Enviva/Endowment Working Bottomland Hardwood Forest Workshop Meeting Report

Executive Summary

In February 2016 Enviva Holdings LP (Enviva) and the U.S. Endowment for Forestry and Communities (Endowment) initiated an effort to identify and engage partners to co-create actionable recommendations for private landowners and companies procuring wood from working bottomland hardwood forests/wetland forests (hereinafter referred to collectively as bottomland hardwood forests), in order to enhance ecological attributes and benefits of working forests in North Carolina and Virginia. By bringing together multiple stakeholders, the objective was to create science-based, practical, and economically viable forest management strategies with a broad base of support among practitioners. In addition, Enviva and the Endowment sought to identify ideas and collaborative solutions that would encourage private forest landowners to manage and protect these forests for the long term. When complete, the recommendations were intended to build upon benefits currently provided by the existing Best Management Practices (BMPs) designed to protect water quality.

This co-creation process began with interested organizations submitting Expressions of Interest (EOIs) to provide a foundation for the discussions described in the May 2016 Co-Creation Workshop and summarized in this report. The Co-Creation Workshop took place in Roanoke Rapids, North Carolina from May 10 – May 12 and convened stakeholders with expertise in managing bottomland hardwood forests, including landowners, foresters, Federal and state natural resources agencies, university scientists, conservation and land trust non-governmental organizations (NGOs), and timber harvesters.

Purpose and Objectives

The purpose of the meeting was to create science-based forest management and harvesting recommendations that landowners could employ, in addition to existing BMPs for protecting water quality, to yield added ecological benefits in working bottomland forests. Enviva committed to adopt specific recommendations that fit its objectives and sphere of influence while, along with the Endowment, providing the learnings from the workshop to other landowners and procuring organizations.

The three objectives for the session were as follows:

1. To develop a set of forest management recommendations to enhance the environmental and conservation attributes of bottomland hardwood forests that:
    - Are based on the best science available;
    - Will improve ecological outcomes for managed bottomland hardwood forests;
    - Are practical for a landowner or procuring organization to understand and implement; and,

- Are economically viable for landowners and/or procuring organizations.

2. To develop a set of recommendations on ways to incentivize, support, and encourage the system of actors in land management to voluntarily manage and enhance ecological attributes of these forests over time, irrespective of who may be the landowner or customer for their wood.
3. To identify major information gaps and research needed in order to better understand forest management impacts and options in working bottomland hardwood forests.

The workshop produced a number of management and implementation recommendations and identified research gaps. Each is described in greater detail in this report. Enviva and the Endowment committed to review the results of the workshop and to provide the opportunity for continued input from participants throughout the co-creation process.

Management recommendations included forest practices that would improve working bottomland hardwood forest conditions with respect to issues such as enhancement of habitat for biodiversity, stand regeneration, and conservation of special habitats and ecotypes. Implementation recommendations outlined ideas on how to support landowners, foresters, and timber harvesters to voluntarily adopt the management recommendations and to better manage these forest types for multiple objectives, including biodiversity and long-term sustainability.

Additionally, participants identified a number of information gaps related to working bottomland hardwood forest management where research could improve forest management recommendations.

Participants also outlined a *Harvest Checklist* tool that, with further development, could provide guidance on the appropriateness of harvest at a specific site based on a variety of weighted factors.

Lastly, participants reviewed and provided feedback on the special ecotypes (bald cypress/tupelo swamps, Atlantic white cedar stands, natural pocosins and Carolina bays) which Enviva, in consultation with the Endowment, had previously committed to protect in cooperation with private landowners.

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Background

About Enviva Holdings LP: Enviva, the world's largest producer of wood pellets, has recently committed to several initiatives to promote sustainable working forests within areas where it procures wood in the North Carolina and Virginia area. Enviva does not own forestland; rather, it purchases wood for its production largely from working forests owned by private forest landowners or in the form of residuals from sawmills within its operating area.

Enviva operates three wood-pellet production facilities within the North Carolina-Virginia coastal plain, a region comprised of 6 million acres of forests of all types that have been harvested for a variety of wood products for centuries. About 20% of the region is comprised of working bottomland hardwood forests. These are low-lying, marshy areas near rivers and streams that are home to tree species such as cypress, gum and oak that offer a wide variety of environmental benefits and contain some of the most unique plant and wildlife communities in the Atlantic coastal plain.

To advance their efforts to encourage sustainable management of these forests, Enviva has taken the following steps:

1. In December 2015 the company established the Enviva Forest Conservation Fund which is administered by the Endowment – a $5 million/10-year effort to protect working bottomland hardwood forests in North Carolina and Virginia;
2. Enviva immediately began working with private landowners from whom it procures wood to protect discrete ecological elements including the special ecotypes referred to in the Executive Summary: bald cypress/tupelo swamps, Atlantic white cedar stands, and natural pocosins and Carolina bays;
3. Enviva and the Endowment are co-funding a process (this workshop) to identify additional science-based recommendations that any company and/or landowner could employ beyond Best Management Practices to protect water quality that would yield added ecological benefits in working bottomland hardwood forests.

To learn more about Enviva's holistic approach, visit www.envivaforestfund.org .

About the Endowment: The Endowment is a not-for-profit, public charity. It was established September 21, 2006, at the request of the governments of the U.S. and Canada in accordance with the terms of the 2006 Softwood Lumber Agreement between the two countries.

The Endowment works collaboratively with partners in the public and private sectors to advance systemic, transformative, and sustainable change for the health and vitality of the nation's working forests and forest-reliant communities. Endowment leaders often state this in shorthand as: 1) keeping working forests as forests; and 2) advancing family-wage jobs in rural forest communities.

The Endowment operates under a "theory of change" that focuses on work in three areas: retaining and restoring healthy working forests; promoting and capturing multiple value streams; and enhancing community capacity, collaboration, and leadership. To learn more about the Endowment visit www.usendowment.org.

Co-Creation Process

Challenges and potential solutions to enhancing the conservation and environmental values within working bottomland hardwood forest are complex and in some cases not well-understood. For that reason, Enviva and the Endowment initiated a co-creation process (depicted in Figure 1) which enlisted a wide variety of expertise and perspectives to help define the opportunities and design a range of solutions that would work effectively in practice. Additionally, by including a broad range of stakeholders to create solutions, they hoped to identify potential partners to help advance common objectives.

The process began with a jointly issued request for Expressions of Interest (EOIs) in February 2016. This request went to a wide range of organizations with expertise in southern forest management and conservation, and was intended to identify partners interested in co-creating recommendations that private landowners and/or companies procuring wood from working bottomland hardwood forests could use to enhance the ecological attributes and benefits of working forests in North Carolina and Virginia.

Specifically for the EOIs, the Endowment and Enviva requested proposed solutions that:

- Were based on the best science available;
- Would improve ecological outcomes for managed bottomland hardwood forests;
- Incentivized landowners to voluntarily manage and enhance their forests over time, irrespective of who the landowner is or the customer for their wood;
- Were practical for a landowner or procuring organization to understand and implement;
- Were economically viable for landowners and/or procuring organizations.

