Anacostia Watershed Forest Management and Protection Strategy

Prepared for:
The Anacostia Watershed Restoration Committee

Prepared by:
The Metropolitan Washington Council of Governments
Department of Environmental Programs

June 2005

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Executive Summary

The creation of this Anacostia Watershed Forest Management and Protection Strategy (FMPS) was initially recommended by the 2001 Anacostia Agreement and companion report, *Anacostia Watershed Restoration Indicators and Targets for the Period 2001-2010*. This plan is an integral step in protecting and expanding forest cover throughout the watershed. This Forest Management and Protection Strategy (FMPS) represents the collaborative efforts of the Anacostia Watershed Restoration Committee's Anacostia Restoration Potential Workgroup (ARPW), Metropolitan Washington Council of Government (COG) staff and various representatives from AWRC-affiliated agencies and organizations. The FMPS includes the analysis of historic 1936-38 black and white aerial photographs and an analysis of the 2000 Landsat and IKONOS imagery to provide an in-depth view of the past and current state of the Anacostia's forests and tree cover.

The FMPS is organized into the six following sections: 1)Watershed Introduction, 2)Definitions and 2010 Restoration Goals, 3)Tree Canopy Cover Trends, 4)Forest Cover Trends, 5)Goals and Strategies by Forest and Tree Cover Categories, and 6)Summary: Forest Management and Protection Options. The forest and tree cover categories analyzed include: 1)riparian forest, 2)upland forest, 3)mature forest and 4)urban forest/street trees.

1.0 FMPS Definitions, 2010 Restoration Goals and ARPW Recommendations

1.1 Tree Canopy Cover

Definition: Tree canopy cover is the land area that is cloaked by the branches and leaves comprising the canopy of a tree, and is generally expressed as percent coverage of a given area.

Tree Canopy Cover Goals:

- Recommended canopy cover as a percentage of land area:

Watershed Type	Impervious Cover	Tree Canopy Cover Goal*
Suburban (Previously Forested)	<25%	>65%
Suburban (Previously Agricultural)	<25%	>40%
Urban	26-60%	>40%
Ultra-Urban	>60%	>25%

* (CWP)

- Jurisdictions should use a subwatershed approach to develop specific tree canopy cover goals and implementation plans based on existing and projected land use patterns, an analysis of the quantifiable benefits of trees in their jurisdiction, Center for Watershed Protection (CWP) tree canopy cover recommendations, and local opportunities for canopy cover protection and expansion.

1.2 Overall Forest Cover

Definition: A forest is an area one acre or greater and wider than 100 feet that is at least 90% covered by tree canopy. Orchards and tree nurseries are not considered forests.

Forest Goals:

- Since the loss of forest has already reached critical levels, at a minimum, maintain the current forest cover level (i.e, 29.6% for the watershed) and where opportunities exist at the subwatershed level, all efforts should be made to increase the forest cover.
- Research opportunities for expanding forest cover in the future.

1.3 Riparian Forest

Definition: Riparian forests are forests that are adjacent to bodies of water and are a minimum of 35 feet in width. Buffer widths of 100 feet are recommended and widths of 200 are preferred for added environmental benefits.

Riparian Forest Goals:

- By 2010, create an additional 12 miles of forested riparian buffer in the Anacostia watershed, representing approximately 45 additional acres.

2.0 Tree Canopy Cover Trends

COG and University of Maryland's Regional Earth Science Applications Center (RESAC) analysis results show that Anacostia watershed tree canopy cover has declined by 6.2% between 1936 and 2000 (i.e., from 42.6% to 36.3%). Tree cover decreased in eighteen of the twenty three subwatersheds, with two subwatersheds (Northwest Branch and Nash Run) experiencing no change in tree cover and three watersheds (Upper Beaverdam Creek, Watts Branch and Fort Dupont) seeing an increase in tree canopy cover. The average increase in tree cover over this period was 8.6%, while tree cover declined by an average of 12.0%. The tree canopy cover in the Northwest Bank (8.8%) is less than half of the minimum 25% tree canopy cover goal suggested by CWP in ultra-urban areas.

3.0 Forest Cover Trends

For the purposes of this FMPS, forest cover is a subset of tree cover. From a natural resources perspective, forest cover is one of the critical components and indicators of the Anacostia's long term ecological health and integrity. Overall, forest cover throughout the Anacostia watershed declined 7.9% during the period from 1936 and 2000 (i.e., from 37.5% to 29.6%). Seventeen of the twenty three subwatersheds experienced a decline in forest cover; whereas, six subwatersheds (i.e., Northwest Branch, Upper Beaverdam Creek, Watts Branch, Fort Dupont, Stickfoot and the Tidal River) showed an increase. While the average decline in forest cover in the subwatersheds was 17%, the average increase was only 3%. Concurrently, the mean forest patch size also decreased during this period, with seventeen of the twenty three watersheds experiencing a decline. In those subwatersheds, the average decline in forest patch size was approximately 12 acres.

4.0 Existing Forest Types and Associated Goals and Strategies

4.1 Riparian Forest

GOALS:

- By 2010, create an additional 12 miles of forested riparian buffer in the Anacostia watershed, representing approximately 45 additional acres.
- Establish an ecologically viable riparian buffer along all streams in the Anacostia watershed (35 ft. minimum, 100 ft. where feasible on each bank).

STRATEGY:

- Focus on reforesting gaps between existing forest stands to re-establish continuous riparian forest buffers.
- Identify and inventory all riparian areas that can be protected or reforested through master plans, local areawide forest management plans, park management plans, etc. (See map No. 1, map sleeve)
- Provide public and private landowners with resources and/or incentives to encourage the protection or re-creation of forested riparian buffers on their properties.
- Foster public education and outreach programs about the benefits of riparian forests.

4.2 Upland Forest

GOALS:

- Protect remaining upland forest.
- Increase upland forest acreage in the watershed.

• Protect and expand the number of "corridor" connections between upland and riparian forest areas so as to reduce habitat fragmentation within and between Anacostia subwatersheds and adjacent watersheds (i.e., Patuxent and Rock Creek).

STRATEGY:

• Provide all landowners with both educational information and plant material resources to help them protect, maintain and/or reforest their upland property. Establish or expand such programs as grants for reforestation, forest bank creation, etc.

• Encourage private landowners to permanently protect upland forested areas on their property through conservation easements, forest banks, or public acquisition.

• Reduce fragmentation of upland forests in new development through encouraging flexible site design techniques, including clustered development, smaller lot sizes, limited road widths, shorter road and driveway lengths. This may require refinements in local zoning codes and ordinances.

• Expand or refine local master planning processes to include the identification, inventory and prioritization of upland forest stands for preservation. Also, encourage the creation of park management plans that include forest protection priorities.

4.3 Mature Hardwood Forest

GOALS:

• Protect the larger, remaining public and private mature hardwood forest tracts in the watershed.

• Identify and restore mature hardwood tracts that are becoming degraded.

STRATEGY:

• Make the conservation of unprotected mature hardwood tracts in the Anacostia a top priority for public land acquisition, conservation easements, forest banks and/or employment of other forest protection techniques.

• As part of the land development regulatory review process, identify and prioritize mature hardwood forested areas that must be adequately protected during development.

• Periodically inventory mature forest tracts in the watershed using remote sensing and groundtruthing techniques.

• Expand the local master planning process to inventory and identify mature forest lands as high priorities for protection.

5.4 Urban Forest/Street Trees

GOALS:

• Preserve the existing urban forest/street trees in the Anacostia watershed.

• Increase the number and long-term viability of street trees in the watershed.

• Improve the maintenance of street trees.

• Create and maintain street tree inventories.

STRATEGY:

• Create and enforce regulations restricting the removal of healthy trees in urban areas.

• Provide incentives for homeowners and business owners to plant native trees on their property.

• Increase funding for street tree planting and maintenance.

• Take a long-term approach to street tree planting by providing adequate space for tree growth and avoiding monocultures.

• Modify current street tree programs to create greater species diversity in new or replacement street tree plantings.

5.0 Summary: Forest Management and Protection Options and ARPW Recommendations

Forest Management and Protection Options	ARPW Recommendations
Land Use Planning and Regulation	
• Land Use Requirements • Master Plans • Local and State Forest Conservation Laws • Master Plans for Parks and Other Public Lands	• Use and refine land use regulations, local and state forest conservation laws, and master plans to protect valuable remaining forest and to promote reforestation. • Maintain and/or enhance existing forest corridors that link Anacostia subwatersheds and that connect the Anacostia to adjacent watersheds (i.e., Patuxent and Rock Creek) to allow for viable ecosystems and wildlife corridors. • Take opportunities during development to reforest areas.
Forest Health	
• Monitoring	• Major landowners should implement long-term forest health monitoring programs or tie into existing programs (e.g., U.S. Forest Service)
Reforestation	
Outreach	• Educate the public and elected officials about the quantifiable benefits of planting trees and the importance of preserving our existing forests. • Involve the public and elected officials in tree planting events.
Plant Material Options • Bare-root seedlings • Container stock • Natural forest regeneration	• Container stock is the recommended plant material type for reforestation events with volunteers.
Riparian Reforestation	• Focus on linking major forest patches with riparian forest buffers. • Take site characteristics into consideration when planning tree plantings.
Upland Reforestation	• Provide information to landowners about the benefits of planting trees on their property and the resources available for reforestation. • Create public/private partnerships to implement upland reforestation projects.
Urban Reforestation	• Avoid creating monocultures with street tree plantings. • Provide adequate space and maintenance for urban forest/street trees. • Encourage planting of native trees on private property.
Control of Exotic Invasive Plants	
Identify Problem	• Develop a comprehensive database of exotic invasive plants in the watershed. • Implement Phase II of COG's Exotic Invasive Plant Surveying Methodology and Indexing System.
Management Options • Prevention • Mechanical Control • Chemical Control • Herbivore Control • Biological Control	• Develop a comprehensive strategy for managing exotic invasive plants based on the results of the watershed survey and encourage local governments to provide dedicated funding for addressing exotic invasive plant problems. • Expand Weed Warriors or similar programs into Prince George's County and the District of Columbia.
Control of Nuisance Wildlife Species	
DEER	
Identify Problem	• Work with the major wildlife resource management agencies and landowners to develop systems for assessing and tracking deer populations in the watershed and for sharing data.
Management Options • Unpalatable Landscape Plants • Repellants • Scare Devices • Physical Exclusion • Direct Population Reduction	• Form an Anacostia Watershed Deer Management Workgroup involving the major wildlife management agencies, landowners and community representatives. • The Anacostia Watershed Deer Management Workgroup should create criteria for using direct deer population reduction techniques and develop a comprehensive deer management strategy. • Use cages or other exclusion techniques at sites with high deer populations.
VOLES	
Management Options • Reduce Available Food • Physical Exclusion • Repellants • Trapping / Poisoning	• Assess potential for vole damage and take proper precautions before planting reforestation sites. • Monitor vole damage and take follow-up actions if necessary during maintenance visits to reforestation sites. • Poisoning voles is not recommended due to danger of harming nontarget organisms.
BEAVERS	
Management Options • Physical exclusion • Trapping	• Use cages to protect trees at sites with high beaver populations. • Survey beaver populations to determine if trapping is necessary.

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1.0 Introduction

Paddlers on the Anacostia River.

1.1 Project Background

The focus on restoring the Anacostia River began in earnest in 1987, when the three jurisdictions comprising the Anacostia River watershed (i.e., Montgomery County, Prince George's County, and the District of Columbia) agreed to bring about the restoration of the river and its tributaries. This cooperation was officially marked by the landmark signing of the 1987 Anacostia Watershed Restoration Agreement by the State of Maryland, the District of Columbia and Montgomery and Prince George's Counties and by the establishment of the Anacostia Watershed Restoration Committee(AWRC). The AWRC is a group of nine local, state and federal agencies whose mandate is to oversee the restoration process. The AWRC includes Montgomery County Department of Environmental Protection, Prince George's County Department of Environmental Resources, District of Columbia Department of Health/Environmental Health Administration, District of Columbia Water and Sewer Authority, the Maryland Department of Natural Resources, the Maryland Department of the Environment, the U.S. Army Corps of Engineers, the National Park Service and the U.S. Environmental Protection Agency.

The importance of forest cover to the restoration of the Anacostia was officially recognized in the Six Point Action Plan that was adopted by the four restoration signatories in 1991. The expansion of forest coverage is identified as one of the six goals of the action plan that was meant to focus restoration efforts. By 1999, the restoration signatories recognized that more specific measures of progress were needed and called for the development of long-term restoration indicators and targets. The 2001 Anacostia Agreement and companion report, *Anacostia Watershed Restoration Indicators and Targets for the Period 2001-2010* describes the 50 indicators and targets that were created for each of the six original goals. The creation of this Anacostia Forest Management and Protection Strategy (FMPS) was recommended as an integral step in reaching and refining the various targets for the indicators relating to forest coverage. As forest management and protection is an ongoing effort, it should be noted that this is a living document and will be updated in the future.

This Forest Management and Protection Strategy (FMPS), represents the collaborative efforts of the AWRC's Anacostia Restoration Potential Workgroup (ARPW), Metropolitan Washington Council of Governments (COG) staff and various representatives from AWRC-affiliated agencies and organizations. It is important to note that the ARPW was originally created to provide technical expertise for the development of the Anacostia Watershed Restoration Indicators and Targets. The FMPS includes the analysis of historic 1936-38 black and white aerial photographs, and an analysis of 2000 Landsat and IKONOS imagery to provide an in-depth view of the past and current state of the Anacostia's forests and tree canopy cover. The University of Maryland's Regional Earth Science Applications Center (RESAC) was hired by COG in 2002 to perform an analysis of tree cover in the Anacostia watershed using 2000 Landsat and IKONOS satellite imagery. COG staff then used the RESAC-generated data to perform further refinement and assessment of major forest and tree cover categories in the watershed. All analyses included in this FMPS are based on remotely sensed data with limited groundtruthing.

The FMPS is organized into six sections: 1)Watershed Introduction, 2)FMPS Definitions, 2010 Restoration Goals, and ARPW Recommendations 3)Tree Canopy Cover Trends, 4)Forest Cover Trends, 5)Goals and Strategies by Forest and Tree Cover Categories, and 6)Summary: Forest Management and Protection Options. Section One provides an introduction to the Anacostia Watershed and an overview of the major forest and tree cover categories discussed in this report. Section Two

Figure 1. Anacostia Watershed

provides major definitions and a discussion of the 2010 restoration goals. Section Three discusses the trends in tree canopy cover between 1936 and 2000. Section Four presents the results of an analysis of forest cover trends between 1936 and 2000. Section Five provides an analysis of the extent of the major forest and tree cover categories in the watershed along with a discussion of the goals and strategies associated with each forest and tree cover category. Section Six presents forest management and protection options, principally addressing reforestation, the control of exotic invasive plants and the management of nuisance wildlife species.

1.2 Watershed Overview

In its 176 square mile drainage area, the Anacostia River watershed includes portions of three political jurisdictions (District of Columbia (30.2 mi^2), Montgomery (60.8 mi^2) and Prince George's counties (85.2 mi^2)) and two physiographic provinces (Piedmont and Coastal Plain). The fall line between the Piedmont and the Coastal Plain roughly parallels the jurisdictional boundary between Montgomery County and Prince George's County. The existing stream network of the Anacostia has more than 344 miles of streams and has three principal sub-drainage areas, including the non-tidal Northwest Branch, the non-tidal Northeast Branch and the tidal drainage (see Figure 1).

The Anacostia Watershed is one of the most densely populated areas in the Chesapeake Bay drainage, with over 800,000 residents. Whereas the population density of the Chesapeake Bay watershed is about 250 people per square mile, the Anacostia's is greater than 4,900 people per square mile (Chesapeake Bay Program 2002). Though the principal land uses today are residential and commercial, with very little agricultural land, that was not always the case. The Anacostia watershed has changed dramatically since Captain John Smith arrived in the area in 1608 to survey the navigable waters of the Potomac region and effectively open the door to subsequent European settlement. When Captain Smith first sailed up the Anacostia River, the area that he traveled through was settled by a semi-agricultural tribe of native Americans, called the Nanchotank. The forest cover at that time is estimated to have been around 95% of the total land area (American Forests 2002). The amount of forest quickly started to decline as a wave of European settlers cleared the land for cultivation of tobacco, corn and other agricultural crops. By 1860, almost all of the land in the Anacostia watershed was devoted to agriculture.


A surviving American chestnut in Western Maryland (DBH = 10.5 in.; 50 ft. tall)

1.3 Tree Cover/Forest Overview

Not surprisingly, the forest in the Anacostia watershed has changed not only in amount, but also in composition. Historically, the local forest was probably a mix of oak, hickory, and chestnut species with some hemlocks in the cooler shaded stream valleys of the Piedmont. The American Chestnut was one of the giants of these early virgin forests, averaging five feet in diameter and 100 feet tall. The extent of the forest was greatly reduced during the extensive clearing of land for agriculture and other uses during the 18th and 19th centuries. As the economy in the area and the country changed, many people left their farms and sought new opportunities in the cities. In the Anacostia watershed, an expanding National Capitol and population booms led to increasing urbanization and decreasing agricultural usage and viability during the 20th century. Not all of the abandoned farm fields were immediately developed and many were left to quickly become overgrown with grasses, weeds, shrubs and some pioneer tree species, like Virginia pine, red maple, tulip poplar

and black locust. Hardwood forest species such as oak, hickory and American beech also colonized the fields and early wood lots and eventually matured and spread to create the forest mosaic of today. While today's forest shares many of the same species as the historical ones of the area, overall species composition is often different. For example, the American chestnut is missing from our 21st century forest, having been wiped out by the chestnut blight in the early part of the 20th century. Likewise, the historical forest was almost entirely composed of hardwoods, while softwood species like pine are more common today (MD DNR 2003).

Benefits of Trees & Forests:
- Improved air quality
- Carbon sequestration
- Removal of gaseous pollutants
- Removal of pollutant particles
- Reduced energy use
- Lower air temperatures
- Shade
- Windbreaks
- Increased traffic safety
- Reduced crime
- Reduced noise
- Increased economic sustainability
- Increased real estate values
- Aesthetic and recreational values

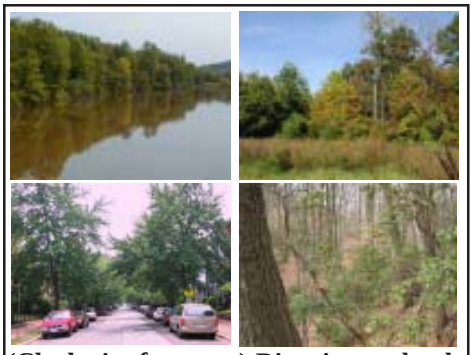
1.3.1 General Benefits

Protecting and restoring our forests is clearly an important step towards the restoration of the Anacostia watershed. The influence that forests have on stream morphology and the stability of streams is profound. Studies have shown that in the years following clear-cutting, baseflow in streams can rise by as much as 40% (Hubbard Brook 2002). The history of the Anacostia Watershed itself demonstrates how deforestation increases sediment loads, as clear-cutting of land for agriculture in the Anacostia during the 18th and 19th centuries led to such dramatically increased sediment loads that the once thriving port of Bladensburg was rendered useless by 1830 (Wright 1977). Forests are a powerful agent for stabilizing stream morphology and improving water quality by infiltrating rainfall, reducing soil erosion, slowing and reducing stormwater runoff and filtering out various harmful pollutants[1]. There are also numerous other benefits that forests provide, from creating wildlife habitat to improving air quality, offering shade and a place for human solace. Currently, prediction models exist to track existing and to forecast future air pollution reduction and stormwater control benefits of trees (American Forests 1996; Nowak and Crane 2000) .

1.3.2a Tree and Forest Cover Categories

For the purposes of this FMPS, the trees and forests of the Anacostia have been broken up into four general forest and tree cover categories: 1) riparian, 2) upland, 3) mature and 4) urban forest/ street trees. Each of these four forest and tree cover categories provides unique benefits to the watershed and is critical to the restoration of the Anacostia.

Riparian forests, located closest to waterbodies, such as streams, ponds and lakes, have the most direct impact both on improving water quality and providing habitat for aquatic and terrestrial wildlife (Welsch 1991). Upland forests, occurring further away from streams and on tops of hills, also have a major role to play in stream morphology by providing infiltration and reducing stormwater runoff. Many local laws and guidelines place higher importance on protecting stream valley habitats than upland habitats, consequently upland forests are more likely to be lost to development than riparian forests. However, upland forests provide habitats for wildlife that are just as important as stream valley habitats, as they support a unique assemblage of species (CCB 2002). Old growth forests are often defined as those comprised of trees 150 years old or older. While there are trees that old within the Anacostia watershed, there are unfortunately



(Clockwise from top) Riparian, upland, mature and urban/street trees are the four general forest categories discussed in this strategy.

[1]Green roofs and LID techniques also provide many water quality benefits, but were not included in this document as they are stormwater management techniques and not necessarily related to trees and forests.

no known remaining old-growth stands. For the purposes of this report, mature forests are defined as forests that are 65 years old or older. These mature forests are important for biodiversity, as they support a species assemblage that is not found in younger forests, and provide more environmental benefits than younger forests (Conner and Dickson 1997, CUFR 2003).

Urban forests are somewhat more difficult to define. For the purposes of this FMPS, urban forest/street trees are defined as tree stands generally less than one acre in size and include individual trees that are both located in developed areas. This urban forest/street tree category includes trees lining roadways, in residential yards and surrounding businesses. Though street trees and landscape trees are often under more stress than their counterparts in forests, they are an integral component of the urban ecosystem. Urban forest/street trees offer water quality, energy saving and aesthetic benefits, as well as food and habitat for wildlife.

1.3.2b Forest Type Classification

The Maryland Department of Natural Resources (MD DNR) recognizes four broad forest community types within the state, including deciduous, coniferous, mixed (deciduous and coniferous) and scrub-shrub. COG staff extracted data about the extent of these forest types within the Anacostia from the land use/land cover data set that RESAC prepared using 2000 Landsat imagery. A map and summary table is included in Appendix A.

1.4 Overview of Forest Management and Protection Strategy (FMPS)

The Washington Metropolitan Area (WMA) is a rapidly developing region encompassing some 3,000 square miles around the Nation's Capitol and is home to a human population of over 4.5 million. Between 1970 and 2000, the population in the region grew by about 1.5 million people and is expected to add 2.0 million more people by 2030. Each of the three jurisdictions (i.e., Montgomery County, Prince George's County and the District of Columbia) that are home to the Anacostia are expected to grow considerably in the next thirty years. It is expected that the District of Columbia, Montgomery and Prince George's counties will collectively add approximately 500,000 new residents by 2030, or roughly a third of the WMA projected growth (MWCOG 2003).

In light of this continued growth, the importance and challenge of actively managing and protecting our forests becomes even more crucial. Many of the local jurisdictions in the WMA and specifically, the Anacostia, have developed forest management plans, including Montgomery County's recent Forest Preservation Strategy Update (2004). As part of an in-depth literature search, COG staff has reviewed existing local, regional and national forest management plans to help guide the creation of this FMPS (Appendix B).

The Anacostia Watershed Forest Management and Preservation Strategy is a unique document that incorporates the following elements and strategies:

- **Takes a watershed approach to forest and tree cover management.**
- **Provides an assessment of existing forest and tree cover and historical changes within the major Anacostia subwatersheds.**
- **Analyzes the extent of four different forest and tree cover categories (i.e., riparian, upland, mature and urban/street trees) within the Anacostia watershed, sets conservation and management goals, and then establishes strategies for reaching those goals.**
- **Uses the identification of mature forestland to develop forest protection priorities within the watershed.**
- **Presents management options for reforestation, exotic invasive plant management and nuisance species management (i.e., deer, voles, beaver) within the watershed.**

2.0 FMPS Definitions,Overall 2010 Restoration Goals and ARPW Recommendations

While many different forest definitions exist, the definitions used in the FMPS were selected based upon the local scale of interest, the methods used to identify forest tracts (e.g., remote sensing, using high resolution satellite and photographic imagery), and the range of existing state and local definitions of forest. The overall category of tree canopy cover includes forest cover as well as the four forest and tree cover categories discussed in this FMPS.

The 2010 Anacostia Restoration goals for the forest and tree cover categories were developed by both the ARPW and the AWRC. In the development of these goals, the potential for the restoration of each forest and tree cover category was considered. In the case of tree canopy cover, the ARPW considered the existing general guidelines for setting tree canopy cover goals developed by American Forests and the Center for Watershed Protection (CWP). The workgroup decided to adopt the more recent CWP guidelines which also factor in percent impervious cover by watershed type (American Forests 2002, Chesapeake Bay Program 2004).

TREE CANOPY COVER

Definition: Tree canopy cover is the land area that is cloaked by the branches and leaves comprising the canopy of a tree, and is generally expressed as a percent coverage of a given area.

Tree Canopy Cover Goals:

• Recommended canopy cover as a percentage of land area (Cappiella *et al.* 2005, Chesapeake Bay Program 2004):

Watershed Type	Impervious Cover	Tree Canopy Cover Goal*
Suburban (Previously Forested)	<25%	>65%
Suburban (Previously Agricultural)	<25%	>40%
Urban	26-60%	>40%
Ultra-Urban	>60%	>25%

• Jurisdictions should use a subwatershed approach to develop specific tree canopy cover goals and implementation plans based on existing and projected land use patterns, an analysis of the quantifiable benefits of trees in their jurisdiction, CWP tree canopy cover recommendations, and local opportunities for canopy cover protection and expansion.

*From CWP

OVERALL FOREST COVER

Definition: A forest is an area one acre or greater and wider than 100 feet that is at least 90% covered by tree canopy. Orchards and tree nurseries are not considered forests (ARPW 2002).

Forest Cover Goals:

• Since the loss of forest has already reached critical levels, at a minimum, maintain the current forest cover level (i.e., 29.6% for the watershed) and where opportunities exist at the subwatershed level, all efforts should be made to increase the forest cover

• Research opportunities for expanding forest cover in the future.

RIPARIAN FOREST

Definition: Riparian forests are forests that are adjacent to bodies of water and are a minimum of 35 feet in width. Buffer widths of 100 feet are recommended and widths of 200 are preferred for added environmental benefits.

Riparian Forest Goals:

• By 2010, create an additional 12 miles of forested riparian buffer in the watershed, representing approximately 45 additional acres (AWRC 2001).

3.0 Tree Canopy Cover Trends

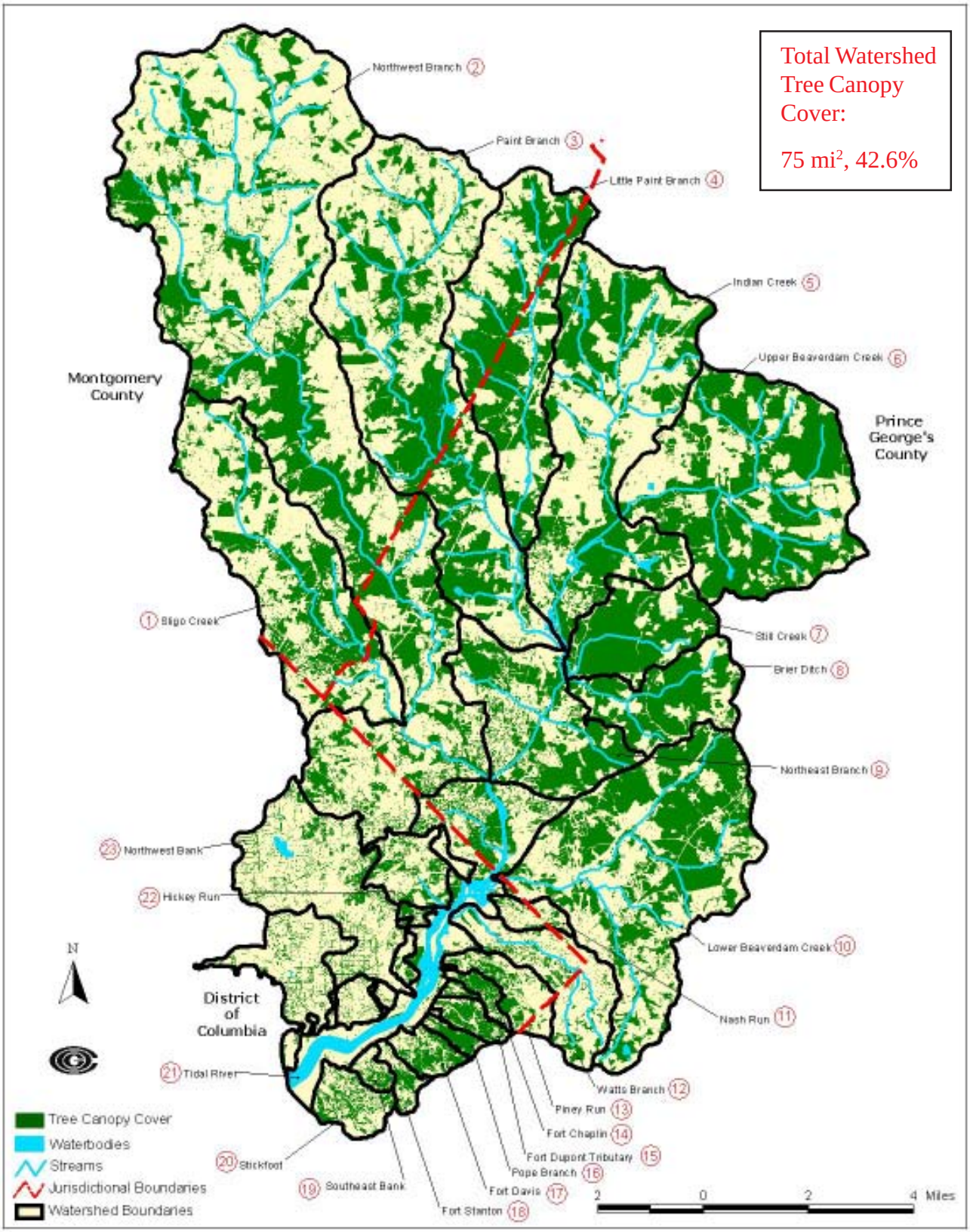
COG and RESAC analysis results show that Anacostia watershed tree canopy cover declined by 6.2% between 1936 and 2000 (Figures 2, 3 and Table 1). More than half (59%) of the tree canopy cover in 2000 is located in the same place as tree cover in 1936/38. Much of the change in the distribution of tree canopy cover may be attributed to the shift of land use from agriculture to residential and the fragmentation of large forest tracts to make way for urban development during this period.

