FORESTRY BMPs
IN SOUTH CAROLINA
Compliance and Implementation Monitoring Report, 2011-2014

South Carolina
Forestry Commission

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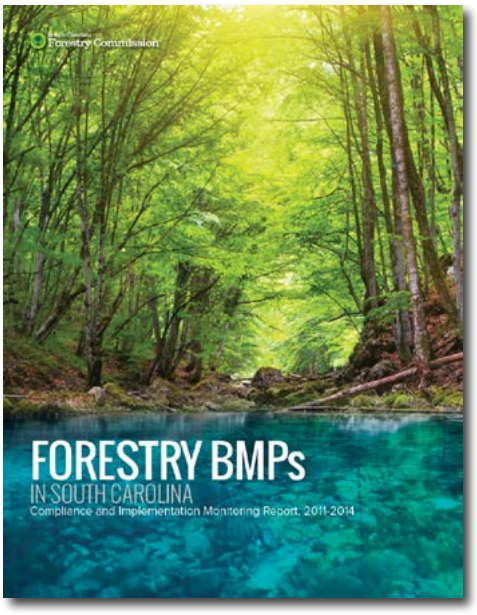

Compliance and Implementation Monitoring of Forestry Best Management Practices in South Carolina 2011-2014: A Follow-up to the 2011-2012 Report

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EXECUTIVE SUMMARY

This is a continuation of the ninth study conducted by the South Carolina Forestry Commission to determine compliance and implementation of South Carolina Best Management Practices for Forestry (BMPs) during silvicultural activities. Forest operations were evaluated on 595 randomly located sites initially in 2011-2012. *Compliance and Implementation Monitoring of Forestry Best Management Practices in South Carolina 2011-2012* was published in December 2012 which reported the results of the initial visits to these sites. Overall BMP compliance on harvesting operations was 93.4% with an overall implementation rate of individual BMP practices of 92.1% Compliance for non-harvesting operations was found to be 87.5% with an overall implementation rate of non-harvest BMPs of 93.2%.

Two subsequent visits were made to each site in 2013 and 2014 for further evaluation. During the second site visit, sites that received non-harvest treatments were evaluated for compliance with non-harvest BMPs. Sites that received no treatments during the first year post-harvest were examined to estimate site stabilization, conversion, and the effectiveness of BMPs implemented during the harvesting operation. During the third and final site visit, sites that received non-harvest treatments during the second year post harvest were evaluated for compliance with non-harvest BMPs. All tracts were evaluated for site stabilization, species and regeneration method used, conversion to other uses and the presence of and ongoing erosion from silvicultural activities.

One of the original 151 sites was unable to be evaluated due to a change in ownership and the new landowner did not wish to be included in the survey. Another site was discarded from the survey because it was thinned at the initial visit and clearcut at the first follow-up visit making it atypical for the purposes of this survey. Three of the remaining 149 sites were converted to non-forest uses.

The goal of South Carolina BMPs for forestry is to protect water quality during forestry operations. Water quality impacts from forestry are considered non-point source pollution. Some examples as related to forestry are sedimentation, increased stream temperature, woody debris left in the stream channel, and algae blooms as a result of a change in dissolved oxygen levels.

STUDY METHODS

SITE FOLLOW UP VISIT: 1 YEAR POST-HARVEST

In spring of 2013, all of the monitoring sites were revisited to evaluate compliance with non-harvest BMPs and to gather additional information on several other variables including conversion, site stabilization, blowdown within streamside management zones (SMZs) and whether or not BMPs implemented during the harvest were still performing effectively.

During this site visit, the entire site was examined to determine if a non-harvest treatment had been conducted during the first year following the harvest. If the site received a non-harvest treatment during the first year after harvest, a BMP compliance inspection was conducted. The inspection covered compliance and implementation of BMPs in each of six categories:

- Site preparation treatments
- Reforestation
- Prescribed burning
- Pesticide application
- Fertilization application
- Minor drainage

Each category was evaluated on a pass/fail basis depending on the responses to a series of yes/no questions within each category. After each operation was evaluated, the site was rated for overall BMP compliance. Sites were rated excellent, adequate, or inadequate depending on the level of BMP compliance.

If the site had not been site prepared or reforested after one year, information was collected on the site regarding site stabilization in both high and light traffic areas. In both high and light traffic areas, percent bare ground was estimated in 5% increments. Other questions were also answered for each site:

- Are stream crossings currently stable?
- Is there a water quality or sediment deposition impact from a crossing failure?
- Are road waterbars and water control structures functioning?
- Is there blowdown within the SMZ? If so, what species?

SITE FOLLOW-UP VISIT: 2 YEARS POST-HARVEST

In spring of 2014, each site was visited a third time. Sites that received non-harvest treatments within the second year post-harvest were evaluated for compliance with an implementation of non-harvest BMPs. All sites were evaluated to examine reforestation methods and degree of site stabilization.

The following information was gathered on all sites on the third and final site visit:

- Method of regeneration
- Planting spacing
- Percent bare ground in light traffic areas
- Percent bare ground in high traffic areas
- Length of SMZ, if present
- Effectiveness of harvesting BMPs two years post-harvest (if no non-harvest activity took place)
- Evidence of ongoing erosion resulting from the harvest operation
- Evidence of ongoing erosion resulting from the non-harvest operation

MONITORING RESULTS: NON-HARVEST OPERATIONS

Non-harvest forest operations include site preparation, reforestation, prescribed burning, pesticide application, fertilizer application, and minor drainage. Within two years post-harvest, at least one non-harvest activity was conducted on 55.0% of sites (82 of 149) evaluated in this survey. Since the initial report published in 2012 included a small number of sites (16) with non-harvest treatments, the results from those sites were included in this analysis to provide a more suitable sample size. For the categories of Prescribed Burning and Minor Drainage, only a small sample size was present, yielding results that were statistically insignificant, but still worth mentioning in this report.

