Alabama

Lightwood Knot Creek
Section 319
National Monitoring Program Project

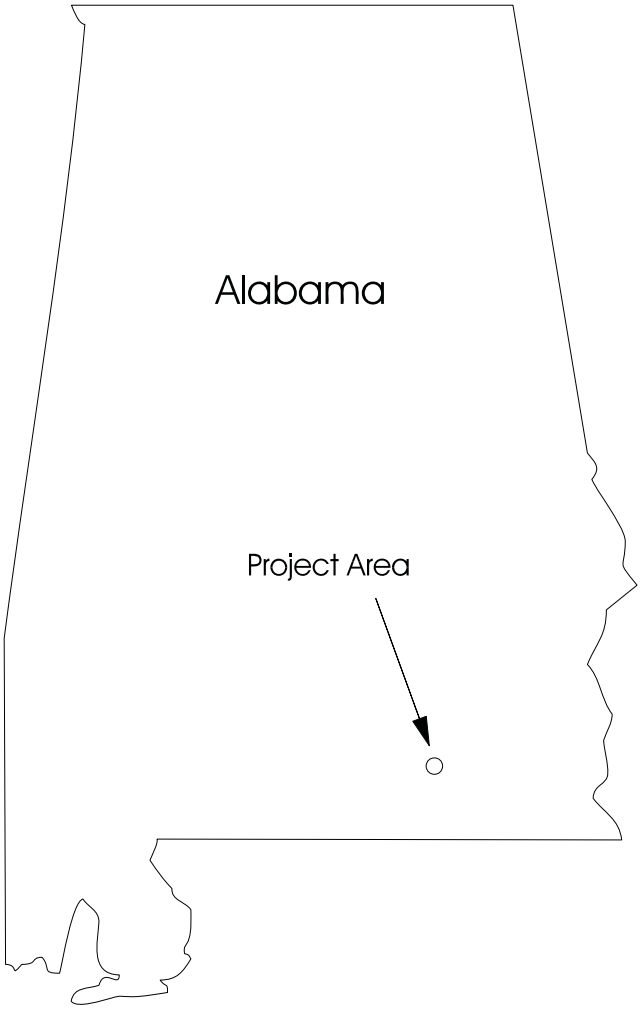

Figure 1: Lightwood Knot Creek (Alabama) Project Location

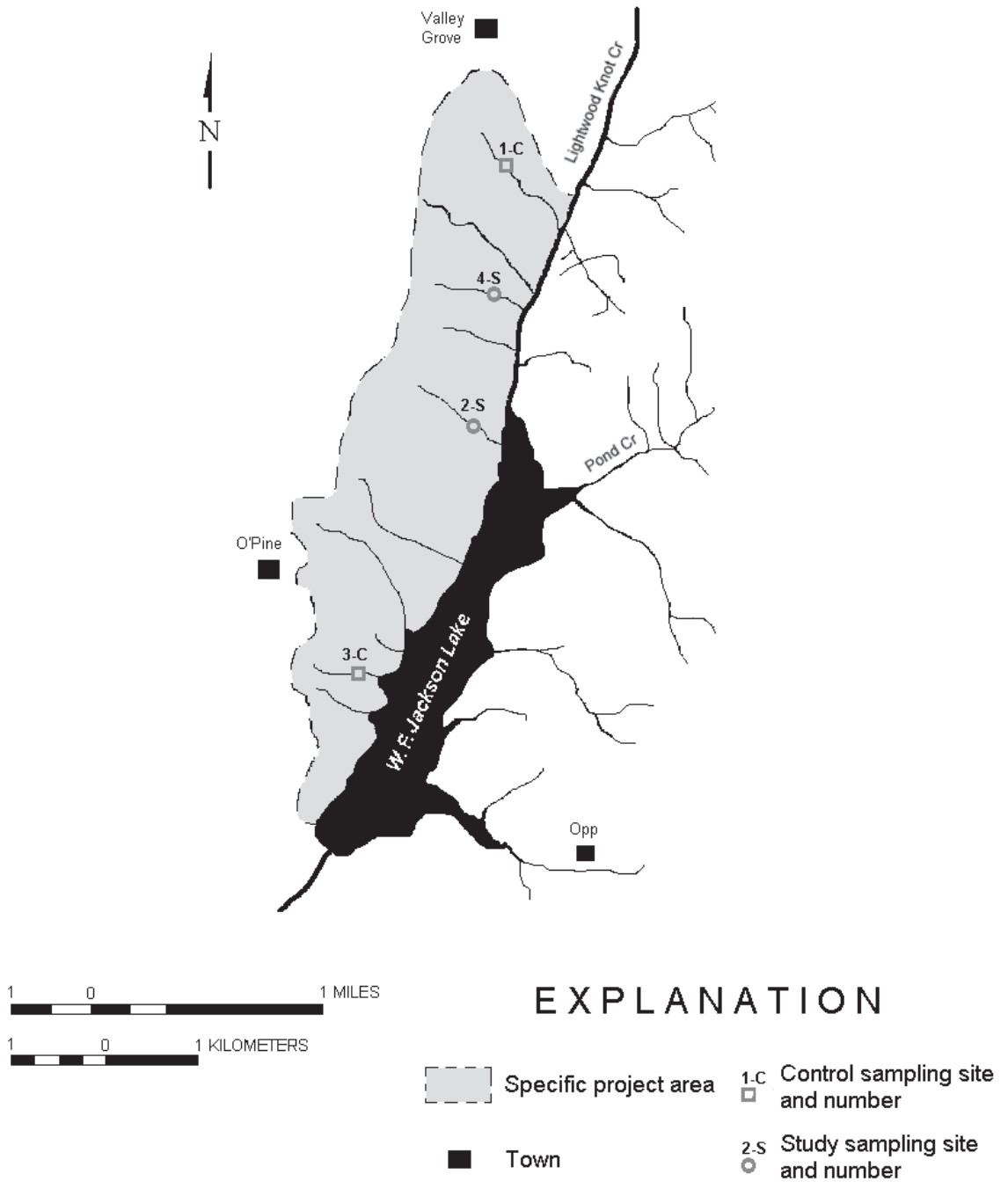

Figure 2: Water Quality Monitoring Stations for Lightwood Knot Creek (Alabama) Watershed

PROJECT OVERVIEW

Lightwood Knot Creek is a tributary of the 1,100-acre W.F. Jackson Lake in Southeastern Alabama (Figure 1). Jackson Lake was constructed for recreational uses in 1987. The 47,300-acre watershed is approximately half forested and half in agriculture. Pasture, hayland, cropland, and poultry production are the dominant agricultural land uses.

Erosion in the Lightwood Knot Creek watershed and resulting sedimentation of Jackson Lake and disposal of animal wastes are major water quality problems. Numerous areas have been identified as sources of sediment. Types of erosion occurring include sheet, rill, ephemeral, and erosion along unpaved roads. Nutrients and bacteria from cattle and poultry operations are also sources of pollution.

Land treatment began after three years of baseline monitoring. Erosion control practices implemented include runoff and sediment control structures, critical area planting, cover and green manure crops, and pasture and hayland management. For animal waste management, practices include poultry litter storage, litter and dead poultry composting and prescribed waste utilization.

The Geological Survey of Alabama conducted physical, chemical, and biological monitoring at two sets of paired watersheds. Each of the sets of watersheds had a control and treatment watershed. These watersheds were small, ranging from 75 to 240 acres. Monitoring was conducted weekly for all parameters (see Water Quality Monitoring section below) from April through August. Only inorganic and physical parameters were monitored for the remainder of the year

The project is completed. Pre-BMP monitoring and installation of BMPs were completed in September 1999, post BMP monitoring and statistical analyses were completed in September 2002. The final report is dated 2002.

