Results of Georgia's
2019 Silvicultural Best Management Practices Implementation and Compliance Survey

Prepared by the

Georgia Forestry Commission

in cooperation with the
Environmental Protection Division
of the
Department of Natural Resources,
State of Georgia

December 18, 2019

WATER QUALITY
PROGRAM

GEORGIA FORESTRY
COMMISSION

The preparation of this report was financed in part through a grant from the United States Environmental Protection Agency under the provisions of Section 319(h) of the Federal Water Pollution Control Act, as amended.

EXECUTIVE SUMMARY

The Georgia Forestry Commission (GFC) is the lead agency, as designated by the Georgia Environmental Protection Division (EPD) of the Georgia Department of Natural Resources (DNR), for statewide development, education, implementation, and monitoring for "Georgia's Best Management Practices for Forestry" (BMPs). Beginning in January of 2019, the GFC began the twelfth Statewide Forestry BMP Implementation and Compliance Survey. Such surveys have been done periodically since 1991.

The objectives of the 2019 Statewide Forestry BMP Survey were to determine the following: rates of BMP implementation, miles of streams in compliance, miles of roads in compliance, total number of *water quality risks* identified, effectiveness of BMPs for any needed modifications, and ownership classes and regions to target for future training.

The protocol and scoring methodology for this twelfth survey was consistent with the revised recommendations developed and adopted by the Southern Group of State Foresters' (SGSF) BMP Monitoring Task Force in June 2002, titled *Silvicultural Best Management Practices Implementation Monitoring, a Framework for State Forestry Agencies* at:
http://www.southernforests.org/resources/publications/SGSF%20Regional%20BMP%20Framework%20Protocol%20publication_2007.pdf/view.

The SGSF Task Force is composed of hydrologists and water specialists from state forestry agencies, the US Forest Service, forest industry, and the National Council for Air and Stream Improvement (NCASI), in consultation with EPA Region IV nonpoint source specialists.

The 2019 Statewide Forestry BMP Survey evaluated 254 sites that were selected in a stratified random sample. These sites had to have been silviculturally treated within the past two years, preferably within the previous six months. By ownership, 156 sites occurred on non-industrial private forest land (NIPF), 69 sites on forest industry / corporate land, and 29 sites on public land. By physiographic region, 11 sites were in the Mountains, 13 sites were in the Ridge & Valley, 69 sites were in the Piedmont, 49 sites were in the Upper Coastal Plain and 112 sites were in the Lower Coastal Plain.

BMP implementation was determined by dividing the total number of individual BMPs that were applicable and fully implemented on the sites by the total number of applicable BMPs. Results were summarized for each practice or category, overall site, region, and statewide. **Of the 8074 individual BMPs evaluated, the statewide percentage of correct implementation was 94.40 percent. This is a 1.23 percentage point improvement in BMP implementation from the 2017 survey**. By ownership, the percentage of BMP implementation statewide was 96.30 percent on corporate lands, 97.98 percent on public lands, and 92.82 percent on NIPF lands. Corporate lands remained at a high level rising by 0.95 percentage points from 2017, while NIPF lands and public lands both improved by 1.11 and 1.77 percentage points respectively from the good levels seen in 2017.

Of particular interest is that the number of Water Quality Risks observed decreased from 51 to 34, for an improvement of 33.33.%. The average ratio of Water Quality Risks per site for the 2019 survey is calculated at 0.13, which is lower than the 0.22 risks per site seen in the 2017 BMP Survey. A more detailed discussion of Water Quality Risks can be found later in this report.

Best Management Practices compliance for stream and road length on all sites was evaluated on a mileage basis for this survey. It should be noted that this per unit BMP compliance scoring methodology goes beyond the SGSF recommendations for BMP monitoring and is specific to Georgia. BMP compliance was determined by dividing miles of streams or roads that were in compliance with BMPs, by the total number of miles of streams or roads.

On the 254 sites, 40950.33 acres of separate forestry operations were evaluated. Of the 131.32 miles of streams evaluated, 127.27 miles (or 96.92 percent) were observed to have no impacts or impairment from forestry practices. This remains a good score, and this figure is slightly higher than the 2017 survey, representing a 0.80 percentage point improvement from the previous survey. Of the 205.09 miles of roads evaluated, 196.56 miles, or 95.84 percent, were observed to have no impacts or impairment from forestry practices. This score is slightly lower than the 2017 survey, representing only a 0.12 percentage point change from the 2017 survey. By practice or category, statewide percentages of BMP implementation and compliance were as follows:

Practice or Category	2019
	Implementation (% BMPs Implemented)
Streamside Management Zones (SMZs)	92.96
Stream Crossings	91.49
Forest Roads	93.21
Timber Harvesting	98.22
Mechanical Site Preparation	87.18
Chemical Site Preparation	96.34
Firebreaks/Burning	86.62
Artificial Regeneration (Tree Planting)	98.25
Equipment Servicing	98.39
Special Management Areas	93.94
Forest Fertilization	100
Weighted Overall Average	94.40

Practice or Category	2019
	Compliance (% Miles meeting BMPs)
Stream Mileage	96.92
Forest Roads Mileage	95.84

Forest operators continue to do a good job of protecting sensitive areas, with a 0.15 percentage point improvement in BMP Implementation in the category of streamside management zones (SMZs) being observed. The score for SMZs remains good at 92.96 percent. Stream crossings improved by 3.30 percentage points to a score of 91.49 percent, and special management areas maintained a good score of 93.94 percent. Compared to 2017, forest operators as a whole are doing a better job of implementing forestry BMPs with an overall implementation rating of 94.40 percent. This 94.40 percent represents a slight improvement of 1.23 percentage points from 2017.

BMP implementation for forest roads improved by 2.58 percentage points to a score of 93.21 percent. There continues to be some room for improvement in the areas of stream crossings, and to a lesser extent, forest roads. Stream crossings on public lands and private lands in the Lower Coastal Plain, as well as private lands in the

Piedmont areas of Georgia, need some improvement. Forest roads on private lands in the Piedmont, forest roads on public lands in the Upper Coastal Plain, and forest roads on Corporate lands in the Ridge and Valley region need improvement as well. Streamside management zones (SMZs) scored well at 92.96 percent implementation overall. However, on private lands in the Ridge and Valley and Lower Coastal Plain, some extra attention to SMZs is warranted. Firebreak/burning scores decreased to 86.62 percent implementation, representing a 3.55 percentage point reduction. More education about firebreak/burning BMPs is needed for landowners (including private and public lands) and private contractors. Plans are already in progress to better address this issue during Prescribed Burning Certification Classes held regularly throughout the state.

There were 129 stream crossings evaluated on 69 sites with an overall implementation rate of 91.49 percent, which represents an increase of 3.30 percentage points from the 2017 survey. We continue to see an improved effort to avoid stream crossings in carrying out forestry operations. There were a total of 129 stream crossings out of a total of 254 sites for the 2019 survey. Of note is that 22 more sites were inspected than in the 2017 survey, yet only 19 more stream crossings were found. The most noted stream crossing problems were associated with approach design, culvert sizing, culvert installation, and the use of improper debris crossings and fill. BMPs related to stream crossings accounted for 14 of the total 34 water quality risks on all the survey sites. A more detailed discussion of the reasons seen as the causes of the BMP implementation changes in some categories is located in the *Educational Opportunities* and *Conclusion* section of this report on pp.16-18.

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INTRODUCTION

Georgia has an abundant amount of forest and water resources that provide a variety of benefits for the people of the state and region. The 24 million acres (2016 forest inventory and analysis data) of commercial forestland (two-thirds of the state) provide for forest products, clean water, clean air, soil conservation, wildlife habitat, recreation, aesthetics, education, and research. Many of the state's 44,056 miles of perennial streams, 23,906 miles of intermittent streams, and 603 miles of ditches and canals begin or flow through forestlands. Therefore, it is important for forest landowners to practice responsible forestry in order to protect these water resources

The 1972 Federal Clean Water Act resulted in the Georgia Environmental Protection Division (EPD) being responsible for managing and protecting the state's waters from point and nonpoint sources of pollution. Since 1977, the EPD has designated the Georgia Forestry Commission (GFC) as the lead agency to develop, educate, implement and monitor the use of Best Management Practices (BMPs) for forestry operations to minimize or prevent the practice's nonpoint source pollution contributions (primarily erosion and sedimentation). Upon passage of the Clean Water Act (CWA) Amendments of 1987, the EPA issued guidance on the relationship of *Nonpoint Source Controls and Water Quality Standards* as part of the *Water Quality Standards Handbook*. To paraphrase the guidance: ***It is recognized that Best Management Practices, designed in accordance with a state approved process, are the primary mechanisms to enable the achievement of water quality standards.*** It goes on to explain that ***it is intended that proper installation of state approved BMPs will achieve water quality standards and will normally constitute compliance with the CWA*.**

BMPs for forestry were first developed and published in Georgia in 1981. A wetlands BMP manual was developed in 1990 and revised in 1993. In January 1999, these manuals were combined into one document, with input from environmental groups, soil and water experts, fish and wildlife biologists, attorneys, private forest landowners, independent timber buyers and loggers, academia, and state and federal water quality personnel. Since then, guidance for the treatment of canals and ditches was adopted in March 2000 and for floodplain features in riverine systems in July 2003. Guidance for headwater areas, i.e. ephemeral areas and gullies, was adopted in October 2005. These guidelines were merged into an updated BMP manual released in summer 2009. In 2019, the manual was updated slightly to include some additional clarification on firebreak BMPs. We also incorporated the new intermittent trout stream SMZs and some additional reference materials in the appendix. Since 1981, more than 95,000 BMP manuals and brochures have been distributed.

The main role of the GFC is to educate and inform the forestry community about these common sense recommendations, known as BMPs, through workshops and field demonstrations. Since publication of the first BMP manual, the GFC has given 3,287 BMP talks to more than 106,180 people and participated in 616 field demonstrations of BMPs (through December 2019). The education process is ongoing, with workshops routinely provided for foresters, timber buyers and loggers through the Sustainable Forestry Initiative® (SFI®) Program in Georgia. Georgia Forestry Commission foresters have also provided BMP advice in more than 79,102 cases covering over 5.52 million acres.

Implementation of BMPs is determined through monitoring surveys. The GFC also tracks BMP implementation through BMP Assurance Exams in the regular course of carrying out complaint resolution. Of statistical importance are the monitoring surveys. The GFC has conducted BMP Implementation Surveys in 1991, 1992, 1998, 2002, 2004, 2007, 2009, 2011, 2013, 2015, and 2017. This current 2019 statewide survey continues nearly 30 years of Forestry BMP monitoring in Georgia. The statewide average BMP implementation over this period has ranged from 65 percent in 1991, to a high of 95 percent in 2011, to the current rate of 94.40 percent for 2019. The purpose of this report is to present the results of the 2019 BMP Implementation and Compliance Survey.

SURVEY PROCEDURE

Methodology for Sampling Intensity and Site Selection

The number of evaluation sites in each of Georgia's 159 counties was based on the amount of timber harvested in each county, as determined by the Georgia Forestry Commission's Forest Inventory Analysis report of wood removals by county for 2011. GFC's forest inventory analysis data collection is overseen by the US Forest Service. This methodology resulted in 254 sites being surveyed. The next step was to target the sample where the practices occurred, to reflect ownership. Ownership classes are categorized into non-industrial private forest (NIPF) land, corporate lands including forest industry and Timber Investment Management Organizations (TIMOs), and public lands, which include federal, state, county, or city ownership. The timber harvest drain for each county was used to target the number of sites to inspect per ownership class in each county. For the 2019 BMP survey, 156 sites (61.41 percent) were inspected on NIPF lands, 69 sites (27.17 percent) on corporate, and 29 sites (11.42 percent) on public lands were inspected.

Georgia Forestry Commission personnel used satellite data from LandSat to pull land disturbance locations within a specified timeframe for the potential survey sites. The timeframe includes sites disturbed within the last two years. The sites were checked initially to confirm which sites were actually forestry sites. The forestry sites were separated by ownership category and the appropriate number of sites was drawn randomly. Table 1 (pages 19-21) shows the distribution of survey sites by county.

Site Evaluation

For this twelfth survey, and as noted in the Executive Summary, the protocol and scoring methodology was consistent with the Southern Group of State Foresters' Protocol titled *Silvicultural Best Management Practices Implementation Monitoring, a Framework for State Forestry Agencies at:* http://www.southernforests.org/resources/publications/SGSF%20Regional%20BMP%20Framework%20Protocol%20publication_2007.pdf/view

After sites had been selected and verified in the field by county foresters or forest technicians, all landowners were contacted to obtain permission to conduct site evaluations. All evaluations were conducted by trained forest water quality specialists or region water quality foresters to provide accuracy, consistency, and quality control using the BMP Compliance Survey Form. For a blank copy of the 14-section 136 question form, please contact Scott Thackston (*sthackston@gfc.state.ga.us*).

Once a site was selected, the forest water quality specialist or region water quality forester inspected the site and completed the survey form. Each site was identified by county, GFC region, physiographic region, ownership, river basin and sub-basin, silvicultural treatment type, terrain class, soil erodibility class, hydric soil limitation class, types of water bodies within the practice area, and miles of streams and roads evaluated within the practice area. Soils and stream data were determined using NRCS county soil survey maps, Web Soil Survey, or USGS topographical maps. Data could be extracted through each of these fields of information.

BMP Implementation

Each site was evaluated for BMP implementation by observing as much of the treated area as possible and answering the 136 specific, YES/NO questions directly related to BMP implementation. Scoring was determined at three levels on each site: (1) individual BMP; (2) category of practice; and (3) overall site implementation.

Level 1 - individual BMP implementation was recorded as either a *NOT APPLICABLE, YES,* or *NO*. For all applicable BMP's, each question was worded so that a *YES* represents a BMP that was implemented properly while a *NO* represents a BMP implemented improperly or not at all. If an individual BMP that was applicable and needed was not fully implemented over the entire area, it received a *NO*. There is no partial credit, as recommended by the SGSF framework.

Level 2 - categories of practice and Level 3 - overall site implementation, scores were expressed as a percent of all applicable BMPs implemented against all applicable BMPs in the category of practice and overall site. Therefore, each category of practice and overall site could score between 0 and 100 percent. The categories of practices evaluated were as follows:

Streamside Management Zones (SMZs)
Stream Crossings
Forest Roads
Timber Harvesting
Mechanical Site Preparation
Chemical Site Preparation
Firebreaks/Burning
Artificial Regeneration (Tree Planting)
Equipment Servicing
Special Management Areas
Forest Fertilization

Significant Water Quality Risk

Each BMP was further evaluated in terms of significant *water quality risk* (WQR). A risk is defined by the SGSF framework for monitoring as "*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*." Documenting the occurrence of risks serves a number of useful and practical purposes. First, risk assessment lends much credibility and integrity to the BMP monitoring process by evaluating the effectiveness of an individual or group of BMPs and allows opportunities to analyze ineffective BMPs for possible revisions. Second, it recognizes that high-risk conditions can occur and that prevention and/or restoration is a high priority for state forestry agencies. Third, routine documentation of risks will determine whether such instances are the exception rather than the rule. Fourth, finally providing forest landowners with an objective risk assessment is a valuable public service that not only protects the environment, but can also protect the landowner and/or operator from what might otherwise result in enforcement proceedings or other personal liability.

BMP Compliance

BMP Compliance was also determined for the categories of forest roads and stream length. This scoring methodology goes beyond the SGSF BMP monitoring protocol and is specific to Georgia. However, this scoring methodology allowed for comparison with previous surveys in determining trends. Forest road and stream length were measured in *miles*. Scores were expressed as a percent of units of measure in BMP compliance against the total units of measure evaluated. Documenting compliance with the units of measure is important in that it allows forest managers, landowners, and regulators to see the holistic picture of forestry operations and our effect on these critical categories. As with the implementation evaluation, the lack of BMP implementation may not necessarily equate to large-scale areas being out of compliance. For those two categories, it provides a better picture of locations to be prioritized for improvements.

RESULTS AND DISCUSSION

The 2019 Statewide Forestry BMP Survey evaluated 254 sites comprising 40,950.33 acres. There were 129 stream crossings, 205.09 miles of forestry roads and 131.32 stream miles evaluated. Table 1 (pages 19-21) shows the distribution of survey sites by county. Figure 1 (page 45) shows the spatial location of the 254 survey sites. Figure 2 (page 46) is a map of the state showing the different physiographic regions for reference. The tables, charts, and maps included with this report provide summaries of the distribution of the sites evaluated by region and ownership, as well as BMP implementation and compliance results.

