Silvicultural Best Management Practices Implementation Monitoring for Virginia

2011

Introduction

In June 1997, the Southern Group of State Foresters Water Resources Committee published the framework for state agencies to monitor silvicultural best management practice (BMP) implementation. This standardized protocol was intended to ensure that data collected by southern states could be effectively combined into one report. That report is periodically compiled, prepared and submitted to the USDA Forest Service Region 8, as well as USEPA in Atlanta, Georgia, by the Southern Group of State Foresters. However, this protocol is sufficiently flexible to be applied to each state's individual BMP guidelines. At the direction of the State Forester, Virginia is monitoring 240 harvested tracts each year and compiling an independent annual report based on this protocol. This data is also submitted periodically for the Southern Group report.

Methods

The Southern Group of State Foresters (SGSF) protocol provides the rationale for the new methods developed and adopted by the Virginia Department of Forestry (VDOF) in 2007. The fourth quarter (October-December) 2007 is the first sampling period for which the new monitoring system was used in Virginia.

Sixty tracts are selected randomly every quarter from harvests that received a VDOF final inspection two quarters previous to the audit quarter. This allows approximately six months between BMP implementation and the audit field visit. This timing allows for an assessment of how BMP integrity changes over time and provides for a modest sampling of silvicultural practices, such as site preparation, tree planting and weed control. VDOF is randomizing within each of the three administrative regions (Eastern, Central and Western) with the number of selected tracts proportional to the number of harvests for each sample quarter. This guarantees that BMP audits are concentrated in areas where most harvesting is occurring. In this, the fourth audit cycle (first quarter 2011 – fourth quarter 2011), there are 240 total audits completed, and the regional breakdown is displayed in Table 1 below. This approach guarantees that the averages reported are weighted by region according to the relative number of harvests in each region for this year.

Each audit tract will result in a "% Yes" score for each BMP category. That percentage describes what proportion of audit questions in that category that were applicable to that tract were positively fulfilled by the operator in the field. The audit questions are evaluated and answered during a field visit by one of four water quality engineers and/or nine water quality specialists who are full-time VDOF personnel. Every auditor is regularly trained in a group setting to maintain accuracy and consistency across the state. This allows VDOF to evaluate audit results generally by BMP category or type.

Table 1. Number of BMP audits completed by VDOF administrative region during the third audit cycle for the 2011 calendar year.

Region	Number of Audits
Eastern	82
Central	107
Western	51

Each of the 240 tracts audited is treated as a discreet unit, and the average tract score is reported as the "tract average." Each audit is comprised of 117 questions in 10 categories (Appendix A). The data are also combined across all tracts and all question responses are averaged together as a single data set by audit category and reported as the "BMP average." This is the average percentage of "Yes" responses when all audit questions are considered together without regard for the individual tract audits. This approach attempts to more accurately describe the overall BMP condition as a whole in Virginia. This BMP average also assigns greater importance to audits that have more applicable questions. These data consist of 28,080 total questions of which 19,455 were

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deemed not applicable, 1,252 were answered "No" and 7,373 were answered "Yes." These categories and questions relate directly to the major recommendations outlined in the BMP manual entitled *Virginia's Forestry Best Management Practices for Water Quality, 5th Edition*. This manual was published by VDOF in July 2002 and re-printed in 2010 and is available online at http://www.dof.virginia.gov/wq/index-BMP-Guide.htm. In most cases, a large portion of the questions may not apply to any specific tract. Questions or entire categories that do not apply to a tract are given a non-applicable (N/A) status and are not included for calculation of final results. This ensures that calculated averages do not reflect missing items that do not apply to the harvest.

Each individual question in the audit process is also tracked over time to determine which BMP issues in the BMP Manual are in need of improvement. This information is particularly valuable to the Sustainable Harvesting And Resource Professional (SHARP) Logger Program (an SFI industry sponsored logger training program) as it can help guide future educational efforts. These data also will assist VDOF, industry and consulting personnel as they inspect tracts and assist operators on the ground.

