A REVIEW OF BEST MANAGEMENT PRACTICES FOR FOREST WATERSHED BIOMASS HARVESTS WITH AN EMPHASIS ON RECOMMENDATIONS FOR LEAVING RESIDUAL WOOD ONSITE

George Ice, National Council for Air and Stream Improvemennt
Matt McBroom, Stephen F. Austin State University
Peter Schweitzer, Oak Ridge National Labratory

Cite as: Ice G, McBroom, Schweitzer. 2010. A review of best managment practcies for forest watershed biomass harvests with an emphasis on recommnedations for leaving residual wood onsite. Center for Bioenergy Sustainability, Oak Ridge National Laboratory, Oak Ridge , TN.

On February 3-4, 2010, Oak Ridge National Laboratory hosted a workshop on **A Watershed Perspective on Bioenergy Sustainability**. One assignment resulting from the workshop was a review of best management practices (BMPs) developed by states to address biomass harvesting. A specific focus was whether or not the states recommended leaving residual wood onsite for habitat, soil, and water conservation. Upon review, we found that many states are adopting state biomass harvesting guidelines (SBHGs) and, furthermore, that there are already reviews of these emerging, focused BMPs. Detailed comments on and reviews of SBHGs are attached hereto; key among them are the Forest Guild review (http://www.forestguild.org/), guidelines by the Council on Sustainable Biomass Production (http://www.csbp.org/), and reviews by the National Council for Air and Stream Improvement (NCASI).

At least six states have developed specific BMP guidelines directed at biomass harvesting (Maine, Michigan, Minnesota, Missouri, Pennsylvania, and Wisconsin), and several others are considering special BMPs (California, Massachusetts, Maryland, Mississippi, and North Carolina) (Vance and Wigley 2010; Evans et al. 2010). NCASI prepared a brief review of SBHGs for Minnesota, Missouri, Pennsylvania, and Wisconsin (Wigley et al. 2009). The Council on Sustainable Biomass Production developed draft guidelines for biomass harvesting (CSBP 2009). The Forest Guild Biomass Working Group issued forest biomass-retention and harvesting guidelines for the Northeast (FGBWG 2010) and a review of the ecology of deadwood (Evans and Kelty 2010) and has reviewed individual state biomass harvesting and retention guidelines (Evans et al. 2010). This Forest Guild review included comments on other guidelines from Europe and Canada as well as certification programs and legislation covering biomass harvesting.

All states with significant commercial forest operations (with the possible exception of Arizona) have adopted BMPs or forest-practice rules as part of silvicultural nonpoint source control programs (NCASI 2009). These BMPs are designed to protect water quality in forests where harvesting, site preparation, road building, and other activities related to forest management occur. SBHGs are developed where there is concern that the intensity of management will lead to greater risks of water-quality or ecological impacts. Common elements of biomass harvesting guidelines (Evans et al. 2010) include:

- Retention of dead woody material (DWM)

- Identification and avoidance (or special management) of sensitive sites for wildlife and biodiversity
- Augmentation of riparian management guidelines and other BMPs designed to protect water quality
- Maintenance of maintain soil productivity
- Restricting re-entry or avoiding harvests that reduce evapotranspiration to degrees that cause an adverse rise in the water table (swamping)

Janowiak and Webster (2010) pointed out that concerns about retaining DWM and the forest floor as part of biomass harvesting are high. Retention guidelines developed for DWM range from very general to highly specific. For example, guidelines for Maine recommend "minimal removal" of fine DWM on low-fertility sites. In contrast, the Forest Guild guidelines have very specific numeric targets for forest structures (e.g., number and basal area of live decaying trees and snags in specific sizes) and DWM (retain ¼ to ⅓ of slash, tops, and limbs). Three of the four states reviewed by Wigley et al. (2009) had either new or more detailed guidelines for retaining coarse and fine wood.

From a watershed perspective, retention of some fraction of slash or litter has less significance than measures like proportion of the site with bare soil or soil disturbance. Considerations recommended for maintaining effective soil cover include:

- utilization standards for wood removal,
- choice of yarding method (e.g., ground based, yarding over snow or when a wetland is dry, and full or partial suspension cable),
- site preparation method (e.g., mechanical or chemical), and
- use and severity of prescribed burn.

The product of all these choices (and of additional practices, such as lop and scattering following shovel logging) determines soil-cover conditions. A simpler, more direct BMPs might be to specify a maximum percent of the watershed with bare or disturbed soil, with special emphasis on riparian areas.

