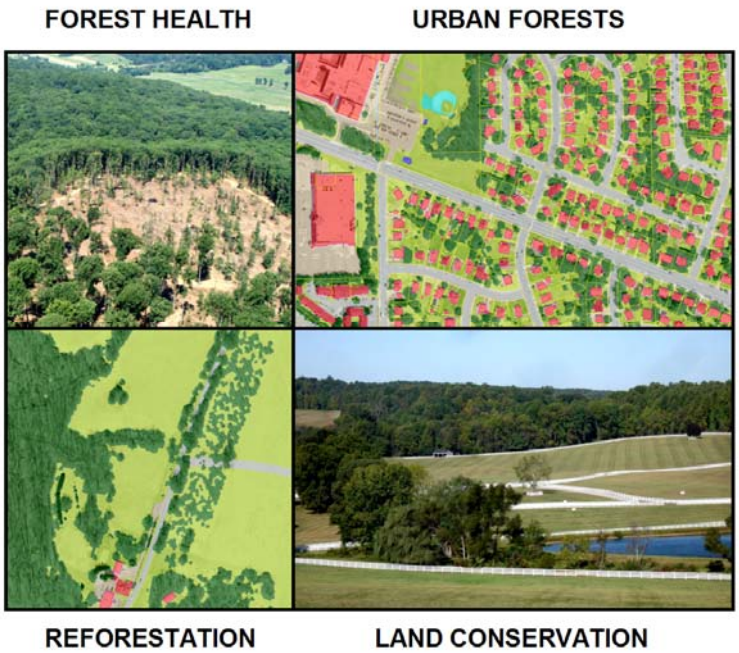
Attachment D:

BALTIMORE COUNTY SUSTAINABILITY NETWORK

Report of the Protection of Natural Resources Working Group



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Baltimore County Sustainability Network

Report of the Protection of Natural Resources Working Group

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Baltimore County Sustainability Network

Report of the Protection of Natural Resources Working Group

EXECUTIVE SUMMARY

> *"Sustainable forest and urban forest management is essential to healthy, productive forests and trees that maximize mitigation for GHGs and carbon sequestration. Additionally, these forests serve as the preferred land use for avoiding emissions. In the face of climate change, it is critical that everything possible is done to increase the amount of, and enhance the condition of forests and trees everywhere. Healthy forests and trees are our single most cost-effective tool for mitigating for climate change."*
>
> MD Climate Action Plan
> Appendix D-1, p. 2

Baltimore County's Office of Sustainability convened a Sustainability Network of agency and non-government members to develop a plan to reduce the greenhouse gas (GHG) emissions from County government operations for 2006 by 10% by 2012. Based on a first approximation model using the Clean Air and Climate Protection (CACP) software developed by the International Council for Local Environmental Initiatives, it was estimated that annual GHG emissions from selected County sectors will increase from 142,701 to 148,258 metric tons [2,204.62 pounds or 1.1 US ton] of equivalent CO_2 (eCO_2) from 2006 to 2012. County government emissions represent an estimated 1.2% of the 2006 and 2012 "community" (County-wide) emissions. The emissions are defined as "equivalent" metric tons of CO_2 because they include emissions of carbon dioxide, methane, and nitrous oxide. The modeled emissions are described as an "end-use, bottom-up" accounting based on local energy consumption (Brady and Fath, 2008). The County's 10% emissions reduction goal is adopted from the near-term goal set in the MD Commission on Climate Change's 2008 *MD Climate Action Plan*.

The CACP model for Baltimore County determined gross GHG emissions without accounting for natural carbon sinks represented by the County's natural resource base, especially its forests and trees. It is assumed that the GHG emissions reduction goal is for net emissions.

The Sustainability Network's Protection of Natural Resources working group (PNR) was charged with reviewing relevant County natural resource management programs to determine their potential for contributing to the proposed GHG emission reduction goal. The PNR finds that the forest and tree resource base of the County is dynamic and not easily measured with respect to changes in carbon stores and releases. Community carbon emissions are a continuous process as is forest sequestration, the process by which atmospheric carbon is removed from the air by trees during photosynthesis and then stored in woody biomass (leaves, trunks, and roots). In addition, scientists measure six distinct components of carbon stocks or pools of forest systems: carbon in live standing trees, carbon in dead standing trees, carbon in understory vegetation, carbon in downed dead wood, carbon in the forest floor, and organic carbon in forest soil (Smith et al., 2004). Carbon sequestration and storage also vary by forest composition factors (e.g., species mix, size class, health).

This report estimates that the forests of Baltimore County represent significant carbon stocks as they remove carbon dioxide from the atmosphere and store it in woody biomass.

- Based on a preliminary tree canopy analysis using 2007 othophotography, Baltimore County's 187,300 acres of canopy covers 49% of the land area including shading over buildings, roads, and other impervious surfaces. About 73.2% (137,128 acres) of the canopy is outside the Urban-Rural Demarcation Line (URDL) in "rural" areas of the County, and 26.8% (50,168 acres) of tree canopy is inside the URDL. Tree canopy covers 54% of rural lands and 38% of land inside the URDL.
- Net sequestration of carbon by the estimated 6.76 million trees inside the URDL was calculated (UFORE analysis, which did not estimate urban canopy cover) at 25,900 tons per year (Nowak et al., 2009), with a value of about $536,000 per year. The annual carbon flux (change in tons) per acre for Maryland, based on the US Forest Service's Forest Inventory and Analysis sampling from 1999-2005, was –0.7218 (negative values indicate flux into the pool). The carbon sequestration for rural Baltimore County is estimated at 98,979 tons per year. This per acre sequestration rate is 39% greater than the rate for areas inside the URDL. The combined urban and rural sequestration is therefore estimated at 124,879 tons per year (0.67 tons per acre), which is 1.08% of the annual "community" eCO_2 emissions.
- From a broad perspective, the County's 187,300 acres of forest and tree canopies also store about 14.42 million metric tons of carbon, based on an assumption of 77 tons of carbon stored per acre (oak-hickory forests of the northeast U.S.). This storage equals about 1.25 years of total community emissions in the County at the 2006 rate of emissions. The UFORE analysis estimated that the forests within the URDL store a total of 1.31 million tons with a value of $27.1 million, or $1,851 per forest acre. Forests owned by Baltimore County, at about 4,762 acres, store about 366,674 metric tons of carbon.
- Based on soil sampling for the UFORE analysis, it was estimated that "the belowground stocks were about 2-fold higher than aboveground levels" and "any further losses of forest will result in a significant decline in those stocks" (Nowak, et a., 2009, p. 58-59).

Both modeled estimates of CO_2 emissions and the ability of a changing forest ecosystem to manage carbon stocks need continued evaluation. These estimates are therefore very preliminary and should be refined with further analysis and implementation of a tracking system for additions and losses to the County's forest and tree cover through multiple agency programs and private actions.

The health and sustainability of the existing forest base of the County are threatened and the findings herein that carbon stocks exceed emissions should not be assumed for the future. As noted in this report:

- the forests in Baltimore County are highly fragmented and exist in numerous small, private ownerships;
- the urban forest assessments reveal that the second most commonly-occurring trees are dead trees, and the species tied for 5th in dominance in urban areas is Ailanthus, a non-native invasive species; and
- land development alone has resulted in a 15-year average annual loss of 245 acres of forest.

The PNR considered four policy options recommended in the MD Climate Action Plan for Agriculture, Forests, and Waste Management (AFW) as an organizing framework for estimating the contribution of forests and trees and open spaces for CO_2 reduction. Existing County programs provide policy support and recommendations for maintaining forest health and sustainability. These were evaluated to better understand the dynamic nature of existing forest resources (both urban and rural) and to estimate the contribution of aggressive tree management for CO_2 reduction. The four CAP policy options and County programs evaluated included the following:

Forest Management for Enhanced Carbon Sequestration

- Conservation Landscaping Policy
- Forest Sustainability Program
- Forest Health Assessments – County-owned Land
- Forest Distribution and Patch Characterization
- Gypsy Moth Suppression Program
- Deer Herd Management
- Rural Forest Health Monitoring
- Wood Waste Utilization

Managing Urban Trees and Forests

- Baltimore Watershed Agreement
- NeighborSpace of Baltimore County, Inc.
- Tree-Mendous Maryland
- Growing Home Campaign
- Street Tree Removals

Afforestation, Reforestation and Restoration of Forests and Wetlands

- Forest Conservation Act
- Rural Residential Reforestation
- Forestry Board Greening Committees

Protection and Conservation of Agricultural Land, Coastal Wetlands and Forested Land

- Land Preservation Programs

A series of market-focused initiatives were also included under “emerging issues” as well as some comments on the future potential of bio-char for soil fertility enhancement as this is further developed through research in temperate climates.

In addition to the local program recommendations in this report for the four CAP policy options above, several overall recommendations are offered for continuing management of Baltimore County’s green infrastructure for CO_2 emissions reductions:

1. Continue to research and utilize carbon sequestration/storage estimates appropriate for the County's forest, tree, and open space resources.
2. Develop a tracking system for additions and reductions to forest and tree resources from implementation of County programs.
3. Determine the multiple ecological benefits provided by forests and trees for each program.
4. Develop indicators of forest carbon storage and sequestration conditions and trends that can be incorporated into the County's Sustainability Program and DEPS's biennial *State of Our Forests* reports.

The working group prioritized the numerous recommendations in this report, a summary of which is presented in the following table.

PROTECTION OF NATURAL RESOURCES Workgroup
SUMMARY OF RECOMMENDATION PRIORITIES

Priority Group	Policy Option or Issue	Rec. #	Recommendation (short version, see text for details)	Time Frame
HIGHEST	**AFW-3**	**1**	Adopt and implement a **no net loss of forest policy.**	**short**
HIGH	**AFW-1**	**1**	Implement the ACEQ's recommendation for the development of a **Conservation Landscaping Policy** and implementation of conservation landscaping BMPs.	**short+**
		4	Implement **deer control at Oregon Ridge Park** as soon as possible.	**short+**
		7	Implement the planned **Rural Forest Health Monitoring program** to determine forest health of large rural patches.	**short+**
		11	Implement the proposed **waste wood utilization project**.	**short-mid**
	AFW-2	**2**	Develop practical alternatives for **street tree-sidewalk conflicts** that will save existing healthy non-hazard trees from being cut down.	**short**
		3	Develop appropriate design standards for **street tree pits** that provide adequate infiltration and soil volume for tree growth.	**short-mid**
		4	Develop an **urban and community forestry program** are areas within the URDL.	
	AFW-3	**4**	Expand DEPRM's **reforestation crew and Rural Residential Reforestation** programs.	**short+**
MEDIUM	**AFW-1**	**3**	Develop a long-term **deer management program** for the County.	**short+**
		8	Enlist others to participate in an **exotic, invasive species assessment and suppression** program for County lands.	**short+**
	AFW-2	**5**	Incorporate **adequate space for urban streetscapes** in new developments and to retrofit older neighborhoods.	**short-mid**
		9	Support state efforts to **ban the sale of exotic, invasive plants.**	**mid**
	AFW-4	**1**	Develop a new **County preservation program** for forest resources.	**mid**
	Buy Local	**1**	Develop a **Buy Local brand image** to support regional producers.	
		2	Create a **virtual market interface** to facilitate brand development.	
		3	Explore **current development models, such as a certified development corporation** or dedication or expansion of county- based programs.	
		4	Encourage and develop **LEED-type certification programs for Maryland wood products**, organic produce and livestock.	
		5	Promote the use of **value-added products** from local woods.	
		6	Provide **education for producers in marketing techniques** and effective local distribution.	
	Leadership and Workforce Development	**1**	Support development of a pilot program to enlist local farmers to participate in **new/young farmer training** programs.	
		2	Develop **informational programs for producers** on all elements of the agricultural industry.	
		3	Improve **accessibility of unskilled labor**.	
	Regulatory Support	**1**	Assemble a **farmer-led team to review county land-use regulations** and policies.	
		2	Ensure that **zoning does not preclude intelligent, sustainable uses**.	
	Mediation Dispute	**1**	Develop a **farmer base to coordinate outreach** and serve as a first line of response in neighbor/industrial conflict.	
		2	Improve **Right to Farm protections**.	
	Carbon Trading Markets	**1**	Promote the **Chesapeake Bay Bank** and/or Upper Chesapeake Nutrient Trading Program, once they are established.	**mid-long**

