North Carolina
Division of Forest Resources

Final Report

For the North Carolina Forestry BMP Implementation Survey 2000-2003

December 2005

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Forestry NPS Unit
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North Carolina Non-point Source Program

forestry nps unit

NONPOINT SOURCE MANAGEMENT PROGRAM
Section 319(h) of the Clean Water Act
319 GRANT

www.dfr.state.nc.us

North Carolina Division of Forest Resources
1616 Mail Service Center
Raleigh, NC 27699-1616

The information provided in this document is made possible by a Federal Clean Water Act Section 319(h) grant administered by North Carolina's Non-point Source (NPS) Management Program and US-EPA Region 4.

Final Report for the North Carolina Forestry Best Management Practices Implementation Survey 2000-2003

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Published by the North Carolina Division of Forest Resources
Department of Environment and Natural Resources
December 2005

Acknowledgements

The Forestry Best Management Practices Implementation Survey was made possible with funding from the U.S. Environmental Protection Agency and the N.C. Division of Forest Resources. The USEPA funds were awarded through a grant under Section 319(h) of the Federal Clean Water Act. The primary agency involved in this project is the NCDFR. The N. C. Division of Water Quality served as the state administrator of the Federal 319(h) Grant Program in North Carolina. The Forestry NPS Unit would also like to thank the NCDFR's Water Quality Foresters and Service Foresters that have made this project possible. The continuing efforts of these foresters have made an immeasurable impact in the field and are vital to the success of this project. A special thanks goes to Jennifer Rall for her work to coordinate the gathering and organization of the field data for this project. Victoria Tillotson and Will Summer also assisted with the final report preparation.

Table of Contents

Executive Summary

In April 2003, the N.C. Division of Forest Resources completed a three-year survey to evaluate the implementation of Forestry Best Management Practices, otherwise known as BMPs. As a result of this baseline survey, the NCDFR has met the established management measures and BMP Implementation Survey (survey) project objectives identified within this report. The survey continues to be an integral part of NCDFR's effort to assess, develop and promote BMPs that protect North Carolina's forest water resources.

The NCDFR surveyed 187 active forest harvesting operations (sites) in 2000-01, 175 sites in 2001-02, and 203 sites in 2002-03. The level of BMP implementation was based on the review of more than 5,000 individual practices identified on 565 harvest sites. The division's field surveyors only evaluated the practices that were applicable to each site at the time of inspection. A water quality risk factor was also assigned to each identified practice. Additionally, an assessment of compliance with North Carolina's Forest Practices Guidelines Related to Water Quality (FPGs) was completed.

Average statewide BMP implementation over the three-year survey period was 82 percent. The level of BMP implementation varied regionally. Implementation of BMPs was high in the Piedmont (87 percent) and Coastal Plain (85 percent). In contrast, only 69 percent of the BMPs were implemented in the Mountain region. Statewide, an average of 8 percent of the forestry related practices threatened water quality. Regionally, few forestry related practices threatened water quality in the Piedmont (5 percent) and Coastal Plain (4 percent), whereas 16 percent of Mountain region forestry-related practices threatened water quality. Approximately 42 percent of the non-implemented BMPs posed a risk or threatened water quality. Threats or risk to water quality due to non-implementation of BMPs was lower in the Coastal Plain (31 percent) and Piedmont (38 percent), whereas in Mountain region was greater than 50 percent. The BMPs for skid trails, stream crossings, Streamside Management Zone (SMZ) conditions and prevention of debris entering the stream were frequently not implemented. These four BMPs accounted for 80 percent of the BMP non-implementation and 90 percent of the risk to water quality. Skid trails alone contributed to one-third of the BMP non-implementation and more than 20 percent of the risk to water quality. Stream crossings accounted for less than 20 percent of BMP non-implementation, however, this BMP category posed one-third of the risk to water quality.

The FPG standards were evaluated for each surveyed site to determine how closely the rule compliance aligned with the BMPs. The mean statewide FPG compliance score of the tracts evaluated during the Survey was 82 percent. The lowest average FPG compliance was found in the Mountain region (61 percent) and the highest occurred in the Coastal Plain (91 percent). The mean FPG compliance score in the Piedmont was 87 percent. Data collected from the Forest Management and Planning Program Accomplishment Report (FM Accomplishment Program) indicates a statewide average FPG compliance of 88 percent on active harvest sites from May 1, 2000 to April 30, 2003. This FPG compliance score is based on 3,281 active harvest site inspections conducted by NCDFR's field personnel. During this survey, four of the performance standards were most commonly observed to be in violation of the FPGs. Specifically, SMZ (.0201), Prohibition of debris entering streams and waterbodies (.0202), Access road and skid trail stream crossings (.0203) and Rehabilitation of project site (.0209) represented 96 percent of the FPG- violations observed during this three-year survey. The FPG compliance scores recorded in the survey are integrated into NCDFR's Forest Management procedures. The procedures are supported by the FM Accomplishment Program that typically captures about 4,000 FPG inspections per year.

Introduction

In April 2003, the N.C. Division of Forests Resources completed a three-year statewide survey on the implementation of Forestry Best Management Practices (BMPs). The BMP Implementation Survey (survey) is an integral part of NCDFR's effort to assess, develop and promote BMPs used to protect North Carolina's forest water resources during forestry operations.

The primary objectives of the survey were to:

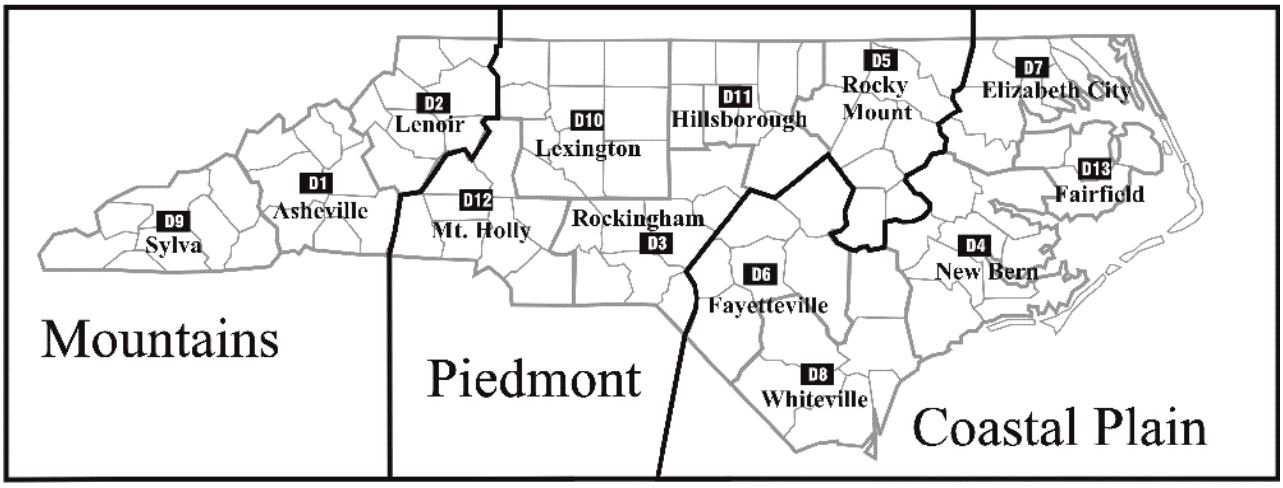
- Survey a minimum of 200 active harvest sites (sites) annually for a three-year period.
- Determine the level of forestry BMP implementation on active logging sites.
- Document NCDFR's prevention of non-point source pollution from forest harvesting.
- Objectively assess the implemented BMPs for strengths and weaknesses with respect to water quality protection.
- Document NCDFR's progress in BMP education, training and monitoring.

Secondary objectives of the survey were to:

- Benchmark BMP implementation with logger participation in the N.C. Forestry Association's ProLogger Program.
- Benchmark the effectiveness of NCDFR's seven water quality foresters.
- Determine compliance with forest harvest requirements found in applicable state river basin buffer rules.
- Compare BMP implementation to compliance with the Forest Practices Guidelines Related to Water Quality Performance Standards (FPGs).

Surveys were conducted in all three physiographic areas of the state (Coastal Plain, Piedmont, Mountain) and included all 100 counties. The NCDFR Districts survey data was aligned, to the extent practicable, with the state's physiographic areas (see Figure 1). Data obtained from the Mount Holly district (D-12) was aligned with the Piedmont and the Fayetteville district (D-6) data with the Coastal Plain.

Figure 1 – Physiographic Map of the State Aligned by NCDFR District Boundaries



The survey assessed BMPs that support the nine FPG performance standards. The BMPs examined in the survey include:

1. *Streamside management zone (SMZ)*
2. *Stream temperature*
3. *Debris entering stream*
4. *Waste entering stream*
5. *Permanent forest roads*
6. *Skid trails*
7. *Stream crossings*
8. *Access road entrances*
9. *Rehabilitation of project site*

Each of these nine practices had one or more conditions that could apply to the given practice. Performance of each practice was rated on the percentage of correctly implemented applicable conditions found in each practice. Physiographic (regional) BMP implementation was then determined by partitioning the surveys by district, physiographic region and statewide levels.

As noted above, each BMP is assessed for one or more conditions. Each of these conditions plays a key role in the implementation of the given practice. Each applicable condition was evaluated for successful implementation. Assessing the condition implementation supported the analysis of each BMP.

A glossary is included in Appendix 1 to support reader understanding of the terminology used in this report.

History

This survey was developed by NCDFR in the 1999 to 2000 timeframe. Three previous surveys completed by NCDFR in 1992, 1994-1995 and 1995-1996 differ from this survey in that they focused on closed or completed harvest sites (NCDFR, 1995; 1996). This three-year survey evaluated only active sites.

The survey was developed based on information contained in the 1989 North Carolina Forestry BMP Manual (NC DFR, 1989). The BMP Manual recommends BMPs for various types of forest operations. The appropriate implementation of BMPs for a given forest operation support compliance with the FPGs established under the N.C. Sedimentation Pollution Control Act of 1973 (SPCA) and the Federal Water Pollution Control Act of 1972 (amended 1977). The Survey was also based on the 1997 Recommendations of the Southern Group of State Foresters (SGSF) BMP Monitoring Task Force (Task Force) (BMP Monitoring Task Force, 1997). The Task Force was comprised of representatives from state forestry agencies, USDA Forest Service, forest industry, hydrologists, environmental specialists, and the National Council for Air and Stream Improvement, Inc. The Task Force received input from USEPA. The critical BMPs survey subject matters addressed by the Task Force included consistency, site selection, practices to be evaluated, reporting, monitoring, risk assessment, and knowledge transfer between the southeastern states. The NCDFR's survey format and layout is based on a survey design previously used by other southern state forestry agencies (i.e., Florida, Virginia, Georgia, Texas, and Tennessee). The Task Force recommendations were revised in June 2002; however, these revisions were not incorporated into this survey, as it was already ongoing (BMP Monitoring Task Force, 2002).

Regulatory Background

The SPCA was amended in 1989 to allow forestry (silvicultural) activities to remain exempt from permitting rules, provided the activities were in compliance with the FPGs. North Carolina's FPGs are performance standards that were developed by a team of forestry and sedimentation experts. The FPGs were reviewed at public hearings and approved by the Secretary of the Department of Environment and Natural Resources in 1990. The NCDFR was given the responsibility by the N.C. Division of Land Resources to inspect and monitor for FPG compliance. Implementation of forestry BMPs is necessary to prevent soil erosion and sedimentation to waterbodies. Using BMPs to comply with the FPGs is an important accountability of all forest operators conducting business in North Carolina.

Project Management Measures

Outside of the recommendations provided by the SGSF Task Force, this project supports milestones found in:

- USEPA-approved action plan for forestry.
- Standards 2, 3, 4, 5, 6, 10, 11 and 13 of the NCDFR's Water Quality Action Plan (1998) (Appendix 2).
- North Carolina governor's two-year initiative (2002-03) to *Educate the Public on How to Stop Polluted Runoff*.

And, in part, fulfills and addresses:

- Recommendations 18, 19 and 20 of the *1996 Report of the Governor's Task Force on Forest Sustainability*.
- Water quality topics discussed in the Southern Forest Resource Assessment Chapters 19, 20, 21 and 22.

Methods

Procedure

The survey is designed to assess practices found in NCDFR's BMP manual that were developed to play an integral role in conserving soil and protecting water quality during timber harvesting operations. A copy of the survey procedure and the survey is located in Appendix 3. The survey also contained some conditions that are currently proposed in the ongoing BMP manual revision. The survey documented both commonly practiced BMPs and innovative BMPs that achieved the same goal. Survey questions were answered with a "Yes" response if a BMP condition was correctly implemented and a "No" response for failure or improper BMP implementation. Non-applicable practices and conditions received a "N/A" response. Conditions that posed a threat or risk to water quality prior to the tract naturally healing over time recorded a "Yes" response. The surveyors considered the following six factors before making a "Yes" response:

1. Sediment was delivered to stream/waterbody;
2. Sediment was likely to be delivered to stream/waterbody during a rainfall event ($\leq$ 1" over 24 hours);
3. Sediment was delivered to stream/waterbody via wind gusts;
4. Adverse stream/waterbody temperatures were a result of harvest;
5. Logging debris and/or other logging byproducts were left in stream/waterbody;
6. Chemical or petroleum products had a high potential to reach stream/waterbody.

A threat or risk was interpreted to mean either a severe or potentially severe water quality problem. A "No" response under the threats or risks to water quality was selected if the condition(s) posed no threat to water quality. Standardized site selection criteria, survey instructions and supplemental training, and quality assurance/quality control methods were employed to ensure consistent and accurate data were collected and recorded.

Survey Implementation

1. Intended Sampling Method

The survey was only conducted on "active" harvest sites equal to or greater than five acres in size. "Active" was defined to be the ongoing operation of tree felling or transport/loading of equipment at the time the survey was conducted. Active also included pre-harvest activities such as forest road, access road, and skid trail construction and post-harvest site rehabilitation efforts. The sites had either intermittent or perennial streams and/or waterbodies located within the "cut zone" or within 50 feet of the harvest operation boundaries. The original procedure required a non-stratified site selection from the air and/or ground using the DeLorme *North Carolina Atlas and Gazetteer, Topo Maps of the Entire State* (Third Edition, 1997). Using this atlas, the surveyor selected a district-applicable map grid-number or atlas page and followed steps listed below to find sites to evaluate:

- The atlas page was randomly sub-sampled for five different quadrants. Each quadrant was approximately 25 square miles in area.
- The five quadrants were then sub-sampled by numbering each quadrant on the grid or page that was applicable to the district and randomly selecting the numbers.

- Quadrants selected were analyzed for road accessibility and timber harvest potential. Quadrants with no road access or harvest potentials (i.e., urban areas) were discarded for the three-year duration of this survey and additional sub-sampling took place to replace them. This process was repeated until five quadrants were available to be surveyed.
- Selected quadrants often did not represent all counties found in the district. To resolve this limitation, another grid was selected. Again, the process was repeated until all five viable quadrants were available for each county in the district.
- The survey was designed so that all counties in the district would be sampled at least twice annually.
- Once a county yielded a successful survey, the surveyor moved the search effort to the next county. This was done to ensure all counties within the district were sampled.
- During a second surveying effort, the surveyor did not include any previously surveyed quadrants to maximize spatial distribution of the sampling on an annual basis.
- A surveyed quadrant was available for sampling the following survey years.
- Each surveyor maintained a map that depicts the location of the sites.

a. Aviation-Supported Site Selection

The five selected quadrants were flown to determine if harvesting operations existed that fit site-selection criterion. In an effort to minimize cost, aviation-supported site selection was often coupled with other forestry-related responsibilities requiring air support.

b. Ground-Supported Site Selection

The five selected quadrants were reviewed via ground to the extent practicable. Sites that met the selection requirements were surveyed at the time of discovery. To minimize bias, the surveyor did not contact the sampled landowners and/or loggers in advance of the survey. However, if these individuals were present on the tract at the time of survey, they were provided the opportunity to accompany the surveyor while the survey was conducted. An information flier (Appendix 4) describing the purpose of the visit was provided to the landowners/loggers at the time of the survey. Surveyors were directed to disassociate the survey from any discussion on potential FPG non-compliance (violation) with the logger and/or landowner, because the survey itself did not represent an enforcement tool.

2. Modified Sampling Method

Alternative sampling was also employed for the survey. When and where time constraints and other forest management and/or forest protection obligations made the above sampling methods impractical, the surveyor asked the NCDFR county office staff to locate where harvest operations were ongoing in a given county. When multiple sites were presented at one time, sample sites were randomly chosen and surveyed. When no sites appeared to be available in a given county, surveyors drove transects in an attempt to find a site.

3. Completing the Survey

The 14 page survey form consists of:

- General Information (Part I)
- Site Information and Characteristics (Part II)
- Forestry Operations (Part III)
- BMPs Applicable to Operations, BMPs and Overall Summary (Part IV).

The survey form was developed to minimize excessive writing in the field. With the exception of Part I (General Information), completing the survey primarily required a check or circle for the appropriate choice for each applicable question (see Appendix 3). Comment lines provided the surveyor the opportunity to clarify a BMP issue not captured by a yes or no response. Based on field testing, the survey itself required 15 - 20 minutes to complete. After completing the survey, a site evaluation/FPG compliance notification component was completed. This FPG compliance information has been compared to the survey data on an annual basis. The data was also compared to other FPG inspections completed outside of this project. The survey did not replace and/or serve as an alternative product to NCDFR's normal forest management record-keeping. All FPG compliance issues discovered during completion of the survey were managed via NCDFR's FPG policy and procedure.

4. Compiling the Survey Data

The NCDFR's Forestry NPS Unit compiled and tracked survey data at the Raleigh Central Office (CO). Completed surveys were sent to the NCDFR CO monthly. A survey copy was kept in the district office from where the survey was completed for record-keeping purposes. The Forestry NPS Unit office assistant compiled the survey data in a Microsoft® Access™ database.

5. Quality Control

The Forestry NPS Unit staff completed quality control by randomly selecting sites where surveys were completed to ascertain the accuracy and completeness of the surveys. A number of surveys were also completed in tandem (field surveyor and CO representative). In this case, each party completed the survey before selections and ratings were compared for discrepancies. If errors or discrepancies were found, the surveyors reviewed and discussed the information to resolve concerns.

6. Analyzing the Survey Data

The BMP Implementation Survey results were based on the sum of the applicable BMP condition(s) found on each site (see Table 1 and Figure 2 below for an example). All survey results were derived from query reports from the database. The BMP implementation data was then assessed to provide specific physiographic regional results (see Statistical Analysis).

The survey findings are based on the evaluation of more than 43,000 BMP conditions representing more than 5,000 practices on 565 sites. Appendix 5 provides state maps that represent the total number of surveys completed in each county. Appendix 3 contains a copy of the survey.

7. Statistical Analysis

The BMPs evaluated represent a sample set of the total population of BMP conditions implemented on harvesting operations across the state during the survey timeframe. Based on the survey procedure, the sample statistics below express the quality of the survey's BMP implementation estimate.

BMP Implementation Estimate (f):

$$f = \frac{\text{BMPs implemented}}{\text{BMPs evaluated (n)}} \qquad f = \frac{15{,}720 \text{ BMPs implemented}}{19{,}217 \text{ BMPs evaluated (n)}} \qquad f = 0.82$$

Standard Error (se):

$$se \sqrt{\frac{f(1-f)}{n}} \qquad se \sqrt{\frac{0.82(1-0.82)}{19{,}217}} \qquad se = 0.0028$$

95% Confidence Interval (ci):

$$ci = f \pm 2se \qquad ci = 0.82 \pm (0.0028) \qquad ci = 81.72\ \%,\ 82.28\%$$

The estimate of statewide BMP implementation (f) is 82 percent, with an estimated standard error (se) of 0.0028. The survey data indicates that BMP implementation will be at least 81.7 percent and no more than 82.3 percent, based on 95 percent confidence interval.

8. Reporting Results

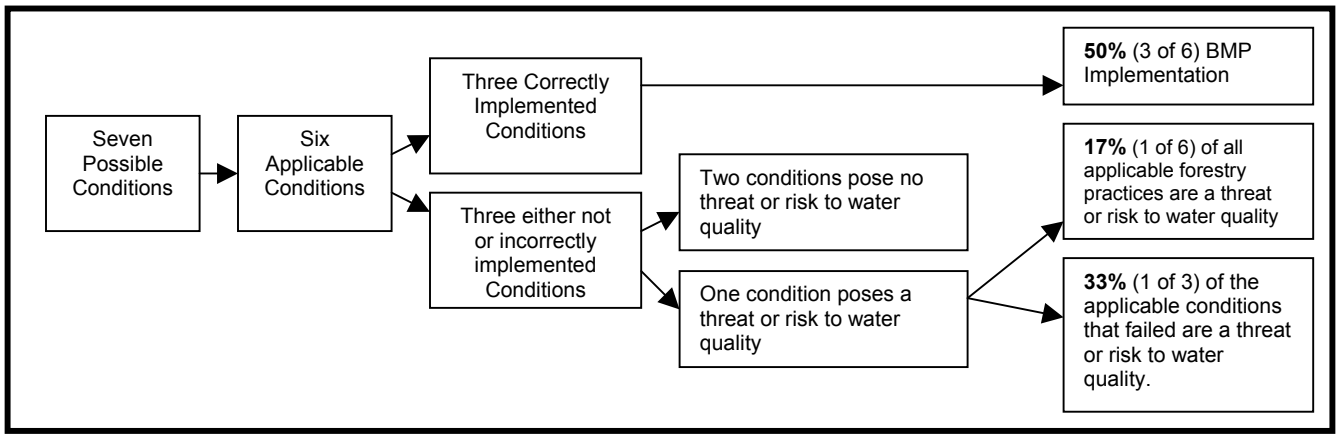
The results and discussion provided in this report are founded on surveyed BMP practices and conditions. Both BMP practices and conditions and some of the General Information, Site Information and Characteristics, and Forestry Operation variables are set apart in **bold text** for ease of recognition.

Table 1 – Sample Page of a Completed Survey Form

Practice → **BMP: Debris Entering Stream** (Refer to pages 12-16 of the 1989 Forestry BMP Manual for more information about these categories)	MEETS BMP GUIDELINES			THREATS OR RISKS TO WATER QUALITY	
	Yes	No	N/A	Yes	No
Conditions: 1. Stream obstructions (i.e., soils) from forestry operation(s) nonexistent.	☐	☒	☐	☒	☐
2. Stream flow impairment (i.e., soils) by forestry operation(s) nonexistent.	☒	☐	☐	☐	☒
3. Logging and site preparation debris kept out of stream channels.	☐	☒	☐	☐	☒
4. Stream obstructions (i.e., logging debris) from forestry operation(s) nonexistent.	☒	☐	☐	☐	☒
5. Stream flow impairment (i.e., logging debris) by forestry operation(s) nonexistent.	☒	☐	☐	☐	☒
6. Stream channel/course has not been altered by obstruction(s).	☐	☒	☐	☐	☒
7. Innovative BMP utilized: ☐Yes ☒ No. If yes, describe in Comments.	☐	☐	☒	☐	☐
Total Responses for Debris Entering Stream	***3***	***3***		***1***	***5***

Table 1 depicts a sample page of a completed survey form that covers the BMP conditions of **Debris Entering Stream**. There are a total of seven possible conditions for this one practice. Only those conditions which applied to this specific tract were evaluated by the surveyor. In this example, six of the seven conditions were considered applicable for this tract. However, of these six, only three were correctly implemented (those resulting in a "Yes" response). The implementation rate of the conditions for the BMP of **Debris Entering Stream** is therefore 50 percent [three correct out of possible six]. Likewise, 17 percent of all applicable forestry practices posed a threat to water quality [one threat or risk out of the six possible conditions]. Lastly, 33 percent of the incorrectly or non-implemented applicable conditions posed a threat or risk to water quality [one threat or risk out of the three non-implemented BMP conditions]. Figure 2 below represents a visual display or flow chart of this process. For the purposes of this report, correctly implemented BMPs posed no threat or risk to water quality.

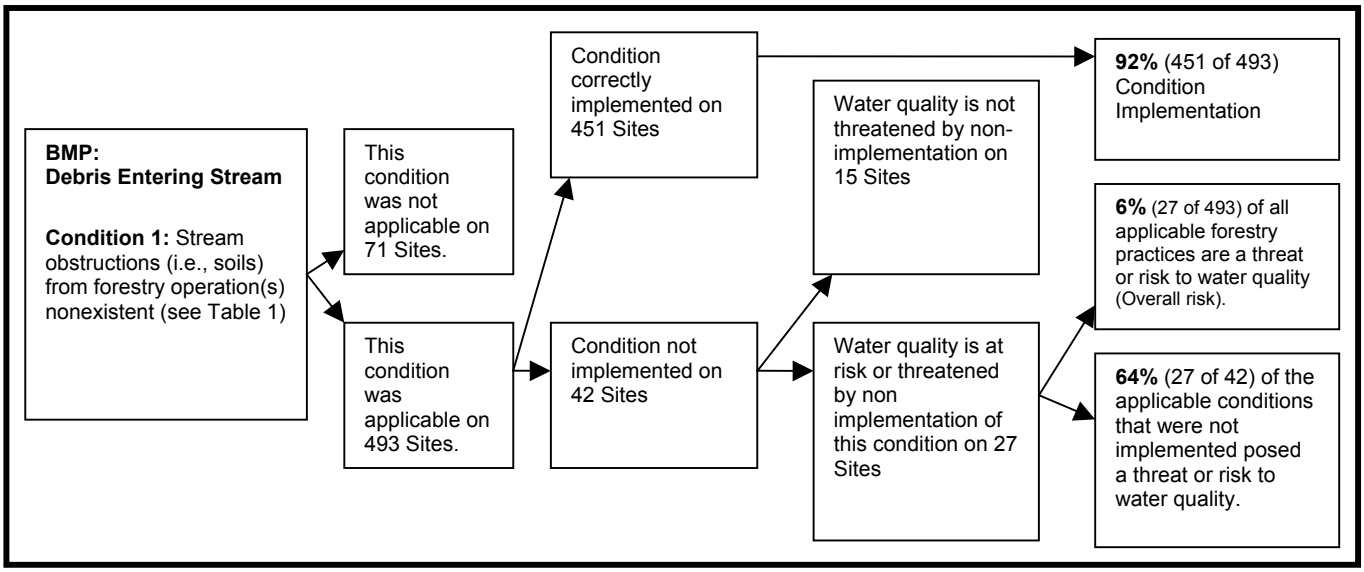
Figure 2: Flow Chart Example of BMP Implementation and Threat/Risk Evaluation



Each BMP condition was individually evaluated for implementation. The BMP condition implementation was determined by averaging the implementation of the same applicable condition from all surveys. Threat or risk to water quality was determined by this same method (Figure 3).

The NCDFR surveyors also looked for 'Innovative' BMPs employed in the harvest operations and documented those found using the designated checkbox on the survey form (Appendix 3). Each BMP practice included an inquiry to document 'Innovative' BMPs.

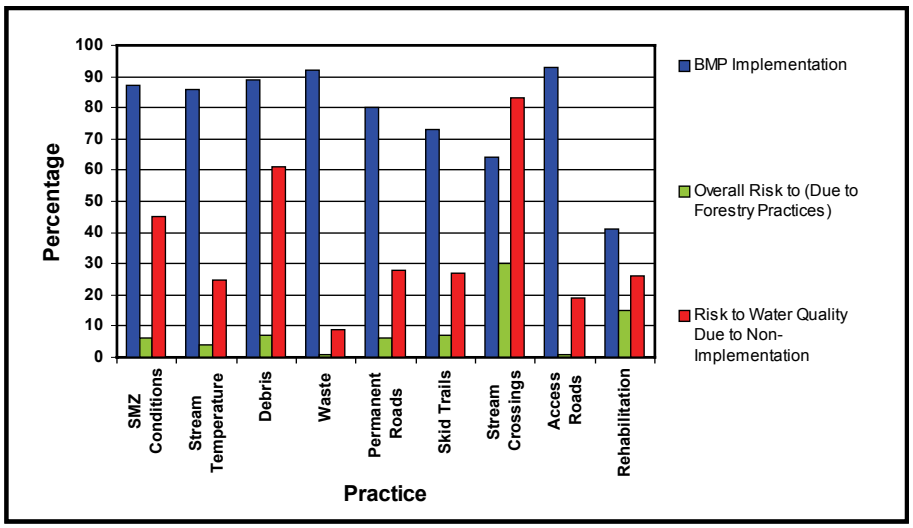
Figure 3: Flow Chart Example of BMP 'Condition' Implementation Evaluation



Results and Discussion

Best Management Practice Implementation

Figure 4: Statewide BMP Implementation by Practice

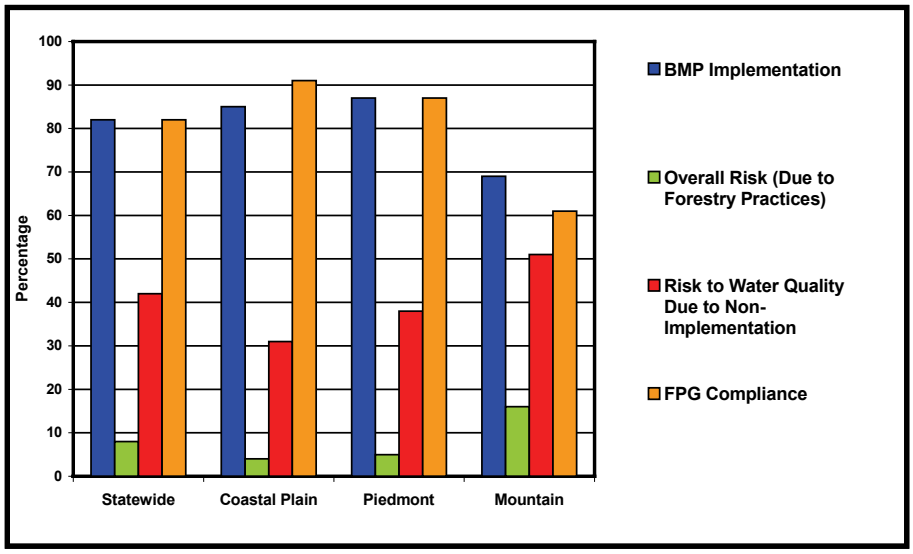


Forestry Best Management Practices (BMPs) are well implemented throughout North Carolina (82 percent). However, some BMP deficiencies identified in this report will need to be addressed through additional training. For example, the BMPs related to **Access Road Entrances** and **Waste Entering Streams, Water bodies or Groundwater** were consistently implemented at high rates across the state; whereas, **Stream Crossings** and **Site Rehabilitation** BMPs were not consistently implemented (Figure 4).

The BMP implementation rates in the Coastal Plain (85 percent) and Piedmont (87 percent) exceeded those operations found in the Mountains (69 percent) (Figure 5). Overall, low BMP implementation performance in the Mountains was amplified by low implementation of BMPs related to **Stream Crossings, Skid Trails** and **Site Rehabilitation**. However, these specific BMPs were also implemented at lower rates in the Coastal Plain and Piedmont (Figure 6), although the differences were not as striking. The data supporting figures presented herein can be found in Appendix 6. These BMP areas of concern can be addressed through NCDFR internal training, and structured (classroom) and informal (tailgate) meetings with consulting foresters and loggers.

Threat/Risk to Water Quality

Figure 5: BMP Implementation and FPG Compliance by Statewide & Regional

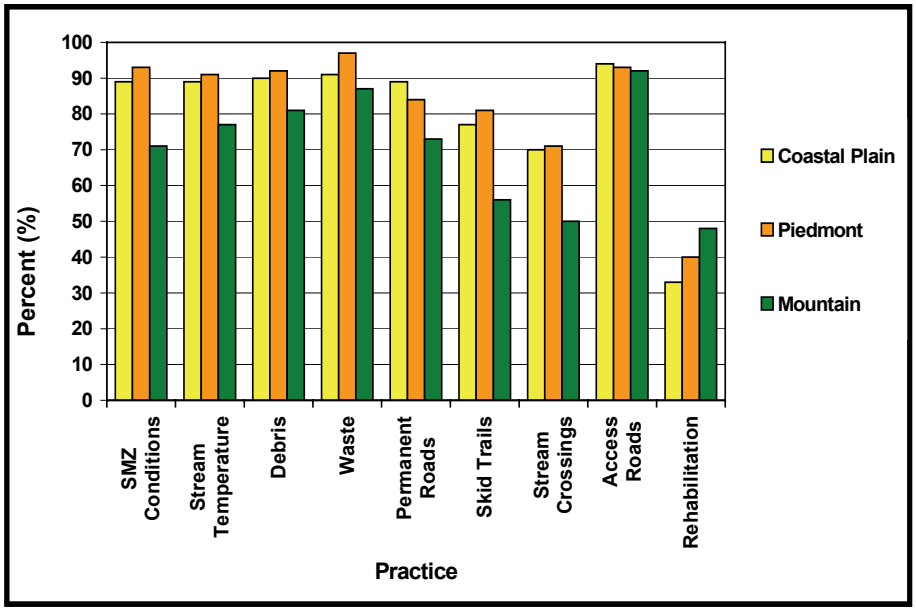


Another measure of statewide BMP implementation can be found with the evaluation of the overall threat or risk to water quality posed by the forestry practice. The terms "threat" and "risk" are used interchangeably for the purposes of this report. Survey results indicate 8 percent of the forestry practices posed a threat to water quality. Mountain surveyed sites had a higher occurrence of risks than the statewide average (Figure 5). An evaluation was also completed to review the risk posed to water quality due to BMP non-implementation. Results from this evaluation

indicated approximately 42 percent of the non-implemented BMPs posed a risk to water quality. These results confirm the importance of adequate BMP implementation. Basically, when BMPs are not implemented, there is a high probability of adverse water quality impacts to water resources close to forest harvesting operations.

