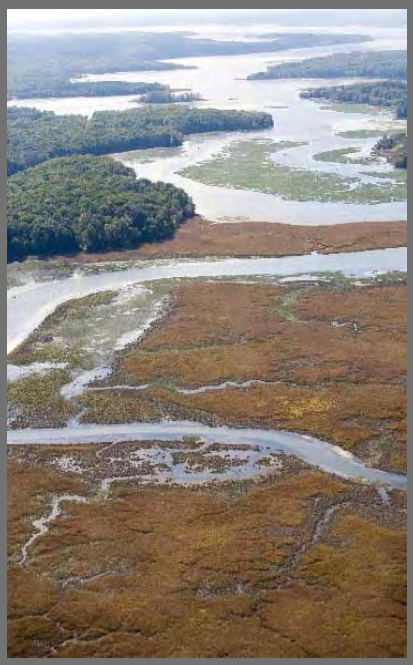
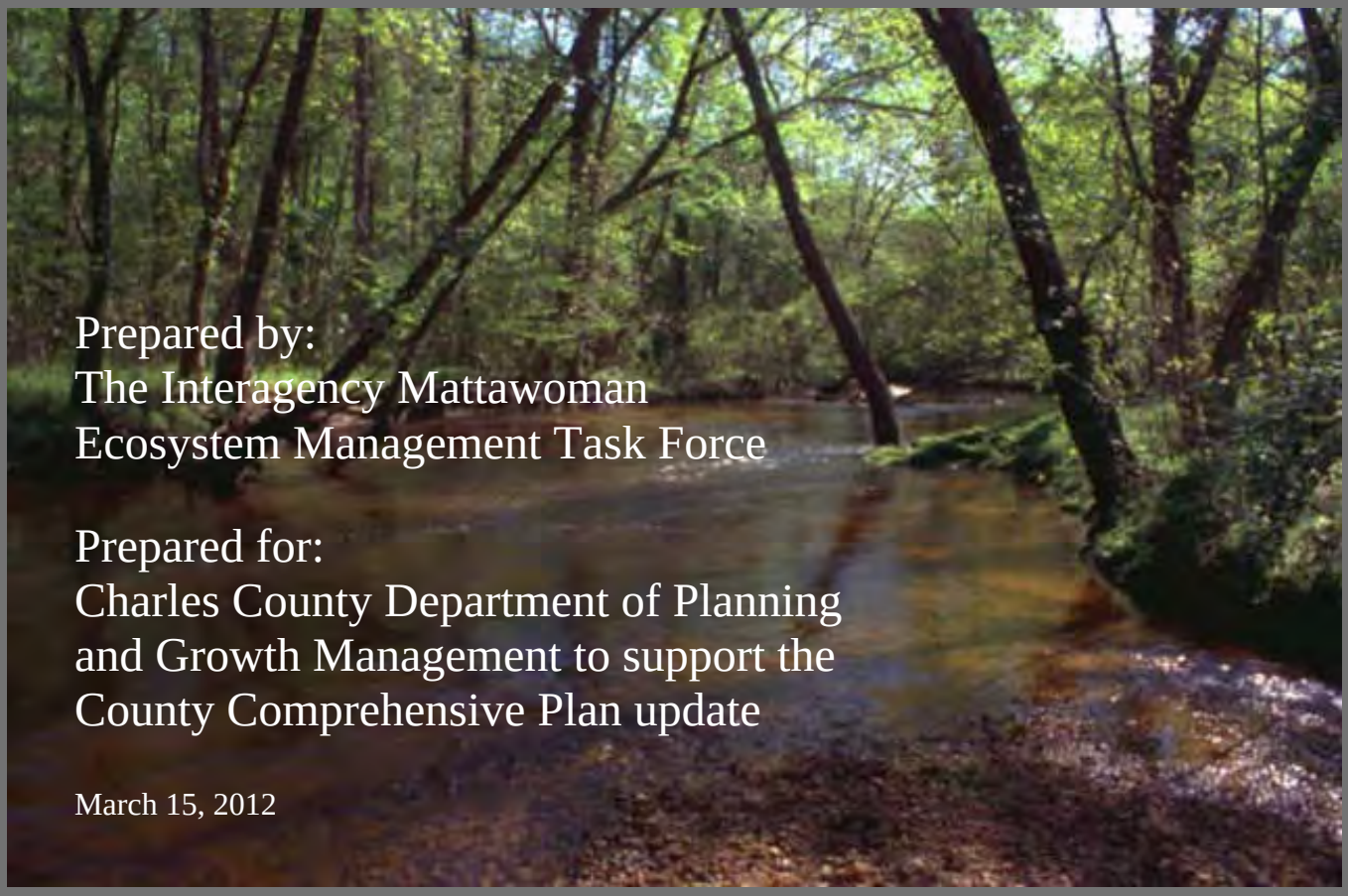
The Case for Protection of the Watershed Resources of Mattawoman Creek



Recommendations and Management Initiatives to Protect the Mattawoman Ecosystem



Prepared by:
The Interagency Mattawoman Ecosystem Management Task Force

Prepared for:
Charles County Department of Planning and Growth Management to support the County Comprehensive Plan update

March 15, 2012

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor
John R. Griffin, Secretary
Joseph P. Gill, Deputy Secretary

March 15, 2012

Mr. Steven Ball
Planning Director
Department of Planning & Growth Management
Charles County Government
200 Baltimore Street
La Plata, MD 20646

Re: Transmittal of Report: *The Case for Protection of the Watershed Resources of Mattawoman Creek: Recommendations and Management Initiatives to Protect the Mattawoman Ecosystem*.

Dear Mr. Steven Ball:

The Mattawoman Ecosystem Management Interagency Task Force is pleased to have had the opportunity to provide recommendations concerning the protection and conservation of resources in the Mattawoman Creek Watershed to guide the County's work in updating the Charles County Comprehensive Plan. Attached, please find a copy of the final product of our work.

The Land Use recommendations for the watershed remain largely the same as those sent you a few months ago. Remaining elements of the report are intended to support future County planning and watershed protection and restoration efforts for each of the topics in the document. We trust that many of the recommendations will be useful beyond guiding the Comprehensive Plan update. In order to ensure a vital future for the Mattawoman, it will be essential to coordinate protection, restoration and management practices. Charles County is encouraged to engage representatives from this Task Force in an ongoing effort to develop and implement a resource protection and restoration plan for the Mattawoman Creek Watershed.

All of us engaged in this effort wish you every success with your continuing work on the County Comprehensive Plan and hope you find many of the recommendations in this report provide value and are supportive of County planning program initiatives.

On behalf of the Mattawoman Ecosystem Management Interagency Task Force,

Tony Redman, AICP	James H. Uphoff, Jr.	Christine Conn, Ph.D.
Environmental Review Unit	Fisheries Service	Office for a Sustainable Future

Targeted Watershed Ecosystem Management Initiative
A Maryland DNR Pilot Program

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The Case for Protection of the Watershed Resources of Mattawoman Creek

Mattawoman Creek supports a diverse, high quality aquatic ecosystem. Non-tidal reaches of the stream system still support regions of excellent water quality and biodiversity, including one MBSS Sentinel Site, a Tier II waters tributary, and stronghold watersheds. Mattawoman Creek is the 8th ranked watershed for freshwater stream biodiversity (of 137 watersheds in Maryland) and is home to six stream species that are referenced within the Rare, Threatened, and Endangered animals of Maryland. Many reaches of the stream system are still bordered by exceptionally large forest tracts. The estuarine portions of the creek can be described as what a restored Chesapeake Bay would look like. There are extensive SAV beds, anadromous fish migrate here to spawn in significant numbers, various native resident fish species thrive, and its fisheries are productive. It is one of the most important habitats and nursery areas of the Potomac River for largemouth bass and this fishery is one of America's best, attracting high-profile tournaments and anglers from all over the country. The estuary has one of only three stations in Maryland's portion of Chesapeake Bay with improving water clarity. Mattawoman Creek was characterized in the early 1990s as "near to the ideal conditions as can be found in the northern Chesapeake Bay, perhaps unattainable in the other systems, and should be protected from overdevelopment." (Carmichael et al. 1992).

The Mattawoman Creek Watershed has been the focus of inquiry, study and concern by a range of state and federal resource agencies. Mattawoman Creek and tributaries are clearly among the State's highest conservation priorities for estuarine systems. However, possible signs of stress associated with human development have appeared. Loss of stream spawning sites with anadromous fish has been detected, perhaps signaling deterioration of stream habitat. Declining, but still good dissolved oxygen in the estuary may be an early warning of deterioration there.

Fisheries Service monitoring indicates that Mattawoman Creek's fish habitat has declined as impervious surface has increased beyond a threshold level (Uphoff et al. 2010). Impervious surface is a quantifiable land-use metric that correlates well with the impacts of polluted runoff and altered hydrographs from development (Arnold and Gibbons 1996, National Research Council 2009); declines in fish habitat and the fish community were concurrent with exceeding a 10% impervious surface threshold in the watershed. Projected growth in the Mattawoman Creek watershed at build-out will result in impervious surface that will be, at best, equal to that of Piscataway Creek (at present, approximately 16-17 % impervious), and is likely to be higher (22% impervious surface; USACOE 2003; Beall 2008). Anadromous fish spawning in Piscataway Creek, widespread in the early 1970s at a level of development similar to Mattawoman Creek's watershed now, has nearly ceased. Stream spawning will disappear from Mattawoman Creek at projected levels of development. Conductivity, an indicator of pollution from inorganic salts, acids, and bases, has become elevated beyond historic readings in non-tidal Mattawoman Creek and indicates that urbanization has affected water quality. The tidal fish community of Mattawoman Creek has declined markedly since the late 1990s-early 2000s.

Designation of most of the watershed in either the County Development Service District or Deferred Development Service District to accommodate future growth virtually assures watershed deterioration over time. Although targeting development and protection of watershed resources are not mutually exclusive concepts when applied to the same land area of the County, these objectives can easily work at cross purposes.

The cumulative impacts of development in watersheds over time are quite well documented. Impacts include loss of and fragmentation of forest cover, habitat and refuge for wildlife together with substantial increases in impervious surface which, in turn, lead to deterioration of creek and stream system water quality and loss of wildlife habitat. Such losses cannot simply be offset by application of best management practices in stormwater management and sediment and erosion control or any number of measures to mitigate the impacts of development. Mitigation can reduce the degree of damage, but the limits of technology will nevertheless result in sustained adverse impacts to the watershed. Stream system health indicators decline when impervious surface within watersheds exceeds 10 percent and severe impacts and degradation can be expected when impervious surface exceeds 25 percent (Allen and Weber, 2007). Guidelines developed by the Maryland Department of Natural Resource (Section 1: Recommended Land Use and Growth Management Initiatives, page 19) caution that in certain highly sensitive watersheds, impacts to aquatic biodiversity can occur at impervious surfaces as low as 2 percent, and that impacts to biodiversity and fisheries are apparent between 5 and 10 percent impervious surface. Tom Schueler, former Executive Director of the Center for Watershed Protection notes that "At 10% imperviousness in its watershed, a stream is considered at risk" http://www.waterlaws.com/commentary/interviews/schueler_interview.html). He goes on to say "If the impervious level is well over this threshold, you have a variety of management strategies available, but realistically you will not be able to restore a stream completely".

Executive Summary

The future of the Mattawoman Watershed is at a turning point. As presently planned, the Development District will irreversibly alter the ability of Charles County citizens and tourists to have access to clean water, high quality fisheries, and a great outdoor experience, unless specific steps are taken to bring regulation and land-use policies in line with the stated county vision of protecting the Mattawoman. The report outlines the scientific basis for concluding that the current designation of most of the watershed as a Development District, including the Deferred Development District, virtually assures continuing and dramatic watershed ecosystem deterioration. A premise of the report is that technical advice on changes in current land-use policies are sought for the ongoing Comprehensive Plan revision. Given that the impervious cover in the watershed is presently at the tipping point, the rate of forest loss, and the recently detected decline in health of the fish community in the estuary, the current update of the Comprehensive Plan may well represent the last opportunity the County will have to establish permanent protection of the Mattawoman's resources and ecological functions. The goal of this report is to provide the County with the necessary resources to grow smartly and to ensure a strong portfolio of natural resources and economic opportunity into the future.

This report was initiated by the Maryland Department of Natural Resources (MDNR) following conversation with the staff of the Charles County Department of Planning and Growth Management. County staff representatives were invited to participate in the development of this report. However, rather than engaging directly with this process, the County encouraged MDNR to independently develop recommendations, within the agency and in collaboration with other state and federal agency partners concerned about the fate of the Mattawoman Creek Watershed. MDNR led the process to coordinate analysis and review among other interested resource agencies and MDNR staff with the intent that a compiled set of reports would be submitted to the County within a timeframe that could inform the comprehensive planning process and subsequent watershed management protection and restoration planning.

Much of the Mattawoman today remains undeveloped. Therefore, unlike watersheds in more urban or urbanizing locations, opportunities continue to remain available, to prevent, rather than retroactively mitigate impacts associated with growth in impervious surfaces as a result of over-development of the watershed. Creating a plan of action to maintain impervious surface area below recommended thresholds and to proactively protect existing high quality natural resources will also save the County money in infrastructure upgrades, mitigation, and TMDL compliance in the future.

This report evaluates likely changes in the watershed that can be expected given the current County land use management and regulatory framework (zoning). It then compares the direction in which the County is heading given current regulation with the County Planning Policy. Findings illustrate County policy and regulation may work at cross purposes. More specifically, County intentions, as expressed in documented planning objectives and policies, are not supported by the regulations that are designed, or would be necessary, to achieve them.

A number of reforms to the current County regulatory framework are proposed for consideration by the County. These measures include changes to the Zoning Structure, restructure of the County's transferable development rights (TDR) program to achieve resource protection objectives and other reforms to direct planned development away from the sensitive resources of the

Mattawoman and to reduce the degree of forest fragmentation, growth in impervious surface area, and impacts to water quality, fish and wildlife habitats over time. The recommendations are designed **to mesh with the County Comprehensive Plan revision** in such a way as to permit the Mattawoman to remain a unique resource that continues to support the County's ecotourism economy and remain a key component of the County's identity, heritage, and landscape in future years.

Elements of this report

In addition to recommended land use reforms, this report contains a number of additional elements to evaluate the range of ecosystem resources present in the Mattawoman and to provide recommendations for topic areas likely to influence future ecosystem components. The full report includes the elements listed below. Each element is presented as a stand alone report and represents the specific products and recommendations of the indicated authors. Each report element is also accompanied with its own specific appendices and bibliographies. Recommendations relevant to each element are summarized in Addendum 1 to allow ready access:

1. Land Use and Growth Management: Provides an overview of past, present and future land use and growth effects on Mattawoman resources.
2. Fisheries Resources: Presents the relationship between growth and development and the health of Mattawoman Creek's fish and fisheries.
3. Non-tidal Streams: Evaluates the current stream health condition of the watersheds stream systems and aquatic biodiversity.
4. Wetlands, Coastal Resources and Coastal Climate Change: Focuses on the condition and extent of wetland and coastal resources. Climate change issues specific to the coastal zone, including sea-level rise, coastal habitat adaptation and shoreline erosion are also evaluated.
5. Forest Resources: Discusses the extent, quality and water quality protection value of forest resources within the watershed.
6. Wildlife and Rare Species Habitats: Identifies the unique wildlife and rare species habitats found within the watershed.
7. Water Resources Management for a Future Climate: Provides guidance on how water resource management efforts should be modified in response to changes in precipitation and temperature resulting from climate change.
8. Stormwater Management: Offers guidance on implementing stormwater management practices for both retrofits and new development.

Why this effort was launched

It is clear that the greatest threat to Maryland's natural resources and the critical ecosystem support functions they provide is land use change to development. It is also equally clear that the authority to control land use lies with local government. The Maryland Department of Natural Resources initiated this effort as a pilot project to develop a proactive collaborative approach with the County to strategically target and coordinate multiple state and federal agency assistance, information and resources to protect the most ecologically valuable resources threatened by development under the spirit that "an ounce of prevention is worth a pound of cure".

Certain criteria related to resource value, degree of threat and likelihood of success needed to be satisfied before DNR management would commit to leading this effort. The Mattawoman Creek watershed met those criteria in the following manner. The aquatic and terrestrial resources within the watershed rank as high quality from a statewide perspective. Anticipated development within the watershed is so high that, if fully executed, would irreparably damage the resources. Most importantly, the likelihood of success was favorable in that Charles County staff was willing to enter into a partnership with this agency and consider the agency's recommendations in their comprehensive planning process.

The project was launched by assembling the Mattawoman Ecosystem Management Task Force (a cross-agency science and support team) to develop customized products to achieve mutually defined objectives for resource sustainability in the Mattawoman Creek watershed. At the onset, it became apparent that multiple resource agencies at federal and state levels were interested in participating in an interagency effort to provide a comprehensive and integrated set of land use, growth management and resource management assessments and implementation recommendations. A series of nine taskforces were created, addressing the eight elements defined above and an additional data management and analysis taskforce which included members from the Watershed Resources Registry project. These groups met over a three month period to assemble the various reports and recommendations assembled in this report. Workgroup contributors are identified within each report section.

Building on existing efforts through State and Federal initiatives, the Watershed Resources Registry (WRR) tool, and model programs from Maryland Counties

The County is encouraged to build upon the work performed by many resource agencies including the US Fish and Wildlife Service, the US Army Corps of Engineers, and the Maryland Departments of Natural Resources, Environment and Planning. Numerous studies, planning documents and resource assessment and prioritization tools have been developed that can be used to advance the sustainable management of Mattawoman Creek natural resources. References to these technical resources are cited through the report.

Within the past two years, a significant amount of interagency effort and coordination among a consortium of federal, state and local governments has already laid the groundwork for integrated protection and restoration efforts through the Watershed Resources Registry tool (http://watershedresourcesregistry.com). For example, Federal regulations require Federal Highway Administration (FHWA) to account for any negative impacts to both wetlands and natural habitats for any proposed transportation improvement projects. To comply with the National Environmental Protection Act and federal regulations, FHWA provides policy and procedures for evaluating and mitigating adverse environmental impacts to those agencies receiving Federal-aid funding. The Watershed Resources Registry facilitates the selection of potential restoration projects and identifies mitigation opportunities yielding high ecological watershed based returns in the Mattawoman Creek Watershed. The Watershed Resources Registry will also improve coordination between federal, state and local agencies and be used as a tool for conservation planning to help minimize any potential impacts in the Mattawoman Creek Watershed. The county is encouraged to rely on the Watershed Resources Registry R scenario analysis and demonstration provided by the Interstate Commission on the Potomac River Basin,

funded by the Maryland Department of the Environment, as a basis to deploy targeted place-based, cost-effective restoration and conservation efforts. The report, "Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed" can be accessed at: http://www.potomacriver.org/cms/publicationspdf/ICPRB11-03.pdf. The recommendations provided in this report are complementary to the Watershed Resources Registry and should be used to enhance the utility of this tool and other technical and financial assistance provided by the agencies authoring this report.

In addition to the Watershed Resources Registry, the task force recommends review of two model programs designed to protect stream resources at the county level. Addendum 2 highlights the stream buffer protection programs implemented by Baltimore County and Carroll County.

Next Steps

Many of the recommendations presented in this report go beyond the Comprehensive Plan update and fall within the realm of place-based best management practices, enhanced or new efforts for resource protection and restoration, changes to ordinances and regulations, focused stewardship outreach to landowners and others. In order to ensure a vital future for the Mattawoman, it is essential that continued effort be expended towards coordinated protection, restoration and management practices. The County is encouraged to engage representatives from this Task Force in an ongoing effort to develop and implement a resource protection and restoration plan for the Mattawoman Creek Watershed.

Section 1: Recommended Land Use and Growth Management Initiatives to Protect the Mattawoman Ecosystem

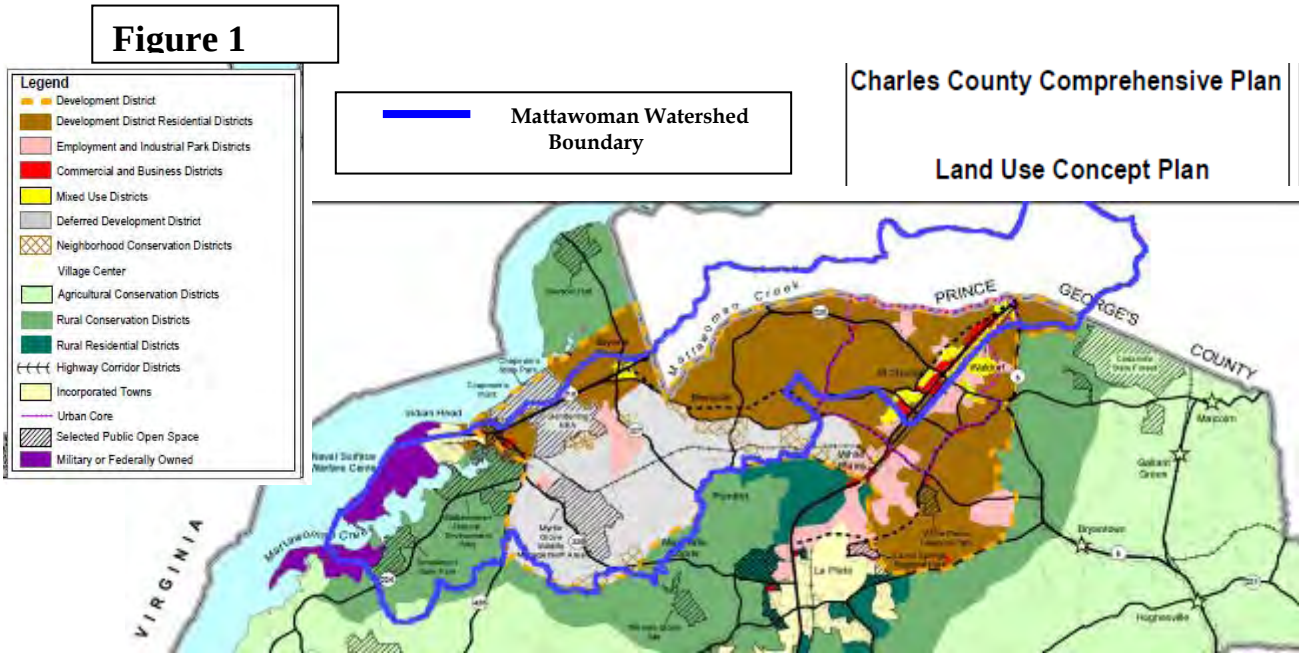
Recommendations to support County Planning Program Direction from the Land Use and Growth Management Workgroup

Tony Redman (MDNR), Tom McCarthy (MDNR), Peter Conrad (MDP), Mike Paone (MDP), Brigid Kenney (MDE), Cathy Shanks (MDNR), Butch Norden (MDNR), Lisa Gutierrez (MDNR)

Part 1: Characterization of Existing Land Use and Land Cover Conditions

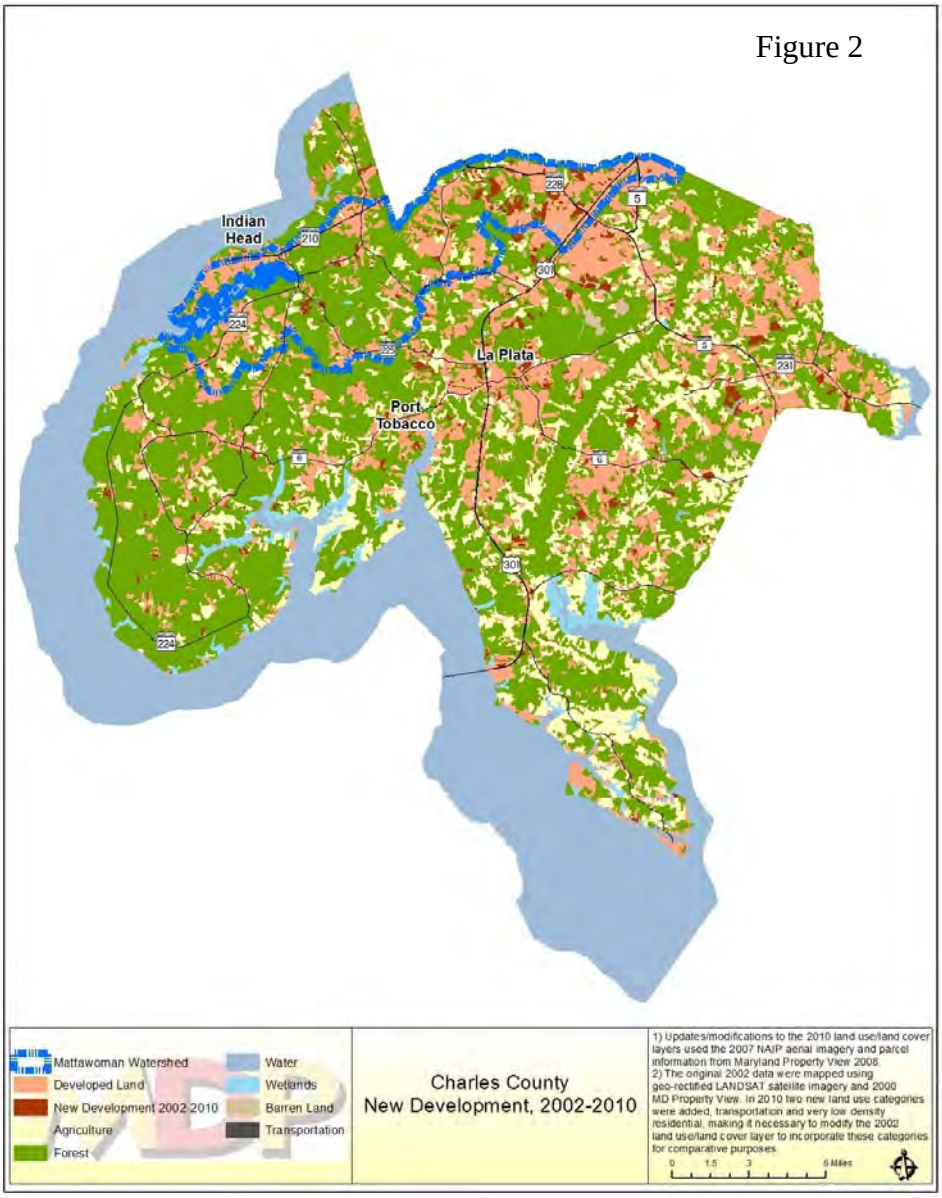
The Mattawoman Creek Watershed represents a significant natural resource for northwestern Charles County, Maryland. The watershed lies almost wholly within Charles County and the vast majority of the watershed is within the County's Development District. As such, it has essentially been targeted for development for a number of years. Figure 1, reproduced from the County's current 2006 Comprehensive Plan illustrates the degree to which areas currently targeted for development correspond to the Mattawoman's watershed boundaries. Very few portions of the watershed with the exception of the stream corridors and their immediate buffers have been designated for long term protection, conservation of rural character or even low density development.

Figure 1



Past trends indicate that elements of the County Comprehensive Plan targeting growth in the watershed are working. Over the last several years there has been significant growth in the watershed. Figure 2, prepared by the Maryland Department of Planning, identifies all developed land in the County as well as that portion of land developed between 2002 and 2010. A cursory review of the map suggests that more than one half of all County development during the 2002-2010 period occurred in the Mattawoman watershed. In fact, most evaluations of the present condition of the Watershed document the fact that major changes have occurred that have had negative impacts on ecosystem resources.

These trends are expected to continue. Current County planning policy and regulation, and analysis of current and County projected land use trends confirm this expectation. The vast majority of the County's Priority Funding Areas (PFA's) fall within the Mattawoman Watershed. Maryland's Smart Growth principles encourage the continued concentration of new development within or adjacent to areas currently developed.

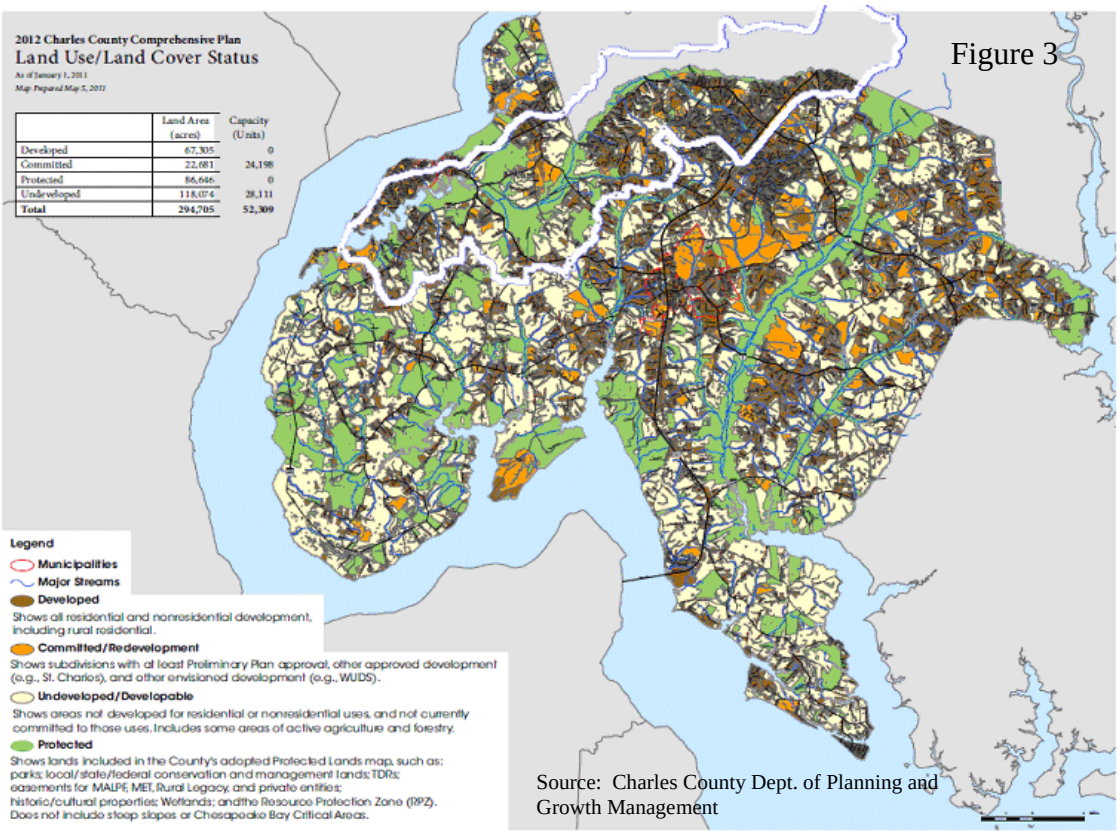


Source: Maryland Department of Planning

Continued development can only be expected to have adverse impacts on habitat value and water quality within the Mattawoman Creek watershed and the Creek is expected to continue its decline as growth continues over the next 20 years. Impervious surface within the watershed, based on study by the US Army Corps of Engineers in 2003 was documented to represent between 7.4 and 8.2 % of the watershed in the year 2000. Some 10 years later, the County currently estimates 4,361 acres of the total 44,662 in the watershed to be in impervious cover (see County Water Resources Plan Element of Comprehensive Plan, 2011). This represents an increase from roughly 8% in 2000 to an estimated 9.8% impervious cover in the watershed today (see section 3, page 94 of County Water Resources Plan Element, 2011).

Part 2: Land Use and Development Trends

As noted, substantial portions of the Mattawoman Creek Watershed are located within the designated Development District for Charles County and have experienced tremendous growth in terms of population and development over the past 20 years. Figure 3, prepared by the County identifies both areas of the watershed currently developed as well as areas not yet developed but committed to development by virtue of subdivisions currently in various stages of the County approval process. These trends demonstrate the potential for ongoing major changes in the character of the watershed as existing forest cover and some scattered agricultural areas are converted into low and medium density residential and business use. This additional development and the corresponding changes in land cover represent the single greatest change influencing the character of the watershed and its ecosystem resources.



	Land Area (acres)	Capacity (Units)
Developed	67,305	0
Committed	22,681	24,198
Protected	86,646	0
Undeveloped	118,074	28,111
Total	**294,705**	**52,309**

Population Growth Trends

Estimates of projected population change within the Charles County portion of the Mattawoman watershed were prepared by the US Army Corps of Engineers as part of their study of the Mattawoman performed in 2003. They noted:

"The Mattawoman Creek Watershed, as the Development District for Charles County, has experienced tremendous growth in terms of population and development. The tremendous growth is one of the major factors influencing the character of the watershed. The population change within the watershed is shown in Table 2.1. Note that population is predicted to nearly double in the thirty years, from 1990 to 2020, with nearly 10,000 additional residents per decade. This represents a major change from rural to suburban development patterns".

Table 2.1: Population Growth in the Mattawoman Watershed

Year	Estimated Population
1990	**34,978**
2000	**44,876**
2010	**51,789**
2020	**59,708**

(Source: US Census data, US ACOE, 2003)

More recent projections for growth developed to support the County's 2012 Comprehensive Plan update affirm those developed by the Corps in 2003. They may even suggest an accelerated growth rate projected within the watershed. As shown in Table 2-2 population in the County's Development District including the Deferred Development District is expected to grow from 105,244 residents (estimated in 2006) to approximately 162, 000 residents by the year 2040. Assuming ½ of these 60,000 new residents would be located in the Mattawoman watershed (a modest assumption given the current comprehensive plan framework), the watershed would be expected to sustain a population increase of 10,000 new residents per decade, somewhat greater than the decennial increases projected by the Corps in 2003.

Table 2.2: Population Projections 2010-2040

Demographics, 2010-40

	Countywide	2006 Plan Development Districts	2006 Plan Deferred Development District	Remainder of County
Population 2010	**146,551**	98,210	7,034	41,308
Population 2040*	**221,950**	154,601	7,777	59,572
Housing Units 2010	**54,963**	36,553	2,683	15,772
Housing Units 2040*	**87,171**	60,720	3,054	23,397
Employment 2010	**62,199**	50,453	884	10,863
Employment 2040*	**83,097**	66,203	1,289	15,605

Notes:
** Under 2006 Comprehensive Plan, as Amended—subject to change through future policy.*
Source: MDP, U.S. Census Bureau, CRA

Quality Places Natural Spaces

15

County Residential Development Land Consumption Trends

Tables 2.3 and 2.4 as well as Figure 4 indicate the number of residential parcels and acres developed both inside and outside of Priority Funding Areas (PFA's) in Charles County before and after Maryland's 1997 Smart Growth legislation. The tables show that there has been very little change in before and after trends. In both cases, the vast majority of all land in the County consumed to accommodate residential development has been located outside the PFA's (a surrogate for the development district and villages). Land committed to residential development outside the PFA's represented 87.2% of all land consumed for such development during the period 1987 to 2007. During the more recent portion of this period, subsequent to passage of Smart Growth legislation, from 2000 to 2007, very little has changed. Land consumed for residential development outside the PFA's during this period continues to represent the vast majority (88%) of all land required to satisfy demand for residential development countywide.

Table 2.3: Improved Residential Single Family Parcels 20 Acres or less in Size 1987-2007

	Total Parcels	**Inside PFA**				**Outside PFA**	
		Certified PFA		PFA Comment Area			
		Parcels	**Percent**	**Parcels**	**Percent**	**Parcels**	**Percent**
Parcels	22,147	13,615	61,5%	330	1.5%	8,202	37%
Acres	25,037	3,100	12,4%	101	0.4%	21,837	**87.2%**
Average acres per Parcel	1.13	0.22		0.31		2.66	

Source: Maryland Department of Planning 2010

Table 2.4: Improved Residential Single Family Parcels 20 Acres or less in Size 2000-2007

	Total Parcels	**Inside PFA**				**Outside PFA**	
		Certified PFA		PFA Comment Area			
		Parcels	**Percent**	**Parcels**	**Percent**	**Parcels**	**Percent**
Parcels	8,554	4,497	53.8%	207	2.4%	3,740	43.8%
Acres	9,692	1,135	11.7%	29	0.3%	8,528	**88.0%**
Average acres per Parcel	1.13	0.25		0.14		2.28	

Source: Maryland Department of Planning 2010

To the County's credit, these tables also note that 55 to 60% of the number of residential parcels are located within the County Development District or within targeted PFA's. But the land consumed by residential development is, by far, the more important variable if the County is to achieve its long term goals to preserve farmland in support of its agricultural industry or protect natural resources and forested watersheds in support of its ecotourism industry.

If these recent trends were to continue, notwithstanding the condition of the economy, within 40 years an additional 48,000 acres of farm or forest land and roughly 1/6th of the total County land area will be lost to residential development in rural locations. The resulting development pattern could only increase demands on county service delivery programs, create greater and demands for highway improvements in more scattered locations and fundamentally change the very sense of "place" and identity currently enjoyed by County residents.

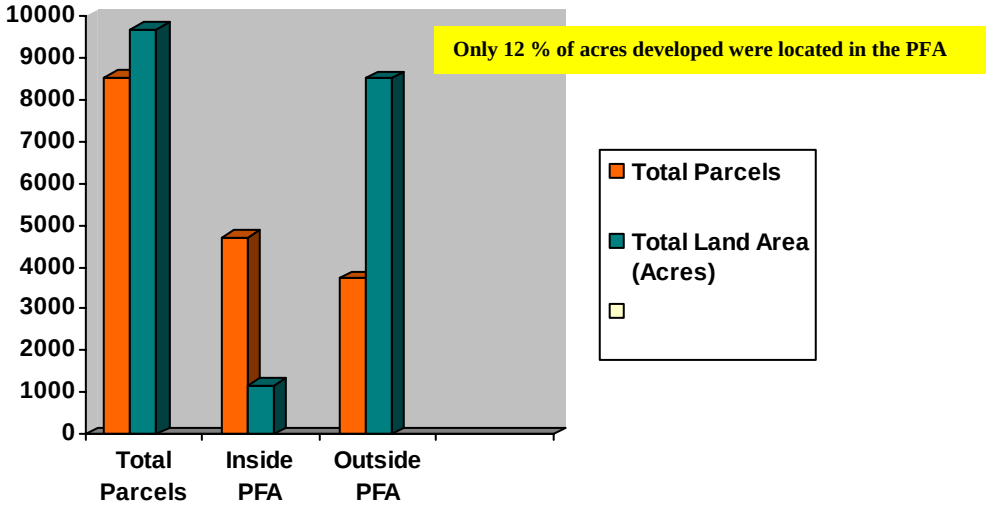


Figure 4: Improved Residential Parcels: 2000- 2007
Charles County, MD

Projections within the Mattawoman Watershed

Table 2.5 identifies 3 alternative Housing Unit projections specific to the Mattawoman watershed using various scenarios and assumptions. They were developed by Charles County in 2011 for purposes of assessing the impacts of alternative land use policies as part of the County's work to prepare a Comprehensive Plan Water Resources Plan Element.

