



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

## 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 to 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 also 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 allows for a modest sampling of silvicultural practices, such as site preparation, tree planting and weed control. VDOF is currently 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, 2012), there are 240 total audits completed and the regional breakdown is displayed in Table 1.

Each audit tract will result in a “% Yes” score for each BMP category. That percentage describes what proportion of audit

**Table 1. Number of BMP audits completed by VDOF administrative region during the audit cycle for the 2012 calendar year.**

Region	Number of Audits
Eastern	79
Central	107
Western	54

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 “tract average or median.” 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 19,550 were deemed not applicable, 878 were answered “No” and 7,652 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 March 2011 and is available online (<http://www.dof.virginia.gov/wq/index-BMP-Guide.htm>). In most cases, a large portion of the questions may not apply to



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

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://sharplogger.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 2012 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 audit scores were simply averaged together (tract average), the value calculated is somewhat different and, in this case, is approximately 91 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 (91 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 2012 audit cycle.**

BMP Category	Number of Tracts	Yes (%)	Margin of Error (%)
Roads	196	85.2	+/- 5.1
Decks	240	94.1	+/- 3.1
Crossings	106	91.5	+/- 5.4
SMZs	175	91.5	+/- 4.2
Wetlands	11	92.3	+/- 16.1
Planning	240	85.4	+/- 4.6
Skidding	237	89.6	+/- 4.0
Mechanical	4	74.2	+/- 43.8
Fire	4	89.5	+/- 30.7
Chemicals	2	100.0	–
All	240	89.7	+/- 3.9
Logging	240	89.8	+/- 3.8

**Table 3. Regional data for the BMP audit by BMP category. These data represent regional averages for all three regions for the 2012 audit cycle.**

BMP Category	Eastern (% Yes)	Central (% Yes)	Western (% Yes)
Roads	83.0	84.0	88.2
Decks	93.9	93.7	94.9
Crossings	90.5	93.3	87.8
SMZs	97.9	90.2	83.9
Wetlands	96.6	N/A	50.0
Planning	94.5	83.6	75.9
Skidding	95.6	88.5	86.4
Mechanical	N/A	95.2	30.0
Fire	N/A	93.0	78.6
Chemicals	100.0	N/A	N/A
All	93.1	89.1	87.3



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

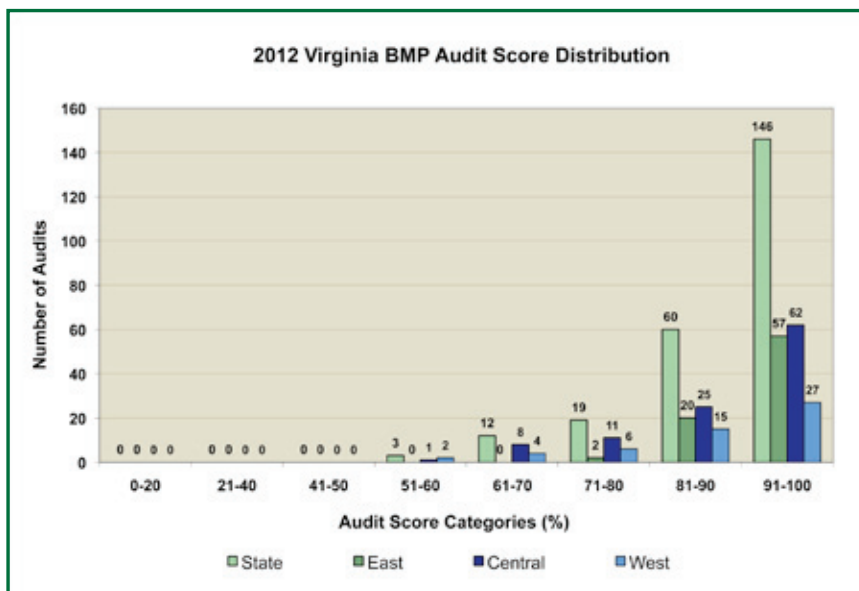
preparation averages. Almost half of all audit tracts (106 of 240) had at least one stream or wetland crossing. It is apparent that three very important categories that often lead to water quality concerns – roads, crossings and skid trails – sometimes lag behind other categories with regard to implementation percentage (Tables 2 and 3).

The histogram (Figure 1) indicates that the vast majority of tracts scored an overall implementation of 81 percent or greater. While the overall mean BMP implementation for all tracts is 89.7 percent (Table 2) and the overall tract average score is 90.7 percent, the median tract score is 93.9 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 substantial increase in BMP implementation statewide over previous years, and it should be understood that random sample averages fluctuate over time and these increases 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. 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

**Figure 1: A histogram describing the score distribution of all 240 audits for the 2012 audit cycle in Virginia.**



independently of all other audits. Out of the 240 tracts in this audit cycle, eight (3 percent) had at least one significant risk and none of those tracts had an active sedimentation concern. Table 4 summarizes the specific problems that were noted on the eight tracts.