Forest Practices Guidelines Related to Water Quality Compliance

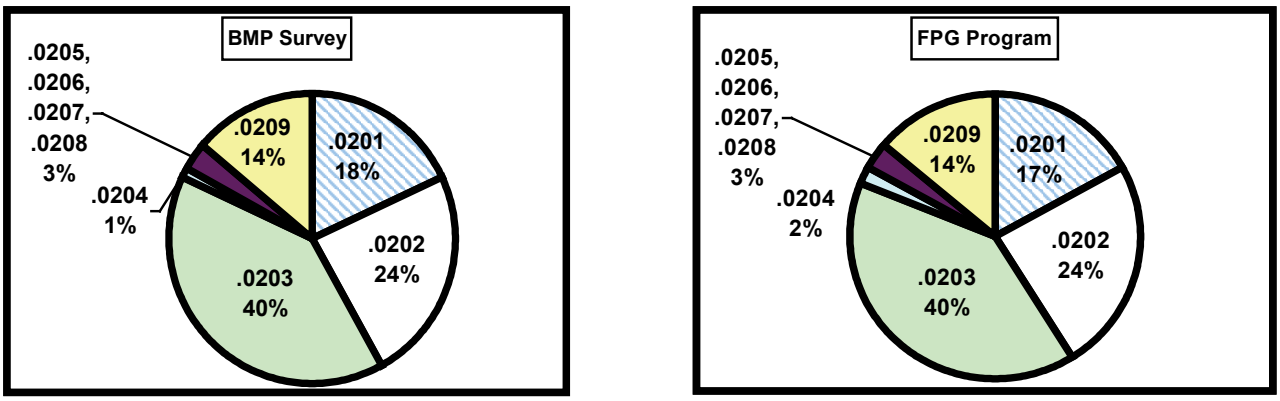
Figure 6: BMP Implementation by Region



With regard to the FPGs, surveyed sites exhibited an 82 percent statewide compliance rate. Compliance in the Piedmont (87 percent) and Coastal Plain (91 percent) was greater than the survey's statewide compliance rate, whereas Mountain sites were nearly 21 percent lower. The survey FPG compliance scores were 6 percent lower than the average compliance of 88 percent identified from NCDFR's Forest Management Accomplishment Reporting and Planning Program. The Program-reported FPG compliance is based on 3,281 active harvest site inspections documented during the same time frame this survey was conducted (NCDFR, 2004). The noted difference in performance levels may be attributed, in part, to the survey's criteria for site selection being more stringent than normal procedures (i.e., site must contain or be proximate to a water body).

To better understand implementation and compliance relationships, specific FPG standards were also examined. For example, FPG standard .0203 (Access Road and Skid Trail Stream Crossings) was violated most frequently (Figure 7). Higher rates of violations were also observed for FPG performance standards .0201, .0202 and .0209 (Streamside Management Zone, Stream Obstruction and Site Rehabilitation, respectively). The remaining five FPG performance standards were regularly

Figure 7 – Percentage of Violations by FPG Regulation



observed to be in compliance. Appendix 7 lists all nine FPG performance standards and respective regulatory codification. The survey FPG compliance results correlate well with the statewide FPG data found in the FPG Program (Figure 7). This observation, in turn supports the value of BMP implementation data collected in this survey and reported herein.

Site Specific Characteristics

The survey incorporated multiple general interview and subjective site description questions or variables that describe both the harvest site and methods of operation. Survey questions addressed the following topics. Each topic is covered in more detail in this section.

- Forestland ownership
- Technical forestry assistance and pre-harvest planning
- Seasonal impacts
- River basin buffer rules
- Site size
- NCDFR's water quality foresters support
- North Carolina Forestry Association's ProLogger Program input
- Forest management type
- Harvest method
- Soil type
- Slope
- Erosion observed and erodibility potential

Appendix 3 contains the specific site and operation questions. The following data results indicate how these specific variables may have influenced BMP implementation. The average harvest site size was 85 acres. Non-industrial private forest landowners (NIPF) were the predominant property owners surveyed. The most commonly surveyed land features included flatwood, foothill, and mountain terrain. The majority of NIPF landowners did not utilize professional technical assistance or a pre-harvest plan. Only 36 percent of the sites had a written pre-harvest plan. Harvest sites supported by technical forestry assistance (13 percent) or a pre-harvest plan (10 percent) had better BMP implementation than sites without assistance (26 percent) or a plan.

More than 75 percent of the survey sites were passively managed (i.e., no in-stand management or planting) and nearly 70 percent of the sites were clearcut harvests. The BMP performance on passively managed forests was poor compared to intensively managed sites, but better than sites managed for wetland or silviculture /agriculture (silvi/agro) purposes. The BMP performance on sites that were clearcut was 4 percent better than the statewide average, but 7 percent worse than sites that were subject to thinning practices.

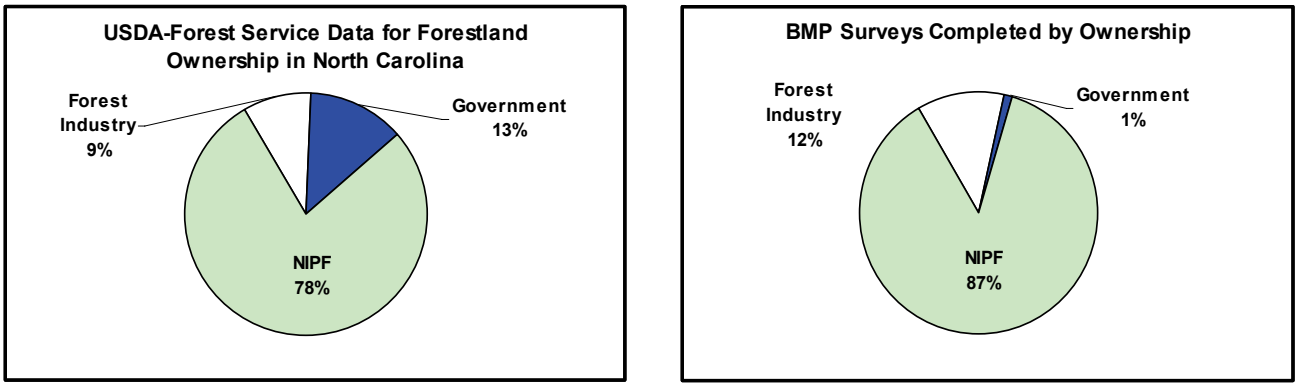
Seventy percent of the survey sites were located on slopes less than 10 percent and more than one-half of the sites were located on clay, loam or clay-loam type soils. Few surveys captured sites deemed to be highly erodible and steep.

Forestland Ownership

Surveyed sites were located on forestland owned by NIPFs, forest industry or government. As random sampling was employed, ownership was not a criterion for selecting sites. Approximately 87 percent of the sites were located on forestland owned by NIPFs. The NIPF landowner sites were concentrated in the Piedmont and Coastal Plain (approximately 66 percent of all the survey sites).

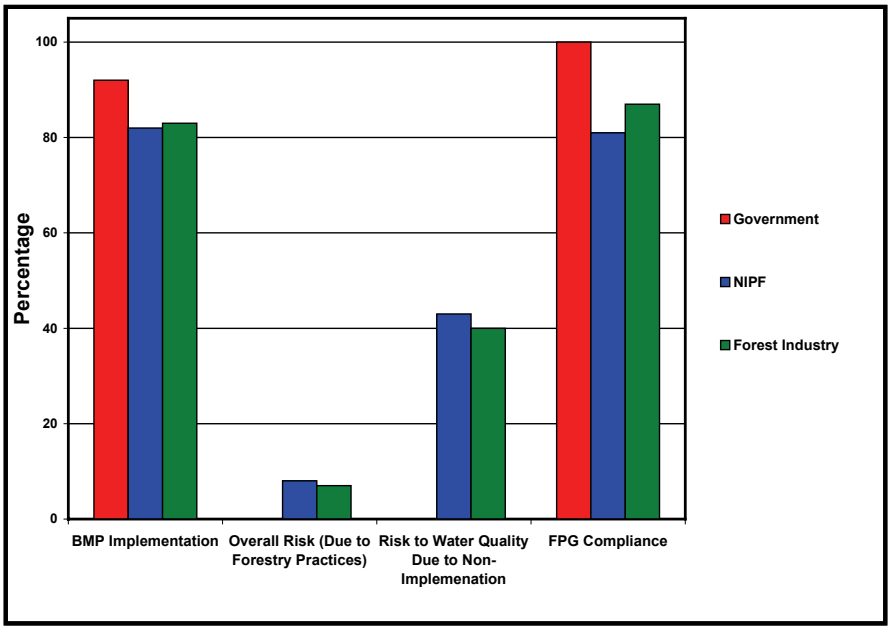
Approximately 12 percent of the sites were located on forestland owned or leased by forest industry and 1 percent of the sites was located on government-owned forests. Ownership data gathered from the survey was relatively similar to the statistics found in the recent Southern Forest Resource Assessment Technical Report, Forest Statistics for North Carolina, 2002. According to the USDA Forest Service, NIPF landowners own approximately 78 percent of the forestland in North Carolina. Government holds approximately 13 percent of forestland and 9 percent is owned or leased by forest industry (Johnson, 1991; Conner and Sheffield, 1999; Johnson and Brown, 2002; Brown, 2002). The survey results differ because there was a higher percentage of harvest sites located on NIPF-owned forestland as opposed to government land (Figure 8).

Figure 8 – Comparison of Ownership USDA-Reported to Survey-Reported Data Ownership



The survey's sampling deviation may be a direct result of harvesting restrictions found on government-owned forestland. These timber harvest restrictions are due to a large portion of government forestland being designated as protected natural resource areas (national parks, state parks, wildlife refuges, properties placed under restrictive conservation easements) or designated military zones used for training and security (e.g., Fort Bragg, Camp Lejeune, Dare Bombing Range). Additionally, North Carolina's national forests that have harvest potential have been limited by increased regulations and new policies. The recently completed forest inventory, performed with the U.S. Forest Service, reinforces the forestland ownership data captured in NCDFR's survey (Brown, 2002).

Figure 9: BMP Implementation and FPG Compliance by Landowner Type



The BMP implementation on government-owned forestland was greater than 90 percent; forestry practices posed little or no risk to water quality (Figure 9). All three of the government-owned sites were documented as FPG compliant. Implementation results on forest industry and NIPF forestland were similar. Approximately 83 percent of the BMPs were correctly implemented; 8 percent of the forestry practices that posed a risk to water quality were recorded on sites owned by

NIPF and industry landowners. Less than 43 percent of the non-implemented BMPs posed a threat to water quality on NIPF and Industry sites. Industry and NIPF-owned lands were found to be in compliance with FPGs 87 percent and 81 percent of the time, respectively.

Technical Forestry Assistance and Pre-harvest Planning

Thirty-seven percent of the surveyed sites were supported by technical assistance from a forestry professional (considered to be a consulting forester, NCDFR personnel or a forester employed by the forest products industry). An additional 37 percent of the sites had technical assistance provided by other sources (timber buyers and unknown parties). Twenty-six percent of the sites had no technical assistance. The BMP implementation (86 percent) and FPG compliance (89 percent) rates were greater on sites that had professional assistance as compared to sites that had no assistance or had assistance from other sources. Furthermore, BMP implementation (84 percent) and FPG compliance (87 percent) on sites with technical assistance from other sources was greater than sites with no technical assistance (76 percent BMP implementation and 71 percent FPG compliance).

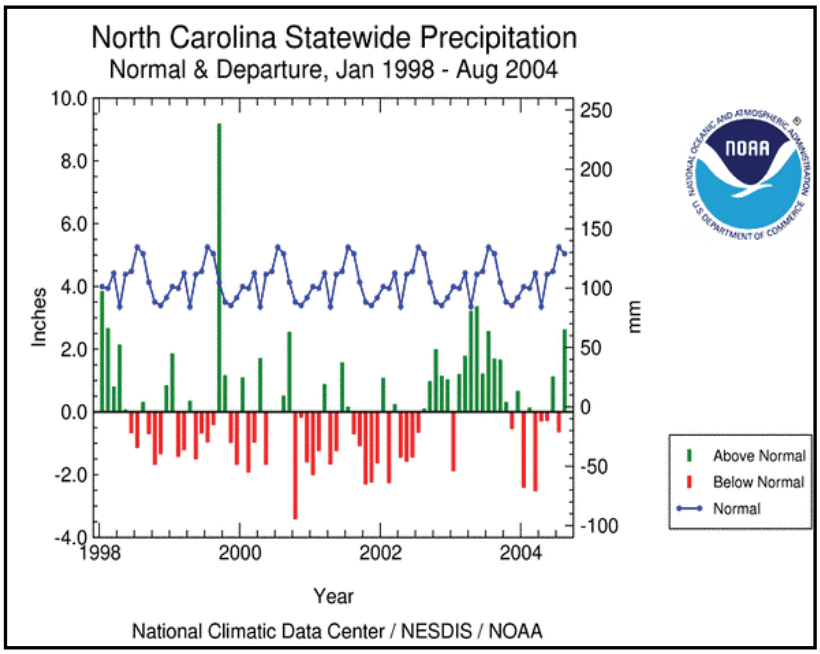
Forestry practices (4 percent) and non-implemented BMPs (31 percent) posed the least risk to water quality on sites that had technical assistance from a forestry professional compared to other sites. Approximately 6 percent of the forestry practices and 35 percent of the non-implemented BMPs posed a risk to water quality on sites with technical assistance from other sources. More than half of the non-implemented BMPs and 13 percent of the Forestry Practices posed a risk to water quality on sites with no technical assistance.

It has been a practice of the NCDFR to encourage landowners to use professional consulting forester assistance for managing their forestland. Landowner assistance is also available from NCDFR personnel and foresters employed in the forest products industry. Forestry professionals provide numerous services that can assist landowners through the complexities of harvesting timber that include the evaluation of timber value, property boundaries, marketing the timber, environmental regulations, timber sale contracts and tax obligations.

The NCDFR considers pre-harvest planning to be a critical step prior to harvesting timber. Pre-harvest planning provides safety, economic and environmental protection benefits. Approximately 36 percent of the operations surveyed had a written pre-harvest plan (PHP) on-site. Sites with a PHP performed better than sites without a PHP. Harvest sites supported by a PHP were compliant with the FPGs 87 percent of the time compared to 79 percent for sites without a PHP. Furthermore, only 5 percent of the forestry practices and 33 percent of the non-implemented BMPs posed a risk to water quality on sites with a PHP. Nearly 10 percent of the forestry practices and half of the non-implemented BMPs posed a risk to water quality on sites without a PHP. Based on survey results, professional technical assistance and pre-harvest planning are two important aspects of successful BMP implementation and FPG compliance.

Seasonal Impacts

The survey was conducted year-round to capture seasonal impacts on harvest operations. Thirty-five percent of the sites were evaluated during the winter; about 40 percent of the sites were evaluated in the spring (21 percent) and summer (20 percent). Less than 25 percent of the sites were evaluated in the fall. Based on the survey data, no seasonal difference was noted in BMP implementation or FPG compliance. However, as the survey occurred during a period of persistent drought through 2000-2003, seasonal impacts may not have been as evident (Figure 10).



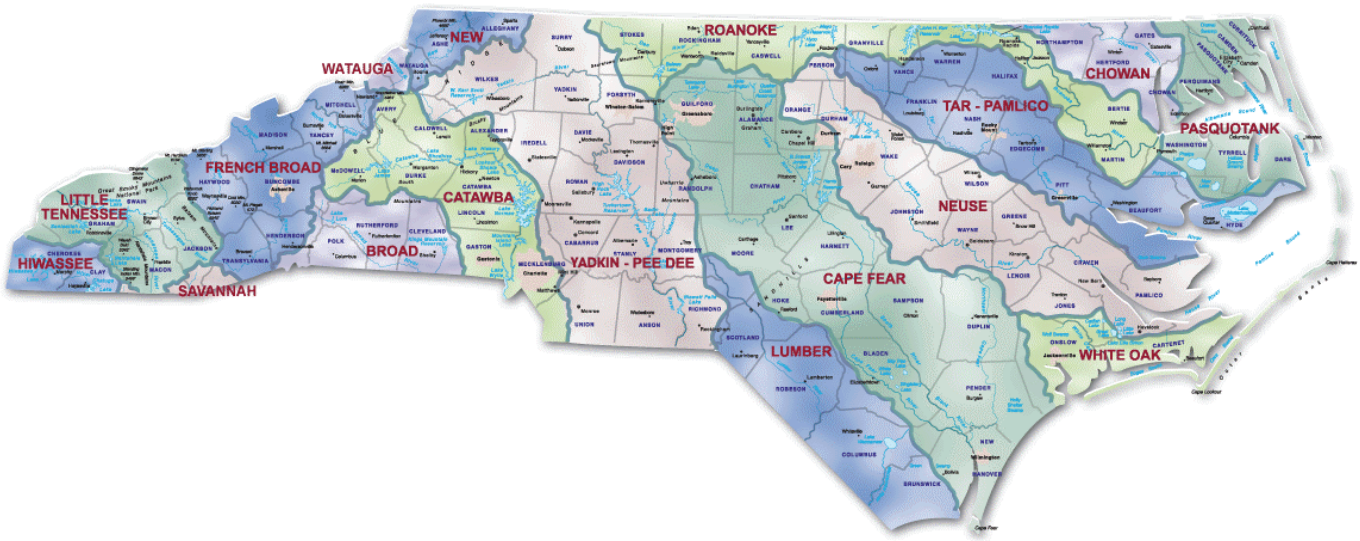
River Basin Riparian Buffer Rule Compliance and River Basin Data

The Neuse River and Tar-Pamlico River basin rules were applicable to 129 sites, or 23 percent of the survey sites. Only one site was applicable to the temporary Catawba River buffer rule. Compliance with the Tar-Pamlico and Neuse River basin rules was 97 percent and 96 percent, respectively. The single applicable site in the Catawba Basin was compliant with the buffer rule. Perennial stream, intermittent stream and perennial waterbody zone rule compliance was greater than 90 percent for the Neuse and Tar-Pamlico river basins (Appendix 6). Survey results show that Neuse River and Tar-Pamlico River BMP implementation and FPG compliance performance rates were among the highest in the state. This high level of BMP implementation and FPG compliance is attributed, in part, to the extra precautions taken to comply with the river basin riparian buffer rules. Flatter terrain also contributed to better BMP and FPG performance in these two river basins. The majority of the poor BMP implementation and FPG compliance was commonly found in river basins located in the mountains (i.e., Broad, Hiawasee, Little Tennessee and New rivers). A summary of BMP implementation, water quality risk and FPG compliance for all 17 river basins is presented in Table 2. A map of the 17 river basins found in North Carolina is also provided (Figure 11).

Table 2: River Basin BMP Implementation and FPG Compliance

River Basin	Number of Surveys	Percent of Surveys	Statewide BMP Implementation (%)	Risk to Water Quality due to Forestry Practices (%)	Risk to Water Quality due to Non-Implementation (%)	FPG Compliance
Broad	22	4	71	12	40	77
Cape Fear	65	12	82	7	39	83
Catawba	49	9	76	10	41	78
Chowan	23	4	83	8	44	78
French Broad	39	7	64	19	53	62
Hiwassee	12	2	66	17	51	50
Little Tennessee	26	5	73	9	35	73
Lumber	35	6	86	3	19	94
Neuse	83	15	95	2	39	95
New	18	3	68	20	62	39
Pasquotank	17	3	83	2	10	100
Roanoke	34	6	90	4	45	88
Savannah	0	0	N/A	N/A	N/A	N/A
Tar-Pamlico	59	10	90	3	31	93
Watauga	0	0	N/A	N/A	N/A	N/A
White Oak	7	1	86	2	11	100
Yadkin-Pee Dee	76	13	83	8	44	79

Figure 11: North Carolina River Basin Map

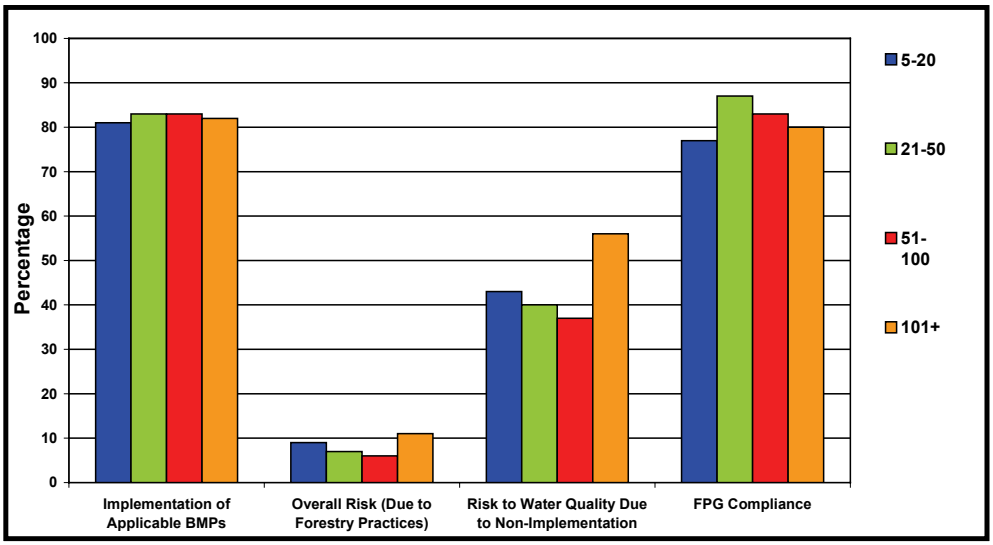


Harvest Site Size

The average harvest site surveyed was 85 acres. The average Piedmont site (66 acres) was small compared to the average Coastal Plain (111 acres) or Mountain sites (81 acres). Surveyed sites were divided into four acreage categories to assess tract size implications on BMP implementation and FPG compliance performance:

1. 5 acres – 20 acres
2. 21 acres – 50 acres
3. 51 acres – 100 acres
4. 101 acres and above

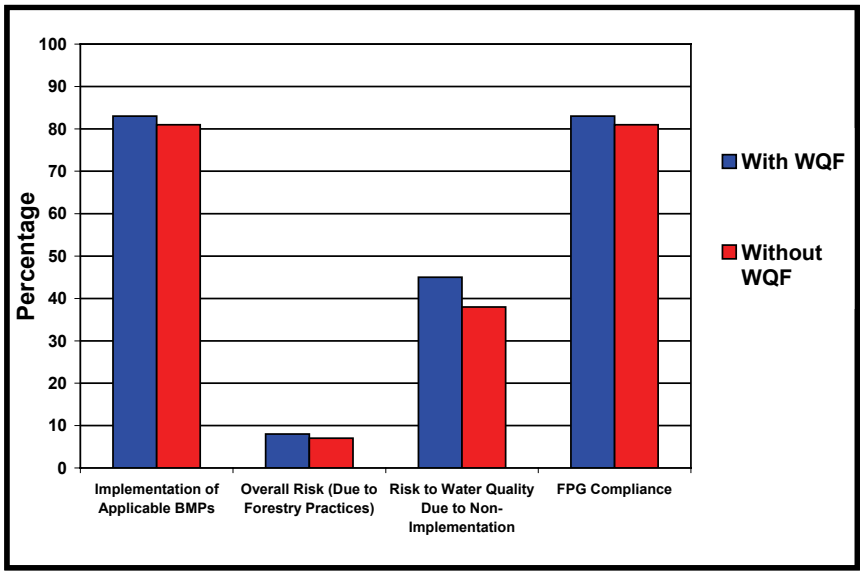
Figure 12: BMP Implementation and FPG Compliance by Number of Acres



Survey results did not show a direct correlation between tract size and BMP implementation or FPG compliance performance. Implementation of BMPs were similar regardless of site size (Figure 12). Risk to water quality posed by forestry practices and non-implemented BMPs was similar for all four categories as well. However, harvesting operations on sites greater than 101 acres threatened water quality more frequently compared to the other sites. More than 10 percent of the Forestry Practices and 56 percent of the non-implemented BMPs posed a risk to water quality. Site FPG compliance ranged from 77 percent (5 to 20 acres) to 87 percent (21 to 50 acres). Eighty percent of the sites greater than 101 acres were compliant with the FPGs.

Water Quality Foresters

Figure 13: BMP Implementation and FPG Compliance Related to WQF Districts and non-WQF Districts



Seven of the state's 13 NCDFR districts have an assigned Water Quality Forester (WQF). The WQFs were the primary BMP survey coordinators in districts 1, 2, 4, 5, 8, 11 and 12. The WQFs evaluated more than 60 percent of the surveyed sites. Since 1999, these foresters have been the primary contacts for water quality issues and coordinators for the water quality programs in their respective districts. The foresters filling these positions serve as the field experts in providing technical water quality assistance and guidance to other district staff and county personnel.

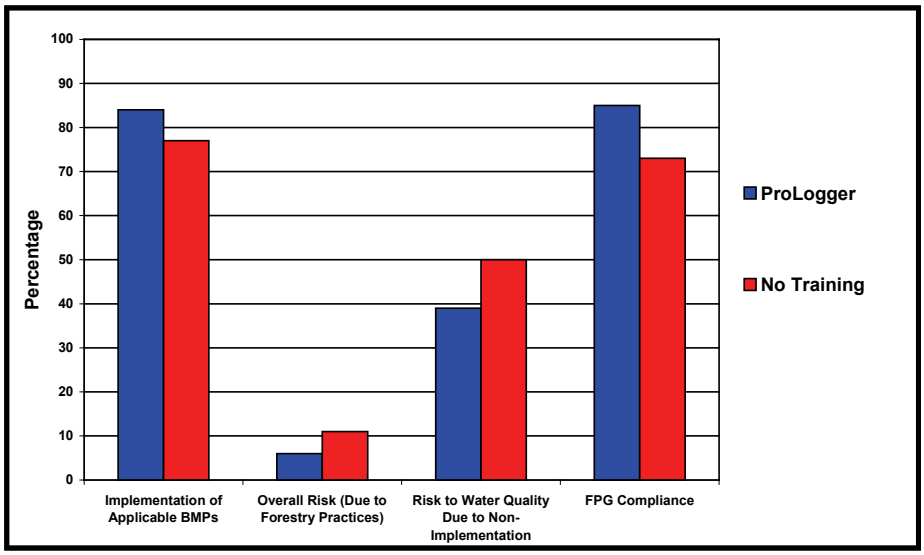
Districts with an assigned WQF exhibited a slightly higher BMP implementation (83 percent) compared to those districts without a WQF (81 percent) (Figure 13). A corresponding slightly higher number of forestry practices risks to water quality were noted in WQF districts (8 percent) than in those districts without a WQF (7 percent). However, 45 percent of the non-implemented BMPs posed a threat to water quality in WQF districts vs. 38 percent in districts without a WQF. The FPG compliance was 3 percent greater in WQF districts (83 percent) compared to the districts not having the WQF services. There are two factors that may have, in some measure, produced the lower performance numbers in WQF districts. First, WQFs were possibly more stringent or demanding in assessing a threat to water quality when conducting the survey. Second, WQFs are assigned to three of the four mountain districts. The BMP implementation of mountain harvest sites was generally lower than piedmont or coastal plain harvest sites. This survey has provided some measure of WQF effectiveness but by itself is inadequate to determine the overall impact these positions have produced to protect water quality during forest operations.

North Carolina Forestry Association's ProLogger Program

The North Carolina Forestry Association's (NCFA) ProLogger program began in 1994 in response to a number of logger injuries and fatalities (NCFA, 2004). The ProLogger program is designed to improve the professionalism of timber harvesters through education and training in safety, business management, forest management and environmental issues. Participants who complete the required 24 credit hours of training through local community colleges receive a diploma and designation as a professional logger or ProLogger (NCFA, 2004). Starting July 1, 2002, the NCFA implemented a new continuing education requirement for all ProLoggers. By requiring additional training to maintain ProLogger status, the NCFA hopes to continually supply loggers with the best available information concerning safety, business and the environment (NCFA, 2004).

Nearly 75 percent of the sites evaluated were ProLogger harvesting operations. Statewide, ProLogger graduates performed better compared to loggers who lacked formal logger training. There was insufficient data to assess BMP and FPG performance of loggers with out-of-state training and/or training other than ProLogger. However, the majority of these loggers had training from Virginia's SHARP Logger Program. The SHARP Logger and ProLogger Programs have similar objectives.

Figure 14: BMP Implementation and FPG Compliance by Logger Training



ProLoggers BMP implementation rate was 84 percent; FPG compliance was 85 percent (Figure 14). In contrast, sites harvested by non-ProLoggers averaged 76 percent BMP implementation and FPG compliant 73 percent of the time. ProLogger BMP implementation was better in all three regions compared to non-ProLoggers.

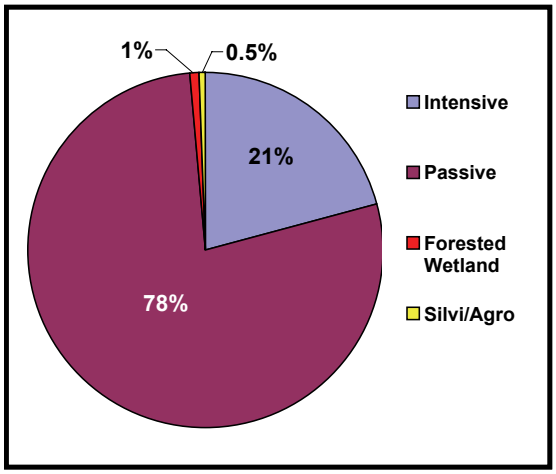
Statewide, ProLoggers had fewer forest operations that posed water quality risks than non-ProLoggers. Six percent of forestry practices and 39 percent of the non-implemented BMPs posed a threat or risk to water quality on ProLogger harvested sites; whereas, 11 percent of forestry practices and 50 percent of the non-implemented BMPs posed a threat or risk to water quality on non-ProLogger harvested sites. The ProLogger FPG compliance rate was also greater than the non-ProLogger compliance rate in the Coastal Plain and Piedmont regions. However, ProLogger FPG compliance in the Mountain region was lower compared to non-ProLoggers in the same region. The reasoning behind this anomaly is unclear. The outcome was based on 135 mountain sites of which ProLoggers conducted operations on more than half of these. As previously noted, mountain site timber harvests are extremely challenging.

Based on survey results, the ProLogger Program has been successful in training loggers about how to protect water quality during harvesting operations. However, the ProLogger Program can do more in the future by focusing training on BMP implementation weaknesses identified in this report. For example, additional training will be needed to improve **Stream Crossing**, **SMZ** and **Site Rehabilitation** BMPs in the mountains. The ProLogger continuing education requirement is one primary pathway to accomplish this BMP training. Visit www.ncforestry.org for more information on NCFA and the ProLogger program, and www.sharp.vt.edu for Virginia's SHARP Logger program.

Forest Management Type

Forest management is tract-specific and based on the landowner's objectives. Objectives may include timber production, wildlife habitat, soil and water conservation, recreation and aesthetics. Each tract and landowner's objective will differ from the next. This survey data indicates that intensively managed forests have better BMP implementation performance results. This could be a result of these landowners being more educated about forestry rules and regulations. Furthermore, landowners have greater financial and personal interests in maintaining their forest and investment. The surveyors selected the site's forest management type based on the 'visible' forest management history. Management history was also determined from documented management history (management plans on file at a NCDFR field office), surveyor's knowledge of the site, discussion with the logger or landowner on site and/or professional judgement based on field experience. The survey offered the surveyor a selection of four forest management types to choose from:

Figure 15: Forest Management Types Surveyed

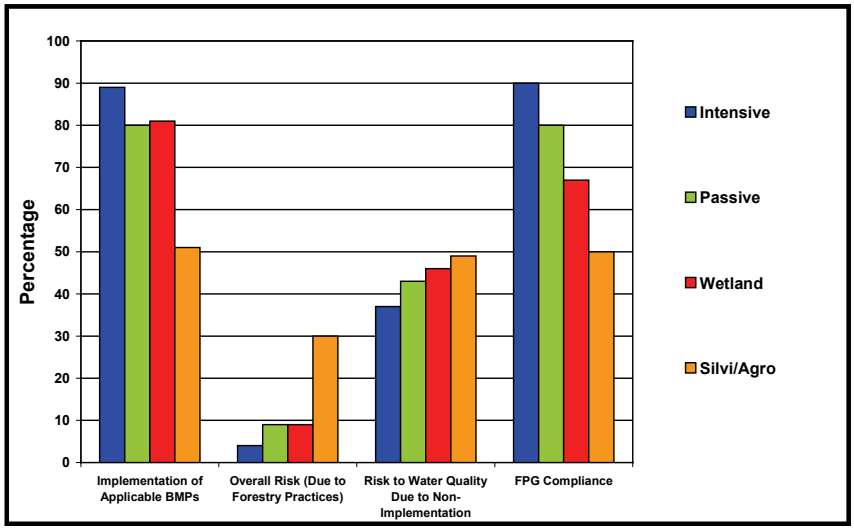


1. Intensive Forest Management
2. Passive Forest Management
3. Forested Wetland Management
4. Silvi/Agro Forest Management

Statewide, nearly 80 percent of the sites were managed passively (Figure 15). The NIPF landowners accounted for 92 percent of the passively managed forest management. Intensive forest management accounted for approximately 20 percent of the survey sites. In comparison, Silvi/Agro and wetland forest management types combined for less than 2 percent of the sites.

