Texas Silvicultural BMP Effectiveness Monitoring Project
FY03 EPA 319(h) Grant

Executive Summary

Between July 2003 and August 2007, $503,293 of EPA 319(h) funds and $335,528.67 of Texas Forest Service (TFS) matching funds allowed the TFS BMP Project to:

- Conduct a highly technological stream monitoring project to test BMP effectiveness during forestry operations.
- Conduct nine biological assessments (benthic macroinvertebrates, fish, and habitat) on each of the four project streams.
- Collect 47 monthly grab samples from each of the four project streams.
- Collect 550 total stormwater samples from the four project streams. These samples were analyzed for Total Suspended Solids, Total Nitrogen, Total Phosphorous, and Turbidity.
- Install and rotate continuous monitoring water quality samplers (Hydrolab minisondes) around the four project sites to obtain 24-hour water quality data.
- Measure rainfall volume, intensity, duration, and date/time at the four project sites.
- Establish and chair a multi-agency Technical Advisory Committee to provide "technical expertise" in the direction and implementation of this project.
- Coordinate numerous field tours of the project sites.
- Publish numerous articles on BMPs and this project in county forest landowner newsletters, the Texas Forestry Association newspaper, the Texas Logging Council magazine, and newspapers.
- Make numerous presentations on the design, setup, and results of this project.

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PROGRAM TASK 1: Evaluation of BMP Effectiveness

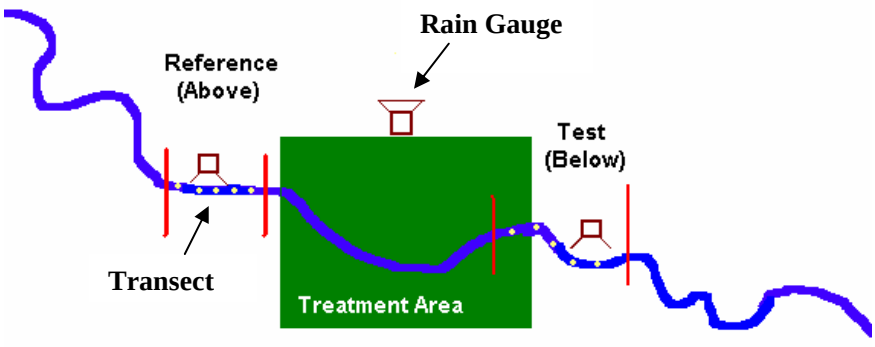
Objective: To assess the effectiveness of Texas' recommended BMPs during forestry operations.

Subtask 1.1 The TFS, in cooperation with TSSWCB, will develop a QAPP to submit to EPA for approval before data collection is started. (Start Date: Month 1; Completion Date: Month 48)

- **The original QAPP was submitted and approved by EPA on August 29, 2003.**
- **An updated QAPP, incorporating minor changes, was submitted to TSSWCB on February 15, 2006. TSSWCB provided comments to TFS on June 15, 2006. These comments were addressed by TFS and resubmitted on June 23, 2006. TFS received approval from TSSWCB on July 24, 2006. TFS received comments from EPA through TSSWCB on September 19, 2006, addressed them, and resubmitted to EPA through TSSWCB on September 21, 2006. EPA formally approved the updated QAPP on September 22, 2006.**
- **TFS submitted FY 08 QAPP signature pages to TSSWCB on July 10, 2007.**

Subtask 1.2 The TFS will monitor the effectiveness of forestry BMPs in protecting water quality on four project sites located throughout East Texas. The monitoring will be conducted by TFS trained staff. Monitoring will be conducted on four intensively managed sites, both above and below the treatment area. The treatment area will consist of harvesting, site preparation, and reforestation activities. These sites will be monitored prior to the treatment and at the culmination of treatment. (Start Date: Month 1; Completion Date: Month 48)

- **Four project sites were selected and located in Cherokee, Houston, Newton, and San Augustine Counties.**
- **Formal *Memoranda of Understanding* were signed by TFS and the project site landowners outlining each entity's duties and responsibilities.**
- **Stream transects were marked on the above and below sections at each site. The graphic below shows a typical project site.**



- **Stormwater monitoring equipment was installed on the project sites.**

The stormwater monitoring equipment is housed in a locked metal box for security and protection from the elements. It consists of an ISCO 3700 water sampler and an ISCO 4230 bubbler flow meter. The equipment is powered by a 12 V deep cycle marine battery and solar panel. A hose extends from the base of the box into the stream. Data is downloaded from the equipment with a laptop.