It is apparent in Table 4 that tracts with at least one risk often had multiple risks, but no active sedimentation concerns were observed at the times of the audits in 2012. This is the first year that inspectors did not observe any active sedimentation on audit tracts. A second analysis, including only tracts with at least one significant risk issue, determined that the average “%Yes” score for those eight tracts was 75 percent, the median score was 76 percent and the BMP average was 75 percent, which indicates that long-term water quality problems tend to persist on tracts where overall BMP implementation is 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 tract average score was 91 percent and the tract median score was 93 percent, while the BMP average of all the audit questions combined for all the Bay tracts was 90 percent. This is in line with the state as a whole. The Bay data also indicate that there were three significant risk issues on only

# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

one tract. All observed significant risks dealt with a perennial stream haul road crossing on that one tract. There were no active sedimentation concerns in the Bay watershed in the 2012 sample.

Table 4 indicates 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, 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: Summary of significant risk issues for the 2012 BMP audit cycle.**

BMP Issue by Region and Type	Occurrences (No.)	Tracts (No.)
<b>Central Region</b>	<b>3</b>	<b>1</b>
Crossings		
Are approaches stable and unlikely to contribute sediment to the stream?	1	
Roads		
Are riprap and/or brush dams used where needed to slow water and trap sediment?	1	
Is there rock or vegetation on slopes where needed to prevent erosion?	1	
<b>Eastern Region</b>	<b>1</b>	<b>1</b>
Crossings		
Do all ford crossings have a 50-foot approach of clean gravel?	1	
<b>Western Region</b>	<b>11</b>	<b>6</b>
Crossings		
Are approaches stable and unlikely to contribute sediment to the stream?	3	
Are water diversion structures present when needed on approaches?	1	
Decks		
Are sediment trapping structures present if needed to prevent pollution?	1	
Roads		
Is water diverted from the road surface at specified intervals using dips, bars or traps?	1	
Skidding		
Are all skid trails free from channelized flow that is likely to cause sedimentation?	1	
Is vegetation established where needed on trails to prevent erosion and sedimentation?	1	
SMZs		
Did the logger avoid silvicultural sediment in the stream?	3	
<b>Statewide Total</b>	<b>15</b>	<b>8</b>

# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

## 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>	<b>–</b>	<b>8</b>	<b>960</b>	<b>100</b>
Did applicators avoid mixing chemicals or filling equipment where runoff would likely enter a stream?	238	–	2	240	100
Did applicators remove all refuse from the tract?	238	–	2	240	100
Did chemical applicators avoid accidental drift into sensitive areas or SMZs?	238	–	2	240	100
Did chemical applicators avoid applying chemical directly into streams or SMZs?	238	–	2	240	100
<b>Crossings</b>	<b>3,758</b>	<b>68</b>	<b>734</b>	<b>4,560</b>	<b>92</b>
Are approaches stable and unlikely to contribute sediment to the stream?	144	6	90	240	94
Are culvert pipes installed properly in the channel to avoid undercutting and channel erosion?	213	4	23	240	85
Are culverts and bridges of adequate length?	177	2	61	240	97
Are culverts covered with adequate and appropriate fill material?	214	1	25	240	96
Are culverts covered with gravel to reduce erosion near the stream?	218	5	17	240	77
Are culverts properly sized according to the BMP manual Tables 6 and 7 or Talbot's formula?	216	6	18	240	75
Are fords used only where a natural rock base (or geoweb) and gentle approaches allow?	228	3	9	240	75
Are headwalls stabilized with vegetation, rock or fabric to minimize cutting?	218	3	19	240	86
Are permanent bridge abutments adequate and stable?	230	3	7	240	70
Are stream banks and approaches re-claimed with sufficient vegetation, rock or slash?	147	8	85	240	91
Are stream crossings installed at or near to right angles where possible?	136	2	102	240	98
Are stream crossings minimized?	135	5	100	240	95
Are temporary culverts, pole bridges and bridges removed?	161	5	74	240	94
Are water diversion structures present when needed on approaches?	174	5	61	240	92
Do all ford crossings avoid restricting the natural flow of water?	228	–	12	240	100
Do all ford crossings have a 50-foot approach of clean gravel?	229	6	5	240	45
Do all ford crossings have underlying geo-textile where needed (on approaches)?	236	3	1	240	25