PROJECT DESCRIPTION

Project Area

The Lightwood Knot watershed draining into Jackson Lake covers 47,300 acres. Jackson Lake is 1,100 acres in size.

Relevant Hydrologic, Geologic, and Meteorologic Factors

Soils consist of a thin sandy loam topsoil and a sandy clay subsoil with a depth of six feet. Coastal plain sediments of the Tertiary aged Lisbon and Tallahatta Formations crop out in the project subwatersheds. Average annual rainfall is 56 inches and average annual runoff is 23 inches.

Land Use

Land Use	Percent
Crop	23
Pasture/hay	26
Forest	47
Residential	2
Lake	2
Total	100

Water Resource and Size

Water resources of concern are Lightwood Knot Creek and other tributary streams to Jackson Lake, a reservoir created in 1987. Four branches of Lightwood Knot Creek were monitored in this study Median seven-day low flow of these branches, sustained by ground water seepage, is approximately 0.32 cubic feet per second per square mile of watershed.

Water Uses and Impairments

Lightwood Knot Creek and Jackson Lake are used for recreation. Disposal of animal wastes and sedimentation of tributaries and the lake are primary concerns. Excessive sediment impairs aquatic life habitat, increases bridge maintenance costs, increases flooding potential, and reduces the capacity of Jackson Lake. Elevated levels of nitrogen and phosphorus and elevated fecal bacteria counts have been found in Lightwood Knot tributaries.

Pollutant Sources

Pollutant sources varied from agricultural fields and roads to confined animal operations. Numerous areas were identified for erosion control BMPs. There were 6 poultry operations that were potential sources of nonpoint source pollution.

Pre-Project Water Quality

Very little background water quality information was available; however, tributary sampling in July of 1994 provided some indication of pre-project water quality. Turbidity ranged from 41 to 55 NTU. Total nitrogen ranged from 0.8 to 5.0 mg/L and total phosphorus ranged from 0.03 to 0.51 mg/L. Fecal coliform and fecal streptococcus ranged from approximately 500 to nearly 9,000 counts per 100 ml.

Water Quality Objectives

The main objective of the project was to achieve and document water quality improvements in the treatment subwatersheds through the implementation of BMPs.

Project Time Frame

1996 to 2002

PROJECT DESIGN

Nonpoint Source Control Strategy

Land treatment began during the summer of 1999. BMPs were constructed to control erosion and sedimentation in the 4-S watershed. Erosion control practices included runoff and sediment control structures, floodplain fencing, critical area repair and planting, cover and green manure crops, and pasture and hayland management.

Animal waste management practices were designed and implemented to limit nonpoint sources of pollution. These included poultry litter storage, mortality composting, and floodplain fencing and rotational cattle feeding.

Project Schedule

Management Unit	Pre-BMP Monitoring Dates	BMP Installed	Date Installed/ Established	Post-BMP Monitoring Dates
Sites 1-C, 2-S, 3-C, and 4-S*	Spring 1996 – June 1999	All BMPs installed September 1999	June-September 1999	Fall 1999 – Fall 2002

* C denotes a control watershed: S denotes a study (treatment) watershed

Water Quality Monitoring

Two paired watershed studies were conducted on tributaries of Lightwood Knot Creek (Figure 2). There were two control watersheds and two treatment watersheds. No BMPs were installed in the treatment watersheds while the three-year baseline monitoring was being conducted. No additional BMPs were installed in the control watersheds until the monitoring study was completed (approximately seven years).