As seen in Table 1 and Figure 4, tree cover decreased in eighteen of the twenty three subwatersheds, with two subwatersheds (Northwest Branch and Nash Run) experiencing no change in tree cover and three watersheds (Upper Beaverdam Creek, Watts Branch and Fort Dupont) seeing an increase in tree canopy cover. The average increase in tree cover over this period was 8.6%, while tree cover declined by an average of 12.0%. The Northwest Bank subwatershed has the lowest percentage of area covered by tree canopy, with 8.8% tree canopy cover, which is less than half of the minimum 25% tree canopy cover goal suggested by CWP in ultra-urban areas.

Table 1. Summary of Tree Canopy Coverage in 1936/38 and 2000

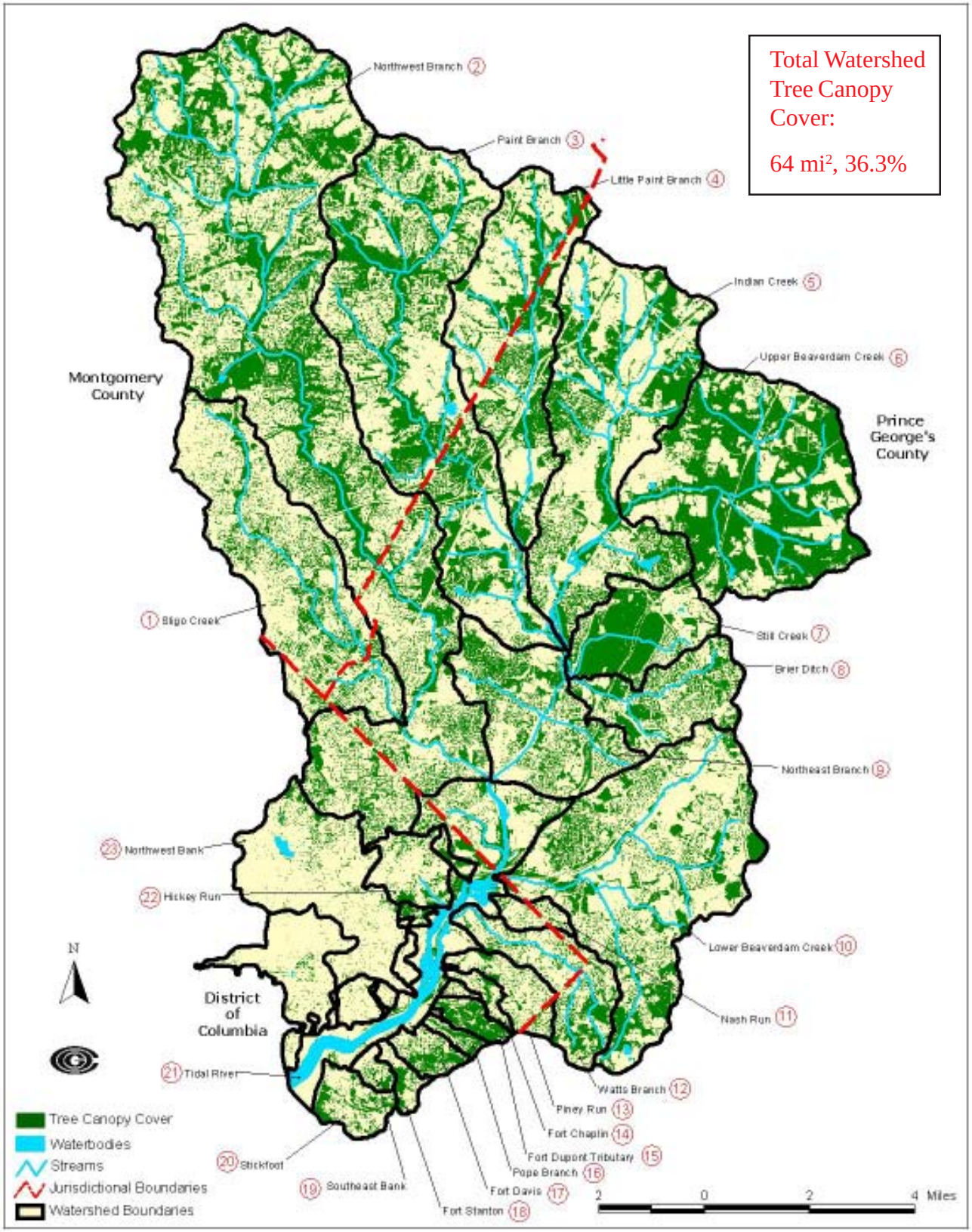
	Subwatershed	1936/38 Tree Canopy Cover		2000 Tree Canopy	
		Tree Canopy Coverage (mi^2)	% Watershed Covered by Trees	Tree Canopy Coverage (mi^2)	% Watershed Covered by Trees
1	Sligo Creek	4.36	37.7%	2.66	23.0%
2	Northwest Branch	14.90	35.6%	14.91	35.6%
3	Paint Branch	9.12	43.9%	8.90	42.9%
4	Little Paint Branch	5.67	54.3%	4.02	38.5%
5	Indian Creek	6.98	45.0%	5.98	38.6%
6	Upper Beaverdam Creek	8.59	61.0%	8.72	62.0%
7	Still Creek	3.00	75.3%	2.45	61.4%
8	Brier Ditch	2.66	65.6%	1.73	42.6%
9	Northeast Branch	3.41	51.1%	2.43	36.4%
10	Lower Beaverdam Creek	7.75	49.3%	5.18	32.9%
11	Nash Run	0.16	21.8%	0.16	21.8%
12	Watts Branch	0.70	18.6%	1.30	34.7%
13	Piney Run	0.51	31.9%	0.37	23.1%
14	Fort Chaplin	0.31	61.9%	0.16	31.5%
15	Fort Dupont	0.43	60.0%	0.49	68.8%
16	Pope Branch	0.29	74.1%	0.20	51.6%
17	Fort Davis	0.49	53.6%	0.42	45.8%
18	Fort Stanton	0.24	42.1%	0.21	36.5%
19	Southeast Bank	0.27	42.4%	0.18	28.4%
20	Stickfoot	0.54	37.3%	0.49	33.4%
21	Tidal River	1.80	25.4%	1.67	23.5%
22	Hickey Run	0.61	34.7%	0.42	24.0%
23	Northwest Bank	2.19	19.2%	1.00	8.8%
	Total Watershed	**74.98**	**42.6%**	**64.04**	**36.3%**

Figure 2. Tree Canopy Coverage in 1936/38[1]



[1] Tree canopy cover layer was created using 1936 and 1938 black and white 1:24,000 photography. Tree canopy cover includes forest cover and all of the forest and tree cover categories.

Figure 3. Tree Canopy Coverage in 2000[1]



[1] Tree canopy cover layer was created by RESAC using 2000 Ikonos Imagery. Tree canopy cover includes forest cover and all of the forest and tree cover categories.

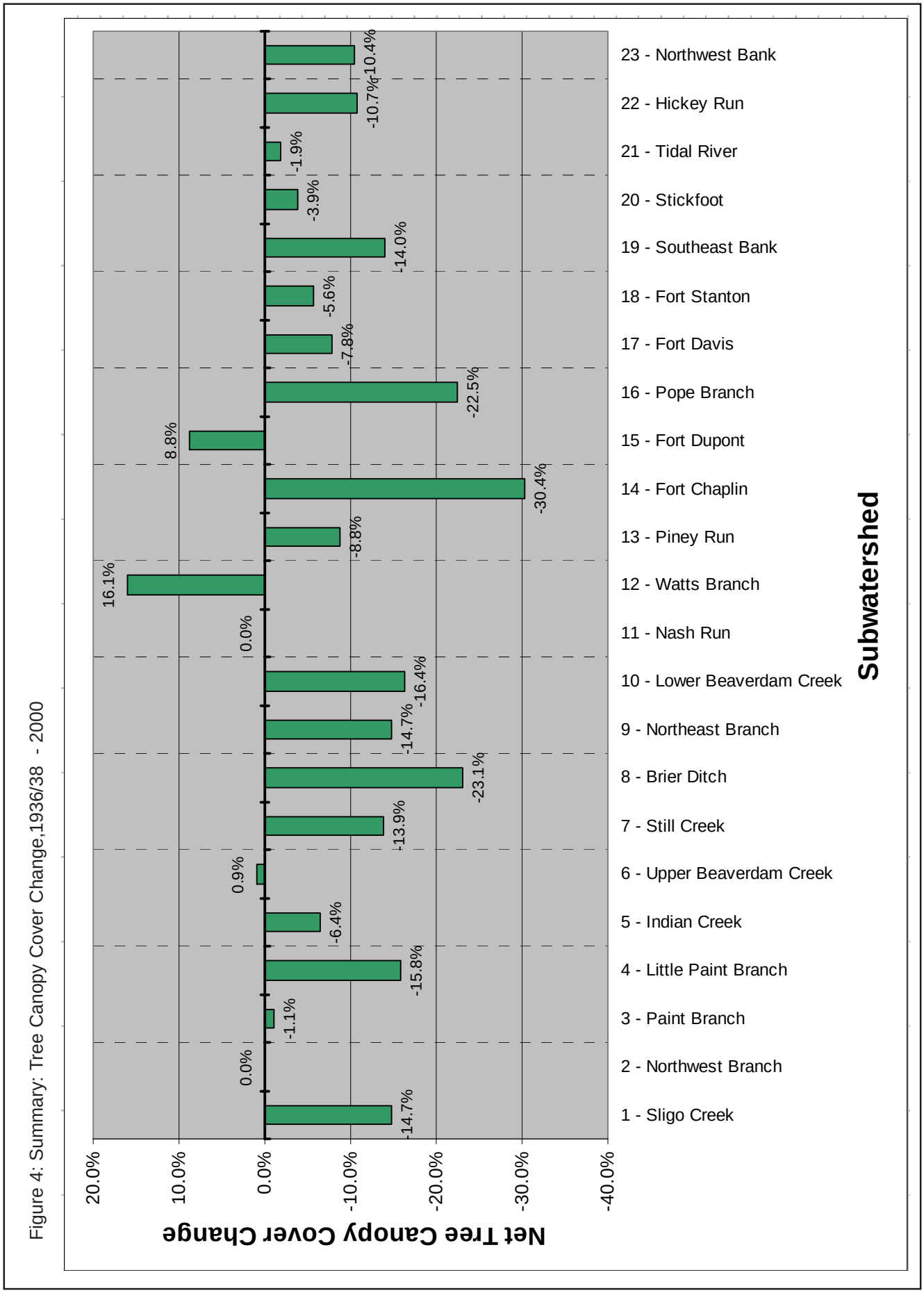


Figure 4: Summary: Tree Canopy Cover Change,1936/38 - 2000

4.0 Forest Cover Trends

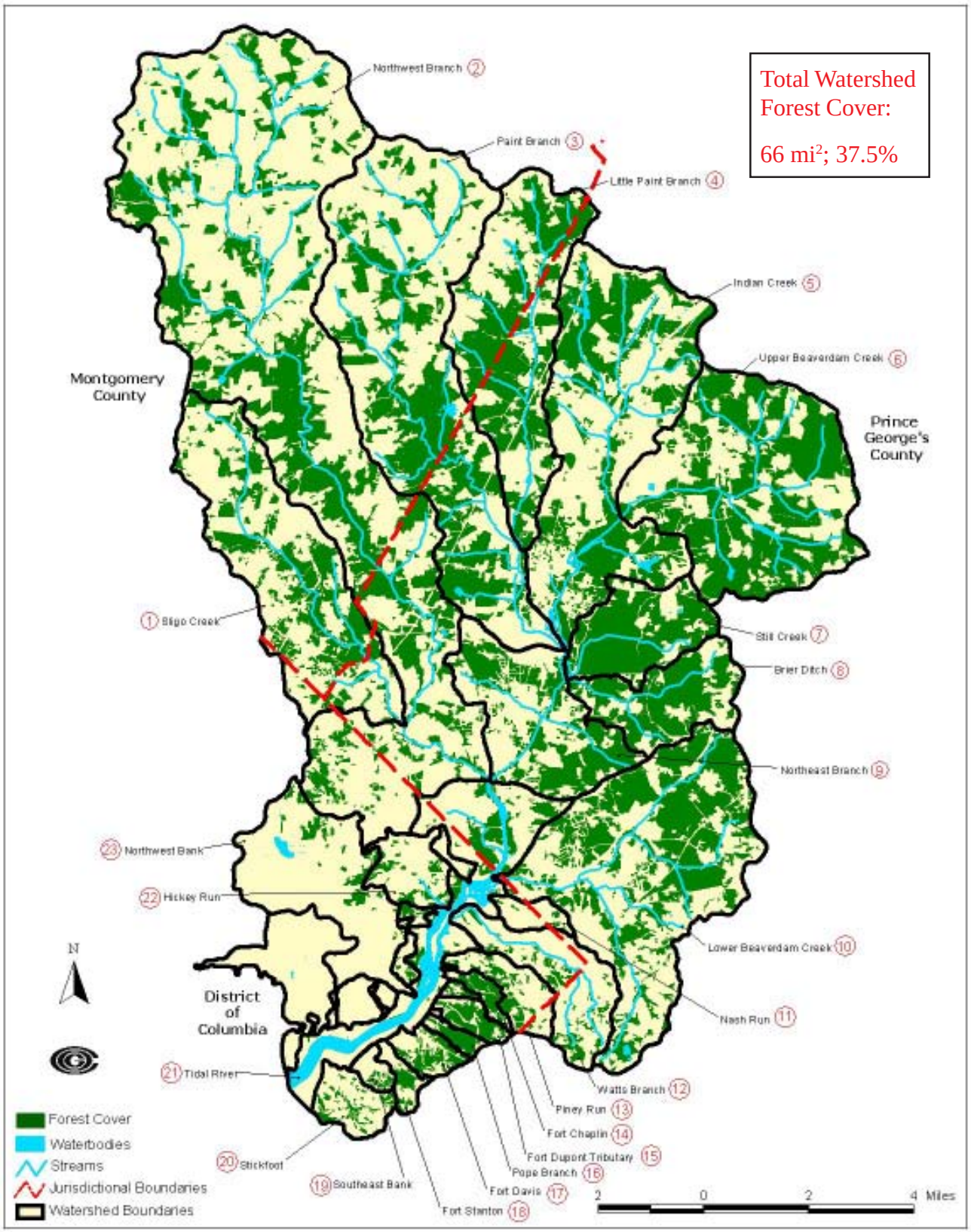
For the purposes of this FMPS, forest cover is a subset of tree cover. From a natural resources perspective, forest cover is the critical component and indicator of the Anacostia's long-term ecological health and integrity. Not surprisingly, between 1936 and 2000, forest coverage in the Anacostia watershed decreased as the suburbs of Washington, D.C. expanded (Figure 5, 6 and Table 2). Much of the land that was previously used for agriculture in the 1930s and before became residential or commercial areas by 2000. This increasing urbanization further fragmented remaining forests.

Overall, there was a 7.9% decline in forest cover throughout the Anacostia watershed during this period. Seventeen of the twenty three subwatersheds experienced a decline in forest cover; whereas, six subwatersheds (i.e., Northwest Branch, Upper Beaverdam Creek, Watts Branch, Fort Dupont, Stickfoot and the Tidal River) showed an increase (Table 2 and Figure 7). While the average decline in forest cover in the subwatersheds was 17%, the average increase was only 3%. Concurrently, the mean forest patch size also decreased during this period, with seventeen of the twenty-three watersheds experiencing a decline (Figure 8). In those subwatersheds, the average overall decline in forest patch size between 1936 and 2000 was approximately twelve acres.

Table 2. Summary of Forest Coverage in 1936/38 and 2000

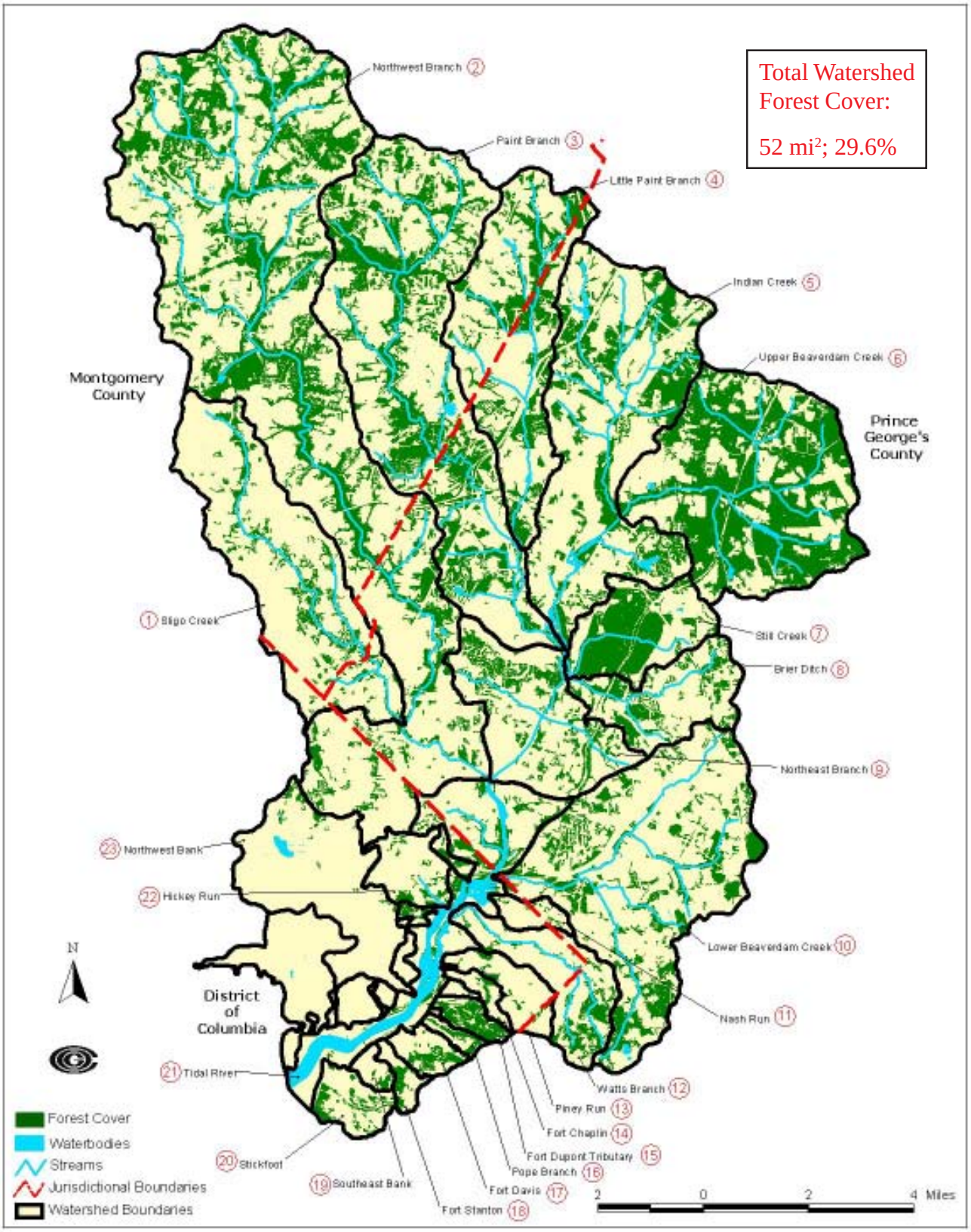
	Subwatershed	1936/38 Forest		2000 Forest	
		Forest (mi^2)	% Watershed Covered by Forest	Forest (mi^2)	% Watershed Covered by Forest
1	Sligo Creek	3.96	34.2%	1.72	14.9%
2	Northwest Branch	12.64	30.2%	12.94	30.9%
3	Paint Branch	8.00	38.6%	7.55	36.4%
4	Little Paint Branch	5.44	52.1%	3.29	31.5%
5	Indian Creek	6.66	42.9%	4.79	30.9%
6	Upper Beaverdam Creek	8.28	58.9%	8.54	60.7%
7	Still Creek	2.98	74.8%	2.19	54.9%
8	Brier Ditch	2.60	64.0%	1.19	29.4%
9	Northeast Branch	2.91	43.7%	1.54	23.1%
10	Lower Beaverdam Creek	7.15	45.4%	3.93	25.0%
11	Nash Run	0.07	9.8%	0.07	9.2%
12	Watts Branch	0.54	14.3%	0.83	22.0%
13	Piney Run	0.40	25.5%	0.14	9.0%
14	Fort Chaplin	0.33	66.4%	0.10	19.5%
15	Fort Dupont	0.42	59.4%	0.46	63.9%
16	Pope Branch	0.26	67.6%	0.14	35.9%
17	Fort Davis	0.42	45.3%	0.27	29.1%
18	Fort Stanton	0.20	35.3%	0.16	28.5%
19	Southeast Bank	0.17	26.9%	0.07	11.4%
20	Stickfoot	0.33	22.3%	0.36	24.5%
21	Tidal River	1.19	16.8%	1.28	18.0%
22	Hickey Run	0.35	20.1%	0.25	14.4%
23	Northwest Bank	0.69	6.0%	0.36	3.1%
	Total Watershed	**66.00**	**37.5%**	**52.15**	**29.6%**

Figure 5. Anacostia Watershed 1936/38 Forest Cover[1]



[1] Forest cover layer is a subset of tree canopy cover and was captured through heads-up digitizing of 1936 and 1938 black and white aerial photographs.
Forest = an area 1 acre or greater and wider than 100 feet that is at least 90% covered by forest.

Figure 6. Anacostia Watershed 2000 Forest Cover[1]



[1] Forest cover layer is a subset of tree canopy cover and was developed from 2000 Ikonos Imagery.
Forest = an area 1 acre or greater and wider than 100 feet that is at least 90% covered by forest.

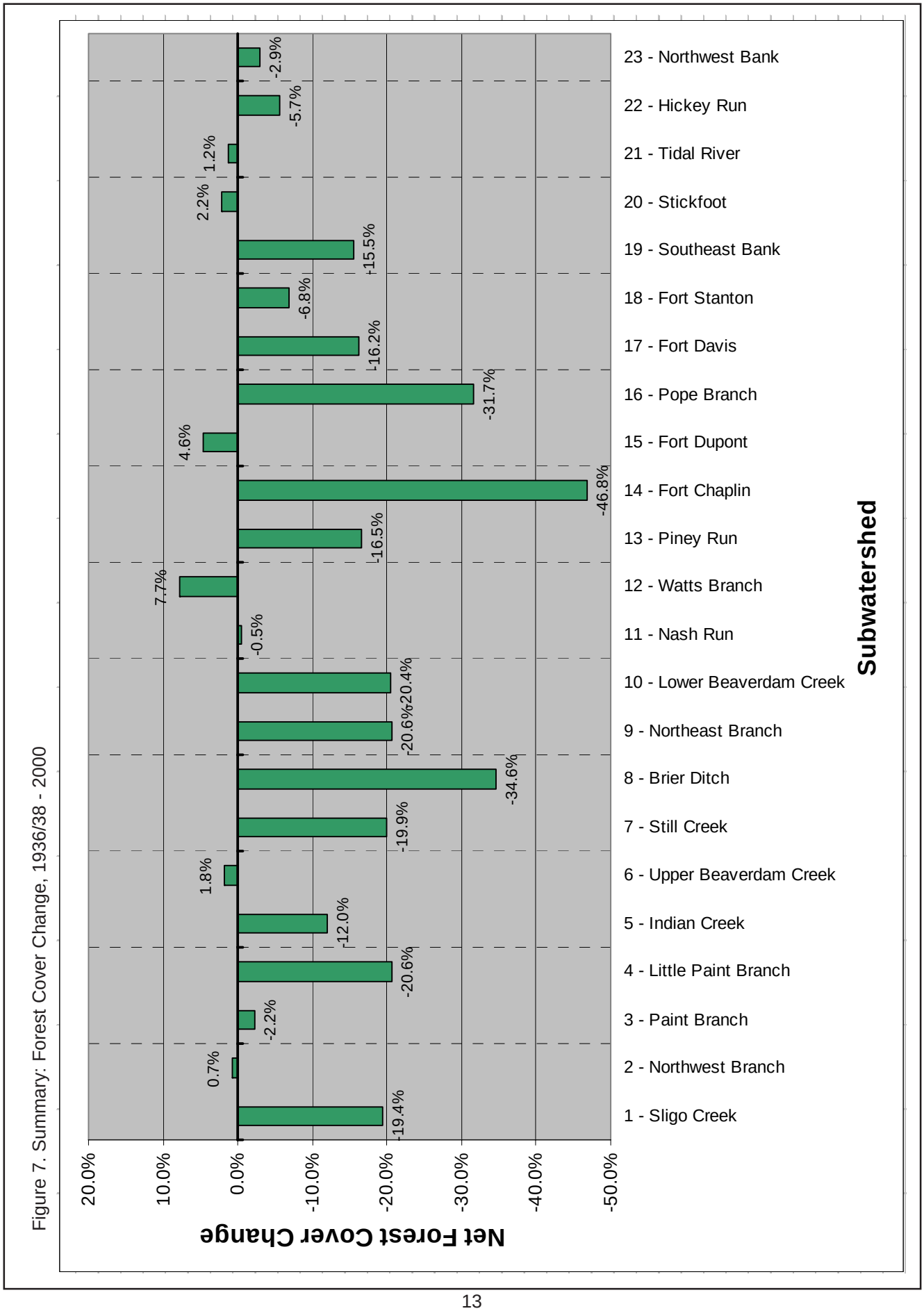


Figure 7. Summary: Forest Cover Change, 1936/38 - 2000

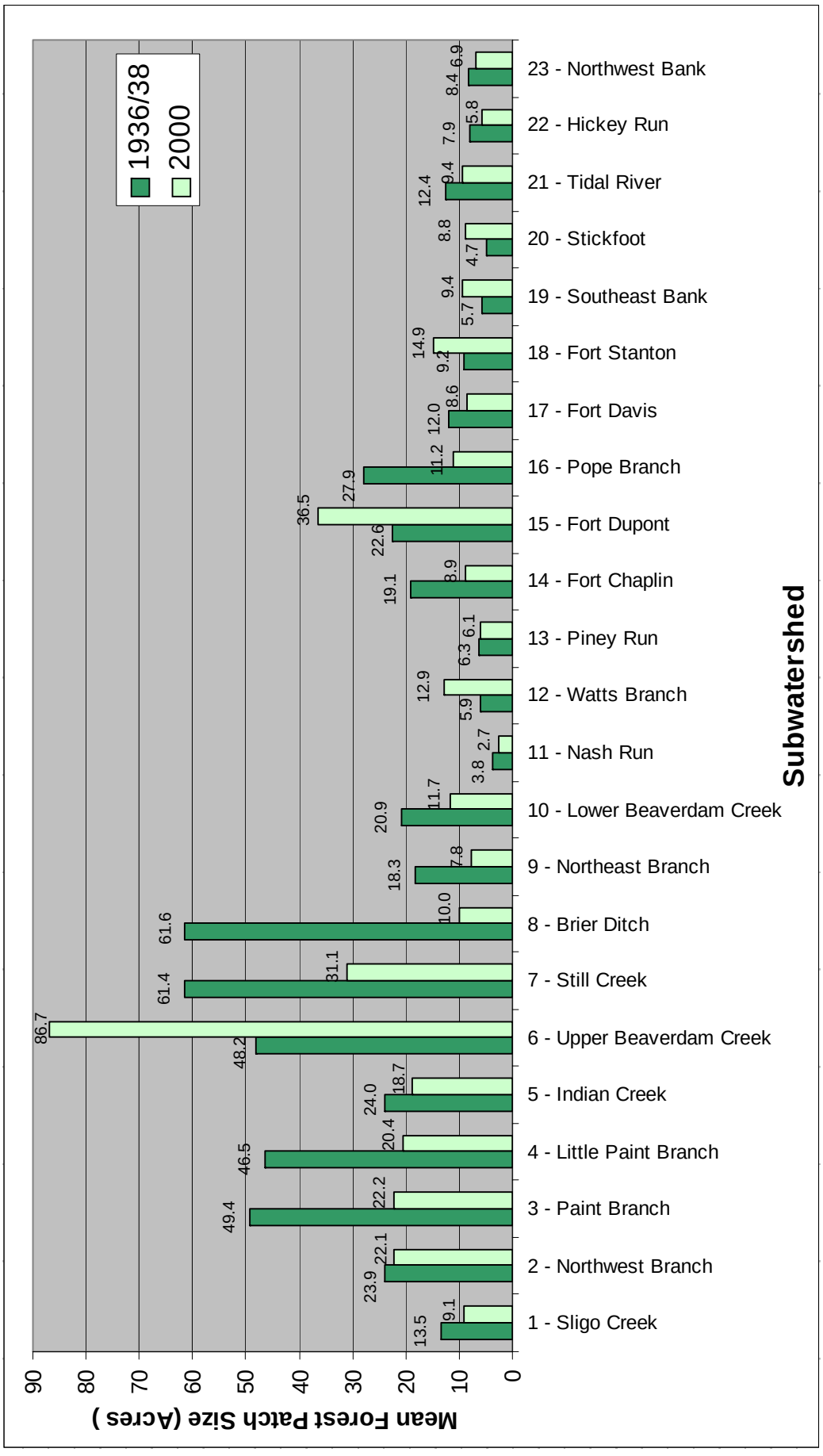


Figure 8. Summary: Mean Forest Patch Size, 1936/38 - 2000

5.0 Goals and Strategies by Forest & Tree Cover Categories

5.1 Riparian Forest

Currently, there is no uniform riparian forest buffer width requirement for the Anacostia watershed. A 35 foot buffer on either side of a stream is generally considered the minimum width to provide shading, water quality and other ecological benefits and is applied by both Maryland Department of Natural Resources and Prince George's County as the minimum riparian buffer required for preservation and/or reforestation in land development projects. Montgomery County employs a minimum 100 foot buffer with a variable width buffer system which factors in both stream sensitivity and steepness of valley side slopes. The District of Columbia does not currently have any stream buffer protection regulations. Most studies show that wider buffers can more consistently and sustainably provide a broad range of water quality/quantity and wildlife habitat benefits (Palone and Todd 1997).