SITE PREPARATION

98.5 % Compliance

Site preparation operations were evaluated on 65 sites, including sites with mechanical site preparation, chemical application, and prescribed fire. On three sites, a combination of operations were conducted including two with mechanical and prescribed fire and one with chemical and prescribed fire. Compliance with site preparation BMPs was sufficient to protect water quality on 98.5% of these sites. One of these sites was rated with inadequate compliance in this category.

A total of 139 applicable practices were evaluated with 92.1% implementation. Eleven individual practices were not properly applied, including one with significant risk to negatively impact water quality. The most common problem noted was failure to use waterbars on firebreaks. The practice noted to have significant risk involved mechanical methods not following the contour on slopes of 11-20%.

REFORESTATION

97.4 % Compliance

Reforestation activities were observed on 77 sites within two years of harvest. Forty-nine sites were hand planted and 28 sites were machine planted. Compliance with BMPs related to reforestation was 97.4%, with two sites rated as having significant risk to negatively impact water quality. Both sites were located on industry-owned[1] land in the Piedmont region of the state. Causes for concern on both included machine planting in, through, and down ephemeral streams and machine planting on steep slopes.

A total of 114 applicable BMPs related to reforestation were evaluated with 93.9% implementation. Seven practices were not implemented including two with significant risk to negatively impact water quality. Problems included failure to hand plant on steep slopes with erodible soils, not machine planting on slopes >5% and the presence of planting bags or garbage associated with planting.

1. *Forest Industry landownership for purposes of this publication includes forest industry that owns a wood processing mill and timber investment groups such as TIMOs and REITs.*

PRESCRIBED BURNING

85.7 % Compliance

Prescribed burning was evaluated on seven sites, and compliance with BMPs was sufficient to protect water quality on 85.7% of those sites (6 of 7). One site was rated with inadequate compliance in this category.

A total of 37 applicable BMPs were evaluated with 81.1% implementation. Problems statewide included the absence of waterbars in firebreaks and the failure to use hand tools to tie firebreaks into streams.

PESTICIDE APPLICATION

100 % Compliance

Pesticide application was evaluated on 33 sites and compliance with BMPs was sufficient to protect water quality on 100% of those sites. A total of 159 applicable BMPs were evaluated with 100% implementation. No sites in this survey were identified with fertilizer application.

MINOR DRAINAGE

100 % Compliance

Seven sites in this survey included activity related to pre-existing minor drainage. No new minor drainage was identified. Compliance with BMPs related to minor drainage was sufficient to protect water quality on 100% of sites. A total of 64 applicable BMPs were evaluated with 93.8% implementation. Problems included possibly using the 404 silvicultural exemption of the Clean Water Act for non-silvicultural objectives and minimizing the depth, width, and number of ditches. However, since these were pre-existing drainage features, it is difficult to discern whether they were dug prior to the implementation of the Clean Water Act.

OVERALL NON-HARVESTING COMPLIANCE

96.6 % Compliance

Compliance with non-harvesting BMPs was sufficient to protect water quality on 96.6% of sites (86 of 89). One site rated excellent, 85 sites rated adequate, and three sites rated inadequate with compliance to BMPs. Two sites rated inadequate were due to machine planting on erodible soils and through ephemeral drains. The other rated inadequate was due to erosion from firebreaks. All three inadequate sites were on industry lands in the Piedmont region of the state.

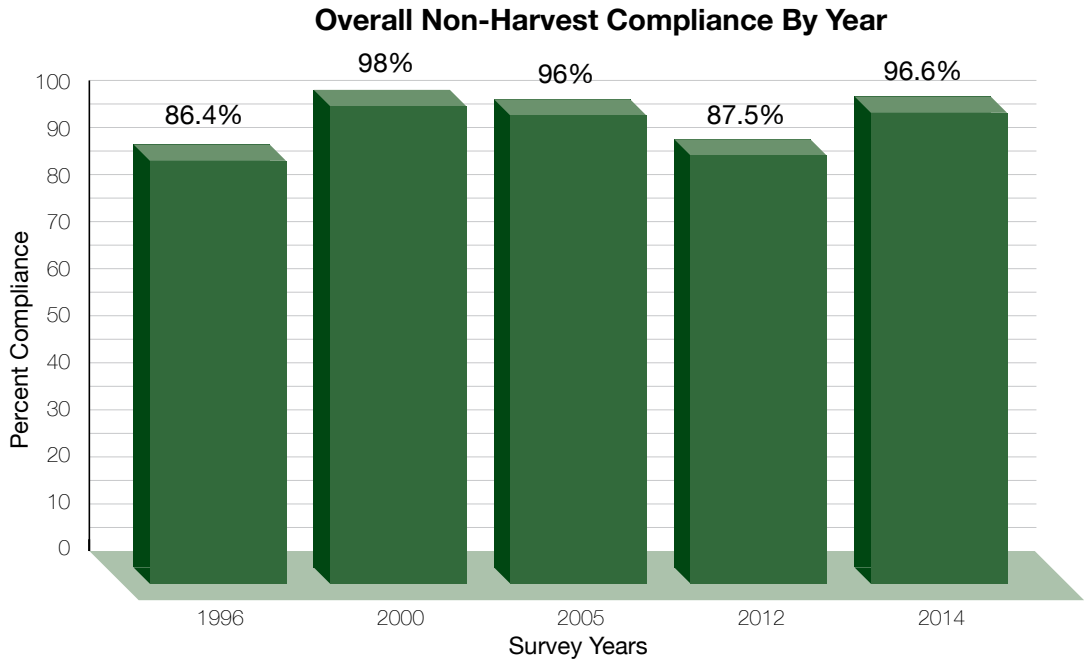
A total of 513 applicable non-harvest BMPs were evaluated with 94.35% implementation. Twenty-nine individual practices were not properly applied.