Table 2.5: Alternative Mattawoman Watershed Housing Unit Projections to 2030 Used for County WRE scenario impact comparisons.

	Housing Units, 2008	2030 Scenarios					
		Baseline*		Waldorf Area* Focus		DDD Focus*	
		Increment	Total	Increment	Total	Increment	Total
Waldorf	12,168	2,843	15,011	4,007	16,175	3,016	15,184
Bryans Road	1,007	1,857	2,864	2,120	3,127	1,495	2,502
Indian Head	1,615	659	2,274	659	2,274	659	2,274
Remainder	5,775	1,617	7,392	1,284	7,059	4,799	10,574
Total Mattawoman Watershed	20,565	6,976	27541	8,070	28,635	9,969	30,534

Source: Charles County Comprehensive Plan Water Resources Plan Element, draft, 2011

Definition of Scenarios used in Table 2.5*:
Baseline: This Scenario reflects the current County adopted 2006 Comprehensive Plan as implemented by current zoning.
Waldorf Area Focus: This scenario assumes that higher-density development will occur in the Waldorf area and in the Bryans Road area. The Deferred Development District (DDD) would remain deferred with permitted densities of one unit per 10 acres through 2030. New development in the portion of the Old Womans Run Tier II catchment area that is outside the DDD would be subject to restrictions similar to those in the DDD.

Deferred Development District Focus: This Scenario opens the DDD for development using the current base zoning for the area (low density residential).

These Scenarios are not intended to reflect any particular County policy position but rather were developed to gauge the impacts of alternative land use policies on water resources during preparation of the County's Comprehensive Plan Draft Water Resources Plan Element.

The alternative projections indicate that, depending on the scenario, Housing Units within the Watershed by 2030 can be expected to grow substantially, ranging from 34% (baseline) to almost 50% (DDD focus). Projected growth within the watershed of some 7,000 to 10,000 new housing units will inevitably impact the ecosystem. These impacts will include some loss of forest land and forest fragmentation, loss of habitat to support forest interior dwelling bird species, greater pressure on sensitive resources like Araby Bog and Old Woman's Run (a Tier II watershed) and loss of fish habitat. The degree of impact will be heavily dependent on the form that new development takes. Seven thousand to 10,000 units constructed at higher densities in the form of redevelopment within Waldorf would provide the least impact or preferred scenario for the watershed and its ecosystem. Development of this same number of units in currently undeveloped areas at lower densities ranging from 1.5 to 3 units per acre would likely create the greatest levels of land disturbance, create widespread requirements for stormwater management measures, displace forest cover serving as habitat for interior dwelling bird species and have the greatest overall adverse impact on ecosystem resources.

County estimates of the current and future levels of impervious surface projected for the year 2030 corresponding with the various development scenarios described in Table 2.5 are shown in Table 2.6

Table 2.6: Estimated current and projected future year 2030 impervious land cover in the Mattawoman Watershed under alternative scenarios.

Total Mattawoman Watershed Acres in Charles County	Existing Impervious		Baseline Projected Impervious		Focused Growth Projected Impervious		DDD Focus Projected Impervious	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
44,662	4,361	9.8%	4,772	10.7%	4,836	10.8%	4,944	11.1%

Source: Charles County Comprehensive Plan Water Resources Plan Element, draft, 2011

These estimates contained in the recently prepared Comprehensive Plan Water Resources Plan element reflect modest increases in impervious surface over the next 20 years but are based on a series of assumptions regarding the densities and form growth in housing units will take. The potential for higher percentages of impervious cover than those shown in Table 2.6 is substantial.

Past projections for growth in the Mattawoman Creek watershed at build-out have indicated impervious surface will be, at best, equal to that of Piscataway Creek (at present, approximately 16-17 % impervious), and is likely to be higher (22% impervious surface; USACOE 2003; Beall 2008). The Corps study projected impervious surface would grow to well over 20% by the year 2040. As shown in Table 2.7, the Corps estimated impervious surface would reach more than 14% by the year 2020 with 3 subwatersheds exceeding 15% in only 10 years.

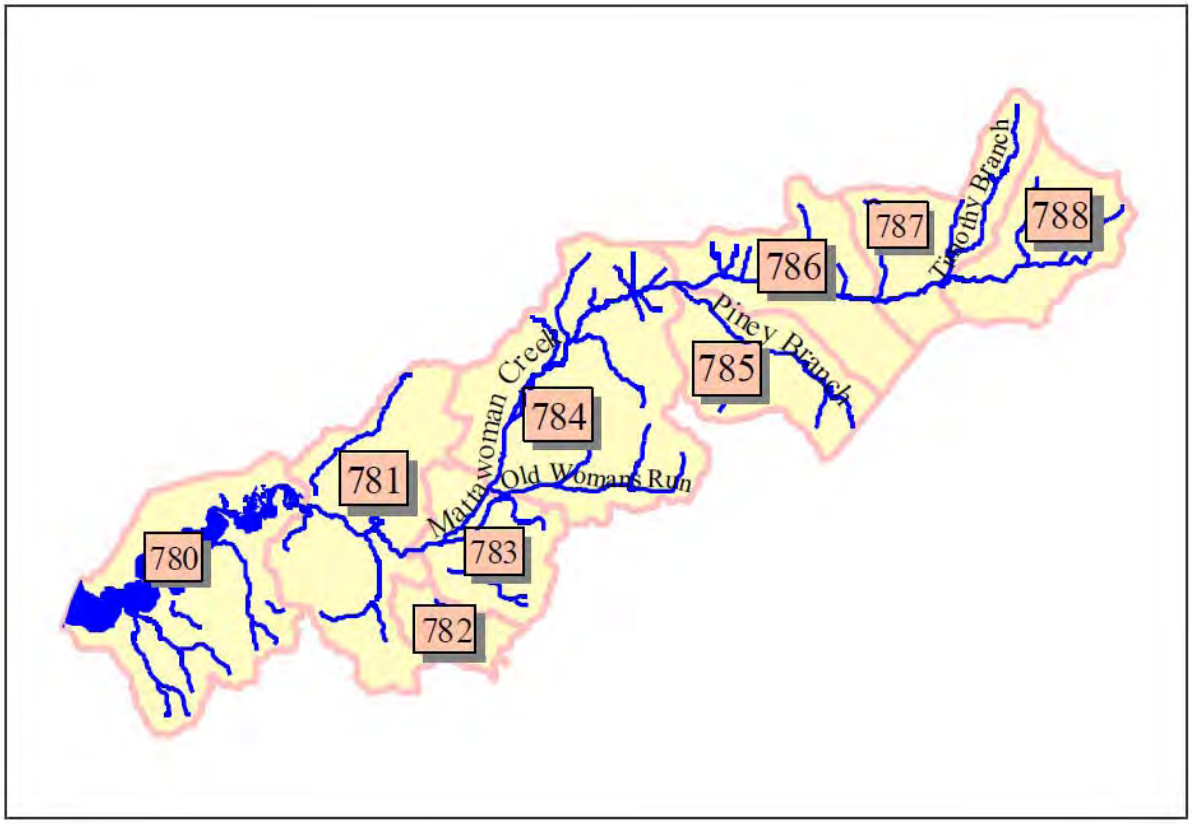
Table 2.7: Estimated Impervious Surface by Subwatershed

PERCENT (%) IMPERVIOUS				
DNR 12-Digit Watersheds	Towson 2000	MDP 2000	MDP 2020	Buildout
021401110788	9.37%	6.60%	7.66%	15.32%
021401110787	10.15%	8.15%	15.41%	34.87%
021401110786	11.84%	9.93%	17.23%	30.82%
021401110785	22.18%	20.27%	35.64%	39.46%
021401110784	5.13%	5.70%	11.81%	17.91%
021401110783	1.83%	2.49%	2.96%	21.03%
021401110782	2.60%	2.01%	4.17%	13.97%
021401110781	4.87%	5.10%	7.75%	19.90%
021401110780*	8.09%	7.35%	15.73%	14.55%
Total (780-788)	8.20%	7.43%	14.16%	22.40%

*subwatershed 780 was not used because the land use and growth rate data was inaccurate for modeling purposes.

Source: Mattawoman Creek Watershed Management Plan, Charles County, Maryland ACOE, 2003

Figure 5: Location of Mattawoman Creek Sub watersheds



Source: Mattawoman Creek Watershed Management Plan, Charles County, Maryland ACOE, 2003

Although the Corps projections may be somewhat high, it is quite possibly a more likely outcome than the modest projections shown in Table 2.6 unless the County planning and land use regulatory framework see reforms that limit impervious surface over the next few years.

For example, development of 9,969 units in the watershed by 2030 (a 48% increase in housing units under the DDD focus scenario) under the current Comprehensive Plan and regulatory framework could result in a corresponding 48% increase in impervious surface: a total of 6,454 acres of impervious surface within the Charles County portion of the watershed. This would result in 14.5% of the County portion of the watershed committed to impervious land cover in less than 20 years.

In the face of these alternative projections of future estimated impervious surface in the watershed, DNR Fisheries Service monitoring indicates that Mattawoman Creek's fish habitat has already declined as impervious surface has increased beyond a threshold level (Uphoff et al. 2010). Impervious surface is a quantifiable land-use metric that correlates well with the impacts of polluted runoff and altered hydrographs from development (Arnold and Gibbons 1996, National Research Council 2009); declines in fish habitat and the fish community were concurrent with exceeding a 10% impervious surface threshold in the watershed. Some fish species are vulnerable to decline at even lower percentages of impervious land cover.

Maryland's Department of Natural Resources recently developed general guidelines for impervious surface thresholds (tipping points that are followed by irreversible resource deterioration) that provide a basis for characterization of watershed conditions under various impervious surface thresholds. Categories include:

- **< 2% Impervious**
  Highly sensitive watersheds that have the highest aquatic biodiversity and very healthy fisheries. Where impervious surface can be maintained at this level, impacts to aquatic biodiversity and fisheries are prevented. In certain highly sensitive watersheds and/or sub-watersheds, impervious surface should be kept to this very low level.
- **2 to 5% Impervious**
  Watersheds between 2 and 5% impervious surface that generally have high aquatic biodiversity and healthy fisheries. Protection is the most important strategy for maintaining these resources, particularly within small non-tidal watersheds, but restoration can also sustain biodiversity and maintain healthy fisheries.
- **5-10% Impervious**
  Between 5 and10% impervious surface, biodiversity and fisheries production begins to decline. Conservation of remaining resources, restoration efforts and minimization of any new impacts is necessary to maintain these resources.
- **10 to 25 % Impervious**
  Biodiversity and fisheries production are generally impaired and unlikely to reach former levels. Restoration projects such as stormwater retrofit, impervious surface removal, or tree planting/revegetation can help mitigate hydrologic impacts, protect vulnerable infrastructure, and improve urban quality of life.
- **> 25% Impervious**
  Biodiversity and fisheries production is generally impaired and will often be beyond recovery. Restoration to improve the viability of resources will have limited success. Limiting future suburban sprawl and redeveloping existing areas at greater than 25%

impervious surface into livable, more densely populated urban neighborhoods that absorb more people per given land area can conserve remaining natural areas and working farms associated with "good" conditions.

Some believe that new stormwater management (SWM) requirements based on Environmental Site Design (ESD) principles now offer treatment of stormwater impacts that renders impervious surface limits irrelevant. This argument discounts impervious surface thresholds since they are based upon old-style stormwater management techniques. Although newer methods to treat the quantity and quality of stormwater may ameliorate conditions of aquatic ecosystems created by impervious surface increases, there are no studies to date to confirm their benefits since ESD principles in stormwater management (SWM) have only been applied recently. Moreover, it is likely that certain ecological features of the watershed will deteriorate with growth in impervious surface, including forest fragmentation, impacts to hydrology, and reductions in available wildlife habitat, regardless of SWM measures applied.

To date, research shows the only sound way to buffer against biological losses is to protect natural landscapes. While new technologies such as ESD are expected to minimize biological habitat losses related to urbanization, the technology has not been tested to evaluate its effectiveness. Therefore, ESD should not be soley relied on to completely protect aquatic systems from degradation, especially not in this watershed as it is already under significant stress from urbanization.

Impervious surfaces have been well documented to be one of the primary factors in influencing the hydrology of stream systems. Impervious surfaces change the rate and route in which water enters the stream system, prevent infiltration, change the flow regime within the stream system and prevent groundwater recharge, which impacts the dry weather base flow in the streams. Impervious surfaces are the by-product of development. As land use changes towards more structures and parking lots, more areas are converted to rooftops, pavement and other types of impervious surfaces that negatively impact hydrology and health of the watershed.

In summary, the following effects and an overall decline in the ecosystem can be anticipated as a result of the current development scenarios:

- Hydrologic changes prompted by growth in impervious surface within the watershed,
- corresponding declines in stream system health and ecosystem biodiversity and,
- increases in the loading of nitrogen, phosphorus, and suspended solids.

Part 3: Findings and Conclusions

From the perspective of protecting the resources of the Mattawoman, past trends have created mixed results. On one hand, the lands within the development district that have been developed in recent years have contributed to the demands on the watershed to assimilate pollutants. As noted elsewhere in this report, the results have been an increase in impervious surface that has been substantial, particularly in the three subwatersheds in proximity to Waldorf and the Indian Head/Bryans Road portions of the watershed.

On the other hand, measures instituted by the County to limit development densities to one residential unit per 10 acres in the "Deferred" development district have thus far protected substantial areas of the watershed to maintain forest cover and related ecosystem components

within the Mattawoman. In this sense, the County has been successful in protecting the Deferred Development District from premature low density development that would have precluded its planned future use for Development District expansion.

In summary, the County's priorities and objectives to guide development are at odds. On one hand, reducing land consumption in rural areas from 88% of all land developed is clearly a priority to protect remaining farmland resources and natural landscape character. On the other hand, guiding development more efficiently into PFA's to achieve this objective will insure greater pressures on Mattawoman Creek which is already an impaired watershed. This conflict is acknowledged in the Charles County Water Resources Element prepared earlier this year (2011). The plan document notes:

"Another consideration is that while the majority of the County's Priority Funding Areas fall within impaired watersheds, Maryland's Smart Growth principles fundamentally encourage the continued concentration of new development within these already developed areas."

Although targeting development and protection of watershed resources are not mutually exclusive concepts when applied to the same land area of the County, these objectives can easily work at cross purposes.

The cumulative impacts of development in watersheds, over time, are quite well documented. Impacts include loss of and fragmentation of forest cover, habitat and refuge for wildlife together with substantial increases in impervious surface which, in turn, lead to deterioration of creek and stream system water quality and loss of wildlife habitat over time. Such losses cannot simply be offset by application of best management practices in stormwater management and sediment and erosion control or any number of measures to mitigate the impacts of development. Mitigation can reduce the degree of damage, but the limits of technology will nevertheless result in sustained adverse impacts to the watershed. Stream health indicators decline noticeably when impervious surface within watersheds exceeds 10 percent and severe impacts and degradation can be expected when impervious surface exceeds 25 percent (Allen and Weber, 2007). Guidelines developed by the Maryland Department of Natural Resource (presented on page 19 in this Section) caution that in certain highly sensitive watersheds, impacts to aquatic biodiversity can occur at impervious surfaces as low as 2 percent, and that impacts to biodiversity and fisheries are apparent between 5 and 10 percent impervious surface. Tom Schueler, former Executive Director of the Center for Watershed Protection notes that "At 10% imperviousness in its watershed, a stream is considered at risk" He goes on to say "If the impervious level is well over this threshold, you have a variety of management strategies available, but realistically you will not be able to restore a stream completely". www.waterlaws.com/commentary/interviews/schueler.

Given the present Comprehensive Plan Land Use classification designations and corresponding Zoning structure established in the watershed, impervious surface can be projected to grow to levels that will further degrade the watershed since so much of the watershed is targeted for development. Restoration at this point would then be cost prohibitive.

Current zoning provisions in the County's Low Density Residential District (RL) zone district, representing a substantial percentage of the watershed, permit coverage of 30% of lots established for residential development. Areas zoned Medium Density Residential (RM) and High Density Residential (RH) permit lot coverage to be higher at 35 and 40% of sites proposed for residential use. The County Zoning Ordinance defines lot coverage to include only the "ground area occupied

by all buildings within a lot". The addition of impervious surfaces associated with driveways and parking areas assure future impervious surfaces will be higher than the lot coverage limits. Institutional uses in the RL district are permitted to place up to 50% of sites in impervious surfaces. Commercial uses in the Residential Office (RO) district are permitted to devote 70% of sites to be developed in impervious surface. (See Figure VI-4: Charles County Zoning Ordinance). In Commercial Zoning Districts the ordinance permits 80% or more of sites to be impervious (see Figure VI-5: Charles County Zoning Ordinance). The County Business Park (BP), Light Industrial (IG) and Heavy Industrial (IH) Zone Districts, much of which are located south of Bryans Road, in proximity or adjacent to the Mattawoman Creek Resource Protection District (RPZ) also establish impervious surface ratios (ISR) that permit impervious surfaces to occupy between 50 and 70% of parcels so zoned (See Figures VI-5 and VI-6 of the County Zoning Ordinance).

Much of the watershed falls within the forenamed zone districts. The Mattawoman's primary sources of regulatory protection are the County's Resource Protection Zone (RPZ) district and the Rural Conservation/Deferred Development (RC-D) districts. The RPZ does not extend to the entire watershed but corresponds only to stream locations and their associated tidal and non-tidal wetlands, floodplains and steep slopes wherein 50 and 100 foot buffers are required depending on stream class. The RC-D district, establishes requirements for low density (one dwelling unit per 10 acres). Such a density affords protection currently, but the district remains a part of the County's greater planned Development District. Frankly, the RC-D is nothing more than a temporary holding zone to avoid premature development within areas designated over the longer term for growth and the extension of public infrastructure to support growth over the next 20 to 30 years. The provisions contained in the County zoning ordinance confirm this finding. They note its planned impermanence since it requires County reconsideration for rezoning every five years; a condition unique to this particular zone district.

On the face of it, the choices appear to be limited to "smart growth" continuing to concentrate development in the County's development district and the Mattawoman Watershed, or dispersing growth to other areas of the County where community facilities and services are not available to support development, rural character would be lost, agricultural preservation priorities would be undermined, and deterioration in other important watersheds (e.g. the Zekiah and Nanjemoy) would likely be sustained. While this appears to lead to a no-win situation, closer examination suggests there are nevertheless actions that can be taken to continue to direct a greater percentage of development into PFA's in portions of the development district and reduce the proportionate land area in rural areas that have been consumed by development in recent years while retaining substantial areas within the currently configured Development District and Mattawoman watershed in an undeveloped state and in forest cover.

Downzoning rural lands in the County's Agricultural Conservation District and Rural Conservation Districts, limiting development to one unit per 20 acres, can achieve protection objectives and rural character outside the designated PFA's. Eliminating the Deferred Development District and including much of that land area in very low density conservation zoning, together with extending the County's Resource Protection District in the Mattawoman to include all portions of the Corps recommended "Mattawoman Creek Stream Valley" would assure protection of substantial portions of the Mattawoman Watershed. Though these simple actions may be less than politically popular, they achieve the County's stated Comprehensive Planning objectives. Short of these actions, other measures can also be taken, albeit they may have limited results. They are discussed in the remainder of this Land Use and Growth Management section.

Part 4: Land Use and Growth Management Recommendations

Given today's smart growth initiatives and development principles that espouse sustainability and compact development forms, the County Comprehensive Plan update presents an opportunity to redefine the future planned use of lands designated deferred development district to provide more permanent protection of natural resources from future development that would be inimical to the Mattawoman watershed and ecosystem.

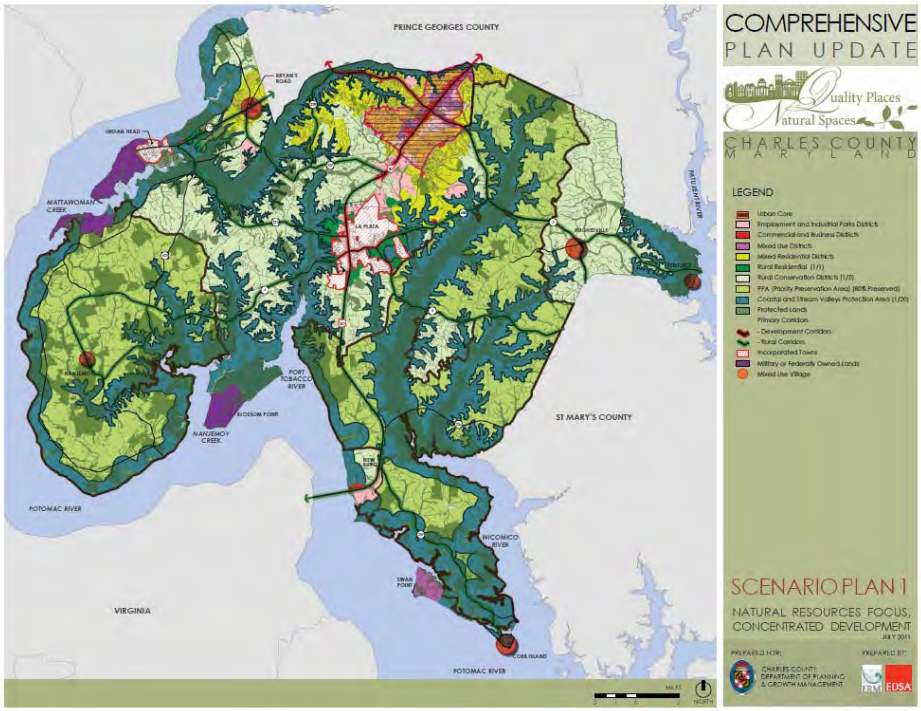
The role of the district should be redefined as it now represents a County opportunity to serve long term resource protection objectives rather than continue its function as a development reserve or land bank for future development. The current update of the Comprehensive Plan may well represent the last opportunity the County will have to establish permanent protection of the Mattawoman's resources and ecological functions. Given current growth trends and projections and corresponding increases in impervious surface that can be expected, watershed ecosystem declines are already manifesting themselves and can only be expected to continue. As noted, 10% impervious cover in a watershed is considered by most experts to be the tipping point at which point impairments to water quality and stream system conditions may become irreparable. The Mattawoman is currently estimated to be at 9.8 percent impervious. In short, there may no future opportunities to reverse trends.

Ironically, many of the provisions established within the County regulatory framework that will do harm to the Mattawoman over time stand in stark contrast to stated County intention, policies and objectives regarding the watershed. Most of the County policy decisions necessary to support much greater protection of Mattawoman resources are already in place. Both the County Comprehensive Plan and the County Land Preservation and Recreation Plan are instructive in this regard. Both documents contain substantial language identifying County goals, objectives and implementation strategies clearly intended and designed to protect and enhance water resources and wildlife habitat throughout the Mattawoman Creek system including its tributaries and watershed resources (See Appendix A). Only through sound linkages between the policy framework and the regulatory program can any real protection results be expected.

There are a number of land use management measures or actions the County can consider to redirect future objectives and purposes for the Deferred Development District that can serve to protect portions of the Mattawoman to maintain critical watershed functions. The first step is to establish and confirm a vision for the Mattawoman as a Watershed with an array of ecological benefits that serve as a resource worthy of protection. Such a vision needs to be embedded in the Comprehensive Plan.

Establishing this vision and the objectives to support it in the current Comprehensive Plan update would elevate the status of the Mattawoman to that of other legacy watershed resources the County has already made commitments to protect (e.g. the Zekiah and Nanjemoy). Recent County efforts to define alternative scenarios for future growth as part of the Comprehensive Plan update, particularly the "Natural Resource Focus, Concentrated Development" based scenario" (see Figure 6) holds promise for moving in this direction if the County adopts the key elements associated with this particular alternative scenario.

Figure 6: Draft County Natural Resource Focus, Concentrated Development Scenario



This Scenario developed by Charles County as part of the County Comprehensive Plan update process, July, 2011

<u>Recommended Land Use/Growth Management Measures for County consideration</u>

Based on the findings concerning previous evaluation of land use trends, current policies and consideration of the existing County regulatory framework, the following recommendations are proffered for County consideration. They are intended to support implementation of County objectives and afford greater protection of the Mattawoman's ecosystem resources.

Recommendations include a number of reforms to the current County regulatory framework for consideration by the County. These measures include changes to the Zoning Structure, restructure of the County's transferable development rights (TDR) program to achieve resource protection objectives and other reforms to direct planned development away from the sensitive resources of the Mattawoman and to reduce the degree of forest fragmentation, growth in impervious surface area, and impacts to water quality, fish and wildlife habitats over time. The recommendations are designed **to support existing County Policies** and permit the Mattawoman to remain a unique resource that continues to support the County's ecotourism economy an remain a key component of the County's identity, heritage, and landscape in future years.

Each recommendation represents an alternative approach the County might take to better protect Mattawoman resources. The Task Force recommends that the County evaluate each proposal for application. Many of these recommendations are offered with the notion that they may work in combination to mutually support the objective of Mattawoman protection. In fact, it is unlikely that any one recommendation alone will achieve protection objectives. The current County regulatory framework provides the context for evaluation of the manner in which they may best be

fitted together for application. Application of any one of these measures can influence the form and substantive approach taken to apply others since they are interactive rather than mutually exclusive alternatives for consideration. They include:

- **Clarify Mattawoman protection policies and identify proposed strategies and actions to implement selected policies and objectives in the Comprehensive Plan update currently being prepared.**

  Past County Comprehensive Plans and Land Preservation and Recreation Plans have clearly stated that the protection of the Mattawoman is an important objective. This is well documented in Appendix A to this report which provides a list of adopted objectives and policies contained in current County planning documents that support the Mattawoman's protection. Unfortunately, such objectives when coupled with designation of most of the watershed within the planned County Development Service District as well as the potential for future growth implied on lands designated Deferred Development District tend to indicate equivocation in the County's resolve in making a long term commitment to protection of the Mattawoman's ecosystem resources. The Comprehensive Plan represents the County's last best hope for eliminating ambiguity in intent and to confirm a vision of protected watershed resources in the Mattawoman. The Plan also needs to identify the means by which the County expects to achieve protection objectives and policies. Clear identification of implementation strategies in the plan document will serve to guide follow-up planning program efforts to reform ordinances, institute protection standards, reshape zoning districts or institute other measures subsequent to adoption of the Comprehensive Plan.

- **Implement the recommendation to provide protection to the US Army Corps of Engineers designated Mattawoman Creek Stream Valley as identified in the 2003 Mattawoman Watershed Management Plan.**

  This recommendation is already identified for implementation in the County's Comprehensive Plan and Land Preservation, Parks and Recreation Plan. The latter document notes:

  "A notable planning effort completed in 2003 was a watershed management plan for Mattawoman Creek in Charles County by the US Army Corps of Engineers. The plan was developed in response to concerns that development within the Development District had the potential to significantly affect Mattawoman Creek resources, with water quality and aquatic biota the primary concerns."

  The first of three key recommendations contained in the plan was to delineate and protect the stream valley – defined as the top of the slope to the stream, and sometimes referred to as the Corps valley. Appendix B illustrates the extent of the Stream Valley as delineated by DNR as a follow up to the Corps 2003 report later in 2007. It illustrates the greater land area that would be afforded protection than that currently protected by the County's Resource Protection Overlay Zone (RPZ). Alternative approaches to afford protection may include modifying the RPZ to include the entire stream valley or creating yet another stream valley protection overlay zone district.

Portions of the Stream Valley have already been developed, particularly along Piney Run and other northern portions of the stream valley bordering Prince George's County. In these locations where development has already occurred and would be grandfathered, standards should be established to limit the degree to which additional impervious surface could be created. These areas might also serve as target locations for stormwater retrofits utilizing Environmental Site Design (ESD) principles.

- **Strengthen protection measures in the County's existing Resource Protection Zone (RPZ) overlay district**

  This recommendation represents an alternative to consider if the County is unable or unwilling to protect the entire Mattawoman Stream Valley Corridor. Because the RPZ overlay zone district is already established in the County Zoning Ordinance, it represents a baseline for further refinement. Provisions within the district that might be strengthened include establishing wider buffers than those currently established from Class I through IV streams within the RPZ. Other options might include requirements that sites developed adjacent to the RPZ buffers, which are also subject to requirements to provide open space, locate the open space adjacent to the RPZ to broaden the land area that remains undeveloped. In either case a greater percentage of riparian forest cover would be accorded to Mattawoman Stream systems throughout the watershed.

- **Remove portions of the Mattawoman Watershed from the Development Service District**

  A case can be easily be made to eliminate the inherent conflicts built into the current County Planning Framework that juxtapose objectives for protecting Mattawoman resources with other objectives to channel the majority of future growth (75% as stated in the Comprehensive Plan) into the same land area. While such an objective may appear sensible to make efficient use of sewer and water and highway system infrastructure, it does little for the green infrastructure objectives of the County.

  Since much of the watershed that is zoned RL is already developed it is not likely that these areas will be removed from the Development District. However, a strong case can be made for removal of those lands zoned RC(D) which are largely undeveloped to date. The RC (D) (D for development deferred) District is currently represented as the repository for future growth. This creates development expectations that virtually assure growth will become a self fulfilling prophecy in this area in the future. Given the resources present in the Mattawoman, the Development District configuration (both present and deferred) should be re-examined. If land area is needed to support growth due to development capacity analysis considerations reflected in current or future plans, other alternatives should be considered. In short, there may be better way to grow, in locations that are less resource dominated.

To the County's credit, several of the alternative growth scenarios, that have been and continue to be explored by the County, appear to propose such a reduction in the land area designated as part of the County Development District within the Mattawoman. The Task Force encourages a Comprehensive Plan update that accomplishes this reduction.

- **Downzone lands in the Mattawoman Watershed designated Rural Conservation to a maximum density of one residential unit per 20 acres in conjunction with their designation as a TDR program sending area allocating rights that can be transferred or purchased and retired.**

  Lower densities will permit the County to manage future increases in impervious surface in those subwatersheds where the Rural Conservation District is located.

- **Focus development within the Development Service District away from Mattawoman Resources**

  This recommendation should be considered in the context of current efforts underway to update the County Comprehensive Plan. Building on past efforts to prepare specific Plans for the Waldorf and Bryans Road areas that identify "core" and "activity center" areas to concentrate development additional areas for these designations could be considered. The notion here is to provide additional areas for smarter growth patterns in certain locations to relieve pressure on other areas that are dominated by more sensitive resources in the Mattawoman.

- **Provide greater incentives to redevelop/revitalize existing developed areas to absorb growth (Waldorf) to reduce development pressure on resource sensitive lands**

  This recommendation holds potential to work well in tandem with others. It is not a novel idea as the County already provides bonus densities for Moderately Priced Dwelling Units. Additional incentives might include permitting greater floor area ratios or greater density bonuses for use of Transferable Development Rights when transferred from the RPZ or portions of the (RC-D) district which are currently located in the deferred development district. This recommendation for exploration of density incentives that might be used to reduce pressures on resource sensitive areas in the Mattawoman Watershed should in no way limit the County in considering additional incentives that may even apply to encourage new development in the "right" places.

- **Require development in Activity Centers or Town Centers to achieve Minimum Densities to assure efficient use of land in appropriate designated growth areas.**

  This recommendation would essentially require new developments and redevelopment in targeted locations to achieve a minimum density rather than be governed by current maximum density requirements. Development that occurs at

less than the permitted densities in zoning districts utilizes land less than efficiently (e.g. more land for fewer new homes). This can be a common occurrence in many communities. The result is greater pressure in a shorter period of time to designate more land for development to satisfy demand for development. This recommendation will need to be considered in the context of efforts to limit development in agricultural and rural conservation district locations. If developers determine the market for higher density development is limited they will seek alternative locations where they can achieve lower densities which would inhibit the effectiveness of this recommendation.

- **Require development in Activity Centers or Town Centers to purchase transferable Development Rights.**

  This recommendation would establish the purchase of TDR's as a threshold requirement for all by-right development in Town Centers and Activity Centers. Such an approach guarantees both retirement of rights in appropriate locations and establishes a market for TDR's where market forces may not otherwise be sufficient to give rise to the purchase and use of TDR's. As rights are utilized, sending area lands (agricultural or resource dominated) are afforded permanent protection. Application of this requirement for TDR use would need to be weighed and balanced against the additional cost burden to developers and the degree to which it could create a disincentive to develop lands in designated Town Centers and Activity Centers. Implementing this recommendation may also require down-zoning of base densities within Town Centers and Activity Centers. The greater the degree of restriction limiting development in alternative agricultural and resource land locations, the greater the potential for successful application of this recommendation.

- **Mandate cluster forms of development to protect resources in the Rural Conservation-Deferred (RC-D), Rural Conservation (RC) and Low Density Residential (RL) zone districts.**

  Current County Plans have called for examining voluntary Cluster development provisions in the County Zoning Ordinance with an eye to making such provisions mandatory. It is likely that this notion will be considered once again in the course of the current process to update the Plan. It is time for the County to seriously consider institutionalizing a requirement to cluster development. Such a requirement may also have applicability to the County's Agricultural Conservation (AC) District. At a minimum it should be considered for application on sites zoned RL, RC and RC-D when such sites are adjacent to or include lands located in the Mattawoman's Resource Protection Zone (RPZ) district.

- **Establish density incentives for clustering away from most sensitive resources.**

  This alternative should only be considered if mandating cluster development fails to be politically acceptable. In this case, bonus densities should limited and only be granted to those sites that are adjacent to the RPZ when such clustering will remove development a minimum distance from the boundary of the RPZ.

- **Target portions of the watershed for easement or acquisition through a variety of Federal, State, local and non-profit partnerships.**

  Develop a conservation plan in partnership with MDNR Land Acquisition and Planning and land trust organizations that operate locally such as The Nature Conservancy, Charles County Conservancy and others. This conservation plan may justify the designation of a new Rural Legacy Area which could open up an additional source of funding for easement acquisition. Work with the Maryland Environmental Trust to develop a donated easement program to complement this plan. While this recommendation does not assure that development within the sensitive areas of the watershed will not occur, it does identify additional protection measures that can be targeted to particularly sensitive resources within the Targeted Ecological Areas, such as land adjacent to the RPZ and in Tier 2 sub-watersheds (Old Womans Run and unnamed streams near Marbury Run). Any lands so protected will provide an important level of support to terrestrial and aquatic habitat protection objectives and represent key locations where future impervious surfaces will not increase.

- **Use the GreenPrint Targeted Ecological Area (TEA) designation as a guide to target land conservation efforts within the watershed.**

  Maryland's GreenPrint initiative identifies the most ecologically valuable areas in the State and designates these lands and waters as "Targeted Ecological Areas (TEAs)". TEAs are the "best of the best" natural resources across the State. TEAs include the most ecologically important:
  - large blocks of forests and wetlands,
  - wildlife and rare species habitats,
  - aquatic biodiversity areas
  - forests for protecting water quality,
  - coastal ecosystems,
  - habitats for climate change adaptation and marsh migration, and
  - areas for supporting commercial and recreational fisheries.