Priority Group	Policy Option or Issue	Rec. #	Recommendation (short version, see text for details)	Time Frame
LOW	AFW-1	6	Secure **federal and state funding for Gypsy moth suppression.**	**short**
		9	develop a program for **deer fencing for smaller forest** patches on private lots.	**mid**
		10	Develop an **educational and self-help program for forest landowners** to get to know their own forest patches and to carry out preliminary qualitative assessments of forest diversity and stressors.	**mid**
	AFW-2	8	Develop an **urban forest identification program** for communities.	**mid-long**
	AFW-3	6	Develop an urban planting program for **trees planted by the County for a fee.**	**mid-long**
	AFW-4	2	Provide cost-share for the **Forest Legacy program** if funded.	**mid-long**
	Bio-char	1	Set up a study project at the **new county demonstration farm**.	
		2	Set up a **larger scale version at the landfills** that collect and compost biomass for the County for multiple benefits.	
		3	Advocate for **demonstration projects on private farms** for their energy, disposal, and fertilizer/amendment needs.	
PRO-GRAMMED	AFW-1	2	**Conduct forest health assessments and to prepare and implement management plans** for large County-owned forested lands.	**short+**
		5	Provide County **cost-share for the MDA Gypsy moth suppression.**	**short+**
		12	**Measure changes in carbon sequestration** through implementation of forest management programs.	
	AFW-2	1	Establish recommended **tree/forest canopy goals.**	**short**
		7	**Develop a "Big Trees" program** for landowners to plant canopy species in larger urban yards.	**mid**
EASY	AFW-2	6	Develop **educational materials for urban residents** about the multiple benefits of healthy urban trees.	**short-mid**
	AFW-3	2	Identify **candidate corridors between forest patches for planting programs.**	**mid**
		3	Develop a geo-referenced **tracking system for public-private reforestation projects.**	**short+**
		5	**Increase the capacity of the DEPRM nursery.**	**short-mid**
		7	Develop a **tree bulletin for the DEPRM website.**	**mid**
	AFW-4	3	**Promote the Chesapeake Bay Bank to landowners** once established.	**mid+**

Baltimore County Sustainability Network

Report of the Protection of Natural Resources Working Group

Introduction

The Protection of Natural Resources (PNR) Working Group was tasked with a review of County environmental policies and programs to determine their potential for contributing to the County's proposed goal of reducing CO_2 emissions and to recommend improvements or additional actions that may better serve implementation of the goal.

In its initial meetings, the Working Group discussed several ways to organize its work. Because the County is adopting the Maryland CO_2 reduction goal recommended by the Maryland Commission on Climate Change in its August 2008 *Climate Action Plan* (CAP), it was decided that the County's program should parallel the natural resources elements of the CAP for Agriculture, Forests, and Waste Management (AFW). Four specific CAP policy options were deemed most appropriate for consideration at the County-level:

- AFW-1: Forest Management for Enhanced Carbon Sequestration
- AFW-2: Managing Urban Trees and Forests;
- AFW-3: Afforestation, Reforestation and Restoration of Forests and Wetlands, and;
- AFW-4: Protection and Conservation of Agricultural Land, Coastal Wetlands and Forested Land.

Fortunately, Baltimore County has made important progress in recent years on programs that will enhance its ability to use forests and trees to reduce and manage CO_2 emissions as well as realize other ecosystem and community benefits. Together, these "green infrastructure" and resource sustainability efforts support the County Executive's *Green Renaissance* initiative announced in 2005. In addition, they are particularly relevant in that they address the "triple bottom line" of sustainability – good for the environment, the economy, and the community. Healthy forests in urban and rural areas and well-managed working lands are effective tools not only for reducing CO_2 emissions and saving energy but also for maintaining clean water, which has special importance in Baltimore County where more than 60% of the watersheds for the Baltimore metropolitan area are located.

Forests and Carbon Management

> *"The benefits of forests and trees are extensive, complex, and beyond measure."*
>
> MD Climate Action Plan
> Appendix D-1, p. 2

The CAP's AFW policy options adopted herein focus primarily on forest ecosystems because of their importance for carbon management. The December 2008 draft *National Report on Sustainable Forests – 2010* summarizes well the role of forests in management of atmospheric carbon. The U.S. report uses the international Montreal Process Criteria and Indicators to measure ecological and economic sustainability of its forest resources. Two of the three Indicators relevant to Baltimore County that measure forest ecosystem and forest products

carbon pools and fluxes are included under Criterion 5, the Maintenance of Forest Contribution to Global Carbon Cycles. Highlights of these indicators, major findings, and available data for Baltimore County are presented in Appendix C.

As presented in the MD Climate Action Plan, forests in Maryland contribute importantly to reducing atmospheric carbon. The Plan concluded:

- *Forests make up 44 per cent of Maryland land cover. In 2000, they absorbed an estimated 11.5 million metric tons more of carbon dioxide equivalents (MMTCO2e) than they emitted. Urban forests added an additional savings of 2.4 MMTCO2e.* (MD CAP, Ch 4, p. 41)

For Baltimore County, the initial GHG model estimated 142,701 metric tons of eCO_2 emissions from County facilities, not including schools (a large inventory), and estimated total community GHG emissions at 11.5 million metric tons eCO_2 for 2006. Based on a **draft** analysis of 2007 aerial orthophotography (National Agricultural Imagery Project) at 1-meter resolution and 2005 County LIDAR data, Baltimore County has 187,297 acres of forest canopy cover or 48.7% of the land area. This estimate is significantly greater than 34% forest land area (leaf off conditions) because the canopy estimate includes the leaf-on extent of trees at their maximum drip lines and includes coverage over buildings, roads and other impervious surfaces and land uses.

Area	Total Land (acres)	% of County	Forest Canopy		
			Acres	% of Area	% of County
Rural (Outside URDL)	254,171	66.1%	137,128	54.0%	35.6%
Urban (Inside URDL)	130,541	33.9%	50,168	38.4%	13.0%
Total	**384,713**	**100.0%**	**187,296**	**48.7%**	**48.7%**

The composition of forests in Baltimore County from the US Geological Services' GAP analysis (Appendix A) indicates that the dominant forest type is mixed oak. Estimates were therefore used for oak-hickory forests in the northeast, obtained from the Forest Carbon Web Toolbox (Appendix B). Adjusting the public and privately-owned forests for ownership patterns in Baltimore County, an estimate of 190 tons of carbon stored per ha (77 tons per acre) was used.

- Net sequestration of carbon by the estimated 6.76 million trees inside the URDL was calculated (UFORE analysis, which did not estimate urban canopy cover) at 25,900 tons per year (Nowak et al., 2009), with a value of about $536,000 per year. If trees outside the URDL, which are 73.2% of total forest cover, functioned equally for sequestration, the rural forests would sequester 70,794 tons and the total forest cover in the County would sequester 96,698 tons per year of carbon, or 0.84% of eCO_2 "community" emissions. However, there are differences between the urban and rural forests in Baltimore County that support a conclusion that the carbon sequestration rate is higher than the 0.84% estimate extrapolating from the UFORE data, including:
    - Trees inside the URDL of any particular species sequester and store less carbon than the same size tree in a rural forest setting. The UFORE analysis noted that "open-grown, maintained trees tend to have less above-ground biomass than predicted by forest-derived biomass equations for trees of the same diameter at breast height. To adjust for his difference, biomass results for urban trees were multiplied by a factor of 0.8." (Nowak et al, 2009, p.14-15)

- The urban trees in Baltimore County are small and are comprised of species less efficient for carbon sequestration and storage. The UFORE analysis found that the urban canopy contains primarily small trees, with a median diameter of only 4.4 inches, 58% with diameters <6" dbh, and only 5.5% with diameters ≥20 inches. The URDL is dominated by non-oak species (only 5.5% are oak species) with smaller leaf-area biomass as well as small trunk and root systems for carbon storage. By comparison, as an example of a true forested area, the medial dbh for the 895 acres of forest at Oregon Ridge Park as reported in the 2007 Oregon Ridge Park Forest Health Assessment and Management Plan was 18.24 inches, more than 4 times the diameter of the "urban" forest. While considerable variation exists in forests in rural areas, about 50,000 acres of forest (not canopy) or 38% of all forests in the County are located in patches of 250 acres and larger, and 81,800 acres (62% of forests) are located in patches of 100 acres or greater, which are likely to be more characteristic of "forests" than of urban trees and smaller patches of woods.

The USDA Forest Service Forest Inventory and Analysis (FIA) program samples forest plots across the US. The annual carbon flux (change in tons) per acre for Maryland, based on FIA sampling from 1999-2005, was –0.7218 (negative values indicate flux into the pool). If applied to the 137,128 acres of forests outside of the URDL, the carbon sequestration for rural Baltimore County alone is estimated at 98,979 tons per year. This per acre sequestration rate is 39% greater than the UFORE rate for areas inside the URDL. The combined urban and rural sequestration is therefore estimated at 124,879 tons per year (.67 tons per acre), which is 1.08% of the annual "community" eCO_2 emissions.

- From a broad perspective, the County's 187,300 acres of forest and tree canopies also store about 14.42 million metric tons of carbon, based on an assumption of 77 tons of carbon stored per acre (oak-hickory forests of the northeast U.S.). This storage equals about 1.25 years of total community emissions in the County at the 2006 rate of emissions. The UFORE analysis estimated that the forests within the URDL store a total of 1.31 million tons with a value of $27.1 million. Forests owned by Baltimore County, at about 4,762 acres, store about 366,674 metric tons of carbon.
- Based on soil sampling for the UFORE analysis, it was estimated that "the belowground stocks were about 2-fold higher than aboveground levels" and "any further losses of forest will result in a significant decline in those stocks" (Nowak, et a., 2009, p. 58-59).

