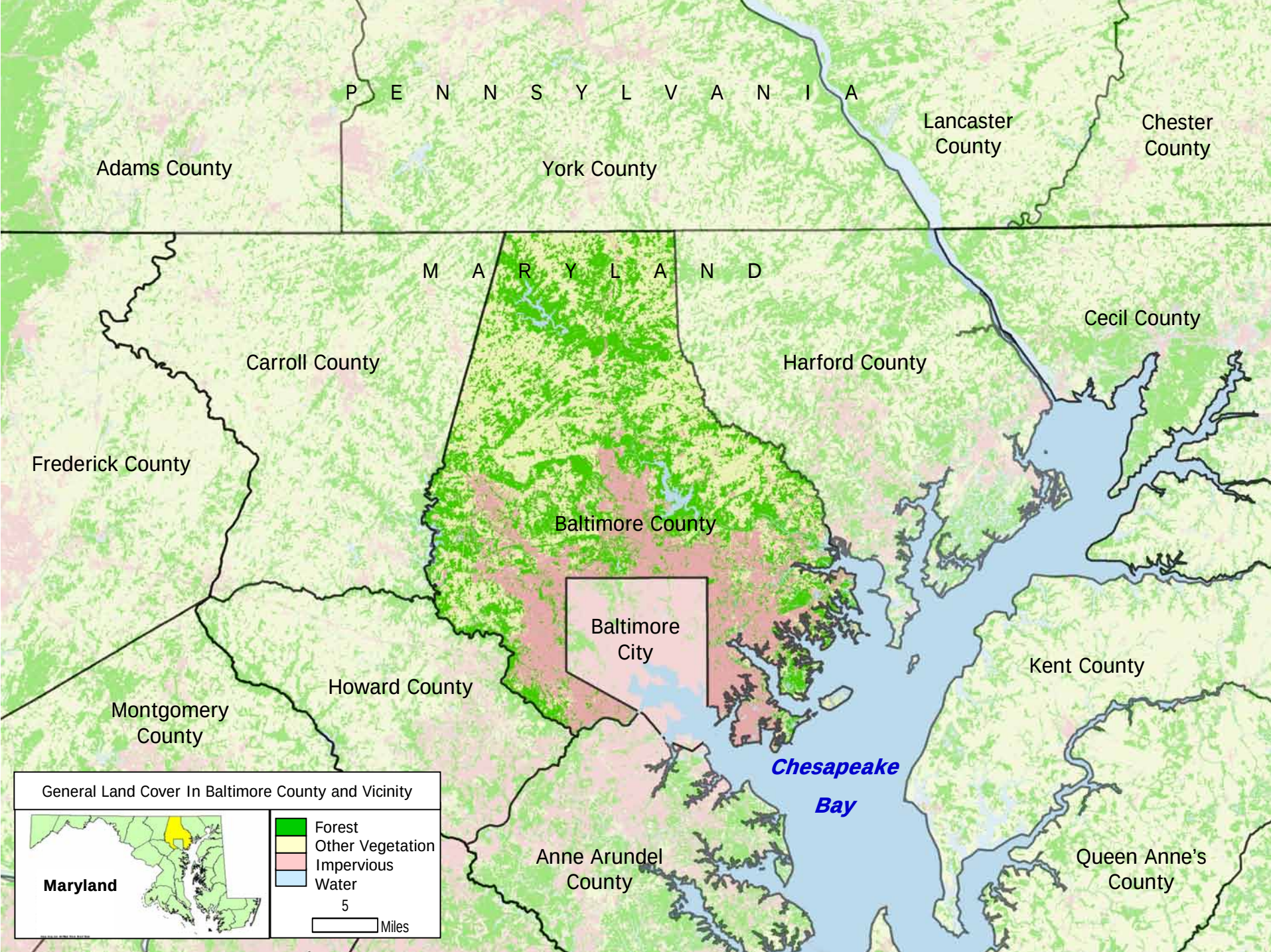
The State of Our Forests – 2007

Baltimore County, Maryland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Adams County
York County
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Baltimore County
Baltimore City
Howard County
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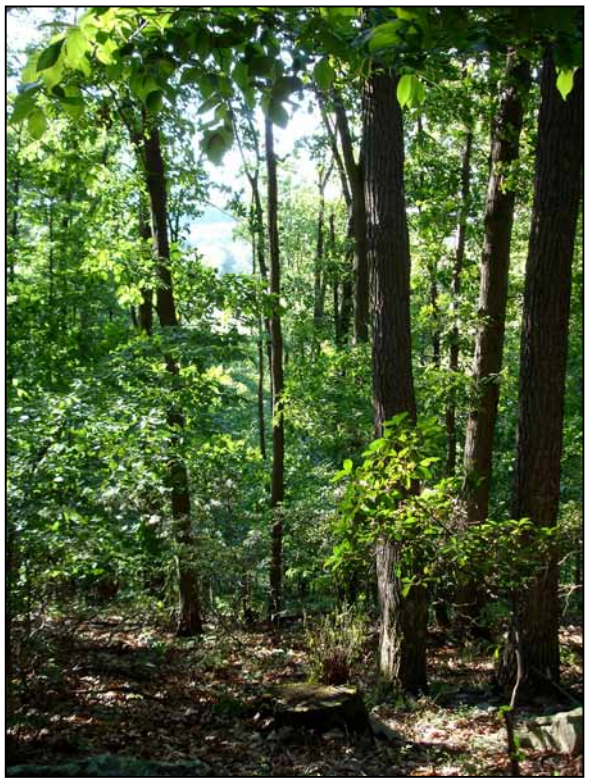
Kent County
Chesapeake Bay
Anne Arundel County
Queen Anne's County
General Land Cover In Baltimore County and Vicinity
Maryland
Forest
Other Vegetation
Impervious
Water
5
Miles

The State of Our Forests – 2007

Baltimore County, Maryland

"better data – better dialogue – better decisions"



sustainable forest management on private land

In November 2005, Baltimore County Executive James T. Smith, Jr. signed a Memorandum of Understanding (MOU) with the USDA Forest Service, the MD Department of Natural Resources, and American Forests to implement the County's draft Forest Sustainability Strategy. The Strategy was prepared by a Steering Committee convened by the Department of Environmental Protection and Resource Management (DEPRM) to recommend actions for its continuing participation in a national pilot project, *Linking Communities to the Montreal Process Criteria and Indicators* (MPCI). The MPCI are science-based measures of the ecological and economic sustainability of forest resources. The MOU called for the County to produce a biennial State of Our Forests Report.

This is the County's first State of Our Forests report. It generally follows the Criteria level of the MPCI and presents a compilation of readily available information from USDA Forest Service, MD Department of Natural Resources, Baltimore County, and other sources. It is a first approximation. Additional assessment and monitoring projects are underway or are in the planning stages, which will add to our collective understanding of forest conditions and trends over time.

The value of the data and their interpretation are to help direct public and private management efforts to assure sustainable forest resources for the future.

Overall, the data and information in this report reveal that, while providing multiple benefits for Baltimore County's environment and economy, our forests face challenges regarding sustainability. Our forests are historically fragmented, increasingly parcelized, and subject to numerous biotic and abiotic stressors. The forest base is also likely declining. These are our challenges. As a result, numerous innovative programs are underway to increase and better manage forests and trees in urban and rural areas.

This report was designed and produced by Donald C. Outen, AICP (Natural Resource Manager) and Robert H. Hirsch, IV (GIS Analyst), with the assistance of additional DEPRM staff: Patricia H. Cornman (Natural Resource Specialist), Emeka C. Obilor (GIS), Diana E. Cohen (Growing Home Campaign Coordinator), and Jeanne C. Armacost (Education Specialist); and DEPRM interns Jessica Buckler and Patricia Brady. Unless noted, photos are by Don Outen.

December 2007

BALTIMORE COUNTY
MARYLAND

David A. C. Carroll, Director, DEPRM

James T. Smith, Jr., County Executive

GREEN RENAISSANCE
BALTIMORE COUNTY

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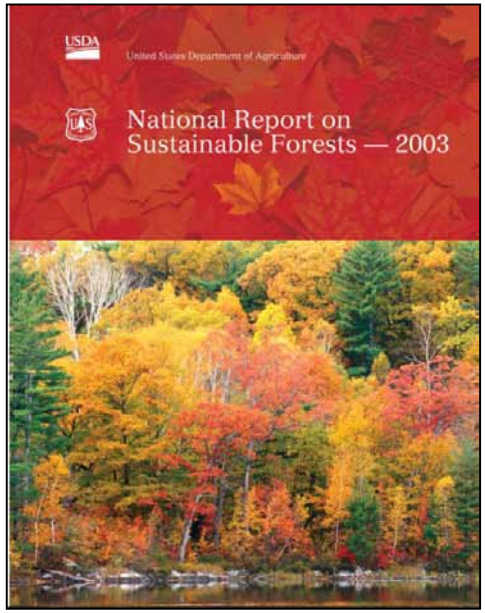
MONTREAL PROCESS CRITERIA	STRENGTHS ⇦ SUSTAINABILITY ⇨	LIMITATIONS
Criterion #1: **Conservation of Biological Diversity**	❑ The dominant forest cover type is Oak, a keystone ecological species. ❑ Two large areas have good FIDs populations. ❑ > 6,000 acres of State-designated Wildlands exist.	❑ Forest cover is only one-third of original extent. ❑ Forests are highly fragmented at >9,000 patches, and they are highly parcelized. ❑ Urban tree canopy is probably less than 40%.
Criterion #2: **Maintenance of Productive Capacity of Forest Ecosystems**	❑ Overall forest cover has increased over the past century. ❑ Non-consumptive timber harvests have declined significantly in recent years.	❑ Forest harvesting during the Colonial era was extensive and largely consumptive. ❑ Forest conversion to development is increasing and now averages 245 acres per year.
Criterion #3: **Maintenance of Forest Ecosystem Health and Vitality**	❑ Most tree species surveyed through FIA have generally good health. ❑ The County is conducting forest health studies. ❑ Few forest fires occur and fire potentials are low to moderate.	❑ Recent years are more droughty than normal. ❑ Ambient ground-level ozone and ozone injury to indicator plants are very high. ❑ Gypsy moth are active and deer are impeding natural regeneration of oak forests.
Criterion #4: **Conservation and Maintenance of Soil and Water Resources**	❑ Productive soils and abundant water are available for the growth of forests. ❑ Forest cover is highest in reservoir watersheds.	❑ About half of streams have no forested buffers. ❑ Reservoir watershed forest cover is low at <50%. ❑ There are few protected primary patches as mapped for the water quality typology.
Criterion #5: **Maintenance of Forest Contribution to Global Carbon Cycles**	❑ Research is underway in the region and for the County to understand the forest's contribution to carbon sequestration.	❑ Offsetting atmospheric carbon using forest strategies needs to be pursued aggressively. ❑ Better education is needed regarding carbon issues.
Criterion #6: **Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies**	❑ Secondary wood manufacturing here is above average for metropolitan counties in Maryland. ❑ The Montreal Process has raised awareness of the issue of economic sustainability of forest resources and studies and projects are being discussed.	❑ Timber and primary wood manufacturing contributes little to the County's economy. ❑ The economic sustainability of forest resources is not promoted and there is likely a high aversion to commercial timber management. ❑ Portions of the County are becoming far removed from forestry support services.
Criterion #7: **Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management**	❑ The County has advanced land use planning tools for forest protection. ❑ The Green Renaissance framework and innovative programs are in place to address needs. ❑ There are citizen organizations with interest and capability to partner in forest programs.	❑ Tree removals appear to exceed replanting in urban areas, and measures of success for some planting programs are declining. ❑ Many innovative and successful programs are dependent on grants.

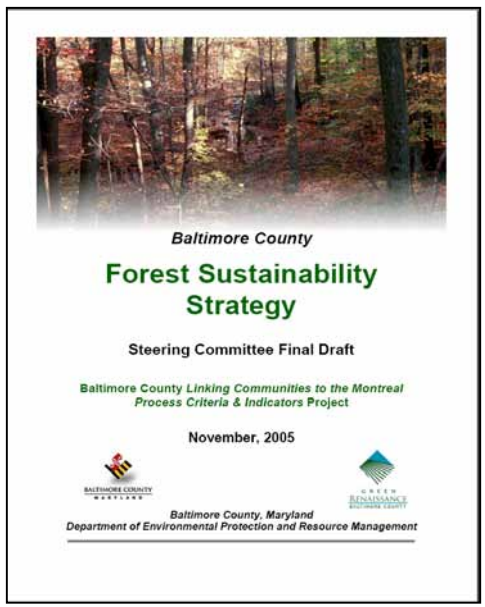
Reporting Forest Sustainability Indicators

The *National Report on Sustainable Forests – 2003*, prepared by the USDA Forest Service, is the first comprehensive attempt to report on forest sustainability in the United States using the Montreal Process Criteria and Indicators (MPCI). This report represents a significant undertaking, yet many of the 67 Indicators were not directly measurable at that time.

Baltimore County is a national pilot for application of the MPCI at the community level; however, local data does not exist for the vast majority of MP Indicators. Until the County develops data to characterize forest resources using appropriate and comparable Indicators, characterization needs to be based on relevant existing data. While many of the MP C&I describe conditions *within* forested areas, County data are better able to characterize forests *across* forested areas, or "patches."

"If the 75% of forest lands in the County that are in private ownership are to remain and not be converted to non-forest, and if they are to contribute to critical ecosystem functions such as stabilizing streams, providing wildlife habitat, and protecting the drinking water supply for 90% of the County's citizens and one-third of the population of Maryland, then the County must work with the forest industry, other agencies, and its citizens to raise their awareness about forest sustainability, to assess the health of their forests, and to engage them in better stewardship."
Draft Forest Sustainability Strategy





What are Indicators?

"Indicators are repeated observations of natural and social phenomena that represent systematic feedback. They generally provide quantitative measures of the economy, human well-being, and impacts of human activities on the natural world. The signals they produce sound alarms, define challenges, and measure progress ... Generally, indicators are most useful when observed over many intervals of observation so that they illustrate trends and changes. Their calculation requires concerted efforts and financial investments by governments, firms, nongovernmental organizations, and the scientific community." The National Research Council, *Our Common Journey: A Transition Toward Sustainability*, 1999.

Excerpts from: *National Report on Sustainable Forests – 2003*

Purpose of the National Report

"This is a report on the state of the forests in the United States of America and the indicators of national progress toward the goal of sustainable forest management. Our goal is to provide information that will improve public dialog and decision-making on what outcomes are desired and what actions are needed to move the Nation toward this goal. We also intend to establish a baseline for future measurement of our progress. The indicators used reflect many of the environmental, social, and economic concerns of the American public regarding forests. While the report presents data primarily at a national or regional scale, it also provides a valuable context for related efforts to use the indicators to measure progress at such other geographic and/or political scales as ecoregions, states, watersheds, and communities. Scale represents the geographic area in which stakeholders operate. Action at all levels is vital to achieving sustainable forest management in the United States. Unless people at all geographical and political levels across the country conserve, protect, and use forest resources in sustainable ways, then what is said or done at the national level means little."

GIS Data and Methods of Analysis

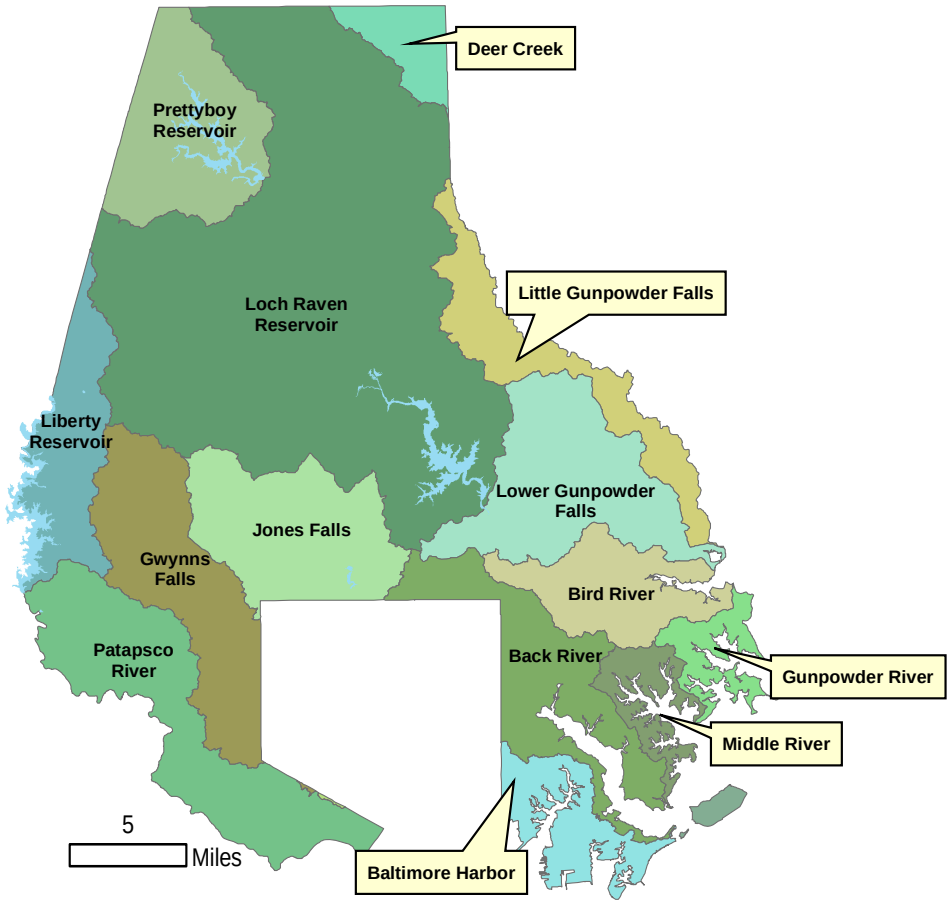
Much of this report describes Baltimore County's forest resources at a "landscape" level. Areal sub-units used for analysis and comparison are the fourteen major MD 8-digit watersheds. These watersheds are familiar to many Baltimore County residents and include the Loch Raven, Prettyboy, and Liberty Reservoir watersheds; the Patapsco River, Deer Creek, and Little Gunpowder Falls watersheds along the western and eastern borders of the County; the Gwynns Falls and Jones Falls watersheds in the south-central portion of the County that drain into Baltimore City; and the Baltimore Harbor, Back River, Middle River, Bird River, Lower Gunpowder Falls, and Gunpowder River watersheds on the eastern side of the County that drain to tidal tributaries of the Chesapeake Bay.

The data in this report provide a reasonably accurate picture of forest resources even though there are several important limitations associated with the data used. The County's forest cover layer is based on 1995 to 1997 leaf-off (early spring) planimetrics (aerial photography) at a scale of 1:2,400 or 1"=200'. Forest areas were digitized and given unique identifiers for each forest "patch." Patches, which range from 45 square feet to more than 4,500 acres, are contiguous forest areas broken and bounded by roads, major streams and rivers, and non-forest land cover.

Using the County's Geographic Information System (GIS), it is possible to spatially overlay the forest data with other data layers such as land ownership, streams, and property parcels (cadastral data). The cadastral data are the geo-referenced State Assessment and Taxation records for each property parcel legally constituted in the County. There are more than 300,000 individual property records. The cadastral data, though not 100% complete, are at least as current as the year 2004.

The spatial comparison of forest cover approaching ten years old and current property records obviously introduces some inaccuracy; however, given the rate of forest cover change, especially outside the County's urban growth boundary (Urban-Rural Demarcation Line, or URDL), the data are considered to adequately capture major forest resource conditions at the landscape level.

Data totals for forest cover are also not consistent across all of the analyses. This is because each GIS data layer may have minor differences, including boundaries of shape files and the loss of some data such as parcel records. Overall, the data totals provide a reasonable characterization of forest patch and ownership conditions.

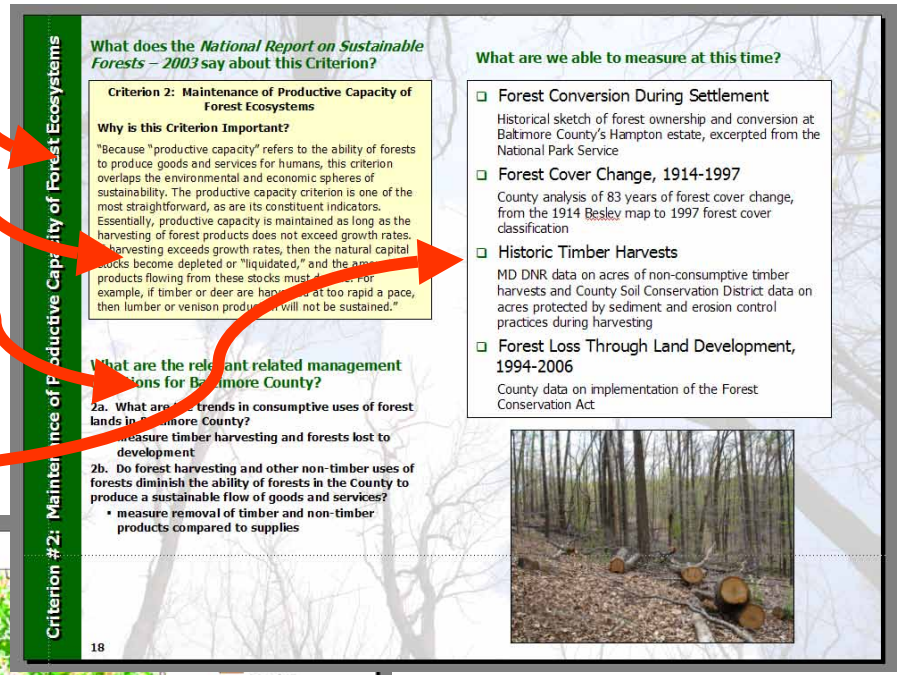


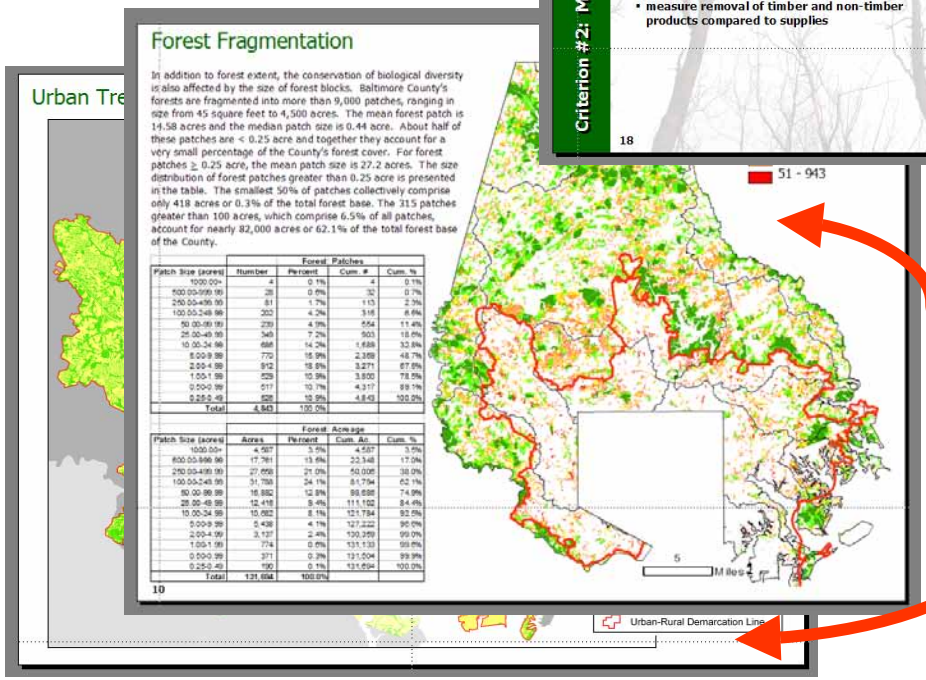
Major Watersheds of Baltimore County
(MD 8-digit)

How This Report Is Organized

CRITERION PAGE

- Criterion Number and Name
- Excerpt: what the *National Report on Sustainable Forests –2003* says about this Criterion
- Relevant related management questions for Baltimore County (adapted from the Forest Sustainability Assessment and Monitoring Framework*
- Annotated list of the Criterion measures included in this report





CRITERION MEASURES

Subsequent pages present Federal, State, County, and other data for each Criterion measure

*Copy of Assessment & Monitoring Poster developed in January 2007 is included in the Appendix

Data Sources

The primary data sources used for this report included:

- USDA Forest Service. 2004. ***National Report on Sustainable Forests - 2003***. FS-766
  http://www.fs.fed.us/research/sustain/
- USDA Forest Service. 2004. ***Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions During 1993-2002***. NA-TP-01-04
  http://fhm.fs.fed.us/pubs/tp/dist_cond/dc.shtm
- USDA Forest Service. 2003. ***Forest Health Monitoring in Maryland 1996-1999***. NE-INF-160-03. Northeastern Research Station.
  http://www.treesearch.fs.fed.us/pubs/5290
- MD Dept. of Natural Resources. 2003. ***Strategic Forest Lands Assessment***.
  http://www.dnr.state.md.us/forests/planning/sfla/index.htm
  http://www.dnr.state.md.us/forests/planning/sfla/criteria.htm
- Baltimore County. 2005. ***Forest Sustainability Strategy: Steering Committee Final Draft***.
  http://www.baltimorecountymd.gov/agencies/environment/workgroup/forest_sustainability.html
- Program Data for selected years from:
  - MD Dept. of Agriculture, Forest Pest Monitoring Program
  - Baltimore County Soil Conservation District. Program Progress (annual newsletters 1999-2007)
  - Audubon Maryland-DC. 2007 Bird Blitz Program
  - MD DNR Tree-Mendous Maryland Program
  - MD DNR State Wildland Fire Assessment Atlas
  - DEPRM Forest Conservation Act implementation
  - DEPRM Community Reforestation Program
  - DEPRM Growing Home Campaign
  - DEPRM Rural Residential Stewardship Program
  - DEPRM Oregon Ridge Forest Health Assessment & Plan
  - Other sources as noted

Visit us at:
http://www.baltimorecountymd.gov/agencies/environment/forestsandtrees

What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 1: Conservation of Biological Diversity

Why is this Criterion Important?

"Biological diversity ("biodiversity") spans a spectrum from genetics to species to the ecosystem. In general, the biodiversity conservation criterion reflects the knowledge that biodiversity is a form of natural capital (along with other stocks of natural capital such as water, soil, timber, and minerals) that provides environmental services essential to the human economy. Each ecosystem has a capacity for biodiversity, and tropical forests typically have greater biodiversity capacity than boreal ecosystems. When the biodiversity capacity of a forest ecosystem is diminished, the forest's underlying ecosystem components and processes are threatened, as are the dependent economic sectors and communities."

What are the relevant related management questions for Baltimore County?

1a. What is the extent of forests by type in Baltimore County and what are the trends in forest cover, and forest fragmentation and parcelization?

- **measure forest extent by a Classification of Ecological Community Groups**
- **measure total forest cover and interior forest area by watersheds**
- **measure forest fragmentation**
- **measure forest parcelization**

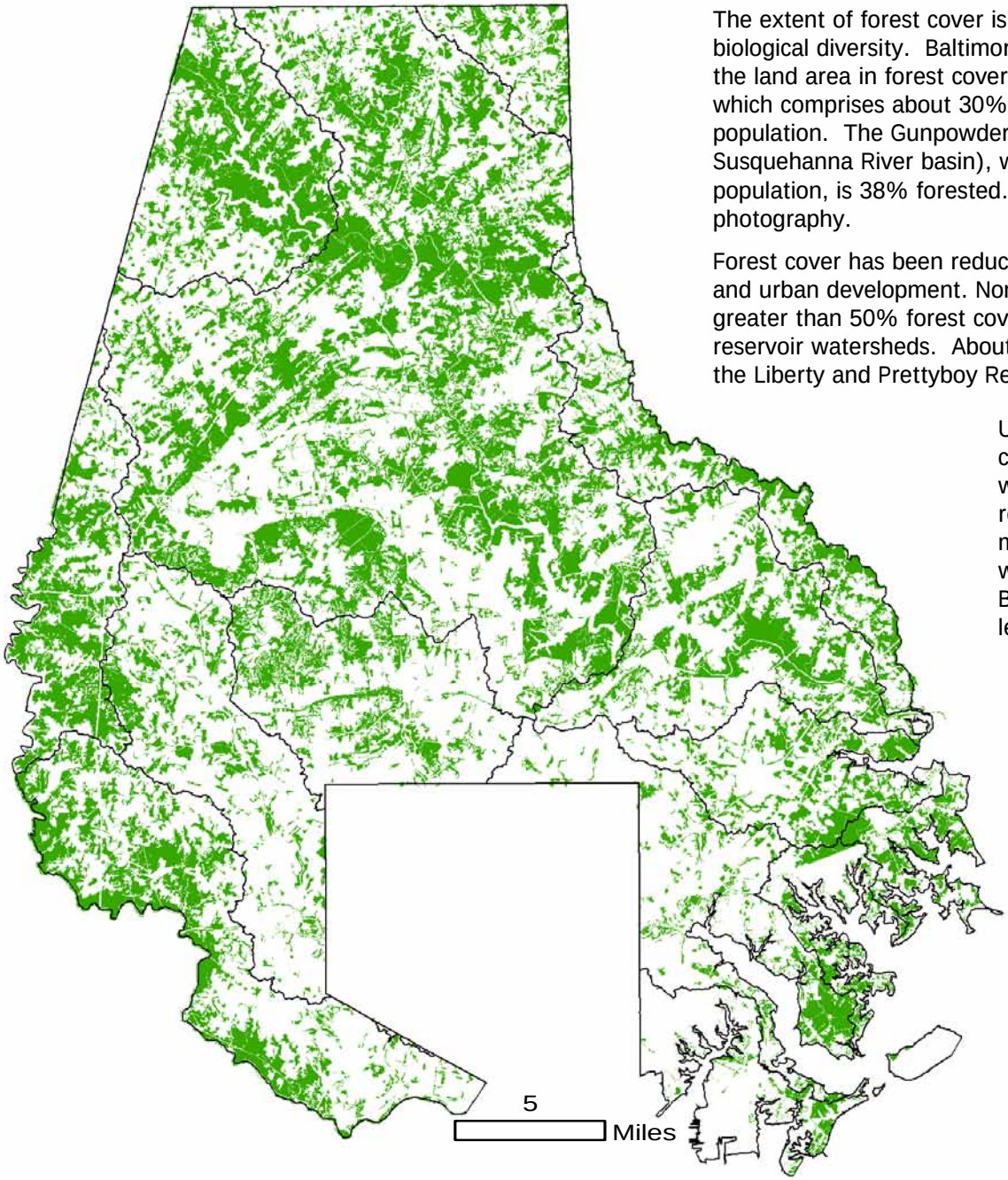
1b. What are the extent and status of forest-dependent species and species at risk?

- **measure the status and vulnerability of forest-dependent species**

What are we able to measure at this time?

- Forest Cover Distribution
  Baltimore County data on distribution of forest cover by major watershed
- Forest Fragmentation
  Baltimore County data on the number and acreage of forest patches
- Designated Wildlands
  MD DNR data on designated Wildlands
- Interior Forest Cover
  Baltimore County data on distribution of forest cover within and outside 300-foot edges by major watershed
- Forest Community Types
  MD DNR forest community types from Mid-Atlantic Gap Analysis project
- Green Infrastructure
  MD DNR network of ecological hubs and corridors
- Important Bird Areas
  Data for potential Important Bird Areas in Baltimore County based on Audubon "Bird Blitz" surveys
- Forest Patch Parcelization - Number
  Baltimore County data on the number of property parcels in forest patches
- Forest Patch Parcelization - Acreage
  Baltimore County data on the acreage of property parcels in forest patches
- Urban Tree Canopy
  Preliminary classification of tree canopy within the Urban-Rural Demarcation Line (URDL) of Baltimore County

Forest Cover Distribution



The extent of forest cover is the primary limiting factor for the conservation of biological diversity. Baltimore County has about 131,900 acres, or about a third, of the land area in forest cover. Forests cover only 26% of the Patapsco River basin, which comprises about 30% of the County's land area but 70% of the County's population. The Gunpowder River Basin (including Deer Creek in the Lower Susquehanna River basin), with about 70% of the land area and 30% of the population, is 38% forested. Forest acreage is based on 1995 to 1997 digitized aerial photography.

Forest cover has been reduced historically as a result of land conversion to agriculture and urban development. None of the 14 major watersheds of the County currently has greater than 50% forest cover. However, forest cover is greatest in the three reservoir watersheds. About 40% of the Loch Raven Reservoir watershed and 48% of the Liberty and Prettyboy Reservoir watersheds are forested.

Urban watersheds generally have little significant forest cover. This is a result of long-term urbanization, most of which occurred in the County before environmental requirements for forest protection and as a result of growth management programs that concentrated development within only one-third of the land area. The Back River, Baltimore Harbor, and Gwynns Falls watersheds each have less than 20% forest cover.

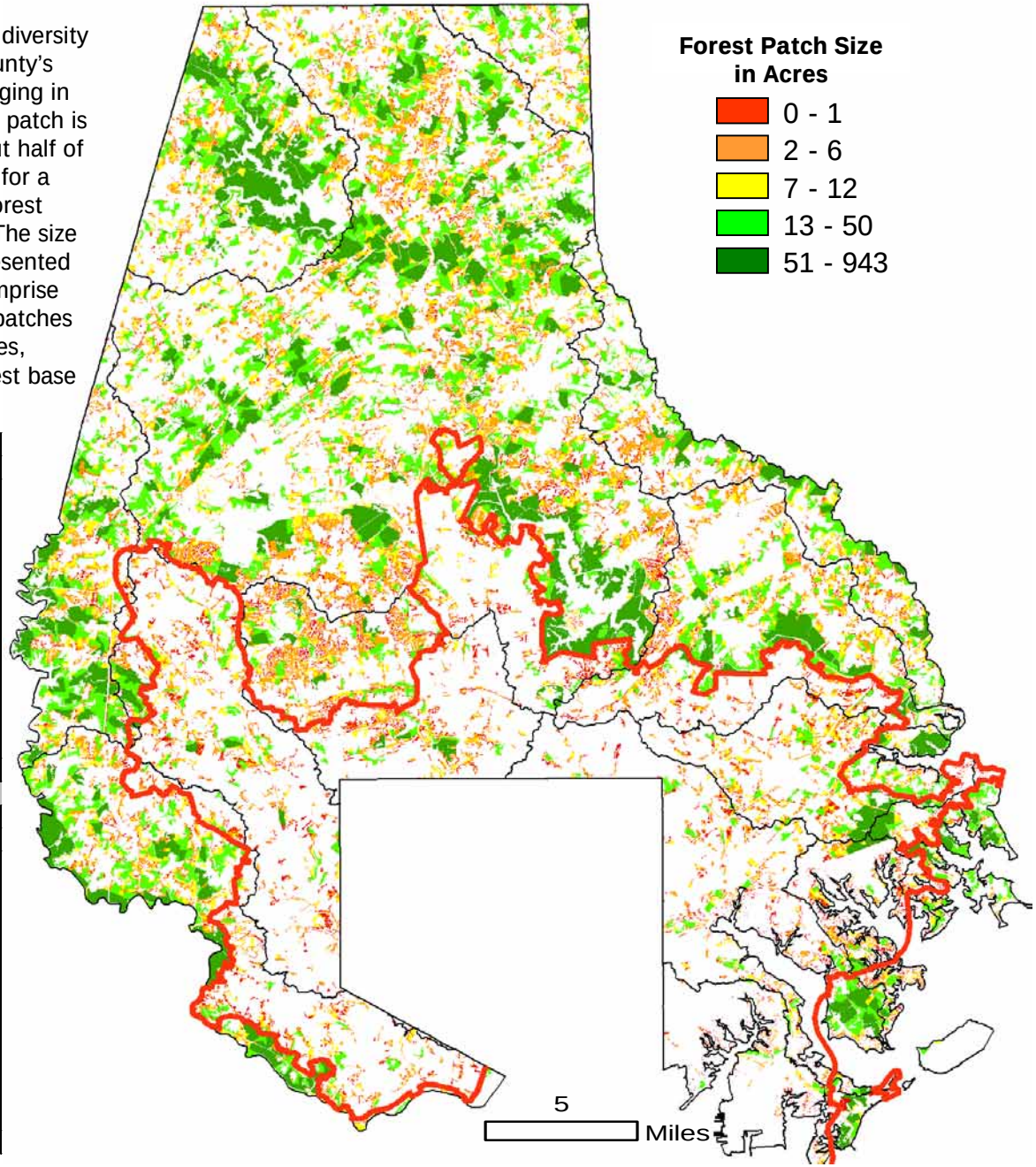
Watershed	Watershed Acres	Forest Acres	% Forest
Deer Creek	7,132	2,319	32.5%
Lower Susq. Basin Total	**7,132**	**2,345**	**32.9%**
Prettyboy Reservoir	25,545	11,731	45.9%
Loch Raven Reservoir	139,554	56,138	40.2%
Little Gunpowder Falls	17,229	6,230	36.2%
Lower Gunpowder Falls	29,471	9,383	31.8%
Bird River	16,463	4,628	28.1%
Gunpowder River	6,065	2,432	40.1%
Middle River	6,520	1,823	28.0%
Gunpowder Basin Total	**240,847**	**92,365**	**38.3%**
Liberty Reservoir	17,555	8,197	46.7%
Patapsco River	33,186	11,565	34.8%
Gwynns Falls	28,643	5,256	18.3%
Jones Falls	25,944	6,914	26.6%
Back River	23,248	4,057	17.4%
Baltimore Harbor	11,453	1,168	10.2%
Patapsco Basin Total	**140,029**	**37,156**	**26.5%**
County Total	**388,008**	**131,866**	**34.0%**

Forest Fragmentation

In addition to forest extent, the conservation of biological diversity is also affected by the size of forest blocks. Baltimore County's forests are fragmented into more than 9,000 patches, ranging in size from 45 square feet to 4,500 acres. The mean forest patch is 14.58 acres and the median patch size is 0.44 acre. About half of these patches are < 0.25 acre and together they account for a very small percentage of the County's forest cover. For forest patches ≥ 0.25 acre, the mean patch size is 27.2 acres. The size distribution of forest patches greater than 0.25 acre is presented in the table. The smallest 50% of patches collectively comprise only 418 acres or 0.3% of the total forest base. The 315 patches greater than 100 acres, which comprise 6.5% of all patches, account for nearly 82,000 acres or 62.1% of the total forest base of the County.

