Indiana DNR Division of Forestry

State Forest Properties

2009

Third-Party Audit

Forestry Best Management Practices Monitoring Results

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Third-Party Audit State Forest BMP Report

I. Executive Summary

The Division of Forestry (DoF) began an internal audit of Best Management Practices (BMP) monitoring in November 2000 of all timber harvests on state forest properties. Sale of monitored timber harvests began in July 1999, when Forestry BMPs were included on the timber sale contract and enforced, even though it was common practice before that date. The Statewide Forestry BMP program conducted four rounds of monitoring before that time in which state properties were monitored by teams including DoF personnel and private and industry people interested in forestry in Indiana.

In 2006, DoF committed to conducting annual external or third-party audits of BMP monitoring to ensure the accuracy of internal audits. Ten percent of sites monitored each year are to be reviewed. Unless otherwise stated, comparisons in this report are for 19 sites that were selected randomly for review by external auditors. The 19 DoF-monitored sites were selected as follows:

- Three in 2005
- Three in 2006
- Three in 2007
- Five in 2008
- Five in 2009

The overall BMP application rate for the 19 sites monitored by state employees was 90.3 percent, and third-party auditors determined the overall BMP application rate to be 93.2 percent (Figure 1a) at the same sites. Of the 19 sites included in this comparison study, state monitors found minor departures in BMP application 8.3 percent of the time (or in 68 instances) and major departures in seven instances (0.86 percent) (Figure 2a). The third-party auditors found minor departures in application 6.5 percent of the time (52 instances) and major departures 0.37 percent of the time (three instances) (Figure 2b).

The overall BMP effectiveness rate for the 19 sites as monitored by state employees was 96.3 percent; 98 percent by third-party auditors (Figure 1b). State monitors found 30 departures in effectiveness. Eleven of the departures (1.38 percent) were determined to have an indirect and temporary impact; four departures (0.5 percent) had an indirect and prolonged effect (Figure 3a). State monitors found one direct and temporary impact to soil and water quality (0.63 percent) and 10 departures (1.25 percent) with a direct and prolonged impact (Figure 3a). Third-party monitors found 17 departures in BMP effectiveness. Thirteen (1.62 percent) were determined to have an indirect and temporary effect on soil and water resources of the sites; two (0.25 percent) an indirect and prolonged impact; one (0.12 percent) a direct, temporary impact; and one (0.12 percent) a direct and prolonged impact (Figure 3b).

The overall rates for forestry BMPs on state forests since 1996 are 87 percent application and 93.6 percent effectiveness in protecting the soil and water quality of the 284 sites monitored. This means that 87 percent of the practices were applied as directed in the BMP guidelines, and another 12.4 percent were departures classified as minor as defined in the monitoring sheet (Appendix B). There were 78 major departures, or only 0.63 percent of all practices that were monitored. Of 284 sites monitored on state properties, only one application question has scored a “Total Negligence”, or 0.01 percent.

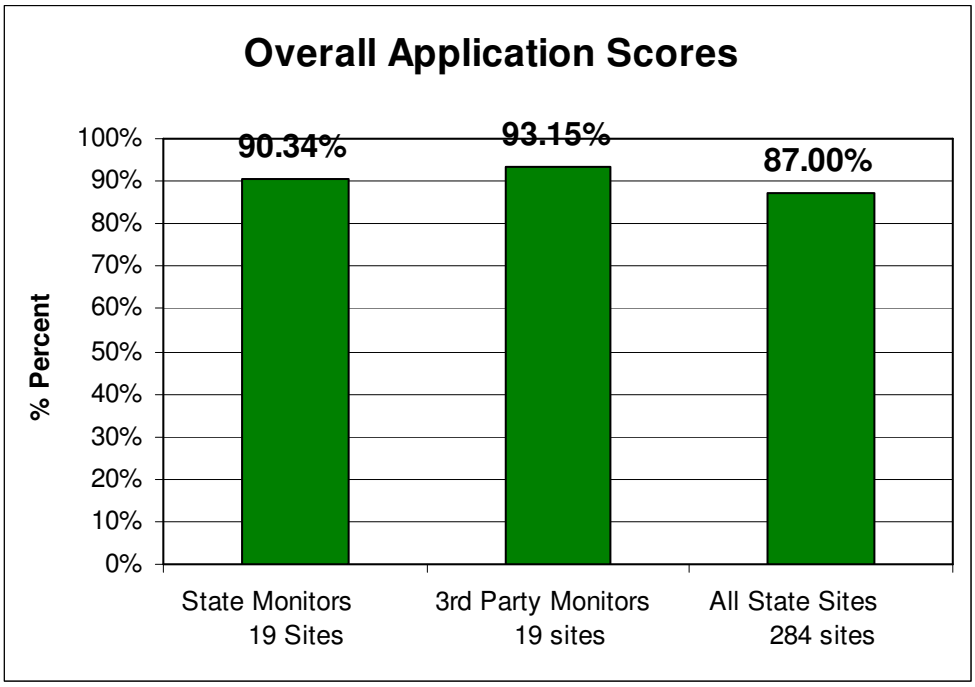

Figure 1a. Overall BMP application scores for the 19 sites monitored by both state and third-party groups compared to the overall application score for the 284 State Forest harvest sites monitored for BMPs from 1996 to 2009.

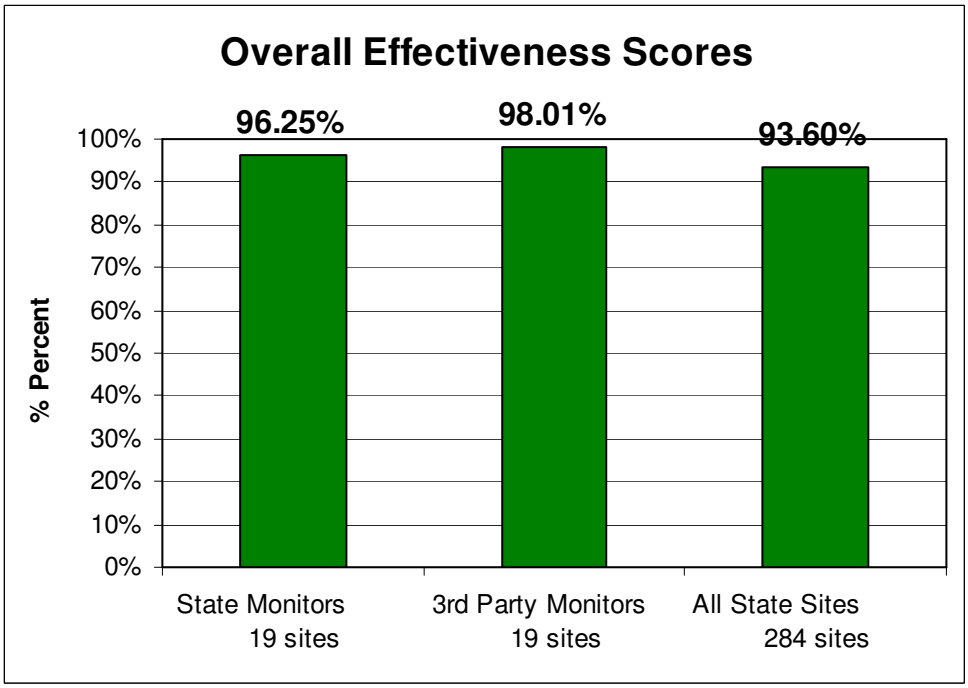

Figure 1b. Overall BMP effectiveness scores for the 19 sites monitored by both state and third-party groups compared to the overall effectiveness score for the 284 state forest harvest sites monitored for BMPs from 1996 to 2009.

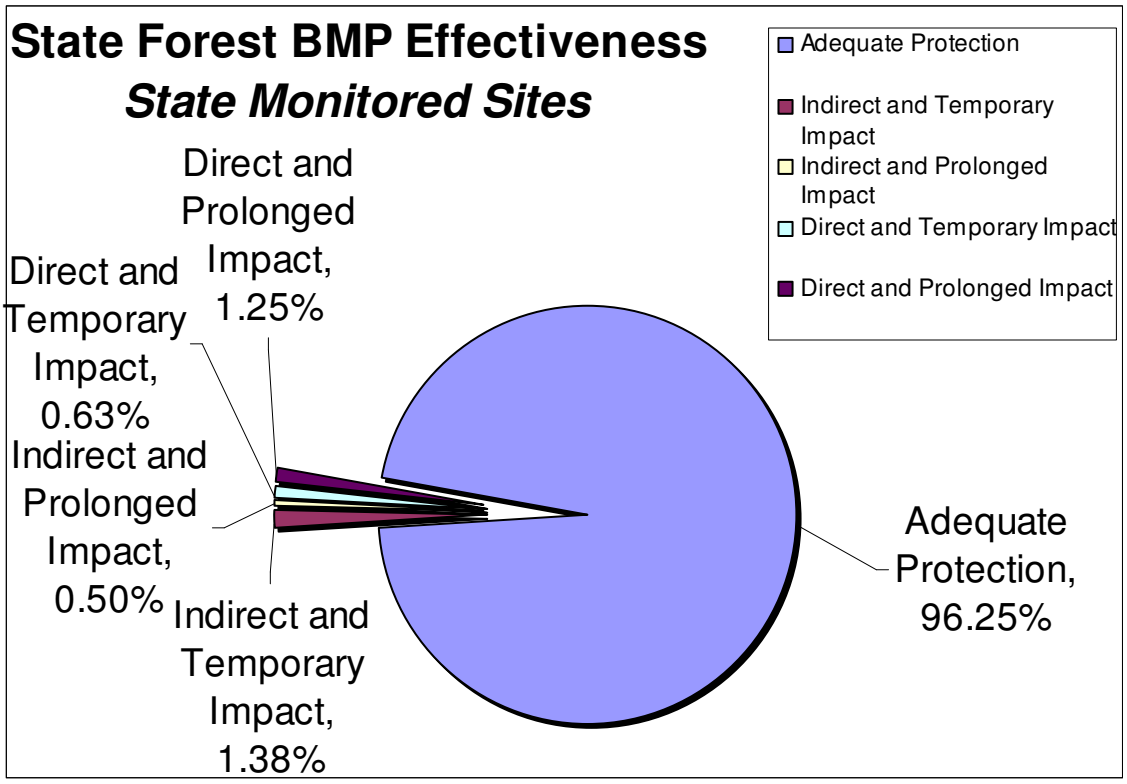

Figure 2a. State Forest BMP application percentages for 19 sites monitored by state personnel.