Statistical Analysis

The 254 sites evaluated during this survey represent only a sample of all operations that met the criteria for selection. Data compiled from county tax assessors' offices indicates that the number of timber harvesting operations conducted annually ranges from 7,000 to 10,000. Therefore, one could assume the sample reflects a range of 3.6 percent to 2.5 percent sample at best. In order to achieve a statistically valid monitoring report, Georgia has adopted the *Statistical Guide for BMP Implementation Monitoring.* This guidance was developed by the Water Resources Committee of the Southern Group of State Foresters, to be used as a model for achieving statistically valid BMP monitoring.

The guide has been used to determine the number of sites needed to conduct a statistically reliable survey, to calculate the margin of error for each BMP category or individual BMP, and analyze statistical trends in implementation.

Formula for Determining the Sample Size, or Number of Sites to Evaluate

$$n = \frac{4p(100 - p)}{m^2}$$

Where n = the number of sites to evaluate
p = the estimated overall percent implementation in the state
m = the margin of error (5%)

- p must be estimated because it is unknown (% implementation from the most recent survey may be used).
- The closer the estimated value of p is to 100, the lower the value of n will be.
- n is highest when p is estimated to be 50 percent.
- m is the margin of error associated with the estimate of P. That is, there is 0.95 probability that the sample taken will produce an estimate that differs from p by a value of m.
  The SGSF framework recommended a margin of error at five percent.

This formula provides the minimum sample size of 102 sites in order to achieve a five percent margin of error. We have evaluated 2.49 times the needed number of sites, so, using the formula, this level of survey should yield a margin of error of 3.17% for this survey. The reason the additional sites were assessed is so subsets of data in the survey, i.e., landowner groups, physiographic regions, river basins, etc., would be more statistically valid when used separately from statewide data.

OVERALL BMP IMPLEMENTATION AND COMPLIANCE RESULTS BY CATEGORY OF PRACTICE

Streamside Management Zones (SMZs)

Streamside Management Zones (SMZs) are designated areas of varying widths adjacent to the banks of perennial (continuous flowing) or intermittent (normally flows only during winter months) streams and other bodies of water. USGS topographical maps and Natural Resource Conservation Service county soil survey maps along with field observations were used to identify these types of streams. In these SMZs, forest management practices are modified in order to minimize potential impacts to protect water quality, fish, or other aquatic resources. According to the 2019 BMP manual, SMZs along intermittent streams vary in width from 20 to 50 feet on most streams, depending on slope. A formal amendment was made to the trout stream SMZs in 2015 and incorporated into the actual manual in 2019. SMZs along intermittent trout streams are now 35 to 50 feet. SMZs along perennial streams vary from 40 to 100 feet, depending on slope, and SMZs should be 100 feet on perennial trout streams. Clearcutting is not recommended in the SMZs, except during the control of documented serious health/pest issues such as southern pine beetles or salvage operations from natural disasters. Special care should still be given to avoid adverse soil disturbance.

It is worth noting that during the course of this survey many sites had areas left where no harvesting occurred adjacent to streams. These unharvested areas are significantly wider than what is recommended by definition as an SMZ. Such areas provide all the water protection of an SMZ plus other multiple use benefits such as wildlife corridors, diversity, and aesthetics. However, areas were not judged as SMZs where they were significantly wider than normal SMZs, and therefore the forestry activities that did occur on the parcels do not have any effect on water quality. In addition, these areas were not marked to show that they were intentionally left as an SMZ. If such areas had been included as SMZs, then scores would likely have been even higher than recorded.

Table 2 (page 22) provides summaries of the results by ownership, region, and state totals. Chart 6 (page 39) provides total BMP Implementation over time. Notable findings include:

- Statewide implementation for SMZs is 92.96 percent.
- Statewide BMP compliance for stream length is 96.92 percent.
- 13 WQRs were identified for SMZs (all on NIPF ownerships), up slightly from 12 in 2017.
- Implementation for overall SMZs have increased slightly, by 0.15 percentage points to a still good overall score of 92.96 percent. Of note, the Ridge and Valley area went up 2.54 percentage points to a score of 94.03 percent, and the Lower Coastal Plain area went down to a score of 87.00 percent, losing 0.92 percentage points from 2017.
- Insufficient SMZ widths, insufficient residual basal area, logging debris left in stream channels, and streambank tree harvesting seem to be the most common BMP deficiencies found in the SMZ category. Additionally, the tie-in of firebreaks within SMZs needs additional attention.

Stream Crossings

Stream crossings are often necessary for access to forestlands. From a water quality standpoint, stream crossings are the most critical aspect of the road system. Failure of a stream crossing due to improper planning or construction can result in erosion and introduction of sediment into a stream, affecting water quality. Types of acceptable crossings include main haul road fords, culvert crossings, and bridges. Dirt/Debris-type crossings and skidder fords are not acceptable crossing types. Permanent crossings are considered those still in place at the time of inspection. Temporary crossings were noted where crossing approaches were still evident, but the actual crossing facility (i.e. temporary bridge, culvert and fill, etc.) had been removed.

Table 3 (page 23) provides a summary of the results by ownership, region, and state totals. Chart 7 (page 39) provides total BMP Implementation over time. A total of 129 crossings were evaluated on 69 sites statewide. Significant findings include:

- Statewide implementation for stream crossings is 91.49 percent. This is a 3.30 percentage point improvement from 2017.
- Stream crossings improved by 7.76 percentage points in the Mountain region, by 5.89 percentage points in the Lower Coastal Plain region, and by 4.44 percentage points in the Ridge and Valley region. Stream crossings declined slightly by 0.85 percentage points for the Piedmont region, and they declined by 0.88 percentage points for the Upper Coastal Plain region.
- 14 WQRs were associated with stream crossings. This represents a 26.3 percent reduction overall in Water Quality Risks for stream crossings from 2017.
- All these WQRs associated with stream crossings occurred on NIPF lands, and no WQRs were found on corporate and public ownerships.
- Areas for improvement in stream crossing design continue to be stream crossing approach design, culvert installation and culvert sizing with respect to storm flow, and culvert placement with respect to migration of aquatic species.

Forest Roads Outside SMZs

Access roads are an essential part of any forest management operation and provide access for other activities, permanent or temporary. With proper planning, location, construction and maintenance, access roads allow for productive operations and minimally impact soil and water quality. However, poorly located, poorly constructed, and/or poorly maintained roads can result in sediment reaching streams. These factors may lead to changing stream flow patterns, degrading fish and aquatic organism habitat, and adversely affected aesthetics.

Table 4 (page 24) provides a summary of the results by region, ownership, and state totals. Chart 8 (page 40) provides total BMP Implementation over time. Approximately 205.09 miles of road were evaluated on 241 sites. Forest road BMP implementation showed an increase of 2.58 percentage points from the 2017 survey. Significant findings include:

- Forest roads BMP implementation across all ownerships is 93.21 percent.
- Forest roads compliance is 95.84 percent, nearly identical to the good results from 2017.
- There were just two WQRs associated with forest roads (all on NIPF ownerships).
- Challenges for forest roads BMP implementation continue to be properly installing water diversions and stabilizing and reshaping of forest roads after activities are complete.

Special Management Areas

This category applies to canals and ditches, riverine floodplain features, and headwater areas that could possibly transport sediments and other pollutants into other water bodies. These areas need some measure of protection, but normally do not need to be treated as streams.

Table 5 (page 25) provides a summary of the results by region, ownership, and state totals. Chart 9 (page 40) provides total BMP Implementation over time. Statewide, there were 215 sites with canals, ditches, ephemeral areas, gullies, floodplain features, and wetland features. Other significant findings include:

- Special management area BMP implementation across all ownerships was 93.94 percent.
- There were three WQRs associated with special management areas, half the number found in 2017.

- Special Management Area BMP implementation maintained a good score with a 1.89 percentage point improvement from the 2017 survey.

Timber Harvesting Outside SMZs

Timber harvesting outside of SMZs poses little threat to water quality in Georgia. Potential impacts can be avoided or minimized if careful consideration is given to seasonal weather conditions, soil type, soil moisture, topography, and equipment type matched to the particular harvesting site. The location, construction, and maintenance of log decks and skid trails are the primary concerns.

Table 6 (page 26) provides a summary of the results by ownership, region, and state total. Chart 10 (page 41) provides total BMP Implementation over time. Approximately 24,145.06 acres were evaluated on 241 sites. A total of 917 log decks were evaluated and 1,459 main skid trails were evaluated. Other significant findings include:

- Timber harvesting outside SMZs BMP implementation, across all ownerships, is 98.22 percent.
- All BMPs for Timber Harvesting scored 93 percent or better, except for minimizing rutting on wetland soils, which scored 83.00 percent.
- There was just one WQR associated with Timber Harvesting (on a NIPF ownership).

Mechanical Site Preparation Outside SMZs

Site preparation methods groom harvested and non-forested areas for the natural and artificial regeneration of desired tree species and stocking. Methods include shearing, raking, chopping, windrowing, piling, bedding, and other physical methods to cut, break apart or move logging debris, or to improve soil conditions prior to planting. The purpose is to reduce logging impacts and debris, control competing vegetation, and enhance seedling survival. The technique or method(s) used depends on soil type, topography, erodibility, condition of the site, and any wetland limitations.

Table 7 (page 27) provides a summary of the results by region, ownership, and state totals. Chart 11 (page 41) provides total BMP Implementation over time. Statewide, approximately 2,335.61 acres were evaluated on 30 sites. Significant findings include:

- Mechanical Site Prep BMP implementation is 8.27 percentage points lower than the 2017 survey. It now sits at 87.18 percent. While this is a noteworthy decline, the score is still acceptable.
- Only one WQR was found (on a corporate ownership).
- Mechanical Site Prep for pine regeneration in wetlands identified in EPA/USACE memo did not occur on any applicable sites surveyed.
- The main challenge observed for Mechanical Site Prep is avoiding bedding that directs water into roadways and ditches.

Chemical Site Preparation Outside SMZs

Herbicides are valuable tools used in forest management to control competing vegetation, invasive species, and enhance tree survival and growth. On many highly erodible sites, the use of herbicides is actually more effective than exposing too much surface area by mechanical site preparation methods. By following EPA approved labels that govern storage, transportation, handling, and application, herbicide application should not pose any threat to water quality.

Table 8 (page 28) provides a summary of the results by region, ownership, and state totals. Chart 12 (page 42) provides total BMP Implementation over time. Statewide, approximately 3,315.47 acres were evaluated on 41 sites. Significant findings include:

- BMP implementation and compliance for Chemical Site Prep is 96.34 percent.
- The one issue for Chemical Site Prep included just two relatively minor instances of drift into sensitive areas.

Firebreaks/Burning Outside SMZs

Controlled burning is often used alone or in conjunction with chemical or mechanical site preparation to prepare sites for regeneration. It may also be used during timber stand management to control or reduce hazardous accumulations of forest fuels, manage competing vegetation, improve wildlife habitat, and perpetuate certain endangered plant and animal ecosystems.

Approximately 6,540.22 acres were evaluated for burning including 56.09 miles of firebreaks. There was a total of 43 sites evaluated for firebreaks/burning. BMP implementation was 86.62 percent. The score dropped by 3.55 percentage points from 2017, but the overall score remained adequate. The main challenges involved firebreaks including proper construction and spacing of water diversions, avoiding intersections with forest roads, and tying improperly into streamside management zones or special management areas. Zero water quality risks (WQRs) were identified on any of the firebreaks inspected here. That is a decrease from the four water quality risks found in 2017. Firebreaks are created by various methods to contain prescribed burns and wildfires. If properly installed according to BMP guidelines, firebreak impacts on water quality can be minimized.

Of the 43 sites, 22 sites included GFC installed firebreaks. GFC installed firebreaks scored 94.24 percent BMP implementation. There were 23 sites that included landowner (private and public) or contractor installed firebreaks. For the 2019 survey landowner/contractor installed firebreaks scored 79.33 percent BMP implementation. However, it is again worth noting that no water quality risks were found on the firebreaks inspected here. Historically relatively little firebreak BMP training has occurred for landowner or contractors. GFC personnel receive regular training on firebreak BMPs. In 2018, GFC started providing some firebreak BMP training to landowners and contractors during regularly held Prescribed Burn Certification classes.

Table 9 (page 29) provides a summary of the results by region, ownership, and state totals. Chart 13 (page 42) provides total BMP Implementation over time.

Artificial Regeneration (Tree Planting) Outside SMZs

Reforestation can be accomplished artificially or naturally. Natural regeneration and hand planting generally pose less of a threat to water quality than mechanical methods.

Table 10 (page 30) provides a summary of the results by region, ownership, and state totals. Chart 14 (page 43) provides total BMP Implementation over time. Approximately 2,320.14 acres were evaluated on 30 sites. Overall BMP implementation for artificial regeneration was 98.25 percent. That maintains a high level nearly the same as the 2017 survey. No water quality risks were identified. Significant findings include:

- The only issue found was a single site where machine planting did not fully follow the contour. No water quality risks were identified.
- BMPs were fully implemented on the vast majority of these sites.
- Pine establishment was avoided on specified wetlands identified in the EPA/USACE memo.

Forest Fertilization

Forest fertilization was known to have occurred on only one survey site. It was a corporate site in the Lower Coastal Plain. A total of 40.49 acres were treated with two BMPs assessed on the one site with a 100% BMP implementation. Indicators of this particular practice include evidence of mixing areas and containers on the site. Since the BMPs call for the removal and proper disposal of containers, additional fertilization that was not obvious may have occurred.

Equipment Washing and Servicing

Improper equipment washing and servicing can introduce hazardous or toxic materials to the site, which can affect water quality. Oils, lubricants, their containers, and other trash and waste should be disposed of properly.

Table 11 (page 31) provides a summary of the results by region, ownership, and state totals. Chart 15 (page 43) provides total BMP Implementation over time. A total of 923 landings were evaluated on 249 sites. Significant findings include:

- BMP implementation for Equipment Servicing was 98.39 percent, up 0.27 percentage points from 2017.
- The most common issue was improper disposal of oil/lubricants, containers, and other trash.
- All BMPs assessed for Equipment Servicing were implemented at or above 97 percent.

Stream Assessments

Perhaps the most important observation in evaluating the effectiveness of BMPs was the visual assessment of the water bodies on each site. A total of 131.32 miles of streams on 156 sites were evaluated for visual signs of impairment. Those signs could include obvious soil erosion entering the stream, logging debris left in the channel, improper stream crossings resulting in blocked flow, excessive removal of canopy trees within the SMZs exposing the stream to elevated temperatures, and impaired stream bank or channel integrity due to forestry practices.
Table 12 (page 32) provides a summary of the results by region, ownership, and state totals by stream type. A total of 73.02 miles of perennial streams were assessed on these sites. Of these, 96.82 percent are in compliance. A total of 58.30 miles of intermittent streams were assessed on these sites. Of these, 97.03 percent are in compliance. Total combined stream compliance was 96.92 percent. Significant findings include:

- 34 water quality risks (WQRs), total, were identified statewide.
- There were 14 WQRs (41.18 percent of the total) involving stream crossings.
  - ✓ 5 of these were associated with steam crossing approaches.
  - ✓ 2 involved disruption of the migration of aquatic species
  - ✓ 5 were associated with temporary fills not removed in their entirety.
  - ✓ 2 involved culvert sizing.
- Forest roads outside of SMZs accounted for 2 WQRs (approximately 5.88 percent of the total).
  - ✓ The lack of properly installed water diversions at SMZs accounted for both water quality risks for forest roads.
- Within SMZs, there were 13 WQRs (38.24 percent of the state total of WQRs).
- 3 WQRs were associated with Special Management Areas.
- 1 WQR was associated with Mechanical Site Prep outside of SMZs for improper methods used on sites with 0-5% slopes.
- 1 WQR was associated with Timber Harvesting outside of SMZs involving rutting in saturated soils.

Overall, the 96.92 percent stream compliance figure in Georgia further supports that BMPs are protecting water resources.

Overall Statewide Results

Table 13 (page 33) provides the statewide implementation results of the total number of sites, the acres evaluated, the number of BMPs evaluated, and the number of water quality risks determined by region and ownership. Chart 16 (page 44) provides total BMP Implementation over time. Statewide, the overall BMP implementation for all practices, all landownership classes, and all regions, was found to be 94.40 percent. This is a 1.23 percentage point improvement from the 2017 survey.