Results

The data for the 2011 audit are displayed as a series of tables and charts below. Table 2 displays overall BMP average data for the entire state by BMP category. Confidence in the data is reported as a 95 percent margin of error and was calculated according to the SGSF protocol and generally accepted statistical procedures.

While Table 2 shows statewide results, Table 3 shows the BMP average values by VDOF administrative region. These averages (Tables 2 and 3) are the result of combining questions in the categories across all 240 audits as a single complete set and averaging those questions by category. This is the best method to evaluate overall BMP issues across the state. It is important to note that when all individual audit scores were simply averaged together (tract average) the value calculated is somewhat different and, in this case, is approximately 87 percent statewide. The averages in Tables 2 and 3 address the overall BMP condition as indicated by all audits combined while the average value of the audits (87 percent) ignores the fact that not all audits are the same with regard to number of pertinent issues (non-N/A questions) involved and assumes all audits are of the same weight

Table 2. Statewide data for the BMP audit by BMP category. These data represent statewide averages for Virginia for the 2011 audit cycle.

BMP Category	Number of Tracts	Yes (%)	Margin of Error (%)
Roads	205	78.4	+/- 5.7
Decks	237	91.6	+/- 3.6
Crossings	83	87.1	+/- 7.4
SMZs	175	90.7	+/- 4.4
Wetlands	11	96.3	+/- 11.4
Planning	240	83.4	+/- 4.8
Skidding	231	83.4	+/- 4.9
Mechanical	1	100.0	–
Fire	2	75.9	+/- 60.5
Chemicals	0	–	–
All	240	85.5	+/- 4.8
Logging	240	85.5	+/- 4.6

Table 3. Regional data for the BMP audit by BMP category. These data represent regional averages for all three regions for the 2011 audit cycle.

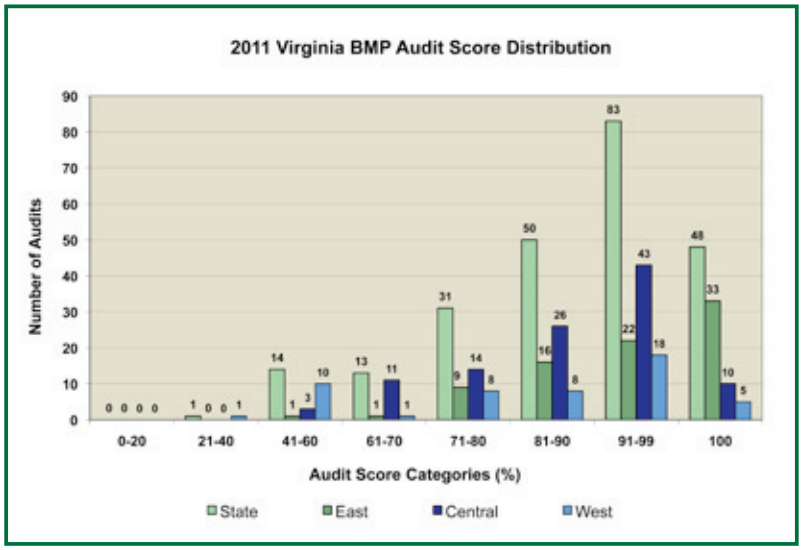
BMP Category	Eastern (% Yes)	Central (% Yes)	Western (% Yes)
Roads	81.3	78.3	76.6
Decks	94.4	91.5	88.0
Crossings	83.7	89.6	87.9
SMZs	95.3	92.4	78.6
Wetlands	96.3	N/A	N/A
Planning	93.9	82.9	69.0
Skidding	91.8	83.4	75.9
Mechanical	100.0	N/A	N/A
Fire	N/A	75.9	N/A
Chemicals	N/A	N/A	N/A
All	90.5	85.7	79.1
Logging Only	90.4	85.8	79.1

regardless. Both values are useful and correct as long as the user understands the difference as stated above and in the previous "Methods" section.