COMPLIANCE TRENDS

Non-Harvest Compliance Trends

Overall compliance for non-harvest activities for this survey was 96.6% (Table 1). This is near the all-time high of 98% for South Carolina in 2000, but reforestation and minor drainage were not evaluated in that survey. The overall rating indicates that landowners and forestry professionals are committed to protecting water quality through proper implementation of Best Management Practices for Forestry.

TABLE 1

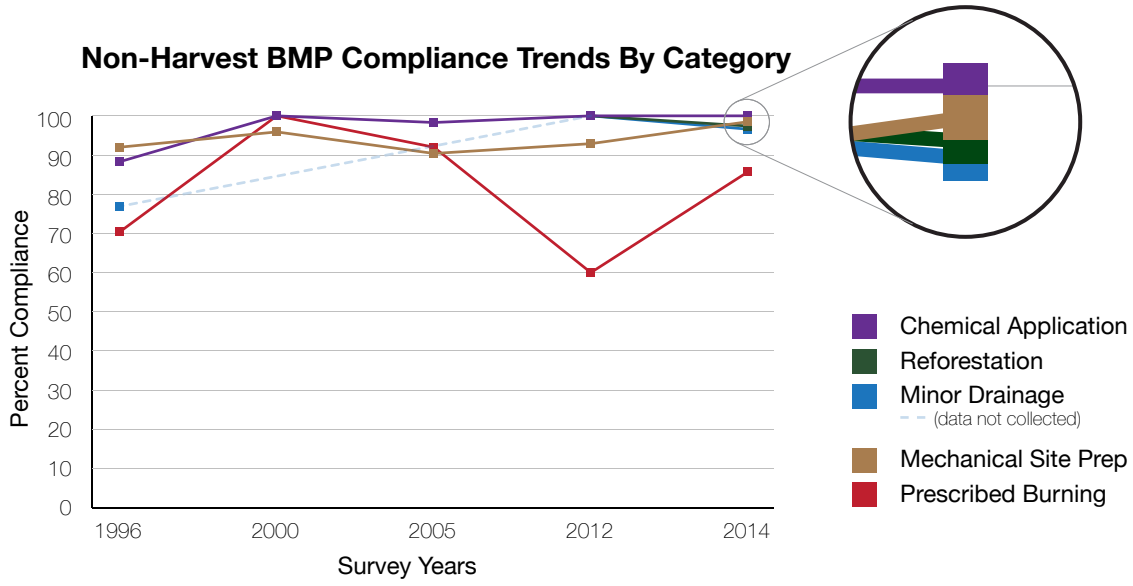


The dip in compliance of 87.5% for the 2012 survey is most likely just due to sampling error. Only 16 sites were evaluated for non-harvest activities in 2012 giving a sample size that does not lend itself to testing statistical significance.

Non-harvest Compliance Trends by Category

Non-harvest compliance for chemical application and minor drainage was 100%, while mechanical site preparation reached a new high compliance rate of 98.5%, (Table 2). Prescribed burning had the lowest compliance at 85.7%, but shows improvement over the last survey.

TABLE 2



OTHER FINDINGS

In conjunction with the non-harvest monitoring, other information was gathered on other variables such as site stabilization, reforestation trends, blowdown in Streamside Management Zones, and the relationship between length of SMZ and area of harvest.

Site Stabilization

The degree of site stabilization was estimated one year post-harvest and two years post-harvest on both light and high traffic areas. One year post-harvest, 79.2% of sites had a high degree of stabilization on light traffic areas (0-5% bare ground) (Table 3). On high traffic areas (Table 4), such as log decks and main skid trails, 49.0% of sites had high stabilization with 0-5% bare ground and 85.2% had less than 20% bare ground. Two years post-harvest, 96.0% of sites had a high degree of stabilization on light traffic areas, and 79.9% of sites with high traffic had 0-5% bare ground and 94.6% of sites had less than 20% bare ground.