Water Quality Risk Assessment

Water Quality Risk assessments were made at each site as a component of the Southern Group of State Foresters' BMP monitoring protocol. Water Quality Risks (WQRs) were observed at 34 specific locations on just 24 sites, out of the 254 total survey sites. This indicates that only a small portion of sites contain any WQRs. The total of 34 WQRs is significantly lower than the previous BMP survey in 2017, representing a 33.33 percent improvement from the 2017 survey. Looking into these numbers a little deeper, it can be seen that 90.55 percent or 230 of the 254 sites surveyed for 2019 had no WQRs. Overall, it is clear that a small percentage of the sites surveyed account for all the observable Water Quality Risks seen. Below is a table showing the distribution of Water Quality Risk occurrence over the past eight survey cycles.

Survey Year	Survey Done	0 WQ Risks		1-3 WQ Risks		4-6 WQ Risks		7-9 WQ Risks		10 or more WQ Risks	
2004	412	352	85.44%	36	8.74%	13	3.16%	5	1.21%	6	1.46%
2007	370	328	88.65%	21	5.68%	15	4.05%	4	1.08%	2	0.54%
2009	221	212	95.93%	8	3.62%	1	0.45%	0	0.00%	0	0.00%
2011	187	178	95.19%	7	3.74%	1	0.53%	1	0.53%	0	0.00%
2013	209	185	88.52%	13	6.22%	6	2.87%	3	1.44%	2	0.96%
2015	213	199	93.43%	7	3.29%	3	1.41%	3	1.41%	1	0.47%
2017	232	214	92.24%	13	5.60%	4	1.72%	1	0.43%	0	0.00%
2019	254	230	90.55%	23	9.06%	1	0.39%	0	0.00%	0	0.00%

Educational Opportunities

BMPs for roads and stream crossings both experienced a slight to modest improvement from our 2017 survey of about three percent. Our educational opportunities continue to be focused on these categories. In addition, we will emphasize mechanical site prep and firebreak/burning BMPs. In particular, educational opportunities include:

- Stream Crossings
  - ✓ Culvert crossing design and installation information.
  - ✓ Basic stream crossing design needs, including storm flow and aquatic migration requirements.
  - ✓ Stream crossing approach design and stabilization.
  - ✓ Temporary portable bridge use.
- Forest Roads
  - ✓ Storm water control structure design and placement.
  - ✓ Proper closeout needs following harvest activities.

- Timber Harvesting
  - ✓ Skid trail stabilization requirements.
  - ✓ Minimizing rutting on saturated soils.
  - ✓ Minimizing harvests on wetland sites during wet weather.
- Mechanical Site Preparation
  - ✓ Avoidance of bedding directing surface runoff to roads and road-ditches.
- Firebreaks/Burning
  - ✓ Proper firebreak planning and water diversion installation.

Charts 1 through 4 (pages 34-37) are perhaps the most important tools in this document for determining BMP implementation trends. These charts provide an overall summary and comparison of BMP implementation by practice and ownership over recent survey cycles. They also provide impetus for continued training and improvement. The table below illustrates BMP Implementation according to three tract size groupings.

Tract Size	No. Sites	Acres	BMPs Assessed	% BMPs Implemented	WQ Risks
Under 100 Acres	139	10854.43	4053	94.42%	18
101-200 Acres	85	16096.28	2871	93.92%	8
201 Acres or more	30	13999.62	1150	95.39%	8
All	254	40950.33	8074	94.40%	34

As shown in the above table, differences in the BMP implementation scores for different tract sizes appear to be minimal, but smaller tracts had more WQRs per acre on average than larger tracts. There are several reasons smaller tracts, on average, experience higher Water Quality Risks. These reasons include: potential poor road location due to tract boundary constraints, potentially more stream crossings due to the access issues and boundary locations of smaller tracts, and having more roads and stream crossings simply because there are more landowners needing access across their parcels. Therefore, parcelization of land into more and smaller parcels seems to be part of the issue. Also, since smaller landowners often have fewer resources and/or knowledge of forestry, problems are often left unnoticed or given little attention, likely resulting in more water quality risks on such ownerships. When land is allocated into larger tracts, there are fewer owners, and therefore, less need for stream crossings and access points from public roads. Larger landowners also tend to have more resources and/or knowledge of forestry to recognize and address potential issues.

All of these results suggest a need for additional outreach to landowners of all sizes of tracts, but especially smaller acreage landowners of fewer than 100 acres. The GFC has already undertaken efforts to make BMP educational information available online. Currently, GFC has five BMP learning modules available for anyone to access at any time to learn about forestry BMPs. Module titles include *Temporary Stream Crossings*, *Stream Classification*, *Forest Roads*, and *Pre-Harvest Planning*, along with a slide-show depicting detailed installation steps for Geoweb rocked ford stream crossing installation. These modules are located on GFC's public website at: http://gatrees.org/forest-management/water-quality/. Additional modules might be created in the future to continue to address these needs. In addition, an ongoing effort further promotes the use of temporary portable bridges for timber harvesting. Although we continue to see efforts made to avoid the need for stream crossings during timber harvesting activities, issues persist with skidders using inadequate crossings. An increased use of proper temporary and/or portable logging bridge stream crossings would help avoid many of these problems. Also, for mechanical site prep, there is a need to re-emphasize the avoidance of bedding directing surface runoff into roads and road-ditches. Finally, we plan to continue to emphasize the BMPs for firebreak installation through our Prescribed Burn Certification training for landowners and contractors that started just last year.

Chart 5 (page 38) shows the current number of Water Quality Risks (WQRs) observed in BMP implementation surveys between the 1998 survey and the present. There had been a dramatic decline in these observed WQRs until the 2013 survey, which exposed some issues with basic BMP implementation and planning, leading to an uptick in WQRs for that 2013 survey. However, our 2019 survey showed a significant reduction in WQRs, from 51 WQRs in the 2017 survey, to 34 WQRs in the 2019 survey, for a 33.33% improvement overall since 2017.

BMP Implementation data available by River Basin and Ecoregion

Regional Water Councils can extract similar statistics for each of the 14 major river basins (Figure 3, page 47), 52 sub-basins, and 12-digit HUCs for use in accordance to the Georgia Comprehensive State-wide Water Management Plan. Each of Georgia's 29 Ecoregions (Figure 4, page 48) could also be used to extract the survey statistics.

CONCLUSION

The percentage of BMP implementation has increased from 64.9 percent in 1991 to 94.40 percent for the current survey. The percentage of stream miles in compliance has increased to around 96.92 percent. Since the 1998 survey, the number of water quality risks has markedly decreased, but experienced a significant upswing in the 2013 survey. However, the number of WQRs have continued to decrease significantly since the 2013 survey. Chart 5 (page 38) tracks the level of observed Water Quality Risks since the 1998 survey.

The 2019 BMP implementation survey shows the need for continued BMP education efforts in order to help stabilize BMP implementation at satisfactory levels. Although the survey shows relatively high overall rates of BMP implementation, it also reveals areas for improvement within certain BMP categories and across certain landowner groups in the state. The information from this survey will be used to target BMP training at Master Timber Harvester workshops, SWPA workshops, and forester and landowner workshops and trainings. In addition, emphasis for the increased use of portable logging bridges could be useful in helping maintain/increase stream crossing BMP implementation.

GFC will continue to use available means to resolve forestry BMP complaints. The Georgia Forestry Commission, the Georgia Forestry Association, the University of Georgia Warnell School of Forestry and Natural Resources, participating companies who subscribe to the Sustainable Forestry Initiative, and the Southeastern Wood Producers Association support this concept. The Georgia SFI® committee will continue to monitor and address "violators," as reported to their Inconsistent Practices sub-committee. Non-compliance cases will be referred to state or federal regulatory agencies.

APPENDIX

Table 1: Site Distribution by County and Ownership

County	Public	Corporate	NIPF	Totals
Appling		1	1	**2**
Atkinson			2	**2**
Bacon		1	2	**3**
Baldwin			1	**1**
Banks			1	**1**
Bartow		2		**2**
Ben Hill			1	**1**
Berrien		1	1	**2**
Bleckley			1	**1**
Brantley		3		**3**
Brooks			2	**2**
Bryan North			1	**1**
Bryan South	1			**1**
Bulloch		1	3	**4**
Burke		1	5	**6**
Butts			1	**1**
Calhoun			1	**1**
Camden		3	1	**4**
Candler			1	**1**
Carroll		1	2	**3**
Charlton	2	1		**3**
Chattooga	2	1		**3**
Cherokee		1	1	**2**
Clay			1	**1**
Clinch		6		**6**
Coffee			2	**2**
Colquitt			1	**1**
Columbia		1		**1**
Cook			1	**1**
Coweta	1		1	**2**
Crawford		1	1	**2**
Dade			1	**1**
Dawson	2			**2**
Decatur			2	**2**
Dodge			3	**3**
Dooly			2	**2**
Douglas			1	**1**
Early			2	**2**
Echols		2	1	**3**
Effingham			3	**3**
Elbert		2		**2**
Emanuel		1	2	**3**
Evans			1	**1**
Floyd	1		1	**2**
Franklin			1	**1**
Gilmer			1	**1**
Glascock		1		**1**
Glynn	1			**1**
Gordon			1	**1**
Grady			2	**2**
Greene		2		**2**

County	Public	Corporate	NIPF	Totals
Hall		1		**1**
Hancock	1	1	2	**4**
Haralson		1	1	**2**
Harris		1		**1**
Hart			1	**1**
Heard			1	**1**
Henry			1	**1**
Houston			1	**1**
Irwin			2	**2**
Jackson		1		**1**
Jasper	1		1	**2**
Jeff Davis	1		1	**2**
Jefferson		1	1	**2**
Jenkins			1	**1**
Johnson	1		1	**2**
Jones	1		2	**3**
Lamar			1	**1**
Lanier		1	1	**2**
Laurens			2	**2**
Lee			1	**1**
Liberty	1	1	2	**4**
Long		2		**2**
Lumpkin			1	**1**
Macon			1	**1**
Madison			1	**1**
Marion		1	1	**2**
McDuffie			2	**2**
McIntosh	1		1	**2**
Meriwether	1	1		**2**
Miller			1	**1**
Mitchell			1	**1**
Monroe	1	1		**2**
Montgomery			1	**1**
Morgan		1	1	**2**
Murray		1		**1**
Newton			1	**1**
Oconee			1	**1**
Oglethorpe	1		2	**3**
Paulding	1			**1**
Pickens		1	1	**2**
Pierce		1	1	**2**
Pike			1	**1**
Polk			2	**2**
Pulaski			1	**1**
Putnam		1		**1**
Quitman			2	**2**
Rabun	2			**2**
Randolph			2	**2**
Schley	1		1	**2**
Screven			4	**4**
Seminole			1	**1**
Spalding			2	**2**
Stewart		1	1	**2**
Sumter			2	**2**

County	Public	Corporate	NIPF	Totals
Talbot		1		**1**
Taliaferro		1		**1**
Tattnall			2	**2**
Taylor			2	**2**
Telfair		1	2	**3**
Terrell			1	**1**
Thomas			1	**1**
Tift			2	**2**
Toombs		2		**2**
Towns			1	**1**
Treutlen			1	**1**
Troup			1	**1**
Turner			1	**1**
Twiggs			2	**2**
Union	2			**2**
Upson		2	1	**3**
Walker	2			**2**
Walton		1	1	**2**
Ware		2	3	**5**
Warren		2	1	**3**
Washington			3	**3**
Wayne		1	3	**4**
Wheeler			2	**2**
White			1	**1**
Whitfield			1	**1**
Wilcox			1	**1**
Wilkes		2	2	**4**
Wilkinson	1	1	2	**4**
Worth		1	1	**2**
Total	**29**	**69**	**156**	**254**

Tables 2 a – d: Distribution of Sites with Streamside Management Zones Evaluated By Region Ownership, Acres Evaluated, BMP Assessed, and % BMPs Implemented, and # Water Quality Risks.

2a. Streamside Management Zones - NIPF					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	65.45	39	97.44%	0
Piedmont	32	200.19	298	94.63%	2
Upper Coastal Plain	16	153.12	142	92.25%	2
Lower Coastal Plain	40	185.15	373	84.45%	8
Ridge and Valley	3	35.87	26	88.46%	1
Total	96	639.78	878	89.86%	13
2b. Streamside Management Zones - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	3	369.09	24	100.00%	0
Piedmont	8	294.14	64	100.00%	0
Upper Coastal Plain	4	30.71	27	100.00%	0
Lower Coastal Plain	2	2.62	18	100.00%	0
Ridge and Valley	3	16.76	23	100.00%	0
Total	20	713.32	156	100.00%	0
2c. Streamside Management Zones - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	48.9	9	100.00%	0
Piedmont	25	725.51	226	98.67%	0
Upper Coastal Plain	5	16.66	47	93.62%	0
Lower Coastal Plain	9	103.36	86	95.35%	0
Ridge and Valley	2	5.81	18	94.44%	0
Total	42	900.24	386	97.15%	0
2d. Streamside Management Zones - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	9	483.44	72	98.61%	0
Piedmont	65	1219.84	588	96.77%	2
Upper Coastal Plain	25	200.49	216	93.52%	2
Lower Coastal Plain	51	291.13	477	87.00%	8
Ridge and Valley	8	58.44	67	94.03%	1
Total	158	2253.34	1420	92.96%	13

Tables 3 a – d: Distribution of Sites with Stream Crossings Evaluated by Region, Ownership, and # Crossings Assessed, # BMPs Assessed, % BMPs Implemented and Water Quality Risks.

3a. Stream and Wetland Crossings - NIPF					
Region	**No. Sites**	**Crossings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	1	10	100.00%	0
Piedmont	13	24	160	88.75%	3
Upper Coastal Plain	6	10	74	94.59%	2
Lower Coastal Plain	21	27	212	88.68%	9
Ridge and Valley	3	4	44	93.18%	0
Total	44	66	500	90.20%	14
3b. Stream and Wetland Crossings - Public					
Region	**No. Sites**	**Crossings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	2	19	31	96.77%	0
Piedmont	3	6	35	100.00%	0
Upper Coastal Plain	0	0	0	NA	0
Lower Coastal Plain	1	2	13	69.23%	0
Ridge and Valley	0	0	0	NA	0
Total	6	27	79	93.67%	0
3c. Stream and Wetland Crossings - Corporate					
Region	**No. Sites**	**Crossings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	12	23	147	93.20%	0
Upper Coastal Plain	1	1	8	100.00%	0
Lower Coastal Plain	5	8	61	95.08%	0
Ridge and Valley	1	4	16	87.50%	0
Total	19	36	232	93.53%	0
3d. Stream and Wetland Crossings - All Ownership					
Region	**No. Sites**	**Crossings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	3	20	41	97.56%	0
Piedmont	28	53	342	91.81%	3
Upper Coastal Plain	7	11	82	95.12%	2
Lower Coastal Plain	27	37	286	89.16%	9
Ridge and Valley	4	8	60	91.67%	0
Total	69	129	811	91.49%	14

Tables 4 a – d: Distribution of Forest Road Sites Evaluated By Region, Ownership, Miles Assessed, % Compliance, # BMP Assessed, % BMPs Implemented, and Water Quality Risks.

4a. Forest Road Sites - NIPF						
Region	**No. Sites**	**Miles**	**% Miles Compliance**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	4	0.98	99.9%	47	91.49%	0
Piedmont	36	19.19	91.30%	314	89.49%	1
Upper Coastal Plain	37	31.42	95.10%	242	91.74%	0
Lower Coastal Plain	68	58.65	96.79%	455	93.85%	1
Ridge and Valley	4	1.26	96.03%	37	91.89%	0
Total	149	111.5	95.39%	1095	91.96%	2
4b. Forest Road Sites - Public						
Region	**No. Sites**	**Miles**	**% Miles Compliance**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	6.31	99.84%	50	98.00%	0
Piedmont	6	6.05	100.00%	64	100.00%	0
Upper Coastal Plain	3	1.5	76.00%	16	81.25%	0
Lower Coastal Plain	5	8.2	100.00%	39	100.00%	0
Ridge and Valley	5	2.32	100.00%	46	100.00%	0
Total	24	24.38	98.48%	215	98.14%	0
4c. Forest Road Sites - Corporate						
Region	**No. Sites**	**Miles**	**% Miles Compliance**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	0.3	100.00%	10	100.00%	0
Piedmont	25	24.15	97.76%	244	95.08%	0
Upper Coastal Plain	6	8.09	98.15%	42	90.48%	0
Lower Coastal Plain	32	32.73	94.84%	229	94.76%	0
Ridge and Valley	4	3.94	83.76%	36	80.56%	0
Total	68	69.21	95.64%	561	93.76%	0
4d. Forest Road Sites - All Ownership						
Region	**No. Sites**	**Miles**	**% Miles Compliance**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	10	7.59	99.87%	107	95.33%	0
Piedmont	67	49.39	95.53%	622	92.77%	1
Upper Coastal Plain	46	41.01	95.00%	300	91.00%	0
Lower Coastal Plain	105	99.58	96.41%	723	94.47%	1
Ridge and Valley	13	7.52	90.82%	119	91.60%	0
Total	241	205.09	95.84%	1871	93.21%	2

Table 5 a – d: Overall Distribution of Special Management Areas Evaluated By Region, Ownership, BMPs Assessed, % BMPs Implemented, and Water Quality Risks.