		Forest	Patches	
Patch Size (acres)	**Number**	**Percent**	**Cum. #**	**Cum. %**
1000.00+	4	0.1%	4	0.1%
500.00-999.99	28	0.6%	32	0.7%
250.00-499.99	81	1.7%	113	2.3%
100.00-249.99	202	4.2%	315	6.5%
50.00-99.99	239	4.9%	554	11.4%
25.00-49.99	349	7.2%	903	18.6%
10.00-24.99	686	14.2%	1,589	32.8%
5.00-9.99	770	15.9%	2,359	48.7%
2.00-4.99	912	18.8%	3,271	67.5%
1.00-1.99	529	10.9%	3,800	78.5%
0.50-0.99	517	10.7%	4,317	89.1%
0.25-0.49	526	10.9%	4,843	100.0%
Total	**4,843**	100.0%		

		Forest	Acreage	
Patch Size (acres)	**Acres**	**Percent**	**Cum. Ac.**	**Cum. %**
1000.00+	4,587	3.5%	4,587	3.5%
500.00-999.99	17,761	13.5%	22,348	17.0%
250.00-499.99	27,658	21.0%	50,006	38.0%
100.00-249.99	31,788	24.1%	81,794	62.1%
50.00-99.99	16,892	12.8%	98,686	74.9%
25.00-49.99	12,416	9.4%	111,102	84.4%
10.00-24.99	10,682	8.1%	121,784	92.5%
5.00-9.99	5,438	4.1%	127,222	96.6%
2.00-4.99	3,137	2.4%	130,359	99.0%
1.00-1.99	774	0.6%	131,133	99.6%
0.50-0.99	371	0.3%	131,504	99.9%
0.25-0.49	190	0.1%	131,694	100.0%
Total	**131,694**	**100.0%**		



Designated Wildlands

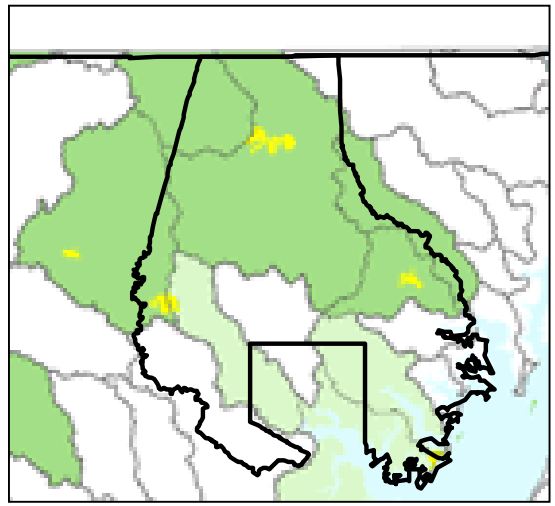
The Indicator

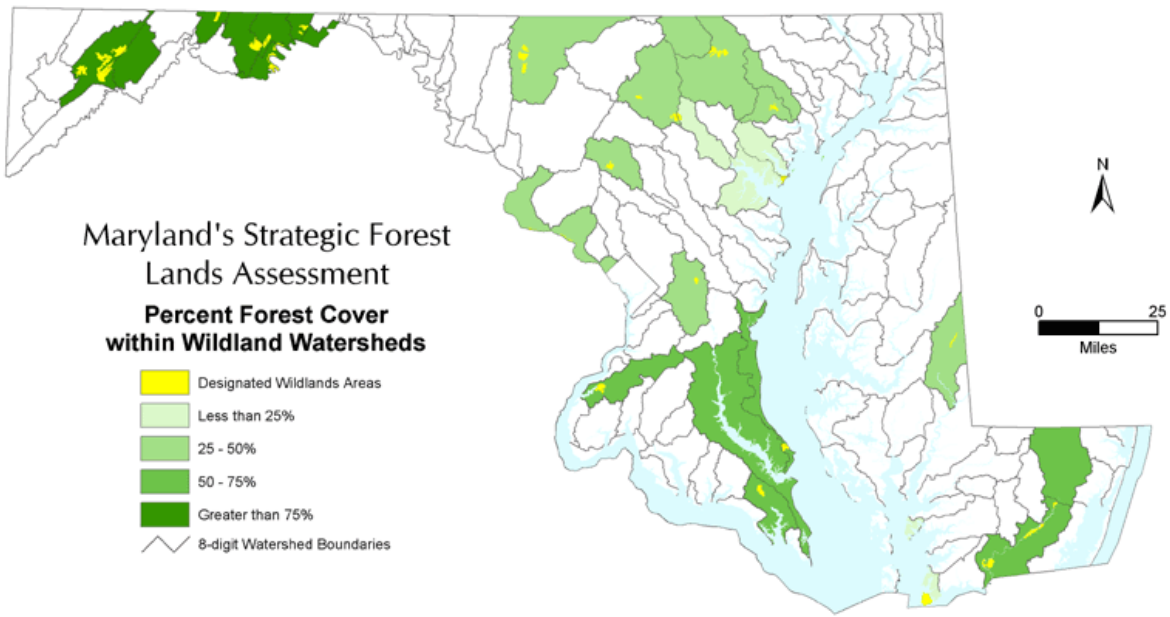
"One means DNR uses to foster biological diversity is to designate some parts of some of its own land holdings as Wildlands. The Maryland General Assembly has formally designated these areas of land and water to retain their wilderness character under the 1971 Maryland Wildlands Act. The law provides for three types of Wildland: one is a primitive area which by its size or location is, in effect, untouched by urban civilization; a second is a scientifically important unit, especially for ecology; the third is not of particular ecological or primitive stature but has the appearance of being in an untouched natural state, or could attain that appearance if held and managed for such a purpose. None of the presently designated Wildlands falls into this type; most are of the second type, while six in Western Maryland are of the first.

The Wildland designation, once enacted by the General Assembly, is an overlay on existing DNR land unit designations (e.g., State Park or Natural Environment Area), protecting the designated area from such landscape modification as road or building construction and limiting the natural resource management activities that can be practiced. Some non-intrusive recreational use of Wildlands may be allowed. There are currently over 39,000 acres of designated Wildlands in the State. As shown, a number of them are found in watersheds that are not heavily forested and may be held in particular esteem for that reason."

Indicator Use

"Wildland designation carries implications for the management of the lands and for public expectation of how they will be used - they represent an effort to maintain some wilderness values in a heavily urbanized State. The presence of Wildlands in a watershed indicates a need for added caution in landscape manipulation in their vicinity that could alter ecological processes, such as hydrology, that are necessary to maintain the natural system." ***MD DNR Strategic Forest Lands Assessment***





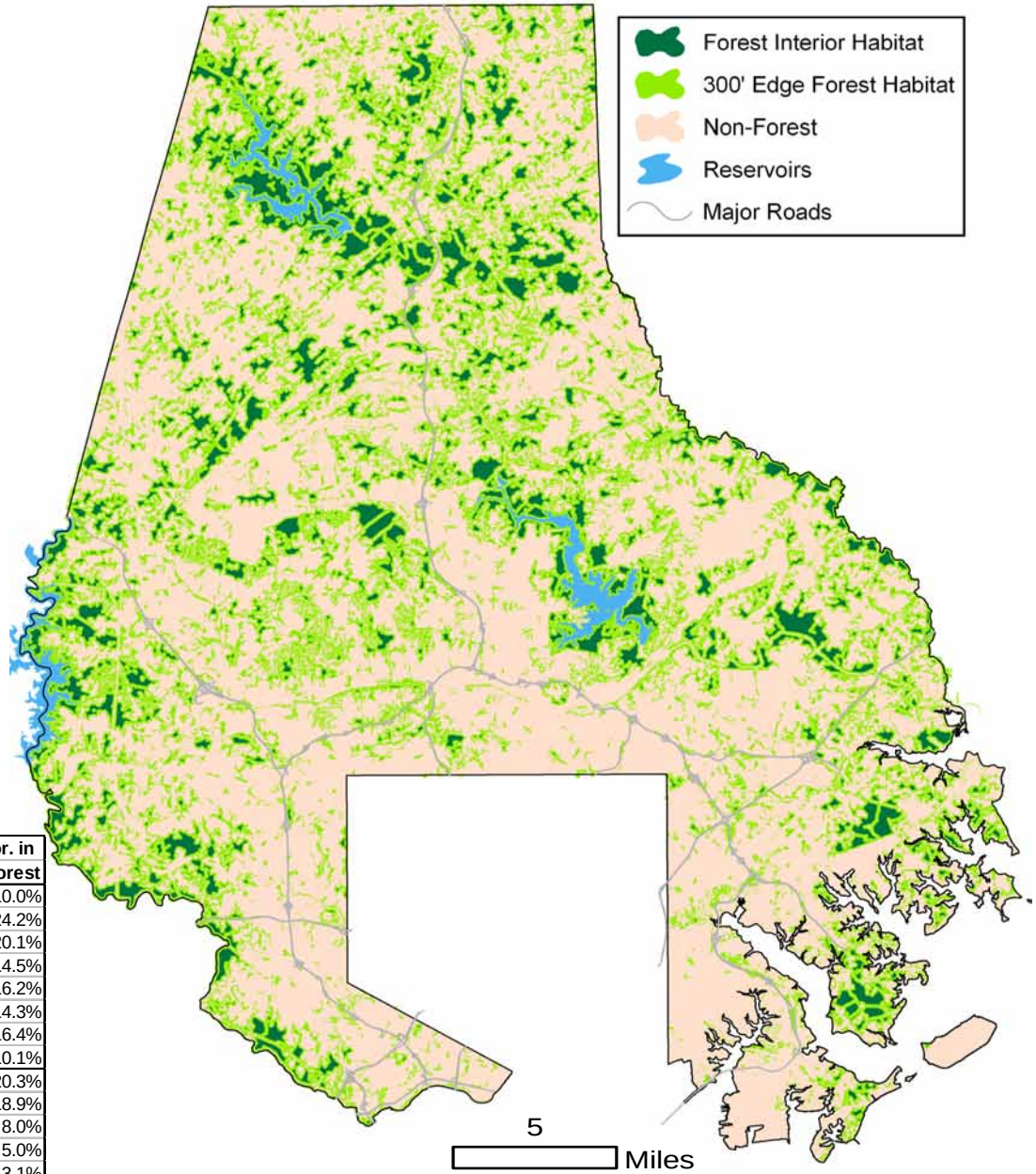
Baltimore County includes five State-designated Wildlands, totaling 6,065 acres:

- **Soldiers Delight**, a 1,526 acre serpentine barrens in the Soldiers Delight Natural Environmental Management Area
- **Panther Branch** (735 acres), **Mingo Branch/Bush Cabin Run** (1,272 acres), and Gunpowder Falls (792 acres), upland forest and riparian systems in the Gunpowder Falls State Park east of the Prettyboy Reservoir
- **Sweathouse Branch**, a 1,073 acre riparian forest in the lower section of the Gunpowder Falls State Park
- **Black Marsh**, a 667 acre tidewater marsh area and coastal forest in the North Point State Park

Interior Forest Cover

Although 34% of Baltimore County's land area is in forest cover, only about 23,400 acres or 17.6% of the total County land forest is interior forest. Interior forest here is defined as forest beyond 300 feet from the edge of a forest patch. At 300 feet, interior forest areas are not significantly influenced by light, wind, and other conditions from outside the edge of the forest patch. It can be anticipated that interior forests potentially host truly area-sensitive, forest-dependent plants and animals.

The Prettyboy watershed has the greatest percentage of interior forest, at 24%, followed by the other reservoir watersheds, Loch Raven and Liberty, which each have 20% interior forest. Overall, Baltimore County's interior forest areas are very small, at an average interior area of only 13.1 acres. Because the County only has 315 forest patches greater than 100 acres, the prospect of retaining significant interior habitat is very challenging. This is because a 100-acre circle with a 300-foot edge yields an interior area of only 55.5 acres.



Watershed	Forest Acres	% in Forest	# Patches w Int. Forest	Acres of Int. Forest	Avg Acres of Int. Forest	% For. in Int. Forest
Deer Creek	2,345	32.9%	35	234.0	6.7	10.0%
Prettyboy Reservoir	11,797	46.2%	154	2,856.9	18.6	24.2%
Loch Raven Reservoir	56,409	40.4%	753	11,329.8	15.0	20.1%
Little Gunpowder Falls	6,340	36.8%	104	917.6	8.8	14.5%
Lower Gunpowder Falls	9,460	32.1%	122	1,537.2	12.6	16.2%
Bird River	4,738	28.8%	64	679.3	10.6	14.3%
Gunpowder River	2,453	40.4%	36	402.4	11.2	16.4%
Middle River	1,789	27.4%	31	180.6	5.8	10.1%
Liberty Reservoir	8,260	47.1%	121	1,673.0	13.8	20.3%
Patapsco River	11,697	35.2%	137	2,207.1	16.1	18.9%
Gwynns Falls	5,245	18.3%	67	417.4	6.2	8.0%
Jones Falls	6,977	26.9%	94	347.2	3.7	5.0%
Back River	4,038	17.4%	53	528.1	10.0	13.1%
Baltimore Harbor	1,133	9.9%	15	66.2	4.4	5.8%
Total	**132,681**	**34.2%**	**1,786**	**23,376.8**	**13.1**	**17.6%**

Forest Community Types

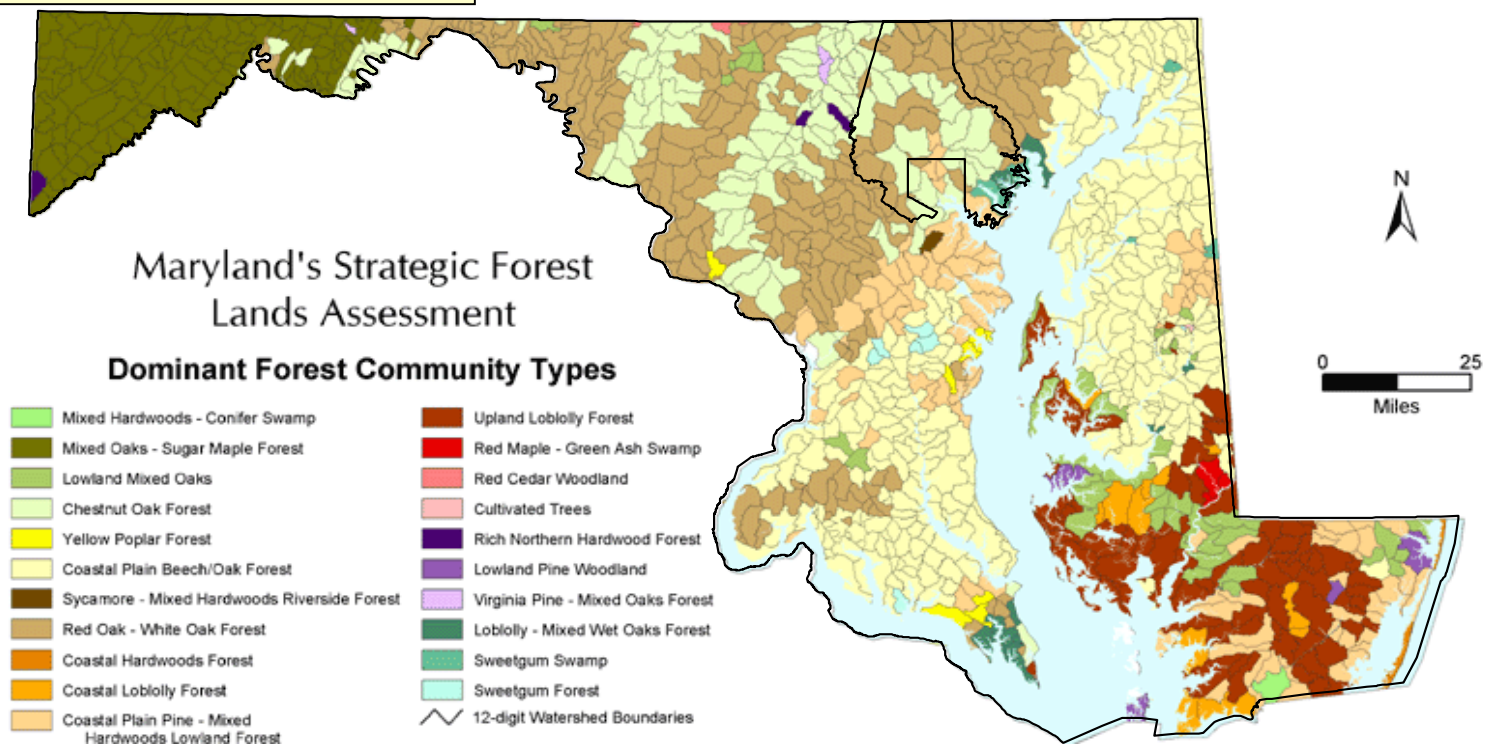
The Indicator

"... the Mid-Atlantic Gap Analysis Project (MID-A GAP) developed ... data layers that can be used ... to provide a variable (vegetation as habitat) for the purposes of mapping vertebrate species habitat associations also known as communities. Community types for this indicator are defined at the "alliance" level of the National Vegetation Classification System (NVCS). An alliance is a group of plant associations that share a similar architecture and one or more diagnostic species, which are generally the dominants in the primary canopy. Accordingly, forest community types, such as Coastal Plain Beech/Oak Forest or Upland Loblolly Forest are characterized by certain plant and animal species that depend on the particular habitat provided by that forest type. ... The GAP data layer is in a grid format, which means the layer is individually valued on a cell-by-cell basis ... depicting which forest community type dominates in each [12-digit] watershed.... [W]hen the area occupied by a forest community declines, populations of animals and plants that are highly dependent upon that community type may also decrease...."

MD DNR Strategic Forest Lands Assessment

The dominant forest community types in Baltimore County are Chestnut Oak and Mixed Oak. Oaks are considered keystone species because of their significant contribution to the structural and biological diversity of the eastern forests and the critical processes that sustain the forest ecosystem. Although the efficiency of nitrogen cycling in forests is dependent upon many factors, oak-dominated forests throughout the eastern U.S. typically have tighter control on nitrogen cycling than do other types of forests, releasing lower levels of nitrates from organic forest floor litter to adjacent streams. Oak forests also maintain a higher ratio of carbon to nitrogen in forest floor litter than other deciduous forest types because of high lignin content, which slows the decomposition rate of downed debris, and the movement of soluble nitrogen compounds through the landscape. Lignins also boost forest soils' capacity for storing and releasing water and cycling nutrients by adding very long-lived (hundreds to thousands of years), degradable-resistant biomass to the humus component, which supports myriad microorganisms and chemical processes that bring resource cycling efficiency and stability to the forest ecosystem. In these ways, oak forests are critical for the maintenance of high stream water quality and productive aquatic habitats.

Through time, myriad interdependent relationships between oak forests and wildlife have developed. At every spatial level, from the tallest trees in the canopy to the smallest plants on the forest floor, mammals, birds, amphibians, reptiles and countless insects and microorganisms feed on and are fed upon by other forest inhabitants in a complex food web that is driven by the presence of oaks. As an example, oak forests play a crucial role in the survival of hatchlings of most eastern forest bird species. In the spring, loopers, inchworms, and spanworms, the caterpillar stages of almost 200 species of forest moths, feed on the young leaves of oaks and other plant species in oak forest communities at a time when forest birds are foraging for hatchling food. Bird foraging reduces the insect pressure on the forest plants, allowing them to grow to their potential. The forest plants provide sufficient habitat for sustaining generations of birds that will consume other insects throughout the year.



Green Infrastructure

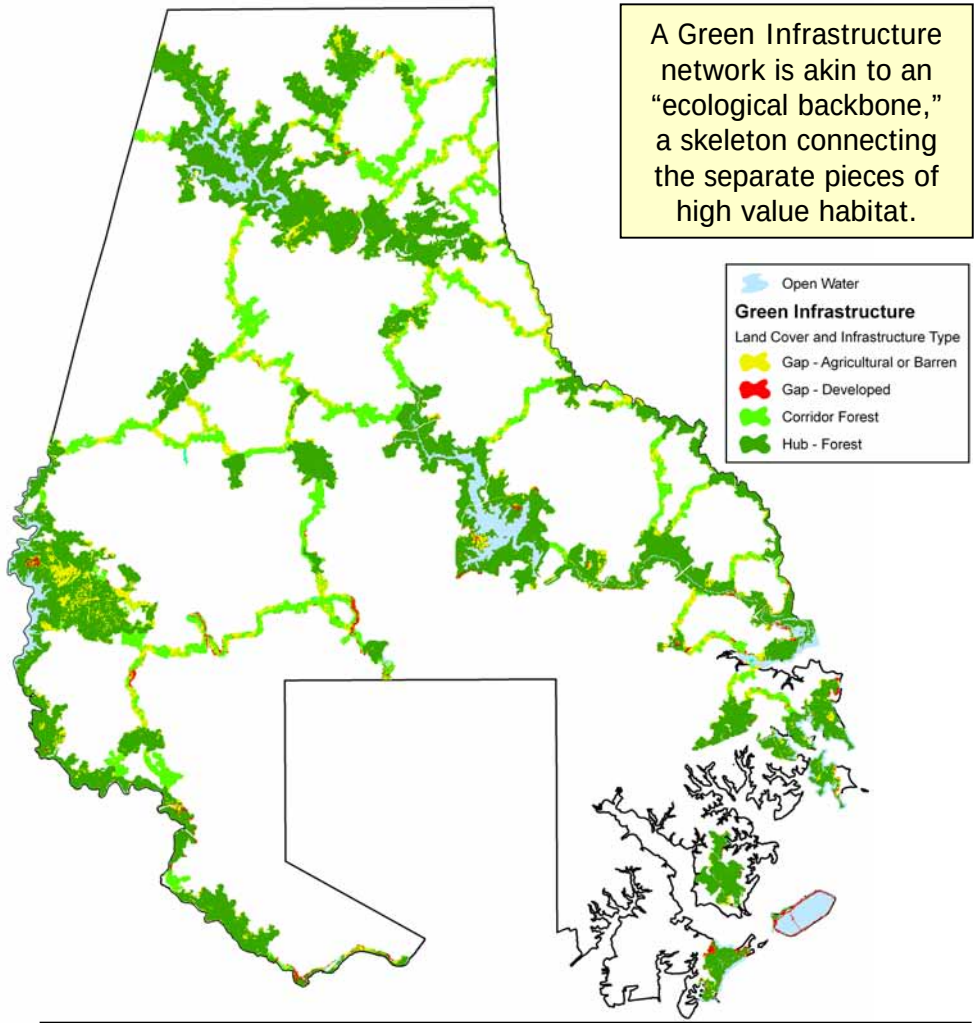
"The Green Infrastructure Assessment was developed to provide decision support for Maryland's Department of Natural Resources land conservation programs. ... Maryland's green infrastructure is a network of undeveloped lands that provide the bulk of the state's natural support system. Ecosystem services, such as cleaning the air, filtering water, storing and cycling nutrients, conserving soils, regulating climate, and maintaining hydrologic function, are all provided by the existing expanses of forests, wetlands, and other natural lands. These ecologically valuable lands also provide marketable goods and services, like forest products, fish and wildlife, and recreation. The Green Infrastructure serves as vital habitat for wild species and contributes in many ways to the health and quality of life for Maryland residents."

"To identify and prioritize Maryland's green infrastructure, we developed a tool called the Green Infrastructure Assessment (GIA). The GIA was based on principles of landscape ecology and conservation biology, and provides a consistent approach to evaluating land conservation and restoration efforts in Maryland. It specifically attempts to recognize: a variety of natural resource values (as opposed to a single species of wildlife, for example), how a given place fits into a larger system, the ecological importance of natural open space in rural and developed areas, the importance of coordinating local, state and even interstate planning, and the need for a regional or landscape-level view for wildlife conservation. The GIA identified two types of important resource lands - "hubs" and "corridors."

"Hubs typically large contiguous areas, separated by major roads and/or human land uses, that contain one or more of the following: Large blocks of contiguous interior forest (containing at least 250 acres, plus a transition zone of 300 feet); Large wetland complexes, with at least 250 acres of unmodified wetlands; Important animal and plant habitats of at least 100 acres, including rare, threatened, and endangered species locations, unique ecological communities, and migratory bird habitats; relatively pristine stream and river segments (which, when considered with adjacent forests and wetlands, are at least 100 acres) that support trout, mussels, and other sensitive aquatic organisms; and existing protected natural resource lands which contain one or more of the above (for example, state parks and forests, National Wildlife Refuges, locally owned reservoir properties, major stream valley parks, and Nature Conservancy preserves). In the GIA model, the above features were identified from Geographic Information Systems (GIS) spatial data that covered the entire state. ... The average size of all hubs in the state is approximately 2200 acres."

Material excerpted from MD Green Infrastructure metadata at www.dnr.state.md.us

A Green Infrastructure network is akin to an "ecological backbone," a skeleton connecting the separate pieces of high value habitat.



"Corridors are linear features connecting hubs together to help animals and plant propagules to move between hubs. Corridors were identified using many sets of data, including land cover, roads, streams, slope, flood plains, aquatic resource data, and fish blockages. Generally speaking, corridors connect hubs of similar type (hubs containing forests are connected to one another; while those consisting primarily of wetlands are connected to others containing wetlands). Corridors generally follow the best ecological or "most natural" routes between hubs. Typically these are streams with wide riparian buffers and healthy fish communities...."

Much of the GI network in Baltimore County is publicly owned.

Important Bird Areas

Some forested areas within Baltimore County are potential **"Important Bird Areas" (IBAs)**, according to Dr. David Curson, Director of Bird Conservation with Audubon Maryland-DC. The information and photos here are provided courtesy of Dr. Curson (dcurson@audubon.org)

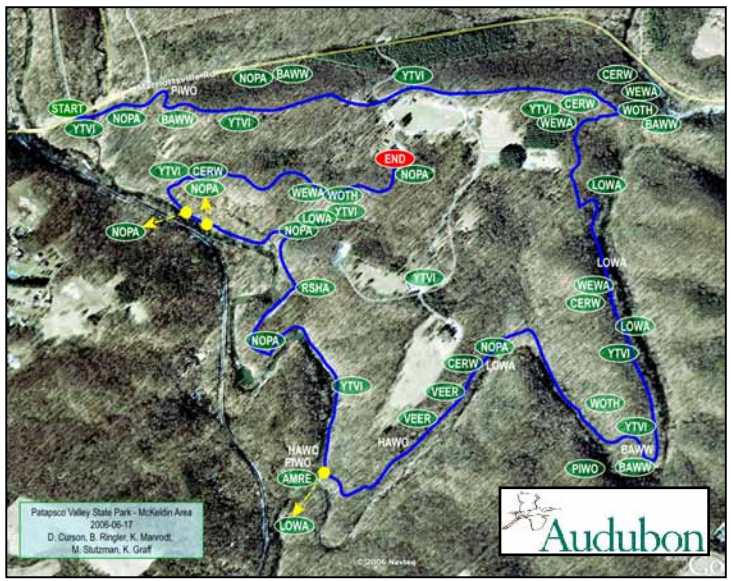
Audubon's Important Bird Areas program was initiated by BirdLife International in mid-1980s. Its purpose is to identify a network of sites that contain habitat needed to maintain healthy bird populations, and to focus conservation efforts on these sites. Site criteria are based on species vulnerabilities. IBAs provide habitat for:

- Bird **species at risk**, e.g. threatened, endangered (primary targets)
- **Species assemblages**, vulnerable because they are dependent on a particular habitat type (secondary targets)
- Birds that are vulnerable because they occur in **dense congregations**

Special, volunteer-based surveys called "Bird Blitz," in which target species are counted and mapped, help to identify IBAs. Blitz's were conducted in the Patapsco Valley State Park in 2006 and the Gunpowder Falls State Park and the Prettyboy Reservoir watershed in 2007. 23 FIDs occur regularly at Patapsco and 18 at Gunpowder, and at least 2 at-risk species at each area exceeded IBA thresholds (in red in table below). Fortunately, these habitat areas are protected through public ownership.

Why Study Birds?

- Birds are good environmental indicators – an "umbrella group" for other animal and plant taxa.
- Scientific knowledge of birds is advanced.
- Bird populations are easily monitored.
- Birds are attractive and popular with the public – good flagship group.



Patapsco Valley Bird Blitz 2006

At-risk Species	Threshold	Blitz Results	
	(pairs)	PAT	GUNP
Bald Eagle	10		2
Black-billed Cuckoo	10		1
Red-headed Woodpecker	10		1
Whip-poor-will	10	7	
Willow Flycatcher	20	12	
Wood Thrush	160	98	43
Blue-winged Warbler	15	14	
Prarie Warbler	30	40	11
Cerulean Warbler	10	5	
Prothonotary Warbler	30	6	1
Worm-eating Warbler	20	18	51
Louisiana Waterthrush	20	39	29
Kentucky Warbler	30	7	3
# Regularly Occurring FIDs		23	18
Year Surveyed		2006	2007
# of Volunteers		23	16
# of Surveys		8	14
Transects (km)		36	74.5

Bird Blitz Results

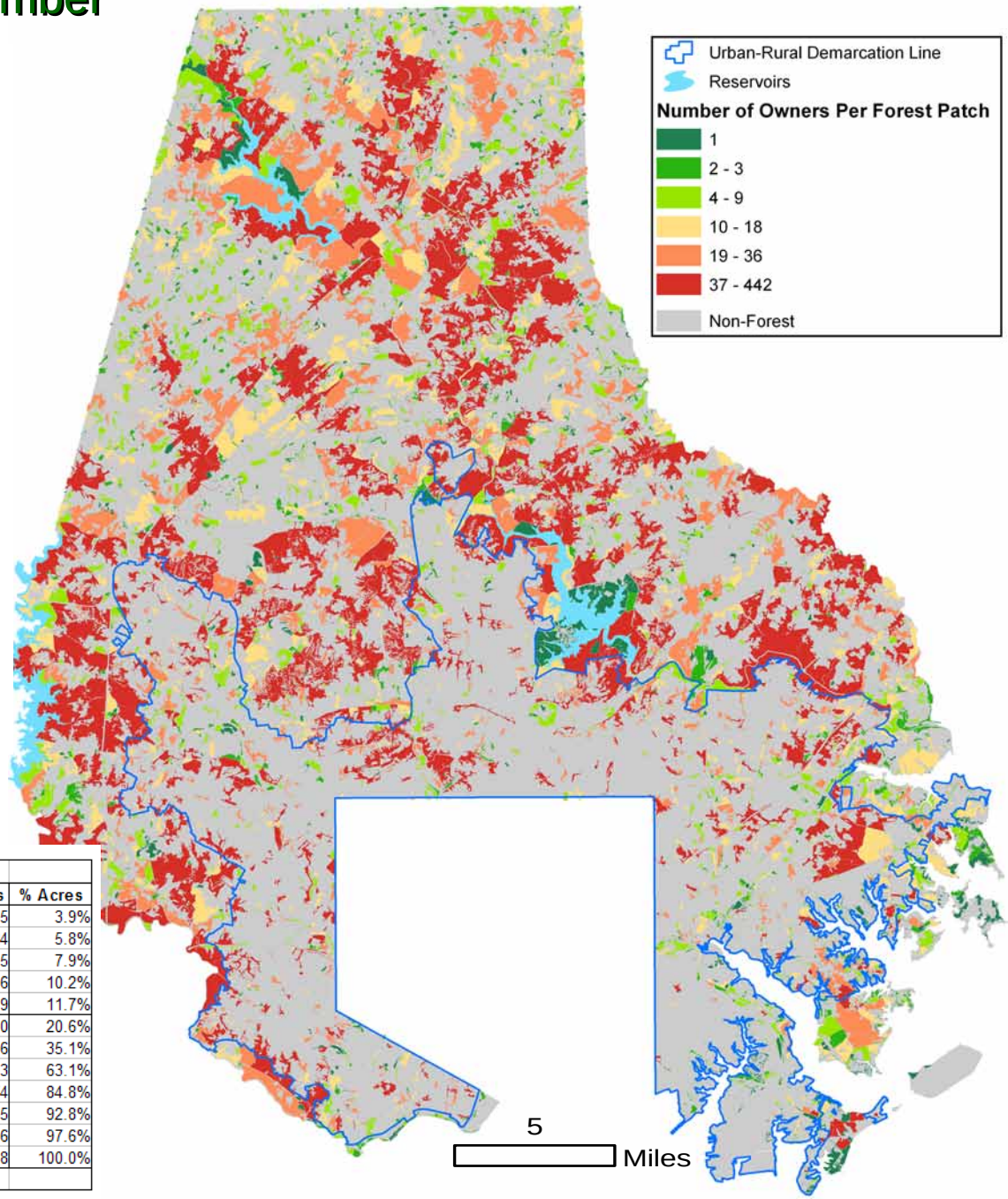
Forest Patch Parcelization - Number

Baltimore County's forests are highly fragmented into approximately 9,000 patches, and these are further fragmented by an estimated 50,000 or more owners. Using GIS, the number of forest patches with various numbers of owners was determined. The data indicate that more than 2,800 patches, or nearly 32% of total forest patches, have only one owner, yet these account for only about 5,000 acres or only 4% of the total forest base. Patches with one or two owners comprise about 53% of patches but only 5.8% of forest acres. And while about 75% of patches have five or fewer owners, these account for less than 12% of forest acres. These data reveal that there are a large number of rather small forest patches that are under the control of a relatively small number of owners. In this analysis, a landowner could have parts of more than one forest patch on a parcel.

The data also reveal that there are a small number of patches with very large numbers of owners, including 14 forest patches with more than 200 owners. These account for only 0.2% of patches and 2.4% of forest acres. This is the result of "paper" lots, or older subdivision plats wherein land is separately recorded for 25 or 50-foot wide lots. These decades-old "paper" lots have never been developed, and the collective area of lots remains in forest cover.

Parcelization: Number and Acreage of Forest Patches by Number of Owners

Number of Owners	# of Patches	% of Patches	# of Acres	% of Acres	Cumulative # Patches	Cumulative % Patches	Cumulative # Acres	Cumulative % Acres
1	2,831	31.6%	5,085	3.9%	2,831	31.6%	5,085	3.9%
2	1,933	21.6%	2,539	1.9%	4,764	53.2%	7,624	5.8%
3	975	10.9%	2,791	2.1%	5,739	64.1%	10,415	7.9%
4	588	6.6%	3,031	2.3%	6,327	70.7%	13,446	10.2%
5	361	4.0%	2,023	1.5%	6,688	74.7%	15,469	11.7%
6-10	829	9.3%	11,661	8.8%	7,517	83.9%	27,130	20.6%
11-20	600	6.7%	19,146	14.5%	8,117	90.6%	46,276	35.1%
21-50	543	6.1%	37,017	28.1%	8,660	96.7%	83,293	63.1%
51-100	197	2.2%	28,581	21.7%	8,857	98.9%	111,874	84.8%
101-150	60	0.7%	10,591	8.0%	8,917	99.6%	122,465	92.8%
151-200	24	0.3%	6,281	4.8%	8,941	99.8%	128,746	97.6%
201-442	14	0.2%	3,202	2.4%	8,955	100.0%	131,948	100.0%
Total	8,955	100.0%	131,948	100.0%				



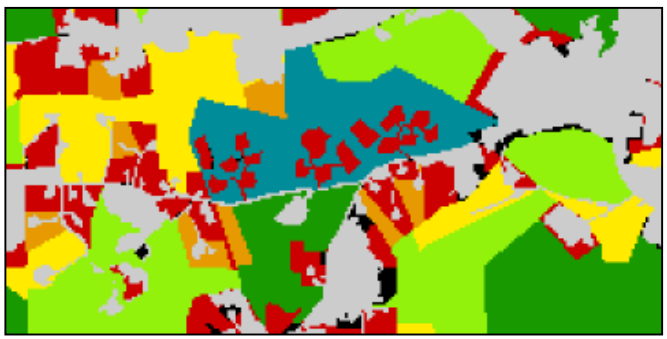
Forest Patch Parcelization - Acreage

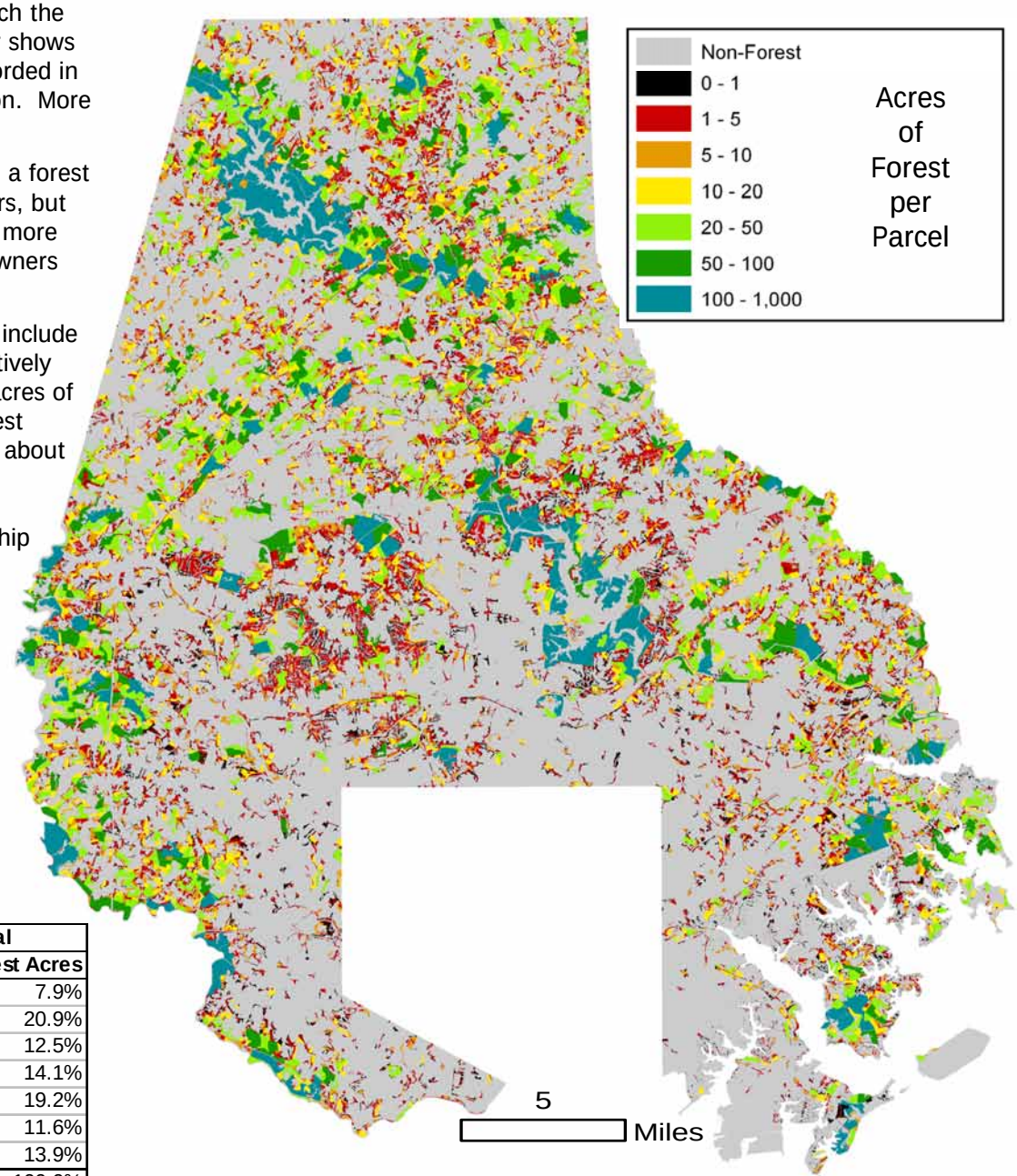
The integrity of forest patches for habitat and conservation of biological diversity can be affected by the degree to which the forest patches themselves are parcelized. This indicator shows forest patches by the size of their individual parcels recorded in the land records for purposes of assessment and taxation. More than 150,000 recorded parcels have forest cover.