Both modeled estimates of CO2 emissions and the ability of a changing forest ecosystem to manage carbon stocks need continued evaluation. These estimates are therefore very preliminary and should be refined with further analysis and implementation of a tracking system for additions and losses to the County's forest and tree cover through multiple agency programs and private actions.

Forest ecosystem carbon dynamics are complex due to the changing condition of forests, including aging, death of trees, and release of stored carbon. These carbon dynamics are of international and national interest, and the U.S. has worked to understand these and other forest sustainability issues through the Montreal Process Criteria and Indicators (MPCI) process. One of seven MPCI Criteria is Criterion #5, Maintenance of Forest Contribution to Global Carbon Cycles. Additional information on both a national scale and for Baltimore County is available through the draft *National Report on Sustainable Forests – 2010*. Excerpts from the Report for two indicators, **Indicator 5.22: Total Forest Ecosystem Carbon Pools and Fluxes** (p. 2-60, 2-61) and **Indicator 5.23: Total Forest Product Carbon Pools and Fluxes** (p. 2-62,

2-63) are presented in Appendix C. Data from the MD Dept. of Natural Resources, Forest Service, through the Strategic Forest Lands Assessment prepared as a State-level summary of the MPCI, is included in Appendix D for **Net Primary Productivity** and **Carbon Sequestration**. As the County's efforts to reduce GHG emissions and manage carbon stocks and fluxes moves forward, greater emphasis can be placed on integrating data and findings from these federal and State programs.

Challenges and Opportunities

- Forest land cover in Baltimore County has been reduced from about 95% at the time of European settlement to about 34% today. The remaining forests are highly fragmented with more than 9,000 separate patches with an estimated 50,000 owners and an average size of only 14.6 acres.
- Through above-ground and below-ground sequestration of carbon in biomass, forests in the U.S. offset 11% of annual CO_2 emissions (2006).
- For oak-hickory forests of the Northeast, an acre of forest can sequester about 77 tons of CO_2 per year.
- Forest loss through conversion to non-forest has declined over recent decades, and the Forest Conservation Act has resulted in about 65% of forests being retained on development sites. However, the County has lost an average of 245 acres of forest per year from land development over the past 15 years.
- The County appears to have approximately 40% canopy cover (measured by leaf-on extent of drip lines) will soon be able to set forest/tree canopy goals County-wide, for communities within the URDL, for reservoir watersheds, and for riparian buffers. Tree and forest canopies may need to be increased about 30+% to match recommended levels of 40% canopy cover. Meeting these goals will be challenging and will require improved inter-agency and public-private sector collaboration.
- About two-thirds of Baltimore County lands were protected from intensive development beginning in the mid-1970's through the enactment of Resource Conservation zoning. Preservation programs began in 1980 to permanently protect farmland and rural forests and wetlands. Today more than 53,000 acres have been protected toward the goal of 80,000 acres of protected lands by 2020.
- The County's land preservation goal requires preserving 2,700 acres per year with an annual conversion of less than 900 acres. For FY 2008 and FY 2009, while only 602 acres were converted, only a total of 2,300 acres were preserved.

Existing Programs and Recommendations

The sections below present the four AFW policy options and the existing and recommended Baltimore County program frameworks, policies, and projects that potentially contribute to the CO_2 reduction goal. Recommendations are identified by relative time frame for implementation (*short-term*, within the next 2 years; *mid-term*, 2-5 years; *long-term*, 5 years and longer).

1. **Forest Management for Enhanced Carbon Sequestration** (CAP AFW-1)

This policy option focuses on maintaining and improving forest health and sustainability for carbon management. Changes in the number of trees and their associated ecosystem services, including reduction of atmospheric carbon through sequestration and storage, occurs through numerous daily actions.

Existing Programs

Several existing County programs provide policy support and recommendations for maintaining forest health and sustainability. These were evaluated to better understand the dynamic nature of existing forest resources (both urban and rural) and to estimate the contribution of aggressive tree management for CO_2 reduction. Current programs include the following:

Conservation Landscaping Policy: In February 2007, the Baltimore County Advisory Commission on Environmental Quality (CEQ) recommended the development of policies and the adoption of practices for conservation landscaping (CL) for County-owned lands and operations. The County has not yet formed a standing or ad hoc inter-agency committee, as recommended, to guide this initiative. Among other benefits, CL practices would increase carbon sequestration through the addition of vegetation to the landscape and would reduce hydrocarbon emissions as the result of efficiencies/reduction in mowing.

Forest Sustainability Program: In November 2005, Baltimore County DEPS and its Steering Committee prepared a Forest Sustainability Strategy to assure the ecological and economic sustainability of forest resources, using the Montreal Process Criteria & Indicators. Criterion # 5 focuses on Maintenance of Forest Contribution to Global Carbon Cycles. The Strategy includes numerous guiding principles, goals, actions, and assessment/data needs for sustainable forest management. As part of this effort, the County Executive committed in March 2006 to participate as one of the first five MD jurisdictions in setting an Urban Tree Canopy (UTC) goal, under Directive 03-1 of the Chesapeake Bay Program (discussed under AFW-2 below). Implementation programs for forest sustainability include the following:

- *Forest Health Assessments – County-owned Land:* DEPS has initiated a program to assess the health of large forested parks in the County and to prepare forest health management plans. These assessments, which use the USDA Forest Service's NED model, are supported through DEPS's capital improvement program. The first assessment and management plan for 900 acres of forest at Oregon Ridge Park was completed in April 2007. Numerous threats to forest health were identified, including that 54% of the forest at Oregon Ridge Park has no tree regeneration due to over-browsing by deer. DEPS has also hired an on-call forester to conduct assessments and monitoring and to perform other related professional forestry tasks. The consultant is presently conducting a qualitative assessment of an additional 1,760 acres at four County parks and another County-owned site. These will then be prioritized for preparation of quantitative assessments and management plans. The on-call forester will provide technical assistance for corrective and proactive actions to maintain forest health at these sites, including addressing stressors to health from invasive species,

pests and disease, and structural problems such as overcrowded stands and even-aged composition.

- *Forest Distribution and Patch Characterization:* DEPS conducted several GIS analyses of the distribution of forest cover and characteristics by forest patches. In addition to loss of forest, increasing fragmentation and parcelization add to concerns about forest health from numerous biotic and abiotic stressors. Available federal, state, and County data are summarized in *The State of Our Forests –2007* report. Major findings include the following:
    - None of the 14 major watersheds in Baltimore County has more than 50% forest cover.
    - 26% of forest cover in the County is vulnerable to conversion to non-forest cover because it is not in public ownership, conservation easements, or protected stream buffers.

- *Gypsy Moth Suppression Program:* Uncontrolled Gypsy moth infestations can lead to stress on or the death of mature forest stands and the resulting release of carbon to the atmosphere. Baltimore County provides cost-share to the MD Dept. of Agriculture's Forest Pest Management program, as requested, for suppression of Gypsy moths. The County provides 50% cost-share for egg mass counts and 30% cost-share for aerial spraying. Current MDA criteria prioritize moderate- to high-density residential areas with a total forest canopy of 25 acres or greater. Smaller areas, areas assessed for non-residential use, and some resource lands are generally not protected through the State program. In recent years, some lower-ranked areas were dropped from the spray program due to reductions in federal and state funding. As well, severe defoliation and stress to mature oak stands occurred in northern Baltimore County in 2007 and 2008 as a result of infestations in forest areas not eligible for suppression spraying. In 2006, an infestation occurred at Oregon Ridge Park that contributed in 2007 to the death of a 20-acre, 110+ year old stand of Chestnut oak. A salvage harvest consisting of 36,000 board feet of logs and 1,400 tons of pulpwood was conducted for the area in 2008 due to the high hazard to park users from decaying and falling trees. This impact to the forest system also likely resulted in an increase in carbon released through decomposition of smaller roundwood left on site to retard erosion and that was too small to be efficiently removed.

- *Deer Herd Management:* Over-browsing and rubbing of tree seedlings and saplings by white-tailed deer retard tree growth and preclude effective forest regeneration, resulting in a decreased efficiency of forest biomass to sequester and store atmospheric carbon. Deer populations have increased significantly in the County over the past two decades. Deer hunting is a regulated activity by the MD DNR, and active programs have existed for many years at public forests such as the Prettyboy and Liberty Reservoirs (owned by the City of Baltimore) and at the Gunpowder and Patapsco State Parks. Deer herd management closer to the urban communities in the County is problematic. In fall and winter 2008, the first public bow hunt and sharpshooter cooperator hunt ever to take place at the Loch Raven Reservoir were completed, reducing the estimated surplus population of 800-900 deer by a total of 395 deer (184 bow hunt, 211 cooperator). Deer populations remain high at Loch Raven and are estimated to be high in many other forested areas across the middle portion of the County.

Proposed Programs

- *Rural Forest Health Monitoring*: DEPS has worked to develop a program for continuous monitoring of the health of rural forest patches. This work was undertaken in cooperation with the Steering Committee for the Forest Sustainability program. Current efforts are looking at stratifying site sampling based on overall forest landscape classification. Another objective is to use established USDA Forest Service monitoring protocols used for the Forest Health Monitoring/Forest Inventory and Analysis (FHM/FIA) program. DEPS plans to use citizen-scientists for data collection for this continuing monitoring program.

- *Wood Waste Utilization*: Through its Forest Sustainability Program, DEPS has also investigated programs to use waste wood in lieu of chipping and other disposal that would hasten release of stored carbon and waste the wood product. One concept studied has been demonstrated by the Washington Metropolitan Council of Governments, which worked with the USDA Forest Service to purchase a small portable band saw to process trees cut in the urban forestry programs that were otherwise chipped and sent to landfills. The project partnered with a commercial joinery and produced furniture, boards for local picnic tables and park fences, wood for shipping pallets, charcoal, and firewood for sale to the public.

Recommendations

1. Implement the recommendations of the County's Advisory Commission on Environmental Quality for the development of a Conservation Landscaping Policy and implementation of conservation landscaping best management practices for all County operations. [*short term to continuing*]
2. Continue to conduct forest health assessments and to prepare management plans for large County-owned forested lands. Implement management recommendations to maintain forest health for multiple benefits including enhanced carbon sequestration and storage. [*short-term to continuing*]
3. Develop a long-term deer management program for the County that focuses on suppressing deer populations in large forest blocks with significant impacts on regeneration and which promotes the use of deer fencing on smaller, privately-owned forest patches. [*short-term to continuing*]
4. Implement deer control at Oregon Ridge Park as soon as possible, as recommended in the Oregon Ridge Forest Health Assessment and Management Plan, to maintain forest health and regeneration. [*short term to continuing as needed*]
5. Continue to provide County cost-share for the MDA Gypsy moth suppression program. [*short term to continuing as needed*]
6. Support efforts to secure federal and state funding for Gypsy moth suppression and to provide options for landowners in high-infestation, low-priority or ineligible areas under the current MDA criteria. [*short-term*]
7. Implement the planned Rural Forest Health Monitoring program to determine conditions and trends for forest health of large rural patches and to educate landowners about actions they can take to enhance forest health. Enlist and train watershed associations and landowners as citizen scientists. [*short-term to continuing*]

8. Enlist the Master Gardener program and/or watershed associations to participate in an exotic, invasive species assessment and suppression program for County parks, community parks, and other open spaces. Work with the County owners of the sites to provide assistance in removing invasive material as it is collected. [*short-term to continuing*]
9. Develop incentives or a coupon program for deer fencing for smaller forest patches on private lots, similar to the Growing Home Campaign. [*mid-term*]
10. Develop an educational and self-help program for forest landowners to get to know their own forest patches and to carry out preliminary qualitative assessments of forest diversity and stressors. [*mid-term*]
11. Implement the proposed waste wood utilization project. [*short-term to mid-term*]
12. To the extent possible, measure changes in carbon sequestration through implementation of forest management programs.