Forestry BMPs were best implemented on **Intensively** managed forests when compared to the other management types (Figure 16). Eighty-nine percent of the BMPs were correctly implemented and 4 percent of the forestry practices posed a risk to water quality. Thirty-seven percent of the non-implemented BMPs posed a risk to water quality. In comparison, approximately 80 percent of the BMPs were correctly implemented on sites managed **Passively** or for **Forested Wetlands**. Less than 10 percent of the forestry practices and less than 46 percent of the non-implemented BMPs posed a risk to water quality on these sites. **Silvi/Agro** site operations performed poorly with regards to BMP implementation (51 percent), water quality risk (31 percent) and water quality risk due to non-implementation (64 percent). However, it is important to note that only two sites were identified as being managed in this manner.

Figure 16: BMP Implementation and FPG Compliance by Forest Management Type



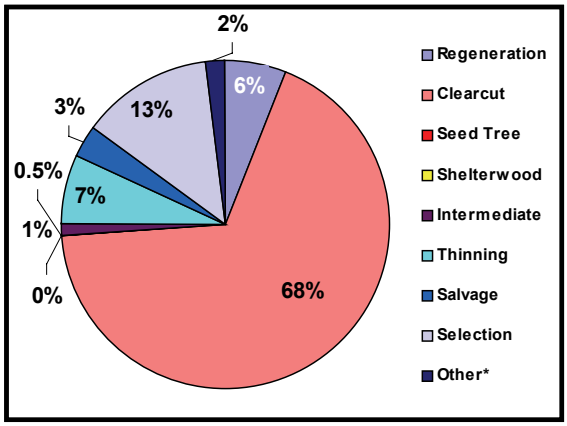
The FPG compliance on **Intensively** managed forests was 90 percent; the highest of all management types identified in the survey. In comparison, **Passively** managed forest performance was lower (80 percent), but exceeded the performance found on sites managed for **Silvi/Agro** (50 percent) and **Wetland** purposes (67 percent). The majority of the regional FPG compliance and BMP implementation results mirror these statewide figures.

Harvesting Method

Many harvesting methods are used in North Carolina due in part to the diversity of topography, soils, slope, market conditions and forest age. Specific landowner objectives also influence the harvest method selected. This survey presented the surveyor a selection of eleven harvesting methods to choose from:

1. Regeneration
2. Clearcut
3. Seed tree
4. Shelterwood
5. Intermediate
6. Thinning
7. Crop tree
8. Improvement
9. Salvage
10. Selection
11. Other (high grade, diameter limit cut or chipping)

Figure 17: Harvesting Methods Surveyed

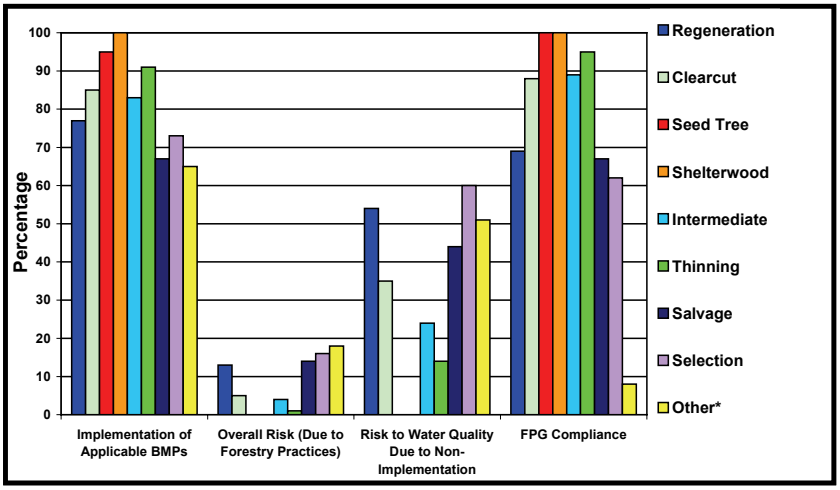


***Crop Tree, Improvement, Other (High Grade, Diameter Limit Cut or Chipping)**

Statewide, 68 percent of the sites were **Clearcut** (Figure 17). Approximately 20 percent of the sites were harvested by **Selection** or **Thinning** methods. The remaining eight harvest methods accounted for less than 12 percent of the harvesting methods selected by the surveyors. Furthermore, **Seed Tree** and **Shelterwood** harvest methods were each selected only once.

Harvest sites subject to **Thinning** exhibited a 91 percent BMP implementation rate (Figure 18). One percent of the forestry practices and 14 percent of the non-implemented BMPs posed a risk to water quality on sites harvested using the **Thinning** method. Eighty-five percent of the BMPs were implemented on **Clearcut** sites. In addition, 5 percent of the forestry practices and 35 percent of the non-implemented BMPs posed a risk to water quality on these sites. BMP implementation was above 70 percent for the remaining harvesting methods except for sites using the **Salvage** (76 percent) and **Other** (65 percent) harvesting methods. Eighteen percent of the forestry practices and more than half of the non-implemented BMPs posed a risk to water quality on sites utilizing the **Other** harvesting method. Nearly 15 percent of the forestry practices and 44 percent of the non-implemented BMPs posed a risk to water quality on sites using the salvage harvesting method. **Salvage** and **Other** harvesting methods combined for approximately 5 percent of the sites. In comparison, Selection harvest method accounted for 13 percent of the sites and 60 percent of the non-implemented BMPs on these sites posed a risk to water quality.

Figure 18: BMP Implementation and FPG Compliance by Harvesting Method



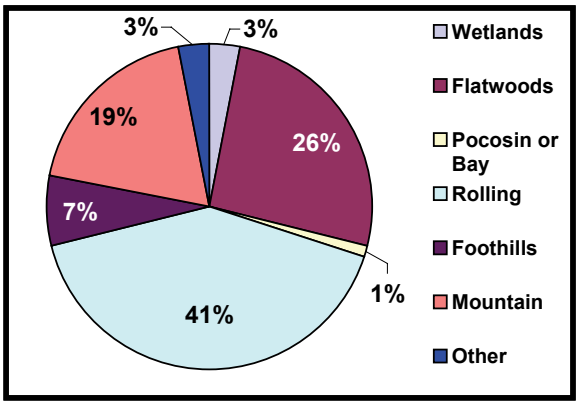
***Crop Tree, Improvement, Other (High Grade, Diameter Limit Cut, or Chipping)**

The FPG compliance rate was highest (95 percent) for harvest sites subject to **Thinning**. **Clearcut** sites had an FPG compliance of 88 percent. **Regeneration**, **Salvage**, **Selection** and **Other** harvesting methods performed poorly compared to the other harvesting methods (Figure 17). In summary, each harvesting method is unique, and each requires a different set and level of BMPs to adequately conserve soil and protect water quality.

Land Feature

Land features are defined by their current topographic characteristics that have been created by geologic deformation, weathering and erosion. North Carolina exhibits a diversity of land features between the Atlantic Ocean and the Appalachian Mountains. During forestry operations, each land feature requires unique BMPs to adequately protect water quality. For the purposes of this survey, the surveyor could select one of seven land features. A selection was made based on the surveyor's field knowledge of the local area:

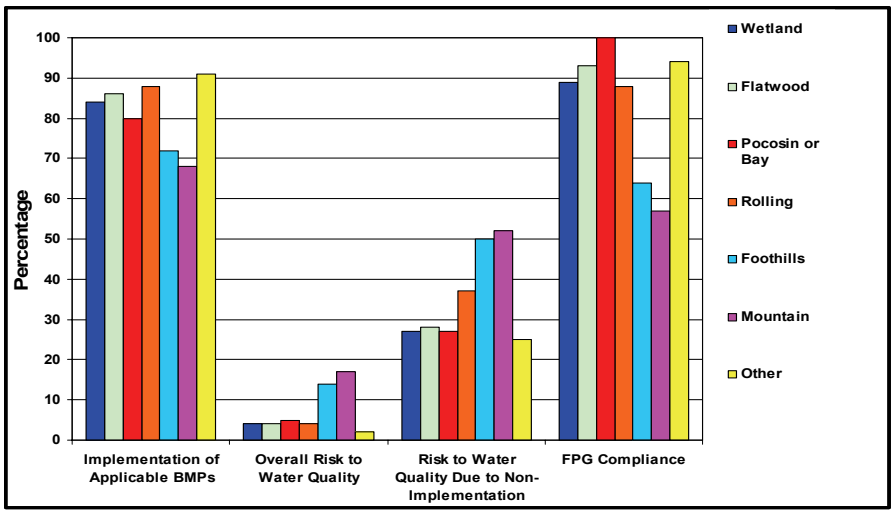
Figure 19: Land Features Surveyed



1. Wetlands
2. Flatwoods
3. Pocosin or Bay
4. Rolling
5. Foothills
6. Mountain
7. Other

Statewide, more than 85 percent of the surveyed sites were located on **Flatwoods**, **Rolling** or **Mountain** land features (Figure 19). **Rolling** land alone accounted for more than 40 percent of the land features surveyed. In comparison, **Wetlands**, **Pocosin** or **Bay**, **Foothills** and **Other** combined for less than 15 percent of the land features selected. This low frequency of sites may be due, in part, to the lack of quality or desirable timber and operational challenges of this land feature.

Figure 20: BMP Implementation and FPG Compliance by Land Feature



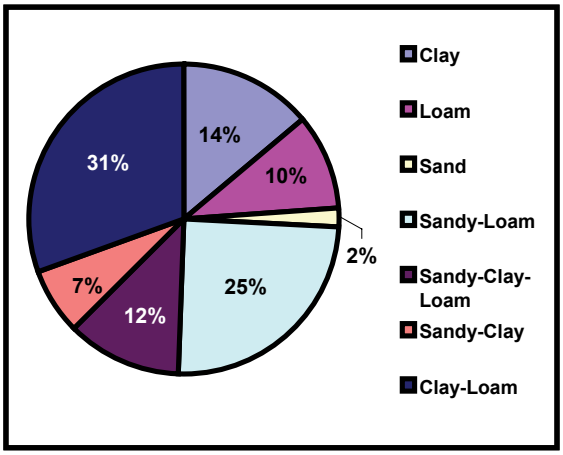
Foothill and **Mountain** operations exhibited the lowest BMP implementation rate (72 percent) when compared to operations found on the other land features (Figure 20). Greater than 14 percent of the forestry practices and 50 percent of the non-implemented BMPs posed a risk to water quality on sites located on **Foothills** and **Mountains**. In contrast, more than 80 percent of the BMPs located on the other five land features were correctly implemented. Less than 5 percent of the forestry practices and less than 30 percent of the non-implemented BMPs posed a risk with the exception of the **Rolling** land feature (37 percent). All land feature operations performed similarly with regards to FPG compliance (Figure 19). Regionally, FPG compliance and BMP implementation statistics comparatively duplicate these statewide results. In summary, as topographic relief increases, the need for aggressive BMP implementation becomes more apparent. Follow-up BMP maintenance also becomes increasingly critical. Increased BMP implementation and maintenance are needed as topographic relief increases. Crossing streams with bridgemats and increased use of waterbars, turnouts, silt catchment basins and erosion control structures is recommended.

Soil Type

Soil is defined structurally by its sand, silt, clay and loam particle composition (Brady and Weil, 1999). Soil type is a collection of soil with a distinctive profile of characteristics. Surveyors determined soil type by using the county's USDA soil survey or sampling soil at the site. This survey presented the surveyor a selection of seven soil types to choose from:

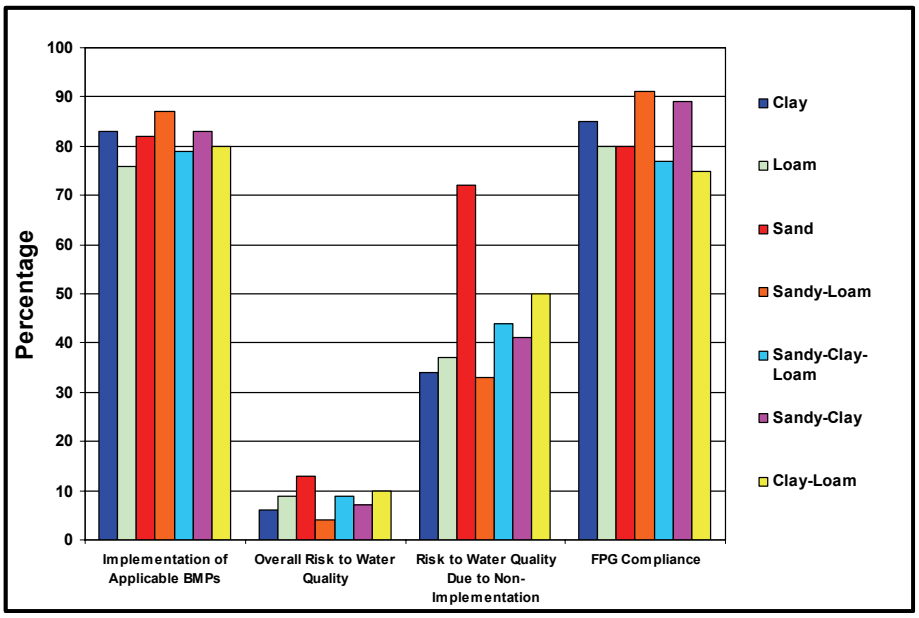
1. Clay
2. Loam
3. Sand
4. Sandy-Loam
5. Sandy-Clay Loam
6. Sandy-Clay
7. Clay-Loam

Figure 21: Soil Types Surveyed



Statewide, greater than 80 percent of the sites were on **Sandy-Loam** (25 percent), **Clay-Loam** (31 percent), **Clay** (14 percent) and **Sandy-Clay-Loam** (12 percent) soil types. **Sand** sites were rare and primarily found in the Coastal Plain (Figure 21).

Figure 22: BMP Implementation and FPG Compliance by Soil Type



Harvest operations conducted on **Sandy-Loam, Clay and Sandy-Clay** soils exhibited a higher level of BMP implementation and FPG compliance as compared to other soil types (Figure 22). BMP implementation was near or above 80 percent for all soil types except for sites containing **Loam** (76 percent). Thirteen percent of the forestry practices and 72 percent of the non-implemented BMPs posed a risk to water quality when the operation was conducted on **Sand**. However, **Sand** only accounted for 2 percent of the survey sites. A lesser operation performance was also noted on **Clay-Loam** soils. Ten percent of the BMPs and half of the non-implemented BMPs posed a threat to water quality when the operations were conducted on **Clay-Loam** soils. In contrast, BMP implementation performance appeared to be greater when operations were conducted on the other remaining soil types. Less than 13 percent of the forestry practices and 41 percent of the non-implemented BMPs posed a risk to water quality on these sites.

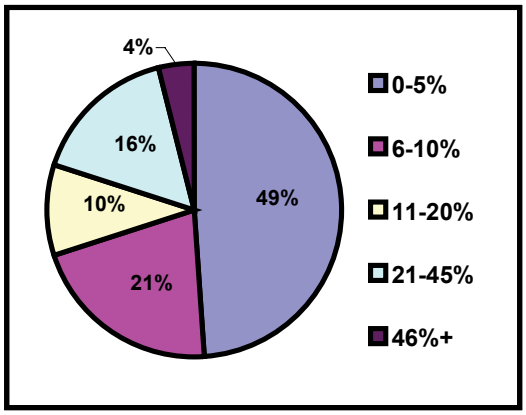
The FPG compliance on **Sandy-Loam** soil was greater than the other soil types (91 percent). In comparison, FPG performance on **Sandy-Clay** soils (89 percent) was lower but exceeded the compliance rates found on sites containing **Sand** (80 percent), **Sandy-Loam** (80 percent), and **Clay** (85 percent). Harvest operations conducted on **Clay-Loam** and **Sandy-Clay-Loam** soils exhibited the lowest environmental performance numbers. In summary, a soils map is important during harvest planning to determine the type of equipment that can be used, what areas need to be avoided and when the operation must stop due to wet weather. A soils map is also important to carefully plan operations to minimize soil impacts. Specifically, soil type should be considered when planning where skid trails are to be placed and how much BMP maintenance the tract will require.

Slope

Slope is determined by the rise and fall of land over a set distance. The survey field participants determined the site's slope by using a clinometer or referring to topographical maps. Slope does play a major role in planning a forestry operation. For example, slope may dictate the type of equipment used during the operation, the season the operation may occur, the number and type of BMPs needed to protect water quality and the frequency of BMP maintenance required to stabilize the land. This survey presented the surveyor a selection of five categories of slope to choose from:

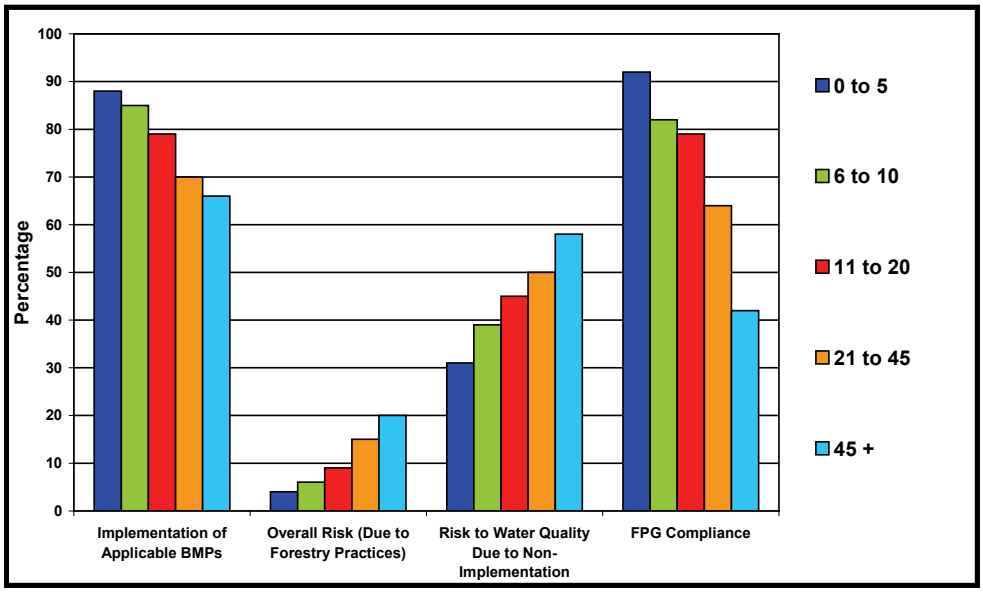
1. 0% to 5%
2. 6% to 10%
3. 11% to 20%
4. 21% to 45%
5. 46%+

Figure 23: Slope Categories Surveyed



This survey also took into account the slope of the site proximate to the stream or waterbody. However, it is worth noting that North Carolina's BMP manual recommends that skid trail grades not exceed 25 percent, regardless of their proximity to surface waters. Statewide, 70 percent of the harvest sites were located on slope less than 10 percent; 4 percent of the sites were located on slopes greater than 46 percent (Figure 23).

Figure 24: BMP Implementation and FPG Compliance by Slope



It is evident from data presented in Figure 24 that steeper slopes introduce a higher potential of water quality impacts. Furthermore, the survey indicates that BMP implementation and FPG compliance values decrease as slope increases. This result was likely due to an inappropriate and/or inadequate level of BMP implementation and maintenance as slope increased. Simply put, steep sites require additional BMPs and a vigilant maintenance program to support site stabilization.

Erosion and Erodibility

The surveyors used their professional experience to determine erosion and erodibility. Survey results indicate the surveyors did not commonly observe ongoing erosion events. Specifically, 83 percent of the surveyed sites had no observed erosion. However, gully or rill erosion was observed on approximately 15 percent of the sites. The fact that erosion was not commonly observed was primarily attributed to fair weather survey visits. The survey had no prerequisites to observe operations during precipitation events. The surveyors also classified the site for erodibility. This survey presented the surveyor a selection of three categories of erodibility to choose from: **Low**, **Moderate** or **High**. Ninety-three percent of the sites were categorized to be **Low** or **Moderate** erodibility. Approximately 7 percent of the sites were considered **Highly** erodible. In summary, the absence of visible erosion was positive but attributed to fair weather survey visits.

Specific Best Management Practices

Results of the nine BMPs surveyed (see Survey Procedure, Appendix 3) are summarized below. This report focuses on the sum of the correctly implemented BMPs found on each site. Figures 25, 26 and 27 illustrate BMP implementation, overall risk to water quality and risk to water quality due to non-implementation by practice within each region. Figure 28 provides a summary of the overall non-implementation and risk to water quality. Furthermore, this report provides analysis on the condition implementation of each BMP to support recommendations for future BMP-targeted studies and training.

Figure 25: Coastal BMP Implementation and Water Quality Risk by Practice

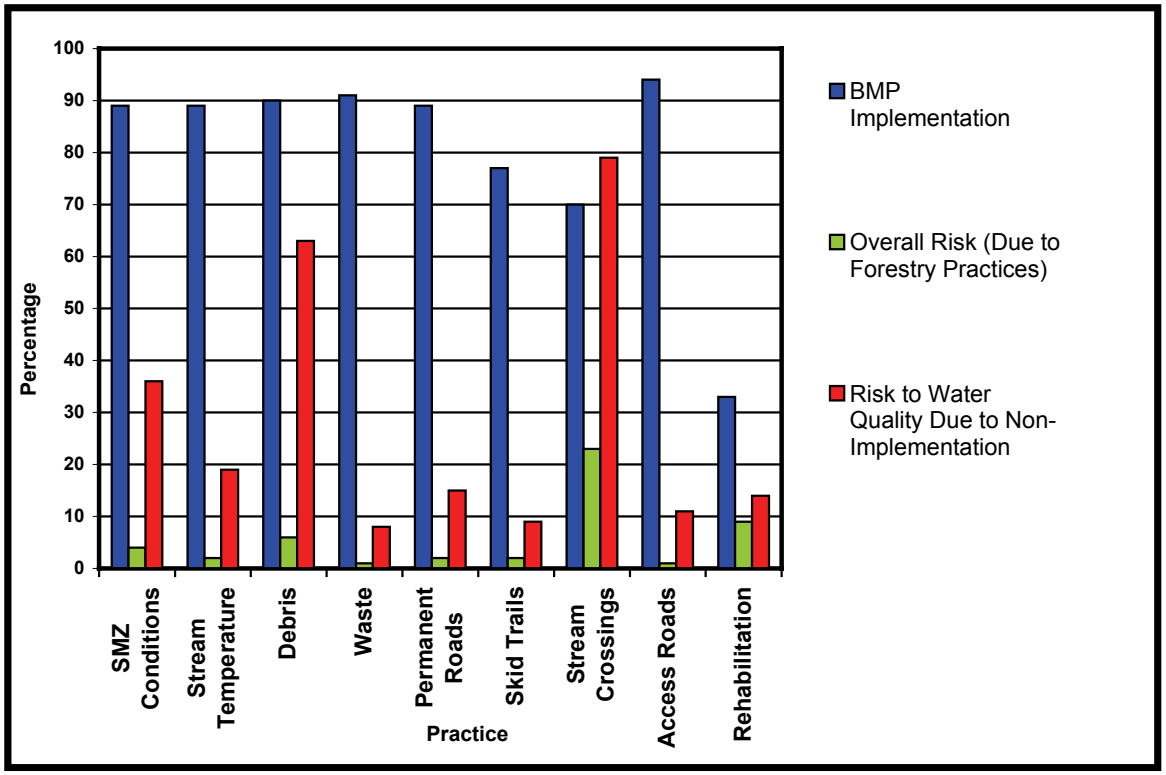


Figure 26: Piedmont BMP Implementation and Water Quality Risk by Practice

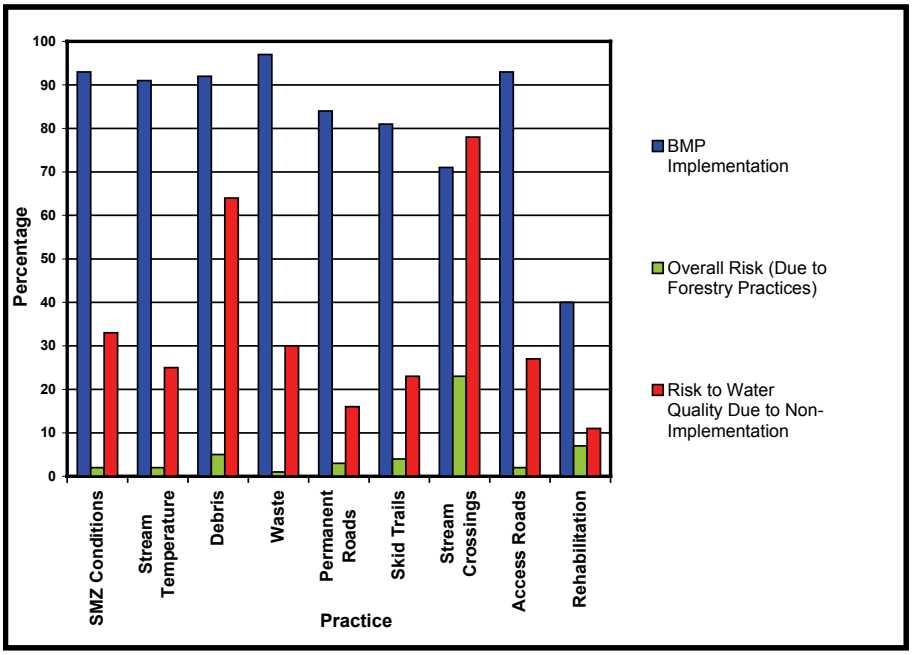


Figure 27: Mountain BMP Implementation and Water Quality Risk by Practice

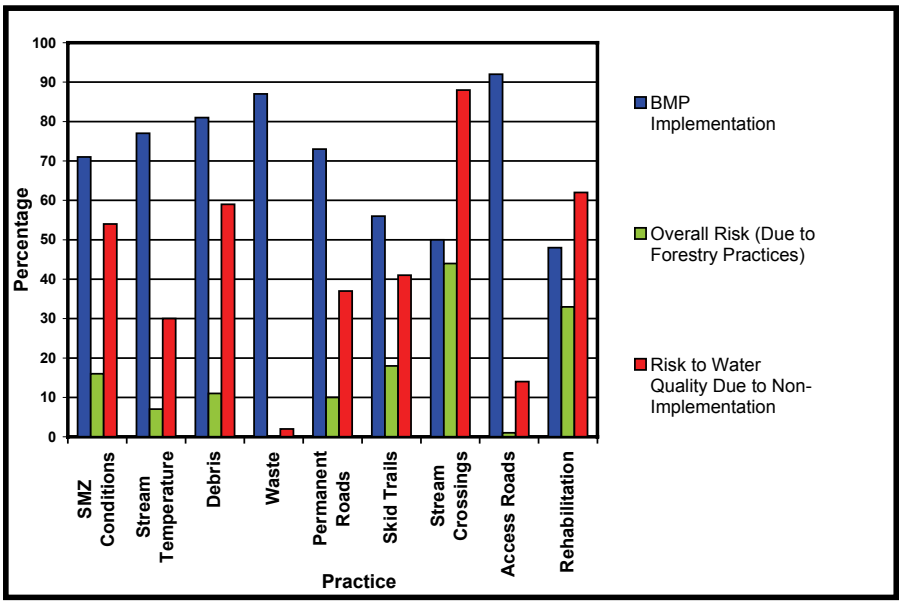
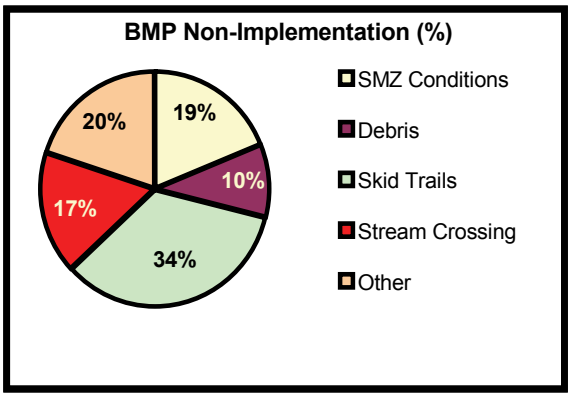
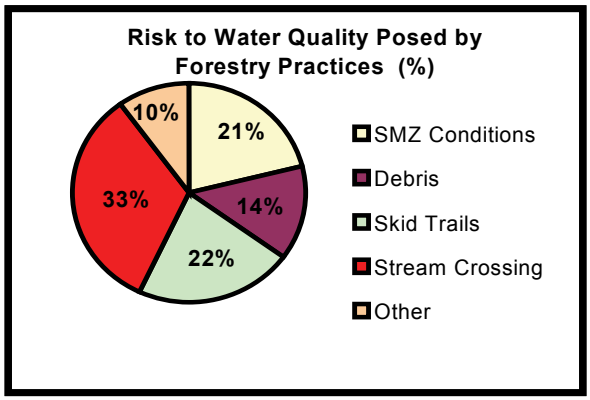


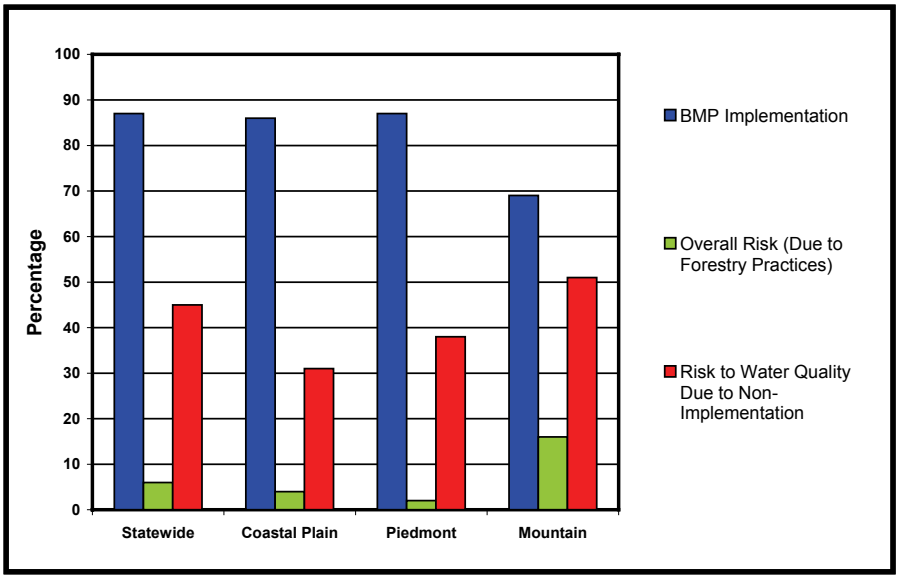
Figure 28:Summary of Overall Non-BMP Implementation and Risk to Water Quality





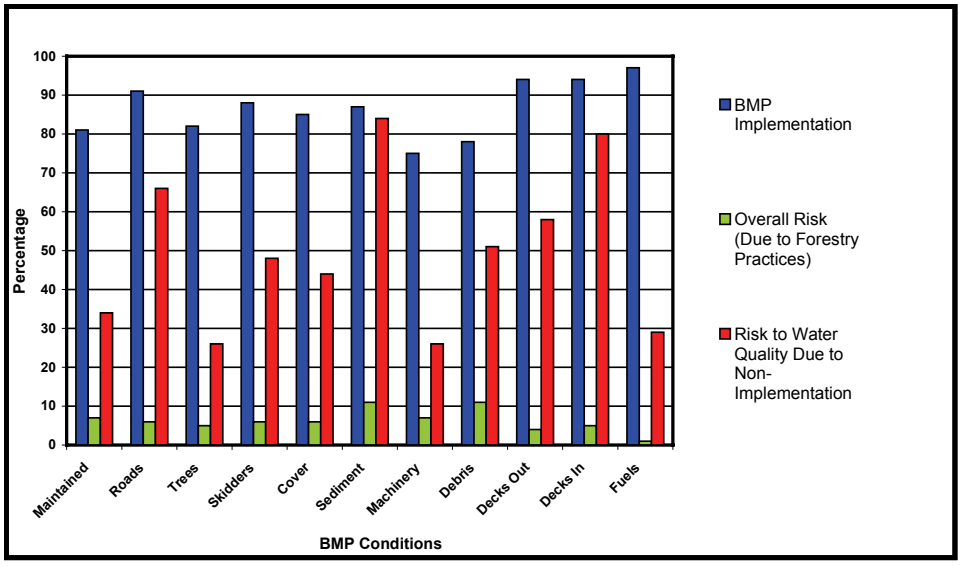
Streamside Management Zones

Figure 29: BMP Implementation for Streamside Management Zone Conditions by Region



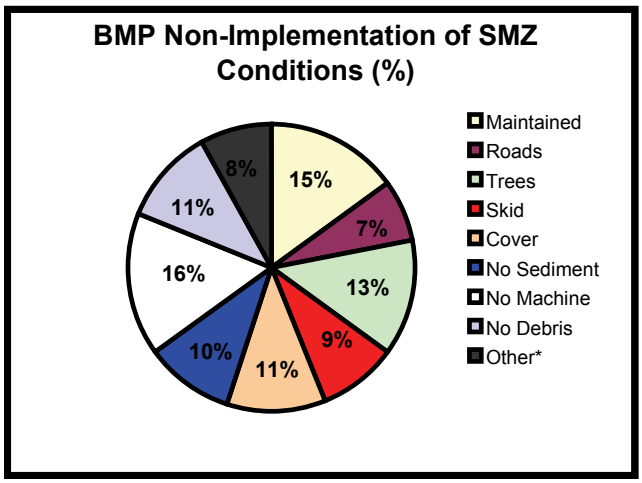
Statewide implementation of Streamside Management Zone (SMZ) BMPs was 87 percent; 6 percent of the forestry practices posed a risk to water quality (Figure 29). Approximately 45 percent of the non-implemented BMPs posed a risk to water quality. A large percentage of the SMZ risks to water quality were found in the Mountains, where only 75 percent of the BMPs were implemented correctly. Thirteen percent of the forestry practices and more than half of the non-implemented BMPs posed a risk to water quality in this region. In contrast, BMP implementation was higher in the Piedmont (87 percent) and Coastal Plain (86 percent). Two percent of the BMPs presented a risk to water quality and nearly 40 percent of the non-implemented BMPs were a risk to water quality in the Piedmont. Approximately 4 percent of the forestry practices caused a risk to water quality and 31 percent of the non-implemented BMPs in the Coastal Plain threatened water quality.