Additionally, the Endowment and Enviva sought partners with at least one or more of the following attributes:

- Expertise in applied conservation science of southern working bottomland hardwood forests, sensitive ecotypes, wildlife habitat, and riparian zones;
- Expertise in hydrology;
- Expertise in developing and/or implementing private forest conservation incentive programs;
- Expertise and experience in engaging private forest owners on sustainable forest management practices;
- Expertise and practical experience in forest management, silviculture and harvesting techniques in southern working bottomland hardwood forests;
- Experience in leveraging funding or in-kind support from other sources;
- Use of knowledge and tools applied in sustainable forest management and conservation;
- Ability to increase the adoption of proven innovations in such a way that systems (around the problem) can sustain the desired results with minimal external inputs;
- Strong likelihood of achieving a substantial impact; and/or

- Enhancement of ongoing work to sustainably manage southern working bottomland hardwood forests.

In addition to the request for EOIs, the partners invited a wide range of participants with demonstrated interest in the management of southern working bottomland hardwood forests to participate in a co-creation workshop. See Appendix 1 for a complete list of organizations invited to participate in the co-creation process.

In the next step of the co-creation process, the facilitation team conducted pre-workshop interviews with the participants in order to establish a baseline understanding of the different perspectives and ideas with respect to challenges and solutions to enhancing conservation and environmental values of bottomland hardwood forests. The facilitation team conducted 26 interview sessions in all, and used the information gathered, along with the EOIs, to frame the workshop agenda.

Finally, a co-creation workshop was convened, which enabled participants with a broad range of expertise, perspectives, and interests to define the problems and opportunities, a vision for the future, and potential solutions. The workshop process details and results are described throughout this report.

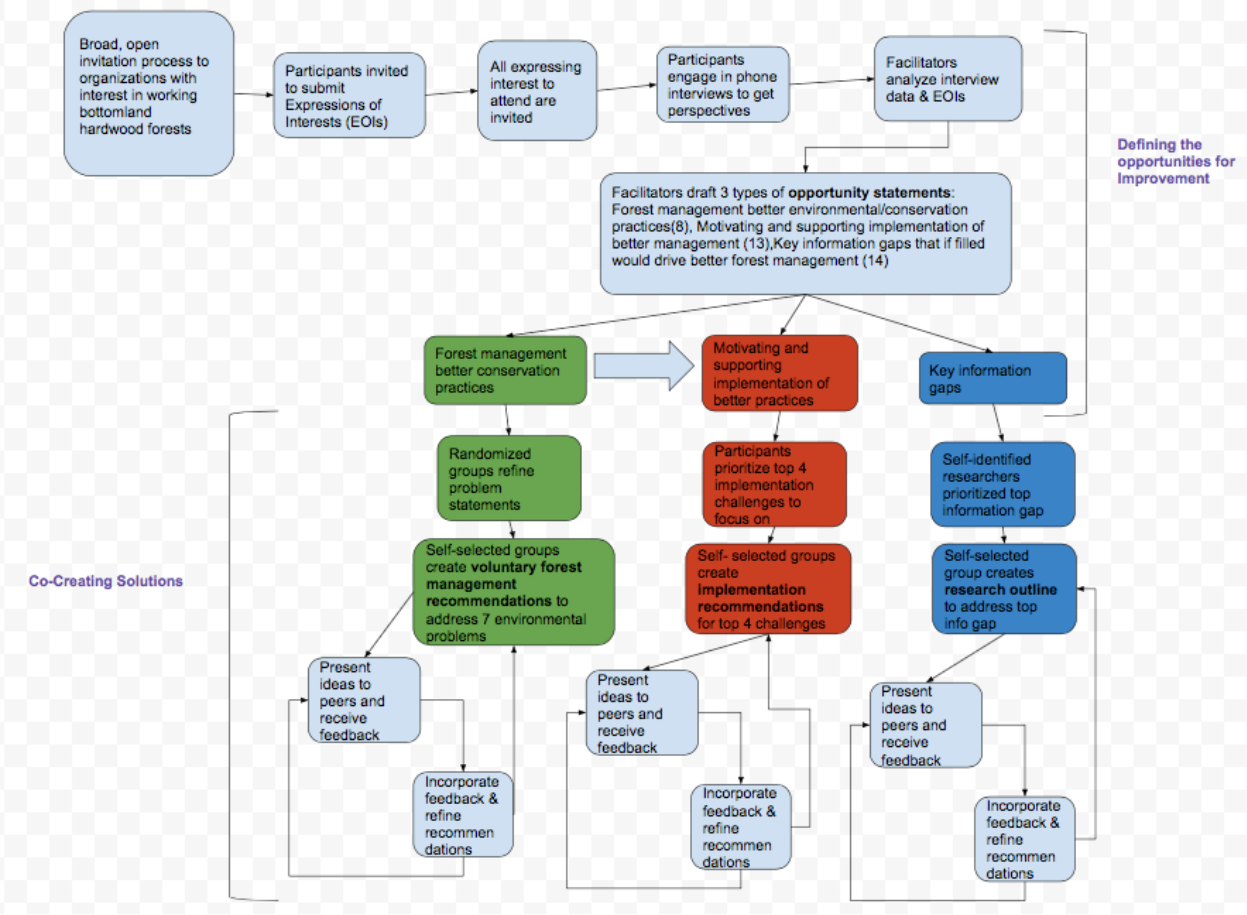

Figure 2: The Bottomland Hardwood Forest Co-Creation Process

Workshop Context-Setting

To ensure participants had a shared understanding of the current state of working bottomland hardwood forests in North Carolina and Virginia, a number of context-setting activities were conducted over the course of the 3-day workshop. The workshop began with a field tour to help participants see relevant forest management practices in the field. It also provided participants an opportunity to hear about specific land management examples, to see the state of regeneration on specific tracts of land, and to better understand the importance of minimizing disruptions to natural hydrologic regimes. Unfortunately swollen streams resulting from recent heavy rains prevented the entire planned tour from being carried out.

Following the field tour, EOI submitters shared their solution concepts with the other participants. The day concluded with a series of context-setting presentations on:

- **Vital Issues**: Participants developed a short list of the most important issues they needed additional background on before the workshop began the following day.
- **State of the Forest:** The USDA Forest Service Southern Research Station described the "Status and trends of working bottomland hardwood forests in the mid-Atlantic region."
- **The Forest Guild's Field Report:** The Forest Guild discussed "Issues, threats, and conservation concerns in bottomland hardwood forests of the southeastern United States."
- **Interview Theme Synopsis and an Overview of Opportunities for Improvement:** The facilitation team reviewed the themes resulting from the interviews with specific attention given to the Opportunities for Improvement identified by meeting participants.

Day 2 context-setting activities included presentations on the following topics:

- **Enviva's Perspective:** Including insights into Enviva's motivations for initiating this process in collaboration with the Endowment, statistics about Enviva's sourcing based on a number of different factors, and an overview of the kinds of input Enviva was hoping to solicit through the co-creation process.
- **The North Carolina Forest Service's Role in Best Management Practices and Forest Management:** Including applicable forestry regulations, statistics on compliance rates and helpful reference materials.
- **The Virginia Department of Forestry Water Resources Program:** Including information about the department, its role in education, inspection, and enforcement, and statistics about the state of forest management in Virginia.