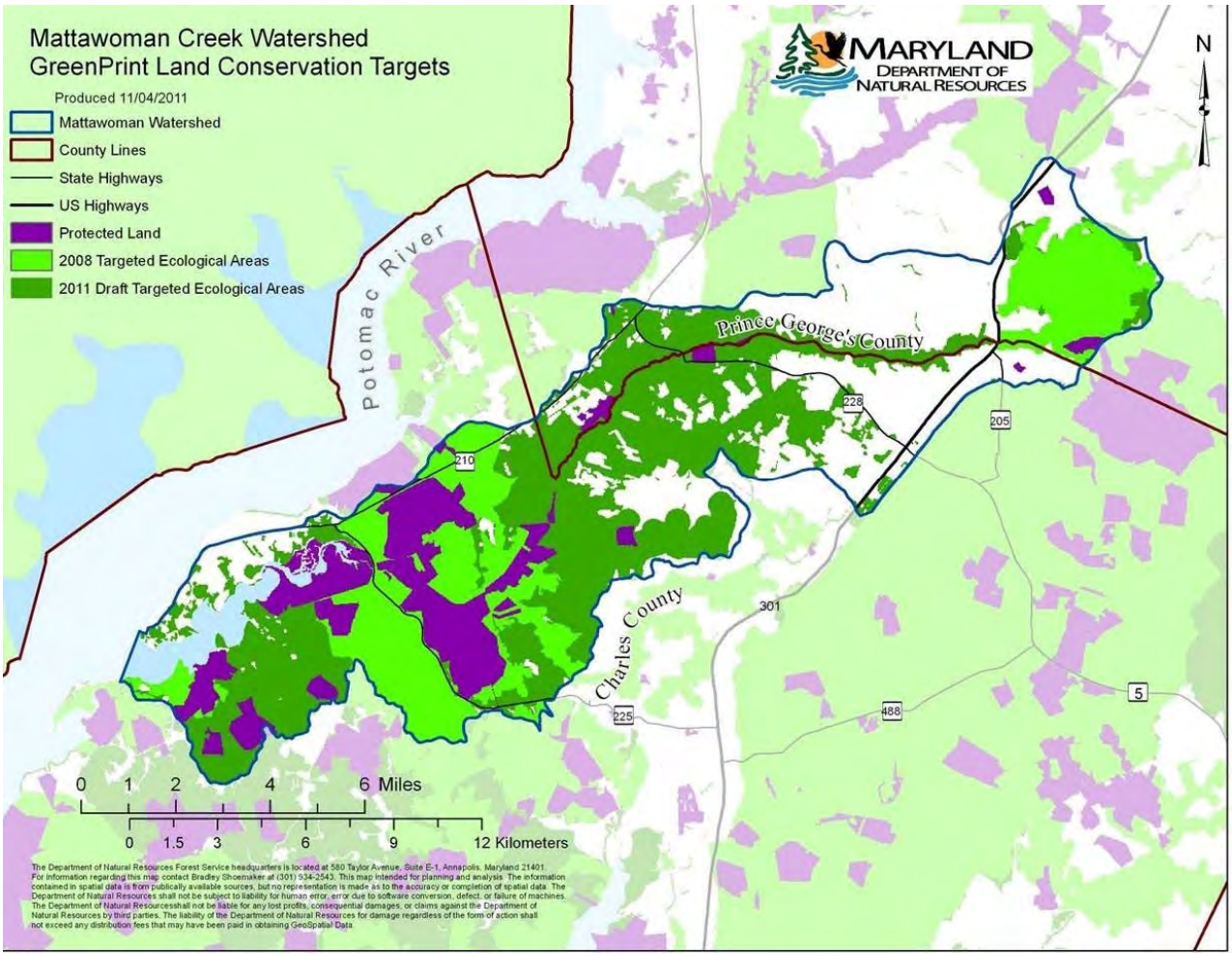
  Together, these areas are identified as conservation priorities by the Maryland Department of Natural Resources for natural resources protection. Program Open Space funds are targeted towards the acquisition and easements of these lands of statewide significance. While the additional sections in this report document the importance of specific resources and the need to protect these areas through a variety of conservation, restoration, management and land use tools, TEAs represent the Departments unified and comprehensive selection of conservation priorities for the purpose of POS expenditures.

  The GreenPrint land conservation targeting system was launched in 2008. At that point, the total TEA acreage within the Mattawoman Creek Watershed was 18,000 acres (see Figure 7). In 2011, MDNR updated the TEA analysis to include additional lands important for sustaining coastal ecosystem and fisheries. The acreage of land identified as a TEA expanded to 41,700 acres within the watershed,

highlighting the ecological importance at a Statewide scale of these watershed resources.

GreenPrint's Targeted Ecological Areas (TEA's) can serve as a guide to target land conservation efforts within the watershed in order to leverage Stateside Program Open Space funds and to match these funds with other government and non-profit conservation programs, such as those referenced on the GreenPrint website (http://www.greenprint.maryland.gov/programs.asp).

Figure 7



- **Re-evaluate Transferable Development Right (TDR) program opportunities for additional applications**

The County has utilized TDR for some time. Its application has been primarily targeted for the purpose of protecting farmland resources within the Agricultural Conservation District the primary designated sending area. The 2006 Land Preservation, Parks and Recreation Plan noted that "TDRs were considered an option to help preserve the Mattawoman's resources and still are." The plan goes on to note that given "the weak performance of the TDR program to date and the desire

to focus this program on agricultural land preservation rather than on natural resource conservation TDRs may be less of an option than once thought".

Recent evaluation of the TDR program by Dr. Tom Daniels indicated areas of forest cover may hold promise as TDR sending areas. Such areas dominate much of the Mattawoman Watershed, particularly the current Deferred Development District. As noted by Dr. Daniels:

"*Agriculture is not a robust industry in Charles County. The value of agricultural products sold in 2007 was less than $9 million. A stronger agricultural industry would make a TDR program more attractive to rural landowners. The 2006 Land Preservation, Parks, and Recreation Plan (LPPRP) notes that forestland covers as much as 197,000 acres of Charles County, and the value of standing timber is $233 million. Thus, the forest products industry has some very real value, and owners of forestland may be interested in selling TDRs to help maintain their forestry operations".*

The County should continue to re-examine the potential for application of a resource protection driven TDR program. In particular consideration should be given to designation of the current portions of the Rural Conservation Zoning District designated as RC and RC-D that are located within the Deferred Development District as sending areas. Much of the undeveloped land within the Mattawoman Watershed falls within this zoning classification. Development transferred out of this district will provide a long term reduction in the percentage of the watershed that will be converted to impervious surface. The County would need to give consideration to the spatial currency with which rights in this district would be distributed. Since owners in the District may have future development expectations but current zoning limits development to one dwelling unit per 10 acres, the area might be permanently rezoned. Such a rezoning might continue to permanently limit development to one unit per 10 acres, mandate clustering, but permit the transfer of rights on such lands at a spatial currency of one dwelling unit per 2 or 2.5 acres. Development pressure in the watershed would be dramatically reduced, long term protection of the watershed enhanced, and landowner value expectations could be realized through such a program. The County would need to examine the implications of transfer of such rights (likely to plan designated "Core" and "Activity centers" as receiving areas. If the number of rights generated exceeds the capacity of these areas to absorb them, then other alternatives would need to be considered.

Counties with successful TDR programs also tend not to give away higher density through re-zonings. Instead, re-zoning is considered only if the developer has purchased TDRs to "earn" the higher density. Thus the current by-right densities permitted in the Development District Zones and Activity Centers may need to be re-examined and reduced to give rise to TDR use. Finally, most successful TDR programs have used fairly strict zoning in the sending areas to limit the potential for development and give rise to TDR sales. For instance, in its sending areas, Montgomery County has agricultural zoning than allows only one house per 25 acres but development rights available for transfer are allocated at one house per 5 acres.

- **Consider creation of a TDR Bank to enhance TDR program function and use.**

  A TDR bank can offer the County certain advantages to increase potential use of the TDR program. Banks provide a convenience to developers since they can purchase TDRs from the bank rather than negotiate purchases with several individual landowners. They can also serve to stabilize TDR values and costs by setting a floor price for TDRs.

- **Modify TDR program provisions that allow re-purchase and transfer of development rights for use in sending areas.**

  The current county TDR program allows rural landowners who have sold TDRs to re-purchase them for use on rural properties in sending areas. This condition creates an impermanence syndrome results in some degree of loss of public trust in uncertainty of the results that may counter to their expectations. This condition also makes difficult any County efforts to target long term planning for preservation of contiguous blocks of farmland and forest land. Given the potential problems arising from this situation, the County should eliminate or substantially restrict intra-zone transfers within the sending area.

- **Permit and possibly require use of TDR's for Commercial Development.**

  Requiring the purchase and use/retirement of TDR's as a threshold requirement for any new Commercial development artificially stimulates the market for their purchase. Although it may increase the cost of commercial construction, it would support achieving a number of land preservation targets. Such an intiative might exclude re-development to provide an incentive to encourage redevelopment initiatives) within the Development Service District. Commercial developments less than a certain threshold size (e.g. 2,000 square feet in building size might also be exempted from such requirements to provide relief to small businesses.

- **Focus development within the Development Service District away from Mattawoman Resources and reduce densities in portions of the DSD, where Mattawoman resource sensitive areas co-occur.**

  This alternative is based on the notion that not all areas within the Development District or Deferred Development District are equal with regard to resources. Those areas more resource laden would be density limited. Criteria would need to be developed to serve as a basis for determining the location of these areas. GIS layering (e.g. the Watershed Registry) might support efforts to determine those areas where density reductions within the Watershed should be sustained.

  This effort would also suggest identification of additional "core", "activity center" or "Town Center" areas to concentrate development or re-development at greater density. Ideally the results would be provision of additional areas for smarter growth in higher density/mixed use form in targeted locations while at the same

time eliminating other areas that are dominated by more sensitive resources as candidate development areas.

- **Implement recommendations established by the US Army Corps of Engineers 2003 Mattawoman Creek Watershed Management Plan to implement low impact design techniques to minimizing the amount of impervious surfaces and promoting stormwater disconnects, and examining existing developments for stormwater retrofit opportunities.**

  The extension of protection of the Mattawoman Stream Valley was one of the key recommendations provided in the "Mattawoman Creek Watershed Management Plan" prepared by the Corps in 2003. This recommendation is already identified for implementation in the County's Comprehensive Plan, the County Land Preservation, Parks and Recreation Plan and identified as a recommendation in this report. Two additional recommendations identified in Corps plan include:

  - Implement low impact design techniques, minimizing the amount of impervious surfaces and promoting stormwater disconnects, and

  - Examine existing developments for stormwater retrofit opportunities.

  In recent years the County has stepped up efforts to require use of ESD (Environmental Site Design) principles in design of stormwater management plans and has completed retrofits for existing stormwater management in several locations. Therefore this recommendation is to sustain these efforts and continue to examine developments for stormwater retrofit opportunities within the Mattawoman Watershed.

- **Re-evaluate Lot Coverage and Impervious Surface limits and standards established in the County Zoning Ordinance.**

  Current zoning provisions in the County's Low Density Residential District (RL) zone district, which represents a substantial percentage of the watershed, permit impervious surface coverage of 30% of lots established for residential development. Areas zoned Medium Density Residential (RM) and High Density Residential (RH) permit lot coverage to be higher at 35 and 40% of sites proposed for residential use. The County Zoning Ordinance defines lot coverage to include only the "ground area occupied by all buildings within a lot". The addition of impervious surfaces associated with driveways and parking areas assure future impervious surfaces will be higher than the lot coverage limits. Institutional uses in the RL district are permitted to place up to 50% of sites in impervious surfaces. Commercial uses in the Residential Office (RO) district are permitted to devote 70% of sites to be developed in impervious surface. (See figure VI-4: Charles County Zoning Ordinance). In Commercial Zoning Districts the ordinance permits 80% or more of sites to be impervious (see figure VI-5: Charles County Zoning Ordinance). The County Business Park (BP), Light Industrial (IG) and Heavy Industrial (IH) Zone Districts, much of which are located south of Bryans Road, in proximity or adjacent to the Mattawoman Creek Resource Protection District (RPZ) also establish impervious surface ratios (ISR) that permit impervious surfaces to occupy between 50 and 70% of parcels so zoned (See figures VI-5 and VI-6 of the County Zoning Ordinance).

The County should re-evaluate these standards and where possible establish greater limits on the percent of sites in various zone districts that may be committed to impervious surface.

- **Target specific subwatersheds within the Mattawoman as Special Protection Areas (SPA's) where impervious surfaces associated with new development are limited or restricted to 10% or less, depending on the resource sensitivity.**

  In addition to modifying lot coverage and impervious surface standards the County may wish to consider standards that restrict levels of impervious surface for any future subdivision and development in the portions of the watershed. These may include sub-watersheds where Tier II streams are located or subwatersheds outside the PFA's where current levels of impervious surface are less than 5% today. By way of example, Montgomery County has established a Special Protection Areas (SPA's) program that limits lot coverage and restricts levels of impervious surface for future development in select targeted sub-watersheds to between 8 and 10% regardless of underlying zone densities permitted. Such an approach might be particularly appropriate in Mattawoman sub-watersheds where Tier 2 streams or other special habitat features are present. The County should consult with stream biologists at the Maryland Department of Natural Resources for additional guidance on specific recommended thresholds for Mattawoman Creek subwatersheds.

- **Establish a County Purchase of Development Rights Program to supplement the TDR options and create a dedicated funding source to insure its successful operation over time.**

Summary

As the County decides the best means to move forward and considers alternative processes and approaches to improve protection of the Mattawoman, the Task Force stands ready to provide any support requested and can assist in connecting the County with additional state and federal agency contacts. Our support can range from assisting the County in identifying resources in greatest need of protection, providing data concerning the current state of habitat for various plant and animal species or water quality to assisting the County in the practical evaluation of land use regulatory reforms or incentive programs to minimize the future impacts of development in the Mattawoman Watershed. We believe greater protection of these resources from future development will benefit the County in a number of ways. They include:

- Reducing the land area and costs associated with provision of and maintenance of future infrastructure to support development.
- Enhancing the character and qualities of the Mattawoman as one of the County's key eco-tourism resources which in turn supports a key component of the County's economic development program.
- Fostering a "smarter growth" pattern of future development that better implements County Planning objectives.

- Protecting the key features and characteristics of the Mattawoman ecosystem to sustain its qualities in future years as a key component of the Charles County Landscape.

Appendix A	Current County Comprehensive Plan and Land Preservation and Recreation Plan provisions in support of the Mattawoman's Protection.
Appendix B	Mattawoman Stream Valley Corridor Map

Appendix A: Current County Comprehensive Plan and Land Preservation and Recreation Plan provisions in support of the Mattawoman's Protection

Charles County has adopted a number of Planning documents and undertaken studies that establish formal adopted policies and objectives that clearly support the protection of the Mattawoman resources. Many of these well intentioned resource protection objectives are documented in language established in the 2006 County Comprehensive Plan and the 2006 County Land Preservation, Parks and Recreation Plan. They include:

- **The 2006 *Charles County Comprehensive Plan***

This County Plan, adopted by the County Commissioners in April, 2006, establishes a number of objectives and policies in support of the protection and enhancement of Mattawoman Resources. These objectives and policies are both broad and very specific in nature. Those which are more specific in nature, or particularly relevant to the Mattawoman, are highlighted in bold text in sections of the plan which follow. Pages where these references can be found include:

Pages 1-1 and 1-2
"This Plan provides the basic policy framework to manage and direct future development in Charles County. It is designed to deal with problems that are immediate in nature as well as to provide the planning for longer-range actions and policies. As such, the Plan is designed to address the County's needs through the year 2025 and thereby provide the county with a means to ensure orderly, managed growth and development throughout the planning period. The general thrust or "theme" of the plan is that the County should endeavor to preserve and enhance the present "character" of the County and improve the quality of life for its citizens while maintaining a pace of growth and development which is managed. **This general theme, when interpreted in terms of land use, says that the County should adopt a "managed growth" philosophy toward the use of the land over which it has zoning authority and that development should be of a controlled nature, channeled into the most appropriate areas and discouraged in other areas. (Bold text for emphasis added)"**

Page 1-2
"This theme, together with objectives more specifically framed in subsequent elements of this Plan, serve as formally adopted policies regarding Charles County's future. They provide guidance for public decisions concerning how development will be managed or regulated, where and how it should occur, and where capital improvements and public services should be provided to support it."

Page 1-2
"The zoning ordinance will continue to be the chief means through which this Plan is to be implemented. The ordinance prescribes ways in which lands located within the County may or may not be used. It prescribes a series of zoning districts and, for each district, enumerates uses permitted and **establishes performance standards for development. The standards are designed to achieve objectives established in the Plan, including protection of sensitive environmental features,** protection of productive farmland, and enhancement of the built environment."

Page 3-1
Plan Objective #3.4
"**Protect environmentally sensitive areas** in using the County's abundant waterfront. Guide development away from areas vulnerable to natural hazards."

Page 3-2
Objective #3.12

"**Require residential development to be** efficient, serviceable, and **designed to protect and retain portions of open space that will assure protection of sensitive resources."**

Page 3-9
"**The County must ensure that the conversion of land from rural to development in the Development Districts does not exceed the capacity of public services and facilities. At the same time, natural resources such as Mattawoman Creek and elements of rural character that are considered desirable within the Development Districts must be protected"**.

Page 3-13
"Consequently, the County recommended that the Deferred Development District be enlarged from 5,000 acres to around 18,000 acres in an area extending from east of Indian Head to Waldorf south of Mattawoman Creek and Billingsley Road. The recommendation was adopted by Ordinance Number 00-93 in December 2000 and implemented through the RC(D) zoning district…"

This 2006 Plan update recognizes the Deferred Development District that was created by the Comprehensive Zoning in 2001, and the area is shown on the Land Use Concept Plan. **The purposes of this district are to maintain low-density residential development (one dwelling unit per 10 acres), and preserve the rural environment, natural features and established character of the area. A provision of Ordinance Number 00-93 is for the County Commissioners to reconsider all RC(D) zoning on a not less than five-year basis as part of, or concurrent with, the update of the Comprehensive Plan.** This reconsideration has taken place as part of this 2006 Comprehensive Plan update with a recommendation that no changes be made to the Deferred Development District (see discussion at the end of this chapter)."

Commentary:

With regard to this provision in the Plan it is important to note that the County is currently engaged in the process of updating the plan and will therefore be giving reconsideration to the provisions and land area included in the RC (D) zone district as part of the update process.

Page 3-16
"This district accommodates residential densities up to one dwelling unit per three acres with cluster development practices permitted. Within the Rural Conservation District are existing scattered clusters and individual non-farm residences on small parcels of land. Although this may satisfy some limited rural housing need or demand, the prime objective of this District is not to accommodate such development".

"The recommendation in Chapter 9 to consider mandatory clustering in the County's agricultural area (AC) would also apply in this RC District."

Page 8-2
"Natural Resource Protection: Goal
The overall goal of the Natural Resources Protection element of the Plan is to:
Protect the natural resources and enhance the environmental features of the County".

Natural Resource Protection: Objectives

"8-1 Cooperate in efforts to improve and protect the water quality of the Chesapeake Bay and its tributaries through support of the state's Tributary Strategies and enforcement of the County's Critical Area Program that are designed to reduce pollution loads in the Bay's subwatersheds".

"8-2 Preserve the Resource Protection Zone to ensure protection of sensitive inland and environmental features in stream valleys outside the Critical Area such as the Mattawoman Creek, Zekiah Swamp Run, Gilbert Swamp Run, Port Tobacco River, Nanjemoy, Swanson, and Indian Creeks' watersheds".

"8-3 Maintain a safe and healthy environment by protecting air, water, and land resources, and preventing the degradation of those resources from pollutants".

“8-4 Place special emphasis on watershed management to balance the protection of the Mattawoman Creek’s natural resources and water quality with the County’s development plans”.

“8-6 Enhance the County's environmental preservation and conservation policies through administrative mechanisms including subdivision regulations, sediment and erosion control, environmental review processes, development regulations, and zoning”.

“8-7 Protect ground water resources”.

“8-9 Encourage best management practices including low-impact development techniques to minimize the impacts of development on the natural environment.”

Page 8-3
“8-10 Through public and private resources, purchase or otherwise acquire conservation easements to preserve environmentally sensitive resources. Develop parks, recreation and open space plans in conjunction with stream valley protection objectives.”

“8-11 Restrict development within 100-year floodplains”.

“8-12 Conserve remaining wooded areas in the County, and require new plantings to support other natural resource objectives including enhancing riparian buffers, reducing erosion and sedimentation, improving air quality, and mitigating the effects of stormwater runoff.”

“8-13 Require special engineering and construction standards when development occurs on erodible soils, steep slopes, or areas requiring special geotechnical consideration.”

“8-14 Protect the habitats of rare, threatened and endangered species to maintain their long-term survival.”

“8-15 Conserve large tracts of contiguous forestland and forest interior dwelling bird habitat determined by the County to be of local significance due to their wildlife habitat value”.

“8-16 Promote wildlife education through the development of nature centers and park visitor centers to explain the importance of preserving natural habitat areas.”

“8-17 Place a high degree of restriction on the use of waterfront land in the form of low residential densities, and high levels of protection for forest land and agricultural land regulated under the Chesapeake Bay Critical Area Program”.

“8-18 **Protect instream and stream bank habitats of anadromous fish spawning waters. Promote land use policies in the watersheds of spawning streams that minimize adverse impacts to aquatic resources”.**

“8-19 Protect shoreline habitats such as tidal wetlands, shellfish harvesting areas, colonial water bird nesting sites, and waterfowl staging and concentration areas through the habitat protection policies established in the County's Critical Area Program”.

“8-21 Improve and maintain water quality in coastal, estuarine, and upper basin tributary streams”.

“8-30 Promote awareness of environmental quality issues through public and school environmental education programs, to cultivate a basic understanding of the earth and its valuable resources”.

Page 8-9
“Unique environmental habitats
Zekiah Swamp and Mattawoman Creek
“In addition to the Chesapeake Bay Critical Area, the Zekiah Swamp and **Mattawoman Creek are recognized as areas of unique ecological importance by the State of Maryland (see Figure 8-3). The areas contain**

extensive tidal and non-tidal wetlands, floodplains and adjacent forest habitat. Both the Zekiah and Mattawoman were designated Areas of Critical State concern in 1981".

Page 8-10
"The tidal wetlands of the Mattawoman are essential nursery areas for numerous species of fish. The main stem and tributaries of the creek are among the Potomac basin's most important spawning waters. Since the Mattawoman drains most of the County's Development District land use activities have the potential to significantly affect Mattawoman Creek resources".

Page 8-20
Mattawoman Creek Watershed Management Plan

"In 2003 the US Army Corps of Engineers completed a watershed management plan for Mattawoman Creek in Charles County. The plan was developed in response to concerns that development within the Development District had the potential to significantly affect Mattawoman Creek resources, with water quality and aquatic biota the primary concerns. The purpose of the plan was to balance the protection of the Mattawoman Creek's natural resources and water quality with the development plans of the County."

"A model was developed for the plan to assess the future pollutant loads within the Mattawoman Creek in a variety of future land use conditions and time scales. **Based on the model results, phosphorous, nitrogen, and sediment loads were projected to increase dramatically, with increases of over 50 percent by 2020 under the build-out scenario – the maximum potential development under current zoning practices**. To allow for the continued development of the Mattawoman Creek Watershed, while emphasizing natural resource protection, the Corps developed a management plan with three specific recommendations:

- **Delineate and protect the stream valley – defined as the top of the slope to the stream.**
- Future development should implement low impact design techniques**, minimizing the amount of impervious surfaces** and promoting stormwater disconnects.
- Examine existing developments for stormwater retrofit opportunities".

Page 8-26
"Implementation strategies:
The following is a summary of the implementation techniques recommended to continue to protect and enhance Charles County's natural resources".

1. **"Mattawoman Creek Watershed Protection. As discussed under watershed management and protection, a watershed management plan for Mattawoman Creek in Charles County was completed in 2003. The three key recommendations were to:**
   _ Delineate and protect the stream valley – defined as the top of the slope to the stream.
   _ Implement low impact design techniques, minimizing the amount of impervious surfaces and promoting stormwater disconnects, and
   _ Examine existing developments for stormwater retrofit opportunities.
   Implementation of these recommendations will be through a combination of regulatory, capital, and programmatic approaches".

• The 2006 *Charles County Land Preservation, Parks, and Recreation Plan*

The County Land Preservation, Parks, and Recreation Plan also contains a number of references that support the protection of the Mattawoman. Many of these references take the form of specific policies and objectives. References cited herein include:

page V-3
c. Protect sensitive resources through regulations and special programs
Sensitive resources are protected through a broad range of regulations and programs. These are catalogued in detail in the Comprehensive Plan (Chapter 8) and include zoning and subdivision regulations & site plan review; the Resource Protection Zone (RPZ) geared to protecting streams and their buffers; floodplain management; steep slope protection regulations; the Critical Area Program; regulations to protect the habitats of rare, threatened and endangered species; grading & sediment control; stormwater management; wetland protection programs; forest protection; and watershed management and protection.

Among the 2006 Comprehensive Plan update's natural resource recommendations are to:

• **Increase protection of the Mattawoman Creek watershed (see below under subsection 5).**
• Develop a Green Infrastructure strategy (see below under subsection 3).
• Consider adopting an urban forest canopy coverage goal. This was identified as an objective of the Waldorf sub-area plan.
• Investigate strategies under the County's forest conservation ordinance to retain as much of the forest and tree cover as possible within urban areas".

pages V-6 &7
"5. Other Regulatory or Management Programs
Development Clustering. Clustering of residential development is encouraged within the Development District. Since the 1992 comprehensive zoning, most subdivisions in the Development District have followed cluster development procedures that encourage better design than development regulations that apply to conventional subdivisions. The procedures assist in the provision of open space, active and passive recreational areas, landscaping and buffering. The **2006 Comprehensive Plan update recommends the County consider mandatory clustering in the County's rural area (AC and RC Districts)".**

"Watershed Planning. A notable planning effort completed in 2003 was a watershed management plan for Mattawoman Creek in Charles County by the US Army Corps of Engineers. The plan was developed in response to concerns that development within the Development District had the potential to significantly affect Mattawoman Creek resources, with water quality and aquatic biota the primary concerns. The three key recommendations were to:

- **Delineate and protect the stream valley – defined as the top of the slope to the stream, and sometimes referred to as the Corps valley (Figure V-3).**

- Implement low impact design techniques, minimizing the amount of impervious surfaces and promoting stormwater disconnects, and

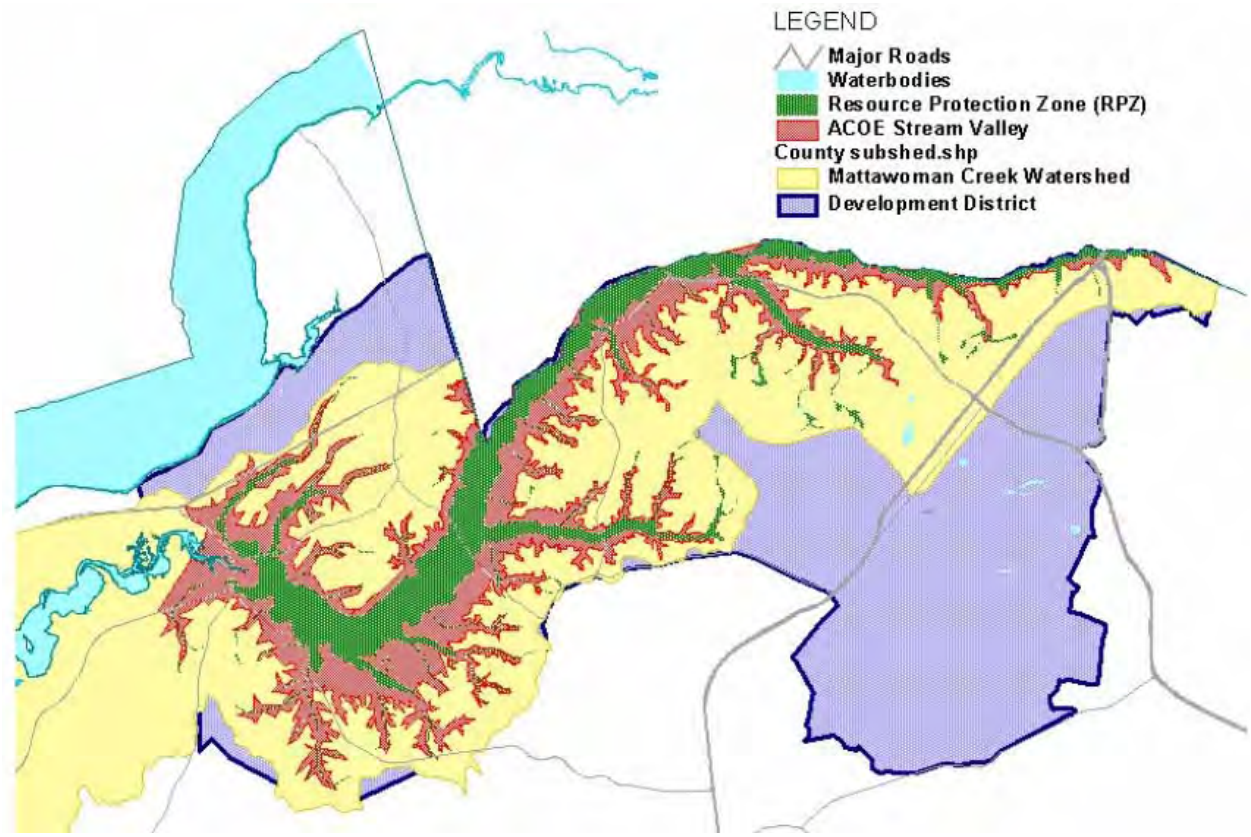
- Examine existing developments for stormwater retrofit opportunities".

Page V-12
"Summary of needed improvements in the implementation program
In summary, the needed improvements in the implementation program are as follows:
- Develop a Green Infrastructure strategy as recommended in the Comprehensive Plan.
- **Develop a program to implement the Mattawoman Creek Watershed Management Plan**
- Complete protection of the Zekiah Swamp Watershed Rural Legacy Area.
- **Strengthen efforts to reduce the impacts of rural development on natural resources in rural parts of the County.**

- **Strengthen the County's role in forest land conservation.**
- **Increase funding for natural resource conservation.**
- Increase the pace of capital projects and program development activities for eco-tourism and resource-based recreation".

Page V-13
"Create a natural resource land conservation focus area
Similar to the target area for agricultural land preservation discussed in Chapter IV, **a focus area for natural resource conservation is recommended, shown in blue on Figure V-5.** The focus area encompasses the main concentrations of natural resource areas along with the unprotected portions of green infrastructure. The area does include some agricultural land worthy of preservation, but the main focus in this area would be natural resource conservation".

Figure V-3 Mattawoman Creek Valley in Charles County
Note: ACOE Stream Valley refers to Army Corps of Engineers valley, see text



page V-14
4. "Focus special attention on protecting the Corps valley. Better integration of watershed perspectives into planning."

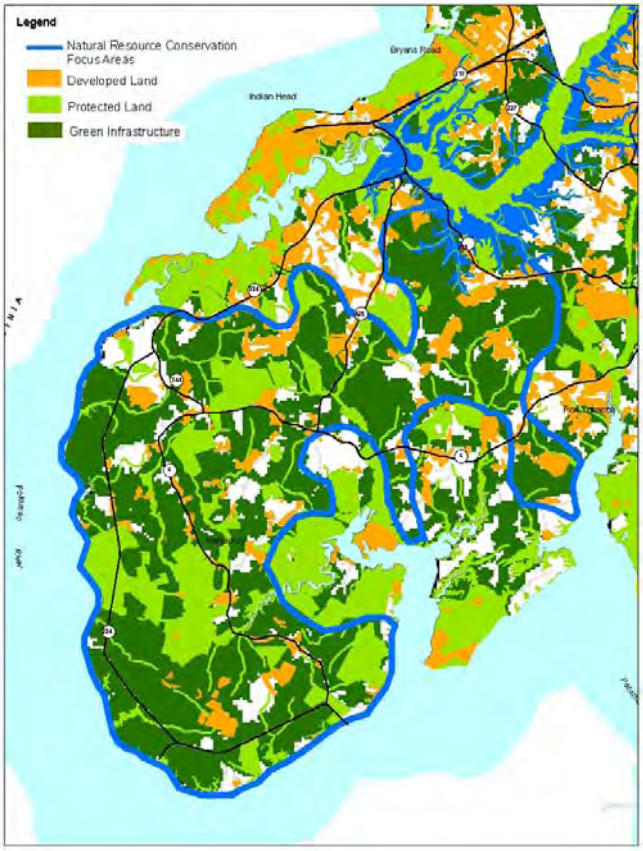
"The Mattawoman Creek Corps valley was identified in the Corps' 2003 Mattawoman Creek Watershed Management Plan**. It is a wider section of the Mattawoman stream valley than is currently protected by the resource protection zone, and is shown in blue on Figure V-5 adjoining the natural resource focus area (see also Figure V-3)**. The Corps valley totals approximately 12,900 acres in Charles County of which approximately 8,970 acres are currently protected or developed leaving approximately 3,900 acres unprotected and undeveloped. Conserving this area will be a major challenge as it represents almost 20 percent of the remaining undeveloped/unprotected land in the Development District.

TDRs were considered an option to help preserve this area and still are (see Appendix D). However, given the weak performance of the TDR program to date and the desire to focus this program on agricultural land preservation rather than on natural resource conservation TDRs may be less of an option than once thought.

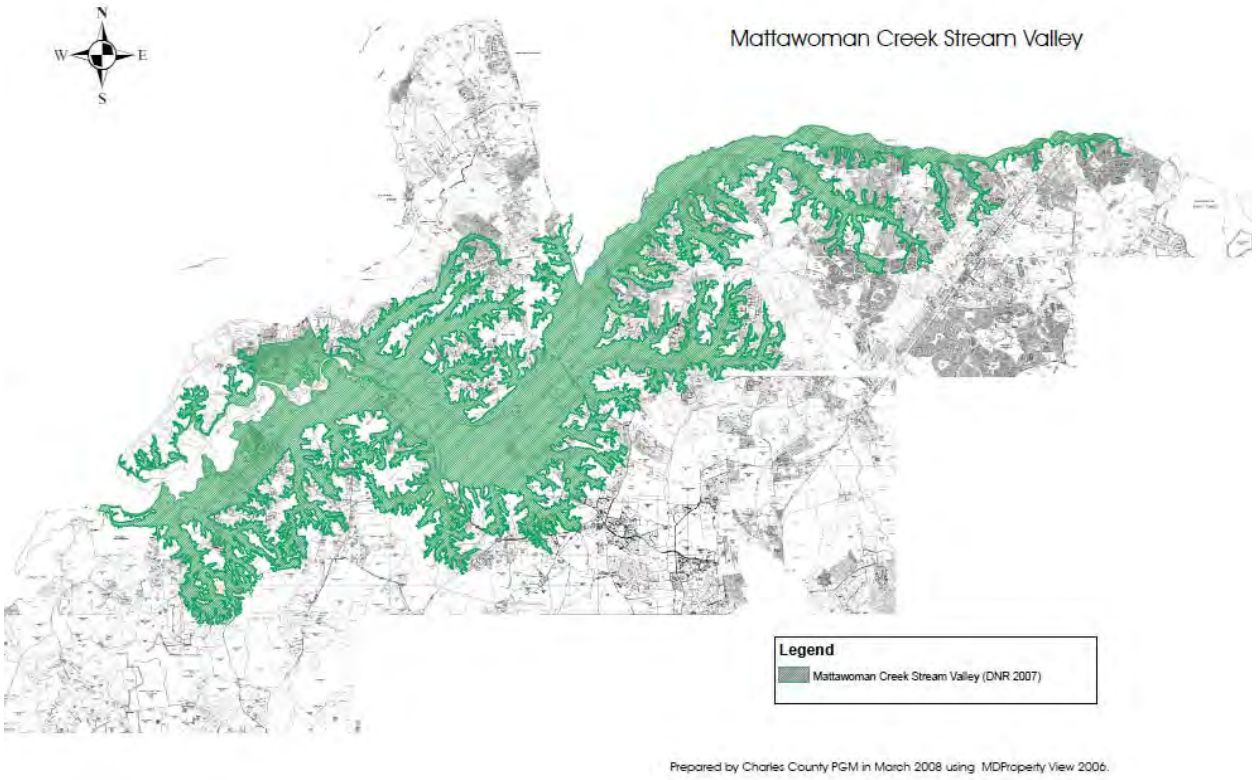
A combination of enhanced cluster development provisions, preservation easements, and low impact development practices may be needed in this area, although consideration will also be given to using commercial TDRs. **The County's varied and various watershed planning efforts (Mattawoman Creek, Patuxent River, Port Tobacco, Wicomico River) need to be better translated into planning and zoning actions and development review processes especially where watershed protection recommendations may conflict with other land use and development policies and practices".**

Figure V-5 Natural Resource Land Conservation Focus Area

Figure shown, taken from 2006 Charles County Land Preservation, Parks and Recreation Plan



Appendix B: Mattawoman Stream Valley Corridor Map



Section 2: Mattawoman Creek Fisheries Resources

Recommendations to support County Planning Program Direction from the Fisheries Resources Section Workgroup

Jim Uphoff, (MDNR), Margaret McGinty (MDNR), Ross Williams (MDNR), Mary Groves (MDNR), Justin Falls (MDNR), Joe Love (MDNR), Nancy Butowski (MDNR), Marek Topolski (MDNR), Tom Parham (MDNR), Steve Minkkinen (MDNR), Bob Sadzinski (MDNR)

Part 1: Planning for Growth in Mattawoman Creek: What it Means to Fisheries

Planning for growth is very important for Mattawoman Creek's fish and fisheries because development affects water quality and quantity. Problems from development flow from Mattawoman Creek's stream to its estuary.

Natural land allows rain and melted snow into the ground because it is porous and this water slowly discharges through the ground into streams (NRC 2009). Swamps and marshes store surface runoff water temporarily and allow it to slowly flow back into streams. Development turns natural areas into paved surfaces, buildings, and compacted soils that surface water cannot penetrate. These hard (impervious) surfaces increase runoff and decrease water that soaks into the ground (NRC 2009).

Impervious surface increases flow extremes (lower lows and more flooding), erosion, and sediment (NRC 2009; Wheeler et al. 2005; Uphoff et al. 2011). As trees are lost, runoff temperature increases. Nutrients from developed lands can be as plentiful as from agriculture and cause algae blooms that deplete oxygen (NRC 2009). In winter, more roads require more salt that pollutes streams and kills freshwater organisms, including fish (Wheeler et al. 2005). Other pollutants such as toxic metals (lead for example) and organic pollutants (oil, grease, and pesticides) enter waterways in urban runoff and wastewater (Paul and Meyer 2001; Wheeler et al. 2005). Some compounds that enter wastewater treatment facilities may not be removed. These compounds may reduce success of fish spawning and make fish less safe to eat. Fish become less abundant and less diverse in polluted waters that result from high development and impervious surface (Wheeler et al. 2005; Uphoff et al. 2011a).

Maryland Fisheries Service has chosen counts of structures per hectare (1 hectare = 2.47 acres) from Maryland Department of Planning (MDP) tax map data as our indicator of development. Tax map indicators are standardized, annually updated, readily accessible and based on observed quantities (structure counts or structure area). Tax map indicators of development are strongly related to impervious surface estimated from satellite images. Impervious surface estimates made by different satellite image interpretation techniques generally agree in trend, but may indicate different percentages of impervious surface. The MDP annually updates tax maps for Maryland's 23 counties, while impervious surface estimates are made intermittently from satellite images. We estimate that Mattawoman Creek had about 10-15% of its watershed in impervious surface in 2009 based on several statistical methods that convert (MDP) property tax map structure counts to percent impervious surface estimates compatible with Towson University satellite interpretation.