Figure 30: Statewide BMP Implementation for Streamside Management Zone Conditions

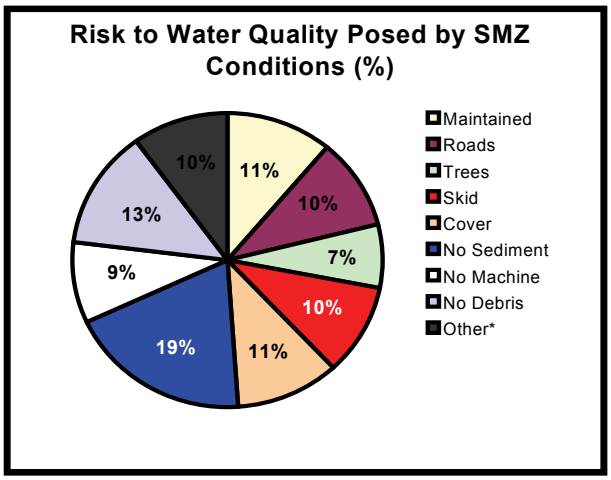


Statewide, SMZ condition implementation ranged from 75 percent (**Machinery)** to 97 percent (**Fuels**). Less than 10 percent of each forestry practice posed a risk to water quality (Figure 30). However, risks to water quality due to non-implementation of the conditions ranged from 26 percent (**Trees**) to 84 percent (**Sediment**). Nearly half of the condition non-implementation was a result of not **Maintaining** the SMZ, allowing **Machinery** to enter the SMZ and **Trees** being felled toward the stream channel (Figure 31 and Table 3). These conditions also posed nearly 30 percent of the risk to water quality. **Sediment** was the single condition that posed the greatest risk to water quality (19 percent). Twelve conditions were surveyed to examine harvesting impacts on the SMZ (Table 3).

Figure 31: BMP Implementation and Water Quality Risk for Streamside Management Zone



*Decks In, Decks Out, Fuels



*Decks In, Decks Out, Fuels

Table 3: Streamside Management Zone Conditions

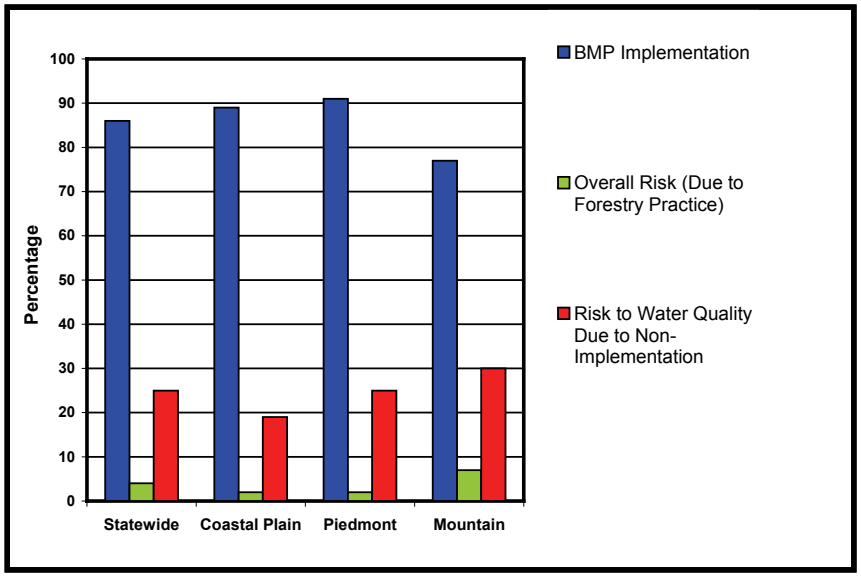
1. SMZ uniformly **maintained** along intermittent and perennial streams/waterbodies.	7. Felled trees removed without **machinery** entering SMZ in areas where ephemeral streams intersect intermittent/perennial waters.
2. **Roads** or trails minimized in SMZ (exclude stream crossing areas).	8. Trees and logging **debris** removed from streams.
3. **Trees** were felled away from stream channel.	9. Logging **decks** and/or sawmill sites located **out**side of SMZ.
4. **Skidders** and other equipment use was minimized in SMZ (except at stream crossings).	10. Logging **decks** and/or sawmill sites **in** SMZ ≥10 feet from stream/waterbody. (Exception)
5. Forest floor/ground **cover** is essentially undisturbed.	11. **Fuels** and chemicals stored outside SMZ.
6. No visible **sediment** from operations present in streams/waterbodies.	

The BMP implementation was noted to be inversely proportioned to the potential risk to water quality. Some BMP conditions were consistently implemented at a high rate, but posed a high risk to water quality when not implemented. For example, 94 percent of the sites had the condition "Logging **decks** and/or sawmill sites located **out**side of SMZ" correctly implemented. However, when this condition was not implemented, 80 percent of these sites were estimated to pose a risk to water quality.

In summary, the SMZ BMP correlates closely to FPG .0201. The SMZ's purpose is to slow, filter and trap sediment and other debris. Unfortunately, survey results show SMZs are not regularly being implemented adequately or correctly. Many conditions need to be improved upon to overcome these SMZ inadequacies. For example, there were eight different BMP conditions that when combined contributed to more than 90 percent of the non-implementation and risk to water quality (Figure 31). Slope, soil type, season, vegetation type and ground cover need to be considered when planning the size of a SMZ. Larger or smaller SMZs widths are acceptable provided the SMZ adequately protects the stream from receiving pollutants. The SMZ width recommendations found in the BMP manual are minimum distances to establish vegetative buffers and represent the best defense to succeed in preventing polluted runoff from reaching a waterbody.

Stream Temperature

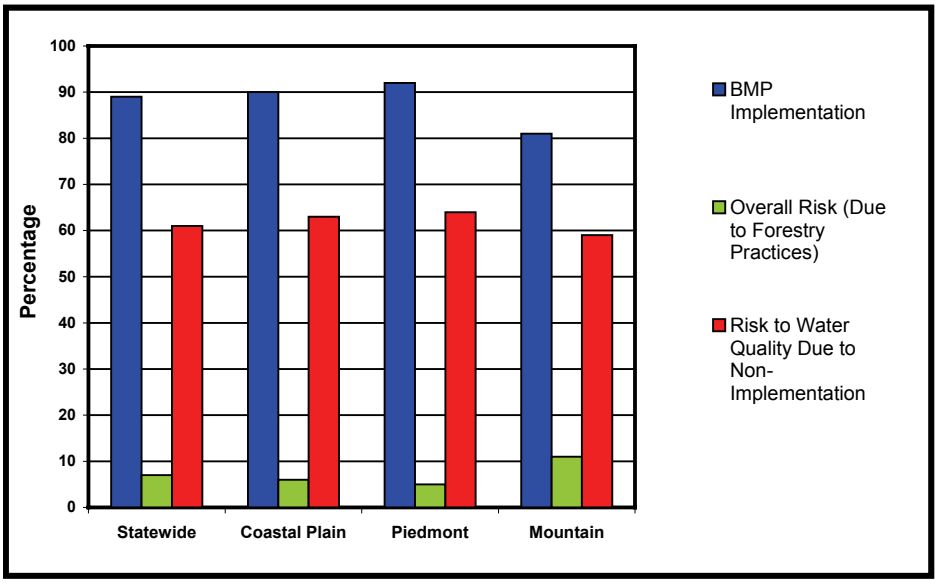
Figure 32: BMP Implementation for Stream Temperature Conditions by Region



Statewide BMP implementation that was conducted to manage stream temperature was 86 percent. Approximately 4 percent of the forestry practices presented a risk to water quality, and 25 percent of the non-implemented BMPs posed a risk to water quality (Figure 32). Implementation in the Mountains was 77 percent, and 7 percent of the forestry practices surveyed presented a risk to water quality. Thirty percent of the non-implemented BMPs posed a threat to water quality. On the contrary, BMP implementation in both the Piedmont (91 percent) and Coastal Plain (89 percent) was higher. There was approximately a 2 percent overall risk to water quality in both regions. Approximately 25 percent of the non-implemented BMPs in the Piedmont and 19 percent in the Coastal Plain posed a threat to water quality. Two possible conditions were surveyed to study the impact that harvesting had on stream temperatures (Appendix 3).

Debris Entering Stream

Figure 33: BMP Implementation for Debris Entering Stream Conditions by Region



Statewide implementation of BMPs to prevent debris entering streams was 89 percent. Seven percent of forestry practices and more than 60 percent of the non-implemented BMPs posed a threat to water quality (Figure 33). Mountain sites scored lower than the statewide average (81 percent). Eleven percent of the forestry practices and nearly 60 percent of the non-implemented BMPs posed a threat to water quality. Piedmont and Coastal Plain BMP implementation were approximately 90 percent, and less than 6 percent of the forestry practices posed a risk to water quality. However, 64 percent of the non-implemented BMPs posed a risk to water quality.

Seven conditions were surveyed to evaluate the activities undertaken to prevent debris entering a stream (Table 4). Statewide, the **Debris Entering Stream** condition implementation ranged from 79 percent (**Logging**) to 96 percent (**Channel**) (Figures 34, 35 and Table 4) and risk to water quality overall condition was less than 10 percent. Risk due to non-implementation of the conditions ranged from 43 percent (**Logging**) to 94 percent (**Channel**). More than 70 percent of the non-implementation condition and 60 percent of the risk to water quality was a due to **Logging, Debris Obstruction** and **Debris Impairment** conditions (Figure 35). Stream **Channel**(s) were rarely altered due to debris and as a result this condition posed the lowest risk to water quality (7 percent).

Figure 34: Statewide BMP Implementation for Debris Entering Stream Conditions

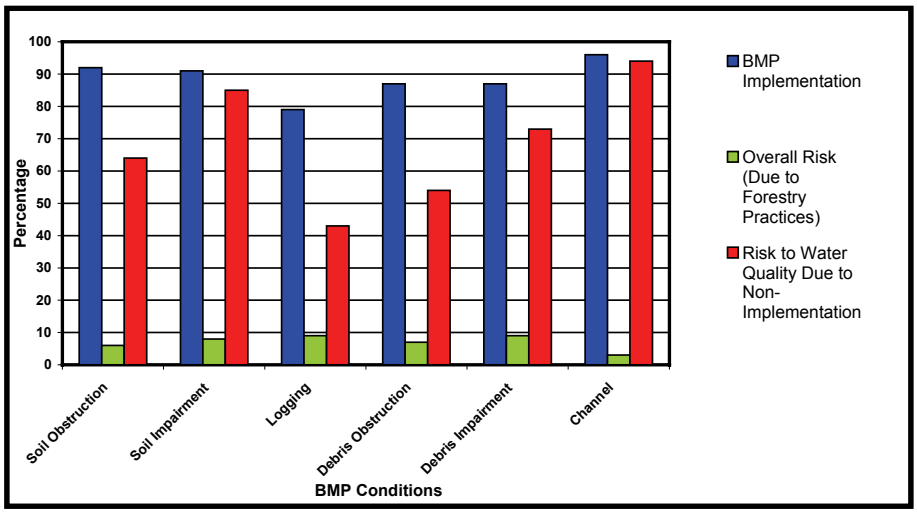
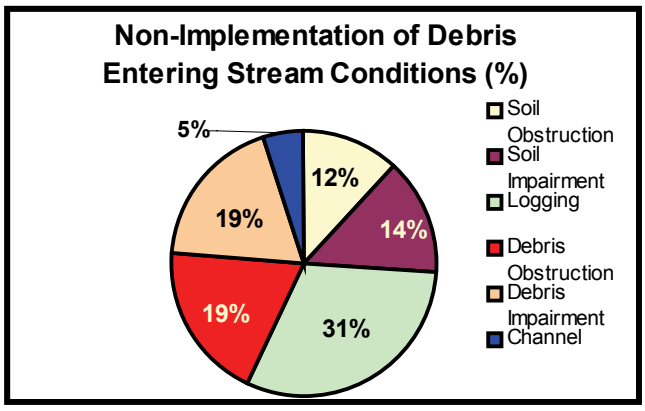


Figure 35: BMP Implementation and Water Quality Risk of Debris Entering Stream Conditions



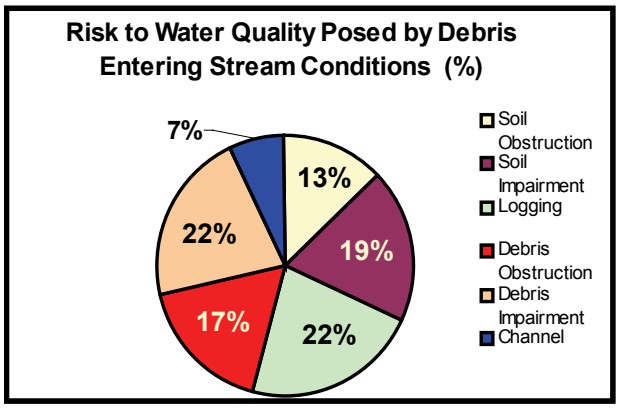


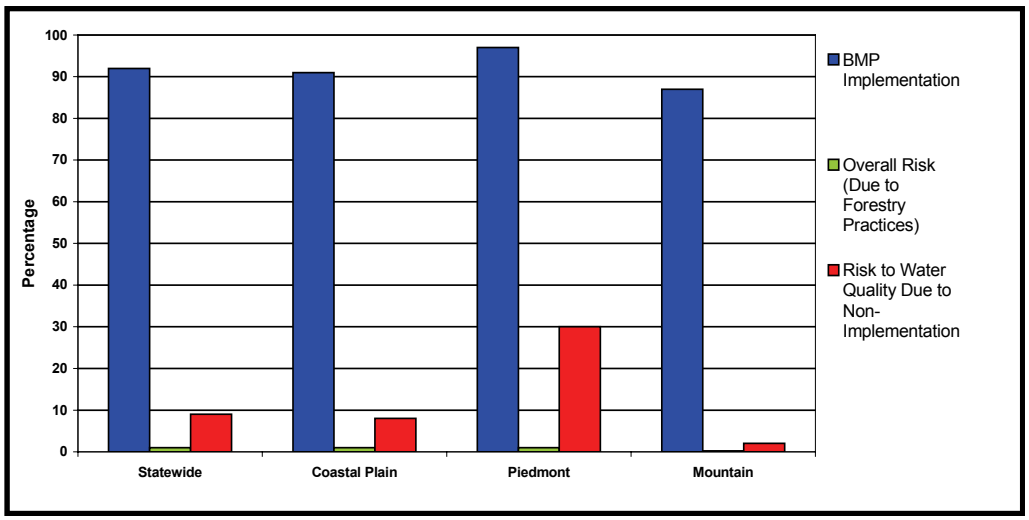
Table 4: Debris Entering Stream Conditions

1. Stream **obstruction**s (i.e., **soils**) from forestry operation(s) nonexistent.	4. Stream **obstruction**s (i.e., logging **debris**) from forestry operation(s) nonexistent.
2. Stream flow **impairment** (i.e., **soils**) by forestry operation(s) nonexistent.	5. Stream flow **impairment** (i.e., logging **debris**) from forestry operation(s) nonexistent.
3. **Logging** and site preparation debris kept out of stream channels.	6. Stream **channel**/course has not been altered by obstruction(s).

In summary, problems with debris entering streams were primarily due to **Logging Debris** found in the stream channel. On many sites there was enough debris to **Impair** or **Obstruct** the stream flow. As a result, nearly a quarter of all FPG violations was due to debris entering streams and waterbodies. This survey finding was verified by the FPG compliance observed from the FPG program. To correct this problem, every effort should be made during an operation to keep stream channels and water bodies free of debris. However, when debris does enter a stream channel or water body it should be removed immediately. Debris prevention and removal should be a part of daily operational maintenance. A maintenance schedule supporting this practice should be included in the pre-harvest plan.

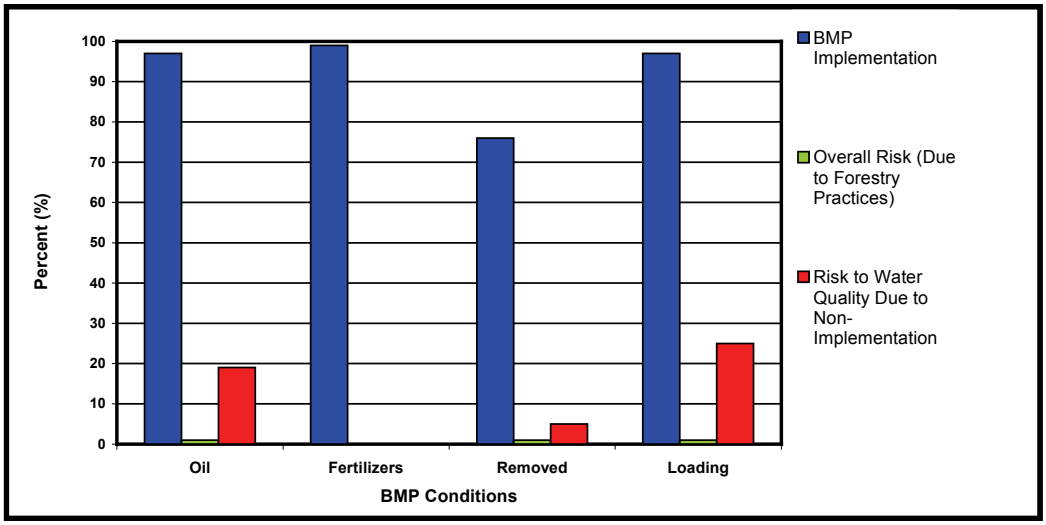
Waste Entering Stream, Waterbodies or Groundwater (Waste)

Figure 36: BMP Implementation for Waste Entering Streams, Waterbodies or Groundwater Conditions by Region



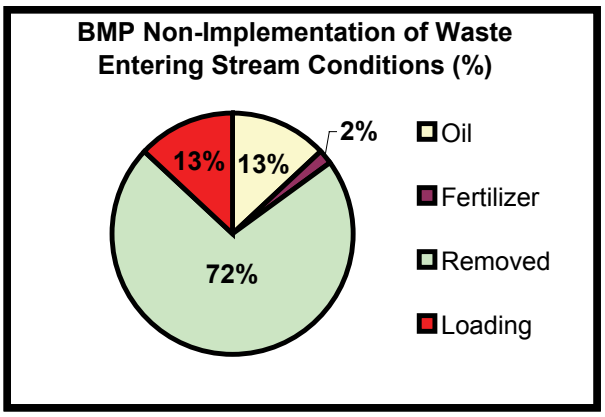
Statewide, 92 percent of the Waste Entering Stream, Waterbodies or Groundwater (**Waste**) BMPs concerning waste management were properly implemented (Figure 36). As a result of this high implementation, only 1 percent of the forestry practices posed a threat to water quality. BMP implementation was high in all three regions (87 percent-97 percent) and there was little or no overall risk posed to water quality. However, up to 30 percent of the non-implemented BMPs posed a risk to water quality in the Piedmont. By compariaon, less than 10 percent of the non-implemented BMPs in the Coastal Plain and Mountain regions posed a threat to water quality.

Figure 37: Statewide BMP Implementation for Waste Entering Streams, Waterbodies, or Groundwater Conditions



Five possible conditions were surveyed across the state (Table 5). Implementation of BMP conditions ranged from 76 percent (**Removed)** to nearly 100 percent (**Fertilizers**). Less than one percent of the forestry practices posed a risk to water quality (Figures 37, 38 and Table 5) and risks to water quality due to non-implementation of the conditions ranged from no risk to 37 percent (**Removed**). Nearly 85 percent of the non-implementation was a result of waste not being **Removed** from the site and fuel or chemical **Loading** or storage being conducted within the SMZ. These two conditions also represented nearly three-quarters of the risk to water quality. **Fertilizers** and other wastes were rarely seen being discharged into a waterbody, and as a result, this condition posed little risk to water quality.

Figure 38: BMP Implementation and Water Quality Risk of Waste Entering Streams, Water bodies, or Groundwater Conditions



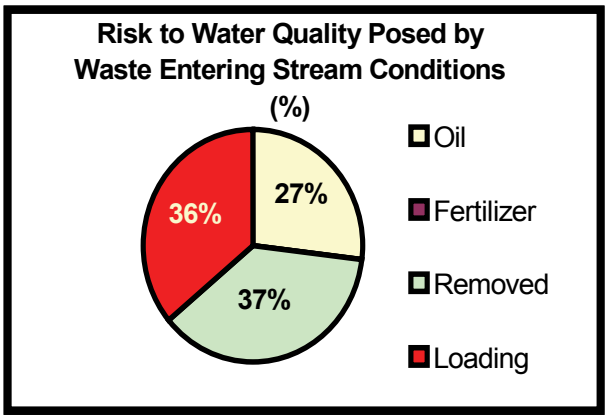
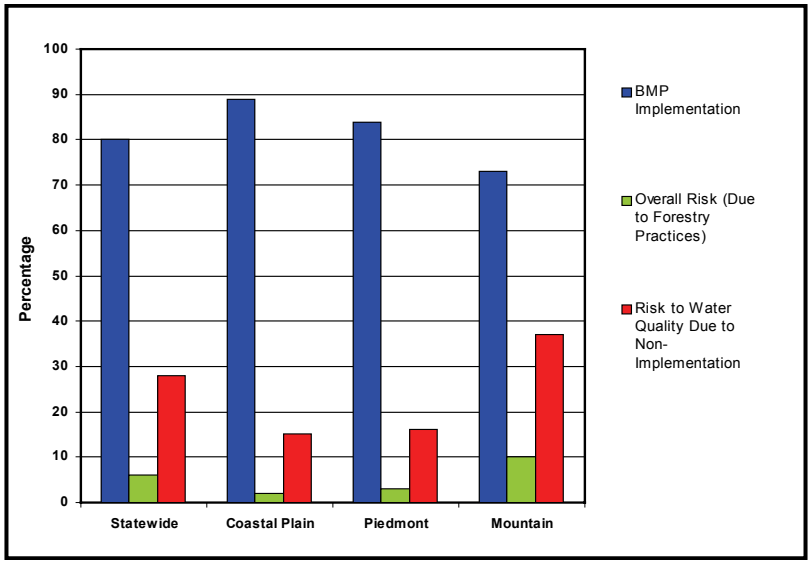


Table 5: Waste Entering Streams, Waterbodies or Groundwater Conditions

1. Waste **oil** or other petroleum products were not discharged on site or into streams, water bodies or groundwater.	3. All petroleum and chemical containers were **removed** from the logging site.
2. **Fertilizers** and other chemical wastes were not discharged into streams, water bodies or groundwater.	4. Chemical and fuel **loading** and storage was conducted outside of the SMZ.

Permanent Forest Roads

Figure 39: BMP Implementation for Permanent Forest Roads Conditions by Region



Statewide implementation of the Permanent Forest Roads BMP conditions were 80 percent (Figure 39). Approximately 6 percent of the forestry practices and less than 30 percent of the non-implemented BMPs posed a threat or risk to water quality. Implementation in the Mountains was 73 percent, with 10 percent of the forestry practices deemed to be a risk to water quality. In comparison, the BMPs were properly implemented at a relatively higher rate (> 84 percent) in the Piedmont and Coastal Plain. Less than 3 percent of these forestry practices and 16 percent of the non-implemented BMPs were considered to be a risk to water quality.

Eleven conditions were surveyed to assess this BMP (Table 6). Implementation of BMP conditions ranged from 47 percent (**Riprap)** to 98 percent (**Width**). Overall risk to water quality ranged from no risk (multiple conditions) to 21 percent (**Rolling Grades**) (Figures 40, 41 and Table 6). Risks to water quality due to non-implementation of the conditions ranged from no risk to 100 percent risk (**Culvert**). In part, this result is likely due to culverts being installed incorrectly or being undersized with respect to watershed size. Nearly two-thirds of the non-implementation was a result of roads not being **Established** a year in advance of the operation, correctly following **Contour** lines and **Grades**, and **Riprap** not being installed correctly. These conditions also posed nearly half of the risk to water quality. **Bridges**, **Outsloping** and **Wing ditch** installation were correctly implemented. These three conditions posed little risk to water quality.

Figure 40: Statewide BMP Implementation for Permanent Forest Roads Conditions

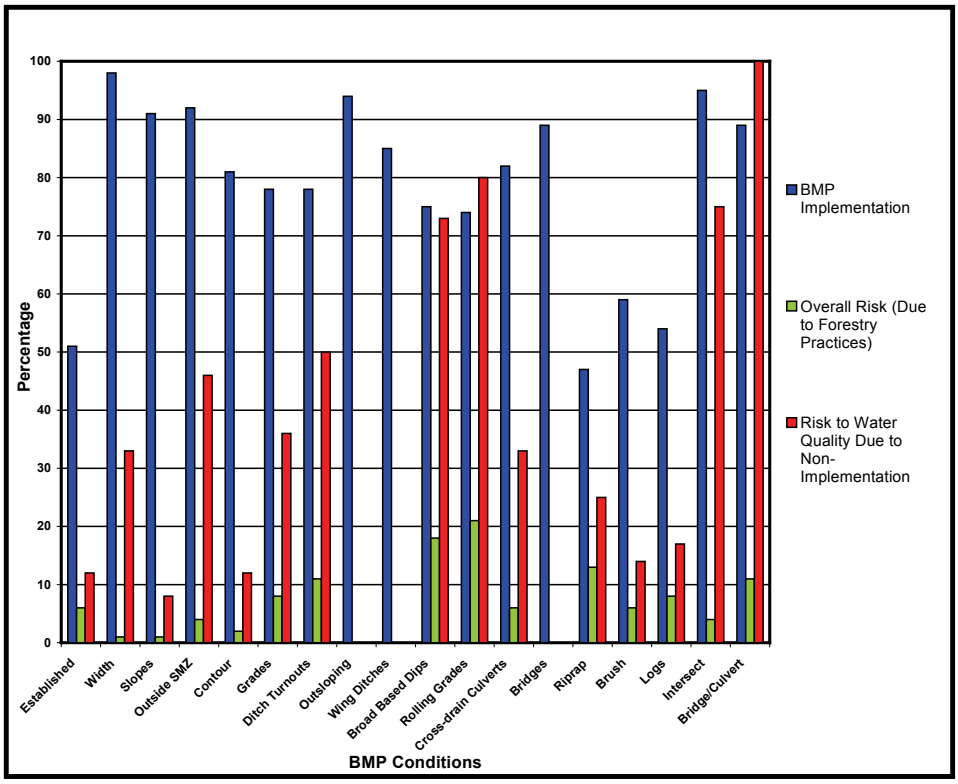
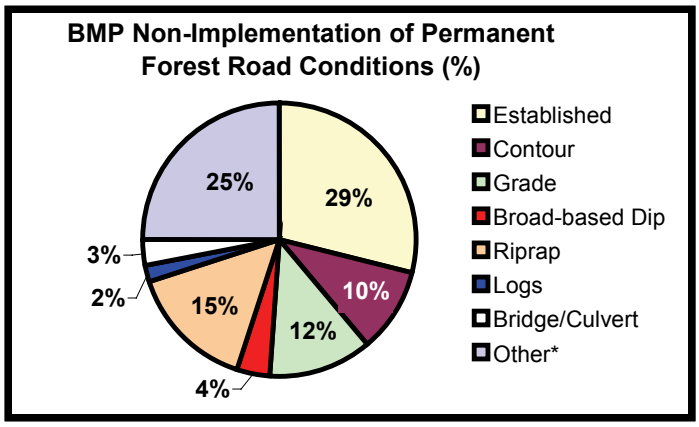
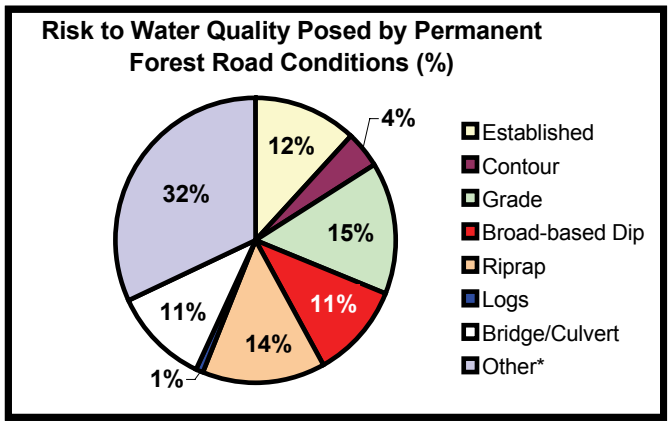


Figure 41: BMP Implementation and Water Quality Risk of Permanent Forest Roads Conditions



***Width, Slopes, Outside SMZ, Ditch Turnouts Outsloping, Wing Ditches, Rolling Grade, Cross-Drain Culverts, Bridges, Brush, Intersect**



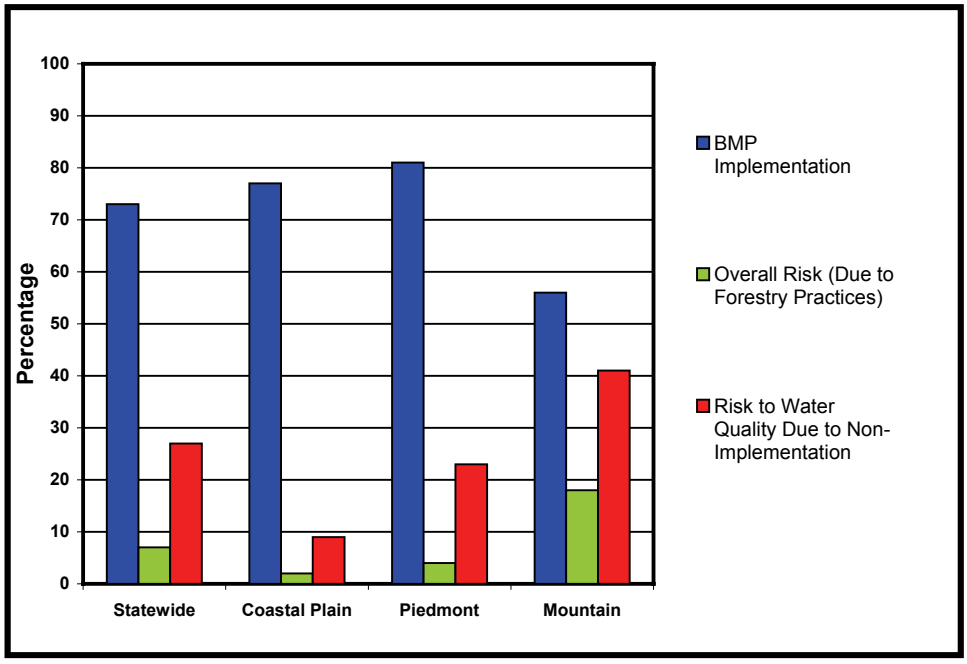
***Width, Slopes, Outside SMZ, Ditch Turnouts Outsloping, Wing Ditches, Rolling Grade, Cross-Drain Culverts, Bridges, Brush, Intersect**

Table 6: Permanent Forest Roads Conditions

1. Permanent roads **established** a year or more in advance of operation.	7. Drainage structures implemented: • **Ditch turnouts** • **Outsloping** • **Wing ditches** • **Broad based dips** (truck haul roads) • **Rolling grade** or dips (skid trails & steep roads) • **Cross-drain culverts** • **Bridges**
2. Permanent roads are a minimum **width** of between 10 and 14 feet for single track road.	
3. Permanent roads placed on gentle side **slopes** and not ridge tops.	
4. Permanent roads are located **outside** of the **SMZ**.	
5. Permanent roads follow **contour** lines.	8. All drainage outfalls stabilized with **riprap**, heavy **brush** or **logs**.
6. Permanent roads have **grades** of between 1 and 10%.	9. Permanent roads **intersect** streams at right angle to stream channel.
	10. **Bridge/culvert** used where permanent roads cross streams or waterbodies.

Skid Trails

Figure 42: BMP Implementation for Skid Trails Conditions by Region



On a statewide level, nearly three-quarters of the Skid Trail BMPs were properly implemented. Approximately 7 percent of forestry practices posed a threat or risk to water quality (Figure 42). Mountain BMP implementation results were lower (56 percent) and 18 percent of the forestry practices threatened water quality. Approximately 40 percent of the non-implemented BMPs posed a risk to water quality. BMP implementation in the Piedmont (87 percent) and Coastal Plain (77 percent) was higher; only 2 percent overall threatened water quality. Less than 10 percent of the non-implemented BMPs posed a risk to water quality in the Coastal Plain and more than 20 percent in the Piedmont.

Twelve BMP conditions were used to describe skid trails (Table 7). Statewide, condition implementation ranged from 45 percent (**Rehabilitation)** to nearly 92 percent (**Minimized**). Overall risk to water quality ranged from less than 1 percent (**Compaction**) to 22 percent (**Water bars**) (Figures 43, 44, and Table 7) and risks to water quality due to non-implementation of the conditions ranged from 5 percent (**Compaction)** to 100 percent risk (**Intersecting**). More than 70 percent of the non-implementation was a result of skid trails not being covered with slash to prevent **Erosion**, **Water bars** not being installed correctly, **Rehabilitation** not being conducted on closed trails, **Rutting** and trails not being **Closed** out properly. These five conditions also posed more than two-thirds of the risk to water quality under this BMP.