The data do not indicate whether the multiple parcels in a forest patch are necessarily owned by different property owners, but that is often likely to be the case, especially for smaller, more urban patches. Parcelization may imply that different owners can be managing for different objectives.

The data indicate that 88% of the property parcels that include forest cover contain one acre or less of forest but collectively these 133,000 parcels total only about 8% of the total acres of forest. Only 102 forest parcels, comprising 0.1% of forest parcels, contain more than 100 acres of forest and total about 14% of total forest cover.

The inset below illustrates the complexity of the ownership pattern within forest patches.





Acres of Forest per Parcel	Number of Parcels	Total Forest Acres	% of Total Parcels	% of Total Forest Acres
0 - 1	133,020	10,461.1	88.4%	7.9%
1 - 5	12,512	27,698.9	8.3%	20.9%
5 - 10	2,366	16,576.5	1.6%	12.5%
10 - 20	1,341	18,645.5	0.9%	14.1%
20 - 50	838	25,520.1	0.6%	19.2%
50 - 100	228	15,416.4	0.2%	11.6%
100 - 1,000	102	18,382.0	0.1%	13.9%
Total	**150,407**	**132,700.5**	100.0%	100.0%

Urban Tree Canopy

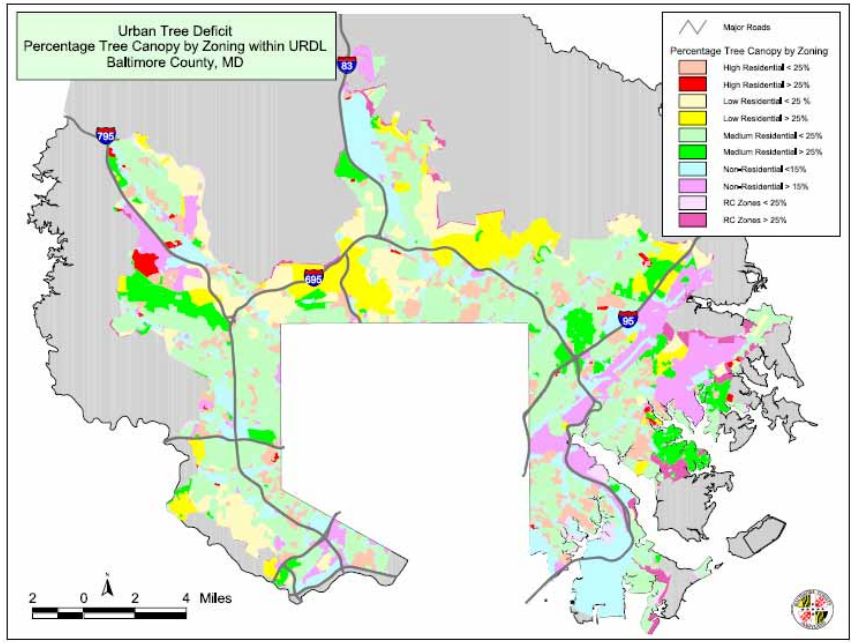
Forests and trees in urban areas may have less value for the conservation of biological diversity compared to large rural patches but they are nevertheless important. "Urban forests" or Urban Tree Canopy (UTC) includes trees on public lands such as schools, parks, and street rights-of-way as well as trees in private yards, businesses, and institutions. Urban tree canopy is important for multiple benefits – reducing the urban heat island and cooling urban landscapes, cleaning the air of pollutants and sequestering and storing carbon, absorbing stormwater from impervious surfaces, and providing habitat for urban wildlife. Urban trees are also an important element of quality of life for urban communities by providing aesthetic, recreational, and health benefits for citizens.

Baltimore County is Maryland's third largest county in both land area and population. Its population in 2007 reached 809,100, making it larger than four states and the District of Columbia. As a result of long-term aggressive growth management initiatives, the population of the County is concentrated in a defined urban area. The County was the first in Maryland and one of the earliest in the nation to adopt an urban growth boundary, the Urban-Rural Demarcation Line or URDL, in 1967. By 2000, 90% of the County's population lived inside the URDL, which encompasses one-third of the land area.

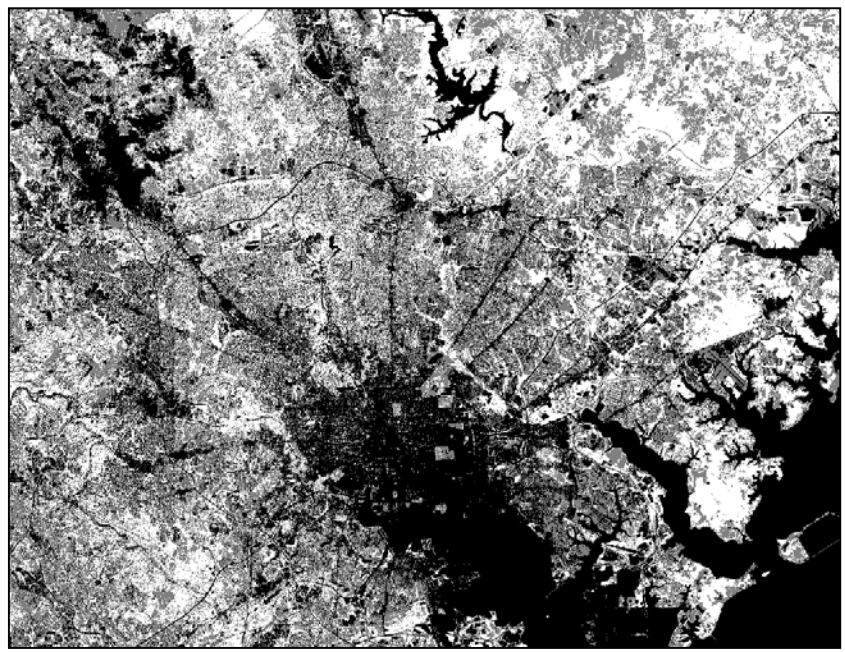
In 2002 Baltimore County conducted a preliminary analysis of urban tree cover within the URDL based on the percent of forest cover (from 1:2,400 planimetrics from 1995-1997) within low and high density residential and non-residential zoning polygons (areas with similar zoning). This assessment suggested that about 17% of the land inside the URDL has canopy cover. DEPRM believed that, because smaller urban canopy areas were not digitized, that the urban tree cover was likely under-estimated. American Forests has established guidelines for canopy cover in urban areas, with a recommended 40% overall tree cover.

An updated and more detailed determination of the percent of urban tree cover inside the URDL is underway (see next page). Additional characteristics of the urban canopy and estimated economic values for stormwater management, carbon sequestration, and energy savings are presently being studied by the USDA Forest Service using the Urban Forest Effects (UFORE) model. Results are expected in early 2008.

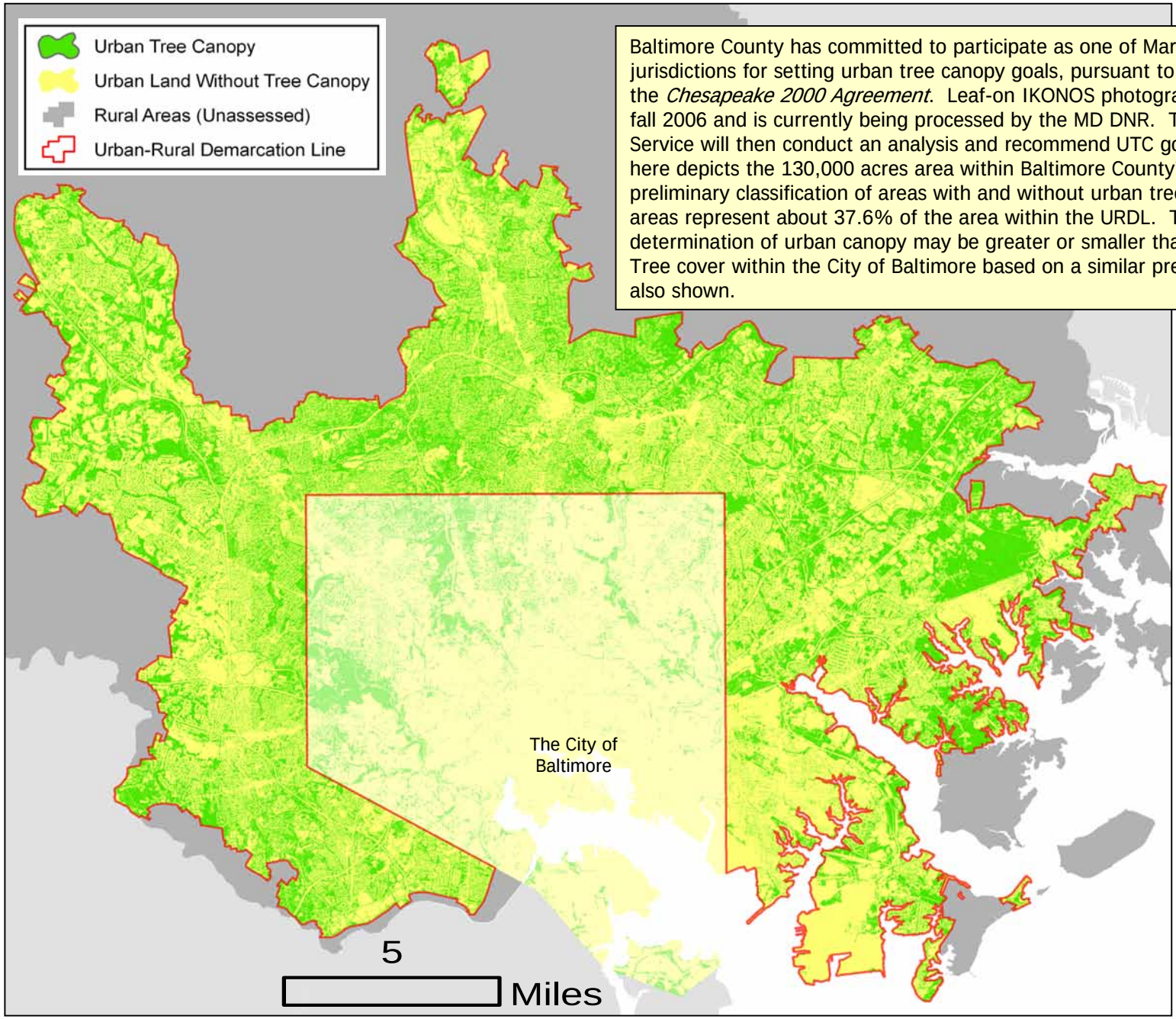
Regardless of the existing canopy coverage overall, there are both the opportunity and need to significantly increase tree canopy in the many of the County's urban communities. Urban residential land comprises approximately 95,000 acres or 72% of the total land cover within the URDL.



Above – percent of urban tree cover by zoning polygons
Below – compiled 2006 IKONOS satellite image



Urban Tree Canopy



Baltimore County has committed to participate as one of Maryland's first five jurisdictions for setting urban tree canopy goals, pursuant to Directive 03-1 of the *Chesapeake 2000 Agreement*. Leaf-on IKONOS photography was flown in fall 2006 and is currently being processed by the MD DNR. The USDA Forest Service will then conduct an analysis and recommend UTC goals. The map here depicts the 130,000 acres area within Baltimore County's URDL and the preliminary classification of areas with and without urban trees. The treed areas represent about 37.6% of the area within the URDL. The final determination of urban canopy may be greater or smaller than this number. Tree cover within the City of Baltimore based on a similar previous analysis is also shown.

What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems

Why is this Criterion Important?

"Because 'productive capacity' refers to the ability of forests to produce goods and services for humans, this criterion overlaps the environmental and economic spheres of sustainability. The productive capacity criterion is one of the most straightforward, as are its constituent indicators. Essentially, productive capacity is maintained as long as the harvesting of forest products does not exceed growth rates. If harvesting exceeds growth rates, then the natural capital stocks become depleted or 'liquidated,' and the amount of products flowing from these stocks must decline. For example, if timber or deer are harvested at too rapid a pace, then lumber or venison production will not be sustained."

What are the relevant related management questions for Baltimore County?

2a. What are the trends in consumptive uses of forest lands in Baltimore County?

- **measure timber harvesting and forests lost to development**

2b. Do forest harvesting and other non-timber uses of forests diminish the ability of forests in the County to produce a sustainable flow of goods and services?

- **measure removal of timber and non-timber products compared to supplies**

What are we able to measure at this time?

- Forest Conversion During Settlement

  Historical sketch of forest ownership and conversion at Baltimore County's Hampton estate, excerpted from the National Park Service

- Forest Cover Change, 1914-1997

  County analysis of 83 years of forest cover change, from the 1914 Besley map to 1997 forest cover classification

- Historic Timber Harvests

  MD DNR data on acres of non-consumptive timber harvests and County Soil Conservation District data on acres protected by sediment and erosion control practices during harvesting

- Forest Loss Through Land Development, 1994-2006

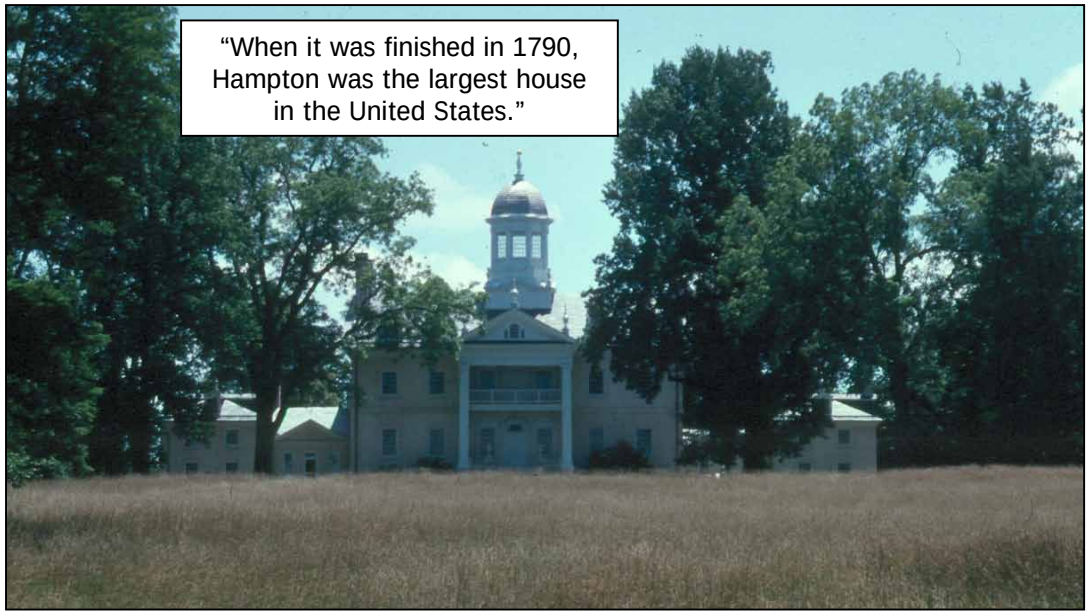
  County data on implementation of the Forest Conservation Act

Forest Conversion During Settlement

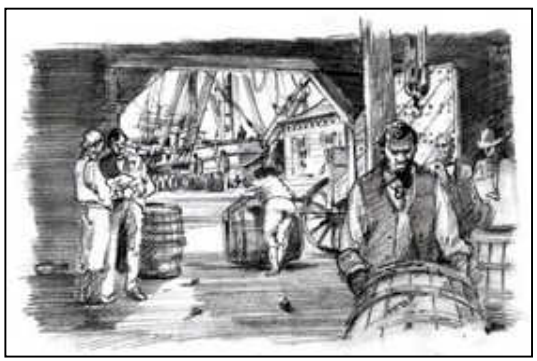
The conversion of forests during early settlement in the United States is told through the history of Hampton, a National Historical Site, located in Baltimore County just north of Towson.

All of the information on this page is excerpted from the US National Park Service's web site at: http://www.nps.gov/hamp/historyculture/index.htm

"Hampton is the story of its people. Scenes from Hampton's past include a colonial merchant shipper amassing thousands of acres of property along Maryland's Chesapeake shore; indentured servants casting molten iron into cannons and ammunition for the Revolutionary army; enslaved people loading barrels of grain, iron, and timber onto merchant ships bound for Europe that would return with fine wines and luxury goods."



"First and foremost Hampton was a family business. The 1,500-acre Northampton tract, first acquired by a Ridgely in 1745, had all the essential elements for ironmaking: iron ore, limestone used in the ironmaking process, timber providing charcoal to fuel the furnace, and waterpower from a tributary of the Gunpowder River. By 1762 when Charles Ridgely established an ironworks on the land he referred to as his "Plantation in the Forest," iron was one of the most profitable exports of the mid-Atlantic colonies. The local government and the British crown encouraged this industry through tax incentives and other benefits. By 1776, the American colonies together were the world's largest producer of raw iron. Ridgely owned a fleet of merchant ships, which transported raw iron and cash crops to Europe in exchange for finished goods. In addition, he owned mills, quarries, orchards, and a general merchandising business in downtown Baltimore. These enterprises made Ridgely a wealthy man and formed the basis of his heir's fortunes as well.
Nearly two centuries after Hampton's ironworks were established, historian Carl Bridenbaugh described ironmaking in colonial times; "a large tract of undeveloped woodlands was needed to supply charcoal for a furnace ...."



1695: Henry Darnall, cousin of Lord Baltimore, is granted the Hampton property.

1745: Colonel Charles Ridgely buys 1,500 acres of Northampton from Darnall's daughter, Ann Hill. He expands his holdings to 11,000 acres.

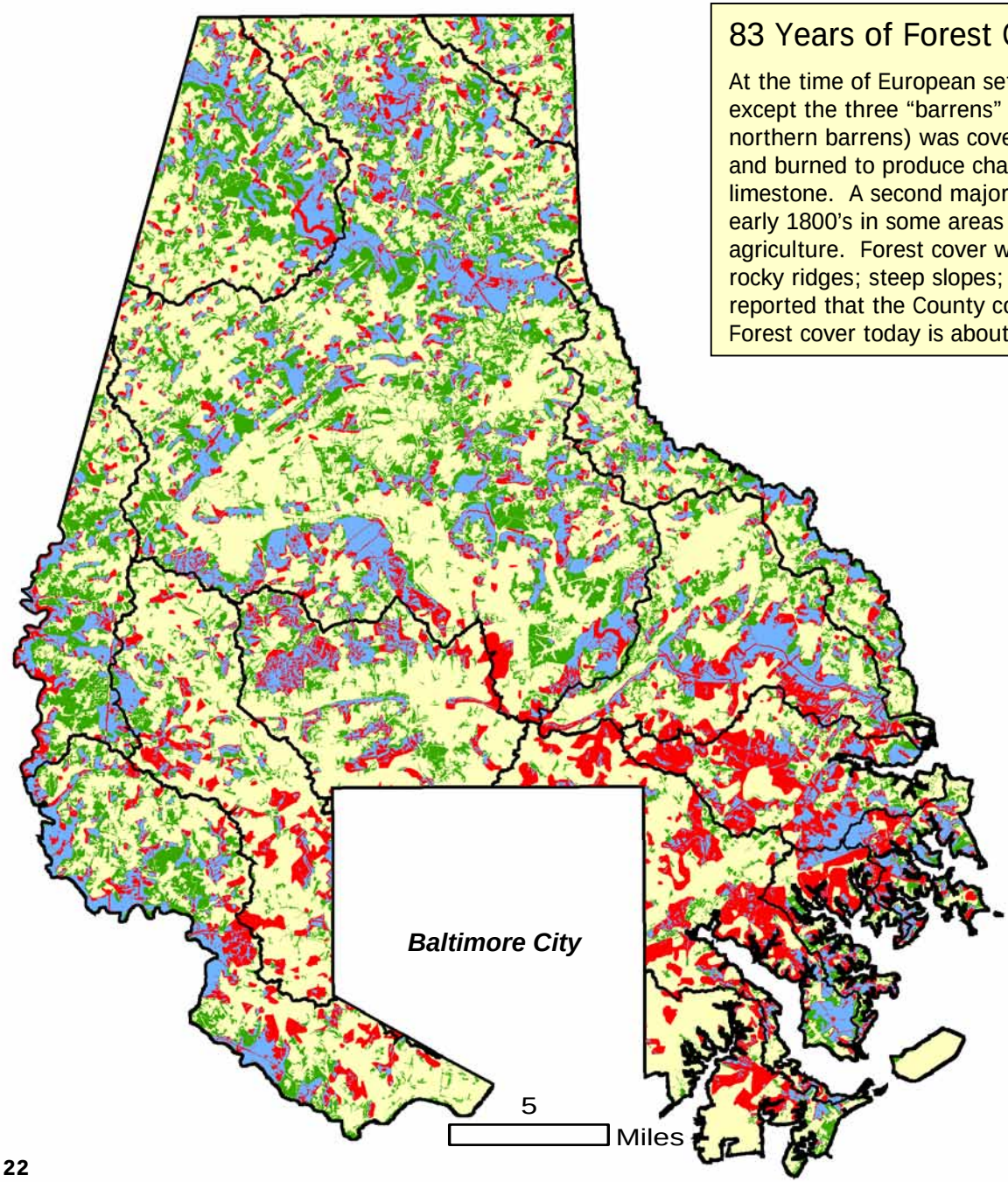
1760: Charles Ridgely, Jr., known as the Captain, receives Northampton tract from his father. Colonel Ridgely, with sons Charles and John, establishes ironworks on a tributary of the Gunpowder River.

1783: Captain Ridgely begins construction of mansion. Ridgely holdings grow to 24,000 acres.

1790--1829: Ridgely's empire grows to 25,000 acres with ironworks, grain crops, beef cattle, thoroughbred horses, coal mining, marble quarries, mills, and mercantile interests. In 1815 Ridgely is elected Governor of Maryland.

"Hardwood trees produced the highest quality and quantity of charcoal to fuel early ironworks. Chestnut was the principal tree of the forest surrounding Hopewell Furnace, and along with Oak, Hickory, Maple and Walnut trees, were harvested by the thousands each year to fuel the furnace."

Forest Cover Change



83 Years of Forest Cover Change in Baltimore County

At the time of European settlement 400 years ago, most of Baltimore County except the three "barrens" areas (Bare Hills, Soldiers Delight, and the northern barrens) was covered by deciduous forests. Forests were first cut and burned to produce charcoal to fire furnaces for smelting iron ore and limestone. A second major clearing of forest occurred in the late 1700's to early 1800's in some areas to supply paper mills, followed by clearing for agriculture. Forest cover was retained primarily on the higher, dry, thin-soil rocky ridges; steep slopes; and wet stream bottom lands. In 1929, it was reported that the County contained 25% forest cover, an "optimal" amount. Forest cover today is about 34%.

Forest Cover Change 1914 - 1997

A report compiled by Fred W. Besley, Maryland's first State Forester, included a 1" = 1 mile map of the County's forest cover in 1914. The map here compares the forest cover in 1914 with forest cover digitized from 1995-1997 aerial photography.

Forest Acres 1914	**114,244**
Acres Lost 1914-1997	**54,359**
Acres Gained 1914-1997	**71,161**
Forest Acres 1997	**131,046**
Net Change	**16,802**

Remaining Since 1914

Lost Since 1914

Gained Since 1914

Historic Timber Harvests

The Indicator

"This indicator depicts where forest management has been occurring in the recent past. Harvests in the northern and western counties are primarily of hardwoods.... This indicator was developed from data on timber harvest permits issued by local Soil Conservation Districts over the period 1995-2000."

Indicator Use

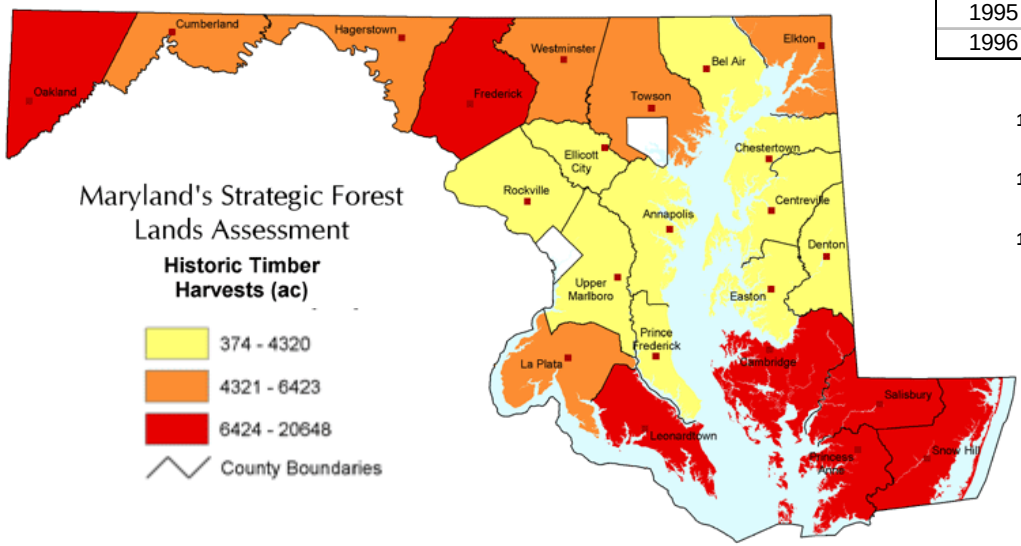
"Where timber harvesting has occurred there is the potential for forest composition to change, particularly if active management does not follow the harvest. Examining historic timber harvest data can help to point to anticipated future activity, since recent trends in timber harvests are expected to continue at similar rates in the near future. These data were used in constructing the economic model for the Strategic Forest Lands Assessment."

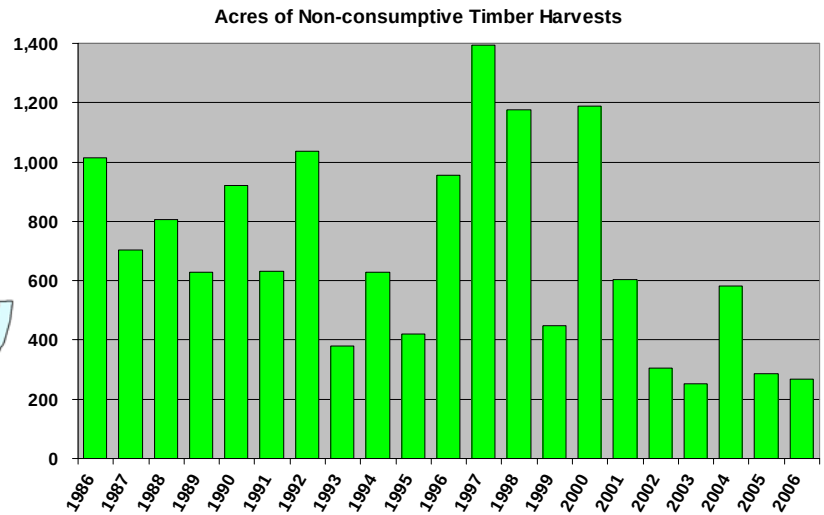
MD DNR Strategic Forest Lands Assessment

The table and graph below present the annual number of acres of timber harvests for non-consumptive or non land development purposes, based on sediment and erosion control plans approved by the Baltimore County Soil Conservation District (SCD) for forest harvest operations. After passage of the State's sediment control law, standards and specifications were established specifically for forestry operations, including best management practices for temporary hauling roads, stream crossings, staging areas, and other activities that might impact sensitive wooded areas and streams.

In the 21 year period from 1986 through 2006, a total of 685 forest harvest operations on 14,630 acres were approved, averaging about 33 plans per year for about 697 acres. Over the 21 years, harvest operations covered about 12% of the County's total forest base. Overall, harvesting is declining.

Year	# Plans Approved	Total Acres Protected	Year	# Plans Approved	Total Acres Protected
1986	22	1,014	1997	55	1,394
1987	27	703	1998	45	1,175
1988	43	807	1999	35	448
1989	24	629	2000	55	1,189
1990	45	922	2001	28	605
1991	38	632	2002	16	305
1992	51	1,035	2003	16	252
1993	20	381	2004	20	581
1994	29	628	2005	15	286
1995	30	419	2006	18	269
1996	53	956			





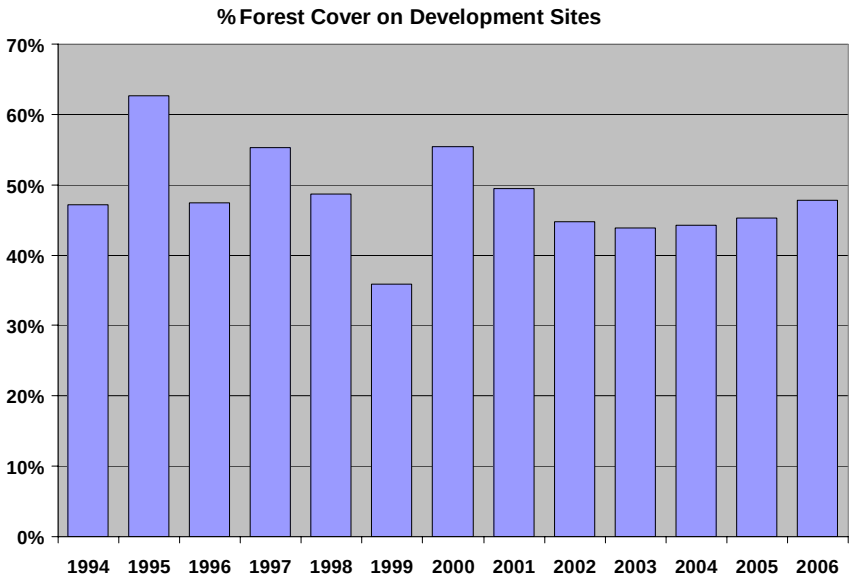
Forest Loss (Conversion) Through Land Development

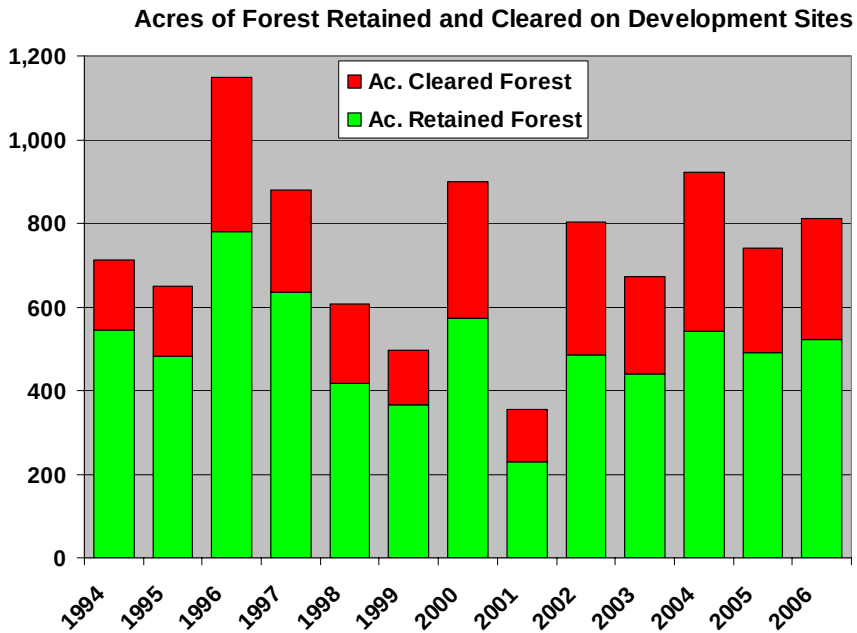
Since implementation of the County's Forest Conservation Act in 1993, more than 1,100 development projects have been subject to the FCA regulations (through FY 2006). Nearly 9,900 acres or 48% of the 20,600 development site acres subject to the FCA were forested prior to development. The percentage of forest on development sites has declined in recent years.

The FCA regulations cumulatively protected 6,510 acres (65.8%) of the existing forest acres on development sites. A total of 3,187 acres (32.2%) of forest were lost to development from 1994 through 2006. Cleared forests averaged about 245 acres per year for the 13 year period. Despite a declining percentage of forests on development sites, the percentage of forest acres cleared for land development has increased steadily from 22% in 1994 to 32% in 2006.

Fees-in-lieu of mitigation have been paid by developers for about 50 acres of cleared forest (through 2002). Hundreds of acres are also harvested each year for non-development purposes under the FCA's Declaration of Intent provisions; however, most of these areas regenerate and continue to grow as forest.

Forest Loss to Development



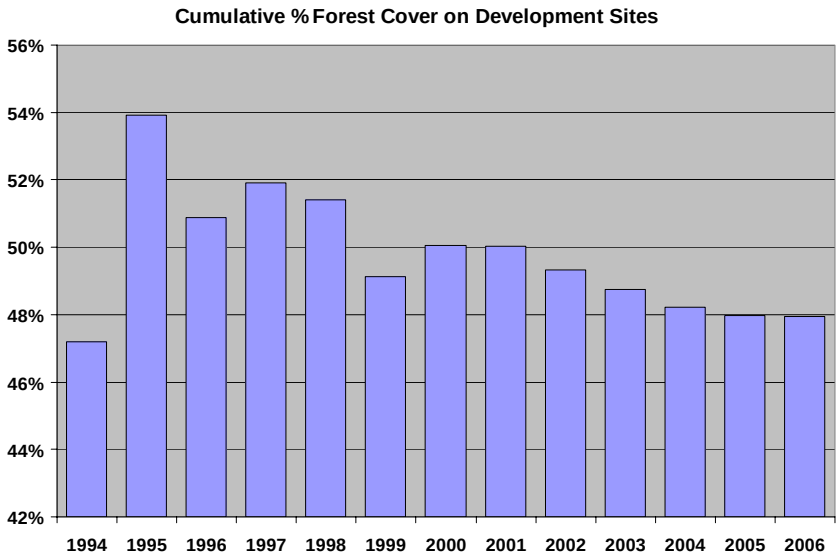


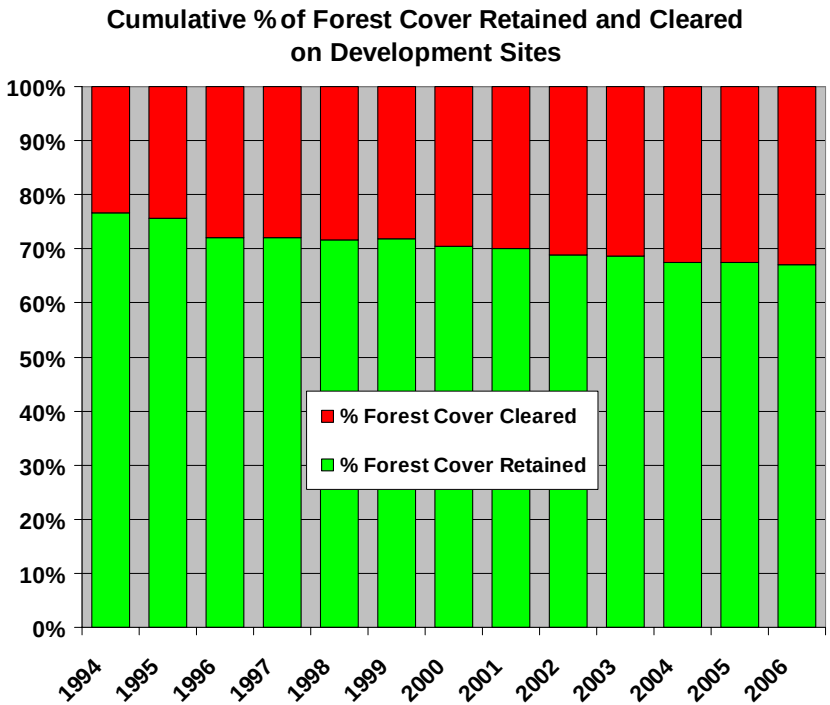
Forest Loss (Conversion) Through Land Development

Forest Acres Retained and Cleared Pursuant to Implementation of the Forest Conservation Act

Fiscal	# of Dev.	Net Tract	Existing Forest		Retained Forest		Cleared Forest	
Year	Projects	(acres)	Acres	%	Acres	%	Acres	%
1994	118	1,567.0	739.6	47.2%	545.9	73.8%	166.1	22.5%
1995	71	1,208.2	756.6	62.6%	483.4	63.9%	165.8	21.9%
1996	108	2,439.9	1,157.8	47.5%	779.8	67.4%	368.0	31.8%
1997	65	1,601.5	884.9	55.3%	635.1	71.8%	245.6	27.8%
1998	67	1,247.3	607.4	48.7%	416.3	68.5%	190.7	31.4%
1999	66	1,400.8	502.2	35.9%	364.9	72.7%	132.7	26.4%
2000	77	1,665.1	923.1	55.4%	572.6	62.0%	328.1	35.5%
2001	40	723.0	357.2	49.4%	229.8	64.3%	124.6	34.9%
2002	72	1,817.1	812.7	44.7%	486.1	59.8%	317.9	39.1%
2003	89	1,543.0	676.5	43.8%	440.6	65.1%	231.6	34.2%
2004	131	2,085.8	924.0	44.3%	542.7	58.7%	378.2	40.9%
2005	95	1,634.7	739.7	45.2%	491.6	66.5%	248.1	33.5%
2006	107	1,700.2	813.4	47.8%	521.8	64.2%	289.8	35.6%
Total	**1,106**	**20,633.7**	**9,895.0**	**48.0%**	**6,510.6**	**65.8%**	**3,187.3**	**32.2%**

Cumula-	# of Dev.	Net Tract	Existing Forest		Retained Forest		Cleared Forest	
tive	Projects	(acres)	Acres	%	Acres	%	Acres	%
1994	118	1,567.0	739.6	47.2%	545.9	73.8%	166.1	22.5%
1995	189	2,775.2	1,496.2	53.9%	1,029.3	68.8%	331.9	22.2%
1996	297	5,215.1	2,654.0	50.9%	1,809.1	68.2%	699.9	26.4%
1997	362	6,816.6	3,538.9	51.9%	2,444.2	69.1%	945.5	26.7%
1998	429	8,064.0	4,146.2	51.4%	2,860.5	69.0%	1,136.2	27.4%
1999	495	9,464.8	4,648.4	49.1%	3,225.4	69.4%	1,268.9	27.3%
2000	572	11,129.9	5,571.5	50.1%	3,798.0	68.2%	1,597.0	28.7%
2001	612	11,852.9	5,928.7	50.0%	4,027.8	67.9%	1,721.6	29.0%
2002	684	13,670.0	6,741.4	49.3%	4,513.9	67.0%	2,039.6	30.3%
2003	773	15,213.0	7,417.9	48.8%	4,954.5	66.8%	2,271.2	30.6%
2004	904	17,298.8	8,341.9	48.2%	5,497.2	65.9%	2,649.4	31.8%
2005	999	18,933.5	9,081.6	48.0%	5,988.8	65.9%	2,897.5	31.9%
2006	1,106	20,633.7	9,895.0	48.0%	6,510.6	65.8%	3,187.3	32.2%





What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

Why is this Criterion Important?

