



**Reducing Nutrient Loss from Lawns,
Gardens, Parks, and Golf Courses in the
Grand Lake Watershed**

**FY 2004 319(h) C9-996100-12 Project 5
Phase 1: Grand Lake (Oklahoma) Watershed Implementation Project**

**Oklahoma Conservation Commission
Water Quality Division**

Task 5.4 - Final report

**Hailin Zhang
Oklahoma State University**

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Introduction

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 have caused concern about pollution of lakes and streams since runoff from the landscape contains soluble and particulate P as well as N. 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 1000ppm (32.5ppm is considered adequate for plant growth). This suggests too much P fertilizer and/or incorrect fertilizer formula have been used by many people. Although an individual lawn or golf course seems small, the total area of grassed area and gardens in the watershed can be a significant nonpoint source of nutrients. The main goal of this task was to change homeowner and landscape professional's lawn and garden care behavior through extensive education.

The objective was 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. The PIs of the project taught 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. The water quality component was successfully integrated into Master Gardener programs and the soil test P levels have leveled off and started to decrease.

Major Accomplishments

A. Promoting better nutrient management using demonstration gardens

In order to demonstrate the proper fertilizing and other lawn and garden care strategies, a demonstration garden was established at Grand Lake Visitor Center. The Demo Garden includes one native flower bed, one herb bed, and one vegetable bed (Figure 1). The flower and herb beds were filled with top soil mixed with compost as it is commonly done by commercial landscapers in the area and planted with native plants. Since they are native to the region, those plants require low maintenance such as fertilization and other chemicals. The vegetable bed received no compost, therefore, soil test nutrients remained low and some nutrients were applied as needed based on soil test recommendations. A soil test at the end of the project showed no nutrient build up in the vegetable bed. The potential for nutrients to be lost to water ways from the vegetable bed and other well managed areas should be minimal. The lawn surrounding the garden beds was under low input management (receiving no fertilizer and weed control chemicals). The soil test phosphorus of lawn is significantly lower than that of most homeowners as discussed in later sections. It is a good example to

have a productive garden and lush green lawn without loading soil with excess phosphorus and other nutrients.



Figure 1. The demonstration garden located behind the Grand Lake Visitor Center in Grove planted with native plants (right), herbs (left), and vegetables (back). The lawn surrounding the garden beds received no fertilizers or chemicals.

The demo lawn and garden have been used for several educational meetings and visited by many visitors. A detailed sign has been posted for self-guided tour. Two mini-composters are available to recycle grass clippings and other yard wastes so that they are not taken to landfills or dumped by the lake. This site will remain for demonstrating tips of proper fertilizer application and management, recycling nutrients through composting, and other best management practices.

B. Educating the public through Master Gardeners Program

The Master Gardener program is a volunteer training program conducted by University Extension designed to help county extension offices meeting the demands for consumer horticulture information. Master Gardeners take 8-12 classroom trainings on basic plant science, pest problems, soils and nutrient management, turf management, fruit & nut trees, ornamentals, houseplants, and vegetable gardens, but water quality is not an important component of the curriculum. 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. They are also required to have

a minimum of 20 hours volunteered activities annually. To raise the awareness of the importance of lawn and garden care in the Grand Lake Region, the Delaware and Ottawa County Master Gardener Program was established in 2005 and continued through 2007 annually (Figure 2). Water quality components, such as nutrient runoff and leaching from lawn and golf courses, were integrated into those trainings. A six-hour training session addressed the concern of nutrients and other chemicals from lawn, garden and golf courses on plant growth and water quality, and provided tips of how to keep the plants green and water clean. A 36-page Oklahoma Homeowner's Handbook for Soil and Nutrient Management was developed and used for the training. The handbook was well received and widely distributed.

More than 30 residents and landscape professionals took the required training and became certified Master Gardeners during the project. They will be an important force to promote environmental agenda in the community. Most participants did not know the importance of soil testing before fertilizing, nor the potential of nutrient loss to water bodies before the training. Survey and test results indicated their environmental awareness was significantly improved. Those certified Master Gardeners provided assistance to maintain the demo garden (Figure 3) and helped to disseminate information to the public. It is an effective method to educate the public about non-point source pollution through the Master Gardeners Program. Therefore, integrating water quality education into Master Gardener Program should be promoted in other regions of the state.