Figure 43: Statewide BMP Implementation for Skid Trails Conditions

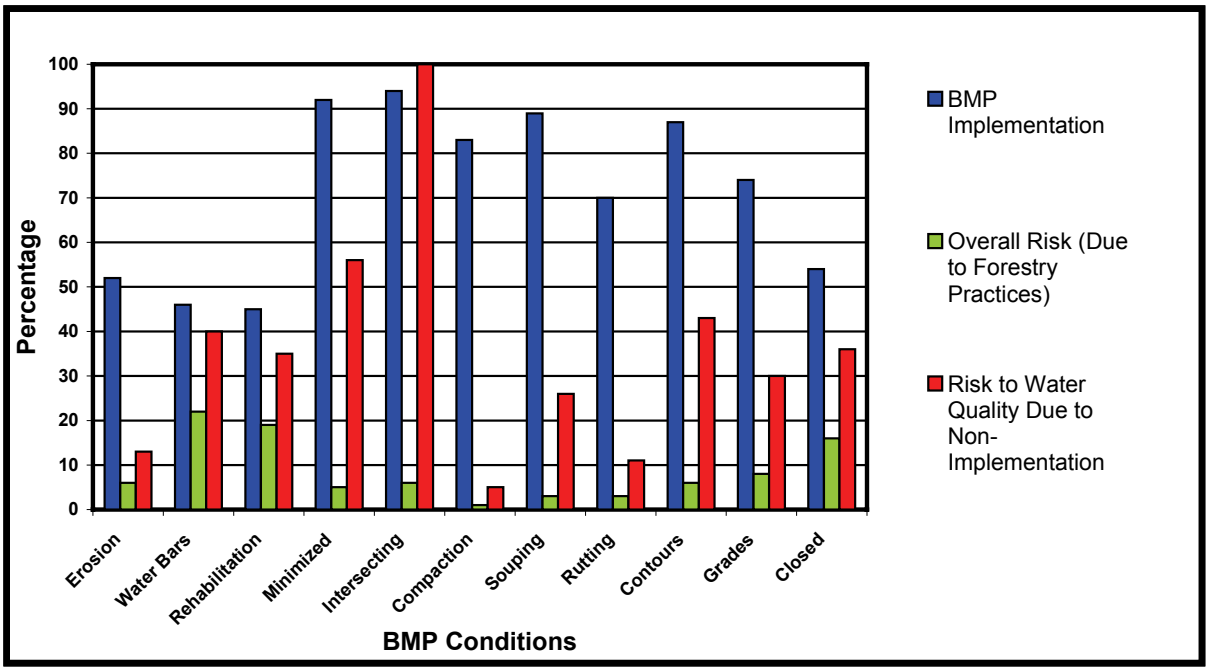
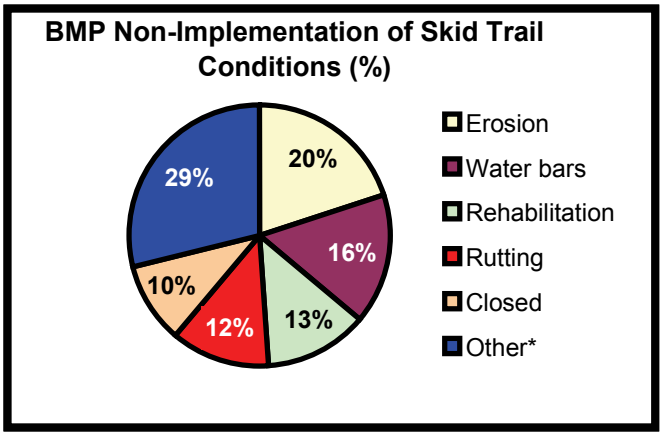
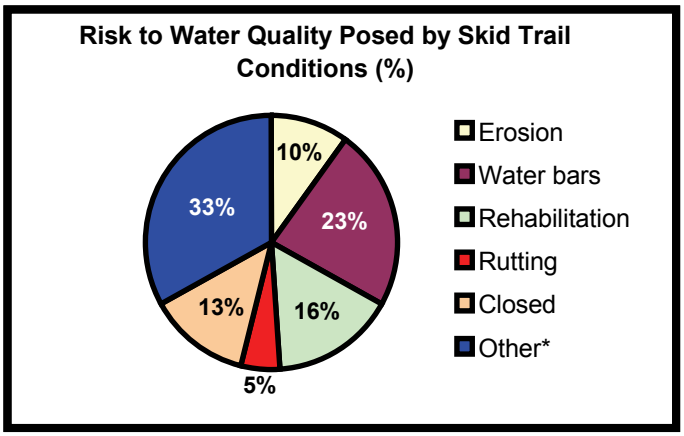


Figure 44: BMP Implementation and Water Quality Risk of Skid Trails Conditions



***Minimized, Intersecting, Compaction, Souping Contours, Grades**



***Minimized, Intersecting, Compaction, Souping Contours, Grades**

Table 7: Skid Trails Conditions

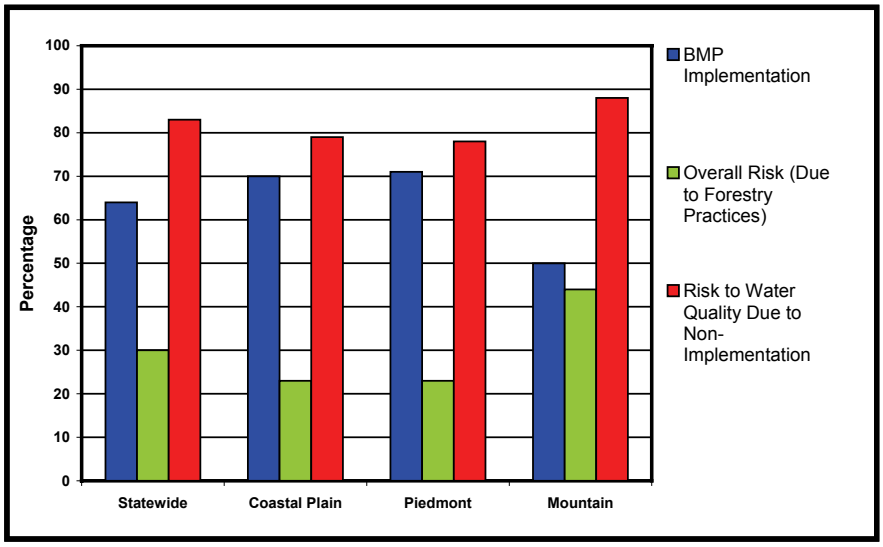
1. Logging slash and debris placed on bare ground to prevent **erosion**.	7. "**Souping**" was avoided.
2. **Water bars**/water diversions constructed where needed.	8. "**Rutting**" was avoided.
3. **Rehabilitation** completed for inactive skid trails.	9. Skid trails follow **contours** where possible.
4. Skid trails **minimized** in SMZ.	10. Skid trails do not exceed **grades** of 25%.
5. Skid trails **intersecting** streams at right angle to SMZ.	11. "**Closed'** skid trails protected by adequate waterbars or brush piles.
6. Soil **compaction** was avoided by concentrating skidder traffic on primary trails.	

Non-implementation of skid trail BMPs was problematic. According to survey data, one-third of all non-implementation was a result of not properly managing the skid trail system with BMPs. Challenges with regards to skid trails are due to a lack of planning, maintenance and rehabilitation.

For example, incorrectly installed or inadequate **Waterbars** and ground cover (**Erosion**) were the two largest problems. Surveyors also observed that skid trails were not properly closed. More than half of the sites had inactive trails that had no or inadequate **Rehabilitation** work completed. To resolve these challenges, skid trails should be minimized and planned in advance, to reduce the need for expensive BMPs. When BMPs are installed they should be installed correctly and maintained on a regular schedule. Pre-harvest planning is crucial to the success of implementing this BMP.

Stream Crossings

Figure 45: BMP Implementation for Stream Crossings Conditions by Region



Sixty-four percent of the BMPs on stream crossings were correctly implemented statewide (Figure 45). Nearly 30 percent of the forestry practices and more than 80 percent of the non-implemented BMPs posed a risk to water quality. Fifty percent of the BMPs in the Mountains were correctly implemented. Approximately 44 percent of the forestry practices and nearly 90 percent of the non-implemented BMPs in the Mountain region threatened water quality. Coastal Plain and Piedmont BMP implementations were better than the statewide average and fewer forestry practices were considered a risk to water quality. However, more than 75 percent of the non-implemented BMPs posed a risk to water quality in both regions.

Eight BMP conditions were used to evaluate **Stream Crossings** (Table 8). Implementation ranged from 43 percent (**Crossing)** to 91 percent (**Rock ford**). Overall risk to water quality ranged from 4 percent (**Channel**) to nearly 50 percent (**Crossing**) (Figure 46, 47 and Table 8), and risks to water quality when BMPs were not implemented ranged from 76 percent (**Ground cover**) to 100 percent risk (**Wood, Steel, Rock ford** and **Bridge**). Stream flow **obstructions**, incorrectly **Stabilized** crossings, insufficient **Water control** devices installed to properly direct water and insufficient **Ground cover** to prevent sedimentation into streams contributed to nearly 80 percent of the implementation failures and risks to water quality. Notably, stream crossings contributed to one-third of the risks to water quality found during this entire survey. The survey data indicates stream crossings cause the greatest amount of risk to water quality when compared to the other forestry practices.

Figure 46: Statewide BMP Implementation for Stream Crossings Conditions

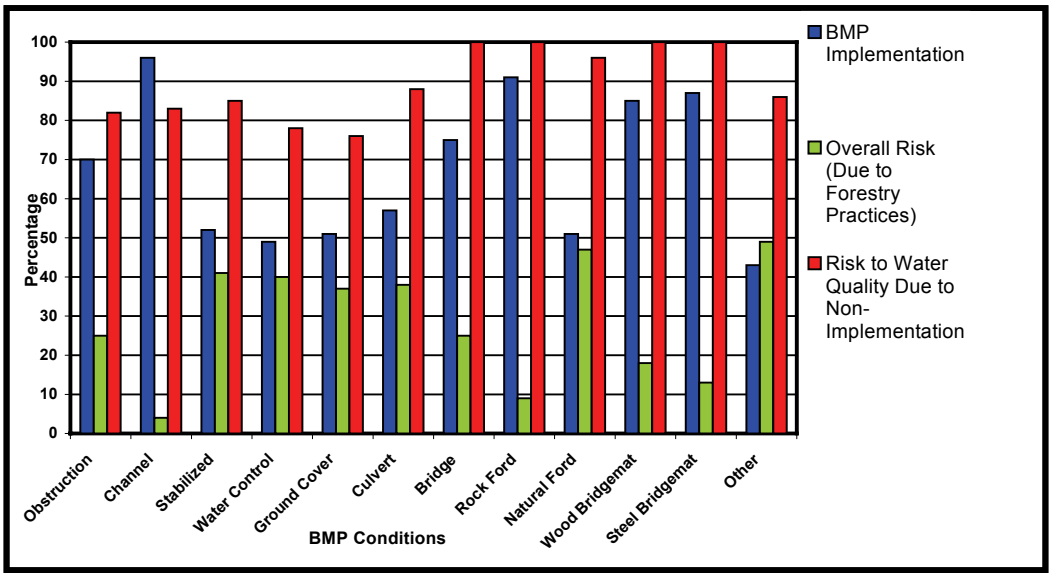
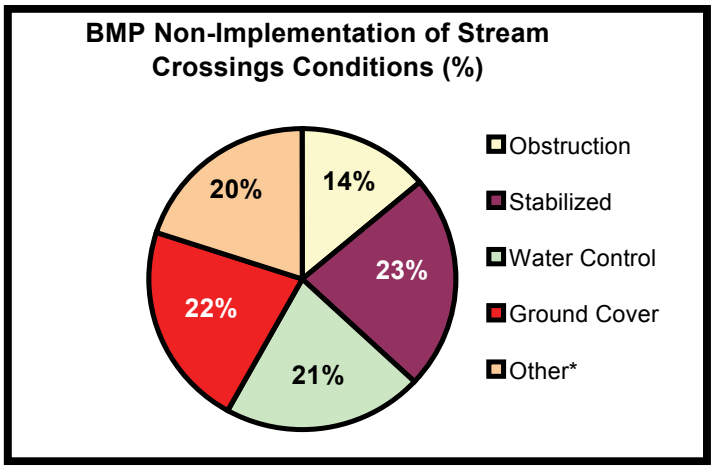
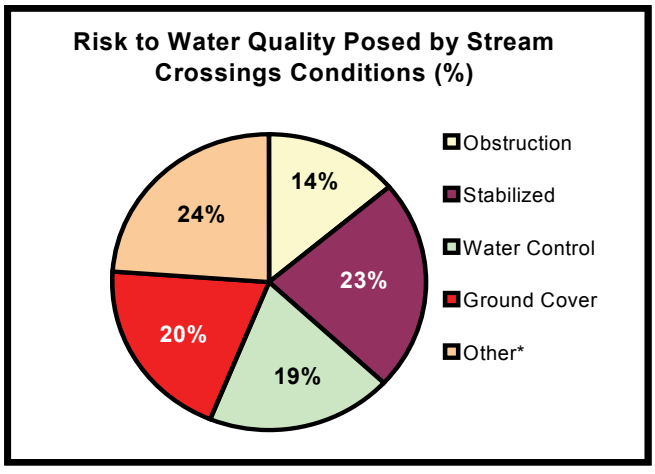


Figure 47: BMP Implementation and Water Quality Risk of Stream Crossings Conditions



***Channel, Culvert, Bridge, Rock Ford, Natural Ford, Wood/Steel Bridge mat, Crossing**



***Channel, Culvert, Bridge, Rock Ford, Natural Ford, Wood/Steel Bridge mat, Crossing**

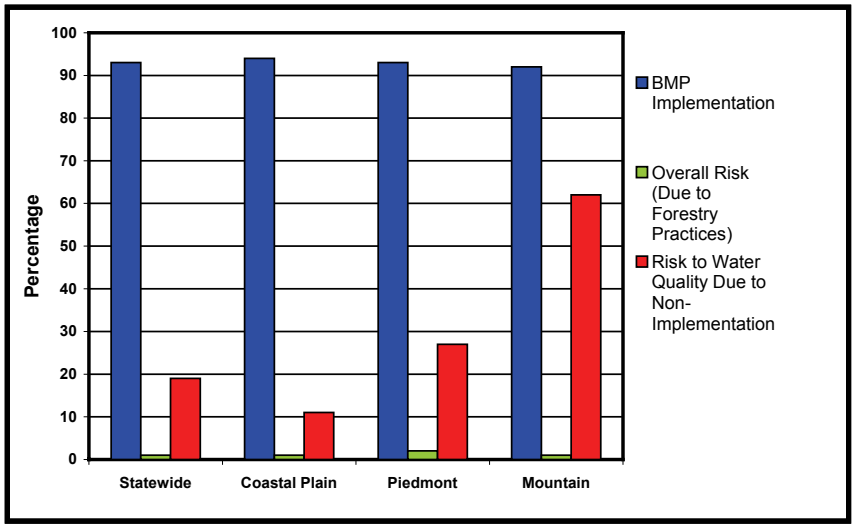
Table 8: Stream Crossings Conditions

1. Stream flow **obstruction** and impairment avoided.	6. Type of stream crossing: • **Culvert** • **Bridge** • **Rock ford** • **Natural ford** • Dragline/bridge mat (**wood**/**steel**) • Other
2. Stream **channel** use as access road or skid trail avoided.	
3. Stream crossings **stabilized** and erosion prevented or controlled.	
4. Sufficient **water control** devices employed to collect and direct surface water flow away from stream.	7. Stream **crossing**(s) are: • Permanent • Temporary • Both Permanent and Temporary
5. **Ground cover** is present to prevent visible sediment in stream.	

When stream crossings are needed, care should be taken to select the most appropriate stream crossing method to complement the operation and minimize impacts to the environment. Bridgemats are the best method for stream crossings since they cause the least impact of all stream-crossing methods. Bridge mats can be expensive, but they also have a long life span and will pay for themselves over time. Survey results show that crossing stability, ground cover at crossing entrances and proper water diversion BMPs were not regularly implemented. Crossing stability should be a top priority as it represents both water quality and safety issues. Crossings should be placed at the safest and most stable stream bank location available that is operationally effective. In the cases of inadequate ground cover and water diversions, increased maintenance is needed to ensure effective results. Maintenance in this area is imperative; otherwise it defeats the BMP work the forest operators have implemented on higher ground.

Access Road Entrances

Figure 48: BMP Implementation for Access Road Entrance Conditions by Region



Statewide, **Access Road Entrance** BMPs were implemented at a consistently high rate of 93 percent (Figure 48). As a result, there was virtually no risk to water quality in regards to access road entrances (1 percent of the forestry practices threatened water quality). However, nearly 20 percent of the non-implemented BMPs posed a threat to water quality. In the Mountain region, BMP implementation was slightly lower than the state average (92 percent). The **Access Road** BMP implementation performance in the Piedmont (93 percent) and Coastal Plain (94 percent) were equal to or greater than the state average. Less than 2 percent of the forestry practices posed a risk to water quality in all three regions. Approximately 27 percent of the non-implemented BMPs in the Piedmont posed a risk to water quality compared to 11 percent in the Coastal Plain. More than 60 percent of the non-implemented Access Road BMPs posed a risk to water quality in the Mountains.

Four possible conditions were surveyed to study access road entrances (Table 9). Each condition was implemented more than 88 percent of the time and less than 3 percent of each condition posed a risk to water quality (Figures 49 and 50). Risks to water quality due to non-implementation of the conditions ranged from 13 percent (**Soil)** to 36 percent (**Debris**). More than half of the non-implementation was a result of **Soil** being left on the highway and crossing roadside **Drainage** ditches incorrectly. However, **Debris** left on the highway was the condition that posed the greatest risk to water quality (36 percent). The minor problems related to this BMP can be easily remedied if forest operators take the time to pick up their debris and clean dirt off paved roads while the operation is ongoing. **Access Roads** are typically the closest vantage point that most people will get to a forestry operation. These areas need to be kept safe and clean to reflect a forest operator's professionalism.

Figure 49: Statewide BMP Implementation for Access Road Entrance Conditions

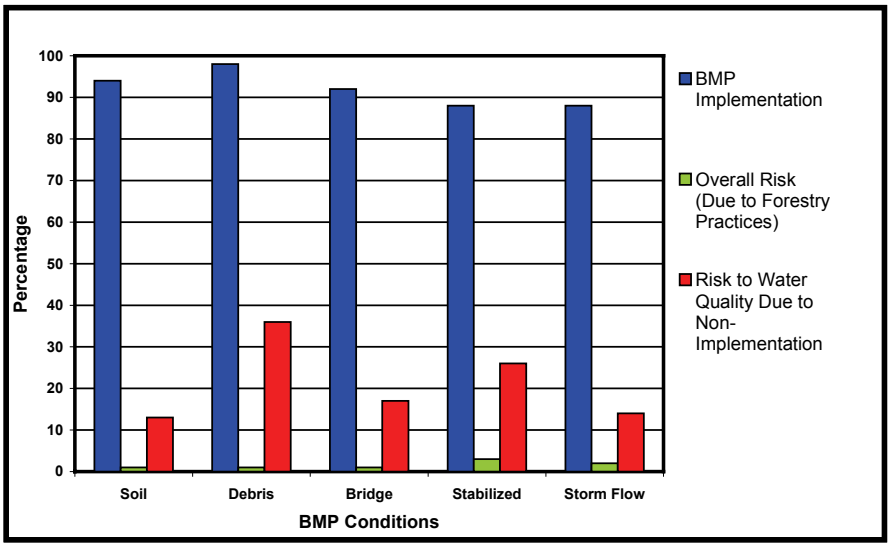
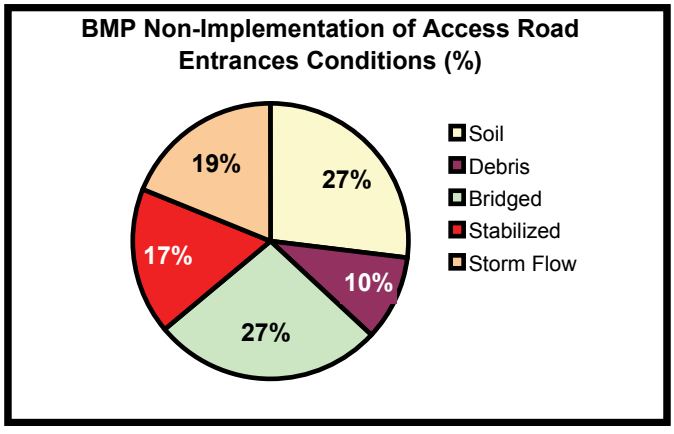


Figure 50: BMP Implementation and Water Quality Risk of Access Road Entrances Conditions



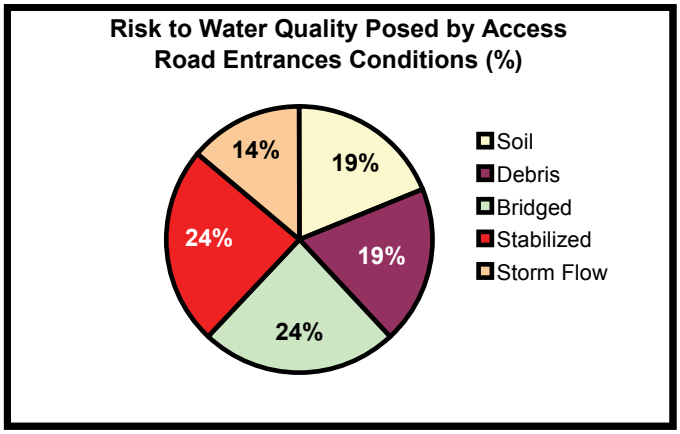
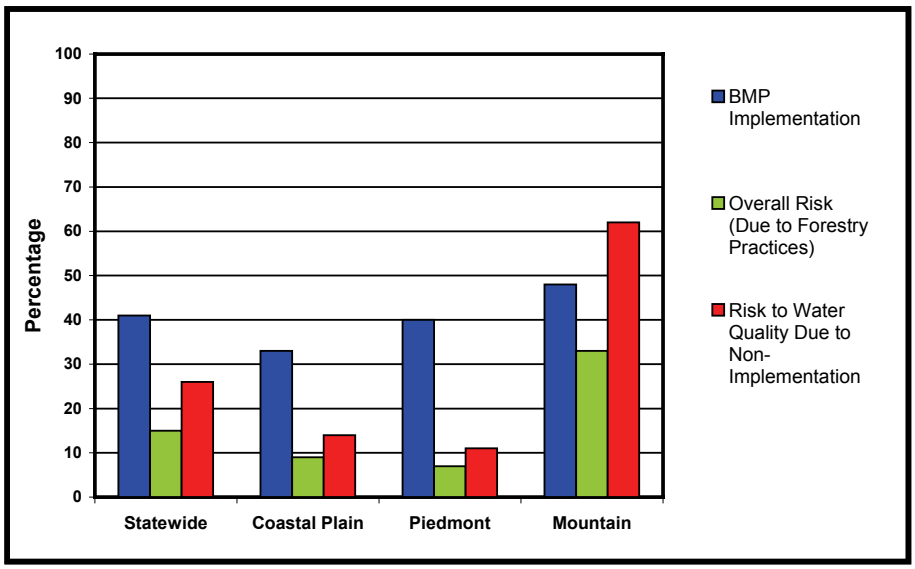


Table 9: Access Road Entrances Conditions

1. Excessive **soil** on the highway adjacent to access was avoided.	3. **Drainage** easement/ditch between main highway and access road (1) **bridge**d by appropriate means; (2) properly **stabilized** and (3) not impeding **storm** water **flow**.
2. Logging **debris** or trash on the highway adjacent to access was avoided.	

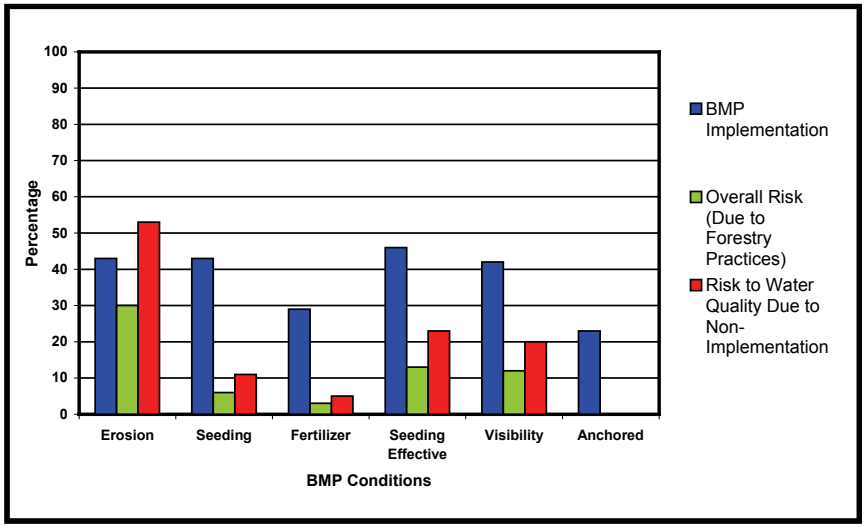
Rehabilitation of Project Site

Figure 51: BMP Implementation for Rehabilitation of Project Site Conditions by Region



Rehabilitation BMP implementation across the state was relatively low (41 percent) compared to the other forestry BMPs (Figure 51). Approximately 15 percent of the forestry practices and more than one-quarter of the non-implemented BMPs posed a risk to water quality. Nearly half of the forestry practices in the Mountains were correctly implemented. However, about one-third of the forestry practices and more than 60 percent of the non-implemented BMPs posed a threat to water quality. Piedmont BMP implementation was nearly equal to the statewide average (40 percent). Seven percent of the BMPs and more than 10 percent of the non-implemented BMPs were deemed a risk to water quality. Less than 35 percent of the BMPs found in the Coastal Plain were properly implemented. Nearly 10 percent of the forestry practices and 14 percent of the non-implemented BMPs posed a risk to water quality.

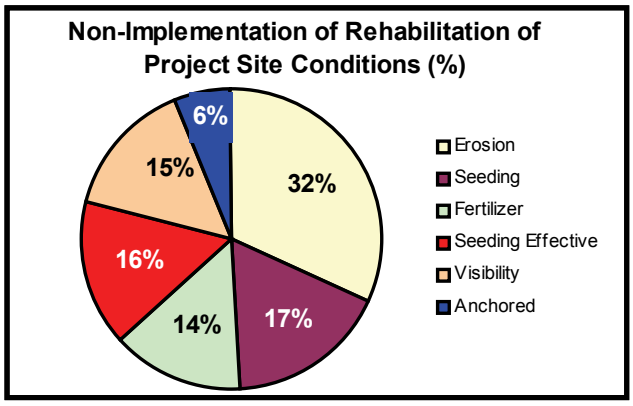
Figure 52: Statewide BMP Implementation for Rehabilitation of Project Site Conditions



Six conditions were surveyed to evaluate the implementation of rehabilitation (Table 10). Statewide implementation of these conditions ranged from 23 percent (**Anchored)** to 46 percent (**Seeding**). Overall risk to water quality ranged from no risk (**Anchored**) to 30 percent (**Erosion**) (Figures 52, 53 and Table 10) and risks to water quality due to non-implementation of the conditions ranged from no risk (**Anchored)** to 53 percent risk (**Erosion**). Thirty percent of the non-implementation and 65 percent of the overall risk to water quality was due to high **Erosion** areas not being provided ground cover or other sediment control measures within 30 working days of a forestry operation.

Based on the survey data, rehabilitation appeared to be an afterthought. The implementation rate of this BMP is the lowest of all BMPs. Rehabilitation should be implemented as the operation is ongoing. Completed (closed out) areas should be immediately rehabilitated and stabilized to ensure soil conservation and water quality protection.

Figure 53: BMP Implementation and Water Quality Risk for Rehabilitation of Project Site Conditions



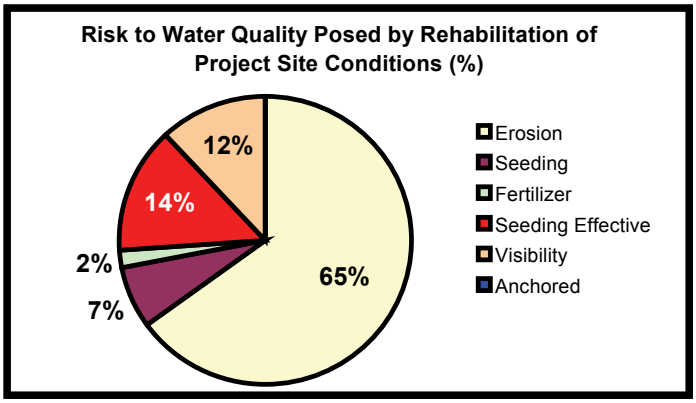


Table 10: Rehabilitation of Project Site Conditions

1. High/accelerated **erosion** areas have been provided ground cover or other sediment control measure(s) within 30 working days after ceasing any operational phase or beginning a period of inactivity in a portion of the entire harvest tract.	3. Lime and **fertilizer** properly incorporated into soils.
	4. **Seeding** accomplished in an **effective** manner.
	5. Mulching (following seeding) meets the (1) 25% ground surface **visibility** standard; (2) mulch properly **anchored**.
2. Soils properly prepared for conventional **seeding**.	

Conclusion

Forestry BMP implementation is critical in protecting water quality during forestry operations. This survey indicates BMPs are being implemented across North Carolina with varying degrees of success. However, BMP implementation improvements are necessary, particularly in the Mountain and Foothill regions of the state. Four BMP categories- **Stream Crossings**, **Debris Entering Stream**, **Skid Trails** and **SMZs** were identified as requiring the most improvement across all regions. These four BMPs collectively accounted for 80 percent of the non-implementation and 77 percent of the overall risk to water quality. In many cases, BMP non-implementation was likely a result of the BMPs being inadequate, incorrectly installed, and/or not being maintained. Not surprisingly, the three FPG performance standards (performance standards .0201, .0202 and .0203) that correspond to these four BMP categories were found to have lowest compliance according to the survey. Survey-derived FPG compliance data results were nearly identical to DFR's 2000 to 2003 Forest Management Accomplishment Reporting and Planning Program's FPG compliance data for active harvest sites.

The **Site Rehabilitation** BMP was the least implemented BMP across all regions in the state. In the Coastal and Piedmont regions, the risk to water quality for non-implementation of this BMP was not much above the overall water quality risk due to forest practices (<10 percent). However, more than 60 percent of the sites in the Mountain region were determined to be at risk from non-implementation of this BMP. The implication may be that steeper slopes in the Mountain region are less forgiving on unstabilized sites. It is important to note that there were only 61 sites for which surveyors indicated that this BMP applied. For that reason, more investigation is needed on this subject.

Survey site compliance with the state's riparian buffer rules was high. Forest harvest operations that fall under the Tar-Pamlico and Neuse River Basin Buffer Rules were in compliance 97 percent and 96 percent, respectively. Only one surveyed site was applicable to the temporary Catawba River Main Stem Rule for forest operations and it was compliant with the buffer rules.

The **Access Road**, **Waste Entering Stream** and **Stream Temperature** BMP categories were regularly implemented and posed little risk to water quality compared to the other six BMP categories. These three BMP categories combined for 8 percent of the non-implementation and less than 3 percent of the overall risk to water quality. Additionally, the two FPG performance standards (.0205 and .0208) that correlate to **Waste Entering Stream** and **Stream Temperature** were rarely found to be not implemented.

Since 1999, seven of the State's 13 NCDFR districts have had an assigned WQF to manage water quality issues in their assigned district. This survey has provided some measure of WQF effectiveness but by itself is inadequate or inconclusive to determine the overall impact these positions have produced to protect water quality during forestry operations. An enhanced WQF performance assessment should be documented in addition to this report.

Survey results indicate the NCFA's ProLogger Program has been successful in training loggers to implement BMPs that protect water quality during harvesting operations. However, the ProLogger Program can do more in the future by focusing training on areas identified in this report that need improvement, such as **Stream Crossings**, **Debris Entering Stream**, **Skid Trails and SMZs**. Also, additional training will be needed to improve performance in the mountains and foothills. The ProLogger continuing education requirement is one primary pathway to accomplish this BMP-specific training.

Survey results indicate that better BMP implementation performance can be accomplished through increased education and training and use of professional technical assistance and pre-harvest planning. Furthermore, landowners, consultants, timber buyers and loggers must consider the costs associated with the planning, implementation and maintenance of the prescribed BMPs when conducting business. Costs must be factored into the timber sale and considered an operational requirement. Forestry BMPs can be costly, but the costs associated with fixing a problem after the forestry operation are typically much higher.

Recommendations

This survey confirmed some generally accepted field knowledge and also provided some new insight on BMP implementation. The following recommendations are based on an analysis of the survey data:

1. Encourage, promote and increase professional forestry assistance and pre-harvest planning. Survey data clearly shows that professional forestry assistance and pre-harvest planning result in better BMP implementation and FPG compliance performance.

2. Mountain and foothill BMP implementation was relatively low. To overcome this, increased BMP training is required. Training enhancement could be further augmented by developing a mountain/foothill specific BMP Pocket Guide as a field reference or including a special mountain/foothill section in the North Carolina Forestry BMP Manual.

