	December 2008
5.6.1	OWW Handbook Addendum to include Total Phosphorus	Contractor- Ridgway et. al	March 2006
5.6.2	Modified OWW QAPP with Project Addendum	Contractor- Ridgway et. al	July 2006
5.6.3	Revised Training Protocols including educational workshops	Contractor- Ridgway et. al	Included in Final Report October 2008

5.6.4	Data summary/Results- included with final report	Contractor- Ridgway et. al	October 2008
5.6.4.a	Semi-annual reports	Contractor- Ridgway et. al	October 2005 – October 2008
5.6.4.b	Final Report	Contractor- Ridgway et. al	October 2008
5.7.1	BT SOPs for new parameters	BT Staff/OCC Tech Writers	August 2006
5.7.2	Modified BT QAPP	BT Staff/OCC Tech Writers	August 2006
5.7.3	A minimum of two BT trainings (or as many as are necessary to include volunteers from other project tasks).	BT Staff/OCC Tech Writers	October 2008
5.7.4	Data summary/Results- included with final report	BT Staff/OCC Tech Writers	October 2008
5.7.4.a	Semi-annual reports	BT Staff/OCC Tech Writers	March and October of the project period
5.7.4.b	Final Report- to include task results plus documentation of the time and associated match contributed to the task efforts by volunteers. Minutes of all interagency coordination meetings will be included in the final report.	BT Staff/Project Coordinator/OCC Tech Writers	December 2008
5.8.2	Implementation Plan	Project Coordinator/OCC Tech Writers	November 2006
5.8.4	Update photodocumentation QAPP	OCC Tech Writers	September 2006
	Project Final Report	Project Coordinator/OCC Tech Writers	December 2008

Project Management:

This project will be managed by the Oklahoma Conservation Commission in cooperation with the Office of the Secretary of the Environment. The Oklahoma Conservation Commission will provide oversight for all project activities.

Project Duration:

Four years. .

Project Budget:

Project 5. Grand Lake Watershed Project	
State	$846,281.93
Federal	$1,269,423.39
Total	$2,115,705.32
Object Class Categories	
a. Personnel	$145,000.00
b. Fringe Benefits	$65,000.00
c. Travel	$12,000.00
d. Equipment	$14,000
e. Supplies	$35,400.00
f. Contractual	$1,530,998.67
g. Construction	0
h. Other	$313,306.65
i. Total Direct Charges (sum of 6a-6h)	$2,115,705.32
j. Indirect Charges	
k. TOTALS (sum of i and j)	$2,115,705.32

OKWBID	NAME	TYPE	SIZE (Lake Acres or Stream Miles)	CATEGORY	Monitoring Date	TMDL Date	Aesthetics	Agriculture	Cool Water Aquatic Community	Emergency Water Supply	Fish Consumption	Habitat Limited Aquatic Community	High Quality Water	Hydropower Generation	Industry	Navigation	Outstanding Resource	Primary Contact (Recreation)	Public/Private Water Supply	Secondary Contact (Recreation)	Sensitive Water Supply	Trout Fishery	Warm Water Aquatic Community	**Assessment Codes**	**Parameter(s)**
OK121600030020_00	Lake O' the Cherokees	L	5,813	5		2004	I	I						A	I			I	I				N		Low DO
OK121600030050_00	Neosho River	R	4	3	2004		I	X							X			X					X		
OK121600030060_00	Lake O' the Cherokees, Lower	L	5,813	2	2004		I	X						A	X			X	X				I		
OK121600030070_00	Duck Creek	R	10	3	2016		X	X							X			X					X		
OK121600030080_00	Duck Creek Cove	L	1	2	2004		X	X						A	X			X	X				X		
OK121600030090_00	Drowning Creek	R	14	5		2009	A	X	N						X			N	X						Low DO, pathogens, turbidity
OK121600030100_00	Woods Springs Branch	R	4	3	2016		X	X							X			X					X		
OK121600030110_00	Muskrat Hollow Creek	R	5	3	2016		X	X							X			X					X		
OK121600030120_00	Jay Creek	R	4	3	2016		X	X							X			X					X		
OK121600030130_00	Sweetwater Hollow Creek	R	4	3	2016		X	X							X			X					X		
OK121600030140_00	Neosho River	R	7	3	2004		I	X							X			X					X		
OK121600030150_00	Lake O' the Cherokees, Lower Middle	L	5,813	2	2004		I	X						A	X			X	X				I		
OK121600030160_00	Horse Creek	R	19	5		2009	I	X		A					X			N					N		DO, pathogens, pH, turbidity
OK121600030170_00	Horse Creek Cove	L	1	3	2004		X	X							X			X					X		
OK121600030180_00	Fly Creek	R	4	5		2009	A	A							A			N					I		Pathogens,
OK121600030190_00	Little Horse Creek	R	6	5		2009	I	A							A			N					N		DO, pathogens
OK121600030200_00	Oseuma Creek	R	4	3	2016		X	X							X			X					X		
OK121600030210_00	West Bay	L	1	3	2004		X	X							X			X					X		
OK121600030220_00	Chigger Cove	L	1	3	2004		X	X							X			X					X		
OK121600030230_00	Woodward Hollow Creek	R	6	3	2016		X	X							X			X					X		
OK121600030240_00	Woodward Hollow Cove	L	1	2	2004		X	X						A	X			X	X				X		