TABLE 3

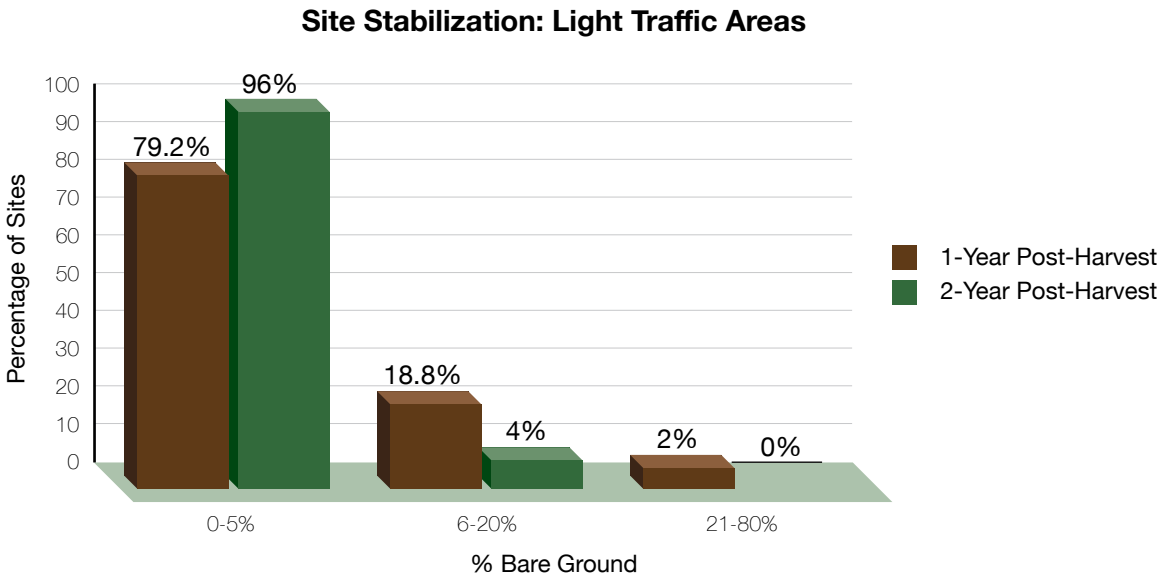
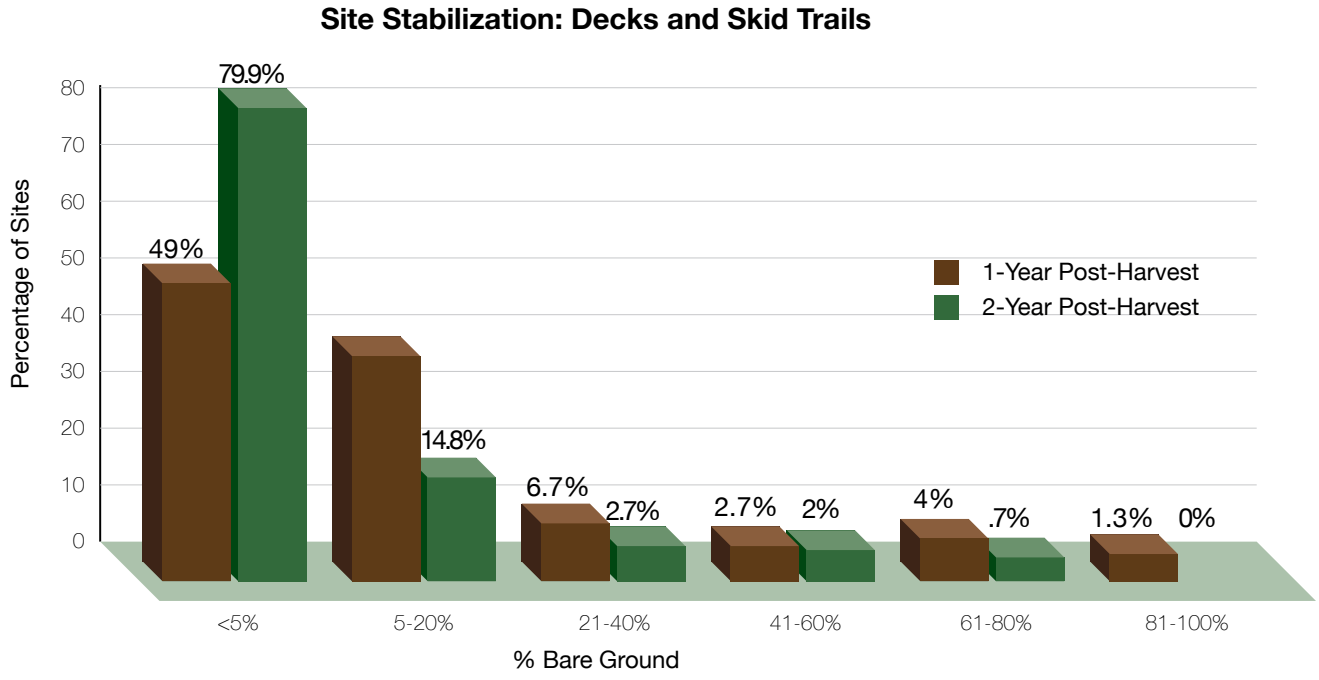


TABLE 4

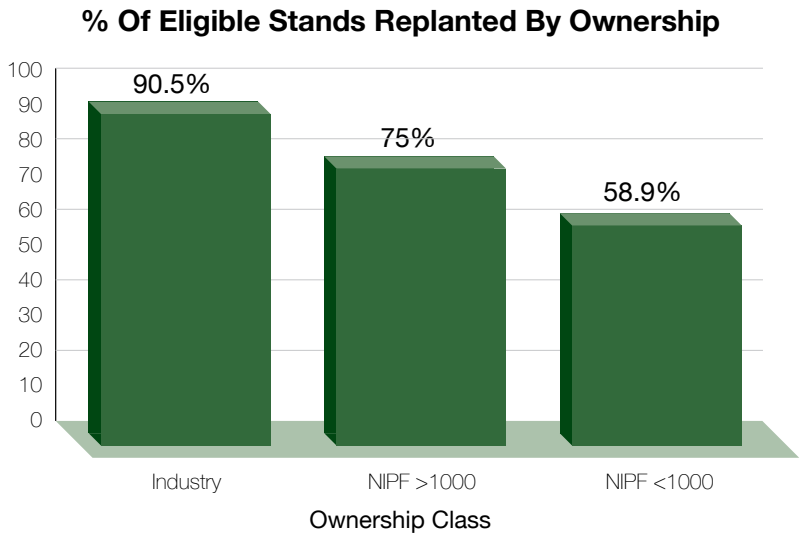


Reforestation

Reforestation methods were noted on each site evaluated in this survey. A total of 77 sites had been reforested artificially by 2 years following harvest, with 70 of those being planted by one year post-harvest. Forty-nine sites were hand planted and 28 were machine planted. Sixty-nine sites were allowed to regenerate naturally.

Planting spacing varied from site to site. The most common spacing was 8x10 with 58.3% of sites planted this way, which results in 544 trees per acre (TPA). The next most common spacings were 6x12 (605 TPA), 5x12 and 6x10 (726 TPA), each performed on 3.4% of sites.