Definition: Riparian forests are forests that are adjacent to bodies of water and extend a minimum of 35 feet from the edge of the water. Buffer widths of 100 feet are recommended in order to provide a broad range of ecological functions while 200 foot buffers are preferred as they offer greater environmental benefits. Buffers should remain undisturbed.

Based on the COG analysis, 62% of the more than 344 miles of open streams in the Anacostia watershed have at least a 35 foot forested buffer. Table 3, Table 4 and Figure 9 show that in 2000, the total land area in the Anacostia covered by riparian forests buffers of 35, 100 and 200 ft. was 3.0, 7.9 and 14.0 mi^2, respectively. In many of the subwatersheds, riparian buffers are frequently 200 feet wide or wider along each side of the stream.

Table 3. Summary of Stream Length Buffered by Minimum Riparian Forest

	Subwatershed	Total Open Stream Channel Length	Linear Stream Length with 35 ft. Forest Buffer	% Linear Stream Length with 35 ft. Buffer
		Miles	Miles	
1	Sligo Creek	22.45	13.01	58.4%
2	Northwest Branch	86.83	57.19	65.9%
3	Paint Branch	49.00	35.78	72.9%
4	Little Paint Branch	22.60	14.28	63.3%
5	Indian Creek	34.54	19.93	57.9%
6	Upper Beaverdam Ck.	35.41	30.01	84.7%
7	Still Creek	7.39	5.88	79.6%
8	Brier Ditch	5.66	2.72	48.1%
9	Northeast Branch	17.59	6.45	36.6%
10	Lower Beaverdam Ck.	29.28	15.79	53.9%
11	Nash Run	1.34	0.53	39.6%
12	Watts Branch	7.43	5.35	72.1%
13	Piney Run	0.80	0.21	27.1%
14	Fort Chaplin	0.24	0.25	100.0%
15	Fort Dupont	3.25	3.18	97.9%
16	Pope Branch	1.31	1.30	99.9%
17	Fort Davis	piped	- -	--
18	Fort Stanton	piped	- -	--
19	Southeast Bank	0.18	0.00	0.0%
20	Stickfoot	piped	- -	--
21	Tidal River	33.54	11.91	35.7%
22	Hickey Run	1.50	1.08	71.7%
23	Northwest Bank	3.51	0.22	6.4%
	Total Watershed	**363.84**	**225.07**	**61.9%**

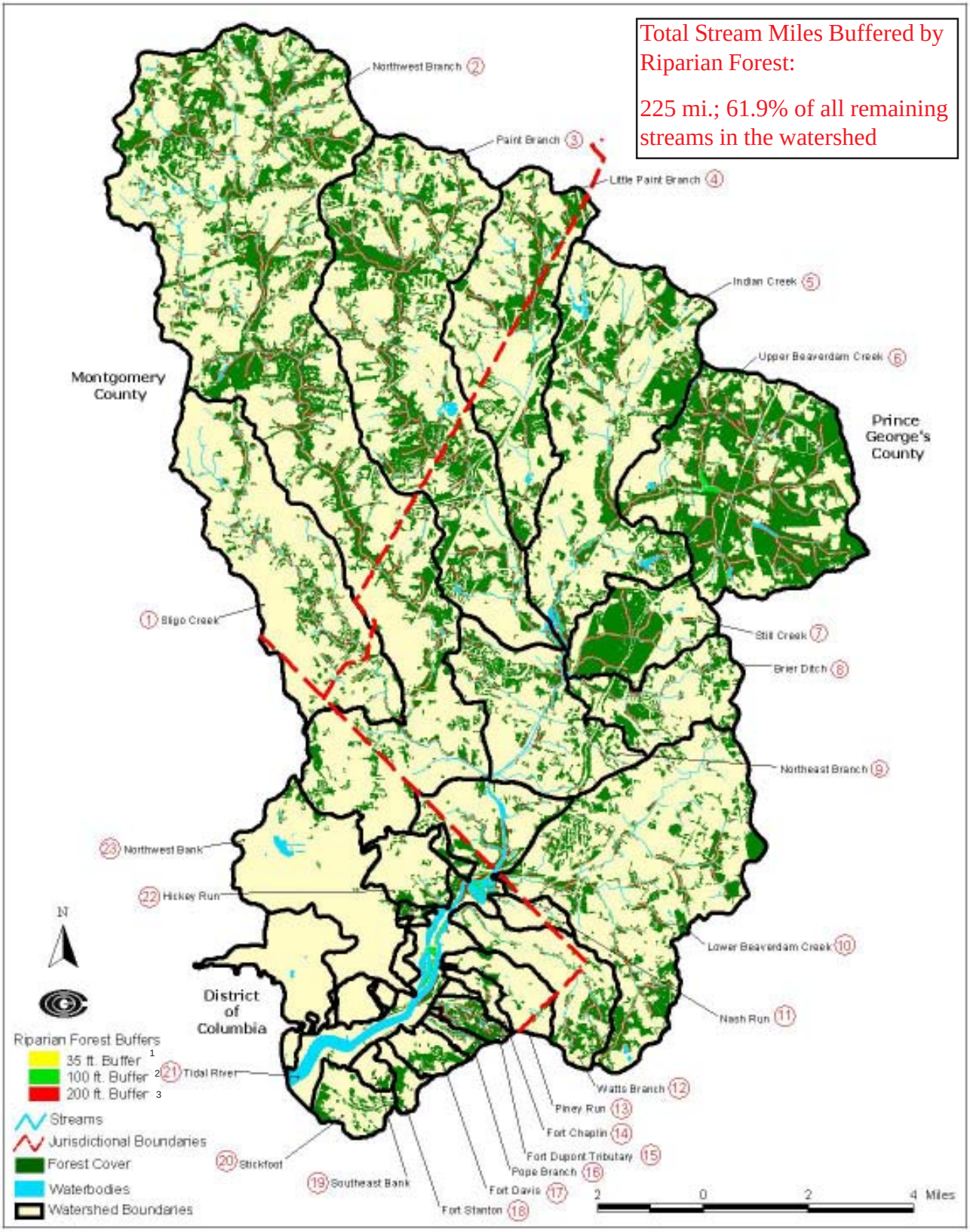
GOALS:

- By 2010, create an additional 12 miles of forested riparian buffer in the Anacostia watershed, representing approximately 45 additional acres (AWRC 2001).
- Establish an ecologically-viable riparian buffer along all streams in the Anacostia watershed (35 ft. minimum, 100 ft. where feasible on each bank (Figure 10)).

STRATEGY:

- Focus on reforesting gaps between forest stands to re-establish continuous riparian forest buffers.
- Identify and inventory all riparian areas that can be protected or reforested through master plans, areawide forest management plans, park management plans, etc. (MC FPTF 2000).
- Provide public and private landowners with resources and/or incentives to encourage the protection or re-creation of forested riparian buffers on their properties (Appendix C).
- Foster public education and outreach programs about the benefits of riparian forests.

Figure 9. Anacostia Watershed 2000 Riparian Forest Buffers



[1] Riparian buffer widths of less than 35ft. on each side of the stream are considered to be unsustainable.
[2] Riparain buffer widths of 100 ft. on each side of the stream provide an array of water quality and habitat functions.
[3] Riparain buffer widths of 200 ft. on each side of the stream are considered optimal for protecting water quality and habitat.

Figure 10. Sample: Upper Beaverdam Creek Subwatershed -- Applied Riparian Forest Buffer Width Options

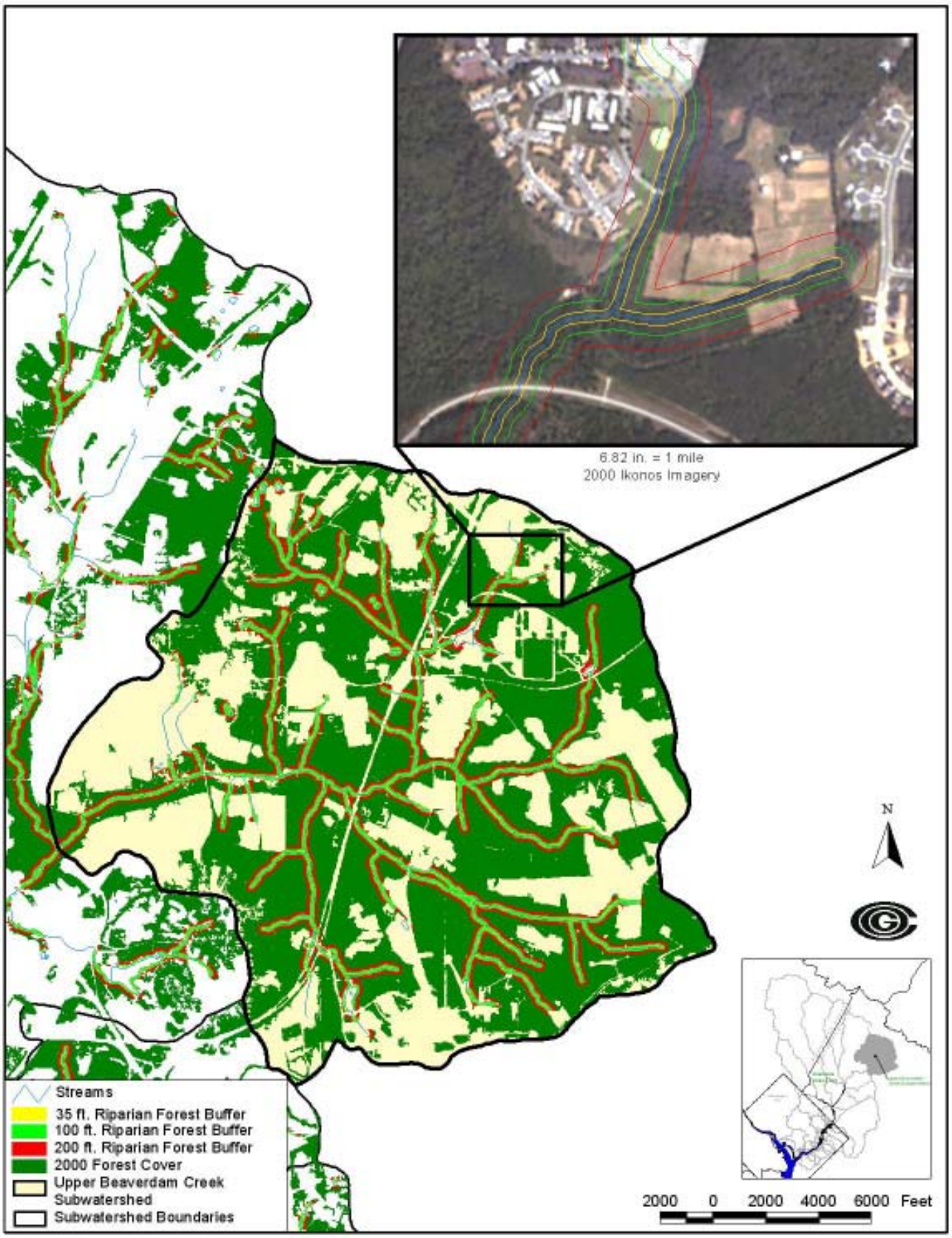


Table 4. Summary of Riparian Forest Area in 2000

	Subwatershed	Total Watershed Area		35 ft. Forest Buffer		% Watershed Covered by 35 ft. Forest Buffer	100 ft. Forest Buffer		% Watershed Covered by 100 ft. Forest Buffer	200 ft. Forest Buffer		% Watershed Covered by 200 ft. Forest Buffer
		Acres	Miles^2	Acres	Miles^2		Acres	Miles^2		Acres	Miles^2	
1	Sligo Creek	7,404.7	11.57	107.5	0.17	1.5%	277.6	0.43	3.7%	480.8	0.75	6.5%
2	Northwest Branch	26,808.6	41.89	482.2	0.75	1.8%	1,326.2	2.07	4.9%	2,393.9	3.74	8.9%
3	Paint Branch	13,285.6	20.76	298.0	0.47	2.2%	788.3	1.23	5.9%	1,415.8	2.21	10.7%
4	Little Paint Branch	6,687.3	10.45	118.8	0.19	1.8%	318.4	0.50	4.8%	558.5	0.87	8.4%
5	Indian Creek	9,930.5	15.52	165.2	0.26	1.7%	429.3	0.67	4.3%	732.0	1.14	7.4%
6	Upper Beaverdam Creek	9,007.9	14.07	252.4	0.39	2.8%	733.5	1.15	8.1%	1,331.3	2.08	14.8%
7	Still Creek	2,550.2	3.98	49.7	0.08	1.9%	139.0	0.22	5.4%	264.9	0.41	10.4%
8	Brier Ditch	2,598.3	4.06	23.4	0.04	0.9%	63.9	0.10	2.5%	117.3	0.18	4.5%
9	Northeast Branch	4,268.9	6.67	54.5	0.09	1.3%	130.6	0.20	3.1%	231.3	0.36	5.4%
10	Lower Beaverdam Creek	10,064.2	15.73	131.7	0.21	1.3%	341.1	0.53	3.4%	593.5	0.93	5.9%
11	Nash Run	464.9	0.73	4.6	0.01	1.0%	11.4	0.02	2.4%	20.1	0.03	4.3%
12	Watts Branch	2,404.8	3.76	43.5	0.07	1.8%	105.2	0.16	4.4%	169.0	0.26	7.0%
13	Piney Run	1,014.6	1.59	1.6	0.00	0.2%	4.6	0.01	0.5%	8.8	0.01	0.9%
14	Fort Chaplin	318.7	0.50	2.2	0.00	0.7%	6.8	0.01	2.1%	12.8	0.02	4.0%
15	Fort Dupont	457.1	0.71	25.9	0.04	5.7%	68.2	0.11	14.9%	120.4	0.19	26.3%
16	Pope Branch	249.9	0.39	10.6	0.02	4.3%	27.2	0.04	10.9%	41.3	0.06	16.5%
17	Fort Davis	588.1	0.92	0.0	0.00	0.0%	0.0	0.00	0.0%	0.0	0.00	0.0%
18	Fort Stanton	366.9	0.57	0.0	0.00	0.0%	0.2	0.00	0.0%	1.6	0.00	0.4%
19	Southeast Bank	413.1	0.65	0.1	0.00	0.0%	0.5	0.00	0.1%	2.0	0.00	0.5%
20	Stickfoot	931.5	1.46	0.0	0.00	0.0%	0.0	0.00	0.0%	0.0	0.00	0.0%
21	Tidal River	4,540.7	7.09	96.0	0.15	2.1%	244.8	0.38	5.4%	331.6	0.52	7.3%
22	Hickey Run	1,130.4	1.77	8.3	0.01	0.7%	18.6	0.03	1.6%	29.7	0.05	2.6%
23	Northwest Bank	7,290.0	11.39	1.9	0.00	0.0%	5.6	0.01	0.1%	10.6	0.02	0.1%
	Total Watershed	112,776.8	176.21	1,878.1	2.93	1.7%	5,040.9	7.88	4.5%	8,867.2	13.86	7.9%

5.2 Upland Forest

Definition: Upland forests are forests that grow in non-hydric soils.

As previously stated, the upland forests, located further away from development restrictions such as streams, floodplains and wetlands, have been severely impacted by the spread of development in the Anacostia watershed.

The COG analysis of upland forest shows that 24% of the Anacostia watershed is covered by upland forest and of the 41 mi^2 of upland forest, 45% is located on public land (Table 5 and Figure 11). The percent of subwatershed area covered by upland forest varies from a high of 63% in Fort Dupont to a low of 3% in the Northwest Bank. Of the jurisdictions in the Anacostia, the District of Columbia has the lowest percentage of area covered by upland forest (10%), but has the highest percentage of upland forest located on public land (65%; Figure 12). Montgomery and Prince George's counties have a similar percentage of area in the Anacostia watershed covered by upland forest (25% and 27%, respectively). However, in Prince George's County, 46% of upland forest is located on public land, while 41% of upland forest in Montgomery County is located on public land.

GOALS:

- Protect remaining upland forest.
- Increase upland forest acreage in the watershed (AWRC 2001).
- Protect and expand the number of "corridor" connections between upland and riparian forest areas so as to reduce habitat fragmentation (AWRC 2001).

Table 5. Summary of Upland Forest Cover in 2000

	Subwatershed	Water-shed Area (mi^2)	Upland Forest (mi^2)	% Watershed Covered by Upland Forest	Upland Forest on Public Land (mi^2)	% Upland Forest on Public Land
1	Sligo Creek	11.57	1.29	11.1%	0.40	31.1%
2	Northwest Branch	41.89	9.74	23.2%	3.10	31.8%
3	Paint Branch	20.76	5.93	28.6%	3.25	54.8%
4	Little Paint Branch	10.45	2.42	23.1%	0.95	39.2%
5	Indian Creek	15.52	3.62	23.3%	1.02	28.3%
6	Upper Beaverdam Creek	14.07	7.17	50.9%	5.37	75.0%
7	Still Creek	3.98	2.03	51.0%	1.74	85.6%
8	Brier Ditch	4.06	1.13	27.7%	0.19	17.2%
9	Northeast Branch	6.67	1.05	15.8%	0.19	17.7%
10	Lower Beaverdam Creek	15.73	3.48	22.2%	0.57	16.3%
11	Nash Run	0.73	0.05	6.9%	0.00	7.4%
12	Watts Branch	3.76	0.74	19.6%	0.16	21.5%
13	Piney Run	1.59	0.14	9.0%	0.07	50.3%
14	Fort Chaplin	0.50	0.10	19.5%	0.08	84.2%
15	Fort Dupont	0.71	0.45	62.8%	0.44	98.0%
16	Pope Branch	0.39	0.12	31.3%	0.09	72.8%
17	Fort Davis	0.92	0.27	29.2%	0.17	61.7%
18	Fort Stanton	0.57	0.16	28.4%	0.12	74.9%
19	Southeast Bank	0.65	0.07	11.4%	0.06	74.8%
20	Stickfoot	1.46	0.36	24.5%	0.25	71.0%
21	Tidal River	7.09	0.52	7.3%	0.23	43.9%
22	Hickey Run	1.77	0.23	13.0%	0.19	81.2%
23	Northwest Bank	11.39	0.35	3.1%	0.20	56.3%
	Total Watershed	**176.21**	**41.41**	**23.5%**	**18.83**	**45.5%**

STRATEGY:

- Provide all landowners with both educational and plant material resources to help them protect, maintain and/or reforest their upland property. Establish or expand such programs as grants for reforestation, forest bank creation, etc.
- Encourage private landowners to permanently protect upland forested areas on their property through conservation easements, forest banks, or public acquisition.
- Reduce fragmentation of upland forests in new development by encouraging flexible site design techniques, including clustered development, smaller lot sizes, limited road widths, shorter road and driveway lengths. This may require refinements in local zoning codes and ordinances (Carter 2003, Center for Watershed Protection).
- Expand or refine local master planning processes to include the identification, inventory and prioritization of upland forest stands for preservation. Also, encourage the creation of park management plans that include forest protection priorities.

Figure 11. Anacostia Watershed 2000 Upland Forest Cover

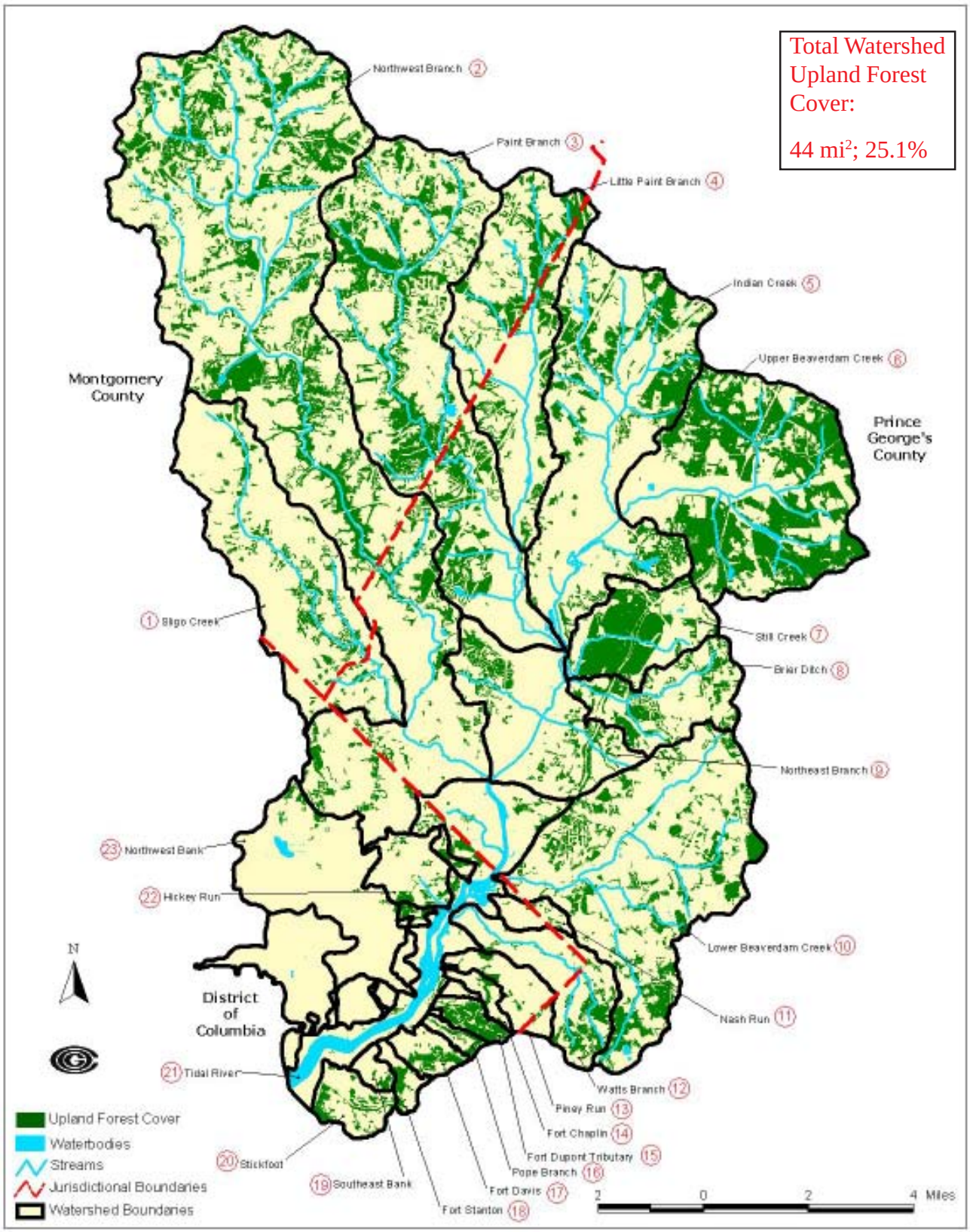
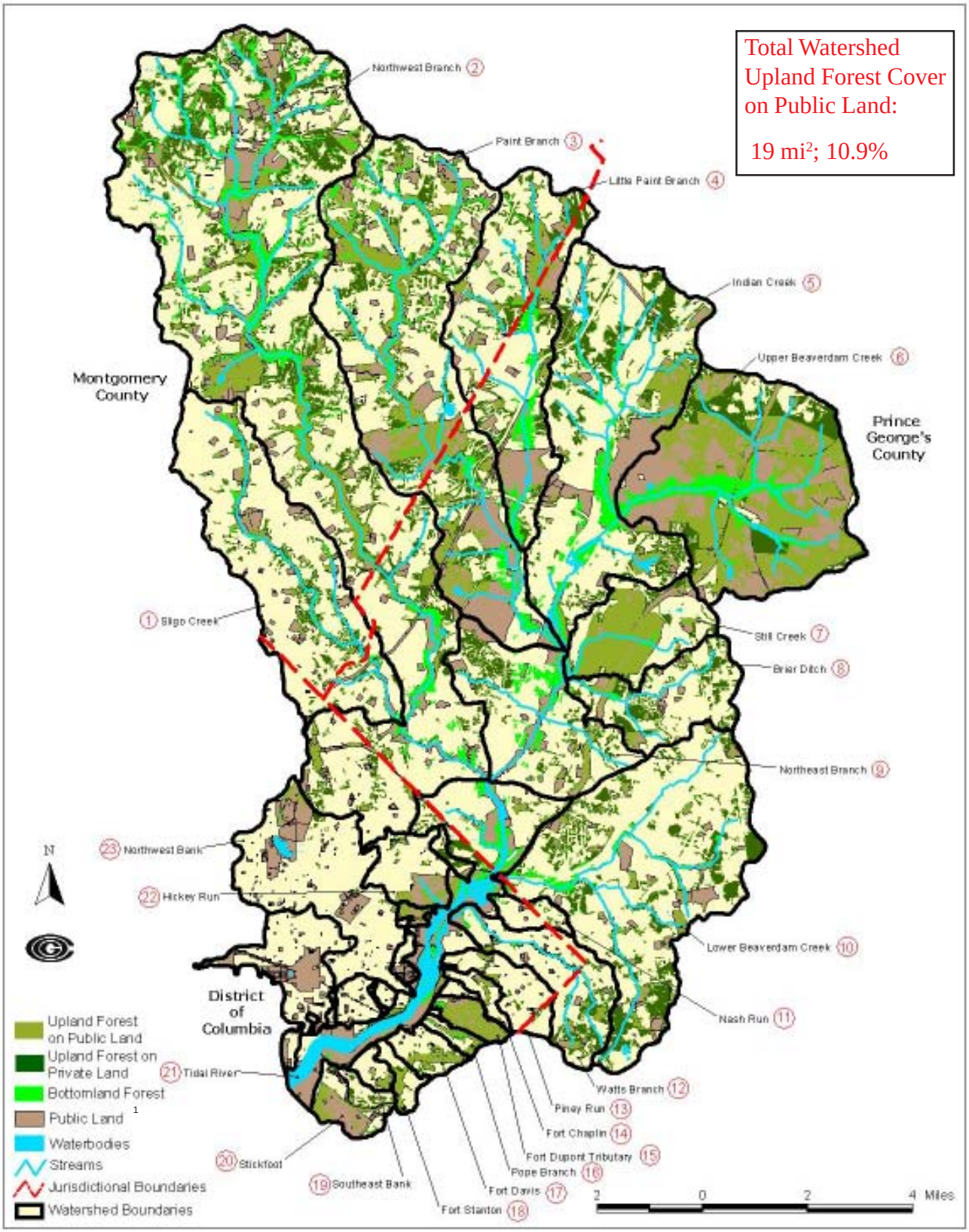


Figure 12. Anacostia Watershed 2000 Ownership of Upland Forest



[1] Public land includes for Prince George's County all county parks, state land (based on GIS data from MD DNR), federal land (based on GIS data from USACOE) and all public works and school properties (digitized from PG county parcel images); for the District of Columbia all city parks (based on GIS data from DC), federal lands (based on GIS data from USACOE) and all National Park Service land (based on GIS data from NPS); and for Montgomery County all county parks, publically owned land, conservation easements, public works and school properites (digitized from MC parcel images) and federal land (based on GIS data from USACOE). NOTE: GIS data may be copyrighted by federal, state or local owner. Reproduction is prohibited without express written permission.

5.3 Mature Hardwood Forest

Due to the extensive clearing of land for timber harvesting, agriculture and housing in the 18th, 19th and 20th centuries, with a few exceptions, the oldest trees in the Anacostia are generally less than one hundred years old. Using 1936 and 1938 black and white aerial photographs, COG staff has been able to identify forest stands that are most likely at least 65 years old, and therefore considered "mature."

In 2000, mature hardwood forest comprised half (50.6%) of the total forest coverage in the Anacostia watershed (Figure 13). A considerable portion of this mature forest (22%) was located in the Upper Beaverdam Creek subwatershed which is largely comprised by the USDA's Beltsville Agricultural Research Center. Much of the mature forest is typically located along the stream valleys. The Northwest Branch and Paint Branch subwatersheds contain the second and third most mature forest land, with 20% and 15% of the total mature forest, respectively (Figures 13 and 14).

An analysis of the ownership of mature forest in the Anacostia watershed revealed that more than half (59%) of the mature forest in the watershed is located on public land (Appendix D). This percentage differs by jurisdiction, with almost all of the mature forest in the District of Columbia located on public land (89%) and over half of the mature forest in Montgomery and Prince George's counties (54% and 60%, respectively) located on public land (Table 7 and Figure 15).

Definition: A mature hardwood forest is an unbroken woodland area greater than or equal to 65 years (as determined through cross-referencing with regional, 1936/38 vintage low-level black and white aerial photographs), generally measuring 5 acres or greater in size which ideally exhibits the following dominant species composition, overstory tree diameter, understory, and structural habitat characteristics (ARPW 2002):

1) dominant species composition – for upland sites, typically oak-hickory-yellow poplar; for bottom land areas, typically oak-sycamore-ash assemblage;

2) overstory tree diameter (dbh) – average 18-24 inches;

3) understory – generally well developed, woody understory plant community comprised of primarily native species;

4) structural habitat – presence of snags and large downed logs greater than or equal to 12 inches in diameter.