5a. Special Management Areas - NIPF				
Region	**No. Sites**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	18	100.00%	0
Piedmont	36	224	98.21%	0
Upper Coastal Plain	21	106	94.34%	0
Lower Coastal Plain	59	211	81.04%	2
Ridge and Valley	4	28	92.86%	0
Total	125	587	91.14%	2
5b. Special Management Areas - Public				
Region	**No. Sites**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	12	100.00%	0
Piedmont	8	45	97.78%	0
Upper Coastal Plain	3	9	100.00%	0
Lower Coastal Plain	6	24	95.83%	0
Ridge and Valley	5	26	100.00%	0
Total	27	116	98.28%	0
5c. Special Management Areas - Corporate				
Region	**No. Sites**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	9	100.00%	0
Piedmont	25	187	97.86%	0
Upper Coastal Plain	6	28	100.00%	0
Lower Coastal Plain	27	113	94.69%	1
Ridge and Valley	4	16	100.00%	0
Total	63	353	97.17%	1
5d. Special Management Areas - All Ownership				
Region	**No. Sites**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	11	39	100.00%	0
Piedmont	69	456	98.03%	0
Upper Coastal Plain	30	143	95.80%	0
Lower Coastal Plain	92	348	86.49%	3
Ridge and Valley	13	70	97.14%	0
Total	215	1056	93.94%	3

Table 6 a – d: Distribution of Harvesting Operations Evaluated By Region, Ownership, Acres Assessed, # BMP Assessed, % Implemented, and Water Quality Risks.

6a. Timber Harvesting Outside SMZs - NIPF					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	4	87.43	31	100.00%	0
Piedmont	36	2964.84	256	98.83%	0
Upper Coastal Plain	38	3833.41	243	98.77%	0
Lower Coastal Plain	68	6678.79	457	95.40%	1
Ridge and Valley	4	219.86	30	96.67%	0
Total	150	13784.33	1017	97.25%	1
6b. Timber Harvesting Outside SMZs - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	3	117.1	22	100.00%	0
Piedmont	6	865.01	46	100.00%	0
Upper Coastal Plain	3	241.91	20	100.00%	0
Lower Coastal Plain	5	679.39	32	100.00%	0
Ridge and Valley	5	454.3	42	100.00%	0
Total	22	2357.71	162	100.00%	0
6c. Timber Harvesting Outside SMZs - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	26.4	8	100.00%	0
Piedmont	25	3497.77	190	100.00%	0
Upper Coastal Plain	6	582.49	45	100.00%	0
Lower Coastal Plain	33	3403.88	229	99.56%	0
Ridge and Valley	4	492.48	31	96.77%	0
Total	69	8003.02	503	99.60%	0
6d. Timber Harvesting Outside SMZs - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	8	230.93	61	100.00%	0
Piedmont	67	7327.62	492	99.39%	0
Upper Coastal Plain	47	4657.81	308	99.03%	0
Lower Coastal Plain	106	10762.06	718	96.94%	1
Ridge and Valley	13	1166.64	103	98.06%	0
Total	241	24145.06	1682	98.22%	1

Table 7 a – d: Distribution of Mechanical Site Preparation Operations Evaluated By Region, Ownership, and Acres Assessed, # BMPs Assessed, % BMP Implementation, and Water Quality Risks.

7a. Mechanical Site Preparation Outside SMZs - NIPF					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	0	0	0	NA	0
Upper Coastal Plain	3	18.23	6	100.00%	0
Lower Coastal Plain	13	967.05	30	86.67%	0
Ridge and Valley	0	0	0	NA	0
Total	16	985.28	36	88.89%	0
7b. Mechanical Site Preparation Outside SMZs - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	1	45.5	3	100.00%	0
Upper Coastal Plain	0	0	0	NA	0
Lower Coastal Plain	4	646	11	81.82%	0
Ridge and Valley	0	0	0	NA	0
Total	5	691.5	14	85.71%	0
7c. Mechanical Site Preparation Outside SMZs - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	0	0	0	NA	0
Upper Coastal Plain	0	0	0	NA	0
Lower Coastal Plain	9	658.83	28	85.71%	1
Ridge and Valley	0	0	0	NA	0
Total	9	658.83	28	85.71%	1
7d. Mechanical Site Preparation Outside SMZs - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	1	45.5	3	100.00%	0
Upper Coastal Plain	3	18.23	6	100.00%	0
Lower Coastal Plain	26	2271.88	69	85.51%	1
Ridge and Valley	0	0	0	NA	0
Total	30	2335.61	78	87.18%	1

Table 8 a – d: Distribution of Chemical Site Preparation Operations Evaluated By
Region, Ownership, and Acres Assessed, BMPs Assessed, % BMP Implementation, and Water Quality Risks.

8a. Chemical Site Preparation Outside SMZs - NIPF					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	8	712.67	16	93.75%	0
Upper Coastal Plain	4	190.69	8	100.00%	0
Lower Coastal Plain	11	709.01	22	95.45%	0
Ridge and Valley	0	0	0	NA	0
Total	23	1612.37	46	95.65%	0
8b. Chemical Site Preparation Outside SMZs - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	2	77.48	4	100.00%	0
Upper Coastal Plain	1	64.72	2	100.00%	0
Lower Coastal Plain	2	182	4	100.00%	0
Ridge and Valley	1	11.8	2	100.00%	0
Total	6	336	12	100.00%	0
8c. Chemical Site Preparation Outside SMZs - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	5	694.82	10	90.00%	0
Upper Coastal Plain	1	150.37	2	100.00%	0
Lower Coastal Plain	6	521.91	12	100.00%	0
Ridge and Valley	0	0	0	NA	0
Total	12	1367.1	24	95.83%	0
8d. Chemical Site Preparation Outside SMZs - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	15	1484.97	30	93.33%	0
Upper Coastal Plain	6	405.78	12	100.00%	0
Lower Coastal Plain	19	1412.92	38	97.37%	0
Ridge and Valley	1	11.8	2	100.00%	0
Total	41	3315.47	82	96.34%	0

Table 9 a – d: Distribution of Firebreak installation and Burning Operations Evaluated by Region, Ownership, % BMP Implementation, and Water Quality Risks.

9a. Fire Breaks & Prescribed Burning- NIPF					
Region	**No. Sites**	**Miles**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	1.16	7	100.00%	0
Piedmont	8	10.95	60	90.00%	0
Upper Coastal Plain	5	7.04	30	76.67%	0
Lower Coastal Plain	13	16.3	78	85.90%	0
Ridge and Valley	0	0	0	NA	0
Total	27	35.45	175	86.29%	0
9b. Fire Breaks & Prescribed Burning- Public					
Region	**No. Sites**	**Miles**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	2	2.94	14	100.00%	0
Piedmont	4	5.41	26	92.31%	0
Upper Coastal Plain	2	1.99	13	76.92%	0
Lower Coastal Plain	2	5.62	7	100.00%	0
Ridge and Valley	0	0	0	NA	0
Total	10	15.96	60	91.67%	0
9c. Fire Breaks & Prescribed Burning- Corporate					
Region	**No. Sites**	**Miles**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	4	3.72	24	87.50%	0
Upper Coastal Plain	1	0.62	7	57.14%	0
Lower Coastal Plain	0	0	0	NA	0
Ridge and Valley	1	0.34	3	66.67%	0
Total	6	4.68	34	79.41%	0
9d. Fire Breaks & Prescribed Burning- All Ownership					
Region	**No. Sites**	**Miles**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	3	4.1	21	100.00%	0
Piedmont	16	20.08	110	90.00%	0
Upper Coastal Plain	8	9.65	50	74.00%	0
Lower Coastal Plain	15	21.92	85	87.06%	0
Ridge and Valley	1	0.34	3	66.67%	0
Total	43	56.09	269	86.62%	0

Table 10 a – d: Distribution of Artificial Regeneration Operations Evaluated By Region, Ownership, Acres Assessed, BMPs Assessed, % BMP Implementation, and Water Quality Risks.

10a. Artificial Regeneration Outside SMZs - NIPF					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	8	612.67	11	100.00%	0
Upper Coastal Plain	2	55.43	3	100.00%	0
Lower Coastal Plain	8	540.78	17	94.12%	0
Ridge and Valley	0	0	0	NA	0
Total	18	1208.88	31	96.77%	0
10b. Artificial Regeneration Outside SMZs - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	1	45.5	3	100.00%	0
Upper Coastal Plain	1	64.72	1	100.00%	0
Lower Coastal Plain	1	32	2	100.00%	0
Ridge and Valley	0	0	0	NA	0
Total	3	142.22	6	100.00%	0
10c. Artificial Regeneration Outside SMZs - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	5	665.58	11	100.00%	0
Upper Coastal Plain	0	0	0	NA	0
Lower Coastal Plain	4	303.46	9	100.00%	0
Ridge and Valley	0	0	0	NA	0
Total	9	969.04	20	100.00%	0
10d. Artificial Regeneration Outside SMZs - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	0	0	0	NA	0
Piedmont	14	1323.75	25	100.00%	0
Upper Coastal Plain	3	120.15	4	100.00%	0
Lower Coastal Plain	13	876.24	28	96.43%	0
Ridge and Valley	0	0	0	NA	0
Total	30	2320.14	57	98.25%	0

<u>Forest Fertilization</u>: Forest fertilization occurred on only 1 corporate site in the Lower Coastal Plain. A total of 40.49 acres were treated with 2 BMPs assessed with 100% BMP implementation.

Table 11 a – d: Distribution of Equipment Servicing Operations Evaluated By Region, Ownership, No. of Landings Assessed, BMPs Assessed, % BMP Implementation, and Water Quality Risks.

11a. Equipment Servicing and Trash Clean-up - NIPF					
Region	**No. Sites**	**Landings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	11	15	100.00%	0
Piedmont	36	112	108	98.15%	0
Upper Coastal Plain	39	118	116	100.00%	0
Lower Coastal Plain	72	252	216	96.30%	0
Ridge and Valley	4	8	12	100.00%	0
Total	156	501	467	97.86%	0
11b. Equipment Servicing and Trash Clean-up - Public					
Region	**No. Sites**	**Landings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	3	4	9	100.00%	0
Piedmont	6	32	18	100.00%	0
Upper Coastal Plain	3	9	9	100.00%	0
Lower Coastal Plain	7	40	21	100.00%	0
Ridge and Valley	5	14	15	100.00%	0
Total	24	99	72	100.00%	0
11c. Equipment Servicing and Trash Clean-up - Corporate					
Region	**No. Sites**	**Landings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	1	3	100.00%	0
Piedmont	25	107	75	98.67%	0
Upper Coastal Plain	6	21	18	100.00%	0
Lower Coastal Plain	33	176	99	100.00%	0
Ridge and Valley	4	18	12	91.67%	0
Total	69	323	207	99.03%	0
11d. Equipment Servicing and Trash Clean-up - All Ownership					
Region	**No. Sites**	**Landings**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	9	16	27	100.00%	0
Piedmont	67	251	201	98.51%	0
Upper Coastal Plain	48	148	143	100.00%	0
Lower Coastal Plain	112	468	336	97.62%	0
Ridge and Valley	13	40	39	97.44%	0
Total	249	923	746	98.39%	0

Table 12 a – d: Distribution of Stream Types, Miles Assessed, and % Compliance by Region, and Ownership.

12a. Stream Assessment - NIPF						
Region	**No. Sites**	**Intermittent Miles Assessed**	**% Miles Compliance**	**Perennial Miles Assessed**	**% Miles Compliance**	**Total % Miles Compliance**
Mountains	5	0.4	100.00%	1.51	85.43%	88.48%
Piedmont	31	7.15	93.57%	11.04	99.37%	97.09%
Upper Coastal Plain	15	5.23	99.43%	4.74	94.09%	96.89%
Lower Coastal Plain	40	14.79	92.83%	8.44	83.53%	89.45%
Ridge and Valley	3	0.82	82.93%	1.11	100.00%	92.75%
Total	94	28.39	94.05%	26.84	92.70%	93.39%
12b. Stream Assessment - Public						
Region	**No. Sites**	**Intermittent Miles Assessed**	**% Miles Compliance**	**Perennial Miles Assessed**	**% Miles Compliance**	**Total % Miles Compliance**
Mountains	3	7.24	100.00%	15.3	100.00%	100.00%
Piedmont	8	2.4	100.00%	9.4	100.00%	100.00%
Upper Coastal Plain	4	0.78	100.00%	0.16	100.00%	100.00%
Lower Coastal Plain	2	0.29	100.00%	0.19	100.00%	100.00%
Ridge and Valley	3	0.38	100.00%	0.64	100.00%	100.00%
Total	20	11.09	100.00%	25.69	100.00%	100.00%
12c. Stream Assessment - Corporate						
Region	**No. Sites**	**Intermittent Miles Assessed**	**% Miles Compliance**	**Perennial Miles Assessed**	**% Miles Compliance**	**Total % Miles Compliance**
Mountains	1	0.19	100.00%	1.11	100.00%	100.00%
Piedmont	25	11.13	99.91%	15.45	98.12%	98.87%
Upper Coastal Plain	5	1.52	100.00%	1.9	100.00%	100.00%
Lower Coastal Plain	9	5.58	99.64%	1.65	95.76%	98.76%
Ridge and Valley	2	0.4	97.50%	0.38	100.00%	98.72%
Total	42	18.82	99.79%	20.49	98.24%	98.98%
12d. Stream Assessment - All Ownership						
Region	**No. Sites**	**Intermittent Miles Assessed**	**% Miles Compliance**	**Perennial Miles Assessed**	**% Miles Compliance**	**Total % Miles Compliance**
Mountains	9	7.83	100.00%	17.92	98.77%	99.15%
Piedmont	64	20.68	97.73%	35.89	99.00%	98.53%
Upper Coastal Plain	24	7.53	99.60%	6.8	95.88%	97.84%
Lower Coastal Plain	51	20.66	94.77%	10.28	85.80%	91.79%
Ridge and Valley	8	1.6	90.63%	2.13	100.00%	95.98%
Total	156	58.3	97.03%	73.02	96.82%	96.92%

Table 13 a – d: Overall Distribution of Sites Evaluated by Region, Ownership, Acres Evaluated, BMPs Assessed, % BMPs Implemented, and Water Quality Risks.