Defining the Opportunities for Improvement

Process

The facilitation team used information gleaned from pre-workshop interviews and EOIs to create a draft list of opportunities identified by workshop participants to lead to better management of conservation and environmental attributes of working bottomland forest. The facilitators organized these opportunities into the following three categories, in line with the three workshop objectives:

1. Forest management improvements that could enhance the environmental and conservation attributes of bottomland hardwood forests.
2. Major information gaps, that if filled, would improve the forest management recommendations.
3. Ways to incentivize, support, and encourage the system of actors in land management to voluntarily manage and enhance ecological attributes of these forests over time.

The facilitation team shared this draft list of opportunities with the participants on the first day of the workshop and invited participants to think about the list overnight and come back with questions and reactions.

On the second day, the facilitation team divided participants into smaller groups, each comprised of a mix of organizations and perspectives. The facilitation team randomly assigned the draft **forest management environmental and conservation opportunity statements** to these smaller groups in order to discuss and refine them. Through a series of exercises that allowed for small group discussion and multiple rounds of small-group and plenary feedback, participants refined and reframed their assigned opportunity statements to be impactful, actionable, and a more accurate articulation of the issue as perceived by the participants as a whole. Table 1 in the "Opportunity Statement" section provides the final revised opportunity statements. These statements were the basis for developing the voluntary forest management recommendations as described in Table 5 of the "Forest Management Environmental and Conservation Recommendations" section.

The facilitators then asked participants to review the list of **major information gaps** identified from pre-workshop interviews and EOIs (see Table 2), that if filled, would improve the forest management recommendations. Those participants self-identifying as researchers voted on the highest priority information gap resulting in the selection of "Long term results on regeneration and productivity of sites harvested in standing water." This information gap was the focus of a research proposal outline described in Table 7 of the "Implementation Recommendations" section.

The participants then reviewed the draft list of opportunities identified from pre-workshop interviews and EOIs (see Table 3) that related to "**implementation challenges" in incentivizing, supporting, and encouraging the system of actors in land management to voluntarily manage and enhance the ecological attributes of these forests over time**. Each participant voted for the one challenge from the list they felt was most significant, resulting in the majority of the votes going to the four issues identified in Table 4 of the "Opportunity Statements" section. These issues were used as the basis of developing

the implementation recommendations as described in Table 6 of the "Implementation Recommendations" section.

Opportunity Statements: Using the process described in the previous section, the participants developed the following opportunity statements. After the workshop, Enviva and the Endowment categorized these opportunities as follows:

- Stand-level -- where an individual landowner can take unilateral action to address.
- Landscape-level – where the issue requires multiple landowners and stakeholders to take action.

Table 1: Refined Forest Management Environmental and Conservation Opportunity Statements

Small Group ID #	Finalized Statement From Working Groups
	Stand-Level Opportunities
4	Ensure harvesting when done in standing water yields desired regeneration and limited site impacts.
5	Existing BMPs do a good job of protecting water quality and some wildlife species. Develop recommendations for landowners and managers to achieve objectives beyond water quality.
8	With respect to special ecotypes (bald cypress/tupelo swamps, Atlantic white cedar stands, and natural pocosins and Carolina bays): while more information is needed to assess the presence and amounts of these habitat types in their natural condition on the one hand, and the range of appropriate management interventions that are compatible with protection of their natural character on the other, individual landowners and managers should identify ways to protect the best examples of these types as additional information is gathered. To aid owners and managers, clear definitions of special habitat types that facilitate easy identification on the ground must be developed.
	Stand and Landscape-Level Opportunities
1	How does working bottomland hardwood forest management (or the lack thereof) create tree age class and species distribution problems? How does it create within-stand structure problems? Often, this problem of poor stand structural diversity is created in part by past high grading or other inappropriate harvest applications and in part due to the landowner not being aware of options or impacts. Develop tools for practitioners to have a positive effect on tree age class and species distribution problems in the regular course of business.
2	Determine how forest owners and managers maintain or increase the amount of working bottomland hardwood forests and decrease fragmentation: 1. Through afforestation – to a predetermined objective 2. By maintaining a healthy age class distribution within tracts

Small Group ID #	Finalized Statement From Working Groups
	3. By identifying and prioritizing management/protection of larger blocks Determine the following parameters about old-growth bottomland hardwood forests:": 1. What age or stand features define old growth? 2. How much exists? How much is desired? 3. Identify ways to advance old-growth and/or old-growth structure/characteristics through management
3	Structural complexity can be addressed both at the stand- and landscape-level. Promote adoption of forest management plans that empower landowners with information and options to address structural complexity before harvest.
6	Identify specific sites where regeneration is not occurring and ascertain causes. Develop management and regeneration responses where possible to remediate. Where harvesting cannot be done with confidence resulting in successful regeneration, harvesting should be delayed.
7	Invasive species (plant, insect/disease, animal) are negatively impacting working bottomland hardwood forests and associated habitat. Develop processes and tools to identify areas subject to threat from invasive species and provide recommendations to landowners and managers for ways to minimize risk/impact.

Table 2: Major Information Gaps

	Gaps
1	How best to promote management plans for family forest ownerships.
2	Synthesize knowledge about managing working bottomland hardwood/wetland forest systems.
3	Means to teach/train forestry professionals about managing working bottomland hardwood hardwoods.
4	How to address shortage of professionals with expertise in these systems.
5	Impact on organic vs. mineral soils when harvesting in standing water.
6	Long term results on regeneration and productivity of sites harvested in standing water.
7	Defining the point of diminishing ecological returns for width of Streamside Management Zones (SMZ).
8	Determining individual wildlife species requirements (especially in SMZs).
9	The impact on regeneration timing & species composition when harvesting is done in standing water.
10	The benefits and challenges associated with intermediate stand treatments.

11	Additional information on the amount of course woody debris (CWM) that advances ecological outcomes.
12	Factors affecting regeneration after harvest.
13	Best practices to protect hydrologic function.
14	Means to implement adaptive management practices as new information becomes available.

Note that statement # 6 “Long term results on regeneration and productivity of sites harvested in standing water” received the most votes.