Structures per hectare in Mattawoman Creek's watershed equaled 0.88 in 2009. We have compared this level of development to provisional levels of watershed development that are favorable and safe (a target), or unfavorable, unsafe, and to be avoided (a threshold) for productive fisheries and aquatic habitats. There are additional impacts to aquatic biodiversity that are apparent at even lower levels of watershed development that are described in DNR's guidelines on impervious surface thresholds as presented in Section 1: Recommended Land Use and Growth Management Initiatives, page 19.

Fisheries managers do not have authority to manage land-use, so they have to consider managing fish differently at different levels of development. The target level of development for fisheries is indicated by about 0.4 structures per hectare or less. This target level of development in Maryland is characterized by forests, working farms, and wetlands that support productive fish habitat and fisheries. Land-use at this level does not undermine effectiveness of harvest controls for sustaining fish populations. Preserving watersheds at this level of development would be ideal. Once above this level of development, increasing consideration has to be given to habitat preservation and revitalization. Lowering harvest levels may be able to offset habitat degradation.

The threshold of development of 0.7 structures per hectare represents a suburban landscape where serious aquatic habitat degradation becomes apparent. At this point, conservation of remaining natural lands and habitat revitalization will be the primary tools for fishery sustainability. Harvest restrictions may be ineffective in stemming fishery declines. By 1.2 structures per hectare, serious habitat problems make fish habitat revitalization very difficult. Managers must deal with substantially less productive fisheries. Cities consist of even higher levels of development and most aquatic life cannot tolerate resulting habitat conditions (NRC 2009). However, concentrating growth into already developed areas saves rural lands that create the best conditions for fish. Well-planned development lessens the need for cars and roads, and saves open lands needed to support healthy watersheds and waterways.

Maryland Fisheries Service realizes that the habitat of fish and future of fishing is linked to conserving forests, wetlands, and working farms. Conserving these areas to the maximum extent possible for fisheries is the best advice we can give to any county as they renew their comprehensive development plan.

Part 2: Assessment of the Quality of Mattawoman Creek's Fisheries Resources and Recent Trends.

Mattawoman Creek's Fisheries

Mattawoman Creek supports commercial and recreational fisheries, either directly from the catchable sized fish that reside there or as a productive nursery for fish in their first years of life. Fishing provides affordable protein for those that eat their catch, income to business people selling catch or the catching experience (guides), and an opportunity to enjoy nature for those who mostly return their catch to the water.

Based on our observations, Mattawoman Creek supports one of the steadiest and busiest recreational fishing destinations in Maryland. There is ample access for both shore-based and boat recreational anglers in Mattawoman Creek. Shore access is particularly important for low-income

anglers and is limited in Maryland. Recreational anglers visiting Mattawoman Creek may have as little invested as a rod, reel, hooks, and bait to as much as trucks, trailers, and tackle tailored for largemouth bass fishing that have a combined worth of more than $100,000. Beyond purchase of a fishing license, bait, tackle, and boats, additional expenses occur for vehicles capable of towing boats, fuel, insurance, vehicle and boat maintenance and repairs, meals, and lodging for out-of-towners. Recreational fishing in Mattawoman Creek generates business opportunities for tackle shops and a cadre of largemouth bass guides. Mattawoman Creek is often a featured stop for national largemouth bass fishing tournaments sponsored by large businesses such as BASS and FLW. These tournaments feature hundreds of contestants, draw thousands of spectators, and are covered nationally in print, on the internet, and on television. An influx of visitors is drawn to Mattawoman Creek because of bass tournaments and many out-of-towners stay in local hotels and eat in local restaurants. These nationally covered tournaments provide free advertising that draws additional anglers from all over the country. Yellow perch fishing in Mattawoman Creek and fishing for large (50+ pound) blue catfish in nearby Potomac River waters have garnered national attention in *In-Fisherman* magazine. An opportunity to catch northern snakeheads in Mattawoman Creek has drawn anglers and guides as well.

Commercial catches may be sold for consumption or bait through local, interstate, or even international markets. Commercial fishermen are not limited to fishing in Mattawoman Creek and roam a large area of the tidal Potomac. Some fish harvested (carp, gizzard shad, eels, and even snakeheads), but not all (catfish, striped bass, yellow perch, and white perch), are of limited interest to recreational anglers. During 2008-2010, top commercial fish harvested in the same region of the tidal Potomac River as Mattawoman Creek (Route 301 Bridge and upstream) were Atlantic menhaden (a baitfish), blue catfish, striped bass, and channel catfish (88% of 2.25 million pounds of all finfish species harvested in the region over these three years; Ellen Cosby, Potomac River Fisheries Commission). Income generated from the sale of seafood purchases workboats, marine engines, trucks, refrigerators, plus costs for nets and other fishing supplies, labor, baskets, boxes, and business-related taxes and licenses.

Until recently, fisheries managers have largely focused on providing access, managing harvest, and minimizing conflicts among angler groups fishing Mattawoman Creek. Angler conflicts have occurred between tournament-based and non-tournament anglers, and recreational and commercial fishermen. These conflicts may become more contentious as development occurs and productive habitat is undermined. Decline of habitat reduces catches and fishing opportunities and increases complaints about fishing quality. Expenditures on habitat restoration and hatchery activities increase, while fishing license revenues decline. Fisheries Service has identified three major habitat-related fisheries management issues in Mattawoman Creek: conservation of the largemouth bass fishery, loss of anadromous fish spawning and nursery habitat, and a decline of the tidal fish community.

Largemouth Bass in Mattawoman Creek

A little under half of Maryland's freshwater anglers target largemouth or smallmouth bass (collectively, black bass; USFWS 2008). The specific contribution by black bass anglers to the economy of Maryland is not known. However, during 2006 anglers spent and estimated $568,000,000 on fishing in Maryland and nearly 3-times as many days were spent fishing for black bass than any other species in fresh or saltwater in Maryland (USFWS 2008). Thus, black bass angling likely contributes heavily to the amount of money anglers spend in Maryland. In Charles

County, fishing, boating and water-related activities generated more than $40 million per year and were the largest visitor and local resident activity under tourism (Reardon 2007).

More largemouth bass fishing tournaments occur at Smallwood State Park (on Mattawoman Creek) than anywhere else in Maryland. Across a full year (1999), Charles County's Office of Tourism estimated that tournament fishing for largemouth bass generated $7,000,000 there (J. Roland, unpublished, Charles County Economic Development Department). In 2010, a single large FLW tournament based at Mattawoman Creek, but also fishing the tidal Potomac River, generated $700,000 (D. Simmons, FLW Outdoors, personal communication). In a study conducted in Texas, most revenue from black bass tournaments went to counties or cities (Chen et al. 2003).

The fate of released bass is very important to the Potomac River fishery. Largemouth bass fishing tournaments occur nearly every weekend from April to October and thousands of fish are released into Mattawoman Creek at the marina. This continuous release of bass replenishes Mattawoman Creek. These fish require suitable habitat quality and oxygen levels to recover from handling stress. Fish kills of largemouth bass have been observed after tournaments in recent years, with counts of as many as 600 dead bass. Multiple causes were suspected, but oxygen readings were low.

In Maryland's portion of Chesapeake Bay, the most productive largemouth bass fisheries occur in fresh-tidal areas that have stable sediment levels, salinities, and nutrients (Love 2011). High sediment loads from development can smother bass nesting sites. Sediment and algae blooms fueled by nutrients carried by sediment cloud the water and reduce growth of underwater grasses that are important for hiding and feeding. Feeding success of largemouth bass may be reduced by poor water clarity that reduces ability to see prey. In addition to sedimentation and water clarity, low oxygen levels can threaten the vitality of largemouth bass. Low oxygen can occur when nutrient-rich waters promote substantial growth of primary producers such as algae and grasses. A continuous water quality monitoring device in a dense submerged aquatic vegetation (or SAV) bed at the Sweden Point Marina has detected episodes of critically low oxygen during summer. Fisheries Service purchased and deployed an oxygenator at the marina in 2011.

Fisheries managers are increasingly concerned that the largemouth bass fishery in Mattawoman Creek will decline as development increases. Limiting future suburban sprawl, redeveloping existing areas into livable, more densely populated urban neighborhoods that absorb more people per area, and conserving remaining natural areas and working farms are important for maintaining Mattawoman Creek's high quality bass fishery.

Anadromous Fish Spawning and Nursery Function

Mattawoman Creek's anadromous fish, herring (alewife and blueback herring primarily), white perch, and yellow perch spawn in Mattawoman Creek's stream and upper tidal reach during March through May. A 1971 survey detected herring spawning upstream as far as Billingsley Road; white perch spawning was documented as far upstream as Route 227; and yellow perch spawning was detected at Route 225 (Uphoff et al. 2011b). Little change in anadromous fish stream spawning in Mattawoman Creek was indicated between 1971 and 1989-1991 as structures per hectare went from 0.16 to 0.45; however, by 2008-2010 stream spawning by all three groups became more sporadic: herring spawning sites were reduced from 6 locations to 2-4; white perch sites fell from 1-2 to 0-1; and yellow perch spawning at Route 225 was not detected in 2009, but

was detected in 2008 and 2010 (Uphoff et al. 2011b). The percentage of stream samples with herring eggs dropped from nearly 70% in 1991 to 8-40% during 2008-2010 (J. Uphoff, MDDNR, unpublished analysis).

Other case studies indicate that stream spawning of white perch, yellow perch, and herring diminished with increasing development. Between 1971 and 2008-2009, stream spawning of anadromous fish largely ceased (5 sites to 0-1) as Piscataway Creek developed from 0.48 structures per hectare to 1.41 (Piscataway Creek is adjacent and closer to Washington D.C. than Mattawoman Creek; Uphoff et al. 2011b). Stream surveys of anadromous fish spawning in Bush River (Maryland, north of Baltimore) during 1973 (0.30 structures per hectare) and 2005-2007 (1.15-1.21 structures per hectare) did not detect a change in herring spawning sites; herring spawning occurred at 8 sites in 1973 and 7-11 sited during 2005-2007 (McGinty et al. 2009). However, spawning sites generally declined for white and yellow perch (from 8 to 0-2 for white perch and from 4 to 0-4 for yellow perch; McGinty et al. 2009). We compared annual percentages of samples with anadromous fish eggs or larvae collected during 2005-2008 between relatively undeveloped section of Bush River's watershed (Aberdeen Proving Grounds or APG; approximately 0.25 structures per hectare) and the remainder of the watershed that was highly developed (1.24-1.30 structures per hectare). Where development was low, herring eggs and larvae were twice as likely to be present in stream samples and yellow perch larvae were 20-times more likely. White perch spawned in streams in APG, but eggs and larvae were not found in streams in the developed portion of Bush River's watershed (J. Uphoff and M. McGinty, unpublished analysis). Alewife and white perch egg and larval densities in Hudson River tributaries likewise declined strongly with development (Limburg and Schmidt 1990).

Loss of stream spawning in Mattawoman Creek reflected changes in stream flow and water chemistry. When structures per hectare were less than 0.7 structures per hectare, there was no relationship between flow magnitude and flow variability for Mattawoman and Piscataway creeks (1950-2009). However, when there were more than 0.7 structures per hectare, flow magnitude was negatively related to flow variability. Mattawoman Creek's flow pattern shifted from that of a rural watershed with a substantial groundwater influence to a suburban one with mostly surface flow. Urbanization affects both discharge and sediment supply of streams that, in turn, affects location, substrate composition, and success of spawning. Estimated loads of sediment in Mattawoman Creek were elevated in comparison to those for the agricultural Choptank River watershed (Gellis et al. 2008).

Elevated conductivity (a measure of water's ability to conduct electricity) has emerged as an indicator of urbanization (Uphoff et al. 2010). Most inorganic acids, bases, and salts are relatively good conductors of electricity. Elevated conductivity in developed areas is related primarily to increased roads and use of road salt. Conductivity measurements in mainstem Mattawoman Creek were elevated beyond historic levels during 2008-2010 (particularly in 2009) and increased with distance from where the stream and estuary met. During 1970-1989, Mattawoman Creek's stream mouth and the stream in the vicinity of Waldorf were areas of elevated conductivity, while conductivity was low for about six miles in between (Uphoff et al. 2010).

Use of salt as a road deicer leads to both acutely toxic "shock loads" of salt and elevated average concentrations that are associated with decreased fish and benthic organism abundance and diversity (Uphoff et al. 2010). Elevated stream salinity increases osmotic stress of fish eggs and larvae and lowers survival. Commonly used road salt anti-clumping agents can break down into toxic cyanide under exposure to ultraviolet light and have been implicated in fish kills. Changing

stream chemistry may disrupt upstream migration of anadromous fish. Physiological details of spawning migrations of herring and perch are not well described, but homing migration in other anadromous fish has been attributed to chemical composition, smell, and pH of natal streams (Uphoff et al. 2010).

Absence of detectable stream spawning does not necessarily indicate an absence of spawning in the estuarine portion of these systems. Neither yellow perch nor white perch appear to be dependent on stream spawning, but stream spawning may confer benefit to the population through expanded spawning habitat diversity (Kraus and Secor 2004). Stream spawning is very important to shore anglers because yellow perch become accessible. The effect of lost stream spawning on the other anadromous species may be different as both blueback and alewife herring ascend streams much further than yellow or white perch (Uphoff et al. 2011b). Shore access to fish such as yellow perch, white perch, and herring during their spring spawning runs depends on maintaining a healthy stream.

The upper portion of Mattawoman Creek's estuary (Indianhead to Route 225) is an important nursery for yellow perch larvae and it is monitored (as are other areas) by towing a conical, fine-mesh nets during late March to late April (Uphoff et al. 2011b). The proportion of tows with yellow perch larvae is a simple measurement of larval relative abundance that integrates egg abundance and hatching success, and survival of early larvae. These are important processes that vary naturally, but they are also negatively affected by contaminants, sediment, and disruption of zooplankton production.

Based on data collected throughout Chesapeake Bay since 1998, development is negatively related to the proportion of tows with yellow perch larvae (larval index) and the larval index was typically higher in fresh-tidal than brackish subestuaries (Uphoff et al. 2011b). Larval indices for Mattawoman Creek during 2008-2010 were within the same high range as minimally developed Nanjemoy Creek in two of three years and were higher than indices from more developed Piscataway Creek.
Yellow perch larval feeding success in 2010 in five Chesapeake Bay subestuaries, including Mattawoman Creek was negatively influenced by development. Feeding success in Mattawoman Creek was lower than less developed Nanjemoy Creek and higher than more developed Piscataway Creek. Adequate zooplankton supply and successful feeding of larvae are considered critical factors for survival (Uphoff et al. 2011b).

Years of high spring flow favor anadromous fish recruitment in Chesapeake Bay and may represent favorable episodes that deliver accumulated organic matter from the watershed to the estuary (Uphoff et al. 2011b). This organic matter fuels higher production of zooplankton that larvae feed on. Land-based organic matter largely supported one of the most successful year-classes of American shad in Virginia's York River, while lesser year-classes were associated with low flows, organic matter based on phytoplankton, and lesser zooplankton production. The amount of organic matter present in samples during 2011 was negatively related to development. Urbanization affects the quality, quantity, timing, and delivery of organic matter in streams as riparian zones and floodplains become disconnected from stream channels by stormwater management as small streams are buried into culverts and pipes, or paved over. Development-related changes in quality, quantity, and timing of organic matter delivered to subestuaries could decrease zooplankton production or alter timing of spring blooms important for feeding success and survival of anadromous fish larvae (Uphoff et al. 2011b).

Tidal Fish Community

Abrupt declines in both the number of species (or species richness) and relative abundance of all species in channel waters of Mattawoman Creek began in the early 2000s at about 0.7 structures per hectare. These abrupt declines indicated that an ecological tipping point (threshold) had been reached. Number of species and relative abundance had varied from year to year without a trend prior to this decline.

Mattawoman Creek's channel habitat has been sampled with trawls continuously since 1989. Seines have been used as well, but extensive SAV growth after 2003 precluded their use. Trawls used during 1989-2002 were smaller and less efficient than those used since 2003. Both gears have been used since 2009 to understand how this gear change may have affected habitat evaluation. Average number of species collected annually in the small trawl during 1989-2002 was 14.6. Only two species were observed in the small trawl collections during 2009 and five were observed in 2010. Large trawls caught between 27 and 29 species during 2003-2005 and species counts fell to 13-20 during 2008-2010. Average catches of all fish in small trawls in 2002 were 91% less than the 1981-2001 average, 99.7% less in 2009, and 95% less in 2010. Average catches of all fish in large trawls declined at a rate of 28% per year during 2003-2010. In general, bass and sunfish have increased in relative abundance while most open water plankton feeders have declined. Changes of this magnitude have not been observed in other subestuaries or in the Potomac River during the same period (Uphoff et al. 2010)

Oxygen levels measured in daytime monitoring of channel conditions during 1989-1999 were high and indicated algae bloom conditions. Oxygen levels recorded since 2000 have declined, but remain acceptable. They do not indicate extensive bottom oxygen depletion observed in developed brackish western shore tributaries such as Severn River (Uphoff et al. 2011a). However, a continuous water quality monitor in a dense SAV bed at the Sweden Point Marina has detected extensive episodes of low oxygen during summer since 2004. It is possible that dense vegetation in Mattawoman Creek contributed to localized oxygen depletion.

Significant changes in the finfish community of channel waters could indicate significant shifts in ecological processes. Large increases in SAV and water clarity and large declines in algae biomass and a downward shift in oxygen levels have occurred in spite of increased sediment and nutrient loads. Sediment loads from construction and stream bank erosion are high considering the limited portion of the watershed these sources occupy (Gellis et al. 2008). Though it is not conclusive that increased urbanization has caused changes in Mattawoman Creek's fish community, there is a considerable basis in scientific literature to support the hypothesis that development is a major factor degrading Mattawoman Creek's estuarine fish habitat (Uphoff et al. 2011b).

Mattawoman Creek was characterized in the early 1990s as "near to the ideal conditions as can be found in the northern Chesapeake Bay, perhaps unattainable in the other systems, and should be protected from overdevelopment."(Carmichael et al.1992).
The present fish community still seems to support Maryland's premier largemouth bass fishery, but it also has experienced a considerable loss of diversity. These losses may indicate diminished ability to function as a nursery for a variety of important forage, commercial, and recreational fishes that could affect the largemouth bass fishery if conditions worsen.

Part 3: Recommendations to Protect Fisheries Resources

1. Adopt the low development, natural resource protection scenario of the comprehensive plan (scenario 1) as the minimum measure to lessen impact on fisheries and fish habitat.
2. Innovative stormwater, flow, and sediment management will need to be applied to the watershed to reduce stream bank erosion and stream degradation associated with new and old development.
3. Management and control of erosion from construction must be improved and vigorously enforced. Construction contributes a disproportionate load of sediment for the portion of the watershed it occupies.
4. Additional measures such as wetland creation, water quality forestry, and expanded riparian buffers should be applied to further control erosion, manage flow, and improve water quality.
5. Stream revitalization measures could follow if flow and sediment management succeeds.
6. Environmental management measures should be paired with monitoring to evaluate success. Very little is known about how stormwater management impacts fish habitat and fisheries.
7. De-icing of roads should minimize salt use and use alternative de-icers that are less toxic to aquatic organisms.

Additional References and Resources

Carmichael, J., M. Roberts, B. Richardson, and S. J. Jordan. 1992. Fish sampling in eight Chesapeake Bay tributaries. CBRM-HI-92-2, Maryland Department of Natural Resources, Annapolis.

Chen, R.J., K.M. Hunt, and R.B. Ditton. 2003. Estimating the economic impacts of a trophy largemouth bass fishery: Issues and applications. North American Journal of Fisheries Management 23:835-844.

Gellis, A. C., C. R. Hupp, M. J. Pavich, J. M. Landwehr, W. S. L. Banks, B. E. Hubbard, M. J. Langland, J. C. Ritchie, and J. M. Reuter. 2008. Sources, transport, and storage of sediment at selected sites in the Chesapeake Bay Watershed. U.S. Geological Survey Scientific Investigations Report 2008–5186, 95 p.

Kraus, R.T. and D.H. Secor. 2004. Dynamics of white perch *Morone americana* population contingents in the Patuxent River estuary, Maryland, USA. Marine Ecology Progress Series 279: 247 – 259.

Love, J.W. 2011. Habitat suitability index for largemouth bass (*Micropterus salmoides*) from the Chesapeake Bay watershed (Maryland, U.S.A.). Transactions of the American Fisheries Society 140: 1049-1059.

Limburg, K.E. and R. E. Schmidt. 1990. Patterns of fish spawning in Hudson River tributaries: response to an urban gradient? Ecology 71:1238-1245.

McGinty, M., J. Uphoff, R. Lukacovic, J. Mowrer, and B. Pyle. 2009. Development of habitat based reference points for Chesapeake Bay fishes of special concern: impervious surface as a test case. Chesapeake Bay Finfish/Habitat Investigations 2008, Project 3. Maryland Department of Natural Resources, Annapolis, Maryland.

National Research Council or NRC. 2009. Urban stormwater management in the United States. National Academies Press, Washington, D.C.

Paul, M. J., and J. L. Meyer. 2001. Streams in the urban landscape. Annual Reviews in Ecology, Evolution, and Systematics 32:333-365.

Reardon, J. 2007. Fishing, boating drive county tourism. Maryland Independent.

Uphoff, J., M. McGinty, R. Lukacovic, J. Mowrer, and B. Pyle. 2010. Development of habitat based reference points for Chesapeake Bay fishes of special concern: impervious surface as a test case. Chesapeake Bay Finfish/Habitat Investigations 2009, Project 3. Maryland Department of Natural Resources, Annapolis, Maryland.

Uphoff, J. H., M. McGinty, R. Lukacovic, J. Mowrer, and B.Pyle. 2011a. Impervious surface, summer dissolved oxygen, and fish distribution in Chesapeake subestuaries: linking watershed development, habitat conditions, and fisheries management. North American Journal of Fisheries Management 31:554-566.

Uphoff, J., M. McGinty, R. Lukacovic, B. Pyle, M. Topoloski, and S. Bornhoeft. 2011b. Development of habitat-based reference points for recreationally important Chesapeake Bay fishes of special concern: development targets and thresholds. Marine and Estuarine Finfish Ecological and Habitat Investigations, Job 1. . Maryland Department of Natural Resources, Annapolis, Maryland.

USFWS (U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau). 2008. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation—Maryland. FHW/06-MD, Washington, D.C.

Wheeler, A. P., P. L. Angermeier, and A. E. Rosenberger. 2005. Impacts of new highways and subsequent landscape urbanization on stream habitat and biota. Reviews in Fisheries Science 13:141-164.

Section 3: Non-Tidal Streams of the Mattawoman Creek Watershed

Recommendations to support County Planning Program Direction from the Non-Tidal Streams Section Workgroup

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Part 1: Assessment of the condition of non-tidal Mattawoman Creek streams

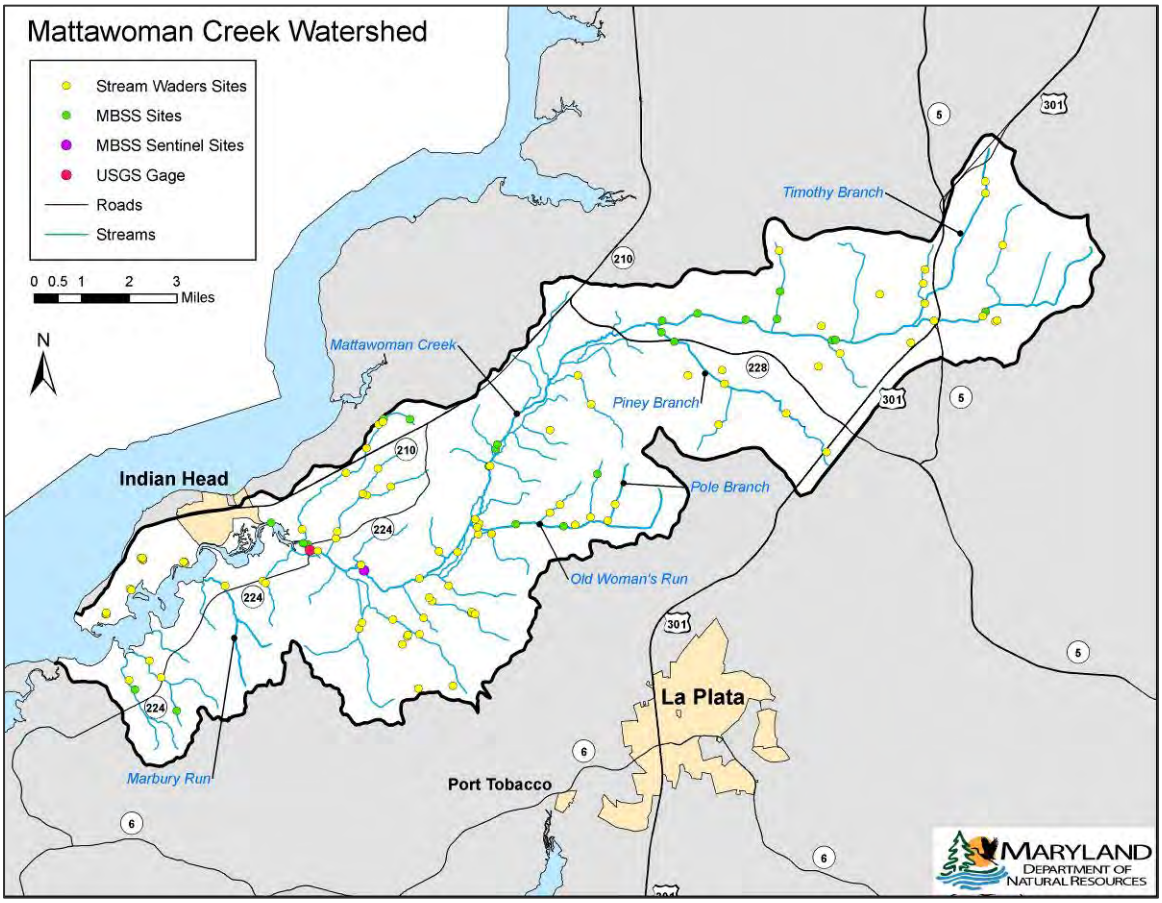
The distinct geology of the Mattawoman Creek watershed provides the natural template for unique physical, chemical, and hydrologic conditions. This context results in a diverse flora and fauna within the streams that make up the watershed. This section describes the biological, physical, and chemical conditions of the streams in the Mattawoman Creek watershed. We've placed this information in a framework that we hope will facilitate protection of the highest quality streams, as well as restoration of areas where improvements are both necessary and have a high likelihood for success.

Mattawoman Creek

The Mattawoman Creek watershed is one of 137, "8-digit" watersheds in the State (identified by the 8-digit number 02140111) defined by the Maryland Department of Natural Resources (DNR). This watershed is further divided into nine, "12-digit" watersheds for resource management

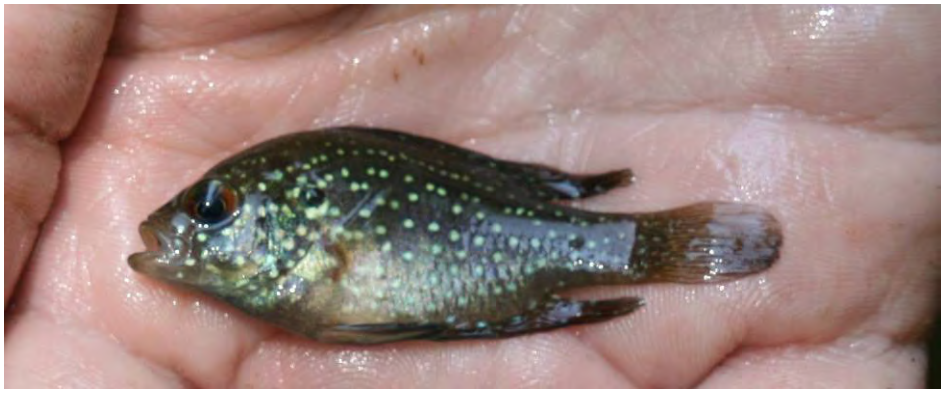
purposes. Named non-tidal streams within the Mattawoman Creek watershed include Marbury Run, Old Woman's Run, Pole Branch, Piney Branch, and Timothy Branch. There are also many unnamed tributaries. Physical, chemical, and biological data from named and unnamed non-tidal tributaries of Mattawoman Creek collected since 2000, primarily by the Maryland Department of Natural Resources (and from other sources where appropriate), are used in this section to describe the current conditions of the watershed (Figure 1).

Figure 1: The Mattawoman Creek watershed with stream names, roads, towns, and stream sites sampled by the Maryland Department of Natural Resources and USGS since 2000. Data from these sites were used to describe the current physical, chemical, and biological condition of the streams in the watershed.



Stream animals

A large number of animal species live in the freshwater streams of the Mattawoman Creek watershed (Table 1), including 44 fish, five crayfish, four freshwater bivalves, and 21 reptiles or amphibians. Nine of these species are of greatest conservation need (GCN) according to Maryland's Wildlife Diversity Conservation Plan (www.dnr.state.md.us/irc/docs/00012773.pdf) and five are listed in the April 2010 version of the Rare, Threatened, and Endangered Animals of Maryland (www.dnr.state.md.us/wildlife/Plants_Wildlife/rte/pdfs/rte_Animal_List.pdf). These species are listed based on an urgent need for conservation. Without a concerted effort to protect and restore habitats used by these species in Maryland, they could disappear from the state entirely. See Section Six of this report for more information regarding rare species and their protection.



Bluespotted Sunfish, *Enneacanthus gloriosus*.

Other groups of species found in the Mattawoman Creek watershed that warrant conservation include gamefish species, which are targeted by anglers, and migratory fish. See Section Two 2 of this report for details regarding game and migratory fish species.

Seven aquatic animal species are known to have been introduced into the Mattawoman Creek watershed (one crayfish, one freshwater bivalve and five fish). Three of these fishes (largemouth bass, black crappie, and channel catfish) have thrived in the watershed for a long time and provide angling opportunities. The northern snakehead, red swamp crawfish, and Asian clam are considered invasive introduced species because they have the potential to drastically influence other species living in the watershed (Moyle 1976; Miller et al. 1989; Lassuy 1995; Wilcove et al. 1998; Tyus and Saunders III 2000). DNR, through its Invasive Species Matrix Team, is working to provide information about the problems that invasive species can cause and how to limit their spread (www.dnr.state.md.us/invasives). Once invasive aquatic species become established in watersheds like Mattawoman Creek, eradicating them is usually impossible and controlling their spread can be challenging. However, it may be possible to keep their abundances low (thus limiting their affect on native species) by educating residents and anglers and taking advantage of any opportunity to remove some individuals of these invasive species from the watershed whenever possible.

Table 1. Fish, reptile and amphibian, crayfish, and freshwater bivalve species encountered by the Maryland Biological Stream Survey (MBSS) in streams of the Mattawoman Creek watershed, 2000-2011. Maryland Status is from the "Rare, Threatened, and Endangered Animals of Maryland" April 2010. Migratory species utilize fresh and saltwater habitats to complete their life cycle. Game species are typically targeted by anglers and the DNR Fisheries Service has established length restrictions for harvest. Introduced species are not native to the Mattawoman Creek watershed. Invasive species are introduced species with a high likelihood of negatively affecting native species.

	Common Name	Scientific Name	Maryland Status	Comment
Fish	Alewife	*Alosa pseudoharengus*		Migratory
	American Eel	*Anguilla rostrata*		Migratory
	Black Crappie	*Pomoxis nigromaculatus*		Game, Introduced
	Blacknose Dace	*Rhinichthys atratulus*		
	Bluegill	*Lepomis macrochirus*		Introduced
	Bluespotted Sunfish*	*Enneacanthus gloriosus*	Watch List	
	Brown Bullhead	*Ameiurus nebulosus*		
	Chain Pickerel	*Esox niger*		Game
	Channel Catfish	*Ictalurus punctatus*		Game, Introduced
	Common Carp	*Cyprinus carpio*		Introduced
	Common Shiner	*Luxilus cornutus*		
	Creek Chub	*Semotilus atromaculatus*		
	Creek Chubsucker	*Erimyzon oblongus*		
	Eastern Mosquitofish	*Gambusia holbrooki*		
	Eastern Mudminnow	*Umbra pygmaea*		
	Eastern Silvery Minnow	*Hybognathus regius*		
	Fallfish	*Semotilus corporalis*		
	Fathead Minnow	*Pimephales promelas*		Introduced
	Gizzard Shad	*Dorosoma cepedianum*		
	Golden Shiner	*Notemigonus crysoleucas*		
	Goldfish	*Carassius auratus*		Introduced
	Green Sunfish	*Lepomis cyanellus*		Introduced
	Largemouth Bass	*Micropterus salmoides*		Game, Introduced
	Least Brook Lamprey*	*Lampetra aepyptera*		
	Longnose Gar*	*Lepisosteus osseus*	State Rare	
	Margined Madtom	*Noturus insignis*		
	Pirate Perch	*Aphredoderus sayanus*		
	Pumpkinseed	*Lepomis gibbosus*		
	Redbreast Sunfish	*Lepomis auritus*		
	Redfin Pickerel	*Esox americanus*		
	Rosyside Dace*	*Clinostomus funduloides*		
	Sea Lamprey	*Petromyzon marinus*		Migratory
	Spotfin Shiner	*Cyprinella spiloptera*		
	Spottail Shiner	*Notropis hudsonius*		
	Striped Bass	*Morone saxatilis*		Migratory, Game
	Tadpole Madtom	*Noturus gyrinus*		
	Tessellated Darter	*Etheostoma olmstedi*		
	Warmouth*	*Lepomis gulosus*	Watch List	
	White Catfish*	*Ameiurus catus*	Uncertain	
	White Perch	*Morone americana*		Migratory, Game
	White Sucker	*Catostomus commersoni*		
	Yellow Bullhead	*Ameiurus natalis*		
	Yellow Perch	*Perca flavescens*		Migratory, Game
	Northern Snakehead	*Channa argus*		Introduced, Invasive

Reptiles and Amphibians	American Bullfrog	*Lithobates catesbeianus*		
	Eastern American Toad	*Anaxyrus americanus americanus*		
	Eastern Cricket Frog	*Acris crepitans crepitans*		
	Eastern Painted Turtle	*Chrysemys picta*		
	Eastern Snapping Turtle	*Chelydra serpentina serpentina*		
	Fowler's Toad	*Anaxyrus fowleri*		
	Gray Treefrog	*Hyla versicolor*		
	Marbled Salamander	*Ambystoma opacum*		
	Northern Dusky Salamander	*Desmognathus fuscus*		
	Northern Green Frog	*Lithobates clamitans melanota*		
	Northern Red Salamander*	*Pseudotriton ruber ruber*		
	Northern Spring Peeper	*Pseudacris crucifer*		
	Northern Two-lined Salamander	*Eurycea bislineata*		
	Northern Watersnake	*Nerodia sipedon sipedon*		
	Pickerel Frog	*Lithobates palustris*		
	Red-spotted Newt	*Notopthalmus viridescens viridescens*		
	Southern Leopard Frog	*Lithobates sphenocephala utricularia*		
	Spotted Turtle*	*Clemmys guttata*		
	Stinkpot	*Sternothernus odoratus*		
	Upland Chorus Frog	*Pseudacris feriarum feriarum*		
	Wood Frog	*Lithobates sylvaticus*		
Crayfish	Devil Crawfish	*Cambarus diogenes*		
	Digger Crayfish	*Fallicambarus fodiens*		
	Spinycheek Crayfish	*Orconectes limosus*		
	Red Swamp Crawfish	*Procambarus clarkii*		Introduced, Invasive
	White River Crawfish	*Procambarus acutus*		
Freshwater Bivalves	Alewife Floater*	*Anodonta implicata*	Watch List	
	Asian Clam	*Corbicula fluminea*		Introduced, Invasive
	Eastern Elliptio	*Elliptio complantata*		
	Eastern Floater	*Pyganodon cataracta*		

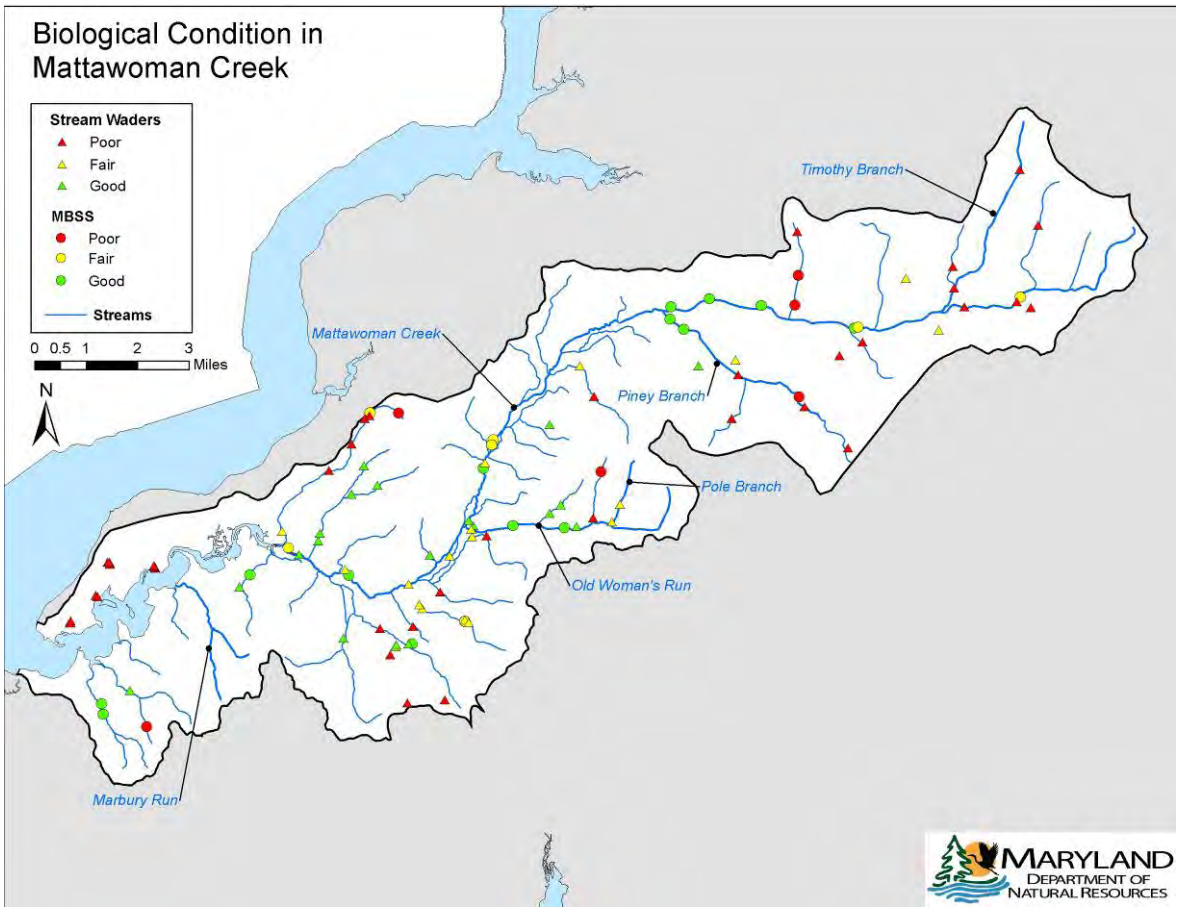
* Maryland Species of Greatest Conservation Need (GCN)

Warmouth, *Lepomis gulosus*.