2. **Managing Urban Trees and Forests** (CAP AFW-2)

The maintenance and expansion of the Urban Tree Canopy (UTC) is critical to meeting the County's proposed CO_2 emission reduction goal. In addition to providing shade and aesthetic beauty to more densely populated urban areas, the UTC should be considered a significant factor in energy efficiency initiatives and other programs aimed at County emissions. The County is using state-of-the-science landcover data to further support program development and implementation. Two recent analyses of importance to urban tree programs are the UTC cover estimate itself and the Urban Forest Effects (UFORE) model:

Urban Tree Canopy (March 2009): As part of its commitment to set an urban tree canopy goal, DEPS cooperated with researchers at the University of Vermont's Spatial Analysis Laboratory, who developed a GIS data layer of vegetation cover for Baltimore County. This data product, which has just been delivered, uses 2007 1-meter orthophotography from the National Agricultural Imagery Project (NAIP) and the County's 2005 LIDAR data. The high resolution is useful in that nearly every tree is classified, and the LIDAR provides a 3D feature including measurement of height of canopies. As data are purchased and analyzed in future years, it will be possible to measure the extent of change in the overall tree canopy in the County. The data are undergoing further review and the working number at this time should be considered a draft estimate and may actually over-state the percentage of tree cover by a few percent. Based on the 2009 data classification, the tree canopy of Baltimore County is 54% outside of the URDL, 38% inside the URDL, and 49% overall. It is noted that this measure is of total crown extent (leaf-on, to the drip line of trees), which is a more extensive measure than ground-level forest land cover. Canopies that extend over buildings, roads, and other impervious surfaces provide additional benefits. The typical recommended UTC goal for communities is 40%. Researchers at UVt and at NC State and the US Forest Service are further collaborating with DEPS to estimate the total biomass of the County's forest cover, which will allow an estimation of total carbon sequestration.

Urban Forest Effects (UFORE) Model (March 2009): DEPS contracted with the USDA Forest Service to apply the UFORE model to the forests within the Urban-Rural Demarcation

Line (URDL). Although there are important methodological limitations associated with this analysis due to sampling error, the final analysis indicated that:

- The estimated 6.76 million trees within the URDL play an important role in fixing carbon during photosynthesis and storing excess carbon as biomass. Gross sequestration of carbon through new tree growth each year is estimated at 38,500 tons with an annual ecosystem services value of $0.797 million. Net carbon sequestration due to continuing death and decline of the urban canopy is estimated at 25,900 tons.
- The trees within the URDL also store an estimated 1.311 million tons of carbon with an ecosystem service value of $27.1 million. This is the amount of carbon that can be re-released into the atmosphere if trees are allowed to die or decay.
- Trees also affect energy consumption and those within the URDL are estimated to reduce annual energy-related costs for residential buildings by an estimated $18.3 million (2007 prices).
- These building energy savings result in the annual reduction of additional carbon otherwise generated for heating and cooling, by an estimated 22,600 tons with an ecosystem services value of $0.467 million.
- Current and future carbon management influenced through the County's urban tree canopy is threatened by issues of forest health. The UFORE sampling found that the second most-frequently occurring tree type within the URDL is dead trees, estimated to account for 8.7% of the total urban tree population.
- Carbon sequestered in soils below trees is about twice the amount sequestered in above-ground biomass. Soil carbon within the URDL is estimated to range from 2.0 to 2.6 million tonnes, with a carbon density of from 4.59 to 6.48 kg/m^3 and a unit area estimate of from 46.0 to 64.8 tonnes/ha^3. It was estimated that conversion of forest land to impervious surfaces results in a loss of carbon storage of from 110,000 to 340,000 tonnes, whereas, if impervious surfaces are converted to forest, the additional amount of carbon stored could amount to 1 million tonnes given time for the soil to accumulate the carbon.

Existing Programs

Baltimore Watershed Agreement (2006): The 2nd Agreement signed by the Baltimore County Executive and the Mayor of the City of Baltimore in 2006 focused on five topic areas including Community Greening. Six core actions (Actions 7.1 to 7.6) for coordinating Community Greening activities were approved in the BWA Action Plan of March 2009. While focused on water quality, these actions (paraphrased here) can also serve the interest of tree health, energy savings, and carbon management:

- Develop greening targets
- Measure UTC condition and function
- Develop urban tree inventories and management programs
- Continue to work with stakeholders for education and implementation
- Collaborate with research in support of programs
- Implement vegetation projects, especially for urban stormwater.

NeighborSpace of Baltimore County, Inc. NeighborSpace of Baltimore County, Inc. is a 501(c)(3) non-profit organization, comprised of dedicated volunteers, that identifies and acquires land in Community Conservation and Growth Areas of Baltimore County to provide small parks, gardens, and natural areas with support of local residents, to benefit residents, and "green" older established neighborhoods. Neighborhood open space is an asset in older established neighborhoods, making them livable and distinctive. However, many neighborhoods within Community Conservation Areas are deficient of open space. These neighborhoods were typically developed prior to open space requirements and have less protected open space when compared to newer developments. In addition, many of these neighborhoods are essentially built-out with few remaining undeveloped parcels of land providing green open space. These remaining undeveloped parcels are being threatened by infill development, which will eliminate the green open space they once provided. NeighborSpace of Baltimore County was formed as a land trust to help preserve these small open spaces in Community Conservation Areas, where 75 percent of the County's population lives. Under Maryland State law, land placed in a qualified land trust cannot be developed. There are three ways to put land in the NeighborSpace land trust: (1) donate the land to NeighborSpace, (2) sell the land to NeighborSpace, and (3) grant NeighborSpace a deed of conservation easement covering the land.

NeighborSpace has acquired six properties to date, totaling approximately 23 acres:

- Pennsylvania Avenue Pocket Park - East Towson
- Tollgate Wyndham Preserve - Owings Mills (7 acres, mostly wooded)
- Volz Neighborhood Park - White Marsh (~ 14 acres of forested land)
- Branchwood Preserve – Pikesville (1 acre wooded buffer)
- Hampton Lane Pocket Park – Towson (~ 1 acre of natural open space)
- Robin Hill Road – Lochern (~ 1.5 acres)

The information above is from the NeighborSpace web site: http://www.neighborspacebaltimorecounty.org/

Tree-Mendous Maryland: Maryland DNR's program to provide low-cost trees for community associations to plant on public lands and community open spaces has been promoted since 1990 in the County. The number and value of trees planted by season are tracked and maintained by DEPS. From 1990 through 2007, citizens have purchased and planted 11,628 trees at a purchase price (not adjusted to constant dollars) of $191,947. This activity is for orders placed through the County, which provides delivery of trees for orders of 10 or more for a community group. Additional orders are placed directly through DNR. This data has not yet been compiled. Benefits can be estimated using the national Tree Benefit Calculator.

Growing Home Campaign: This program provides education and a coupon incentive to increase tree canopy on residential lots by homeowners. The Campaign is now beginning its fourth year and is partially regional in that Baltimore City and Harford County joined the program in 2008. The coupon incentive is $10 off the price of trees costing $25 and greater, and the discount is cost-shared in the amount of $5 each by the jurisdictions and the participating nursery retailers. Data collected through the coupons includes the location, species, size, and cost of trees purchased by homeowners. While all vegetation in the urban area is beneficial, the small size of trees purchased and planted under the Campaign

means that it will take time for them to contribute significantly to the CO_2 reduction goal. None of the trees equaled or exceeded the minimum of 2" diameter (dbh) developed for calculating tree benefits using the national Tree Benefit Calculator (Davey Tree Expert Co and Casey Trees). Campaign results to date include:

- For the period from 2006 through 2008, a total of 4,055 trees were purchased by homeowners in the County and surrounding jurisdictions at a retail cost of $267,577. At a modest $25 per tree to transport, plant, and care for a tree, the total economic impact of the Campaign has been $368,972 to date. Campaign costs average just over $50,000 per year (printing educational brochures and Coordinator salary).
- Assuming that the trees purchased from 2006-2008 through the Growing Home Campaign were 2" dbh, they would have managed 73,400 lbs. of CO_2 annually with an ecosystem services value of $560. Total benefits including stormwater management, property value increase, and energy savings would total $20,840. This includes trees planted in the City and in counties outside of Baltimore County through the Campaign.
- If these same 4,000+ trees were to grow to 7" dbh, they would manage 648,000 lbs. of CO_2 annually with an ecosystem services value of $4,800 and total benefits of $140,000. All benefits increase significantly as trees grow from 10" to 20" and more dbh due to significantly increased leaf area. Growth rates vary by species and site, but a small 5' pin oak sapling would typically grow to about 12-14" dbh in about 20 years.

Street Tree Removals: Data are available for some of the street tree removals by the County Dept. of Public Works, Bureau of Highways, pursuant to the MD Roadside Tree law. The data include tree species and diameters, so ecosystem benefits lost through removal of trees can be calculated for the available data and extrapolated across the total program activity reported. Highlights of the data available to date include the following:

- DPW reported the removal of more than 8,600 street trees from FY 04 through FY 08. Permit records are available for some 656 removed trees. The data reveal that 589 trees (90%) were removed during calendar years 2006-2008. The reason for the smaller number of trees with permits compared to the total trees removed has not been determined.
- Permit records for the 656 removed trees were evaluated. Excluding dead trees, storm damaged trees, trees in sewer lines and other trees removed for obvious structural or health reasons, a total of 463 trees (70.6% of the 656 tree removals with permits) were removed for lifting sidewalks. The data for each tree by species and size class was evaluated using the US Forest Service STRATUM model. These 463 trees had a mean diameter of 26 inches dbh and a combined crown area of 20 acres.
- The 463 trees removed due to lifting of sidewalks sequestered about 361,500 lbs. of CO_2 per year at a value of $2,711, based on their size at the time they were removed. Total CO_2 stored is estimated at 6.83 million lbs. with a value of $51,260 per year. The trees provided total energy benefits equivalent to 99.4 MWh of total electricity use with an annual value of $13,000. These trees also intercepted about 3.65 million gals. of rainfall annually with total stormwater benefits of $36,100. The estimated replacement value of trees lost to sidewalk conflicts was estimated at $6.55 million. The DPW has reported that the cost to the County for removal of all

trees, due to sidewalk lifting and other health or nuisance reasons but not including tree trimming or stump removals, was $3.28 million from FY02 through FY07.