These data indicate that very little site preparation (fire, mechanical and chemical) is taking place up to six months after harvest, and it is for this reason that extreme caution should be used when considering the importance or value of the site preparation averages. About $^1/_3$ of all audit tracts (83 of 240) had at least one stream or wetland crossing. It is apparent that three very important categories – roads, crossings and skid trails – that often lead to water quality concerns tend to lag behind other categories with regard to implementation percentage (Tables 2 and 3).

Figure 1 indicates that the vast majority of tracts scored an overall implementation percentage of 70 percent or greater. While the overall mean implementation for all tracts is 85.5 percent (Table 2), the median is 92.0 percent. Given the skewed distribution of the overall scores in Figure 1, the median is perhaps a better judge of central tendency of the data. This audit report includes the expectation that all BMPs should be done per the manual regardless of likely impacts on water quality on each job. In most cases, BMPs that are not done do not directly impact water quality whether completed or not. These BMPs can be considered "luxury" BMPs as they are recommended by the manual but are not necessarily impacting water quality. Any BMP failures on the part of the operator that directly impact water quality are apparent in the significant risk and active sedimentation tallies as reported in Table 4 and the following explanation. These singular failures are also handled through the VDOF Silvicultural Water Quality Law enforcement process.

Figure 1: A histogram describing the score distribution of all 240 audits for the 2011 audit cycle in Virginia.



It was determined by the SGSF that each state should monitor significant risks to water quality and associated active sedimentation. The definition of significant risk describes a water quality concern that is observed on an audit tract that, due to a lack of BMPs, is causing or is likely to cause pollution. When a significant risk was noted during an audit field visit, the auditor also determined if active sedimentation was occurring. Audits that indicated a significant risk were isolated and evaluated independently of all other audits in

Table 4: Number of audit issues by BMP category which were noted to have a BMP failure and an associated significant risk.

BMP Category	State			Eastern			Central			Western		
	No. Issues	Active Sedi.[1]	No. Tracts	No. Issues	Active Sedi.[1]	No. Tracts	No. Issues	Active Sedi.[1]	No. Tracts	No. Issues	Active Sedi.[1]	No. Tracts
Stream Crossings	19	8	10	13	5	6	4	3	2	2	–	2
Decks	5	–	3	3	–	1	0	–	–	2	–	2
Roads	23	1	8	12	–	4	0	–	–	11	1	4
Skidding	5	–	1	0	–	–	5	–	1	0	–	–
Total	52	9	22	28	5	11	9	3	3	15	1	8

[1] Active Sedimentation Issues

Table 4. Of the 240 tracts in this audit cycle, 22 (9 percent) had at least one significant risk, and four of those tracts (1.7 percent) had active sedimentation concerns.

It is apparent in Table 4 that tracts which had at least one risk often had multiple risks and sometimes had an active sedimentation concern. A second analysis including only tracts with at least one active sedimentation issue determined that the average "% Yes" score for those four tracts was 55 percent, which indicates that long-term water quality problems tend to persist on tracts where overall BMP implementation is poor. Of the four active sedimentation tracts, the highest overall score is 83 percent and the lowest score was 28 percent. Persistent water quality problems obviously occur in a small minority of cases (4 out of 240). Individual BMP issues that are often associated with significant risks are included in Table 5.

The 59 audit tracts that were located in the Chesapeake Bay watershed were isolated and averages were calculated. The bay tract average score was 90.7 percent, and the BMP average of all the audit questions combined for all the tracts was 89.8 percent. This is slightly higher than for the state as a whole. The bay data also indicate that there were 15 significant risk issues and four active sedimentation problems on three tracts. All observed sedimentation concerns dealt with roads, decks and/or stream crossings. The active pollution concerns all dealt with a stream crossing on one tract.

The issues described in Table 5 indicate that operations that disturb or expose soil near to streams are more likely to cause a risk if not properly stabilized. A combination of improper road drainage and unstable stream crossing approaches combine to include a large number of risks. Nearly all risks are related directly to un-stabilized, exposed soil near a waterway. Simply avoiding most operations in or near to riparian areas would likely reduce risks to water quality. Minimizing roads, skid trails and stream crossings would clearly be beneficial to water quality risk reduction and would also reduce the number of BMP issues that need attention during and after the operation.