Biological condition

The numbers and types of fish, stream insects and other types of invertebrates are used by DNR as one indication of "stream health" (Roth et al. 1998; Southerland et al. 2007; Stribling et al. 1998). Stream health is tightly linked to physicochemical factors, representing the cumulative physical and chemical conditions of streams (Fausch et al. 1990; Dudgeon et al. 2006). Data from DNR's Maryland Biological Stream Survey (MBSS) and Stream Waders volunteer sampling program collected since 2000 (Figure 2) reveal an abundance of high quality streams in the Mattawoman Creek watershed. More than half (15 of 28) of the sites sampled by the MBSS were rated as "Good" quality streams (the highest category possible). Six stream sites (21%) were rated "Poor" and the remaining seven stream sites were rated "Fair".

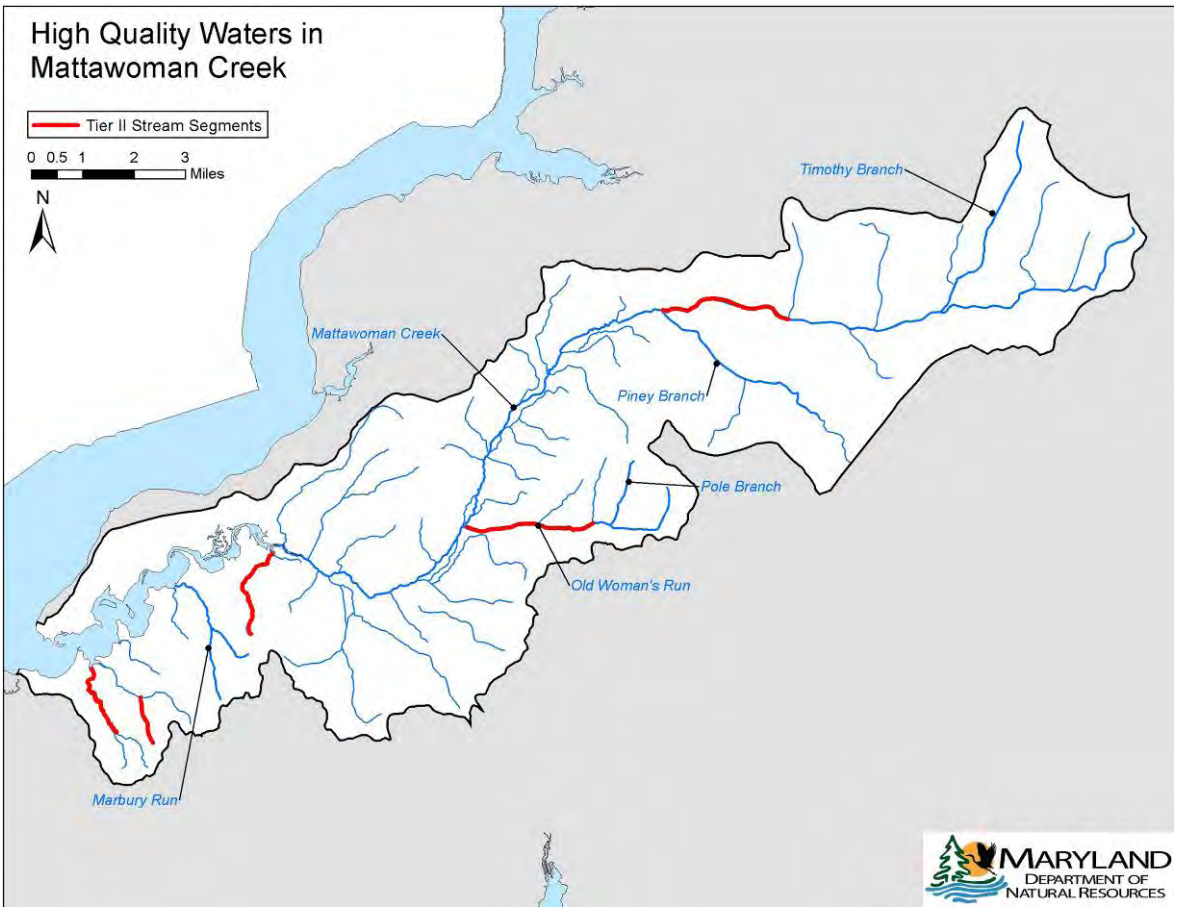
Figure 2: Biological condition at MBSS and Stream waders monitoring sites in the Mattawoman Creek watershed.



A total of 77 sites were sampled by Stream Waders volunteers in the Mattawoman Creek Watershed. Nineteen sites (24%) were rated Good. Thirty-two sites (42%) were rated Poor, while 26 (34%) were rated Fair. The difference in the proportion of sites rated as Good, Fair, or Poor by Stream Waders and MBSS data likely results from the way the locations of the sites were chosen. MBSS site locations were primarily chosen at random to provide an unbiased representation of stream health in the watershed. Stream Wader volunteers chose the locations where they sampled and, as a result, the sites were often located near roads and towns.

MBSS biological indicator data are used by the Maryland Department of the Environment (MDE) to assess water quality and for determining goals for restoration and protection of streams. Tier II (High Quality) waters are stream segments that, according to Maryland's anti-degradation regulations (www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/Antidegradation.aspx), require additional protection to maintain their exceptional water quality. There are six five Tier II stream segments in the Mattawoman Creek watershed including Mattawoman Creek (approximately between Berry Road and Gardner Road), two segments of Old Woman's Run, and three unnamed stream segments (Figure 3).

Figure 3: Tier II (High Quality) designated stream segments in the Mattawoman Creek watershed.

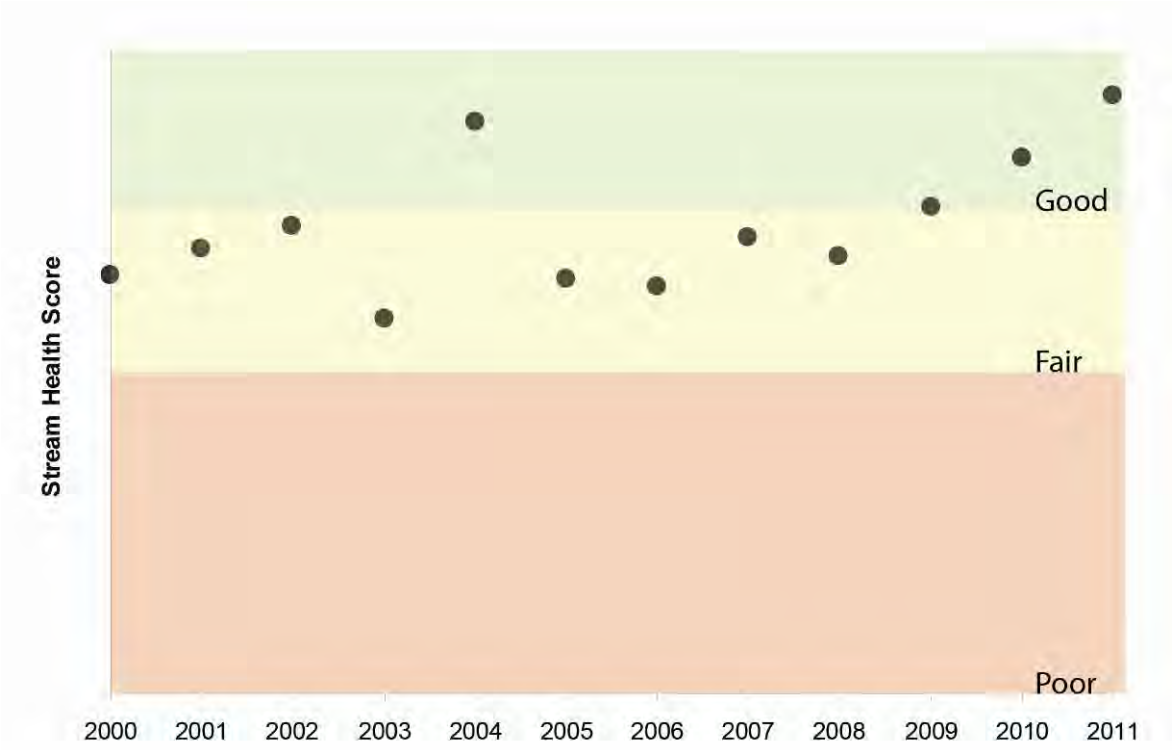


Although the percentage of stream sites rated as Poor based on MBSS biological samples was relatively low (21%), there were enough to qualify the watershed for placement on Maryland's list of "Impaired" watersheds by MDE (www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/index.aspx). Impaired watersheds are considered to be in need of restoration to improve their health. MDE, through the Biological Stressor Identification effort (www.mde.state.md.us/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/bsid_studies.aspx), determines the relative likelihood of any particular stressor being the cause of degradation for a watershed. MDE's Biological Restoration Initiative (www.mde.state.md.us/programs/Water?TMDL/Pages/Programs/WaterPrograms/tmdl/bsid_studies.aspx) then focuses and prioritizes restoration efforts toward areas with the most potential for having success.

Stream health based on the biology of Mattawoman Creek has also been assessed by DNR each year since 2000, at a single site in Mattawoman Creek upstream from Hawthorne Road, since 2000. This site is a MBSS "Sentinel Site" and is one of 28 sites considered to be some of the best quality streams in Maryland (www.dnr.maryland.gov/streams/pdfs/2010SentinelSiteReport.pdf). Maryland DNR uses these sites to document natural variability in stream ecological conditions and to detect variations in future conditions that may occur due to predicted climatic changes. Stream health at this Sentinel Site varied from Fair to Good, with the lowest stream health scores in 2003 and the highest in 2011 (Figure 4). Because this site is located on the main-stem of Mattawoman

Creek, continued monitoring there will also provide an opportunity to document the success of attempts to protect and restore the creek, its valley, and tributaries in the future.

Figure 4: Biological stream health scores observed at the Mattawoman Creek MBSS "Sentinel Site" since 2000. Stream health was determined using multi-metric indicators of fish and benthic macroinvertebrate community condition.



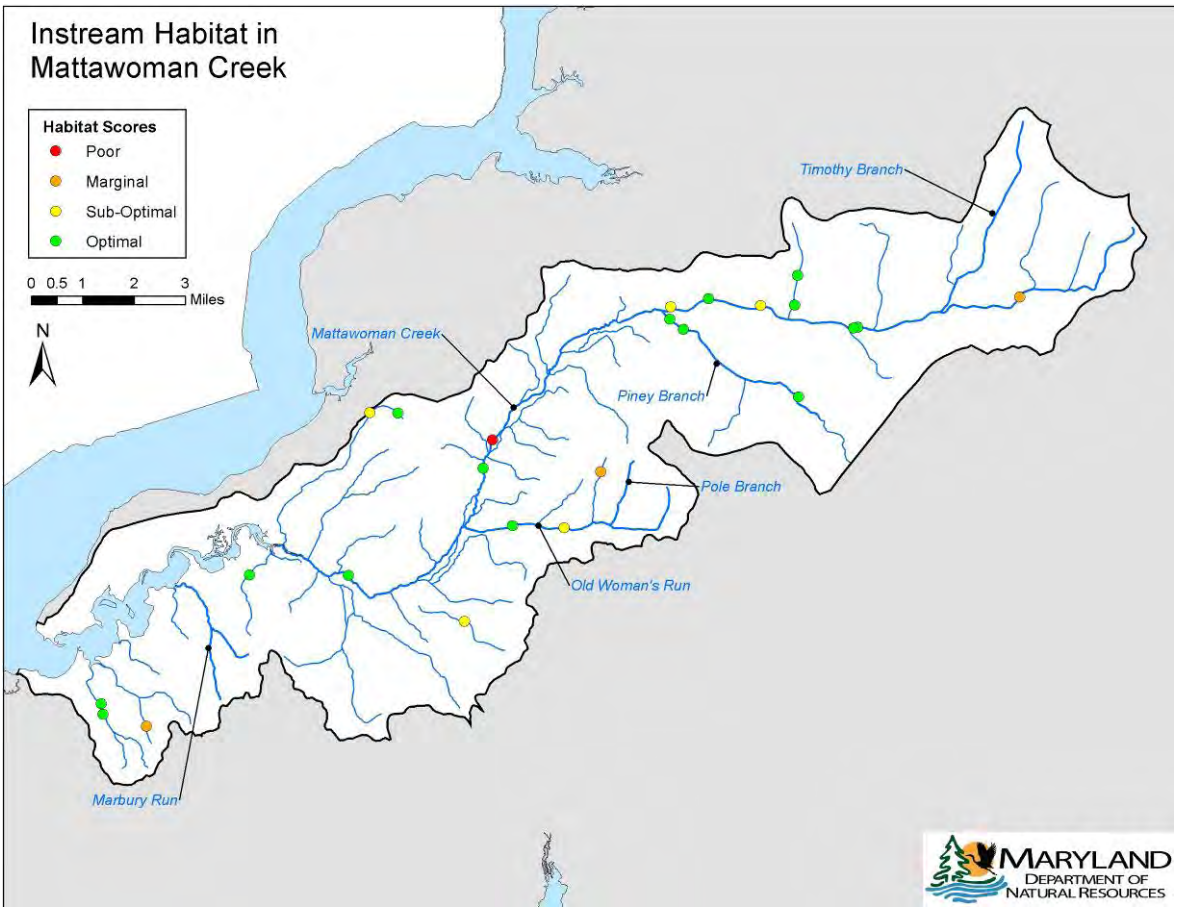
Physical and chemical conditions

The biological health of a stream depends, in large part, on the physical and chemical conditions of that stream. Such conditions are integrally related to human influences through direct and indirect alterations to the land and water within the stream's watershed. Many of the physical and chemical alterations that degrade streams typically transfer downstream to larger streams, rivers, and in some cases tidal rivers (as with Mattawoman Creek, and downstream in the Potomac River). While certain aspects of a stream's physical and chemical conditions can sometimes improve through restoration, a stream must have all aspects intact to be healthy and able to provide a plethora of ecological services. Since restoring many aspects of a stream's physical and chemical condition can be challenging and expensive (Palmer et al. 2005), protecting streams from alteration is the most ecologically and economically cost effective alternative to attempting to restore stream health once it has been compromised (Stranko et al. 2011).

Instream habitat

A measure of "instream habitat" is provided by the MBSS to represent the quality and quantity of underwater structure available for insects, fish, and other stream inhabitants (Stranko et al. 2007; Barbour et al. 1999). Instream habitat condition varies widely across streams in the Mattawoman watershed. Sixty percent (15 of 25) of the MBSS sites with instream habitat scores (Figure 5) scored in the optimal range (the highest category). Only two of the 25 sites scored in the poor range for instream habitat. The remaining eight sites (32 %) were intermediate in terms of instream habitat quality.

Figure 5: Instream habitat scores recorded at MBSS sampling sites in the Mattawoman Creek watershed since 2000.



Erosion

Sediment eroded from stream banks during high flow events can have drastic effects on stream habitat by filling in deep pools and spaces in the substrate where stream-dwelling animals live. Eroded sediment can also be transported downstream to tidal areas where it can also affect plants and animals, as well as fill navigation channels. Reducing sediment transported from streams to tidal rivers has been a major focus of funds and effort throughout Maryland and the entire Chesapeake Bay Watershed. The total area of eroded stream banks at 25 MBSS sites in the Mattawoman Creek watershed ranged from none at seven sites to more than 100 square meters of erosion per 100 meter stretch of stream at eight sites (Figure 6). Preventing erosion can be challenging. Often attempts to control erosion focus on stabilizing banks where they are eroding

by armoring them. Alternatively, the most successful attempts to prevent erosion do so by addressing the hydrologic issues at their source.

Figure 6: Eroded banks at an MBSS monitoring site in the Mattawoman Creek watershed.

Riparian buffers

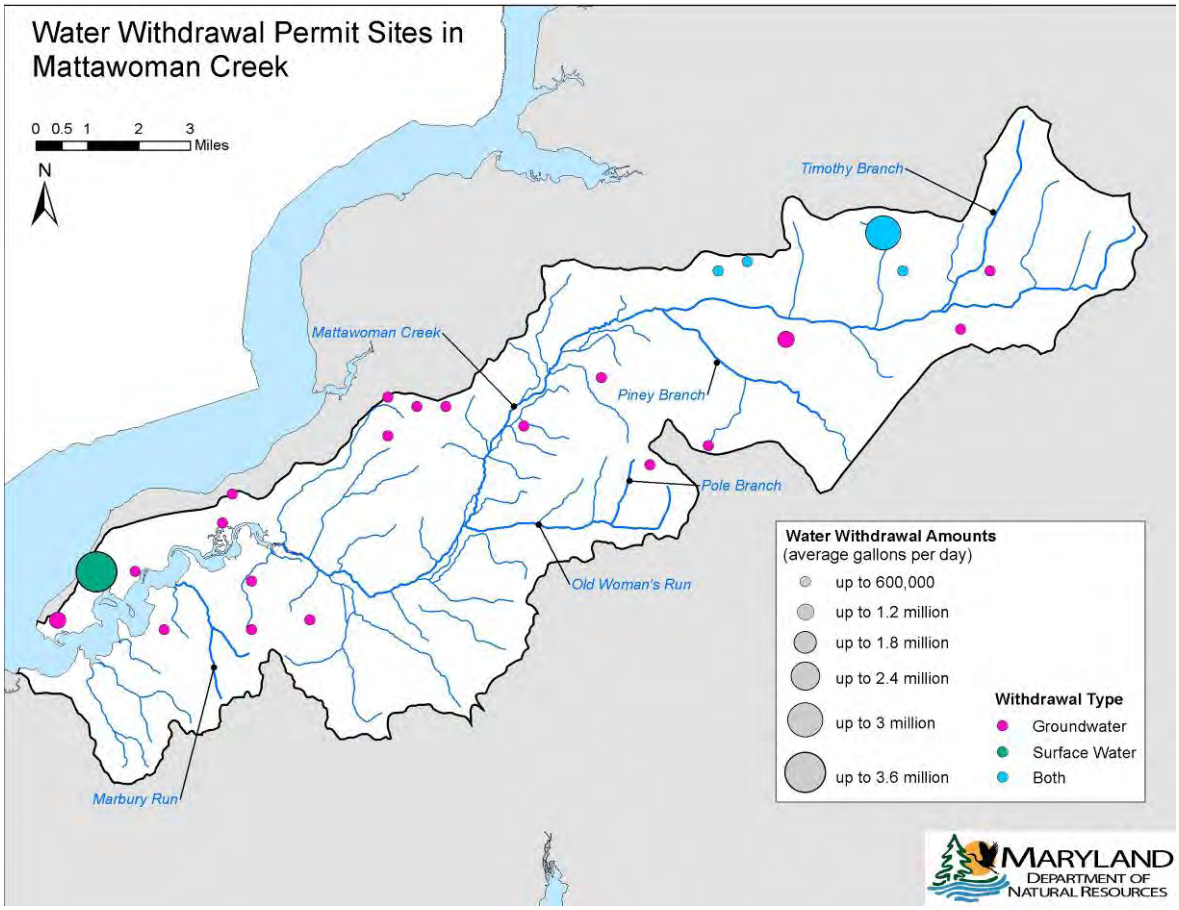
Vegetated buffers adjacent to streams can sometimes prevent or filter polluted runoff and sediment from entering streams. Tree and large shrub buffers also shade the stream to keep water cool during the hot summer. Vegetation adjacent to streams also provides the basis for the food web in stream ecosystems in the form of leaves and other organic material (Figure 7) that fall into the water (Vannote et al. 1980). Sixteen of 27 sites (60%) where the vegetated buffer adjacent to streams was measured by the MBSS had wide (greater than 50 m) intact buffers. The riparian buffers along two of the stream sites were narrow (less than 10 m). These represent areas where buffers should be expanded. Ensuring that trees are left intact or are planted in riparian areas is an excellent and relatively inexpensive way to maintain or improve stream health.

Figure 7: Riparian buffer along a Mattawoman Creek tributary near Danville, MD.

Water withdrawal

Water withdrawn from streams and from the ground is used for many purposes by residential communities, industries, and agriculture. The need for adequate quantities of water in streams to maintain stream health is obvious. Reduced quantities of water can negatively affect habitat for stream dependent animals and plants and reduce the stream's capacity to process nutrients and other pollutants (Poff et al. 1997). Due to the lack of connection between the deep aquifers and stream water in the area around Mattawoman Creek, withdrawal of water from the ground may not affect stream flow. However, withdrawal of surface water directly decreases stream flow. To assess the ecological impacts of surface water withrawls, we need to know the eventual fate of surface water withdrawal within the Mattawoman Creek watershed. In some cases, water that is withdrawn can be, and is, returned to the stream where it was taken. However, the quality of the water is often degraded when it is returned. In other cases, water could be taken from one stream and returned to a different stream or to groundwater. MDE's Water Management Administration documents 24 locations in the Mattawoman Creek watershed with permits to withdraw at least 10,000 gallons of water per day (Figure 8). Nineteen of these are permits for groundwater extraction, one is for surface water, and four are for both surface and groundwater. At one location on a small stream near Accokeek, 2.9 million gallons per day are permitted for surface water withdrawal and 60,000 gallons per day for ground water withdrawal. These are relatively large quantities of withdrawal taken from a small stream. However, we currently have no data to determine if this withdrawal may or may not be affecting the flow, water quality, instream habitat, or biological health of this system.

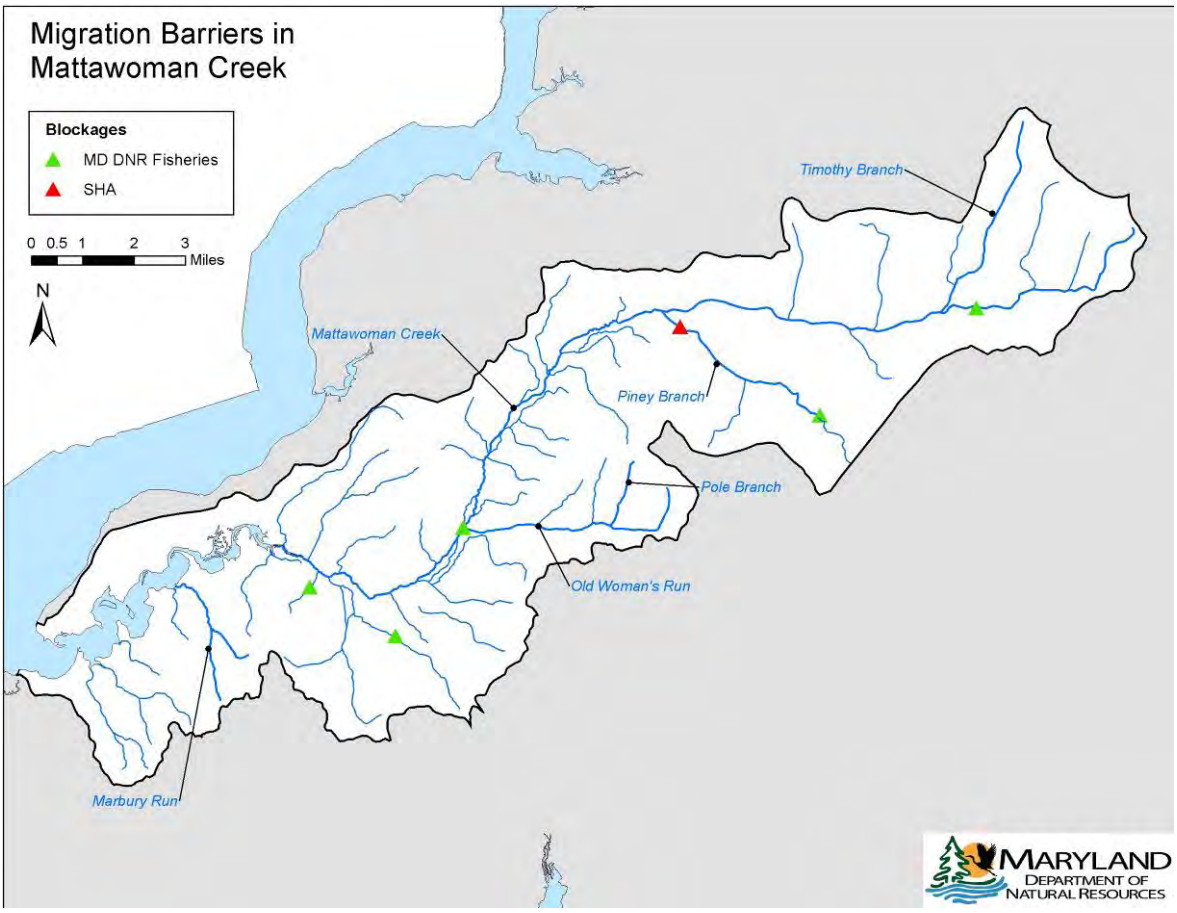
Figure 8: Water withdrawal permit site locations in the Mattawoman Creek watershed.



Blockages

A continuous, unimpeded stream network is vitally important to many stream dwelling animals. They must be able to travel freely to different parts of the stream network to feed, breed, and sometimes to find refuge from stochastic events such as floods, droughts, or acute spates of pollution. Since many fish and other animals are confined to living strictly within the wetted portion of a stream channel, blockages to free movement upstream or downstream within the channel can be detrimental to their survival. Some fish species migrate long distances from the Atlantic Ocean or Chesapeake Bay to find suitable spawning habitat in freshwater streams. Blockages are particularly detrimental to the reproductive success of these species. Many human-made structures can act as blockages in streams. Dams are obvious blockages. Road crossings can also act as blockages because of the drop in stream level that can occur downstream of the culvert. In some cases culverts are too small to allow for adequate fish passage. Stream blockage information reported here came from two sources, the State Highway Administration (SHA) (based on inspections of road crossings and culverts on state roads) and from the Maryland DNR Fisheries Service (based on an inventory of migratory fish blockages). These two sources indicate there are at least six stream blockages in the Mattawoman Creek watershed (Figure 9). Improving upstream passage at blockages, especially for migratory fish, can often be achieved by building fish ladders. However, the best approach is to remove unused or unnecessary blockages from the stream and to replace culverts that act as blockages.

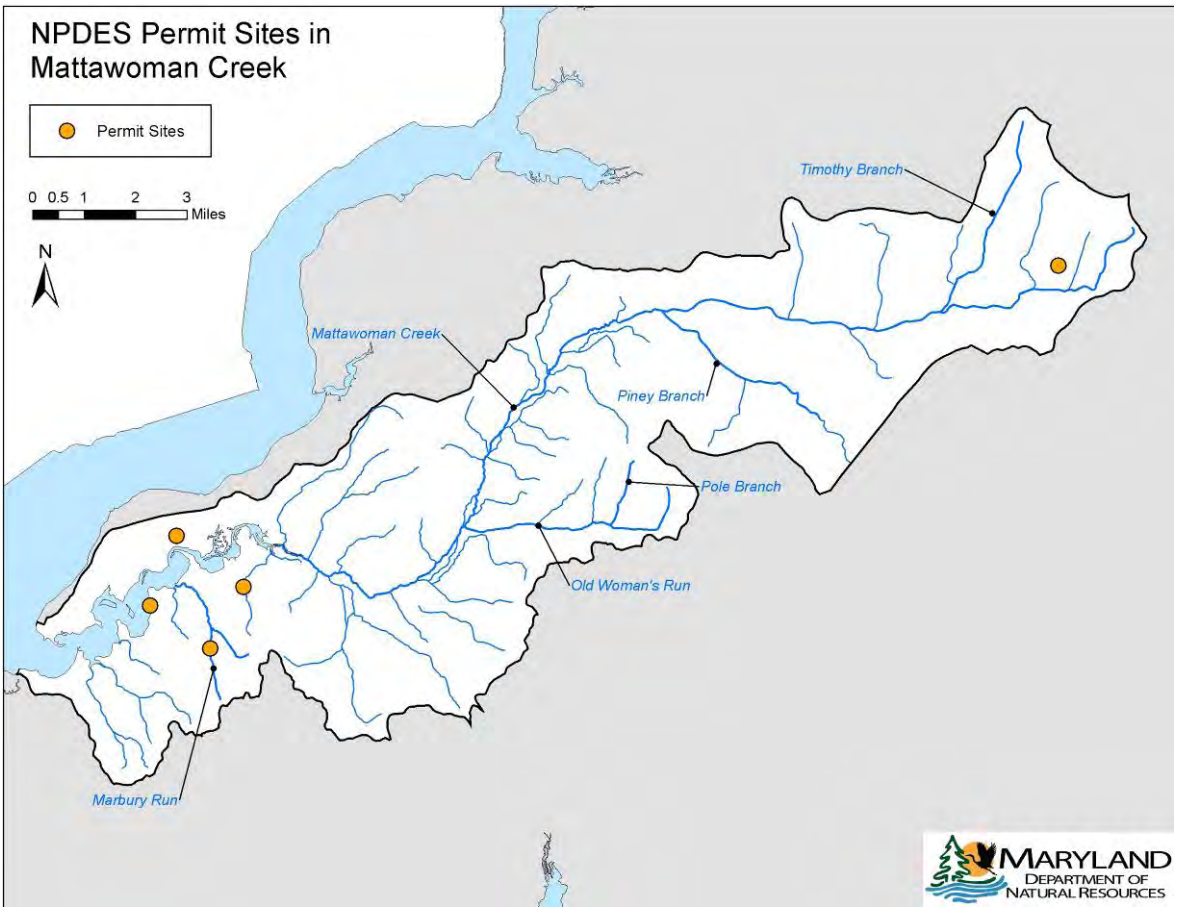
Figure 9: Known migration barrier locations in the Mattawoman Creek watershed. Locations were provided by the Maryland State Highway Administration and the Maryland DNR Fisheries Service.



Chemical pollutants

The chemical condition of streams can be altered by a large number of human derived substances or pollutants. Such pollutants may be put directly into streams, may flow into the stream from land surface runoff, or seep in from under ground sources. National Pollutant Discharge Elimination System (NPDES) permits (http://www.mde.state.md.us/programs/Permits/WaterManagementPermits/WaterDischargePermitApplications/Pages/Permits/WaterManagementPermits/water_permits/index.aspx) are granted by MDE to allow lawful wastewater discharges into Maryland's waters, where appropriate. These permits establish effluent limits that dischargers must attain in order to be in compliance. These limits are meant to be protective of receiving waters. According to MDE, there are five NPDES permits for the discharge of wastewater in the Mattawoman Creek watershed. One of these is for the town of Indian Head, one is for a receiving station (near Brandywine), two are for schools, and one is for a residence (Figure 10).

Figure 10: NPDES discharge permit sites in the Mattawoman Creek watershed.



Nutrients

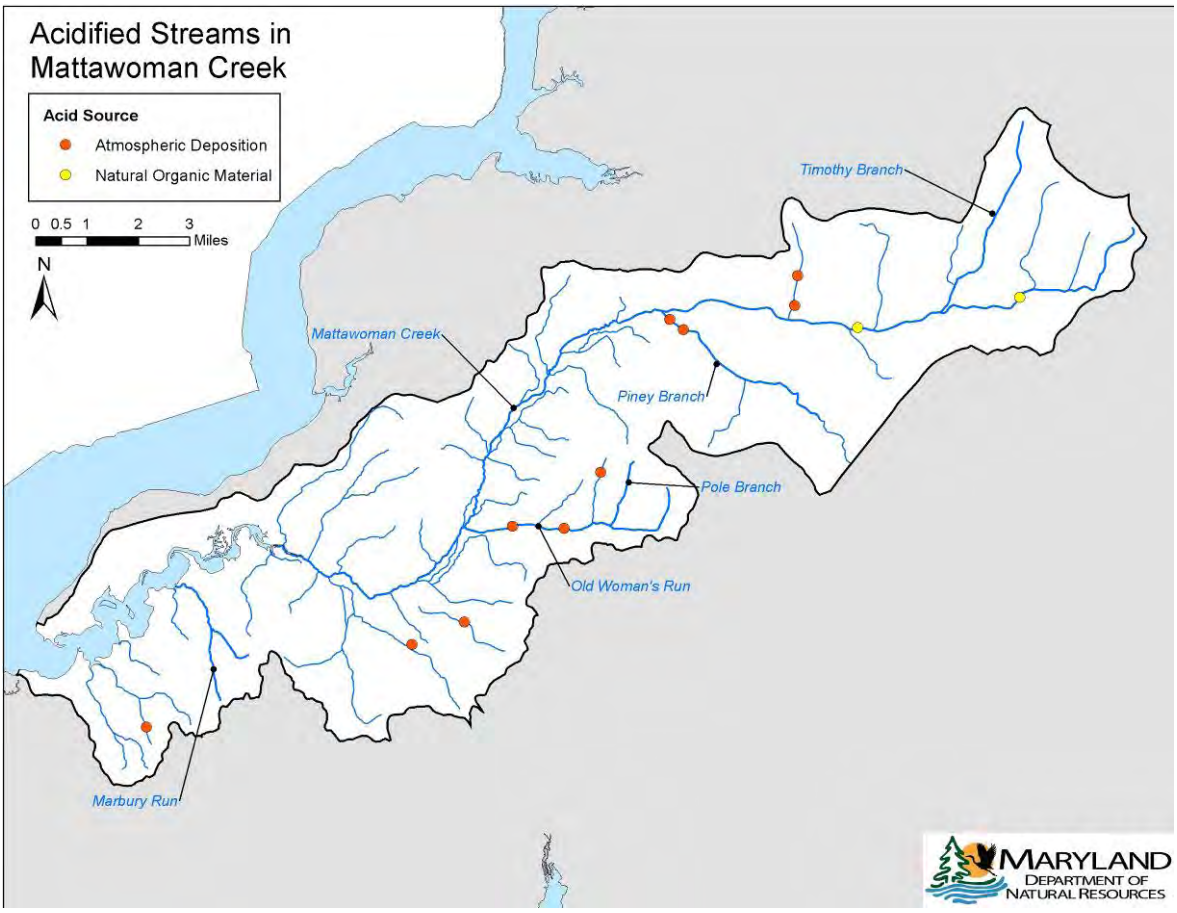
Most pollutants do not enter streams via discrete discharge points. Nutrient pollution is probably the most pervasive non-point source pollution in Maryland. Nutrients typically originate from farms and urban areas and can enter streams via overland or under ground routes. Reducing nutrient pollution to streams and Chesapeake Bay is a top priority for MDE and the U.S. Environmental Protection Agency (EPA), because of the importance of reducing nutrients to restoring the health and productivity of Chesapeake Bay and its tidal tributaries. In 2010, the EPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) which calls for a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus, and 20 percent reduction in sediment for Bay watersheds. Total nitrogen concentrations were less than 1.0 mg/L at all 27 sites sampled by the MBSS from 2000 -2011 in the Mattawoman Creek watershed, suggesting levels may not be substantially elevated. Total phosphorus concentrations were moderately elevated (> 0.025 mg/L < 0.07 mg/L) at 13 of the 27 (48%) sites. Maintaining low nutrient levels in watersheds like Mattawoman Creek is imperative if Chesapeake Bay nutrient reduction goals are to be met. Allowing watersheds like Mattawoman Creek to degrade will only worsen the situation for the Tidal Potomac River and Chesapeake Bay. As it is now, the relatively low nutrient tidal portions of Mattawoman Creek probably resemble what many other Chesapeake Bay tributaries were once like (See Section 2 for details). Maintaining large forested tracts of land, especially along the Mattawoman Creek stream valley, and not allowing additional point or non-point sources of nutrient pollution to enter the system are the best ways to keep nutrients at their relatively low levels.