- **Stormwater samples were collected at the project sites. The table below shows the total number of samples and matched samples (results from both the above and below locations for the same storm event) collected.**

Pre Treatment

Project Site	# of Samples	Matched TSS samples	Matched TP Samples	Matched TN Samples
Cherokee	21	20	19	19
Houston	17	14	10	10
Newton	25	23	20	20
San Augustine	6	7	5	7

Post Treatment

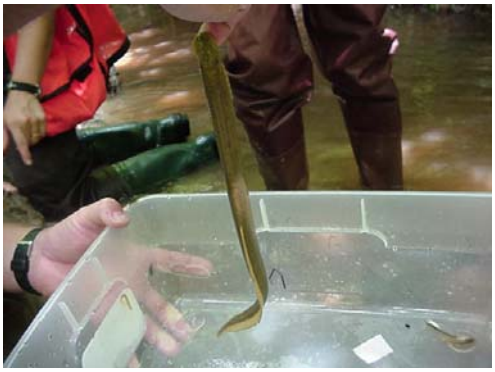
Project Site	# of Samples	Matched TSS samples	Matched TP Samples	Matched TN Samples
Cherokee	79	41	33	35
Houston	49	31	23	24
Newton	48	32	25	32
San Augustine	67	38	34	32

- **Biological assessments were conducted on the project sites beginning in the fall 2003 and were completed in the fall 2007. The tables below show the aquatic life use score for each site by season and community.**

Fish

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall 03	***44***	***48***	***44***	***48***	***58***	***55***	***45***	***45***
Spring 04	***45***	***49***	***44***	***39***	***51***	***46***	***46***	***49***
Fall 04	***43***	***51***	***41***	***39***	***58***	***54***	***40***	***45***
Spring 05	***46***	***50***	***39***	***51***	***52***	***55***	***47***	***43***
Fall 05	***47***	***51***	***42***	***42***	***49***	***51***	***42***	***48***
Spring 06	***50***	***51***	***40***	***48***	***51***	***55***	***41***	***45***
Fall 06	***47***	***53***	***44***	***48***	***55***	***55***	***43***	***51***
Spring 07	***49***	***47***	***33***	***43***	***50***	***54***	***42***	***43***
Fall 07	***47***	***49***	***40***	***48***	***54***	***52***	***48***	***48***

The fish sampling consists of electroshocking and seining. The electroshocker temporarily stuns the fish by producing an electrical current in the water. The seine is a large net that is used to trap fish. Both methods are necessary to obtain a complete sample.



Fish are identified if possible and measured upon collection. The fish on the left is a spotted bass and is 235 mm long. The fish on the right is a chestnut lamprey and is 265 mm long. Fish are released when they can be field identified.

Benthics

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall 03	***28***	***28***	***27***	***33***	***27***	***27***	***28***	***30***
Spring 04	***36***	***28***	***25***	***31***	***29***	***30***	***26***	***24***
Fall 04	***32***	***31***	***28***	***27***	***31***	***27***	***30***	***30***
Spring 05	***33***	***32***	***26***	***23***	***28***	***31***	***25***	***29***
Fall 05	***34***	***25***	***27***	***29***	***27***	***25***	***26***	***28***
Spring 06	***29***	***23***	***24***	***32***	***28***	***28***	***31***	***27***
Fall 06	***28***	***18***	***21***	***30***	***20***	***23***	***26***	***26***
Spring 07	***31***	***34***	***23***	***28***	***23***	***20***	***33***	***31***
Fall 07	***27***	***25***	***27***	***25***	***25***	***24***	***33***	***24***

Benthic macroinvertebrate sampling is conducted using a kick net to dislodge organisms from the stream bottom into a net. The contents of the dip net are emptied into a pan so that the aquatic organisms can be removed and preserved. This process continues until 100 benthics are collected.

Benthic macroinvertebrates are preserved in a 70% ethanol solution and sent to the contract taxonomist. The picture on the right includes the following benthics (from top, left to right): dragonfly, water beetle, crawfish, damselfly, whirlygig beetle, caddisfly, and mayfly.

