Voluntary Implementation of Forestry Best Management Practices in East Texas

Results from Round 8 of
BMP Implementation Monitoring

TEXAS FOREST SERVICE
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Results from Round 8 of BMP Implementation Monitoring
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by

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TEXAS FOREST SERVICE
Sustainable Forestry
Water Resources Program

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EXECUTIVE SUMMARY

A Best Management Practices (BMP) monitoring program evaluated the level of implementation of voluntary forestry BMPs in East Texas. A total of 150 randomly selected sites on which silvicultural activities occurred were evaluated. These sites were monitored between June 28, 2010, and September 9, 2011, and are believed to be a representative sample of the forestry activities that occurred in East Texas during that time.

Overall BMP implementation on the monitored sites was 94.1%. In general, implementation was highest on sites under public ownership. These national forestland sites had an overall implementation of 98.3%, while industrial sites had a 97.7% implementation rating. Corporate lands (commercial landowners that do not have wood processing facilities) scored 96.7% overall, while family forest owners scored 88.0%.

Implementation with BMPs was statistically higher when:

- the landowner was familiar with BMPs
- the logging contractor had attended formal BMP training
- a forester was involved in the sale or activity
- BMPs were included in the timber sale contract
- the property had certification in the American Tree Farm System® (ATFS®)
- the timber was delivered to a Sustainable Forestry Initiative® (SFI®) mill
- the landowner had a forest management plan

Implementation was generally lowest on sites when:

- owned by family forest owners
- a forester was not involved in the sale or activity
- BMPs were not included in the timber sale contract
- the landowner did not have a forest management plan
- the logger had not attended the BMP workshop

Major deficiencies noted during the evaluations included:

- failure to remove and stabilize stream crossings on temporary roads
- inadequate SMZ width along intermittent and perennial streams

Major improvements from previous rounds included:

- overall BMP implementation across all ownerships
- overall BMP implementation on temporary roads and skid trails
- overall BMP implementation on stream crossings

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BACKGROUND AND OBJECTIVES

The Clean Water Act (CWA), as reauthorized in 1987, called for states to establish a program for development and implementation of Best Management Practices (BMP) to reduce nonpoint source (NPS) water pollution. The Act also required states to develop methods for determining "BMP effectiveness," including a measure of BMP implementation.

The Texas Silvicultural Nonpoint Source Pollution Prevention Project, funded by a Fiscal Year 2008 CWA Section 319(h) grant from the Environmental Protection Agency (EPA) through the Texas State Soil and Water Conservation Board (TSSWCB), requires that a monitoring program be instituted to document the level of voluntary BMP implementation and effectiveness of BMPs in reducing NPS pollution from silvicultural activities. Objectives of the monitoring program are to:

1) Measure the degree of BMP implementation by forest landowners, silvicultural contractors, forest industry, and government agencies.

2) Evaluate the effectiveness of BMPs as applied in the field and identify any weaknesses in the BMP guidelines.

This report documents the findings of BMP implementation monitoring for 150 sites evaluated between June 28, 2010, and September 9, 2011, and represents the eighth round conducted by Texas Forest Service. Previous surveys were published in October 1992, March 1996, April 1998, September 2000, November 2002, October 2005, and December 2008. These reports can be viewed online at http://texasforestservice.tamu.edu/water.

DISTRIBUTION AND SELECTION OF IMPLEMENTATION MONITORING SITES

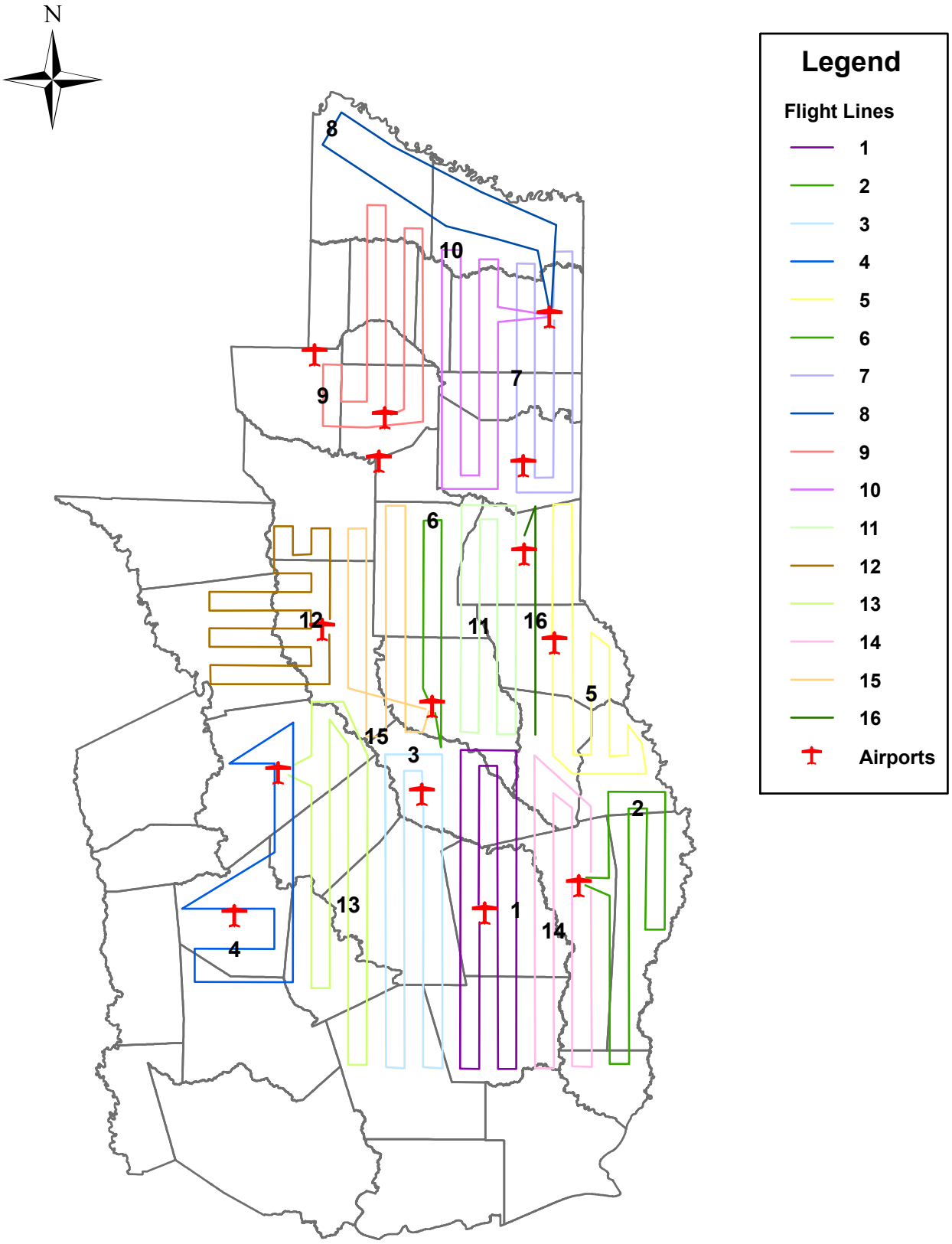
To obtain a valid estimate of overall implementation of forestry Best Management Practices, monitoring sites were distributed throughout East Texas and among all forestland ownership categories. Sites were believed to be representative of all silvicultural activities occurring across East Texas. The distribution of monitoring sites was based on the estimated annual timber harvest for each county as reported in the Texas Forest Service publication *Texas Forest Resource Harvest Trends 2009,* and the average annual removals of growing stock by ownership class, as reported in a June 2010 query of the Forest Inventory EVALIdator web-application version 1.5.00. See Table 1.

In order to obtain a sample of recently conducted silvicultural operations for implementation monitoring, Digital Aerial Sketchmapping technology was utilized. Approximately 1,806 operations were identified across East Texas, from which 150 sites were randomly selected to be monitored for this survey, using the distribution parameters outlined above. See Figure 1.

Table 1. Distribution of Implementation Monitoring Sites by County.

County	Number of Sites Monitored
Anderson	5
Angelina	7
Bowie	2
Camp	1
Cass	7
Cherokee	8
Hardin	8
Harrison	3
Houston	4
Jasper	13
Leon	1
Liberty	5
Marion	3
Montgomery	2
Nacogdoches	7
Newton	11
Panola	6
Polk	8
Red River	3
Rusk	5
Sabine	5
San Augustine	10
San Jacinto	3
Shelby	4
Smith	2
Trinity	4
Tyler	10
Upshur	1
Walker	2
Total	**150**

Figure 1. Aerial Detection Flight Paths.



QUALITY CONTROL

To eliminate bias, implementation monitoring sites were randomly selected from a pool of recent silvicultural operations identified through aerial detection. All monitoring evaluations were conducted by one or a combination of two trained foresters assigned to the TFS Water Resources Program. Using only program employees as inspectors provided greater accuracy and quality control. At the beginning of the monitoring project, as well as periodically throughout the survey, inspectors jointly evaluated sites to ensure consistency. All monitoring data was collected in accordance with a Quality Assurance Project Plan, approved by TSSWCB and EPA.

MONITORING CHECKLIST

The monitoring checklist that was used in Round 8 was also used for the previous four surveys, a period dating back to 1999. This objective, 45-question form follows the *BMP Implementation Monitoring Framework*, a guidance document approved by the Southern Group of State Foresters to promote consistency among the southern states when conducting BMP implementation monitoring. The form is found in the Appendix.

The monitoring form evaluates BMPs for seven different categories: Permanent Roads, Temporary Roads/Skid Trails, Stream Crossings, Streamside Management Zones, Site Preparation, Landings, and Wetlands. Each question is worded so that a positive response is answered with a "Yes," while a negative response, indicating a departure from BMP recommendations, is answered "No." Questions that are not applicable to the site are answered "NA." Questions answered "No" are also evaluated to determine if a "significant risk" to water quality exists. A significant risk is an existing on-the-ground condition resulting from failure to correctly implement BMPs that if left unmitigated, has already or will likely result in an adverse change in the chemical, physical, or biological condition of a water body. Such change may or may not violate water quality standards. Follow up questions are answered, when applicable or known, to determine trends associated with BMP implementation. A comments section at the end of the form provides additional information related to BMP implementation on the site.

Each site was scored with a value representing percent implementation. This score was computed by dividing the number of questions receiving a yes answer by the total number of applicable questions [Y/(Y+N)]. A qualitative assessment was also included in which sites were rated as *No Effort, Poor, Fair, Good,* or *Excellent*.

Site evaluations were entered into a database for storage and analysis. These data were also imported into a Geographic Information System (GIS) for further analysis and spatial representation.

INSPECTION CONTACTS

Landowners were contacted prior to inspecting the site so that permission for entry onto the property could be obtained. During this initial contact, the inspector explained the program, recorded information regarding the operation, and invited the landowner and his/her representative to join him on site during the evaluation. Sites were resampled if the landowner denied access. In nearly all cases on industrial, corporate, or public forestland, a professional forester accompanied the inspector.

Landowners, logging contractors, foresters, and timber buyers (where applicable and identifiable) were provided a copy of the completed checklist, along with a cover letter explaining the Water Resources program and instructions on interpreting the form. A map, including geo-referenced photographs of any significant risk found during the inspection, along with recommendations for remediation, were also provided when applicable. Follow up site visits were conducted to assess BMP remediation efforts and provide technical assistance.

RESULTS

Between June 28, 2010, and September 9, 2011, TFS Water Resources foresters evaluated BMP implementation on 150 sites, totaling 22,625 acres, throughout 29 counties in East Texas. These sites are spatially represented by ownership category in Figure 2. Tabulated results for each question on the BMP implementation monitoring checklist are located in the Appendix.

SITE CHARACTERISTICS

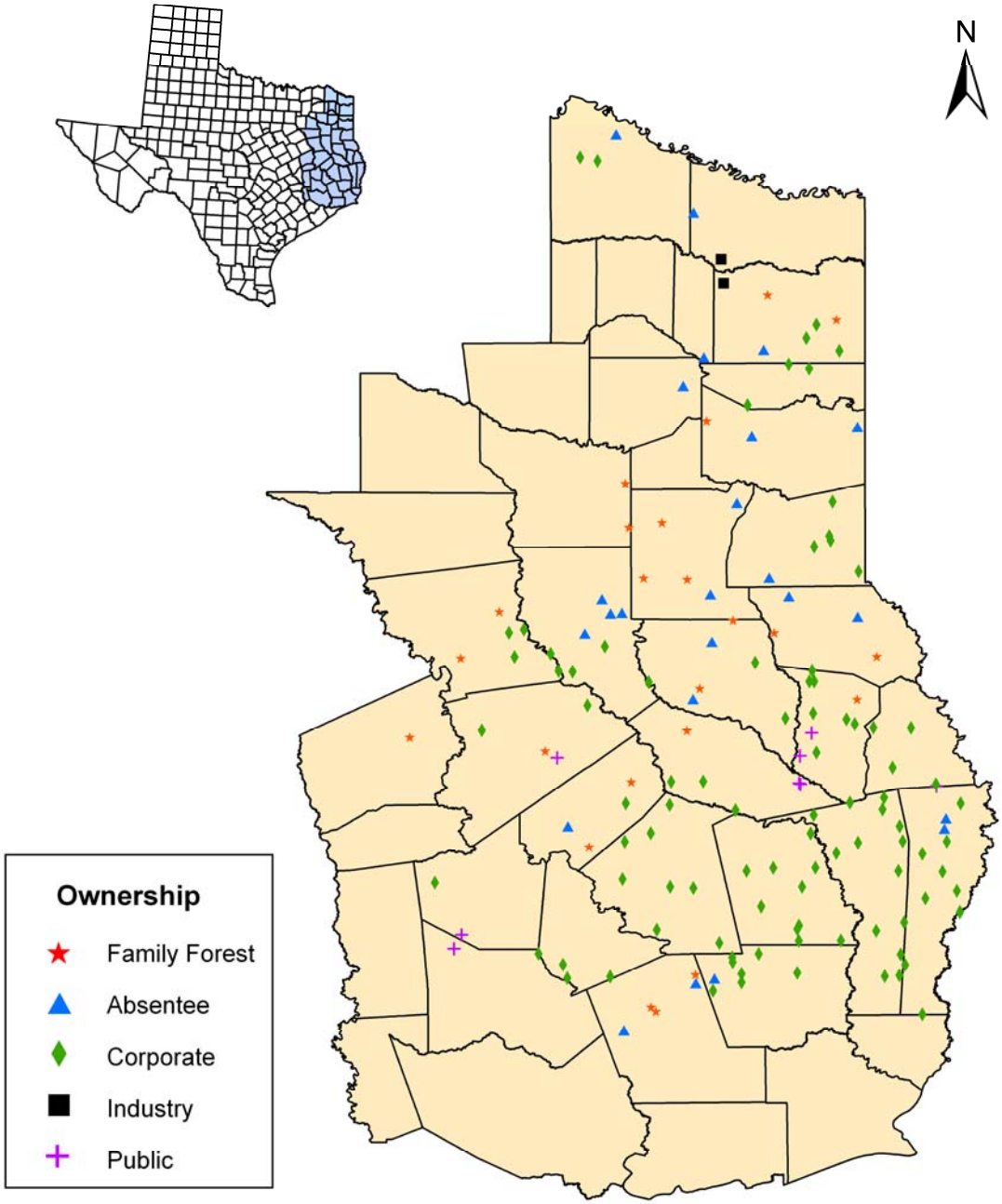
Forty-seven of the 150 sites (31%) were on family forest lands. Ninety-three sites (62%) were owned by corporate landowners. Two sites (1%) were owned by forest industry. Eight sites (5%) were on publicly owned lands.