Acid

Acid from coal mine drainage, atmospheric deposition (commonly called 'acid rain'), and agricultural runoff is deleterious for freshwater streams, rivers, and lakes. Non-tidal streams in the Mattawoman Creek watershed, a region in the Coastal Plain of Maryland with inherently poor buffering capacity in the rocks and soils, are more susceptible to acidification from these and other acid sources than streams in the Piedmont region. The primarily sandy soils in the Mattawoman Creek watershed provide little buffering ability. Consequently, wet and dry acid deposition falling on the landscape will experience minimal neutralization before it runs off into streams and percolates into the shallow groundwater. Acidic deposition also leaches forms of aluminum from the soils that are toxic to fish and other aquatic animals (Baker and Schofield 1982). Relatively recent data collected by the MBSS demonstrated that acid deposition was influencing 12 of 27 stream sites where water samples were collected (Figure 11). This finding is consistent with the results of several studies conducted during the 1980's in Maryland (Janicki and Cummins 1983; Janicki and Greening 1987; Kaufmann et al. 1988; Janicki et al. 1990; Rice and Brinker 1991). These studies showed that many streams in the lower western shore area of Maryland were either chronically acidic or very sensitive to acidic depositions, exacerbated by a growing body of evidence that Maryland was receiving acidic rainfall (pH 4.0-4.2, Janicki et al.1989). Acid pulses (episodes) in several Coastal Plain Maryland streams, associated with storm events, were thought to be contributing to declining spawning runs of blueback herring, alewife, and yellow perch (Klauda and Palmer 1986; Klauda 1989). A multi-year project was launched in 1987 to test the ability of an automated limestone-slurry doser to neutralize these acidic pulses in Mattawoman Creek (Greening et al. 1989; PPRP 1989; Hall et al. 1992, 1993, 1994). In recognition of the documented impacts of acid deposition on human health and the environment, Congress enacted Title IV, part of the Clean Air Act Amendments, in 1990. Title IV requires significant decreases in sulfur dioxide (SO2) and nitrous oxides (NOx) emissions, major precursors of acid deposition, from fossil fuel-burning power plants. Implementation of Title IV has substantially reduced emissions of SO2 and NOx, and has also decreased sulfate and inorganic nitrogen deposition in the Mid-West and eastern U.S. (Burns et al. 2011). As a result, lakes and streams that were detrimentally affected by acid deposition should be recovering, although delays are being observed. DNR will repeat portions of the 1987 Maryland Synoptic Stream Chemistry Survey (Knapp et al. 1988) in 2012, to see if our streams are recovering from acidic inputs coming from atmospheric deposition. Seven stream sites in the Mattawoman Creek watershed will be sampled in March as part of the 2012 Maryland Synoptic Stream Chemistry Survey.

There are, however, also organic inputs of acidity from natural sources. These acids are derived from the leaching of leaves and wood that fall into streams. Slow moving and poorly-buffered streams, like those in the Mattawoman Creek watershed, are often naturally acidic. Their pH values can fall far below neutral (7.0), but the organic chemicals associated with natural acidity usually prevent the formation of toxic aluminum forms. Two streams recently sampled by the MBSS receive most of their acidic inputs from natural sources. These naturally occurring acidic conditions mean that the community of organisms living there is made up of species that can tolerate, are adapted to, and prefer mildly-acidic habitats. This distinct group of aquatic animals exemplifies the unique nature of the streams that drain the Mattawoman Creek watershed. However, when natural organic acidity is amplified by atmospheric sources of inorganic acidity, even these acid loving species are affected.

Figure 11: Acidified MBSS monitoring locations in the Mattawoman Creek watershed. Sources of acid include atmospheric deposition and natural organic materials.

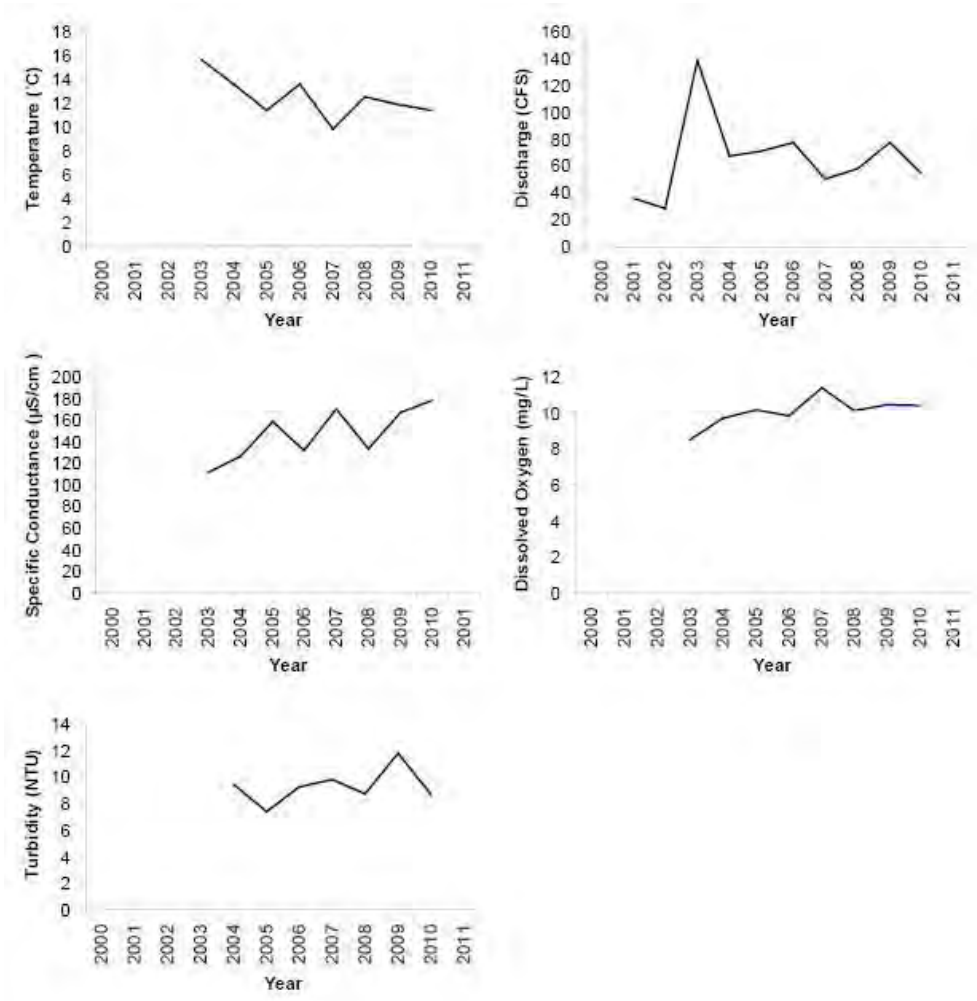


Long-term water quality

Discrete samples and continuous (every 15 minutes) water quality data were collected by the US Geological Survey from a site on Mattawoman Creek, near Pomonkey (http://waterdata.usgs.gov/md). Parameters measured include temperature, specific conductance, dissolved oxygen, and turbidity (Figure 12). This site was co-located with the USGS stream gage, so discharge (flow) data are also available. The time during which these data are available is different for each parameter. Although data were not available during all years, we show annual mean measurements for each parameter that were taken any time since 2000. These data are included here to illustrate variability in the annual means for these parameters and to elucidate potential trends. Annual mean discharge was highly variable at this site, with the lowest discharge (36 cfs) during 2002 (a drought year) and highest during 2003 (138 cfs). Annual mean water temperature showed a slight cooling trend. Dissolved oxygen increased slightly from 2003 to 2010, and the dissolved oxygen levels were above the state water quality criteria minimum of 5.0 mg/L. Mean annual turbidity varied between 7.4 and 11.7 NTU, indicating the water was relatively clear most of the time. Mean annual specific conductance varied within a range (112 – 178 µS/cm) expected for Coastal Plain streams like Mattawoman Creek. These data represent a relatively short time series (for most parameters there are only seven years of data) and thus cannot capture long-term trends. However, continuing to collect these water quality data into the future would improve our ability to detect trends and associate any observed changes with climate, weather, land use, and other changes that could occur within the watershed.

Northern Red Salamander, *Pseudotriton ruber ruber*.

Figure 12: Annual means of several water quality parameters collected from the USGS gage on Mattawoman Creek near Pomonkey, Maryland. Parameters measured include water temperature, discharge, specific conductance, dissolved oxygen, and turbidity.



Part 2: Implications for the future health of Mattawoman Creek non-tidal streams

As described throughout this report, the streams of the Mattawoman Creek watershed are not free from human-related alterations. There is chemical, physical, landscape and biological stress from point and non-point sources throughout the watershed. Six of 28 stream sites sampled by the MBSS had Poor biological quality scores. Four of these six streams appear to be affected by acidic deposition and have highly acidic water (pH less than 6.0 and low concentrations of organic carbon). The other two sites appear to be affected by urbanization (urban land use is greater than 40% and impervious land cover greater than 10%). None of the stream sites with Fair or Good stream health scores were affected by these same magnitudes of acidity or urbanization.

Stream dwelling rare, threatened, and endangered species tend to be more sensitive to altered conditions compared to other species (Stranko et al. 2010). The distribution of these imperiled species in the Mattawoman Creek watershed is consistent with this pattern. The eight sites where the MBSS found rare, threatened, or endangered fish or bivalves all had less than 22% urban land cover, less than 7% impervious land cover, more than 58% forested land cover, and pH values above 6.0. Certain highly sensitive species have been shown to be affected by even lower levels of urban and impervious land cover (Angermeier et al. 1995; Stranko et al. 2008; King et al. 2011), emphasizing the need for land protection to protect aquatic resources.

So far human induced alterations to most parts of this watershed appear to be relatively minimal. Mattawoman Creek and its tributaries still support rare and diverse animal assemblages indicative of some of the highest quality streams in Maryland. Physical habitat, water quality, and landscape characteristics of the watershed also reflect this condition in most streams. The human-induced acidic condition of several streams will likely continue to improve due to clean air regulations and more stringent emission reduction standards.

The most recent and imminent threat to stream quality in the Mattawoman Creek watershed comes from the construction of housing developments, roads, and commercial development to accommodate projected population growth in Charles County. As the human population of Charles County increases, forests in parts of the watershed will likely be cut down and replaced with housing developments, roads, and other urban-related features. A large number of scientific investigations unequivocally report severe impacts to streams due to urbanization and the associated addition of impervious land cover (pavement, rooftops) that accompanies urbanization (e.g., Paul & Meyer 2001; Walsh et al. 2005; Stranko et al. 2008). The most effective approach to maintaining the high quality of Mattawoman Creek's streams is to strictly limit or control the encroachment of additional urbanization within the watershed. Several recent scientific investigations have also shown that the detrimental effects of urbanization are extremely difficult (maybe impossible) to reverse given current restoration technology (e.g., Stranko et al. 2011). While limiting or carefully controlling urbanization on streams is vitally important to the health of the watershed, other potential sources of human alteration (such as those described in this Section) will also be important.

Redfin Pickerel, Esox *americanus americanus*.

Although the streams of the Mattawoman Creek watershed are of relatively high quality, there is room for improvement. If implemented successfully, such improvements could elevate the condition of the Mattawoman Creek watershed to serve as a model for stream conservation in Maryland and the Chesapeake Bay basin. Elimination of certain aspects (e.g., loss of stream connectivity, large narrow riparian buffers, inorganic acidity, and erosion) of streams in this watershed could be conducted, resulting in healthier, more efficiently functioning streams throughout the watershed and better tidal resources downstream. DNR's Monitoring and Non-Tidal Assessment Division recommends that the suite of management actions considered include a triage approach to planning stream restoration, where those streams that are only moderately impaired and have the best chance for recovery are targeted first. Appendix A presents DNR's methodology for Prioritizing Streams for Protection and Restoration Based on a Triage System. MDE's Biological Restoration Initiative also recommends targeting impaired watersheds with the fewest and least drastic impacts first, based on a higher likelihood for success. Targeting Mattawoman Creek for restoration, along with preservation, is consistent with these approaches.

Maintaining, and even improving, the conditions of Mattawoman Creek's streams will provide abundant ecosystem services and preserve the rural landscape that is a desirable characteristic of Charles County. Such an approach will also afford resilience to streams in the face of anticipated global climate change and the associated weather and hydrologic changes that may accompany it. Preparing for future pressure to the watershed's streams will ensure long-term benefits from current conservation actions.

The streams of the Mattawoman Creek watershed are unique in their physical, chemical, and biological condition. Many of these streams reflect stream conditions indicative of what streams were like within this region before widespread human alterations. It may be possible to preserve this natural heritage by preserving the forested landscapes within the stream valley and limiting other human-related stresses. It may also be possible to improve stream conditions with a concerted effort to carry our targeted restoration work, where appropriate, along with preservation. Such a progressive effort would almost certainly provide a model for stream conservation as well as abundant benefits for the residents of Charles County, Maryland, and the biological diversity of Chesapeake Bay.

Mattawoman Creek

Part 3: Summary of recommendations for non-tidal streams in the Mattawoman Creek watershed

- The County should continue to protect undeveloped areas of the Mattawoman Watershed from alteration, development and increases in impervious surface. Since restoring many aspects of a stream's physical and chemical condition can be challenging and expensive (Palmer et al. 2005), protecting streams from alteration is the most ecologically and economically cost effective alternative to attempting to restore stream health once it has been compromised (Stranko et al. 2011).

- Utilize the locations where stream dwelling rare, threatened and endangered species are present as the priority locations for the greatest levels of protection from development. As noted earlier in this section, stream dwelling rare, threatened, and endangered species tend to be more sensitive to altered conditions compared to other species (Stranko et al. 2010). The distribution of these imperiled species in the Mattawoman Creek watershed is consistent with this pattern. The eight sites where the MBSS found rare, threatened, or endangered fish or bivalves all had less than 22% urban land cover, less than 7% impervious land cover, more than 58% forested land cover, and pH values above 6.0.

- The County should recognize that certain highly sensitive species can be affected by even lower levels of urban and impervious land cover (under 7%) (Angermeier et al. 1995; Stranko et al. 2008; King et al. 2011), and target key watershed locations to achieve such higher levels of land protection to protect aquatic resources.

- The County should prioritize protection over restoration and strictly limit or control encroachment of additional urbanization within the watershed since several recent scientific investigations have also shown that the detrimental effects of urbanization are extremely difficult (maybe impossible) to reverse given current restoration practices and performance.

- Management recommendations for protection, restoration and stabilization for specific Mattawoman Creek streams, using DNR's Triage Systems Approach methodology or other similar approaches, should be considered by the County to prioritize the use of limited restoration and protection funding in order to achieve the maximum benefit to stream health (Section 3, Appendix A).

References Cited

Angermeier, P.L. 1995. Ecological attributes of extinction-prone species: loss of freshwater fishes of Virginia. Conservation Biology 9: 143-158.

Baker, J.P. and C.L. Schofield. 1982. Aluminum toxicity to fish in acidic waters. Water, Air, and Soil Pollution 18:289-309.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Burns, D.A., J.A. Lynch, B.J. Cosby, M.E. Fenn, and J. S. Baron. 2011. National Acid Precipitation Assessment Program Report to Congress 2011: An Integrated Assessment. National Science and Technology Council, Washington, DC.

Greening, H.S., A.J. Janicki, R.J. Klauda, D.M. Boulder, D.M. Levin, and E.S. Perry. 1989. An Evaluation of Stream Liming Effects on Water Quality and Spawning of Migratory Fishes in Maryland Coastal Plain Streams: 1988 Results.

Hall, L.W. Jr., S.A. Fisher, W.D. Killen Jr., M.C. Ziegenfuss, and R.D. Anderson. 1994. Doser Study in Maryland's Coastal Plain: Use of a Limestone Doser to Mitigate Stream Acidification. Prepared for Maryland Department of Natural Resources, Acid Deposition Program, Annapolis. AD-94-2.

Janicki, A. and H. Greening. 1987. A summary of Maryland stream pH and alkalinity data: an analysis of its application to assessing the impacts of acidic deposition. Prepared for Maryland Department of Natural Resources, Power Plant Research Program, Annapolis. AD-87-11.

Janicki, A. and R. Cummins. 1983. An analysis of survey data on the chemistry of twenty-three stream in the Chesapeake Bay watershed: some impactions of the impact of acid deposition. Prepared for Maryland Department of Natural Resources, Power Plant Siting Program. PPSP-MP-51.

Janicki, A., M. Bonoff, J. Lynch, and M. Morgan. 1990. Sources of Acidity in Maryland Coastal Plain Streams. Prepared for Maryland Department of Natural Resources, Acid Deposition Program, AD-90-2.

Kaufman, P.R. and 14 co-authors. 1988. Chemical characteristics of streams in the Mid-Atlantic and southeastern United States. Volume 1: Population descriptions and physico-chemical relationships. U.S. Environmental Protection Agency, Washington, D.C. EPA/600/3-88/021A,B.

King, R. S., M. E. Baker, P. F. Kazyak, and D. E. Weller. 2011. How novel is too novel? Stream community thresholds at exceptionally low levels of catchment urbanization. Ecological Applications. 21: 1659-1678.

Klauda, R.J. 1989. Definitions of Critical Environmental Conditions for Selected Chesapeake Bay Finfish Exposed to Acidic Episodes in Spawning and Nursery Habitats. Prepared for Maryland Department of Natural Resources, Acid Deposition Program, Annapolis. Ad-89-6.

Klauda, R.J. and R.E. Palmer. 1986a. Laboratory and field bioassay experiments on blueback herring from Maryland coastal plain streams. Prepared for Maryland Department of Natural Resources, Power Plant Siting Program, Annapolis. PPSP-AD-15.

Klauda, R.J. and R.E. Palmer. 1986b. Response of blueback herring eggs and larvae to pulses of acid and aluminum. Transactions of the American Fisheries Society. 116:561-569.

Knapp, C.M. and W.P. Saunders. 1988. Maryland Synoptic Stream Chemistry Survey: Estimating the Number and Distribution of Streams Affected by or At Risk from Acidification. Prepared for Maryland Department of Natural Resources, Power Plant Research Program, Annapolis. AD-88-2.

Lassuy, D.R. 1995. Introduced species as a factor in extinction and endangerment of fishes. Biological Conservation 9:101–118.

Miller, R.R., J.D. Williams, and J.E. Williams. 1989. Extinctions of North American fishes during the past century. Fisheries 14:22–38.

Moyle, P.B. 1976. Fish introductions in California: History and impact on native native fi sh species. In H.L. Schramm, Jr. and R.G. Piper (Eds.). Uses and Effects of Cultured Fishes in Aquatic Ecosystems. American Fisheries Society, Symposium
Palmer, M. A., E. S. Bernhardt, J. D. Allan, P. S. Lake, G. Alexander, S. Brooks, et al. 2005. Standards for ecologically successful river restoration. Journal of Applied Ecology 42:208–217.

Paul, M.J., and J.L. Meyer. 2001. Streams in the urban landscape. Annual Review of
Poff, N.L., J. D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, J.C. Stromberg. 1997. The Natural Flow Regime. BioScience 47: 769-784.

PPRP (Power Plant Research Program). 1989. Acid Deposition in Maryland: Summary of Results through 1989. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis. AD-89-1.

R. L. Vannote, G.W. Minshall, K.W. Cummins, J.R. Sedell, C.E. Cushing. 1980. The River Continuum Concept. Canadian Journal of Fisheries and Aquatic Sciences37:130-137.

R.J. Klauda. 1992. 1991 Doser Study in Maryland Coastal Plain: Use of Lime Doser to Mitigate Acidification. Prepared for Maryland Department of Natural Resources, Acid Deposition Program, Annapolis.

R.J. Klauda. 1993. Assessing the relationship between critical acidic conditions in Maryland coastal plain streams and predicted mortality of early life stages of migratory fish. Aquatic Toxicology 26:239-272.

Rice, K. and O. Bricker. 1991. Geology-based Method for Assessing Sensitivities of Streams to Acid Deposition in Charles and Anne Arundel Counties, Maryland. Prepared for Maryland Department of Natural Resources, Acid Deposition Program, Annapolis. AD-91-5.

Roth, N., M. Southerland, J. Chaillou, R. Klauda, P. Kazyak, S. Stranko, S. Weisberg, L. Hall, Jr., and R. Morgan II. 1998. Maryland Biological Stream Survey: Development of an Index of Biotic Integrity for fishes in Maryland streams. Third EMAP Symposium, Albany, NY. Environmental Monitoring and Assessment 51: 89-106.

Southerland, M.T., G.M. Rogers, M.J. Kline, R.P. Morgan, D.M. Boward, P.F. Kazyak, R.J. Klauda, and S.A. Stranko. 2007. Improving biological indicators to better assess the condition of streams. Ecological Indicators 7: 751-767.

Stranko, S.A., D.M. Boward, J.V. Kilian, C.J. Millard, A.J. Becker, R. Gauza, A. Schenk, A. Roseberry-Lincoln, and M. O'Connor. 2007. Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources, Annapolis, Maryland.

Stranko, S.A., R.H. Hilderbrand, and M.A. Palmer. 2011. Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams. Restoration Ecology DOI: 10.1111/j.1526-100X.2011.00824.x

Stranko, S.A., R.H. Hilderbrand, R.P. Morgan III, M.W. Staley, A.J. Becker, A. Roseberry-Lincoln, E.S. Perry, and P.T. Jacobson. 2008. Brook trout declines with changes to land cover and temperature in Maryland. North American Journal of Fisheries Management 28: 1223-1232.

Stranko, S.A., S.E. Gresens, R.J. Klauda, J.V. Kilian, P.J. Ciccotto, M.J. Ashton, and A.J. Becker. 2010. Differential effects of urbanization and non-natives on imperiled stream species. Northeastern Naturalist 17: 593-614.

Stribling, J.B., B.K. Jessup, J.S. White, D. Boward, and M. Hurd. 1998. Development of a Benthic Index of Biotic Integrity for Maryland Streams. Maryland Department of Natural Resources Publication number CBWP-EA-98-3, Annapolis, Maryland.

Tyus, H.M., and J.F. Saunders III. 2000. Nonnative fi sh control and endangered fish recovery: Lessons from the Colorado River. Fisheries 25:17–24.

Walsh, C.J., T.D. Fletcher, and A.R. Ladson. 2005. The urban stream syndrome: current knowledge and the search for a cure. Journal of the North American Benthological Society 24: 706–723.

Wilcove, D.S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. Bioscience 48:607–615.

Appendix A: Prioritizing Streams for Protection and Restoration Based on a Triage System

Ronald Klauda (MDNR) and Patrick Graves (MDNR)

Background

Although Maryland is a small state (9,974 square miles), it has a dense drainage network of at least 10,000 miles of perennial streams and rivers. The human population in 2010 was 5,773,552 (an increase of 9.0% since 2000), making Maryland the seventh most densely-populated state in the U.S. (595 people per square mile). Urbanization and other land use changes are major stressors on the State's waters.

Protecting healthy and restoring degraded streams are goals of local, state, and federal agencies in Maryland. Protecting streams before they become degraded is especially important because protection is less costly than trying to restore them after they decline. But with so many miles of streams to deal with and agency budgets being cut and stretched to the limit, there are far more miles of streams to be restored than there are available dollars to allocate.

A prioritization strategy is needed to decide when, where, and how limited dollars should be spent to achieve maximum benefit. The prioritization strategy should embrace the fact that the benefits per restoration dollar spent (the costs) will be highest for slightly-degraded streams and lowest for severely and critically-degraded streams impacted by many stressors and having a very low probability of recovery.

This situation is analogous to a hospital emergency room, a battle field, or the site of a natural disaster---all places where the number of sick, injured, or wounded people often exceeds the available medical staff and/or supplies needed to threat them all in a timely manner. To prioritize patients' treatments based on the severity of their injuries and their chances of recovery, a sorting process or system called "triage" is performed (Kennedy et al. 1966; Rutherford 1989).

Triage comes from the French word "trier", meaning to sort, separate, select, choose, or cull. Triage was first used by Dominique Jean Larrey, a surgeon in Napoleon's army. Larrey used a triage system to ration limited medical resources for optimal benefit and achieve the greatest good for the largest number of sick, injured, and wounded soldiers.

Triage has been used in species protection and biodiversity conservation for many years (e.g., Bennett 1986; Hobbs and Kristjanson 2003; Wilson et al. 2006; Turner and List 2007; McDonald-Madden et al. 2008, Hilderbrand et al. 2010, Schneider et al. 2012). This approach has been much less frequently used to prioritize habitat restoration projects (e.g., Holt and Vinney 2001; Bottrill et al. 2008).

Methods for Using a Triage System to Sort and Group Maryland Streams

Between 2000 and 2009, the Maryland Department of Natural Resources (DNR) sampled 1,370 randomly-selected, 1st through 4th order, non-tidal stream sites statewide with the Maryland Biological Stream Survey (MBSS). Data from this survey were used to calculate multi-metric biological indicators of stream condition. These indicators, called indices of biotic integrity (IBI), were calculated for benthic macroinvertebrate and fish assemblages.

Stream Ecological Condition categories needed for development of a triage system were calculated by averaging the benthic and fish IBI scores for each sampled site, expressed as a Combined Biotic Integrity (CBI) score, that ranged from 1.0 (worst) to 5.0 (best). CBI scores from the 1,370 stream sites sampled by the MBSS between 2000 and 2009 were used to estimate the total miles of streams, statewide, that fall into each of the five Stream Ecological Condition (SEC) categories (see Table 1).

For the triage system approach, we viewed these SEC categories as being analogous to five medical condition triage categories. This system was used to sort Maryland streams into five priority groups (1 through 5) that were also color-coded for mapping purposes. For each SEC category, we suggested appropriate management actions for streams that ranged from Protect to Do Nothing.

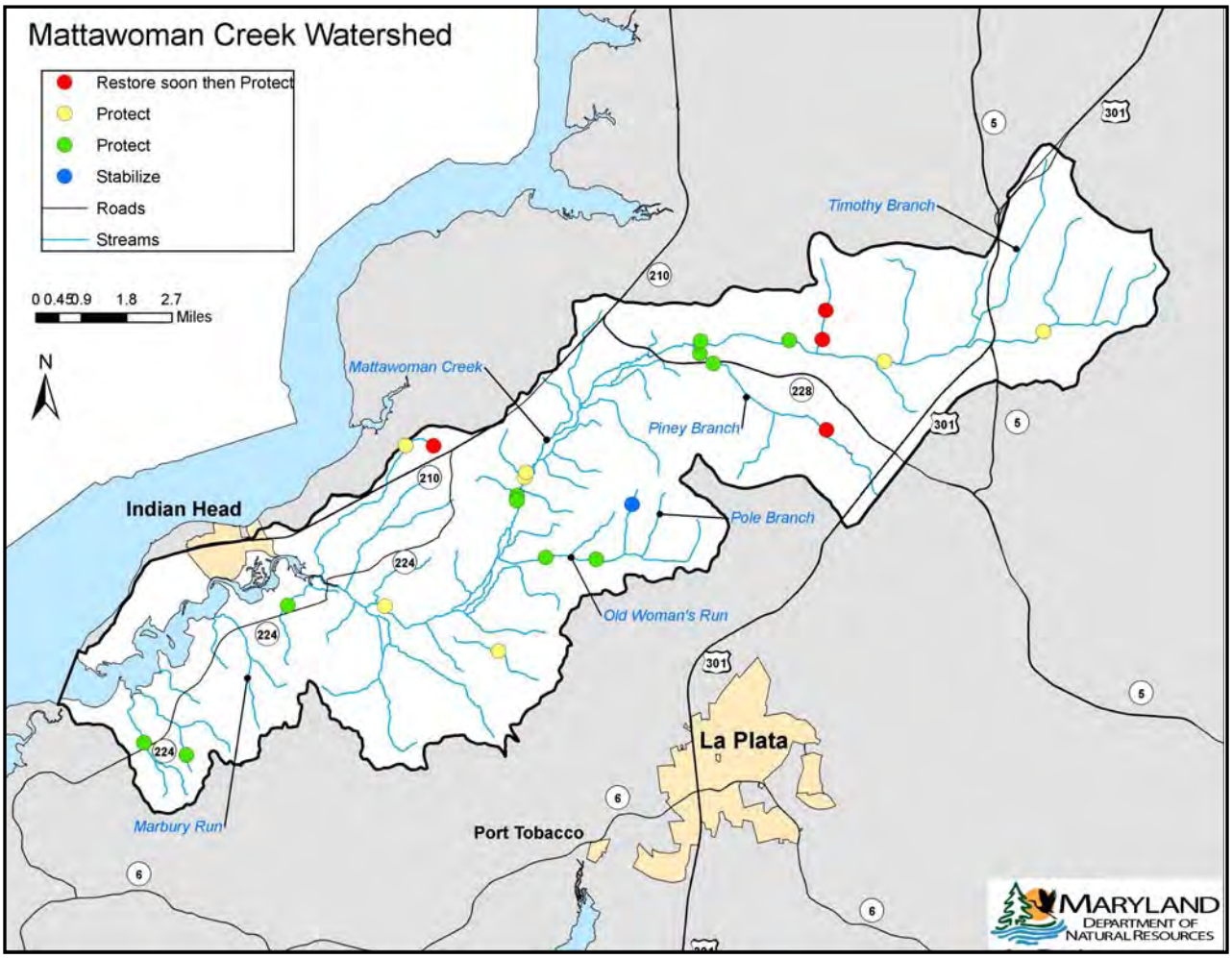
Application of a Triage System to the Mattawoman Creek Watershed

Data from 23 stream sites that were sampled by DNR's MBSS in this watershed between 2000 and 2009 were used to calculate a CBI for each site. Each CBI score was assigned to a SEC category, color-coded for the relevant Triage Group, and mapped (Map 1). Four of the 23 sampled stream sites are Priority 1 (red) streams that are moderately degraded and should be restored soon, then protected. Seven stream sites are Priority 2 (yellow) and only slightly-degraded. If these yellow sites are protected and the threats are minimized, it's likely they will be able to heal themselves with no further management actions. The even more encouraging observation is that over half (11) of the 23 sampled stream sites appear to be mostly healthy (Priority 3, green) and should be protected to prevent them from degrading. Only one of the 23 stream sites that have been sampled by the MBSS in the Mattawoman Creek watershed had a SEC score in the severely-degraded (Priority 4, blue) category, where stabilization rather than extensive/expensive restoration attempts are recommended. Fortunately, no sampled stream sites were critically-degraded and in the Priority 5 (do nothing) category.

Table 1: Triage Systems Approach using Stream Ecological Condition

Medical Condition for Triage	Triage Group Priority and Color	Stream Ecological Condition	Range of CBI Scores* (Total Miles)
•Routine or minor but not serious injuries •walking wounded •little or no treatment needed •delayed care is OK •can return to duty in short period of time	Priority 3	•Mostly healthy •comparable to minimally-disturbed reference stream •reduce and prevent threats •**PROTECT**	4.0 to 5.0 (1804)
•Moderate to serious but non-life threatening injuries •treatment can be delayed •in stable condition but requires medical assistance	Priority 2	•Slightly degraded •minimize threats •**PROTECT** so stream can heal itself	3.0 to < 4.0 (3263)
•Severe life-threatening injuries •will probably survive if treated soon •cannot wait but must have 1st priority	Priority 1	•Moderately degraded •significant deviation from reference streams •**RESTORE soon then PROTECT**	2.3 to < 3.0 (1759)
•Critical injuries, beyond help, expectant •likely to die regardless of care received •low priority for treatment •care required is beyond medical personnel capability and time •administer drugs to reduce pain	Priority 4	•Severely degraded •lost cause •**STABILIZE** then take short-term remedial actions to eliminate hazards to human health, improve aesthetics •DO NOT attempt extensive/expensive restoration	1.6 to < 2.3 (1562)
•Deceased with no vital signs, beyond help	Priority 5	•Critically degraded •only most tolerant biota present, if any; **DO NOTHING**	1.0 < 1.6 (807)

Map 1: Management guidance for Mattawoman Creek streams based on applying the Triage Systems Approach



Conclusions

The triage system described above is a suggested first step in targeting stream protection and restoration actions. Triage can sort out those streams with still mostly intact ecological integrity (i.e., mostly healthy or only slightly-degraded) that do not require restoration actions, but deserve protection/preservation actions that should be taken. Triage can also sort out those streams that are moderately-degraded and whose ecological integrity should be restored with modest management actions, if the key stressors are first removed and appropriate actions taken fairly soon. And, perhaps most importantly, a triage system can sort out those streams whose ecological integrity is severely compromised or irretrievably lost and restoration is not possible, even if much money and other resources are expended in the attempt. The most effective strategy for these streams is to implement the minimal necessary management actions to improve their appearance and ensure they do not endanger human health and safety. Allocating public resources to stream restoration actions should consider the value of the degraded system, the benefits if restoration is successful, the probability of success, and the total costs.

References

Bennett, D.H. 1986. Triage as a species preservation strategy. Environmental Ethics 8:47-58.

Botrill, M.C. and 13 co-authors. 2008. Is conservation triage just smart decision making. Trends in Ecology and Evolution 23(12):649-654.

Hilderbrand, R.H., R.M. Utz, S.A. Stranko, and R.L Raesly. 2010. Applying thresholds to forecast potential biodiversity loss from human development. Journal of the North American Benthological Society 29(3):1009-1016.

Hobbs, R.J. and L.T. Kristjanson. 2003. Triage: How do we prioritize health care for landscapes? Ecological Management and Restoration 4:39-45.

Holt, D. and H. Vinney. 2001. Targeting environmental improvements through ecological triage. Eco-management and Auditing 8:154-164.

Kennedy, K. R.V. Aghabagian, L. Gans, and C.P. Lewis. 1996. Triage techniques and applications in decision making. Annals of Emergency Medicine 28:136-144.

McDonald-Madden, E., P.W.J. Baxter, and H.P. Possingham. 2008. Subpopulation triage: How to allocate conservation effort among populations. Conservation Biology 22(3):656-665.

Schneider, R.R., G. Hauer, W.L. Adamowicz, and S. Boutin. 2010. Triage for conserving populations of threatened species: The case of woodland caribou in Alberta. Biological Conservation 143(7):1603-1611.

Turner, D.S. and M.D. List. 2007. Habitat mapping and conservation analysis to identify critical streams for Arizona's native fish. Aquatic Conservation: Marine and Freshwater Ecosystems 17:737-748.

Wilson, K.A., M.F. McBride, M. Bode et al. 2006. Prioritizing global conservation efforts. Nature 440:337-340.

Section 4: Wetlands, Coastal Resources and Climate Change

Recommendations to support County Planning Program Direction from the Wetlands, Coastal Resources and Climate Change Section Workgroup

Catherine McCall (MDNR), Chelsie Papiez (MDNR), Denise Clearwater (MDE)

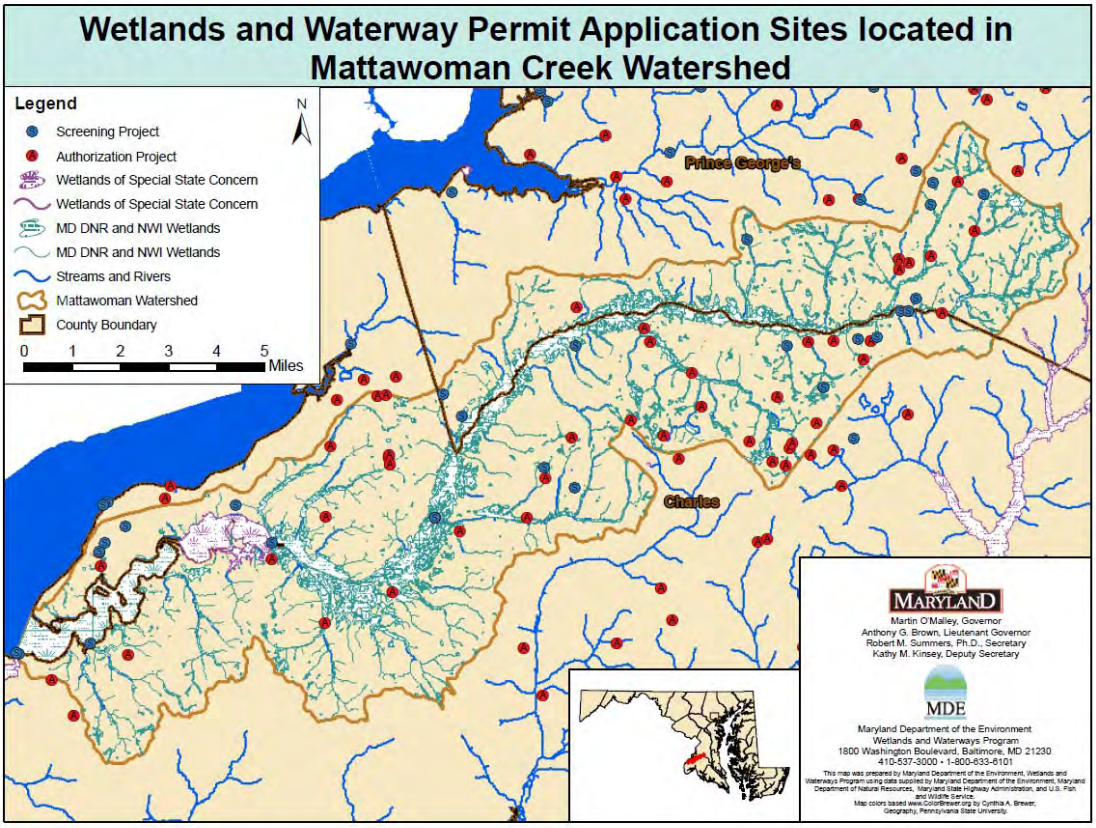
Part 1: Summary of Watershed Characteristics, Ecological Values and Resource Protection needs

Wetlands

The Mattawoman Creek watershed is characterized by broad stream valley floodplains that provide biological and nutrient cycling, pollutant filtering, habitat connectivity, floodwater storage, and stream stabilization. The watershed also contains extensive wetland types, including low bottomland forest along much of the creek. Wetlands in Charles County exist as estuarine and freshwater tidal communities, along floodplains, in isolated depressions, in abandoned mine sites, and as boglike communities. Wetland hydrology is from overbank flooding, tidal inundation, groundwater, and perched surface water sources. Along the shoreline of the Potomac River, tidal wetlands are not extensive, though there are large areas of tidal wetlands along the Potomac River tributaries. Some wetlands that developed in disturbed areas such as unreclaimed surface mines and under powerlines now support rare plants. Charles County also contains large wetland complexes long recognized for wildlife habitat and biodiversity.