Habitat

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall 03	***21.5***	***19***	***20***	***22***	***20.25***	***20***	***20***	***18.5***
Spring 04	***21.5***	***20.5***	***21***	***24***	***18***	***18.5***	***21.5***	***20.5***
Fall 04	***20.5***	***20***	***21.5***	***22***	***21.5***	***16.5***	***20.5***	***19.5***
Spring 05	***22***	***22***	***21.5***	***23.5***	***21.5***	***20***	***21.5***	***19***
Fall 05	***18.5***	***21***	***21***	***22.5***	***23***	***19.5***	***21.5***	***20.5***
Spring 06	***21***	***22***	***21.5***	***23.5***	***23***	***22.5***	***22***	***20***
Fall 06	***21.5***	***21.5***	***21***	***21.5***	***22.5***	***22***	***22***	***21***
Spring 07	***19.5***	***21***	***23***	***23.5***	***23.5***	***21.5***	***22.5***	***19.5***
Fall 07	***19.5***	***20***	***21.5***	***23***	***22***	***22***	***22***	***18***

Measurements were taken at each transect for the habitat assessment. They included stream depth, bank slope and erosion potential, substrate, % gravel, % instream cover, cover types, and % canopy cover.

- **Grab samples were collected monthly at each site from October 2003 – August 2007. The table below is a summary of the grab samples collected.**

Monthly grab samples are analyzed for Total Nitrogen, Total Phosphorous, Total Suspended Solids, Dissolved Oxygen, pH, Temperature, Conductivity and Turbidity.

Project Site	Pre Treatment Samples	Post Treatment Samples	Total Samples
Cherokee County	13	34	47
Houston County	14	33	47
Newton County	17	30	47
San Augustine County	5	42	47

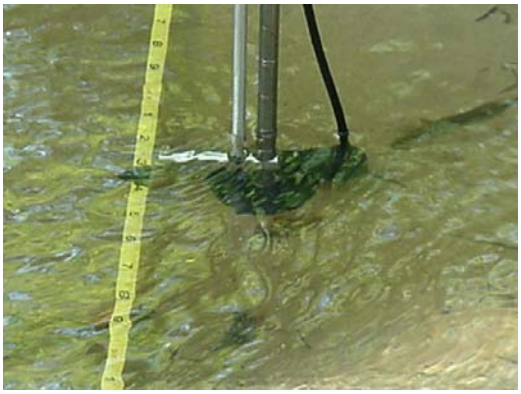
- **Standard National Weather Service (NWS) and Isco tipping bucket rain gauges were installed on project sites in October 2003. The table below is a summary of the rainfall that has been measured at each project site.**

The rain gauge on the left is a tipping bucket rain gauge used to measure intensity and duration. The rain gauge on the right is a standard NWS rain gauge and is used to measure amount. The NOAA weather station is used for comparison purposes and is located near the project site.

Project Site	2004 (Rain Gauge)	2005 (Rain Gauge)	2006 (Rain Gauge)	2007* (Rain Gauge)	Historical (NOAA)
Cherokee	70.5	32.22	49.94	36.10	44.47
Houston	62.26	30.9	56.78	35.55	44.49
Newton	76.41	47.06	70.72	29.32	54.58
San Augustine	80.17	40.08	53.88	41.12	53.75

***** Data through August 31, 2007.

- **Flow and stream profile measurements were taken at the project sites to develop stage-discharge curves.**



A Marsh-McBirney flowmeter is used to measure the flow rate and stream depth at various intervals along the stream channel. This allows for a stage-discharge curve to be developed that is the basis for flow weight composite storm sampling.

- **Continuous water quality monitors (Hydrolab Minisonde 4a, MS5) were installed at project sites and rotated to obtain monthly 24-hour diurnal data.**

The continuously monitoring hydrolab measures pH, DO, temperature, and conductivity every 30 minutes. It is housed in a PVC pipe for protection and secured to a bank tree.

- **Project sites were harvested, site prepared, and reforested.**

These pictures show the continuous cycle of sustainable forestry. Once a stand of trees has reached maturity, they are harvested (top left). The site is then prepared (top right) to facilitate the planting operation (bottom right). Once the seedlings are planted, the cycle starts over (bottom right).