GOALS:

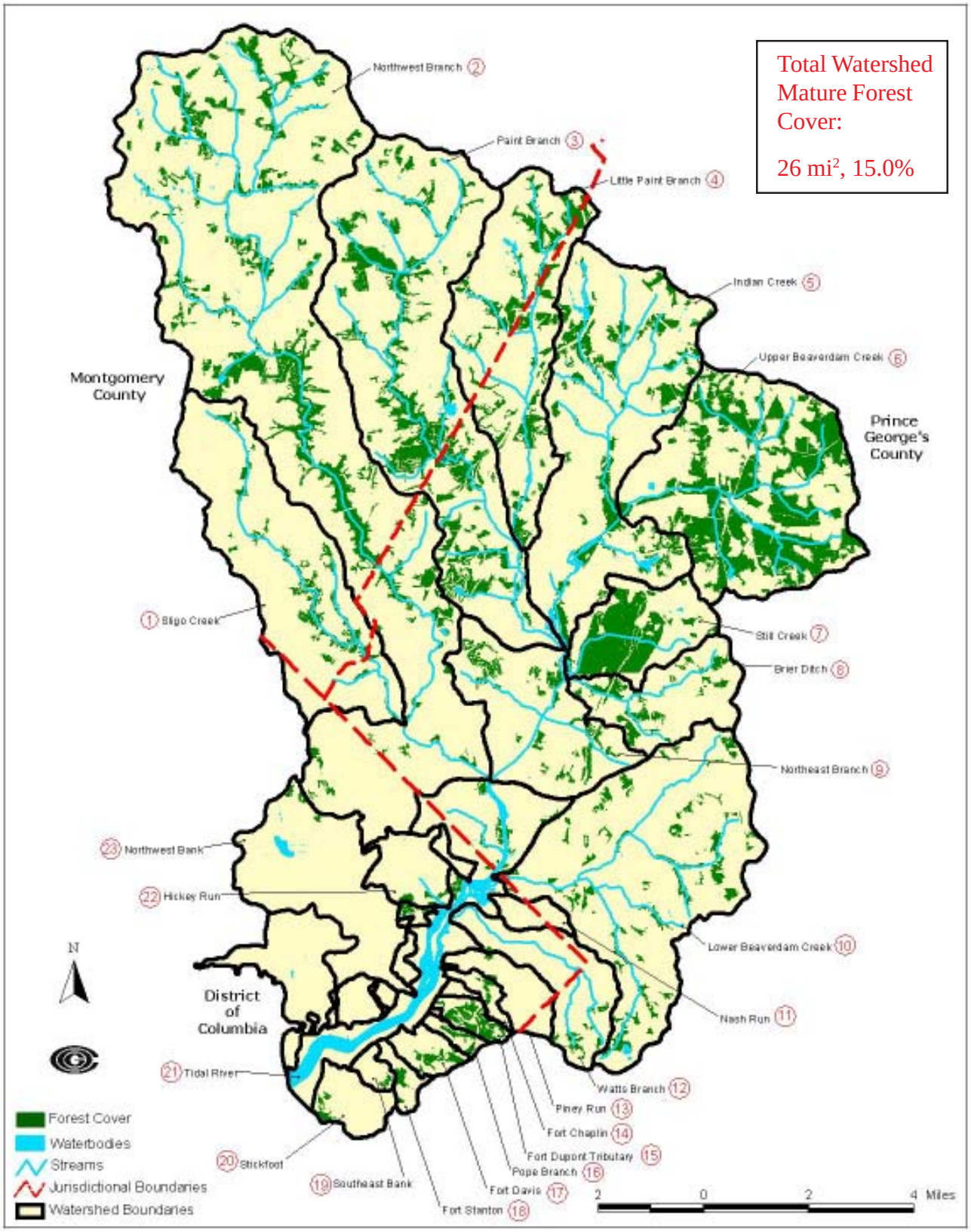
- Protect the larger, remaining public and private mature hardwood forest tracts in the watershed (AWRC 2001).
- Identify and restore mature hardwood tracts that are becoming degraded.

STRATEGY:

- Make the conservation of the unprotected mature hardwood tracts in the Anacostia a top priority for public land acquisition, conservation easements, forest banks and/or employment of other forest protection techniques.
- As part of the land development regulatory review process, identify and prioritize mature hardwood forested areas that must be adequately protected during development.
- Periodically inventory mature forest tracts in the watershed using both remote sensing and groundtruthing techniques.
- Expand the local master planning process to inventory and identify mature forest lands as high priorities for protection.

Upper Pope Branch subwatershed - Mature hardwood forest with laurel understory.

Figure 13. Anacostia Watershed 2000 Mature Forest Cover[1]



[1] Mature forest cover layer was developed by overlaying the 2000 forest layer (developed from Ikonos Imagery) on the 1936/38 forest layer (developed from panchromatic aerial photographs) and selecting the overlapping patches of forest.
Mature Forest = a forested area estimated to be 65 years or older and measuring 5 acres or greater and wider than 100 feet.

Table 6. Summary of 1936/38 Forest Cover, 2000 Forest Cover and 2000 Mature Forest Cover

		1936/38 Forest		2000 Forest		2000 Mature Forest	
	Subwatershed	**Forest (mi^2)**	**% Subwatershed Covered by Forest**	**Forest (mi^2)**	**% Subwatershed Covered by Forest**	**Forest (mi^2)**	**% Subwatershed Covered by Forest**
1	Sligo Creek	3.96	34.2%	1.72	14.9%	0.83	7.2%
2	Northwest Branch	12.64	30.2%	12.94	30.9%	5.38	12.9%
3	Paint Branch	8.00	38.6%	7.55	36.4%	4.07	19.6%
4	Little Paint Branch	5.44	52.1%	3.29	31.5%	2.05	19.6%
5	Indian Creek	6.66	42.9%	4.79	30.9%	2.32	14.9%
6	Upper Beaverdam Creek	8.28	58.9%	8.54	60.7%	5.87	41.7%
7	Still Creek	2.98	74.8%	2.19	54.9%	1.77	44.5%
8	Brier Ditch	2.60	64.0%	1.19	29.4%	0.60	14.7%
9	Northeast Branch	2.91	43.7%	1.54	23.1%	0.68	10.2%
10	Lower Beaverdam Creek	7.15	45.4%	3.93	25.0%	1.34	8.5%
11	Nash Run	0.07	9.8%	0.07	9.2%	0.00	0.0%
12	Watts Branch	0.54	14.3%	0.83	22.0%	0.16	4.3%
13	Piney Run	0.40	25.5%	0.14	9.0%	0.02	1.6%
14	Fort Chaplin	0.33	66.4%	0.10	19.5%	0.06	12.5%
15	Fort Dupont	0.42	59.4%	0.46	63.9%	0.30	42.0%
16	Pope Branch	0.26	67.6%	0.14	35.9%	0.09	22.5%
17	Fort Davis	0.42	45.3%	0.27	29.1%	0.16	16.9%
18	Fort Stanton	0.20	35.3%	0.16	28.5%	0.08	13.3%
19	Southeast Bank	0.17	26.9%	0.07	11.4%	0.03	4.2%
20	Stickfoot	0.33	22.3%	0.36	24.5%	0.09	5.9%
21	Tidal River	1.19	16.8%	1.28	18.0%	0.27	3.7%
22	Hickey Run	0.35	20.1%	0.25	14.4%	0.09	5.1%
23	Northwest Bank	0.69	6.0%	0.36	3.1%	0.12	1.1%
	Total Watershed	**66.00**	**37.5%**	**52.15**	**29.6%**	**26.37**	**15.0%**

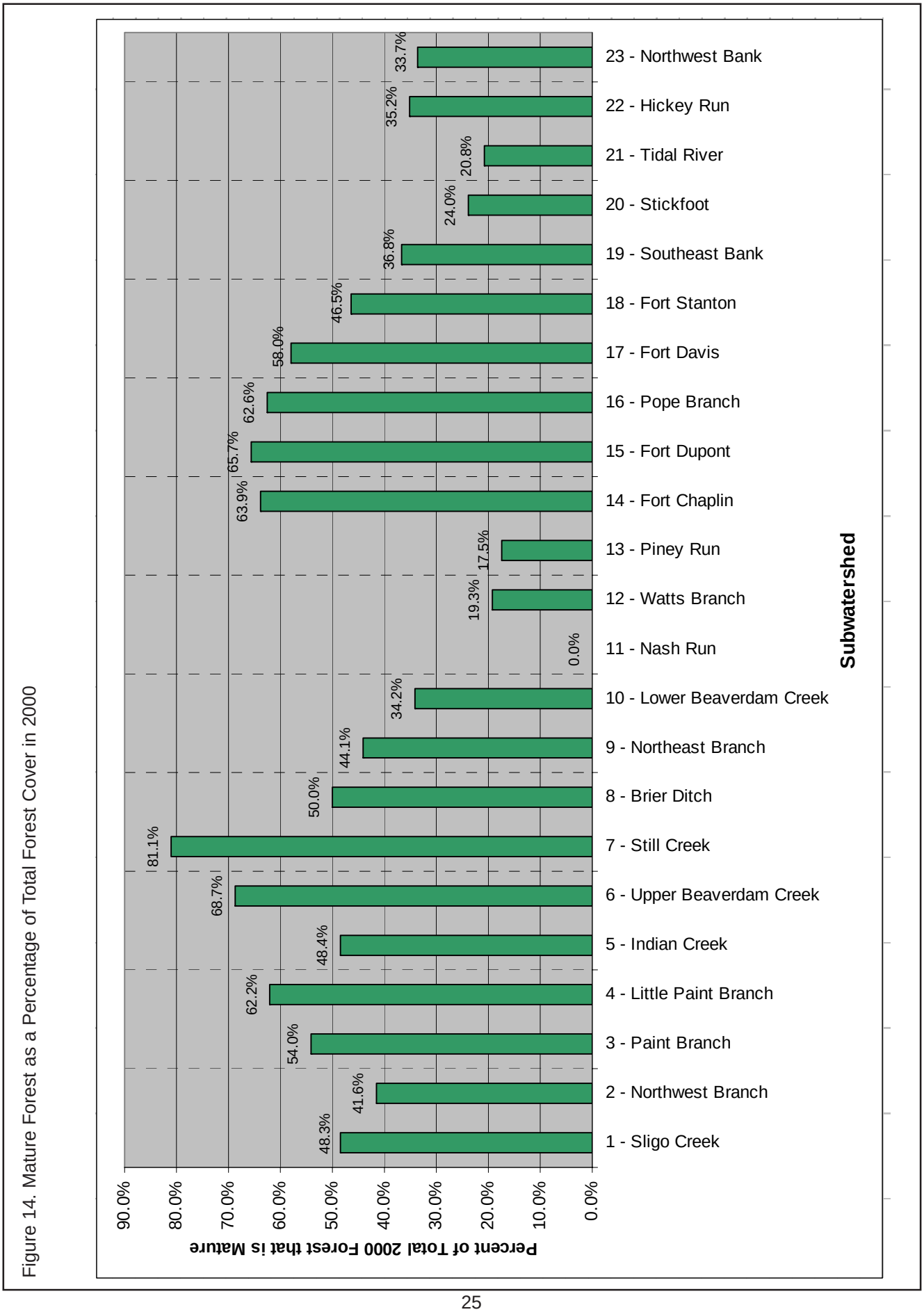
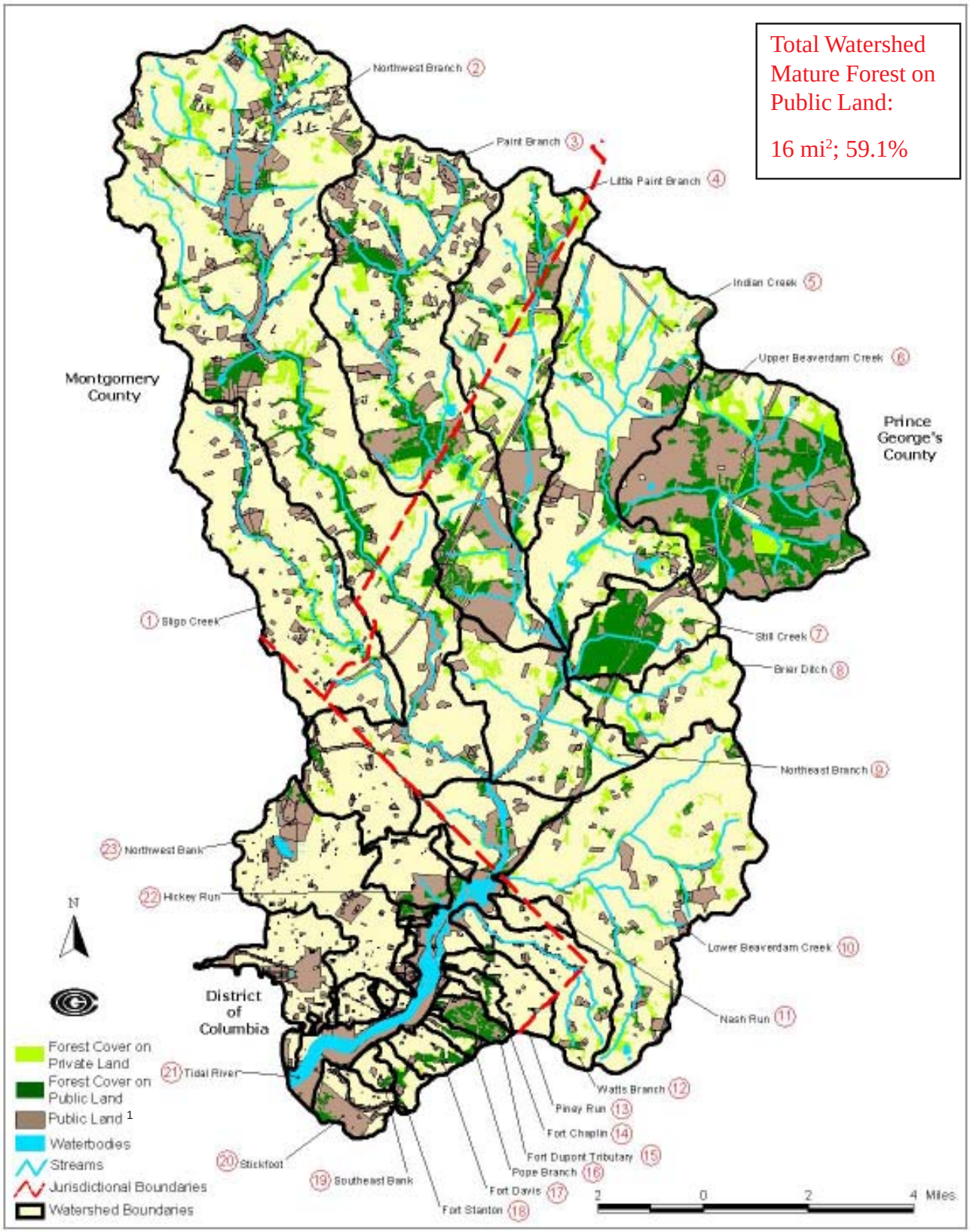


Figure 14. Mature Forest as a Percentage of Total Forest Cover in 2000

Figure 15. Anacostia Watershed 2000: Ownership of Mature Forest



[1] Public land includes for Prince George's County all county parks, state land (based on GIS data from MD DNR), federal land (based on GIS data from USACOE) and all public works and school properties (digitized from PG county parcel images); for the District of Columbia all city parks (based on GIS data from DC), federal lands (based on GIS data from USACOE) and all National Park Service land (based on GIS data from NPS); and for Montgomery County all county parks, publically owned land, conservation easements, public works and school properites (digitized from MC parcel images) and federal land (based on GIS data from USACOE). NOTE: GIS data may be copyrighted by federal, state or local owner. Reproduction is prohibited without express written permission.

Table 7. Summary of Mature Forest Coverage and Ownership in 2000

	Subwatershed	Watershed Area		Mature Forest		% Watershed Covered by Forest	Mature Forest Patch Size (Acres)				Mature Forest on Public Land		% Mature Forest on Public Land
		Acres	Miles^2	Acres	Miles^2		Max.	Min.	Mean	Median	Acres	Miles^2	
1	Sligo Creek	7,404.7	11.57	532.1	0.83	7.2%	5.4	93.7	19.0	15.2	249.7	0.39	46.9%
2	Northwest Branch	26,808.6	41.89	3,445.3	5.38	12.9%	5.1	201.9	22.4	10.7	1,639.2	2.56	47.6%
3	Paint Branch	13,285.6	20.76	2,607.8	4.07	19.6%	5.1	627.6	35.2	11.6	1,707.8	2.67	65.5%
4	Little Paint Branch	6,687.3	10.45	1,309.1	2.05	19.6%	5.0	119.2	26.7	12.6	612.6	0.96	46.8%
5	Indian Creek	9,930.5	15.52	1,483.8	2.32	14.9%	5.3	127.8	23.9	13.9	577.0	0.90	38.9%
6	Upper Beaverdam Creek	9,007.9	14.07	3,756.4	5.87	41.7%	5.1	390.5	48.8	21.0	2,887.6	4.51	76.9%
7	Still Creek	2,550.2	3.98	1,135.4	1.77	44.5%	5.9	759.1	81.1	15.3	1,066.9	1.67	94.0%
8	Brier Ditch	2,598.3	4.06	381.2	0.60	14.7%	5.0	60.8	22.4	15.5	110.6	0.17	29.0%
9	Northeast Branch	4,268.9	6.67	434.2	0.68	10.2%	5.3	61.8	15.0	11.0	144.1	0.23	33.2%
10	Lower Beaverdam Creek	10,064.2	15.73	859.2	1.34	8.5%	5.1	59.9	14.3	9.8	185.7	0.29	21.6%
11	Nash Run	464.9	0.73	0.0	0.00	0.0%	0.0	0.0	0.0	0.0	0.0	0.00	0.0%
12	Watts Branch	2,404.8	3.76	102.3	0.16	4.3%	6.0	20.5	11.4	9.6	31.3	0.05	30.6%
13	Piney Run	1,014.6	1.59	15.9	0.02	1.6%	7.8	8.1	8.0	8.0	15.9	0.02	99.9%
14	Fort Chaplin	318.7	0.50	39.8	0.06	12.5%	5.1	12.4	9.9	11.1	37.0	0.06	93.1%
15	Fort Dupont	457.1	0.71	192.0	0.30	42.0%	7.0	85.8	48.0	49.6	191.7	0.30	99.8%
16	Pope Branch	249.9	0.39	56.3	0.09	22.5%	56.3	56.3	56.3	56.3	45.7	0.07	81.3%
17	Fort Davis	588.1	0.92	99.4	0.16	16.9%	7.1	34.4	16.6	9.7	73.4	0.11	73.9%
18	Fort Stanton	366.9	0.57	48.6	0.08	13.3%	6.9	41.7	24.3	24.3	40.7	0.06	83.7%
19	Southeast Bank	413.1	0.65	17.3	0.03	4.2%	5.3	6.2	5.8	5.9	16.0	0.03	92.1%
20	Stickfoot	931.5	1.46	54.7	0.09	5.9%	8.3	36.5	18.2	9.9	54.7	0.09	100.0%
21	Tidal River	4,540.7	7.09	169.8	0.27	3.7%	5.7	41.4	17.0	14.9	150.4	0.24	88.6%
22	Hickey Run	1,130.4	1.77	57.2	0.09	5.1%	5.2	24.6	14.3	13.7	57.2	0.09	100.0%
23	Northwest Bank	7,290.0	11.39	76.8	0.12	1.1%	6.7	20.0	12.8	12.2	69.7	0.11	90.8%
	Total Watershed	**112,776.8**	**176.21**	**16,874.8**	**26.37**	**15.0%**					**9,965.2**	**15.57**	**59.1%**

5.4 Urban Forest/Street Trees

Definition: Urban forest/street trees are located in developed areas and include both individual trees and tree stands generally less than one acre in size. Trees lining roadways, in residential yards and surrounding businesses are included in this category.

It is widely recognized that urban forest/street trees make up an important part of the urban ecosystem. However, our urban forest is often threatened by new development. Street trees face many stresses due to their location along roadways, proximity to new or existing utility lines, inadequate planting space and lack of species diversity.

The COG analysis of urban forest/street trees in the Anacostia watershed included all of the trees from the 2000 Anacostia tree cover data that were not classified as part of a forest in the 2000 Anacostia forest cover data.

The results of the COG/RESAC urban forest/street trees analysis show that 8% of the Anacostia watershed is covered by urban forest/street trees. Upper Beaverdam Creek has the lowest percentage of area covered by urban forest/street trees (1.3%), while Southeast Bank has the highest percentage (16.9%; Table 8 and Figure 16)).


D.C. Urban Forestry Admin.

London Plane trees on a D.C. street.

GOALS:

- Preserve the existing urban forest/street trees in the Anacostia watershed.
- Increase the number and long-term viability of urban forest/street trees in the watershed.
- Improve the maintenance of urban street trees.
- Create and maintain street tree inventories (A sample of Casey Trees Endowment Fund's 2002 DC Street Tree Inventory Data is included in Appendix E).

STRATEGY:

- Create and enforce regulations restricting the removal of healthy trees in urban areas.
- Provide incentives for homeowners and business owners to plant native trees on their property.
- Increase funding for street tree planting and maintenance.
- Take a long-term approach to street tree planting by providing adequate space for tree growth and by avoiding monocultures.
- Modify current street tree programs to create greater species diversity in new or replacement street tree plantings.

Table 8. Summary of Urban Forest/Street Trees in the Anacostia

	Subwatershed	Watershed Area (mi^2)	Urban Forest (mi^2)	% Watershed Covered by Urban Forest
1	Sligo Creek	11.57	1.38	11.9%
2	Northwest Branch	41.89	4.10	9.8%
3	Paint Branch	20.76	1.36	6.5%
4	Little Paint Branch	10.45	0.81	7.7%
5	Indian Creek	15.52	1.20	7.7%
6	Upper Beaverdam Creek	14.07	0.18	1.3%
7	Still Creek	3.98	0.26	6.5%
8	Brier Ditch	4.06	0.54	13.3%
9	Northeast Branch	6.67	0.89	13.3%
10	Lower Beaverdam Creek	15.73	1.25	7.9%
11	Nash Run	0.73	0.09	12.5%
12	Watts Branch	3.76	0.48	12.7%
13	Piney Run	1.59	0.22	14.1%
14	Fort Chaplin	0.50	0.06	12.0%
15	Fort Dupont	0.71	0.03	4.9%
16	Pope Branch	0.39	0.06	15.7%
17	Fort Davis	0.92	0.15	16.7%
18	Fort Stanton	0.57	0.05	9.1%
19	Southeast Bank	0.65	0.11	16.9%
20	Stickfoot	1.46	0.13	8.9%
21	Tidal River	7.09	0.39	5.5%
22	Hickey Run	1.77	0.17	9.9%
23	Northwest Bank	11.39	0.64	5.6%
	Total Watershed	**176.21**	**14.56**	**8.3%**

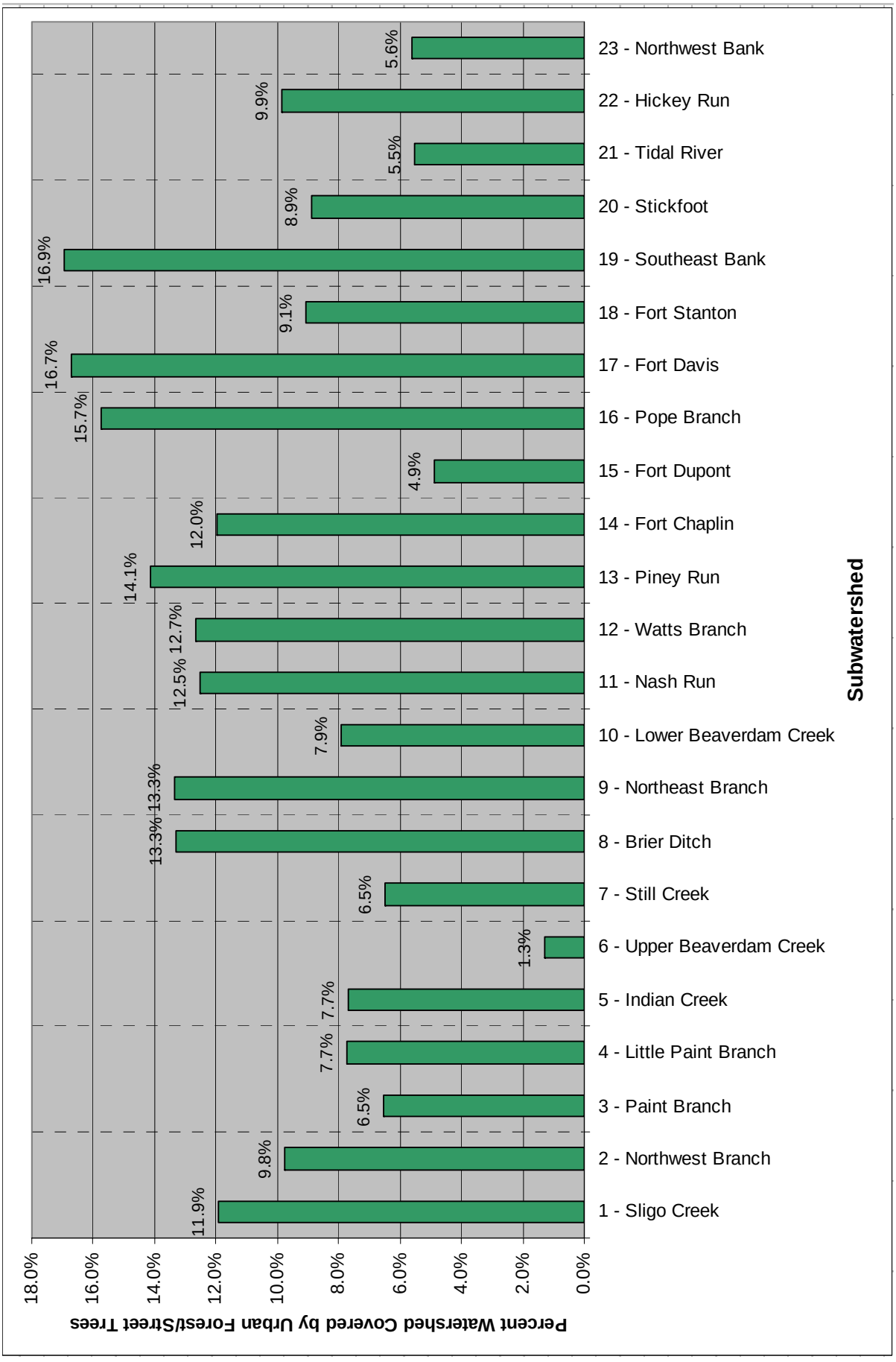


Figure 16. Percent of Anacostia Subwatersheds Covered by Urban Forest/Street Trees in 2000[1]

[1] Urban Forest/Street Trees include all trees from the 2000 Tree Canopy Cover data that are not classified as forest in the 2000 Forest Cover data.

6.0 Summary: Forest Management and Protection Options

The management of the forests in the Anacostia watershed requires a multifaceted approach involving forest preservation (including the retention of high quality mature forests), reforestation, land use planning tools, control of exotic invasive plants, management of nuisance wildlife species, public education and outreach, and meeting the 2010 restoration goals established by the ARPW/ AWRC and agreed to by the Anacostia Watershed Restoration Signatories.

One large component of forest management in the Anacostia watershed is federal, state and local regulatory and land use planning requirements. In Maryland, state and local forest conservation laws regulate how, when and where land development projects protect forests and trees and/or plant additional forests and trees. These laws can reduce, though not completely prohibit, the amount of forest or trees that are lost to land development and can require reforestation to compensate for forest cleared during development. Forests and individual trees preserved or newly planted forests created as part of a land development project are protected through either private conservation easements or dedication as public parkland.

At the local level, master plans can and should identify lands that have high natural resource values, such as large forests, for acquisition as public conservation areas or stream valley parklands.

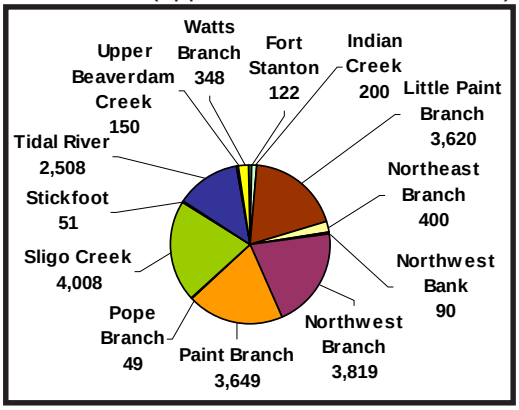
Regulatory and master planning tools enable the more valuable forests to be protected and allow land, such as stream buffers, to be identified as priority areas in which to locate reforestation projects required by state or local forest conservation laws.