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

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?	228	1	11	240	92
Were pole bridges used only in appropriate circumstances?	226	–	14	240	100
<b>Decks</b>	<b>458</b>	<b>101</b>	<b>1,601</b>	<b>2,160</b>	<b>94</b>
Are all decks limited in size?	–	2	238	240	99
Are all log decks located at least 50 feet from the nearest SMZ.	43	7	190	240	96
Are appropriate soil protection measures in place to prevent erosion on the deck?	14	32	194	240	86
Are decks reshaped where needed to ensure drainage?	119	9	112	240	93
Are fluid spills from equipment minimal?	4	2	234	240	99
Are log decks located on relatively well-drained ground with low to moderate slopes?	–	3	237	240	99
Are sediment trapping structures present if needed to prevent pollution?	148	3	89	240	97
Are water diversion structures installed to prevent water from crossing the deck?	129	35	76	240	68
Is the deck free of trash, garbage and other non-slash debris related to the harvest operation?	1	8	231	240	97
<b>Fires</b>	<b>3,543</b>	<b>6</b>	<b>51</b>	<b>3,600</b>	<b>89</b>
Are command and staging areas located away from streams?	236	–	4	240	100
Are large areas of bare soil re-vegetated where slope exceeded 5%?	236	2	2	240	50
Are water bars installed properly on firelines, roads and cleared areas?	236	–	4	240	100
Did fire crew avoid plowing up and down slopes where possible?	236	–	4	240	100
Did fireline construction avoid disturbing existing gullies?	236	–	4	240	100
Did the burning crew avoid exposing large areas of mineral soil?	236	1	3	240	75
Did the burning crew avoid pushing firelines directly into streams?	236	–	4	240	100
Does fireline construction follow appropriate skid trail BMPs?	236	1	3	240	75
Does fireline construction divert water away from streams where necessary?	236	–	4	240	100
Is all fire-related debris removed from stream channels?	238	–	2	240	100
Is all refuse and sewage disposed of properly?	236	–	4	240	100
Is vegetation or slash on firelines and cleared areas to prevent erosion as needed?	236	2	2	240	50
Were high intensity site-prep burns kept out of the SMZs?	236	–	4	240	100

# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

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?	237	–	3	240	100
Were steep grades and/or fragile soils protected from excessive burn and ground disturbance?	236	–	4	240	100
<b>Mechanical_SP</b>	<b>3,329</b>	<b>8</b>	<b>23</b>	<b>3,360</b>	<b>74</b>
Are SMZs maintained with no significant disturbance?	236	2	2	240	50
Did all mechanical operations avoid slopes in excess of 45%?	236	–	4	240	100
Did all mechanical operations avoid wet or fragile ground?	236	–	4	240	100
Did all mechanical operations take place on the contour to the extent possible?	236	1	3	240	75
Did bedding contractor avoid tying beds into streams, ditches or drainage structures?	239	1	–	240	0
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?	236	–	4	240	100
Did raking, piling and windrowing avoid excessive movement or exposure of mineral soil?	236	1	3	240	75
Did scalping, furrowing and sub-soiling avoid connections to drainages?	239	1	–	240	0
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?	236	1	3	240	75
Was bedding conducted on the contour where possible?	239	1	–	240	0
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>221</b>	<b>73</b>	<b>426</b>	<b>720</b>	<b>85</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?	216	11	13	240	54
Is there evidence or knowledge of a harvest plan (painted lines, flagging, delineated hazards, SMZs or decks, engineered roads, etc...)?	3	61	176	240	74
Is there evidence that the logger utilized a harvesting system that is generally appropriate for the site and timber conditions?	2	1	237	240	100
<b>Roads</b>	<b>2,551</b>	<b>298</b>	<b>1,711</b>	<b>4,560</b>	<b>85</b>
Are grades between 2% and 10% except for necessary deviations?	64	5	171	240	97

# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

Audit Questions by Category	Response Counts				% Yes
	N/A	No	Yes	Total	
Are new roads located and constructed to allow for proper drainage?	176	3	61	240	95
Are new roads located to avoid erodible, wet and sensitive ground?	176	–	64	240	100
Are riprap and/or brush dams used where needed to slow water and trap sediment?	212	11	17	240	61
Are roads built outside of SMZs where possible?	97	2	141	240	99
Are roads daylighted where needed and feasible?	69	10	161	240	94
Are roads in SMZs as far from the channel as possible and built to prevent stream sedimentation?	208	–	32	240	100
Are roads on the contour where practical?	78	3	159	240	98
Are roads outsloped where needed and conditions allow?	162	15	63	240	81
Are temporary roads retired with properly constructed water bars or tank traps?	200	9	31	240	78
Are turnouts directing water and/or sediment away from riparian areas?	175	5	60	240	92
Are under road culverts installed, spaced and maintained properly?	208	4	28	240	88
Is access being controlled with a functional gate or barrier?	57	66	117	240	64
Is construction of dips, bars, turnouts and traps adequate to maintain function?	155	23	62	240	73
Is gravel or vegetation present to protect water bars from erosion?	142	25	73	240	74
Is there rock or vegetation on slopes where needed to prevent erosion?	93	39	108	240	73
Is water being "turned out" into surrounding landscape with appropriate structures?	118	33	89	240	73
Is water diverted from the road surface at specified intervals using dips, bars or traps?	111	45	84	240	65
Was road construction and use minimized?	50	–	190	240	100
<b>Skidding</b>	<b>1,347</b>	<b>184</b>	<b>1,589</b>	<b>3,120</b>	<b>90</b>
Are all skid trails free from channelized flow that is likely to cause sedimentation?	7	7	226	240	97
Are all skid trails located outside the SMZ?	53	10	177	240	95
Are appropriate cross drainages installed where springs or seeps crossed the trails?	230	1	9	240	90
Are bladed skid trails limited to less than 26% grade unless absolutely necessary?	177	8	55	240	87
Are bladed skid trails limited to sideslopes less than 60%?	177	7	56	240	89
Are un-bladed trails limited to sideslopes less than 36% in general?	59	1	180	240	99



# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

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?	135	41	64	240	61
Are water turnouts built to ensure drainage of skid trails where needed?	162	21	57	240	73
Did the logger avoid skidding logs through intermittent or perennial streams?	50	4	186	240	98
Do trails avoid long, continuous grades?	49	15	176	240	92
Do trails avoid rutting that will likely cause channelized erosion near a stream?	41	3	196	240	98
Is vegetation established where needed on trails to prevent erosion and sedimentation?	131	39	70	240	64
Were brush mats used to stabilize trails and prevent erosion where needed?	76	27	137	240	84
<b>SMZs</b>	<b>1,536</b>	<b>135</b>	<b>1,449</b>	<b>3,120</b>	<b>91</b>
Are all SMZs a minimum of 50 feet wide on each side of the stream bank?	69	32	139	240	81
Are SMZ widths modified to accommodate cold water fisheries and municipal water supplies?	238	–	2	240	100
Did the logger avoid exposing large sections of soil in the SMZ?	65	9	166	240	95
Did the logger avoid partial or patch clear cutting in the SMZ?	72	22	146	240	87
Did the logger avoid silvicultural debris in the stream that would warrant a law enforcement action under the "debris in the stream law?"	66	–	174	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?"	65	4	171	240	98
Do all intermittent and perennial streams have an SMZ?	70	10	160	240	94
Do all sinkholes or karst features have an SMZ?	240			240	N/A
Does at least 50% of the original basal area exist in the SMZ?	71	30	139	240	82
In tidal areas, has a 50-foot SMZ been maintained from the grass or marsh edge?	235	1	4	240	80
Is SMZ width relatively consistent along the entire length?	67	19	154	240	89
Is the SMZ free of roads and landings where possible?	69	5	166	240	97
Was exposed soil in the SMZ revegetated or covered with organic materials?	209	3	28	240	90
<b>Wetlands</b>	<b>1,855</b>	<b>5</b>	<b>60</b>	<b>1,920</b>	<b>92</b>
Are landings located on appropriate ground?	230	–	10	240	100

# Silvicultural Best Management Practices Implementation Monitoring for Virginia

2012

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?	229	–	11	240	100
Was low ground pressure equipment (LGP) utilized where needed?	232	2	6	240	75
Was the harvesting system appropriate for the site conditions?	229	1	10	240	91
Were the 15 mandatory road BMPs followed for wetland roads?	236	–	4	240	100
Were the six mandatory site-prep BMPs followed as needed?	240	–	–	240	N/A
<b>Grand Total</b>	<b>19,550</b>	<b>878</b>	<b>7,652</b>	<b>28,080</b>	<b>90</b>

## Acknowledgements

Virginia Department of Forestry  
[www.dof.virginia.gov](http://www.dof.virginia.gov)

### Written by

William Lakel, Ph.D, Water Quality Program Supervisor  
 Matt Poirot, Assistant Director of Forest Management for Water Quality

Design by Janet Muncy, Public Information Specialist



**Virginia Department of Forestry**  
 900 Natural Resources Drive, Suite 800  
 Charlottesville, Virginia 22903  
 Phone: (434) 977-6555  
[www.dof.virginia.gov](http://www.dof.virginia.gov)

VDOF P00143; 03/2013

This institution is an equal opportunity provider.