Figure 2. Homeowners in Ottawa and Delaware counties sought Master Gardener certification by attending required training. Training materials included significant amount of information on the environment for the first time.



Figure 3. Master Gardener volunteers maintain the demonstration garden in Grove. They also use the garden to teach others about proper nutrient management.

C. Demonstrating nutrient loss using a rainfall simulator

The movement of nutrients from lawns and gardens, and its consequences to water quality are not well understood by the general public. On the contrary, most people do not realize that phosphorus is mobile. In order to effectively illustrate the mobility of P, a portable rainfall simulator was used to demonstrate nutrient and sediment losses from both lawn and gardens. The rainfall simulator has been successfully used by scientists to establish the relationship between soil properties and management and the amount of nutrients lost. Runoff simulation was conducted following protocol established by the National Phosphorus Project (Figure 4). Runoff from boxes with and without vegetation, with and without fertilizer application was collected and analyzed on site for phosphorus using a test kit. The boxes had no vegetative cover had more runoff water and contained more sediments, which is not ideal from the soil and water quality point of view. The boxes that received fertilizer or poultry litter had more P in the runoff. Therefore, the potential for those nutrients to enter water body would be very high. This was proven to be an effective demonstration to the general public.



Figure 4. A rainfall simulator was used to demonstrate nutrient and soil losses from different management strategies. The amount of runoff and nutrients and sediments in the runoff varied with management, such as ground cover and amount of fertilizers applied.

In addition to educating homeowners, a conference on managing lawn, garden and golf course to protect water quality in the Grand Lake was held on April 17, 2008. It attracted golf course superintendents, lawn care professionals, city and state park maintenance workers, cooperative extension educators, and students and faculty from local colleges (over 30 people participated in the event). Specialists in nutrient management, integrated pest management, turf grass, and horticulture, and water quality all contributed to the day's educational activities. The field demonstration and classroom presentation greatly improved their knowledge on water quality protection. A pre- and post-meeting questionnaire indicated participants' knowledge on environment related questions increased by 23% (Table 1). The improvement on nutrient-related questions was even greater.

Table 1. The rates of correct answers for the pre- and post-meeting questionnaire at the Managing Lawn, Garden and Golf Course to Protect Water Quality of the Grand Lake Conference April 17, 2008.

No.	Question	Pre-meeting	Post meeting
1	Number of cores needed for a good sample	48%	100%
2	Choose the right fertilizer to use	88%	100%
3	What is the impact of P on water quality	88%	100%
4	Way to reduce disease	84%	100%
5	Spring dead spot	88%	75%
6	Mowing practice	56%	75%
7	Adequate soil test P (65)	24%	100%
8	Should I fertilize before rain	88%	94%
9	What is a rain garden	24%	69%
10	What are the benefits of native plants	92%	94%
11	Name some plants native to OK	84%	94%
12	Official native wildflower of OK	28%	69%
Average		66%	89%

D. Monitoring nutrient levels by extensive soil testing

Soil testing is considered the best management practice for minimizing nutrient loss. However, most homeowners never soil test their lawn and gardens, and some do soil test occasionally, but don't know how to follow soil test recommendations to apply the appropriate amount or type of fertilizer. This is the main reason for excessive nutrients in lawn and garden soils. This task focused on assessing nutrient status in the watershed through extensive soil sampling and testing. Table 2 shows the summary of lawn and garden soil samples in the Grand Lake Region from 2004 to 2008. There were close to 700 lawn and garden soil samples submitted to OSU Soil, Water, and Forage Analytical Laboratory. There might be samples submitted to other laboratories. The number of samples is higher than that of any other regions in the state, indicating the success of this educational program. The adequate soil test P level for plant growth in Oklahoma is 32.5ppm (no P fertilizer is needed when STP > 32.5). However, the average in the watershed is 183. It clearly shows fertilizer misuse and room for improvement. Nutrients in runoff are directly related to the levels in soils. As soil test nutrients increase, the amount of nutrients lost to water bodies also increases. The lawn and garden soils in the watershed need to be continuously monitored and better nutrient management strategies to be implemented in order to minimize the impact on Grand Lake water quality.

Table 2. Summary of lawn and garden soil samples from the Grand Lake Region from 2004 to 2008.