Volunteers plant trees in Sligo Creek

6.1 Reforestation

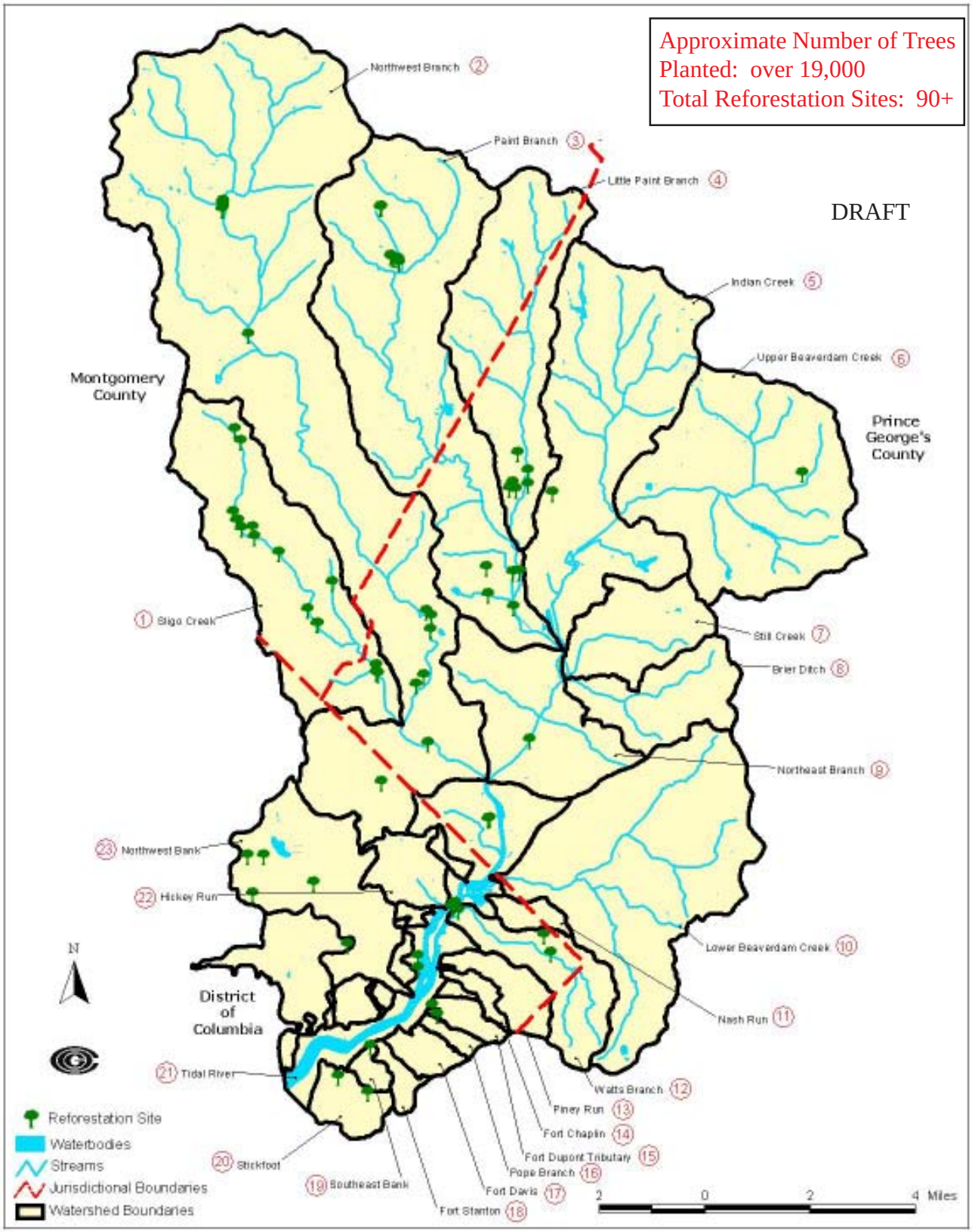
One of the most obvious ways to increase forest cover in the Anacostia watershed is to continue planting more trees. Though that may sound simple enough, a successful tree planting requires hours of planning and countless decisions about the site location, site preparation, plant materials, type of mulch, etc. The following overview is meant to provide a range of options for the successful reforestation of the different types of forest discussed in this forest management and preservation strategy. This overview is intended to provide government agencies and interested individuals and groups with guidance on planning and implementing tree planting projects that are separate from any regulatory requirements. It is not meant to supercede any minimum requirements set up by local jurisdictions for any reforestation or afforestation projects required by local/state laws, regulations, or permits. However, many of these points and recommendations are relevant to regulated forestation projects and should be used to refine and improve existing local forest conservation law programs.

Figure 17. Trees in Reforestation Plantings by Anacostia Partners in Subwatersheds, 1993 - 2005 (approximate numbers shown)



Since 1989, there has been a concerted and growing effort to reforest the Anacostia watershed. A variety of different government agencies, environmental organizations and local citizen volunteers have been involved in planting more than 19,000 trees throughout the watershed (Figures 17 and 18). The methods and the success rates of these various reforestation events have varied greatly with generally higher success rates at sites where holes were augered rather than manually dug (Appendix F).

Figure 18. Sites Reforested in the Anacostia Watershed Since 1989 by Anacostia Partners



6.1.1 General Reforestation Considerations

While all reforestation sites are unique, there are many common elements that go into any successful reforestation event. Appendix G contains a complete discussion of the process of planning and implementing a reforestation planting in the Anacostia watershed.

Decisions about where to conduct reforestation events are extremely important and can be guided by the recommendations included in this management strategy (Figures 19, 20 and 21). The specific characteristics of each site should be carefully considered to determine which method of reforestation will be most successful. The basic reforestation strategies discussed in this plan include:

1) reforestation using bare root seedlings,
2) reforestation using container stock, and
3) allowing for natural forest regeneration through the establishment of no-mow zones.

The preparation necessary before planting depends largely on the specific site characteristics, and could include the removal of exotic invasive species or the application of a soil amendment. At any tree planting event, holes will need to be dug. Based on survivability surveys performed by COG staff, survival rates appear to be markedly higher at plantings where the holes were uniformly made with a mechanical auger (Appendix F).

Volunteers can help in actually planting the trees, mulching and constructing tree shelters. Involving volunteers in tree plantings is a great way to reduce the costs of reforestation while educating citizens about the Anacostia's forests and waterways. When using volunteers, container stock is the preferred plant material type, yielding greater success rates. Placing signage at the planting site is a good way to inform the local community of the reforestation project and can prevent newly planted trees from being damaged through mowing activities.

In a study of the success of riparian buffer plantings in Maryland, the most common problem that impaired the growth of trees was competition from weeds and other broadleaf grasses (Pannill *et al.* 2000). Mulching is one method of reducing competition from other vegetation while helping the soil around the plant to retain moisture. Conducting periodic follow-up maintenance during the first three to five years after planting can also ensure that plants are not being outcompeted by exotic invasive species, are receiving enough water and are protected from nuisance wildlife species (e.g., deer, voles, rabbits, beavers).



The use of power augers, volunteers and signs can improve the success and efficiency of a reforestation event.

Case study:

The Do Nothing Approach to Reforestation: No-Mow Zones

A no-mow zone was established along the Paint Branch and Little Paint Branch within the Beltsville Agricultural Research Center property in 1989. COG and the Interstate Commission on the Potomac River Basin arranged with the land managers at BARC to stop mowing a buffer, averaging 35ft. on each side of about 2 miles of the Paint Branch and Little Paint Branch. This no-mow zone was arranged after the observation that black willows and other saplings were being regularly cut down. Black willows are trees that can easily regenerate after being cut, and land managers could reasonably assume that if the mowing stopped, the black willows would come back. That was exactly what happened. In ten years, the stream corridors were buffered by a new riparian forest consisting primarily of black willows, sycamores and red maples.

The same stretch of Paint Branch (BARC) before it became a no-mow zone and about 8 years after mowing stopped.

Currently, these results may not be replicable in many parts of the watershed, as the high numbers of deer and exotic invasive plants increase the risk that young seedlings will be either eaten or outcompeted. Ensuring that regeneration areas are fenced off from deer and have a good mix of native species in the soil seed bank could greatly increase the chance that a healthy native forest will regenerate.

6.1.2 Riparian Reforestation Recommendations

In carrying out a riparian reforestation project, as with any other tree planting effort, the specific goals of the planting need to be determined. Different forested buffer widths provide varying water quality and habitat benefits. By taking into account site soil conditions, slope of the stream valley and floodplain, the size and sensitivity of the stream and the adjacent land use, etc., riparian buffer plantings can be designed to meet a variety of watershed restoration and management objectives.

The recommended minimum forested riparian buffer width to provide a range of ecological functions is 100 feet on each bank. An analysis of the riparian areas in the Anacostia watershed identifies about 4 square miles of non-forested areas within 100 foot riparian buffers (Appendix H). Approximately one third of this area (36%) is located on public land.

6.1.3 Upland Reforestation Recommendations

Due to the generally increasing scarcity of upland open spaces in the Anacostia watershed, finding upland reforestation sites on both public and private land is difficult. The recommended approaches to upland reforestation in the Anacostia, are:

1) Identify remaining upland reforestation sites through additional watershed land cover/land use and land ownership analyses and incorporate findings and recommendations in local master plans, local watershed plans, park management plans, etc.
2) Prioritize critical upland areas warranting reforestation.
3) Provide educational opportunities for landowners in upland areas regarding the benefits of reforestation on their property and the various resources and incentives that are available for reforestation (Appendix C).
4) Create additional public/private partnership opportunities for actual reforestation project implementation.

6.1.4 Urban Reforestation Recommendations

Planting street trees involves a different set of considerations from native forest plantings. The following are recommendations for planning urban reforestation events:

1) Consult with a certified arborist to make sure the species planted is suitable for the site. Take into account ecological (soil conditions, hydrology, etc.) as well as cultural (proximity to busy street, size of planting area location of utility lines, etc.) factors when choosing plant materials.
2) Provide trees with adequate area in which to grow (e.g., make sure the tree box is large enough for the species planted in it and make improvements to the soil if necessary).
3) Limit the amount of road salt that can get to a tree, or plant salt-tolerant species in areas where trees receive a lot of salt.
4) Consider the fruiting characteristics and life expectancy of tree species before deciding where to plant them.
5.) Take a long-term approach to street tree planting by increasing species diversity. Street tree monocultures are unsustainable as trees with the same life expectancy are likely to die around the same time, necessitating the removal of many trees at one time and leaving the streets treeless until another planting is arranged.
6.) Provide adequate maintenance for street trees.
7). Maintain an updated street tree inventory to track tree replacements, maintenance schedules, tree health, etc. (Appendix E)

Anacostia Watershed Society

Young volunteers mulch a tree during an urban reforestation event.

6.2 Exotic Invasive Plant Management Options

Exotic invasive plants are generally defined as nonnative plants which quickly invade, out-compete and replace more desirable native species. Due to their wide spread and fast growth, competition from exotic invasive plants is one of the leading factors in reduced growth rates of newly planted trees (Pannill *et al.* 2001). The spread of exotic invasive plant material disrupts not only newly reforested areas, but established forest ecosystems as well. Controlling the spread of exotic invasive plants is critical to the maintenance of the biodiversity of forests. A more detailed discussion of management options is included in Appendix I.

An exotic invasive species (Porcelainberry) taking over an Anacostia reforestation site.

6.2.1 Identify problem

In order to assess the magnitude of the exotic invasive plant problem in the Anacostia watershed, MD DNR contracted COG in September 2003 to develop an Exotic Invasive Plant Surveying Methodology and Indexing System. This methodology (Appendix I) provides a simple method for generating the data about the nature and extent of exotic invasive plant problems along the tributaries of the Anacostia, that is necessary for the development of a comprehensive management strategy.

6.2.2 Management Options

There are various options for controlling the spread of exotic invasive plant species and any comprehensive management strategy will include aspects of many of the following options.

1) **Prevention --** The likelihood of new exotic invasive species becoming established in an area can be reduced by simply not planting nonnative species and reducing soil disturbances.
2) **Mechanical Control --** The mechanical control of exotic invasive species includes hand-pulling, mowing, rototilling, and the use of hand and power tools to cut, remove or girdle plants. In these efforts, care must be taken to limit the potential for the regeneration of the plants. Mechanical methods are most effective if they are applied annually for up to six years.
3) **Chemical Control --** Herbicides can offer a cost-efficient and effective way to control exotic invasive plants in problem areas. Care must be taken to tailor the chosen product and

Case Study:
Weed Warriors


Carole Bergmann (M-NCPPC) trains Weed Warriors.

In Montgomery County, the solution to the spread of exotic invasive plants has been to fight numbers with numbers. The Weed Warriors program has recruited 300 volunteers, ranging in age from 18 to 80, to pull out non-native invasive plants in Montgomery County parks since 1999. Volunteers attend a two hour training session with the Maryland - National Capitol Park and Planning Commission Forest Ecologist to learn how to identify the species of concern and what can be done to control the spread of those species. Then, volunteers are set loose to attack the exotic invasive species in county parks on their own schedule and at their own pace.

In addition to weed pulling duties, the Weed Warriors are responsible for reporting how many hours they have spent battling invasives each month, and, the top three worst weeds in their work areas.

According to Carole Bergmann, the M-NCPPC Forest Ecologist who started this program, one of the main benefits of Weed Warriors is its educational value. “[Weed Warriors] is great even if people aren’t out pulling weeds. Its helpful the more people that even just know about [the problem with exotic invasive plants] to the point of telling neighbors not to buy English ivy.”

application technique to each site, in order to reduce potential toxic-related problems and damage to native species.

4) Herbivore Control -- Studies have shown that grazing animals, like goats, sheep and cows, can be used to cost-effectively control the spread of exotic invasive plants.

5) Biological Control -- The biological control of nonnative plants involves reconnecting exotic invasive plants with the specialized natural enemies that limited their densities in their native range (Van Driesche *et al.* 2002). A thorough examination of the costs and benefits of using biological control agents is necessary before this is a recommended management option in the Anacostia watershed.

Some of the top invasive species in the Anacostia include (clockwise) Japanese stiltgrass, English ivy, Japanese honeysuckle and Mile-a-minute.

6.2.3 General Recommendations

1) Implement Phase II of COG's Exotic Invasive Plant Surveying Methodology and Indexing System throughout the Anacostia watershed and develop a comprehensive, watershed-wide database of exotic invasive plants.

2) Develop a comprehensive strategy for managing exotic invasive plants within the Anacostia watershed based on the results of the watershed wide survey and encourage local governments to provide dedicated funding for addressing exotic invasive plant problems.

3) Expand Weed Warriors and other volunteer-based programs into Prince George's County and the District of Columbia.

6.3 Wildlife Management Options

The nuisance wildlife species identified and presented in this forest management and preservation strategy are species which pose the greatest non-anthropogenic threat to the success of reforestation efforts, by either damaging or destroying young trees, and/or interfering with the natural regeneration of the forests. These nuisance wildlife species include whitetail deer, voles and beavers.

6.3.1 White-tailed Deer

The population of white-tailed deer in the Anacostia watershed has grown steadily in recent decades as human population growth in the area has led to increased fragmentation of land-uses coupled with increased restrictions on deer hunting.

http://www.cheshome.com/garden/deer/deer.asp

A whitetail deer browses in a yard.

6.3.1.1 Identify Problem

A reliable estimate of the deer population within the Anacostia watershed would be useful in the development of a comprehensive management strategy. As the patchwork of public and private lands in this urbanized watershed makes it difficult to accurately estimate the size of our deer population, a combination of deer survey techniques designed to estimate minimum population size or approximate deer density may be used along with indicators of cultural impacts of deer (e.g., deer-vehicle collisions) to track deer populations.

6.3.1.2 Management Options

A whitetail deer stretches to eat a tree limb five feet above the gound.

Strategies for managing deer populations range from nonlethal techniques designed to reduce deer damage on valuable plants or critical areas to the direct reduction of local deer populations through managed public deer hunts. It is critical to involve the public in the decision making process to ensure that the strategy chosen is acceptable with local communities. The following are management options for reducing the negative impacts of deer overcrowding in our forests.

1) **Physical Exclusion --** The physical exclusion of deer from an area is considered one of the most effective ways of reducing or eliminating deer damage (MD DNR 2004). Methods of physically excluding deer from an area can range from plant specific protection (e.g., tree shelters) to a fencing system (either electric or nonelectric) encompassing, sometimes, several acres of land. The selected technique is site specific and will depend on the local density of deer and the management objectives.
2) **Repellants --** Deer repellants operate by either making protected plants smell or taste bad to deer. These products are often only effective for a limited time and their use is most effective in areas with low to moderate population pressures, when used in conjunction with unpalatable plants, and where deer have easy opportunities to eat unprotected plants (DeNicola *et al.* 2000).
3) **Scare Devices --** There are a variety of devices that can be used to scare deer away from an area, ranging from visual and auditory deterrents to pyrotechnics. Loud auditory devices or pyrotechnics would be unacceptable in the urbanized Anacostia watershed. The effectiveness of most of these scare devices is fairly short-term and they work best in areas with low deer pressure and at the onset of deer problems (DeNicola *et al.* 2000).
4) **Unpalatable Landscape Plants --** Certain plants are a more appealing snack for deer than others. One possible way to reduce deer damage of reforestation plantings is to replace those plants that are palatable to deer with unpalatable plants (MD DNR 2004).
5) **Direct Population Reduction --** The remaining deer management options presented include techniques for directly reducing the population of deer through nonlethal and lethal methods. Deer have small home ranges that they rarely leave and in the Washington Metropolitan Area seasonal migration is rare, making localized population reduction efforts a viable method of reducing deer damage (DeNicola *et al.* 2000).

Friends of Sligo Creek

A deer exclosure in upper Montgomery County allows the establishment of a forest understory (left is inside fence).

a. Trapping and Relocation

This option involves capturing deer and transporting them to a suitable habitat that can support more deer without affecting any existing herds. There are no sites that can support more deer in Maryland and the costs involved could range from $400 to almost $3,000 per animal. This technique is impractical, expensive, stressful to captured deer and often results in high post-release mortality (DeNicola *et al.* 2000).

b. Trapping and Euthanasia

Trapping combined with euthanasia is an option for reducing deer populations in areas where discharge of firearms is not permitted or acceptable. The trapping experience is stressful for deer and this strategy can be expensive with costs estimated to be a minimum of $300 per deer (DeNicola *et al.* 2000).

c. Managed Public Deer Hunts

Managed public deer hunts involve allowing pre-approved hunters, who have passed training and marksmanship tests, to hunt antlerless deer for a limited time in a specified area that is not usually open for hunting. This is one of the most cost-effective and efficient ways of reducing deer damage, as costs have been estimated to be between $43 and $60 per animal for a managed deer hunt in Montgomery County (MCDMWG 1995).

d. Sharpshooting

The use of sharpshooters may be a more acceptable method of directly reducing deer populations on smaller tracts of land, in suburban areas, on corporate or government campuses or where safety and liability concerns make managed deer hunts unfeasible. Sharpshooting programs involve hiring trained, experienced personnel to reduce deer densities in specific areas. The cost of sharpshooting programs vary, generally ranging from $91 - $310 per deer.

e. Experimental Contraceptive Techniques

There are a variety of contraceptive techniques for controlling deer populations that are currently in experimental phases. While limited studies have shown the success of these methods in captive deer populations, the use of contraceptive techniques in free-ranging deer population still involves overcoming considerable complications in the need to periodically capture and handle animals, the method of administering the contraceptives and the overall prohibitive cost of these contraceptive programs (MCDMWG 1995).

6.3.1.3 Recommendations

1.) Work with the major wildlife resource management agencies and landowners (e.g. MD DNR, M-NCPPC, NPS, and the larger Federal facilities such as BARC) to develop a survey methodology for assessing and tracking deer populations within the Anacostia watershed and to implement a system for sharing data amongst themselves.

2.) Form an Anacostia Watershed Deer Management Workgroup involving

Case Study:

Deer Contraceptive Trials In and Around the Anacostia Watershed

The use of contraceptives to control deer populations is under investigation at both the White Oak Federal Research Center and at the federal research campus of the National Institute of Standards and Technology (NIST) in nearby Gaithersburg, Maryland. The experimental trial of the immunocontraceptive porcine zona pellucida (PZP), conducted by the Humane Society of the United States in partnership with NIST has been going on since 1997 and has been successful at reducing the NIST deer herd from a peak of 320 in the late 1990s to about 200. The immunocontraceptive PZP is a vaccine that must be administered annually and functions by employing proteins obtained from pigs to create antibodies in the deer that prevent pregnancy.

The contraceptive that will be used at the White Oak Federal Research Center starting in August 2004 differs considerably from PZP, in that it is believed to be effective for two to three years and actually shuts down the reproductive system of deer by disabling hormones necessary for reproduction. By reducing the frequency that contraceptive booster shots must be given to does, the costs of deer contraceptive programs, currently estimated at between $300 to $500 per deer, could potentially decrease significantly.

http://stonewall.nist.gov/CONTENT/misc3.jpg

A deer at NIST.

representatives of the major wildlife resource management agencies and landowners as well as community representatives.

3.) The recommended Anacostia Watershed Deer Management Workgroup should: a) create a set of criteria for implementing direct deer population reduction techniques in the watershed, and b) develop a comprehensive strategy for managing deer populations within the watershed.

6.3.2 Voles

Voles can cause considerable damage to reforestation sites and woodland areas by either girdling the trunks of trees and shrubs at or above ground level or damaging underground roots.

http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/meadow_vole.htm

A meadow vole (*Microtus pennsylvanicus*).

6.3.2.1 Vole Management Options

There are a variety of techniques for minimizing woodland damage by voles.

1) Mow and/or chemically treat the problem area to reduce the amount of food available to the voles.
2) Use protective tree shelters and cages, like those recommended for deer control, to prevent the girdling of tree trunks.
3) Repellants can be used to minimize vole damage.
4) Trapping or poisoned baits can directly reduce vole populations in problem areas.

6.3.2.2 Recommendations

1) During pre-planting site visits, assess the potential for vole damage and take appropriate precautions depending on the area.
2) Use maintenance visits to reforestation sites to determine if follow-up action is needed to minimize vole damage.

3.) Poisoning voles is not recommended by ARPW due to danger of harming nontarget organisms.

6.3.3 Beavers

Beavers are large, semiaquatic rodents that live in and near water and instinctively make dams. Often these dams create ponded areas and habitat for other animals but also damage trees in riparian areas. Damage will occur through both physical cutting of trees and impoundment of water.

6.3.3.1 Beaver Management Options

Various strategies exist for minimizing beaver damage.

1) Four feet high cages made of hardwire mesh, securely anchored to the ground and covering exposed roots, can be used to protect individual planted trees.
2) Trapping of beaver is permitted in Maryland and could be an effective management strategy in areas with high beaver populations.

Beaver damage at a reforestation site.

6.3.3.2 Recommendations

1) Use cages to protect individual trees at sites where the potential for beaver damage is high.
2) Survey beaver populations in problem areas to determine if trapping is necessary.

6.4 Summary of Management Options

The diverse forest-related problems and opportunities in the Anacostia watershed necessitate a multifaceted management approach. The following summary provides a list of available options for expanding and protecting forest cover in order to meet the 2010 restoration goals.

Table 9. Forest Management and Protection Options and ARPW Recommendations

Forest Management and Protection Options	ARPW Recommendations
Land Use Planning and Regulation	
• Land Use Requirements • Master Plans • Local and State Forest Conservation Laws • Master Plans for Parks and Other Public Lands	• Use and refine land use regulations, local and state forest conservation laws, and master plans to protect valuable remaining forest and to promote reforestation. • Maintain and/or enhance existing forest corridors that link Anacostia subwatersheds and that connect the Anacostia to adjacent watersheds (i.e., Patuxent and Rock Creek) to allow for viable ecosystems and wildlife corridors. • Take opportunities during development to reforest areas.
Forest Health	
• Monitoring	• Major landowners should implement long-term forest health monitoring programs or tie into existing programs (e.g., U.S. Forest Service)
Reforestation	
Outreach	• Educate the public and elected officials about the quantifiable benefits of planting trees and the importance of preserving our existing forests. • Involve the public and elected officials in tree planting events.
Plant Material Options • Bare-root seedlings • Container stock • Natural forest regeneration	• Container stock is the recommended plant material type for reforestation events with volunteers.
Riparian Reforestation	• Focus on linking major forest patches with riparian forest buffers. • Take site characteristics into consideration when planning tree plantings.
Upland Reforestation	• Provide information to landowners about the benefits of planting trees on their property and the resources available for reforestation. • Create public/private partnerships to implement upland reforestation projects.
Urban Reforestation	• Avoid creating monocultures with street tree plantings. • Provide adequate space and maintenance for urban forest/street trees. • Encourage planting of native trees on private property.
Control of Exotic Invasive Plants	
Identify Problem	• Develop a comprehensive database of exotic invasive plants in the watershed. • Implement Phase II of COG's Exotic Invasive Plant Surveying Methodology and Indexing System.
Management Options • Prevention • Mechanical Control • Chemical Control • Herbivore Control • Biological Control	• Develop a comprehensive strategy for managing exotic invasive plants based on the results of the watershed survey and encourage local governments to provide dedicated funding for addressing exotic invasive plant problems. • Expand Weed Warriors or similar programs into Prince George's County and the District of Columbia.
Control of Nuisance Wildlife Species	
DEER	
Identify Problem	• Work with the major wildlife resource management agencies and landowners to develop systems for assessing and tracking deer populations in the watershed and for sharing data.
Management Options • Unpalatable Landscape Plants • Repellants • Scare Devices • Physical Exclusion • Direct Population Reduction	• Form an Anacostia Watershed Deer Management Workgroup involving the major wildlife management agencies, landowners and community representatives. • The Anacostia Watershed Deer Management Workgroup should create criteria for using direct deer population reduction techniques and develop a comprehensive deer management strategy. • Use cages or other exclusion techniques at sites with high deer populations.
VOLES	
Management Options • Reduce Available Food • Physical Exclusion • Repellants • Trapping / Poisoning	• Assess potential for vole damage and take proper precautions before planting reforestation sites. • Monitor vole damage and take follow-up actions if necessary during maintenance visits to reforestation sites. • Poisoning voles is not recommended due to danger of harming nontarget organisms.
BEAVERS	
Management Options • Physical exclusion • Trapping	• Use cages to protect trees at sites with high beaver populations. • Survey beaver populations to determine if trapping is necessary.

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Appendix

Figure 1. MD DNR Forest Community Types in the Anacostia Watershed, 2000

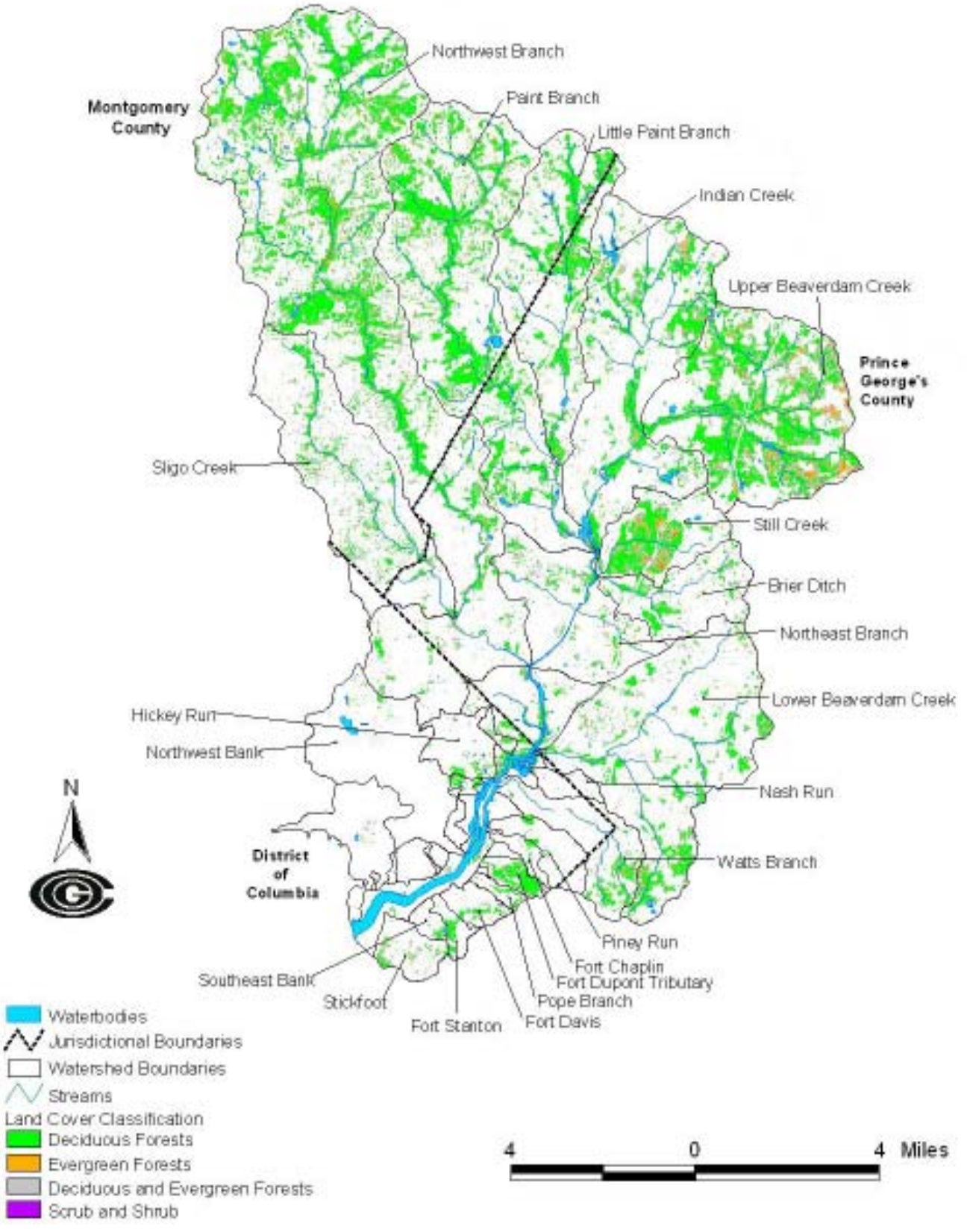

Table 1. Summary: MD DNR Forest Community Types in the Anacostia Watershed, 2000

Subwatershed	Deciduous Forests (acres)	Evergreen Forests (acres)	Deciduous and Evergreen Forests (acres)	Scrub and Shrub (acres)
Sligo Creek	826.39	157.89	758.56	368.72
Northwest Branch	5,610.60	775.91	2,921.72	1,072.13
Paint Branch	3,106.30	360.71	1,329.43	619.13
Little Paint Branch	1,347.22	143.44	538.62	264.20
Indian Creek	1,553.37	187.03	897.11	405.41
Upper Beaverdam Creek	2,794.29	477.24	1,500.44	281.54
Still Creek	707.64	149.44	415.42	94.29
Brier Ditch	329.13	40.70	187.92	119.42
Northeast Branch	324.24	58.93	312.01	197.92
Lower Beaverdam Creek	1,191.99	151.22	737.88	411.64
Nash Run	10.67	3.34	13.57	15.57
Watts Branch	250.41	45.59	161.68	97.63
Piney Run/Fort Chaplin	87.84	6.89	51.15	40.25
Southwest Bank	28.24	2.00	11.56	16.01
Fort Dupont Tributary	204.60	6.89	64.27	20.01
Pope Branch	45.37	4.23	26.91	14.01
Fort Davis	79.39	6.00	54.71	24.02
Fort Stanton	61.60	2.45	22.91	13.12
Stickfoot	81.84	16.01	68.27	40.03
Tidal	346.48	53.37	270.42	128.98
Hickey Run	70.72	13.12	49.59	41.59
Northwest Bank	112.75	22.91	83.17	300.44
Total	19,171.09	2,685.32	10,477.32	4,586.06

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Table 1. Resources for Protecting and Restoring Forest Land in the Anacostia watershed

	Program	Description	Criteria	Web Site / Contact Info
	Acquisition Programs			
	STATE			
1.	Program Open Space	• Provides funds to local governments to protect open space • Funded by a realty transfer tax	• Local governing bodies must have a *Local Land Preservation and Recreation Plan* approved by DNR and MDP • Each year, local governing bodies must have an *Annual Program* reviewed and approved by DNR and MDP	• Program Open Space 580 Taylor Avenue, E-4 Annapolis, MD21401 410-840-9378 • http://www.dnr.state.md.us/pos.html
2.	Maryland Environmental Trust	• State-wide land trust • Provides assistance to local land trusts		• 100 Community Place 1st Floor Crownsville, MD 21032 TOLL FREE 1-877-514-7900 • http://www.conservemd.org/index.html
3.	Rural Legacy	• Encourages local governments to identify Rural Legacy Areas and provides money to protect those areas from development • There are no Rural Legacy Areas within the Anacostia Watershed • To establish RLA's, land must be agriculturally significant, etc.	• Land must be in a Rural Legacy Area	• http://www.dnr.state.md.us/rurallegacy/rlprogram/index.html
4.	Maryland Agricultural Land Protection Foundation	• Designed to protect farmland, but may include some wooded agricultural land • Land must meet minimum criteria	• Minimum district size 50 acres (adjoining landowners can join together to meet minimum requirements) • The land must have suitable soils • There must be an existing Soil Conservation and Water Quality plan • Land within a 10-year water and sewer service area plan is usually ineligible • Minimum term of agreement = 5 years	• Montgomery County John Zawitoski 18410 Muncaster Road Derwood, MD 20850 301-590-2831 • Prince George's County Dave Bourdon 5010 Brown Station Road Upper Marlboro, MD 20772 301-574-5162 • http://www.malpf.info/
	LOCAL			
5.	M-NCPPC Montgomery County Legacy Open Space	• Legacy Open Space is a public/private initiative to expand the existing park system by protecting thousands of acres of open space through out Montgomery County	• Exceptional open-space lands that are of County-wide significance, including exceptional forest stands	• Legacy Open Space 8787 Georgia Ave. Silver Spring, MD 20910 301-650-4360 • http://www.mc-mncppc.org/legacy_open_space/index.shtm

Table 1. Resources for Protecting and Restoring Forest Land in the Anacostia watershed, cont'd.