3. Place a statewide BMP training emphasis on stream crossing, debris prevention, SMZ conditions, skid trail and site rehabilitation BMPs.

4. Future BMP surveys should include the following additions or changes to better capture BMP implementation and risks to water quality performance:
   a. Conduct a year-long BMP survey every other year for the next 10 years. By doing so, temporal trends can be captured and assessed.
   b. Develop a paperless BMP survey for more accurate and efficient data capture, transfer and analysis. A survey can be done with handheld computers such as personal data assistants.
   c. The survey should reflect the degree of BMP implementation choices to the field such as:
      - BMP implemented;
      - BMP attempted but inadequate;
      - BMP attempted but incorrectly installed and
      - BMP not-implemented.
   d. Change the survey procedure so that when a BMP is found to have been implemented it is assumed that there is no risk to water quality. Specifically, the BMP has to be adequately and correctly installed to be considered "BMP Implemented."
   e. Record the average SMZ width (i.e., width of tree buffer) for each survey site.
   f. Record the stream/waterbody temperature above and below each survey site.
   g. Record the number of days since the last rainfall.
   h. Record the soil moisture (i.e. dry, moist, wet, saturated, etc.).
   i. Record the number of stream crossings at each survey site.
   j. Record the number of unneeded stream crossings. Note the alternatives to these unneeded crossings.
   k. Record the number of bridge mat sets used on each survey site.
   l. Record the estimated cost of the BMPs implemented on-site using NCDFR standardized BMP cost figures.

5. Stress that stream crossings should be avoided whenever possible. Survey data indicated stream crossings posed the highest risk to water quality. When crossings cannot be avoided, extreme care should be taken and the best stream crossing method available should be employed. Promoting bridgemats as the best temporary method for stream crossings should continue. Therefore, the Division of Forest Resources needs to maintain and further enhance its Bridgemat Loan & Education Program. Furthermore, NCDFR should conduct a bridgemat

use survey to determine where to expand or re-emphasize the Bridgemat Loan & Education Program within the state.

6. The noted debris entering stream problems were primarily due to logging debris that was found in the stream channel. On many sites there was enough debris to impair or obstruct the stream flow. Consequently, nearly one-quarter of all FPG violations in the survey were due to debris entering streams and water bodies. This survey finding was verified by the FPG compliance performance rates observed from the FPG Program. To correct this problem, every effort should be made during an operation to keep stream channels and water bodies free of debris. Daily stream inspections by the logger, buyer, consulting forester or landowner would facilitate this BMP being consistently implemented.

7. Non-implementation of skid trail BMPs was common. According to survey data, one-third of all non-implementation was due to this BMP. The survey data shows that challenges with regards to skid trails are due to a lack of planning, maintenance and rehabilitation. To resolve these challenges, skid trails should be minimized and properly laid out to reduce environmental impacts and operational expenses. When BMPs are installed they should be installed correctly and maintained on a regular schedule. Each trail needs to be closed out immediately after the trail segment is no longer needed. To facilitate and promote skid trail BMPs, additional hands-on training with regards to water diversion construction and maintenance will be beneficial for loggers, buyers, consulting foresters, landowners and NCDFR personnel. Creating a forestry BMP video on skid trails would be a valued tool to address this BMP deficiency.

8. The SMZ BMP correlates closely to a FPG (.0201). Survey results indicate that this FPG needs to be re-emphasized across the state. The SMZ's purpose is to slow, filter and protect the stream or water body from sediment and other pollutants. Unfortunately, SMZs are not routinely implemented adequately or correctly. Factors such as slope, soil type, season, vegetation type and ground cover must be taken into account when planning for SMZs. Wider or narrower SMZs widths can be implemented as long as it adequately protects the stream from sediment and other pollutants. The SMZ width recommendations found in the North Carolina Forestry BMP Manual represents minimum widths. Future North Carolina Forestry BMP Manual revisions should continue to provide SMZ width recommendations based on the slope, soil and other factors. Furthermore, survey data indicated river basins that had buffer rules performed better with regards to SMZ BMPs. Based on this, further study and discussion needs to occur regarding to the potential benefits and costs of buffer rules and the potential expansion of these rules to other river basins.

9. Since 1999, seven of the state's 13 NCDFR districts have had an assigned WQF to manage water quality issues in their assigned district. This survey has provided some measure of the effectiveness of Water Quality Foresters but by itself is inadequate or inconclusive to determine the overall impact these positions have produced to protect water quality during forest operations. An enhanced WQF performance assessment should be documented.

Literature Cited

Blue Ribbon Task Force on Forest Sustainability. 1996. Report of Governor's Task Force on Forest Sustainability. North Carolina Department of Environment, Health, and Natural Resources, N.C. Division of Forest Resources and North Carolina State University, Raleigh, NC.

BMP Monitoring Task Force. 1997. Silviculture Best Management Practices Implemented Monitoring – A Framework for State Forestry Agencies.

BMP Monitoring Task Force. 2002. Silviculture Best Management Practices Implementation Monitoring - A Framework for State Forestry Agencies.

Brady and Weil. 1999. The Nature and Properties of Soil, 12th Edition. Prentice Hall. Upper Saddle River, NJ.

Brown, David. 2002. Forest Statistics for North Carolina, 2002. Resource Bulletin SRS-88. USDA Forest Service, Southern Research Station, Asheville, NC.

Conner, Roger C. and Raymond, Sheffield M. 2001. Forest Statistics for the Southern Coastal Plain of North Carolina, 1999. Resource Bulletin SRS-59. USDA Forest Service, Southern Research Station, Asheville, NC.

Gueth, Moreland. 2002 NC Division of Forest Resources Forest Practices Guidelines Related to Water Quality Annual Compliance Report. N.C. Division of Forest Resources, Raleigh, NC.

Henson, Mickey. 1995. Best Management Practices Implementation and Effectiveness Survey on Timber Operations in North Carolina. North Carolina Department of Environment and Natural Resources, N.C. Division of Forest Resources, Raleigh, NC.

Henson, Mickey. 1996. Best Management Practices Implementation and Effectiveness Survey on Timber Operations in North Carolina. North Carolina Department of Environment and Natural Resources, N.C. Division of Forest Resources, Raleigh, NC.

Johnson, Tony G. 1991. Forest Statistics for North Carolina, 1990. Resource Bulletin SE-120. USDA Forest Service, Southeastern Forest Experimental Station, Asheville, NC.

Johnson, Tony G. and Brown, David R. 2002. North Carolina's Timber Industry - An Assessment of Timber Product Output and Use, 1999. Bulletin SRS-73. USDA Forest Service, Southern Research Station, Asheville, NC.

North Carolina Division of Forest Resources. 1989. Forestry Best Management Practices Manual. North Carolina Department of Environment, Health, and Natural Resources, Division of Forest Resources, Raleigh, NC.

White, Fred. 1992. History of Forest Practice Guidelines in North Carolina, North Carolina Department of Environment, Health, and Natural Resources, N.C. Division of Forest Resources, Raleigh, NC.

Appendix 1

Glossary

Glossary

Bay - "Carolina bays" are isolated wetlands in natural shallow depressions that are largely fed by rain and shallow groundwater. These bays have an elliptical shape and are typically oriented from northwest to southeast.

Clearcut (harvest method) - A method of regenerating an even-aged stand in which a new age class develops in a fully exposed microclimate after removal of all trees in the previous stand.

Croptree Release (harvest method) - A harvest designed to reduce competition for the croptree. A croptree is identified as one that will be grown to maturity and intended for the final harvest cut. It is usually selected on the basis of its location to other trees and its quality and species.

Flatwoods - A site with flat to gently-sloping topography and relatively poorly drained, sandy soils that often have standing water during wet weather.

Foothills - Hilly land on the lower slopes of the mountains that is characterized by moderate slopes.

Forested Wetland Management - Management of timber in areas that have wetlands characteristics.

Improvement (harvest method) - A cutting made in a stand of pole-sized or larger trees primarily to improve composition and quality by removing less desirable trees of any species.

Intensive Forest Management - Using a wide variety of silvicultural practices, such as planting, thinning, fertilization, release, harvesting and genetic improvement, to increase the capability of producing forest products.

Intermediate (harvest method) - Any removal of trees from a stand between the time of its formation and the regeneration cut.

Mountain - A landform that extends above the surrounding land and is characterized by steep slopes.

Passive Forest Management - Allowing previously harvested lands to naturally regenerate without the use of the silvicultural practices associated with intensive forest management (see above).

Pocosin - An upland swamp of the coastal plain of the Southeastern United States. Generally, these swamps are characterized by poorly drained, organic soil and evergreen trees and shrubs.

Regeneration (harvest method) - Any cutting method by which a new age class is created.

Rolling Topography - A land form characterized by gentle to moderate slopes.

Rutting - Depressions in roads or trails made by repeated passage of vehicles or mobile equipment.

Salvage (harvest method) - The removal of trees that are dead, damaged or dying due to factors other than competition. This harvest method is designed to recover timber values that would otherwise be lost.

Seedtree (harvest method) - A method of regenerating an even-aged stand. In this method a new age class develops from seeds that germinate in fully exposed microenvironments after everything is removed from the previous stand except for a small number of trees left to provide seed. Seed trees are removed after regeneration is established.

Selection (harvest method) - A method of regenerating uneven-aged stands in which trees are removed and new age classes are established in small groups. The maximum width of groups is approximately twice the height of the mature trees. Small openings provide a microenvironment suitable for tolerant regeneration, and the larger openings provide conditions suitable for more intolerant regeneration.

Shelterwood (harvest method) - A method of regenerating an even-aged stand in which the old crop is harvested in two or more cuttings to provide seed and/or protection for regeneration. A new age class develops beneath the moderated microenvironment provided by the trees left after the harvest.

Silvi/Agro Management - A system of land use in which harvestable trees or shrubs are grown among or around crops or on pastureland. This management preserves or enhances the productivity of the land.

Souping - A term used to describe a condition when soils lose structure from repeated traffic during saturated conditions.

Thinning (harvest method) - A treatment made to reduce stand density. The main goal is to improve growth, enhance forest health or to recover potential mortality.

Wetlands - Areas that are saturated by surface or ground water sufficient enough to support most of the vegetation typically adapted for saturated or near-saturated soil conditions. In order for a wetland to be considered a *"jurisdictional wetland"* for regulatory purposes it must possess all of the following characteristics: (1) hydrophytic vegetation (2) hydric soils and (3) wetland hydrology.

Appendix 2

DFR Water Quality Action Plan

Water Quality Action Plan

North Carolina Division of Forest Resources

April 21, 1998

Approved By:

_____
Stanford M. Adams, Director

_____
Date

NC Division of Forest Resources Water Quality Action Plan

Standards

1) Establish standard timeframes for dealing with water quality complaints at the county/district level.
Since establishment of the FPG's, there has been no standard timeframe for responding to either citizen complaints regarding forestry activities or to completing paperwork when a FPG violation was discovered. To bring greater uniformity to the DFR's water quality program the following timeframes for action were approved by the DFR's Management Team and are now expected of field personnel:

1) *Response to Complaints*	*5 Working Days Maximum*
2) *Follow-up to Potential Violation w/Notice of Non-Compliance*	*3 Working Days Maximum*
3) *Length of Time to Bring Into Compliance*	*Be reasonable. Base on severity, complexity of situation, not automatically 30 days. Violators we have dealt with previously on same problem - give less time than a first time offender. Do not let personalities affect decisions.*
4) *Follow-up Compliance Checks*	*On day specified or next working day.*
5) *Referrals to Other Agencies*	*5 Working days maximum after expiration of deadline/failure to bring into compliance*

Action/Task: Follow up on FPG complaints and problems discovered in a timely manner. Do not let problems continue with little or no effort made by the responsible party(ies) to bring into compliance.

By Whom: DFR county and district personnel will be responsible for meeting these timeframes. Regional and Central Office forest management staffs will provide oversight to ensure that timeframes are being met.

Target Date: Adopted by DFR Management Team during August 26, 1997 meeting.

Status: Timeframes are in place and expected to be met. DFR's Policy and Procedure for its Forest Water Quality Program is being revised. When completed, these timeframes will be included.

2) Revise, update and reprint the *Forestry Best Management Practices Manual*.
The *Forestry Best Management Practices Manual* was created in 1989, when the SPCA was amended to create the FPG's. It has not been updated or revised since.

Action/Task: New methods and technologies have evolved since the Manual's creation. The Manual is being updated to reflect these changes and provide the best source of treatments and measures to remain in compliance with the FPG's as is possible.

By Whom: The rewriting is being done by the DFR Forest Hydrologist under a Section 319 Grant. Review is by DFR Forest Management Staff Foresters and the NC Forest Practices Guidelines Technical Advisory Committee.

Target Date: The projected completion and publication date is June 1, 1998.

Status: Several drafts have been circulated for review. One more draft is anticipated, which will include all tables and illustrations not previously included.

3) Complete revision of *Best Management Practices For Forestry In North Carolina's Wetlands* and publish.
Originally published in June, 1990, the Wetlands BMP Manual has not been updated or revised until now. Draft is in review process and will be published as soon as approval to do so is received.

Action/Task: The updating includes revision of practices recommended, to be in compliance with the Corps of Engineers guidance for "Application of Best Management Practices to Mechanical Silvicultural Site Preparation Activities for the Establishment of Pine Plantations in the Southeast".

By Whom: The updating and revision was started by the former FM/FD Section Chief, prior to his retirement. After retirement, he continued to work on the draft manual. The FM/FD Section Chief is now working to get the manual into an acceptable form.

Target Date: June 30, 1998

Status: The manual has been revised to take into account input from public meetings and written comments which were received. It is currently under review by other DENR Divisions and is waiting on approval at the Department level to be published.

Policy

4) Conduct periodic aerial reconnaissance of potential water quality problems
DFR pilots are in the air on various missions year round. They have been directed to be alert for potential water quality problems whenever they are in the air.

Action/Task: Any potential problems observed by a pilot are to be reported to their district forester or to the district forester of the district the problem was observed in. The district forester will see that the problem is investigated and corrective action taken if it is a forestry operation. If it is not a forestry operation, then the district forester will contact the appropriate regulatory agency and inform them of the problem.
In addition to on-going efforts, District foresters will personally fly their district, at least four times per year, after significant rainfall events to look for water quality problems caused by forestry operations. If any are detected, they will be handled according to DFR procedures. A record of the problems found will be maintained in the Central Office.

By Whom: DFR pilots and district foresters will be responsible for these measures. The Watershed Protection Forester will oversee the record keeping in the Central Office.

Target Date: By no later than April 1,1998.

Status: Training for pilots in what to look for has been completed, along with training in use of a draft reporting form. Revisions to the reporting form, and procedures for the pilots and district foresters to follow are being reviewed before being sent to the field.

5) Make concerted effort to visit and inspect logging jobs while logger is on site.
Currently, many of the sites that the DFR inspects for FPG compliance are ones where the logging or other site disturbing activity has been completed. In extreme situations, it can be up to a a year after the logging was completed, before some sites are inspected. In this length of time, considerable water quality damage can occur as well as possibly natural healing.
If there is a problem or FPG violation, then it can be corrected much sooner, thereby limiting the damage that can occur.

Action/Task: The DFR wants to inspect more active logging jobs since FPG compliance is expected from the start of the logging until permanently stabilized after completion. The major limiting factor to doing this is current workload and lack of adequate field staff.

By Whom: Site examinations for FPG compliance are made by county technicians and district staff members. In the counties with significant numbers of active logging jobs, both county and district staff are overworked with other Forest Management responsibilities. The addition of Water Quality/BMP Foresters in each district would significantly increase the number of site inspections made, especially while logging is underway.

Target Date: 1998 with current limited staff. Increase in FY 1999-00 with the addition of requested Water Quality/BMP Foresters.

Status: The Director has stated that inspection of active logging jobs is a high priority. County and district personnel are to make every effort to inspect active logging jobs as they find them. This is only a stop gap measure until the DFR can increase its personnel.

6) Continue to increase number of FPG compliance inspections during course of routine field work.
Inspections are made during reforestation exams of cut over tracts, when a questionable tract is observed by DFR personnel, prior to approving reforestation cost-share assistance and in response to complaints.

Action/Task: As reforestation requests increase and complaints about logging from the public increase, the number of tracts inspected will have to increase. The concern is that given current staffing levels and workloads, there will come a point at which it will be impossible to do more with current resources. Ways must be found to increase the number of field personnel, redistribute the available personnel to areas with the greatest need, reduce the current workload, or otherwise find more time to devote to water quality inspections. Permanent funding of the Water Quality/BMP Foresters will cause the number of inspections to increase.

By Whom: County and district personnel will be expected to conduct as many inspections as possible. Back up and technical assistance will be available from regional and central office foresters. DFR Management Team will have to continue to work for new positions, the possible reallocation of current resources and defining DFR priorities.

Target Date: 1998 Legislative session for funding of new positions for FY 1999-00.

Status: The number of tracts inspected has increased each year since the inception of the FPG Program. Compliance rates have been relatively steady for the last three (3) years. Without more resources it is going to be very hard to bring about further improvement.

7) Initiate a voluntary harvest notification system for logging in North Carolina.
At this time, no one knows how much timber is cut in North Carolina each year. A voluntary harvest notification system will assist in estimating total annual timber drain in the state. Also, by asking for the right information, logging jobs with the greatest potential to adversely impact water quality can be identified. Special efforts can be made to prevent problems. Also, landowners of harvested areas can be contacted to offer reforestation assistance. DFR staff is working on creating a workable system, which can be implemented in the near future.

Action/Task: Develop a voluntary harvest notification system that is simple enough to generate use, but detailed enough to provide the DFR with usable information. A segment within the forest products industry does not feel such a system is necessary, due to current high compliance levels with the FPGs. This objection is abating as forest industry companies attempt to comply with the principles of the *Sustainable Forestry Initiative* ©; the DFR believes this initiative will cause industry participation in a Harvest Notification system. A draft of the proposed system will be distributed to the forest industry and DENR divisions for comment as soon as it is ready.

By Whom: The DFR's Watershed Protection Forester is working on creating this harvest notification system, in conjunction with the other FM staff foresters.

Target Date: July 1, 1998

Status: Several drafts have been reviewed since work started on creating this system. Methods used in other states have been compared, to come up with the best system for North Carolina. A draft is currently being worked on that will meet the needs of the state.

Enforcement

8) Emphasize uniformity of expectations and enforcement of FPG requirements across county, district and regional boundaries.
A complaint occasionally expressed by members of the forestry community is that DFR expectations for FPG compliance vary from county to county and district to district. Many procurement personnel and loggers cross these lines regularly and should meet the same expectations any where they go in the state. Hurricane FRAN also caused many loggers to move to work in areas out of their normal work area. The DFR's expectations should be the same statewide, realizing that geographic and topographic variations will require different means to achieve FPG compliance.

Action/Task: Conduct interagency technical training for DFR, DLR and DWQ personnel involved in FPG compliance activities. This training will bring these agencies together so that each will better understand the others' role. The training is intended to increase each individual's understanding of the FPG requirements and improve uniformity of expectations across county, district and regional lines.

By Whom: The Watershed Protection Forester is working with the Assistant Regional Foresters and Assistant District Foresters to plan and present this training in each of the 13 DFR districts.

Target Date: June 30, 1999 to have conducted training in each district.

Status: Since the training was begun in December, 1996, it has been conducted in three districts. A fourth would have been completed but the January, 1998 snow caused it to be postponed.

9) Increase referrals to enforcement agencies, rather than grant extensions to the deadlines when FPG violations are not corrected in a timely manner.
In some cases, compliance has not been achieved by the initial deadline. Rather than immediately referring project to appropriate enforcement agency, DFR personnel have, in some cases, continued to work with the responsible party(ies) to achieve compliance. This has given some individuals the impression they can take their time to get into compliance; as long as they do something, no referral would be made.

Action/Task: To strengthen DFR compliance efforts and to minimize water quality impacts, projects not brought into compliance by the specified deadline will be promptly referred to the appropriate enforcement agency for them to deal with in a more forceful manner.

By Whom: Referrals are made at the district level by the district forester. This initiative will require cooperation and support with district personnel keeping supervisors advised of on going problems with compliance. Regional and central office staff will also need to be involved to assure all cases are handled the same.

Target Date: This is part of initiative number 1, that was adopted by the DFR management team at their August 26, 1997 meeting.

Status: All field personnel have been advised of this and are expected to be carrying it out. As work with loggers and timber buyers make sure that they are informed of this action.

Technical Assistance

10) Encourage the use of "bridge mats" for stream crossings through bridge mat loaner program.
Stream crossings are one of the worst contributors of sediment to water bodies on forestry operations. Crossings which do not involve fill over culverts or other major disturbance are not likely to contribute significant amounts of sediment and are not as difficult to stabilize. Use of "bridge mats" to cross streams is a preferred method of crossing streams. Many loggers across the state do not realize the utility of these mats. In order to increase

awareness of their ease in use, and to improve the quality of stream crossings, a 319 grant request was made and approved to purchase and distribute sets of mats to each of the DFR piedmont and mountain region districts. The sets of three individual mats have been placed in the nine districts and are available for logger's use. The mats are not intended for permanent use by one logger; rather they are to be used on one or two jobs to see their utility, then returned to the DFR for use by other loggers. It is anticipated that after a logger uses the mats he will purchase his own for long term use.

Action/Task: The mats have already been purchased and distributed to DFR district offices. The availability of these mats must be made known the loggers in the areas where they are available. After a logger has used a set of mats he needs to be able to find where they are available from. A list of known sources of mat suppliers has been prepared and sent to all DFR field offices and some Cooperative Extension Centers. Also records of their use need to be kept to show their long term positive impact on water quality.

By Whom: Advising loggers of the mats' availability is the responsibility of all DFR field personnel in the affected districts. During logger training sessions other staff can also advise loggers and timber buyers of the availability of the mats. A use tracking system is in place where the districts periodically report usage to the Forest Hydrologist.

Target Date: The mats were distributed to the districts and the tracking of their use begun in fall, 1997. The list of mat sources was prepared at the same time and is up dated as is needed.

Status: . The response so far has been very positive.

11) Continue educational efforts to reach loggers, timber procurement personnel and landowners through: new Forestry Leaflets and brochures; an educational display at the *Carolina Log-N-Demo*; instruction of the ProLogger Program; and conduct FPG/BMP training sessions where needed.

Action/Task: As new rules are imposed, new technologies are developed and new persons come into the forest products industry, continuing education is very important. Passing on information learned from other loggers, as well as information from sources such as the USDA-USFS and university researchers is one means of assisting loggers to do their job in a more environmentally sound manner.

By Whom: Leaflets and brochures are developed by the FM Staff Foresters as a need is identified. Topics are assigned to the individual with the most expertise in that area.
The Demo exhibit was planned and created by FM Staff Foresters, Regional, District and County personnel. The Central Office, Regions I and II, and seven districts were involved in the planning, preparation/set up and staffing of the display.
Instruction of the ProLogger course and the FPG/BMP training involves the same mixture of personnel. It is by both foresters and technicians who have been recognized as qualified to provide quality instruction.

Target Date: These activities have been and continue to be on going efforts. FPG/BMP instruction for loggers, timber buyers and forest managers began prior to the January 1,1990 effective date of the amendment to the SPCA, limiting the forestry exemption.

Status: Leaflets prepared in the last year include "Stream Crossings", "Maintaining Water Quality", "Preharvest Planning for Landowners", "Establishing Water Control Structures", "Effects of Sediment", "Use of Bridge and Road Mats", and "Riparian Forest Buffers".
The Carolina Log-N-Demo is a large biennial trade show which draws loggers, timber buyers and forest managers from the eastern seaboard and as far west as Kentucky. The Cooperative Extension Service reported over 3500 in attendance at the show, held September 27, 1997. The DFR produced a large exhibit area covering the FPGs, preharvest planning, the Neuse Temporary Rule for Riparian Forest Buffers, site stabilization, and with assistance from the DWQ, how to manage oil spills.
The ProLogger Program is a logger training program prepared and presented by the DFR, NCFA, and Cooperative Extension Service. Training is aimed at the "boss logger" and crew foreman. To date over 1800 individuals have completed this six night plus one half-day field day training. Topics covered include Forest Management and the

Environment, Safety, and Business. The DFR teaches the six hours devoted to Forest Management and the Environment, as well as takes part in the field day session.
When requested , DFR staff has presented FPG and related water quality training to forest industry groups, consulting foresters and landowners.

12) Provide detailed recommendations on means to correct FPG violations which are discovered.
When FPG violations are found, and the responsible party(ies) are notified of the need to take corrective action, suggestions are made as to what to do. Often DFR personnel have dealt with similar situations, and can give detailed recommendations on what is needed to correct the problem(s).

Action/Task: DFR personnel must be familiar with the *Forestry BMP Manual For Water Quality Protection.* Also they need to have observed what has been done on other tracts to achieve compliance with the FPGs. This information can then be shared with other loggers when they are notified of FPG violations. Ultimately, it is the usually the logger and timber buyer who decide what is done to achieve compliance. However, the information the DFR provides can prevent similar mistakes to what has been observed on other tracts.

By Whom: DFR field personnel with assistance from regional and central office staff foresters.

Target Date: On going and continuous.

Status: This has been on going, and will continue to be, since the inception of the FPGs and the DFR's involvement in water quality. The improvement in detail of recommendations is expected to be continuous as personnel gain more experience. The need to provide the most detail possible will be stressed at the District FPG training sessions and in other training opportunities as they occur.

Funding

13) Continue to seek funding for positions needed to improve DFR's Water Quality Program.
Since the creation of the FPG Program and the DFR's acceptance of responsibility for implementation, there has been no increase in personnel or funding to handle this responsibility. If the program is to continue to grow, and more sites be inspected, especially active logging jobs, it is imperative that the positions requested be funded. These positions are 13 Water Quality (BMP) Foresters, 1 Forest Engineer, 1 Forest Hydrologist and 1 clerical support position. The Water Quality Foresters would provide one dedicated person per DFR district to deal with FPG/BMP concerns. This would include more inspections and follow up on violations, preharvest planning with landowners to help prevent problems from occurring and training loggers and others as the need arises. The Forest Engineer would be a technical resource to work primarily with loggers to better plan their jobs so as not to cause water quality problems. The Forest Engineer would also assist in the development and testing the effectiveness of new BMPs. The Forest Hydrologist would continue the work currently funded with Section 319 Grant funds. This includes surveys of implementation and effectiveness of BMPs, production of various leaflets and brochures and a technical resource to field personnel.

Action/Task: Continue to submit these 16 positions in Division budget requests. Make appropriate presentations to Department administration, the Governors Office, and the Legislature on the need for these positions. Seek support from outside interest groups such as the NCFA and the Nature Conservancy.

By Whom: The DFR and DENR administrations and others who are delegated to pursue this support.

Target Date: 1998 Legislative session for FY 1999-00.

Status: These positions have been sought since the 1990 legislative change. At different times they have been cut from the Department's budget request and other from the Governor's budget request. When submitted to the legislature, the positions have not been funded. The only funding has been two years funding of three temporary FPG/BMP Foresters.

Appendix 3

BMP Implementation Survey Procedure and Surveys Form

2000-2003 Forestry BMP Implementation Survey Procedure

Survey Introduction

The primary goals of this survey are to (1) determine what level of Best Management Practice (BMP) implementation is occurring on "active" logging sites throughout NC and (2) assess the implemented BMP practices for strengths and weaknesses with regard to water quality protection. Any BMP practice "problem areas" identified by the survey will be subsequently addressed in the near term through policy change (i.e., training, educational efforts) and site-specific technical recommendations; long-term resolution will be affected through periodic upland/wetland forestry BMP manual revisions. Additionally, we will utilize the survey to quantify the NC Division of Forest Resources (NCDFR) progress in implementing it's Forestry BMP Program and determine if BMP application inequities exist geographically. Secondary goals of the survey include benchmarking BMP implementation with respect to NCFA's ProLogger Program and NCDFR's District Water Quality Foresters (DWQFs) positioned in seven of the Division's thirteen Districts. Finally, the survey also contains a component to determine forest management (FM) practice compliance with the Neuse River Buffer that had a June 22, 1999 revised effective date, the Tar-Pamlico River Buffer Rule that had an August 1, 2000 effective date, and the Catawba Mainstem Buffer Rule that had an effective date of June 30, 2001. The "buffer rules section" of this survey will be expanded to include additional Riverbasin Buffer Rules as they become effective. On a related note, the survey also contains an inquiry as to the presence of other local buffer rules or tree ordinances you may encounter during the course of performing a survey. The primary interest in these local rules is one of awareness only at this time. In summary, all survey output will be used to support future NCDFR decision-making on forestry water quality issues.

The 2000-2003 NCDFR BMP Implementation Survey has been developed to support a three-year survey of "active" logging sites throughout North Carolina. The NCDFR's Forest Management staff's present goal is to survey a minimum of 200 ongoing harvest operations annually. We plan to survey all 100 counties of the State over a three-year period or in all counties that support viable forest harvest operations. The survey format and layout is based on a similar design previously used by state forestry agencies in Florida and Tennessee and conforms to the Silviculture Best Management Practices Implementation Monitoring Protocol established in 1997 for the Southern Group of State Foresters. The survey is designed to assess practices found in NCDFR's 1989 BMP manual that were originally developed to play an integral role in protecting water quality during timber harvesting operations. The survey also contains questions that align with BMPs that are anticipated to appear in future forestry BMP manual revisions. Survey questions are worded to yield a "yes" response if the BMP has been correctly implemented and a "no" response for failure or improper BMP implementation. We believe this survey can provide an accurate picture of forestry BMP implementation in NC provided site selection criteria, survey completion instructions and training, and Quality Assurance/Quality Control (QA/QC) supporting this project are closely followed. Your adherence to these critical project components will serve greatly to advance the overall accuracy and precision of this Federal 319 NPS Water Quality Grant initiative and yield information vital to the continued success and improvement of NCDFR's Forestry BMP program.

One final note -- this survey document is not a replacement or alternative product to NCDFR's Procedure 4808 or any associated records or forms thereof. Logging information entered on the

BMP Implementation Survey Form that indicates a compliance concern exists with the Forest Practice Guidelines Related to Water Quality (FPG) Performance Standards (15 NCAC 1I.0101 - .0209) should continue to be addressed using Procedure 4808. FPG compliance issues "discovered" when performing this BMP survey should be pursued via normal NCDFR communication channels and protocol. More on this concern is included in the text that follows.

Survey Implementation

The following procedure sections will detail the site criteria and "steps to completing and processing" the survey. The words or statements that appear in **bold print** within these sections are viewed as critical components to the survey. Your attention to these survey details is appreciated! Any questions arising should be directed to the CO Forest Hydrologist, Bill Swartley.

Random Sampling

[Note: This random sampling method will be supplemented with one-on-one and group training. These sampling methods are flexible, provided alternative random sampling techniques are reported as discussed in survey training sessions.]

The BMP Implementation Survey will be completed for **"active" logging tracts five (5) acres in size or greater. "Active" is defined to be the ongoing operation of tree felling and/or transport/loading equipment at the time the survey is conducted; "active" also includes preharvest activities such as forest road/access road/skid trail construction and post-harvest site rehabilitation efforts. The tracts surveyed will have either intermittent or perennial streams and/or waterbodies located within the "cut zone" or within fifty (50) feet of the harvest operation boundaries.** Site selection will be conducted by the CO and designated field staff and will occur from the air and/or ground as follows, **using the DeLorme *North Carolina Atlas and Gazetteer, Topo Maps of the Entire State* (Third Edition, 1997).**

Using the above referenced map, District Water Quality Foresters and designated District Service Foresters should select a District-applicable map "grid number" or map page (see page 1 of the atlas map). The selected grid should then be randomly sub-sampled for five (5) different quadrants. Each quadrant is approximately 25 square miles. The five quadrants can be sub-sampled by simply numbering each quadrant on the grid or page that is applicable to the District and randomly selecting the numbers. The quadrants selected should be "proofed" at this time for **road accessibility** and **timber harvest potential.** The quadrants that have no road access or harvest potential should be discarded for the three-year duration of the project and additional sub-sampling should occur to replace them. The process should be repeated until five quadrants are available for surveying. These randomly selected quadrants will not represent all counties found in the District. Another District-applicable grid should be selected and the process repeated until five quadrants have been sampled for each county found in the District. Selecting five quadrants per county will maximize the potential of finding a viable survey site. **The survey should be conducted so that all counties comprising the District will be sampled at least twice annually.** Once a county quadrant yields a successful survey, the surveyor should move the search effort to the next county that has been subsampled. This will ensure all counties within the District are sampled. **When a county is to be sampled again, the surveyor should not include any previously surveyed quadrants to maximize spatial distribution of the**

dataset on an annual basis; however, the same quadrant may be sampled in different sample years. Those individuals conducting the survey will maintain a map, which depicts the location of the tracts surveyed.

Alternatively, where time constraints and other Forest Management/Forest Protection obligations make the above "Gazetteer method" unworkable, you can query the DFR County office staff to locate where harvest operations are ongoing in a given county. Should a number of opportunities be presented at one time, randomly chose which ones to visit.

Where County staff are obligated to inspect "every active harvest operation" they observe, you should request that County staff provide you the location of the active harvest and a "window of opportunity" (e.g., 24-48 hour period) to assess the harvest for survey applicability and conduct the survey prior to a required County FPG inspection. As our project target is only two (2) surveys per county per sample year, we believe that County staff's support of this request would represent a "low or negligible impact" to their operations. If County staff conduct their inspection and then notify you of the active harvest location, you can still use the tract if it meets the site-selection criteria, provided you follow-up the survey by contacting the County staff to determine if a change in operation had resulted from the County inspection – this action will then be incorporated into your findings.

