Forest Harvest Best Management Practices in Maryland and Delaware: Use and Effectiveness: 2016 Results

Forest harvesting best management practices are required by law in Maryland[1] and Delaware[2], and are an important safeguard to avoid damage to water quality. Forest lands yield excellent water quality, including forests producing raw materials that society and economies need, generation after generation. Practices are designed to work with the site conditions and natural materials on-site as much as possible, and have been shown to protect water quality for sustainable forestry operations over several decades[3].

Common best practices

- Harvest planning to avoid stream crossings, steep slopes and wetlands;
- Locating roads and skid trails on low slopes (usually less than 15 percent);
- Timing harvest operations to avoid wet periods;
- Diverting water off roads and skid trails to infiltrate into the forest floor using earthen berm water bars, broad-based dips or other diverters;
- Stabilizing roads, landings and steep skid trails;
- Using bridges, culverts or temporary corduroy logs for water crossings;
- Crossing streams at right angles to minimize disturbance; and
- Leaving buffers to shade waterways.

Some harvesting can occur within buffers but a minimum of 60 square feet of basal area must be left, usually over half of the trees in an area.

Top: re-vegetated haul road, Vision Forestry.
Bottom: Waterway buffer and removed crossing structure, Maryland Forest Service.

Methods

A study was conducted from 2014 to 2016 to evaluate the rates at which best management practices were applied on forest harvesting operations and how effective they were in preventing sediment from entering waterways: the goal of the Clean Water Act.

Sites were assessed using two methods:

1) State best management practice compliance checklists for the state-specific requirements, and

[1] Maryland Department of Environment. 2015. The 2015 Maryland Soil Erosion and Sediment Control Standards and Specifications for Forest Harvest Operations. MDE, Baltimore, MD. 166p.

[2] Forestry Best Management Practices to Protect Delaware's Water Quality. 1990. Delaware Dept. of Agriculture, DE Forest Service, Dover, DE. 92p.

[3] Aust, W.M., and C.R. Blinn. 2004. Forestry best management practices for timber harvesting and site preparation in the eastern U.S.: An overview of water quality and productivity research during the past 20 years (1982-2002). Water, Air and Soil Pollution: Focus 4(1):5-36.

2) The U.S. Forest Service Northeastern Area Best Management Practices Monitoring approach[4] (Welsch et al., 2007), which focuses on measuring effectiveness of the best management practices in protecting waterways from sediment, loss of shade, chemical pollution, and fish blockages.

A forestry contractor visited 72 sites throughout Maryland and Delaware. (Figure 1.) Eleven sites were visited for quality assurance by state forestry staff, with resulting 94 percent consistency in sediment evaluation results.

Results

Compliance with state-required best management practices was **88 percent in Maryland**—covering sites from the mountains to the coastal plain—and **93 percent in Delaware**—all coastal plain sites.

The sites selected for assessment were locations with waterway crossings and buffers with the greatest potential for water quality impacts. Of 2,080 harvest permits (2011-2014), 345 (17 percent) had crossings. The remainder avoided crossing waterways, and those potential impacts. Effects were expected to be larger than normal because of the high rainfall 2014-2016, more than 20 percent above the 30-year average.