"Ecosystem health depends on the functionality of natural, nondegraded ecosystem components and processes. The underlying premise is that forest species and ecosystems have evolved to function within particular environmental conditions determined largely by geological and climatic factors. Humans, meanwhile, have historically (and prehistorically) adapted their economic and social activities to environmental conditions and to the resulting ecological processes. Substantial modification of environmental conditions therefore threatens species' adaptive capacities, ecosystems' functional capacities, and that of the associated human economies and societies. For example, many local and regional U.S. economies depend on forests. To the extent that exotic species, air pollution, or disease threatens the forests, the associated economies and communities are likewise threatened."

What are the relevant related management questions for Baltimore County?

3a. What is the extent of forests affected by human activities that reduce or threaten the functional capacity of forest ecosystems?

- **measure human disturbances such as fire**
- **measure the extent & effect of air pollutants on forests**

3b. What is the extent of forests affected by natural processes and agents that reduce or threaten the functional capacity of forest ecosystems?

- **measure the extent and trends of disease and infestation such as gypsy moth, oak and ash diseases, and wildfire**
- **measure the extent and trends of invasive plant species and effect on forests**
- **measure the extent and trends of deer damage to forest regeneration**

What are we able to measure at this time?

- Forest Fire Potential

  MD DNR data on Forest Fire Potential from the Wildland-Urban Interface Assessment, and average number of forest fires and acres burned, 1990-2000

- Drought

  USDA Forest Service compilation of drought data for the Northeast based on the Palmer Drought Index

- Acid Deposition

  USDA Forest Service data on acid deposition from Forest Health Monitoring, 1994-2001

- Ground-Level Ozone

  USDA Forest Service data on ground-level ozone and damage to indicator plants, from FHM, 1994-2001

- Insects and Diseases that Damage Trees

  USDA Forest Service description of pest and disease monitoring and FIA and FHM grids and data plots

- Tree Health for Baltimore County

  USDA Forest Service data from Forest Inventory and Analysis program for tree health conditions in Baltimore County

- Gypsy Moth Infestations

  MD Dept. of Agriculture data on Gypsy Moth egg mass surveys and treatment acreage, 2005-2006

- Public Lands Assessment (Oregon Ridge Park Forest Health Assessment and Plan)

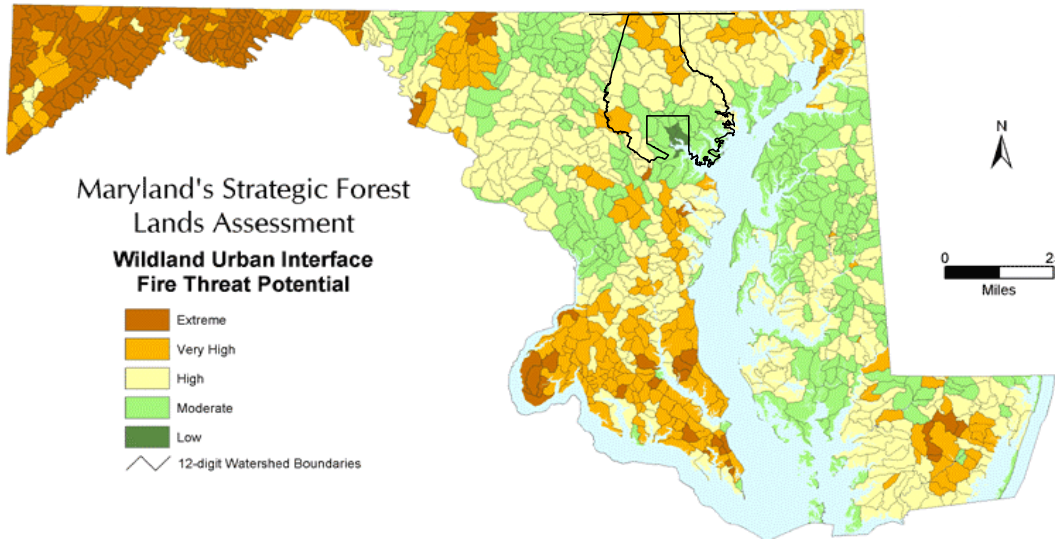
  Results of the County's consultant study of Oregon Ridge using the USDA Forest Service NED model

Forest Fire Potential

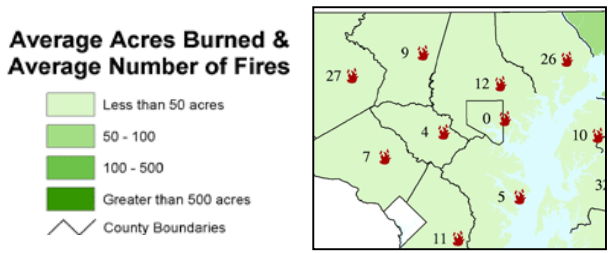
"Forest fires become of particular concern when they have the potential to take lives or to damage significant economic investments in homes or businesses. As urban types of development have spread into ever more far-flung parts of the state, particularly to areas where fire-fighting infrastructure may be lacking or access difficult, this potential has grown.

As portrayed in this indicator, fire threat is modeled to reflect six important variables: Fuel hazard is based upon the amount and type of vegetation within a subwatershed; risk of fire relates both to the dryness of the vegetative fuel and to presence of human activities that could ignite a fire. Aspect is based on the direction faced by slopes, with south- and west-facing slopes tending to be much drier than north- or east-facing slopes; slope itself affects the rate at which a fire spreads due to the chimney effect of steep slopes. Sensitivity is a measure of public perception of losses that would be caused by a fire; fire protection resources reflect road accessibility in a watershed and the location and availability of fire-fighting personnel and equipment.

This indicator suggests areas in Maryland where particular vigilance may be called for in detecting fires at an early stage and where property owners should be instructed in preventive measures...." ***MD DNR Strategic Forest Lands Assessment***

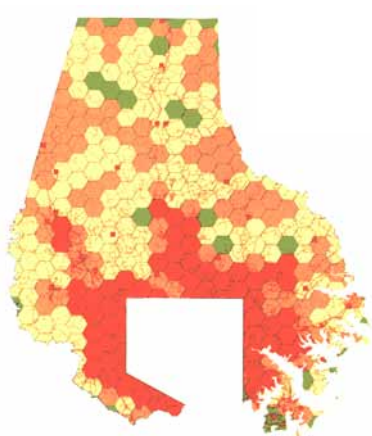


According to data compiled by MD DNR Forest Service, from 1990-2000, Baltimore County averaged 12 fires per year and less than 50 acres burned per year.

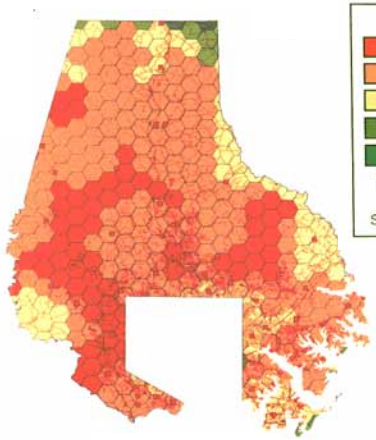


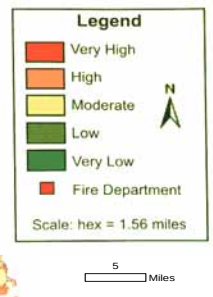
The four maps below are from MD DNR's *State Wildland Fire Assessment Atlas*, Wildland-Urban Interface GIS. September 2005.

Fire Start Potential

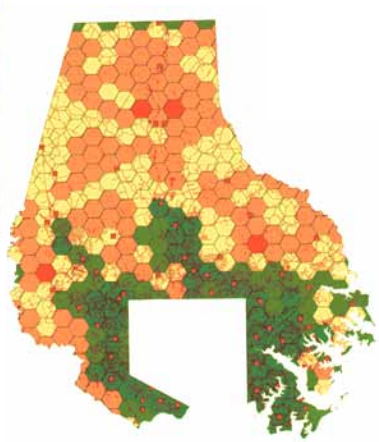


Fire Impact Potential

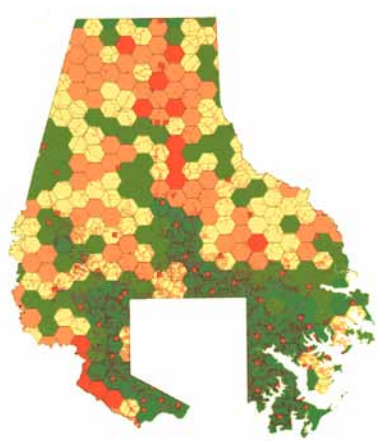




Fire Hazard Potential



Composite



Drought

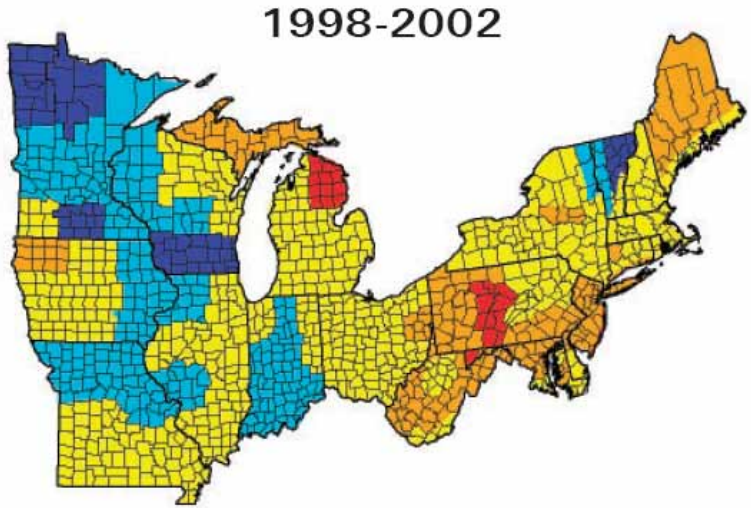
"During recent years, most states within the Northeast have received less than average amount of rainfall, which has led to droughts. This recent droughty period followed a wetter-than-average interval during the mid 1990s, however, and was not as severe as similar drought periods during the 1930s and 1960s (National Oceanic and Atmospheric Administration 2003).

Trees are generally tolerant of dry soil conditions because of their large root systems. However, foresters in many states have reported premature loss of leaves from forest trees during the past few summers and subsequent tree mortality related to drought symptoms. These water deficits will also be directly related to less growth in tree diameter and height, and to mortality at some locations.

The coincidence of drought with insect and disease pests can cause additional stress to trees. Trees weakened from previous damage are likely to be less tolerant of drought than healthy trees. Likewise, the stress of drought can make trees more vulnerable to tree diseases that easily spread during subsequent growing seasons with normal to high amounts of rainfall....

Trees in urban settings are typically subjected to wounding, soil compaction, and limited rooting space in addition to the insect and disease problems of forest trees. Many urban trees are not capable of surviving the additional stress of drought. In particular, trees along streets and confined in parking lot islands tend to suffer most. Dogwoods and red maples are particularly prone to multiple stresses when in urban environments."

USDA Forest Service. 2004. Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions during 1993-2002. (NA-TP-01-04), P4.



Example of Drought conditions map for Northeast (from USDA Forest Service, NA-TP-01-04)

Drought Data for Baltimore County

Period	County				
1933-1937			Palmer Drought Index		
1963-1967				>1.5	Droughty
				0.5 to 1.5	
1983-1987				-0.5 to 0.5	Normal
1988-1992				-1.5 to -0.5	
1993-1997				< -1.5	Moist
1998-2002					

Baltimore County has trended toward droughty conditions in recent years.

Drought conditions at Prettyboy Reservoir in Baltimore County, February 2002

Acid Deposition

Visible air-borne pollution

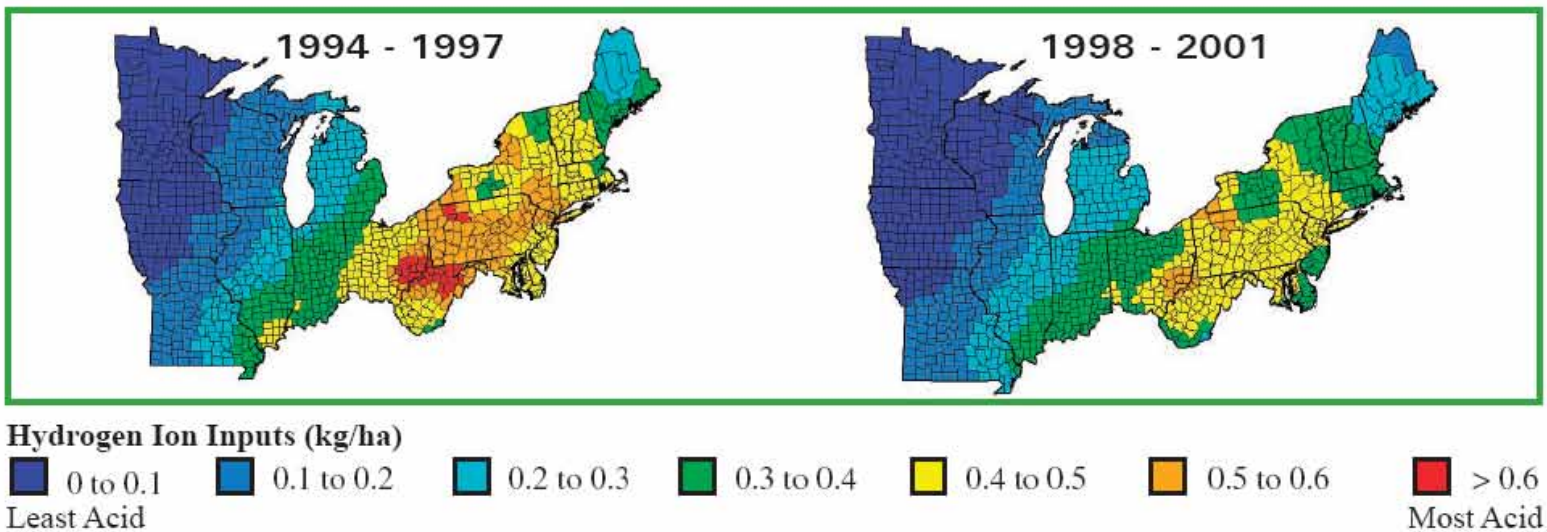
"Acidic deposition is a consequence of atmospheric emissions of nitrogen and sulfur compounds from some power generation plants, industries, and automobiles. Recognition of related problems has led to mandates to reduce emissions, and to a resulting decrease in acidic deposition in the Northeast from 1994 to 2001 (see Figure 11 below).

Although pollutant emissions and acidic deposition have decreased, forest ecosystems are still monitored for residual and long-term effects. Accumulation of pollutants in forest ecosystems can increase soil acidity, interfere with uptake of nutrients by plants, predispose their roots to pathogens, and result in growth loss or premature mortality. Such relationships are difficult to demonstrate, however, because of three factors: (1) the presence of other disturbances that contribute to tree growth loss and mortality, (2) the lack of historical data prior to the onset of air pollution, and (3) an inability to conduct controlled experiments in forests.

Difficulties with demonstrating the effects of air pollution on forests have led to using forest lichens as surrogate indicators of pollutants. Lichens readily uptake nitrogen and sulfur compounds and die as a result of absorbed toxic amounts. Data from FIA plots ... show a low number of lichen species in Pennsylvania and New York as a possible response to air pollutants in these States."

USDA Forest Service. 2004. Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions during 1993-2002. P. 14.

Acid deposition for Baltimore County has averaged 0.4 to 0.5 kg/ha, a slightly acid condition.



Acidic deposition during 1994-1997 and 1998-2001. (Source: National Atmospheric Deposition Program 2003).

Ground-Level Ozone

"Ozone naturally occurs in the upper atmosphere as a protective layer that inhibits harmful levels of incoming ultraviolet radiation. Ozone is also an air pollutant that forms near the ground as a byproduct of emissions from power plants, industrial facilities, and automobiles. Direct uptake of ozone by plants through openings in their leaves (stomata) can interfere with the assimilation of carbon dioxide for photosynthesis. A decrease in photosynthetic abilities can in turn result in foliar injury, reductions in plant growth, and predisposing stress to other pathogenic problems.

Ambient ozone near ground level is continually monitored by the U.S. Environmental Protection Agency (EPA) and serves as an indicator of the amount of ozone exposure to the forest. For a given year, the cumulative amount of ozone from June 1 to August 31 at 8 am to 8 pm can be used to express exposure to plants during the growing season. As shown in the Figure 1 below, the average of values during 1998-2001 shows that ground-level ozone is commonly greater in much of the lower portion of the Northeast.

Effects of ground-level ozone on forest plants in the Northeast are not yet fully understood; however, several forest plant species are known to be sensitive to ground-level ozone and are monitored on FIA plots to detect foliar injury from ozone. Ozone-sensitive species that are common throughout the Northeast are black cherry (*Prunus serotinus*), milkweed (*Asclepias* spp.), and blackberry (*Rubus allegheniensis*). The incidence of foliar injury on these indicator species, as summarized from FIA data in Figure 2 below, shows that amounts of foliar injury in southern parts of the Northeast are greater than those in northern parts of the region. The correspondence between locations of foliar injury and incidence of high amounts of ambient ozone suggests there may be other types of damage to the forest."

USDA Forest Service. 2004. Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions during 1993-2002. P. 15.

Baltimore County ranks in the highest category for ambient ground-level ozone and ozone injury to indicator plants.

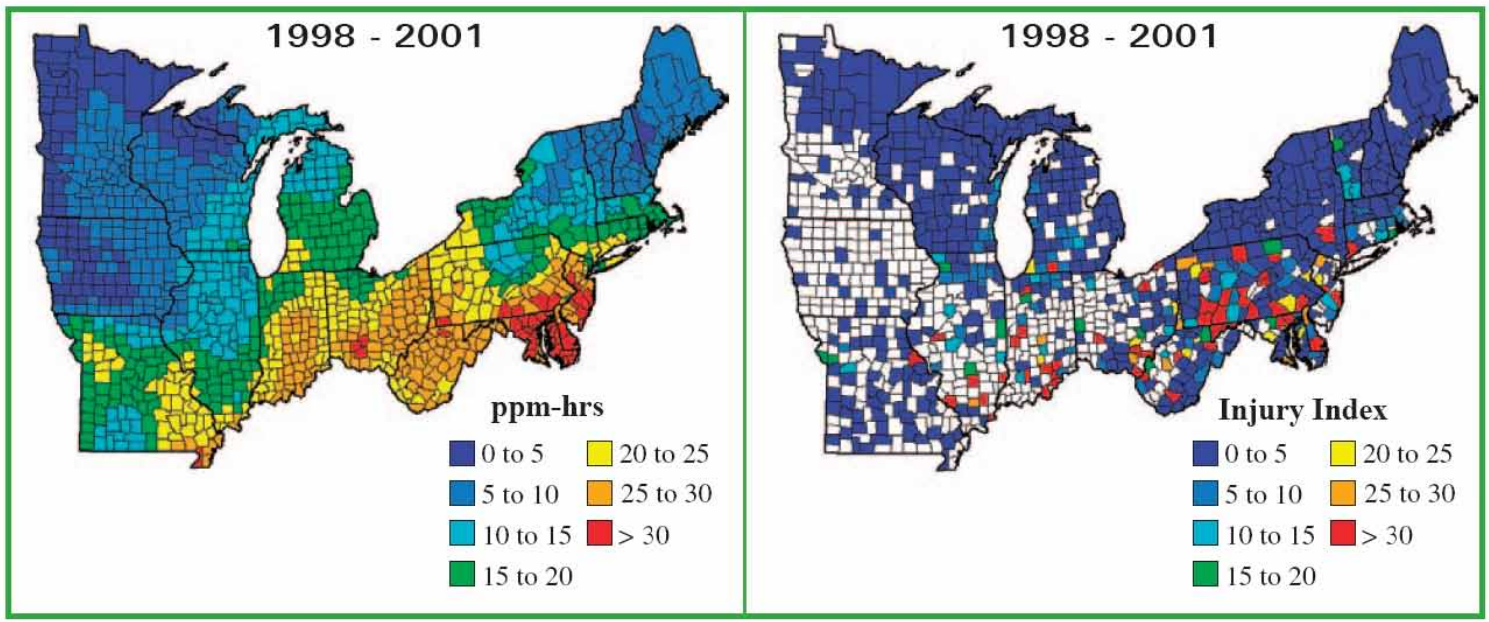
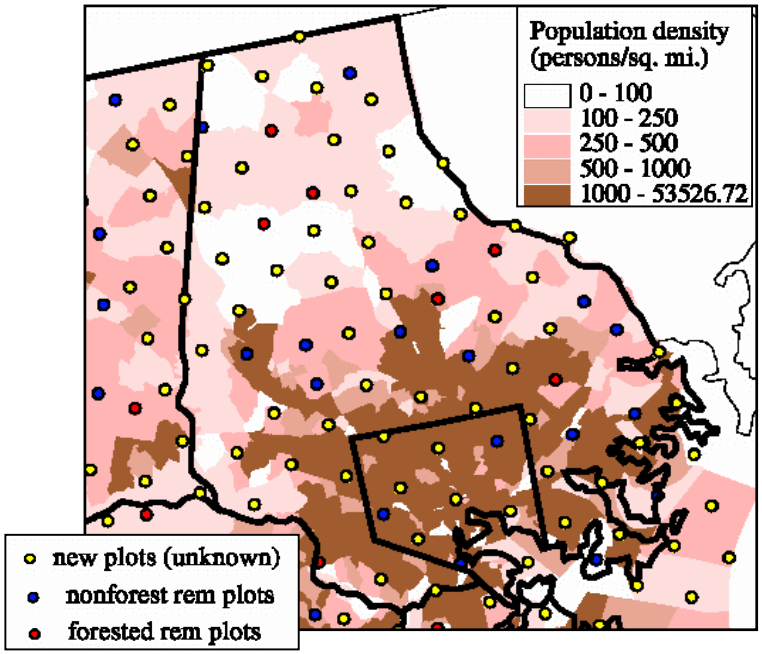


Figure 1: Ambient ground-level ozone during 1998-2001.

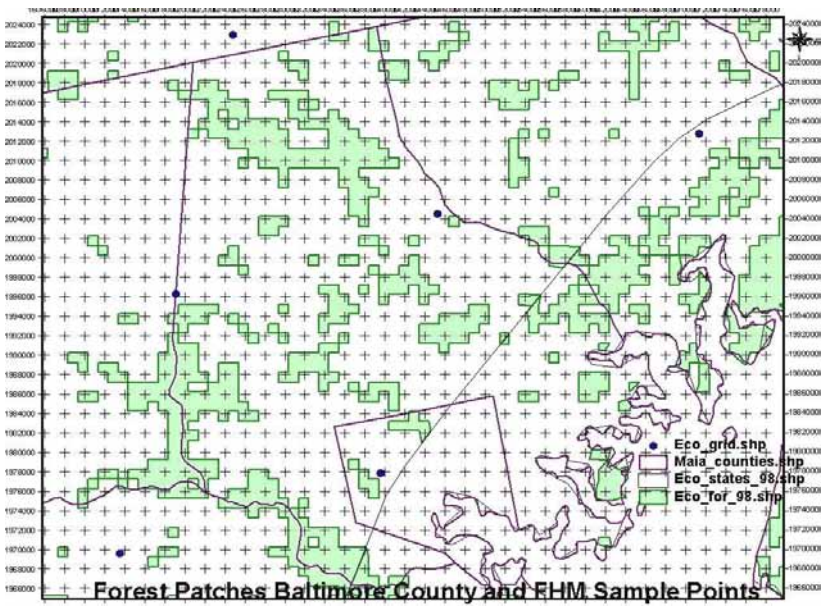
Figure 2: Ozone injury to indicator plants of black cherry, milkweed, and blackberry during 1998-2001.

Insects and Diseases That Damage Trees



Forest Inventory and Analysis (FIA) grid & plots – above

Forest Health Monitoring (FHM) grid & plots – below



"Between 1997 and 2002, 70 insects and 27 diseases were reported to cause tree damage or mortality on over 30 million acres of forestland in the Northeast.... The most common type of observed damage was direct defoliation by larvae of forest tent caterpillar, gypsy moth, spruce budworm, eastern tent caterpillar, and many other insects that feed on tree leaves and needles. The second most common type of damage was indirect defoliation associated with wood boring insects and vascular diseases such as oak wilt, white pine blister rust, dogwood anthracnose, and beech bark disease. Other types of observed and reported tree damage from insects and diseases include branch dieback of crowns, cankers on stems and branches, and tree mortality. Although growth loss is not directly observed, defoliation, crown dieback, and other types of damage can lead to reduced increments in tree diameter and height....

Specific insects and diseases generally affect only one to several tree species, are active within a limited area of several thousand acres, and endure for just a few years. Exceptions occur when some defoliators, such as gypsy moth and spruce budworm, attain high populations and cause epidemics over widespread areas. Exceptions also exist for many diseases, such as dogwood anthracnose, that tend to persist in areas once they have become established. As discussed earlier, drought can result in additional stress and premature tree mortality. Trees can normally tolerate up to 3 years of defoliation, but may die when just 1 year of defoliation is combined with ... drought.

It is difficult to quantify the loss of growth and the mortality of trees associated with insects and diseases. Impact assessments require data sets that can precisely demonstrate spatial correlations between the incidence of pests and tree conditions. In addition, tree conditions need to be represented by data collected after the occurrence of a damaging pest event because of the lag in associated tree growth loss and mortality. Most of the available FHP pest survey data for the Northeast are for 1997-2002, while most FIA data represent tree conditions before this time period. However, additional data are available for gypsy moth and spruce budworm for 1975-1997, and thus facilitate analyses to demonstrate associations between these pests and the condition of their respective host tree species." **USDA Forest Service. 2004.** ***Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions During 1993-2002***.

Presence in Baltimore County, 1997-2002:

Insects:	**Hemlock Wooly Adelgid**	**YES**
Diseases:	**Dogwood anthracnose**	**YES**

Tree Health for Baltimore County

"The status and trends of the health of forest trees is of primary interest when assessing forest conditions. Tree health is affected by a wide variety of acute and chronic disturbances.... Other types of disturbances include competition from invasive plants and storm events. ...overall tree health in the Northeast is described in terms of growth rate, mortality rate, crown condition, and incidence of damage. These same parameters are used to describe the health of individual tree species and species groups."

		Species Measured						
Metric	Survey	*ALL	BL CH	HICK	OAK	R MAP	Y POP	Y PIN
Net Growth Rate	1985-1995							
Mortality Rate	1985-1995							
Unhealthy Crowns	1998-2001							na
Decay	1998-2001							na
Breakage	1998-2001							na
Open Wounds	1998-2001							na

% per Year		Metric	Bottom 4 Metrics		ALL	All Species Combined
Growth	Mortality	Scales	% Basal Area		BL CH	Black Cherry
<0.6	>2.0		>20		HICK	Hickory species
0.6-1.0	1.6-2.0		16-20		OAK	Oak species
1.1-1.5	1.1-1.5		11-15		R MAP	Red Maple
1.6-2.0	0.6-1.0		6-10		Y POP	Yellow-Poplar
>2.0	<0.6		0-5		Y PIN	Yellow Pine species

Health of Individual Tree Species

"Comparisons among tree species in the Northeast can show whether some are prone to more problems than others. ...growth and mortality rates generally show that each species is healthy in most of the region.... Condition of tree crowns and damage of different tree species help determine which ones contribute to the forest-wide conditions. ...crown condition and tree damage generally show that each species is healthy in most of the region. The relatively high incidence of decay among most hardwood species corresponds to forest-wide estimates, and is most likely associated with the mature age of forest stands throughout much of the region."

*** Health of All Combined Tree Species**

"Net growth and mortality are key indicators of tree health that help determine if rates in certain geographic areas differ from regional averages. An examination of FIA data for all tree species in the Northeast during 1985-1995 indicates problems with tree growth and mortality rates at only some localities. Net tree growth rates are good—commonly more than 2% a year across the region....

The condition of tree crowns and incidence of different types of tree damage help explain reduced growth rates and tree mortality. For this report, unhealthy crowns are defined as trees having at least 25% dieback, at least 30% foliage transparency, or less than 35% crown density. The most frequent types of damage selected for display were tree decay; breakage of tree roots, stems, and branches; and mechanical wounds."

USDA Forest Service. 2004. ***Forest Health Monitoring in the Northeastern United States: Disturbances and Conditions During 1993-2002***

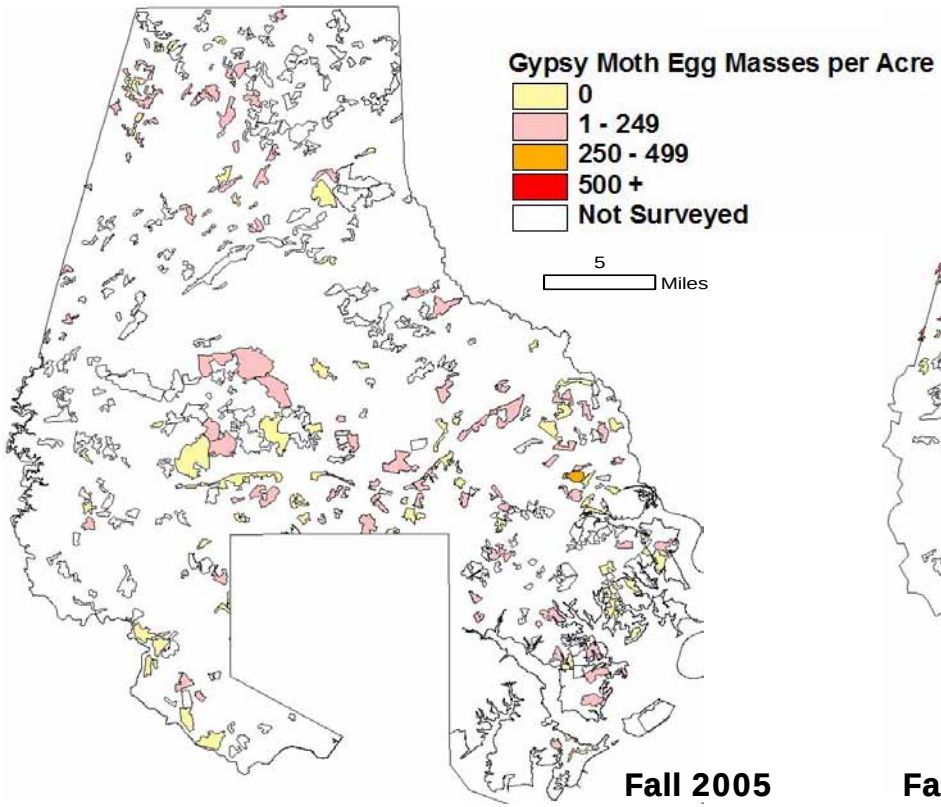
Gypsy Moth Infestations

The MD Department of Agriculture, Forest Pest Management Program, is the lead in the State for assessing Gypsy moth presence and the need for suppression, which consists of aerial spraying using B.t. or Dimilin. Baltimore County, among a few other counties, cost-shares with the MDA for survey and spray activity. MDA has 2,797 permanent survey sites in the County covering 54,637 acres in more than 400 blocks in susceptible woodlots ≥25 acres. Egg mass surveys are conducted each year on a prioritized portion of these based on population trends and prior activity.

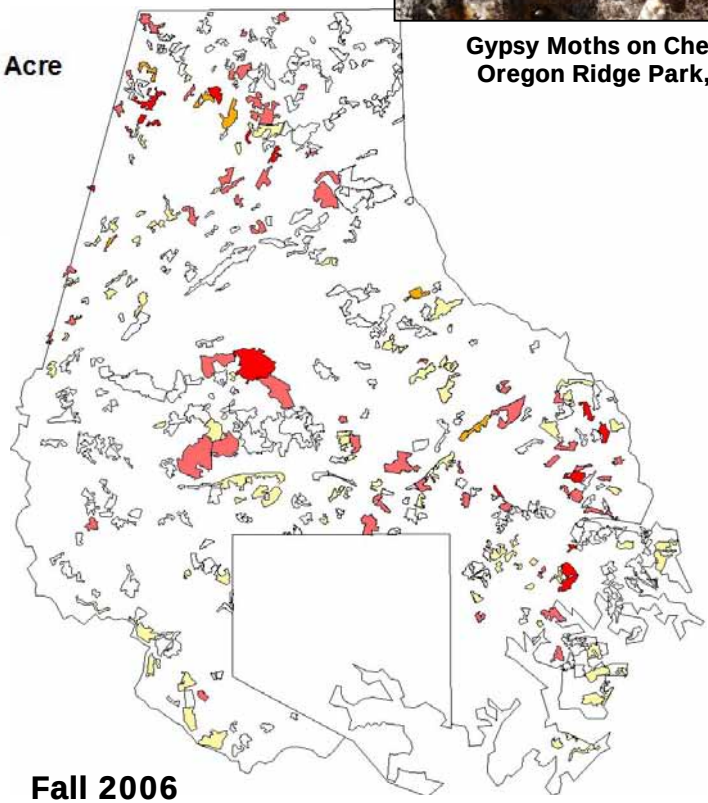
Gypsy Moth suppression projects have occurred in 19 of the past 26 years, 6 of the past 11 years, and 5 of the past 8 years. Surveys in 2005 revealed elevated counts but only a few that exceeded the 250 egg masses/acre that represents the treatment threshold. Surveys in fall 2006 revealed a more widespread and intensified infestation. Baltimore County contributed $8,589 for egg mass surveys in fall 2006 (50% cost share), and $34,600 (30% cost share) for treatment of 3,138 acres.

	Surveyed			G.M. Presence	
Year	# surveys	# blocks	# acres	# blocks	% acres
2001	754				
2002	593				
2003	801				
2004	557			124	22%
2005	638	167	26,560	181	28%
2006					

Gypsy Moths on Chestnut oak at Oregon Ridge Park, June 2006



Fall 2005



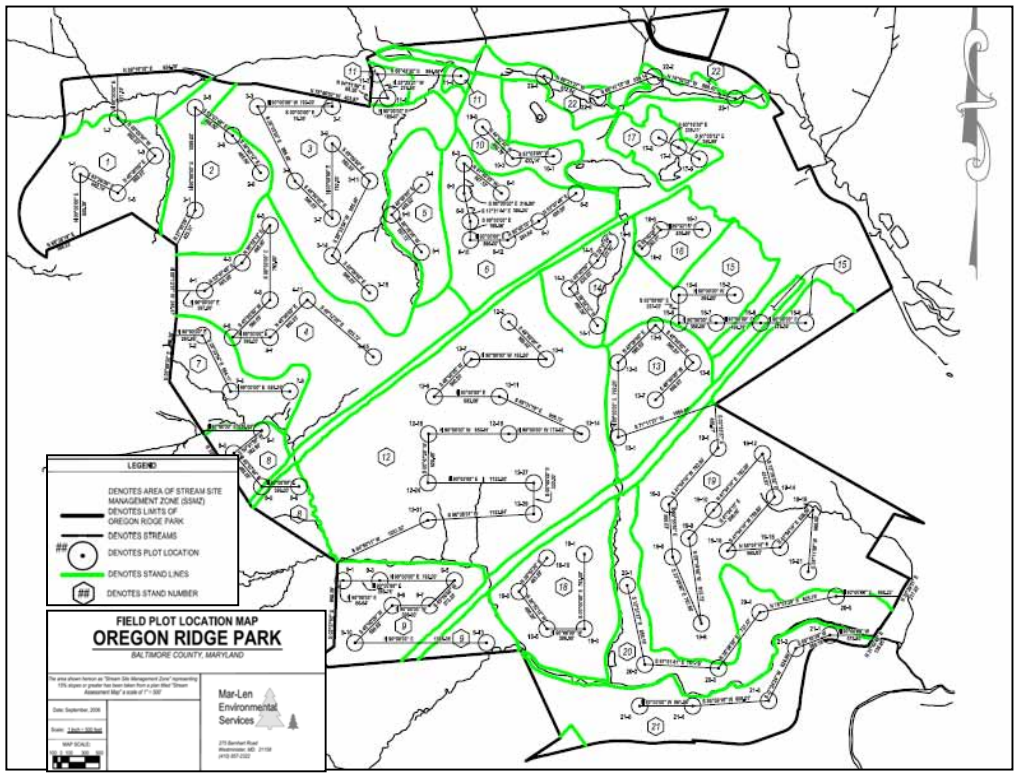
Fall 2006

Public Lands Forest Health Assessment

2007 Oregon Ridge Park Forest Health Assessment and Forest Management Plan

"With nearly 900 acres of contiguous forest located centrally in Baltimore County, Oregon Ridge Park provides the County's 800,000+ citizens and others in the region with ample opportunity to experience nature in close proximity to their communities. Nearly 6 miles of trails allow visitors to hike throughout a diverse forest community with 90 overstory, understory, and ground-layer plant species. More than 6 miles of streams originate within or flow through the Park, providing habitat for numerous aquatic species, including native brook trout. The casual Park visitor, observing the seasonal changes at Oregon Ridge, likely sees the forest as an aesthetically pleasing and healthy system.

But beyond the general story told by educational exhibits at the Oregon Ridge Nature Center, few visitors likely understand that this invaluable recreational resource exists on a landscape altered greatly by humans over the past two centuries. Visitors and non-visitors alike may assume that the forest system at Oregon Ridge is well-protected by its public ownership and Park designation."



In fall 2005 Baltimore County issued a Request for Proposals for a forest health assessment and forest management plan for its second largest publicly-owned block of forest at Oregon Ridge Park. Field work was conducted by a consultant in 2006 using the USDA Forest Service's NED assessment tool. The forest assessment identified significant environmental threats to the health and long-term sustainability of the Oregon Ridge Park forest that, without thoughtful management response, will change and potentially degrade the forest as it now exists.