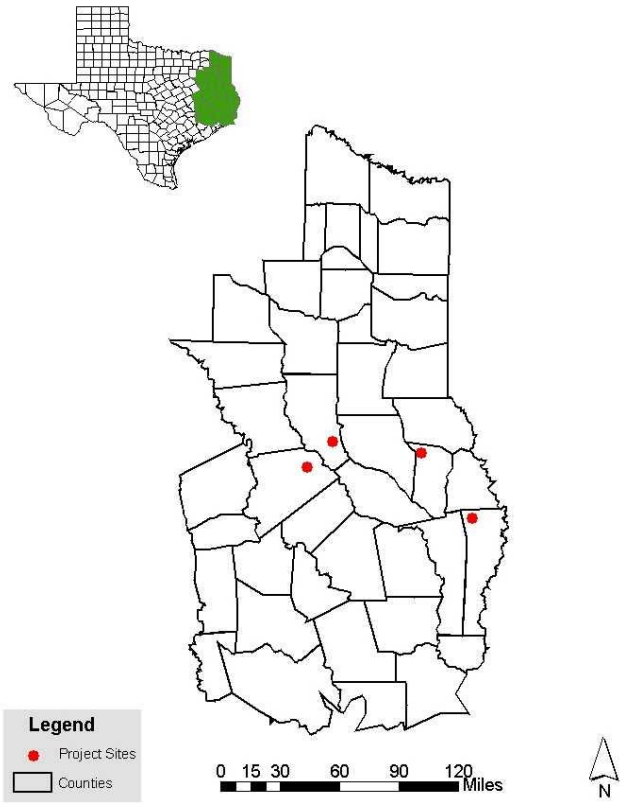
Subtask 1.3 The TFS will maintain a BMP database for the project results, including GIS data, for Hydrologic Unit Codes (HUCs), as provided by the TSSWCB. (Start Date: Month 1; Completion Date: Month 48)

- **An Access database was developed to store project data.**
- **Queries and reports were designed to provide easy access to project results.**

Subtask 1.4 The TFS will produce maps of the project sites using GIS. (Start Date: Month 1; Completion Date: Month 48)

- **The following maps were made:**
  - **General site maps (aerial, topographic, soils, location, stand type)**
  - **Location of monitoring equipment and rain gauges**
  - **Pre and post harvest maps**

- **Pre and post treatment aerial photographs were taken of the project sites.**
- **A GIS database has been created for this project. Layers include aerial photos, topographical maps, tract boundaries, streams, SMZs, roads, and locations of monitoring equipment.**



Subtask 1.5 The TFS, in cooperation with SWCDs, will prepare and distribute a BMP Effectiveness Monitoring Report to interested entities. (Start Date: Month 1; Completion Date: Month 48)

- **Project updates were posted to the Texas Forest Service website and can be found at (http://texasforestservice.tamu.edu/main/popup.aspx?id=792)**
- **The Texas Silvicultural BMP Effectiveness monitoring report was published on November 28, 2008.**
- **An electronic version was posted to the Texas Forest Service website and can be found at http://texasforestservice.tamu.edu/sustainable/bmp.**

Deliverables:

* QAPP approved by EPA before monitoring begins

  See Appendix A

* Monitor BMP effectiveness on 4 project sites

  BMP effectiveness was monitored on 4 project sites.

* Provide additional biological monitoring data on East Texas streams

  See Appendix A

* BMP Effectiveness Monitoring Report

  See Appendix A

* Produce GIS maps which show BMP effectiveness monitoring sites in ` relation to 303(d)-listed segments.

  See Appendix A

* Document project sites with before/after pictures and/or descriptions

  See Appendix A

PROGRAM TASK 2: BMP Education

Objective: To provide technical assistance and educational opportunities to landowners, loggers, foresters, and other interested groups through demonstration areas.

Subtask 2.1 The TFS will install BMPs on the project sites for educational purposes. (Start Date: Month 1; Completion Date: Month 48)

- **BMPs were installed on project sites before, during, and after operations. These included leaving Streamside Management Zones, properly constructing roads and skid trails by using water bars and wing ditches, avoiding or minimizing stream crossings, revegetating roads, conducting operations on the contour.**

The picture on the left shows the outlet for a water bar being created. The picture on the right shows the contractor spreading seed and fertilizer on the roadway to prevent erosion.

The picture on the left is a haul road that has been revegetated to prevent erosion. The picture on the right shows an up close image of a water control structure (water bar) that is also used to prevent erosion.

Subtask 2.2 The TFS will include articles regarding this project in quarterly newsletters to natural resource professionals in Texas and forest landowners in target watersheds. (Start Date: Month 1; Completion Date: Month 48)

- **Articles on this project were included in the following publications:**
  - **Forest Stewardship Briefings**
  - **Toledo Bend BMP Informer**
  - **Sam Rayburn BMP Informer**
  - **Texas Logger**
  - **Texas Forestry**
  - **County Forest Landowner Association Newsletter**
  - **Arbor Reader – TFS newsletter**
  - **Branching Out – Texas PLT**

Subtask 2.3 The TFS will coordinate field tours of the project sites throughout the duration of the project. (Start Date: Month 1; Completion Date: Month 48)

- **Tours of the project sites were conducted for the following groups:**
  - **SGSF Water Resources Committee**
  - **Technical Advisory Committee**
  - **BMP / Wetland Coordinating Committee**
  - **SGSF Water Resources Review Team**
  - **Lufkin Daily News Environmental Reporter**
  - **Numerous tours for project cooperators**

The BMP / Wetland Coordinating Committee toured the Houston County project site. Attendees were given a general overview of the project as well as an equipment demonstration.