TABLE 5



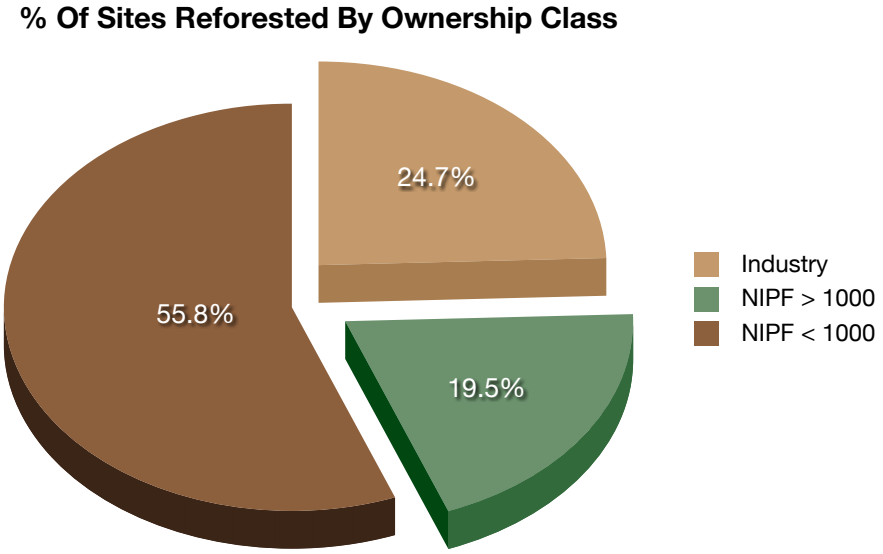
Of the original 151 sites surveyed, 115 were clearcuts and 36 thinning harvests. Of the 115 sites eligible for reforestation, a total of 77 were reforested. The ownership class most likely to reforest after harvesting was found to be forest industry (Table 5). Of 21 clearcut sites owned by forest industry, 90.5% (19 sites) were reforested within two years post-harvest. Non-industrial private landowners owning more than 1,000 acres held the next highest rate of reforestation at 75.0% (15 of 20 clearcut sites). Non-industrial private landowners owning fewer than 1,000 acres reforested on 58.9% of sites (43 of 73 sites). Of the five publicly owned sites surveyed, only one was a clearcut. This site was not artificially reforested within two years of harvest, but rather left to naturally regenerate.

Of the 77 sites artificially regenerated, 24.7% (19 sites) were owned by forest industry, 19.5% (15 sites) were owned by non-industrial private landowners owning more than 1,000 acres, and 55.8% (43 sites) were owned by non-industrial private landowners owning fewer than 1,000 acres (Table 6).

The conclusions drawn from the reforestation trends are that for forest industry, and largely the non-industrial private landowners owning more than 1,000 acres, forests are a monetary investment, more so than for the average smaller landowner. For this survey, Timber Investment Management Organizations (TIMOs) or Real Estate Investment Trust (REITs) are lumped into the Industry category. These organization have financial returns at the top of their list of objectives, as many serve as a retirement funds for their investors. Larger family-owned tree farms fit into the NIPF>1,000 category, but may have other objectives such as wildlife or aesthetics in mind. With either, reforestation is essential to perpetuate the process.

Even with the opportunity of cost-share, the NIPF<1000 class often has fewer resources to reforest than NIPF>1000 or Industry landowners. Also, reforestation is not always on their list of landowner objectives.