Tests	pH	NO3-N (ppm)	STP (ppm)	STK (ppm)
No. of Samples	675	675	675	675
Average	6.6	21	183	253
Min	4.5	1	2	31
Max	9.8	408	1416	3721
Median	6.7	11	75	180

Since the beginning of this educational program, the number of soil samples from lawn and gardens, and golf courses has steadily increased (Figure 5). The number of samples submitted in 2005 doubled the take from the previous year since it was the first year of the program. Samples remained high for the following years with gradual increase annually. Not only the number of soil samples from non-agricultural area increase, both the average and median soil test P levels in the Grand Lake Region have also been gradually decreasing from 2004 to 2008 (Figure 6). However, they are still several times higher than the adequate level for plant growth. The long term effect of this program will continue making contributions to an improved water quality in the Grand Lake watershed, especially as those well trained Master Gardeners influence others to do the right thing.

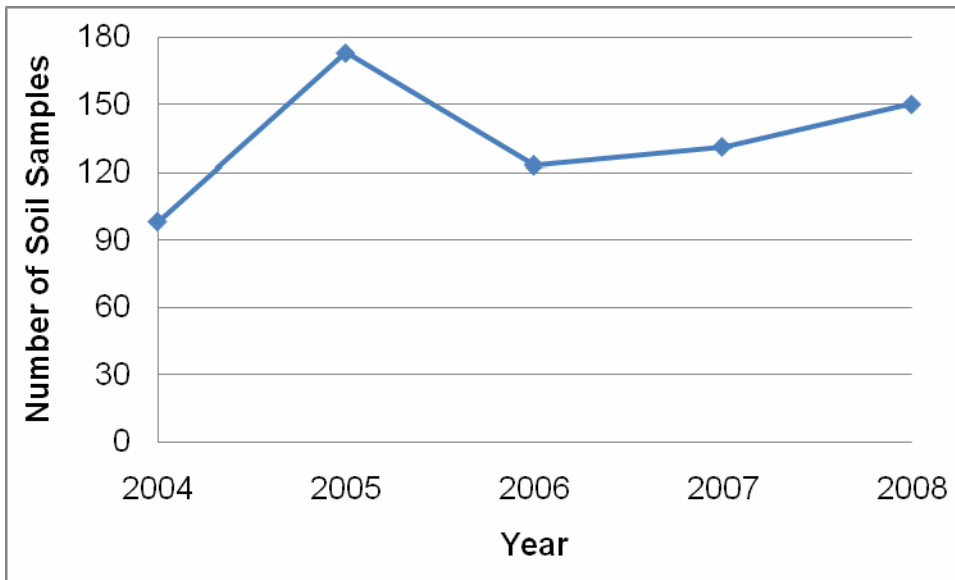


Figure 5. Number of soil samples tested from lawns, gardens, and golf courses in the Oklahoma part of the Grand Lake Watershed. 2005 was the first year of the educational program.