6.	M-NCPPC Prince George's County Park Planning and Development Division	• Directs land acquisition in PG County	• Land must be in Prince George's County • Proposed park locations are determined through the Master Plan process	• http://www.pgparks.com/planning/planning.html
7.	Potomac Conservancy	• Conducts outreach to promote land protection through conservation easements and land donations. • Provides counseling and support for the Potomac Land Trust Network (an association for local land trusts)	• Landowner must draft a conservation easement, which is then reviewed by the Board of Directors. The Directors consider the conservation value, whether the land is in a target area and the contribution to protecting the Potomac.	• Potomac Conservancy 8601 Georgia Avenue Suite 612 Silver Spring, MD 20910 (301) 608-1188 • http://www.potomac.org/index.html
8.	Greater Sandy Spring Green Space, Inc.	• Land Trust for the greater Sandy Spring Area		• GSSGS P.O. Box 92 Sandy Spring, MD20860 (301) 260-8860 • http://www.sandyspringgreenspace.org/
	Cost-Share, Grant and Technical Assistance Programs			
	FEDERAL			
10.	Forest Land Enhancement Program	• Provides cost-share assistance of up to 75% for landowners • Approved practices range from development of a Forest Stewardship Plan to Afforestation/Reforestation, Water Quality Improvement & Watershed Restoration, Fish & Wildlife Habitat, and Invasive Species Control	• The practices must impact at least 1 acre • Practices must be in an approved Forest Stewardship Plan	• MD DNR 580 Taylor Avenue Annapolis, Maryland 21401 (410) 260-8531 • http://www.dnr.state.md.us/forests/programapps/sip.html
11.	Environmental Quality Incentive Program	• Provides cost-share assistance for up to 75% of approved conservation practices	• Must be an agricultural producer	• NRCS • http://www.dnr.state.md.us/forests/programapps/eqip.html
12.	Conservation Reserve Program	• Provides cost-share assistance to establish and rental payments to maintain resource-conserving covers designed to reduce erosion	• Cropland • Must own land for 1 year before applying • Weighted erosion index 8 or more	• FSA • http://www.fsa.usda.gov/dafp/cepd/crp.htm
13.	FWS Partners for Wildlife	• Provides financial and technical assistance to private land owners who want to restore or improve wildlife habitat on their property	• Any land not owned by the State or Federal Government is eligible Landowner must sign an agreement with the FWS that the restoration project will be maintained for 10 years.	• FWS MD State Contact: Al Rizzo 177 Admiral Cochrane Dr. Annapolis, MD 21401 410-573-4500 • http://partners.fws.gov/index.html

Table 1. Resources for Protecting and Restoring Forest Land in the Anacostia watershed, cont'd.

14.	Forest Stewardship Program	• Offers technical assistance to non-industiral private forest owners to encourage and maintain long-term forest management • Aids landowners in developing forest stewardship plans	• Available to owners of 5 or more acres of forest land or non-forest land that can be planted to trees • Must commit to actively managing forested land for at least 10 years	• MD DNR 580 Taylor Avenue Annapolis, Maryland 21401 (410) 260-8531 • http://www.dnr.state.md.us/forests/programapps/steward.html
15.	USDA Wetlands Reserve Program	• Provides either cost-share assistance or easement payment to private landowners for restoration of drained wetlands in cropland, pasture, hay land, and woodland • Offers up to 75% cost-share for restoration projects with a 10-year agreement or a 30-year easement, and up to 100% cost-share with a permanent easement	Riparian Corridors are eligible if: 1.) they connect 2 or more permanently protected wetlands 2.)the protected wetlands are no more than one mile apart 3.)the corridors average 300 ft. or less in width on one side, or a total of 600 ft. wide if both sides are enrolled	• NRCS MC Service Center 18410 Muncaster R.d Derwood, MD 20855 (301) 590-2855 • NRCS PG County Center 5010 Brown Station Rd Upper Marlboro, MD 20772 (301) 574-5162 • http://www.nrcs.usda.gov/programs/wrp/
16.	USDA Wildlife Habitat Incentives Program	• Provides up to 75% cost-share and technical assistance for the implementation of habitat improvement projects, primarily on private lands • Projects should address MD's WHIP Priorities: (1) Restore and manage upland grassland habitat to benefit groundnesting birds and associated wildlife; (2) Restore and manage riparian corridor habitat to benefit fish and wildlife; (3) Restore and manage shallow water and wetland habitat to benefit waterfowl, wading birds, and wildlife.	• Must agree to prepare and implement a wildlife habitat development plan for 5 to 10 years. • Minimum of one acre of wildlife habitat improvement practices or at least $300 of cost-share assistance (applicants can cooperate with adjoining neighbors to meet minimum requirements)	• NRCS MC Service Center 18410 Muncaster R.d Derwood, MD 20855 (301) 590-2855 • NRCS PG County Center 5010 Brown Station Rd Upper Marlboro, MD 20772 (301) 574-5162 • http://www.md.nrcs.usda.gov/programs/whip/whip.html
	STATE			
17.	Conservation Reserve Enhancement Program	• Landowners are paid an annual soil rental payment for planting a streamside forest, a grass buffer or a wetland. There are higher incentive payments for planting a forest buffer • Landowners are reimbursed 87.5% for planting a forest and 50% for planting a grass buffer or restoring a wetland	• Eligible lands include either (1)Cropland, hayland, or pastureland adjacent to a stream or waterbody; or (2) Highly erodible lands within 1,000 ft of a stream or waterbody • A 15 year contract is required • Maintenance is required	• MD Farm Service Agency 8335 Guilford Road, Suite E Columbia, MD 21046 (410) 381-4550 • http://www.dnr.state.md.us/wildlife/milo.html
18.	Maryland's Buffer Incentive Program	• Provides grant for tree planting if at least 65% of seedlings survive after 1 year. • A reduced payment of 50% is available for 50-60% survival.	• 1-50 non-forested acres • Within 300' of a stream + 4' for every 1% slope for slopes avg. greater than 6%	• http://www.bcfb.sailorsite.net/IncentivePrograms/AgriculturalLand/AgriculturalLandBufIncenProg.htm
19.	Chesapeake Bay Trust	• Provides small grants to civic and community organizations, schools and volunteer groups for tree and vegetative buffer planting	• Tree planting activities must be within 1000 feet of the Bay, a tributary or a tidal wetland area. • The planted species must be native. • 75% of grants equal $5,000 or less	• Chesapeake Bay Trust 60 West St., Suite 200A Annapolis, MD 21401 (410) 974-2941 • http://www.chesapeakebaytrust.org/

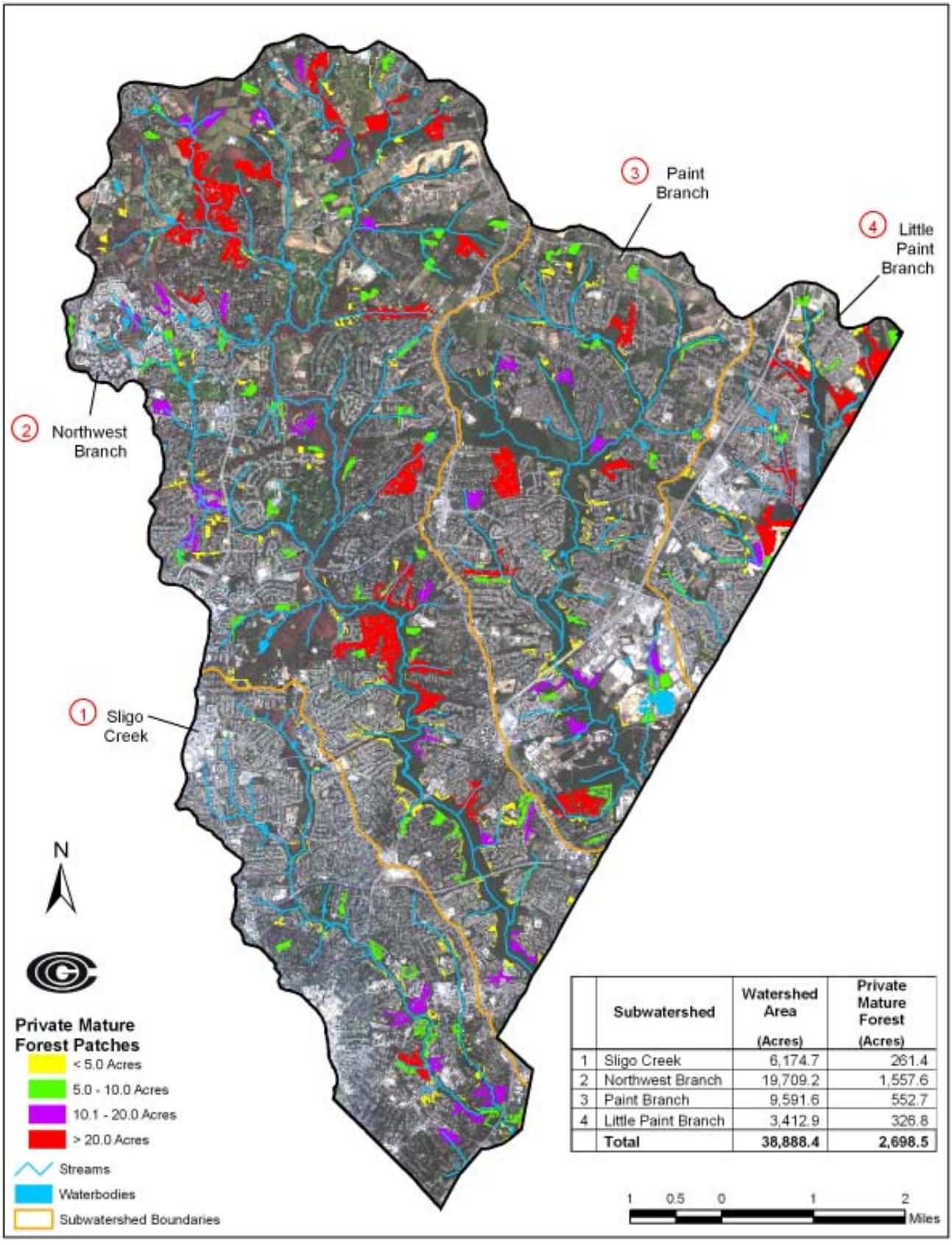
Table 1. Resources for Protecting and Restoring Forest Land in the Anacostia watershed, cont'd.

20.	Chesapeake Bay School Reforestation Program	• Provides grants for tree planting on school property • Co-sponsored by MD DNR and the County Forestry Conservation Boards	• Must use native plants	• http://www.mdforest.sailorsite.net/fcdb.html
21.	Maryland's Woodland Incentive Program	• Pays for up to 50% of eligible practices, including: tree planting, site preparation, and timber improvement practices	• Available to owners of 10 to 500 acres that may be harvested • Must have an approved forest stewardship plan • Trees must be maintained for at least 15 years	• Maryland DNR Forest Service 580 Taylor Avenue Annapolis, Maryland 21401 (410) 260-8531 • http://www.dnr.state.md.us/forests/programapps/wood.html
22.	Forest Conservation and Management Program	• Provides a tax break to owners of 5 or more acres of contiguous forest land who have a forest stewardship plan and agree to follow the plan for at least 15 years • The Forest Conservation and Management Agreement establishes the length of the agreement (15 year minimum)and the responsibilities of the owner and DNR • If you sell your property before the plan expires or stop complying, you owe penalty taxes for years your property was on the plan	• 5 or more contiguous acres of forest land (open land recently planted to forest seedlings is eligible) • Must have an approved forest stewardship plan • Minimum 15 year enrollment	• Maryland DNR Forest Service 580 Taylor Avenue Annapolis, Maryland 21401 (410) 260-8531 • http://www.dnr.state.md.us/forests/programapps/fcmp.html
23.	Chesapeake Bay Small Watershed Grants Program	• Provides grant of $5,000 to $50,000 to organizations working on a local level to improve watersheds in the Chesapeake Bay basin while building citizen-based stewardship	• Projects must either (1) Support the development or implementation of local watershed management plans that address the water quality and living resource needs in the Chesapeake Bay ecosystem; or (2)Promote locally based protection and restoration efforts that complement watershed management strategies. • Must address one of the goals of the *Chesapeake 2000 Agreement*	• National Fish and Wildlife Foundation Attn: Chesapeake Bay Small Watershed Grants Program 1120 Connecticut Ave., NW, Suite 900 Washington, DC 20036 • (202) 857-0166 • http://www.nfwf.org/chesapeake/application.htm
24.	Chesapeake Bay Ecosystem Initiative	• Offers financial and technical assistance to private land owners for restoration and management projects.	• Eligible projects include the restoration and enhancement of wetlands, upland grass buffers, forested riparian corridors, and water quality improvement projects for working farmers	• Ducks Unlimited Mid-Atlantic Field Office 203 Romancoke Rd.,Suite 90 Stevensville, MD 21666 (410) 643-5300 • http://www.ducks.org/conservation/Projects/GreatLakesAtlantic/ChesapeakeBAy/index.asp
25.	DC Green Grants Neighborhood Planting Program	• Offers grants up to $10,000 to local organizations for tree planting projects in the District of Columbia.	• Projects must be in DC on non-federally owned land • Projects must include a 50-50 match from a non-federal funding source • Maintenance plans are required.	• DC Urban Forestry Administration John A. Wilson Building 1350 Pennsylvania Avenue, NW Washington, DC 20004 http://ddot.dc.gov/ufa/cwp/view,a,1293,q,575536,ufaNav_GID,1631,ufaNav,|32699|.asp

Table 1. Resources for Protecting and Restoring Forest Land in the Anacostia watershed, cont'd.

	LOCAL			
26.	M-NCPPC Reforestation Program	• Organizes volunteer tree planting projects in Montgomery County parks	• Must be on M-NCPPC parklands in Montgomery County.	• M-NCPPC Natural Resources Management Group 2000 Shorefield Rd Wheaton, MD 20902 301-949-3601 http://www.mc-mncppc.org/naturalresources/index.shtm
27.	M-NCPPC Weed Warriors Program	• Trains volunteers to remove non-native invasive plants from M-NCPPC parks in Montgomery County.	• All volunteers must go through training which allows them to work in M-NCPPC parks in Montgomery County.	• To sign up call Volunteer Services at 301-495-2464. Weed Warriors Natural Resources Management Group M-NCPPC 2000 Shorefield Rd. Wheaton, MD 20902 http://www.mc-mncppc.org/Environment/weed_warriors/intro.shtm
28.	M-NCPPC Montgomery County Countywide Planning, Environmental Planning Section	• The Montgomery County Forest Conservation Law is administered by M-NCPPC.	• Private forest conservation banks are allowed. A private landowner may use existing forest or plant a new forest to "sell" for credits to land development projects that cannot meet forest conservation requirements onsite.	• Environmental Planning, M-NCPPC 8787 Georgia Ave. Silver Spring, MD 20910 301-495-4540 • http://www.mc-mncppc.org/environment/forest/index.shtm

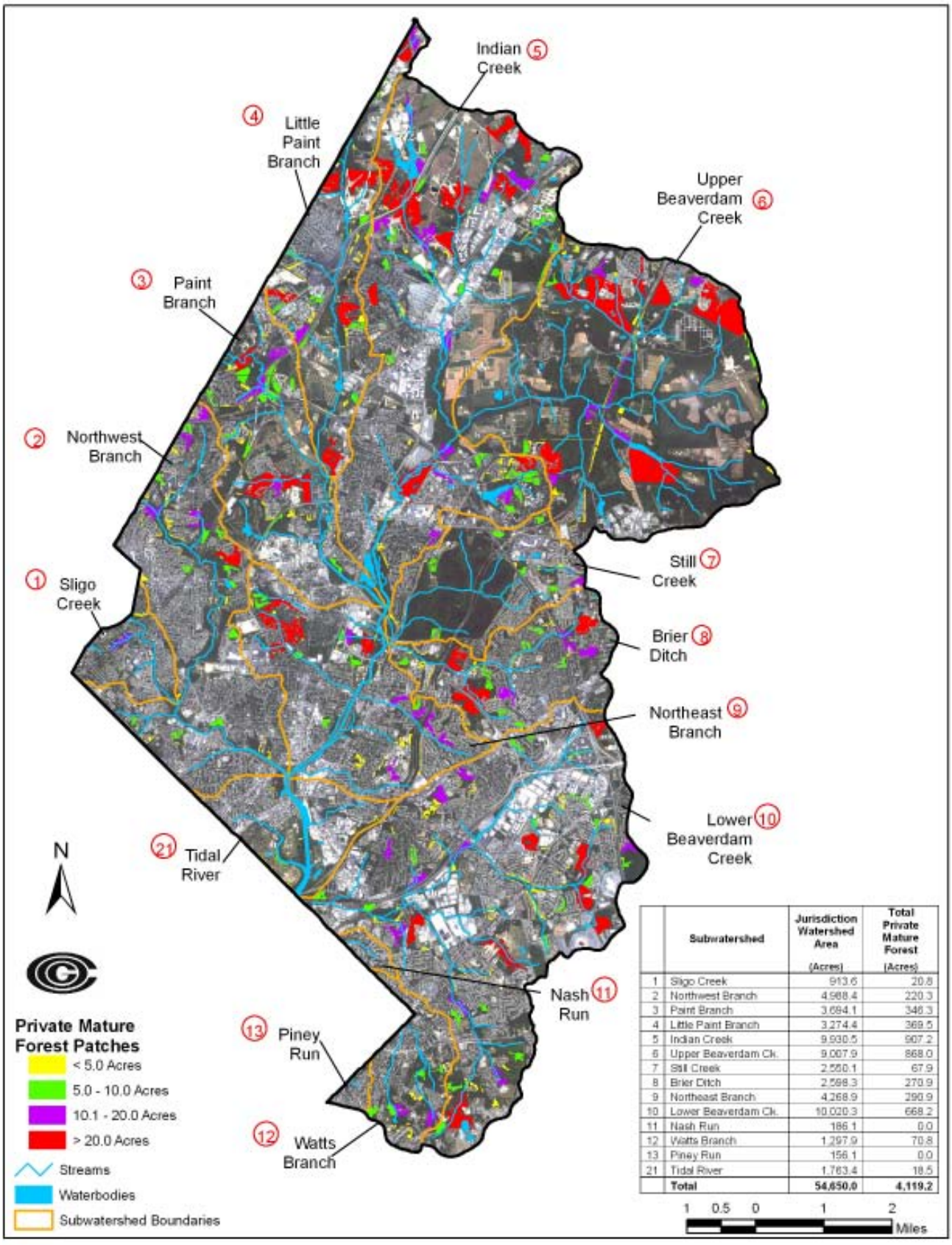
Figure 1. Anacostia Watershed 2000: Privately Owned Mature Hardwood Forest in Montgomery County[1]



	Subwatershed	Watershed Area (Acres)	Private Mature Forest (Acres)
1	Sligo Creek	6,174.7	261.4
2	Northwest Branch	19,709.2	1,557.6
3	Paint Branch	9,591.6	552.7
4	Little Paint Branch	3,412.9	326.8
	Total	**38,888.4**	**2,698.5**

[1]It is recognized that these areas will need to be groundtruthed to verify actual age, quality, and potential jurisdictional priority.

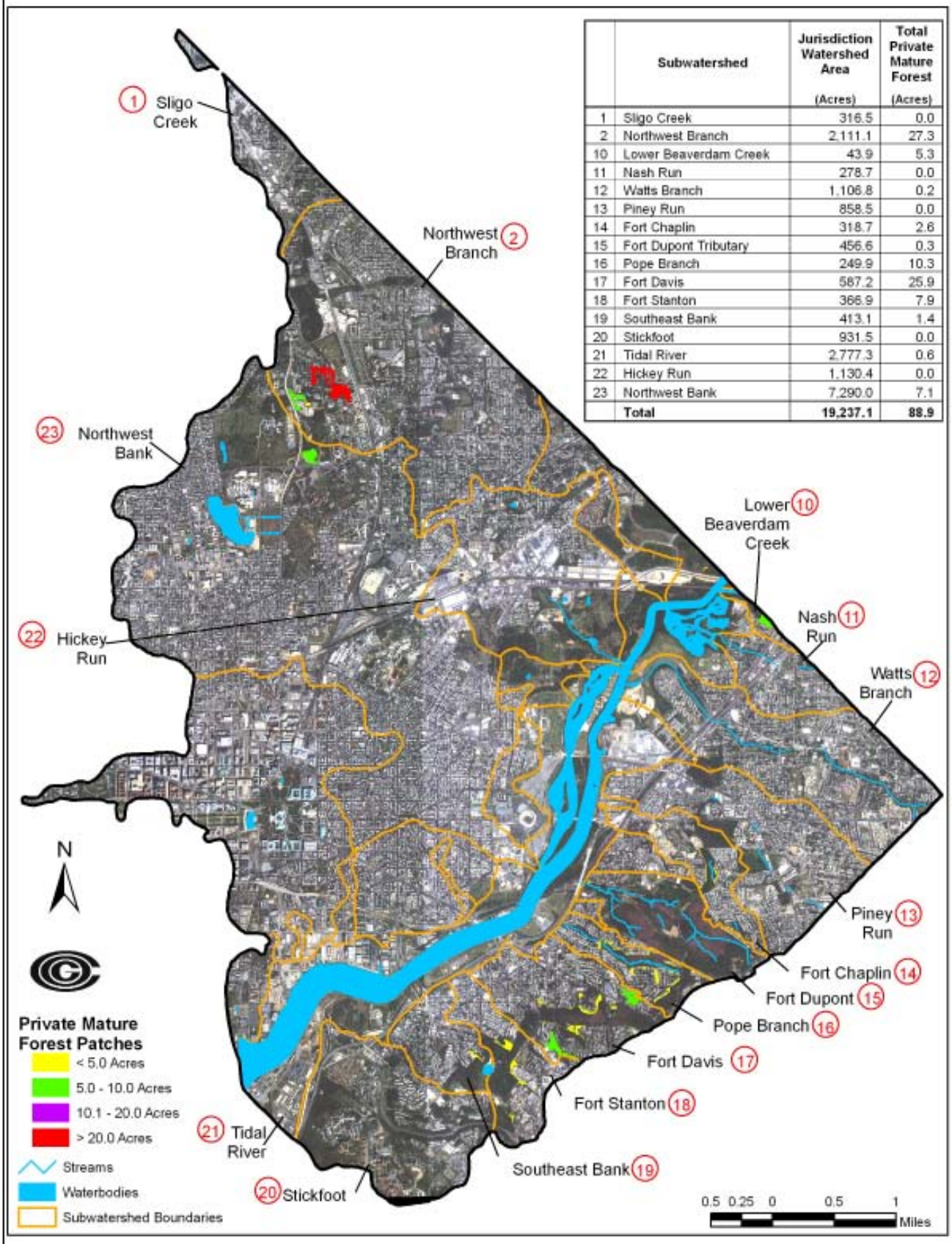
Figure 2. Anacostia Watershed 2000: Privately Owned Mature Hardwood Forest in Prince George's County[1]



	Subwatershed	Jurisdiction Watershed Area (Acres)	Total Private Mature Forest (Acres)
1	Sligo Creek	913.6	20.8
2	Northwest Branch	4,988.4	220.3
3	Paint Branch	3,694.1	346.3
4	Little Paint Branch	3,274.4	369.5
5	Indian Creek	9,930.5	907.2
6	Upper Beaverdam Ck.	9,007.9	868.0
7	Still Creek	2,550.1	67.9
8	Brier Ditch	2,598.3	270.9
9	Northeast Branch	4,268.9	290.9
10	Lower Beaverdam Ck.	10,020.3	668.2
11	Nash Run	186.1	0.0
12	Watts Branch	1,297.9	70.8
13	Piney Run	156.1	0.0
21	Tidal River	1,763.4	18.5
	Total	**54,650.0**	**4,119.2**

[1]It is recognized that these areas will need to be groundtruthed to verify actual age, quality, and potential jurisdictional priority.

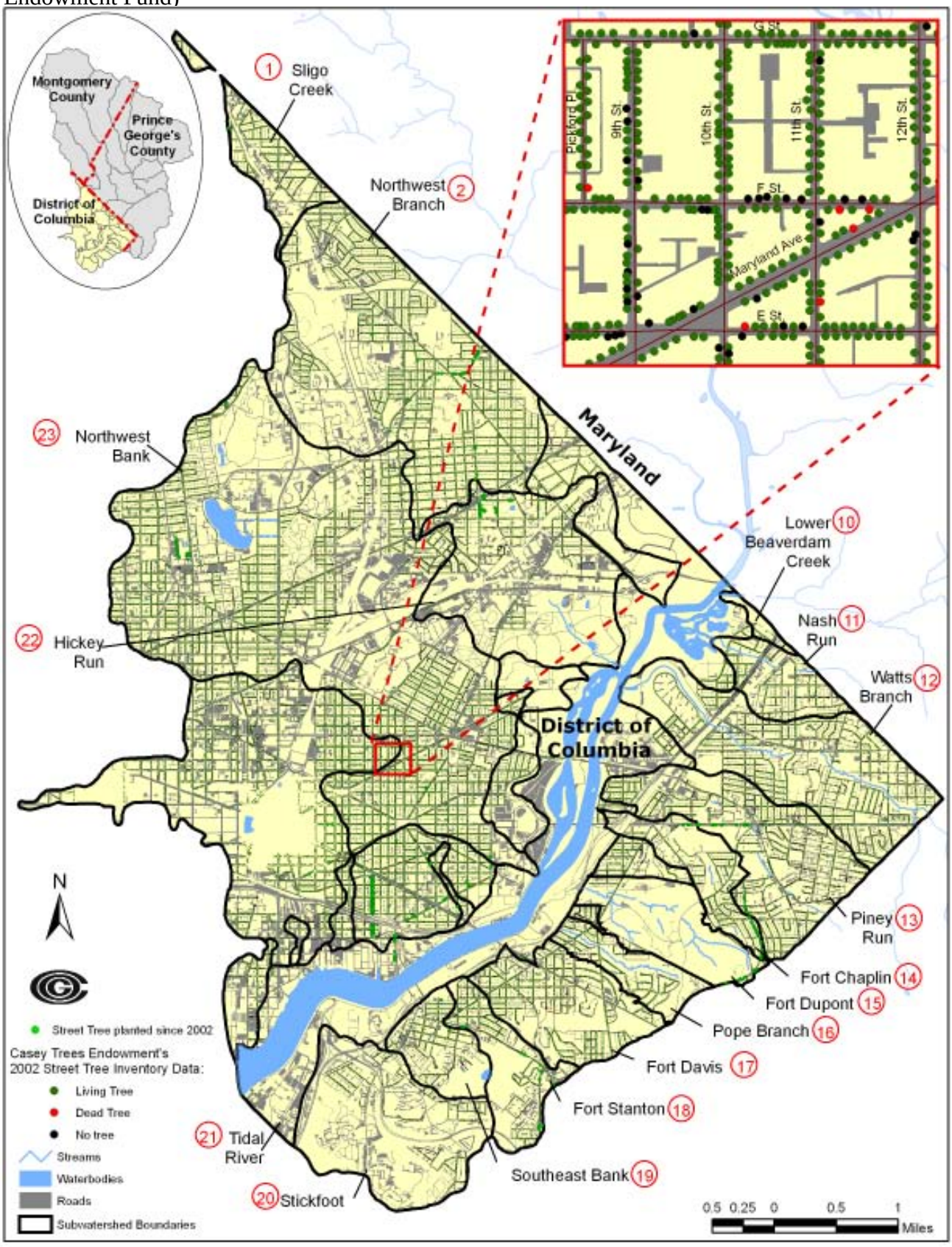
Figure 3. Anacostia Watershed 2000: Privately Owned Mature Hardwood Forest in the District of Columbia[1]



	Subwatershed	Jurisdiction Watershed Area (Acres)	Total Private Mature Forest (Acres)
1	Sligo Creek	316.5	0.0
2	Northwest Branch	2,111.1	27.3
10	Lower Beaverdam Creek	43.9	5.3
11	Nash Run	278.7	0.0
12	Watts Branch	1,106.8	0.2
13	Piney Run	858.5	0.0
14	Fort Chaplin	318.7	2.6
15	Fort Dupont Tributary	456.6	0.3
16	Pope Branch	249.9	10.3
17	Fort Davis	587.2	25.9
18	Fort Stanton	366.9	7.9
19	Southeast Bank	413.1	1.4
20	Stickfoot	931.5	0.0
21	Tidal River	2,777.3	0.6
22	Hickey Run	1,130.4	0.0
23	Northwest Bank	7,290.0	7.1
	Total	**19,237.1**	**88.9**

[1]It is recognized that these areas will need to be groundtruthed to verify actual age, quality, and potential jurisdictional priority.