Table 3: Implementation Challenges Identified From Pre-Workshop Interviews

	Implementation Challenges
1	Improved range of choices for harvesting systems and regeneration treatments would require either investments by harvesters or costs/reduced income to landowners.
2	Lack of education, easy-to-access/use information, and/or access to on-demand/just-in-time technical expertise impedes decision making by landowners, managers and harvesters.
3	Existing sustainable forestry management incentives lack adequate data/science resulting in an inability to reach the right people/actors in ways that will alter their practices and behaviors to demonstrably improve sustainability (i.e., forest science and social science needs and recommendations are unclear resulting in misaligned incentive programs).
4	Lack of streamlined easement infrastructure. [limits participation and adoption]
5	Lack of innovative options for increasing participation in sustainable forest management practices limits the overall potential impact/success of these practices.
6	Lack of resources and support for adoption of sustainable forest management practices.
7	Land tax valuation mitigates against landowner interests in maintaining habitat.
8	Lack of diverse, robust markets for various types of wood yields a lack of market incentives to retain/maintain different ecotypes to counter competing land uses and encroachment (urban/suburban development, agriculture etc.).
9	Foresters and timber harvesters don't always have proper training in specialized silvicultural practices like those for working bottomland hardwood forests.
10	Landowners don't always have good and/or low-cost sources of advice on state-of-the art training in best silvicultural practices especially in working bottomland hardwood forests.
11	It is often difficult to convince a landowner of the benefits of employing BMPs much less advanced ecological outcome practices. Many just want to maximize returns from harvest.
12	Landowners and foresters are not always aware of silvicultural options to enhance ecological outcomes in working bottomland hardwood forests,

Table 4: Top Implementation Challenges As Voted On By Participants

Challenge #	Implementation Challenge
5	Lack of innovative options for increasing participation in sustainable forest management practices limiting the overall potential impact/success of these practices.
8	Lack of diverse, robust markets for various types of wood yields a lack of market incentives to retain/maintain different ecotypes to counter competing land uses and encroachment (urban/suburban development, agriculture etc.).
11	It is often difficult to convince a landowner of the benefits of employing BMPs much less advanced ecological outcome practices. Many just want to maximize returns from harvest.
12	Landowners and foresters are not always aware of silvicultural options to enhance ecological outcomes in working bottomland hardwood forests.

Envisioning the Future

In order to encourage big-picture thinking in preparation for developing creative solutions to the challenges identified in the previous section, participants were asked to reflect on the following question and describe their ideal future:

What if Southern working bottomland hardwood forests could be ecologically diverse, sustainable, and highly profitable? What would that look like?

Listed below is a summary of those responses:

- 100% of landowners have a forest management plan
- Land managers, procurement organizations and/or natural resources agencies have land management assistance foresters available to help landowners
- Snags, coarse woody debris and two-four large trees/acre are retained after harvest
- Monitoring programs are in place to assess ecological success and data is shared with stakeholders and available to the general public
- Viable carbon markets exist to support ecological practices
- Reliable & diverse wood markets are available for all grades of trees – especially low-grade material
- Landowners get more income from biomass harvests
- Forest stand intermediate treatments are available that are economically viable
- Landowners receive a premium or are paid for the costs of implementing ecological approaches
- Timber harvester & forester training is widely available to ensure they are equipped with the latest information including practices to enhance ecological outcomes

- Landowner-to-landowner education programs are in place to motivate family members & neighbors (cascading effect)
- Hydrologic function drives harvest regeneration decisions
- Age & size class diversity occurs across the landscape
- Stands and landscapes are free of invasive species
- Regeneration is adequate & site appropriate
- Harvesting has minimal site impact
- Natural hydrology is not changed by management
- Stocking and proper management are incentivized over time

Co-Creating the Solutions

Forest Management Environmental and Conservation Recommendations

Following the prioritization of the list of opportunities to better manage bottomland hardwood forests for environmental and conservation values (see Table 1), participants selected the opportunity for which they were most interested in developing recommendations. They then broke into smaller groups and developed their ideas in a structured format, using the worksheet found in Appendix 4. Through a series of small-table rotations and plenary feedback sessions, the groups refined their recommendations.

Table 5 summarizes the recommendations the working groups developed to address the opportunities for improvement listed in Table 1 (group numbers correspond to the Opportunity for Improvement listed in Table 1). Note that participants did not develop recommendations through a strict consensus process, and many of these recommendations need to be further developed and vetted before being implemented.

Table 5: Voluntary Forest Management Recommendations

Group ID #	Opportunity for Improvement	Recommendation
1	**Stand structural diversity:** How does working bottomland hardwood forest management (or the lack thereof) create tree age class and species distribution problems? How does it create within-stand structure problems? Often, this problem of poor stand structural diversity is created by high grading or other inappropriate harvest applications utilized in part due to the landowner not being aware of options or impacts. How can practitioners, in the course of regular business, have a positive effect on this problem?	• In order to address past management decisions, improve/restore a productive state, and provide the landowner with a range of options including those related to enhancing biodiversity, harvesting/procurement organizations should launch an outreach program to engage with landowners in their sphere of influence. The first step is to advocate that every landowner has a site-appropriate management plan. Such plans should include the range of management options from no management to intensive culture as well as intermediate treatments. • All involved with landowners should advocate that the landowner employ a professional Consulting Forester (CF) to aid them in achieving their objectives and to serve as their agent to ensure that plans and objectives are implemented as expected. • Harvesting/procuring organizations must understand the landowner's management objectives and work to advance those objectives to the extent practical with the CF working to ensure that the landowner's wishes and all contractual obligations are met. • Specific to increasing stand structural diversity, prescriptions that address seed trees should be included as well as recommendations for harvest seasonality, avoiding damage to residual trees, and leaving wildlife habitat features such as snags and coarse wood on the forest floor. All of these prescriptions are well-described in the literature and should be appropriate to the site. On dry bottomland sites that may be thinned, leave "guard trees" to protect the valuable stems in the residual forest.
2	**Mature habitat:** How can forest owners and managers maintain or increase the amount of working bottomland hardwood forests and decrease fragmentation: Through afforestation – to	• Promote management plans for all landowners. • Where practical, restore hydrologic function in previously ditched and drained sites. • If needed, replant to native species. • Consider forest management options to create larger patch sizes and more wildlife habitat enhancement. • Create and implement programs to expand the number of professionals with expertise in

Group ID #	Opportunity for Improvement	Recommendation
	a predetermined objective Maintaining age class distribution within tracts Identifying and prioritizing management/protection of larger blocks Old-Growth: What age or stand features define old growth? 1. How much exits? How much is desired? 2. Identify ways to advance old-growth and/or old-growth structure/characteristics through management	management of working bottomland hardwood forests.
3	**Stand and landscape structural diversity:** Structural complexity can be addressed both at the stand and landscape level. Promote adoption of forest management plans that arm landowners with information and options to address structural complexity before harvest.	To address structural complexity: • Leave an average of 2-4 trees per acre with a preference for seed trees and wildlife trees with potential to become dominant over-story trees. Note: when cruising, consider flagging a valuable tree (e.g. cypress) and retain it and a few neighboring trees. • Retain snags, particularly those of large-diameter, when appropriate and safe. • Retain a diversity of coarse woody debris on site post-harvest. Consider leaving tops, some low-quality logs in the shovel mat, and some fine woody material. E.g. 10% of chipwood on site - leaving 1 out of every 10 tops. • Consider harvest timing to optimize regeneration potential - dry years. • Advance landowner understanding of and appreciation for ecological elements and practices, such as why leaving snags and coarse woody material is good for certain wildlife species.
4	**Harvesting in standing water:** Ensure harvesting when done in standing water	• Timing: harvest during dry periods as much as possible to aid regeneration from seed and to allow for operator accuracy. • Drainage: ensure that adequate drainage/hydrologic function is maintained to allow water movement.