Variables Measured

Biological

Aquatic habitat assessment and biotic indexing
Fecal coliform (FC)
Fecal streptococcus (FS)

Chemical

Aluminum (Al)
Ammonia (NH3)
Antimony (Sb)
Arsenic (As)
Barium (Ba)
Beryllium (Be)
Biochemical oxygen demand (BOD)
Boron (B)
Cadmium (Cd)
Calcium (Ca)
Chemical oxygen demand (COD)
Chloride (Cl)
Chromium (Cr)
Copper (Cu)
Iron (Fe)
Lead (Pb)
Magnesium (Mg)
Manganese (Ma)
Nickel (Ni)
Nitrite (NO2)
Nitrate + nitrite (N03+ N02)
Orthophosphate (OP)

pH
Selenium (Se)
Silica (Si)
Silver (Ag)
Sulfate ($SO4^-$)
Tin (Sn)
Total dissolved phosphorus (TDP)
Total dissolved solids (TDS)
Total Kjeldahl nitrogen (TKN)
Total suspended solids (TSS)
Turbidity
Zinc (Zn)

Covariates

Bedload sediment
Discharge
Precipitation
Specific conductance

Sampling Scheme

Samples were taken daily and composited for all parameters from April through August. Total dissolved solids, total suspended solids, and covariates were monitored weekly during the remainder of the year.

Surface water quality monitoring at four project sites was initiated on April 1, 1996. Stream discharge, water level, specific conductance, and temperature data were recorded at 15-minute intervals. Water samples were collected every 24 hours from April to September and every 8 hours from three to six storm event samples per week. Water samples were analyzed for more than 30 constituents including metals and nutrients. Continuous bedload sediment volumes were monitored for all four streams and continuous rainfall data were collected at two sites. Because of the required short holding time for samples used for bacteria and biochemical oxygen demand analyses, these samples were collected as weekly grab samples from April to September. Best management practices installation was completed in September 1999 in the two treatment watersheds. No additional BMPs were installed in the control watersheds until the monitoring study was completed (approximately seven years).

Monitoring Scheme for the Lightwood Knot Creek Section 319 National Monitoring Program Project

Design	Sites or Activities	Primary Parameters	Covariates	Frequency of WQ Sampling	Frequency of Habitat/Biological Assessment	Duration
Two paired watersheds	Tributary subwatersheds	P NH_3 $N0_2$ $N0_3 + N0_2$ DO TDS Turbidity TSS FC FS pH Conductivity	Discharge Precipitation Sediment Conductance	Variable Weekly Daily 15-minute event	2 times per year	7 years

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

All chemical monitoring results collected during the Lightwood Knot Creek 319 National Monitoring Project were entered into the USEPA STORET database and the Alabama Department of Environmental Management's database. Biological data were stored in the USEPA BIOS database.

NPSMS Data Summary

The project intended to track water quality parameters and land use activities with the Nonpoint Source Management System (NPSMS) software.

Final Results

Due to drought, flood, and beaver activity, the data from the 3-C and 4-S watersheds received most of the analytical evaluation related to statistical determinations of water quality change for the pre- and post-treatment periods. Average concentrations of nitrate for the Pre-BMP period (April 96-June 99) were 2.47mg/L at site 3-C, and 2.30 mg/L at site 4-S. Average concentrations of nitrate for the Post-BMP period (Sept 99-Sept 02) were 1.68 mg/L at site 3-C, and 0.62 mg/L at site 4-S.

Average fecal coliform counts for the pre-treatment period (April 96-June 99) for the 3-C and 4-S watersheds were 1,352 and 1,420 colonies per 100 milliliters (col./100 ml), respectively. Average fecal coliform counts for the post-treatment period (Sept 99-Sept 02) were 1,279 and 1,121 col./100 ml, respectively. Average fecal streptococcus counts for the pre-treatment period (April 96-June 99) for the 3-C and 4-S watersheds were 7,381 and 6,903 col./100 ml, respectively. Average fecal streptococcus counts for the post-treatment period (Sept 99-Sept 02) were 4,160 and 3,101 col./100 ml, respectively

Sedimentation rates for the pre-treatment period (April 96-June 99) for the 3-C and 4-S watersheds were 2.2 and 13.4 tons of suspended sediment per year, respectively. Post-treatment period (Sept 99-Sept 02) rates were 5 and 11.1 tons of suspended sediment per year, respectively. Bedload sedimentation rates for the pre-treatment period (April 96-June 99) for the 3-C and 4-S watersheds were 2.7 and 460 tons of per year, respectively. Post-treatment period (Sept 99-Sept 02) rates were 2.9 and 165.4 tons per year, respectively.