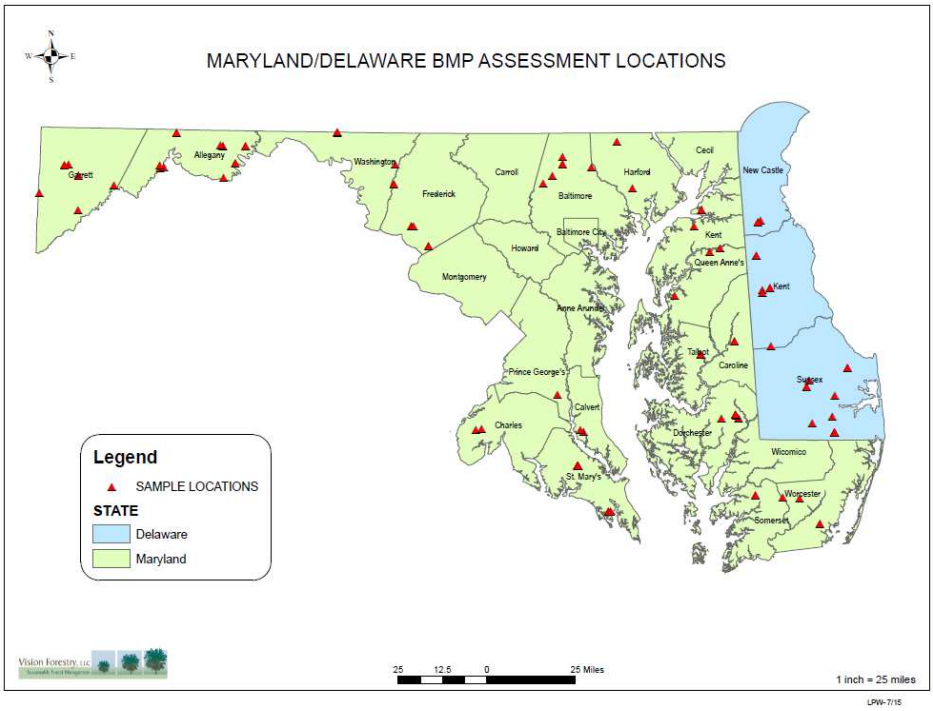

Figure 1: Forest Harvest best management practices evaluation locations in Maryland and Delaware a

Sediment Impacts to Water

On sites with water crossings, **90 percent** avoided delivering sediment to waterways, while 6 percent delivered measurable amounts of sediment at crossings or approaches (Figure 2).

The average volume of delivered sediment, estimated from rill and gully dimensions, was 14 cubic feet. Factoring in all sites, including those without water crossings, average sediment delivery per harvest site was **less than 1 cubic foot**. Sites with crossings averaged 4 cubic feet per site. The most common location for sediment impacts was at the crossing itself, where there are the fewest opportunities to divert or filter out

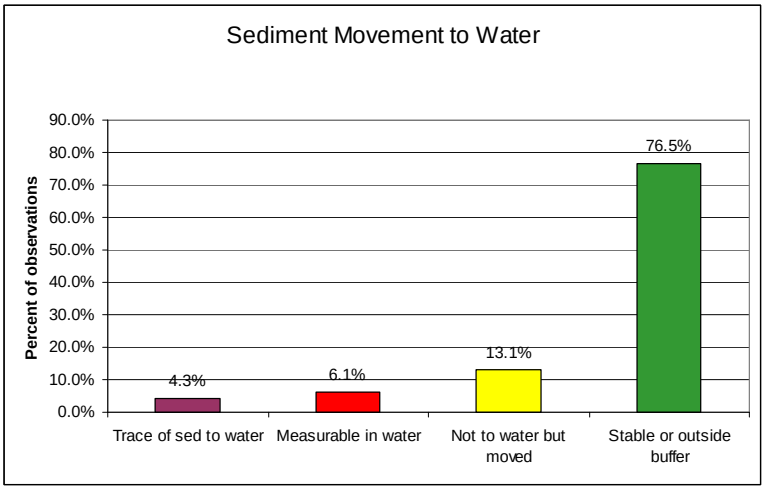

Figure 2: Evidence of sediment movement on harvests with crossings.

[4] Welsch, D., R. Ryder, and T. Post. March 2007. Best Management Practices (BMP) Monitoring Manual-Field Guide: Implementation and Effectiveness for Protection of Water Resources. USDA Forest Service Northeastern Area State and Private Forestry NA-FR-02-06, Newtown Square, PA. 130p.

sediment. Temporary bridges are now more commonly used to limit stream impacts, but some sediment can be added as they are removed.
On the few sites that did not apply some or all best management practices, sediment delivery was greater. The maximum observed delivery was 280 cubic feet in Maryland (an order of magnitude more than other observations) and 23 cubic feet in Delaware, compared to the most common rate of 1 cubic foot of sediment.


Left: Skid trail with tops used to protect soil, Maryland Forest Service.
Right: Skid trail without BMPs with rill erosion, Vision Forestry.

Buffers

Buffers around waterways were an important best management practice. Sediment had moved into buffers in 12 percent of observations. On average, sediment moved **45 percent** of the way through the buffer, then deposited before reaching water. In Delaware, the greatest distance moved was 60 percent of buffer width, while Maryland had a location where sediment reached the water through the buffer around crossings. On two of the 72 sites, log landings were in the buffer area (3 percent). These were in Delaware, where many sites are on old fields next to ditches and may have been using an existing cleared area.