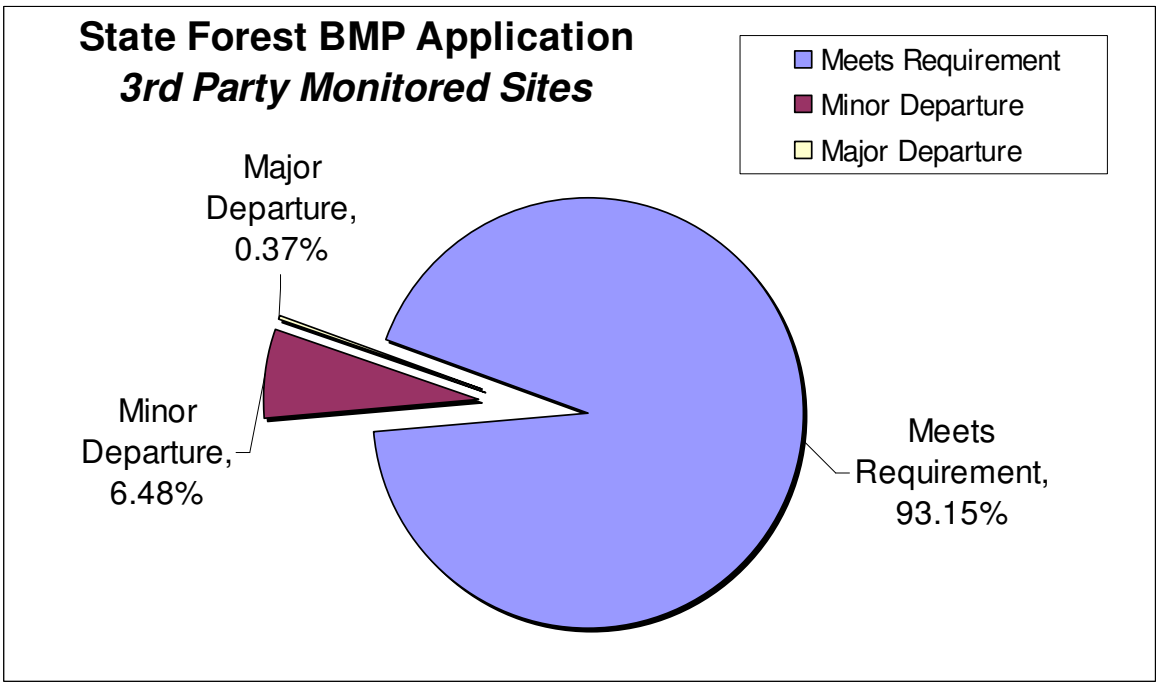

Figure 2b. State Forest BMP application percentages for 19 sites monitored by the third-party audit team.

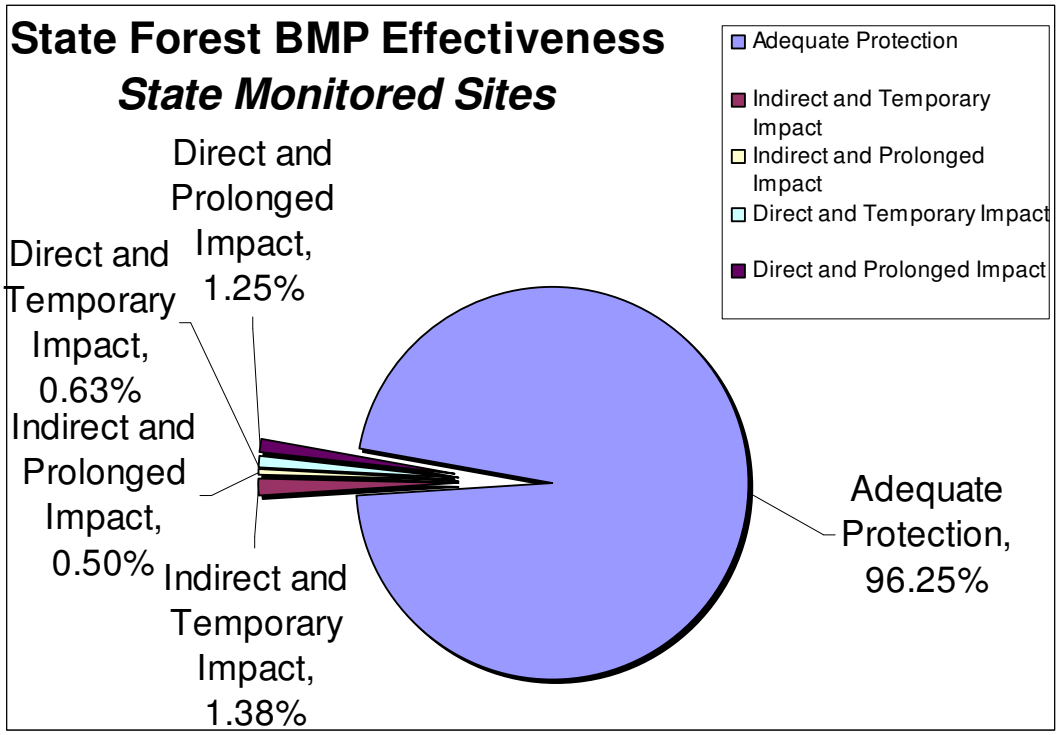

Figure 3a: State Forest BMP effectiveness percentages for the 19 sites monitored by state personnel.

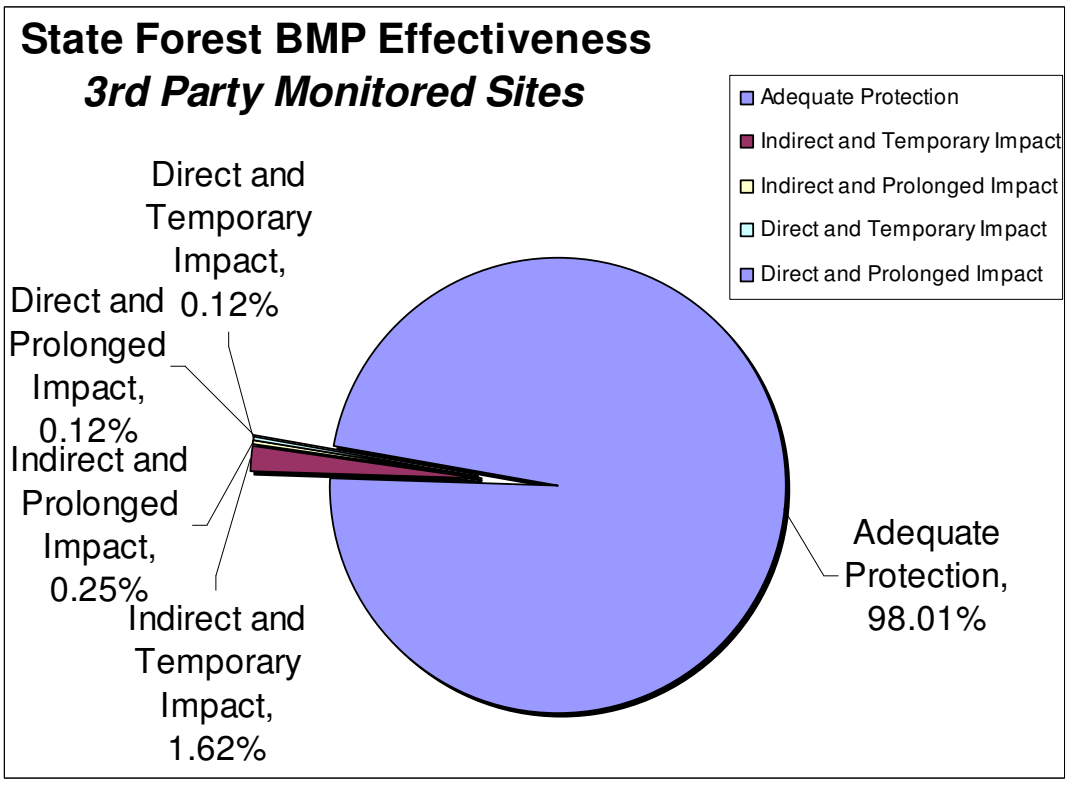

Figure 3b: State Forest BMP effectiveness percentages for the 19 sites monitored by the 2010 third-party audit team.

II. Acknowledgments

The Division of Forestry thanks Richard Langdon and Barry Wilson for taking time from their small businesses; Barbara Wilhoit for her time and effort and Foley Hardwoods for allowing her to participate; and Allen Pursell and The Nature Conservancy for their help with this project.

III. Introduction

Indiana contains 4.7 million acres of forestland that provide many benefits to Indiana's people and wildlife. The State Forest system owns only 3.3 percent or 153,878 acres of Indiana's forestland; however, this land is important to many Hoosiers who frequently use these properties for recreation such as hiking, biking, hunting, fishing and wildlife watching. Since State Forest lands are important to the public, it is imperative that harvesting of State Forests is done in a way that reduces environmental impacts as much as possible.

Although forests are extremely effective in reducing nonpoint source pollution (NPS) to waterways, they also can be a source of pollutants. When forest soils are bared, NPS pollution can occur. Forestry BMPs are employed to reduce or eliminate impacts that harvesting can have on forest soils and water quality. BMPs are a foundation for water-quality protection and guidelines for protecting water quality during forest operations. The purpose of BMPs is to minimize the impact of forest activities that may affect soil and water quality.

This report compares BMP monitoring results from DoF employees and a third-party monitoring group for the same 19 sites, which are reviewed independently by the two groups. The intent is to determine if there is consistency between the internal and external monitors in order to assure the public that State Forest lands are being managed adequately to reduce soil and water impacts during and after timber harvests.

From July 1999 to winter 2003, BMP monitoring on State Forests was conducted with the Watershed Conservation (WC) Forester and/or the License Timber Buyer (LTB) Forester from the special programs section of the DoF, the Administering Forester of the timber harvest being monitored, an Administering Forester from another property, and the Property Specialist who administered the timber harvest program. The Property Specialist stopped coordinating the monitoring and participating in the monitoring of sites late in 2003. In October 2004, the DoF started to change the monitoring system to a sampling method, but was transitioning the system when a change in leadership halted the monitoring until new leadership was put in place. At that time, DoF moved back to 100 percent monitoring. Presently, DoF monitors 100 percent of the timber harvests after they are completed, but the monitoring team consists of the LTB Forester and/or one of the trained BMP Monitoring staff, and the Administering Forester of the timber harvest being monitored.

The third-party audit needed to cover at least 10 percent of the sites that were monitored through the regular process in the years 2005, 2006, 2007, 2008, and 2009. This total was determined to be three sites for 2005, 2006, and 2007 and five sites in 2008 and 2009. The site-selection process is described later and labeled as such. The basic data on the front page of the monitoring sheet, such as the location and time of the harvest, minus data that could bias the monitoring of the group such as that of the logger and forester, was given to the monitoring team. Its members monitored the sites as described in the Monitoring Process section. The division's LTB forester coordinated the efforts of the

third-party auditing team. The division's property personnel were not informed of the sites or locations where the monitoring was to be done.

BMP monitoring is a site evaluation based on the Indiana Logging and Forestry Best Management Practices: BMP Field Guide (BMP Field Guide) and Indiana's Forestry BMP Monitoring Worksheet. Fifty-eight BMP specifications are evaluated under the five forestry operation categories: 1) forest access roads, 2) log landings, 3) skid trails, 4) stream crossings, and 5) riparian management zones. Each BMP specification is rated for application of the BMP and effectiveness in protecting water quality. Seven general questions are posed about the root of the site's noted failures and successes. The evaluation also records other land uses on the site that could affect water quality.