Group ID #	Opportunity for Improvement	Recommendation
	yields limited site impacts and desired regeneration	• Seed trees: leave 8-10 seed trees per acre to encourage regeneration. • Harvest above the high-water mark to allow for stump sprouting. • Use adequate close-out procedures after harvest: retrieve shovel mats and leave the site with as little unnecessary disturbance as practical. • Use harvesters who are trained and equipped to operate on these types of sites.
5	**Streamside buffer zones with multiple ecological benefits:** Existing BMPs do a good job of protecting water quality and some wildlife species. Develop recommendations for landowners to achieve objectives beyond water quality.	• To avoid having to address specific SMZ widths for individual wildlife species adopt an ecological outcome-based approach founded on stream order. Such an approach would cluster ecological benefits in a more easily understood and implemented way so as to retain greater wildlife and biodiversity needs without the need to try and operate on a species-by-species approach • BMP-dictated SMZs should be used on 1st order streams with width increasing as stream order increases. Specific widths and allowed selective harvesting levels should be based on site- and landowner-specific management plans. • To ensure longevity and maximize habitat value perpetual conservation easements with low-intensity management interventions should be employed wherever possible.
6	**Stand regeneration:** Identify specific sites where regeneration is not occurring and ascertain causes. Develop management and regeneration responses where possible to remediate. Where harvesting cannot be done with confidence in successful regeneration, harvesting should be delayed.	• Landowners should have a management plan in place and the service of a CF before implementing harvesting practices. • Ensure that hydrology has not been altered prior to harvest and that function will be maintained after harvest. • Pay special attention to drainage, roads, culverts and beaver activity in both new and old roads. • Use temporary vs. permanent crossings where possible. • Augment information on regeneration following harvest with periodic post-harvest surveys. • Share information with the broader field of practice.
7	**Invasive species:** Due to other higher priorities, participants did	• Due to other priorities and limited time, no specific recommendations were developed.

Group ID #	Opportunity for Improvement	Recommendation
	not develop recommendations for this topic.	

8	**Special habitats and ecotypes:**
	With respect to special ecotypes (bald cypress/tupelo stands, Atlantic white cedar stands, and natural pocosins and Carolina bays): while more information is needed to assess the presence and amounts of these habitat types in their natural condition on the one hand, and the range of appropriate management interventions that are compatible with protection of their natural character on the other, individual landowners and managers should identify ways to protect the best examples of these types as additional information is gathered.
	To aid owners and managers, clear definitions of special habitat types that facilitate easy identification on the ground must be developed.
		Conduct literature reviews to determine knowledge gaps regarding management of these special types; identify research needs to fill gaps.
		Identify existing datasets for special habitat types (may be different for different types, i.e. landforms vs cover type) to determine presence and prevalence on the landscape (may require "ground-truthing"); make sure information is readily available to CF/managers.
		• Develop criteria to help foresters/managers determine if the site is of a quality that warrants special attention (may end up with multiple thresholds for different levels of quality) – e.g. species composition (plant and/or animal), vegetative structure, hydrology, availability of seed source, condition of adjacent lands, etc.).Develop guidelines for management (for each special forest type) of those sites that pass the threshold (or various thresholds based on quality).
		• With respect to Cypress/Tupelo stands, management plans should include:
		  ○ Leaving visual buffers (greater than 50 feet) along navigable waters.
		  ○ Retain stringers of cypress on stream channels, leave standing dead cypress for seed source and wildlife
		Consider partial harvest regimes to mimic natural disturbance on the landscape

Implementation Recommendations

Following the prioritization of the list of opportunities to incentivize, support, and encourage the system of actors in land management to voluntarily manage and enhance ecological attributes of these forests over time (see Table 4 in the "Opportunity Statements" section), participants were asked to select one of the top four priority challenges for which they were most interested in developing recommendations.

Participants formed 4 small groups and developed their ideas in a structured format, using the worksheet found in Appendix 4.

Some of the participants, rather than work one of the four priority implementation challenges described above, formed a small group to create the outline of a pre-harvest checklist tool that could enable better management decision making in bottomland hardwood forests.

Another group formed to further develop recommendations on whether to and how to manage special habitats and ecotypes, with special attention to cypress/tupelo stands.

Those self-identifying as researchers had the option to develop a research outline for the information gap “Long term results on regeneration and productivity of sites harvested in standing water” prioritized in the "Opportunity Statements.”

Through a series of small-table rotations and plenary feedback sessions, all of the groups refined their ideas and recommendations. See Table 6 for Implementation Recommendations, Table 7 for the Research Outline, Table 8 for the Harvest Checklist Outline, and Table 9 for recommendations for special habitats and ecotypes.

Table 6: Implementation Recommendations

Rec. #	Implementation Opportunity	Recommendation

5	Innovative options for increasing participation in sustainable forest management practices	• Enhance financial feasibility:
		  ○ Robust markets for forest products are perhaps the single greatest tool to ensure that landowners can and will invest in management.
		  ○ Incorporate historically low value timber into higher value solid wood product.
		  ○ Develop innovative cost share ideas to subsidize necessary harvests to regenerate high-graded stands.
		• Support landowner outreach/education:
		  ○ Identify and equip landowner advocates to champion sustainable practices.
		  ○ Develop regional/local conservation plans for local reference.
		  ○ Create demonstration forests for landowner reference.
		Modify education materials to be more user friendly (e.g. brief, layman’s language, and 2-3 minute “how to” videos).
		Connect landowners to the larger landscape scale

Rec. #	Implementation Opportunity	Recommendation
		implications ○ Identify creative funding sources to encourage landowner participation and forest management planning. ○ Consider corporate-funded assistance foresters to create forest management plans. ○ Do the necessary social science necessary to improve conveyance and understanding. • Increase certification enrollment: ○ Use consultants with group certificates to lower the cost of entry for smaller private landowners. ○ Certification requires documentation of sustainable forest management practices. Implement systems that fit small acreage owners. • Create sustained funding sources to landowners for conservation practices: ○ Encourage statewide initiatives to provide funding. • Increase logger capacity to harvest sustainably: ○ Work with large operators to create smaller crews to implement alternative harvest/silvicultural practices. ○ Explore innovative debt mechanisms to help defray equipment costs related to sustainable harvests. ○ Explore cooperative logistics to reduce costs. ○ Provide technical education opportunities to ensure a well-trained workforce. ○ Elevate public perception of timber harvesters. • Procuring organizations should work directly with landowners to provide assistance if it isn't available from other sources
8	Diverse, robust markets for various types of wood creating market incentives to retain/maintain	Robust markets for the full range of products (size/species/quality of trees) on the land is foundational to successful land management. If there are no markets for special species/habitat types (e.g. longleaf pine, Atlantic White Cedar), many landowners will not want to retain them unless compensated through other means.