More than 10.5 miles of waterway buffers were assessed in Maryland (7.9 miles) and Delaware (2.6 miles.). No sediment breached buffers in Delaware, aided by the gentle slopes in the coastal plain. In Maryland, with a greater variety of terrain, sediment was observed breaching buffers at four of 56 sites, delivering an average of 82 cubic feet of sediment per mile of monitored buffer. Three sites had another 26 observations where sediment entered the buffer but was filtered out before reaching water.

Buffered coastal plain waterway, Marvland Forest Service.

Most buffers provided good shade, averaging **82 percent canopy** (80 percent in Maryland, 86 percent in Delaware). Shade had been reduced some in 30 percent of the buffers by the harvest (33 percent in Maryland, 21 percent in Delaware). Most buffers, 87 percent, met state requirements, or buffers were not required on the types of waterways assessed (Maryland met on 84 percent, Delaware 100 percent). The largest trees on the assessed buffer plots after the harvest averaged **20 inches in diameter**, a substantial size for supplying future large woody debris in streams. Basal area was generally high, 98 square feet per acre, typical of a fully stocked forest stand.

Oil spills and Trash

No evidence of large oil leaks or spills were observed on 70 sites, but one site in Delaware had minor drips and one site in Maryland had a stain less than 10 square feet. No trash was seen on Delaware sites, but five of 56 Maryland sites had trash; three sites with logging-related oil containers and two with trash from other land uses.

Wetlands

Wetlands were **avoided on 91 percent of sites** (92 percent in Maryland, 88 percent in Delaware.) For the 9 percent that had to cross wetlands, average crossing length was 53 feet. Corduroy logs (small logs laid perpendicular to a travel path) and logging mats were most commonly used to minimize soil damage.

Perched culvert, Maryland Forest Service.

Fish Passage

Most sites allowed movement of fish and other aquatic dwellers such as benthic macroinvertebrates (stream insects)**.** On 8 percent of sites, crossings structures were perched or lacked natural substrate that would aid passage. More than half of stream crossing structures were removed after harvest to aid fish passage. Only 20 percent of remaining structures, usually culvert pipes, constricted the stream cross-section.

DATA SUMMARY	Delaware	Maryland	All
Harvest sites	367	1713	2080
Harvest sites with crossings	126 (34%)	219 (13%)	345(17%)
Crossing sites w/measureable sediment to water	5%	7%	6%
Avg. volume, sites with delivered sediment to water	4 cu. ft.	20 cu. ft.	14 cu. ft.
Delivered sediment, average over all sites	0.3 cu. ft.	0.7 cu. ft.	0.6 cu. ft.
Buffers with trapped sediment	8%	13%	12%
Avg. percent distance sediment moved in buffer	22%	49%	45%
percent of sites sediment delivered through buffer	0%	7%	6%
Median sediment per mile of buffer, crossing sites	0 cu. ft.	1 cu. ft.	1 cu. ft.
Average shade in buffer, post-harvest	86%	80%	82%
Some shade reduction from harvest	21%	33%	30%
Diameter of largest tree/buffer plot, future woody debris	19 inches	21 inches	20 inches
Basal area in buffer (minimum is 60 sq. ft. / ac.)	130 sq. ft. / ac.	90 sq. ft. / ac.	98 sq. ft. / ac.
Evidence of oil drips or spill (< 10 sq. ft.)	1 of 17 sites	1 of 56 sites	2 of 72 sites
Evidence of trash from harvest	0	3 of 56 sites	3 of 72 sites
Wetlands avoided	88%	92%	91%
Fish passage constrained by culvert	6%	9%	8%

MARYLAND
MARYLAND DEPARTMENT OF NATURAL RESOURCES
MARYLAND FOREST SERVICE
Larry Hogan, Governor | Mark Belton, Secretary

Maryland Department of Natural Resources Forest Service
Tawes State Office Building, 580 Taylor Avenue, E-1, Annapolis, MD 21401
Phone: 410-260-8531 | TTY via Maryland Relay: 711 | Out of State: 800-735-2258 | Toll Free: 877-620-8DNR ext 8531
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