TABLE 6

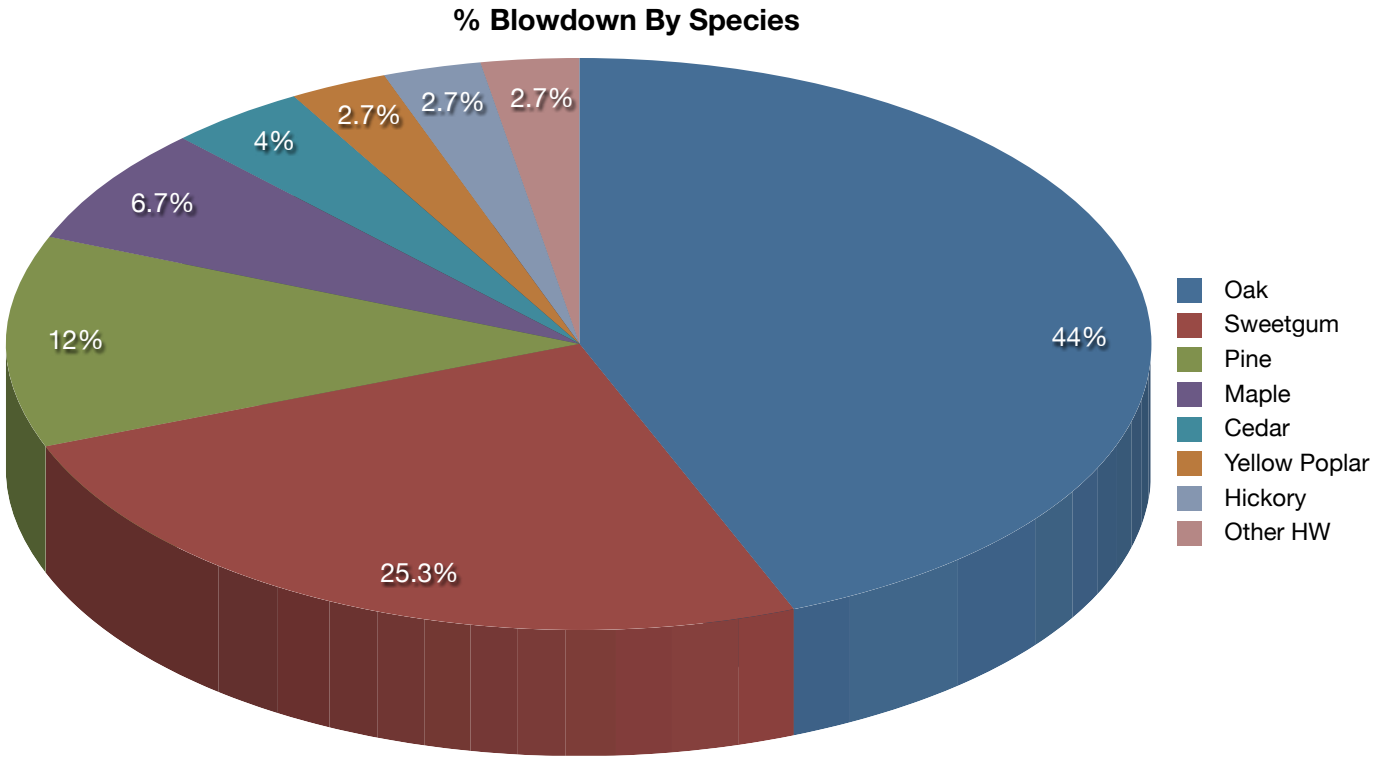


Blowdown In SMZs

Streamside Management Zones (SMZs) are a crucial part of Best Management Practices and essential to protect water quality. SMZs function to filter nutrients and sediment before runoff reaches the stream channel and also provide shade to the stream resulting in lower water temperature. SMZs also serve as habitat and travel corridors for many species of bird, mammal, and amphibian. However, often the residual trees left in SMZs are subject to be blown over due to moist soil conditions, root patterns of the residual trees, and as a result of being exposed to the wind when the rest of the adjacent stand has been clearcut.

For this survey, 42 sites contained SMZs. Of these, 27 had blowdown within the SMZ. Seventy-five total trees were blown down on these 27 sites. Oak (Quercus spp.) was the most common species downed by wind accounting for 44% (33 trees) of windthrow (Table 7). The next most common species was sweetgum (Liquidambar styraciflua) with 25.3% (19 trees). The least common windthrown species were yellow poplar (Liriodendron tulipifera), hickory (Carya spp.), and other hardwoods with 2.7% (2 trees) each.

TABLE 7



SMZ Length and Acres Harvested

Forty-two sites in this survey contained Streamside Management Zones. The Piedmont region (see page 15 for a map of SCFC regions) of the state contained 29 sites with SMZs, the Pee Dee region 11 sites, and the Coastal region 2 sites. The length of SMZs on these sites varied from 200 feet to one mile long. The harvest area also varied from 10 acres to 185 acres.

In the Piedmont the average harvest containing an SMZ was 66.28 acres with an average SMZ length of 1,181 feet. The Pee Dee was slightly higher with an average harvest area of 85.91 acres with an average SMZ length of 1,647.27 feet. The Coastal region average harvest area with an SMZ was 67 acres with an 850-feet average SMZ. The statewide average harvest with an SMZ was 72 acres with a 1,287.33 foot SMZ.

The takeaway is that in the Piedmont region a harvest with an SMZ will occur 2.45 times more often than in the Pee Dee region and 14.5 times more often than in the Coastal region. On average, a harvest in the Pee Dee region will have a longer associated SMZ by 1.4 times than in the Piedmont region and almost 2 times as in the Coastal region.

CONCLUSION

The results of this study are a testament to the continued success of South Carolina's Best Management Practices for Forestry program. The high compliance and implementation rates are evidence that South Carolina's voluntary approach to BMPs is well received by landowners, loggers, and forestry professionals.

Strengths in BMP compliance are evident:

- 100% Compliance with Chemical Application and Minor Drainage
- 98.5% Compliance with Mechanical Site Preparation is the highest since monitoring began
- An overall Non-harvest Compliance rate of 96.6%

This study will also be used to target areas identified as needing special attention and training programs and outreach will be tailored accordingly.

Opportunities for improvement include:

- Increased attention on firebreaks including the installation of waterbars and the use of mechanized equipment tying in the firebreaks to water bodies.
- Increased awareness of mechanical tree planting, especially in and around ephemeral streams

This survey also shows that the earth has a way of healing itself. After two years, 96% of sites with light traffic areas and nearly 80% of sites with high traffic areas had healed itself to less than 5% bare ground surface. These site were able to re-vegetate naturally.

This survey was also able to tell us that oak is the predominate species susceptible to blowdown in SMZs around perennial streams. This information could be used to guide selective harvesting within the SMZ.

The results of this survey will be used to further the compliance and implementation of South Carolina's Best Management Practices for Forestry and to continually improvement upon the coordination and delivery of the program throughout the state keeping protection of water quality during forestry operations at the forefront.

APPENDIX

FOLLOW-UP BMP COMPLIANCE MONITORING FORM

Site ID: Visit Number: Date: Observer:

RATE ANY NEW ACTIVITY ON BMP MONITORING NON-HARVEST FORM
All percentages to nearest 5%

SITE	Y	N	SR	NA
1. Has site been converted to non forest use	☐	☐		
2. Artificial or natural regeneration _____				
3. Spacing of artificial regeneration _____				
4. Any new activity rated on nonharvest form _____				
STREAMSIDE MANAGEMENT ZONES				
5. Length of SMZ _____				
6. Number of overstory trees blown down _____				
7. Species down (pine, oak, other) _____				
8. Sediment trails reaching stream	☐	☐	☐	☐
9. WQ impact related to SMZ failure?	☐	☐	☐	☐
STREAM CROSSSINGS				
10. Crossing currently stable	☐	☐	☐	☐
11. Crossing blown-out,damaged,or altering water flow	☐	☐	☐	☐
12. WQ impact or sediment deposition from crossing failure	☐	☐	☐	☐
ROADS				
13. Culverts stable and functioning	☐	☐	☐	☐
14. Waterbars and water control structures functioning	☐	☐	☐	☐
15. Wetland road use meet silvicultural exemption	☐	☐	☐	☐
16. Excessive erosion on roads	☐	☐	☐	☐
17. WQ impact from degradation of road system	☐	☐	☐	☐
TIMBER HARVESTING				
18. Percent bare ground on light traffic areas _____				
19. Percent bare ground on high traffic areas (decks, main skid trails. _____				
20. Skid trail stabilization measures functioning	☐	☐	☐	☐
21. Excessive erosion on decks	☐	☐	☐	☐
22. Excessive erosion on trails or harvest area	☐	☐	☐	☐
23. WQ impact from degradation of harvesting activity	☐	☐	☐	☐
NON-HARVEST				
24. Type Activity				
site prep ____ presc burn ___ fertilization ____ regen ____ minor drain ____				
25. Percent bare on previously disturbed area: _____				
26. WQ impact from degradation of non harvest activity	☐	☐	☐	☐
OVERALL				
27. Have any new water quality impacts developed since last visit	☐	☐	☐	☐
28. Have any previous problems corrected naturally	☐	☐	☐	☐
29. Have any previous problems corrected artificially	☐	☐	☐	☐