Statistical analyses for calibration of paired watersheds were performed after 20 months of monitoring. Nine of eleven parameters were calibrated to detect a change of less than 10% in the log-transformed data for both pairs of watersheds.

Results of statistical analyses of paired watershed data indicated a 71% reduction of nitrate, a 92% reduction in bedload sediment, and an 11% reduction in fecal coliform bacteria in the 4-S watershed. Regression analysis indicated an 18% increase in suspended solids load for the 4-S watershed during the post-treatment period. This increase was not caused by increased erosion but was attributed to a dramatic increase in iron bacteria (iron hydroxide) in the stream resulting from stabilization of the stream bed and reductions of bedload sediment. Also, fecal streptococcus bacteria increased by 14 % in the 4-S watershed during the post-treatment period. This increase was caused by a design flaw in the constructed cattle crossing that encouraged cattle to stop while crossing the stream.

INFORMATION, EDUCATION, AND PUBLICITY

A program of educational outreach and information distribution was initiated in April, 1996.

Numerous presentations, field tours, and demonstrations have occurred since initiation of the project. A tour of the Lightwood Knot Creek Project watersheds was conducted by GSA and NRCS to promote environmental awareness and ongoing water quality improvement efforts to local and state officials. Several mayors, state legislators, and the Speaker of the Alabama House of Representatives were in attendance.

A brochure about the project and nonpoint source pollution was produced by the Geological Survey of Alabama. The brochure describes, for the general public, the nature and purpose of the project, and some of the preliminary results.

TOTAL PROJECT BUDGET

The estimated budget for the Lightwood Knot Creek Section 319 National Monitoring Program project for the life of the project is:

Project Element	Funding Source ($)			
	Federal	State	Local	Sum
Proj Mgt	120,693	59,305	NA	179,998
I & E	NA	NA	NA	NA
L T	100,000	NA	NA	100,000
WQ Monit	544,307	715,695	NA	1,270,002
TOTALS	775,000	775,000	NA	1,550,000

Source: Geological Survey of Alabama, 1995

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

In 1994, a Water Quality Incentive Project (WQIP) was approved for the Yellow River basin. The project included funding for BMPs in the Lightwood Knot Creek watershed to improve erosion control and implementation of animal waste management practices. However, WQIP funding is no longer available for the project.

The Lightwood Knot Creek watershed is being targeted for funding for water quality improvement projects under the Environmental Quality Incentives Program (EQIP). However, no funding of projects has been applied specifically to the National Monitoring Program Project watersheds.

The Natural Resources Conservation Service distributed more than 1.4 million dollars in Covington County, Alabama through the Emergency Watershed Protection Act for roadside repairs performed after March and September 1998 floods. The Farm Service Agency distributed more than 1 million dollars for pond and field repairs performed as a result of the flooding. A significant portion of this funding was spent in the Lightwood Knot Creek watershed.

Methodologies developed for the Lightwood Knot Creek project for monitoring nonpoint source impacts on surface-water quality are now being used state-wide to assess impacts on other water bodies.

OTHER PERTINENT INFORMATION

Surface-water quality and discharge data collected during the pre and post BMP monitoring indicated close interaction between surface and ground water in the project area. The data indicated that shallow, nonpoint source contaminated ground water may be a major source of surface-water contamination, particularly during periods of low flow Nitrate concentrations of more than 20 mg/L were documented from analyses of ground water samples collected in the project subwatersheds.

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