Overall Distribution - NIPF					
13a. Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	176.78	167	97.01%	0
Piedmont	36	5030.51	1447	94.26%	6
Upper Coastal Plain	39	4327.24	970	94.74%	4
Lower Coastal Plain	72	9752.66	2071	90.54%	21
Ridge and Valley	4	255.73	177	93.22%	1
Total	156	19542.92	4832	92.82%	32
13b. Overall Distribution - Public					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	5	4012.69	162	98.77%	0
Piedmont	8	1968.58	308	99.03%	0
Upper Coastal Plain	4	494.95	97	93.81%	0
Lower Coastal Plain	7	1957.01	171	95.91%	0
Ridge and Valley	5	482.86	154	100.00%	0
Total	29	8916.09	892	97.98%	0
13c. Overall Distribution - Corporate					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	1	75.3	39	100.00%	0
Piedmont	25	6049.28	1114	96.95%	0
Upper Coastal Plain	6	836.52	197	94.92%	0
Lower Coastal Plain	33	5031.93	868	96.54%	2
Ridge and Valley	4	498.29	132	90.15%	0
Total	69	12491.32	2350	96.30%	2
13d. Overall Distribution - All Ownership					
Region	**No. Sites**	**Acres**	**BMPs Assessed**	**% BMPs Implemented**	**WQ Risks**
Mountains	11	4264.77	368	98.10%	0
Piedmont	69	13048.37	2869	95.82%	6
Upper Coastal Plain	49	5658.71	1264	94.70%	4
Lower Coastal Plain	112	16741.6	3110	92.51%	23
Ridge and Valley	13	1236.88	463	94.60%	1
Total	254	40950.33	8074	94.40%	34

Chart 1: Statewide Trends in BMP Implementation

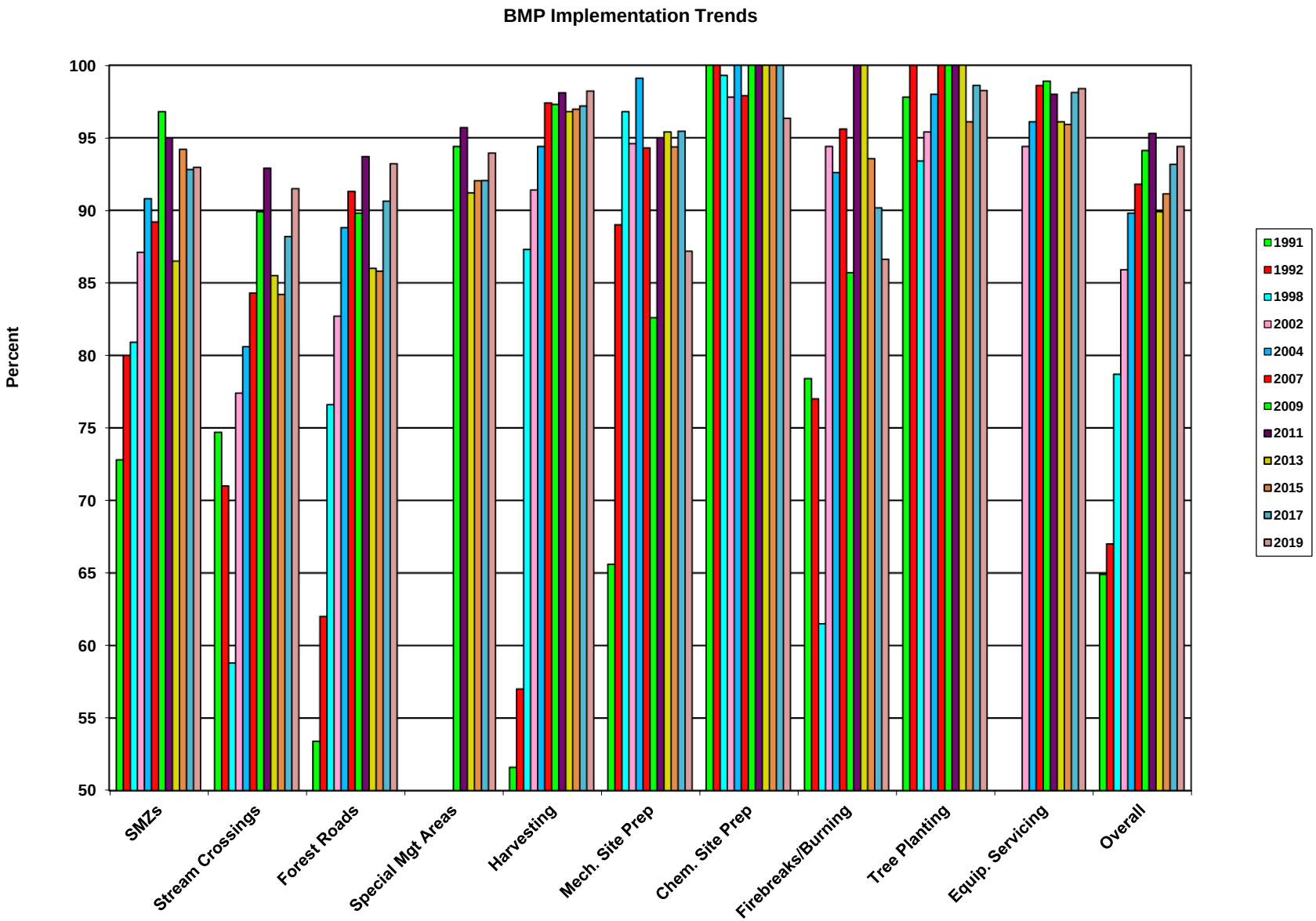


Chart 2: Statewide Trends in BMP Implementation on NIPF Sites

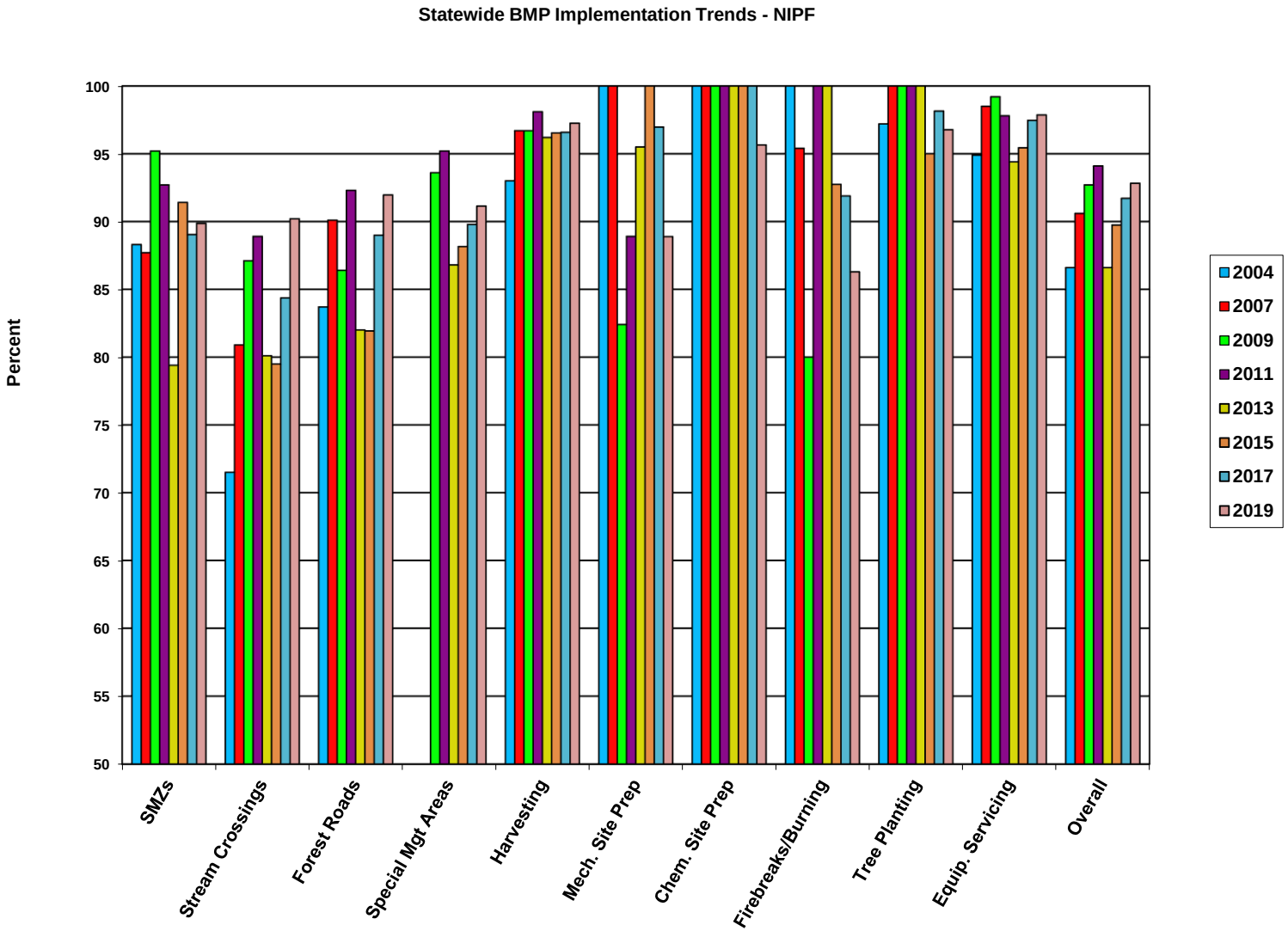


Chart 3: Statewide Trends in BMP Implementation on Corporate Sites

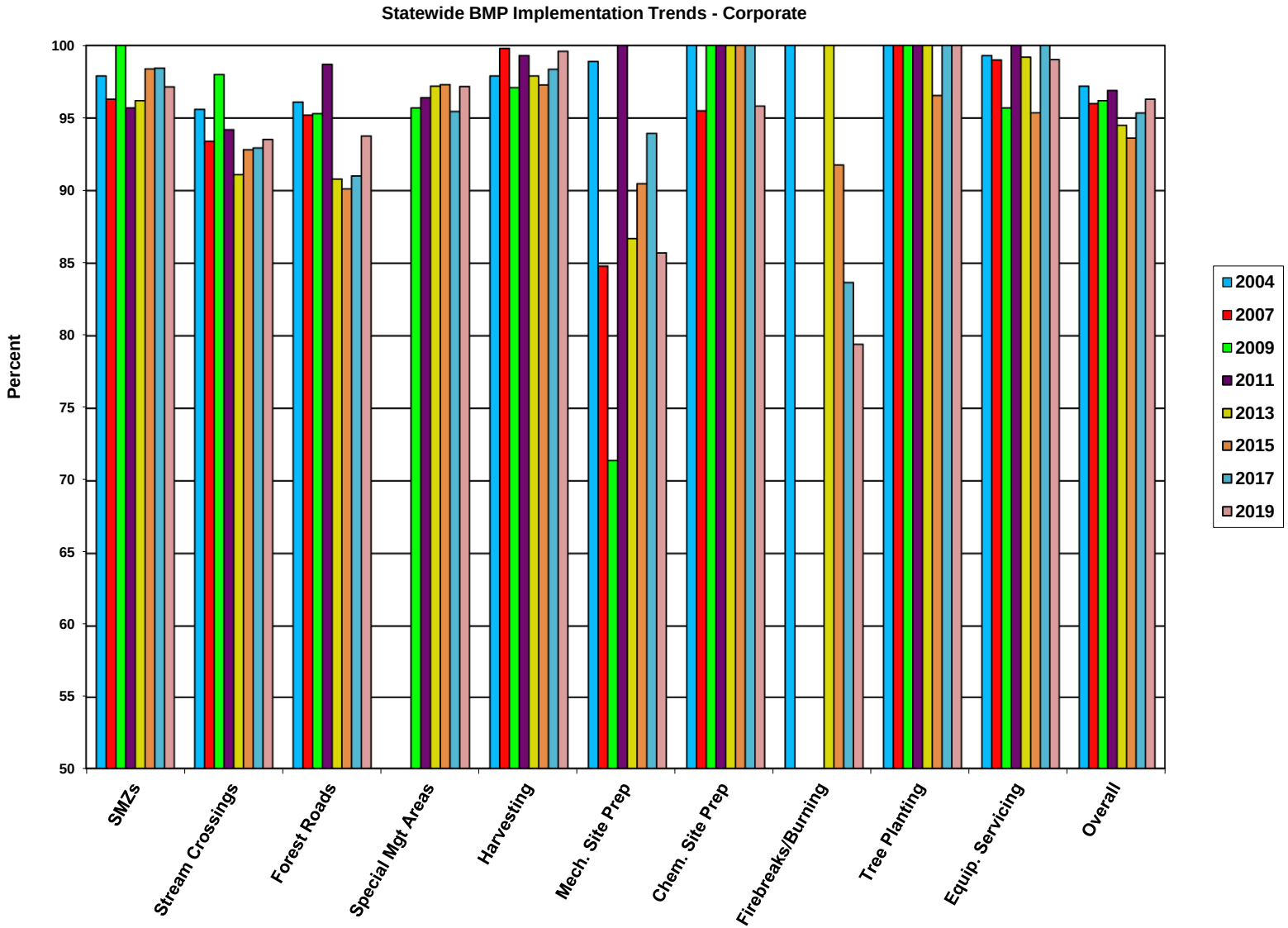


Chart 4: Statewide Trends in BMP Implementation on Public Sites

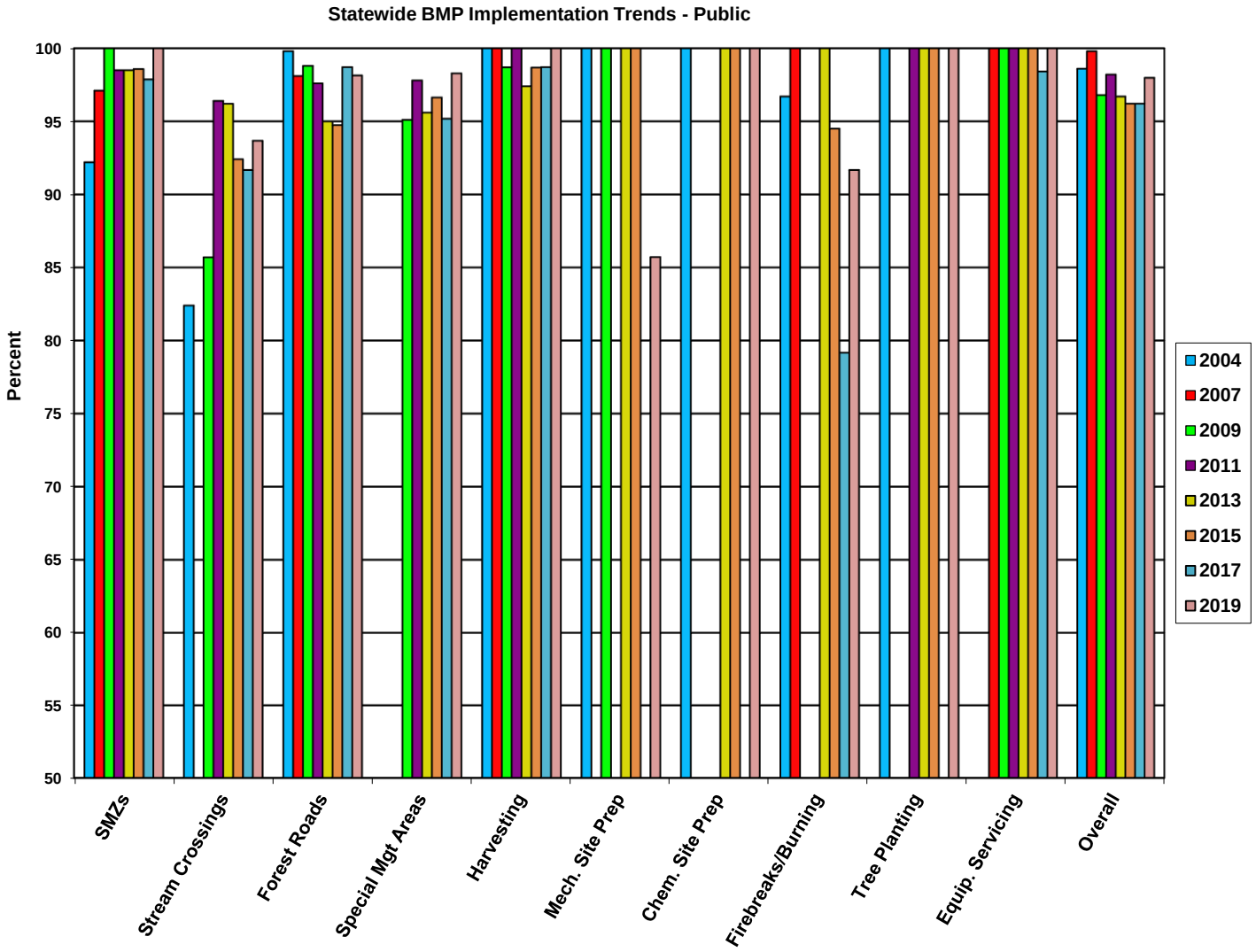
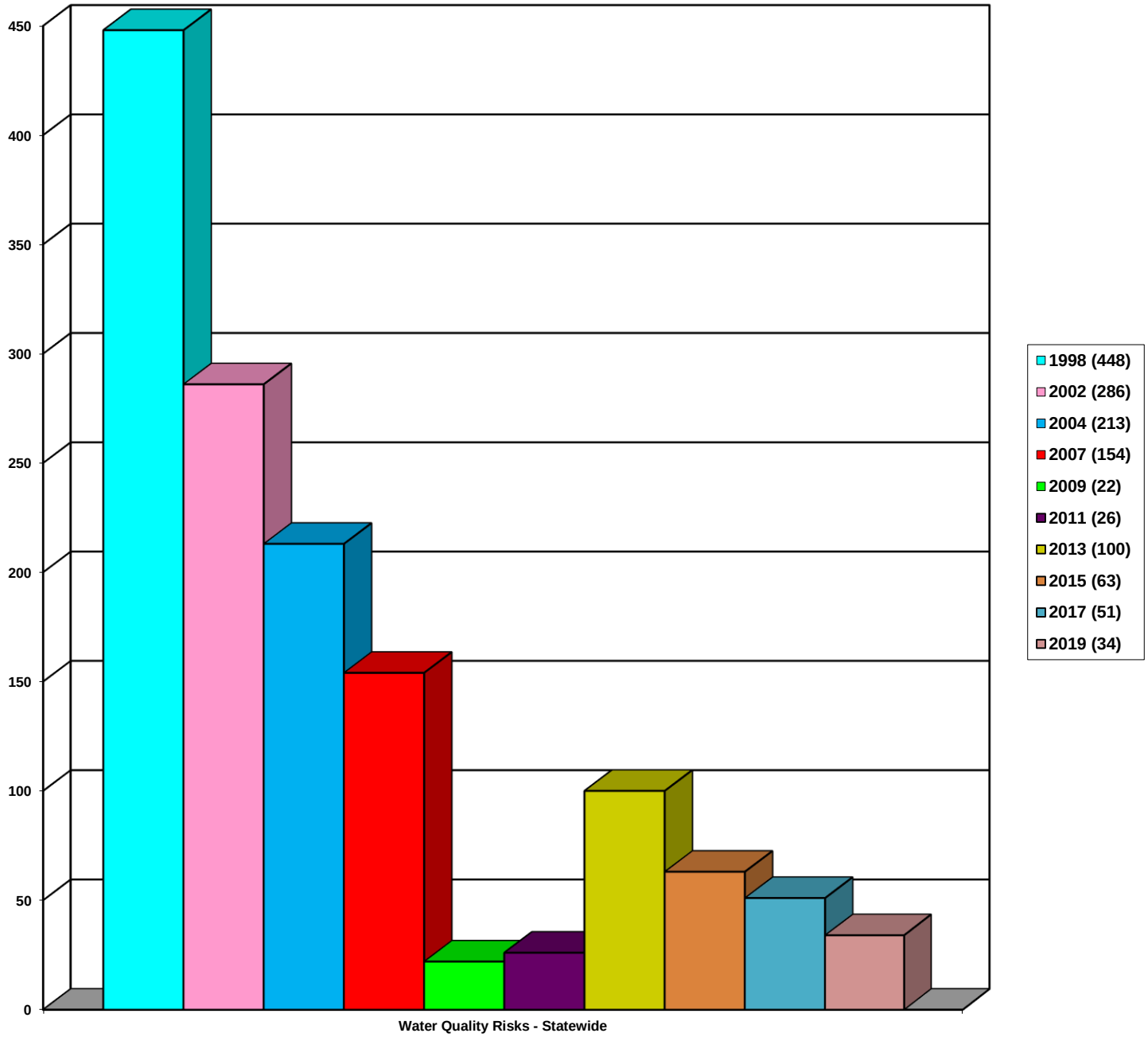