Recommendations

1. Complete data review for forest land cover and establish recommended tree/forest canopy goals as soon as practicable, including goals for overall County-wide canopy, urban tree canopy (within the URDL), forest cover in reservoir watersheds, and forest cover for riparian buffers. [*short-term*]
2. Work with the County DPW and other agencies and researchers to develop practical alternatives for dealing with existing street tree-sidewalk conflicts that will save existing healthy non-hazard trees from being cut down. These should include evaluation of options such as cutting a bevel edge on heaved sidewalk sections where practical, replacement of lifted sidewalk sections, root pruning, and other options. Consider the replacement value and values of measurable ecosystem services of trees by species in the cost-benefit decision for removal. Assure that removed trees are replaced as required by homeowners. [*short-term*]
3. Work with County agencies and researchers to develop appropriate design standards for street tree pits that provide adequate infiltration and soil volume for tree growth. Investigate alternative paving and other structural methods (such as Cornell University's CU-structural soil) to accommodate tree growth in areas where sidewalks and other paving are necessary over root systems. Add the replacement values and measurable cumulative ecosystem services values for proposed trees by species through expected maturity to the cost-benefit decision for installation of trees and associated streetside infrastructure. Begin implementing demonstration projects and work with researchers to evaluate performance. [*short-term to mid-term*]
4. Develop an urban and community forestry program for areas within the URDL that has the responsibility for comprehensive urban tree management (planting, tree care, and removals). Develop an urban street tree inventory system within the URDL that is designed to inform the management program. Develop a unified, inter-agency tracking system for tree interventions and for providing annual estimates of multiple benefits of the urban canopy. Include professionals appropriate to the importance and value of the County's urban forest (note that the District of Columbia, through its Dept of Transportation, has 16 certified arborists to care for the District's 140,000 street trees). [*short-term to mid-term*]
5. Work with the Offices of Planning and Community Conservation to incorporate adequate space for urban streetscapes in new developments and to retrofit older neighborhoods with appropriate easement and sidewalk designs for replacing or adding new major trees in streetscapes. [*short-term to mid-term*]
6. Develop educational materials for urban residents about the ecological function, reduced energy costs, and air quality benefits associated with maintaining healthy urban trees in both streetscapes and on private properties. [*short-term to mid-term*]
7. Develop a "Big Trees" program to augment the Growing Home Campaign. "Big Trees" would provide incentives and/or trees at cost for landowners to plant traditional canopy species (such as oak, tulip tree, sugar maple, hickory, chestnut, elm, beech, black gum, sycamore) in larger urban yards where appropriate. Most of these "big tree" species are not sold by commercial nurseries and garden centers that participate in the Growing Home Campaign. [*mid-term*]

8. Develop an urban forest identification program for communities that will help to target streetscape and other open spaces for major tree planting, and to identify and remove exotic, invasive plant species from their private lots. [*mid-term to long-term*]
9. Enlist the support of the MD DNR to sponsor legislation to ban the sale throughout Maryland of the most egregious exotic, invasive plants by local nurseries and garden centers, as has been done in Oregon. [*mid-term*]

3. **Afforestation, Reforestation and Restoration of Forests and Wetlands** (CAP AFW-3)

Large tracts of forested land will undoubtedly play a large role in carbon sequestration. As such, while urban canopy cover is critical to the County's proposed CO2 emissions reduction goal, it is the forest cover in rural areas throughout the County that will provide the most benefits with regard to sequestration in the County primarily because rural forests account for about 80% of the County's total forest cover. As such, the preservation and expansion of these forested areas is a cornerstone of a comprehensive approach to forest sustainability for the County.

Existing Programs

Baltimore County Forest Conservation Act: The acreage of forest permanently lost through conversion to non-forest from land development activity is required to be tracked by DEPS. From FY 1994 through FY 2006, a total of 3,187 acres of forest or an average of 245 acres per year of forest has been lost due to land development in Baltimore County. DEPS's Community Reforestation Program uses fees-in-lieu of mitigation to reforest public lands for the portion of forest loss that requires mitigation and for which developers pay the County for that obligation. Some additional research is necessary to estimate the ecosystem and economic impacts of this forest loss.

Rural Residential Reforestation: Baltimore County's Rural Residential Stewardship and Valleys Reforestation Initiative projects resulted in expansion of riparian buffers and forest patches on large low-density rural lots. In the first pilot, 17 acres of new forest was planted on 12 rural lots. The current project has a target of 21.7 acres, which has been planted. The ecosystem benefits and values can be calculated using the same method used for forest acres lost to land development. In addition to mitigating for GHG emissions, the projects will ultimately reduce total annual nitrogen loads from 14.1 to 1.4 lbs. per year, total phosphorus loads from 1.1 to 0.02 lbs. and reduce sediment from 0.45 to 0.04 tons (based on the Chesapeake Bay model).

Baltimore County Forestry Board Greening Committees: The Forestry Board has worked for years with community associations to plant trees on schools grounds and County parks. The data for this activity are maintained by the Board and are likely available to calculate the benefits and value of reforestation.

Recommendations

1. Adopt a no-net-loss of forest policy for the County to assure that the forest base continues to function for multiple benefits including to sequester and store carbon. [*short-term*]

2. Utilize existing mapping to identify candidate corridors between forest patches for a range of planting programs. [*mid-term*]
3. Develop a geo-referenced tracking system for reforestation progress by County agencies, other organizations, and citizens. [*short-term to continuing*]
4. Expand DEPS's reforestation crew and Rural Residential Reforestation programs to accelerate planting on private lands including large lot subdivisions and land with conservation easements. [*short-term to continuing*]
5. Increase the capacity of the DEPS nursery to include growing out a range of appropriate forest and urban tree species for urban planting projects. [*short-term to mid-term*]
6. Develop an urban tree-planting program in which citizens may choose to have trees planted by the County for a fee that includes growing out and planting costs. [*mid-term to long-term*]
7. Develop a tree bulletin for the DEPS website that focuses on a recommended tree of the month, gives maintenance advice on caring for trees, and can also contain other tips or information about exotic invasives and healthy, native gardens. [*mid-term*]

4. **Protection and Conservation of Agricultural Land, Coastal Wetlands and Forested Land** (CAP AFW-4)

Maryland's Climate Action Plan emphasizes that land conservation programs help communities mitigate and adapt to climate change through the protection of forest and other resource lands through sequestration of carbon and avoidance of emissions associated with land clearing and development. Local land use planning and environmental management programs assure that valuable "Green Infrastructure" services are maintained and land conversion pressures are reduced through Smart growth practices.

Master Plan and Growth Management Framework: Baltimore County's Master Plans have long-established that the County has distinct urban and rural areas, supported through implementation mechanisms including the Urban-Rural Demarcation Line (URDL), rural Resource Conservation zoning, designated planned growth areas, and coordinated provision of urban infrastructure. Currently about 87% of the 2008 population of the County lives within the URDL on only one-third of the land. The Master Plan designates the rural two-thirds of the County for resource protection, agriculture, and limited low-density development. These designations support the continuation of working lands economies and the protection of regionally-important water supply reservoirs. The Master Plan has designated 135,400 acres of land for agricultural preservation.

Existing Programs

Land Preservation programs: A number of land preservation programs are in place to primarily purchase development rights easements for permanent protection from land conversion. The County is ranked as the seventh most active in the nation for land preservation. The County has established a goal of 80,000 acres of core lands for future protection through these easement programs, which are supported through County capital bond funds, Maryland cost-share programs, and federal grants. DEPS has previously estimated that about 20% of land in traditional agricultural preservation programs and about

40% of the land in other programs (Rural Legacy, MET, and GreenPrint) is forested. The status of forest protection through preservation programs will soon be updated through a GIS analysis using the new landcover classification and currently preserved lands. Active programs include:

- MD Agricultural Land Preservation Foundation (MALPF) program
- Baltimore County Land Preservation Program
- County Imminent Threat program
- MD Rural Legacy program
- MD GreenPrint Program
- MD Environmental Trust (MET) Conservation Easement program
- Viewshed Protection program (federal Transportation Efficiency Program - TEP)
- Farm and Ranch Protection Program (federal grant program)

Although the land preservation effort is a priority for the County, funding has come under pressure periodically as other local and state needs compete for available funds. Fortunately, other mechanisms are in place in the County that reduce the potential for loss of forest cover and associated multiple benefits. Public land ownership and Baltimore County's rural Resource Conservation zoning, for example, provide additional protection of forest areas. A "forest conservation typology" was developed by DEPS that evaluates forest cover by the degree of protection from conversion to non-forest. The analysis indicates that:

- About 36,400 acres or 27% of the forests in the County are protected through public ownership.
- About 23,100 acres or 17% of the forests in the County are on lands under various conservation easements.
- Another 29,700 acres or 22% of forest cover occurs on land with long-standing resource conservation zoning. While not permanently protected, these forests have low potential for conversion due to the low development densities of the RC zones.
- Some 4,350 acres or 3% of forests exist on rural lots with no further development potential, and nearly 2,450 acres or 3% of forests are on undeveloped rural lands in riparian buffers that cannot be developed.
- Even in urban areas with development potential, about 3,800 acres or 3% of forests are in riparian buffers that are protected from development through stream protection regulations.
- Overall, about 34,500 acres or 26% of the County's forest cover is potentially subject to conversion to development because it is not in public ownership or conservation easements and not in regulated stream buffers. On these lands, the Forest Conservation and Chesapeake Bay Critical Area Acts will likely reduce the potential for conversion, but this is a site-by-site determination.

Forest Legacy: The competitive federal Forest Legacy program protects significant green infrastructure areas. Two large areas in Baltimore County totaling 65,763 forested acres were designated in the State's recent Assessment of Need. Funding for this program has been limited and no acres of land have actually been protected in the County to date.

Bay Bank: The Chesapeake Bay Program is working to establish a land registry through which landowners can sell the value of ecosystem services benefits of existing protected forests and wetlands to GHG generators such as power plants. The bank is under development by the Pinchot Institute for Conservation.