Deliverables

* Pictures of BMPs on project sites

  See Appendix B.

* Copies of articles published in newsletters to natural resource professionals and forest landowners

  See Appendix B

PROGRAM TASK 3: Develop and Implement Forestry Water Quality Management Plans

Objective: To increase forest landowner awareness of and enrollment into silvicultural WQMPs.

Subtask 3.1 The TFS will increase forest landowner awareness of silvicultural WQMPs via media options listed in subtask 2.2 as well as other means that may be made available. (Start Date: Month 1; Completion Date: Month 48)

- **Project staff provided information to landowners inquiring about WQMPs.**
- **Several articles have been written regarding WQMPs.**

Subtask 3.2 The TFS, in cooperation with SWCDs, will enroll the forest landowners in WQMPs, if applicable. (Start Date: Month 1; Completion Date: Month 48)

- **Numerous discussions between the TFS and project cooperators have been held regarding the development of a WQMP on project sites under their ownership. Currently, project cooperators are not interested.**

Deliverables

* TSSWCB-certified WQMPs

  Project cooperators were not interested in WQMP certification

* Newspaper/media articles regarding WQMPs

  See Appendix C

PROGRAM TASK 4: Project Coordination

Objective: To coordinate project efforts with natural resource agencies and project participants.

Subtask 4.1 The TFS will create and chair a BMP Effectiveness Monitoring committee made up of state, federal, academia, and industry cooperators (Start Date: Month 1; Completion Date: Month 48)

- **Technical Advisory Committee Meetings were held in Lufkin on:**
  - **August 20, 2003**
  - **March 30 – 31, 2004**
  - **October 14, 2004**
  - **March 31, 2005**
  - **November 8, 2005**

The BMP Effectiveness Monitoring Technical Advisory Committee was formed to provide "technical expertise" in the direction and implementation of this project.

- **Committee members include representatives from TFS, TSSWCB, TCEQ, TPWD, EPA, NCASI, TLC, SFASU, Temple-Inland, International Paper, TNC, NETMWD, and USDA-ARS.**
- **A statistical analysis sub committee was formed to decide how to analyze the data that is collected from this project.**

Subtask 4.2 The TFS will work with local media to promote project activities. (Start Date: Month 1; Completion Date: Month 48)

- **A press release was developed and submitted to local and statewide media.**
- **The Lufkin Daily News ran an article on the monitoring project.**
- **This project was featured in Texas Forestry, a monthly publication of the Texas Forestry Association.**
- **Natural resources reporter for Lufkin Daily News utilized a multi-media approach to feature this project (web video and newspaper article).**

Christine Diamond, Lufkin Daily News, filming the water quality monitoring component of this project.

Subtask 4.3 The TFS will give BMP presentations to various groups in East Texas. These groups will consist of, but not limited to the following, Kiwanis, Rotary, and Lions clubs. (Start Date: Month 1; Completion Date: Month 48)

- **Presentations on this project were given to the following groups:**
  - **2003 State Stewardship Coordinating Committee**
  - **2003 Wetland BMP Coordinating Committee**
  - **2004 Texas Farm Bureau tour**
  - **2004 Temple-Inland Research Summit**
  - **2004 EPA Region 6 Ag Fair**
  - **2004 SGSF Water Resources Regional BMP meeting**
  - **2004 NETMWD Steering Committee meeting**
  - **2005 Four State BMP meeting**
  - **2005 TCEQ SWQM meeting**
  - **2005 Society of American Foresters National Convention**
  - **2006 USDA-CSREES National Water Conference**
  - **2006 EPA Region 6 SWQM meeting**
  - **2006 Lufkin Kiwanis Club meeting**
  - **2006 Metroplex Timber and Forestry Association meeting**
  - **2006 Texas SWCD Directors Annual Meeting**
  - **2007 Society of American Foresters National Convention**

A BMP project forester presented an overview of this project at the 2006 Texas Soil and Water Conservation District Directors Annual Meeting in Arlington.

Deliverables

* BMP Effectiveness Monitoring committee participants

  See Appendix D

* Newspaper articles

  See Appendix D

* Local media interviews

  See Appendix D