Chart 5: Statewide Trends in Reduction of Water Quality Risks from 1998 through 2019 Surveys



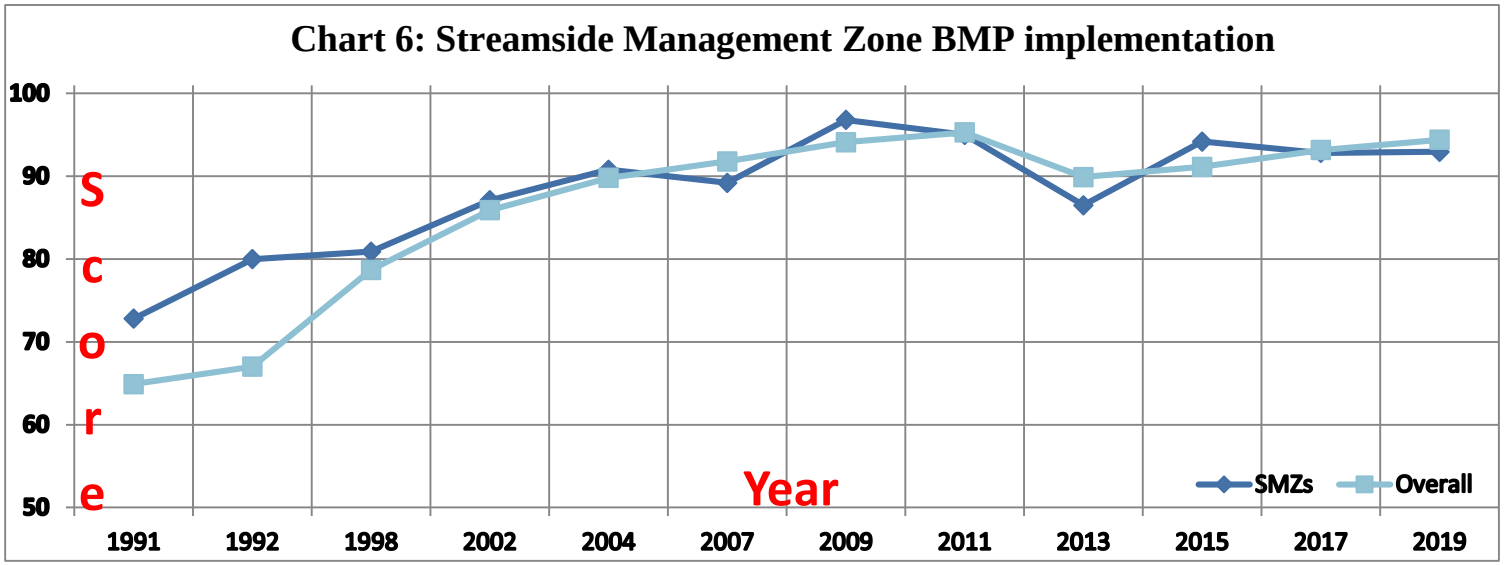


Chart 6: Streamside Management Zone BMP implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
SMZs
Overall

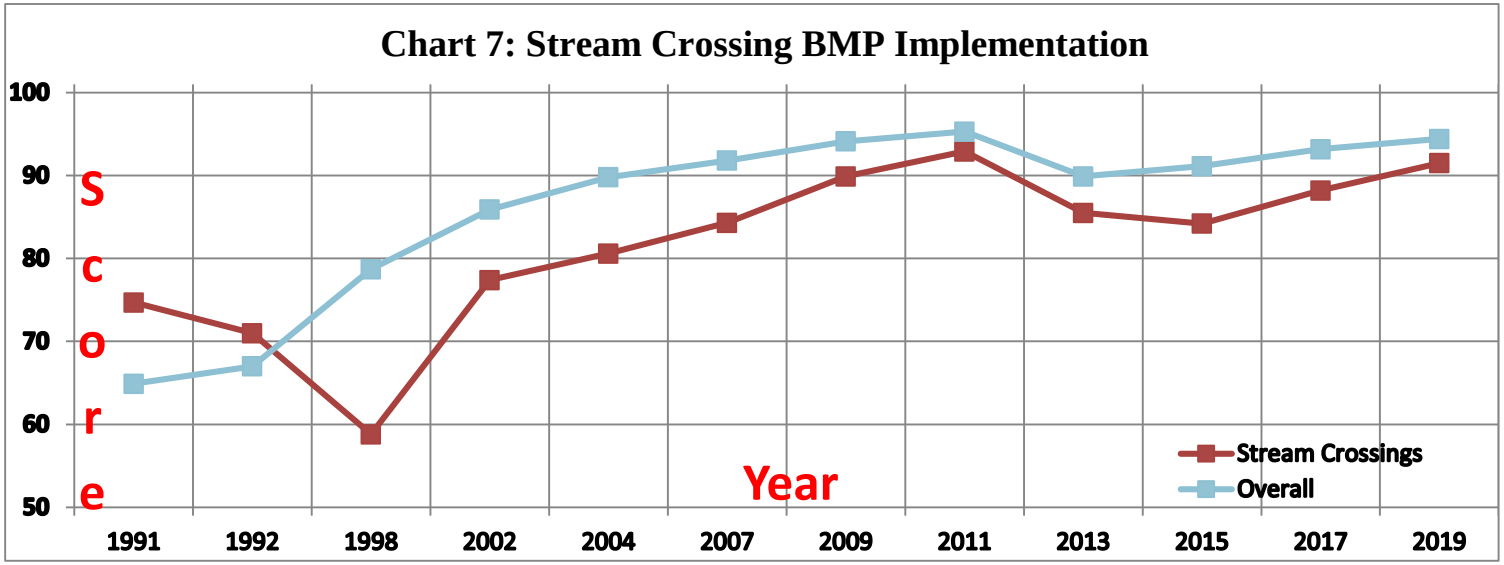


Chart 7: Stream Crossing BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Stream Crossings
Overall

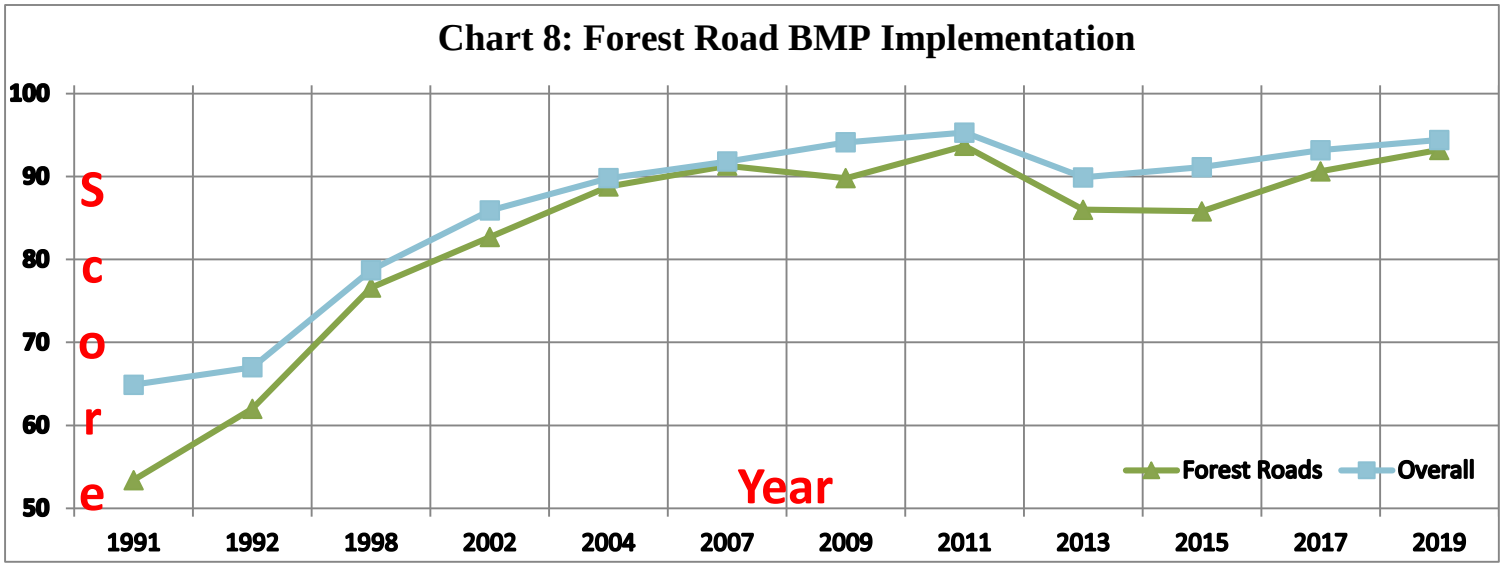


Chart 8: Forest Road BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Forest Roads
Overall

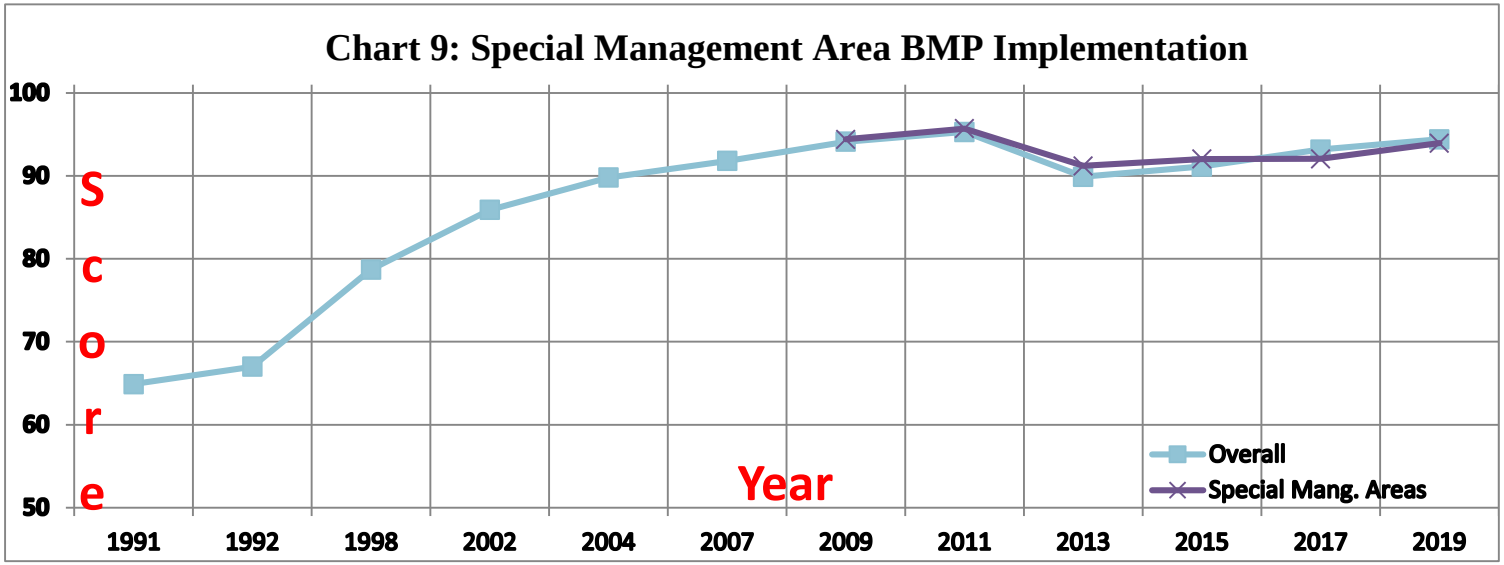


Chart 9: Special Management Area BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Overall
Special Mang. Areas

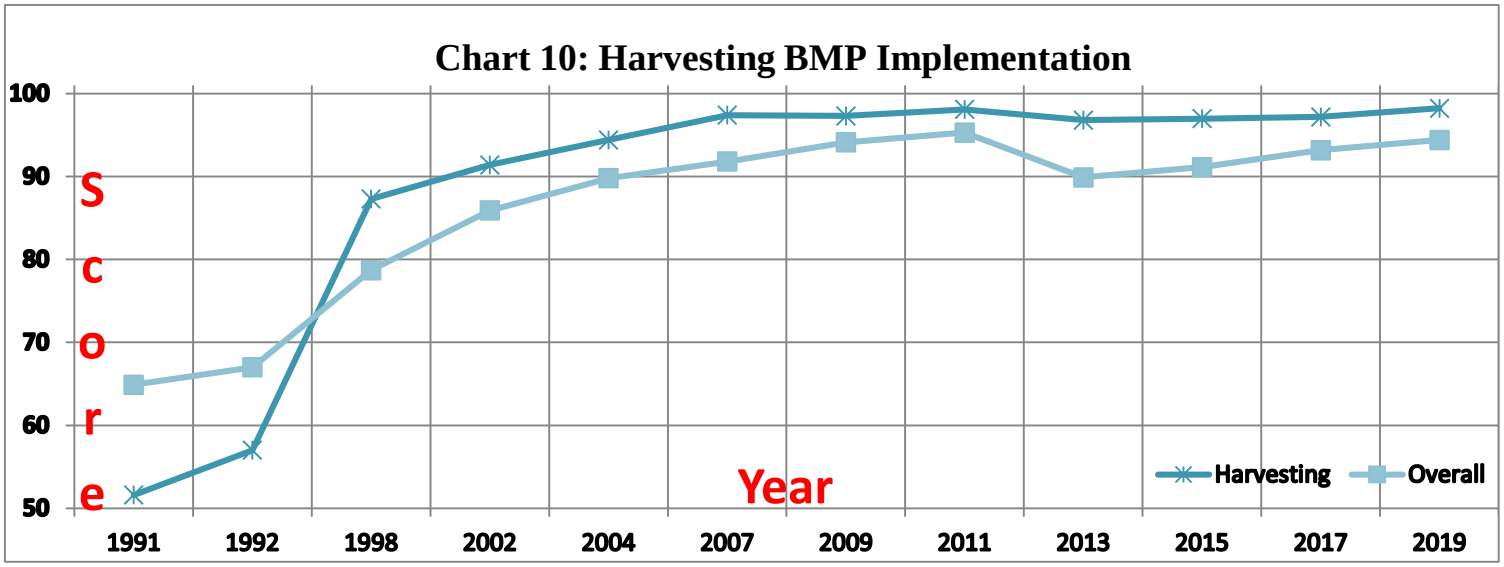


Chart 10: Harvesting BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Harvesting
Overall