Rec. #	Implementation Opportunity	Recommendation
	different ecotypes	Therefore, educate landowners, wood suppliers, timber harvesters, and economic development professionals of the importance of diverse and new markets for wood products, even to advance conservation objectives. *Note Forestproductslocator.org has GIS map of producers, mills, etc.*
11	Convincing landowners of the value of retaining BMPs	• Communicate to landowners that establishing and embracing BMP's ahead of prospective harvest can save money and avoid potentially costly fines or rehabilitation efforts. • Consider ways to aggregate services to meet the needs and lower the costs for smaller landholders. • Identify and advance communities of landowners for peer-to-peer "selling-in" of the value of BMPs and other ecological practices. • Explore the use of Present Use Values (PUVs) to offset the tax liability that a landowner may accrue with respect to forest streamside buffers. • Explore incentives or cost-share programs to aid landowners in implementing BMPs. • Use pre-harvest planning to communicate to a landowner the value of BMPs above Forest Practice Guidelines. • Benchmark across states to determine best practices for encouraging landowners to implement BMPs.
12	Silvicultural options for enhancing bottomland hardwood for conservation values	• Encourage landowners and operators to take advantage of training and information available from state agencies (NCFS, VDOF), Extension Service, and others. • Create consolidated website – create a one-stop shop for working bottomland hardwood forest management information and resources. • Create demonstration sites showcasing sound forest management options • Develop a series of leaflets on working bottomland hardwood forest management options. • Create a publication on working bottomland hardwood forest improvement practices and sources of cost share availability. • Develop a working bottomland hardwood forest school based on upland hardwood forest school already in existence in NC (for practitioners).

Rec. #	Implementation Opportunity	Recommendation
		• Add bottomland hardwood forest training to Pro Logger and SHARP Logger training programs. • Provide on-site short training tool for timber harvesters. • Conduct pre-harvest planning and site layout training for timber harvesters. • Work with NRCS to make bottomland hardwood forest improvement treatments eligible in CAP 106 program/plans. • Create PR videos for the public – short, visual easy to digest information – like forestry fast break videos. • Ensure outreach is getting to other issues – wildlife, ecosystem services, social aspects, carbon, etc. • Create a series of brief videos that show good and bad harvesting and other practices. • Make research information more accessible – especially older documents that are out-of-print and not digitized. • Recognize that not all landowners are internet savvy. Use a range of methods of distribution (church, neighbors, etc.). • Create reading-level-appropriate versions of technical materials to aid in getting information into the hands of landowners.

Table 7: Research Outline

Information Gap	Research Questions That Would Be Addressed By Proposal Outline
Potential problems associated with harvesting in standing water: • Impacts on regeneration • Impacts on drainage/soils • Impacts on wildlife • Impacts on long-term productivity/and value	• Do the timing and conditions during harvest affect regeneration success and species composition? • How do different buffer widths affect wildlife community composition? • What are the impacts of shovel logging on drainage and soil properties? • What is the successional pattern following shovel logging over longer periods of time? • What are the effects of SMZ width on sediment and sediment sensitive species? • Document coarse woody debris in SMZ's & harvest • Design research to evaluate post-harvest sites now instead of (or in addition to) pre- and post-harvest comparisons in order to get quicker results. --Note: there is very little research on impacts of shovel logging on bottomland hardwood forests so this would fill a relatively unique gap. At

	the same time results be applicable to a relatively limited number of sites across the landscape.

Table 8: Harvest Checklist Outline

Harvest Checklist Goal	Harvest Checklist Outline

With a group of experts, develop a "red-yellow-green" checklist to assist foresters and timber harvesters in asking the right questions with respect to appropriate management options within bottomland hardwood forests. The checklist would enable:
• Harvesting without damage to site
• Harvesting to enhance the stand and encourage regeneration
• Identification of "showstoppers" and how to handle these
	• **Stand conditions**
	  ○ Species composition & size/age
	  ○ Advanced regen of desired species
	  ○ Species-site suitability
	  ○ Invasives threat post-harvest
	  ○ Unique or T&E species & natural communities of conservation concern
	• **Flooding regime (including alterations)**
	• **Soil type (including associated site productivity)**
	• **Landowner objectives**
	  ○ Landowner intends to maintain forest cover
	  ○ Wildlife objectives
	• **Access & seasonality**
	• **Landscape context & position**
	
	<u>Regulatory concerns</u>
	• Site is not going to be developed (silvicultural exemption applies)
	• ESA species
	
	<u>Red flag conditions</u>
	• Stand conditions
	  ○ Invasive species threat post-harvest
	  ○ Natural communities of conservation concern
	• Flooding regime
	  ○ Irreversible hydrologic alterations present or likely
	--Note: this tool could be developed in collaboration with other groups not participating in the workshop

Table 9: Special Ecotype and Habitat Criteria

Special Ecotype and Habitats Criteria	For cypress/tupelo stands: • There may be site-by-site instances where management could be beneficial to encourage regeneration • Identify a potential group of third parties to evaluate a site to provide recommendations on cypress regeneration • Create a checklist of stand factors to evaluate for suitability of harvest. The assessment should address:

Special Ecotype and Habitats Criteria	○ Advanced regeneration ○ Effects of post-harvest hydrology ○ Adequate seed source exists pre- and post-harvest ○ Correct hydrological regime • Develop management plans that include: ○ Retaining visual buffers (greater than 50 feet) along navigable waters and stringers of cypress on stream channels post-harvest ○ Retaining some live cypress as a seed source as well as standing dead cypress for wildlife post-harvest • Document effects of logging on cypress regeneration, explore opportunities for partial harvest to mimic natural disturbance on the landscape • Provide clear guidance to suppliers on where and when additional guidelines are required and monitor implementation over time • Work with timber buyers to reach out to landowners to discuss benefits of good management practices for long term benefit of cypress/tupelo • Host a workshop or training for suppliers and foresters on appropriate management and decision making in this ecotype and encourage management plans • Involve a group of interested stakeholders to promote the need to maintain cypress on the landscape and to develop strategies to do so • Reference existing relevant literature (e.g. USDA Forest Service Cypress Resource Paper) **For other special habitats and ecotypes:** • Rather than eliminating the option of managing specific ecotypes, which could inadvertently limit conservation opportunities, it may be more prudent to evaluate sensitive forest types on a site-by-site basis. • However, some rare forest types should not be harvested, at least not commercially. • Active management can support old growth stand conditions if done correctly and could be used to restore important ecological features and improve upon previous poor management. • Harvesting individual stands can mimic natural disturbance across the landscape. • Atlantic White Cedar stands are relatively rare on the landscape but can be artificially regenerated at a low cost if desired by the landowner. • The majority of participants believe that non-converted Bays &

	pocosins should be restricted from active forest management. • Review NatureServe Global rankings (G1/G2) with regard to special habitat or ecotypes.

In general, participants suggested that these recommendations would benefit from:

- Further vetting with a broader audience to provide opportunity for more feedback and ideas;
- Landowner focus groups to test assumptions; and
- Where relevant information exists, conduct a rapid, focused literature review to address key information gaps identified in the workshop.