Common elements of state BMPs include keeping slash, debris, chemicals, and equipment out of streams and maintaining shade. These elements should also protect streams adjacent to biomass harvest units. The main difference between conventional and biomass harvests is the utilization standard, so BMPs should be effective unless soil conditions are affected differently by the two treatments. Stednick (2010), in a review of forest fuel management strategies and their effect on water quality, concluded that "These treatments have the potential to affect water quality, but the implementation of best management practices (BMPs) will minimize or eliminate potential water quality effects. There is a relationship between the amount of area disturbed and the amount of potential erosion, thus the amount of disturbed area should be minimized. Streamside management zones or streamside buffers are effective in capturing overland flows, removing sediment and nutrients, and aiding in maintaining stream temperature." An Oregon Department of Forestry (2008) review of environmental impacts from biomass removal found that "erosion rates associated with woody biomass harvests are in general much lower than effects from wildfire or roads, but result in higher erosion levels than in undisturbed landscapes. Wildfire risk reduction, if done appropriately can have long term positive effect on water quality, especially in areas of high fire risk." Similarly, Elliot (2010) concluded that increased water quality impacts were not an inevitable consequence of biomass harvesting if active management allowed foresters to address legacy road conditions.

The flood of recent guidelines and reviews of guidelines is reflected by the fact that all but one of the references cited here were published in 2009 or 2010, showing the high level of activity on forest biomass harvesting. With multiple states applying new guidelines or considering development of guidelines, there is a need to keep current in this area. One of the most exciting developments has been adoption of some large-scale experiments in Minnesota, North Carolina, and Georgia to test the impacts of biomass harvesting on critical ecosystem components. The Minnesota study is testing how various levels of wood retention and arrangements of green-tree retention affect saproxylic communities, nutrient cycling, and site productivity (MFRC 2009). The North Carolina and Georgia study involves replicated treatments in blocks, assessing biodiversity and soil responses to alternative harvest residuals. Treatments being tested include commercial clearcut with no biomass harvest, retaining 15% of biomass (clumped), retaining 15% of biomass (dispersed), retaining 30% of biomass (clumped), retaining 30% of biomass (dispersed), and commercial clearcut plus a biomass harvest. Additional research, such as a bird-response study, is in development. Other studies designed to test alternative harvesting intensities, such as the Fall River Long-Term Soils Productivity Project, provide opportunities to develop science-based guidelines for wood retention (Vance and Wigley 2010). One research effort will calibrate and validate the APEX (Agricultural Policy/Environmental eXtender) model to the Alto Watersheds in east Texas. This project will then test biomass harvesting alternatives and their estimated impacts on erosion.

The challenge in designing effective wood-retention strategies for biomass harvesting is to have adequate specificity to ensure protection of key environmental services but sufficient flexibility to allow land managers to respond to the site-specific conditions of their operations. This needs to be done in a manner that is both economically and environmentally sustainable.

REFERENCES

Council on Sustainable Biomass Production (CSBP). 2009. *CSBP Draft Standard*, September 11. http://www.csbp.org/.

Elliot, W.J. 2010. Effects of forest biomass use on watershed processes in the western United States. *Western Journal of Applied Forestry* 25(1):12-17.

Evans, A.M. and M.J. Kelty. 2010. *Ecology of dead wood in the Northeast.* Forest Guild. http://www.forestguild.org/publications/research/2009/biomass_guidelines.pdf.

Evans, A.M., R.T. Perschel, and B.A. Kittler. 2010. *Revised assessment of biomass harvesting and retention guidelines*. Forest Guild. http://www.forestguild.org/publications/research/2010/FG_Biomass_Guidelines_NE.pdf.

Forest Guild Biomass Working Group (FGBWG). 2010. *Forest biomass retention and harvesting guidelines for the Northeast.* Forest Guild. http://www.forestguild.org/.

Janowiak, M.K. and C.R. Webster. 2010. Promoting ecological sustainability in woody biomass harvesting. *Journal of Forestry* 108(1):16-23.

Minnesota Forest Resources Council (MFRC). 2009. *2008 Annual report to the governor and legislature on the implementation of the Sustainable Forest Resources Act*. St. Paul, MN: Minnesota Forest Resources Council.

National Council for Air and Stream Improvement (NCASI). 2009. *Compendium of forestry best management practices for controlling nonpoint source pollution in North America.* Technical Bulletin No. 966. Research Triangle Park, NC: National Council for Air and Stream Improvement.

Oregon Department of Forestry. 2008. *Report: Environmental effects of forest biomass removal*. Salem, OR: Office of the State Forester.

Stednick, J.D. 2010. Chapter 8: Effects of fuel management on water quality, pp. 149-163 in *Cumulative watershed effects of fuel management in the western United States*. Elliot, W.J., I.S. Miller, and L. Audin [Eds.]. RMRS-GTR-231. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station.

Vance, E.D. and T.B. Wigley. 2010. Biomass harvesting guidelines in the Northeastern Region. Presented at the 2010 NCASI Northern Regional Meeting, Portland, ME. Research Triangle Park, NC: National Council for Air and Stream Improvement.

Wigley, T.B., E.D. Vance, and E.B. Schilling. 2009. *A preliminary analysis of state biomass harvesting guidelines in Minnesota, Missouri, Pennsylvania, and Wisconsin*. Research Triangle Park, NC: National Council for Air and Stream Improvement.