IV. Methods

A. Third-Party BMP Monitoring Objectives

The objectives of BMP monitoring are: 1) to assess the effectiveness of the BMP guidelines in minimizing soil erosion and stream sedimentation, 2) provide information on the extent of BMP implementation, past and current, 3) identify areas to focus future program training and educational efforts to improve BMP implementation and effectiveness, 4) identify BMP specifications that may need technical modification, 5) identify improvements needed in future monitoring efforts, and 6) determine if internal monitoring is being implemented and reported in a consistent, truthful and environmentally significant way.

B. Monitoring Team Selection

For State Forest properties, the DoF previously tried to have the WC and LTB foresters come to every BMP monitoring. However, at many sites, one or the other was absent for either personal or professional reasons. At present, the LTB Forester or the BMP monitoring staff reviews all the sites if possible. Monitoring still continues, helping maintain a balance between being consistent and keeping production of results on schedule.

The other participants were the Administering Forester and an Administering Forester from another property. This balanced the team for input in site evaluation of the monitoring process and provided good training and discussion.

From July 1999 until 2003, the coordination of monitoring dates and people was carried out by the Property Specialist, who also attended the monitoring of every timber harvest. This practice was discontinued when administrative duties increased for that position, and the coordination of the monitoring was passed to the WC forester.

The third-party team needed to have at least three people who could take the time to visit the 19 sites together. The team represented an array of interested parties from outside state government. Richard Langdon, a private landowner, has participated in the BMP monitoring program since its inception in 1997. Allen Pursells is a forester from The Nature Conservancy with no past Indiana Forestry BMP monitoring experience. Barry Wilson, who previously was a forester with The Nature Conservancy, is currently a private consulting forester. Barry had no previous experience with Indiana Forestry BMP monitoring. Barbara Wilhoit is a forester for Foley Hardwoods and has participated in past rounds of BMP monitoring.

C. Site Selection

It was determined in 2007 that 10 percent of sites monitored in the two previous years and every year thereafter would be re-monitored for quality-control purposes. Sites were given numbers, and then the numbers were chosen randomly. The six sites from 2005 and 2006 were monitored during a two-week period in 2007. Three sites, approximately 10 percent of sites monitored in 2007, also were audited in a two-day period in October 2008. Five sites, approximately 10 percent of sites monitored in 2008, were monitored by third-party auditors in three days during April and May of 2009. Ten percent of the sites monitored by the state in 2009 equaled five sites; those also were randomly chosen and monitored by the third-party team in three days during September 2010.

2005

The three sites randomly chosen for this audit from those monitored internally in 2005 were Clark State Forest Compartment 18 Tracts 2 and 6 (C18T2+6), Yellowwood State Forest C14T6, and Owen State Forest C9T1.

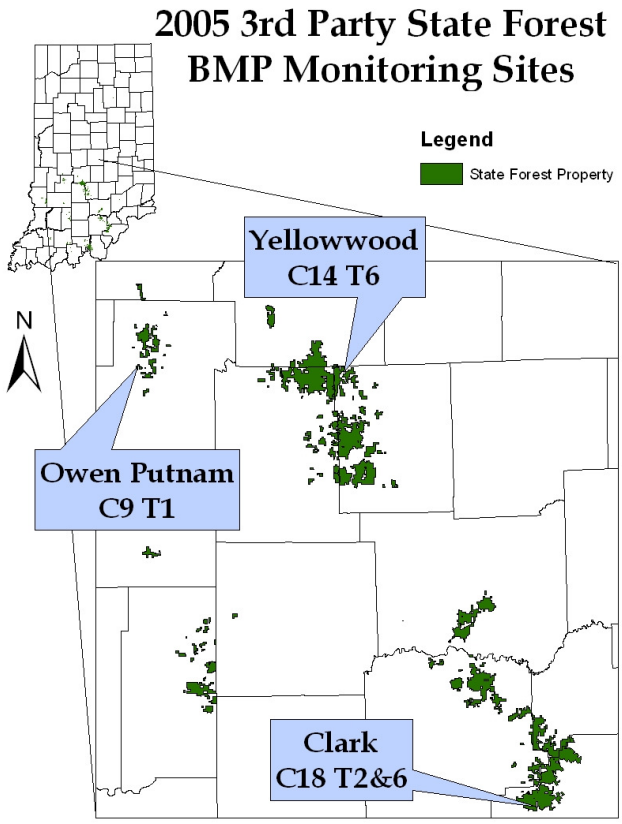

Figure 4 a. Locations of 2005 third-party monitoring sites

2006

The three sites randomly chosen for this audit from those monitored internally in 2006 were Clark State Forest C5T7, Jackson-Washington State Forest C1T2, and Morgan-Monroe State Forest C18T7.

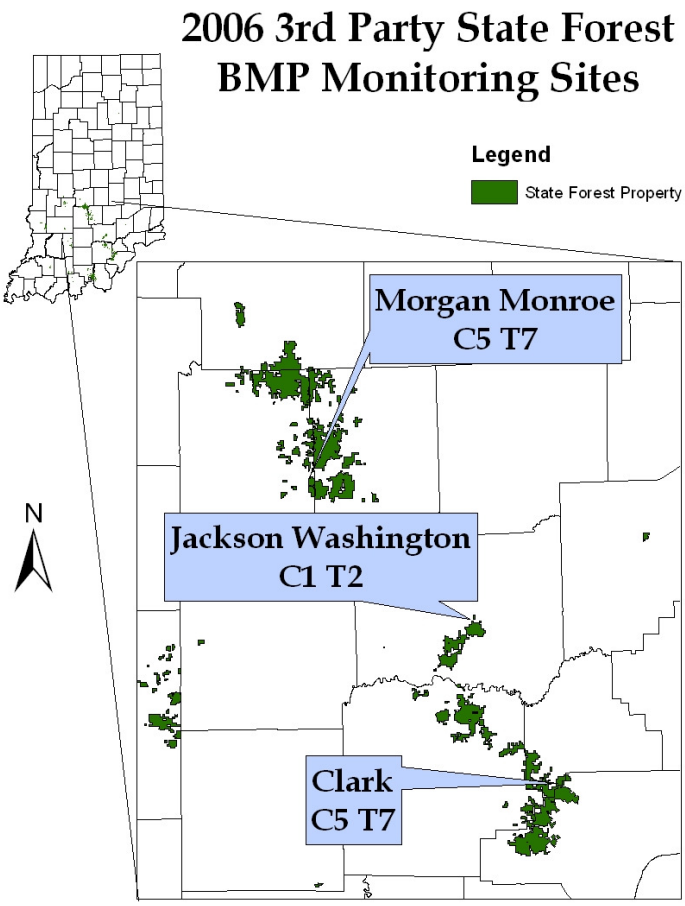

Figure 4b. Locations of 2006 third-party monitoring sites.

2007

The three randomly chosen sites for this audit from those monitored in 2007 were Greene-Sullivan State Forest C4T4, Martin State Forest C2T1 and Ferdinand State Forest C5T4.

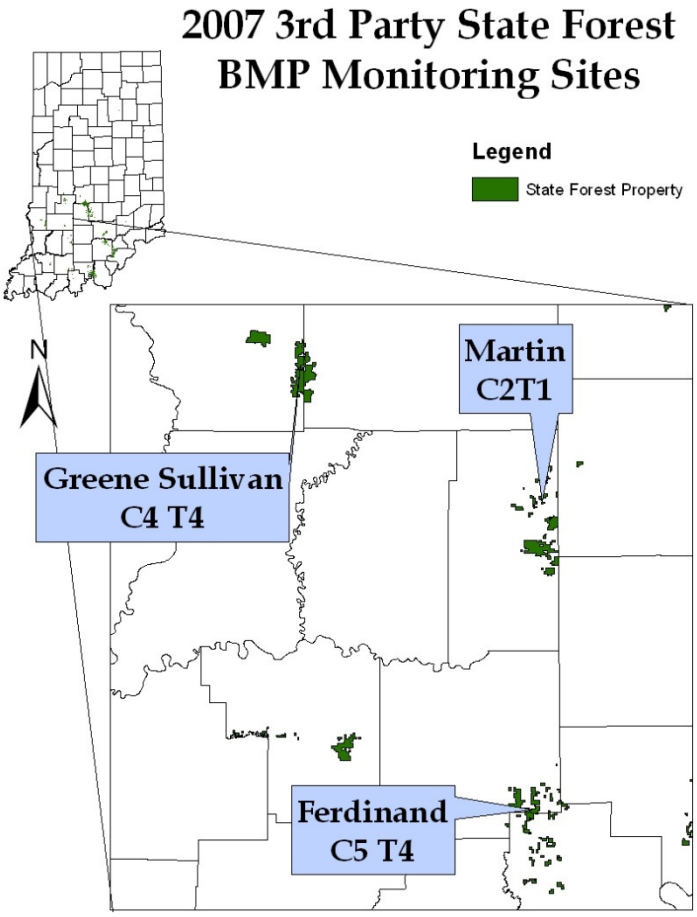

Figure 4c. Locations of 2007 third-party monitoring sites.

2008

Five sites were randomly chosen for the 2008 round of third-party BMP reviews. The sites were Yellowwood State Forest C10 T18, Owen Putnam State Forest C8 T10, Morgan-Monroe State Forest C5 T7, Pike State Forest C10 T3, Martin State Forest C3 T7.

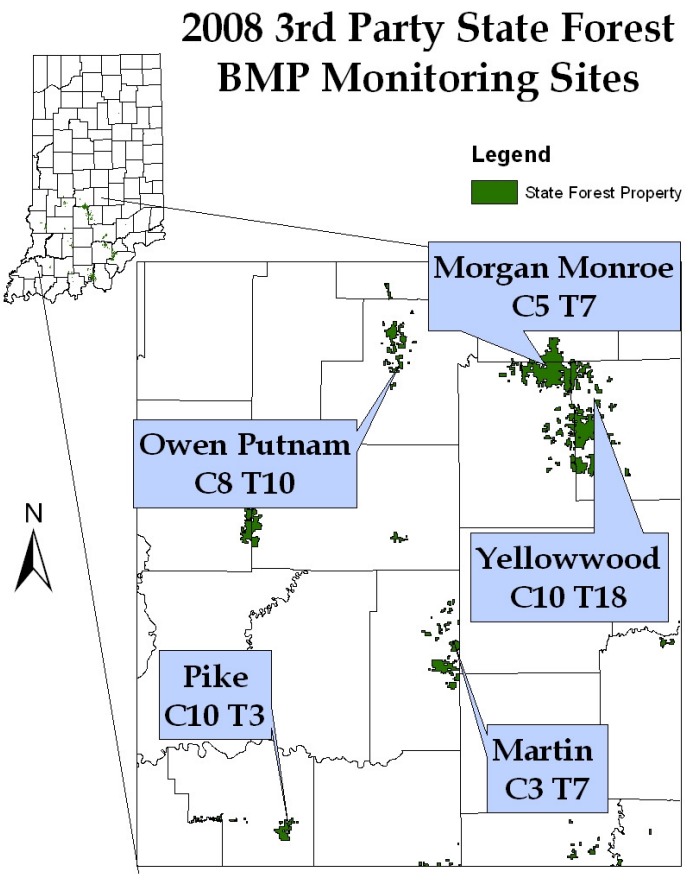

Figure 4d. Locations of 2008 third-party monitoring sites.