Site Selection Criteria

Aviation-Supported Site Selection

[Note: Aircraft support can be used provided conflicts do not arise with respect to District budget and personnel resources.]

The five selected quadrants can be flown to determine if logging operations are present that fit the site-selection criteria. It is recommended, however, that this activity be coupled with other forestry-related accountabilities requiring air support to minimize costs. **Based on comments received from field staff, we strongly recommend that sites identified from the aircraft as meeting the survey criteria be visited as quickly as possible to capture the "active" harvest operation.**

Ground-Supported Site Selection

The five selected quadrants should be reviewed via ground transportation to the extent practicable. Encountered sites that meet the site-selection requirements should be surveyed upon discovery. **In order to minimize bias, the "survey personnel" should not contact the landowners and/or loggers involved in advance of the survey.** However, if these individuals are present on the tract at the time of survey, they should be provided an opportunity to accompany the NCDFR staffer while the survey is conducted. Identification of the purpose of the visit will be facilitated by a survey flyer handout describing the purpose of the visit. **We encourage all "survey personnel" to disassociate the BMP Implementation Survey from a discussion on potential FPG non-compliance with the customer. Your best judgement under this circumstance is appreciated.**

Completing the Survey

The fourteen (14) page survey form consists of four (4) parts: Part I, General Information; Part II, Site Information and Characteristics; Part III, Forestry Operations; and Part IV, BMP Practices Applicable to Operations. All four parts were developed to minimize excessive writing in the field. With the exception of Part I, completing the survey will primarily require "checking" or "circling" the appropriate choice for each of the applicable questions. Comment lines provided within the BMP Practice and Overall Summary sections should only be used to clarify a BMP issue(s) that is not fully captured by a "yes-no" response. Based on previous field-testing, the survey document itself will likely require about fifteen to twenty minutes to complete. **We strongly recommend the active harvest site undergo a complete and thorough walkthrough prior to completing the survey.**

Part I (General Information) – Page 1 should be completed with the following points noted:

- Site location requires only one of three choices—whichever one is most readily accessible to the survey; the preferred order (first to last) is GPS instrument readout – Lat/Long estimate – QBSP. Lat/Long estimates can be made directly from the DeLorme maps. Be certain to circle which option you chose on the form proper.
- Enter the logger's full name, address, and telephone numbers; when requesting this information from the logger, you may want to briefly state that the survey is a research project and that their participation is appreciated. Distributing the research flyer prepared for this study should facilitate the customers' understanding of the visit.
- Indicate whether the logger is a graduate of the ProLogger Program (PLP); if this information is not available at the time of survey, the CO staff will provide an answer via a PLP records check after you have forwarded the survey to the CO.

Part II (Site Information and Characteristics) – Page 2 should be completed with the following points noted:

- Principle soil class selection should be based on the "Feel Method" and should be done in the field per previous training.
- Estimated slope should be determined by using previously learned practices or field instruments.
- Soil Erodibility class for this survey will be a subjective estimate taking into account the components of the "universal soil loss equation" of rainfall potential, soil erodibility slope length/gradient, ground cover, and BMP (i.e., erosion control practice).
- Soil Erosion Type: **Sheet** – Soil is removed more or less uniformly form every part of the slope; **Rill** – Tiny gullies irregularly dispersed; **Gully** – Formation of large or small ravines by undermining and downward cutting.

Part III (Forestry Operations) – Page 2

- No special instructions needed.

Part IV (BMP Practices Applicable to Operations, BMPs, Overall Summary) – Pages 3-13 should be completed with the following points noted:

- Check the applicable boxes on the matrix found on page 3 of the survey. Those BMP descriptions not deemed applicable to the survey should be left blank, however, the survey should be left intact (i.e., do not tear out and discard pages containing BMP practices not applicable to the surveyed logging operation). **Please remember that the surveyor determines the BMPs that apply, not the logger or landowner's actual BMP implementation itself (which may be appropriate or inappropriate).**
- BMP practice questions are worded to yield a **"Yes"** answer provided the surveyor finds the BMP correctly installed and functioning. A **"No"** answer will imply that the BMP is not present or has not been correctly installed; however, it does not mean a water quality problem has resulted from improper BMP implementation. The **"N/A"** (i.e., Not Applicable) box should be checked if the BMP practice is not required for the harvest operation at the time the survey is conducted.
- The **"Yes" box** under **Threats or Risks to Water Quality** should be checked to indicate that one or more of the following has, or potentially will occur, prior to the tract "healing over" naturally over time:

    1. Sediment is actually being delivered to a stream or waterbody (e.g., logs are being skidded through a stream; water diversion devices are absent or are present but have failed allowing sediment to enter or appear proximate to the stream or waterbody).
    2. Sediment is likely to be delivered to a stream or waterbody during a **"normal"** rainfall event. **"Normal" rainfall events are defined to be a precipitation occurrence that amounts to less than or equal to one inch (≤1") within a 24-hour period.**
    3. Substantive amounts of sediment are likely to be delivered to a stream or waterbody via wind gusts or sustained winds eroding bare mineral soils. Fugitive or escaping soil emissions from logging decks and forest roads exhibiting exposed mineral soil can be wind-transported substantial distances to streams and waterbodies.
    4. Adverse stream temperature fluctuations resulting from overcutting a previously well-forested stream channel and substantially reducing or eliminating shading over the stream channel.
    5. Logging debris and/or other logging by-products are left in a stream or waterbody to the extent and magnitude that water flow or water movement is adversely impeded or completely obstructed, the later resulting in water damming on the upstream side and/or the debris remaining will adversely effect the dissolved oxygen (DO) levels through increased oxidation of this organic debris.
    6. Chemical or petroleum products associated with the harvest operation have a moderate to high potential of reaching the stream or waterbody.

A **"threat"** or **"risk"** may be interpreted as both a **"severe"** or **"potentially severe"** water quality problem. Check the **"No" box** under **Threats or Risks to Water Quality** if the given practice(s) pose "no threat" to water quality and would indicate that either the logger/landowner applied BMPs effectively or that the disturbed area is too far from a stream or waterbody to

receive any sediment-laden runoff and/or impacts to the SMZ and stream or waterbody proper are negligible. Use the comment lines below each BMP Practice as deemed necessary.

- The surveyor will evaluate all applicable BMPs on each harvest operation. For example, a logging operation may involve only timber harvesting, road construction, SMZs, and waste disposal (with no stream crossings).
- The surveyor will describe and evaluate any "Innovative BMP" utilized for each BMP category (excluding SMZ width); these data will be incorporated into the overall BMP Implementation Summary. [Note: All "Innovative BMPs" identified will be further assessed for incorporation into future forestry BMP manual revisions.]
- Enter the total number of responses ("yes," "no," N/A," and "threats or risks" (Yes, No)) for each applicable statement for each practice observed in the total responses box of each BMP.
- When it is determined that no apparent effort was made to apply a BMP practice but no threat to water quality exists, place a check in the appropriate box(es) that appear just above the "Comments" section.
- Enter any additional pertinent information about any aspect of the practice that may provide clarification in the "Comments" section at the bottom of the page.

Complete the Overall BMP Implementation Summary as follows:

- Enter the county, landowner's name, and date of the inspection in the space provided at the top of the page.
- Enter the total number of "yes" and "no" answers tallied on pages 4 through 12 for the practices that apply to the operation in the corresponding spaces on page 13 and the total for each at the bottom of each column.
- Enter the sum of "yes" and "no" answers tallied in the "total yes + no" column.
- Calculate the percent "yes" answers for each practice by dividing the total number of "yes" answers by the sum of both "yes" and "no" answers for the practice, and enter them in the "% yes" column.
- Calculate the overall implementation percent by dividing the total number of "yes" answers by the sum of both "yes" and "no" answers (bottom of Total yes + no column), and enter it in the appropriate space at the bottom of the "% yes" column.
- Enter the total number of "Yes" **"threats"** or **"risks"** to water quality observed at the bottom of the last column. You <u>do not</u> need to total the "No" answers.
- Calculate the **Total Practices with Threats or Risks to Water Quality (%)** by dividing the total number of **"threats"** or **"risks" to water quality** by the sum of both "yes" and "no" answers (bottom of Total yes + no column) and enter it in the appropriate space at the bottom of the summary matrix.
- Enter any appropriate comments about the **operation as a whole** in the "Comments" section.

<u>Completing the FPG Compliance Notification</u>

After completing the BMP Implementation Survey, the "Site Evaluation/Compliance Notification" component must be completed. This FPG compliance information will be

correlated to the survey data on an annual basis. The data will also be compared to other inspections performed outside of this 319 research project.

Documenting Total Survey Time/Travel and "Zero" Harvest Sites

In order to document the Division's labor and equipment investment in this project, we have amended the survey (page 14) to capture the total hours and mileage for each attempted survey event(s). We are also documenting time/travel invested that fails to yield a successful survey(s). There are several potential benefits in acquiring this information that will be addressed in a forum outside of this procedure.

We continue to ask surveyors to attempt to locate candidate harvest operations (in all counties historically known to have a history of sustainable harvest operations) **throughout the sample year**. To document this effort, we amended the survey (Page 14) to include a compressed check-the-applicable-box(es) for a 100 county matrix that documents, on each survey accomplished, whether effort was expended on any additional counties visited in the "timeframe" of the completed survey. The completion of this query is not limited to the day an actual survey is successfully accomplished; therefore, fruitless effort expended either before, during, or after the day of the successful survey capture can be documented on that survey by transposing notes from another reference source (e.g., DFR daily pocket calendar or work log) accordingly. As all surveys are dated, the chronological order of their collection coupled with the required monthly submittal to the CO will serve to document and track your efforts to capture, without success, survey effort in a given county throughout the sample year. You will also have available the option of photocopying the modified survey page and recording each "day event" if so desired and submitting a photocopy(ies) of the single page along with the surveys completed for the given month – the choice is left up to you.

Disposition of Survey Forms

Submit the original survey forms to the CO (Attention: Bill Swartley) **at the end of each month**. Make a copy for your records in case the original is lost in the mail or questions arise and subsequent discussion is required between CO and field staff. The surveyor will maintain a map of their respective districts which spatially depicts sampled tracts. As time progresses, grids and quadrants therein not previously sampled may be subject to sampling to ensure all counties have been sampled and that sampling "over time" (i.e., over a three-year period) has occurred uniformly throughout North Carolina.

When "Threats" or "Risks" to Water Quality are Discovered

Anytime a water quality problem is encountered that relates to the logging operation, the surveyor should notify the appropriate NCDFR employee charged to address FPG compliance concerns. **Should the surveyor and compliance contact be one in the same, then we encourage you to disassociate the survey from the FPG compliance issue in order to prevent the survey from being viewed as a "compliance hammer" as opposed to the research tool it is intended to be.**

Water Quality Related Complaints

In order to minimize project bias, a BMP implementation survey shall not be conducted as follow-up to a water quality-related complaint on a logging operation. However, no attempt should be made to avoid potential "bad actor'" harvest tracts, provided the site(s) are randomly selected for the survey effort without prior knowledge of the on-site logger or logging company.

Questions/Problems/Feedback

Any questions or comments concerning the survey or support documents should be addressed to Bill Swartley of the CO staff. Bill can be reached at (919)733-2162 ext. 206 or Bill.Swartley@ncmail.net.

North Carolina Department of Environment and Natural Resources
Division of Forest Resources
Forest Management

BMP Implementation Survey Form

Part I. General Information

Date: _____ County_____ # Acres in Harvest Operation_____
District #_____ Region #_____ Name of Adjacent Highway_____
Inspector Name _____ Location (GPS; Lat/Long; QBSP)_____

Logger Name: _____Company Name: _____

Logger Address: _____

_____

Home Phone: ( ) _____ Work Phone: ( ) _____

Ownership (check one): ❒ Government ❒ Private Non-industrial ❒ Private Industrial

Technical forestry assistance was provided for the harvest by (check all that apply):
❒ DFR Forester/Technician ❒ Industrial Forester ❒ Forestry Consultant ❒ None Received
❒ Timber Buyer (Logging Company) ❒ Unknown ❒ Other_____

Is logger/contractor a graduate of the NCFA ProLogger Program? ❒ Yes ❒ No
(If Yes, answer questions below. Answer if logger onsite, otherwise CO will obtain information.)
Approximate month/year graduated _____ Course location _____

Logger has DFR reference material on-site: ❒ Yes ❒ No (If Yes, check all that apply)
❒ Wetland Forestry BMP Manual ❒ BMP Checklist for Forest Harvest Operations
❒ Upland Forestry BMP Manual ❒ FPG Booklet/Regulations
❒ Other Guidance Material: _____

Logger notified ❒ County ❒ District office of his intent to harvest: ❒ Yes ❒ No

Pre-harvest plan (PHP) performed: ❒ Yes ❒ No
PHP completed by: ❒ Consultant ❒ DFR Staff
❒ Timber Buyer (Company) ❒ Other _____
Did you see written PHP? ❒ Yes ❒ No

Estimated completion (%) of harvest operation at time of survey:
❒ 0-25% ❒ 25-50% ❒ 50-75% ❒ 75-100% complete

Part II. Site Information and Characteristics

1. Dominant forest type prior to harvest treatment (check one):
   - ❒ Intensive Forest Management
   - ❒ Passive Forest Management
   - ❒ Forested Wetland Management
   - ❒ Silvi/Agro Forest Management

2. Dominant Land Feature (check one):
   - ❒ Wetlands
   - ❒ Flatwoods
   - ❒ Pocosin or Bay
   - ❒ Rolling
   - ❒ Foothills
   - ❒ Mountain
   - ❒ Other: _____

3. Physiographic Province (check one): ❒ Coastal Plain ❒ Piedmont ❒ Mountain

4. Principle Soil Class (check one): ❒ Clay ❒ Loam ❒ Sand ❒ Sandy-Loam ❒ Sandy-clay-loam ❒ Sandy-clay ❒ Clay-loam

5. Estimated slope of harvested/treated area **approaching predominant waterbody** (circle one):

   0-5% | 6-10% | 11-20% | 21-45% | 46+%

6. Soil erodibility Class (circle one):

   A (LOW) | B (MODERATE) | C (HIGH)

7. Soil Erosion Type **observed near waterbody**:
   ❒ Sheet ❒ Rill ❒ Gully ❒ Wind ❒ None Observed

Part III. Forestry Operations

1. Timber Harvest Method (check all that apply):
   - ❒ Regeneration Harvest
   - ❒ Clearcut
   - ❒ Seed Tree
   - ❒ Shelterwood
   - ❒ Intermediate Harvest
   - ❒ Thinning
   - ❒ Croptree Release
   - ❒ Improvement
   - ❒ Salvage Cut
   - ❒ Selection
   - ❒ Other_____ _____

2. Primary (merchantable) timber species harvested:
   - ❒ N/A
   - ❒ Loblolly Pine
   - ❒ Longleaf Pine
   - ❒ Eastern White Pine
   - ❒ Other Pine species & Mixed Pine
   - ❒ Cypress/Juniper
   - ❒ Hardwood species
   - ❒ Pine-Hardwood Mix

3. Are Forested Wetland Roads present on this site? ❒ Yes ❒ No

4. Are Stream Crossings present on this site? ❒ Yes ❒ No

Part IV. BMPs Applicable to Operations

BMP Description	Check if BMP applies*	Go To Page
Streamside Management Zones (SMZ)		
• SMZ Width	❒	6
• SMZ Conditions	❒	7
• Stream Temperature	❒	7
Debris Entering Stream	❒	8
Waste Entering Stream	❒	8
Roads, Skid Trails, & Stream Crossings		
• Permanent Forest Roads	❒	9
• Skid Trails	❒	10
• Stream Crossings	❒	11
• Access Road Entrances	❒	12
Rehabilitation of Project Site	❒	12

***Note: For the purpose of this survey, the DFR "surveyor" determines which BMPs apply, not the logger or landowner. Avoid bias resulting from the presence of BMPs that are not applicable and vice versa. Forest Harvest Operations can be viewed as a three-step process: (1) Pre-harvest Planning, (2) Logging Operation, and (3) Project Closeout. The BMP Implementation Survey you conduct will be in one of these three phases or a transition from one phase to another. Please refer to DFR's BMP Checklist for Forest Harvest Operations handbook published in 1996. This reference will assist you in determining what to look for with respect to the "surveyed" forest harvest phase. Please indicate below the phase of the operation:**

❒ Pre-harvest Planning ❒ Logging Operation ❒ Project Closeout
❒ Pre-harvest Planning/Logging Operation ❒ Logging Operation/Project Closeout

---

State and Local Buffer Protection Rules: Presently, there are state-mandated forest harvest compliance requirements for the Neuse and Tar-Pamlico River basins and a portion of the Catawba River Mainstem. This survey contains questionnaire components that address the above three (3) rules only. Other specific watershed, stream, and local buffer rules and tree ordinances exist within NC that are not addressed in this survey. Should you be aware of additional buffer rule or tree ordinance applicability when completing this survey, please identify the following:

Government Entity:_____

Applicable Ordinance (Including codification)_____
_____

Other Comments:_____
_____

Note: The purpose of this inquiry is to identify the rule/ordinance existence for information management; determining compliance for the purposes of this survey is not required.

If harvest operation is in the ❒ Neuse River Basin / ❒ Tar-Pamlico River Basin answer the following:

For Perennial Streams*

Fifty-foot SMZ width present: ❒ Yes ❒ No ❒ N/A

In first ten feet of Zone 1, "selective harvest" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In outer twenty feet of Zone 1, "selective harvest" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In twenty-feet of Zone 2, ground cover is in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

For Intermittent Streams*

Fifty-foot SMZ width present: ❒ Yes ❒ No ❒ N/A

In first ten feet of Zone 1, "selective cut" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In outer twenty feet of Zone 1, "selective cut" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In Zone 2, ground cover is in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

For Perennial Waterbody*

Fifty-foot SMZ width present: ❒ Yes ❒ No ❒ N/A

In first ten feet of Zone 1, "selective cut" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In outer twenty feet of Zone 1, "selective cut" in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

In Zone 2, ground cover is in compliance with Neuse/Tar-Pam Buffer Rule: ❒ Yes ❒ No

*Do not transfer responses to Overall BMP Implementation Summary page.

Note: The Neuse and Tar-Pamlico Buffer Rules require that the property be under present use valuation or managed according to a forest management plan prepared or approved by a registered professional forester. Within the first 10 feet of Zone 1, selected high value trees (defined within the rule) may be cut, so long as the tree has no exposed primary roots in the streambank. In the outer 20 feet of Zone 1, up to 50% of the trees greater than 5 inches in DBH may be removed, with reentry no more frequent than 15 years. In plantations, reentry is allowed every 5 years. In Zone 2, harvesting and regeneration is allowed provided that sufficient ground cover is maintained to provide for diffusion and infiltration of surface runoff. Please consult the buffer rules for further details or call the Central Office staff.

Comments: _____

_____

_____

_____

If harvest operation borders the mainstem of the Catawba River and/or mainstem lakes including Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake, and Lake Wylie (NC portion) answer the following:

For Zone 1*

Thirty-foot SMZ width present: ❒ Yes ❒ No ❒ N/A

**In first ten feet of Zone 1, "selective harvest" in compliance with Catawba Buffer Rule:

❒ Yes ❒ No

**In outer twenty feet of Zone 1, "selective harvest" in compliance with Catawba Buffer Rule: ❒ Yes ❒ No

Specific Harvest Requirements For Zone 1**:

Timber felling has been directed away from the waterbody:

❒ Yes ❒ No ❒ N/A

Tracked and wheeled vehicles have been kept out of the buffer except at stream crossings:

❒ Yes ❒ No ❒ N/A

Skidding, by alternative methods, has been directed away from the waterbody in a manner that minimized soil disturbance and is in compliance with the FPGs:

❒ Yes ❒ No ❒ N/A

Logging decks and sawmill sites are located outside the buffer:

❒ Yes ❒ No ❒ N/A

For Zone 2*

Twenty-foot SMZ width present: ❒ Yes ❒ No ❒ N/A

Specific Harvest Requirements For Zone 2:

Harvesting and regeneration of Zone 2 is in compliance with the FPGs.

❒ Yes ❒ No ❒ N/A

*Do not transfer responses to Overall BMP Implementation Summary page.

Note: The Catawba Buffer Rule establishes a 50-foot buffer width divided into two zones; Zone 1 (closest to the waterbody) being 30-feet and Zone 2 being 20-feet. Selective harvesting requirements allows removal of individual high value trees (trees greater or equal to 18 inches stump diameter for both pines and hardwoods) in the first 10 feet of Zone 1; this includes removal of trees with exposed primary roots in the streambank. In the outer 20 feet of Zone 1, trees greater than 12-inch diameter stump may be cut and removed. There is no requirement that a certain percentage of trees are left but the remaining trees should be evenly spaced. Application of fertilizer (prohibited except for permanent stabilization), natural regeneration/tree planting (permitted provided soil disturbance is minimized), and high intensity prescribed burns (prohibited) are not addressed in the context of the survey. If you should notice a violation of any of these three, please make a note in the Comments section below. Other buffer rule compliance issues should be commented on as well. Please consult the buffer rules for further details or call the Central Office staff should other questions arise.

Comments: _____

_____

County: _____ Landowner: _____ Date: _____

BMP:
Streamside Management Zone (SMZ) Width

(Refer to 12-16 of the 1989 Forestry BMP Manual for more information about these categories)

Type of stream: ❒ Perennial ❒ Intermittent ❒ Both Perennial and Intermittent
Name of stream or waterbody, if known (optional): _____

1. Was a braided stream present in the harvest zone? ❒ Yes ❒ No

2. If stream, indicate Stream Order (circle all that apply): 1st 2nd 3rd 4th Higher

3. Indicate approximate width (feet) of intermittent stream or waterbody found on this site:
   ❒ N/A ❒ 0-5' ❒ >5'

   Indicate approximate width (feet) of perennial stream or waterbody found on this site:
   ❒ N/A ❒ 0-5' ❒ 6-10' ❒ 11-20' ❒ >20'

4. Pre-harvest stream canopy provides: ❒ 0-25% ❒ 26-50% ❒ 51-75% ❒ 76-100% shade.

5. Post-harvest stream canopy provides: ❒ 0-25% ❒ 26-50% ❒ 51-75% ❒ 76-100% shade.

Type of Stream or Waterbody (check one)	**Percent Slope of Adjacent Land and BMP Recommended SMZ Width (feet)** (From Forestry BMP Manual)					**SMZ Sufficient Width To Confine Sediment? (Circle Yes, No or N/A)**			
	0-5%	6-10%	11-20%	21-45%	46+ %	Left Bank*		Right Bank*	
❒ Intermittent	50'	50'	50'	50'	50'	Y / N	N/A	Y / N	N/A
❒ Perennial	50'	50'	50'	50'	50'	Y / N	N/A	Y / N	N/A
❒ Perennial, Trout waters	50'	66'	75'	100'	125'	Y / N	N/A	Y / N	N/A
❒ Public Waterbodies	50'	100'	150'	150'	200'	Y / N	N/A	Y / N	N/A

*Determine left and right banks by facing downstream

Comments:_____

_____

_____

County: _____ Landowner: _____ Date: _____

BMP: **Streamside Management Zone (SMZ) Conditions** **(Refer to pages 12-16 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
SMZ uniformly maintained along intermittent & perennial streams/waterbodies.	❒	❒	❒	❒	❒
Roads or trails minimized in SMZ (exclude stream crossing access).	❒	❒	❒	❒	❒
Trees were felled away from stream channel.	❒	❒	❒	❒	❒
Skidders and other equipment use was minimized in SMZ (except at stream crossings).	❒	❒	❒	❒	❒
Forest floor/ground cover is essentially undisturbed.	❒	❒	❒	❒	❒
No visible sediment from operations present in streams/waterbodies.	❒	❒	❒	❒	❒
Felled trees removed without machinery entering SMZ in areas where ephemeral streams intersect intermittent/perennial waters	❒	❒	❒	❒	❒
Trees and logging debris removed from streams.	❒	❒	❒	❒	❒
Logging decks and/or sawmill sites located outside of SMZ.	❒	❒	❒	❒	❒
Logging decks and/or sawmill sites in SMZ ≥ 10 feet from stream/waterbody. (Exception)	❒	❒	❒	❒	❒
Fuels and chemicals stored outside SMZ.	❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Streamside Management Zone (SMZ) Conditions					

BMP: **Stream Temperature** **(Refer to page 13 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
Adequate shade (≥ 75% original canopy) maintained on stream channel to protect perennial/intermittent streams from adverse temperature fluctuations.	❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Stream Temperature					

BMPs were not applied to: ❒ SMZ Width / ❒ SMZ Conditions / ❒ Stream Temperature, but no threat to water quality (WQ) exists.

Comments: _____

County: _____ Landowner: _____ Date: _____

BMP: Debris Entering Stream **(Refer to pages 12-16 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
Stream obstructions (i.e., soils) from forestry operation(s) nonexistent.	❒	❒	❒	❒	❒
Stream flow impairment (i.e., soils) by forestry operation(s) nonexistent.	❒	❒	❒	❒	❒
Logging and site preparation debris kept out of stream channels.	❒	❒	❒	❒	❒
Stream obstructions (i.e., logging debris) from forestry operation(s) nonexistent.	❒	❒	❒	❒	❒
Stream flow impairment (i.e., logging debris) by forestry operation(s) nonexistent.	❒	❒	❒	❒	❒
Stream channel/course has not been altered by obstruction(s).	❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Debris Entering Stream					

BMP: Waste Entering Streams, Waterbodies, or Groundwater **(Refer to pages 13 & 47-48 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
Waste oil or other petroleum products were not discharged on site or into streams, waterbodies, or groundwater.	❒	❒	❒	❒	❒
Fertilizers and other chemical wastes were not discharged into streams, waterbodies, or groundwater.	❒	❒	❒	❒	❒
All petroleum and chemical containers were removed from logging site.	❒	❒	❒	❒	❒
Chemical and fuel loading and storage was conducted outside of SMZ.	❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Waste Disposal					

BMPs were not applied to: ❒ debris in stream / ❒ waste in stream, but no threat to WQ exists.

Comments: _____

County: _____ Landowner: _____ Date: _____

BMP: **Permanent Forest Roads** **(Refer to pages 17-20 of the 1989 Forestry BMP Manual for more information about these categories)**		**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
		Yes	No	N/A	Yes	No
Permanent roads established a year or more in advance of operation.		❒	❒	❒	❒	❒
Permanent roads are a minimum width of 10-14 feet for single track road.		❒	❒	❒	❒	❒
Permanent roads placed on gentle side slopes and not ridge tops.		❒	❒	❒	❒	❒
Permanent roads are located outside of SMZ.		❒	❒	❒	❒	❒
Permanent roads follow contour lines.		❒	❒	❒	❒	❒
Permanent roads have grades of 1-10%.		❒	❒	❒	❒	❒
Drainage structures implemented: (check all that apply) ❒ ditch turnouts ❒ outsloping ❒ wing ditches ❒ broad based dips (truck haul roads) ❒ rolling grade or dips (skid trails & steep roads) ❒ cross-drain culverts ❒ bridges	Correctly Installed ❒ Yes ❒ No ❒ Yes ❒ No ❒ Yes ❒ No ❒ Yes ❒ No ❒ Yes ❒ No ❒ Yes ❒ No ❒ Yes ❒ No	❒ ❒ ❒ ❒ ❒ ❒ ❒	❒ ❒ ❒ ❒ ❒ ❒ ❒	❒ ❒ ❒ ❒ ❒ ❒ ❒	❒ ❒ ❒ ❒ ❒ ❒ ❒	❒ ❒ ❒ ❒ ❒ ❒ ❒
All drainage outfalls stabilized with riprap, heavy brush, or logs (circle all that apply).	❒ Yes ❒ No	❒	❒	❒	❒	❒
Permanent roads intersect streams at right angle to stream channel.		❒	❒	❒	❒	❒
Bridge/culvert used where permanent roads cross streams or waterbodies.		❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.		❒	❒	❒	❒	❒
Total Responses for Permanent Roads						

BMPs were not applied to: ❒ forest roads, but no threat to WQ exists.

Comments: _____

_____

_____

_____

_____

County: _____ Landowner: _____ Date: _____

BMP: **Skid Trails** **(Refer to pages 25-27 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
Logging slash and debris placed on bare ground to prevent erosion.	❒	❒	❒	❒	❒
Water bars/water diversions constructed where needed.	❒	❒	❒	❒	❒
Rehabilitation completed for inactive skid trails.	❒	❒	❒	❒	❒
Skid trails minimized in SMZ.	❒	❒	❒	❒	❒
Skid trails intersecting streams at right angle to SMZ.	❒	❒	❒	❒	❒
Soil compaction was avoided by concentrating skidder traffic on primary trails.	❒	❒	❒	❒	❒
"Souping" was avoided.	❒	❒	❒	❒	❒
"Rutting" was avoided.	❒	❒	❒	❒	❒
Skid trails follow contours where possible.	❒	❒	❒	❒	❒
Skid trails do not exceed grades of 25%.	❒	❒	❒	❒	❒
"Closed" skid trails protected by adequate waterbars or brush piles.	❒	❒	❒	❒	❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Skid Trails					

BMPs were not applied to: ❒ skid trails, but no threat to WQ exists.

Comments: _____

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_____

County: _____ Landowner: _____ Date: _____

BMP: **Stream Crossings** **(Refer to pages 28-32 of the 1989 Forestry BMP Manual for more information about these categories)**		**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
		Yes	No	N/A	Yes	No
Stream flow obstruction and impairment avoided.		❒	❒	❒	❒	❒
Stream channel use as access road or skid trail avoided.		❒	❒	❒	❒	❒
Stream crossings stabilized and erosion prevented or controlled.		❒	❒	❒	❒	❒
Sufficient water control devices employed to collect and direct surface water flow away from stream.		❒	❒	❒	❒	❒
Ground cover is present to prevent visible sediment in stream.		❒	❒	❒	❒	❒
Type of stream crossing: (check all that apply)	Correctly Installed					
❑ culvert	❒ Yes ❒ No	❒	❒	❒	❒	❒
❑ bridge	❒ Yes ❒ No	❒	❒	❒	❒	❒
❑ rock ford	❒ Yes ❒ No	❒	❒	❒	❒	❒
❑ natural ford	❒ Yes ❒ No	❒	❒	❒	❒	❒
❑ dragline/bridge mat (❒ wood/ ❒ steel)	❒ Yes ❒ No	❒	❒	❒	❒	❒
❑ other _____	❒ Yes ❒ No	❒	❒	❒	❒	❒
Stream crossing(s) are: ❑ Permanent ❑ Temporary ❑ Both Permanent and Temporary						
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.		❒	❒	❒	❒	❒
Total Responses for Stream Crossings						

BMPs were not applied to: ❒ stream crossings, but no threat to WQ exists.

Comments: _____

_____

_____

_____

_____

_____

County: _____ Landowner: _____ Date: _____

BMP: Access Road Entrances **(Refer to page 19 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
Excessive soil on the highway adjacent to access was avoided.	❒	❒	❒	❒	❒
Logging debris or trash on the highway adjacent to access was avoided.	❒	❒	❒	❒	❒
Drainage easement/ditch between main highway and access road (**1**) bridged by appropriate means; (**2**) properly stabilized and (**3**) not impeding storm water flow.	1 ❒ 2 ❒ 3 ❒	1 ❒ 2 ❒ 3 ❒	1 ❒ 2 ❒ 3 ❒	1 ❒ 2 ❒ 3 ❒	1 ❒ 2 ❒ 3 ❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Access Road Entrances					

BMP: Rehabilitation of Project Site **(Refer to pages 51-66 of the 1989 Forestry BMP Manual for more information about these categories)**	**MEETS BMP GUIDELINES**			**THREATS OR RISKS TO WATER QUALITY**	
	Yes	No	N/A	Yes	No
High/accelerated erosion areas have been provided ground cover or other sediment control measure(s) within 30 working days after ceasing any operational phase or beginning a period of inactivity in a portion of the entire harvest tract.	❒	❒	❒	❒	❒
Soils properly prepared for conventional seeding.	❒	❒	❒	❒	❒
Lime and fertilizer properly incorporated into soils.	❒	❒	❒	❒	❒
Seeding accomplished in an effective manner.	❒	❒	❒	❒	❒
Mulching (following seeding) meets the (**1**) 25% ground surface visibility standard; (**2**) mulch properly anchored.	1 ❒ 2 ❒	1 ❒ 2 ❒	1 ❒ 2 ❒	1 ❒ 2 ❒	1 ❒ 2 ❒
Innovative BMP utilized: ❒ Yes ❒ No. If yes, describe in Comments.	❒	❒	❒	❒	❒
Total Responses for Rehabilitation of Project Site					

BMPs were not applied to: ❒ access road entrances / ❒ rehab of site, but no threat to WQ exists.

Comments: _____

_____

Overall BMP Implementation Summary

BMP Description	Number of Yes Responses	Number of No Responses	Total Yes + No	% Yes	Total Number of Threats or Risks to Water Quality
Streamside Management Zones (SMZ)					
• SMZ Width					
• SMZ Conditions					
• Stream Temperature					
Debris Entering Stream					
Waste Entering Stream					
Roads, Skid Trails, & Stream Crossings					
• Permanent Forest Roads					
• Skid Trails					
• Stream Crossings					
• Access Road Entrances					
Rehabilitation of Project Site					
Totals					
Overall Implementation (%)					
Total Practices with threats or risks to water quality (%)					

4808 Information

On ____ / _____/ _____ this forestry operation was inspected for compliance with the Forest Practices Guidelines, applicable buffer rules, and other water quality regulations.