ASSESSMENT METHODS

The Oregon Ridge Park forest system assessment included three field study components:

Forest - The condition and health of the 895-acre forest system at Oregon Ridge Park was assessed using two methods:

Forest overstory, understory, and ground-layer characteristics were assessed quantitatively for 22 stands, presented in Figure 1, using the USDA Forest Service North East Decision (NED) model. Data were collected for 119 separate forest plots within these stands, including measurement of more than 1,700 overstory trees alone. Overall, tens of thousands of data observations were recorded.

The herbaceous community was assessed independently for species presence and coverage.

Streams - Streambank erosion and habitat condition were assessed qualitatively by walking all of the 6.2 miles (32,450 linear feet) of headwater and larger streams that originate within or traverse the Park.

Trails - Potential hazard trees (dead trees and large overhanging dead branches) were identified and marked along the 5.9 miles of recreational trails in the Park.

Oregon Ridge Assessment Findings

FOREST - The forest system, including its herbaceous plants and wildlife, is the County's most important natural asset at Oregon Ridge Park.

Canopy Composition - The forest is comprised of four forest cover types, of which oak species dominate 80% of the 895 forested acres. Although 30 overstory species and 25 understory tree species exist within the forest stands, trees are found in only two size classes: 84% of all trees fall within the 18+" DBH size class, while the remaining 16% are in the 11-17.9" DBH size class. As documented in the Conservation Fund's 2006 *The State of Chesapeake Forests*, oaks are the most ecologically important species in the Bay region's forests.

Tree Age and Growing Potential - Twenty of the 22 forest stands are more than 100 years old and 15 stands are between 108 and 121 years old, suggesting that the forest was widely harvested in the 1880's and 1890's. Fourteen stands are now relatively crowded, with insufficient room for good continued tree growth. Only one stand (#3), at 140 years old (2nd oldest) and with a stand relative density of 73.6%, has good potential for old growth.

Forest Health - A Gypsy moth infestation in 2006 was severe but localized (stand #6). Trees here and in other stands are stressed due to overcrowding and are therefore vulnerable to mortality from repeated infestations.

Regeneration - As a result of deer browsing, 54% of the field plots sampled lacked oak regeneration, as well as regeneration of any other native species. All stands lack adequate regeneration.

Ground-layer Composition - The ground-layer inventory identified only 48 species, 44 of which are herbaceous. Deer have also greatly impacted the herbaceous community, with 25% of the 127 plots devoid of herbaceous plants due to deer pressure. This is low species diversity for the site conditions.

STREAMS - Healthy forests in the Park are vital for providing good water quality by intercepting precipitation, shading streams and soil to reduce temperatures, filtering and trapping pollutants, and reducing soil erosion. These forests serve to protect the 6.2 miles of streams in the Park that drain into the Loch Raven Reservoir, as well as to protect the 640 acres of slopes with grades of 15% or greater adjacent to streams.

Stream Channel Stability - 18.2% of stream length has excellent stability, 32.1% has good stability, 47.4% has fair stability, and 2.2% has poor stability. Downed woody debris is causing streamflow blockages in segments of stream sections #2, #5, #7B, and #7.

Habitat Conditions - 68.2% of the stream system has excellent habitat conditions, 8.4% has good conditions, 11.3% has fair conditions, and 12.1% has poor conditions. The Baisman Run stream system has excellent habitat conditions for 95.4% of its length.

TRAILS - The 5.9 miles of trails provide access for citizens to enjoy the Park's aesthetic and ecological benefits.

Trail Stability - Approximately 90% of the trails are in good condition. Portions of the Green and Blue trail, however, are badly eroded in sections.

Hazard Trees - As often associated with forest trails, tree hazards are present. A total of 105 trees with dead overhead branches were identified and marked along the trail system, in addition to 127 dead trees.

Table 1.1: Summary of Forest Stand Management Recommendations for Oregon Ridge Park

Stand #	% Relative Density All species	Basal Area (sf/ac)	Existing Stand Condition	Stand Management Objectives	Recommended Management Action	Recommended Silvicultural Method
1	117.0	157.0	25 sq ft unacceptable stock	oak regeneration	reduce BA to 80 sf/ac	Single Tree Selection
2	124.0	152.0	52 sq ft unacceptable stock	oak regeneration	reduce BA to 80 sf/ac	Single Tree Selection
3	73.6	120.0	optimum for good oak growth	maintain stand health	control invasives	none
4	79.8	140.0	36.7 sq ft unacceptable stock	oak regeneration	reduce BA to 100 sf/ac	thin undesirable trees
5	108.5	133.3	>15 % slopes near stream	maintain stand health	control invasives	none
6	121.8	162.5	recently defoliated	reduce Gypsy moths	control invasives	none
7	110.5	143.3	>15% slopes near stream	maintain stand health	control invasives	none
8	101.5	147.5	steep slopes and streams	maintain stand health	control invasives	none
9	106.5	140.0	slopes and stream crossings	maintain stand health	control invasives	none
10	52.0	140.0	high recreational usage	maintain stand health	control invasives	none
11	66.3	103.3	young - low crowding	oak regeneration	control heavy invasives	none
12	93.4	138.6	40 sq ft unacceptable stock	oak regeneration	control invasives	Shelterwood Harvest
13	103.0	144.0	32 sq ft unacceptable stock; no oak regeneration	oak regeneration	reduce BA to 90 sf/ac; control invasives	Initial thinning to reduce crowding; in 5-8 yrs, create canopy gaps
14	101.8	137.5	steep slopes	maintain stand health	control invasives	none
15	109.7	146.0	32 sq ft unacceptable stock	oak regeneration	reduce BA to 70 sf/ac; control invasives	Single Tree Selection
16	56.8	140.0	former pine dominance	oak regeneration	control invasives	none
17	56.4	113.3	optimum for good oak growth	oak regeneration	control invasives	remove Ailanthus trees
18	92.0	122.0	>15% steep slopes	maintain stand health	none	none
19	106.7	142.0	oak dominated; over crowded	oak regeneration	control invasives	Shelterwood Harvest
20	115.9	130.0	very steep slopes	maintain stand health	control invasives	none
21	120.4	156.0	steep slopes	maintain stand health	control invasives	none
22	124.2	140.0	riparian area	improve stand health	control heavy invasives	remove Ailanthus trees

Table 1.2: Recommended Time Schedule for Stand Management Activities

Stand	Recommended Management Activity	Total Acres	Activity Acres	Target Year #
1-22	Spray to control Gypsy moths	500+	895.7	1
1-22	Inspect annually for Gypsy moths	895.7	895.7	all
1-22	Control deer populations to 10 deer/sq. mi.	895.7	895.7	1
1-22	Control deer annually	TBD	895.7	all
1	Conduct Selection harvest for oak regeneration	37.0	6.0	2
2	Conduct Selection harvest for oak regeneration	33.5	4.4	2
3	Inspect for and control invasives	76.2	76.2	2
4	Selection harvest for regeneration	70.5	44.0	2
5	Inspect for and control invasives annually	18.9	18.9	3
6	Inspect for and control Gypsy moths annually	42.5	42.5	all
7	Inspect for and control invasives annually	24.7	24.7	3
8	Inspect for and control invasives annually	17.9	17.9	3
9	Inspect for and control invasives annually	38.2	38.2	3
10	Inspect for and control invasives annually	16.0	10.0	3
11	Inspect for and control invasives annually	5.2	5.2	3
12	Conduct 1st Shelterwood cut for regeneration	150.9	62.0	4
12	Conduct 2nd Shelterwood cut for regeneration	"	62.0	14
12	Conduct 3rd Shelterwood cut for regeneration	"	62.0	24
13	Conduct Selection harvest for oak regeneration	28.9	15.3	5
13	Conduct Group selection harvest for regeneration		5.0	10
14	Control invasives	17.5	17.5	5
15	Conduct Selection harvest for oak regeneration	44.3	3.3	6
15	Control invasives-eastern boundary	"	5.0	6
16	Inspect for and control invasives annually	14.1	14.1	6
17	Inspect for and control invasives annually	12.2	12.2	6
18	None	37.8	0.0	n/a
19	Conduct 1st Shelterwood cut for oak regeneration	105.6	48.0	7
19	Conduct 2nd Shelterwood cut for oak regeneration	"	48.0	17
19	Conduct 3rd Shelterwood cut for oak regeneration	"	48.0	27
20	Inspect for and control invasives annually	43.9	43.9	7
21	Inspect for and control invasives annually	42.4	42.4	7
22	Inspect for and control invasives annually	17.5	17.5	7

Note: Target Year represents relative sequence across stands and timing for multiple treatments within stands.

What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 4: Conservation and Maintenance of Soil and Water Resources

Why is this Criterion Important?

"Soil and water are primary stocks of natural capital in all terrestrial ecosystems. They constitute the foundation for the human economy and for the 'economy of nature' with its birds, mammals, fish, reptiles, amphibians, invertebrates, and plants. Forest ecosystems differ from other types of ecosystems in that the soil and water resources support the growth of trees (which themselves constitute a form of natural capital). The amount of soil and water and their characteristics determine the capacity of ecosystems to sustain forests, forest economies, and forest-dependent societies."

What are the relevant related management questions for Baltimore County?

As Baltimore County was nearly completely forested at the time of European settlement, there are no significant soil and water limitations for sustaining the growth of forests. Here, forests are evaluated regarding their function to protect soil and water resources.

4a. What is the extent of land with soil limitations for sustainability of forest ecosystems?

- **measure forest land with significantly diminished soil organic matter, erosion, or other soil properties**

4b. What are the extent and function of forests managed to protect water quality?

- **measure the extent of forests managed for reservoir and watershed protection including riparian functions**
- **measure the extent to which the lack of forest cover threatens water quality**

What are we able to measure at this time?

- Reservoir Watershed Forests

  Baltimore County data on percent of reservoir watersheds in forest cover

- Riparian Forests

  Baltimore County data on the percentage of forest cover for hypothetical 100-foot stream buffers

- Water Quality Typology

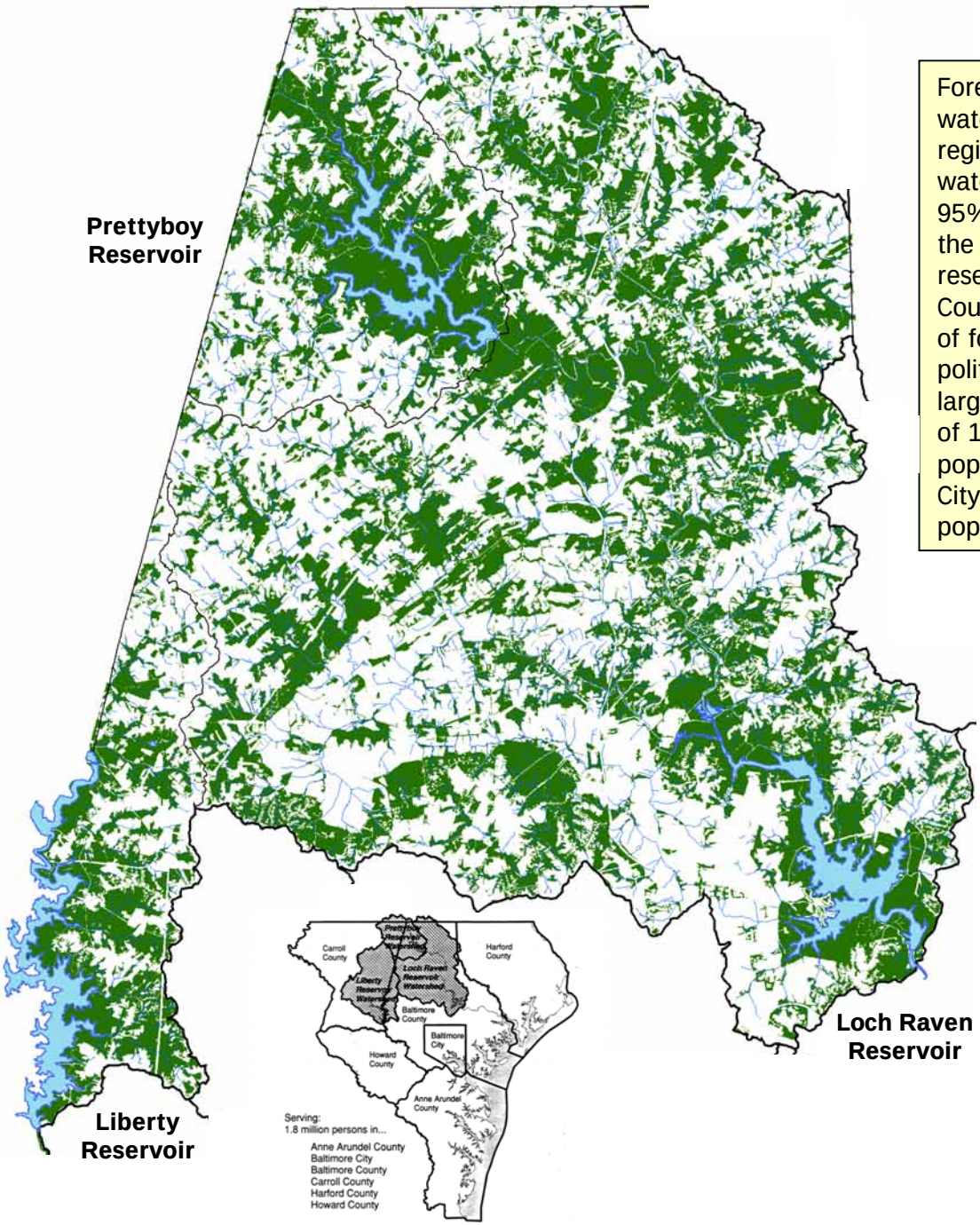
  Baltimore County analysis of forest patches most important for water quality based on extent of sub-watershed and riparian cover

- Water Quality Value - RLA

  An analysis of the importance of forest for water quality from the USDA Forest Service's Resource Lands Assessment project for the Chesapeake Bay Program

City-owned forests help protect the Liberty Reservoir in Baltimore and Carroll Counties

Reservoir Watershed Forests



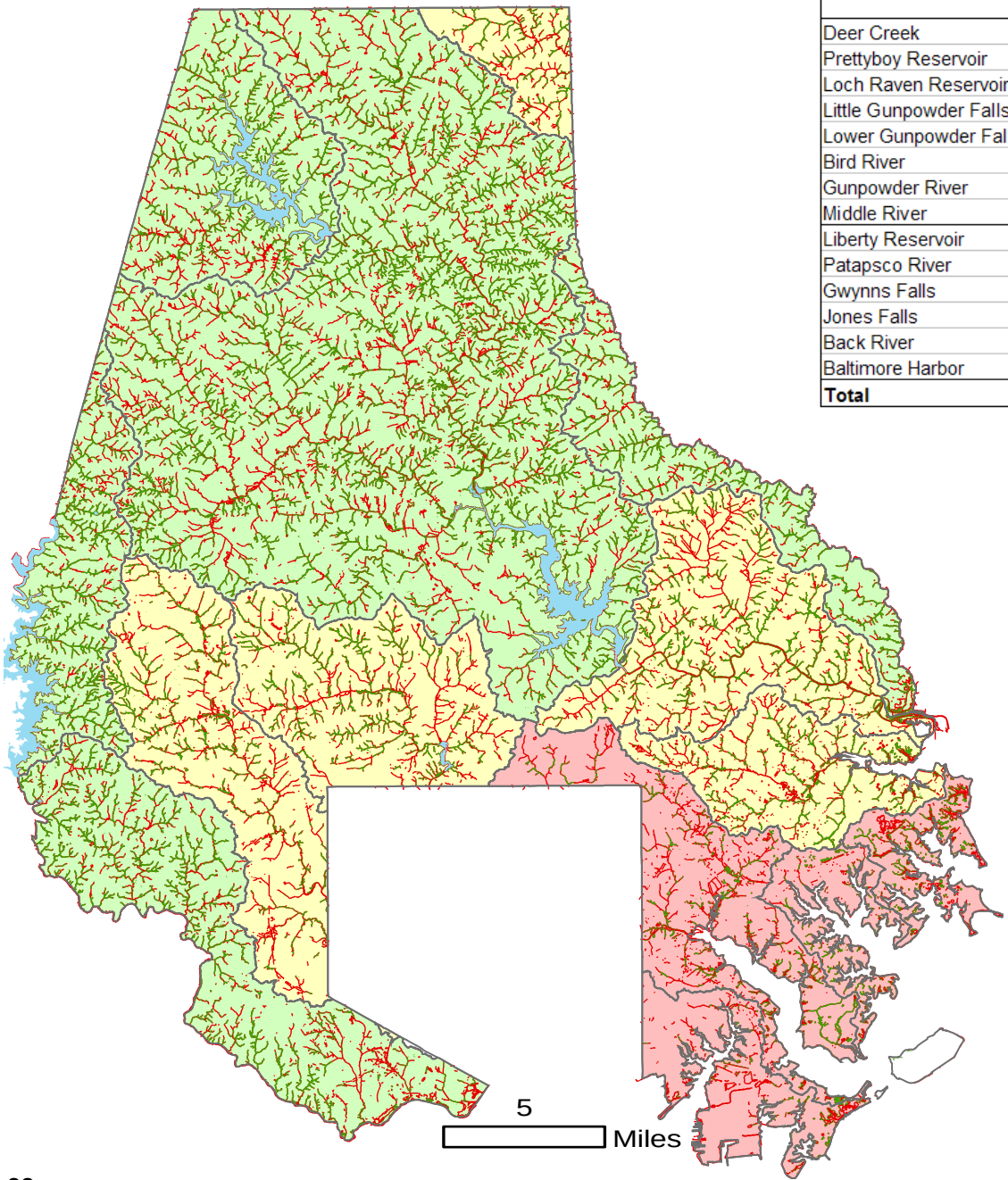
Forests are important for protecting the three drinking water reservoir watersheds for the Baltimore metropolitan region. About 63% of the Maryland area of these watersheds is located in Baltimore County, including about 95% of the Loch Raven, 55% of the Prettyboy, and 17% of the Liberty Reservoir watersheds. In Baltimore County, the reservoirs total 294 square miles or nearly half of the County. The reservoirs and a total of about 17,000 acres of forest are owned by the City of Baltimore, a separate political jurisdiction. The Baltimore water system is the largest public water supply in Maryland and serves a total of 1.8 million people or about one-third of the State's population. Baltimore County is the largest user of the City's water, which serves about 90% of the County's population. The County pays the City for water used.

Watershed	Acres	Forest	% Forest
Prettyboy	25,545	11,797	46.2%
Loch Raven	139,554	56,409	40.4%
Liberty	17,555	8,260	47.1%
Total	**182,654**	**76,466**	**41.9%**

The reservoirs store about 80 billion gallons of water, with Liberty the size of Loch Raven and Prettyboy combined. Prettyboy does not have a direct water intake and serves to maintain the level of the Loch Raven Reservoir downstream.

The table presents the watershed acreage, acres of forest, and percent forest. These watersheds have the greatest forest cover in the County, but cover nevertheless likely needs to be increased to assure long-term water quality.

Riparian Forests



Watershed	# Riparian Buffer Areas	Total Acres Riparian Buffer	# Riparian Forest Areas	Acres Riparian Forest	% Riparian Buffers w Forest
Deer Creek	15	1,191	390	566	47.5%
Prettyboy Reservoir	20	5,091	2,278	2,899	56.9%
Loch Raven Reservoir	227	26,400	10,369	15,682	59.4%
Little Gunpowder Falls	46	3,130	1,288	1,932	61.7%
Lower Gunpowder Falls	100	5,199	1,364	2,449	47.1%
Bird River	176	2,847	1,142	1,294	45.4%
Gunpowder River	69	1,802	999	591	32.8%
Middle River	79	1,218	1,869	404	33.2%
Liberty Reservoir	48	3,795	1,182	2,534	66.8%
Patapsco River	143	5,874	1,830	3,225	54.9%
Gwynns Falls	110	3,854	1,494	1,620	42.0%
Jones Falls	98	3,945	1,402	1,945	49.3%
Back River	219	3,649	2,152	1,147	31.4%
Baltimore Harbor	79	1,730	1,320	274	15.8%
Total	**1,429**	**69,724**	**29,079**	**36,562**	**52.4%**

Regardless of the total percentage of land in a watershed that is in forest cover, the most important characteristic of forest cover for water quality is forest cover along streams. For this analysis, a hypothetical 100-foot buffer on all streams in Baltimore County was determined, and the presence or absence of forest cover within the buffer was calculated. Overall, about 52% of the nearly 70,000 acres of land comprising 100-foot buffer areas along the County's streams is forested. Also, about 27.5% of all forest cover in the County is located within riparian buffer areas. Riparian cover is at least 30% for all watersheds except the Baltimore Harbor. The Liberty Reservoir and Little Gunpowder Falls watersheds have greater than 60% forest cover along stream buffers.

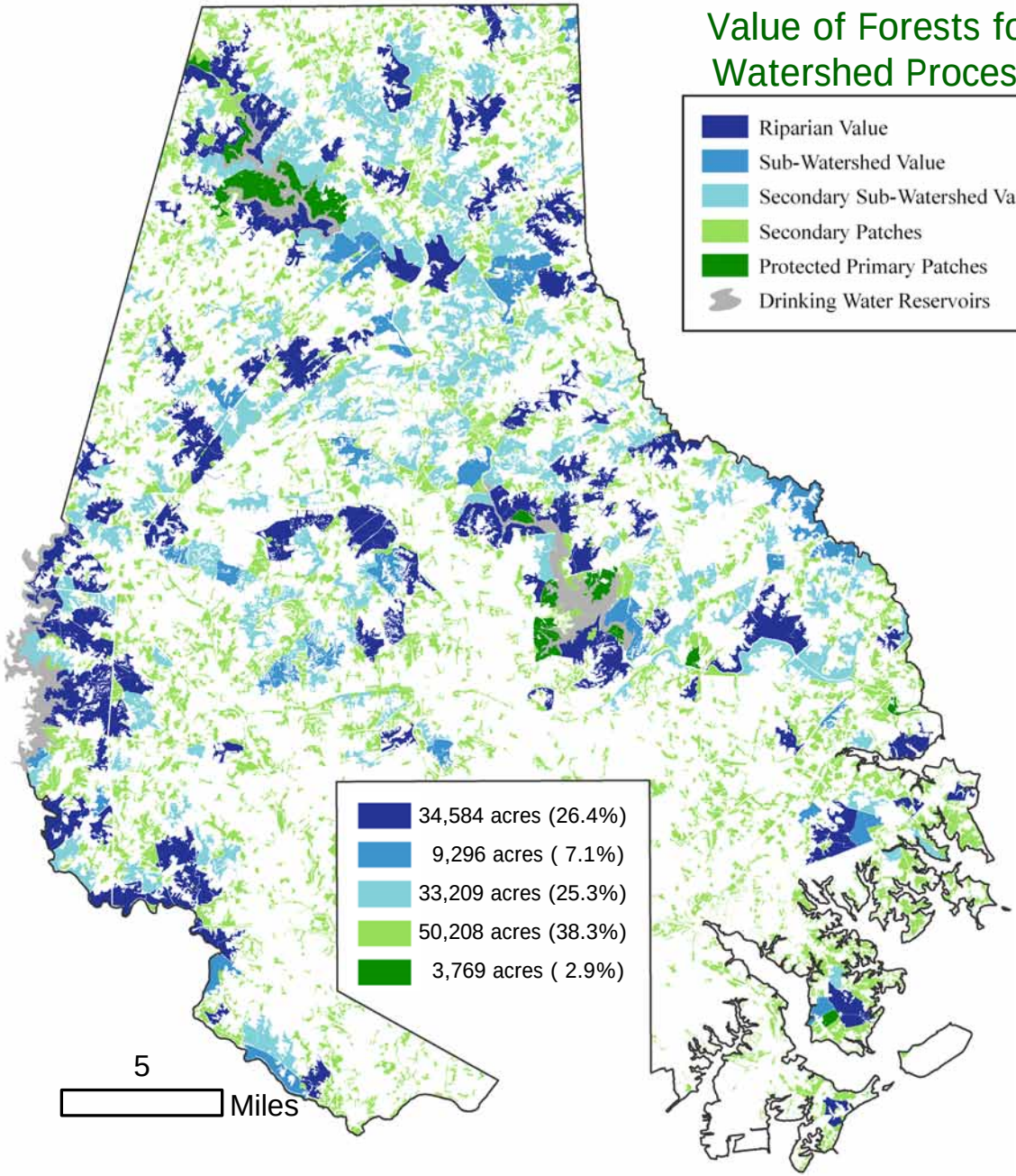
Unforested Buffers (100')
Forested Riparian Buffers

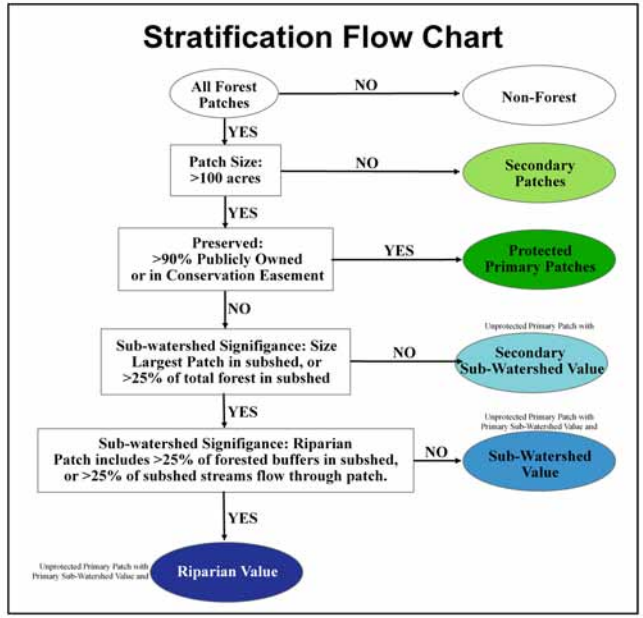
Watersheds with:

33% or less riparian forest
33% to 50% riparian forest
50% to 66% riparian forest

2 1 0 2 4 6 Miles

Water Quality Typology

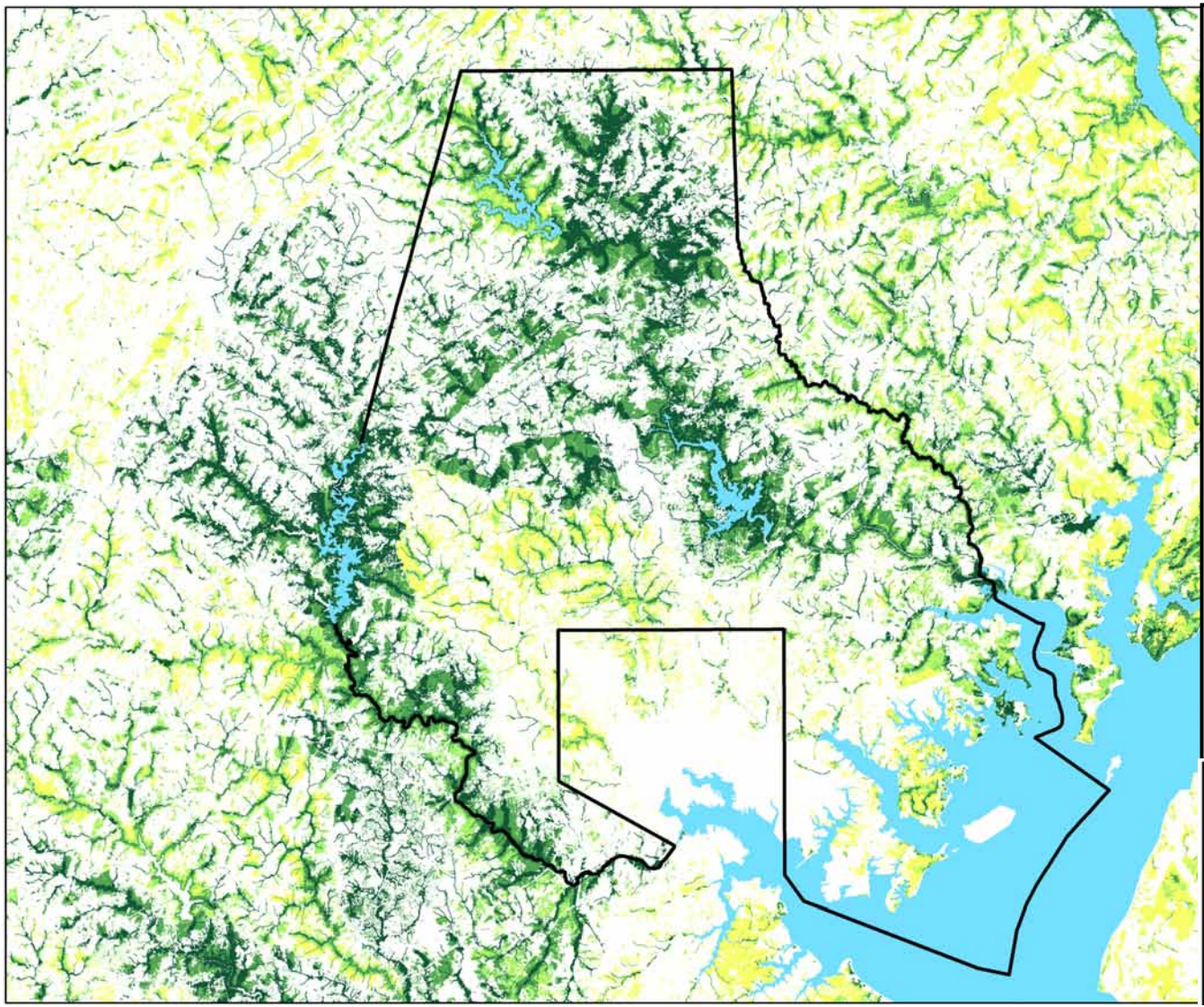




This map differentiates forest patches by varying degrees of value for watershed process. The premise, outlined in the flow chart above, is that larger patches are more important than smaller patches; protected patches are more important than unprotected patches, based on public ownership or conservation easements; and patches containing more stream length are more important than patches with fewer streams. The thresholds for importance are arbitrary and are set at 25% for sub-watershed and riparian coverage. Therefore, if a forest patch comprises more than 25% of the total forest cover in a sub-watershed, it is more likely to contribute the greatest to the overall hydrologic stability of that watershed. The overall “best” or most valuable forest patches for water quality are those large, protected patches with high riparian importance, shown in dark green on the map. These would be the patches most important to protect from future conversion of forest including loss of riparian cover.

Water Quality Value – Resource Lands Assessment

As part of its work for the Chesapeake Bay Program, a national restoration effort for the Bay and its 64,000 square mile watershed that is the largest estuary in the U.S. and one of the most productive in the world, the USDA Forest Service has developed a model of the water quality ranking of forests in the Bay watershed. The "Resource Lands Assessment" ranks numerous factors, including distance to streams and water bodies such as reservoirs and water intakes, slope, soil characteristics, and other features.



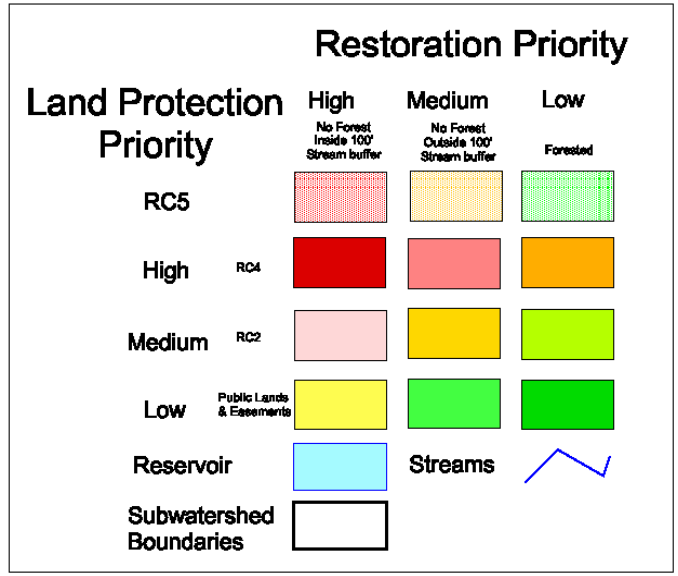
The map depicts the forest cover in Baltimore County and environs with respect to value for water quality. A large portion of the rural forests in the County are ranked high or medium high, noticeably higher than many of the forest in adjacent counties, due to their location in drinking water reservoir watersheds.

Higher value areas include forests adjacent to the reservoirs and along the north- and southeast-facing slopes of the Worthington Valley, as well as tributaries to Little Falls such as Beetree Run north and east of the Gunpowder Falls near the Prettyboy Reservoir.

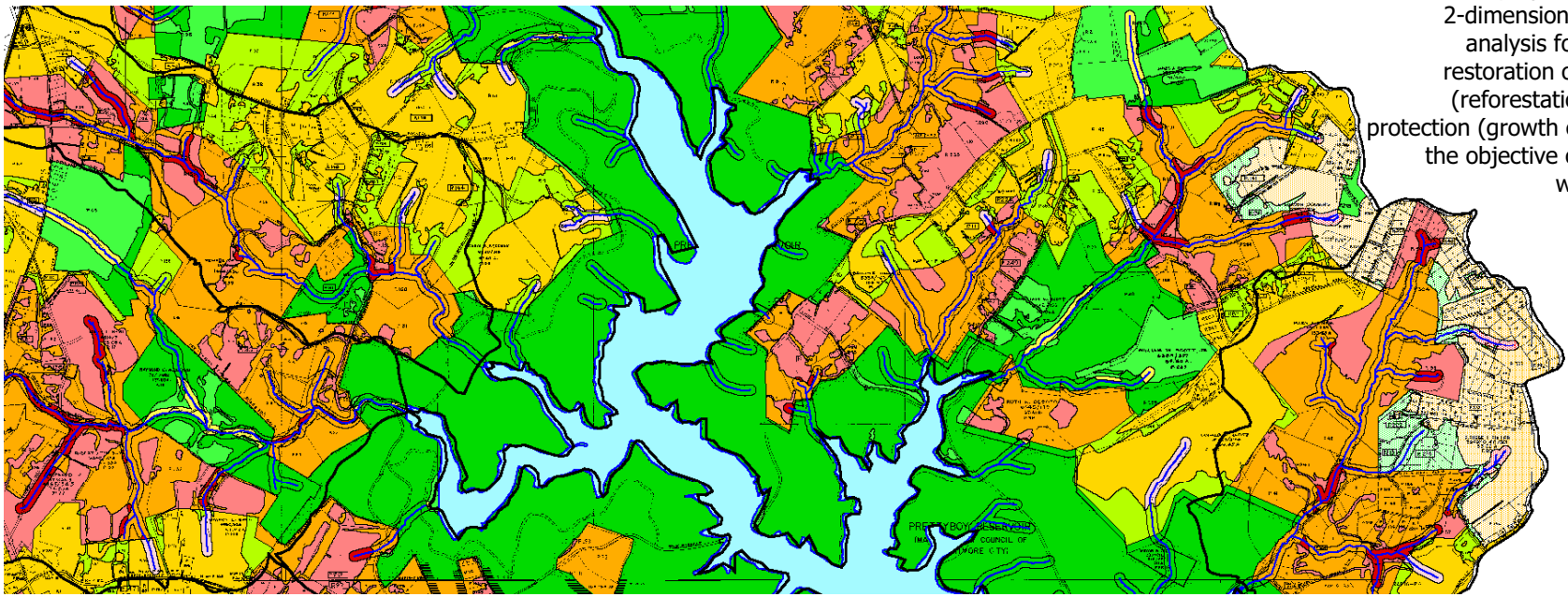
Water Quality Protection

- Low
- Moderate
- Medium High
- High

It is possible to conduct a two-dimensional landscape analyses, using GIS, of forest management for water quality by simultaneously evaluating restoration priorities for water quality through reforestation and the vulnerability of existing forest cover to loss from development. Baltimore County DEPRM participated in a Trust for Public Land Source Water Stewardship project in 2002-2003 as one of four pilots under an EPA grant and developed a landscape typology as an alternative to a raster model developed by one of the project partners. Detailed information about the project and mapping approaches can be found on the TPL web site at: ***http://www.tpl.org/tier2_rp2.cfm?folder_id=2007***



"Part of the coordinated effort involves a comprehensive watershed assessment, including GIS mapping and a ranking system. DEPRM developed a straightforward, intuitive, and simple approach to ranking parcel protection and restoration value. The potential threat of landuse change to development is considered for protection priorities, while the potential for better land management is considered for restoration. Classified map categories indicate the protection and restoration values for each parcel in the Baltimore County portion of the Prettyboy watershed. The protection priority dataset combined zoning, public lands, and easements, while the restoration priority dataset combined the forest cover and derived riparian buffer widths."



The Prettyboy Reservoir Watershed project employed a 2-dimensional landscape analysis for watershed restoration opportunities (reforestation) and land protection (growth control) with the objective of protecting water quality.

What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

Why is this Criterion Important?

"More than any other criterion, this one reflects the fact that forests exist within a context of the global environment and the world's economic and social activities. Criterion 5 embodies a direct link between the environment and the economy, because carbon cycling concerns result from the fossil fuel combustion that powers the human economy. The capacity of forests to sequester carbon may be –or may become- a primary factor for determining the capacity of fossil fueled economies. The global economy, in other words, may be a function not only of the global environment, but particularly of the forested environment."

What are we able to measure at this time?

- Net Primary Productivity

  MD DNR data from the Strategic Forest Lands Assessment for Net Primary Productivity, a measure of utilization of atmospheric carbon during photosynthesis

- Carbon Sequestration

  MD DNR data from the Strategic Forest Lands Assessment for estimates of carbon sequestration based on field measurements and modeling

- Carbon Flux

  Description of the Baltimore Ecosystem Study research on carbon flux at the metropolitan fringe

What are the relevant related management questions for Baltimore County?

5a. What is the contribution of county forest lands to carbon budgets?