2009

Five sites were randomly chosen from the sites monitored in 2009 for the third-party BMP monitoring. These sites were; Yellowwood State Forest C09 T12, Selmier State Forest C01 T06, Owen Putnam State Forest C04 T15, Morgan Monroe State Forest C11 T22 & 23, Owen Putnam State Forest C02 T02.

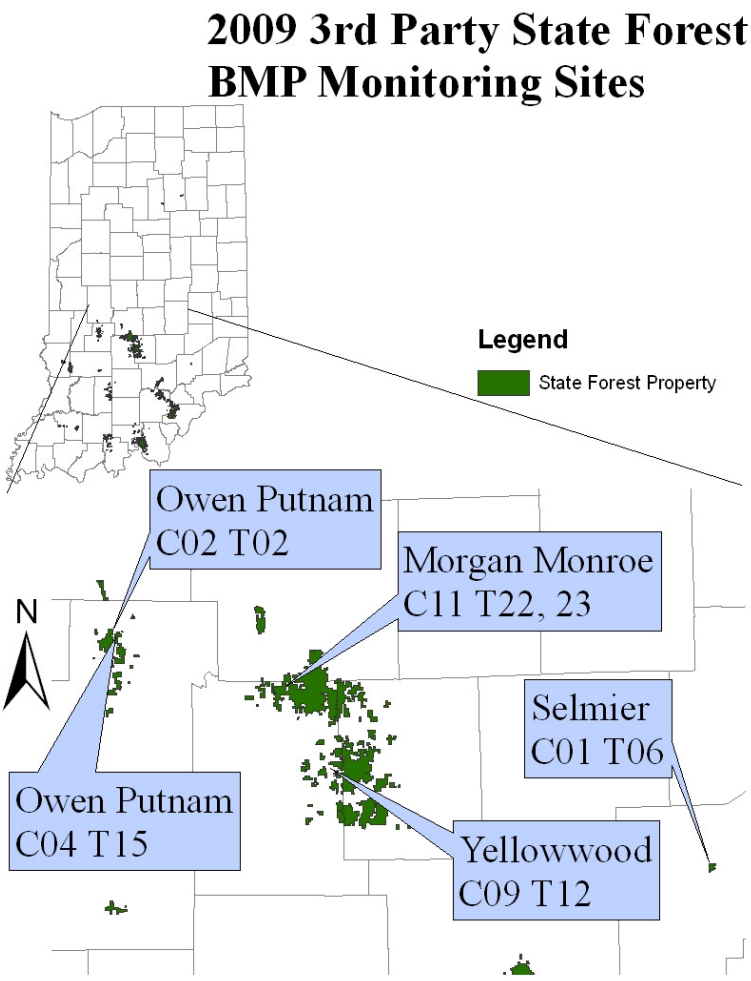

Figure 4e. Locations of the 2009 third-party monitoring sites.

D. Monitoring Process

BMP monitoring is based on the evaluation of each specific practice for application and effectiveness. Application is the installation of a practice and the condition of the practice at the time of monitoring. Effectiveness is the level of success a practice has in the prevention of pollutants entering a water body or the level of impact the pollutant is having on the water body at the time of monitoring. It is possible to apply all of the BMPs properly and get a good score in application but still have soil entering a stream, which would call for a lower score in effectiveness. The opposite also is possible.

The monitoring on State Forest properties follows the same format as that for all other forestry BMP monitoring in Indiana, except that the team of monitors is made up of people from similar backgrounds. On any monitoring day, the team meets at the forest office and then goes to the field to conduct the BMP monitoring on a harvest that is already completed and closed. The team walks each part of the harvest area, covering all of the access roads, inspecting the log landings, skid trails, riparian management zones and stream crossings as suggested in the Indiana BMP Monitoring Protocol, and comments on

successes and departures from the BMP guidelines. Also, the Watershed Conservation Intermittent or the LTB forester walks all of the intermittent or larger streams in or adjacent to the timber harvest area.

Once on the site, the State Forest monitoring team walks the area and its adjacent and interior intermittent or larger streams while carrying maps of the site, the BMP monitoring form and the BMP Field Guide. This time allows each team member to individually evaluate the BMPs on the site. Once they have walked most of the area, team members meet at the vehicle or another gathering place to discuss each question on the BMP monitoring form until they reach consensus. This process also was followed by the third-party audit team.

On State Forest properties, the definition of intermittent streams focuses on streams that are 4-feet wide at the bed of the stream or marked as mapped intermittent streams on U.S. Geological Service quadrangle maps. This allows for easier determination of which streams need to be monitored for stream crossings and which need to have large woody debris removed that entered the streams due to timber harvest. A better history and definition for streams that qualified as being 4-feet wide is in Appendix A of this report.

V. Results

A. Overall Application and Effectiveness

Third-party monitors found the overall application of forestry BMPs to be 3 percent higher than the State monitors with rates of 90.3 percent for state and 93.2 percent for third-party monitors (Figure 1a). State BMP monitors found 68 (8.31 percent) minor departures and seven (0.86 percent) major departures in BMP application (Figure 2a). Third-party monitors found 52 (6.47 percent) minor departures and three (0.37 percent) major departures in application (Figure 2b).

There was minimal deviation between groups on overall BMP effectiveness. State employees scored the BMPs as having a 96.25 percent overall effectiveness, and the third-party group scored overall effectiveness as 98 percent (Figure 1b).

Arranging the overall application and effectiveness scores of both groups by year demonstrates the agreement between groups (Figures 4a & 4b). The two groups were within 2 percent on the average application and effectiveness scores for each year's monitoring round, until 2009. In 2009, state application was 86.64 percent and the third-party application average was 97.72 percent. The average effectiveness for 2009 was 93.95 percent for state monitors and 98.21 percent for third-party monitors. The third-party monitors had higher ratings for application and effectiveness of forestry BMPs for the previously mentioned sites for every year except 2006. In the 2006 monitoring, the third-party monitors scored both BMP application and effectiveness at the three randomly selected sites lower than did the state monitoring group (Figures 5a & 5b).

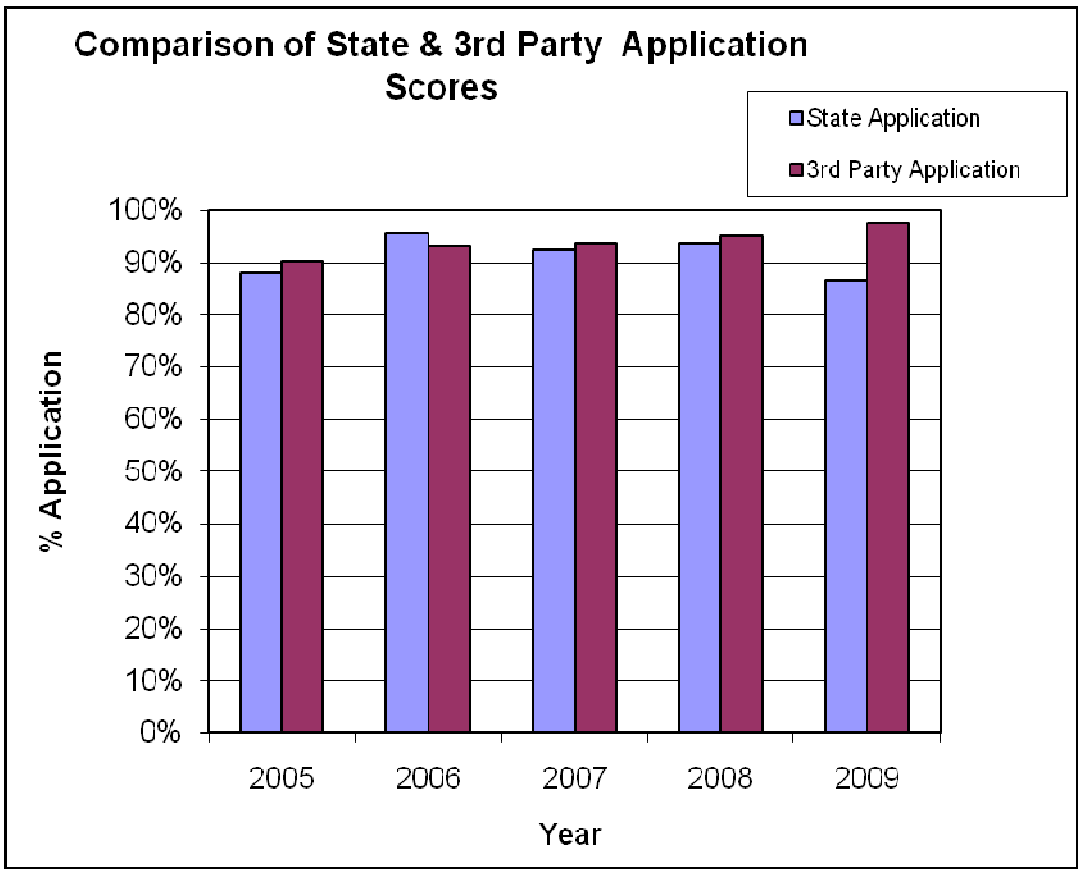

Figure 5a. Yearly trends of application scores for state and third-party monitors at the randomly selected sites for those years.