OK121600030250_00	Courthouse Hollow Creek	R	4	3	2016		X	X						X			X				X	
OK121600030260_00	Courthouse Hollow Cove	L	1	3	2004		X	X						X			X				X	
OK121600030270_00	Neosho River	R	11	3	2004		I	X						X			X				X	
OK121600030280_00	Lake O' the Cherokees, Middle	L	5,813	2	2004		I	X					A	X			X	X			I	
OK121600030290_00	Lake O' the Cherokees, Honey Creek Arm	L	5,813	2	2004		I	I					A	X			X	X			I	
OK121600030291_00	Honey Creek	R	4	3	2016		X	X						X			X				X	
OK121600030291_01	Honey creek	R	2	3	2016		X	X						X			X				X	
OK121600030295_00	unnamed trib to Honey Creek	R	4	3	2016		X	X						X			X				X	
OK121600030300_00	Dilar Cove	L	1	2	2004		X	X					A	X			X	X			X	
OK121600030310_00	Elm Creek	R	10	3	2016		X	X	X					X			X	X				
OK121600030320_00	Whitewater Creek	R	15	5		2009	A	A	N					A			I	X				DO
OK121600030330_00	Snail Creek	R	4	3	2016		X	X						X			X				X	
OK121600030340_00	Cave Springs Branch	R	13	5		2004	I	N	N			X		X			N	X				Cause unknown, chlorides, pathogens, sulfides, TDS
OK121600030350_00	Echo Bay	L	1	3	2004		X	X						X			X				X	
OK121600030360_00	Carey Bay	L	1	2	2004		X	X					A	X			X	X			X	
OK121600030370_00	Neosho River	R	3	3	2004		I	X						X			X				I	
OK121600030380_00	Lake O' the Cherokees, Upper Middle	L	5,813	2	2004		I	X					A	X			X	X			I	
OK121600030390_00	Wolf Creek	R	10	3	2016		X	X						X			X				X	
OK121600030400_00	Wolf Creek Cove	L	1	3	2004		X	X						X			X				X	
OK121600030410_00	Spring Branch	R	4	3	2016		X	X						X			X				X	
OK121600030420_00	Hickory Creek	R	6	3	2016		X	X						X			X				X	
OK121600030430_00	Neosho River	R	22	3	2004		X	X						X			X				I	
OK121600030440_00	Elk River	R	13	5		2005	I	A	I		I			A			N	I				Pathogens
OK121600030445_00	Honey Creek	R	10	5		2005	I	A	I		I			A			N	I				Pathogens
OK121600030450_00	Lake O' the Cherokees, Elk River Arm	L	5,813	2	2016		X	X					A	X			X	X			X	
OK121600030460_00	Carr Branch	R	5	3	2016		X	X						X			X				X	
OK121600030470_00	Buffalo Creek	R	3	3	2016		I	I						X			X				X	
OK121600030480_00	Three Finger Cove	L	1	3	2004		X	X						X			X				X	
OK121600030490_00	Council Hollow Creek	R	6	3	2016		X	X	X					X			X	X				
OK121600030500_00	Council Cove	L	1	3	2004		X	X						X			X				X	
OK121600030510_00	Sycamore Creek	R	9	5		2009	I	I	I					X			N	X				pathogens
OK121600030520_00	Brush Creek	R	7	3	2016		I	I	I					X			X	X				
OK121600030530_00	Roark Creek	R	2	3	2016		X	X						X			X				X	

OK121600030540_00	Mason Springs Valley Creek	R	2	3	2016		X	X						X			X				X	
OK121600030550_00	Ogeechee Creek	R	5	3	2016		X	X						X			X				X	
OK121600030560_00	Lost Creek	R	3	2	2016		A	A	I					A			I	X				
OK121600030570_00	Modoc Valley Creek	R	13	3	2016		X	X						X			X				X	
OK121600040010_00	Neosho River	R	17	4a	2004		I	A			I			A			A	I				I	
OK121600040020_00	Lake O' the Cherokees, Neosho River Arm	L	5,813	2	2004		X	X					A	X			X	X				I	
OK121600040040_00	Hudson Creek	R	8	5		2004	A	A						A			I					N	Low DO, turbidity
OK121600040043_00	Flanders Creek	R	2	3	2016		X	X						X			X					X	
OK121600040050_00	Little Elm Creek	R	7	3	2016		I	I						X			X					I	
OK121600040060_00	Tar Creek	R	12	5		2009						N							I				lead
OK121600040070_00	Miami Creek	R	3	3	2016		X	X						X			X					X	
OK121600040080_00	Garrett Creek	R	3	3	2016		X	X						X			X					X	
OK121600040090_00	Quapaw Creek	R	4	3	2016		X	X						X			X					X	
OK121600040100_00	Lytle Creek	R	4	4a	2011		X	X						X			X					X	
OK121600040110_00	Coal Creek	R	10	3	2016		X	X						X			X					X	
OK121600040120_00	Neosho River	R	3	3	2016		X	X						X			X					X	
OK121600040130_00	Cow Creek	R	12	5		2009	A	A						A			N					N	Low DO, pathogens, turbidity
OK121600040140_00	Windy Creek	R	5	3	2016		X	X						X			X					X	
OK121600040150_00	Elm Creek	R	11	3	2016		X	X						X			X					X	
OK121600040160_00	Mud Creek	R	3	3	2016		X	X						X			X					X	
OK121600040170_00	Fourmile Creek	R	7	5		2009	A	A						A			N					N	Low DO, pathogens, turbidity
OK121600040180_00	Squaw Creek	R	6	3	2016		X	X						X			X					X	
OK121600040190_00	Slow Creek	R	4	3	2016		X	X						X			X					X	
OK121600040200_00	Russell Creek	R	11	5		2009	A	X						X			N					N	Low DO, pathogens
OK121600040210_00	Elm Creek	R	5	3	2016		X	X						X			X					X	
OK121600040220_00	Neosho River Oxbow Lake	L	14	2	2016		I	A			I			A			I	I				I	

A = attaining, I = insufficient information, N = not attaining