- **measure total forest ecosystem biomass and the contribution of forest ecosystems and forest products to carbon budgets**

Net Primary Productivity

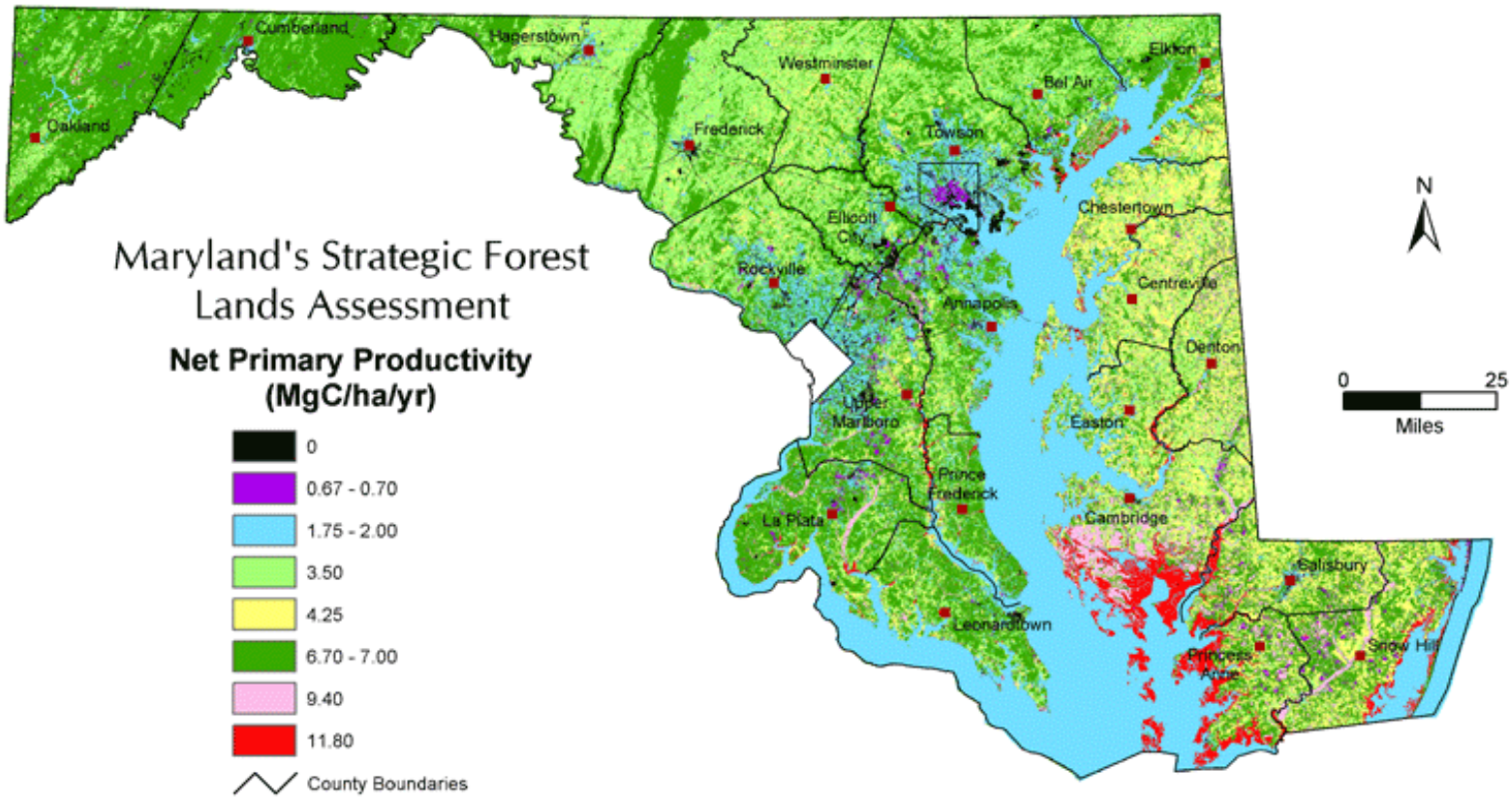
The Indicator

"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."

Indicator Use

"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."

MD DNR Strategic Forest Lands Assessment



Carbon Sequestration

The Indicator

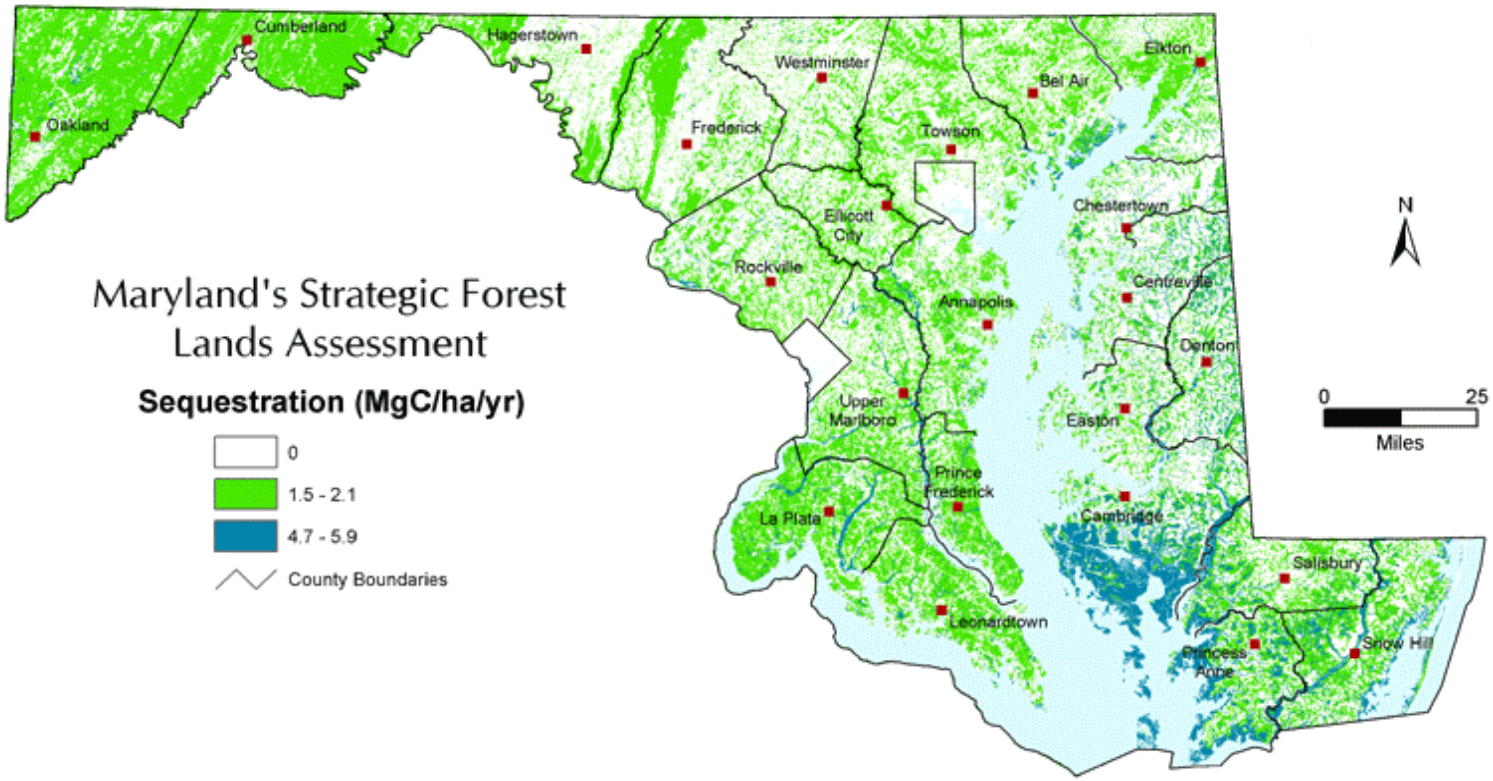
"Carbon sequestration — the permanent removal of carbon from the atmosphere — is driven by Net Primary Productivity (NPP) for any given area of land. What humans do with the vegetation has a lot to do with how much is actually sequestered. Rates at which carbon is permanently tied up in vegetation and 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."

Indicator Use

"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."

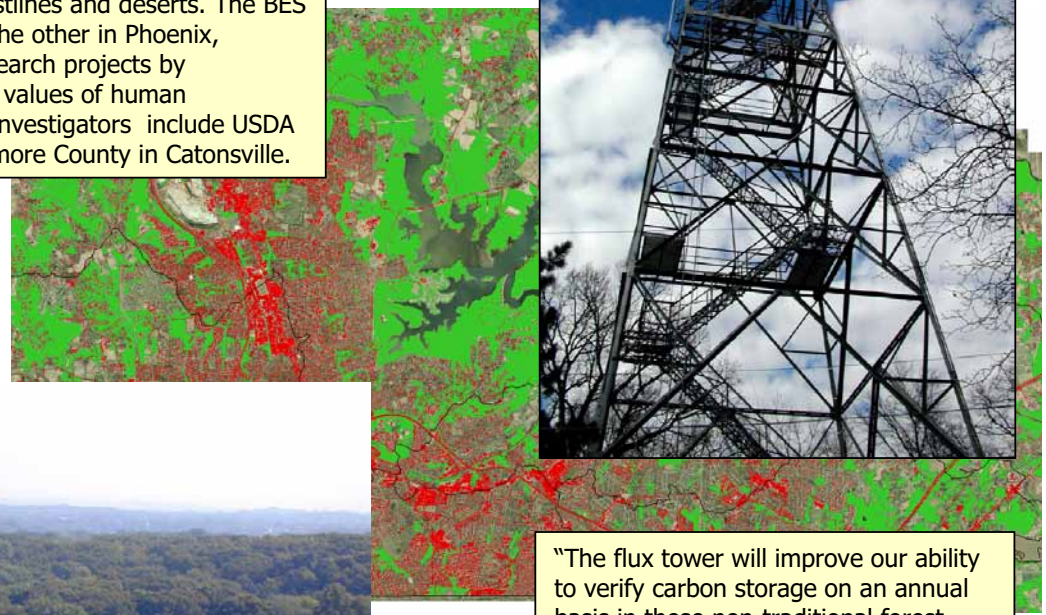
MD DNR Strategic Forest Lands Assessment



Carbon Flux

Much of the needed knowledge about the complex processes involving atmospheric carbon is being developed through research in Baltimore County on the rural-urban fringe as part of the Baltimore Ecosystem Study, a Long-term Ecological Research Project (LTER).

The Baltimore Ecosystem Study (BES) is one of 26 research programs funded by the National Science Foundation to conduct long-term studies on the dynamics and trends of ecological processes in a range of ecosystems, from forests and grasslands to coastlines and deserts. The BES is one of only two research projects taking place in urban ecosystems, the other in Phoenix, Arizona. These urban LTERs differ from more traditional ecosystem research projects by introducing analyses of the impacts of social interactions, activities, and values of human communities on the natural components of the urban ecosystem. BES investigators include USDA Forest Service scientists stationed at the University of Maryland at Baltimore County in Catonsville.



The BES is utilizing an existing 40-meter MD DNR fire lookout tower at the Cub Hill Ranger Station to obtain among other variables continuous carbon flux measurements in the urban/suburban environment. In addition, the BES has established a network of study plots, including eight forest and four grass plots in a distribution from near the urban core to within 30 km into the rural/suburban fringe. According to the BES, "The primary purpose of this research is to measure the net carbon uptake of non-forest lands in forested and developed regions of Baltimore." **(http://www.beslter.org/frame4-page_3a_01.htm)**

Photos from BES web site

"The urban/suburban sites are being established to address questions of elevated levels of CO, temperature, and nitrogen deposition in urban/suburban sites, the effects of temporal cycles on the atmospheric composition of ozone, N deposition, and CO concentration, carbon sequestration rates in suburban and rural forested systems, the potential effects of atmospheric fertilization (CO , N deposition) on carbon uptake storage and net productivity, the effects of climatic variation, and the urban heat island effect on the annual net uptake of CO, the mechanisms by which built structure and vegetation affect heat, water and carbon dioxide exchange in an urban-suburban ecosystem, and what new methodologies are needed for ecosystem carbon flux measurements in an urban-suburban footprint."

"The flux tower will improve our ability to verify carbon storage on an annual basis in these non-traditional forest areas and improve and add to our stocks inventory information used in our national carbon budget. The Forest Inventory and Analysis (FIA) is conducting a pilot study and collecting forest inventory information on plots traditionally called "non-forest" in Baltimore which will provide some of the monitoring of these "non-forest" plots." "…The tower site will play a major role in the air quality and meteorological flux research for the Baltimore Ecosystem Study. **(http://www.fs.fed.us/ne/global/pubs/maps_posters/pdfs/balttower.pdf)**

What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 6: Maintenance and Enhancement of Long-term Multiple Socioeconomic Benefits to Meet the Needs of Societies

Why is this Criterion Important?

"While the first five criteria are centered in the environmental sphere of sustainability (with the exception of Criterion 2, which clearly overlaps the economic sphere), Criterion 6 is centered firmly in the economic sphere. As the sole criterion with an economic focus, it has more (19) indicators than any of the environmental criteria. Its first two subcategories reflect the basic economic breakdown of goods (e.g., wood products) and services (e.g., tourism). The investment subcategory provides indicators of society's attention to forest maintenance. The cultural subcategory includes the most social of the socioeconomic indicators, and the employment subcategory provides indicators of the forests' capacity to provide work, wages, and subsistence."

What are the relevant related management questions for Baltimore County?

6a. What are the extent and value of forest production and consumption in the county?

- **measure the value and quantity of forest and non-forest products and consumption**
- **measure the value of investment and employment in the forest industry**

6b. What are the extent and value of non-timber forest uses and values?

- **measure the extent and value of forest lands managed for non-consumptive uses**

What are we able to measure at this time?

- Baltimore County's Historic Paper Mills

  An historical sketch of forest use at Hoffmanville, Maryland's first paper mill

- Timber and Primary Wood Manufacturing

  MD DNR data on the importance of timber and primary wood manufacturing to the local economy

- Secondary Wood Manufacturing

  MD DNR data on the importance of the secondary wood manufacturing sector to the local economy

- Probability of Commercial Timber Management

  MD DNR data on population density influences ion likelihood of commercial harvesting

- Sawmills and Distance to Sawmills

  MD DNR data on distance to local sawmills

Photo of Original Oil Mural "The Clear Cutting of Oregon Ridge" by Sandy Glover, mid-1990's, at Oregon Ridge Park Nature Center

Baltimore County's Historic Paper Mills

In addition to the clearing thousands of acres of Baltimore County's forests in the Colonial era to producie charcoal to fuel iron ore and limestone furnaces, another early economic use of forests was for paper making. This page presents a brief history of the mills of Hoffmanville near the present-day Prettyboy Reservoir, the location of Maryland's first paper mill. Citizens of the Prettyboy Watershed Alliance prepared a poster (left) about the history of the paper mills of the late 1700's and their operation for more than a century. The poster credits Mary A. Seitz' *The History of the Hoffman Paper Mills in Maryland* (1946). The information here is provided courtesy of the Prettyboy Watershed Alliance.

The Gunpowder River's water and watershed forests favored the construction and operation of several paper mills:

- **Clipper Mill** – Maryland's first paper mill; damaged by flood and abandoned in 1889 (same storm as Johnstown PA flood)
- **Gunpowder Mill** – built in 1781 by Friedrich Wilhelm Hoffman; damaged in 1889; closed in 1898
- **Marblevale Paper Mill** –at Ashland near Loch Raven; bought by grandson Wm. Henkle Hoffman; destroyed by fire, 1888
- **Rockdale Paper Mill** – acquired by Wm. Henkle Hoffman and expanded, 1852; damaged by flood of 1889

Gunpowder Paper Mill workers 1893

"The grandson (William), like all the Hoffmans, was very community conscious. He established a village at the NE corner of Alesia and Gunpowder Rds. where his workers could either buy a home of rent on a 50:50 basis. … Shortly before he died in 1886, the name of the settlement Paper Mills was changed to Hoffmanville."

Hoffmanville

"Papermaking came to America in 1690 when Wm. Rittenhouse established our first paper mill in Philadelphia. Pennsylvania had several mills in the early 1700's and a 28-year-old German immigrant, Friedrich Wilhelm Hoffman (1740-1811), became an apprentice in one of these mills in 1768. He married and in 1775 he decided to leave the competition in Philadelphia and move to Maryland. After an extensive search, he chose to establish his mill on the banks of the Gunpowder Falls because the water was exceptionally clean and pure – essential for making high quality paper – and it was abundant. This was important because water was used to power the mill. This mill – The Clipper Mill – was the first paper mill in Maryland.

Friedrich Wilhelm (or William as he now called himself) was an enthusiastic supporter of the Revolution of 1776 and when the new currency was adopted he manufactured the paper for the Continental money.

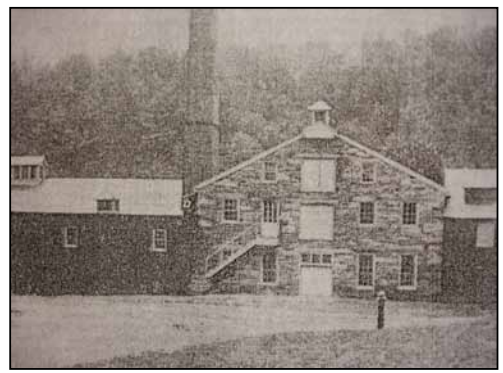
He was able to buy about 2000 acres bordering the Gunpowder and in 1781 he erected a second mill – The Gunpowder Mill – one-quarter mile upstream of the Clipper Mill. In time, a settlement known as Paper Mills grew up around the mills.

Then in 1889, an extensive rain settled in – the same rains that causes the Johnstown, Pa flood with its loss of 2200 lives. The Great Gunpowder falls was at high water mark and the mill dam gave way. The Gunpowder and Rockdale mills could be repaired but the Clipper Mill was so badly damaged that it was never used again. Unfortunately at about this same time, paper production was moving to the New England states and the Hoffmans found it difficult to remain competitive. So, after 117 years of operation the mills were closed.

In 1901 the land was sold to the Rockdale Powder Company. A new dynamite plant was built about 300 yards downstream from the Gunpowder Mill. A powder plant was erected near the Clipper Mill. Before both plants ceased operations in 1908 there was one explosion at the dynamite plant and four at the powder plant.

In 1925 the former Hoffman land went into possession of the City of Baltimore as it had been decided that the Loch Raven Reservoir was no longer sufficient. The Prettyboy Dam was completed in 1933 covering the greater part of the Hoffman land."

The Gunpowder Paper Mill in Hoffmanville (photo ca. 1900) was built by Wm. Hoffman in 1781. Hoffman house (right rear).



The Rockdale Paper Mill Built by William H. Hoffman, 1852

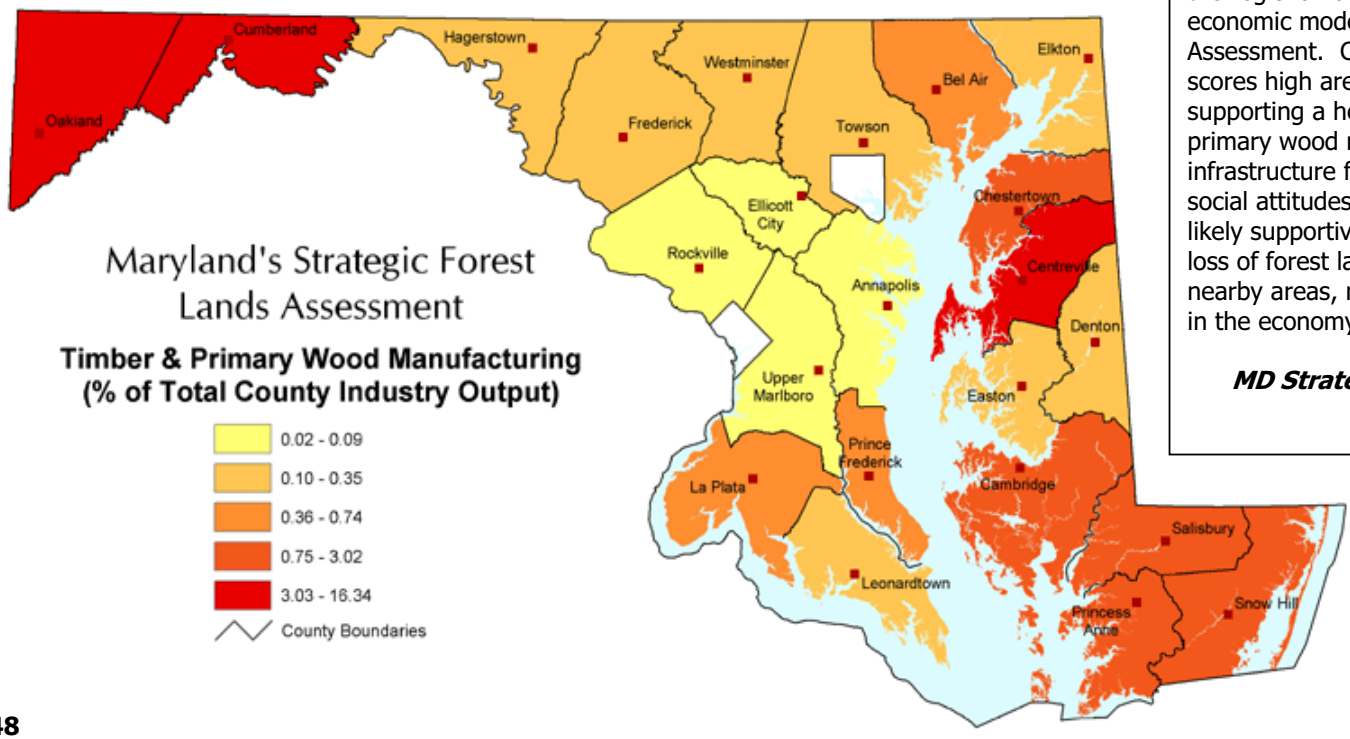
Timber and Primary Wood Manufacturing

The Indicator

"The timber and primary wood manufacturing sectors represent industries related to logging, timber management, sawmills, pulp mills and other mill work. Timber management activities include operation of timber tracts, tree farms, and forest nurseries; harvesting and transporting logs; producing rough, round, hewn or riven primary forest or wood raw materials; and reforestation services. Primary wood manufacturing includes processing of logs and related products into lumber, veneer and plywood, pulp and turpentine and other products, like particle board or mulch. These activities tend to be located in relatively close proximity to the forest resource base.

In order to create this indicator, output for timber and primary wood manufacturing industries relative to total output of all economic sectors is evaluated at a county level to index the importance of these industries to the local economy. Total output is the total value of production of goods and services produced in a given time period. It is similar to industry sales, plus or minus inventory.

Data for this indicator were taken from 1999 IMPLAN database from Minnesota IMPLAN Group, Inc. (http://www.implan.com/index.html). IMPLAN data files are compiled from a wide variety of sources including the US Bureau of Economic Analysis, the US Bureau of Labor, and Census."



Indicator Use

"The data comprising this indicator were among the regional factors incorporated into the economic model for the Strategic Forest Lands Assessment. Counties where this indicator scores high are more likely to continue supporting a healthy timber management and primary wood manufacturing industry. The infrastructure for these industries is in place and social attitudes towards these activities are likely supportive. From another perspective, loss of forest land in these counties, or in nearby areas, may trigger a significant decline in the economy."

MD Strategic Forest Lands Assessment

Secondary Wood Manufacturing

The Indicator

"The secondary wood manufacturing sector represents the remanufacture of lumber, plywood, paper and other timber products into finished goods, such as furniture, toys, containers, or structural components. It may also include paper manufacturing where this is carried out in a facility that does not also pulp timber. The location of these industry activities is predominantly influenced by proximity to other manufacturing and to wholesaling infrastructure, such as shipping, the availability of manufacturing supplies, and market outlets.

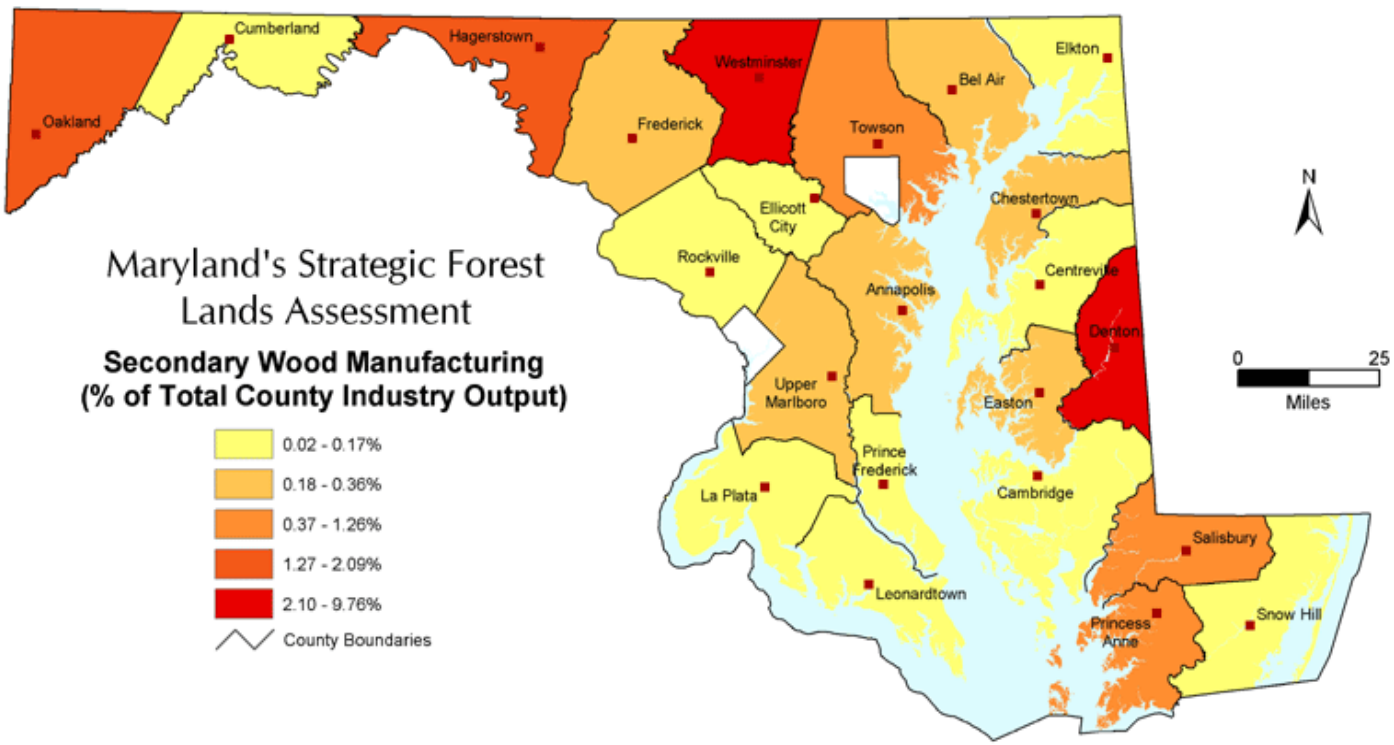
In order to create this indicator, industry output of secondary wood manufacturing sectors relative to total industry output of all industry sectors is evaluated at a county level to index the importance of these industries to the local economy.

Data for this indicator were taken from 1999 IMPLAN database from Minnesota IMPLAN Group, Inc. (http://www.implan.com/index.html). IMPLAN data files are compiled from a wide variety of sources including the US Bureau of Economic Analysis, the US Bureau of Labor, and Census."

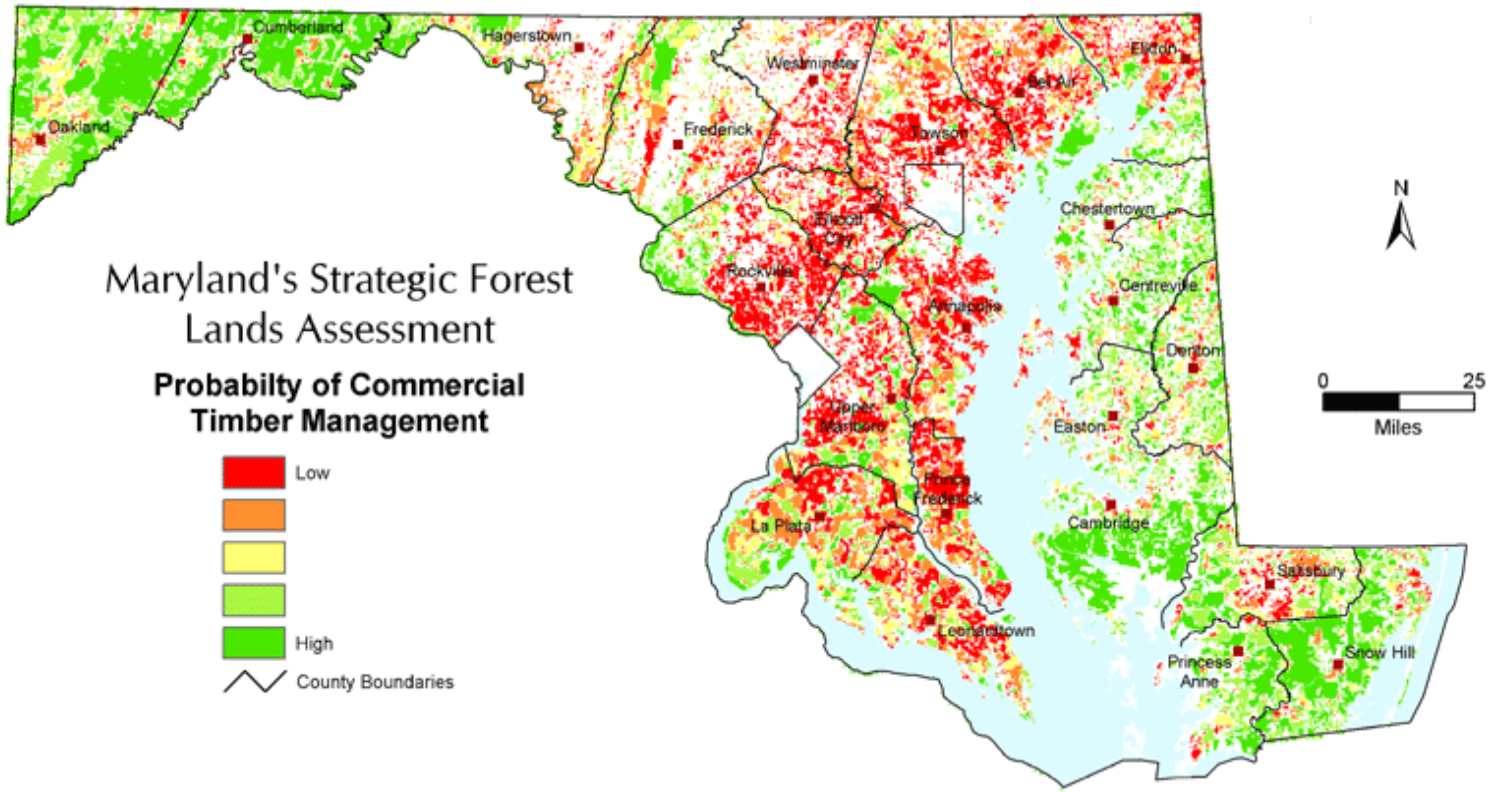
Indicator Use

"This indicator points to the importance of the forest products industry even in counties where forests themselves are not the dominant cover in the landscape. Regional loss or gain of forest land managed for economic purposes may impact these secondary wood manufacturing economies. The data comprising this indicator were among the regional factors used in the economic model for the Strategic Forest Lands Assessment."

MD DNR Strategic Forest Lands Assessment



Probability of Commercial Timber Management



The Indicator

"Increasing population density can affect timber supply by a shift in forest management objectives as well as by direct conversion of forested land to developed areas. For example, management for timber production may shift to management of forests as residential or park settings when population density increases. Land clearing accompanies this transition and may provide timber products, but only in the form of a one-time cutting called a terminal harvest. More land-use conflicts over timber management in remaining woodlots accompany this trend, adding to the difficulties for forest management created by smaller tract size and decreasing forest contiguity.

To develop this indicator, population density derived from year 2000 census data was overlaid on forest cover from the National Land Cover Data set."

Indicator Use

"This indicator, based on population density, highlights forested areas that are more likely to support sustainable commercial timber activities and those areas that are more suited for other forest-based uses, such as soil and water conservation/protection, wildlife habitat, recreation, etc. It paints a bleak picture for timber availability for Maryland's forest products industry. Only the Eastern Shore and Western Maryland are likely to have significant amounts of timber available for commercial management. Maintenance of the viability of the forest products industry can become a factor in local government planning affecting population density in a way analogous to efforts to protect agriculture."

MD DNR Strategic Forest Lands Assessment

Sawmills and Distance to Mills

The Indicator

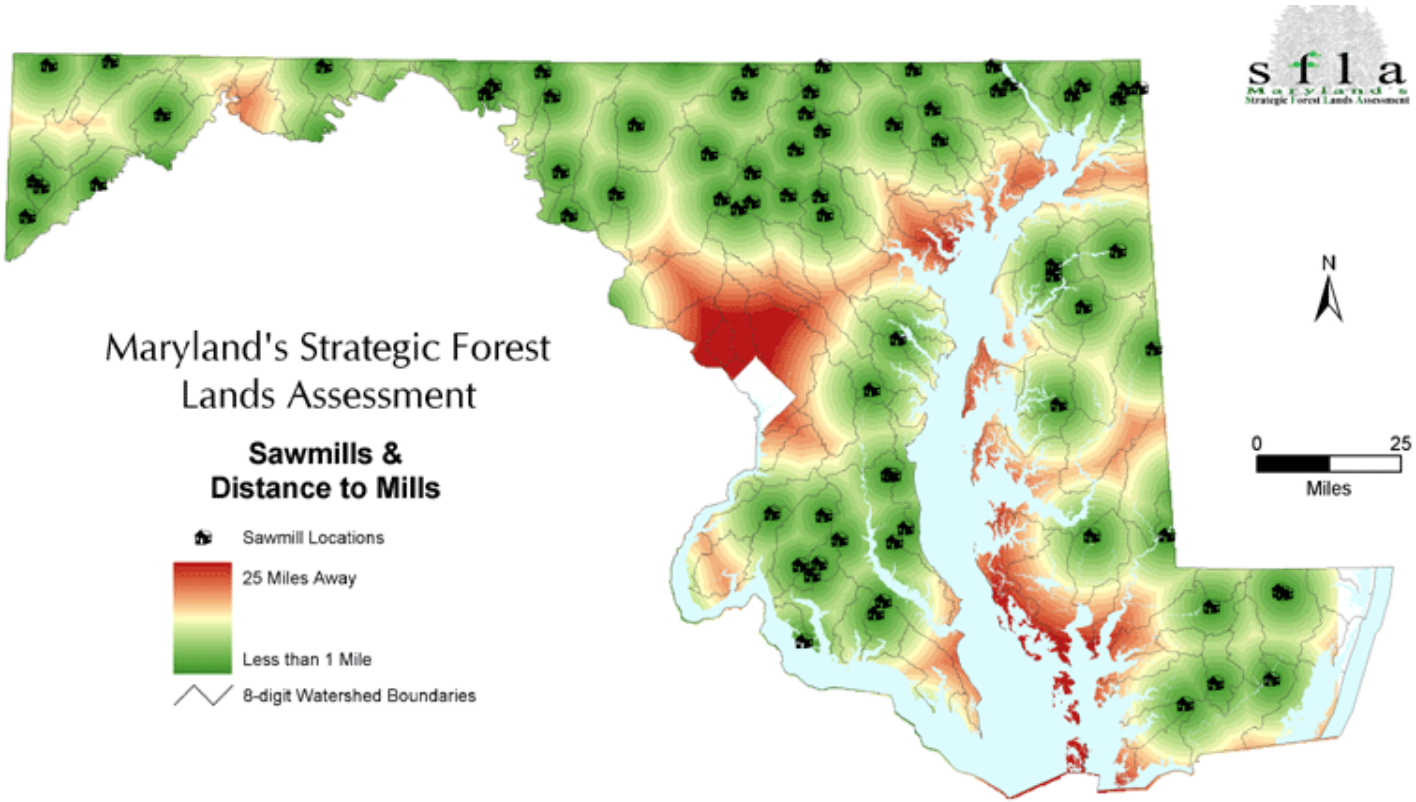
"Because of high transportation costs, sawmills are usually located relatively close to where timber is harvested. Forested areas closer to primary processing mills, such as sawmills or pulp mills, are more likely to be important sourcing areas than are those areas farther away. In fact, most forest land in Maryland is within 10 miles of one of the roughly 100 mills shown as active in this indicator. Many of these mills are small; some in the central part of the State serve primarily final cuts preceding land development activities. Mills in the northern and western parts of the State process primarily hardwoods, while those on the Lower Eastern Shore deal mostly with pine—the high value timber types in their regions.

Locations of sawmills were derived from forest product operators' licenses issued by the Maryland Forest Service. Distances around these points were calculated in a Geographic Information System."

Indicator Use

"Forested areas closer to primary processing mills, such as sawmills or pulp mills, are more likely to be important sourcing areas than are those areas farther away. Maintaining these mills as functioning operations is an important factor in maintaining forest management in their sourcing areas."

MD DNR Strategic Forest Lands Assessment



What does the *National Report on Sustainable Forests – 2003* say about this Criterion?

Criterion 7: Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

Why is this Criterion Important?

"Although it overlaps with the economic sphere, this criterion is centered in the social sphere of sustainability. Its first three subcategories provide for the assessment of laws, regulations, policies, planning, and public involvement pertaining to sustainable forest management. The last two subcategories address the nature and levels of forest research, monitoring, and reporting. Together, they reflect society's propensity and capacity to sustain forested ecosystems and associated economies."

What are the relevant related management questions for Baltimore County?

7a. Are current laws, regulations, policies, planning, and public involvement effective for promoting forest sustainability?

- **measure the legal & institutional framework in support of forest sustainability**
- **measure the value of forests to the citizens of Baltimore County**

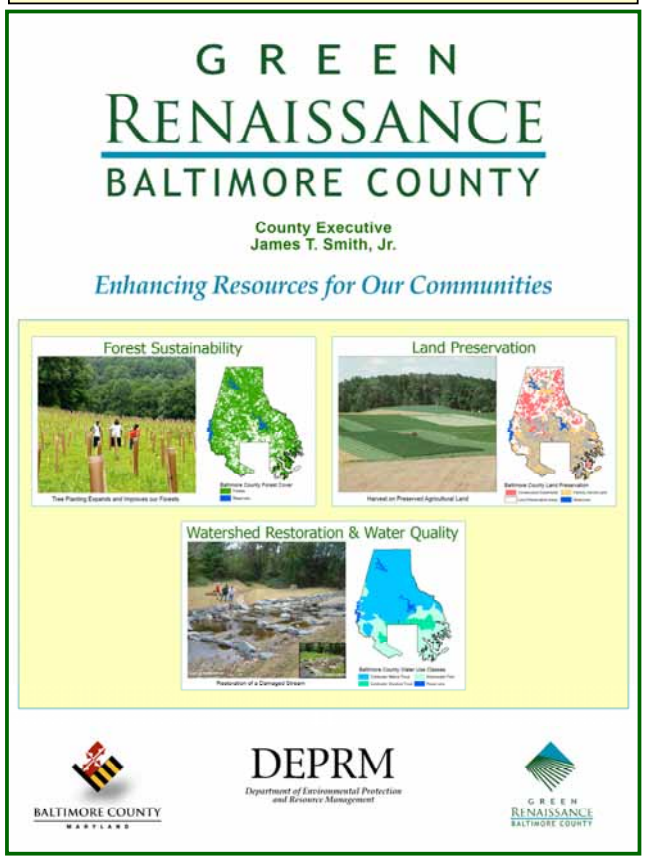
What are we able to measure at this time?