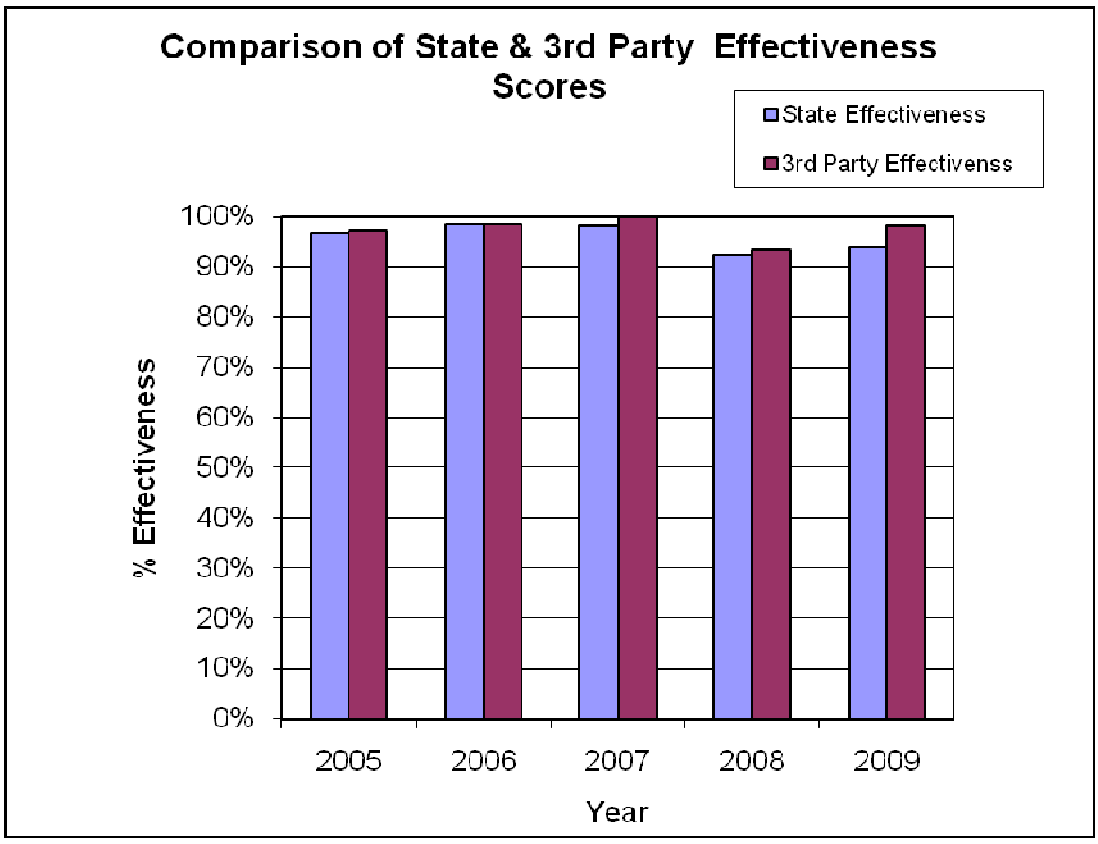

Figure 5b. Yearly trends of effectiveness scores for state and third-party monitors at the randomly selected sites for those years.

B. BMPs by Category

1. Access Roads

Access roads were considered to be implemented correctly 95.2 percent of the time by the state monitors while the third-party auditors determined they were applied correctly 97.7 percent of the time. State monitors determined that the BMPs in place were 98.3 percent effective in protecting the soil and water resources of the site. Third-party auditors rated the access road BMPs as 99.6 percent effective.

Table 1: Application and effectiveness of BMP specifications for access roads.

Access Roads	Percent Application State Monitored	Percent Application Third-Party Monitored	Percent Effective State Monitored	Percent Effective Third-Party Monitored
A1. Uses existing routes where appropriate	100	100	100	100
A2. Adequate buffer strip next to watercourses and sensitive areas	94.1	100	100	100
A3. Avoids unstable gullies, seeps, very poorly drained areas	100	100	100	100
A4. Road grades are within standards	100	100	100	100
A5. Amount of roads minimized	100	100	100	100
A6. Stream crossings minimized	100	100	100	100
A7. Road excavation minimized	100	100	100	100
A8. Excavated and fill materials placed properly	100	100	100	100
A9. Roads constructed to drain well	82.4	94.4	100	100
A10. Appropriate road stabilization, drainage and diversions installed	88.2	94.4	100	100
A11. Water diversions functioning properly	82.4	94.1	87.5	100
A12. Runoff diverted onto stable forest floor areas	88.4	94.1	87.5	100
A13. Mud kept off public roadway	100	100	100	94.4
A14. Public road's drainage maintained	100	100	100	100
A15. Traffic barriers installed	94.1	88.9	100	100
Overall Access Road	**95.2**	**97.7**	**98.3**	**99.6**

Both parties agree the access roads could have been constructed to drain better, state monitors giving an 82.4 percent application rate in this area and third-party monitors scoring 94.4 percent. However, both parties said this departure in application had no negative effect on soil and water quality. State monitors determined there was only 82.4 percent application on proper function of water diversions (A11) and runoff diverted onto stable forest floor (A12). Third-party monitors scored 94.1 percent application on both of these specifications. State monitors determined both specifications had an 87.5 percent effectiveness rating, while third-party monitors found no effectiveness problems for these areas. The third-party group gave a major application departure to one site for the lack of a traffic barrier. No negative effects to the soil and water resources of the site were detected due to this departure. Access roads are often permanent fire trails or other roads that are used and maintained to varying degrees; thus some are more structurally stable than others that have had the diversions worn down by use over long periods.

2. Log Landings

State monitors found the overall Log Landing BMP application to be 91 percent and third-party monitors scored this category at a 95.2 percent application rate. State monitors scored log landings to be 98.9 percent effective at protecting the soil and water resources of the site. Third-party monitors determined all log landing BMPs were 100 percent effective in protecting soil and water resources of the evaluated sites.

Table 2: Application and effectiveness of the BMP specifications for log landings.

Log Landings	Percent Application State Monitored	Percent Application third-party Monitored	Percent Effective State Monitored	Percent Effective third-party Monitored
Y1. Suitable number and size of landings	100	100	100	100
Y2. Landings located outside RMZ	100	100	94.7	100
Y3. Landings located on stable areas	84.2	100	100	100
Y4. Excavation of site minimized	100	100	100	100
Y5. Landings avoid concentrating or collecting runoff	63.2	84.2	94.7	100
Y6. Landing's runoff enters stable area	84.2	89.5	100	100
Y7. Proper water diversions in working order	94.4	94.1	100	100
Y8. Landing smoothed and soil stabilized	89.5	89.9	100	100
Y9. Landings free of fuel and lubricant spills and litter	94.7	94.4	100	100
Y10. Landing location suitable for equipment fueling & maintenance	100	100	100	100
Overall Log Landings	**91**	**95.2**	**98.9**	**100**

The state and third-party monitors saw problems with some landings collecting runoff, 63.2 percent and 84.2 percent, respectively. Only one departure in effectiveness was indicated by state monitors in the concentrating or collecting runoff specification. Third-party monitors found no effectiveness departures in this area.

3. Skid Trails

State and third-party monitors found skid trail BMP application to be 84 percent. The state monitors recorded 95.2 percent effectiveness of BMPs in this category and the third-party group determined skid trail BMPs to be 95.6 percent effective in maintaining soil and water integrity.

Table 3: Application and effectiveness of BMP specifications for skid trails.

Skid Trails	Percent Application State Monitored	Percent Application Third-party Monitored	Percent Effective State Monitored	Percent Effective Third-party Monitored
S1. Uses existing routes were appropriate	100	100	100	100
S2. Adequate buffer strip next to water courses and sensitive areas	94.7	84.2	100	94.7
S3. Avoids steep and long straight grades (>20 percent for >200')	94.1	100	100	100
S4. Avoids unstable gullies, seeps, poorly drained areas	78.9	89.5	94.7	94.7
S5. Amount of skid trails minimized	73.7	73.7	94.7	100
S6. Trail excavation minimized	94.7	89.5	94.7	100
S7. Appropriate drainage and diversions installed	63.5	66.7	88.9	94.4
S8. Water diversions in working order	84.2	66. 7	94.7	88.9
S9. Runoff diverted onto stable forest floor areas	68.4	77.8	89.5	88.9
S10. Streams not used as skid trails (except for crossings)	89.7	94.7	94.7	94.7
Overall Skid Trail	**84**	**84**	**95.2**	**95.6**

Both monitoring groups found departures in application of skid trail minimization, both scoring that specification at 73.7 percent. Neither group found a major impact of these extra skid trails upon the resources of the site with state and third-party monitors giving a 94.7 percent and 100 percent effectiveness rating respectively. Both groups agreed that appropriate drainage and diversions were not installed in some areas; state application 63.5 percent and third-party application 66.7 percent. Both groups determined this was causing minimal impact with state giving an 88.9 percent and third-party giving a 94.4 percent in effectiveness for S7. The monitoring groups disagreed upon the application of water diversions in working order (S8). The state monitors gave this specification an 84.2 percent, and third-party monitors gave it a 66.7 percent rating. The effectiveness scores are higher, with the state giving a 94.7 percent and third-party scoring 88.9 percent on water diversions in working order. This indicates that although the drainage and diversions were not applied properly on all sites, the soil and water resources of the sites were suitably protected. Both groups agreed some sites had issues with runoff being diverted to the stable forest floor with state monitors giving an application score of 68.4 percent and third-party monitors scoring application at 77.8 percent. Both groups scored effectiveness of this specification in the high 80th percentile as well.

4. Stream Crossings

State monitors found 87.3 percent stream crossing BMP application for the five sites with a crossing. Third-party monitors gave a 96.2 percent BMP application rate to the five sites. Both groups determined there was little to no negative effect on the soil and water resources of the sites, and thus the state monitors gave 92.3 percent and third-party monitors gave 100 percent over stream crossing BMP effectiveness rate.

Table 4: Application and effectiveness of BMP specifications for stream crossings.

Stream Crossing	Percent Application State Monitored	Percent Application Third-party Monitored	Percent Effective State Monitored	Percent Effective Third-party Monitored
X1. Number of crossings minimized	93.3	100	100	100
X2. Crossings minimize disturbance to the natural bed and banks	80	80	100	100
X3. Streambank approaches properly designed and stabilized	80	100	80	100
X4. Water runoff diverted from road prior to crossing	100	80	100	100
X5. Crossing as close to 90 degrees as practicable	100	100	100	100
X6. Crossing does not unduly restrict water flow	80	100	100	100
X7. Soil has not been used as fill in the stream (except culverts)	100	100	100	100
X8. Ford constructed of non erosive materials	100	100	100	100
X9. Fords have stable banks and streambeds	66.7	100	66.7	100
X10. Culverts are properly sized and installed	50	100	100	100
X11. Culverts clear of significant flow obstructions	50	100	100	100
X12. Temporary structures properly anchored	N/A	N/A	N/A	N/A
X13. Temporary structures and resulting obstructions removed	N/A	N/A	N/A	N/A
Stream Crossing	**87.3**	**96.2**	**92.3**	**100**

There are only two departures in effectiveness for all the specifications in the stream crossing category. Both were determined by the state monitors; one departure for

"stream bank approaches properly designed and stabilized" (X3) and the other in "fords have stable banks and streambeds" (X9). Both of these had direct and temporary impacts, which is typical of departures in the stream crossing area. Due to the proximity of water, the probability of sediment reaching the stream is much greater. There were two crossings that had culverts. State monitors found problems with culvert installation and obstructions on one site where the third-party monitors found none. Since stream crossings deal directly with intermittent streams, which is defined on state properties as 4-foot or wider streams, often state properties have stream crossings where many other property ownership types in the past would have been classified as ephemeral crossings.

5. Riparian Management Zones

State monitors gave RMZ BMP application a rating of 90.4 percent, while the third-party monitors gave a rating of 92.6 percent. RMZ effectiveness was given a 91.9 percent by state monitors and 94.2 percent from third-party auditors.