The majority of sites (67%) were monitored after a regeneration harvest, which included 101 clearcuts. One site preparation and 48 thinning operations were evaluated. In 69 cases, the site preparation was evaluated as an element of the preceding timber harvest operation or succeeding planting operation.

Professional foresters were involved in planning and/or administering the silvicultural operation on 135 (90%) of the sites. Private consultants were involved on 40 of the sites. On 87 sites, the forester was employed by forest industry or corporations, while U.S. Forest Service foresters were involved on 8 sites.

Terrain classification was observed on the site and general soil erodibility was determined from the Natural Resources Conservation Service (NRCS) Soil Survey, if available, or estimated by the forester in the field. Sixty-one sites (41%) were on flat

Figure 2. Site Locations by Ownership Category.



terrain. Seventy-four sites (49%) were on hilly terrain and 15 (10%) were on steep terrain. Eighty-six sites (57%) were on soils with low erodibility, 45 sites (30%) on medium erodibility soils, and 19 (13%) were on high erodibility soils.

Of the 150 sites, 103 contained either a perennial (18) or intermittent (50) stream or both (35). A permanent water body was found within 1,600 feet of 97 sites (65%)

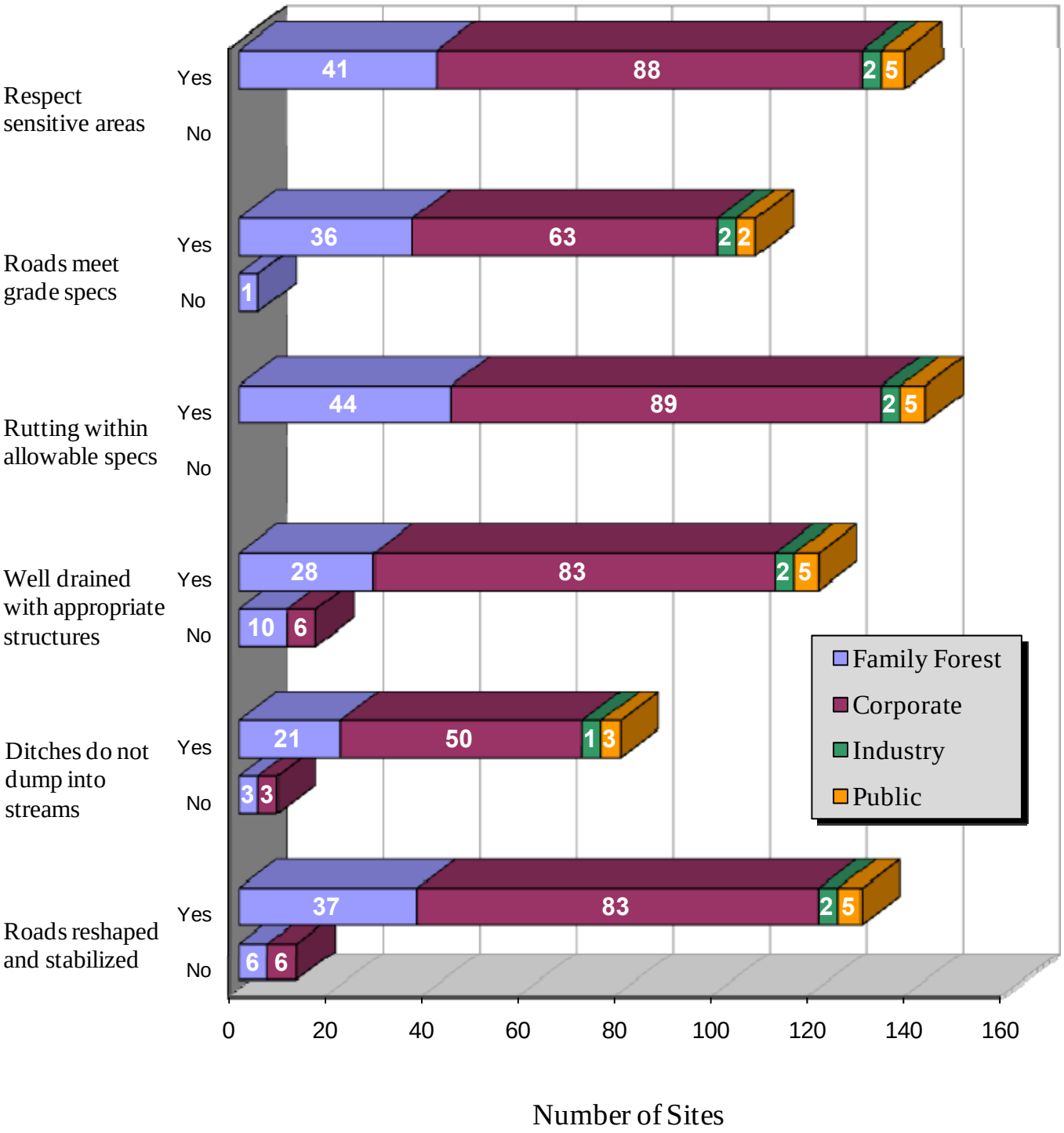
PERMANENT ROADS

Permanent roads were evaluated for BMP implementation when they were used in the forestry operation. Permanent roads in the forestry context are generally graded dirt roads that are used for year-round access. County roads were not included in the monitoring, as they are not under the management control of the landowner. Permanent roads were applicable on 140 of the 150 sites. The percent implementation for permanent roads was 95% with one significant risk. Within this category, the lowest score (88%) was for roads being well drained with appropriate structures. The highest scores were for roads respecting sensitive areas and rutting within allowable specifications (100%). See Table 2. Figure 3 breaks down the numbers of sites into ownership type.

Table 2. Implementation of BMPs Relating to Permanent Roads.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Respect sensitive areas	136	0	14	100	0	-
Roads meet grade specifications	103	1	46	99	0	2.0
Rutting within allowable specs	140	0	10	100	0	-
Well drained with appropriate structures	118	16	16	88	0	5.6
Ditches do not dump into streams	75	6	69	93	1	5.7
Roads reshaped and stabilized	127	12	11	91	0	4.8
Overall	**699**	**35**	**166**	**95**	**1**	**1.8**

Figure 3. BMP Implementation on Permanent Roads by Ownership Type.



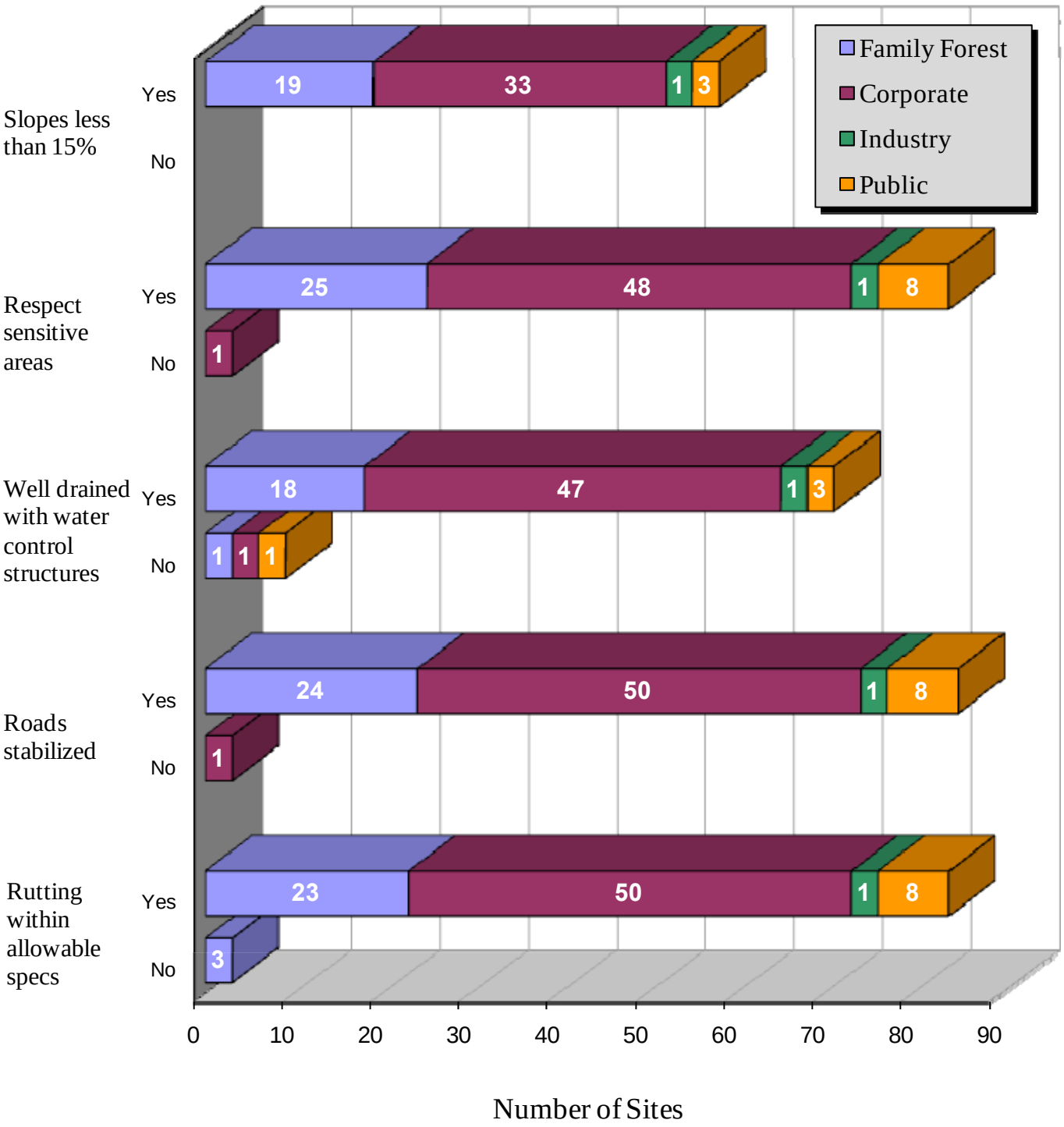
SKID TRAILS AND TEMPORARY ROADS

Skid trails and temporary roads were evaluated on 85 of the 150 monitoring sites. Skid trails are routes through the logging area in which logs are skidded or dragged to a central loading point called a "deck," "landing," or "set." Temporary roads are not designed to carry traffic long-term and are usually retired, closed, or reforested after the harvest activity. The percent implementation for temporary roads was 98% (an 11.4% increase over the last survey) with no significant risks. Within this category, the lowest implementation scores were for roads being well drained with appropriate water control structures and rutting within allowable specifications (96%). The highest score (100%) was for roads meeting grade specifications. See Table 3 and Figure 4.

Table 3. Implementation of BMPs Relating to Skid Trails and Temporary Roads.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Slopes less than 15%	57	0	93	100	0	-
Respect sensitive areas	82	1	67	99	0	2.2
Well drained with water control structures	70	3	77	96	0	4.6
Roads stabilized	83	1	66	99	0	2.2
Rutting within allowable specifications	82	3	65	96	0	4.3
Overall	**374**	**8**	**368**	**98**	**0**	**1.7**

Figure 4. BMP Implementation on Skid Trails/Temporary Roads by Ownership Type.



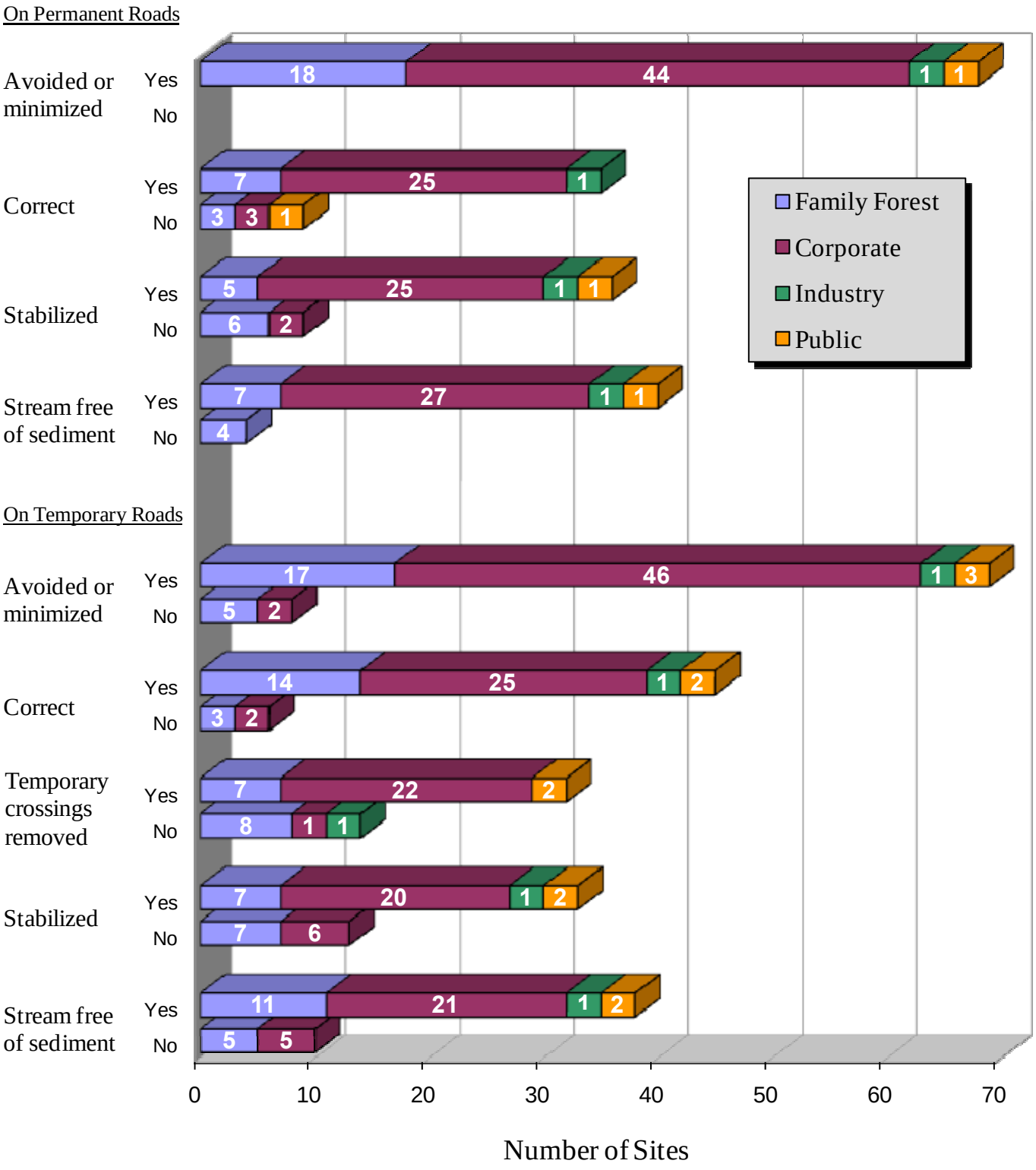
STREAM CROSSINGS

Stream crossings were evaluated on 70 sites. Twenty-three sites had crossings on permanent roads only, 29 had crossings on temporary roads only, and 18 had crossings on both permanent and temporary roads. The percent implementation for stream crossings was 85% with a total of 16 significant risks. Within this category, the lowest implementation score for stream crossings on both permanent and temporary roads was stabilization of crossings (80% and 70%, respectively). However, stabilizing crossings on temporary roads increased by 25% over Round 7, and has increased by 125% since Round 6. The highest implementation in both categories was for avoiding or minimizing the number of crossings. See Table 4 and Figure 5.