Recommendations

1. Develop and fund a new County preservation program specifically designed to purchase development rights on tracts of land with significant forest resources. [*mid-term*]
2. Provide local cost-share funds for participation in the Forest Legacy program if federal funds become available. [*mid-term to long-term*]
3. Promote the Chesapeake Bay Bank to landowners, once it is established, to encourage long-term sequestration of carbon as mitigation for regulated emissions. [*mid-term to continuing*]

Emerging Issues

Market Incentives: While the traditional government tools for protecting and conserving agricultural and forested lands – public ownership, preservation easements, zoning and land use regulations – have had a significant impact and will continue to be used, ever-increasing development and economic pressures on these lands call for new approaches that focus on market incentives to protect them by making farming and forestry profitable to the people who live and work on these lands. Emerging market strategies include the following:

- *Support Local Producers:*
  - North County Preservation, Inc. (NCP), a non-profit organization dedicated to supporting rural life in northern Baltimore County, recently completed a study identifying priority actions for promoting agriculture as a profitable business in the County. (*Rural Baltimore County Agricultural Growth and Action Plan*, prepared by ACDS, LLC, February 2009.) Its suite of recommendations includes the development of a brand image for local/regional products, leadership training, zoning and land use reform, and a mediation board to resolve neighbor disputes. A more detailed summary of the recommendations appears under **Recommendations**, below, noted as "*NCP.*"
  - Maryland's Climate Action Plan includes a "buy local" policy option (AFW-5), which aligns with several of NCP's recommendations. This would involve the Maryland Department of Agriculture and other state agencies working with local governments, farmers and farmer's market associations, lumber mills, furniture makers, and other value-added producers and trade associations to develop LEED-type certification for local products, educate producers in marketing and distribution, support the creation of local durable wood products, and develop supportive zoning and siting regulations. A more detailed summary of the recommendations appears under **Recommendations**, below, noted as "*CAP*".
- *Develop Carbon Trading Markets:*

- *Nutrient Trading for Carbon Benefits:* This policy option in the state's Climate Action Plan (AFW-8) builds on a market-based nutrient trading program originally designed to achieve water quality improvements in the Upper Chesapeake Bay through improved agricultural practices. Nutrient trading can also provide significant GHG reduction benefits. Tradable nutrient credits are created through nutrient reduction – specifically nitrogen and phosphorus – achieved through practices that increase soil carbon sequestration and reduce use of nitrogen fertilizers that release nitrous oxide (N2O), a GHG with 310 times the effect of one unit of CO2. Program elements include the following:
  - Entities who need to apply or release more nutrients than are currently permitted under their nutrient management plans can obtain credits from sellers who have reduced their use.
  - Carbon and enhanced nitrogen credits are "stacked" onto existing nutrient credits as tradable commodities, adding more value to the total credit package, creating a more robust nutrient trading market.
  - Credit trading occurs between non-point sources (e.g. agricultural operations) and point sources (e.g. wastewater treatment plants, industrial dischargers, highway contractors and developers) which would:

    - Create opportunities for GHG reductions.

    - Improve water quality.

    - Reduce fertilizer use and soil erosion.

    - Restore wildlife habitat and wetlands.

    - Expand economic opportunities for farmers and foresters.

    - Promote Smart Growth goals by preserving agricultural and forested lands.

- *Chesapeake Bay Bank:* The Chesapeake Bay Program is working to establish a land registry through which landowners can sell the value of ecosystem services benefits of existing protected forests and wetlands to GHG generators such as power plants. The bank is under development by the Pinchot Institute for Conservation. It will build upon existing national, state, and local ecosystem markets, including carbon sequestration, water quality protection, forest conservation, habitat conservation, and traditional conservation programs. Aggregating the value of various ecosystem services into tradable bundles will support a more robust market than if each is traded separately and will enhance the per acre stewardship value to the landowner.

Recommendations

Buy Local Programs:

1. Develop a brand image that can be leveraged by regional producers such as the Hudson Valley's County Bounty Program or the Buy Fresh/Buy Local program. (*NCP*)
2. Create a virtual market interface to facilitate brand development. (*NCP*)
3. Form an exploratory committee to examine various development models, such as a certified development corporation or dedication or expansion of county- based programs. (*NCP*)

4. Encourage and develop LEED-type certification programs for Maryland wood products, organic produce, and livestock to enable participating producers to offer consumers products that meet established standards for being raised and/or harvested sustainably, with net reductions in GHG emissions. (*CAP*)
5. Encourage the creation of value-added products from local woods in lieu of shipping raw materials from long distances. (*CAP*)
6. Provide education for producers in marketing techniques and effective local distribution. (*CAP*)

Leadership and Workforce Development:

1. Support development of a multi-year pilot program, to be started in 2009, in conjunction with the Baltimore County Agriculture Center and interested local farmers that creates individualized new/young farmer training programs. (*NCP*)
2. Work with Baltimore County LEAD Maryland graduates to develop an open format leadership training program modeled after efforts in the eastern panhandle of West Virginia. Program should focus on broadening producer exposure to all elements of the agricultural industry as well as government, politics, and input/output industries. (*NCP*)
3. Improve accessibility of unskilled labor. (*NCP*)

Regulatory Support:

1. Appoint a farmer-led team to review county land-use regulations and policy with involvement from elected officials and community members. Develop a virtual agricultural policy book to keep farmers informed of land-use related development requirements. (*NCP*)
2. Ensure that zoning does not preclude intelligent, sustainable uses that support "buy local" enterprises, by unduly constraining local value added mills or siting/participation in local markets. (*CAP*)

Mediation Dispute:

1. Work with the Baltimore Agricultural Resource Center to develop a farmer base to coordinate outreach and serve as a first line of response in neighbor/industrial conflict. (*NCP*)
2. Improve Right to Farm protections with the creation of a mediation board to review, as a requirement, agricultural nuisance claims to include representatives from the Maryland Cooperative Extension, the farm community, community at large, planning officials, and others as necessary. (*NCP*)

Carbon Trading Markets:

1. Pay farmers and foresters for stewardship by promoting the Chesapeake Bay Bank and/or Upper Chesapeake Nutrient Trading Program to landowners, once they are established, to encourage long-term sequestration of carbon as mitigation for regulated emissions. (*CAP*) [*mid-term to continuing*]

Carbon Sequestration, Energy Production and Soil Fertility Restoration and Enhancement through Pyrolysis of Waste Biomass

Soils contain over 3 times as much CO_2 as air and over 4 times as much as plants and animals. Disturbed soil releases much of its carbon dioxide to the atmosphere. However, with proper

management soil can provide a potential sink for CO_2. Most agricultural soils have lost as much as 50 to 70% of their original carbon. They represent a large potential carbon sink if efforts are made to restore organic carbon to the soil. Returning carbon to the soil sequesters CO_2.

In addition to being a sink for CO_2, organic carbon is also effective for enhancing soil fertility. Before development of mineral fertilizers in the 19th century, management of organic carbon was the way people maintained or restored soil fertility. Mineral fertilization temporarily boosts crop production through replenishment of mineral nutrients, but does not treat soil degradation and accelerated loss of carbon. Eventually, loss of carbon in the soil is correlated with yield decreases, reduced nutrient recycling and reduced plant nutrient uptake efficiency of applied mineral fertilizers. In contrast, application of nutrient-rich materials to agricultural land has often produced conditions of heightened fertility.

Use of agricultural and forestry crop residues, construction waste, garbage, and other surplus biomass can be an energy source that may improve soil fertility, and reduce greenhouse gas emissions through a pyrolitic process that can generate fuel and produce biochar, a charcoal like product, as a very effective soil amendment. It enhances productive soils and remediates depleted soils. Carbon is an important indicator of soil quality, improved structure, increased plant available surface water purification and storage capacity, and increased soil biodiversity and crop yields.

Conventional means of increasing soil quality does sequester some carbon temporarily as long as best management practices are constantly maintained. Composting and manure, crop diversification, cover cropping and field rotation, and use of permaculture on steep and erodible soils provide amendments that must be regularly renewed. Only a third of fresh biomass remains in the soil after one year and less than 20% after 2 years, and can increase nitrous oxide and methane (serious greenhouse gases) emissions into the atmosphere. Biochar, on the other hand, is stable over many years and therefore provides a permanent form of carbon sequestration. Charcoal production can capture over 50% of the carbon in biomass and become an important carbon sink and component of a sustainable system. Pyrolytic conversion of biomass to energy and residual biochar combine renewable energy production, carbon sequestration and soil restoration. Biochar can be produced by incomplete combustion of any biomass as a byproduct of pyrolytic technology used to produce bio-fuel and bio-energy. If the demand for renewable fuels can be met though pyrolysis, biochar sequestration could exceed current emissions from fossil fuels.

Biochar research has focused typically on increasing agricultural production in highly weathered tropical soils with very low soil organic carbon. Because of global interest in biochar, the U.S. Congress has included biochar research in the high priority research and extension areas of a new farm bill. If biochar applications are determined to be feasible in temperate soils, the following recommendations are made.

Recommendations:

1. Set up a study project at the new county demonstration farm that shows the process, describes the different scales at which it can be done, and describes the agricultural,

economic, energy saving, and production and ecological value of its use for the farming community.

2. Set up a larger scale version at the landfills that collect and compost biomass for the County, to reduce the amount of mass in the landfill, produce energy for county use, sequester CO_2 for much longer periods of time than compost does, make the bio-char available to the County for its use as fertilizer and soil amendment, and to County citizens once government needs are met.
3. Advocate for demonstration projects on private farms within the County to engage the agricultural community in the use of the process for their energy, disposal, and fertilizer/amendment needs.

Report of the Protection of Natural Resources Working Group

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APPENDIX A

GAP land covers

Class	Description	Vegetation Type	Percent of County	Percent of Forest land
436	Red Oak - White Oak Forest	Deciduous	11.9%	41.5%
438	Chestnut Oak Forest	Deciduous	7.9%	27.5%
428	Lowland Mixed Oak Forest	Deciduous	1.6%	5.6%
422	Yellow Poplar Forest	Deciduous	1.0%	3.4%
423	Sweetgum Forest	Deciduous	0.5%	1.9%
424	Sycamore - Mixed Hardwood Riverside Forest	Deciduous	0.6%	1.9%
442	Rich Northern Hardwood Forest	Deciduous	0.3%	1.2%
445	Piedmont Beech - Oak Forest	Deciduous	0.2%	0.5%
421	Coastal Plain Beech - Oak Forest	Deciduous	0.1%	0.5%
441	Mixed Oak - Sugar Maple Forest	Deciduous	0.1%	0.4%
411	Coastal Upland Pine Forest	Evergreen	0.2%	0.7%
416	Virginia Pine Forest	Evergreen	0.1%	0.4%
434	Mixed Pines Forest	Evergreen	0.0%	0.1%
444	Redcedar Woodland	Evergreen	0.0%	0.1%
410	Coastal Lowland Pine Forest	Evergreen	0.0%	0.0%
418	Coastal Plain Pine - Mixed Hardwood Lowland Forest	Mixed	1.9%	6.7%
415	Loblolly - Mixed Oak Forest	Mixed	0.9%	3.2%
419	Sweetgun Swamp	Mixed	0.7%	2.3%
417	Virginia Pine - Mixed Oak Forest	Mixed	0.6%	0
Total			**28.7%**	**100.0%**

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APPENDIX B

Forest Carbon Website Toolbox (http://forestcarbon.net/)

Expanded Version of Table 2. Estimates of carbon mass density (metric tons carbon per hectare) according to carbon pool, based on forest type.