Next Steps

The Endowment and Enviva are currently reviewing the concepts and recommendations that resulted from the workshop. Once reviewed, the recommendations may be:

1. Developed further, with Enviva and the Endowment gathering more information and ideas from workshop participants and others to refine certain recommendations in order to implement;
2. Combined, in part or in whole, in order to implement; and/or
3. Deemed outside of the scope of vision and/or influence set forth by the Enviva and Endowment. Some of these recommendations could be worthy of consideration by other organizations.

Many of the recommendations are beyond the capacity of Enviva and/or the Endowment to implement independently and would thus require multiple organizations to collaborate in order to develop, fund, and put into place. For example, the recommendations that relate to desired conditions at the landscape level will be difficult to implement independently. Enviva and the Endowment may consider supporting some of these multi-organizational recommendations where they are deemed to have high potential positive impact, are feasible to implement, and relevant to Enviva's and the Endowment's core business and mission.

Finally, Enviva and the Endowment have committed to publicly share this report for the advancement of sustainable forest management in southern bottomland hardwood forests.

Appendix 1 – List of invited organizations

Organization
American Forest Foundation
Audubon
Center for BioEnergy Sustainability
Columbia Forest Products
Ducks Unlimited
Dogwood Alliance
Domtar
Enviva
Forest Landowner's Association
Forest Stewards Guild
Forest Stewardship Council
Gelbert, Fullbright & Randolph Forestry Consultants, PLLC
International Paper
National Council for Air and Stream Improvement
National Wild Turkey Federation
Natural Resources Conservation Service
Natural Resources Defense Council
North Carolina Association of Professional Loggers
North Carolina State University Department of Forestry
North Carolina State University Wildlife Department
North Carolina Wildlife Resources Commission
North Carolina Forest Service
North Carolina Forestry Association
North Carolina Foundation for Soil and Water Conservation

North Carolina State Department of Forestry and Environmental Resources
Rainforest Alliance
Resource Management Service
Roanoke Electric Cooperative
Seaboard Timber
Society of American Foresters
Southern Environment Law Center
Sustainable Forestry Initiative
Tar River Land Conservancy
The Conservation Fund
The Nature Conservancy – VA Chapter
The Nature Conservancy – NC Chapter
The Nature Conservancy – Cape Fear Arch Conservation Collaboration
Tri-State Land & Timber LLC
Trust for Public Land
U.S. Endowment for Forestry and Communities
U.S. Fish and Wildlife Service
USDA Forest Service
Virginia Department of Forestry
Virginia Department of Game and Inland Fisheries
Virginia Forestry Association
Virginia Logging Association
Virginia Tech College of Natural Resources and Environment
Virginia Tech Department of Forest Resources and Environmental Conservation
Weyerhaeuser/PlumCreek
Working Lands Trust

Appendix 2 – List of attendees

Name	Organization	Position
Chris Erwin	American Forest Foundation	Director, Woodland Conservation; forest management
Curtis Smalling	Audubon	Director of Land Bird Conservation
Mary Elfner	Audubon	
Latha Malar Baskaran	Center for BioEnergy Sustainability	Oak Ridge National Lab
Jamie Rader	Ducks Unlimited	Manager of Conservation Programs in the South Atlantic
Allison Gratz	Enviva	Director of Sustainability; Forest management, operations
Jennifer Jenkins	Enviva	Vice President & Chief Sustainability Officer
Tyrone Williams	Forest Landowner	Forest landowner
Amanda Mahaffey	Forest Stewards Guild	Northeast Region Director
Amy Clark Eagle	Forest Stewardship Council	Director of Science & Certification
Bruce White	Gelbert, Fullbright & Randolph Forestry Consultants, PLLC	Consulting Forester
Eric Vance	National Council for Air and Stream Improvement	Sustainable Forest Productivity; soils; nutrient cycling plus co-workers with forested wetland management, biodiversity and water quality expertise
Terry Best	Natural Resources Conservation Service	NRCS District Conservationist Halifax Co. NC
Timothy Beard	Natural Resources Conservation Service	State Conservationist
Paul Boone	Natural Resources Conservation Service	District Conservationist, Jackson Field Office

Michael Champion	Natural Resources Conservation Service	District Conservationist, Windsor Field Office
Brian Saunders	Natural Resources Conservation Service	District Conservationist, Gatesville Field Office
Doug Wassum	Natural Resources Conservation Service	District Conservationist, Edenton Field Office
Christopher Moorman	NC State University Wildlife Department	Wildlife and Forestry Expertise
Brent Wilson	NC Wildlife Resources Commission	Wildlife Forester
Jim Slye	North Carolina Forest Service	Coastal Plain Assistant Regional Forester for Forest Management
Sean Brogan	North Carolina Forest Service	Director Forest Management and Development
Pryor Gibson	North Carolina Forestry Association	Forestry Programs Manager
Michelle Lovejoy	North Carolina Foundation for Soil and Water Conservation	Executive Director
Chris DePerno	North Carolina State Department of Forestry and Environmental Resources	Professor; Wildlife ecology & management of bottomland hardwood forests
Douglas Fredrick	North Carolina State Department of Forestry and Environmental Resources	Professor; Bottomland hardwood silviculture and management, biomass, energy and nutrient content of bottomland hardwood forests
Robert Kellison	North Carolina State Department of Forestry and Environmental Resources	Emeritus Professor; Hardwood silviculture and management, Past NC State Hardwood Coop Director

Alton Perry	Roanoke Electric Cooperative	Sustainable Forestry and African American Land Retention Project
Bill Wilson	Seaboard Timber	Logger
Mark Gurganus	Seaboard Timber	Logger
Jessica McGlyn	Staff	
Mary Kate Wise	Staff	
Richard Crespin	Staff	
Rick Cantrell	Staff	
Rob McIntyre	Staff	
Buck Vaughan	The Conservation Fund	Manager, Forest Financial Planning & Analysis
David Whitehouse	The Conservation Fund	Forest Operations Manager, Working Forest Fund
Jean Lorber	The Nature Conservancy	Forest Protection Specialist
Charlie Marshburn	Tri-State Land & Timber LLC	Wood Supplier
Carlton Owen	U.S. Endowment for Forestry and Communities	President & CEO
Florence Colby	U.S. Endowment for Forestry and Communities	Manager, Organizational Support
Matthew Connolly Ware	US Fish and Wildlife Service	Roanoke River National Wildlife Refuge Manager
Dr. Peter Caldwell	USDA Forest Service	Hydrologist
Anita Rose	USDA Forest Service	
Steve Meadows	USDA Forest Service	Principal Silviculturist
Matt Poirot	VA Department of Forestry	Assistant Director, Water Qualify Program Forest

		Management Division
Robert Farrell	VA Department of Forestry	Deputy State Forester
Rick Busch	VA Department of Game and Inland Fisheries	Assistant Director, Bureau of Wildlife Resources
Paul Howe	Virginia Forestry Association	Executive Director
Dean Stauffer	Virginia Tech College of Natural Resources and Environment	Professor of Wildlife Conservation; wildlife-habitat relationships
Chad Bolding	Virginia Tech Department of Forest Resources and Environmental Conservation	Associate Professor; Harvesting systems and impacts
Jennifer Gagnon	Virginia Tech Department of Forest Resources and Environmental Conservation	Past Chair; Appalachian Society of American Foresters; Coordinator VA Tech Forest Landowner Education Program
Mike Aust	Virginia Tech Department of Forest Resources and Environmental Conservation	Professor; Harvesting Impacts in Bottomlands and Wetlands; BMPs and Water Quality
Bob Schaefer	Working Lands Trust	Chair; forest management; procurement; land trust