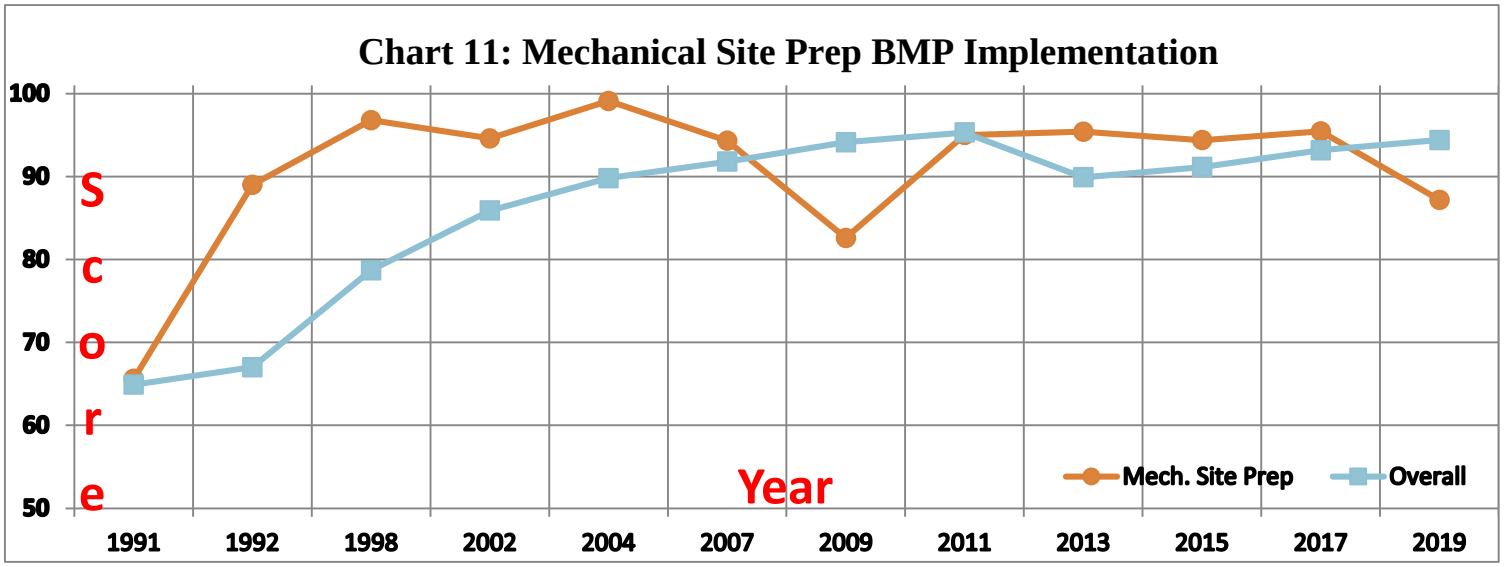


Chart 11: Mechanical Site Prep BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Mech. Site Prep
Overall

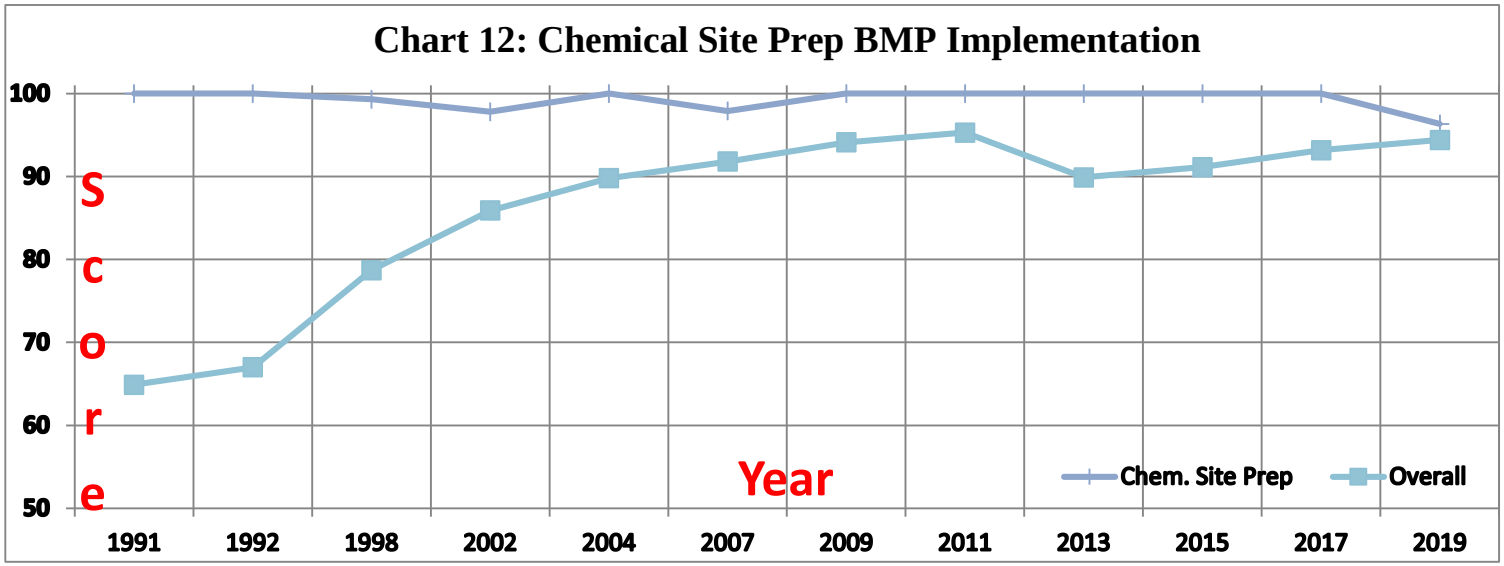


Chart 12: Chemical Site Prep BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Chem. Site Prep
Overall

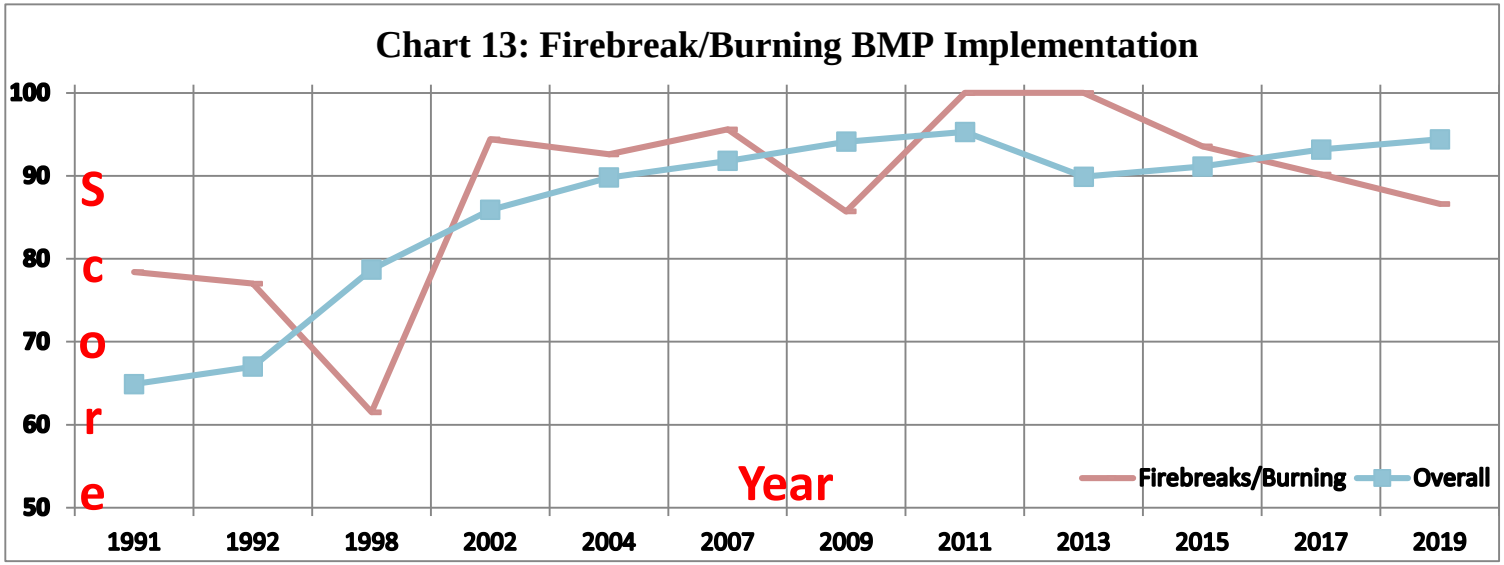


Chart 13: Firebreak/Burning BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Firebreaks/Burning
Overall

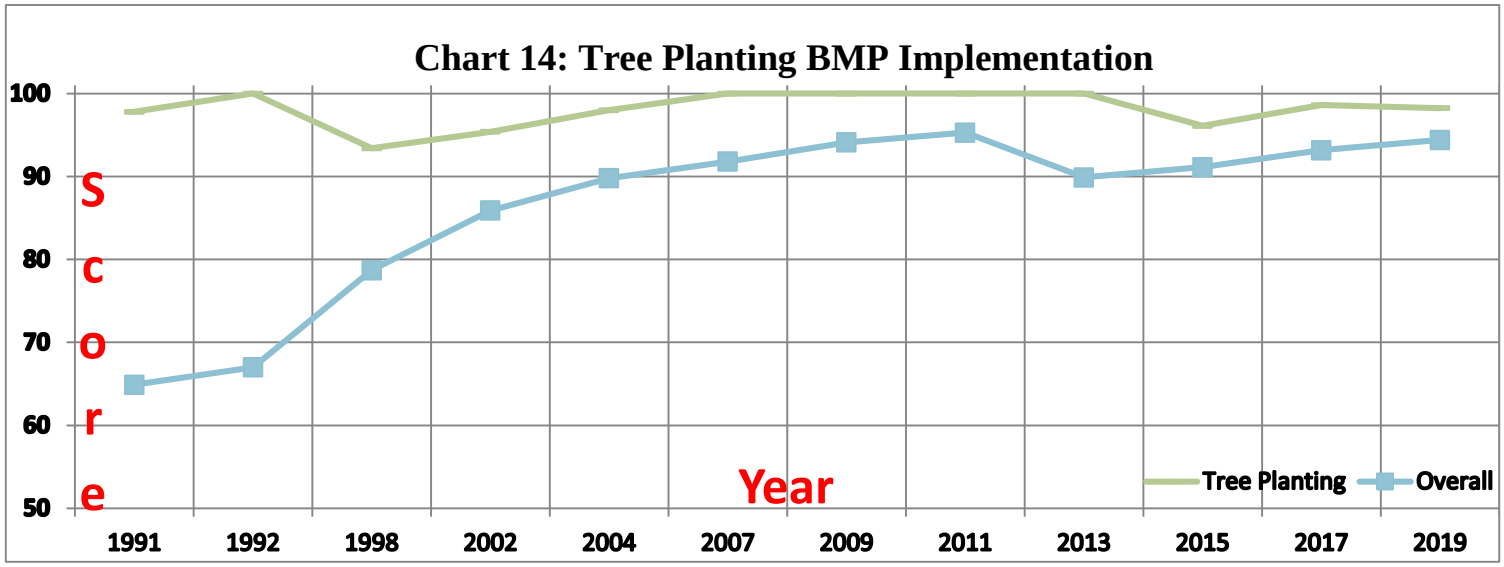


Chart 14: Tree Planting BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Tree Planting
Overall

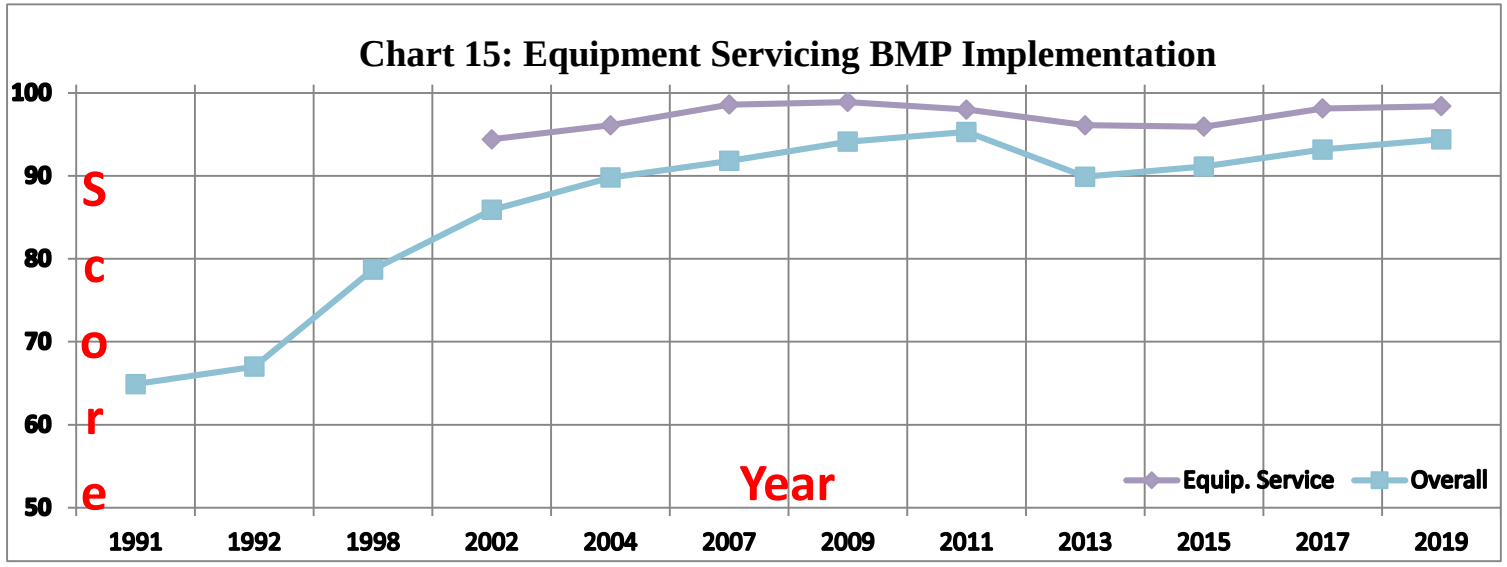


Chart 15: Equipment Servicing BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Equip. Service
Overall

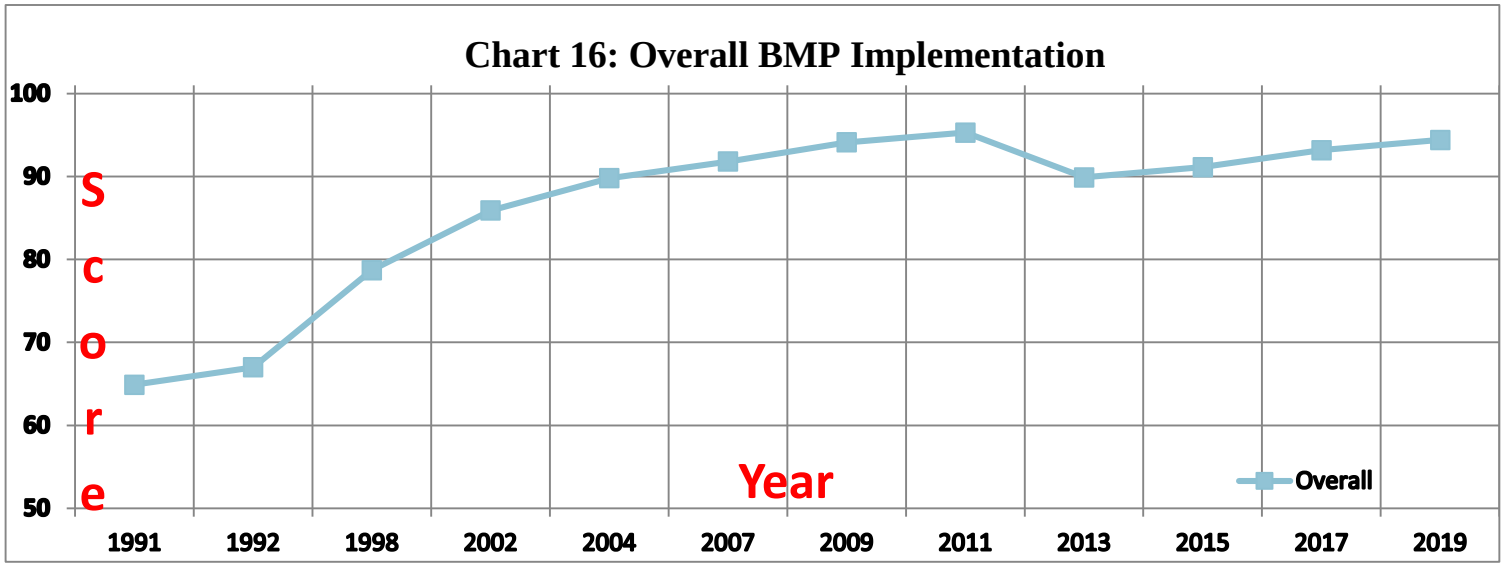


Chart 16: Overall BMP Implementation
100
90
80
70
60
50
Score
Year
1991
1992
1998
2002
2004
2007
2009
2011
2013
2015
2017
2019
Overall