This section presents data and information for a number of local public programs and involvement relevant to Criterion #7:

- Green Renaissance
- Forest Ownership
- Zoning of Forested Land
- Land Use Classification of Forested Land
- Forest Conservation
- Tree-Mendous Maryland
- Community Reforestation
- Community Forestry Operations
- Growing Home Campaign
- Green Schools
- Rural Residential Stewardship Initiative

Green Renaissance

Criterion #7 of the MPCI assesses the laws, regulations, policies, planning, and public involvement pertaining to sustainable forest management, as well as forest research, monitoring, and reporting. In any community, these institutional instruments and their implementation evolve over time. In Baltimore County, direct and indirect public involvement in forest management is represented by a significant amount of "program." In 2005, County Executive Smith announced the Green Renaissance initiative, itself a framework for enhancing resource management for the benefit of our communities. While elements of public programs that relate to forest management are presented elsewhere in this report, this section outlines the range of activity and highlights several newer elements for our forests.



Prior to the Green Renaissance initiative, Baltimore County benefited directly and indirectly from more traditional approaches to forest protection, especially though polices in the Master Plan and its implementation tools, including:

- the adoption of the urban growth boundary (the URDL) in 1967,
- the application of Resource Conservation zoning across the northern two-thirds of the County beginning in 1975,
- the establishment of land preservation programs beginning in 1980,
- the enactment of development policies and regulations including non-tidal wetland protection by policy beginning in the early to mid 1980's and leading to the enactment in 1988 of *Chesapeake Bay Critical Area* regulations, the *Regulations for the Protection of Water Quality, Streams, Wetlands and Floodplains* ("forest buffers") in 1990, and the *Forest Conservation Act* in 1992.

While these have been effective in protecting and restoring resource functions in watersheds, additional targeted approaches are needed. Green Renaissance includes major program enhancements including Forest Sustainability, Land Preservation, and Watershed Restoration and Water Quality. For each of these, special strategies and plans have been prepared or are underway to provide a more strategic management framework. Forest Sustainability using the MPCI is integrating ecological and economic perspectives, while the Land Preservation program is conducting optimization studies to determine how to best reach the current 80,000 acre preservation goal. The Watershed Restoration and Water Quality

program is preparing Small Watershed Action Plans in conjunction with citizens, and is developing restoration alternatives to address specific water quality impairments.

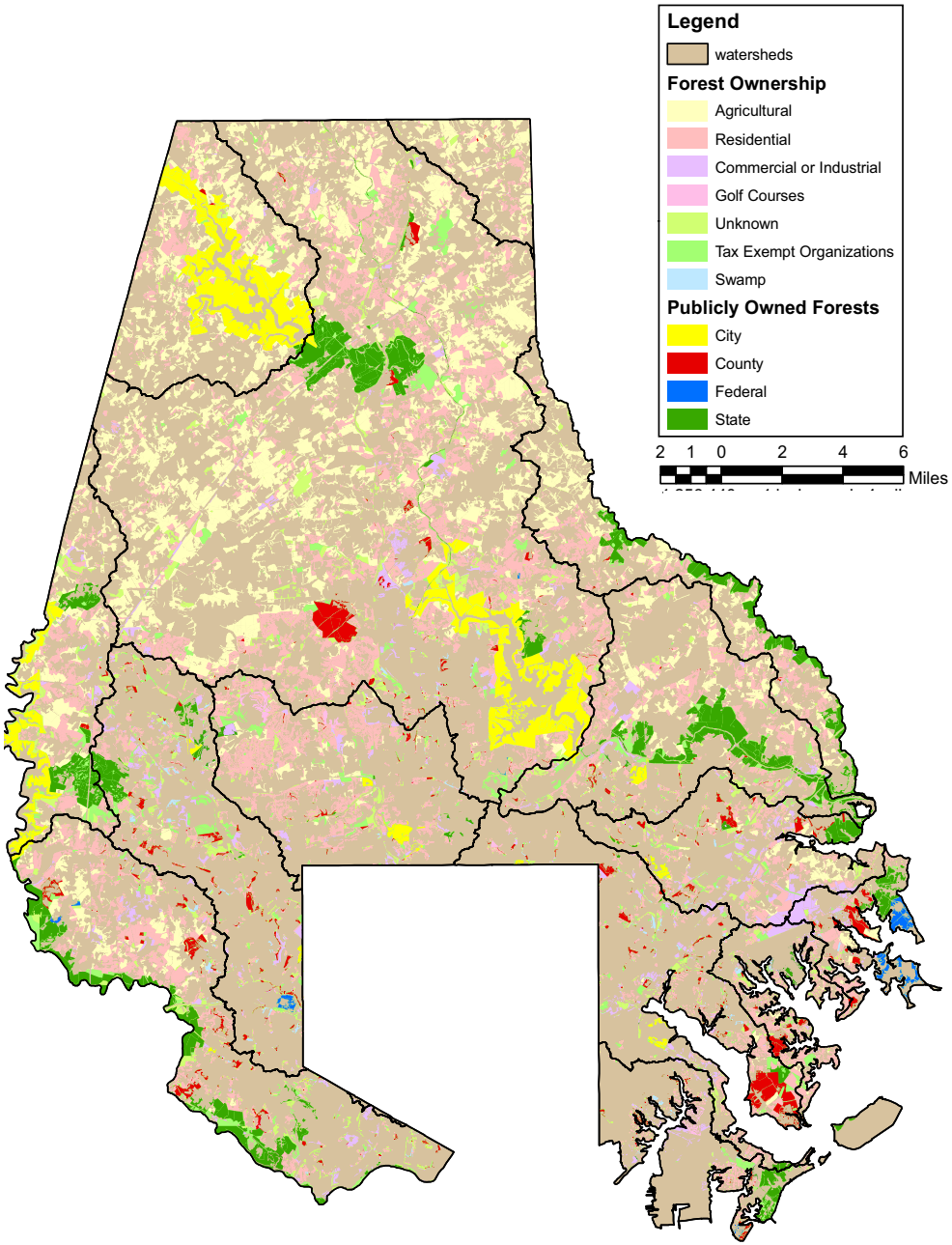
Ultimately, these three components of Green Renaissance are themselves fully integrated through both policy and measurement of effectiveness.

In this section that describes public involvement for forest sustainability, several newer programs administered by DEPRM that serve three core themes for forest sustainability - "keep forests as forests," pursue strategic reforestation opportunities, and educate and partner with citizens and organizations for better forest stewardship - are presented:

- Green Schools
- The Growing Home Campaign
- Rural Residential Stewardship Initiative

In the near future, additional elements will include new inter-jurisdictional efforts such as the Community Greening element of the 2006 Baltimore (City-County) Watershed Agreement.

Forest Ownership



"Far and away the majority, some 76%, of Maryland's 2.6 million acres of forest land is privately owned, by 130,600 individuals and corporations. But 75% of these owners control woodlots of fewer than 10 acres. Division of large tracts of forest land among multiple owners is referred to as parcelization, and it has major implications for the protection and management of forests.

With parcelization into small ownerships, the reasons for forest land ownership are likely to shift away from management for forest products, wildlife and recreation. Coordination of multiple owners to deal with forest health issues, like invasive species of non-native plants or insects, is also complicated and may hold serious implications for long-term health and viability of the remaining forests. Finally, parcelization contributes to the forest fragmentation which has also become manifest in Maryland's landscape, with its associated impacts on wildlife habitat, biological diversity, water quality, and the viability of resource-based industry. Increasingly forest land owners are among the older of the State's citizens—the 65+ age group is increasing dramatically—which suggests an increasing rate of parcelization may be anticipated in the future."

MD Strategic Forest Lands Assessment

More than 32,000 acres (24.6%) of Baltimore County's forest lands are in public ownership. Publicly owned forests comprise the largest contiguous forest blocks. The State of Maryland is the largest forest landowner in the County, with approximately 14,880 acres located primarily in three major State parks: the Gunpowder Falls State Park on the Little Gunpowder Falls on the Harford County border and along the (Big) Gunpowder Falls downstream of Prettyboy Reservoir, and the Patapsco River State Park along the Patapsco River on the Howard and Anne Arundel County borders. The City of Baltimore owns about 12,400 acres of forest lands surrounding the Prettyboy, Loch Raven, and Liberty Reservoirs, and Lake Roland, a former water supply reservoir now used for recreation. Baltimore County owns more than 4,760 acres of forest land, including Oregon Ridge Park, the Shapiro Property/Essex Skypark, and numerous other regional and local parks throughout the urbanized area of the County. The federal government also owns nearly 600 acres of forested land, mostly adjacent to Harford County as part of the Aberdeen Proving Grounds.

Forest Ownership

Acres of Publicly-owned Forests by Watershed and Level of Government

Watershed	Federal	State	Balto. City	County	Total
Deer Creek	-	-	-	4.4	4.4
Prettyboy Reservoir	-	55.8	5,139.1	18.4	5,213.2
Loch Raven Reservoir	9.8	3,406.8	4,790.8	1,271.0	9,478.4
Little Gunpowder Falls	-	1,888.7	-	17.1	1,905.8
Lower Gunpowder Falls	-	2,813.5	163.8	94.9	3,072.2
Bird River	-	442.8	100.9	364.2	908.0
Gunpowder River	442.1	417.2	-	352.8	1,212.2
Middle River	-	77.1	-	208.6	285.7
Liberty Reservoir	-	1,260.5	1,665.1	33.2	2,958.7
Patapsco River	35.9	2,955.7	88.8	642.2	3,722.6
Gwynns Falls	88.3	841.9	78.2	543.6	1,552.0
Jones Falls	-	102.9	289.5	123.3	515.7
Back River	-	184.3	113.1	1,004.8	1,302.2
Baltimore Harbor	4.1	426.0	-	84.8	514.9
Total	**580.2**	**14,873.2**	**12,429.4**	**4,763.2**	**32,645.9**

Forest Ownership by Parcel Tax Assessment Classification

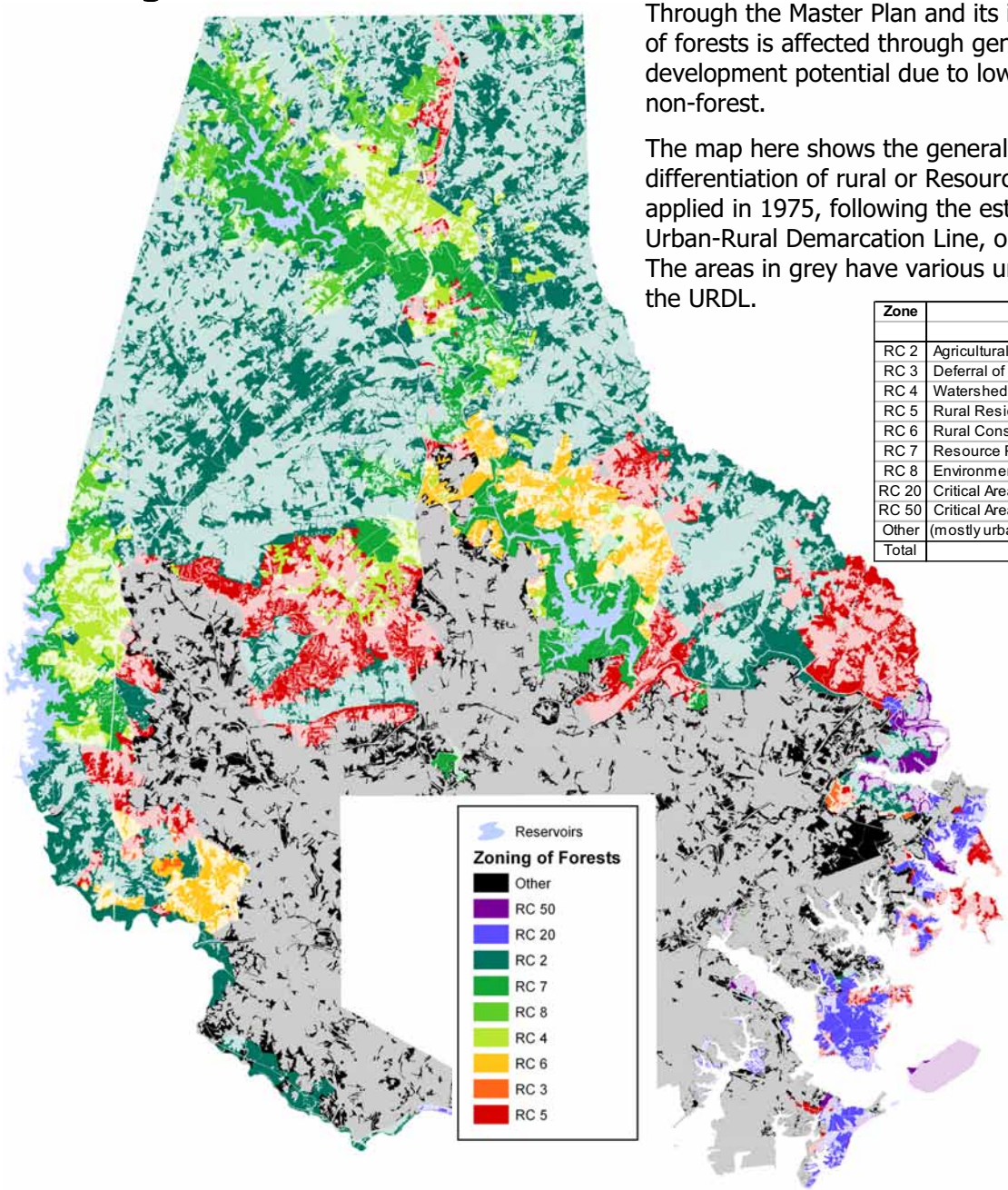
Watershed	Resid.	Agric.	Com.	Ind.	Exempt	Swamp	Unk.	Total
Deer Creek	511	1,727	5	11	3	-	88	2,345
Prettyboy Reservoir	1,901	4,380	12	1	136	-	5,367	11,797
Loch Raven Reservoir	17,084	23,654	759	598	6,250	78	7,986	56,409
Little Gunpowder Falls	1,761	2,405	20	4	1,847	0	302	6,340
Lower Gunpowder Falls	2,982	1,913	266	146	3,360	8	785	9,460
Bird River	1,449	643	169	888	1,096	19	474	4,738
Gunpowder River	485	200	46	439	974	19	292	2,453
Middle River	884	51	33	273	378	32	139	1,789
Liberty Reservoir	2,189	1,859	139	51	2,488	3	1,530	8,260
Patapsco River	4,096	1,791	230	461	3,541	69	1,509	11,697
Gwynns Falls	1,339	102	421	345	2,023	177	840	5,246
Jones Falls	4,215	592	658	52	965	14	482	6,977
Back River	1,267	104	166	384	1,587	79	451	4,038
Baltimore Harbor	139	-	91	190	639	5	70	1,133
Total	**40,303**	**39,419**	**3,015**	**3,842**	**25,285**	**503**	**20,315**	**132,683**

Publicly-owned forests meet recreational needs of citizens.

Forest ownership by use, based on the tax assessment classification of parcels with forest cover, is hampered by an imperfect database. The cadastral (property) data layer used for this analysis includes approximately 15% of total forest acres on parcels for which the assessment classification is described as "Unknown." In fact, however, based on a visual scan of the location of these parcels, a large share of these acres is public land, including City-owned reservoir lands. Furthermore, as Exempt forests include publicly-owned forest lands and institutional ownerships, at least a respectable share of the "Unknown" forest use types can safely be assumed to be public as a result of comparing the 25,000 aces of Exempt forest lands to the 32,600+ acres of publicly-owned forests.

Overall, the predominant use types are Residential and Agriculture, each accounting for about 30% of total forest acres. The percentage of forest lands assessed for Commercial and industrial use are an order of magnitude smaller than Residential and Agriculture uses.

Zoning of Forested Land



Through the Master Plan and its implementation tools, especially zoning, the sustainability of forests is affected through general control over the use of land. Areas with low development potential due to low density will be less vulnerable to conversion of forests to non-forest.

The map here shows the general zoning pattern of Baltimore County, especially the differentiation of rural or Resource Conservation (R.C.) zones. These R.C. zones were first applied in 1975, following the establishment of the County's urban growth boundary, the Urban-Rural Demarcation Line, or URDL, in 1967 within the southern third of the County. The areas in grey have various urban, denser zoning classifications and are largely inside the URDL.

Zone	Zone Name	Zoning Acres	Forest Acres	% of Zone Forested	Density (du/ac)
RC 2	Agricultural Protection	139,333.1	48,749.1	35%	0.02 du/ac (1 lot/50 ac.)
RC 3	Deferral of Planning	811.7	329.4	41%	0.3 du/ac (1 lot/3.3 ac.)
RC 4	Watershed Protection	17,441.9	8,632.9	49%	0.2 du/ac (1 lot/5 ac.)
RC 5	Rural Residential	37,022.1	14,093.8	38%	0.5 du/ac (1 lot/2 ac.)
RC 6	Rural Conservation and Residential	12,818.9	5,959.6	46%	0.2 du/ac net (1 lot/5 ac.)
RC 7	Resource Preservation	32,089.1	21,133.7	66%	0.0 < 50 ac.; 0.04 ≥ 50 ac. (1:25)
RC 8	Environmental Enhancement	11,006.6	6,031.9	55%	0.05 ≥ 50 ac; (1:10, 2:30, 3:50)
RC 20	Critical Area	7,093.5	3,850.1	54%	0.05 (1 lot/20 ac.)
RC 50	Critical Area Agricultural	4,091.4	1,088.2	27%	1 lot/50 for > 20 ac; 1 lot/20-100 ac.
Other	(mostly urban zones)	127,711.6	20,329.5	16%	
Total		389,419.7	130,198.2	33%	

As indicated in the table above, only 16% of the County's forest cover is located in the urban zones (black or m"other" on the map), which also accommodate 90% of the County's population. This means that the bulk of the County's forest cover is relatively protected from conversion due to low development potential.

Outside of the Chesapeake Bay Critical Area zones, the R.C. zone with the least percentage of forest cover is the expansive R.C.2 Agricultural Protection zone, which also has the overall lowest density. R.C.7 Resource Preservation and R.C.8 Environmental Enhancement are the two zones with the greatest percentage of forest cover, at 66% and 55% respectively; however, much of the 21,134 acres of R.C.7 are publicly owned (City of Baltimore reservoir watersheds and State parkland) and not at risk for conversion.

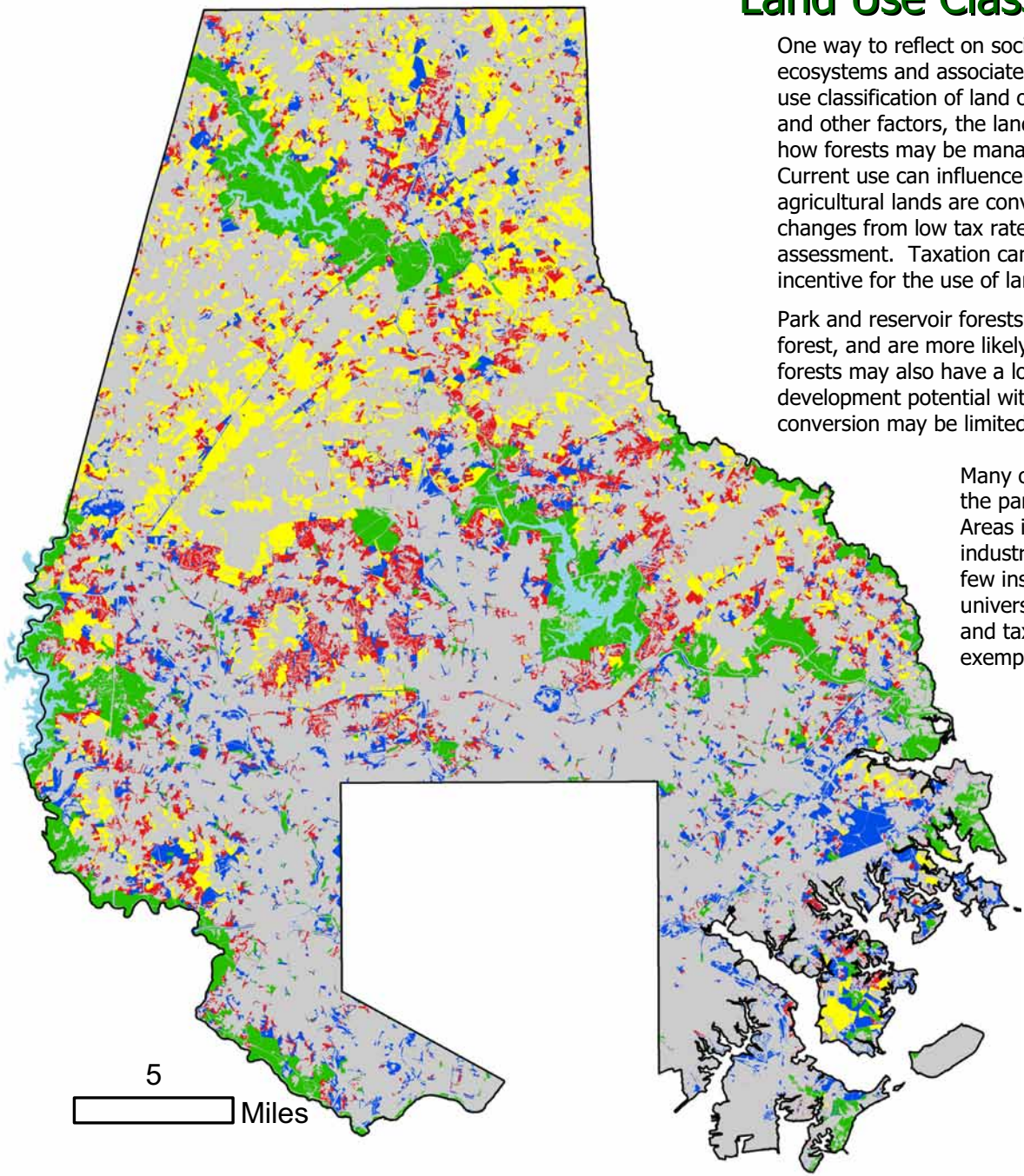
Overall, Baltimore County's zoning is relatively protective of its forest cover, which is the first prerequisite for the sustainability of the resource.

Land Use Classification of Forested Land

One way to reflect on society's propensity and capacity to sustain forested ecosystems and associated economies is to consider how forests relate to land use classification of land ownership parcels. While still affected by local zoning and other factors, the land use classification of forests can provide insight into how forests may be managed and their vulnerability to conversion to non-forest. Current use can influence the taxation classification of land. For example, when agricultural lands are converted to residential use, the taxation assessment also changes from low tax rate agricultural assessment to high rate residential assessment. Taxation can also influence land use, as it acts as an economic incentive for the use of land to correspond to the cost of ownership.

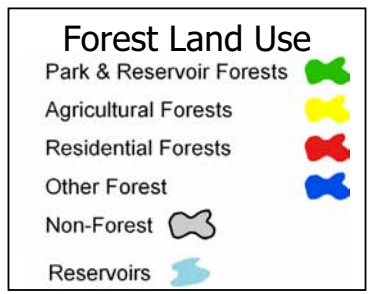
Park and reservoir forests are likely the most secure regarding conversion to non-forest, and are more likely to be managed for ecosystem values. Agricultural forests may also have a lower risk of conversion, especially if they have little development potential with respect to zoning. In areas of residential use, forest conversion may be limited to re-subdivision and infill opportunities.

Many of the largest forest blocks in Baltimore county are in the park/reservoir and agricultural forest areas on the map. Areas in blue near the urban area of the County are mostly industrial or commercial in land use and tax class, with a few institutional/exempt uses such as colleges and universities. In the rural north they are commercial in use and tax class, including golf courses, or institutional and exempt, including schools or churches.



Land Use Classification of Forests

Land Use Type	Total Acres	% of Total
Park & Reservoir	42,973	32.9%
Agricultural	25,965	19.9%
Residential	32,497	24.9%
Other	29,006	22.2%
Total	**130,441**	**100.0%**



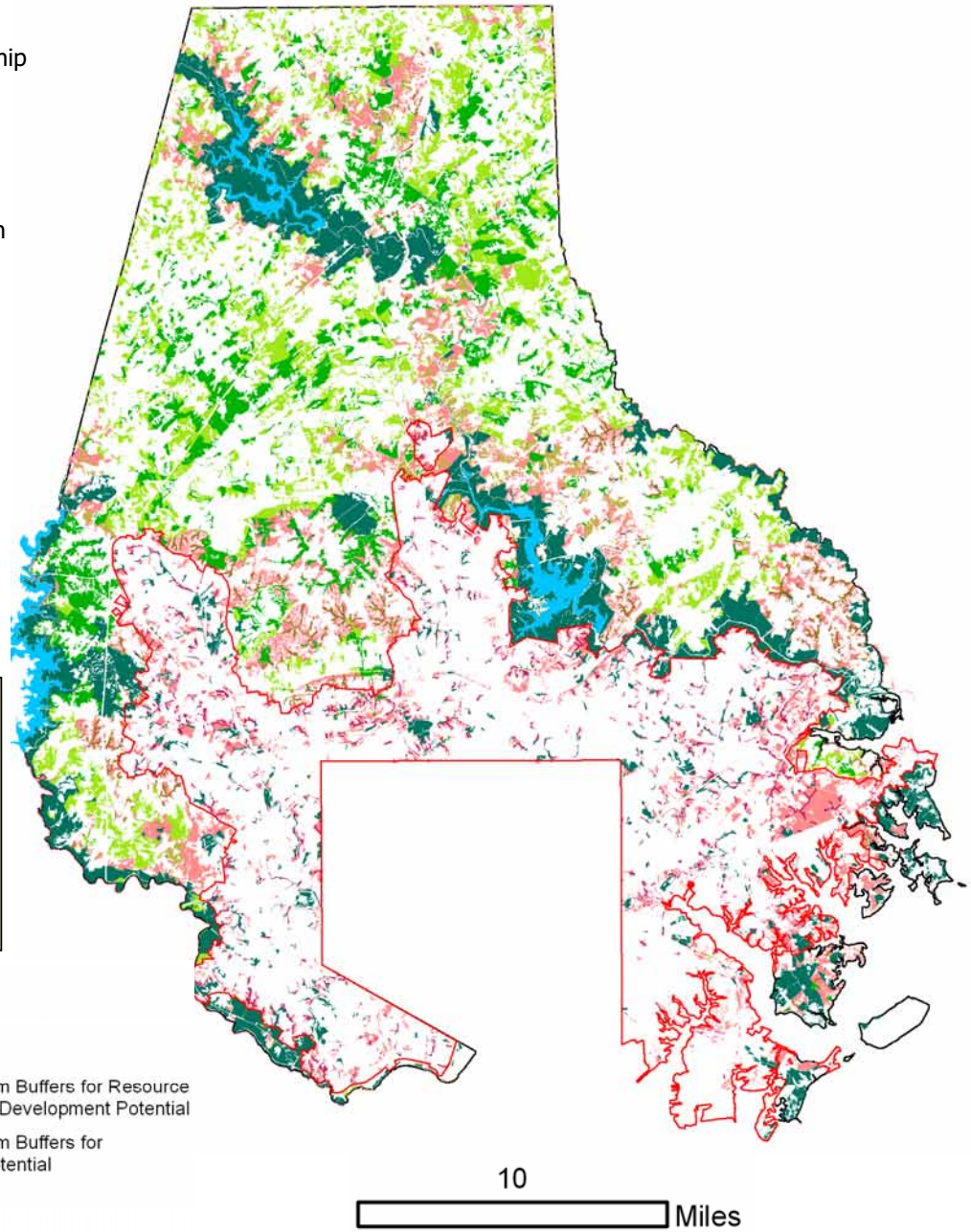
Forest Conservation

The Forest Conservation typology evaluates forest cover by degree of protection from conversion to non-forest due to public ownership, conservation easements, and protective zoning. Forests in public ownership (27%), various conservation easement programs (17%), and resource lands with the County's lowest development densities (22%), collectively totaling 66% of existing forest cover, have a high probability of remaining forest. An additional 5% of forest cover in zoned with degrees of development potential are protected by County stream buffer regulations. About 3 % of forest cover is vulnerable to development in rural areas with Resource Conservation zones other than RC 2, even if with low density. About 26% of forests Countywide are potentially vulnerable to more significant degrees of conversion due to higher rural zoning (RC 5) and urban zoning.

Total Acreage	Forest %	Cumulative Forest %
36,394	27	27
23,132	17	44
29,668	22	66
4,345	3	69
2,445	2	71
3,806	3	74
34,505	26	100

Publicly owned lands offer opportunities to provide "laboratories" to study differing approaches to resource management and watershed restoration, while private lands under conservation easement may offer good opportunities for restoration work, since the owners have committed to their long-term conservation. Private forest lands that are under easement may also help to secure the resource base necessary to sustain the forest products industry.

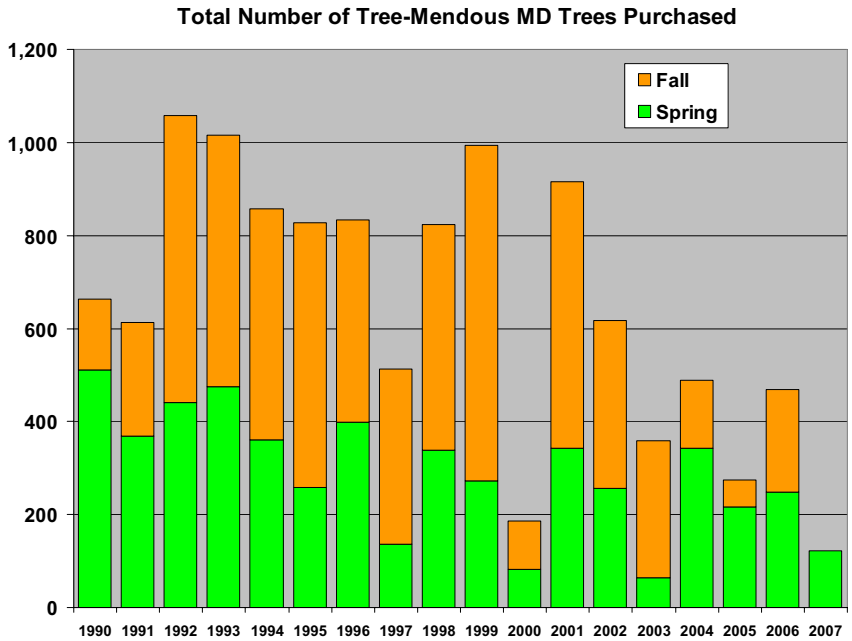
MD DNR Strategic Forest Lands Assessment

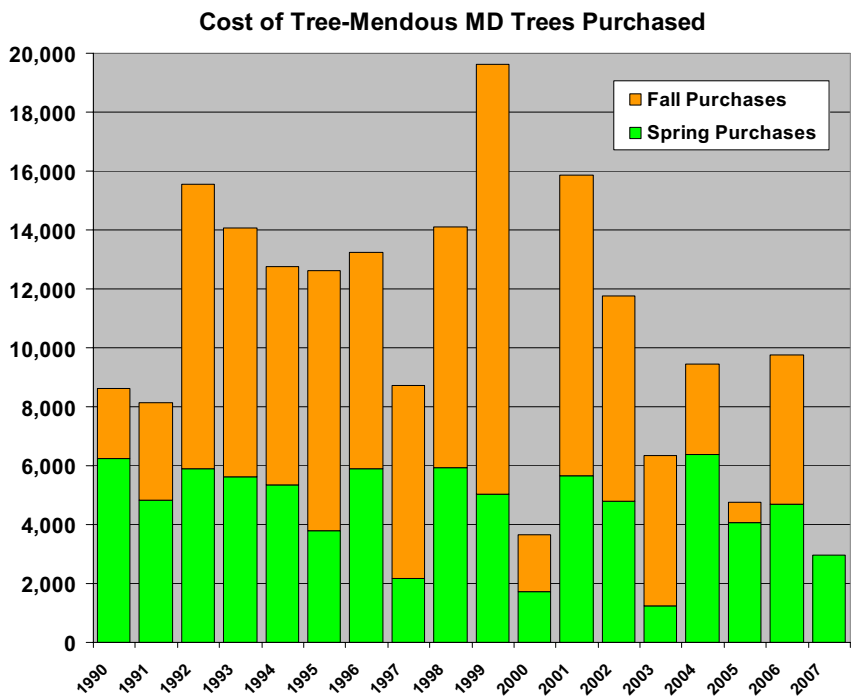


Legend

- URDL
- County Boundary
- 1 Forest In Public Ownership
- 2 Forest In Conservation Easements
- 3 Forest In Resource Conservation Areas With Low Conversion Potential
- Reservoirs
- 4 Forests In Resource Conservation Development Areas
- 5 Forest In Potential Protected Stream Buffers for Resource Conservation Areas with Moderate Development Potential
- 6 Forest In Potential Protected Stream Buffers for Urban Lands With Development Potential
- 7 All Other Forests

Reforestation: Tree-Mendous Maryland





The Tree-Mendous Maryland Program represents a successful organizational partnership for reforestation in Baltimore County. Since Spring 1990, the County has actively promoted Tree-Mendous Maryland, a tree planting program administered by the Maryland Department of Natural Resources (DNR). The program provides reasonably-priced trees for planting by community organizations on public lands and in community open spaces.

In the early years of the program, The MD DNR and County Forestry Board provided technical assistance for the formation of local "greening committees" for planning and fundraising for the planting projects. DEPRM promoted the program through more than 700 mailings to individual citizens, schools, greening committees, and other interested groups, as well as local and State elected officials. Program information was also provided to umbrella groups such as the Federated Garden Clubs of MD, as well as to community and business coalitions, at DEPRM education events, to DEPRM staff, and to the public who visit DEPRM's office. Also, the Department of Public Works customarily picked up all tree orders for the County from whichever cooperating nursery received the State's order from growers. DPW assisted with free delivery for community orders of 10 trees or greater. In recent years, the MD DNR and the County Forestry Board have been less active in working with communities, and DEPRM now handles the free delivery of trees. Baltimore County is the only local jurisdiction to provide delivery of trees and, as a result of its promotion of the Program, the County 's citizens have consistently led the State in the number of trees planted each season.

Many factors affect the number of tree orders over the seasons, such as drought. Since 1990, DEPRM has received 458 orders for Tree-Mendous Maryland trees. Citizens have purchased and planted 11,628 trees at a total purchase price of $191,947. For 18 spring seasons, 5,236 trees were purchased at $82,211, and for 17 fall seasons 6,392 trees were purchased at $109,736.

TREE-MENDOUS MARYLAND
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Community Reforestation

The Community Reforestation Program (CRP) was established by the Department of Environmental Protection and Resource Management to provide a dedicated workforce for the planting, monitoring, and maintenance of forest mitigation projects. The Program is funded through fees-in-lieu of mitigation for forests removed as a result of public and private land development, as required by the implementation of the County's Forest Conservation Act and Chesapeake Bay Critical Area Regulations. Several approaches and program structures were utilized to meet increasing demands for site maintenance and long-term cost efficiency. These included contracting individual reforestation projects starting in 1994, to contracting for a comprehensive operation in 1999 with a youth service organization affiliated with the federal AmeriCorps program. In 2003 the Program was established as a dedicated effort within DEPRM. The CRP is the only full-time County-wide reforestation mitigation program among Maryland's counties.

To date, the CRP has resulted in reforestation of over 150 acres in urban and rural areas of Baltimore County. Despite weather fluctuations, ever-present deer and vole predation, and other natural and human stressors, the Program has maintained a strategy of flexibility in matching species selection, planting techniques, tree protection equipment, and maintenance efforts to site characteristics. As a result the Program has experienced a steady increase in tree survival to the present 85+% in recent projects.

Reforestation Program Progress

Year	Acres Planted	# of Trees Planted	# of Trees Reinforcement
2007	15.07	922	715
2006	20.83	2,893	1,175
2005	16.70	3,986	1,689
2004	17.01	2,834	12
2003	21.01	3,253	-
2002	15.05	695	-
2001	15.25	6,781	
2000	5.77	3,602	
1999	6.23	127	
1998	5.13	737	
1997	1.60	143	
1996	10.80	3,592	
Total	150.45	28,643	3,591

The CRP includes a four-person reforestation crew. Year-round reforestation operations are based at a 1-acre site in eastern Baltimore County that is provided by the Department of Recreation and Parks. This home base houses a growing out nursery for 15 thousand tree seedlings; equipment and machinery needed for planting, monitoring, and maintaining the reforestation projects; and office space for the reforestation team. Occasionally, the CRP will undertake special grant-funded projects, the most recent example being the expansion of forest buffers on private rural properties.

Community Forestry Operations

Photos courtesy of DPW

Part of the legal, institutional, and economic framework for forest management is the provision of services by local government for urban forestry operations. Forests and trees often interface with communities under less than favorable conditions, and a reliable response capability is important, especially in a large county with a large population and no incorporated municipalities.

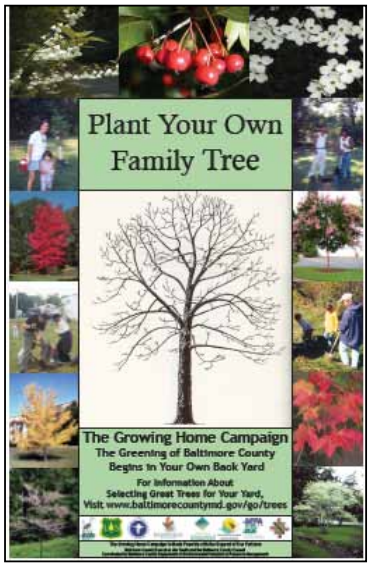
In Baltimore County, the Department of Public Works performs many necessary functions related to community forestry. The Bureau of Highways conducts tree trimming, and tree and stump removal, as necessary following storm events and in response to other circumstances where public safety becomes an issue. The Bureau also deals with trees that have raised public sidewalks. Activities to respond to these hazards is performed under a program permit from the MD Dept. of Natural Resources in accordance with the MD Roadside Tree Law. The Bureau also collects Christmas trees from residential areas. The DPW's Bureau of Solid Waste mulches those trees and also manages contracts for tree trimming in alleys where the collection of solid waste is impacted by trees.