Northeast Region

Forest type	Group	Live Tree	Stand Dead	Understory	Down Dead Wood	Forest Floor	Soil 1m	Total
White-red-jack pine	public	99.9	5.6	1.6	5.5	13.3	196.1	322.0
White-red-jack pine	private	90.6	5.9	1.6	5.0	13.3	196.1	312.6
White-red-jack pine	other	46.6	3.6	1.9	2.6	13.6	196.1	264.4
Spruce-fir	public	83.7	6.5	1.4	7.7	33.0	192.9	325.2
Spruce-fir	private	65.5	5.7	1.4	6.0	32.4	192.9	303.9
Spruce-fir	other	33.0	3.1	1.6	3.0	32.6	192.9	266.3
Loblolly-shortleaf pine	public	49.3	4.6	3.2	3.2	13.1	91.7	165.0
Loblolly-shortleaf pine	private	52.2	4.6	3.2	3.4	12.0	91.7	167.1
Loblolly-shortleaf pine	other	29.6	3.3	3.7	1.9	13.3	91.7	143.5
Oak-pine	public	77.3	3.7	2.6	4.7	28.9	82.3	199.6
Oak-pine	private	74.8	3.6	2.7	4.6	26.8	82.3	194.8
Oak-pine	other	47.7	2.5	3.2	2.9	29.7	82.3	168.4
Oak-hickory	public	88.3	4.5	1.8	6.0	8.4	85.0	194.0
Oak-hickory	private	84.1	4.4	1.8	5.8	7.7	85.0	188.8
Oak-hickory	other	59.5	3.1	1.9	4.1	8.2	85.0	161.8
Oak-gum-cypress	public	89.8	5.5	1.8	6.4	7.8	152.2	263.3
Oak-gum-cypress	private	81.2	5.4	1.8	5.7	7.4	152.2	253.7
Oak-gum-cypress	other	34.5	3.9	1.9	2.4	6.9	152.2	201.9
Elm-ash-cottonwood	public	63.0	5.7	1.8	4.5	25.1	118.1	218.1
Elm-ash-cottonwood	private	55.5	5.4	1.8	3.9	23.3	118.1	208.1
Elm-ash-cottonwood	other	43.1	3.7	1.9	3.1	24.6	118.1	194.5
Maple-beech-birch	public	92.1	6.8	1.7	6.5	27.5	139.5	274.1
Maple-beech-birch	private	76.7	6.8	1.8	5.4	26.2	139.5	256.4
Maple-beech-birch	other	33.2	3.2	2.0	2.4	27.5	139.5	207.7
Aspen-birch	public	61.6	2.7	2.1	4.8	9.3	237.0	317.4
Aspen-birch	private	47.8	2.1	2.1	3.7	8.8	237.0	301.4
Aspen-birch	other	47.7	2.0	2.1	3.7	9.5	237.0	302.1
Nonstocked	private	2.9	5.0	2.0	0.1	4.8	99.6	114.3
Nonstocked	other	2.9	5.0	2.0	0.1	4.8	99.6	114.3

APPENDIX C

Excerpts from Criterion 5, Maintenance of Forest Contribution to Global Carbon Cycles, from the December 2008 draft *National Report on Sustainable Forests – 2010*.

http://www.fs.fed.us/research/sustain/2010SustainabilityReport/documents/draft2010sustainabilityreport.pdf

Indicator 5.22: Total Forest Ecosystem Carbon Pools and Fluxes (p. 2-60, 2-61)

"The United States emitted a gross 5.9 billion metric tons of CO_2 in the year 2006. Because plants use carbon dioxide in the photosynthesis process, forests provide a primary vehicle to sequester carbon from the atmosphere. During this process, the carbon becomes part of the plant mass. Once forest biomass dies, carbon continues to remain in the forest ecosystem and cycle through dead trees, dead wood, duff/litter, and finally soil carbon pools. Thus, managing forest ecosystems to sequester carbon reduces the net amount of carbon dioxide accumulating in the atmosphere. Less carbon dioxide in the atmosphere may help reduce the possibility/extent of human-induced climate change. In contrast, forests can also serve as a net emitter of CO_2 during years of extreme wildfires or widespread disturbance."

- *"Forest ecosystem carbon stocks in the United States continue to represent a substantial carbon pool of over 165,000 Tg, with live trees and soil organic carbon accounting for the majority of this stock. The forest carbon stock is equivalent to over 27 years of CO_2 emissions in the United States."*
- **According to the report, Baltimore County is in an area of generally high carbon stocks associated with live biomass.**

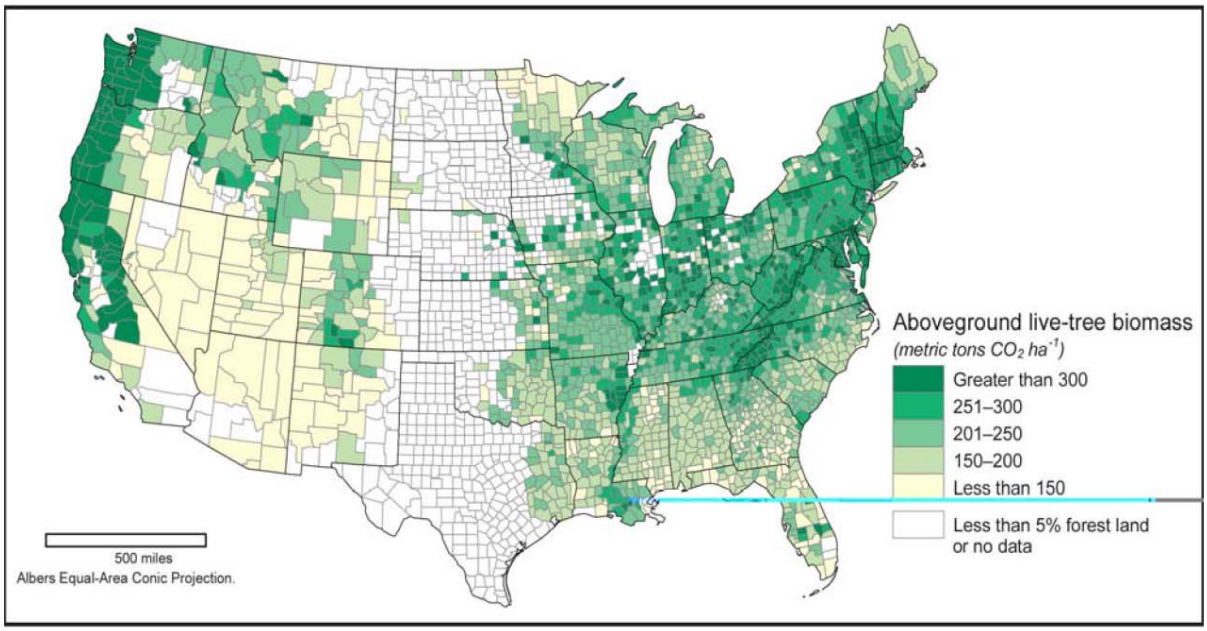


Figure. 22-2. Forest aboveground live biomass carbon stocks by county for United States, 2006.

- *"In terms of annual changes or carbon flux, both above- and below-ground forest ecosystem living biomass components account for the majority of annual carbon sequestration. These rates of sequestration have remained rather static since 2000. The spatial distribution of forest sequestration is evenly distributed within forested regions of the country. U.S. forests offset over*

11 percent of total annual CO2 emissions in 2006. This rate of offset has remained relatively constant for past two decades. Overall, the tremendous forest carbon stocks of the U.S. continue to gradually increase while increasing greenhouse gas emissions continue to greatly outpace what can be sequestered by forests annually."

Indicator 5.23: Total Forest Product Carbon Pools and Fluxes (p. 2-62, 2-63)

"This indicator assesses the role that forest products play in the sequestration, cycling, or emission of carbon. Long-term storage of carbon in products and landfills delays or reduces emissions. Use of wood products can also reduce emissions if they substitute for products with higher carbon emission processes. As forest biomass is harvested carbon is shifted from forest ecosystems to forest products held in products and landfills. The rate of accumulation of carbon in products can be influenced by the mix of products and uses (e.g. lumber in housing versus paperboard in boxes) and by patterns of disposal, recycling, and landfill management. This indicator shows the harvested wood product (HWP) contribution to the combined system of annual CO_2 emissions and removals by forests and products. This indicator primarily uses the Production accounting approach to track the HWP contribution. This approach tracks carbon in wood that was harvested in the U.S. including carbon held products that are exported."

- *"In 2006, under the Production approach, HWP contribution due to carbon additions to forest products in use and in landfills was 110 million tons CO_2 equivalent or about 17 percent of the value of annual carbon additions to forest ecosystems. In 2006 this contribution offset emissions equal to about 34% of the CO_2 emitted by fossil fuel combustion in residential housing. The annual contribution is now less than in 1990 due in part to decreasing U.S. timber harvest and replacement of domestic harvest by imported products."*
- *"The annual amount of HWP contribution as a percent of total forest carbon stock has decreased since 1990. In 2007, total carbon stored in forest products in use and in landfills under the Production approach equaled more than 8,000 Tg (giga-tons) CO_2 equivalent or over 1 years worth of CO2 emissions in the U.S."*
- *"A rough estimate of the greenhouse gas emission savings due to building wood framed single family detached homes in 2005 instead of building homes using example designs that use steel or concrete walls is 1.7 million tons of CO_2 equivalent. This potential savings is due to lower GHG emissions associated with production of wood products. This is only part of the total savings, which would also include wood framed single family attached and multifamily houses. Single family detached houses provided about 54% of the total housing floor area build in 2005."*
- *"Regional differences in contribution to carbon storage in products were identified by estimating the contribution each county makes to wood carbon storage. The objective is to estimate the portion of carbon harvested in 2006 that is still stored after 100 years. To do this we estimate the wood harvest in each county, estimate the wood products that are produced (lumber, panels, paper), the end uses where those products are used (e.g. housing, paper products), the rate of discard from use, the rate of disposal to landfills and their decay from landfills. The amount still stored after 100 years has offset an equivalent CO_2 emission for 100 years – which is the approximate lifetime of a CO_2 molecule emitted in the year the wood was harvested.*

  Figure 23-4 shows the estimated amounts of carbon still stored in products from 2006 harvest in U.S. counties after 100 years in tons of carbon per hectare of timberland. Storage is highest for timberland in Midwest and mid Atlantic states. The amount stored per hectare after 100 years is influenced by the harvest per hectare and by the mix of sawlogs or pulpwoods and softwoods or hardwoods produced. About 30% of carbon from both hardwood and softwood sawlogs is stored after 100 years along with about 20% from hardwood pulpwood and 10% from softwood pulpwood."

  The data available for Baltimore County indicates that long-term storage of carbon in products is high, but the County does not rank in the highest category.