A 2006 wetlands report estimated that within the Mattawoman Creek watershed there are a total of 7,432 acres of wetlands. However, a more recent 2010 review currently being updated indicates that there may be closer to 8,627 acres of wetland in the watershed. Of the wetland types identified in the 2006 report, 231 acres were classified as estuarine emergent and 2 acres as estuarine unconsolidated shore wetland types. Additionally, the Creek's watershed has extensive palustrine wetland types including aquatic bed (10 acres), emergent (332 acres), scrub shrub (290 acres), forested (6,298 acres), unconsolidated bottom (241 acres), farmed (21 acres) and unconsolidated shore (6 acres)[1]. A map illustrating wetlands and waterway permit application sites and wetland types is shown on the following page:

[1] Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Maryland. May 18, 2006 - Maryland Department of the Environment



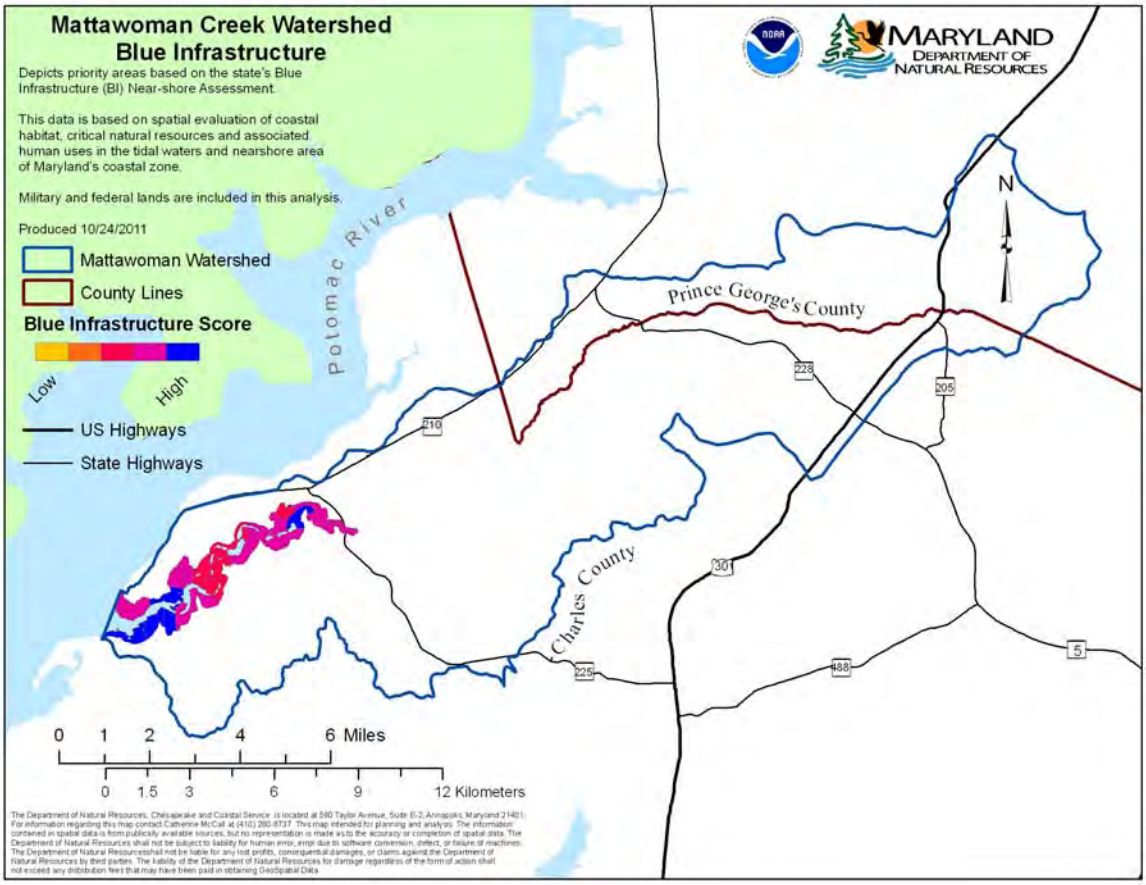
Each of these wetland types is comprised of different wetland plant species and provides different habitat and ecosystem service functions. Estuarine emergent wetlands can be either salt or brackish tidal wetlands and the vegetation varies based on salinity and hydrology. The Mattawoman Creek watershed's palustrine wetland types are diverse. Here, aquatic bed wetlands are both the wettest and most rare wetland type and may be characterized by small ponds with vegetation on the bottom and/or surface. Forested wetlands are the dominant palustrine wetland type in the Coastal Plain region and are often located in floodplains, depressions and drainage divides. Scrub shrub wetlands are less common than forested wetland types in the watershed and are often dominated by buttonbush in wetter systems as well as silky dogwood, arrowwood and alder tree saplings. Wetlands classified as farmed may indicate that the area has been previously drained to increase farm crop yields. Unconsolidated shore wetlands in either estuarine or palustrine systems may include areas such as beaches, bars and flats.

These wetlands function to provide excellent habitat for aquatic species, birds, and other wildlife, and are essential to the foodchain. Wetlands in the Mattawoman Creek watershed also assist with stormwater and flood control, facilitate groundwater recharge and discharge processes and help to remove nutrients, sediment and toxics from nearby waterways. Even with the large remaining wetland areas in the Mattawoman Creek watershed, there is a huge amount of hydric soil that has been converted from wetlands[2].

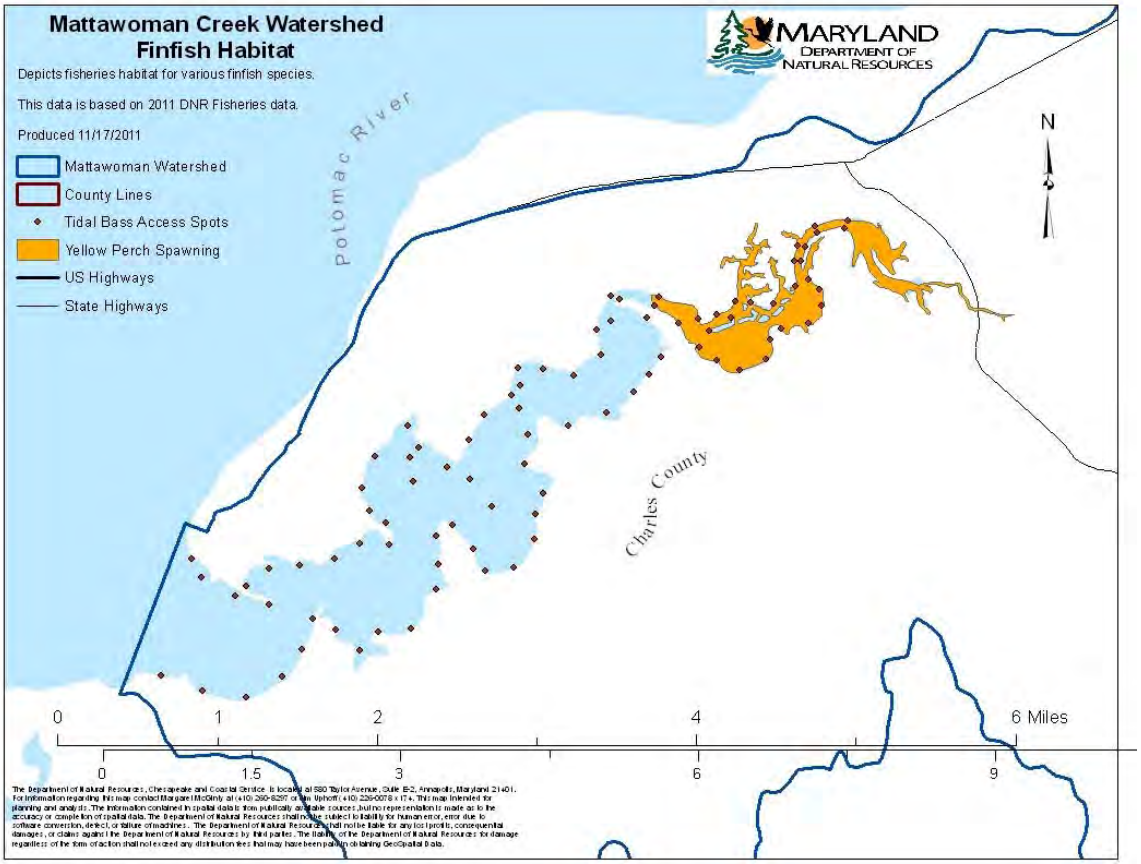
[2] US Army Corp of Engineers. 2003. Mattawoman Creek Watershed Management Plan Charles County, Maryland.

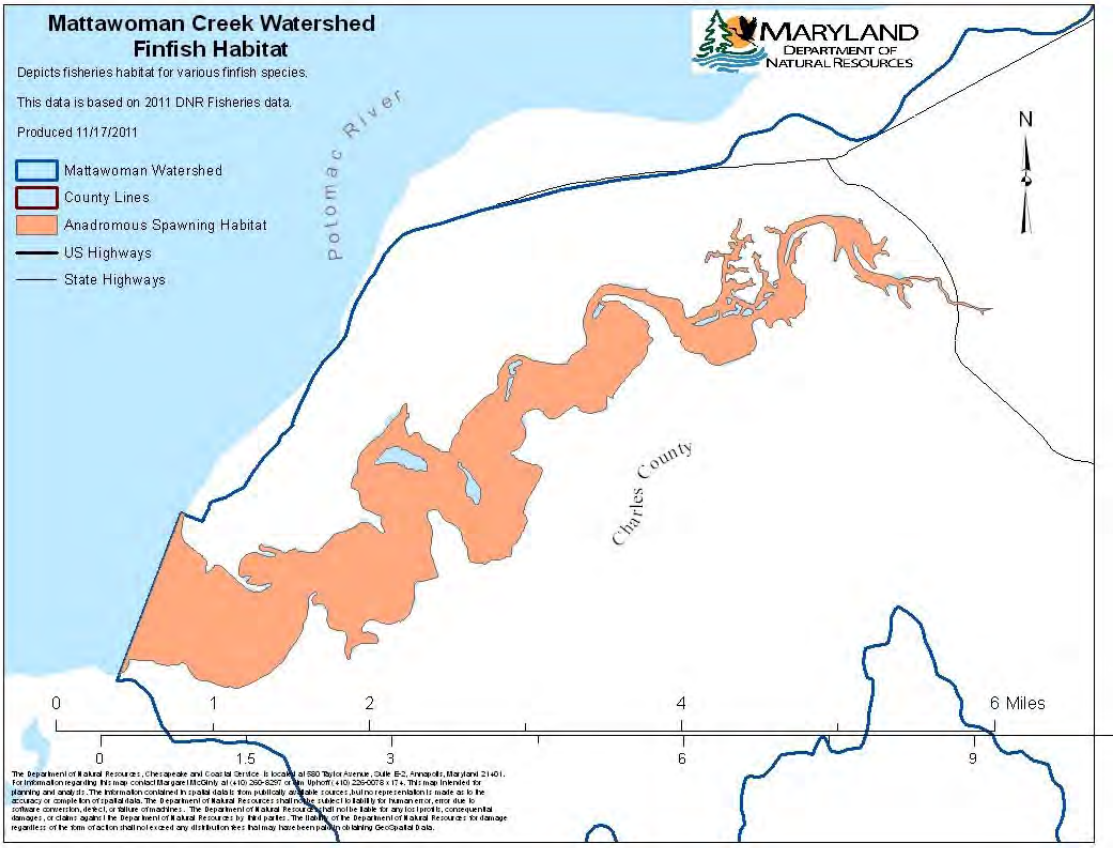
Coastal Resources

The tidal wetlands and waters of Mattawoman Creek provide nursery and juvenile habitat for many fish species including herring, spot croaker and weakfish, yellow and white perch and striped bass. As a result, it is also a feeding ground for many large fish-eating birds like Great Blue Herons, Common Egrets, and Black-Crowned Night Herons. This information about wetlands and other coastal resources was also used to develop the state's Blue Infrastructure (BI) Near-shore Assessment. The BI assessment is a spatial evaluation of coastal habitat, critical natural resources and associated human uses in the tidal waters and near-shore area of Maryland's coastal zone. The near-shore assessment serves as a link between Maryland's terrestrial and aquatic environments and contributes to prioritization systems that help target conservation and management activities to maintain and improve coastal habitats. In the Mattawoman Creek area, there are several areas of high near-shore BI priority, including the mouth and upper reaches of the creek (see figure below). In addition, the upper portion of the Mattawoman is home to several sensitive shoreline-dependent species, or those plants or animal species that rely upon intact shoreline habitats to thrive. The high BI values along the Mattawoman Creek are a result of the presence of a diverse set of aquatic and near-shore living resources such as submerged aquatic vegetation, fish spawning habitat, sensitive species, waterfowl areas and beach habitat. In addition, many of the surrounding 12-digit watershed are characterized by lower levels of impervious cover and developed areas. Each of these features contributed to the high BI ranks in the Mattawoman Creek. Charles County has some of the highest Blue Infrastructure values of the entire coastal zone of Maryland.



Specific maps that show spot croaker weakfish juvenile habitat, yellow perch and herring spawning habitat, anadromous spawning habitat and tidal bass access spots are shown in the following map figures.




Mattawoman Creek Watershed
Finfish Habitat
Depicts fisheries habitat for various finfish species.
This data is based on 2011 DNR Fisheries data.
Produced 11/17/2011
Mattawoman Watershed
County Lines
Anadromous Spawning Habitat
US Highways
State Highways
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES
Potomac River
Charles County
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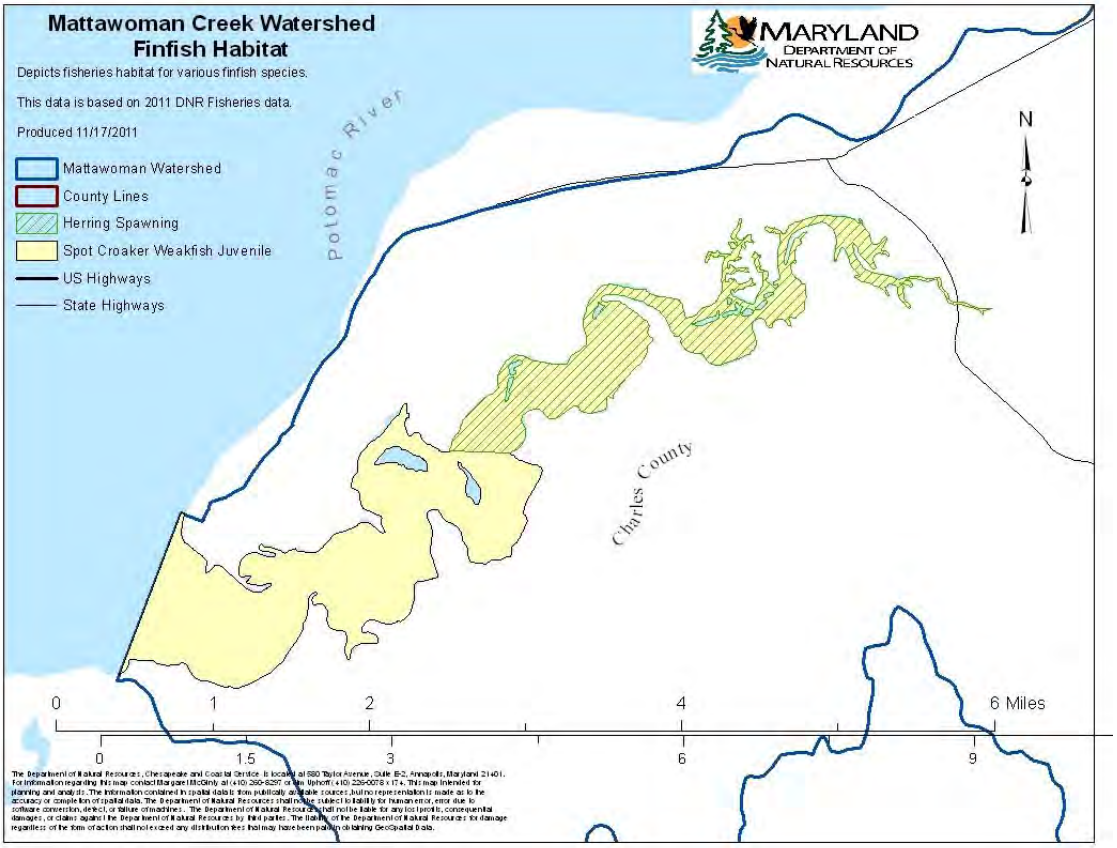
Mattawoman Creek Watershed
Finfish Habitat
Depicts fisheries habitat for various finfish species.
This data is based on 2011 DNR Fisheries data.
Produced 11/17/2011
Mattawoman Watershed
County Lines
Herring Spawning
Spot Croaker Weakfish Juvenile
US Highways
State Highways
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES
Potomac River
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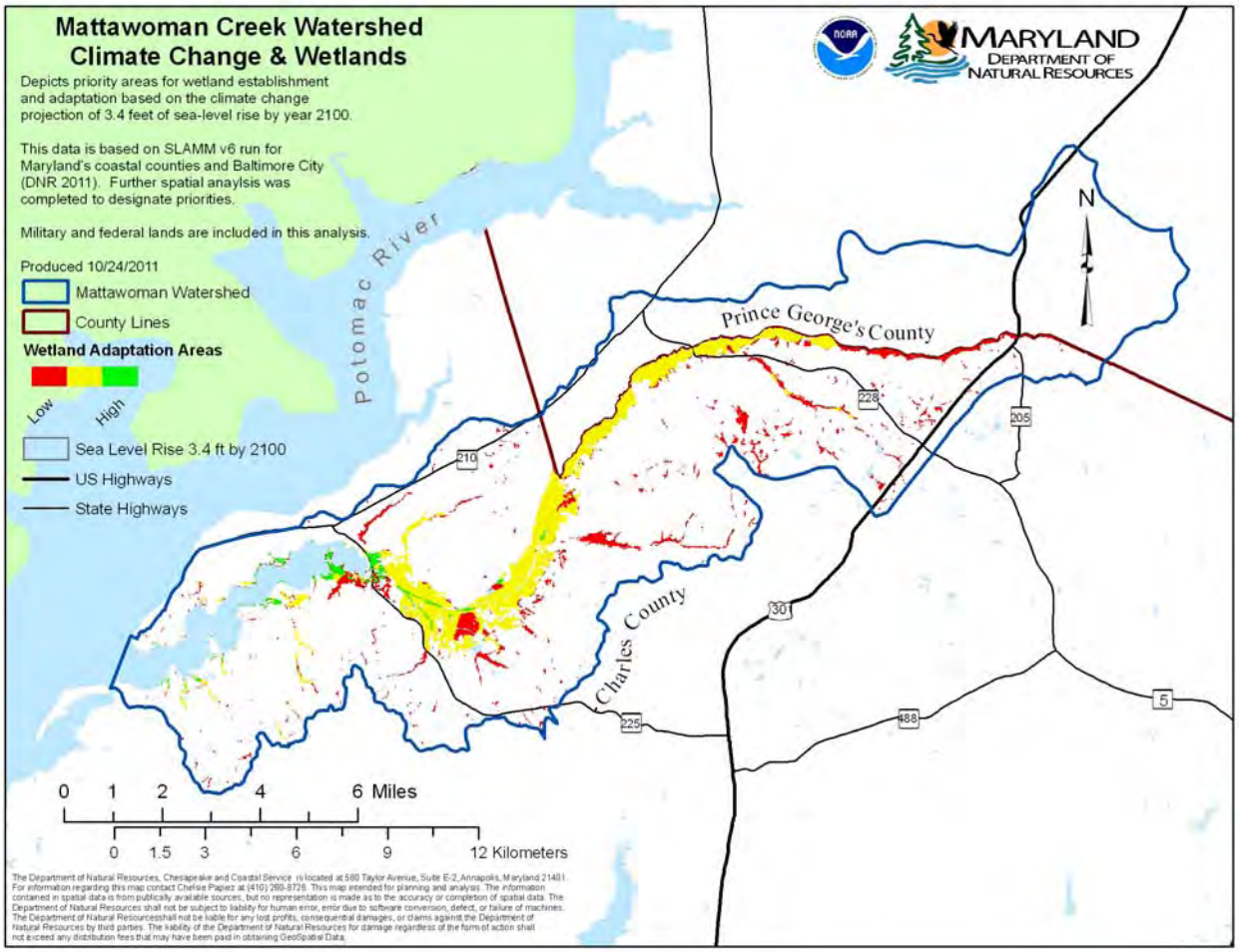
Within the broader watershed, there exist several particular areas that are sensitive to changes in impervious surface, degraded water quality and changes in the landscape. Some of these particularly sensitive areas are already protected, but some are not. These areas include:

- Pomonkey School Stream (DNR name: Chapman's Forest). This bottomland forest contains circumneutral soil and a Highly State Rare plant species (DNR, 1991). This site is not protected.
- Several areas may meet the criteria for WSSCs but are not currently designated in regulation and include:
  - Site connects to Pomonkey School Stream WSSC to the south and is partially protected by the State-owned Mattawoman NEA.
  - Site is south of Mason Springs and is unprotected.
  - Sites are south of Chapman Point and are partially protected by the State-owned Mattawoman NEA.
  - Site is south of Indian Head Manor and is not protected.
- Another site called Araby Bog is described as being a diverse 6.5 acre Magnolia Bog along a tributary to Mattawoman Creek. This bog is an acidic seep with unique vegetation. This type of bog is uncommon and generally degraded, making this particular site unique for its pristine condition.
- In addition, there are numerous wetlands adjacent to the Mattawoman Creek that are also designated as Nontidal Wetlands of Special State Concern.

Climate Change

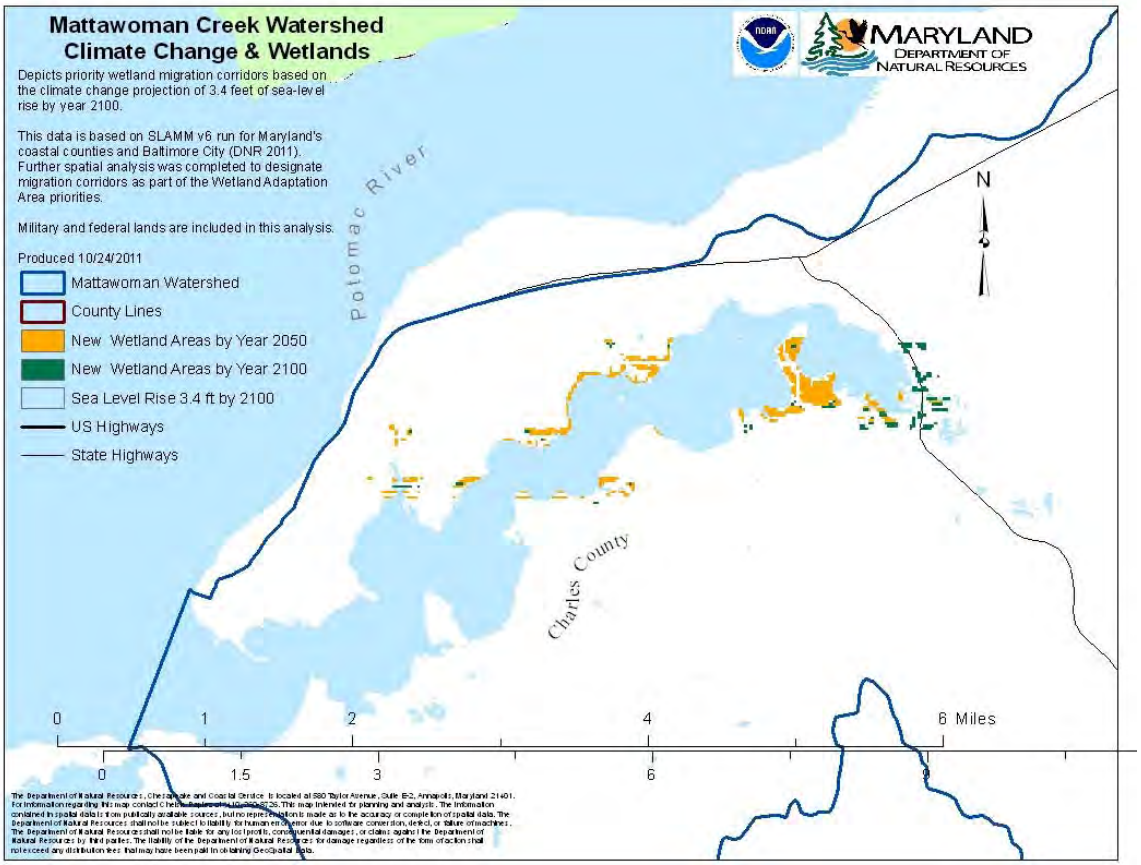
In 2008, Maryland's Commission on Climate Change[3] set forth sea level rise projections for the Chesapeake Bay region of 3.4 feet by the year 2100 under a high greenhouse gas emission scenario. In addition to sea level rise, precipitation is projected to increase during winter months in the form of extreme weather events. Wetlands can help mitigate high flow events by absorbing and slowing inflow and outflows of riparian systems.

The hydrology of the coastal region will likely change as sea level rises, increasing water salinity and raising water tables. Wetlands may establish in increased areas of hydric soils and help mitigate inland flooding. In response to sea level rise, coastal wetlands will need to migrate inland as the shoreline retreats. The Maryland Department of Natural Resources used a model entitled, Sea Level Affecting Marshes Model (SLAMM) to designate high priority wetlands under future sea level rise conditions (See figure below). The top priorities indicate the wetlands of the greatest size, diversity, wildlife habitat and suitable hydric soils where new wetlands are projected to occur along stream corridors throughout the Mattawoman Creek watershed.



[3] Maryland Commission on Climate Change. 2008. Comprehensive Assessment of Climate Change Impacts in Maryland. Report of the Scientific and Technical Working Group

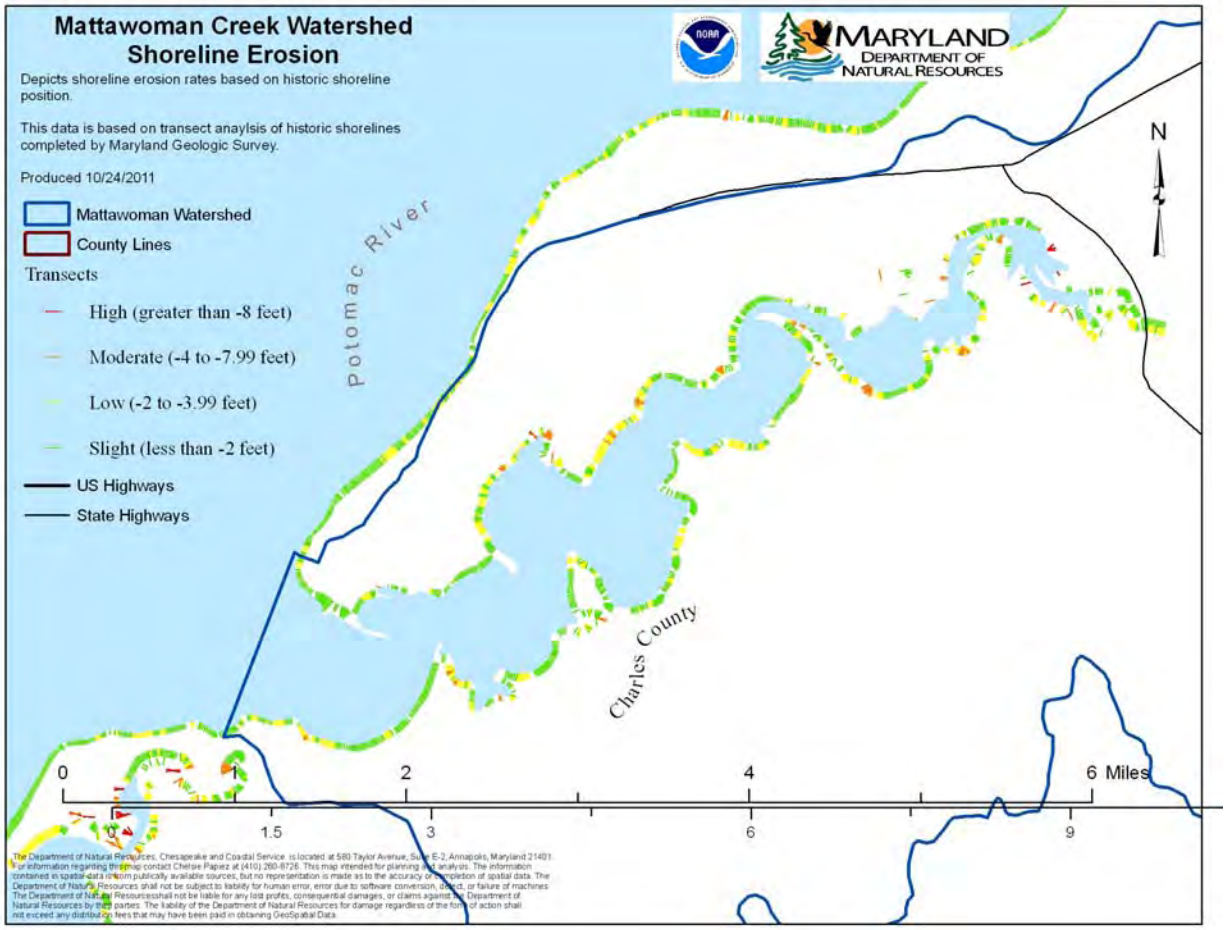
As part of the high priority areas, the projected wetland migration corridors make up some of the most important areas for coastal adaptation in response to sea level rise (See figure below). These areas are designated by the projected establishment of wetlands in currently non-wetland areas by the years 2050 and 2100 using SLAMM. Maintaining areas for wetland migration may provide opportunity for inland retreat of our coastal and nearshore wetlands that provide a variety of ecosystem services such as: wildlife habitat, water quality improvement, storm surge abatement, flood mitigation, aquifer recharge, carbon sequestration and recreation.



Erosion

Over the last century Maryland has lost up to 18,000 hectares of coastal lands in the Chesapeake Bay through coastal erosion. This averages approximately 580 acres per year. The effects of sea level rise will likely only exacerbate coastal erosion.

Recognizing this problem the Maryland Geologic Survey measured erosion rates based on historical shoreline data. The data was completed using transects that measured from existing to historic shorelines (See figure below). Mattawoman Creek exhibits areas of moderate to high erosion; these are areas that require proper shoreline management to mitigate the rate of shoreline loss. Shoreline management will not only help mitigate erosion rates but will also help to restore and maintain near-shore habitat such as beaches and wetlands. The key to selecting the appropriate management option is to understand the characteristics and history of the particular stretch of shoreline, the rate of erosion, depth of adjacent water, substrate, bank elevation and orientation, severity of tides, and distance of fetch, all of which are part of the assessment for shoreline restoration and design.



Part 2: Analysis and Evaluation of Current and Anticipated Threats and Stressor to Key Resources

While much of the Mattawoman remains undeveloped, as is currently outlined in zoning plans, projected growth in the Mattawoman Creek watershed at build-out will result in significant increases to impervious surface levels that will be, at best, equal to that of Piscataway Creek (at present, approximately 16-17 % impervious), and is likely to be higher (22% impervious surface)[4]. The potential for significant changes in land ownership, levels of impervious surface and development patterns in the Mattawoman watershed may likely compromise, degrade or cause the loss of the area's rich coastal resources and wetland habitats.

Wetland functions and values may be lost or altered by such direct impacts in wetlands as draining, filling, grading, excavating, flooding, or destruction or removal of vegetation. The activities are generally regulated in Maryland. Activities adjacent or draining to, wetlands may also cause adverse impacts and degrade wetland function. Surface runoff that carries excess nutrients, sediment or other pollutants may enter wetlands at levels beyond their ability to retain or transform these substances. Erosion may also occur. These impacts may cause a change in the plant communities that support certain species of wildlife. Invasive species may also enter wetlands due to adjacent disturbances. An increase in impervious surface in the watershed may prevent infiltration of precipitation that provides groundwater recharge to the wetland.

Increases in impervious cover and fragmentation also pose an increased risk to a variety of other coastal resources, many of which are noted in Section 1: Recommended Land Use and Growth Management Initiatives, Section 2: Fisheries Resources and Section 3: Non-Tidal Streams of the Mattawoman Creek Watershed.

As development increases, it is anticipated that fragmentation of natural and working landscapes will also increase. Wildlife may be adversely affected by such fragmentation that interrupts contiguous habitat and may leave certain species without migratory corridors. This potential threat may result in a reduction in the ability of wetlands to provide habitat and some ecosystem services upon which both people and living resources depend. In some cases, particular wetland types such as bogs and seepage slope wetlands are virtually impossible to replace or restore, resulting in a near-complete loss of their function. Fragmentation of lands may also reduce the County and State's ability to support the landward migration of coastal habitats such as wetlands as sea levels rise, putting people, property and resources in harm's way.

It is anticipated that Maryland will generally experience more winter and spring precipitation and as a result, vernal pools may increase and benefit species that hatch early in year. Species that reproduce through the summer may lose habitat and decline in numbers.

Longer periods of warmer temperatures through summer and fall will speed evapotranspiration and pools may dry sooner, threatening survival of amphibians. The longer, warmer temperatures may also delay filling of pools in autumn and reduce breeding season for animals that reproduce or lay eggs in fall. If there is more spring precipitation, size and number of certain wetlands may increase and associated species composition may change.

[4] USACOE 2003; Beall 2008

One of the more profound vulnerabilities the County may face as a result of changing climate is that higher summer and fall temperatures may result in increasing water withdrawals, more frequent and intense storms may mean less recharge. Thus, groundwater-dominated wetlands may become drier during these time periods. Species composition and habitat use may change.

With rising sea levels, tidal wetlands along Mattawoman Creek may be inundated and lost if their vertical accretion does not keep pace with sea level rise. This may lead to conversion to open water and changes in wetland type. In some areas of low topography, wetlands may migrate inland. In the Mattawoman, with its steeper topography along the some sections of shoreline, some tidal wetlands may be lost without ability to migrate.

More frequent and intense storms may increase erosion and downcutting of streams channels, thus reducing the flood attenuation function of wetlands in watersheds with inadequate stormwater management.

As these various wetlands are lost due to rising sea levels or changes in weather and precipitation factors, so too will their ecosystem service values be lost. Reductions in capacity to buffer population centers from storm surge inundation and flooding may be experienced.

Part 3: Recommended Principles and Policies to Guide Watershed Protection and Restoration

To conserve the unique natural resources of the Mattawoman watershed – including wetlands, coastal resources and coastal habitats that may provide climate adaptation benefit – it is important to implement practices that support natural function and resources. Recommended principles and policies that can be used to guide watershed protection and restoration include:

1) Continue to fully enforce existing regulations and policies
2) Where possible, use 300-foot vegetated buffers along shorelines, streams and wetland and hydric soils
3) Where feasible, implement living shoreline practices for shore erosion control management that is now required
4) Protect forested and farmed land from fragmentation due to conversion to more intensive development
5) Encourage and implement cluster development for new residential development in the watershed to protect open space and natural resources
6) Pre-identify mitigation sites as part of capital improvement planning and include acquisition and construction costs in capital budgets
7) Maintain the connectivity of existing natural lands as well as areas that may support wetland migration opportunities for inland retreat of our coastal and nearshore wetlands
8) For growth and annexation areas, plan development to avoid wetland and stream impacts, and maintain contiguous green corridors
9) Consider site design over multiple parcels to maintain contiguous wetland and stream corridors with minimum fragmentation from roads, buildings, or other structures
10) Provide consideration of stream valleys as part of parcel development negotiations
11) Protect high priority wetland areas to maintain natural protection for public and private infrastructure

12) Where possible protect wetland migration areas from impervious surfaces, development and infrastructure that would impede the movement of coastal wetlands inland to increase the adaptability of coastal wetlands to sea level rise

Part 4: Recommended Watershed Resource Protection and Enhancement Initiatives, Implementation Measures and Actions

Several broad and area-specific recommendations to improve resource protection and enhance project implementation related to coastal resources, climate change adaptation and wetlands are outlined below and organized into general categories.

MS-4, Shoreline and Wetland Issues

1) Related to the County's MS-4 plans and projects: update watershed restoration plans and goals for the Mattawoman Creek watershed in the County's MS-4 documents; incorporate stormwater management techniques in new development and retrofits for existing areas into the MS-4 plan; and include stream system restoration, rehabilitation and stabilization plans into MS-4 plans and capital projects
2) Identify the range and types of recommended restoration projects that may be considered to protect existing wetlands and floodplains.
3) Adopt updated floodplain ordinances, including increased freeboard standards
4) Apply for shoreline restoration and living shoreline project implementation funding through the Chesapeake Bay Trust RFP process.
5) Pursue opportunities to work with new partners and/or take better advantage of different funding sources to support implementation of recommended projects and activities.
6) Take full advantage of pre-application and guidance support at the Maryland Department of the Environment for proposed activities in wetlands, waterways and floodplains
7) Where feasible, use 300-foot vegetated buffers along shorelines, streams and wetlands and hydric soils
8) Review overlap between tidal fresh wetlands and proposed zoning designations. As tidal fresh wetlands are difficult, if not impossible, to restore consideration should be given to avoid degradation of these wetland types wherever possible.
9) Review proposed growth and resource areas to plan to increase utilization of existing floodplain wetland functions to take advantage of natural riverine hydrology to prevent the need for future restoration
10) Incorporate language about nontidal Wetlands of Special State Concern that are in the planning, growth, or annexation areas into the comprehensive plan
11) Protect nontidal Wetlands of Special State Concern and their expanded 300 foot buffers.
12) Restore wetlands associated with streams within the Chapman State Park and Governor Parris N. Glendening Natural Environment Area (DNR, 2003a).
13) Protect and restore wetlands and streams within the headwaters, working with Prince George's County as necessary to accomplish this objective.
14) Protect tidal wetlands used as reference sites in the DNR tidal wetland vegetative community studies, since they are high-quality systems (Harrison, 2001; Harrison and Stranko, 2003).