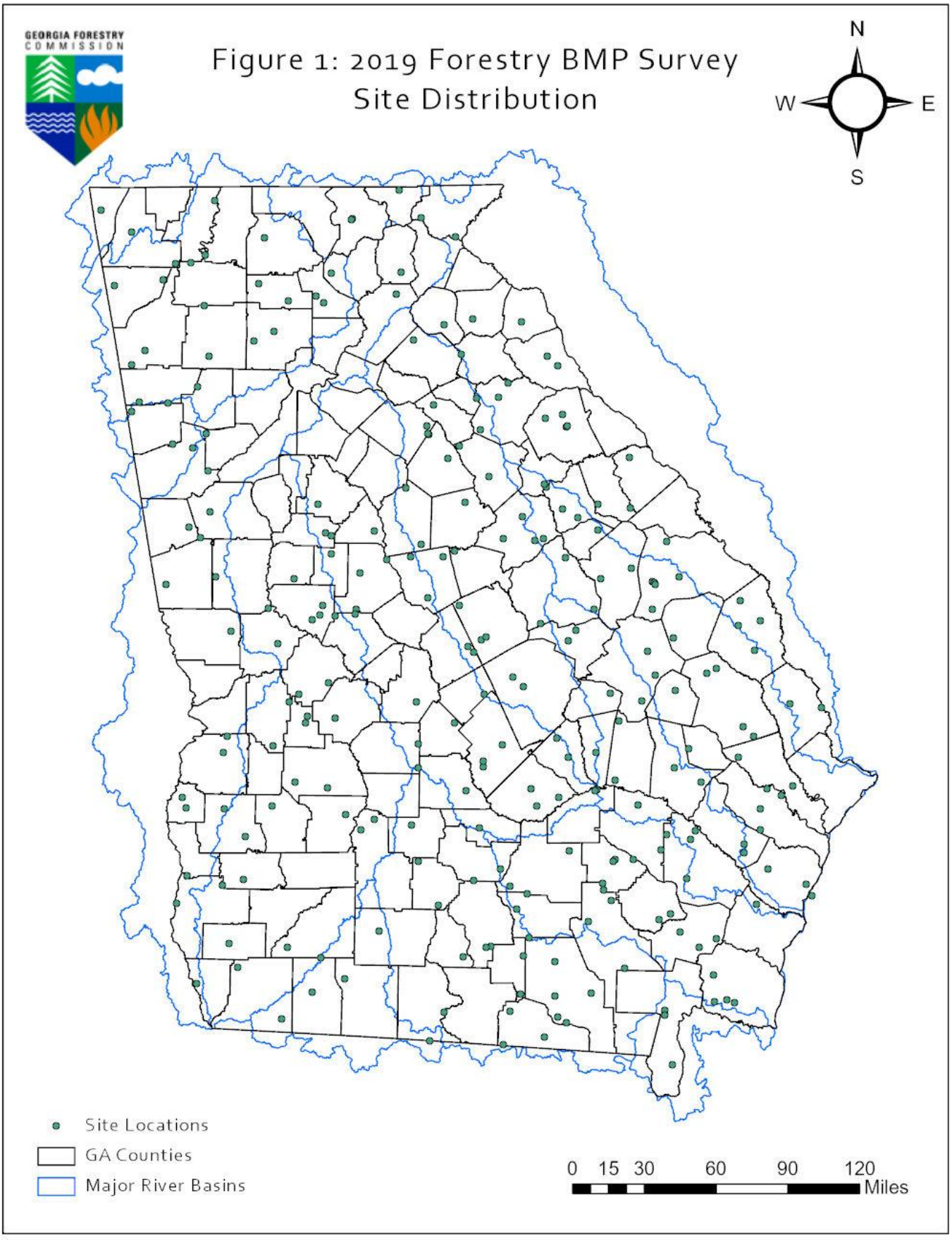

GEORGIA FORESTRY COMMISSION
Figure 1: 2019 Forestry BMP Survey
Site Distribution
N
W
E
S
Site Locations
GA Counties
Major River Basins
0 15 30 60 90 120
Miles

Figure 2: Physiographic Regions of Georgia

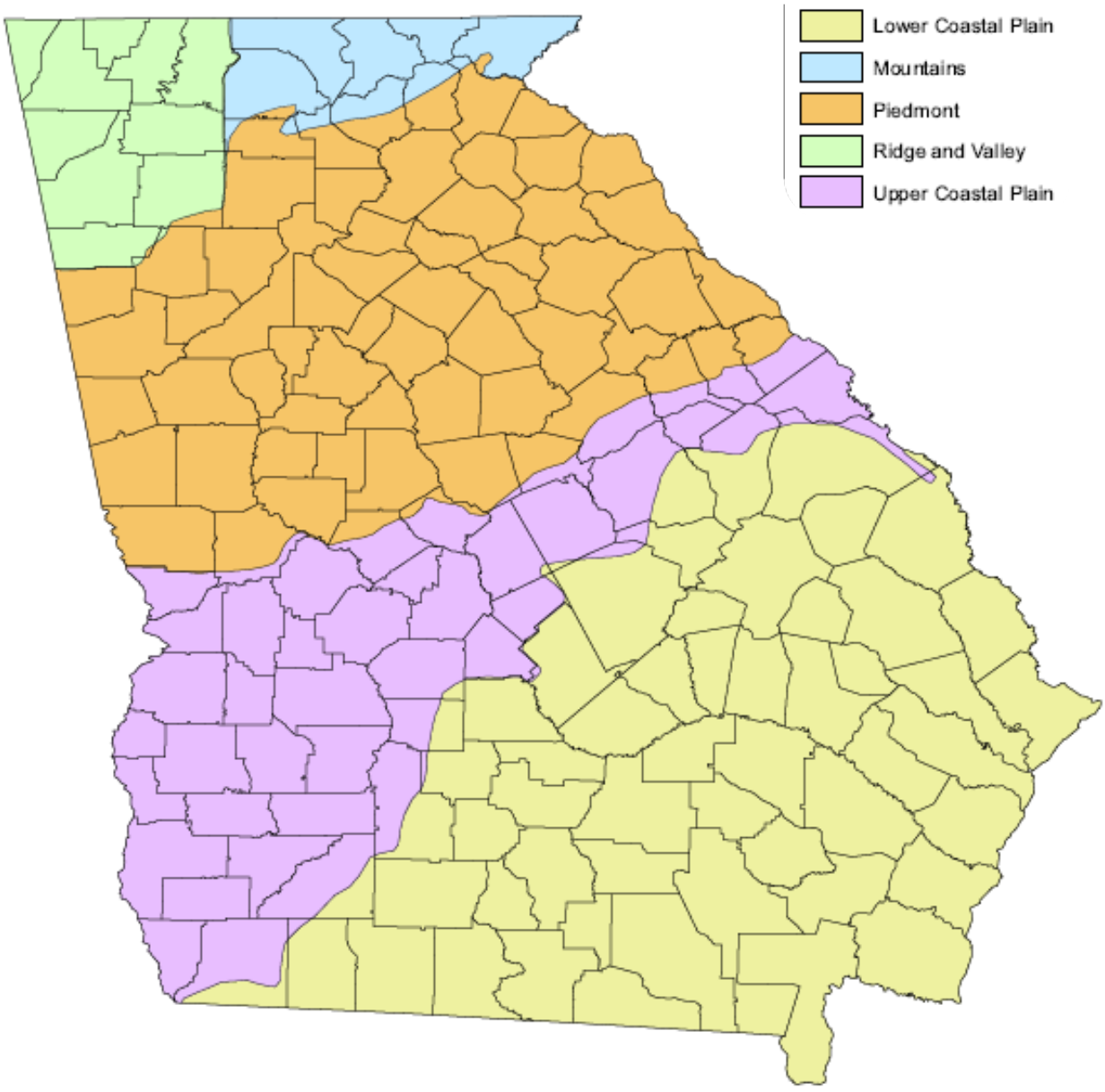
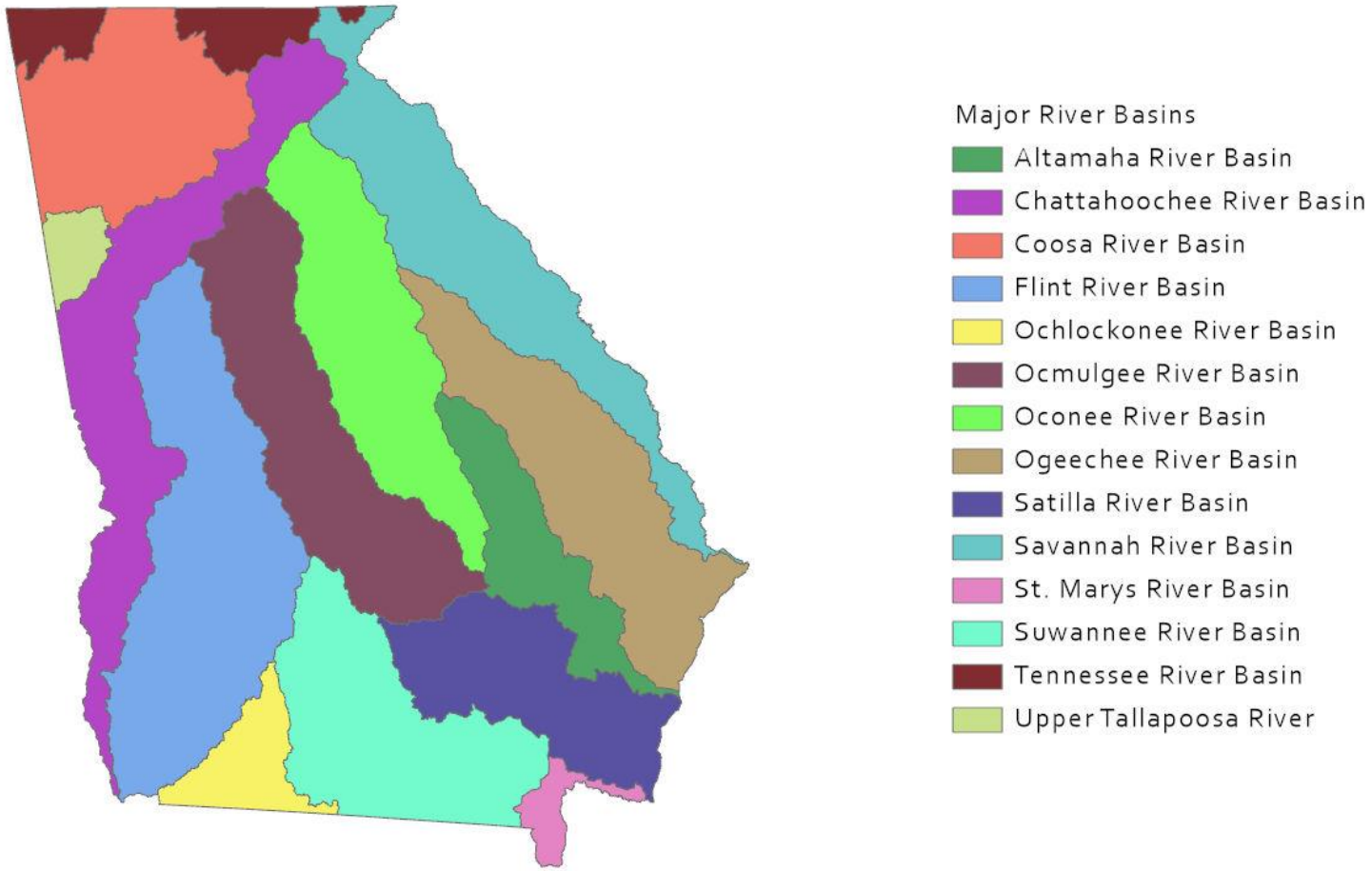
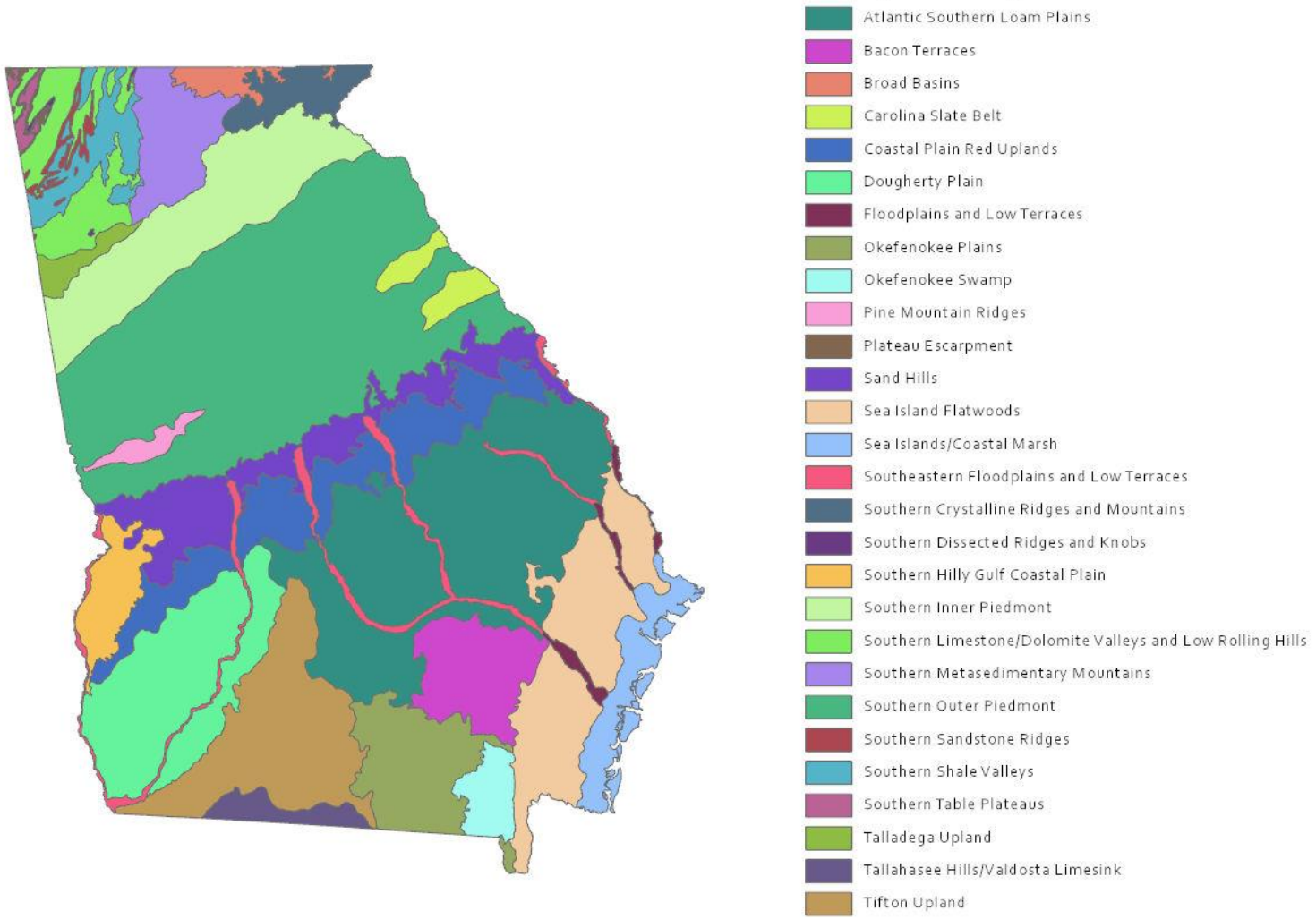


Figure 3: Georgia's 14 Major River Basins



Source: Atlanta Regional Commission

Figure 4: Georgia's Ecoregions



Source: US Environmental Protection Agency

Notes: