



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2013

## Introduction

The Virginia Department of Forestry Best Management Practices Implementation Audit Program is based primarily on the Southern Group of State Foresters published framework for state forestry agencies ([http://www.southernforests.org/publications/SGSF%20Regional%20BMP%20Framework%20Protocol%20publication\\_2007.pdf/view](http://www.southernforests.org/publications/SGSF%20Regional%20BMP%20Framework%20Protocol%20publication_2007.pdf/view)). This standardized protocol was intended to ensure that data collected by southern states could be 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 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. These data are submitted periodically for the Southern Group five-year report (<http://www.southernforests.org/publications>).

## Methods

Every quarter of every year, 60 tracts are selected randomly 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 concentrates BMP audits in areas where most harvesting is occurring. In this, the fifth audit cycle (1st – 4th quarter, 2013), there are 240 total audits completed and the regional breakdown is displayed in Table 1.

**Table 1. Number of BMP audits completed by VDOF administrative region during the audit cycle for the 2013 calendar year.**

Region	Number of Audits
Eastern	84
Central	104
Western	52

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 enables VDOF to evaluate audit results generally by BMP category or type.

Each of the 240 tracts audited is treated as a discreet unit, and the average and median tract scores are reported as the “harvest average or median score.” Each audit is comprised of 117 questions in 10 categories (Appendix A). These 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 20,352 were deemed not applicable, 884 were answered “No” and 6,844 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 technical manual is available online

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(<http://www.dof.virginia.gov/water/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 SHARP Logger program, which is an SFI industry-sponsored logger training program at Virginia Tech (<http://sharpllogger.vt.edu/>) 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 2013 audit are displayed as a series of tables and charts. 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 harvest audit scores were simply averaged together (harvest average) the value calculated is somewhat different and in this case is approximately 90 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 tract audits (90 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. 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 caution should be used when considering the importance or value of the site

**Table 2. Statewide data for the BMP audit by BMP category. These data represent statewide averages for Virginia for the 2013 audit cycle.**

BMP Category	Number of Tracts	Yes (%)	Margin of Error (%)
Roads	175	83.1	+/- 5.7
Decks	236	93.4	+/- 3.2
Crossings	92	92.4	+/- 5.5
SMZs	150	90.0	+/- 4.9
Wetlands	8	93.6	+/- 17.3
Planning	240	85.4	+/- 4.6
Skidding	229	87.6	+/- 4.4
Mechanical	0	–	–
Fire	4	83.9	+/- 36.8
Chemicals	2	100.0	–
All	240	88.6	+/- 4.1
Logging	240	88.6	+/- 4.1

**Table 3. Regional data for the BMP audit by BMP category. These data represent regional averages for all three regions for the 2013 audit cycle.**

BMP Category	Eastern (% Yes)	Central (% Yes)	Western (% Yes)
Roads	86.0	78.4	88.4
Decks	96.8	91.2	93.1
Crossings	93.8	94.2	84.2
SMZs	95.3	91.5	73.2
Wetlands	93.6	N/A	N/A
Planning	91.3	87.8	70.8
Skidding	95.9	86.9	80.8
Mechanical	N/A	N/A	N/A
Fire	88.9	83.0	N/A
Chemicals	100.0	N/A	N/A
All	93.7	87.3	84.3

preparation averages. Greater than one third of all audit tracts (92 of 240) had at least one stream or wetland crossing. It is apparent that three very important categories that often lead

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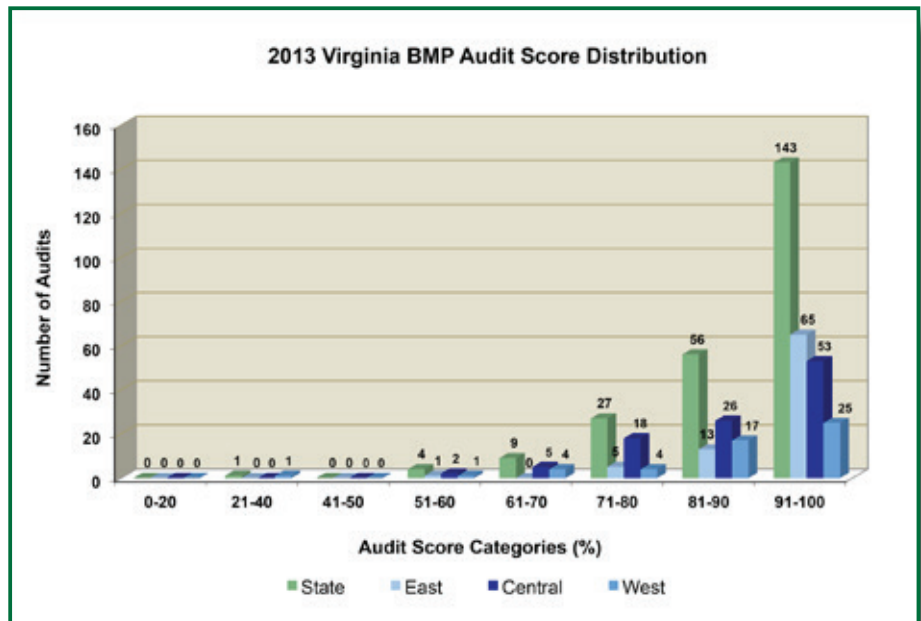
to water quality concerns, roads, crossings and skid trails, sometimes lag behind other categories with regard to implementation percentage (Tables 2 and 3).

The histogram (Figure 1) indicates that the vast majority of tracts scored an overall implementation percentage of 81 percent or greater. While the overall mean BMP implementation for all tracts is 88.6 percent (Table 2) and the overall harvest average score is 89.6 percent, the harvest median score is 92.2 percent. Given the skewed distribution of the overall scores in Figure 1, the median is perhaps a better judge of central tendency of the tract score data. These results indicate a steady level of BMP implementation statewide over recent years, and it should be understood that random sample averages fluctuate over time and small year to year changes may not indicate a real change in BMP implementation. Any real changes will become apparent over the long term as more data are accumulated.

This audit report includes the expectation that all BMPs should be done per the manual regardless of likely impacts on water quality on each harvested tract. In most cases, BMPs that are not done do not directly impact water quality. 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 explanation below. These singular failures are also handled through the VDOF silvicultural water quality law enforcement process according to § 10.1-1181.2 (<http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+10.1-1181.2>).

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. Out of the 240 tracts in this audit cycle, six (2.5 percent) had at least one significant risk and four of those tracts (1.7 percent)

**Figure 1: A histogram describing the score distribution of all 240 audits for the 2013 audit cycle in Virginia.**



had an active sedimentation concern. Table 4 summarizes the specific problems that were noted on the six tracts.

It is apparent in Table 4 that tracts that had at least one risk often had multiple risks in 2013. A second analysis including only tracts with at least one significant risk issue determined that the average “% Yes” score for those six harvests was 61 percent, the median harvest score was 63 percent and the average harvest score was 61 percent, which indicates that long-term water quality problems tend to persist on tracts where overall BMP implementation is well below the average and median values for all tracts.

The 97 audit tracts that were located in the Chesapeake Bay watershed were isolated and averages were calculated. The Bay harvest average score was 91 percent, and the tract median score was 94 percent while the BMP average of all the audit questions combined for all the Bay tracts was 90 percent. This is slightly better than the state as a whole. The Bay data also indicate that there were four significant risk issues on only two tracts, and active sedimentation was observed on both tracts. All observed significant risks dealt with haul roads near a stream that lacked necessary drainage and stabilization work.

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Table 4 indicates that operations that disturb or expose soil near to streams are more likely to cause a significant sedimentation 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, decks 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. Specific BMP deficiencies that almost always contribute to sedimentation issues deal specifically with a lack of drainage and stabilization of roads particularly on or near to stream crossings approaches. It is critical that operators use dips, bars and turnouts to guide water off of roads and clean gravel on slopes and approaches near waterways.

**Table 4: Tally and description of significant risks to water quality and associated active sedimentation for the 2013 BMP audit cycle.**

<b>BMP Issue by Region and Type</b>	<b>Risk</b>	<b>Sediment</b>
<b>Central Region</b>	<b>4</b>	<b>3</b>
Crossings	1	0
Are fords used only where a natural rock base (or geoweb) and gentle approaches allow?	1	0
Roads	3	3
Is there rock or vegetation on slopes where needed to prevent erosion?	1	1
Is water being "turned out" into surrounding landscape with appropriate structures?	1	1
Is water diverted from the road surface at specified intervals using dips, bars or traps?	1	1
<b>Eastern Region</b>	<b>1</b>	<b>1</b>
Roads	1	1
Is construction of dips, bars, turnouts and traps adequate to maintain function?	1	1
<b>Western Region</b>	<b>12</b>	<b>7</b>
Crossings	4	2
Are approaches stable and unlikely to contribute sediment to the stream?	1	1
Are culverts and bridges of adequate length?	1	0
Are culverts properly sized according to the BMP manual Tables 6 and 7 or Talbot's formula?	1	0
Are water diversion structures present when needed on approaches?	1	1
Skidding	6	4
Are all skid trails free from channelized flow that is likely to cause sedimentation?	1	0
Are water bars established on trails where erosion is likely at recommended intervals?	2	1
Are water turnouts built to ensure drainage of skid trails where needed?	1	1
Did the logger avoid skidding logs through intermittent or perennial streams?	1	1
Is vegetation established where needed on trails to prevent erosion and sedimentation?	1	1
SMZs	2	1
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"?	2	1
<b>Statewide Total</b>	<b>17</b>	<b>11</b>

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## Appendix A: Individual Audit Questions and Scores

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
<b>Chemicals</b>	<b>952</b>	–	8	<b>960</b>	100.0
Did applicators avoid mixing chemicals or filling equipment where runoff would likely enter a stream?	238	–	2	240	100.0
Did applicators remove all refuse from the tract?	238	–	2	240	100.0
Did chemical applicators avoid accidental drift into sensitive areas or SMZs?	238	–	2	240	100.0
Did chemical applicators avoid applying chemical directly into streams or SMZs?	238	–	2	240	100.0
<b>Crossings</b>	<b>3,807</b>	<b>57</b>	<b>696</b>	<b>4,560</b>	<b>92.4</b>
Are approaches stable and unlikely to contribute sediment to the stream?	148	4	88	240	95.7
Are culvert pipes installed properly in the channel to avoid undercutting and channel erosion?	207	2	31	240	93.9
Are culverts and bridges of adequate length?	172	2	66	240	97.1
Are culverts covered with adequate and appropriate fill material?	206	1	33	240	97.1
Are culverts covered with gravel to reduce erosion near the stream?	210	8	22	240	73.3
Are culverts properly sized according to the BMP manual Tables 6 and 7 or Talbot's formula?	213	3	24	240	88.9
Are fords used only where a natural rock base (or geoweb) and gentle approaches allow?	233	1	6	240	85.7
Are headwalls stabilized with vegetation, rock or fabric to minimize cutting?	218	2	20	240	90.9
Are permanent bridge abutments adequate and stable?	236	–	4	240	100.0
Are stream banks and approaches re-claimed with sufficient vegetation, rock or slash?	151	5	84	240	94.4
Are stream crossings installed at or near to right angles where possible?	140	1	99	240	99.0
Are stream crossings minimized?	140	6	94	240	94.0
Are temporary culverts, pole bridges and bridges removed?	175	3	62	240	95.4
Are water diversion structures present when needed on approaches?	192	11	37	240	77.1
Do all ford crossings avoid restricting the natural flow of water?	232	2	6	240	75.0
Do all ford crossings have a 50-foot approach of clean gravel?	234	2	4	240	66.7
Do all ford crossings have underlying geo-textile where needed (on approaches)?	239	1	–	240	0.0

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	N/A	No	Yes	Total	
Is the addition of unnatural materials in the stream to facilitate the use of a ford minimized?	234	1	5	240	83.3
Were pole bridges used only in appropriate circumstances?	227	2	11	240	84.6
<b>Decks</b>	<b>568</b>	<b>105</b>	<b>1,487</b>	<b>2,160</b>	<b>93.4</b>
Are all decks limited in size?	4	1	235	240	99.6
Are all log decks located at least 50 feet from the nearest SMZ.	63	10	167	240	94.4
Are appropriate soil protection measures in place to prevent erosion on the deck?	8	43	189	240	81.5
Are decks reshaped where needed to ensure drainage?	128	4	108	240	96.4
Are fluid spills from equipment minimal?	3	2	235	240	99.2
Are log decks located on relatively well-drained ground with low to moderate slopes?	3	4	233	240	98.3
Are sediment trapping structures present if needed to prevent pollution?	195	2	43	240	95.6
Are water diversion structures installed to prevent water from crossing the deck?	161	33	46	240	58.2
Is the deck free of trash, garbage and other non-slash debris related to the harvest operation?	3	6	231	240	97.5
<b>Fires</b>	<b>3,544</b>	<b>9</b>	<b>47</b>	<b>3,600</b>	<b>83.9</b>
Are command and staging areas located away from streams?	236	–	4	240	100.0
Are large areas of bare soil re-vegetated where slope exceeded 5%?	238	2	–	240	0.0
Are water bars installed properly on firelines, roads and cleared areas?	237	1	2	240	66.7
Did fire crew avoid plowing up and down slopes where possible?	235	–	5	240	100.0
Did fireline construction avoid disturbing existing gullies?	235	–	5	240	100.0
Did the burning crew avoid exposing large areas of mineral soil?	235	–	5	240	100.0
Did the burning crew avoid pushing firelines directly into streams?	236	–	4	240	100.0
Does fireline construction follow appropriate skid trail BMPs?	235	2	3	240	60.0
Does fireline construction divert water away from streams where necessary?	236	1	3	240	75.0
Is all fire-related debris removed from stream channels?	238	–	2	240	100.0
Is all refuse and sewage disposed of properly?	236	–	4	240	100.0
Is vegetation or slash on firelines and cleared areas to prevent erosion as needed?	236	3	1	240	25.0
Were high intensity site-prep burns kept out of the SMZs?	237	–	3	240	100.0

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	N/A	No	Yes	Total	
Were prescribed burns on fragile soils and steep slopes absolutely necessary to achieve goals?	239	–	1	240	100.0
Were steep grades and/or fragile soils protected from excessive burn and ground disturbance?	235	–	5	240	100.0
<b>Mechanical_SP</b>	<b>3,360</b>	<b>–</b>	<b>–</b>	<b>3,360</b>	<b>N/A</b>
Are SMZs maintained with no significant disturbance?	240	–	–	240	N/A
Did all mechanical operations avoid slopes in excess of 45%?	240	–	–	240	N/A
Did all mechanical operations avoid wet or fragile ground?	240	–	–	240	N/A
Did all mechanical operations take place on the contour to the extent possible?	240	–	–	240	N/A
Did bedding contractor avoid tying beds into streams, ditches or drainage structures?	240	–	–	240	N/A
Did machine planters avoid excessive slopes?	240	–	–	240	N/A
Did operators prevent debris or soil in the stream sufficient to degrade banks or impede flow?	240	–	–	240	N/A
Did raking, piling and windrowing avoid excessive movement or exposure of mineral soil?	240	–	–	240	N/A
Did scalping, furrowing and sub-soiling avoid connections to drainages?	240	–	–	240	N/A
Is scalping and furrowing less than 6 inches deep and on the contour?	240	–	–	240	N/A
Is soil disturbance minimized across the site relative to establishment goals?	240	–	–	240	N/A
Was bedding conducted on the contour where possible?	240	–	–	240	N/A
Was machine planting done on the contour?	240	–	–	240	N/A
Was sub-soiling or ripping done on the contour?	240	–	–	240	N/A
<b>Planning</b>	<b>228</b>	<b>72</b>	<b>420</b>	<b>720</b>	<b>85.4</b>
In the case of severe site conditions (very wet or steep) was the harvesting system modified to reduce damage to soil, site and water?	224	6	10	240	62.5
Is there evidence or knowledge of a harvest plan (painted lines, flagging, delineated hazards, SMZs or decks, engineered roads, etc...)?	4	63	173	240	73.3
Is there evidence that the logger utilized a harvesting system that is generally appropriate for the site and timber conditions?	–	3	237	240	98.8

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Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
<b>Roads</b>	<b>2,806</b>	<b>296</b>	<b>1,458</b>	<b>4,560</b>	<b>83.1</b>
Are grades between 2% and 10% except for necessary deviations?	65	1	174	240	99.4
Are new roads located and constructed to allow for proper drainage?	187	4	49	240	92.5
Are new roads located to avoid erodible, wet and sensitive ground?	186	1	53	240	98.1
Are riprap and/or brush dams used where needed to slow water and trap sediment?	226	5	9	240	64.3
Are roads built outside of SMZs where possible?	140	1	99	240	99.0
Are roads daylighted where needed and feasible?	73	13	154	240	92.2
Are roads in SMZs as far from the channel as possible and built to prevent stream sedimentation?	216	–	24	240	100.0
Are roads on the contour where practical?	89	–	151	240	100.0
Are roads outsloped where needed and conditions allow?	153	15	72	240	82.8
Are temporary roads retired with properly constructed water bars or tank traps?	212	9	19	240	67.9
Are turnouts directing water and/or sediment away from riparian areas?	196	4	40	240	90.9
Are under road culverts installed, spaced and maintained properly?	203	3	34	240	91.9
Is access being controlled with a functional gate or barrier?	67	82	91	240	52.6
Is construction of dips, bars, turnouts and traps adequate to maintain function?	184	10	46	240	82.1
Is gravel or vegetation present to protect water bars from erosion?	158	27	55	240	67.1
Is there rock or vegetation on slopes where needed to prevent erosion?	101	43	96	240	69.1
Is water being “turned out” into surrounding landscape with appropriate structures?	145	36	59	240	62.1
Is water diverted from the road surface at specified intervals using dips, bars or traps?	139	42	59	240	58.4
Was road construction and use minimized?	66	–	174	240	100.0
<b>Skidding</b>	<b>1,456</b>	<b>206</b>	<b>1,458</b>	<b>3,120</b>	<b>87.6</b>
Are all skid trails free from channelized flow that is likely to cause sedimentation?	11	8	221	240	96.5
Are all skid trails located outside the SMZ?	82	14	144	240	91.1
Are appropriate cross drainages installed where springs or seeps crossed the trails?	235	1	4	240	80.0
Are bladed skid trails limited to less than 26% grade unless absolutely necessary?	181	8	51	240	86.4



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Audit Questions by Category	Response Counts				% Yes
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Are bladed skid trails limited to sideslopes less than 60%?	185	3	52	240	94.5
Are un-bladed trails limited to sideslopes less than 36% in general?	74	–	166	240	100.0
Are water bars established on trails where erosion is likely at recommended intervals?	141	50	49	240	49.5
Are water turnouts built to ensure drainage of skid trails where needed?	169	24	47	240	66.2
Did the logger avoid skidding logs through intermittent or perennial streams?	77	3	160	240	98.2
Do trails avoid long, continuous grades?	53	13	174	240	93.0
Do trails avoid rutting that will likely cause channelized erosion near a stream?	57	4	179	240	97.8
Is vegetation established where needed on trails to prevent erosion and sedimentation?	120	44	76	240	63.3
Were brush mats used to stabilize trails and prevent erosion where needed?	71	34	135	240	79.9
<b>SMZs</b>	<b>1,758</b>	<b>136</b>	<b>1,226</b>	<b>3,120</b>	<b>90.0</b>
Are all SMZs a minimum of 50 feet wide on each side of the stream bank?	90	36	114	240	76.0
Are SMZ widths modified to accommodate cold water fisheries and municipal water supplies?	238	1	1	240	50.0
Did the logger avoid exposing large sections of soil in the SMZ?	92	6	142	240	95.9
Did the logger avoid partial or patch clear cutting in the SMZ?	93	24	123	240	83.7
Did the logger avoid silvicultural debris in the stream that would warrant a law enforcement action under the "debris in the stream law?"	91	–	149	240	100.0
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?"	90	3	147	240	98.0
Do all intermittent and perennial streams have an SMZ?	99	9	132	240	93.6
Do all sinkholes or karst features have an SMZ?	239	–	1	240	100.0
Does at least 50% of the original basal area exist in the SMZ?	93	27	120	240	81.6
In tidal areas, has a 50-foot SMZ been maintained from the grass or marsh edge?	237	–	3	240	100.0
Is SMZ width relatively consistent along the entire length?	92	18	130	240	87.8
Is the SMZ free of roads and landings where possible?	91	10	139	240	93.3
Was exposed soil in the SMZ revegetated or covered with organic materials?	213	2	25	240	92.6

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	N/A	No	Yes	Total	
<b>Wetlands</b>	<b>1,873</b>	<b>3</b>	<b>44</b>	<b>1,920</b>	<b>93.6</b>
Are landings located on appropriate ground?	232	–	8	240	100.0
Did operations in wetlands avoid altering hydrology of the site to such a degree as to convert a wetland to a non wetland?	232	–	8	240	100.0
Did the operation avoid activities during particularly wet weather?	232	1	7	240	87.5
Is water movement maintained on the site?	232	–	8	240	100.0
Was low ground pressure equipment (LGP) utilized where needed?	234	1	5	240	83.3
Was the harvesting system appropriate for the site conditions?	232	1	7	240	87.5
Were the 15 mandatory road BMPs followed for wetland roads?	239	–	1	240	100.0
Were the six mandatory site-prep BMPs followed as needed?	240	–	–	240	N/A
<b>Grand Total</b>	<b>20,352</b>	<b>884</b>	<b>6,844</b>	<b>28,080</b>	<b>88.6</b>

## Acknowledgements

Virginia Department of Forestry


[www.dof.virginia.gov](http://www.dof.virginia.gov)

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