Table 5: Individual audit issues that are often associated with significant risks to water quality over the past four years.

BMP Category	Specific Issues Leading to Significant Risks
Roads	Drainage problems, dips, bars, sloping
	Lack of gravel/vegetation on slopes
	Turnouts directed into riparian zones
Decks	Deck in SMZs
	No soil protection measures
	No water diversions
	No sediment trapping structures
Stream Crossings	Culvert size and installation
	No water diversions on approaches
	Headwall instability
	Lack of bank stabilization
Skidding	Rutting near streams
	Channelized flow near streams
	Lack of waterbars or turnouts

Appendix A: Individual Audit Questions and Scores

Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Chemicals	**960**	–	–	**960**	–
Did applicators avoid mixing chemicals or filling equipment where runoff would likely enter a stream?	240	–	–	240	–
Did applicators remove all refuse from the tract?	240	–	–	240	–
Did chemical applicators avoid accidental drift into sensitive areas or SMZs?	240	–	–	240	–
Did chemical applicators avoid applying chemical directly into streams or SMZs?	240	–	–	240	–
Crossings	**3,856**	**91**	**613**	**4,560**	**87**
Are approaches stable and unlikely to contribute sediment to the stream?	157	12	71	240	86
Are culvert pipes installed properly in the channel to avoid undercutting and channel erosion?	212	2	26	240	93
Are culverts and bridges of adequate length?	180	2	58	240	97
Are culverts covered with adequate and appropriate fill material?	212	3	25	240	89
Are culverts covered with gravel to reduce erosion near the stream?	214	9	17	240	65
Are culverts properly sized according to the BMP manual Tables 6 and 7 or Talbot's formula?	212	6	22	240	79
Are fords used only where a natural rock base (or geoweb) and gentle approaches allow?	228	1	11	240	92
Are headwalls stabilized with vegetation, rock or fabric to minimize cutting?	215	8	17	240	68
Are permanent bridge abutments adequate and stable?	236	–	4	240	100
Are stream banks and approaches re-claimed with sufficient vegetation, rock or slash?	169	14	57	240	80
Are stream crossings installed at or near to right angles where possible?	150	1	89	240	99
Are stream crossings minimized?	150	1	89	240	99
Are temporary culverts, pole bridges and bridges removed?	187	1	52	240	98
Are water diversion structures present when needed on approaches?	180	17	43	240	72
Do all ford crossings avoid restricting the natural flow of water?	228	1	11	240	92
Do all ford crossings have a 50-foot approach of clean gravel?	228	7	5	240	42
Do all ford crossings have underlying geo-textile where needed (on approaches)?	234	5	1	240	17

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Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Is the addition of unnatural materials in the stream to facilitate the use of a ford minimized?	229	–	11	240	100
Were pole bridges used only in appropriate circumstances?	235	1	4	240	80
Decks	**438**	**145**	**1,577**	**2,160**	**92**
Are all decks limited in size?	3	4	233	240	98
Are all log decks located at least 50 feet from the nearest SMZ.	37	3	200	240	99
Are appropriate soil protection measures in place to prevent erosion on the deck?	18	40	182	240	82
Are decks reshaped where needed to ensure drainage?	115	14	111	240	89
Are fluid spills from equipment minimal?	3	8	229	240	97
Are log decks located on relatively well-drained ground with low to moderate slopes?	3	5	232	240	98
Are sediment trapping structures present if needed to prevent pollution?	132	13	95	240	88
Are water diversion structures installed to prevent water from crossing the deck?	124	48	68	240	59
Is the deck free of trash, garbage and other non-slash debris related to the harvest operation?	3	10	227	240	96
Fires	**3,571**	**7**	**22**	**3,600**	**76**
Are command and staging areas located away from streams?	238	–	2	240	100
Are large areas of bare soil re-vegetated where slope exceeded 5%?	238	2	–	240	0
Are water bars installed properly on firelines, roads and cleared areas?	238	1	1	240	50
Did fire crew avoid plowing up and down slopes where possible?	238	–	2	240	100
Did fireline construction avoid disturbing existing gullies?	238	1	1	240	50
Did the burning crew avoid exposing large areas of mineral soil?	238	–	2	240	100
Did the burning crew avoid pushing firelines directly into streams?	238	–	2	240	100
Does fireline construction follow appropriate skid trail BMPs?	238	2	–	240	–
Does fireline construction divert water away from streams where necessary?	238	–	2	240	100
Is all fire-related debris removed from stream channels?	238	–	2	240	100
Is all refuse and sewage disposed of properly?	238	–	2	240	100
Is vegetation or slash on firelines and cleared areas to prevent erosion as needed?	238	1	1	240	50
Were high intensity site-prep burns kept out of the SMZs?	238	–	2	240	100