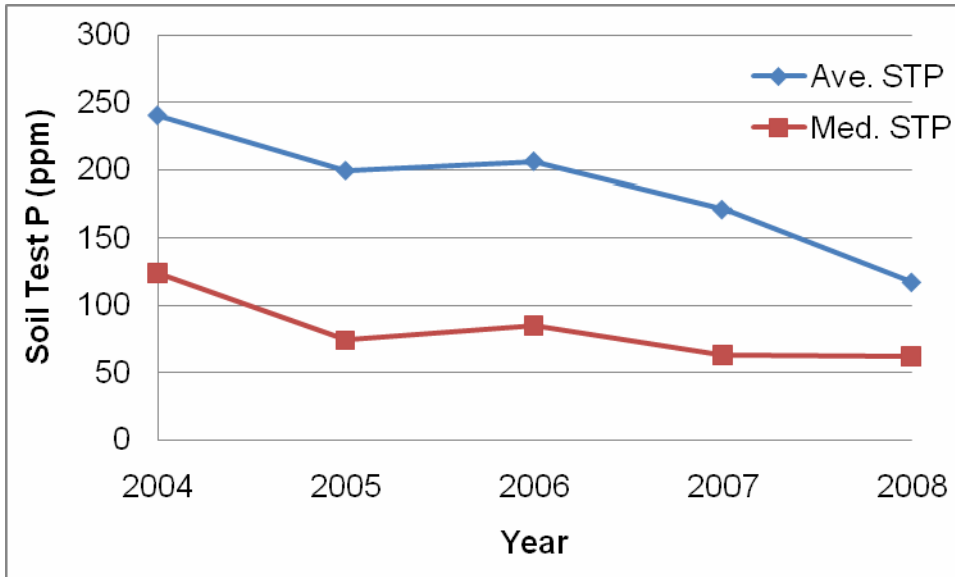


Figure 6. The average and median soil test phosphorus (STP) levels in the Grand Lake Region from 2004 to 2008 (STP of 32.5 ppm is considered adequate for plant growth in Oklahoma).

Major Task Outputs

1. A Quality Assurance Project Plan was submitted and approved;
2. Semi-annual reports were submitted as needed;
3. Final project report submitted December 2008;
4. A Homeowner's Handbook for Soil and Nutrient Management was developed and widely distributed;
5. A factsheet on Responsible Lawn and Garden Care was published;
6. A handout on using rainfall simulator to demonstrate nutrient and sediment loss was produced.

Major Activities

Date	Activity Description	Outputs
May 4, 2005	Delaware/Ottawa Master Gardeners Program Training	Take care of plant nutrients for lawn and garden presentation
Jan. 2, 06	Delaware Master Gardeners Monthly Meeting, Grove	Presented "Take a right first step: soil sampling", ppt and handouts
April 7, 06	Presentation at OK Clean Lakes Meeting	How does phosphorous move from land to water? ppt
Feb. 9, 2006	Delaware Master Gardeners Monthly Meeting, Grove	What can a homeowner do to protect water quality?
April 13, 06	Delaware Master Gardeners Monthly Meeting, Grove	Presented and discussed soil test results, how to use them to minimize nutrient loss

April 26, 06	Delaware Master Gardeners Training	Taking care of nutrients for lawn and garden, ppt, handout, and test
September 06	Pelican Festival in Grove, OK	Poster and soil sampling demonstration / promotion
June 06	Designed and constructed 2 raised garden beds at GLA Visitor Center	2 garden beds were ready to plant
June 20, 06	Purchased plants and supplies for summer gardening	
Oct. 12, 06	Invited Marilyn Stewart, Native Plant Specialist, to speak to Delaware Master Gardeners Monthly Meeting	Presentations on native plants and their value for water quality and wildlife
Nov. 8, 06	Harvesting vegetable, soil sampling	
Nov. 16, 06	Ordered 2 composters to recycle garden residues	2 composters were sent to Grove
Feb. 8, 07	Delaware Master Gardener Monthly Meeting	Daily life and food production in China
Feb. 9, 07	Delaware New Master Gardener Training	Taking care of nutrients for lawn and garden, ppt, handout, and test
April 13, 07	Presentation at OK Clean Lakes Meeting	Improving nutrient management in lawn and gardens to protect water quality
April 21, 07	Grand Lake Earth Day Celebration in Grove	Tips for a green, healthy lawn and garden
June 14, 07	Delaware Master Gardener Monthly Meeting	Nutrient management for garden and wildlife food plots
Feb. 9, 08	Grove Home and Garden Show	2 presentations on Plant nutrient needs and water quality protection
April 17, 08	Managing Lawns, Gardens and Golf Courses to Protect Water Quality in Grand Lake Conference	Homeowner's Handbook, presentations, rainfall simulation demonstration, demo gardens, handouts
April 19, 2008	Grand Lake Earth Day Celebration in Grove	Display, demo garden tour, handouts, free soil test offer
June 28, 2008	Environmental education at Grove Wal-Mart	Poster and fertilizer display, handouts, free soil test offer

Summary

This project successfully integrated water quality components into Master Gardener Training Program. It is an effective strategy to educate homeowners and non-agricultural personnel on nutrient management. Due to this educational effort, the number of soil samples tested for lawn, garden and golf courses has increased, while the soil test P levels in collected samples have decreased in the Grand Lake Watershed. The environmental awareness among homeowners and landscape professionals has also improved. Once again, the Water Quality Division of the Oklahoma Conservation Commission and its partners are making a difference in Oklahoma's watersheds.