The table presents DPW community forestry operations data – activity and cost - for FY 2002 through FY 2007. The number of roadside trees trimmed varies per year and averaged about 4,170 trees. Tree removals (sidewalk conflicts and other removals) have increased rather steadily and averaged 1,325 per year. Data is less complete for Christmas tree collection but show a noticeable decline, despite a slow increase in the total cost of Christmas tree mulching. Contractual trimming varied over the period and may reflect, as with other activities, the frequency and magnitude of storm events. The overall DPW community forestry operations have doubled in cost over the past 6 years and averaged about $1.1 million per year.

DPW Community Forestry Operations

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 02-07
Bureau of Highways								**Total**
Tree Trimming (Roadside Trees)								
	number	3,531	3,079	2,722	2,228	5,203	8,248	**25,011**
	cost	108,747	146,301	115,451	133,103	361,867	373,906	**1,239,375**
Tree Removal (Roadside Trees)								
	number	863	972	1,344	1,490	1,732	1,547	**7,948**
	cost	348,085	363,714	501,856	580,982	672,164	810,072	**3,276,873**
Stump Removal								
	number	375	267	194	331	538	446	**2,151**
	cost	17,090	18,626	12,658	36,800	53,234	49,620	**188,028**
Christmas Tree Removal								
	number				6,716	5,455	1,823	**13,994**
	cost	16,418	8,621	4,969	13,512	13,307	4,498	**61,325**
Sweeping		17,805						**17,805**
Arborist	cost				48,859	53,064	56,453	**158,376**
Tree Form Printing	cost				184			**184**
Total Bureau Tree Operations Expenditures		**508,145**	**537,262**	**634,934**	**813,440**	**1,153,636**	**1,294,549**	**4,941,966**
Bureau of Solid Waste								
Christmas tree mulching	cost	220,525	222,458	223,905	230,950	237,432	245,569	**1,380,839**
Contractual trimming (alleys)	cost	30,815	19,147	21,963	27,770	28,104	20,689	**148,488**
Total Bureau Tree Operations Expenditures		**251,340**	**241,605**	**245,868**	**258,720**	**265,536**	**266,258**	**1,529,327**
DPW Total Tree Operations Expenditures		**759,485**	**778,867**	**880,802**	**1,072,160**	**1,419,172**	**1,560,807**	**6,471,293**

Increasing Urban Tree Canopy: The Growing Home Campaign



The *Growing Home Campaign* is an innovative market-based approach to expanding urban tree canopy on private residential properties. As a partnership between Baltimore County, local retail nurseries and garden centers, and homeowners, the *Growing Home Campaign's* goal is to have homeowners plant 10,000 new trees on residential land in the County. The *Campaign* addresses behavior change at the homeowner level by educating the public about the multiple environmental benefits of planting trees in their yards and providing a $10 coupon redeemable toward the purchase of a qualifying tree with a retail value of at least $25.

Participating retail nurseries and garden centers provide a $10 point-of-purchase discount and are reimbursed $5 for every coupon returned to the County in exchange for information on the coupons about the location and species of trees purchased. The coupons also serve as a mechanism to track the success of the Campaign to add trees to targeted tree deficient areas. Local nurseries play an important role by 1) promoting tree planting, 2) stocking a diverse selection of trees that are appropriately sized and priced for the average homeowner to transport and plant, and 3) offering customers knowledgeable horticultural advice about their tree selections.

Homeowner outreach for the *Growing Home Campaign* includes comprehensive education about the value of adding trees within existing neighborhoods and in individual yards, guidance about site considerations and species selection, and tree planting and maintenance instructions.
Growing Home Campaign brochures containing the *Growing Home $10 Tree Coupon* are widely available at all County libraries, Senior Centers, and Recreation and Parks facilities, as well as online at Baltimore County's Website at: www.baltimorecountymd.gov/go/trees

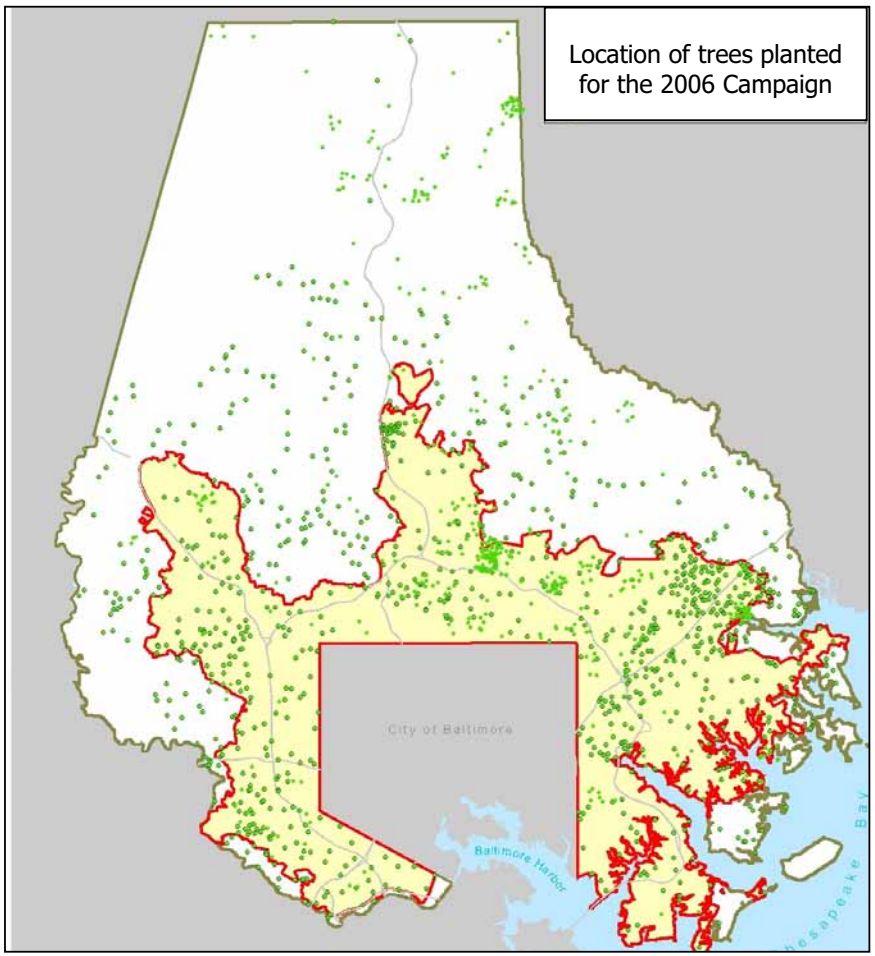
Residential land comprises approximately 95,000 acres or 72% of the total land cover within the County's Urban Rural Demarcation Line. Increasing tree planting on private residential land is crucial to successfully increasing the County's Urban Tree Canopy.

Campaign photos by Diana Cohen

Increasing Urban Tree Canopy: The Growing Home Campaign

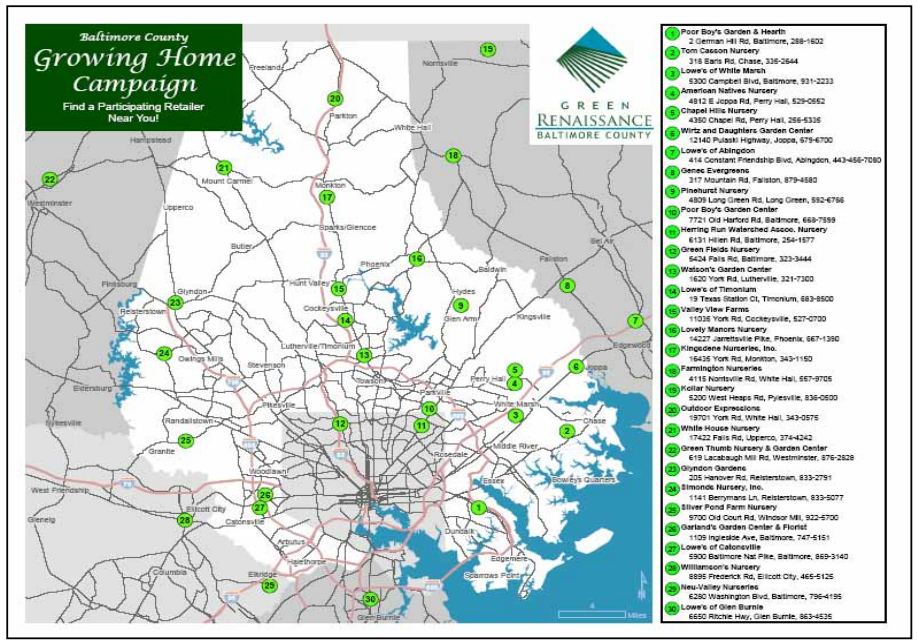
The Growing Home Campaign supported local businesses and provided an average discount of 15.5% per tree for homeowners. It also leveraged about $18 of total private sector investment per dollar of County cost share funds. The initial 2006 pilot and the 2007 Campaign were supported by grants from the USDA Forest Service, awarded through the Chesapeake Bay Small Watershed Grant program and administered by the National Fish and Wildlife Foundation. The grants support the Campaign Coordinator position and printing costs for educational and marketing material. The 2008 Campaign is supported by an Urban Greening Initiative Grant Program administered by the Chesapeake Bay Trust. County capital funds provide the $5 retailer cost-share per tree. Grants were also provided by Baltimore Gas and Electric Company and the Weyerhaeuser Foundation.

Growing Home Campaign Activity		2006	2007	Total
Trees Purchased	#	1,600	1,022	**2,622**
Total Retail Tree Cost	$	91,980	77,360	**169,340**
Average Cost/Tree	$	57.49	75.69	**64.58**
Nursery Retailers Participants	#	35	30	
Brochures Distributed	#	11,000	30,000	**41,000**
Web Site Downloads	#	5,500	3,507	**9,007**
Duration of Campaign	months	3	10	**13**
County & Retailer Coupon Cost Share	$	16,000	10,220	**26,220**
Investment by Homeowners				
Tree Purchase After Discount	$	75,980	67,140	**143,120**
Volunteer Labor @ $25/Tree	$	40,000	25,550	**65,550**
Total Economic Impact	**$**	**131,980**	**102,910**	**234,890**
Campaign Coordinator & Printing	-$	48,787	41,600	90,387
Net Economic Impact	**$**	**83,193**	**61,310**	**144,503**



Location of trees planted for the 2006 Campaign

The 2007 Campaign included 30 retail nurseries and garden centers across the County and in adjacent jurisdictions.



Green Schools: Growing in the Classroom and the Community

Since 1999, Baltimore County's **Green Schools** have accomplished over 500 schoolyard and community projects including planting trees for classroom study and to provide shade on their schoolyard, as well as planting for habitat enhancement, water pollution prevention, and erosion control.

What does it take to become a **Green School** in Baltimore County?

- **Green Schools** make curricular connections at every grade level, using the school site to prepare students to understand and act on current and future environmental challenges facing all Marylanders. It uses the school and community as a context for learning across disciplines.
- **Green Schools** model conservation and environmental best management practices.
- **Green Schools** work in partnership with the community to enhance learning opportunities in the school and in the community.

Photos courtesy of Jeanne Armacost

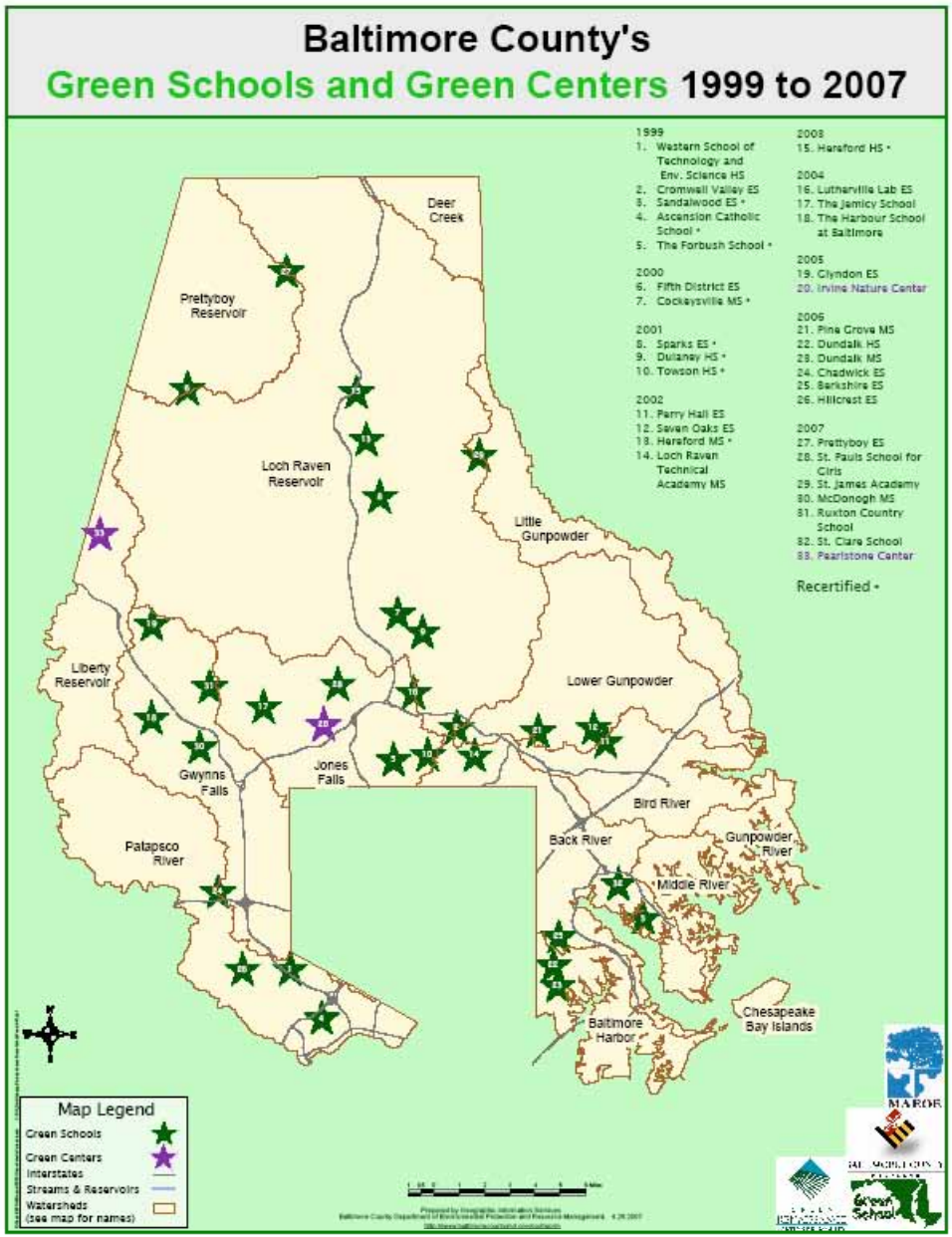
What are the benefits?

- **Environmental education**: Students engage in authentic site-based learning and apply their learning to real-word problems.
- **Student achievement**: Research indicates a positive, statistically-significant relationship between reading and math scores and a Maryland Green School designation.
- **Learning environment**: Teachers report better attendance rates, fewer disciplinary referrals, and increased job satisfaction.
- **Environmental stewardship**: Schools provide a visible model for the community with projects in conservation landscaping, solid waste reduction, responsible transportation, pollution prevention, energy conservation, and other best management practices.

The Maryland Green School Award Program is sponsored by the Maryland Association for Environmental and Outdoor Education (MAEOE).

MAEOE

Green Schools: Growing in the Classroom and the Community



Baltimore County Green Schools and Green Centers 1999-2007

Year	# Schools	# Centers
1999	5	
2000	2	
2001	3	
2002	4	
2003	1	
2004	3	
2005	1	1
2006	6	
2007	6	1
Total	**31**	**2**

Getting Greener Schools

Statewide, 163 schools and 16 Green Centers have been recognized.

Baltimore County leads the State with 19% of the Maryland Green Schools.

In Baltimore County, approximately 30% are private/independent/or faith-based schools and 70% are public schools. 87% have re-certified after three years, reporting sustained operations as a Maryland Green School.

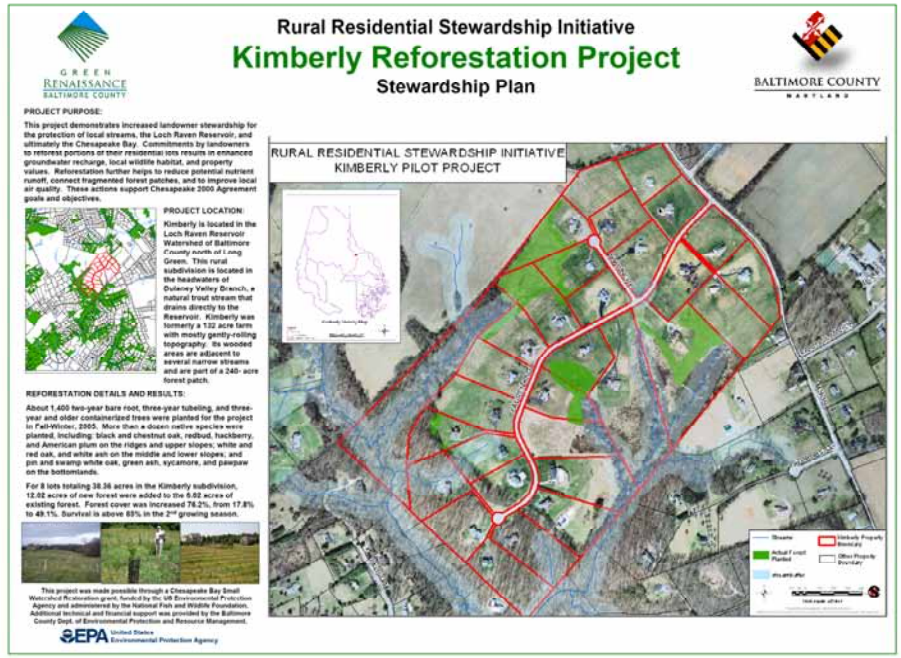
DEPRM works in cooperation with the County public school system and many independent schools to assist them in efforts to institute Green School activities and to provide ongoing support to recognized Green Schools.

Reforestation: Rural Residential Stewardship Initiative

This project seeks to increase forest cover in priority rural areas such as stream buffers and contiguous forest patches, primarily in reservoir watersheds. It educates rural residential lot owners about their role as managers of larger forest and stream systems shared with other lot owners. Landowners are provided an incentive – free tree planting – to convert mowed, "excess" lawn areas to new forests. Landowners agree to monitor and maintain the reforestation areas on their lots.

The 2006 pilot project resulted in reforestation of 17 acres on 12 lots in two rural residential subdivisions (Kimberly and Bernoudy farms). The pilot project was supported by a grant from the US Environmental Protection Agency, awarded through the Chesapeake Bay Small Watershed grant program and administered by the National Fish and Wildlife Foundation.

"Growing, not mowing" at Kimberly in the Loch Raven Reservoir Watershed



Rural Residential Stewardship Initiative

Kimberly Reforestation Project

Stewardship Plan

GREEN RENAISSANCE BALTIMORE COUNTY

BALTIMORE COUNTY MARYLAND

PROJECT PURPOSE:

This project demonstrates increased landowner stewardship for the protection of local streams, the Loch Raven Reservoir, and ultimately the Chesapeake Bay. Commitments by landowners to reforest portions of their residential lots results in enhanced groundwater recharge, local wildlife habitat, and property values. Reforestation further helps to reduce potential nutrient runoff, connect fragmented forest patches, and to improve local air quality. These actions support Chesapeake 2000 Agreement goals and objectives.

PROJECT LOCATION:

Kimberly is located in the Loch Raven Reservoir Watershed of Baltimore County north of Long Green. This rural subdivision is located in the headwaters of Dulaney Valley Branch, a natural trout stream that drains directly to the Reservoir. Kimberly was formerly a 132 acre farm with mostly gently-rolling topography. Its wooded areas are adjacent to several narrow streams and are part of a 240- acre forest patch.

REFORESTATION DETAILS AND RESULTS:

About 1,400 two-year bare root, three-year tubeling, and three-year and older containerized trees were planted for the project in Fall-Winter, 2005. More than a dozen native species were planted, including: black and chestnut oak, redbud, hackberry, and American plum on the ridges and upper slopes; white and red oak, and white ash on the middle and lower slopes; and pin and swamp white oak, green ash, sycamore, and paupaw on the bottomlands.

For 8 lots totaling 38.36 acres in the Kimberly subdivision, 12.02 acres of new forest were added to the 5.02 acres of existing forest. Forest cover was increased 76.2%, from 17.8% to 49.1%. Survival is above 85% in the 2nd growing season.

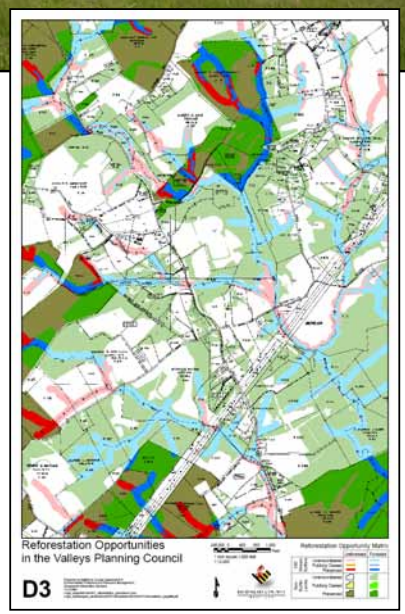
This project was made possible through a Chesapeake Bay Small Watershed Restoration grant, funded by the US Environmental Protection Agency and administered by the National Fish and Wildlife Foundation. Additional technical and financial support was provided by the Baltimore County Dept. of Environmental Protection and Resource Management.

EPA United States Environmental Protection Agency

RURAL RESIDENTIAL STEWARDSHIP INITIATIVE
KIMBERLY PILOT PROJECT

DEPRM asks for a resident to volunteer to host a meeting of their neighbors to introduce the project. The program is therefore brought to the community. The "watershed context" is presented, as well as a poster-sized detailed aerial photograph of the subdivision. DEPRM subsequently conducts "walk and talk" sessions with each landowner to design the reforestation. After installation of the trees, DEPRM trains landowners to monitor the project and provides a booklet explaining exactly how and why the reforestation was completed, in addition to maintenance guidance. A community "stewardship plan" showing reforestation areas is provided to each participating landowner.

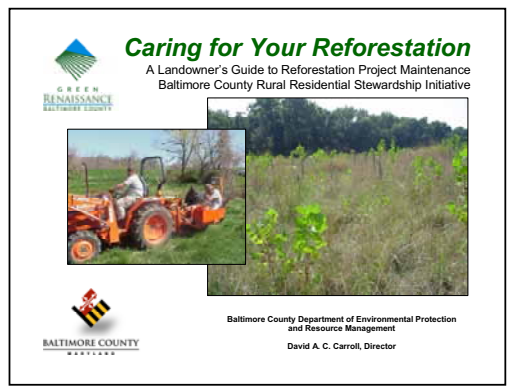
Another grant was received to continue the program in 2008. The "Valleys Reforestation Initiative" has a target to reforest 21.7 acres within the Membership area of the Valleys Planning Council, which covers 21% of Baltimore County. The VPC, established 40 years ago, is a leading land preservation organization. DEPRM will credit future nutrient and sediment load reductions from reforestation toward program goals for protecting drinking water reservoirs and numeric targets for Clean Water Act Total Maximum Daily Loads (TMDLs).



Reforestation Opportunities in the Valleys Planning Council

D3

P. Cornman



Caring for Your Reforestation

A Landowner's Guide to Reforestation Project Maintenance

Baltimore County Rural Residential Stewardship Initiative

GREEN RENAISSANCE BALTIMORE COUNTY

BALTIMORE COUNTY MARYLAND

Baltimore County Department of Environmental Protection and Resource Management

David A. C. Carroll, Director

Looking Ahead

As we look ahead, Baltimore County's ability to interface with the Montréal Process Criteria and Indicators should continue to improve. DEPRM is continuing to expand its partnerships, resulting in direct access to forest data and information, as well as implementation opportunities. The continuing support of the Administration and County Council for the Forest Sustainability Program through the operating and capital budgets further enables progress. Some recent and emerging developments are listed below.

Urban Tree Canopy Assessment

Existing forest canopy cover and opportunities for increasing urban tree canopy within the Urban-Rural Demarcation Line (URDL) are being identified for the Chesapeake Bay Program's Urban Tree Canopy Goals project. The County has also contracted with the US Forest Service to conduct an assessment of forest values for energy conservation, carbon sequestration, and stormwater management using the Urban Forest Effects (UFORE) Model.

Rural Forest Health Monitoring

DEPRM is presently outlining a proposal for a forest health monitoring network for rural forest patches in order to develop conditions and trends and define management needs. The intent is to include a citizen monitoring component. The monitoring will include many elements in common with the US Forest Service's Forest Health Monitoring/Forest Inventory and Analysis (FHM/FIA) protocols.

Forest Fragmentation Index

The US Forest Service is working with the Spatial Analysis Lab at the University of Vermont in Burlington to develop an urban forest fragmentation index for Baltimore County using advanced software (eCognition).

Emergy Audit

Working with the EPA, Towson University faculty and students will conduct a study of the environmental costs and benefits of the County's forest resources using Emergy (energy and other materials) accounting, including an Emergy Income Statement and Balance Sheet.

Street Tree Inventory

An inventory of street trees within the URDL by species, location, size, and health is being investigated to facilitate proper care and replacement in order to contribute to the County's Urban Tree Canopy goals.

Wood Waste Biomass Assessment

An assessment of wood waste sources (supplies), current utilization and disposal, and the potential for alternative uses prior to ultimate disposal, including fuel for the carbon-neutral production of energy, will be conducted.

Urban Experimental Forest Network

Baltimore County has been invited by the US Forest Service to join a network with Chicago, New York, Boston, and Baltimore to identify research, education, and application needs for community forestry.

BALTIMORE COUNTY, MARYLAND

Forest Sustainability Assessment and Monitoring

Linking Communities to the Montreal Process Criteria and Indicators

GREEN RENAISSANCE BALTIMORE COUNTY

BALTIMORE COUNTY MARYLAND

1. Conceptual Framework

Montreal Process Criteria & Indicators

Criterion #1:
Conservation of Biological Diversity

Criterion #2:
Maintenance of Productive Capacity of Forest Ecosystems

Criterion #3:
Maintenance of Forest Ecosystem Health and Vitality

Criterion #4:
Conservation and Maintenance of Soil and Water Resources

Criterion #5:
Maintenance of Forest Contribution to Global Carbon Cycles

Criterion #6:
Maintenance and Enhancement of Long-Term Multiple Socioeconomic Benefits to Meet the Needs of Societies

Criterion #7:
Legal, Institutional, and Economic Framework for Forest Conservation and Sustainable Management

2. Forest Sustainability Management Questions

1a. What is the extent of forests by type in Baltimore County and what are the trends in forest cover, protection of forests, and forest fragmentation?
- measure forest extent by DNR's Classification of Ecological Community Groups
- measure total forest cover and interior forest area by watersheds
- measure forests protected by public ownership, easements, protective zoning
- measure forest fragmentation and parcelization

1b. What are the extent and status of forest-dependent species and species at risk?
- measure the status and vulnerability of forest-dependent species

2a. What are the trends in consumptive uses of forest lands in Baltimore County?
- measure timber harvesting and forests lost to development

2b. Do forest harvesting and other non-timber uses of forests diminish the ability of forests in the County to produce a sustainable flow of goods and services?
- measure removal of timber and non-timber products compared to supplies

3a. What is the extent of forests affected by human processes and agents that reduce or threaten the functional capacity of forest ecosystems?
- measure forest lost to development and other human disturbances

3b. What is the extent of forests affected by natural processes and agents that reduce or threaten the functional capacity of forest ecosystems?
- measure the extent and trends of invasive plant species and effect on forests
- measure the extent and trends of deer damage to forest regeneration
- measure the extent and effect of air pollutants on forests
- measure the extent and trends of disease and infestation such as gypsy moth, oak and ash diseases, and wildfire

4a. What are the extent and function of forests managed to protect water quality?
- measure the extent of forests managed for reservoir and watershed protection including riparian functions
- measure the extent to which the lack of forest cover threatens water quality

4b. What is the extent land with soil limitations for sustainability of forest ecosystems
- measure forest land with significantly diminished soil organic matter, erosion, or other soil properties

5a. What is the contribution of county forest lands to the global carbon budget?
- measure total forest ecosystem biomass and the contribution of forest ecosystems and forest products to carbon budgets

6a. What are the extent and value of forest production and consumption in the county?
- measure the value and quantity of forest and non-forest products and consumption
- measure the value of investment and employment in the forest industry

6b. What are the extent and value of non-timber forest uses and values?
- measure the extent and value of forest lands managed for non-consumptive uses

7a. Are current laws, regulations, policies, planning, and public involvement effective for promoting forest sustainability?
- measure the legal & institutional framework in support of forest sustainability
- measure the value of forests to the citizens of Baltimore County

CORE QUESTIONS

Are Baltimore County's forests healthy? Sustainable?
Are existing forests being protected well? Where can we best reforest?
Are landowners managing forests for ecological & economic goods & services?

3. Assessment & Monitoring Methods and Programs

Management Questions Addressed

ASSESSMENT & MONITORING PROGRAMS

Landscape-level GIS Forest Resource Characterization
1a, 3a, 4a,b — Maps and tabular data are generated for forest distribution at multiple watershed scales using GIS data layers. Outputs include the distribution of forest patches by size, ownership, riparian cover, interior forest area, protection & development vulnerability.

County Forest Land Assessment & Management Planning
4b — Stand-level assessments of forest structure, composition, and regeneration are made using the USDA Forest Service North East Decision Model (NED-1) for large County parks. Management plans include recommended actions for hazard trees, control of forest pests and disease, and water quality.

Urban Forest Canopy Assessment
3a,b, 5a — Existing forest canopy and opportunities for increasing urban tree canopy within the Urban-Rural Demarcation Line (URDL) are identified for Chesapeake Bay Program Urban Tree Canopy Goals. Assessments of forest values for energy conservation, carbon sequestration, and stormwater management are also made using the USDA Forest Service Urban Forest Effects (UFORE) Model.

Rural Forest Health Monitoring
1b, 3b — US Forest Service's Forest Health Monitoring and Forest Inventory and Analysis (FHM/FIA) protocols are used to assess the long-term health of forest patches outside of the URDL.

Emergy Audit
6a,b — Working with Towson University and the EPA, a study will be conducted of the environmental costs and benefits of the County's forest resources using Emergy (energy and other materials) accounting, including an Emergy Income Statement and Balance Sheet.

Street Tree Inventory
An inventory of street trees within the URDL by species, location, size, and health will be established to facilitate proper care and replacement in order to contribute to the County's Urban Tree Canopy goals.

Wood Waste Biomass Energy Assessment
6a,b — An assessment of waste wood supply and demand and the potential for use as alternative fuel for the production of energy will be conducted in cooperation with the MD DNR.

Strategic Forest Land Assessment
6a — MD DNR will produce an economic sustainability model for Baltimore County's forests, following the State-wide model.

4. Data Products for Decision Support

DATA IN SUPPORT OF COUNTY DECISIONS

- *Baltimore County Master Plan including Sensitive Area Protection and Water Resource Elements*
- *Comprehensive Zoning Map Process*
- *Reservoir Watershed Management Agreement*
- *Land Preservation Programs*
- *Land Development Regulatory Programs*
- *Chesapeake Bay Program Tributary Strategies*
- *Total Maximum Daily Load (TMDL) Implementation*
- *Management of County-owned Forested Lands*
- *Urban Tree Canopy Goal Implementation*
- *2005 MOU for Forest Sustainability and bi-annual State of Our Forests Reports*

Additional Forest Data
IMPLEMENTATION PROGRAM TRACKING

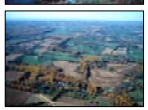
2a, 3a — ***Forest Conservation & Chesapeake Bay Critical Areas***
Track and map forest acres protected during development.

Community Reforestation Program
7a — Track/map reforestation for fee in-lieu of mitigation under the Forest Conservation and Chesapeake Bay Critical Area Acts.

Tree-Mendous MD Program
7a — Track and map the number of trees planted by community associations on public lands and community open spaces.

Growing Home Campaign
7a — Track and map the number of trees planted by citizens in residential yards using coupons redeemed through retailers.

4a, 7a — ***Rural Residential Stewardship Initiative***
Track and map the acreage of reforestation on large-lot low-density rural residential lands.



Research Partners

EPA ORD - US Environmental Protection Agency, Office of Research and Development (ORD)

USDA Forest Service

MD Department of Natural Resources, Forest Service

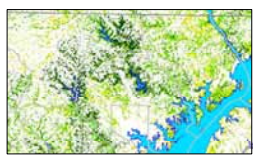
Towson University

BES-LTER - Baltimore Ecosystem Study, Long-Term Ecological Research

MARYLAND DEPARTMENT OF NATURAL RESOURCES

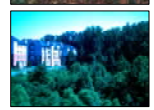
AMERICAN FORESTS americanforests.org

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE



Additional 'Linking Communities' Partners

US Dept. of the Interior, Biological Resources Division
MD Association of Forest Conservancy District Boards
Gunpowder Valley Conservancy
Glatfelter Pulp Wood Company
Mar-Len Environmental
Prettyboy Watershed Alliance
Baltimore City Department of Public Works
Baltimore County Office of Planning
Baltimore County Department of Recreation & Parks



This is a copy of the preliminary monitoring framework produced in January 2007 as a 30" x 40" poster.

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Kathy Martin
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Kim Mead
Bill Miles
Susan Mockenhaupt
Jon-Michael Moore
Teresa Moore
Hugh Murphy
Mel Noland
Phil Norman
Dave Nowak
Emeka Obilor
Renae Olver
Don Outen
Susan Overstreet
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Pat Pudelkewicz
Nicolas Read
James Remuzzi
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Chan Robbins
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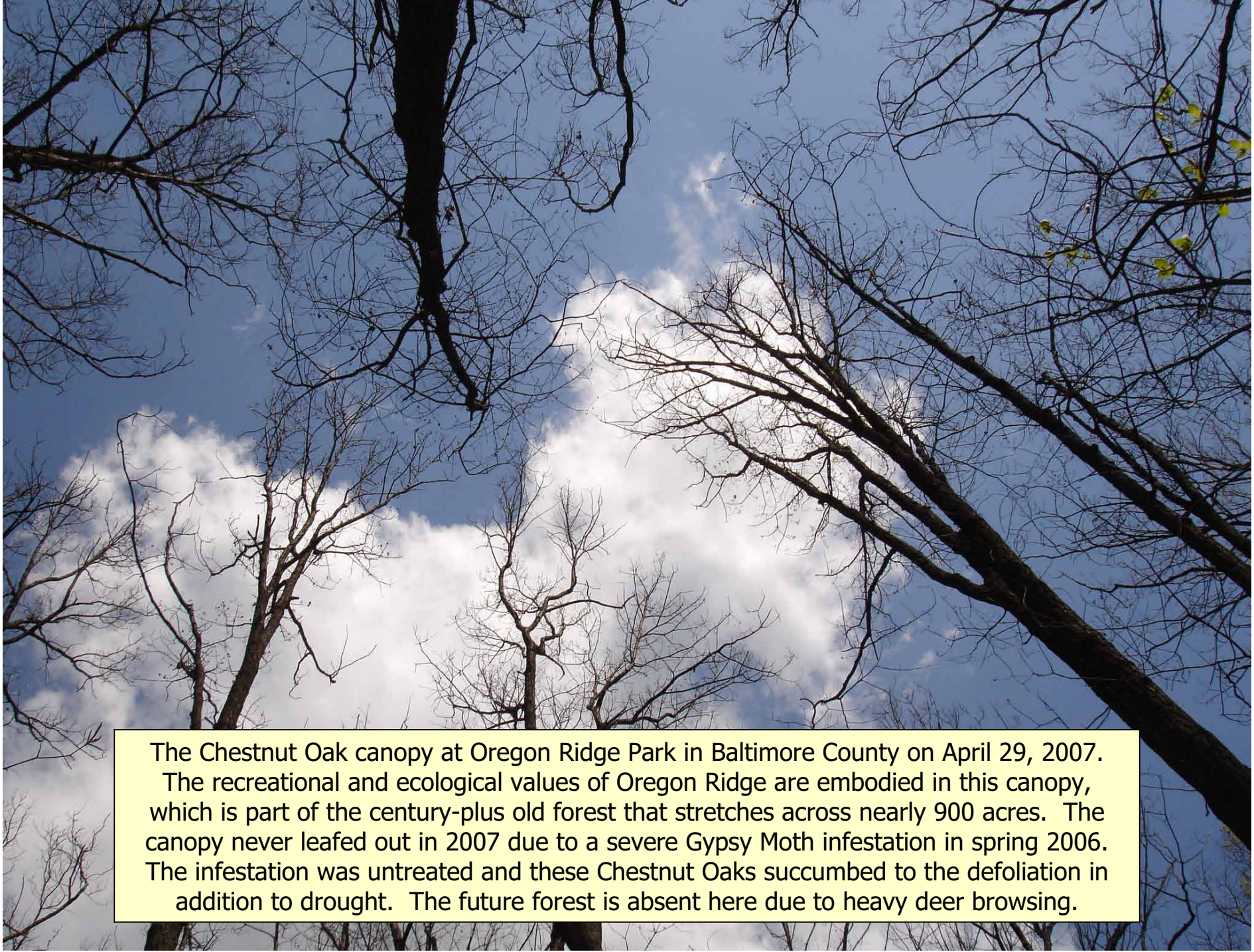
Hon. Jim Smith
Riley Smith
Tim Smith
Mike Spenser
Eric Sprague
Bill Stack
Steve Stewart
Christina Suarez
Ken Stolte
Joe Sullivan
Bob Tatman
Bob Tichenor
Al Todd
Mark Twery
Halle Van der Gaag
Erin Wisnieski
Jane Wolfson
Jeff Wolinski
Len Wrabel
Lucy Wright
Vesela Veleva
Tom Young

For more information, contact:

Donald C. Outen, AICP
410-887-4488, x238
douten@baltimorecountymd.gov

For GIS information:

Robert H. Hirsch, IV
410-887-4488, x266
rhirsch@baltimorecountymd.gov



The Chestnut Oak canopy at Oregon Ridge Park in Baltimore County on April 29, 2007. The recreational and ecological values of Oregon Ridge are embodied in this canopy, which is part of the century-plus old forest that stretches across nearly 900 acres. The canopy never leafed out in 2007 due to a severe Gypsy Moth infestation in spring 2006. The infestation was untreated and these Chestnut Oaks succumbed to the defoliation in addition to drought. The future forest is absent here due to heavy deer browsing.