Figure 1. Anacostia Watershed 2002: District of Columbia Street Tree Inventory Data (Casey Trees Endowment Fund)[1,2]



[1]Casey Trees Endowment Fund has planted approximately 275 street trees in the DC portion of the Anacostia watershed from 2003-04.
[2]Note: There have been 1,528 street trees planted in the Montgomery County portion of the Anacostia watershed from 2000-2004.

Table 1. Partial Listing of Anacostia Reforestation Projects since 1993[1]

Site	Season	Year	Site	Participating Organizations[2]	Watershed	County	# Trees	Success Rate (%)	# Acres[3]	Augered
1	Fall	1993	Good Hope Road	COG/MDNR/M-NCPPC	Paint Branch	MC	360	ND	ND	No
2	Fall	1994	Kenilworth Park I	COG	Watts Branch	DC	300	0	ND	No
3	Fall	1994	Colmar Manor I	COG/MDNR/AWS	Tidal River	PG	96	ND	ND	No
4	Spring	1995	Colmar Manor II	COG	Tidal River	PG	50	23	ND	No
5	Fall	1994	Acredale Community Park	COG/MDNR	Paint Branch	PG	235	ND	ND	No
6	Spring	1995	Acredale Community Park II	COG/MDNR	Paint Branch	PG	325	ND	ND	No
7	Spring	1995	Rte 1 Paint Branch	COG/MDNR	Paint Branch	PG	226	27	ND	No
8	Spring	1995	Adelphi Manor Park	COG/MDNR	Northwest Branch	PG	100	ND	ND	No
9	Spring	1995	Adelphi Manor Park II	COG/MDNR	Northwest Branch	PG	415	67	ND	No
10	Spring	1995	Kenilworth Park II	COG	Tidal River	DC	170	40	ND	No
11	Spring	1997	Lane Manor Park	COG/MDNR	Northwest Branch	PG	415	54	ND	No
12	Spring	1997	University of Maryland SWM Pond	COG/MDNR	Paint Branch	PG	127	70	ND	Yes
13	Spring	1998	Univ Blvd/Kemp Mill SWM Pond	COG/M-NCPPC	Sligo Creek	MC	113	67	ND	Yes
14	Spring	1998	Parklawn Park	COG/MDNR/CBF	Sligo Creek	PG	435	ND	ND	Yes
15	Spring	1998	Kenilworth Park III	COG/AM-FOR/NPS/MDNR	Tidal River	DC	600	ND	ND	Yes
16	Fall	1998	Layhill Park #1 nearest Rt. 182	COG/MDNR/M-NCPPC	Northwest Branch	MC	160	83	ND	Yes
17	Fall	1998	Sligo Creek Park Boardwalk	COG/MDNR/M-NCPPC	Sligo Creek	MC	155	79	ND	Yes
18	Fall	1998	Parklawn Park II	COG/MDNR/M-NCPPC	Sligo Creek	PG	635	56	ND	Yes
19	Spring	1999	Kenilworth Park IV at NPS Soccer Fields	COG/AM-FOR/NPS/MDNR	Tidal River	DC	130	ND	ND	No
20	Spring	1999	Sligo Creek Golf Course Pond	COG/MDNR/M-NCPPC	Sligo Creek	MC	100	ND	ND	Yes
21	Spring	1999	Maple Ave Trail at Adventist Hospital	COG/MDNR/M-NCPPC	Sligo Creek	MC	200	53	ND	Yes
22	Spring	1999	UMD Behind Aquacenter/gym	COG/MDNR/UMD	Paint Branch	PG	180	94	ND	Yes
23	Fall	1999	Park Valley Drive	COG/MDNR/M-NCPPC	Sligo Creek	MC	260	86	ND	Yes
24	Fall	1999	Soccer Field/SWM Pond at Beltway East	COG/MDNR/M-NCPPC	Sligo Creek	MC	220	55	ND	Yes
25	Fall	1999	Kenilworth Park V at NPS Soccer Fields	COG/AM-FOR/NPS/MDNR	Tidal River	DC	130	26	ND	No
26	Spring	2000	Beltway East Stormwater Wetland	COG/MDNR/M-NCPPC	Sligo Creek	MC	120	26	ND	ND
27	Spring	2000	Godwin Marsh understory enhancement	COG/MDNR/M-NCPPC	Sligo Creek	MC	200	51	ND	ND
28	Spring	2000	Sligo Creek at East West Highway	COG/MDNR/M-NCPPC	Sligo Creek	PG	200	49	ND	ND
29	Spring	2000	Long Branch Park	COG/MDNR/M-NCPPC	Sligo Creek	MC	170	36	ND	ND
30	Fall	2000	Benington Road	COG/MDNR/M-NCPPC	Sligo Creek	MC	250	ND	0.25	Yes
31	Fall	2000	Layhill Park #2 by Back Field Gate	COG/MDNR/M-NCPPC	Northwest Branch	MC	188	ND	0.33	Yes
32	Fall	2000	Gum Springs #1	COG/MDNR/M-NCPPC	Paint Branch	MC	400	ND	1	Yes

[1]The majority of these tree planting events were carried out with the help of volunteers who generously donated their time and energy to the reforestation effort.
[2]Note:Tree planting projects in Paint Branch, Sligo Creek, Northwest Branch and Indian Creek include the following subwatershed groups: Eyes of Paint Branch, Friends of Sligo Creek, Neighbors of the Northwest Branch and Citizens to Conserve and Restore Indian Creek
[3]Note: COG is in the process of regenerating accurate acreage data for all COG planting sites using GPS techniques.

Table 1. Partial Listing of Anacostia Reforestation Projects since 1993, cont'd.

Site	Season	Year	Site	Participating Organizations	Watershed	County	# Trees	Success Rate (%)	# Acres	Augered
33	Fall	2000	Briggs-Chaney Pipestem/Field	COG/MDNR/M-NCPPC	Paint Branch	MC	505	ND	0.55	Yes
34	Spring	2001	BARC - Sleepy Hollow Tributary	COG/MDNR/M-NCPPC	Little Paint Branch	PG	250	20	0.23	Yes
35	Spring	2001	Sligo Maple Avenue	COG/MDNR/M-NCPPC	Sligo Creek	MC	250	ND	0.33	Yes
36	Spring	2001	Layhill	COG/MDNR/M-NCPPC	Northwest Branch	MC	100	ND	0.2	Yes
37	Spring	2001	Gum Springs Meadow #2	COG/MDNR/M-NCPPC	Paint Branch	MC	350	ND	0.7	Yes
38	Fall	2001	Gum Springs #3 Roadway	COG/MDNR/M-NCPPC	Paint Branch	MC	300	ND	0.5	Yes
39	Fall	2001	BARC - Spray Irrigation Ditch #1	COG/MDNR/M-NCPPC	Little Paint Branch	PG	1105	ND	0.71	Yes
40	Spring	2002	Layhill Park #3	COG/MDNR/M-NCPPC	Northwest Branch	MC	180	ND	0.33	Yes
41	Spring	2002	Sligo at I-495	COG/MDNR/M-NCPPC	Sligo Creek	MC	200	ND	0.5	Yes
42	Spring	2002	Gum Springs #4 Meadow	COG/MDNR/M-NCPPC	Paint Branch	MC	141	ND	0.7	Yes
43	Spring	2002	BARC - Spray Irrigation Ditch #2	COG/MDNR/M-NCPPC	Little Paint Branch	PG	1360	ND	1	Yes
44	Spring	2002	BARC - Library Trib at Pond	COG/MDNR/BARC	Indian Creek	PG	200	27	0.15	Yes
45	Fall	2002	BARC - Behind Ikea	COG/MDNR/BARC	Little Paint Branch	PG	285	55	0.34	Yes
46	Fall	2002	BARC - Sewerline Mitigation	COG/MDNR/BARC	Little Paint Branch	PG	400	44	0.4	Yes
47	Fall	2002	Sligo at University	COG/MDNR/M-NCPPC	Sligo Creek	MC	300	ND	0.42	Yes
48	Fall	2002	Layhill Park #4	COG/MDNR/M-NCPPC	Northwest Branch	MC	381	ND	0.69	Yes
49	Spring	2003	Gum Springs #5 Meadow and Pond	COG/MDNR/M-NCPPC	Paint Branch	MC	350	ND	0.33	Yes
50	Spring	2003	Fletcher's Field	COG/MDNR/M-NCPPC	Northwest Branch	PG	465	68	1.25	Yes
51	Fall	2003	Layhill Park #5 by Soccer Field	COG/MDNR/M-NCPPC	Northwest Branch	MC	400	ND	0.22	ND
52	Fall	2003	Riggs Manor	COG/MDNR/M-NCPPC	Northwest Branch	PG	215	68	1.03	ND
53	Fall	2003	BARC- Spray Irrgtn Ditch #3	COG/MDNR/BARC	Little Paint Branch	PG	220	52	0.39	ND
54	Spring	2003	Therapeutic Rec Center	CTEF/UFA/DC-DPR	Fort Dupont	DC	10	100	ND	No
55	Summer	2003	Anacostia Park	CTEF/NPS	Tidal River	DC	16	ND	ND	No
56	Fall	2003	Langdon Park	CTEF/DC-DPR	Hickey Run	DC	28	100	ND	No
57	Fall	2003	Shaw Fields	CTEF	Northwest Bank	DC	10	10	ND	No
58	Fall	2003	Watts Branch Park	CTEF/WPP/NCCC	Watts Branch	DC	20	90	ND	No
59	Spring	2004	Banneker Rec. Center	CTEF/DC-DPR/UFA/NCCC	Northwest Bank	DC	28	85	ND	No
60	Spring	2004	Michigan Ave. NBRHD Park	CTEF	Northwest Bank	DC	4	100	ND	No
61	Spring	2004	Layhill Park #6 behind backstop	COG/MDNR/M-NCPPC	Northwest Branch	MC	200	ND	0.22	Yes
62	Spring	2004	RFK Stadium/Kingman Lake	CTEF/DC-EHA/CBF/NCCC	Tidal River	DC	427	ND	ND	Yes
63	Spring	2004	McKinley High School	CTEF/DCPS	Northwest Bank	DC	6	6	ND	No
64	Spring	2004	Queens Chapel Rd	COG/MDNR/M-NCPPC	Northwest Branch	PG	300	92	0.42	Yes
65	Spring	2004	BARC - Pond near Patuxent NWR	COG/MDNR/BARC	Upper Beaverdam Ck.	PG	150	ND	0.6	Yes
66	Fall	2004	Virginia Ave Boxing Center	CTEF/DC-DPR	Northwest Bank	DC	13	100	ND	No
67	Fall	2004	Pope Branch Park	CTEF/DC-DPR	Pope Branch	DC	22	100	ND	No
68	Fall	2004	Prospect Learning Center	CTEF/DCPS/NCCC	Northwest Bank	DC	13	100	ND	No

Table 1. Partial Listing of Anacostia Reforestation Projects since 1993, cont'd.

Site	Season	Year	Site	Participating Organizations	Watershed	County	# Trees	Success Rate (%)	# Acres	Augered
69	Fall	2004	Briggs-Chaney at Good Hope Rd.	COG/MDNR/M-NCPPC	Paint Branch	MC	150	ND	0.56	Yes
70	Fall	2004	Randolph Rd at Kemp Mill	COG/MDNR/M-NCPPC	Northwest Branch	MC	100	ND	0.13	Yes
71	Fall	2004	RFK	CTEF/DC-EHA/NPS/UFA/NCCC	Tidal River	DC	285	ND	ND	Yes
72	Fall	2004	Anacostia Riverwalk/11th Street Bridge	CTEF/ECC/NCCC	Tidal River	DC	27	100	ND	No
73	Fall	2004	Anacostia Riverwalk/Half St SE	CTEF/ECC/NCCC	Tidal River	DC	13	100	ND	No
74	Fall	2004	Anacostia Riverwalk/Matthew Henson Cntr.	CTEF/ECC/NCCC	Tidal River	DC	5	100	ND	No
75	Fall	2004	Wilkinson ES	CTEF/NCCC	Stickfoot	DC	10	90	ND	No
76	Fall	2004	Anacostia HS	CTEF/NCCC/City Year	Tidal River	DC	14	85	ND	No
77	Spring	2005	Fletcher's Field	COG/AWS/MDNR/M-NCPPC	Northeast Branch	PG	400	ND	1.03	Yes
78	Spring	2005	Randolph Rd at Kemp Mill	COG/MDNR/M-NCPPC	Northwest Branch	MC	200	ND	0.3	Yes
79	Spring	2005	Anacostia Park	CTEF/NPS/NCCC/Canadian Embassy	Tidal River	DC	500	ND	ND	Yes
80	Spring	2005	Barry Farm Rec Center	CTEF/DC-DPR/NCCC	Stickfoot	DC	41	97	ND	No
81	Spring	2005	Sligo Ck.- Forest Glen/Dennis	COG/MDNR/M-NCPPC	Sligo Creek	MC	200	ND	0.5	Yes
82	Spring	2005	Kenilworth-Parkside Rec Center	CTEF/DC-DPR/NCCC	Tidal River	DC	45	100	ND	No
83	Spring	2005	Fort Stanton/Fort Ricketts	CTEF/NPS/NCCC	Fort Stanton	DC	122	ND	ND	Yes
84	Spring	2005	Dupont Park 7th Day Adventist School	CTEF/NCCC	Pope Branch	DC	27	100	ND	No
85	Spring	2005	Burville Elementary School	CTEF/DCPS/NCCC/ECC	Watts Branch	DC	15	100	ND	No
86	Spring	2005	200 block 54th Street NE	CTEF/DC-Habitat for Humanity/NCCC	Watts Branch	DC	13	100	ND	No
87	Spring	2005	Randle Circle	CTEF/NCCC	Southeast Bank	DC	17	100	ND	No
88	Spring	2005	McKinley High School	CTEF/AM-FOR/DCPS	Northwest Bank	DC	5	100	ND	No
89	Spring	2005	Cardozo High School	CTEF/AM-FOR/DCPS	Northwest Bank	DC	4	100	ND	No
90	Spring	2005	Banneker High School	CTEF/AM-FOR/DCPS	Northwest Bank	DC	7	100	ND	No
91	All	95-'05	Lower Anacostia Watershed	AWS	Lower Anacostia	All	12,000	ND	ND	ND

Table 2. Key to Acronyms of Organizations Involved in Anacostia Reforestation Events[1]

Acronym	Organization	Acronym	Organization
AM-FOR	American Forests	**ECC**	Earth Conservation Corps
AWS	Anacostia Watershed Society	**MDNR**	Maryland Department of Natural Resources
BARC	USDA Beltsville Agricultural Research Center	**M-NCPPC**	Maryland - National Capitol Park and Planning Commission
CBF	Chesapeake Bay Foundation	**NCCC**	AmeriCorps National Civilian Community Corps
COG	Metropolitan Washington Council of Governments	**NPS**	National Park Service
CTEF	Casey Trees Endowment Fund	**UFA**	District Department of Transportation - Urban Forestry Administration
DC-DPR	District of Columbia Department of Parks and Recreation	**UMD**	University of Maryland
DC-EHA	District of Columbia Environmental Health Administration	**WPP**	Washington Parks and People
DCPS	District of Columbia Public Schools		

Summary: Reforestation Strategies and Recommendations

I. General Reforestation Considerations

While all reforestation sites are unique, there are many common elements that go into any successful reforestation event. The following is a summary of the options available for planning a tree planting.

A. Choosing a site

The site that is chosen for a reforestation project obviously has a great impact on every other aspect of that project. Reforestation on public land involves a whole different set of considerations than reforestation on private land. Unless you personally own or manage land that is in need of reforestation, reforestation on private land involves working with landowners to find an affordable way to reforest their property.

Reforestation on public land also involves working closely with land owners. In the Anacostia, some of the principal owners of public land include Maryland-National Capital Park and Planning Commission, the National Park Service and the USDA's Beltsville Agricultural Research Center. The first step in planning a tree planting event on public land would be to contact one of these landowners to determine an appropriate place for reforestation.

B. Evaluating Site Conditions

Once a suitable reforestation site is chosen, it is extremely important to visit the site prior to picking out plants. At the site, examine all of the conditions that plants will experience while growing there. The soil moisture is critical to take note of, as the type of plants that would be appropriate for the planting vary depending on how wet or dry the soil is. The organic content of the soil is also important to examine, as it will help to determine whether amendments to the soil are necessary. The level of soil compaction is significant, because it will determine how difficult it will be to dig holes in the soil and it will also affect how much air and water the plants receive. Many other site conditions are important to take note of as well, including the presence or absence of construction debris in the soil, the slope of the site and how much available sunlight there is. It is also crucial to notice what type of vegetation already exists at the site and determine whether it needs to be mowed or if exotic invasive species have to be cleared out before planting can begin.

C. Plant Material Selection

The limitations of the site and the soil are the first set of criteria that should be used to choose which plants are suitable for a reforestation event. Ultimately, the planting manager needs to determine the goals and objectives of the tree planting. The species chosen and the type of plant material might vary depending on whether the principle goal of the planting is aesthetic, to provide habitat for wildlife, or to shade a stream. In most cases, native species are recommended as they are more suited to the local environment, are generally easier to maintain than nonnative species and don't pose a threat of invading our native forests.

When choosing plant species, it might be useful to consider the process of ecological succession. Usually, an abandoned field that naturally progresses to a forest is initially colonized by a few pioneer species and not by a complex assemblage of canopy species, shade-loving understory trees and shrubs like you might find in an established forest and is often imitated in tree plantings. One option for a tree planting, then, is to plant a few pioneer species and allow for the natural regeneration of forest. Another possibility is not to plant

Plant materials set out before a reforestation event.

anything at all, but facilitate natural forest regeneration by simply arranging for an area to stop being mowed. While this is certainly a low-cost option for reforestation, its success depends on the presence of desirable species growing adjacent to the site or having previously grown on the site (and still having seeds in the soil seed bank) and the absence of exotic invasive plant species and browsing by wildlife (See Case Study on Page 32).

After determining which species will be planted, the type of plant material (e.g., seedlings or container stock) needs to be chosen. While seedlings are much less expensive than container plants, they also have a much lower chance of surviving, are more susceptible to deer browsing and are not easily noticed (they could easily be run over by a lawnmower). Seedlings are not recommended by the ARPW for reforestation plantings in the Anacostia watershed. Container plants, while they are much more expensive have a much higher chance of surviving and are more resistant to deer browsing. Due to their hardiness and higher rate of survival, container plants are the preferred type of plant material for tree plantings in the Anacostia watershed. In the end, much of the decision about what plant materials to use will depend on their availability and on the wants and needs of the landowner.

D. Site Preparation

The amount of site preparation that is required before planting depends largely upon the existing condition of the site. If the planting area is overgrown with weeds, before planting it would be necessary to remove the weeds either manually, through herbicide application, or mechanically. However, if there is just tall grass throughout the planting area, it would be necessary to either mow the entire area, or simply weed whack around the locations where trees will be planted. Depending on the initial site evaluation, it might also be beneficial to apply some type of soil amendment. This preparation is best addressed in the weeks prior to the planting and should be handeled by a contractor or other landscape professional.

At any tree planting event, holes will need to be dug. The main decision to make when it comes to the holes is whether to use a mechanical auger or a shovel to dig the holes. Augers are rather expensive, but the history of reforestation in the Anacostia shows that at events where the holes were dug by an auger, rather than by a volunteer with a shovel, the survival rates of the trees were much higher (Appendix F). Holes can be augured the day of the event or the week prior.

E. Outreach

One way to cost-effectively conduct a reforestation event is to recruit volunteers to help out with the actual planting. It is not too technical or too grueling of an activity and with the right advertising, outreach and incentives (free refreshments don't hurt), an energized crew of volunteers can be drummed up with minimal effort. By conducting tree plantings with partner organizations this task is made even easier, as each organization can call on their own web of contacts. An effort should be made to involve people that live close to the tree planting site, as they might be able to easily monitor the reforested site and be more likely to help maintain the trees in the future. Keep in mind that a tree planting event could also be an easy and fun way for high school students to complete some of their required community service hours.

Volunteers gather before a tree planting event along Little Paint Branch.

On the day of the tree planting event, it helps to have everything prepared before the volunteers arrive. If an auger is used, all of the holes should be dug before the day of the tree planting. All the plants should be set out at the places where they will be planted and everything else that is needed for the planting should be ready. Once the volunteers arrive, it is important to have an introduction to the purpose of the planting, the groups involved, and the proper techniques to

plant a tree. It is critical that all of the volunteers, even the late comers, be shown the correct way to plant a tree, as an improperly planted tree has a much lower chance of surviving.

F. Mulching

Mulching is an effective way to help the soil around the plant retain moisture and to reduce competition from other vegetation. In a study of the success of riparian buffer plantings in Maryland, the most common problem that impaired the growth of trees was competition from weeds and other broadleaf grasses (Pannill *et al.* 2001). There are many different types of mulch, including traditional hardwood mulch, geotextile fabric that you spread on the ground surrounding the trees, and mulch collars made from recycled paper (see case study above).

A tree with a mulch collar.

Preliminary Case Study:

Mulch Collars

COG began using mulch collars at a 2004 riparian tree planting along the Northwest Branch near Queen's Chapel Road. Mulch collars are made of recycled paper and are designed to biodegrade into the soil in 3-4 years. The collars are placed at the base of the tree after planting and are designed to reduce competition from grass and other vegetation. Water collects in channels on the top of the collar and the extra weight of the water pins the collars to the ground. The natural glue in the collar ensures that the collar stays in place as it dries.

Mulch collars are relatively inexpensive, easy to install and contain bird-cherry extract, which is a natural vole repellant. COG staff will monitor the success of the mulch collars over time.

G. Signage

Putting up signage to mark a reforested area is both a good way to inform the local community of the goals of the reforestation effort and could potentially prevent trees from being damaged through mowing activities. By clearly marking an area a "no-mow reforestation zone," mowers are additionally reminded not to cut around the trees.

H. Follow-up Maintenance

Returning to the tree planting site and conducting follow-up maintenance periodically for three to five years is one of the most critical parts of a reforestation effort. By ensuring plants are receiving enough water, protected from nuisance wildlife species (e.g., deer, voles, beavers, rabbits), and are not being outcompeted by exotic invasive plants, the survival rate at a reforestation site can be dramatically improved. One way to coordinate maintenance of several different planting sites would be to conduct a survivability survey, which identifies the major problems at each reforestation site, and then tailor maintenance actions to the main problems at each site.

II. Riparian Reforestation

In carrying out a riparian reforestation project, as with any other tree planting effort, the specific goals of the planting need to be determined. Different forested buffer widths provide varying water quality and habitat benefits. By taking into account site soil conditions, slope of the stream valley and floodplain, the size and sensitivity of the stream and the adjacent land use, etc., riparian buffer plantings can be designed to meet a variety of watershed restoration and management objectives.

There are multiple resources available for planning riparian forest buffers and deciding which plants to use (Maryland Cooperative Extension Service 1997; Tjaden and Weber 1997). One low cost option for creating a streamside buffer in an area that is regularly mowed, is to simply arrange for the area to stop being mowed. If the site has a good mix of native species in the soil and young shoots are protected from wildlife browsing, a healthy forest may be allowed to naturally regenerate (See case study on page 32).

III. Upland Reforestation

Due to the generally increasing scarcity of upland open spaces in the Anacostia watershed, finding upland reforestation sites on both public and private land is difficult. The recommended approaches to upland reforestation in the Anacostia include: 1) identification of remaining upland reforestation sites through additional watershed land cover/land use and land ownership analyses, 2) prioritization of critical upland areas warranting reforestation, 3) education of landowners in upland areas regarding the benefits of reforestation on their property and the various resources and incentives that are available for reforestation (Appendix C), and 4) creating additional public/private partnerships for the implementation of reforestation projects.

IV. Urban Reforestation

Volunteers participate in an urban tree planting. Anacostia Watershed Society

Planting street trees involves a different set of considerations from forest plantings. In urban areas, important site considerations include the location of utilities (e.g., both above ground powerlines and underground sewer and water lines). Newly planted trees should not be located directly under overhead powerlines, if possible, or they will require extensive pruning in their later years. The choice of which species to plant as street trees is also complicated. Trees planted directly next to the road should obviously by predisposed to grow in harmony with their surroundings (e.g., trees with low branching or wide branching habits would not be suitable, as they would have to be frequently pruned to prevent driving hazards). The size of the tree box, or area that the tree has to grow, should help to determine which species to plant in which locations, with smaller trees matched with the smaller tree boxes. A certified arborist should be consulted to ensure that the species planted is suitable for the planting site. The amount of road salt (sodium chloride) that a tree is likely to receive should also be considered, as sodium chloride can easily disfigure and kill sensitive species. Possible solutions include planting salt-tolerant species, raising the planting site, blocking the tree from the road with a barrier, or adjusting the grading of the planting site so that salt is leached away from the tree. Other characteristics of trees, like their average life expectancy and fruiting characteristics, should also be considered in planning urban reforestation projects.

While many municipalities plant monocultures along their streets, this approach to street tree planting is not recommended. Though monocultures may have a certain aesthetic appeal, they are unnatural and unsustainable. If trees of the same species were all planted in the same year, chances are that they will start to die around the same time, which would create a huge job for the public works department and leave the streets treeless until another planting is arranged. Obviously, a long-term approach to street tree planting is beneficial. A street planted with a mixture of trees is also visually appealing and will provide a variety of food and habitat for wildlife for many years.