Table 5: Application and Effectiveness of BMP Specifications for Riparian Management

Riparian Management Zones	Percent Application State Monitored	Percent Application Third-party Monitored	Percent Effective State Monitored	Percent Effective Third-party Monitored
Z2. Perennial & large intermittent streams clear of obstructing debris	58.8	88.2	58.8	93.8
Z3. Tree tops and cutoffs placed back from water course to prevent movement into streams during floods	88.2	100	88.2	100
Z4. RMZ free of excavated material & debris (other than above)	94.1	100	94.1	100
Z5. Less than 10 percent bare mineral soil exposed within RMZ (not including crossings)	100	100	100	100
Z6. Adequate tree stocking in primary RMZ next to perennial streams	100	100	100	100
Z7. RMZ free of roads and landings (except crossing)	88.2	94.1	100	100
Z8. Water diverted from roads before entering RMZ	100	80	100	80
Z9. Water diverted onto stable areas of the forest floor	100	80	100	80
Z10. Road and trail surfaces stabilized as needed within RMZ	100	100	100	100
Z11. Ephemeral channels free of excavated material	94.4	76.5	94.4	76.5
Riparian Management Zones	**90.4**	**92.6**	**91.9**	**94.2**

Interestingly, there was a discrepancy between groups as to the existence of an RMZ on one site. The third-party monitors showed no RMZ on one site for which the state group determined there was one present. Obstructing debris in perennial and large intermittent streams was considered a problem at one site by both groups. State monitors gave a 58.8 percent in application and effectiveness for this specification while the third-party monitors scored it at 88.2 percent for application and 93.8 percent for effectiveness. Both groups determined there were landings and roads that were in the RMZ, but neither group showed detrimental effects to the soil and water quality of the sites affected; both scoring 100 percent in effectiveness. While state monitors found no issues with water being diverted onto stable forest floor, third-party monitors gave this specification an 80 percent in application and effectiveness. There was divergence between the two groups on excavated material in the ephemeral channels. The third-party auditors scored 76.5 percent

on application and effectiveness in this area. While the state monitors gave application and effectiveness a rating of 94.4 percent. Part of the discrepancy could be due to a salvage harvest that happened on the same site between the state's internal monitoring (Dec. 6, 2006) and the third-party audit (July 10, 2007).

6. Overall Site Ratings

At the conclusion of each site evaluation, monitors are asked to give a rating of the application and effectiveness of BMPs at the site. Ratings for application and effectiveness can range from 1 to 4. Monitors are welcome to use integers or non-integers. Ratings for application of BMPs: 1 = above average, 2 = average, 3 = poor, 4 = total negligence. Ratings for effectiveness or overall impact to water quality are: 1 = no visible impact, 2 = slight impact, 3 = moderate impact, 4 = severe impact. The ratings given by each monitor are then averaged to give an overall application and effectiveness rating for each site. The overall ratings for application and effectiveness are then summed and divided by two to determine the overall site rating (Table 6). It is important to note these numbers do not necessarily directly reflect the worksheet ratings for application and effectiveness. This rating is a general impression of each monitor of the overall BMP application and effectiveness of the site. The average ratings for all years show the state monitors judging the sites' BMP application and effectiveness more harshly than the third-party monitors. Third-party monitors had a higher rating only one time in 2007 on BMP application (Figure 6a – 6c.)

Table 6: Average Ratings Given to 19 Sites Audited by State and Third-Party Monitors

	Application	Effectiveness	Overall score
State Monitored Sites	1.53	1.61	1.57
third-party Monitored Sites	1.39	1.22	1.31

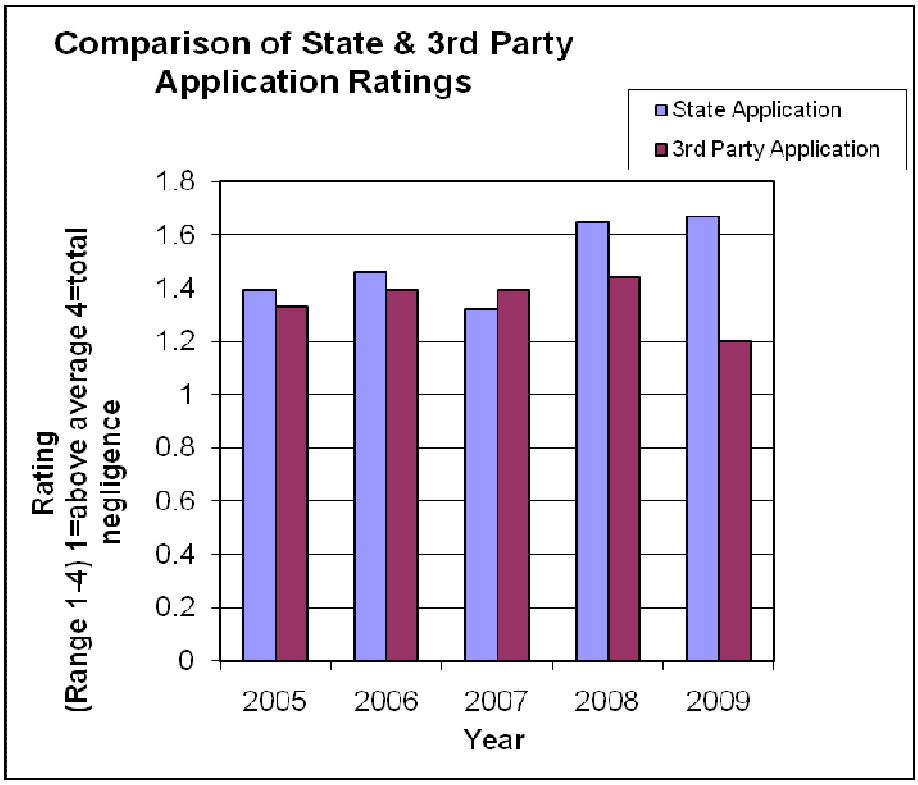

Figure 6a. Comparison of average application ratings by state and third-party monitors for each year of monitoring.

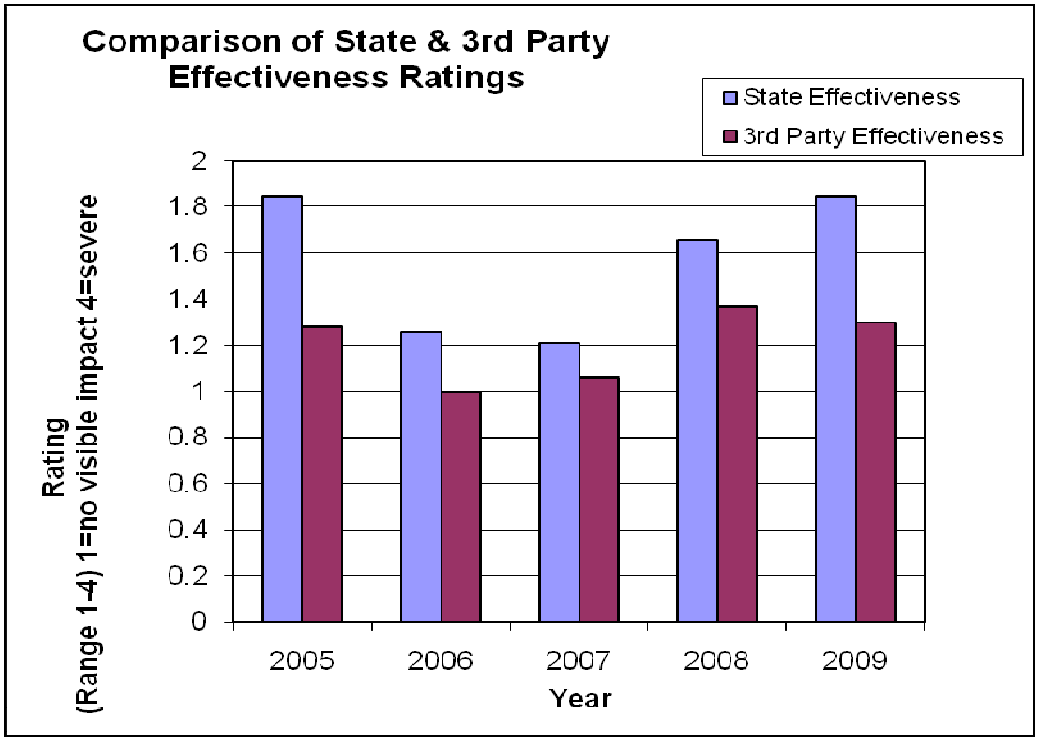

Figure 6b. Comparison of average effectiveness ratings by state and third-party monitors for each year of monitoring.

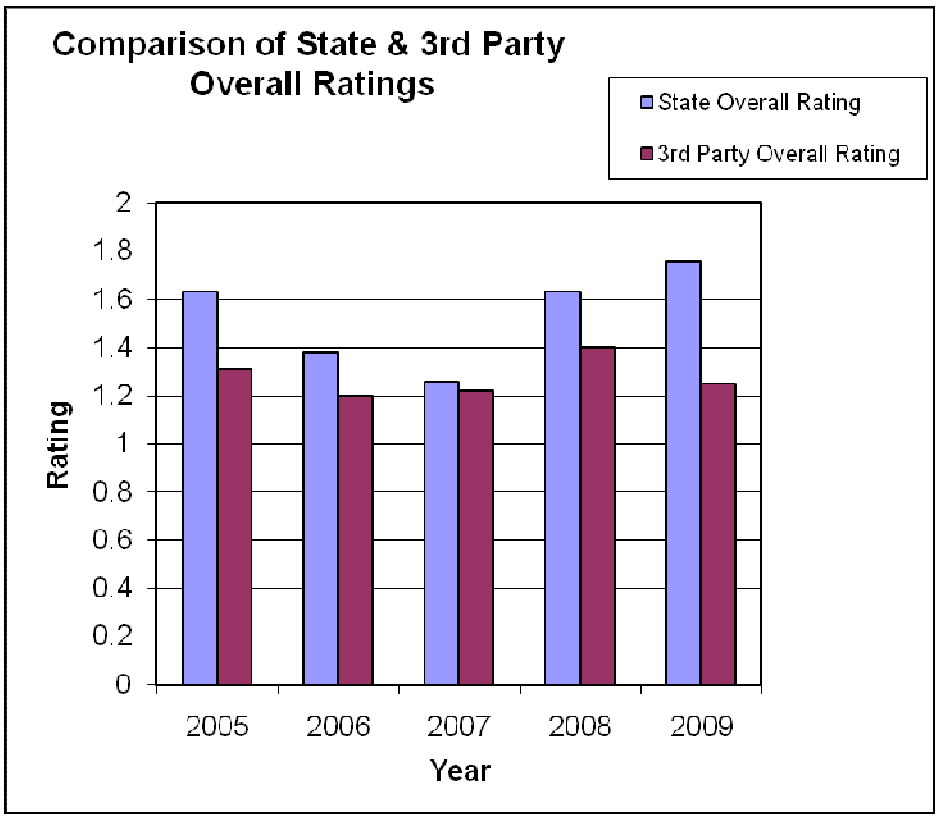

Figure 6c. Comparison of average overall site ratings by state and third-party monitors for each year of monitoring.

VI. Discussion

Overall BMP ratings for the 19 randomly selected sites were mostly congruent between the state and third-party monitors, with the third-party monitors giving about a 2 percent higher score in both application and effectiveness. State monitors determined application rates to be 90.34 percent and third-party monitors scored BMP application at 93.15 percent. State monitors scored overall effectiveness at 96.25 percent, third-party monitors gave a 98 percent overall effectiveness rate. The lower application rating for each monitoring group corresponds to higher effectiveness rates, showing that, usually, where there are departures in application, there is little negative effect to the soil and water resources at the site.