Appendix 3 – Additional resources identified during the workshop

NatureServe Global Ranking List

NC Forest Service homepage

- North Carolina's Forest Action Plan
- North Carolina Forestry BMP Manual
- North Carolina Forestry Best Management Practices Quick Reference Guide

Southern Group of State Foresters (SGSF) Publications

Southern Forest Resource Assessment - Technical Report

The Forest Products Network

Virginia Natural Heritage Program

The resources below have been compiled in the Forest Stewards Guild report: Ecological Forestry Practices for Bottomland Hardwood Forests of the Southeastern U.S. Amanda Mahaffey and Alexander Evans, May 2016.

State Best Management Practices

- Alabama's Best Management Practices for Forestry www.forestry.state.al.us/BMPs.aspx
- Arkansas Best Management Practices www.arnatural.org/forestry/bmps.htm
- Florida Silviculture Best Management Practices www.fl-dof.com/forest_management/bmp/index.html
- Georgia Best Management Practices www.gfc.state.ga.us/forestmanagement/bmp.cfm
- Kentucky Forest Practice Guidelines for Water Quality Management www.ca.uky.edu/forestryextension/Publications/FOR_FORFS/FOR67.pdf

- Field Guide to Best Management Practices for Timber Harvesting in Kentucky www.ca.uky.edu/forestryextension/Publications/FOR_FORFS/FOR69.pdf
- Recommended Forestry Best Management Practices for Louisiana www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMP.pdf
- Guidelines for Practicing Forest Environmental Enhancement in Louisiana www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMP.pdf
- North Carolina Best Management Practices ncforestservice.gov/water_quality/bmp_manual.htm
- Oklahoma Best Management Practices Guidelines www.forestry.ok.gov/waterqualitybmp
- South Carolina Best Management Practices www.state.sc.us/forest/refbmp.htm
- Tennessee Forestry Best Management Practices www.tn.gov/agriculture/forestry/bmps.shtml
- Texas Forestry Best Management Practices txforestservice.tamu.edu/main/article.aspx?id=14536
- Virginia's Forestry Best Management Practices for Water Quality http://dof.virginia.gov/infopubs/BMP-Field-Guide_pub.pdf
- West Virginia Silvicultural Best Management Practices for Controlling Soil Erosion and Sedimentation from Logging Operations www.wvforestry.com/BMP%20Book%202009.pdf

Extension offices & publications

- Regenerating Hardwoods in Mississippi – Department of Forestry, Mississippi State University http://extension.msstate.edu/sites/default/files/publications/publications/p2470.pdf
- Bottomland Hardwood Management – Mississippi State University Extension Service http://extension.msstate.edu/sites/default/files/publications/publications/p2004_1.pdf
- Forest management in bottomland hardwoods – Louisiana Department of Wildlife and Fisheries

  www.wlf.louisiana.gov/sites/default/files/pdf/publication/34723-forest-management-bh-low-res/forest_management_in_bh_low-res.pdf

USDA Forest Service resources

- Southern Hardwood Forest Management – U.S.D.A. Forest Service http://web.extension.illinois.edu/forestry/publications/pdf/forest_management/USFS_Southern_Hardwood_Mgmt.pdf

- A Guide to Bottomland Hardwood Restoration – USDI, USGS, USDA Forest Service
  www.nwrc.usgs.gov/wdb/pub/diglib/bottomland_hardwood.htm

Forest Stewards Guild Reports

- Forests to Faucets: Protecting upstream forests for clean water downstream

  http://forestguild.org/publications/research/2013/forests-to-faucets-report.pdf

- Forest Biomass Retention and Harvesting Guidelines for the Southeast

  http://www.forestguild.org/publications/research/2012/FG_Biomass_Guidelines_SE.pdf

- Biomass Supply and Carbon Accounting for Southeastern Forests

  http://www.southernenvironment.org/uploads/publications/biomass-carbon-study-FINAL.pdf

- Ecology of Dead Wood in the Southeast

  http://www.forestguild.org/publications/research/2011/ecology_of_dead_wood_SE.pdf

Appendix 4 – Workshop Tools

1. **CHALLENGES**: What implementation challenges does your recommendation address?	2. **SOLUTION**: How would address this challenge?	3. **Encouraging Uptake**: How might you support and encourage landowners and/or loggers to adopt this recommendation?

4. MEASURES OF SUCCESS: Is your Recommendation…							
a) **Easy and practical for landowners to implement?**	**Easy**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Difficult**
b) **Economically affordable for landowners/procuring organizations?**	**Low**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**High**

c). **Based on scientific research? Is more research needed?**

6. ACTIVITIES/TIMELINE: Describe specific activities that would be needed to 1) implement the recommendation and 2) encourage landowners and/or loggers to adopt the recommendation. Please provide a high-level timeline, if applicable.

7. RESULTS & TESTING What are the expected results of this concept? What indicators will tell us if we're making progress? How might this concept be tested and then improved upon?	**8. POTENTIAL CHALLENGES** What are the challenges in bringing this concept to life? What are the specific costs and to whom?	**9. INFORMATION / EXPERTISE** What additional information, expertise, or resources will be needed to move forward with this concept? What are the resources needed?
10. EXISTING EFFORTS Are there existing efforts of this type that could be leveraged to carry out these activities?	**11.** Potential **ASSUMPTIONS & UNINTENDED CONSEQUENCES** of these recommendations?	**12. STAKEHOLDER ENGAGEMENT** Who are the key stakeholders? What stakeholders would need to be part of this solution?

THE PROBLEM: What information is missing?	KEY PLAYERS:
	Lead Investigator: Partner Organization: Main Beneficiaries: Other players' needed that are not at workshop:
RESEARCH OBJECTIVES: What are your research objectives?	STUDY SITES: Where are your study sites?
STUDY DESIGN: What are your Methods and Activities?	
TIMELINE: What is your timeline for testing?	
BUDGET: What is your budget and expected funding sources?	DELIVERABLES: What are your deliverables/expected results?

THE PROBLEM: What specific ecological or environmental challenge does your recommendation address?			Does this apply to every harvest or to specific sites? If specific sites, please provide more detail.
FOREST MANAGEMENT GUIDELINE: What is your recommended voluntary management guideline?			Is this a site-level or a landscape-level recommendation?
PROS:	CONS:	When is it a good idea?	When is it a bad idea?
		If this works, what will a stand look like in 20 years?	
COSTS: How much will this guideline cost to implement vs. baseline and who would have to pay for it? (Example: logger? Landowner?)		GAPS in KNOWLEDGE: What big scientific unknowns are there that if were answered would greatly improve this recommendation?	