NOTES AND OBSERVATIONS

(include extreme weather events, excessive standing dead trees, etc.)

NON-HARVEST BMP COMPLIANCE MONITORING FORM

Site ID:

LANDOWNER QUESTIONNAIRE

Landowner Name _____
Landowner Address _____
Landowner City,State _____
Landowner ZIP _____
Landowner Phone _____

Ownership Class
NIPF<1000 ☐ Industry ☐
NIPF>1000 ☐ Public ☐

	Y	N	NA
Are you familiar with SC BMPs for Forestry?	☐	☐	☐
Did you rely on a forester during harvest?	☐	☐	☐
Was there a written contract for the harvest?	☐	☐	☐
Was BMP compliance required in the contract?	☐	☐	☐
Will you allow SCFC to include your property in the monitoring project?	☐	☐	☐
Did landowner request a copy of the completed form?	☐	☐	☐

SITE

Acres treated _____ Waypoint Number _____
Date Logged _____ Latitude _____
County _____ Longitude _____
Region _____ Courtesy Exam Site ID _____
Date of field evaluation _____
Evaluator _____

Physiographic Region
Blue Ridge ☐
Southern Piedmont ☐
Carolina Sandhills ☐
Southern Coastal ☐
Atlantic Coastal ☐

Terrain Type
Upland Clay ☐
Sandhills ☐
Flatwoods ☐
Bottomland ☐
Carolina Bay ☐

Dominant soil texture: Sand ☐ Clay ☐ Loam ☐

	Y	N	NA
Is the site predominantly wetland?	☐	☐	☐

SITE PREPARATION

Type of Site Prep Mechanical ☐ Chemical ☐ Presc Fire ☐ None ☐

	Y	N	SR	NA
On slopes 6-10%, mechanical methods follow contour	☐	☐	☐	☐
On slopes 11-20%, mechanical other than chopping follows countour	☐	☐	☐	☐
Untreated strips 5-10' wide left evert 100' if erosion potential high	☐	☐	☐	☐
On slopes 21-30%, only herbicide, fire, or low intensity mechanical	☐	☐	☐	☐
On slopes over 30%, only herbicide, hand tools, or fire	☐	☐	☐	☐
Logging debris and other litter left where accelerated erosion likely	☐	☐	☐	☐
Minimized soil in windrows and piles	☐	☐	☐	☐
Windrows periodically broken	☐	☐	☐	☐
Planting beds only as high as necessary	☐	☐	☐	☐
On slope >5%, beds follow contour and frequently broken	☐	☐	☐	☐
Waterbars or other methods used to prevent erosion in firebreaks/lines	☐	☐	☐	☐
Vegetation and soil disturbance limited in stabilized gullies	☐	☐	☐	☐
Mechanical site prep avoided in primary SMZ	☐	☐	☐	☐
Avoided significant soil disturbance in secondary SMZ	☐	☐	☐	☐
Broadcast application of any pesticide avoided in SMZ	☐	☐	☐	☐
Left vegetated buffer strip 10' along public roads to slow runoff	☐	☐	☐	☐
Overall, site preparatoin BMPs sufficiently protected water quality	☐	☐	☐	☐

(form continued on next page)

REFORESTATION

Type of planting: Machine ☐ Hand ☐ None ☐

	Y	N	SR	NA
Steep, erodible sites hand planted	☐	☐	☐	☐
Machine planting on contour with slopes >5%	☐	☐	☐	☐
Avoided leaving bags or garbage on site	☐	☐	☐	☐
Overall planting BMP sufficiently protected water quality	☐	☐	☐	☐

PRESCRIBED BURNING

Prescribed burning present? Yes ☐ No ☐

	Y	N	SR	NA
Fire timed to prevent entire humus layer from being burned	☐	☐	☐	☐
Firebreaks located on contour as much as possible	☐	☐	☐	☐
Waterbars used in firebreak lines where needed	☐	☐	☐	☐
Hand tools used to tie firebreak lines into stream channels	☐	☐	☐	☐
Avoided too hot fire and exposed mineral soil	☐	☐	☐	☐
Kept high intensity fire out of SMZs	☐	☐	☐	☐
Avoided burning on severly eroded soils with less than 1/2” duff	☐	☐	☐	☐
Avoided water controls that divert runoff into streams	☐	☐	☐	☐
Overall prescribed burning suffiently protected water quality	☐	☐	☐	☐

PESTICIDES

Pesticides applied on site? Yes ☐ No ☐

	Y	N	SR	NA
Pesticide containers properly disposed	☐	☐	☐	☐
Avoided excessive drift	☐	☐	☐	☐
Pesticide handling done away from water	☐	☐	☐	☐
All spills cleaned up immediately	☐	☐	☐	☐
Avoided applying pesticides to water bodies	☐	☐	☐	☐
Avoided broadcast application within SMZ	☐	☐	☐	☐
Avoided damage to trees in the primary SMZ	☐	☐	☐	☐
Overall pesticide application sufficient to protect water quality	☐	☐	☐	☐