Access roads application and effectiveness scores are high between both groups. The third-party group scored this category higher than did the state group. State employees scored application and effectiveness for access roads at 95.2 percent and 98.3 percent, respectively. The third-party group scored these at 97.7 percent and 99.6 percent, respectively.

Log landings also had a high application and effectiveness rates. State monitors gave this category a 91 percent in application; the third-party monitors, 98.9 percent. State monitors determined that log landing BMPs for the 19 sites were 95.2 percent effective at protecting the soil and water resources of the site, while the third-party monitors found 100 percent effectiveness of these practices.

Skid trails have a somewhat lower application score than the other categories. State monitors and third-party monitors determined that skid trail BMPs were correctly applied 84 percent of the time. Skid trails can have a spectrum of disturbance levels depending on the amount of times the equipment drives over a particular point on the ground. For instance, the main trail just off the landing would have a higher disturbance level because all of the harvested logs have to be moved to the landing, where an area that is traveled over only twice, once to get to access logs and the other to pull out the logs, has a much lower level of disturbance. Also, skid trails go to areas that other equipment cannot access, so they may cross drainages, travel down or across hill slopes, or go into areas that are wet most of the time; therefore, most of the application and effectiveness issues of a site are from skid trails. Also, most of the closeout practices are put in place with limited space as landforms, and adjacent vegetation will often limit the equipment's ability to place structures where they would be most effective. This causes minor departures with little to no effect on water quality. The good news is that even with the relatively low applications scores on skid trials, the effectiveness remained high. At these 19 sites, the departures in application had little negative effect on the resources of the site. State monitors gave the skid trail BMPs a 95.2 percent effectiveness rate; third-party monitors rated it at 95.6 percent. Both groups scored effectiveness over 11 percentage points higher than the application scores.

Stream crossings are the BMP category that must be handled with a lot of care. Departures in this area could lead to pollution being directly deposited into a water body. Of the 19 sites chosen for this comparison study, only five had stream crossings. State monitors found BMP application on stream crossings to be 87.3 percent, third-party monitors scored them at 96.2 percent application. Effectiveness for stream crossings was 92.3 percent (two departures) for state monitored sites and 100 percent at third-party sites.

Riparian Management Zone BMP departures also can have a direct negative impact on the water bodies of a site. The third-party group scored application and effectiveness of RMZ BMPs lower than did the state, with a 92.6 percent application and 94.2 percent effectiveness rating. The state monitors scored RMZ application at 90.4 percent while the effectiveness rate was 91.9 percent. There was a differing interpretation of the definition of a riparian management zone between groups. The state group determined that one site had an RMZ while the third-party group did not recognize this same area as having an RMZ.

VII. Recommendations

- Concentrate on areas where problems are more common, such as skid trails, RMZs, and stream crossings.
- Continue to emphasize the importance of diverting water before it concentrates on roads, landings, skid trails and enters streams and RMZs.
- Continue providing BMP educational information and programs for loggers and resource professionals who work on state properties. If there is an area of concern on state properties, focus training on that area.

VIII. Conclusions

The Indiana Forestry BMP Guidelines are scrutinized and enforced on State Forest properties more than on any other landowner category in the state of Indiana. When the internal inspections began, the application scores actually dropped due to the standards on the State Forest properties such as the 4-foot rule being raised by regulations. However, effectiveness in protecting water quality, which is the main goal of Indiana's Forestry BMPs, has always been high and continued as such at the time of this report. The consistency between the state and third-party monitors confirms the DoF is implementing and monitoring State Forest BMPs in an acceptable and reliable manner.

Our State Forest system has diverse usage. It is the responsibility of the DoF to ensure that all forest users have a minimal impact on the other resources of the forests. Forestry BMPs are the means by which soil erosion from harvesting areas is minimized. Minimal soil erosion allows for quick recovery of the site because the topsoil is still in place to allow for natural succession to take place. Limited sedimentation to the water resources of the forest protects or restores water quality.

Appendix A

BMP Definition Clarification – 4-Foot Rule

Background

The BMP Field Guide states: "Remove felled tops and logging debris from the channels of perennial and large intermittent streams." On the BMP Monitor Sheet (expanded) the definition of the streams is further defined as "… wider than 6 feet…"

The purpose of this is to identify a specified width for monitoring purposes rather than using a vague descriptive term (e.g., "large intermittent"). Readers should realize that BMPs are guidelines—in some instances, even a 6-foot width may not be "large." In others, streams narrower than 6 feet may be considered "large" from a hydrological standpoint. Foresters therefore are expected to interpret the local hydrology and make on-site determinations when applying BMPs. This is clearly true for this BMP standard.

At the start of BMP monitoring on State Forests, DoF tried to adhere to a tighter standard for streams on State Forests—hence, the 4-foot standard for large intermittent streams. This would serve both as a demonstration of commitment to water quality, and as a demonstration and test of a tighter standard.

Variable stream width cropped up as a problem early in this process, requiring clarification of stream width. Streams would widen to more than 4 feet then narrow to less than 4 feet. This created a burden of trying to find the last point upstream at which a stream was 4 feet wide. To solve this, DoF decided that to meet the 4-foot rule, a stream had to be consistently 4 feet wide or wider. This solved some but not all concerns. Examples of unsolved concerns were what debris needs to be removed and how best to determine where a stream is consistently 4 feet wide or wider.

The latest attempt to clarify the 4-foot rule follows. This clarification covers both the definition of the stream and of what debris needs to be removed.

Removing Logging Debris from Streams – 4-Foot Rule

To meet the BMP Field Guide guidelines for riparian zones that states "Remove felled tops and logging debris from the channels of perennial and large intermittent streams," the BMP Monitor Sheet has Item Z2 "Perennial & large intermittent streams clear of obstructing debris." On State Forests, all streams that are to meet this standard will have a clearly defined bed with a width that equals or exceeds 4 feet.

The bed is that portion of the stream that is the lowest level where water commonly flows at typical (i.e., not storm) levels. This will generally be at the base of the banks and will usually consist of aggregate or exposed alluvium. The bed will generally be free of any significant vegetation because of the regular scouring and water flows. An area with a strong, well-rooted vegetative component with a relatively stable soil surface will not be considered stream bed. In streams where the channel is strewn with large rocks, the bed will be the area of smaller gravel at the base of the large rocks.

The stream will be considered 4 feet or wider until the bed, moving upstream, reaches the first point where the stream-bed width drops below 4 feet for a lineal distance of 10 feet or more. Any portion of the drainage system upstream of this point will not be subject to the debris-removal guidelines for large intermittent streams, and debris left in these portions of the drainage will not be considered a departure during monitoring.

Downstream of the identified 4-foot-wide point, all logging debris, except as noted later, that will come in contact with the water when the stream is “bank full,” and impede or divert stream flow, must be removed from the stream channel. Unattached, individual pieces of debris, less than 2 inches in diameter or less than 4 feet in length will not ordinarily impede flow and do not need to be removed. Debris that bridges the stream channel from top of bank to top of bank, does not impede flow, and is unlikely to fall into the stream channel within one year is not required to be removed. Debris less than 2 inches in diameter obstructing less than 20 percent of the stream channel does not need to be removed.

Debris removal is to be accomplished in a manner that minimizes disturbance to the stream banks. The recommended method of removal is pulling the material free of the channel using a cable skidder or other equipment that is kept back from the stream edges. Another option is to cut debris into smaller pieces that can be removed from the channel or that would no longer impede flow. Equipment should not be used in the stream channel to push the material out of the channel. Careful marking of the trees to be harvested, use of directional felling, and clearly explaining the BMP requirements during the pre-harvest conference will minimize the amount of debris that must be removed from stream channels.

The point where the stream channel reaches the 4-foot width threshold should be clearly delineated in harvest areas. While upstream of this point will not be considered subject to debris removal from streams, care should be taken to avoid excessive, intentional deposition of debris in all naturally occurring drainage features, regardless of size. Excessive piling (beyond felling) of debris in any drainage that severely impedes flow may be considered a departure.

Appendix B

FORESTRY BMP MONITORING WORKSHEET

(2000)

DATE INSPECTED:_____TEAM:_____

OWNER:_____ PHONE:_____.

_____

_____

COUNTY:_____SITE #:_____ ACRES HARVESTED:_____

CIVIL TWP:_____ USGS QUAD:_____

SEC:_____TWP:_____ RANGE:_____

MAJOR WATERSHED:_____

DATE OF ACTIVITY:_____

HARVEST EQUIPMENT USED: Dozer:__ Skidder:__ Horses:__ Other:__

TYPE OF HARVEST: Diameter limit:__ Single Tree:__ Group Selection:__ Clear Cut:__ Other:__

SITE CONDITIONS

TERRAIN: BOTTOMLAND_____ percent RIDGES_____ percent SIDE SLOPES_____ percent

SLOPE STEEPNESS: (2-6 percent)_____ (6-12 percent)_____ (12-20 percent)_____ (20+ percent)_____

LAKES PRESENT: name:_____shore length:_____

PERENNIAL STREAMS PRESENT: name:_____width:_____length:_____

SINKHOLES PRESENT: Yes_____ No_____ FLOWING SPRINGS PRESENT: Yes_____ No_____

OPEN WATER WETLANDS PRESENT: Yes_____ No_____ .

FOR OFFICE USE – DO NOT COMPLETE

OPERATOR/FORESTER: (leave blank)_____

TYPE OF OWNERSHIP: nipf:__ clf:__ industry:__ state:__ fed:__ county:__ other:__

APPLICATION	EFFECTIVENESS
0--The Practice Not Needed or Applied on Site	1--Adequate Protection of Water Resources.
1--Operation Meets Requirement of BMP	2--Indirect and Temporary Impacts on Water Resources.
2--Minor Departure from BMP	3--Indirect and Prolonged Impacts on Water Resources.
3--Major Departure from BMP	4--Direct and Temporary Impacts on Water Resources.
4--Gross Neglect of BMP	5--Direct and Prolonged Impacts on Water Resources.

APPLICATION DEFINITIONS (BY EXAMPLE)

MINOR DEPARTURE: Practice not clearly needed; attempted practice but poorly applied; small potential for soil to reach streams.

MAJOR DEPARTURE: Practice clearly needed; common departures from practice; large potential for soil to reach streams.

GROSS NEGLECT: No attempt at application; total disregard for water quality; large and direct impacts.

EFFECTIVENESS DEFINITIONS (BY EXAMPLE)

ADEQUATE: Small amount of material eroded; material does not reach drainages, streams, lakes or sinkhole openings.

INDIRECT IMPACT: Erosion and delivery of material to drainages (including ephemerals) but not to intermittent or perennial streams, lakes or sinkhole openings.

DIRECT IMPACT: Erosion and subsequent delivery of sediment to intermittent or perennial streams, lakes or sinkhole openings.