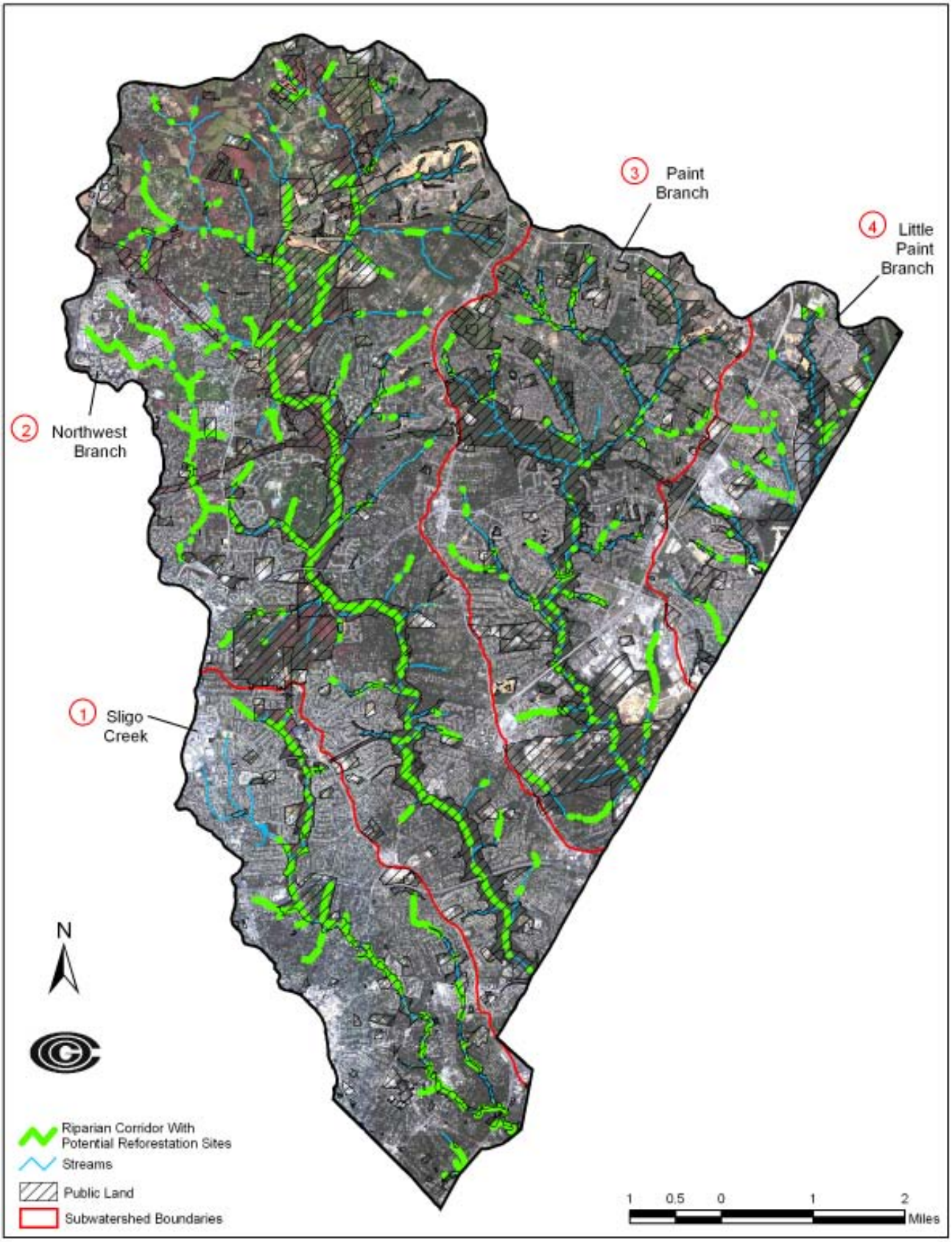
When planting trees in urban areas, it is important to take steps to ensure that the plants have the greatest chance of survival. By correctly installing a tree, with proper percolation, a good layer of mulch, and an adequately sized tree box, the tree's chances of survival are greatly increased. As the soil in urban areas is often of poor quality (e.g., very compacted or low in nutrients), the survival rate of trees could be greatly increased by improving the soil at urban reforestation sites before planting. Where possible, the long term health of street trees could be maintained by involving local residents and business owners in caring for their street trees by simply monitoring the health of the tree, watering the tree during droughts, and alerting the correct agency when the tree is in need of pruning.

Table 1. Summary of Average Costs of Reforestation Materials[1]

Reforestation Materials	Unit Price	# Needed	Price/Acre
Soil Compaction Tester	$215	1	$215.00
Auger	$1,700	1	$1,700.00
Weed Whacker	$400	1	$400.00
Shovels	$25	25	$625.00
Wheelbarrows	$75	2	$150.00
Plants			
Seedlings	$0.36	500	$180.00
	$0.25	1000	$250.00
Container Stock			
1 gal, 12-18" average	$5.25	400	$2,100.00
1 gal, 18-24" average	$6.50	400	$2,600.00
1-2 gal., 2-3' average	$7.40	400	$2,960.00
1-2 gal., 3-4' average	$9.00	400	$3,600.00
1-2 gal., 4-5' average	$10.80	400	$4,320.00
2 gal., 5-6' average	$13.10	400	$5,240.00
AVERAGE	$8.68	400	$3,470.00
Deer/Vole Repellents			
Repellex ML2 Systemic Tablets	$0.25	1200	$300.00
Repellex Liquid Concentrate	$32/quart	2	$64.00
Deer-Off Liquid Concentrate	$50/quart	2	$100.00
Mulch			
Hardwood Mulch	$25/yd^3	100	$2,500.00
Geotextile Fabric			
Lumite squares (4'x4')	$1	400	$400.00
Lumite squares (6'x6')	$2	400	$800.00
Compost	$10/yd^3	100	$1,000.00
Mulch Collar	$0.75	400	$300.00
Tree Shelters			
Wire Mesh (per 100'x48" roll of 1 in stainless steel mesh, 0.022 wire)	$300.00	11	$3,300.00
Galvinized Hardware Cloth (2 in. mesh, 0.041wire 100'x48" roll)	$72.00	11	$792.00
Tubex Tree Shelter (48")[2]	$2.75	400	$1,100.00
Tubex Tree Shelter (60")[2]	$2.95	400	$1,180.00
Blue-X Tree Shelters (48")[2]	$1.25	400	$500.00
Stakes			
White Oak Stakes (47")	1.25	400	$500.00
White Oak Stakes (58")	1.45	400	$580.00
Deer Fencing			
Standard 1320 ft. Electric Fencing Kit (solar powered)	$0.35/ft.	836	$292.60
Benner's Polypropylene Fencing (materials + professional installation)	$9/ft.	836	$7,524.00
Fickle Hill Polypropylene Fencing (7.5 ft. high; bulk discount of 10%)	$1.13/ft.	836	$944.68
Fence Stakes - 10ft x 1/2" rebar	1.7	55	$93.50
Metal Orchard Fence	$0.58/ft.	836	$484.88
8 ft steel t-posts	$3.61	84	$303.24

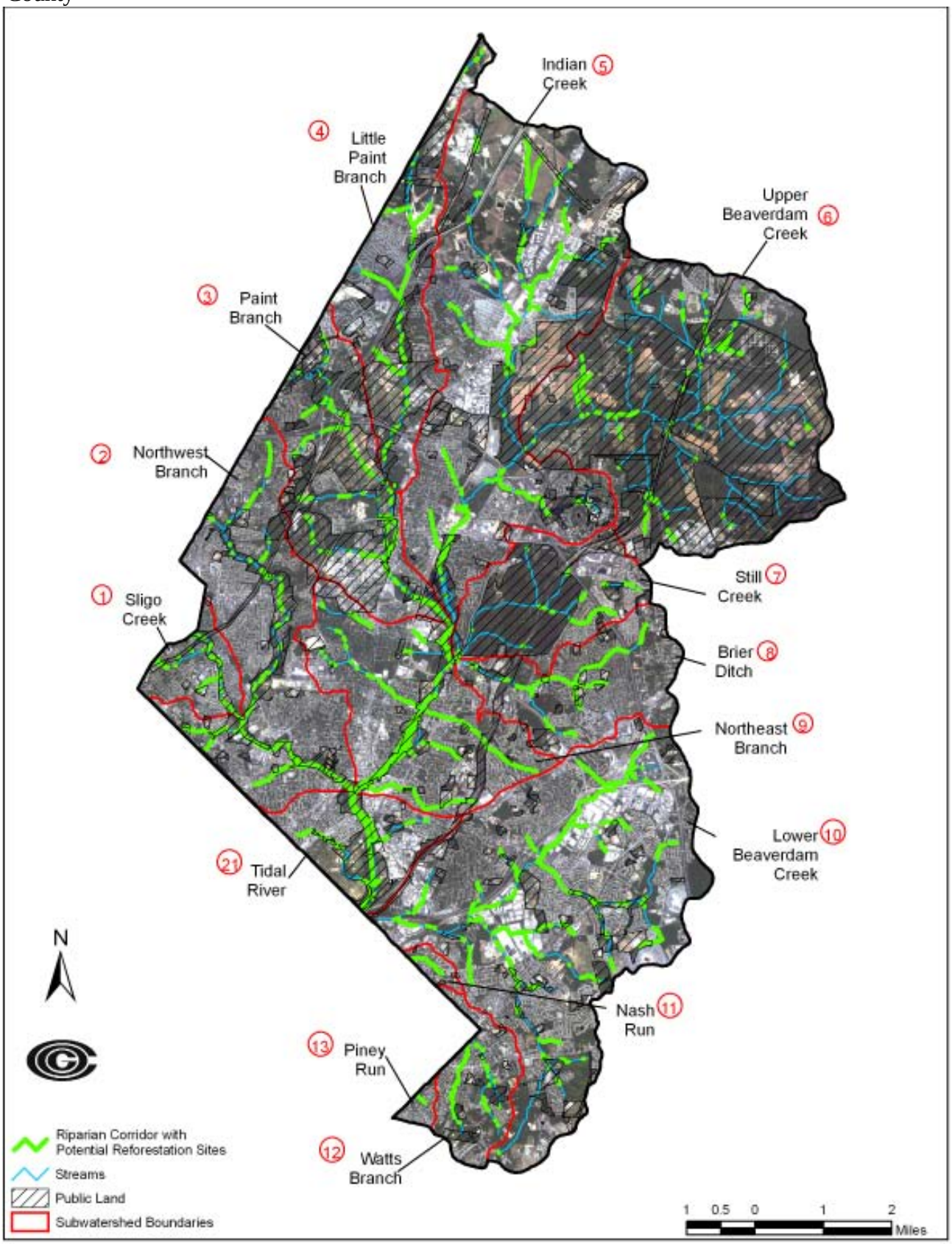
[1]Acre cost is calculated based on a recommended stocking level of 400 trees/acre.
[2] Not recommended by ARPW.

Figure 1. Anacostia Watershed 2000: Potential Riparian Reforestation Areas in Montgomery County[1]



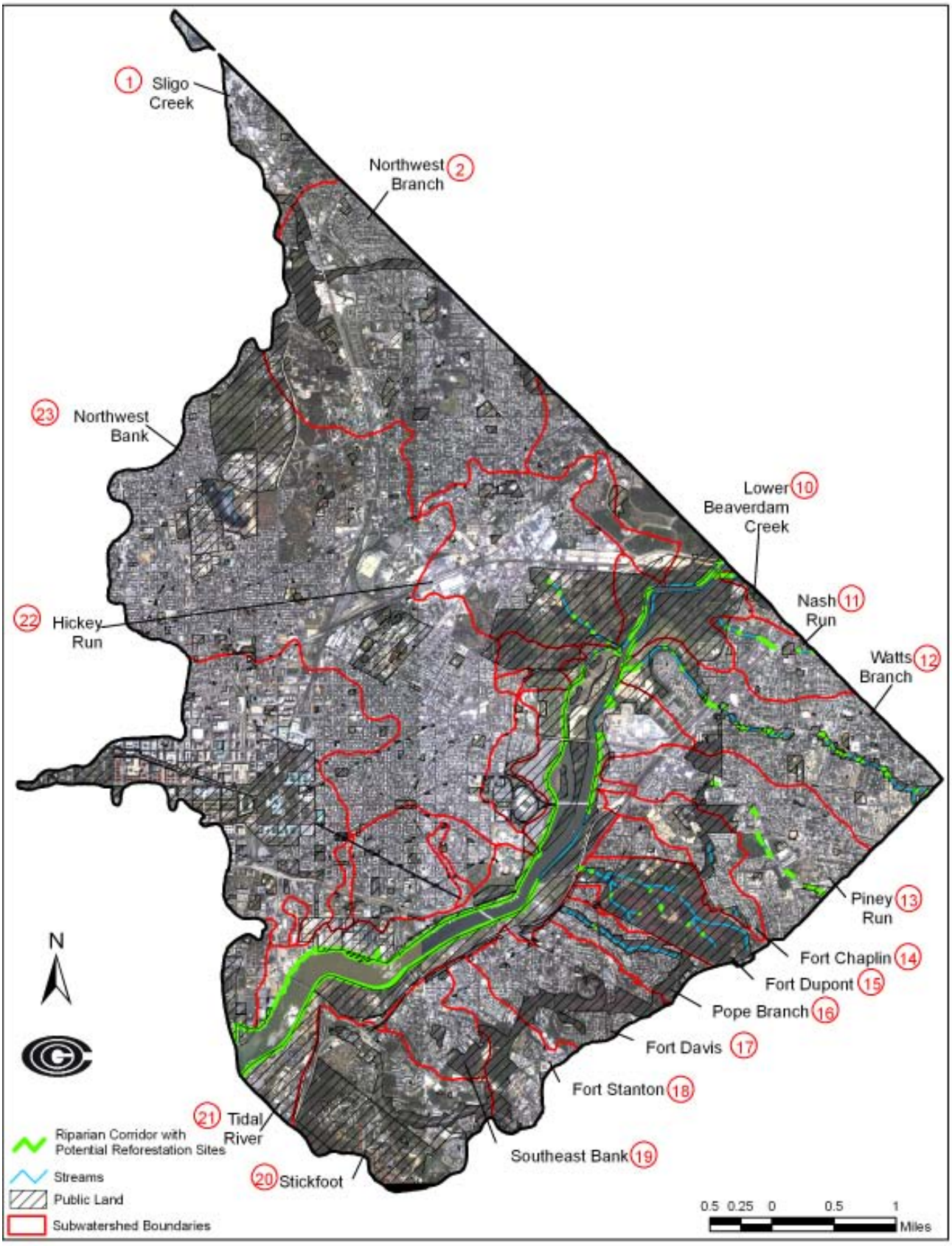
[1] Please note that existing development, infrastructure such as roads, park facilities, etc., or land features, may preclude the reforestation of some of the highlighted potential reforestation areas. In addition, it is also recognized that these areas will need to be groundtruthed and that actual reforestation of these sites is incumbent upon approval of the landowner.

Figure 2. Anacostia Watershed 2000: Potential Riparian Reforestation Areas in Prince George's County[1]



[1] Please note that existing development, infrastructure such as roads, park facilities, etc., or land features, may preclude the reforestation of some of the highlighted potential reforestation areas. In addition, it is also recognized that these areas will need to be groundtruthed and that actual reforestation of these sites is incumbent upon approval of the landowner.

Figure 3. Anacostia Watershed 2000: Potential Riparian Reforestation Areas in the District of Columbia[1]



[1] Please note that existing development, infrastructure such as roads, park facilities, etc., or land features, may preclude the reforestation of some of the highlighted potential reforestation areas. In addition, it is also recognized that these areas will need to be groundtruthed and that actual reforestation of these sites is incumbent upon approval of the landowner.

Exotic Invasive Plant Management Options

The edge of an Anacostia forest covered with exotic invasive species.

Exotic invasive plants are generally defined as nonnative plants which quickly invade, out-compete and generally replace more desirable native species and their associated plant communities. Often these plants are unintended escapees from nearby landscaped urban areas, where seeds and other plant propagules are easily dispersed (by both humans and wildlife) within public and private open space located along stream corridors.

Most exotic invasive species are abundant seed producers and often spread through the dispersal of seeds by birds and other wildlife, the rapid growth of runners or rhizomes, the distribution of upstream seeds to downstream sites along waterways, the transport of seeds by automobiles or through landscape plants "escaping" onto adjacent properties. Eradication is difficult due to the persistence of exotic species in the soil seed banks of infested sites. Due to their wide spread and fast growth, competition from exotic invasive plants is one of the leading factors in reduced growth rates of newly planted trees (Pannill *et al.* 2001). The spread of exotic invasive plants disrupts not only newly reforested areas, but established forest ecosystems as well. In many areas the removal of exotic invasive species is critical to the maintenance of the biodiversity of forests.

I. Identify problem

One of the first steps in developing a exotic invasive plant management strategy is to identify where these nonnative invasive plants occur and to determine the level of invasive plant coverage. Concerned by the spread of exotic invasive plants within the Anacostia River's riparian corridor system and their growing threat to the long-term survivability of both state and locally funded riparian reforestation projects, MD DNR contracted COG in September 2003 to develop a quick and simple method for quantifying and ranking their problem level in the Anacostia tributary system. In response, COG has developed and is field testing a pilot exotic invasive plant survey methodology in the Sligo Creek subwatershed. If the methodology proves successful and a subsequent watershed-wide database is developed, it is anticipated that COG and MD DNR (working in partnership with the AWRC's Anacostia Restoration Potential Workgroup) will next begin working with the various watershed riparian landowners and resource management agencies to develop, prioritize and implement associated management actions and programs.

COG's Exotic Invasive Plant Surveying Methodology and Indexing System involves surveying the degree of exotic invasive plant coverage in 100-200 ft. wide stream buffers along 500 ft. stream

Some of the top invasive species in the Anacostia include (from left to right) Garlic Mustard, Multiflora Rose, Oriental Bittersweet, and Climbing Euonymus.

COG staff sets up an invasive species survey plot.

reaches. Along each stream reach, the total percentage of exotic invasive plant coverage is ranked using a verbal ranking system and the exotic invasive plant coverage of five $1m^2$ subplots within four $20m^2$ is estimated to the nearest 10 percent on each side of the stream.

The proposed second phase of this Exotic Invasive Plant Surveying Methodology and Indexing System is to develop 10-15 permanent monitoring test plots along the Anacostia River tributary system. The purpose of these plots is to provide some ability to gauge the types and areal extent of exotic invasive plants present (and temporal variations) in each of the major tributaries within the Maryland-portion of the Anacostia. Proposed survey sites will afford relatively easy foot access and will be representative of riparian conditions present. Over the long-term, data from these monitoring plots should provide more quantifiable information on the type and extent of exotic invasive plants in the tributary system. In addition, reference streams known to have low levels based on recent COG RSAT stream surveys (i.e., riparian areas having low densities of exotic invasive plants and low development levels within their drainage areas) have been identified. They will be surveyed as part of a proposed future Phase II study, to provide an additional baseline as to the percentage of exotic invasive plants to be expected along natural and relatively unimpaired stream corridors.

With the information from a exotic invasive plant survey, the threats that are posed by nonnative plants in different areas can be assessed and decisions can be made about whether or not to take action. The presence of exotic invasive plants alone does not usually justify taking action. Controlling the spread of these nonnative plants is costly and a variety of factors should be considered before deciding on a management plan. Land managers should consider the conservation value of the site and the species it supports, the threat to rare and/or natural communities and the potential damage to ecosystem processes or cultural resources. The significance of the impact of exotic invasive species on a site and the feasibility of controlling them should be weighed before developing a management strategy (Heffernan 1998). By taking the time to thoroughly assess the threat that exotic invasive species pose in various areas, a control and management plan can be created that efficiently focuses resources on priority areas of concern.

II. Management Options

The management options for dealing with exotic invasive plants are extensive and varied, ranging from prevention to control methods like chemical spraying, mechanical removal and biological control.

A. Prevention

The most effective and least expensive method of managing invasive species is to prevent them from colonizing new sites and becoming established. Though this may seem to be a daunting task, by simply not planting nonnative species and reducing soil disturbance the chances of exotic invasive species becoming established in an area is reduced. The construction of trails and roads involves a great deal of soil disturbance and exotic invasive species often get established in natural areas around roads and trail heads (Heffernan 1998). By following best management practices during the construction process to reduce soil disturbance, this method of invasion may be reduced. When natural or human-induced disturbances result in large areas of unvegetated soil, it its important to quickly

revegetated those areas with native species to preempt the infestation of the area by exotic invasive plants.

B. Mechanical Control

The mechanical control of exotic invasive species includes hand-pulling, using hand and power tools to cut, remove or girdle plants, mowing and rototilling. In all mechanical control efforts it is important to remove as much of the root system as possible and to act before the plant sets seed. It is also critical that discarded plant material cannot regenerate and that any soil disturbance caused by the mechanical control method be repaired and perhaps covered with mulch. Due to the length that the seeds of many exotic invasive plants remain in the soil seed bank and the potential for the regeneration of plants, mechanical control methods are most effective if they are applied annually for up to six years.

C. Chemical Control

The use of chemical herbicides to control exotic invasive plants requires more planning than mechanical methods to safely and effectively manage the spread of nonnative plants. However, with the proper preparation, herbicides can offer a cost-efficient and effective way to control exotic invasive plants in problem areas.

It is extremely important to evaluate the conservation goals for each site and the overall effect of herbicide use on those goals before using chemical methods to control exotic invasive species. Before using chemical control methods it should be determined that herbicides will cause more good than harm and that they will not endanger the applicators or others in the area.

In order to apply herbicides in both Maryland and the District of Columbia, organizations must be licensed pesticide operators, must have at least one employee that is a certified pesticide applicator and must have the proper insurance. All employees that use pesticides must attend training courses in the principles of pest control and the proper way to handle, apply and properly dispose of pesticides. In both jurisdictions there are fees associated with each of the required licenses, though the fee is waived for public agencies. Private landowners do not need any certification to apply general use pesticides purchased "over-the-counter" on their own property.

Case Study:

Spraying Lesser Celandine in Rock Creek Park

A dense patch of lesser celandine.

The effectiveness of the controlled spraying of herbicides to limit the spread of lesser celandine (*Ranunculs ficaria*) was examined during a study from 2000 to 2003 by NPS Rock Creek Park and the USGS Patuxent Wildlife Research Center. Two 20 acre floodplain areas with dense concentrations of lesser celandine in lower Rock Creek Park in D.C. were selected as study areas. The study examined the response of Lesser Celandine populations to treatment with 2 different concentrations of the Rodeo formulation of glyphosate (1.5% and 0.75%) and to treatment at different times of the year. The importance of annual retreatment was also evaluated.

The results of this study show that treatment with a 1.5% Rodeo concentration is more effective than lower concentrations at reducing the ability of lesser celandine to recover after spraying. The study's authors suggest a two year treatment with the 1.5% Rodeo concentration to further reduce population levels. March was found to be the most effective time to spray.

Due to the low price of Rodeo (one gallon costs $100 or less and can treat an acre), the main costs of controlled spraying are in personnel time. Therefore the management objectives for different areas (e.g., eradication, or suppression) in order to determine the best treatment schedule.

There are many herbicides on the market today and it is extremely important to understand the herbicide's effectiveness against the target species, mechanisms of dissipation, behavior in the environment, toxicity to nontarget organisms, human toxicology, application and safety considerations (Tu *et al*. 2001). Herbicides containing glyphosate are preferred for control of grasses and herbaceous plants, as glyphosate is relatively nontoxic, breaks down quickly and is safe to use near aquatic areas. Triclopyr based herbicides are preferred for the control of woody species (Palone and Todd 1997).

There are a variety of techniques for applying herbicides. Foliar spraying is the application of an herbicide to the leaves of plants. While foliar spraying is an easy way to apply herbicides to a heavily infested area, there are possible risks to native species and it should not be carried out in windy conditions. Wick application involves using a cloth wick or sponge to apply herbicide to leaves or cut stumps and is more accurate and less wasteful than spraying. Herbicides can also be applied to the basal bark of small or young woody species with thin bark in a 6-12 inch band around the base of the trunk. The cut-surface application method involves cutting down a tree or shrub and applying herbicide immediately to the sapwood. Frilling, or the hack-and-squirt method, is similar to cut-surface application, but involves making cuts around the trunk of a tree with a chainsaw, axe or machete and then immediately applying herbicide to the cuts (Heffernan 1998).

It is important when applying herbicides near water (i.e. streams, wetlands, ponds, etc.) that appropriate products are used at the correct concentrations and with suitable application methods, so as to reduce the possibility of their movement into waterbodies. Herbicides that are highly mobile (e.g., Hexazinone or Picloram) or more toxic (e.g., Atrazine, Fluazifop) should never be used in riparian areas. The only herbicide that can be used directly in aquatic areas is the Rodeo formulation of glyphosate, as it does not contain any surfactants (Palone and Todd 1997).

D. Herbivore Control

Grazing animals, such as goats, sheep, horses and cows can, and are, being used to control the spread of exotic invasive plants (Tu *et al.* 2001). Studies have shown that grazing animals, like cows and goats, can be taught to eat nonnative invasive plants and to leave desirable species alone (Provezna 2003). A study in the southern Appalachians showed that grazing by goats is a cost effective method to reclaim areas infested by invasive plants and to control multiflora rose (Luginbuhl *et al.* 1997). The predominately urban landscape of the Anacostia watershed may make an invasive plant management program involving goats or other grazing animals more difficult than in areas with more agricultural land uses, but the promise of a low-cost, environmentally friendly and targeted method for nonnative species control merits investigation into the possibilities.

A goat eating kudzu.

E. Biological Control

The biological control of nonnative plants involves reconnecting exotic invasive plants with the specialized natural enemies that limit their densities in their native range (Van Driesche *et al.* 2002). The development of biological control agents is a lengthy process and testing of control agents is still ongoing for many of the main exotic invasive species present in Anacostia forests. There are serious concerns about the effects of released biological control agents on nontarget species and ecosystem processes (Heffernan 1998). A thorough examination of the costs and benefits of using biological control agents is necessary before biological control could be a recommended management option in the Anacostia watershed.

Table 1. Maryland Department of Natural Resources List of Non-Native Plant Species in Maryland that Threaten Native Species and Native Habitats[1]

Common Name	Scientific Name	[2]	Serious Threat[3]
Herbaceous Aquatic			
Brazilian Elodea	*Elodea densa*		
Common Reed	*Phragmites australis (P. communis)*	X	X
Curly Leaved Pondweed	*Potamogeton crispus*		
Eurasian Milfoil	*Myiophyllum spicatum*		
European Yellow Iris, Water Flag	*Iris pseudacorus*		
Giant Salvinia	*Salvinia molesta*	X	
Hydrilla	*Hydrilla verticillata*	X	X
Marine Macroalgae	*Caulerpa taxifolia*	X	
Parrot Feather	*Myriophyllum brasiliense*	X	
Water Chestnut	*Trapa natans*	X	X
Water Hyacinth	*Eichhornia azurea crassipes*	X	
Herbaceous Terrestrial			
An arum, resembles Green Dragon	*Pinellia ternata*		
Barren Brome Grass	*Bromus sterilis*		
Beefsteak Mint	*Perilla frutescens*		
Bull Thistle	*Cirsium vulgare*	X	
Canada Thistle	*Cirsium arvense*	X	X
Common Daylily	*Hemerocallis fulva*		
Creeping Bugleweed	*Ajuga reptans*		
Creeping Lilyturf	*Liriope spicata*		
Crown-vetch	*Coronilla varia*		
Eulalia, an ornamental grass	*Miscanthus sinensis*		
Giant Chickweed	*Myosoton aquaticum (Stellaria aquatica)*		
Giant Hogweed	*Heracleum mantegazzianum*		
Giant Knotweed	*Polygonum sachalinense*		
Garlic Mustard	*Alliaria petiolata (A. officinalis)*		X
Gill-over-the-ground, Ground Ivy	*Glechoma hederacea*		
a grass	*Arthraxon hispidus*		
Henbit	*Lamium amplexicaule*		
Indian Strawberry	*Duchesnea indica*		
Japanese Hops	*Humulus japonicus*		
Japanese Knotweed	*Polygonum cuspidatum*		X
Japanese Stiltgrass	*Microstegium vimineum (Eulalia viminea)*		X
Johnsongrass	*Sorghum halepense*	X	X
Lesser Celandine	*Ranunculus ficaria*		X
Long-bracted Beggar-ticks	*Bidens polylepis*		X
Moneywort	*Lysimachia nummularia*		
Mugwort	*Artemisia vulgaris*		
Musk Thistle	*Carduus nutans*	X	
Nodding Star of Bethlehem	*Ornithogalum umbellatum*		
Plumeless Thistle	*Carduus acanthoides*	X	
Purple Dead Nettle	*Lamium purpureum*		
Purple Loosestrife	*Lythrum salicaria*		X
Reed Canary Grass	*Phalaris arundinacea*		X
Sericea Lespedeza	*Lespedeza cuneata*		X
Shattercane	*Sorghum bicolor*	X	X
Spotted Knapweed	*Centaurea maculosa*		

[1]Refer to http://www.mdinvasivesp.org/invasive_species_md.html for information on identifying these plants.
[2]Regulated by state or federal law
[3]These species are considered a "Most Serious Threat to Natural Areas" because they are both damaging and strongly invasive.

Table 1. Maryland Department of Natural Resources List of Non-Native Plant Species, Cont'd.[1]

Common Name	Scientific Name	[2]	Serious Threat[3]
Star of Bethlehem	*Ornithogalum nutans*		
Tall Fescue, K31 Fescue	*Festuca elatior (F. arundinacea)*		
Teasel	*Dipsacus sylvestris*		
Wild Garlic	*Allium vineale*	X	
Vines			
Cinnamon Vine	*Dioscorea oppositifolia (D. batatas)*		X
Climbing Euonymus, Wintercreeper	*Euonymus fortunei*		
English Ivy	*Hedera helix*		X
Japanese Honeysuckle	*Lonicera japonica*		X
Kudzu	*Pueraria lobata*	X	X
Matrimony Vine	*Solanum dulcamara*		
Mile-a-minute	*Polygonum perfoliatum*		X
Oriental Bittersweet	*Celastrus orbiculatus*		X
Periwinkle	*Vinca minor*		
Porcelainberry	*Ampelopsis brevipedunculata*		X
Wisteria	*Wisteria floribunda, W. sinensis*		
Yam-leaved Clematis	*Clematis terniflora (C. dioscoreifolia)*		X
Shrubs			
Amur Honeysuckle	*Lonicera maackii*		
Autumn Olive	*Elaeagnus umbellata*		
Bamboo - running varieties	*Phyllostachys spp., Pseudosasa japonica*		X
Belle Honeysuckle	*Lonicera x bella*		X
Bush Honeysuckles	including *Lonicera spp.*		X
Common Buckthorn	*Rhamnus cathartica*		
Coralberry	*Symphoricarpos orbiculatus*		
European Buckthorn	*Rhamnus frangula*		
Japanese Barberry	*Berberis thunbergii*		
Japanese Spiraea	*Spiraea japonica*		X
Morrow's Honeysuckle	*Lonicera morrowii*		
Multiflora Rose	*Rosa multiflora*		X
Privet	*Ligustrum spp.*		
Russian Olive	*Elaeagnus angustifolium*		
Strawberry-raspberry, Balloonberry	*Rubus illecebrosus*		
Tartarian Honeysuckle	*Lonicera tatarica*		
Wineberry	*Rubus phoenicolasius*		
Winged Euonymus, Winged Wahoo	*Euonymus alatus*		
Trees			
Catalpa	*Catalpa spp.*		
Empress Tree	*Paulownia tomentosa*		
Norway Maple	*Acer platanoides*		X
Sweet Cherry, Bird Cherry	*Prunus avium*		
Tree of Heaven	*Ailanthus altissima*		X
White Mulberry	*Morus alba*		
White Poplar	*Populus alba*		
White Spruce	*Picea glauca*		

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