FERTILIZATION

Fertilizer applied on site? Yes ☐ No ☐

	Y	N	SR	NA
Water bodies protected with appropiate buffers	☐	☐	☐	☐
Fertilizer containers properly disposed of	☐	☐	☐	☐
Avoided applying fertilizer to water bodies	☐	☐	☐	☐
Overall fertilizer application sufficient to protect water quality	☐	☐	☐	☐

MINOR DRAINAGE

Minor drainage on site? Yes ☐ No ☐

	Y	N	SR	NA
New minor drainage	☐	☐	☐	☐
Minor drainage used only where necessary	☐	☐	☐	☐
Depth, spacing, number of ditches minimized	☐	☐	☐	☐
Designed to minimize maintenance	☐	☐	☐	☐
Spoil does not impede entry of surface water into ditch	☐	☐	☐	☐
Ditches empty into areas where runoff filtered before reaching channel	☐	☐	☐	☐
Ditches maintained as needed to keep system functioning	☐	☐	☐	☐
Avoided converting wetlands to upland	☐	☐	☐	☐
Avoided emptying drainage ditches into perennial or intermittent streams	☐	☐	☐	☐
Avoided re-dredging more than original depth, width	☐	☐	☐	☐
Did not cause ponding with placement of fill	☐	☐	☐	☐
Did not use 404 exemption for non-silvicultural objectives	☐	☐	☐	☐
Overall minor drainage sufficient to protect water quality	☐	☐	☐	☐

Overall Rating Excellent ☐ Adequate ☐ Inadequate ☐

COMMENTS

(List major prolems if Inadequate/Noteworthy positive and negative aspects for all)

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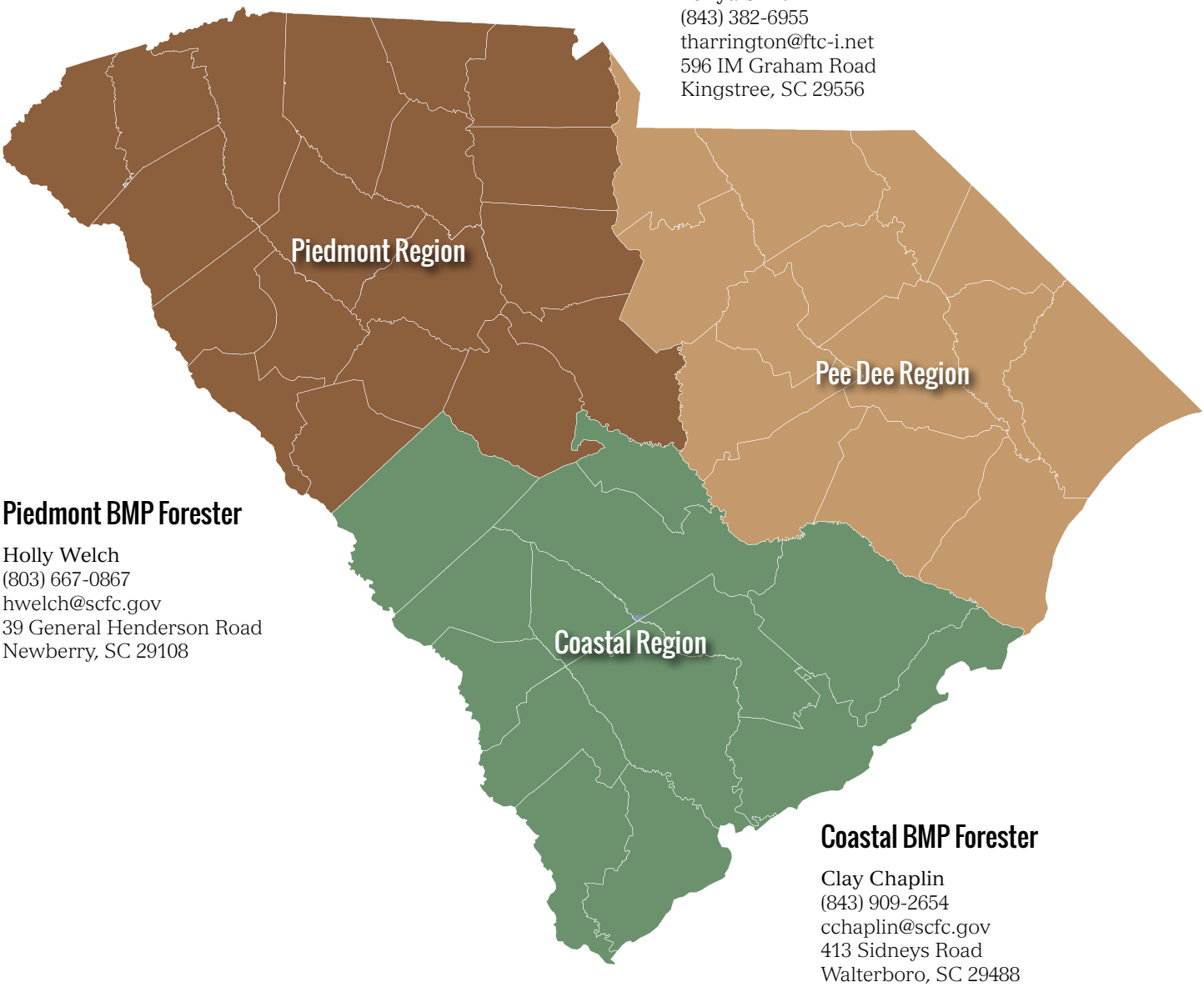

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