TEMPORARY IMPACT: Impacts lasting one year or less; no more than one runoff season; small amount of material involved.

PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

*It is possible to have a departure from BMPs and still have adequate protection.

ACCESS ROADS							APPLICATION (0-4)		
								EFFECTIVENESS (1-5)	
									COMMENTS
There is no access road present _____ (If true, do not answer questions below)									
A1. Uses existing routes where appropriate									
A2. Adequate buffer strip next to watercourses and sensitive areas									
A3. Avoids unstable gullies, seeps, very poorly drained areas									
A4. Road grades are within standards									
A5. Amount of roads minimized									
A6. Stream crossings minimized									
A7. Road excavation minimized									
A8. Excavated and fill materials placed appropriately									
A9. Roads constructed to drain well									
A10. Appropriate road stabilization, drainage & diversions installed									
X=applied	**water bars_____ dips/rolls_____ outslopes_____ berms cut_____ culverts____ geotextile____ rock____ seed____ mulch_____**								
A11. Water diversions are in working order (_____ percent working) **Failure due to: installation, damage, location, timing, weather, other**									
A12. Runoff diverted onto stable forest floor areas									
A13. Mud kept off public roadways									
A14. Public road drainage system maintained									
A15. Appropriate traffic barriers installed									

APPLICATION

0--The Practice Not Applicable

1--Operation Meets Requirement of BMP

2--Minor Departure from BMP

3--Major Departure from BMP

4--Gross Neglect of BMP

EFFECTIVENESS

1--Adequate Protection of Water Resources.

2--Indirect and Temporary Impacts on Water Resources

3--Indirect and Prolonged Impacts on Water Resources.

4--Direct and Temporary Impacts on Water Resources.

5--Direct and Prolonged Impacts on Water Resources.

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PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

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LOG LANDINGS									
							APPLICATION (0-4)		
								EFFECTIVENESS (1-5)	
									COMMENTS
Y1. Suitable number and size of landings									
Y2. Landings located outside RMZ									
Y3. Landings located on stable areas									
Y4. Excavation of site minimized									
Y5. Landings avoid concentrating or collecting runoff									
Y6. Landing's runoff enters stable area									
Y7. Proper water diversions in working order									
Y8. Landing smoothed and soil stabilized									
Y9. Landings free of fuel and lubricant spills and litter									
Y10. Landing location suitable for equipment fueling and maintenance									
Number of log landings _____ **Size: (acres)** _____.									

APPLICATION

0--The Practice Not Applicable

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3--Major Departure from BMP

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EFFECTIVENESS

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PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

*It is possible to have a departure from BMPs and still have adequate protection.

SKID TRAILS				APPLICATION (0-4)		
					EFFECTIVENESS (1-5)	
						COMMENTS
S1. Uses existing routes where appropriate						
S2. Adequate buffer strip next to watercourses & sensitive areas						
S3. Avoids steep and long straight grades (>20 percent for >200')						
S4. Avoids unstable gullies, seeps, poorly drained areas						
S5. Amount of skid trails minimized						
S6. Trail excavation minimized						
S7. Appropriate drainage and diversions installed						
X= applied	**water bars____ outslopes____ dips/rolls____ berms cut____ culverts____ seed____ mulch____ rock____ other____**					
S8. Water diversions in working order (_____ percent working) **Failure due to: installation, damage, location, timing, weather,** **other**						
S9. Runoff diverted onto stable forest floor areas						
S10. Streams not used as skid trails (except crossings)						
Types of streams involved and length of disturbance: perennial_____ , mapped intermittent_____. **Unmapped intermittent_____ , ephemeral_____.**						

APPLICATION

0--The Practice Not Needed or Applied on Site

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2--Minor Departure from BMP

3--Major Departure from BMP

4--Gross Neglect of BMP

EFFECTIVENESS

1--Adequate Protection of Water Resources.

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3--Indirect and Prolonged Impacts on Water Resources.

4--Direct and Temporary Impacts on Water Resources.

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PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

*It is possible to have a departure from BMPs and still have adequate protection.

STREAM CROSSINGS	
	APPLICATION (0-4)

		EFFECTIVENESS (1-5)	
			COMMENTS
X1. Number of crossings minimized			
X2. Crossings minimize disturbance to the natural bed & banks			
X3. Streambank approaches properly designed and stabilized			
X4. Water runoff diverted from road prior to crossing			
X5. Crossing as close to 90 degree angle as practicable			
X6. Crossing does not unduly restrict water flow			
X7. Soil has not been used as fill in the stream (except culverts)			
X8. Ford constructed of non-erosive materials that will not degrade water quality			
X9. Fords have stable banks and streambed			
X10. Culverts are properly sized and installed			
X11. Culverts clear of significant flow obstructions			
X12. Temporary structures properly anchored			
X13. Temporary structures and resulting obstructions removed			

Number of perennial crossings_____ widths_____.

Number of intermittent crossings_____ widths_____ Number of unmapped intermittents widths_____.

APPLICATION

0--The Practice Not Needed or Applied on Site

1--Operation Meets Requirement of BMP

2--Minor Departure from BMP

3--Major Departure from BMP

EFFECTIVENESS

1--Adequate Protection of Water Resources.

2--Indirect and Temporary Impacts on Water Resources.

3--Indirect and Prolonged Impacts on Water Resources.

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*It is possible to have a departure from BMPs and still have adequate protection.

RIPARIAN MANAGEMENT ZONES			
	APPLICATION (0-4)		
		EFFECTIVENESS (1-5)	
			COMMENTS
Z1. RMZ present on this site include: _____ lakes, _____ rivers, _____ perennial streams, _____ intermittent streams, _____ sinkhole openings (specify), _____ open water wetlands, _____ unmapped intermittent streams			
Z2. Perennial & large intermittent streams clear of obstructing logging debris			
Z3. Logging debris placed back from watercourse to prevent movement into streams during floods			
Z4. RMZ free of piled slash, debris and fill			
Z5. Less than 10 percent bare mineral soil scattered within RMZ - not including crossing			
Z6. Adequate tree stocking in primary RMZ next to perennial streams			
Z7. RMZ free of roads and landings (except crossings) Were roads pre-existing? _____			
Z8. Water diverted from roads before entering RMZ			
Z9. Water diverted onto stable areas of the forest floor			
Z10. Road and trail surfaces stabilized as needed within RMZ			
Z11. Ephemeral channels free of excavated material			

APPLICATION

0--The Practice Not Needed or Applied on Site

1--Operation Meets Requirement of BMP

2--Minor Departure from BMP

3--Major Departure from BMP

4--Gross Neglect of BMP

EFFECTIVENESS

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TEMPORARY IMPACT: Impacts lasting one year or less; no more than one runoff season; small amount of material involved.

PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

*It is possible to have a departure from BMPs and still have adequate protection.

SUPPLEMENTAL QUESTIONS AND SUMMARY

1) What went right on this site? Please summarize highlights.

2) What went wrong on this site? Please summarize problems.

3) Have other activities occurred on this site that potentially impact water quality (e.g., ATV use, other vehicle traffic, grazing, etc.)? If so, please explain.

4) Were traffic barriers in place to prevent trespass damage? _____.
What kind of trespass damage was observed?

5) Are there mitigating activities that should take place on this site or is corrective action already being taken?

6) -Has the sale administrator received BMP training? Yes_____ No_____Unknown_____.
- Has the operator (logger) received any BMP training? Yes_____ No_____Unknown_____.
- Was the sale administered by a forester? Yes_____ No_____Unknown_____.
- Is the landowner aware of BMPs? Yes_____ No_____Unknown_____.

7) Give this site an overall rating of 1-8 combining application of BMPs with impact to water quality.

Rate this site from 1-4 for the overall application of BMPs _____
1=above average 2=average 3=poor 4=total negligence

Rate this site from 1-4 for its overall impact to water quality _____
1= no visible impact 2=slight 3=moderate 4=severe

SITE RATING _____/2=_____

Note: These numbers do no necessarily need to directly reflect the worksheet ratings for application or effectiveness

Field Guide Cross Reference

On this page is each question in the monitoring sheet and the corresponding pages on the subject in the BMP Field Guide.

ACCESS Roads == Section II, pages 8-16

A1 == pages 4, 8, 10

A2 == pages 8, 9, 12, Section V page 32, 33, Table 4 page 34, 35

A3 == page 8

A4 == page 8

A5 == page 10

A6 == page 8 and Section IV page 24 – 30

A7 == pages 8, 10

A8 == pages 10, 12, 24, 29

A9 == pages 8, 10, Table 1 page 11, 12

A10 = pages 8, 10 Table 1 page 11, 12, 14, 15, Table 2 page 21, 22

X=Applied == (waterbars, pages 21-22), (dips/rolls, pages 21-22), (outslopes, Glossary), (berms cut, Glossary), (culverts, pages 27-28), (geotextile, Glossary), (rock, page 10), (seed, Appendix A), (mulch, Appendix A).

A11 = pages 14, 15, Table 1 page 11, 18, Table 2 page 21

A12 = page 10

A13 = pages 13, 14

A14 = page 14

LOG LANDINGS == Section IV, pages 36-40

Y1 == pages 36, 39

Y2 == Table 4 page 34, 36

Y3 == page 36

Y4 == page 38

Y5 == pages 36, 38-40

Y6 == pages 38-40

Y7 == pages 38-40

Y8 == pages 38-40

Y9 == pages 39, 40

Y10 = page 39

SKID TRAILS == Section III, pages 18-22

S1 == pages 4, 18

S2 == pages 18, 20, Section V pages 32-35

S3 == page 18

S4 == page 18

S5 == page 18

S6 == page 18

S7 == Table 1 page 11, pages 18-20, Table 2 page 21, 22, 27, 28

X=Applied == (waterbars, pages 21-22), (dips/rolls, pages 21-22), (outslopes, Glossary), (berms cut, Glossary), (culverts, pages 27-28), (geotextile, Glossary), (rock, page 10), (seed, Appendix A), (mulch, Appendix A).

S8 == Table 1 page 11, pages 14, 15, 20 Table 2 page 21

S9 == page 20

S10 = pages 18-20, Section IV pages 24-30

Types of Streams == page 24, Glossary, and Section V pages 32-35

STREAM CROSSINGS == Section IV, pages 24-30

X1 == page 24

X2 == page 24

X3 == pages 24, 25

X4 == pages 24, 25

X5 == page 24

X6 == pages 24-26, 28

X7 == pages 24, 29

X8 == pages 24, 29

X9 == pages 24, 25, 29

X10 = pages 25, 27, Table 3 page 28

X11 = pages 24, 27, 28

X12 = pages 25, 26

X13 = pages 25-29

RIPARIAN MANAGEMENT ZONES == Section V, pages 32-35

Z1 == pages 32, 34, Glossary

Z2 == page 33

Z3 == pages 32-34

Z4 == pages 32-34

Z5 == pages 32-34

Z6 == pages 32-34

Z7 == pages 32, 34

Z8 == pages 33, 34

Z9 == pages 32-34

Z10 = pages 33, 34

Z11 = page 35