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Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Were prescribed burns on fragile soils and steep slopes absolutely necessary to achieve goals?	239	–	1	240	100
Were steep grades and/or fragile soils protected from excessive burn and ground disturbance?	238	–	2	240	100
Mechanical_SP	**3,352**		**8**	**3,360**	**100**
Are SMZs maintained with no significant disturbance?	239	–	1	240	100
Did all mechanical operations avoid slopes in excess of 45%?	239	–	1	240	100
Did all mechanical operations avoid wet or fragile ground?	239	–	1	240	100
Did all mechanical operations take place on the contour to the extent possible?	239	–	1	240	100
Did bedding contractor avoid tying beds into streams, ditches or drainage structures?	240	–	–	240	–
Did machine planters avoid excessive slopes?	240	–	–	240	–
Did operators prevent debris or soil in the stream sufficient to degrade banks or impede flow?	239	–	1	240	100
Did raking, piling and windrowing avoid excessive movement or exposure of mineral soil?	239	–	1	240	100
Did scalping, furrowing and sub-soiling avoid connections to drainages?	239	–	1	240	100
Is scalping and furrowing less than 6 inches deep and on the contour?	240	–	–	240	–
Is soil disturbance minimized across the site relative to establishment goals?	239	–	1	240	100
Was bedding conducted on the contour where possible?	240	–	–	240	–
Was machine planting done on the contour?	240	–	–	240	–
Was sub-soiling or ripping done on the contour?	240	–	–	240	–
Planning	**221**	**83**	**416**	**720**	**83**
In the case of severe site conditions (very wet or steep) was the harvesting system modified to reduce damage to soil, site and water?	218	11	11	240	50
Is there evidence or knowledge of a harvest plan (painted lines, flagging, delineated hazards, SMZs or decks, engineered roads, etc…)?	2	65	173	240	73
Is there evidence that the logger utilized a harvesting system that is generally appropriate for the site and timber conditions?	1	7	232	240	97
Roads	**2,354**	**476**	**1,730**	**4,560**	**78**
Are grades between 2% and 10% except for necessary deviations?	54	6	180	240	97

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Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Are new roads located and constructed to allow for proper drainage?	166	15	59	240	80
Are new roads located to avoid erodible, wet and sensitive ground?	163	4	73	240	95
Are riprap and/or brush dams used where needed to slow water and trap sediment?	205	16	19	240	54
Are roads built outside of SMZs where possible?	78	4	158	240	98
Are roads daylighted where needed and feasible?	59	17	164	240	91
Are roads in SMZs as far from the channel as possible and built to prevent stream sedimentation?	190	5	45	240	90
Are roads on the contour where practical?	72	10	158	240	94
Are roads outsloped where needed and conditions allow?	130	25	85	240	77
Are temporary roads retired with properly constructed water bars or tank traps?	193	21	26	240	55
Are turnouts directing water and/or sediment away from riparian areas?	168	17	55	240	76
Are under road culverts installed, spaced and maintained properly?	206	4	30	240	88
Is access being controlled with a functional gate or barrier?	40	93	107	240	54
Is construction of dips, bars, turnouts and traps adequate to maintain function?	157	35	48	240	58
Is gravel or vegetation present to protect water bars from erosion?	137	43	60	240	58
Is there rock or vegetation on slopes where needed to prevent erosion?	78	54	108	240	67
Is water being "turned out" into surrounding landscape with appropriate structures?	115	46	79	240	63
Is water diverted from the road surface at specified intervals using dips, bars or traps?	108	59	73	240	55
Was road construction and use minimized?	35	2	203	240	99
Skidding	**1,306**	**301**	**1,513**	**3,120**	**83**
Are all skid trails free from channelized flow that is likely to cause sedimentation?	9	16	215	240	93
Are all skid trails located outside the SMZ?	51	8	181	240	96
Are appropriate cross drainages installed where springs or seeps crossed the trails?	232	4	4	240	50
Are bladed skid trails limited to less than 26% grade unless absolutely necessary?	169	12	59	240	83
Are bladed skid trails limited to sideslopes less than 60%?	173	9	58	240	87
Are un-bladed trails limited to sideslopes less than 36% in general?	78	–	162	240	100