∂ This forestry operation is currently **in compliance** with the Forest Practices Guidelines.

∂ This forestry operation is currently **in non-compliance** with the Forest Practices Guidelines because of the following marked violations:

0 .0201 Streamside management zone
0 .0202 Stream obstruction
0 .0203 Access road and skid trail stream crossings
0 .0204 Access road entrances
0 .0205 Prohibition of waste entering streams, waterbodies and groundwater
0 .0206 Pesticide application
0 .0207 Fertilizer application
0 .0208 Stream temperature
0 .0209 Rehabilitation of project site

CORRECTIVE ACTION(S) NEEDED:

_____

_____

_____

_____

Surveyor Name:_____ District:_____

On _____(month/day/year) I invested a total of _____hours and _____ mileage to capture _____survey(s).

On _____(month/day/year) I attempted, without success, to conduct a survey in the county(ies) checked below. This attempt yielded no viable harvest operations that fit the survey's site selection criteria. My time and mileage investment in this effort was about _____hours and _____mileage.

☐ Alamance	☐ Cumberland	☐ Johnston	☐ Randolph
☐ Alexander	☐ Currituck	☐ Jones	☐ Richmond
☐ Alleghany	☐ Dare	☐ Lee	☐ Robeson
☐ Anson	☐ Davidson	☐ Lenoir	☐ Rockingham
☐ Ashe	☐ Davie	☐ Lincoln	☐ Rowan
☐ Avery	☐ Duplin	☐ Macon	☐ Rutherford
☐ Beaufort	☐ Durham	☐ Madison	☐ Sampson
☐ Bertie	☐ Edgecombe	☐ Martin	☐ Scotland
☐ Bladen	☐ Forsyth	☐ McDowell	☐ Stanly
☐ Brunswick	☐ Franklin	☐ Mecklenburg	☐ Stokes
☐ Buncombe	☐ Gaston	☐ Mitchell	☐ Surry
☐ Burke	☐ Gates	☐ Montgomery	☐ Swain
☐ Cabarrus	☐ Graham	☐ Moore	☐ Transylvania
☐ Caldwell	☐ Granville	☐ Nash	☐ Tyrrell
☐ Camden	☐ Greene	☐ New Hanover	☐ Union
☐ Carteret	☐ Guildford	☐ Northampton	☐ Vance
☐ Caswell	☐ Halifax	☐ Onslow	☐ Wake
☐ Catawba	☐ Harnett	☐ Orange	☐ Warren
☐ Chatham	☐ Haywood	☐ Pamlico	☐ Washington
☐ Cherokee	☐ Henderson	☐ Pasquotank	☐ Watauga
☐ Chowan	☐ Hertford	☐ Pender	☐ Wayne
☐ Clay	☐ Hoke	☐ Perquimans	☐ Wilkes
☐ Cleveland	☐ Hyde	☐ Person	☐ Wilson
☐ Columbus	☐ Iredell	☐ Pitt	☐ Yadkin
☐ Craven	☐ Jackson	☐ Polk	☐ Yancey

Summary Comments: _____

_____

_____

_____

_____

_____

Appendix 4

BMP Implementation Survey
Informational Flier

North Carolina Division of Forest Resources

Notice to Loggers or Landowners

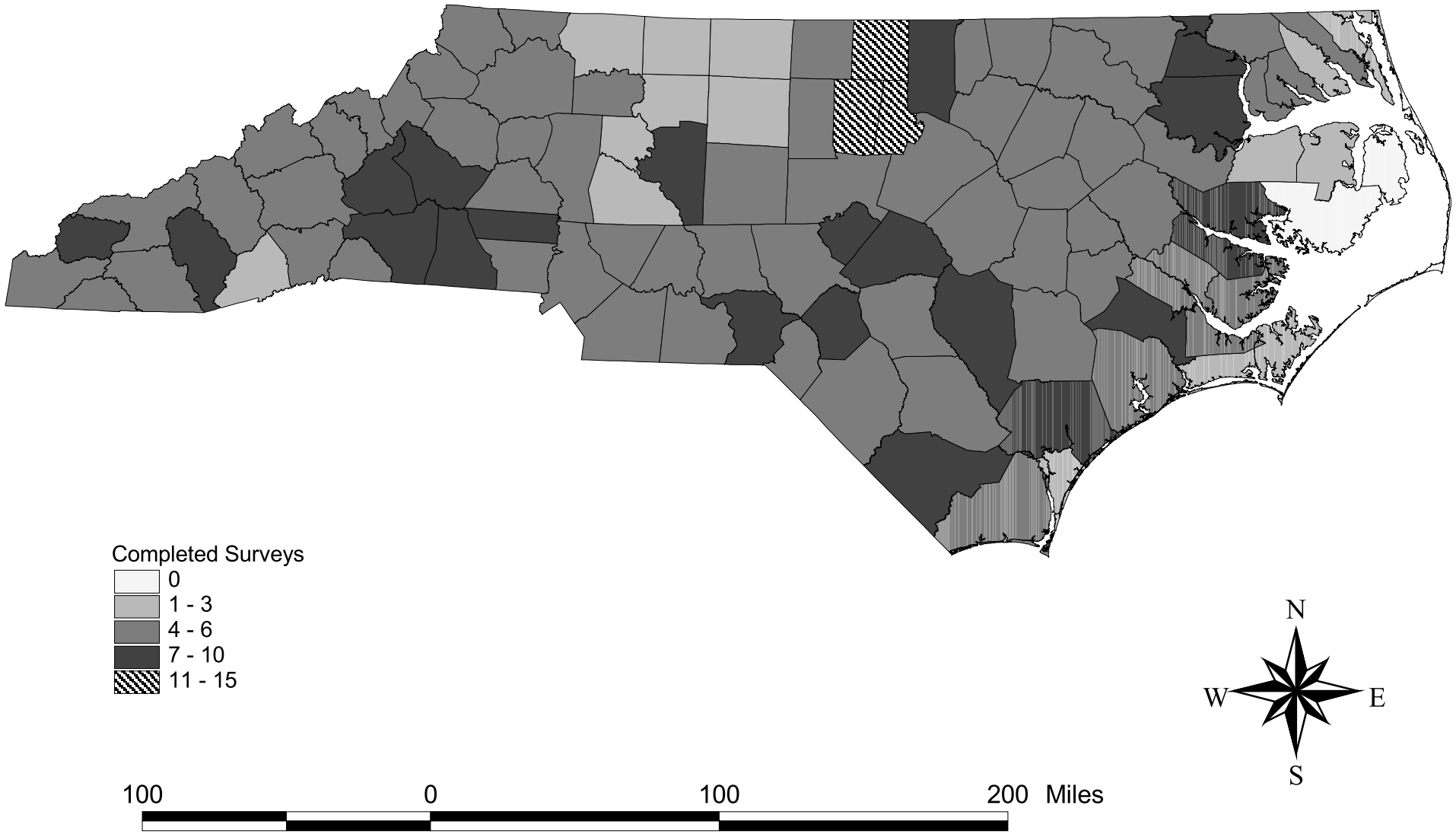
The North Carolina Forest Service is conducting a three-year survey of "active" logging operations throughout the state. Your logging operation/ property has been selected for this research effort.
The survey typically requires one visit to the harvest operation. The information obtained will be placed in a database that will be used to revise forestry Best Management Practices (BMPs) in the coming years. If you have questions about this research please contact the NCFS at (919) 733-2162 ext. 206.

Your cooperation is appreciated.

Appendix 5

BMP Implementation Surveys Completed Statewide

North Carolina BMP Implementation Surveys Completed per County
2000 - 2003



Appendix 6

Data Tables Related to Graphs

Figure 4 Data Table: Statewide BMP Implementation by Practice

Practice	BMP Implementation	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation
SMZ Conditions	87	6	45
Stream Temp	86	4	25
Debris	89	7	61
Waste	92	1	9
Permanent Roads	80	6	28
Skid Trails	73	7	27
Stream Crossings	64	30	83
Access Roads	93	1	19
Rehabilitation	41	15	26
State Summary	**82**	**8**	**42**

Figure 5 Data Table: BMP Implementation and Compliance Statewide & Regional

	BMP Implementation	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
Statewide	82	8	42	82
Coastal Plain	85	4	31	91
Piedmont	87	5	38	87
Mountain	69	16	51	61

Figure 6 Data Table: BMP Implementation by Region

	Coastal Plain	Piedmont	Mountain
SMZ Conditions	89	93	71
Stream Temperature	89	91	77
Debris	90	92	81
Waste	91	97	87
Permanent Roads	89	84	73
Skid Trails	77	81	56
Stream Crossings	70	71	50
Access Roads	94	93	92
Rehabilitation	33	40	48

Figure 9 Data Table: Implementation & Compliance by Landowner Type

Landowner Type	BMP Implementation	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation
Government	92	0	0
NIPF	82	8	43
Forest Industry	83	7	40
State Summary	**82**	**8**	**42**

Figure 12 Data Table: BMP Implementation & FPG Compliance by Number of Acres

Acres	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
5-20	81	9	43	77
21-50	83	7	40	87
51-100	83	6	37	83
101+	82	11	56	80

Figure 13 Data Table: Implementation & Compliance Related to WQF Districts & non-WQF Districts

Districts	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
With WQF	83	8	45	83
Without WQF	81	7	38	81
State Summary	**82**	**8**	**42**	

Figure 14 Data Table: BMP Implementation & FPG Compliance by Logger Training

Logger Training	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
ProLogger	84	6	39	85
No Training	77	11	50	73
State Summary	**82**	**8**	**42**	

Figure 16 Data Table: BMP Implementation & FPG Compliance by Forest Management Type

FM Type	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
Intensive	89	4	37	90
Passive	80	9	43	80
Wetland	81	9	46	67
Silvi/Agro	51	30	49	50
State Summary	**82**	**8**	**42**	

Figure 18 Data Table: BMP Implementation & FPG Compliance by Harvest Type

Harvest Type	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
Regeneration	77	13	54	69
Clearcut	85	5	35	88
Seed Tree	95	0	0	100
Shelterwood	100	0	0	100
Intermediate	83	4	24	89
Thinning	91	1	14	95
Salvage	67	14	44	67
Selection	73	16	60	62
Other*	65	18	51	8

*Crop Tree, Improvement, Other (High Grade, Diameter Limit, or Chipping)

Figure 20 Data Table: BMP Implementation & FPG Compliance by Land Feature

Land Feature	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
Wetland	84	4	27	89
Flatwoods	86	4	28	93
Pocosin or Bay	80	5	27	100
Rolling	88	4	37	88
Foothills	28	14	50	64
Mountain	68	17	52	57
Other	91	2	25	94

Figure 22 Data Table: BMP Implementation & FPG Compliance by Soil Type

Soil Type	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
Clay	83	6	34	85
Loam	76	9	37	80
Sand	82	13	72	80
Sandy-Loam	87	4	33	91
Sandy-Clay-Loam	79	9	44	77
Sandy-Clay	17	7	41	89
Clay-Loam	80	10	50	75
State Summary	**82**	**8**	**42**	

Figure 24 Data Table: BMP Implementation & FPG Compliance by Slope

% Slope	Implementation of Applicable BMPs	Overall Risk to Water Quality	Risk to Water Quality Due to Non-Implementation	FPG Compliance
0 to 5	88	4	31	92
6 to 10	85	6	39	82
11 to 20	79	9	45	79
21 to 45	70	15	50	64
45 +	66	20	58	42
State Summary	**82**	**8**	**42**	

Figure 25 Data Table: Coastal BMP Implementation and Water Quality Risk by Practice

Practice	Implementation of Applicable BMPs	% Threat or Risk to WQ of All Applicable BMPs	%Threat or Risk Resulting from Incorrect or Non Implementation of Applicable BMPs
SMZ Conditions	89	4	36
Stream Temperature	89	2	19
Debris	90	6	63
Waste	91	1	8
Permanent Roads	89	2	15
Skid Trails	77	2	9
Stream Crossings	70	23	79
Access Roads	94	1	11
Rehabilitation	33	9	14
Coastal Summary	**86**	**4**	**31**

Figure 26 Data Table: Piedmont BMP Implementation and Water Quality Risk by Practice

Practice	Implementation of Applicable BMPs	% Threat or Risk to WQ of All Applicable BMPs	%Threat or Risk Resulting from Incorrect or Non Implementation of Applicable BMPs
SMZ Conditions	93	2	33
Stream Temperature	91	2	25
Debris	92	5	64
Waste	97	1	30
Permanent Roads	84	3	16
Skid Trails	81	4	23
Stream Crossings	71	23	78
Access Roads	93	2	27
Rehabilitation	40	7	11
Piedmont Summary	**87**	**5**	**38**

Figure 27 Data Table: Mountain BMP Implementation and Water Quality Risk by Practice

Practice	Implementation of Applicable BMPs	% Threat or Risk to WQ of All Applicable BMPs	%Threat or Risk Resulting from Incorrect or Non Implementation of Applicable BMPs
SMZ Conditions	71	16	54
Stream Temperature	77	7	30
Debris	81	11	59
Waste	87	0	2
Permanent Roads	73	10	37
Skid Trails	56	18	41
Stream Crossings	50	44	88
Access Roads	92	1	14
Rehabilitation	48	33	62
Mountain Summary	**69**	**16**	**51**

Figures 29 & 30 Data Table: BMP Implementation for Streamside Management Zone Conditions by Region & Statewide BMP Implementation for Streamside Management Zone Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
Condition	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Maintained	81	84	91	60	7	4	2	19	34	23	16	48
Roads	91	95	98	76	6	2	2	18	66	33	60	77
Trees	82	87	91	59	5	4	2	10	26	30	22	25
Skidders	88	92	95	70	6	3	2	17	48	33	36	55
Cover	85	86	94	71	6	3	3	18	44	19	46	64
Sediment	87	93	94	67	11	5	5	30	84	71	75	91
Machinery	75	71	86	60	7	6	2	16	26	19	15	40
Debris	78	80	88	62	11	13	5	20	51	63	37	53
Decks Out	94	97	99	79	4	2	1	11	58	80	50	54
Decks In	94	93	98	85	5	11	0	13	80	100	0	83
Fuels	97	99	100	91	1	1	1	1	29	100	100	9
Overall BMP for SMZ	**87**	**86**	**87**	**69**	**6**	**4**	**2**	**16**	**45**	**31**	**38**	**51**

Figure 32 Data Table: BMP Implementation for Stream Temperature Conditions by Region

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	C	P	M	State	C	P	M	State	C	P	M
Stream Temperature	86	89	91	77	4	2	2	7	25	19	25	30

Figures 33 & 34 Data Table: BMP Implementation for Debris Entering Stream Conditions by Region & Statewide BMP Implementation for Debris Entering Stream Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	C	P	M	State	C	P	M	State	C	P	M
Soil Obstruction	92	91	94	89	6	5	5	8	64	50	75	71
Soil Impairment	91	92	94	83	8	6	6	14	85	79	100	17
Logging	79	83	85	64	9	8	6	16	43	48	37	43
Debris Obstruction	87	89	91	77	7	6	6	11	54	55	65	46
Debris Impairment	87	90	91	78	9	8	6	17	73	78	67	22
Channel	96	97	99	93	3	4	1	6	94	100	100	6
Overall BMP for Debris	**89**	**90**	**92**	**81**	**7**	**6**	**5**	**11**	**61**	**63**	**64**	**59**

Figures 36 & 37 Data Table: BMP Implementation for Waste Entering Streams, Waterbodies, or Groundwater Conditions by Region & Statewide BMP Implementation for Waste Entering Streams, Waterbodies, or Groundwater Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	C	P	M	State	C	P	M	State	C	P	M
Oil	97	94	100	97	1	1	1	0	19	18	100	0
Fertilizer	99	100	100	97	0	0	0	0	0	0	0	0
Removed	76	67	90	65	1	2	1	0	5	33	13	0
Loading	97	99	99	89	1	0	2	1	25	0	100	8
Overall for Waste BMP	**92**	**91**	**97**	**87**	**1**	**1**	**1**	**0.2**	**9**	**8**	**30**	**2**

Figures 39 & 40 Data Table: BMP Implementation for Permanent Forest Roads Conditions by Region & Statewide BMP Implementation for Permanent Forest Roads Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Established	51	79	52	35	6	7	2	10	12	33	3	16
Width	98	100	97	98	1	0	0	2	33	0	0	100
Slopes	91	95	96	83	1	0	0	2	8	0	0	11
Outside SMZ	92	93	99	83	4	0	0	10	46	0	0	60
Contour	81	90	93	67	2	0	0	5	12	0	0	16
Grades	78	100	93	53	8	0	4	16	36	0	50	33
Ditch Turnouts	78	80	79	75	11	20	13	6	50	100	60	25
Outsloping	94	100	92	100	0	0	0	0	0	0	0	0
Wing Ditches	85	50	100	86	0	0	0	0	0	0	0	0
Broad Based Dips	75	50	81	73	18	50	19	15	73	100	100	57
Rolling Grades	74	n/a	100	69	21	0	0	25	80	0	0	80
Cross-drain Culverts	82	100	80	69	6	0	0	15	33	0	0	50
Bridges	89	100	100	67	0	0	0	0	0	0	0	0
Riprap	47	55	37	54	13	0	10	20	25	0	16	44
Brush	59	0	44	100	6	0	11	0	14	0	20	0
Logs	54	50	29	100	8	0	14	0	17	0	20	0
Intersect	95	90	96	97	4	0	0	9	75	0	0	100
Bridge/culvert	89	93	88	88	11	0	0	25	100	0	0	50
Overall BMP for Roads	**80**	**89**	**84**	**73**	**6**	**2**	**3**	**10**	**28**	**15**	**16**	**37**

Figures 42 & 43 Data Table: BMP Implementation for Skid Trails Conditions by Region & Statewide BMP Implementation for Skid Trails Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Erosion	52	70	60	16	6	2	4	15	13	7	10	17
Water Bars	46	51	52	36	22	4	12	41	40	8	25	64
Rehabilitation	45	22	65	29	19	4	10	41	35	5	29	58
Minimized	92	94	97	81	5	2	1	13	56	40	33	68
Intersecting	94	91	96	94	6	5	3	13	100	57	80	100
Compaction	83	86	92	64	1	0	1	1	5	0	18	2
Souping	89	84	93	92	3	2	3	5	26	10	36	63
Rutting	70	65	76	69	3	2	3	6	11	6	10	20
Contours	87	91	94	73	6	0	3	13	43	0	55	49
Grades	74	95	92	41	8	2	2	18	30	33	29	30
Closed	54	48	68	39	16	2	8	37	36	4	26	60
Overall BMP for Skid Trails	**73**	**77**	**81**	**56**	**7**	**2**	**4**	**18**	**27**	**9**	**23**	**41**

Figures 45 & 46 Data Table: BMP Implementation for Stream Crossings Conditions by Region & Statewide BMP Implementation for Stream Crossings Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Obstruction	70	66	77	63	25	25	18	33	82	74	79	90
Channel	96	94	97	95	4	6	2	4	83	100	75	75
Stabilized	52	65	58	31	41	32	33	61	85	91	79	88
Water Control	49	56	59	33	40	27	30	60	78	60	73	89
Ground Cover	51	63	60	30	37	25	29	58	76	67	72	83
Culvert	57	100	65	47	38	10	20	48	88	100	57	91
Bridge	75	100	40	100	25	20	40	0	100	100	67	0
Rock Ford	91	100	100	80	9	0	0	20	100	0	0	100
Natural Ford	51	59	63	29	47	35	38	71	96	86	100	100
Wood Bridgemat	85	75	88	60	18	25	16	40	100	100	100	100
Steel Bridgemat	87	89	92	n/a	13	11	8	100	100	100	100	100
Other	43	57	44	17	49	39	44	75	86	90	78	90
Overall BMP for Stream Crossings	**64**	**70**	**71**	**50**	**30**	**23**	**23**	**44**	**83**	**79**	**78**	**88**

Figures 48 & 49 Data Table: BMP Implementation for Access Road Entrance Conditions by Region & Statewide BMP Implementation for Access Road Entrance Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Soil	94	92	95	96	1	1	1	1	13	7	18	25
Debris	98	99	97	97	1	1	1	1	36	50	33	33
Bridge	92	92	93	89	1	1	2	2	17	9	25	14
Stabilized	88	96	88	71	3	2	4	0	26	50	36	0
Storm Flow	88	87	88	91	2	0	3	0	14	0	100	0
Overall BMP for Access Roads	**93**	**94**	**93**	**92**	**1**	**1**	**2**	**1**	**19**	**11**	**27**	**62**

Figures 51 & 52 Data Table: BMP Implementation for Rehabilitation of Project Site Conditions by Region & Statewide BMP Implementation for Rehabilitation of Project Site Conditions

	Implementation (%)				Overall Risk (%)				Risk Due to Non-Implementation (%)			
	State	**C**	**P**	**M**	**State**	**C**	**P**	**M**	**State**	**C**	**P**	**M**
Erosion	43	44	54	32	30	11	14	54	53	20	31	80
Seeding	43	25	39	64	6	8	4	7	11	11	7	20
Fertilizer	29	20	19	50	3	0	0	10	5	0	0	20
Seeding Effective	46	33	36	71	13	11	8	21	23	20	13	75
Visibility	42	43	39	50	12	14	4	30	20	25	7	60
Anchored	23	0	33	0	0	0	0	0	0	0	0	0
Overall BMP for Site Rehab	**41**	**33**	**40**	**48**	**15**	**9**	**7**	**33**	**26**	**14**	**11**	**62**

Appendix 7

Forest Practices Guidelines Related to Water Quality

SECTION .0100 - GENERAL PROVISIONS

15A NCAC 01I .0101 INTRODUCTION AND PURPOSE

(a) Forests are a major contributor to the economy and quality of the environment in North Carolina. Forestry best management practices allow for the production, harvesting, and utilization of forest resources while maintaining satisfactory water quality. The rules in this Subchapter establish performance standards for the protection of water quality. The intent and purpose of these rules is not to cease or obstruct the lawful, proper and responsible use of forest resources. Persons must adhere to the standards related to land disturbing activities in order to retain the forestry exemption provided in the N.C. Sedimentation Pollution Control Act of 1973 as amended in 1989.

(b) The Division of Forest Resources is responsible for the protection and development of forest resources in North Carolina, and has been designated by the Secretary of North Carolina Department of Environment, Health, and Natural Resources as the Division within the Department best able to assist the Secretary in the implementation of these rules.

(c) The Forestry Best Management Practices Manual, published by the Division of Forest Resources in September, 1989, and as amended from time to time, contains specifications for a variety of practices which may be used to meet the performance standards set forth in this Subchapter. Best Management Practices (BMPs) shall be selected to allow for the variation in weather, topography, soil, and vegetation expected for the site and season. Implementation of these rules shall recognize that extreme and unusual weather can cause reasonable and otherwise adequate application of BMPs to fail to control sedimentation. Where installed BMPs fail, additional and more effective BMPs may be required. This manual and the rules in this Subchapter may be obtained by contacting the Director, Division of Forest Resources, Raleigh, North Carolina.

History Note: Authority G.S. 113-3; 113-8; 113A-52(6); 113A-52.1; 143B-10; Eff. January 1, 1990.

15A NCAC 01I .0102 DEFINITIONS

In addition to the terms defined in G.S. 113-44.4 and 113A-52, the following definitions shall apply throughout this Subchapter:

(1) "Accelerated Erosion" means any increase over the rate of natural erosion, as a result of land-disturbing activities.
(2) "Access Road" means a temporary or permanent access route.
(3) "Adverse Impact" as used for pesticides and fertilizers means actions which result in a violation of adopted water quality standards of the Environmental Management Commission Sections 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina, 15A NCAC 2L .0200 - Classifications and Water Quality Standards (related to groundwater) and the N.C. Pesticide Board Rule 2 NCAC 9L .1005 - Restricted Areas.
(4) "Best Management Practice" (BMP) means a practice, or combination of practices, that is determined to be an effective and practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals.
(5) "Channel" means a natural water-carrying trough cut vertically into low areas of the land surface by erosive action of concentrated flowing water or a ditch or canal excavated for the flow of water.
(6) "Colloidal Particles" means fine grained materials, organic or inorganic, that are easily suspended such as clay particles.
(7) "Ford" means a submerged stream crossing which will bear intended traffic.

(8) "Ground Cover" means any natural vegetative growth or other natural or manmade material which renders the soil surface stable against accelerated erosion.

(9) "Land-Disturbing Activity" means any use of the land by any person in residential, industrial, educational, institutional or commercial development, highway and road construction and maintenance that results in a change in the natural cover or topography and that may cause or contribute to sedimentation.

(10) "Groundwater" means phreatic water or subsurface water in the zone of saturation.

(11) "Log Deck" means a place where logs are gathered in or near the forest for further transport, sometimes called a "landing".

(12) "Mill Site" means any place where forest products are stored, altered, or processed.

(13) "Permanently Stabilized" means the site is protected to the state at which no further accelerated erosion is expected to occur from the forestry activities.

(14) "Pesticides" means a chemical used to kill pests. The term includes insecticides, fungicides, herbicides, and rodenticides.

(15) "Site Preparation" means a forest activity to prepare the site for reforestation.

(16) "Skid Trail" means a temporary pathway principally used to drag or transport felled trees or logs or other material to a landing.

(17) "Stream" means a body of concentrated flowing water in a natural low area of the land surface.

- (a) "Ephemeral stream" means a stream that flows only during and for short periods following precipitation and flows in low areas that may or may not have a well-defined channel.
- (b) "Intermittent stream" means a stream that flows only during wet periods of the year (30-90 percent of the time) and flows in a continuous well-defined channel.
- (c) "Perennial stream" means a stream that flows throughout a majority of the year (greater than 90 percent of the time) and flows in a well-defined channel.

(18) "Streamside Management Zone (SMZ)" means an area along both sides of intermittent and perennial streams and perennial waterbodies where extra precaution is used in carrying out forest practices in order to protect water quality.

(19) "Visible Sediment" means solid particulate matter, both mineral and organic, which can be seen with the unaided eye that has been or is being transported by water, air, gravity, or ice from its site of origin. This does not normally include colloidal sized particles.

(20) "Waterbody" means a natural or man-made basin that stores water, not including jurisdictional wetlands or beaver ponds.

(18) "Working Days" means days exclusive of Saturdays and Sundays during which weather conditions or soil conditions permit land-disturbing activity to be undertaken.

History Note: Authority G.S. 113-44.4; 113A-52; 113A-52.1;
Eff. January 1, 1990.

SECTION .0200 - PERFORMANCE STANDARDS

15A NCAC 01I .0201 STREAMSIDE MANAGEMENT ZONE

(a) A streamside management zone (SMZ) shall be established and maintained along the margins of intermittent and perennial streams and perennial waterbodies. The SMZ shall be of sufficient width to confine within the SMZ visible sediment resulting from accelerated erosion.

(b) Ground cover, or other means, within the SMZ shall be sufficient to restrain accelerated erosion.

(c) Access roads, skid trails, except as provided in Rule .0203 of this Section, logging decks and mill sites shall be placed outside of SMZs. When barriers such as property lines or limiting land features prohibit the location of any of these outside of SMZs, they can be located within the SMZs. When located within SMZs they shall have effective erosion control and sediment control structures or measures installed to restrain accelerated erosion and prevent visible sediment from entering intermittent or perennial streams or perennial waterbodies.

History Note: Authority G.S. 113A-52.1;
Eff. January 1, 1990.

15A NCAC 01I .0202 PROHIBITION OF DEBRIS ENTERING STREAMS AND WATERBODIES

Stream obstruction and the impediment of stream flow and/or degradation of water quality shall be prevented by keeping debris from construction, harvesting, mill site residue, and site preparation out of intermittent and perennial streams and perennial waterbodies.

History Note: Authority G.S. 77-13; 77-14; 113A-52.1;
Eff. January 1, 1990.

15A NCAC 01I .0203 ACCESS ROAD AND SKID TRAIL STREAM CROSSINGS

Stream crossings shall be avoided when possible. Access roads and skid trails which must cross intermittent or perennial streams or perennial waterbodies shall be constructed so as to minimize the amount of sediment that enters the streams because of the construction. These crossings shall be installed so that:

(1) stream flow will not be obstructed or impeded;

(2) no stream channel or perennial waterbody shall be used as an access road or skid trail;

(3) crossings are provided with effective structures or ground cover to protect the banks and channel from accelerated erosion;

(4) they shall have sufficient water control devices to collect and divert surface flow from the access road or skid trail into undisturbed areas or other control structures to restrain accelerated erosion and prevent visible sediment from entering intermittent and perennial streams; and

(5) ground cover, or other means, sufficient to prevent visible sediment from entering intermittent and perennial streams and perennial waterbodies shall be provided within ten working days of initial disturbance and will be maintained until the site is permanently stabilized.

History Note: Authority G.S. 113A-52.1;
Eff. January 1, 1990.

15A NCAC 01I .0204 ACCESS ROAD ENTRANCES

Access road entrances intersecting public highways shall be constructed and maintained with measures, devices or techniques effective to prevent excessive soil and other debris from being carried to and deposited on the highway to the extent that sedimentation problems will result.

History Note: Authority G.S. 113A-52.1;
Eff. January 1, 1990.

15A NCAC 01I .0205 PROHIBITION / WASTE ENTERING STREAMS / WATERBODIES / GROUNDWATER

Measures shall be taken to prevent equipment servicing waste, petroleum, fertilizers or other chemical waste from entering streams, perennial waterbodies, and groundwater which result in a violation of an adopted water quality standard of the Environmental Management Commission in Sections 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina, and 15A NCAC 2L .0200 - Classifications and Water Quality Standards (related to groundwater).

History Note: Authority G.S. 113A-52.1; 143-214.1;
Eff. January 1, 1990.

15A NCAC 01I .0206 PESTICIDE APPLICATION

Application of pesticides shall be limited to those labeled for that intended use, shall be used in accordance with labeling and rules adopted by the N.C. Pesticide Board as set forth in 2 NCAC 9L .1005, Restricted Areas, and applied in a manner to prevent adverse impacts on water quality.

History Note: Authority G.S. 113A-52.1; 143-214.1; 143-458;
Eff. January 1, 1990.

15A NCAC 01I .0207 FERTILIZER APPLICATION

When used, fertilizers shall be applied in a manner to prevent adverse impacts on water quality.

History Note: Authority G.S. 113A-52.1; 143-214.1;
Eff. January 1, 1990.

15A NCAC 01I .0208 STREAM TEMPERATURE

Adequate shade within SMZs associated with natural perennial streams shall be retained to protect those streams from adverse temperature fluctuations which result in a violation of an adopted water quality standard of the Environmental Management Commission as contained in Rule 15A NCAC 2B .0211 - Fresh Surface Water Classifications and Standards.

History Note: Authority G.S. 113A-52.1; 143-214.1;
Eff. January 1, 1990.

15A NCAC 01I .0209 REHABILITATION OF PROJECT SITE

Areas on the project site that have the potential for accelerated erosion, resulting in concentrated flow directly entering an intermittent or perennial stream or perennial waterbody, shall be provided with ground cover or other means of adequate sedimentation control within 30 working days after ceasing any phase of an operation or beginning a period of inactivity. Treatment and maintenance of those areas shall be sufficient to restrain accelerated erosion and prevent visible sediment from entering intermittent and perennial streams and perennial waterbodies until the site is permanently stabilized.

History Note: Authority G.S. 113A-52.1;
Eff. January 1, 1990.

NCDFR BMP Implementation Survey, Round 1 - 2000 – 2003
Final Report Customer Survey

This report was developed for you, the customer. If you have any comments or advice about how we might better collect and deliver this type of information in the future, we would appreciate you taking the time to answer the questions below.

FEEDBACK SURVEY

Was this report presented in a clear and concise way, given the nature of the information?
- ❑ Yes
- ❑ There is room for improvement
- ❑ No

Comments:_____
_____

Do you believe that the survey was designed to adequately capture and convey the most relevant information regarding BMP implementation?
- ❑ Yes
- ❑ No

Comments:_____
_____

Do you believe that North Carolina's Best Management Practices address all of the areas of forest management as they apply to water quality?
- ❑ Yes
- ❑ No

Comments:_____
_____

In general, the level of voluntary BMP implementation detailed in this report was
- ❑ Higher than you expected
- ❑ About what you expected
- ❑ Lower than you expected

Comments:_____
_____

Do you think we should look at additional BMP practices or conditions in future surveys?
- ❑ Yes, you should also consider_____
_____
- ❑ No

Any other Comments:_____
_____
_____
_____

Please remove this survey from the book, fold into thirds, tape, apply postage, and mail to the NCDFR (the address is already applied to the other side of this form). Or if you prefer you may contact our Program Assistant with your comments: Phone 919-733-2162 ext. 250

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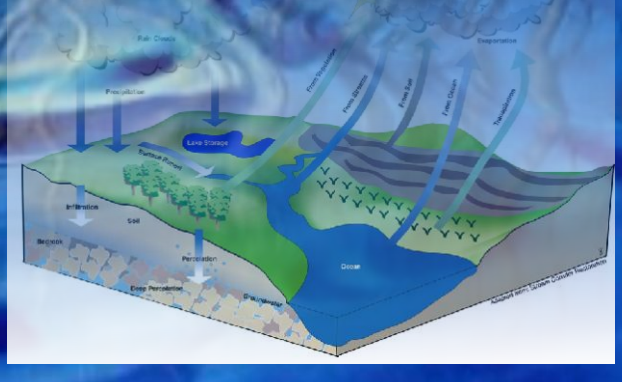
Forest Water Quality

Making Every Drop Count

FMNPS-0205



NCDENR
North Carolina Department of Environment and Natural Resources

William G. Ross Jr.
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