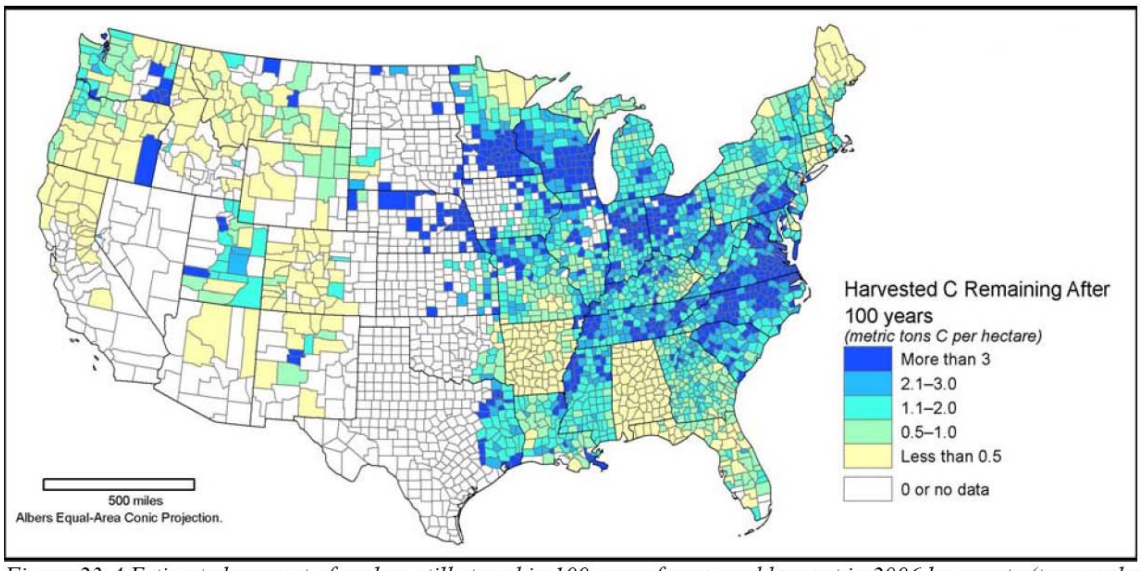
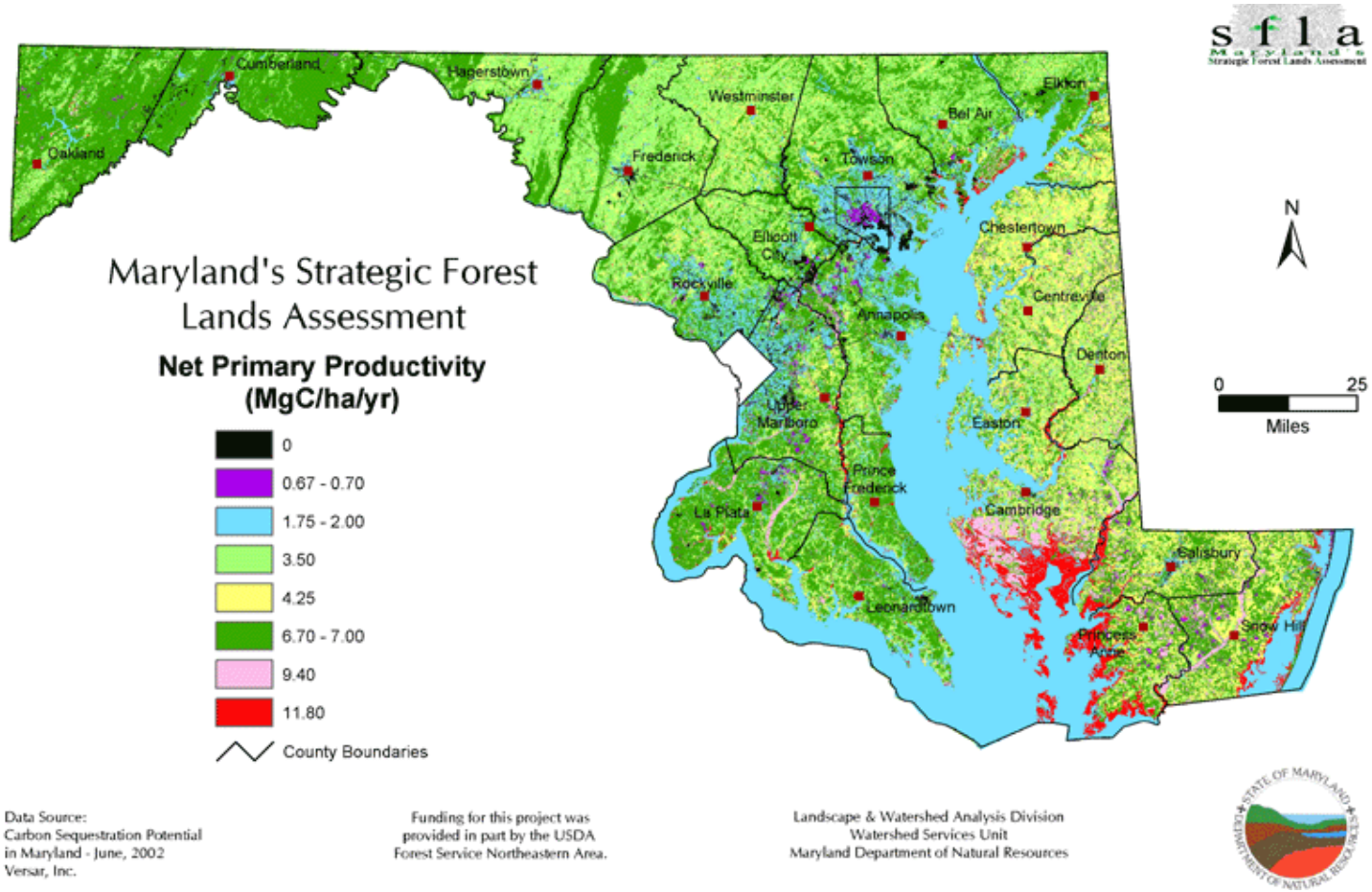


Figure 23-4 Estimated amount of carbon still stored in 100 years from wood harvest in 2006 by county (tons carbon per hectare of timberland).

APPENDIX D
Maryland Strategic Forest Lands Assessment (FSLA)

Net Primary Productivity

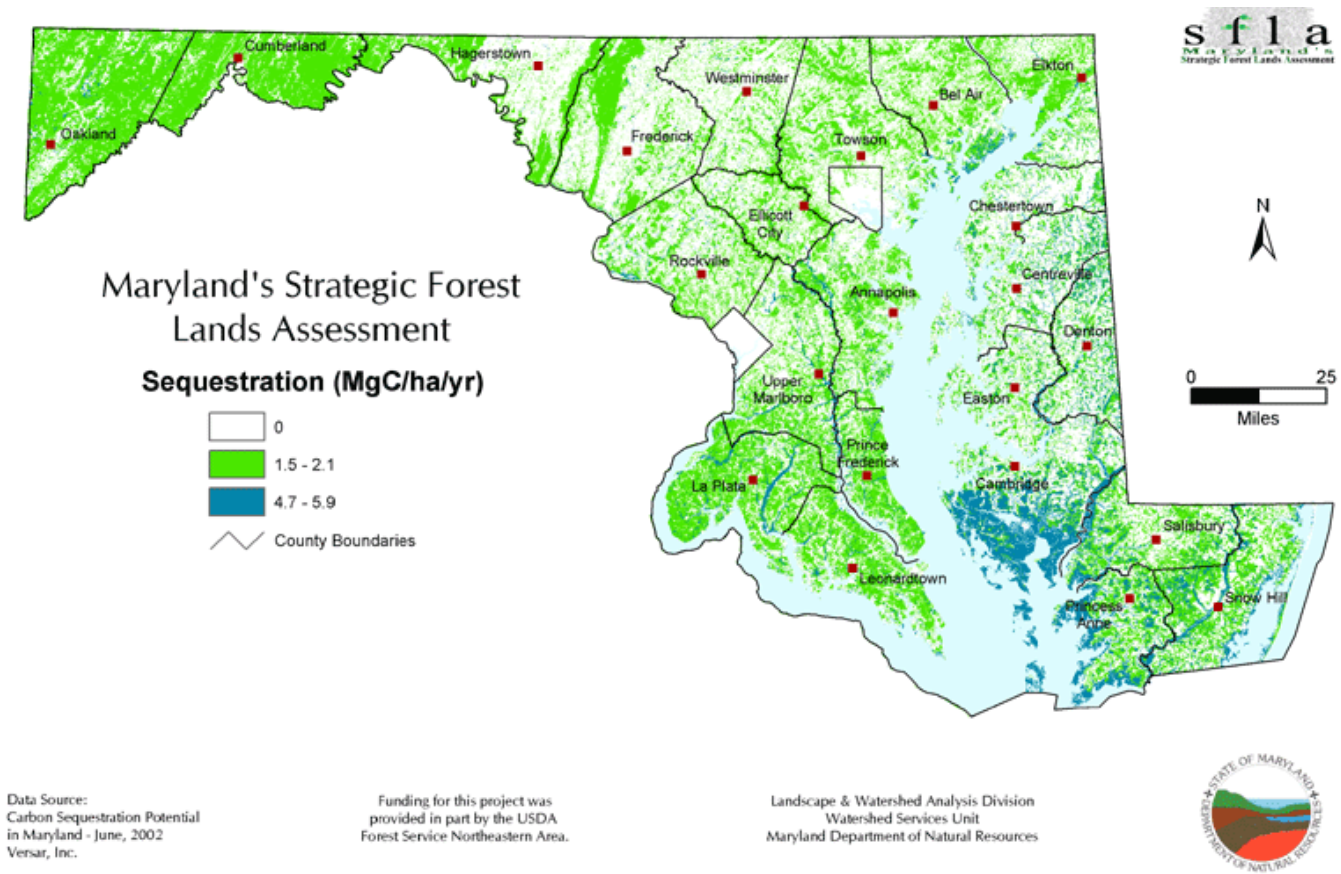
Net Primary Productivity (NPP) is the rate at which plants incorporate atmospheric carbon through photosynthesis--forests account for almost 48 % of the Maryland's carbon fixation (only swampy areas and marshes, such as those on the Lower Eastern Shore, tie up more carbon annually). The NPP of an area sets the upper limit for the rate at which carbon can be sequestered by that area--how much carbon is stored in biomass and therefore not contributing to atmospheric carbon levels. Approximately a seventh of total atmospheric carbon dioxide is passed into vegetation annually. This indicator points toward land management opportunities to offset CO_2 emissions from burning fossil fuels. Where net primary productivity is low, restoration of forest and wetland land cover could be beneficial from the perspective of greenhouse gases.



http://www.dnr.maryland.gov/forests/planning/sfla/indicators/npp.htm

Carbon Sequestration

Carbon sequestration — the permanent removal of carbon from the atmosphere — is driven by Net Primary Productivity(NPP) for any given area of land. What humans do with the vegetation has a lot to do with how much is actually sequestered. Rates at which carbon is permanently tied up in vegetation and soils can vary from about 15% to about 50%. For example, most agricultural production is almost immediately recycled through animals and humans, which results in essentially no sequestration. Sequestration rates have been estimated by both models and field measurements. The modeling and field work examined by Versar, from which this indicator is drawn, yielded very close to the same estimates for Maryland sequestration rates: about 24% of NPP for forests and 50% for wetlands. Versar estimated that optimal implementation of a variety of measures to improve sequestration rates—heavily emphasizing protection and management of forests and wetlands for sequestration values and the conversion of underutilized farm land to wetlands and forest—could increase these rates as much as 70% to offset carbon dioxide emissions from power plants and other burning of fossil fuels.



http://www.dnr.maryland.gov/forests/planning/sfla/indicators/carbon_seq.htm