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Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Are water bars established on trails where erosion is likely at recommended intervals?	127	59	54	240	48
Are water turnouts built to ensure drainage of skid trails where needed?	150	46	44	240	49
Did the logger avoid skidding logs through intermittent or perennial streams?	43	4	193	240	98
Do trails avoid long, continuous grades?	58	19	163	240	90
Do trails avoid rutting that will likely cause channelized erosion near a stream?	47	13	180	240	93
Is vegetation established where needed on trails to prevent erosion and sedimentation?	104	65	71	240	52
Were brush mats used to stabilize trails and prevent erosion where needed?	65	46	129	240	74
SMZs	**1,531**	**147**	**1,442**	**3,120**	**91**
Are all SMZs a minimum of 50 feet wide on each side of the stream bank?	66	42	132	240	76
Are SMZ widths modified to accommodate cold water fisheries and municipal water supplies?	235	1	4	240	80
Did the logger avoid exposing large sections of soil in the SMZ?	70	2	168	240	99
Did the logger avoid partial or patch clear cutting in the SMZ?	65	20	155	240	89
Did the logger avoid silvicultural debris in the stream that would warrant a law enforcement action under the "debris in the stream law?"	68	–	172	240	100
Did the logger avoid silvicultural sediment in the stream that might endanger public health, beneficial uses or aquatic life as stated in the "silvicultural water quality law?"	68	3	169	240	98
Do all intermittent and perennial streams have an SMZ?	71	12	157	240	93
Do all sinkholes or karst features have an SMZ?	238	2	–	240	0
Does at least 50% of the original basal area exist in the SMZ?	66	33	141	240	81
In tidal areas, has a 50-foot SMZ been maintained from the grass or marsh edge?	235	–	5	240	100
Is SMZ width relatively consistent along the entire length?	66	21	153	240	88
Is the SMZ free of roads and landings where possible?	65	7	168	240	96
Was exposed soil in the SMZ revegetated or covered with organic materials?	218	4	18	240	82
Wetlands	**1,866**	**2**	**52**	**1,920**	**96**
Are landings located on appropriate ground?	229	–	11	240	100

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Audit Questions by Category	Response Counts				% Yes *
	N/A	No	Yes	Total	
Did operations in wetlands avoid altering hydrology of the site to such a degree as to convert a wetland to a non wetland?	229	–	11	240	100
Did the operation avoid activities during particularly wet weather?	230	2	8	240	80
Is water movement maintained on the site?	231	–	9	240	100
Was low ground pressure equipment (LGP) utilized where needed?	238	–	2	240	100
Was the harvesting system appropriate for the site conditions?	230	–	10	240	100
Were the 15 mandatory road BMPs followed for wetland roads?	239	–	1	240	100
Were the six mandatory site-prep BMPs followed as needed?	240	–	–	240	–
Grand Total	**19,455**	**1,252**	**7,373**	**28,080**	**85**

*Shaded "Percent Yes" figures indicate scores less than average (85 percent), which clearly indicates a need for improvement.

Acknowledgements

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