Table 4. Implementation of BMPs Relating to Stream Crossings.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Permanent Roads						
Avoided or minimized	64	0	86	100	0	-
Correct	33	8	109	80	4	12.5
Stabilized	32	8	110	80	1	12.7
Stream free of sediment	36	4	110	90	1	9.5
Permanent Roads Total	*165*	*20*	*415*	*89*	*6*	*5.1*
Temporary Roads						
Avoided or minimized	67	7	76	91	0	6.7
Correct	42	5	103	89	0	9.1
Temporary crossings removed	31	10	109	76	4	13.3
Stabilized	30	13	107	70	5	14
Stream free of sediment	35	10	105	78	1	12.4
Temporary Roads Total	*205*	*45*	*500*	*81*	*10*	*5.3*
Overall	**370**	**65**	**915**	**85**	**16**	**4.3**

Figure 5. BMP Implementation on Stream Crossings by Ownership Type.



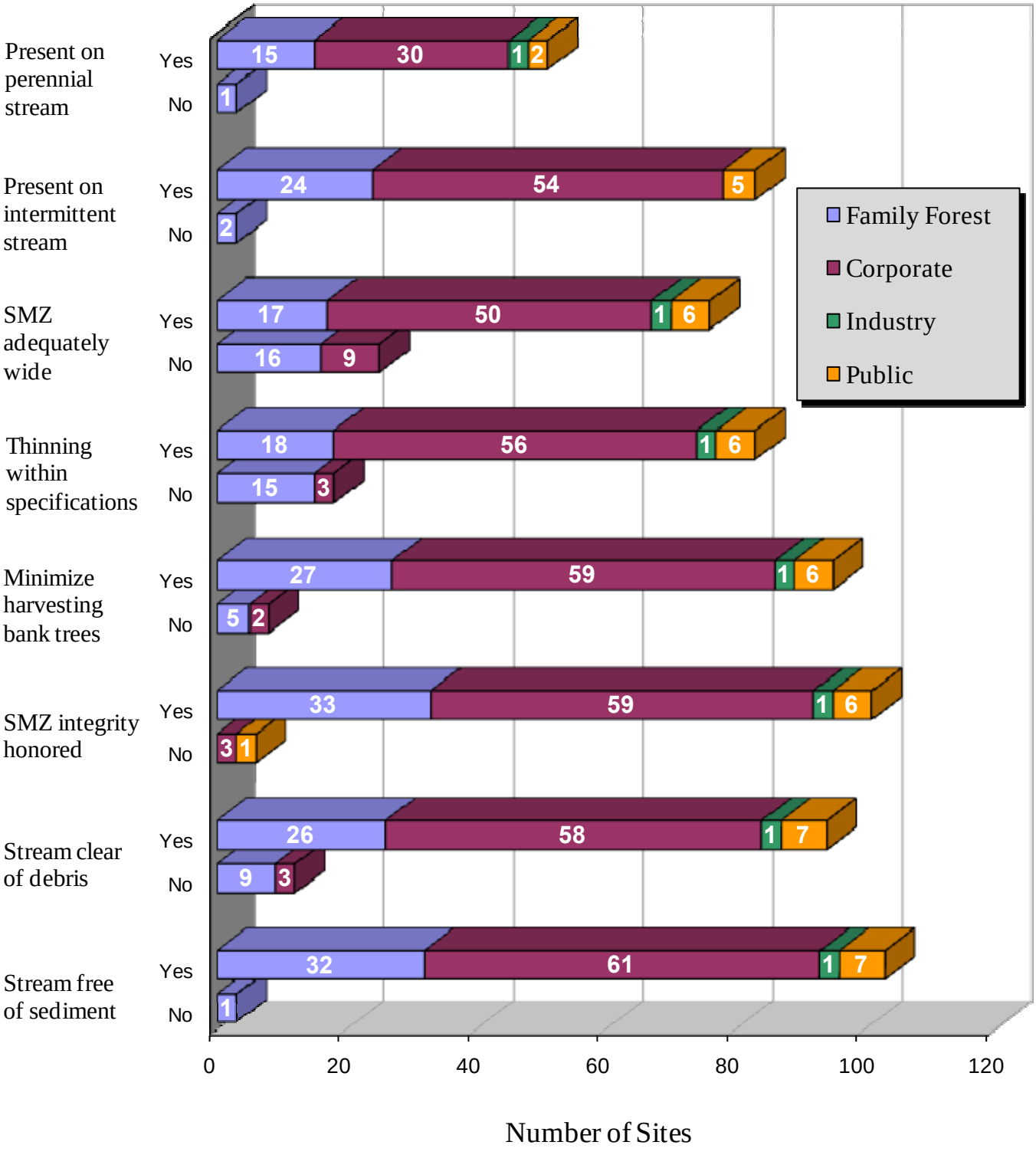
STREAMSIDE MANAGEMENT ZONES

Streamside management zones (SMZs) are recommended on all perennial and intermittent streams. All sites with either a perennial or intermittent stream were evaluated for the presence and adequacy of SMZs. Streams were present on 103 of the 150 sites. Of these 103 sites, 18 had perennial streams only, 50 had intermittent streams only, and 35 had both perennial and intermittent streams. The percent implementation for SMZs was 90% with two significant risks. Within this category, the lowest implementation was for adequate SMZ width (75%), while the highest was for stream free of sediment, SMZs present on permanent streams, and SMZs present on intermittent streams (99%, 98%, and 98% respectively). See Table 5 and Figure 6.

Table 5. Implementation of BMPs Relating to SMZs.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Present on perennial stream	48	1	101	98	0	4.0
Present on intermittent stream	83	2	65	98	0	3.0
SMZ adequately wide	74	25	51	75	0	8.7
Thinning within specifications	81	19	50	81	0	7.9
Minimize harvesting bank trees	93	7	50	93	0	5.1
SMZ integrity honored	99	4	47	96	0	3.9
Stream clear of debris	92	13	45	88	2	6.3
Stream free of sediment	101	1	48	99	0	2.0
Overall	**671**	**72**	**457**	**90**	**2**	**3.4**

Figure 6. BMP Implementation on Streamside Management Zones by Ownership Type.



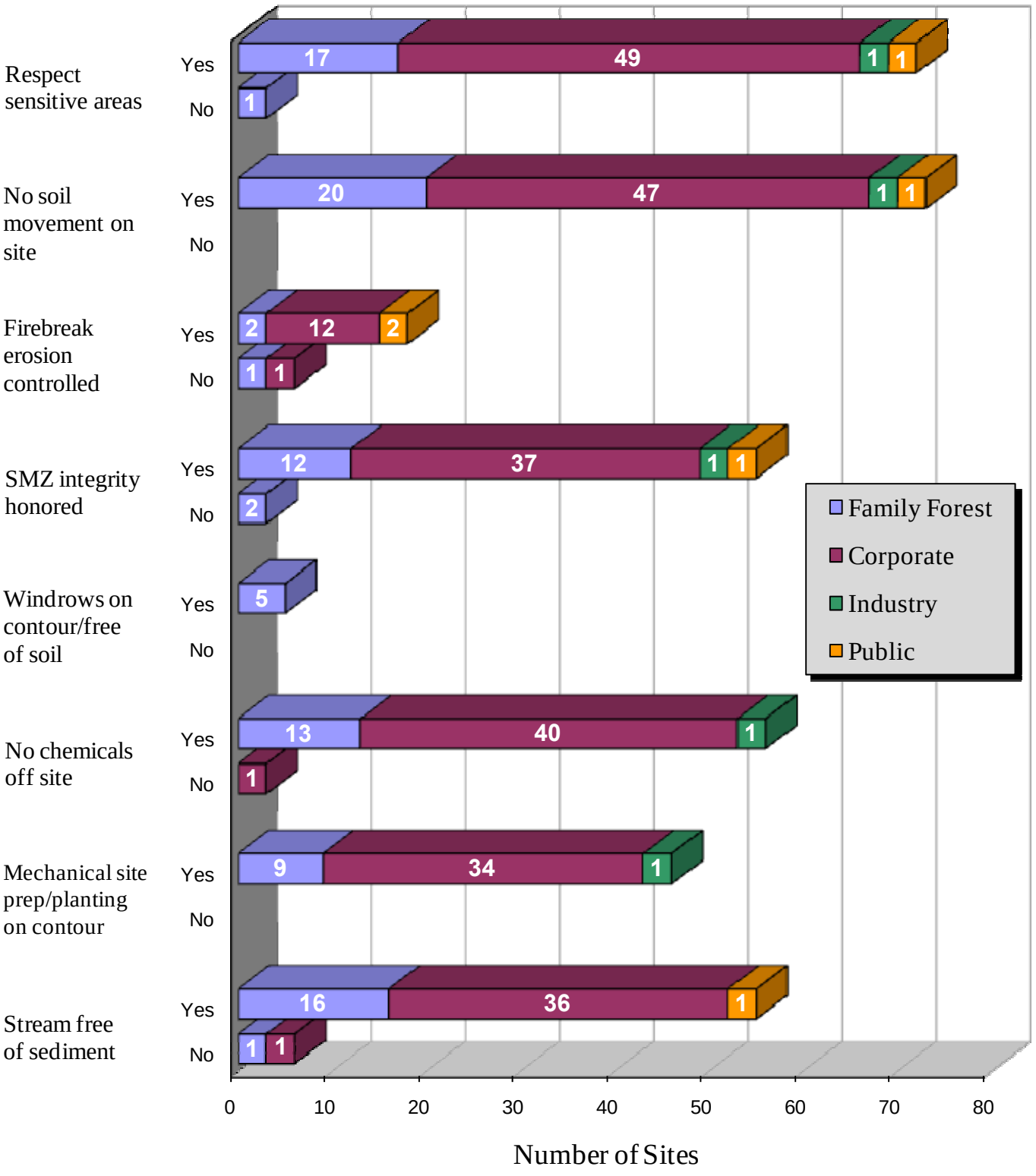
SITE PREPARATION

Seventy sites were evaluated for implementation of site preparation BMPs. A variety of site preparation techniques were evaluated, including 51 with some combination of herbicide, shearing, piling, subsoiling, bedding, and/or burning. Nineteen sites involved application of herbicide only. The implementation for site preparation was 98% with one significant risk. Within this category, several areas were found to have fully implemented BMPs (100%), including no soil movement on site, windrows on contour/free of soil, and mechanical site prep/planting on contour. The lowest implementation score was for controlling firebreak erosion (89%). It is important to note that firebreaks were only evaluated on 18 sites. See Table 6 and Figure 7.

Table 6. Implementation of BMPs Relating to Site Preparation.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Respect sensitive areas	68	1	81	99	0	2.4
No soil movement on site	69	0	81	100	0	-
Firebreak erosion controlled	16	2	132	89	1	14.8
SMZ integrity honored	51	2	97	96	0	5.4
Windrows on contour/free of soil	5	0	145	100	0	-
No chemicals off site	54	1	95	98	0	3.8
Mechanical site prep /planting on contour	44	0	106	100	0	-
Stream free of sediment	53	2	95	96	0	5.3
Overall	**360**	**8**	**832**	**98**	**1**	**1.5**

Figure 7. BMP Implementation on Site Preparation by Ownership Type.



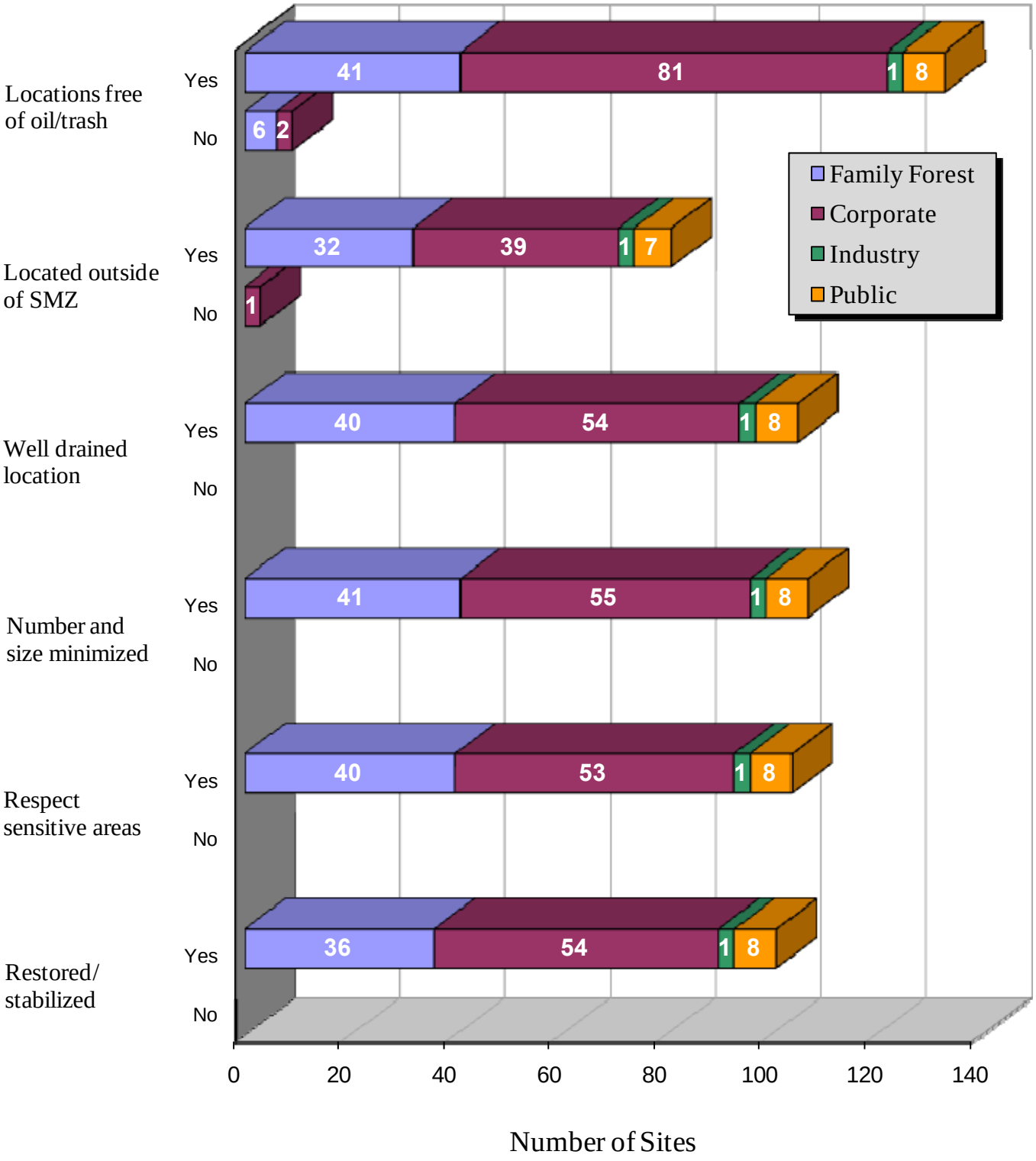
LANDINGS

Landings, sometimes called “decks” or “sets,” are areas where logs are gathered, delimbed, bucked, and loaded onto trucks. Landings were evaluated on 139 sites with an overall implementation of 99% with no significant risks. Within this category, several areas were found to have fully implemented BMPs (100%), including respecting sensitive areas, being on well drained locations, minimizing the size and number, and restoring and stabilizing these areas. The lowest implementation score was for landings being free of oil/trash (94%). See Table 7 and Figure 8.

Table 7. Implementation of BMPs Relating to Landings.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Location free of oil/trash	131	8	11	94	0	4
Located outside of SMZ	79	1	70	99	0	2.22
Well drained location	103	0	47	100	0	-
Number and size minimized	105	0	45	100	0	-
Respect sensitive areas	102	0	48	100	0	-
Restored/stabilized	99	0	51	100	0	-
Overall	**619**	**9**	**272**	**99**	**0**	**2.1**

Figure 8. BMP Implementation on Landings by Ownership Type.



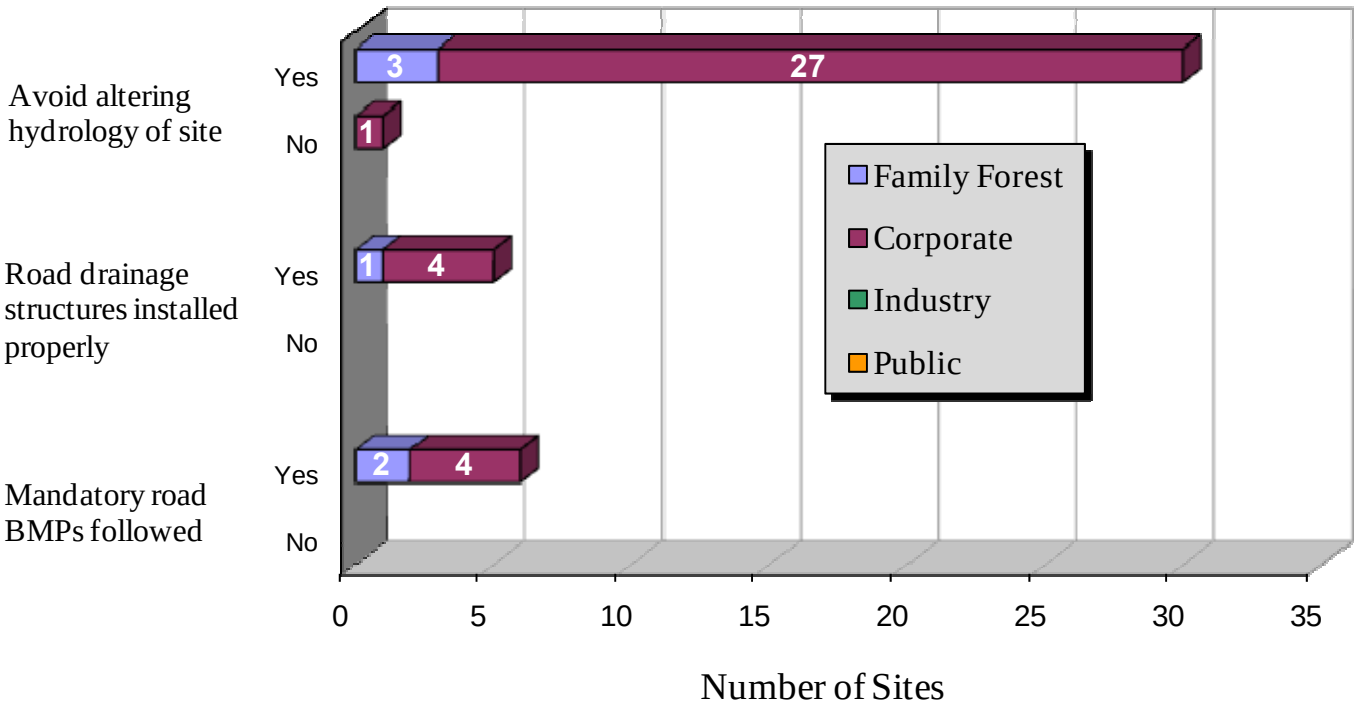
WETLANDS

Thirty-one sites had wetland or "wetland like" areas – not necessarily jurisdictional wetlands. These sites had an overall implementation of 98%. No significant risks were noted and all mandatory road BMPs for wetlands were followed. See Table 8 and Figure 9.

Table 8. Implementation of BMPs Relating to Wetlands.

BMP	Yes	No	N/A	% Implementation	Number of Significant Risks	Margin of Error
Avoid altering hydrology of site	30	1	119	97	0	6.3
Road drainage structures installed properly	5	0	145	100	0	-
Mandatory road BMPs followed	6	0	144	100	0	-
Overall	**41**	**1**	**408**	**98**	**0**	**6.5**

Figure 9. BMP Implementation on Wetlands by Ownership Type.



OVERALL BMP IMPLEMENTATION

To illustrate the range of the overall implementation scores, Figures 10 and 11 separate the results into five categories: 0-50%, 51-70%, 71-80%, 81-90%, and 91-100%. Figure 10 spatially illustrates implementation across all ownership types. Figure 11 demonstrates the distribution of sites by implementation score class and ownership type.

IMPLEMENTATION BY SITE CHARACTERISTICS

Ownership

BMP implementation varied by ownership type. The public ownership category fared best, with an overall implementation of 98.3% and one significant risk on eight sites.

Forest industry comprised two of the sites and had an overall implementation of 97.7% with no significant risks.

The 93 sites managed by corporate entities had an overall implementation rate of 96.7% with twelve significant risks.

Family forest owners had an implementation rating of 88.0% with seven significant risks on 47 sites. This represents the lowest implementation level of the four ownership categories.

Type of Activity

Three types of silvicultural activities were monitored: regeneration harvests, thinning, and site preparation. One site was evaluated for site preparation only, although site preparation was evaluated along with a regeneration harvest or planting on 69 sites. See Table 9.

Table 9. Overall BMP Implementation by Type of Operation.

Type of Operation	BMP Implementation
Regeneration harvest (clearcut)	93.8%
Thinning	97.5%
Site preparation (only)	65.5%

Figure 10: Overall Implementation Scores Across all Ownerships and Monitoring Criteria.

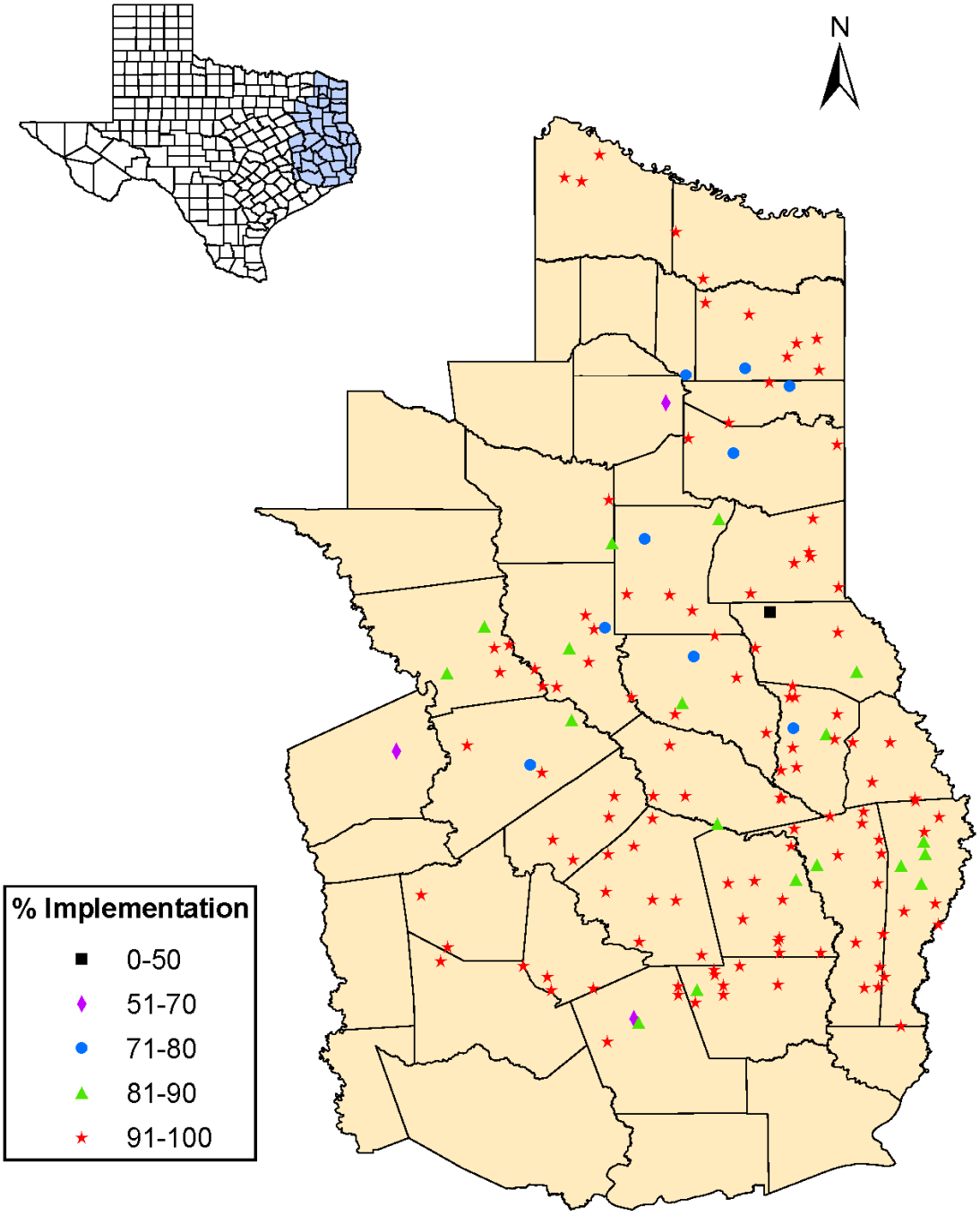
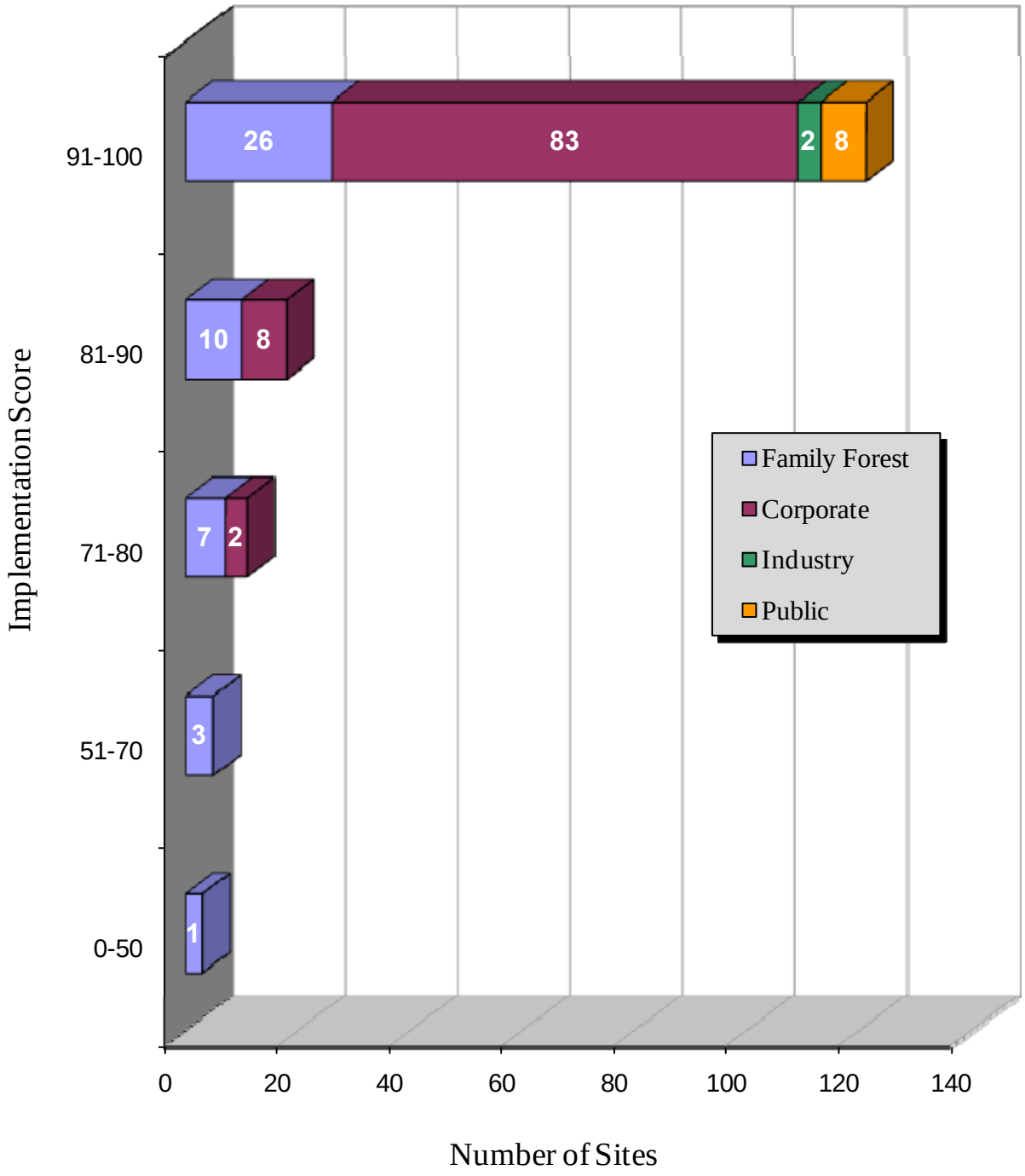


Figure 11. Overall Implementation Scores by Number of Sites and Ownership.



Region

East Texas was divided into two regions, North and South, for easy comparison of BMP implementation rates. The line was drawn along the northern boundary of Leon, Houston, Angelina, San Augustine, and Sabine Counties. Ninety-three sites were monitored in the southern region and had an implementation rating of 95.8%, while 57 sites were monitored in the northern region with an implementation rating of 93.2%. The higher BMP implementation in Southeast Texas is expected due to the high concentration of corporate, public, and industrial ownership; flatter topography; and less erodible soils.

Terrain

Monitoring sites were classified as *Flat*, *Hilly*, or *Steep*. BMP implementation on the 61 flat sites was 96.4% with four significant risks; 94.2% with eleven significant risks on the 74 hilly sites; and 91.2% with five significant risks on the 15 steep sites.

Erodibility

Monitoring sites were identified as having *Low*, *Medium*, or *High* soil erodibility. BMP implementation was 96.5% with seven significant risks on a total of 86 low erodibility sites; 94% with eight significant risks on 45 medium erodibility sites, and 88.9% with five significant risks on 19 high erodibility sites.

Distance to Permanent Water

Distance to the nearest permanent waterbody was determined for each monitoring site. BMP implementation on 73 sites with permanent water less than 300 feet away was 92.3% with fourteen significant risks. BMP implementation was 95.4% with two significant risks on 12 sites with permanent water 300 to 800 feet away; 97.2% with one significant risk on 12 sites with permanent water 800 to 1600 feet away; and 97.5% with three significant risks on the 53 sites in which permanent water was greater than 1,600 feet away.

River Basin

Monitoring sites were located in the following river basins: Cypress, Neches, Red, Sabine, San Jacinto, Sulphur, and Trinity. BMP implementation was highest in the San Jacinto River Basin (100%, 7 sites) and lowest in the Trinity Basin (88.5%, 14 sites). See Table 10 and Figure 12.

Hydrologic Unit Code (Watershed)

Monitoring sites were also assessed by their eight digit hydrologic unit code (HUC). Two HUCs (12040101, 12040103) had an implementation score of 100%. Seventeen of the 21 watersheds (81%) scored over 90%. The lowest rated watershed had a BMP implementation rating of 69.6% (12030203). It should be noted that only two sites were monitored within this watershed. See Table 11 and Figure 13.

Table 10. BMP Implementation by River Basin.

River Basin	Number of Sites	% Implementation	Significant Risks
Cypress	13	90.2	3
Neches	74	96.1	9
Red	3	97.7	0
Sabine	35	94.4	6
San Jacinto	7	100.0	0
Sulphur	4	99.2	0
Trinity	14	88.5	2

Table 11. BMP Implementation by 8-digit Hydrologic Unit Code.

Hydrologic Unit Code	Number of Sites	% Implementation	Significant Risks
11140106	3	97.7	0
11140302	4	99.2	0
11140304	1	95.0	0
11140305	2	74.0	2
11140306	8	94.2	0
11140307	2	88.3	1
12010002	9	94.9	2
12010004	8	86.8	1
12010005	19	97.2	3
12020001	9	97.1	1
12020002	9	95.4	2
12020003	6	95.6	2
12020004	10	94.9	1
12020005	21	95.4	3
12020006	11	99.5	0
12020007	7	95.4	0
12030201	2	91.3	0
12030202	10	91.7	1
12030203	2	69.6	1
12040101	2	100	0
12040103	5	100	0

Proximity to 303 (d) Listed Stream Segments

The proximity of BMP monitoring sites to 303(d) listed (impaired) stream segments was analyzed using GIS. Twenty-three sites were identified to be within one mile of a listed stream segment and had an implementation rating of 95.2%. It should be noted that BMP implementation was higher near these listed waters than the overall BMP implementation for all monitored sites. Forest operations provided greater water quality protection near these sensitive areas.

Figure 12. Site Location by River Basin.

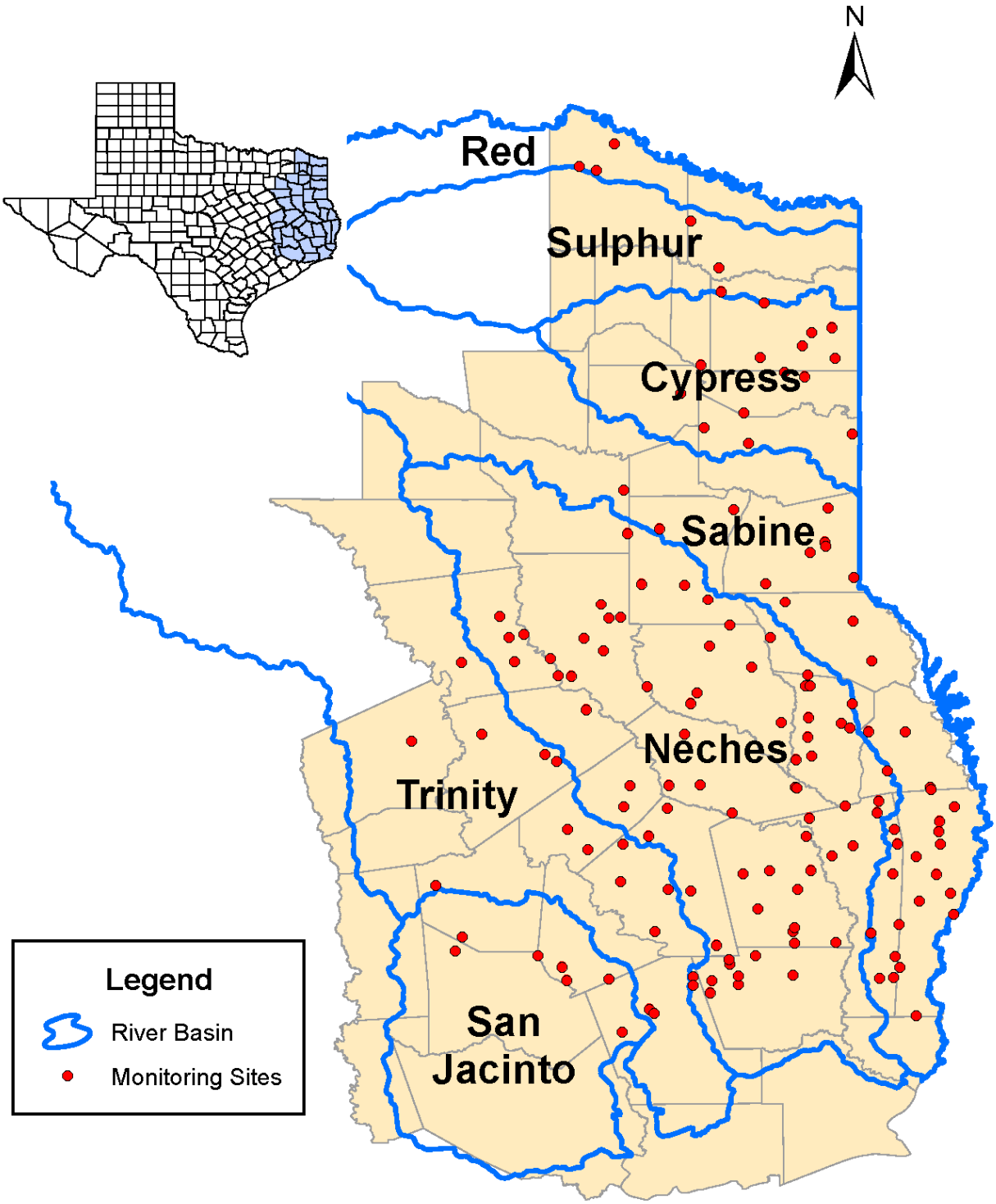
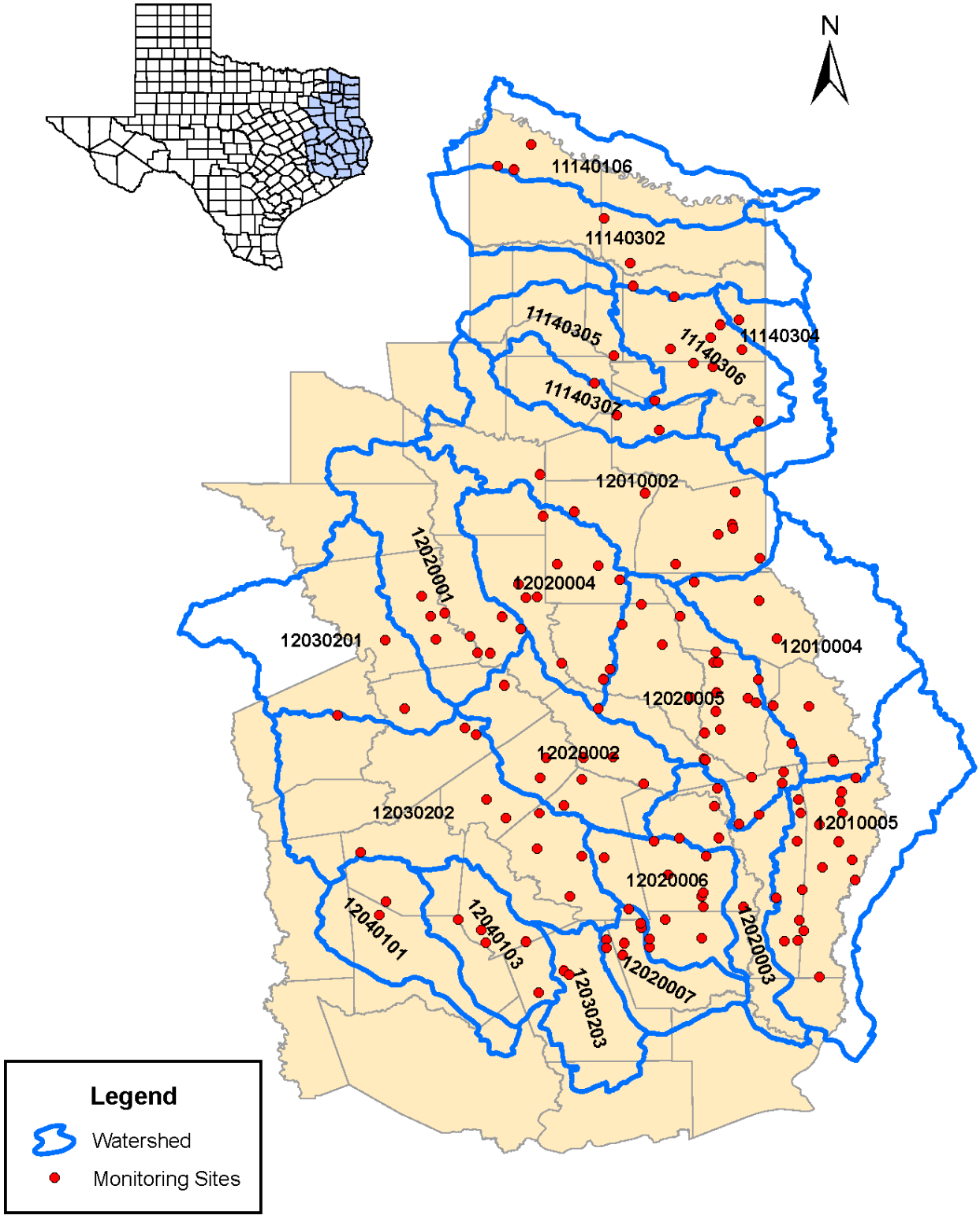


Figure 13. Site Location by Hydrologic Unit Code (Watershed).



STATISTICAL ANALYSIS

Statistical tests were performed to provide further information about the accuracy of the data collected. BMP trend analyses were also performed on certain categories to determine statistical significance. By understanding trends where lower BMP implementation occurred, Texas Forest Service can develop outreach efforts that target these areas for improvement.

STATISTICAL TESTS

Margin of Error

The margin of error expresses the maximum likely difference observed between the sample mean and the true population mean with 95% probability. It is an important statistical calculation that was performed on all individual BMPs (i.e., SMZs present on perennial streams) using the respective percent implementation and total number of applicable questions. The formula used to calculate the margin of error is outlined below. See Tables 2 – 8.

$$m = 2\sqrt{\frac{P(100-P)}{n}}$$

Where m = margin of error for a single BMP
P = the percent implementation for a single BMP
n = the number of sites on which the BMP was evaluated

Confidence Interval

The 95% confidence interval is a tool that statisticians use to demonstrate their confidence in the measured mean of a sample. It provides a range for which they are 95% confident (i.e., 19 times out of 20) that the actual mean will be found. To calculate the confidence interval, the mean, variance, standard deviation, standard error, and margin of error must also be calculated. The formula used to calculate the confidence interval is listed below. For Round 8, the 95% confidence interval for the overall BMP implementation across all sites was (93.3, 96.3).

95% CI = Mean ± Margin of Error

STATISTICAL SIGNIFICANCE OF BMP TRENDS

Two different statistical analyses were performed on the following categories:

- Forester Involved in Sale or Activity
- Logging Contractor Attended BMP Training
- Landowner Familiar with BMPs
- BMPs Included in the Timber Sale Contract
- Property Certified in American Tree Farm System®
- Timber Delivered to SFI® Mill
- Landowner Has a Forest Management Plan

The first statistical analysis was a parametric two sample t-test, which was conducted because of the large sample size. An arcsin square root transformation was performed on these data prior to analysis. Percentage data must be transformed because it is not normally distributed, which invalidates the normality assumption of the parametric test. A non-parametric test (Wilcoxon) was also performed to add greater statistical validity. To determine statistical significance, the resulting *P* value was compared to the level of significance. The *P* value is the probability of observing a value of the test statistic as contradictory (or more) to the null hypothesis as the computed value of the test statistic. In these tests, a 0.05 (5%) level of significance was used. For the two implementation ratings to be significantly different, the *P* value must be lower than the level of significance. The implementation ratings for the "yes" and the "no" answers were calculated to be significantly different in all of these categories. See Table 12.

Table 12. Results of Statistical Tests Determining Statistically Significant Differences.

	% Implementation		Parametric *P* value	Non Parametric *P* value	Level of Significance	Statistically Different?
	Yes	No				
Forester Involved	95.7	86.6	< 0.001	< 0.001	0.05	YES
Logger Trained	95.9	82.0	< 0.001	0.004	0.05	YES
Landowner Familiar	96.0	88.7	< 0.001	0.007	0.05	YES
BMPs in Contract	96.5	81.7	< 0.001	< 0.001	0.05	YES
Tree Farm Certification	96.5	87.6	0.007	0.016	0.05	YES
SFI® Mill	96.2	86.4	< 0.001	< 0.001	0.05	YES
Management Plan	96.7	83.6	< 0.001	< 0.001	0.05	YES

Forester Involved in the Sale or Activity

BMP implementation was higher when a professional forester was involved in the sale or activity. One hundred thirty-five sites were identified as having a professional forester involved and had an implementation rating of 95.7%. Sites in which there was no forester involvement had a BMP implementation rating of 86.6%. See Figure 14.

Logging Contractor Attended BMP Workshop

Texas Forest Service conducts BMP training workshops for logging contractors. One hundred thirty-eight inspections identified the logging contractor as having attended the formal BMP training, with an implementation of 95.9%. Sites in which the activities were administered by a logger that did not attend the formal BMP training or where the logger was unknown had an implementation rating of 82.0%. See Figure 14.

Landowner Familiar with BMPs

Sites whose owners were not familiar with BMPs (24) had an overall implementation rating of 88.7%, while sites whose owners were familiar with BMPs (126) had an implementation rating of 96.0%. See Figure 14.

BMPs Included in the Timber Sale Contract

BMPs were included in the timber sale contract on 133 sites. Implementation on sites with BMPs in the contract was 96.5%, while implementation on sites without BMPs in the contract, or where BMP inclusion was unknown, was 81.7%. See Figure 15.

Property Certified in American Tree Farm System®

Members of the American Tree Farm System® are required to implement BMPs in order to maintain their certification. Sixteen sites were identified as being Tree Farm certified and had an implementation rating of 96.5%, while implementation for eligible nonmembers on 37 sites was 87.6%. See Figure 15.

Timber Delivered to SFI® Mill

BMP implementation was higher on sites in which the receiving mill was known to be a SFI® member. This applied to 128 sites with an implementation rating of 96.2%, compared to an 86.4% rating on the 22 sites in which the timber went to other mills or the receiving mill was unknown. See Figure 15.

Landowner Has a Forest Management Plan

Landowners who have a forest management plan are more likely to use BMPs. On the 128 sites in which landowners had a forest management plan, implementation was 96.7%, compared to an implementation rating of 83.6% on the 22 sites that did not have a forest management plan or where it was unknown if a plan existed. See Figure 15.

Figure 14. Overall Implementation by Various Types of Involvement.

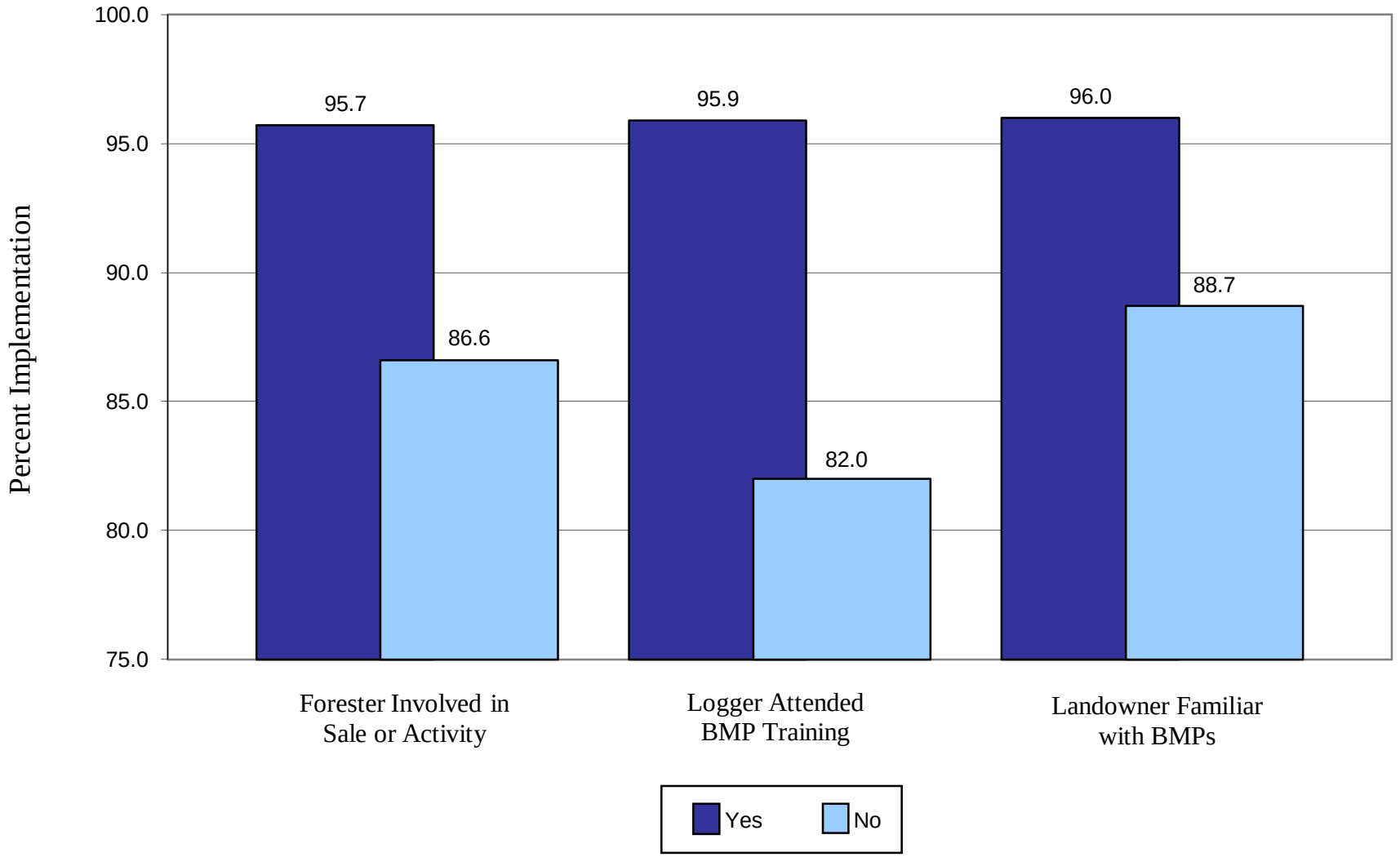
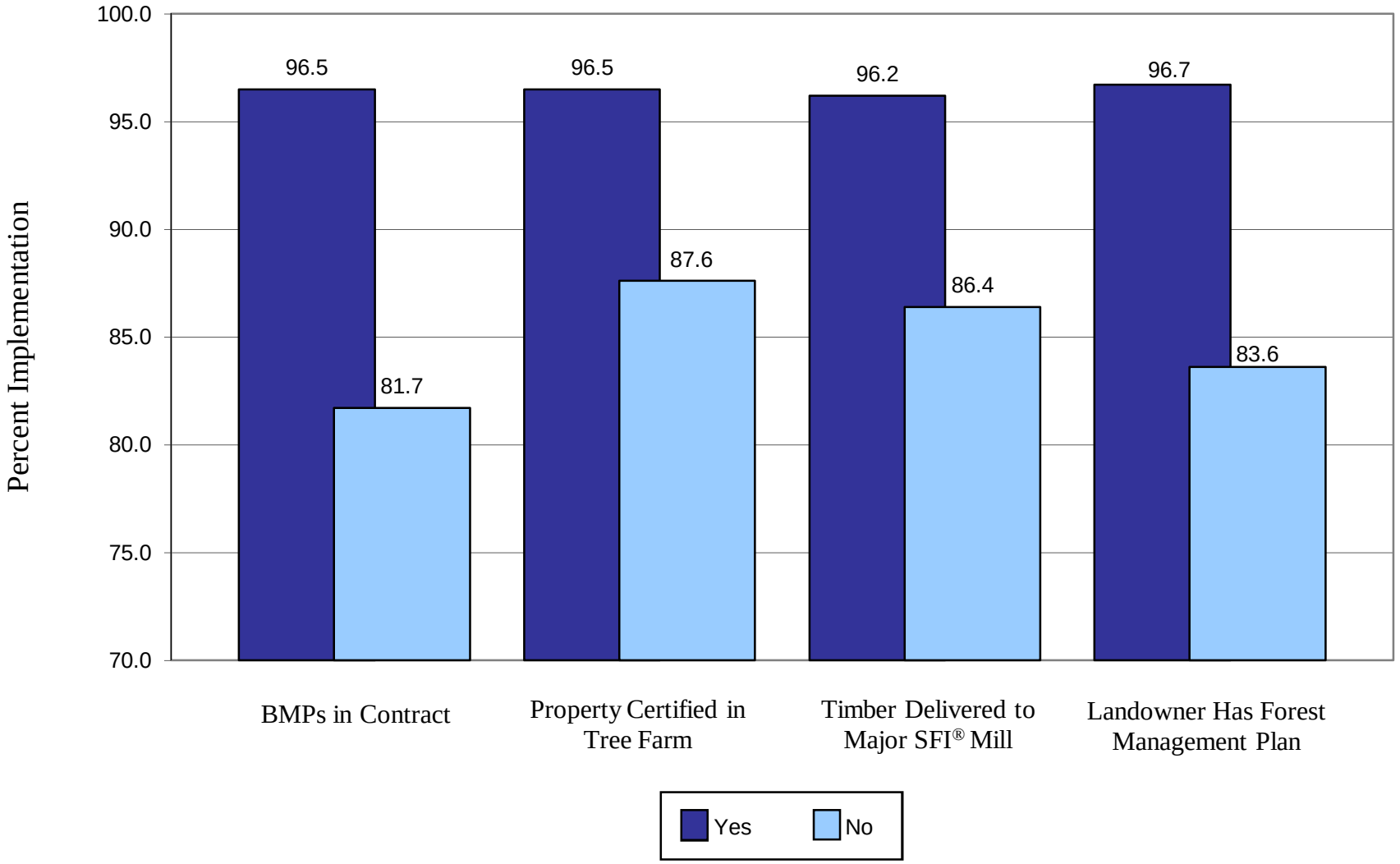


Figure 15. Overall Implementation by Various Categories.



DISCUSSION

As mentioned in the monitoring checklist section of this report, the current methodology used to monitor BMP implementation has been in place since 1999. Prior to that, a more subjective approach was used in which sites were scored as *No Effort, Poor, Fair, Good, or Excellent.* In order to determine percent implementation for an individual site under this older method, passing sites (*Fair, Good, or Excellent*) scored 100%, while failing sites (*No Effort, Poor*) scored 0%.

The current objective method more accurately scores percent implementation. Individual sites are rated on a 0 - 100 percent scale based on their actual level of BMP implementation. Due to the change in reporting methods, results from Rounds 4 - 7 *cannot* be directly compared to Rounds 1 - 3. However, site evaluations conducted in Rounds 1 - 3 were scored using the current method in the Texas Forest Service report, *A History of BMP Implementation Monitoring in Texas, 2007,* to facilitate this comparison.

A brief discussion of the previous rounds of monitoring is provided to give a historical perspective on BMP monitoring in Texas.

OVERALL IMPLEMENTATION – Rounds 1 through 7

Overall BMP implementation on forest operations in East Texas has shown tremendous improvement since the first round of monitoring was completed in 1992 (Figure 16). Implementation on public and industry sites has shown steady improvement over the previous seven rounds. Implementation on industry lands dropped slightly in Round 7; however, only 8 industry sites were included in that round as compared to an average of 50 sites in the previous six rounds. This is reflective of the divestiture of industrial forestlands that began prior to 2005, which resulted in a shift in ownership type. The corporate category was established in Round 6 in response to these changes and has demonstrated a high, steady rate of implementation over the last two rounds. Of the four ownership categories, family forest owners have shown the most remarkable progress in BMP implementation, improving from 69.8% in Round 1 to nearly 90.0% in Round 7.

OVERALL IMPLEMENTATION – Round 8

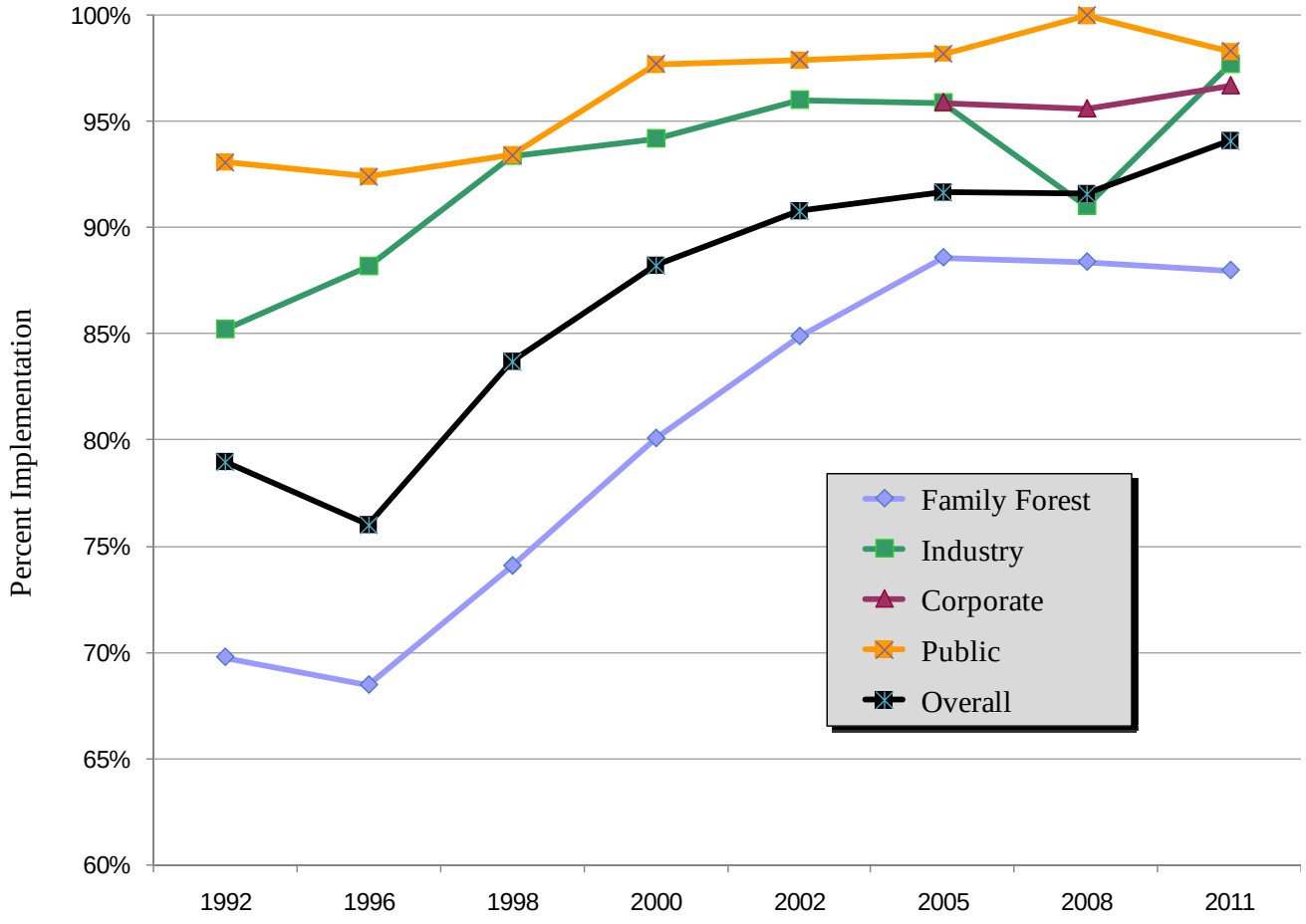
BMP implementation on public land for Round 8 was 98.3% with one significant risk to water quality identified. Implementation on industry land during this time period was 97.7% with no significant risks, while implementation on corporate land was 96.7% with twelve significant risks. Family forest owners received an implementation rating of 88.0% with seven significant risks. This resulted in an overall BMP implementation rating of 94.1% with a total of 20 significant risks across all ownership categories. See Table 13 and Figure 16.

Table 13. Percent Implementation by Ownership and Round.

	Round 1* 1992	Round 2* 1996	Round 3* 1998	Round 4 2000	Round 5 2002	Round 6 2005	Round 7 2008	Round 8 2011
Family Forest	69.8	68.5	74.1	80.1	84.9	88.6	88.4	**88.0**
Corporate	-	-	-	-	-	95.9	95.6	**96.7**
Industry	85.2	88.2	93.4	94.2	96.0	95.9	91.0	**97.7**
Public	93.1	92.4	93.4	97.7	97.9	98.2	100	**98.3**
Overall	79.0	76.0	83.7	88.2	90.8	91.7	91.6	**94.1**

**Data from these rounds follow the current methodology used to determine BMP implementation*

Figure 16. Percent Implementation by Ownership and Round.



BMP implementation on family forest owners lagged behind other ownerships and accounted for 7 of the 20 significant risks. Family forest owners are generally less involved in forest management, only infrequently sell timber, may be absentee, and may lack technical knowledge necessary to implement BMPs. It is important to note that the average size of the harvested family forest owner site was smaller than the industrial and corporate sites. Therefore, this lower level of implementation occurred across a smaller areas while the higher level of BMP implementation occurred across a larger area.

AREA WEIGHTED BMP IMPLEMENTATION

Traditionally, monitoring sites have been weighted equally when determining percent implementation scores. This method is good for determining overall BMP implementation across the state or for a particular landowner category. However, it does not provide this information on a landscape scale like the area weighted BMP implementation method. Using this approach, larger sites are weighted more heavily than smaller sites, primarily because they have a greater opportunity to impact water quality. The results of this monitoring round were reanalyzed using the area weighted approach. BMP implementation scores actually increased for all four landowner types and overall. See Table 14.

$$AW\ \% = \Sigma\ (((Site\ A/Total\ A)\ *100))\ *\ \%\ BMP)))$$

Where AW % = area weighted BMP implementation %
A = area (acres)
% BMP = individual site % BMP implementation

Table 14. Area Weighted Percent Implementation by Ownership, Round 8.

Landowner Type	Area Weighted % Implementation
Family Forest Owner	90.4
Corporate	96.9
Industry	99.5
Public	98.9
Overall	96.4

CONCLUSION

Positive statistical correlations between landowner familiarity with BMPs, forester involvement, logging contractor training in BMPs, and BMP implementation were shown. This demonstrates the importance for family forest owners to involve a forester and a BMP-trained logging contractor to ensure BMP implementation.

Forest products manufacturers and large corporate landowners played a significant role in increasing BMP implementation. This occurred primarily from their support of the Texas Forest Service Water Resources Program and participation in forest certification programs. Water quality protection is obviously a top priority for this sector, as evident by requiring all contractors to attend BMP training workshops, including BMPs in their timber sale contracts, and procuring wood for their mills from landowners that implement BMPs.

Special programs advocated by Texas Forest Service are continuing to have an effect on BMP implementation. The Texas Reforestation and Conservation Act of 1999 encouraged landowners to leave a streamside management zone when harvesting timber through special property tax reductions. The American Tree Farm System® requires landowners to implement BMPs on their operations in order to maintain their certification. Texas Forestry Association sponsors many workshops and field days each year emphasizing sustainable forestry and water resource protection.

Overall BMP implementation was found to be at an all time high (94.1%). Although family forest owners have lower implementation than the other ownership types, considerable progress has been demonstrated since monitoring began. BMP implementation on family forest owner sites was 88.0%, representing a 26% increase since the monitoring program began (1992). This improvement demonstrates that the ongoing education and training strategies geared towards loggers, landowners, and foresters were the driving force behind the increases in implementation.

Although BMP implementation is currently at 94.1%, there is still room for improvement. The past round of monitoring noted a deficiency in removing and stabilizing stream crossings on temporary roads and leaving adequate streamside management zone widths along water bodies. While substantial increases were observed in these categories over the last survey (2008), Texas Forest Service continues to target these areas. A BMP training workshop focusing specifically on streamside management zones is in development to go along with previously released workshops targeting stream crossings and forest roads. Site-based training will also be delivered to contractors through tailgate sessions, in which Water Resources foresters provide technical assistance during active forest operations. An online GIS pre-harvest planning application will be created to further increase implementation by helping loggers and foresters plan for BMPs prior to an operation. Continuing effective educational programs for family forest owners, providing technical assistance on BMPs to the forestry community, and conducting BMP training for loggers will continue to minimize the potential water quality impacts from silvicultural operations in Texas.

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Appendix

Implementation Monitoring Checklist

Evaluation Criteria

Summary of Results

TEXAS FOREST SERVICE
The Texas A&M University System

TEXAS BMP MONITORING CHECKLIST

Site ID

I. General Landowner and Tract Information

County | TFS Block and Grid | Region

Owner Type: ☐ N ☐ A ☐ C ☐ I ☐ P

Latitude | Longitude

Landowner:

Forester Type | Name

Name | Address

Timber Buyer | Contractor

City | State

Activity | Acres Affected

Zip

Estimated Date of Activity | Date of Inspection

Phone

Inspector | Accompanied by

II. Site Characteristics

River Basin

Terrain: ☐ Flat ☐ Hilly ☐ Steep

Distance to nearest permanent water body:

Erodibility hazard: ☐ Low ☐ Medium ☐ High

☐ < 300' ☐ 300 - 800' ☐ 800 - 1600' ☐ 1600' +

Type stream present: ☐ Perennial ☐ Intermittent

Predominant soil series/texture:

Watershed Code

☐ Clay ☐ Clay Loam ☐ Loam ☐ Sandy Loam ☐ Sand

III. Permanent Roads

	YES	NO	NA	Sig. Risk
1. Respect sensitive areas, such as SMZs, steep slopes, and wet areas	☐	☐	☐	☐
2. Meet grade specifications by having slopes between two and ten percent	☐	☐	☐	☐
3. Rutting within allowable specs of less than six inches deep for not more than fifty feet	☐	☐	☐	☐
4. Well drained with appropriate structures to minimize soil movement	☐	☐	☐	☐
5. Wing ditches, waterbars, and water turnouts do not dump into streams	☐	☐	☐	☐
6. Reshaped and/or stabilized to minimize soil movement	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

BMPs present: ☐ RD ☐ WD ☐ WB ☐ RE ☐ OC ☐ PL ☐ RS ☐ CU ☐ SD ☐ BD

IV. Temporary Roads / Skid Trails

	YES	NO	NA	Sig. Risk
1. Respect sensitive areas, such as SMZs, steep slopes, and wet areas	☐	☐	☐	☐
2. Slopes less than 15% and laid out on the contour of the land	☐	☐	☐	☐
3. Rutting within allowable specs of less than six inches deep for not more than fifty feet	☐	☐	☐	☐
4. Well drained with appropriate structures to minimize soil movement	☐	☐	☐	☐
5. Stabilized to minimize soil movement	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

BMPs present: ☐ WD ☐ WB ☐ RE ☐ OC ☐ PL ☐ RS ☐ LS

V. Stream Crossings

	YES	NO	NA	Sig. Risk
On Permanent Roads				
1. Crossings avoided or minimized	☐	☐	☐	☐
2. Stream crossings correct	☐	☐	☐	☐
3. Stream crossing stabilized	☐	☐	☐	☐
4. Stream free of sediment	☐	☐	☐	☐
On Temporary Roads				
5. Crossings avoided or minimized	☐	☐	☐	☐
6. Stream crossings correct	☐	☐	☐	☐
7. Temporary crossings removed	☐	☐	☐	☐
8. Stream crossings and approaches stabilized	☐	☐	☐	☐
9. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

BMPs Present ☐ CU ☐ BR ☐ LW

VI. Streamside Management Zones

	YES	NO	NA	Sig. Risk
1. Present on perennial stream	☐	☐	☐	☐
2. Present on intermittent stream	☐	☐	☐	☐
3. SMZ adequately wide by leaving fifty feet on both sides of the stream	☐	☐	☐	☐
4. Thinning within allowable specs by leaving 50 square feet of BA	☐	☐	☐	☐
5. Minimize harvesting bank trees	☐	☐	☐	☐
6. SMZ integrity honored by keeping skidders, roads, landings, and firebreaks out	☐	☐	☐	☐
7. Stream clear of debris, such as tops and limbs	☐	☐	☐	☐
8. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

VII. Site Preparation

Site preparation method

Regeneration method

	YES	NO	NA	Sig. Risk
1. Respect sensitive areas by preventing site prep intrusion	☐	☐	☐	☐
2. No soil movement on site, especially broad scale sheet erosion	☐	☐	☐	☐
3. Firebreak erosion controlled to prevent potential erosion	☐	☐	☐	☐
4. SMZ integrity honored by preventing site prep intrusion	☐	☐	☐	☐
5. Windrows on contour / free of soil to minimize soil disturbance	☐	☐	☐	☐
6. No chemicals off site or entering water bodies	☐	☐	☐	☐
7. Mechanical site prep, machine planting on contour	☐	☐	☐	☐
8. Stream free of sediment	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

VIII. Landings

	YES	NO	NA	Sig. Risk
1. Locations free of oil / trash and properly disposed of	☐	☐	☐	☐
2. Located outside of SMZ to minimize traffic and erosion in the SMZ	☐	☐	☐	☐
3. Well drained location to mimimize puddling, soil degradation, and soil movement	☐	☐	☐	☐
4. Number and size minimized	☐	☐	☐	☐
5. Respect sensitive areas, including steep slopes and wet areas	☐	☐	☐	☐
6. Restored / stabilized by back blading, spreading bark, or seeding to minimize erosion	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

IX. Wetlands (may or may not be jurisdictional)

	YES	NO	NA	Sig. Risk
1. Avoid altering hydrology of site by minimizing ruts and soil compaction	☐	☐	☐	☐
2. Road drainage structures installed properly to maintain flow of water	☐	☐	☐	☐
3. Mandatory road BMPs followed	☐	☐	☐	☐
Section Total	0	0		0
Percent Implementation	N/A			

X. Overall Compliance

	YES	NO	NA	Sig. Risk
III. Permanent Roads	0	0	☑	0
IV. Skid trails/Temporary Roads	0	0	☑	0
V. Stream Crossings	0	0	☑	0
VI. Streamside Management Zones	0	0	☑	0
VII. Site Preparation	0	0	☑	0
VIII. Landings	0	0	☑	0
IX. Wetlands	0	0	☑	0
Overall Total	0	0		
Total Significant Risk				0
Percent Implementation				

Needs Improvement		Pass		
☐ No Effort	☐ Poor	☐ Fair	☐ Good	☐ Excellent

Follow Up Questions

	YES	NO	NA
Was activity supervised by landowner or representative?	☐	☐	☐
Who?			
Was landowner familiar with BMPs?	☐	☐	☐
Has logger attended BMP Workshop?	☐	☐	☐
Were BMPs included in the contract?	☐	☐	☐
Is landowner a member of TFA? Landowner Association? Tree Farm? Other?	☐	☐	☐
Organization			
Was timber delivered to SFI mill?	☐	☐	☐
Does landowner plan to reforest?	☐	☐	☐
Does landowner have a forest management plan?	☐	☐	☐
Is remediation planned by landowner (if needed)?	☐	☐	☐

Date

Comments (Explain observed actions in the field check. Make recommendations.)

Evaluation Criteria for BMP Monitoring Checklist

I. General Landowner and Site Information

County: Texas County inspection was located.
TFS Block and Grid: Enter only entry point if multiple blocks or grids.
Region: TFS Water Resources Region (N or S)
Latitude and Longitude: coordinates in decimal degree (D.d) format.
Forester Type: Professional, i.e. consultant, industry, etc.
Forester Name: First and last name.
Timber Buyer: First and last name or Corporation name.
Contractor: First and last name or business name.
Activity: Type activity occurring, e.g. harvesting, site preparation, etc.
Acres Affected: Acres affected by activity.
Estimated Date of Activity: Quarter and year activity appears to have occurred.
Date of inspection: mmddyy.
Inspector: Name of TFS forester doing BMP inspection.
Accompanied by: Name of landowner, forester, logger, etc. who is present during the inspection.
Owner Type: Nonindustrial (N), Absentee nonindustrial (A), Corporate (C) Industry (I), Public (P).
Name, Address, City, Zip, and Phone: Contacts for the landowner.

II. Site Characteristics

Terrain: Check only one; Flat, Hilly, or Steep.
Erodibility hazard: Check only one; Low, Medium, or High.
Type stream present: Perennial or Intermittent.
Watershed Code: 8 digit hydrologic unit code where site is located.
River Basin: River basin where site is located.
Distance to nearest permanent water body: Distance to nearest blue line stream or lake.
Predominant soil series: Series name from Soil Survey data (if available).
Predominant soil texture: Check only one; Clay, Clay Loam, Loam, Sandy Loam, or Sand.

III. Permanent Roads

1. Respect sensitive areas: Do roads avoid wet areas, SMZs, steep slopes if an alternative exist, erosion prone areas if an alternative exists, etc.?
2. Roads meet grade specs: Pertains to new roads or roads which are substantially reworked. Are roads within 2-10 percent grade except for short distances? Are roads on contour?
3. Rutting within allowable specs: Is the road free of ruts in excess of 6 inches deep for more than 50 feet?
4. Well drained with appropriate structures: Are roads constructed so that water will quickly drain from them to minimize soil movement?
5. Ditches do not dump into streams: Are water turn outs and water bars venting far enough from the stream to prevent sediment from entering the stream channel?

6. Roads reshaped and stabilized: If needed, are roads reworked to minimize soil movement?

BMPs present: Which types of BMPs were used? Rolling dips (RD), Wing ditches (WD), Water bars (WB), Revegetate (RE), On contour (OC), Proper placement (PL), Reshaping (RS), Culverts (CU), Side Ditch (SD), Broad based dip (BD).

IV. Temporary Roads/ Skid Trails

1. Respect sensitive areas: Do skid trails and temporary roads avoid wet areas, SMZs, steep slopes if an alternative exist, erosion prone areas if an alternative exists, etc.?
2. Slopes less than 15 %: Are skid trails laid out on or near contour, rather than up and down steep slopes?
3. Rutting within allowable specs: Are skid trails and temporary roads free of ruts in excess of 6 inches deep for more than 50 feet?
4. Roads well drained with water bars or other water control structures: Were BMPs installed effectively to reduce erosion from the road?
5. Roads stabilized: If needed, are skid trails and temporary roads reworked to minimize soil movement?

BMPs present: See Section III above. Logging Slash (LS).

V. Stream Crossings

On Permanent Roads:

1. Crossings avoided or minimized: Was an effort made to use as few crossings as possible?
2. Stream crossings correct: Are crossings installed correctly? Are crossing located properly? Are culverts properly sized? Are bridges used where necessary? Are crossings at right angles?
3. Stream crossings stabilized? Are stream banks and approaches stabilized? Are washouts evident?
4. Stream free of sediment: Has sedimentation from the road into the stream channel been minimized?

On Temporary Roads

5. Crossings avoided or minimized: Was an effort made to use as few crossings as possible?
6. Stream crossings correct: Are crossings installed correctly? Is the crossing located so as to minimize the potential erosion in the stream channel? Is the crossing at a right angle to the stream channel? Was a proper stream crossing method used?
7. Temporary crossings removed: Have the temporary crossings been removed? Excess fill removed from the stream channel
8. Stream crossings stabilized: Banks and approaches stabilized against erosion? Are washouts evident?
9. Stream free of sediment: Has sedimentation from the road into the stream channel been minimized?

BMPs present: Which types of BMPs were used? Culverts (CU), Bridge (BR), Low water crossing (LW).

VI. Streamside Management Zones

1. Present on permanent stream: Is there an SMZ present on any permanent stream?
2. Present on intermittent stream: Is there an SMZ present on any intermittent stream?
3. SMZ adequately wide: Is the stream being protected from erosion and deposition of sediment? Does the width meet the guidelines recommendations?
4. Thinning within allowable specs: If thinning was done, is the basal area remaining at least 50 square feet? Is there minimal soil disturbance from felling and skidding?
5. Minimize harvesting bank trees: Was an effort made to minimize harvesting bank trees? Were trees felled across the stream?
6. SMZ integrity honored: Was an effort made to stay out of the SMZ with skidders, landings, roads, etc. (except for designated stream crossings)? Is the SMZ free of firebreaks?
7. Stream clear of debris: Are tops and limbs removed from permanent and intermittent stream channels? Has any brush or debris pushed into the stream channel been removed?
8. Stream free of sediment: Has sedimentation reaching the stream channel through the SMZ been minimized?

VII. Site Preparation

Site preparation method: Mechanical, chemical, prescribed burn.
Regeneration method: Mechanical, Hand, Natural.

1. Respect sensitive areas. Effort to prevent site prep intrusion into sensitive areas? Effort to prevent heavy equipment intrusion into sensitive areas? Effort to prevent fire intrusion into sensitive areas?
2. No soil movement on site: Is there no soil movement on site? Are rills or gullies prevented? Is there no problem with broad scale sheet erosion?
3. Firebreak erosion controlled: If present, has potential erosion from firebreaks been minimized as per guideline recommendations?
4. SMZ integrity honored: Effort to prevent site prep intrusion into the SMZ? Effort to prevent heavy equipment intrusion into the SMZ? Effort to prevent fire intrusion into the SMZ? Are perennial or intermittent streams free of debris?
5. Windrows on contour / free of soil: Are windrows on contour on hilly lands rather than up and down slopes? Was soil disturbance minimized? Was soil in windrows minimized?
6. No chemicals off site: Does it appear that chemicals were used according to label directions? Have they remained on site and out of water bodies?
7. Mechanical site prep and machine planting on contour: Are rows on contour on hilly lands rather than up and down slopes?
8. Stream free of sediment: Has sedimentation reaching the stream channel because of site prep activities been minimized?

VIII. Landings

1. Locations free of oil/trash: Any sign of deliberate oil spills on soil? Is trash picked up and properly disposed of?
2. Located outside of SMZ: Was the landing located 50 feet outside SMZ so as to minimize traffic and erosion in the SMZ?
3. Well drained location: Were the landings located so as to minimize puddling, soil degradation and soil movement?
4. Number and size minimized: Were the number and size of landings kept to a minimum?
5. Respect sensitive areas: Were landings kept out of wet areas, steep slopes, and other erosion prone areas if an alternative exist?
6. Restored/stabilized: Has the landing been back bladed or otherwise restored as per guideline recommendations? Has erosion been minimized through spreading bark, etc., seeding, water bars, or other recommended BMP practices?

IX. Wetlands (may or may not be jurisdictional)

1. Avoid altering hydrology of site: Were ruts and soil compaction kept to a minimum?
2. Road drainage structures installed properly: Were BMPs installed effectively to maintain the flow of water and keep erosion to a minimum in the wetland?
3. Mandatory road BMPs followed: Were the 15 federal mandatory BMPs followed?

X. Overall Implementation

Section implementation percentages are determined by dividing the number of questions receiving a yes answer by the total applicable questions in each section. Y/(Y+N)

Overall implementation is determined in a similar manner using the totals from all sections combined. Y/(Y+N)

Significant Risk. A significant risk is an existing on-the-ground condition resulting from failure to correctly implement BMPs, that if left unmitigated will likely result in an adverse change in the chemical, physical or biological condition of a waterbody. Such change may or may not violate water quality standards.

Subjective Score.

No Effort Substantial erosion as a result of operations. Sedimentation in streams. Temporary stream crossings not removed. No SMZ when needed, etc. Poor attitude evident about the job.

Poor: Some effort at installing BMPs. Generally poor quality construction or no effort in certain locations which suffer from erosion, stream sedimentation, etc. Substantial lack of BMPs in a particular emphasis such as roads, skid trails or SMZ.

Fair: (1) Generally a pretty good effort at BMPs. Poor application procedures perhaps. Lack of BMPs in a particular emphasis but with moderate

consequences. (2) No BMPs on a site which requires few BMPs but has some resultant minor problems.

Good: (1) BMPs generally installed correctly. Guidelines generally followed. Allows for some failures of BMP devices or failure to observe guidelines but with light consequences. (2) Good quality job which required no BMPs and has few problems.

Excellent: (1) BMPs installed correctly. Guidelines followed. (2) Some BMPs implemented even when they might not have been required. Few if any problems exist.

Follow up Questions

Was activity supervised by a professional forester or representative? Check Yes, No, or NA
Who? If yes, list name of individual.
Was landowner familiar with BMPs? Check Yes, No, or NA.
Has logger attended BMP workshop? Check Yes, No, or NA
Were BMPs included in the contract? Check Yes, No, or NA
Is landowner a member of TFA? Landowner Association? Other? Check Yes, No, or NA
Organization: If yes, list name of organization.
Was timber delivered to SFI mill? Check Yes, No, or NA
Does landowner have a forest management plan? Check Yes, No, or NA
Is remediation planned by the landowner? Check Yes, No, or NA.
Date: If yes, include date of planned remediation.

Summary of Responses to BMP Implementation Monitoring Checklist Items, All Sites, Round 8

I. General Landowner and Tract Information

Owner type		Forester type		Activity	
Family Forest Owner	23	Industry / Corporate	87	Regeneration Harvest	
Absentee	24	Private Consultant	40	Clearcut	101
Corporate	93	Public	8	Thin	48
Industry	2			Site Prep only	1
Public (Fed, State)	8				

II. Site Characteristics

Terrain		Erodibility hazard		Type stream present	
				Perennial	18
Flat	61	Low	86	Intermittent	50
Hilly	74	Medium	45	Both	35
Steep	15	High	19	None	47

Distance to nearest permanent water body		Predominant soil series/texture			
< 300'	73	Clay	3	Sandy loam	100
300 - 800'	12	Clay loam	12	Sand	14
800 - 1600'	12	Loam	21		
1600' +	53				

III. Permanent Roads

140 applicable

	Yes	No	NA	Sig. Risk
1. Respect sensitive areas	136	0	14	0
2. Roads meet grade specs	103	1	46	0
3. Rutting within allowable specs	140	0	10	0
4. Well drained with appropriate structures	118	16	16	0
5. Ditches do not dump into streams	75	6	69	1
6. Roads reshaped and stabilized	127	12	11	0

IV. Skid Trails/Temporary Roads

85 applicable

	Yes	No	NA	Sig. Risk
1. Slopes less than 15%	57	0	93	0
2. Respect sensitive areas	82	1	67	0
3. Roads well drained with water control structures	70	3	77	0
4. Roads stabilized	83	1	66	0
5. Rutting within allowable specs	82	3	65	0

V. Stream Crossings

On Permanent Roads	41 applicable	Yes	No	NA	Sig. Risk
1. Crossings Avoided or minimized		64	0	86	0
2. Stream crossings correct		33	8	109	4
3. Stream crossings stabilized		32	8	110	1
4. Stream free of sediment		36	4	110	1
On Temporary Roads	74 applicable				
5. Crossings avoided or minimized		67	7	76	0
6. Stream crossings correct		42	5	103	0
7. Temporary crossings removed		31	10	109	4
8. Stream crossings and approaches stabilized		30	13	107	5
9. Stream free of sediment		35	10	105	1

VI. Streamside Management Zones

105 applicable

	Yes	No	NA	Sig. Risk
1. Present on permanent stream	48	1	101	0
2. Present on intermittent stream	83	2	65	0
3. SMZ adequately wide	74	25	51	0
4. Thinning within allowable specs	81	19	50	0
5. Minimize harvesting bank trees	93	7	50	0
6. SMZ integrity honored	99	4	47	0
7. Stream clear of debris	92	13	45	2
8. Stream free of sediment	101	1	48	0

VII. Site Preparation

69 applicable

	Yes	No	NA	Sig. Risk
1. Respect sensitive areas	68	1	81	0
2. No soil movement on site	69	0	81	0
3. Firebreak erosion controlled	16	2	132	1
4. SMZ integrity honored	51	2	97	0
5. Windrows on contour/free of soil	5	0	145	0
6. No chemicals off site	54	1	95	0
7. Machine planting on contour	44	0	106	0
8. Stream free of sediment	53	2	95	0

VIII. Landings

139 applicable

	Yes	No	NA	Sig. Risk
1. Locations free of oil/trash	131	8	11	0
2. Located outside of SMZ	79	1	70	0
3. Well-drained location	103	0	47	0
4. Number and size minimized	105	0	45	0
5. Respect sensitive areas	102	0	48	0
6. Restored/stabilized	99	0	51	0

IX. Wetlands

31 applicable

	Yes	No	NA	Sig. Risk
1. Avoid altering hydrology of site	30	1	119	0
2. Road drainage structures installed properly	5	0	145	0
3. Mandatory road BMPs followed	6	0	144	0

X. Overall Compliance

	Yes	No	NA	Sig. Risk
III. Permanent Roads - 95%	699	35	166	1
IV. Temporary Roads /Skid Trails- 98%	374	8	368	0
V. Stream Crossings - 85%	370	65	915	16
VI. Streamside Management Zones - 90%	671	72	457	2
VII. Site Preparation - 98%	360	8	832	1
VIII. Landings - 99%	619	9	272	0
IX. Wetlands - 99%	41	1	408	0

Follow-up Questions

	Yes	No	NA
Was activity supervised by a professional forester?	135	15	0
Was landowner familiar with BMPs?	126	24	0
Has logger attended BMP workshop?	138	5	7
Were BMPs included in the contract?	133	10	7
Is landowner a member of TFA, CFLOA, ATFS, etc.?	118	24	8
Was timber delivered to SFI mill?	128	6	16
Does landowner have a forest management plan?	128	20	2
Does landowner plan to reforest?	55	0	95