Land Conservation Strategies to Conserve Coastal Resources and Support Climate Adaptation

15) Increase the County's land conservation efforts by partnering with DNR's Coastal Zone Program to apply for Coastal and Estuarine Land Conservation Program (CELCP) funding to protect key Mattawoman Creek coastal habitats and potential future wetland areas identified in

GreenPrint. Utilize updated GreenPrint Targeted Ecological Area maps when partnering with DNR's Program Open Space on land conservation projects.

16) Identify recommended easement acquisition initiatives and general locations where easement acquisition efforts should be targeted based on conservation priorities to ensure that high value aquatic and terrestrial resources are not further degraded and/or that enables coastal wetlands to adaptively respond to climate change stressors. Implementation opportunities and prospective partners will also be identified.

Land Use Strategies

17) Identify and recommend land use planning objectives, initiatives and reforms that minimize long term impacts to coastal ecosystem resources in the Mattawoman.
18) Identify prospective County regulatory reforms that might foster protection of the resources described in this chapter.
19) Identify incentive programs, or other initiatives that might be taken to reduce the number, level and degree of likely future impacts that reduce biodiversity or impair watershed ecosystem resources. This may include assessment and analysis of the feasibility to institute a County Resource Protection TDR program and opportunities to stimulate markets to support transfer activity.
20) Consider adopting provisions similar to those in the Baltimore County Code for plats and protective covenants (§33-3-110), and environmental protection and sustainability §33-3-114), which would dedicate forest buffers to the County when plats are recorded.

Additional References and Resources

Kusler, Jon. 2006. Common Questions: Wetlands, Climate Change, and Carbon Sequestering. Association of State Wetland Managers.

Maryland's Coastal Atlas Estuaries Mapper: http://dnr.maryland.gov/ccp/coastalatlas/estuaries.asp

Maryland's Coastal Atlas Shorelines Mapper:
http://dnr.maryland.gov/ccp/coastalatlas/shorelines.asp

MD MERLIN Mapper:
http://www.mdmerlin.net/

Maryland Department of the Environment. 2006. Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Charles County, Maryland.
http://mde.maryland.gov/programs/Water/WetlandsandWaterways/AboutWetlands/Documents/www.mde.state.md.us/assets/document/wetlandswaterways/CH.pdf

Section 5: Forest Resources

Recommendations to support County Planning Program Direction
From the Forest Resources Workgroup

Timothy Culbreth (MDNR), Brad Shoemaker (MDNR)

Part 1: Summary of Mattawoman Watershed's Forest Cover Characteristics and Attributes.

Large tracts of forest greatly contribute to stream health. Forest cover is the best use of land when attempting to improve water quality; its properties are superior to grass and vegetative cover in relation to, groundwater recharge, runoff and pollutant reduction, as well as providing wildlife habitat, and resisting invasive species.

Mattawoman Watershed is split between two counties. 72% of the watershed is in Charles County and the remaining 18% is in Prince George's County. For the purpose of this forest cover assessment only the parts of Mattawoman Watershed located in Charles Co. will be examined. See Figure 1 on the next page for a map of the entire watershed. The Mattawoman Watershed is predominately forested as shown in Figure 1 and is characterized by a mixed hardwood coniferous forest. Based on 2008 data, 72.5% of the watershed in Charles Co. is forested[5]. The watershed contains upland forest, riparian forest and a large number of forested wetlands.

Mattawoman Watershed is a diverse mix of upland and riparian forests. The two types of forests are characterized based on topographic influences from the flat costal plains to the wide stream valleys which comprise the watershed. Upland forests are found on the flat costal plains while riparian forests, as well as a number of forested wetlands, are found in the stream valleys and throughout the numerous non-tidal wetlands which surround Mattawoman Creek. The wide valleys function as the floodplain, allowing nutrient cycling and filtering of many types of pollutants which are present in this developing area. The floodplain also serves as a large habitat corridor as the areas immediately around the creek possess extensive forest cover.

Current Forest Cover

Upland forests in the Mattawoman Watershed are comprised of mixed hardwood coniferous forests which contain species such as Virginia pine (*Pinus virginiana*), white oak (*Quercus alba*) and pin oak (*Quercus palustris*). These species grow well on the sandy clay soils which dominate the upland areas of the watershed. Wickham sandy clay and Exum clay loam are two common soil types. These soil types are characterized by gentle slopes, deep soil, high moisture capacity, moderate to moderate-slow permeability and are moderately to well drained.

Riparian forests in the Mattawoman Watershed are comprised of mixed hardwoods which contain species such as red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), black willow (*Salix nigra*), various species of birch (*betula spp*.) and numerous oaks (*Quercus spp*.). These species grow well

[5] Augmentation of forest cover by The Conservation Fund, checked with 2007 satellite imagery

in the hydric soils present within the riparian areas of the watershed. Bibb silt loam is the most common soil immediately around the waterways. Bibb soils are deep, level, poorly drained soils which flood at irregular intervals. Other hydric soils common in the area include Beltsville silt loam and Leonardtown silt loam.

Forested wetlands are common in the Mattawoman Watershed immediately around waterways, growing in numbers further downstream. Most are characterized by mixed riparian hardwoods and flooding for brief periods during the year. For most of the year the water table is located below the soil surface. These forests, which have a similar species composition to the ones described in riparian forests, provide the greatest water quality improvements.

Current Protected Areas

Figure 1 depicts forest cover throughout the watershed but also depicts two important features: Mattawoman Creek Resource Protection Zone (RPZ) and the Mattawoman Stream Valley delineation. The RPZ is a 6,350 acre area 86% of which is forest cover currently protected around streams. Charles Co. regulations Article XI subsections 297-171 & 172 currently protect streams based on order. First and 2nd order streams are protected with a buffer of 50', 3rd order and larger streams 100', expanded for wetlands, floodplains, and slopes over 15% to 100' or break of slope, whichever is less. Mattawoman Stream Valley is a 12,900 acre area defined from the stream bottom in the watershed to the top of the surrounding slope. While the RPZ limits protection of the streams based on order, the Mattawoman Stream Valley delineation accurately shows the acreage which need protection to keep water quality in Mattawoman Watershed high. Approximately 8,970 acres of the valley are already protected or developed. This leaves 3,900 acres unprotected and undeveloped (MD DNR 2011).

Federal, State and locally owned properties are held within the Mattawoman Watershed. The publicly owned state and local lands will most likely maintain their tree cover and natural benefits. In fact, targeting those areas for increasing tree cover is not out of the question. Federal owned land, the Indian Head Naval Support Facility, has the ability to increase tree coverage by planting more trees on its land. Connecting with the Support Facility and sharing ideas would be a great place to start improving the Support Facility's ecosystem services.

Part 2: Analysis and Evaluation of Current and Anticipated Threats and Stressors to Key Resources

There are many threats and stressors to forest resources within Mattawoman Watershed. Numerous invasive species are already present and others threaten to invade. Along with invasive pests, there are human-based threats to forest cover in the Mattawoman Watershed, forest fragmentation and development.

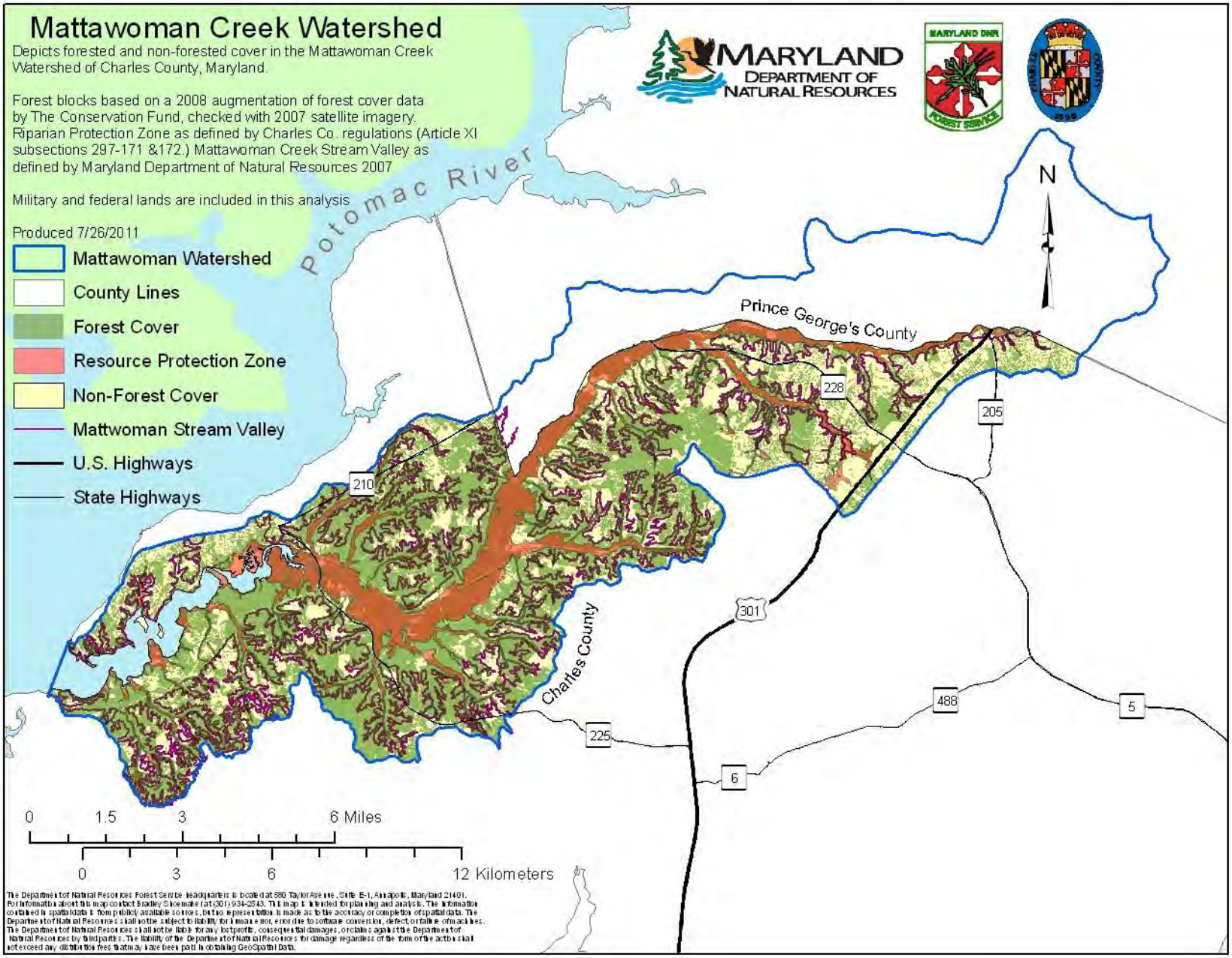


Figure 1: Forested and Non-Forested Areas of Mattawoman Watershed

Forest Fragmentation & Development

Forest fragmentation is the process in which large contiguous tracts of forest are cut down to small, isolated patches of forest. This occurs especially in conjunction with development of an area previously in forest cover. As population density increases so does forest fragmentation and the effects of such fragmentation. Fragmented forests are less likely to be managed for forest products or wildlife benefits. Fragmented forests provide reduced water quality benefits and lose their ability to provide wildlife habitat corridors which aid in wildlife movement between larger habitat areas. Fragmentation becomes a threat to the Mattawoman Watershed forest cover as the area becomes more developed. Unchecked growth within the fixed acreage will result in the above described effects of fragmentation.

Invasive Species

Invasive species have been identified by the USDA Forest Service as one of four major threats to our native ecosystems (USFS). Invasives are exotic species that have been introduced from a different ecosystem, naturalized and have no natural predators to keep them in check. Invasive plants have the ability to overrun a natural area and turn it into a monoculture that provides minimal wildlife habitat and minimal natural benefits.

Maryland forests are no stranger to invasive species, Japanese stiltgrass, multiflora rose, tree of heaven, Japanese barberry, emerald ash borer, and gypsy moth are just a few of the invasive species that strangle, shade out, or compete with our native species for resources. Studies have shown that more developed areas have significantly more invasive species and concentrations than undeveloped areas. The stress applied to native species causes a negative shift in the natural benefits provided by forests. For example Maryland has been invaded by the emerald ash borer, an invasive insect that has decimated ash trees, an important wildlife and water quality tree. Native grasses that are well adapted to anchoring soils can be replaced by exotic plants increasing erosion and runoff. Keeping forests native is a top priority identified in the Maryland Forest Action Plan. More development will lead to more invasive species.

If more forest is cleared for development, the amount of edge effects will also rise. Edge effects are where forests transition into full sunlight. Roads, agricultural fields and development all create increased edge effects. This ecotone favors increased invasive species and higher populations of deer (Feldt). Increased development will lead to more dirt roads for construction equipment. Dirt road maintenance has been linked to spreading invasive seeds faster and further than natural rates of spread (Sohn).

Part 3: Recommended Principles and Policies to Guide Watershed Protection and Restoration

The Water Quality Treatment Map (Figure 2) targets the areas that are most important for protecting or improving water quality. It’s a starting point for areas for conservation or establishment of forest cover. Areas in purple and red are the highest priority protection

areas. Any opportunities to conserve forest cover in the Mattawoman stream valley should be utilized. The factors used to identify water quality protection benefits are presented in a table at the end of this section report.

A Maryland Priority Funding Area runs right down the middle of the Mattawoman watershed. Maryland recently launched FastTrack, a program designed to streamline desired development inside of PFA's. The concentration of development is highly desirable, as it reduces sprawl and the unnecessary infrastructure that goes with it. A waterway in any development area needs to be buffered. Protection of the entire stream valley within the PFA should be a top priority since construction and more impervious surface will lead to more run off entering the creek.

Forest Conservation Act: (FCA)

The Maryland Forest Conservation Act of 1991 (FCA) was developed to reduce the loss of forest during development. In a nutshell, any subdivision plan, grading permit or sediment control permit on 40,000 square feet or more must mitigate the land use change or land disturbance by planting or retaining forest, on or off site. If mitigation cannot occur onsite, then it must occur on land in the same county and watershed or same county or watershed as the project. The priority areas for mitigations include creating, expanding and protecting riparian stream buffers. If all mitigations options have been exhausted, then fee-in-lieu can be used. Highway construction activities are exempt from FCA but must comply with the Maryland Reforestation Law (NRA 5-103) and are required to mitigate an acre of forest for each acre of forest disturbed. Wetland impact needs to comply with Maryland Nontidal Wetland Law and impacted wetlands are to be mitigated. Wetland mitigation projects will also need to comply with FCA.

Part 4: Recommended Watershed Resource Protection and Enhancement Initiatives, Implementation Measures and Actions

Policy & Zoning:

The extensive forest cover within the watershed has afforded Mattawoman Creek large forest resources and a high quality riparian buffer. Future water quality of Mattawoman Creek depends on keeping a high percentage of forest cover across the watershed, especially within the stream valley. This may be accomplished by extending the RPZ to the limits of the Mattawoman Stream Valley. Regulations similar to those which protect the RPZ will then protect the rest of the stream valley, including the 3,900 acres of the Mattawoman Stream Valley which are currently undeveloped and unprotected. Much of this acreage is within the floodplain or on steep slopes so its removal would not greatly impact the amount of development possible within the watershed. Protecting these remaining acres of forest resources must be of highest priority.

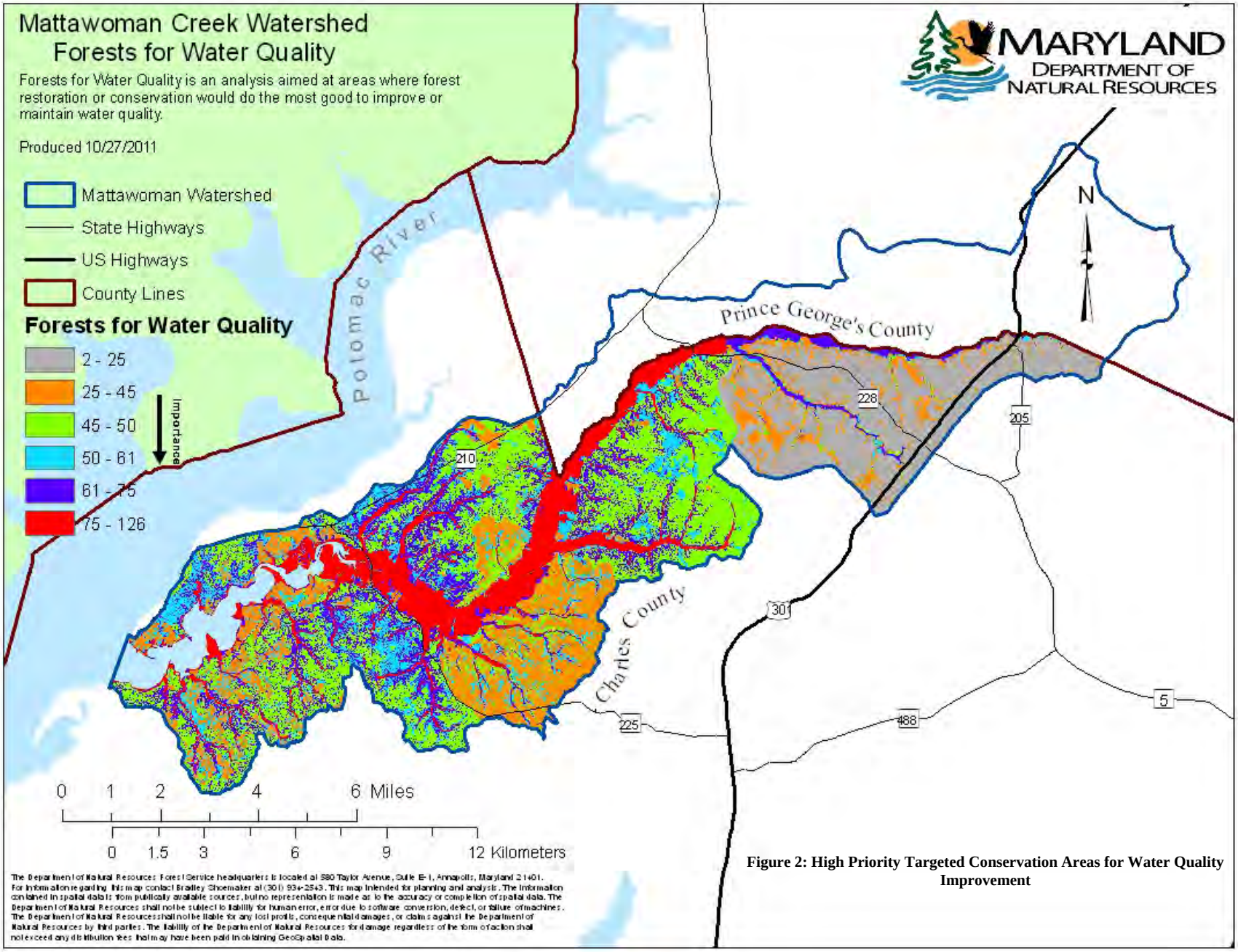
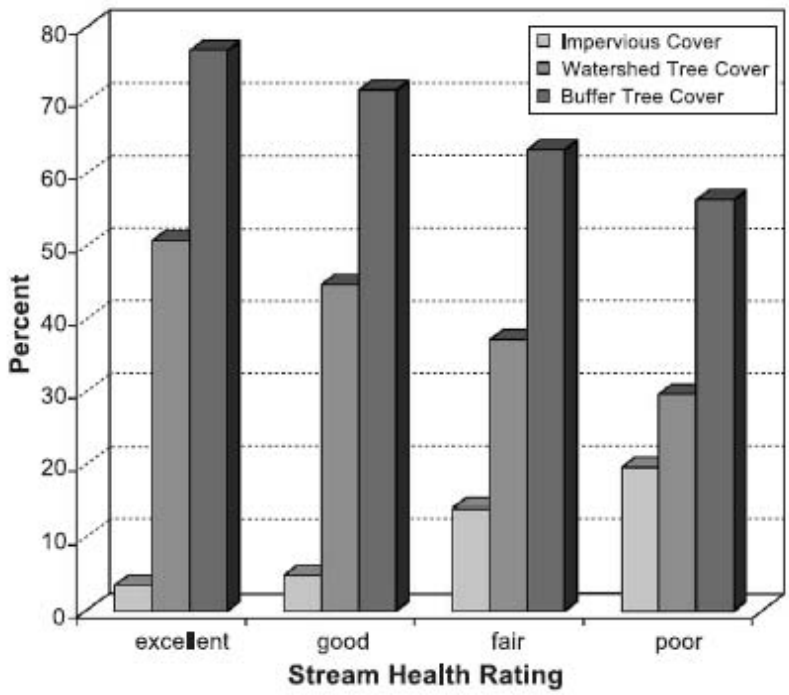


Figure 2: High Priority Targeted Conservation Areas for Water Quality Improvement

Figure 3: Stream health rankings in relation to (a) impervious surface cover, (b) watershed tree cover, and (c) riparian buffer tree cover. Source: Goetz and others, 2003



As shown in Figure 3, percent forest cover within the riparian area of a watershed must be higher than that of the overall watershed to maintain high water quality. While the entire watershed needs to be at least 51% forest cover, the riparian area must maintain at least 77% forest cover to maintain high water quality. Zoning within the stream valley should be changed to promote the preservation of the current forest cover and establishment of new forest cover.

The reduction of forest cover in the riparian zone from reduces stream health. Fair water quality and inadequate forest cover will not support the special ecological processes that take place every day within Mattawoman Watershed. Every acre of forest that can be conserved must be to ensure the health of this ecosystem because every acre of forest has an impact. Table 1 outlines watershed level benefits of forest cover and shows the impact each acre of forest has on its surrounding ecosystem.

With water quality in mind, conservation of the riparian forest and forested wetland areas is most important. Forest resources in the Mattawoman Watershed are more prevalent in the central and western portions of the watershed.

Stream health is related to a number of environmental factors, one of the most indicative is forest cover. As shown in Figure 3, percent forest cover within a watershed, especially within the riparian area, is directly related to stream health. Forest cover provides a number of benefits listed in Table 1, which create this relationship, while complex in nature, it is simple to understand the end result. Keeping Mattawoman Watershed with over 51% forest cover overall and 77% forest cover within the riparian areas is essential to mitigating development threats and maintaining the high water quality currently

present in the watershed. Even a small drop in forest cover can have large adverse impacts on water quality.

Grass(Tree)roots:

Along with zoning and policy changes, there are many on-the-ground, grassroots programs from all over Maryland that can be emulated to maintain and increase forest cover. It is beneficial to package education and implementation together so landowners understand why they are being encouraged to do something. Many of the programs can be implemented at a county level, running Mattawoman as a test pilot would be good starting place.

Backyard Buffers is a program that began in western Maryland where landowners living along waterways that own fewer than 5 acres are given "buffers in a bag." The bags contain 25 free native tree seedlings for establishing or expanding riparian areas that run through homeowners yards. Identifying eligible landowners is a simple GIS exercise and seedlings are reasonably priced and available every year from the John S. Ayton State Tree Nursery on the Eastern Shore.

Montgomery County has been using their "Rainscapes" program to increase the amount of stormwater captured. Rainscapes works by issuing rebates to landowners that install approved practices for capturing stormwater such as, but not limited to: rain barrels, porous pavers, or rain gardens. Rain gardens are a great place to plant "wet-footed" trees that are drought tolerant like sycamore or black gum. Along with increasing tree cover and capturing stormwater, rain gardens increase wildlife habitat in an urban environment.

The Marylanders Plant Trees program was launched in 2009 to encourage and assist private landowners to plant more trees in their yards. The program offers a $25 discount off a $50 or more approved species of tree at participating nurseries. Montgomery County took it a step further and had an additional $25 off a $75 tree coupon. The coupons had the ability to be stacked which meant interested landowners were able to purchase a $75 tree for $25. If Charles County has the resources available to sponsor additional discounts for larger stock, the benefits of the planted trees will be realized sooner.

Tree-Mendous Maryland is a program where near wholesale priced trees are available for planting on public properties such as school grounds and median strips. The Charles County portion of the Mattawoman watershed has 13 schools. Schools are a great place to target additional tree plantings through the Tree-Mendous program. School plantings are a good way to build the community and educate children about the benefits of trees.

Education programs are available to be implemented and imitated. Getting people to realize the "What's in it for me?" is a huge step in getting the ball rolling on increasing forest cover. Frederick County has had success with their "Neighborhood Green" program, a landowner education program to teach them about the benefits of native plantings in their own yards. Charles County could develop a neighborhood green program and start outreach to encourage landowners to plant more trees on their land.

Table 1. Watershed Benefits of Forest Cover[6]	
Benefit	**Description**
Reduce storm water runoff and flooding	▪ Trees intercept rainfall in their canopy, reducing the amount of rain that reaches the ground. A portion of this intercepted rainwater evaporates from tree surfaces. This effect is greater in low rainfall events. ▪ Mature deciduous trees can intercept 500 to 760 gallons of water/year[7]. A Mature evergreen can intercept more than 4,000 gallons/year[8]. ▪ An acre of mature forest can take up more than 1,800 gallons of water per day, reducing the amount of water and increasing the time it takes water to become runoff.[9] ▪ Trees promote infiltration by attenuating runoff and by increasing soil drainage due to the creation of macropores by tree roots. The addition of organic matter (e.g., leaf litter) also increases storage of water in the soil, further reducing runoff.
Improve regional air quality	▪ Trees directly remove nitrogen dioxide, carbon monoxide, sulfur dioxide, ozone, and particulate matter such as dust, ash, pollen, and smoke.[10] ▪ Trees reduce air temperature, which indirectly reduces emissions of temperature dependent pollutants such as ozone and hydrocarbons.[11]
Reduce stream channel erosion	▪ Trees growing along a stream bank prevent erosion by stabilizing the soil with root systems and the addition of organic matter, and by dispersing raindrop energy. ▪ Upland trees reduce stream channel erosion by reducing runoff and reducing total volume that would otherwise cause channel erosion.
Improve soil and water quality	▪ Trees prevent erosion by stabilizing soil with root systems and the addition of organic matter, and by dispersing raindrop energy. ▪ Trees take up nutrients such as nitrogen from soil and groundwater. ▪ Forested areas can filter sediment and associated pollutants from runoff. ▪ Trees can be used to clean up metals, pesticides, solvents, explosives, crude oil, polycyclic aromatic hydrocarbons, and landfill leachates from contaminated soils.[12]
Provide habitat for terrestrial and aquatic wildlife	▪ Forests serve as habitat for wildlife through migratory corridors, food supply, and interior breeding areas. ▪ Trees provide leaf litter and large woody debris, which create habitat for fish, macroinvertebrates, amphibians, and reptiles. ▪ Leaf litter is an important source of energy to streams in the form of food for aquatic community food webs. A typical acre of mature forest will drop 2-3 tons of litter every year.[3]
Reduce summer air and water temperature	▪ Riparian forests regulate surface water temperatures for fish and aquatic insects through the shade they provide along stream channels. ▪ Trees shade impervious surfaces, reducing temperature of storm runoff, which can mitigate thermal shocks that would be transmitted to streams.

[6] Adapted from Cappiella, K. and others, 2005
[7] Envirocast, 2003 and CUFR, 2001
[8] Portland BES, 2000 and CUFR, 2001
[9] Envirocast, 2003
[10] MD DNR, 2002 and Norwak, 1999
[11] Norwak, 1999, McPherson and others, 1997, and Scott and others, 1998.
[12] U.S. EPA, 1998

The Woods in Your Backyard is a joint venture between Penn State, Virginia Tech, University of Maryland Extension, and federal and state agencies. The Woods in Your Backyard is designed to educate people away from having large lawns, and encourage the planting of forest or brush land. There are nice booklets available for purchase to host workshops on ending the "mindless mowing."

Finally, encouraging forest owners to enroll their properties in Forest Conservation Management Agreements will mean less tax pressure on families. An FCMA reduces the assessed tax rate on the forested land for 15 years at a time, the Woodland Assessment Program is a similar program that works on a year-to-year basis with a reduced assessment rate, but not as low as an FCMA. Enrollment into any tax program requires a forest stewardship plan. Practicing forest management and making your forest work for you is a good way to keep forest in forest.

Bibliography

Brennan, K.; Deliman, P.; Nook, K.; Kopecky, S.; Beauchamp, J.; and Santos, R. U.S. Army Corps of Engineers. Baltimore District. Mattawoman Creek Watershed Managment Plan. 2003.

Cappiella, K.; Schueler, T.; and Wright, T. 2005. Urban Watershed Forestry Manual Part 1: Methods for Increasing Forest Cover in a Watershed. USDA Forest Service, Northeastern Area, State and Private Forestry. NA-TP-04-05.

Cappiella, K.; Schueler, T.; and Wright, T. 2006 Urban Watershed Forestry Manual Part : 2 Conserving and Planting Trees at Development Sites. USDA Forest Service, Northeastern Area, State and Private Forestry. NA-TP-01-06.

Cappiella, K.; Schueler, T.; Wright, T.; and Tomlinson, J. 2006. Urban Watershed Forestry Manual Part 3: Urban Tree Planting Guide. USDA Forest Service, Northeastern Area, State and Private Forestry. NA-TP-01-06.

Center for Urban Forest Research. 2001. Benefits of the urban forest: Fact Sheet #1. Davis, CA: USDA Forest Service, pacific Southwest Research Station.

Charles County Department of Planning and Growth Management. Charles County Comprehensive Plan. Charles County, MD. 2006.

Charles County Department of Planning and Growth Management. Mattawoman Creek Watershed. Charles County, MD. 2009. Accessed Jul. 2011.

The Conservation Fund. "Forest Cover." GIS layer of forest cover in Charles County, Maryland. 2007.

CUFR—See Center for Urban Forest Research

Envirocast. 2003. Seeing the forests through the trees: Part 2, autumn leaf fall and the watershed. Envirocast 12(2); 1-4.

Feldt, R.; Hairston-Strang, A. 2009. A strategic forest assessment of Charles County, Maryland / report and analysis. Annapolis, Md. Maryland Department of Natural Resources, Forest Service.

Feldt, Rob. *Maryland's Strategic Forest Lands Assessment*. Maryland Forest Service.Print.

Goetz, S.; Wright, R.; Smith, A.; Zinecker, E; Schaub, E. 2003. IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in mid-Atlantic region. Remote Sensing of Environment. Accessed August 2011.

Maryland Department of Natural Resources. 2002. Forest health report. Annapolis, MD

Maryland Department of Natural Resources. 2011. Mattawoman Creek White Paper. Annapolis, MD.

McPherson, E. G.; Simpson, J. R.; Scott, K. I. 1997. Benefits from shade trees in parking lots. Davis, CA USDA Forest Service, Pacific Southwest Research Station, Western Center for Urban Forest Research and Education. Briefing Paper.

Norwak, D. The effects of urban trees on air quality. 1999. Syracuse, NY: USDA Forest Service, Northeast Station. Accessed 2011.

Portland Bureau of Environmental Services. 2000. Clean River Plan. Portland, OR.

Reaves, Jim, and Mary Ellen Dix. "Four Threats to the Health of the Nation's Forests and Grasslands." *USDA Forest Service*. USDA, 30 Oct. 2006. Web. 8 Sept. 2011.

Scott, K. I.; Simpson, J. R.; McPherson, E. G. 1998. Green parking lots: Can trees improve air quality? California Urban Forests Council Newsletter: CUF Link. Spring: 1-2. Accessed 2003.

Sohn, Emily. "Dirt Road Maintenance Spreads Invasive Plants." *Discovery News*. Discovery, 9 Aug. 2011. Web. 8 Sept. 2011.

U.S. Department of Agriculture Soil Conservation Service. 1974. Soil Survey of Charles County, Maryland. Washington, DC.

U.S. Environmental Protection Agency. 1998. A citizen’s guide to phytoremediation. EPA 542-F-98-011. Washington, DC: Office of Solid Waste and Emergency Response.

Charles County Matrix for Forest Conservation									
FACTOR	**Components**	**Data Source**	**Layer name**	**Layer Description**	**Ranking** **Out Values are given a value of 0				**Weight**
	Forests for Water Quality Treatment/Infiltration				4 - Highest	3	2	1 - Lowest	
WATER QUALITY PROTECTION	FEMA 100 Year Flood Plain	FEMA	Fema_0_4	100 year flood plain	In			Out	3
	Wetlands	DNR	wetlands_0_4	From DNR	In			Out	3
	Depth to Water Table	NRCS	DepthH20recls	Depth to water table in cm - Natural Breaks	0 - 5	5 - 107	107 - 164	> 164	4
	Saturated Hydraulic Conductivity (Ksat)	NRCS	K_Sat_Recls	Movement of subsurface water - Natural Breaks	0-9 µm/sec	9-22 µm/sec	22-36 µm/sec	>36 µm/sec	4
	Steep Slopes	USGS	steep_slp_0_4	NED 3 meter	Greater than or equal to 15% slopes			Less than 15% slopes	4
	Impervious Surfaces in Watershed	Charles County	imp_sur_0_4	12 Digit Watersheds with less than 15% impervious surface	In			Out	4
	Stronghold Watersheds	DNR	strng_hld_0_4	Areas of high aquatic biodiversity (<2% Impervious Surfaces)	In			Out	4
	SPARROW	USGS	sparw_recls	Total Nitrogen From Watersheds - Natural Breaks	>42	4.1 - 42	4 - 2	<2	1
	High Quality Waters	MDE	MDE_HQ_0_4	Watersheds of streams classified as High Quality Waters by MDE	In			Out	3
	Resource Protection Zone	Charles Co. & MD DNR	rpz_0_4	Riparian Protection Zone as defined by Charles Co.	In			Out	5

Additional layers to be considered include National Wetland Inventory (NWI) wetlands and the new draft FEMA maps that have just been released (MDE).

Section 6: Wildlife and Rare Species Habitats

Recommendations to support County Planning Program Direction from the Wildlife and Rare Species Habitat Section Workgroup

Tim Larney (MDNR), Katharine McCarthy (MDNR), Lynn Davidson (MDNR), Julie Slacum (USFWS)

Part 1: Summary of Watershed Characteristics, Ecological Values and Resource Protection needs

Section 1: Summary and Overview of Watershed Characteristics and Values

In 2011, information on Maryland's wildlife and rare species habitats were synthesized and prioritized in a new targeting system called the Biodiversity Conservation Network or BioNet. The ultimate goal of this new system is to maintain the full complement of Maryland's native plants, animals, and habitats within Maryland's natural landscape. In this system, numerous separate geographic information system (GIS) data layers were compiled based on criteria that weight their relative value to biodiversity conservation in Maryland. The criteria used within BioNet primarily have a dual focus on both the most irreplaceable species and habitats, as well as on the habitats that concentrate larger numbers of species. In addition to focusing on vanishing species and habitats, and on high quality common habitats, the criteria also were designed to incorporate the larger landscapes required for migratory animals, population dispersal, and habitat shifts resulting from climate change.

BioNet specifically includes and prioritizes:

- Only known occurrences of species and habitats in Maryland
- Globally rare species and habitats
- State rare species and habitats
- Concentrations (aka "hotspots") of rare species and habitats
- Animals of Greatest Conservation Need
- Watch List plants and indicators of high quality habitats
- Animal assemblages (e.g., colonial nesting waterbirds, forest interior species)
- Wildlife corridors and concentration areas

In a nutshell, the rarest species and habitats, as well as concentrations of rare and vanishing species and the highest quality remaining habitats, are given the highest conservation value. The end result is one GIS data layer that assigns a relative priority to many undeveloped areas of the State. These areas are prioritized into a five-tiered system:

Tier 1 – Critically Significant for Biodiversity Conservation
Tier 2 – Extremely Significant for Biodiversity Conservation
Tier 3 – Highly Significant for Biodiversity Conservation
Tier 4 – Moderately Significant for Biodiversity Conservation
Tier 5 – Significant for Biodiversity Conservation

This five-tiered system was designed to capture and support the full array of biological diversity within Maryland – not just those places that are one-of-a-kind, but also the places that are needed to maintain viable populations of more common species. Keeping common species common is a goal that will provide enormous benefits to both our quality of life and our economy. We simply can not afford to wait until herculean efforts are necessary to save species from the brink of extinction. The costs of these efforts are staggering. Therefore, even Tier 5 BioNet Areas are still significant to conserve, both for the species they directly support, as well as for maintenance of the larger fabric of our natural landscape.

The BioNet GIS data layer is somewhat dynamic because the data used to build it are continuously being updated as new information is gathered and processed into the various baseline data layers. These various baseline GIS layers are discussed separately below.
Section 2 of this report provides a summary of the BioNet areas within the Mattawoman Watershed and statistics on acreages of the various Tiered areas is reported in Table 1.

Ecologically Significant Areas (ESAs)

The Mattawoman Watershed is home to many plants and animals considered rare, threatened, or endangered in Maryland by the Department of Natural Resources. A subset of these species are legally regulated and listed in COMAR as In Need of Conservation, Threatened, or Endangered. A list of these rare species is included in Table 2 within Section 2 and an explanation of the rank and status codes used in Table 2 is found in Appendix A.

The locations where rare species and significant natural communities occur are grouped into places called Ecologically Significant Areas (ESAs). ESAs contain one or more rare plant, animal, or ecological community occurrences. The size and configuration of the ESA are based upon proximity of the occurrences, life history needs of the species, and the type and extent of the supporting habitats. Many rare species occur within declining or limited habitats, such as bogs or seepage swamps. Others live in high-quality remnants of more common habitats. ESAs are designed to contain not only the rare resource itself, but also their habitats and appropriate buffers (i.e., adjacent lands needed to conserve the species and habitats). Thus, they are intended to be used as conservation boundaries for the resources within them. ESAs are then assigned to prioritized BioNet Tiers based on the rarity, potential viability, and number of resources they contain. Section 2 provides details on the number of ESAs within the Mattawoman Watershed and the resources contained within them. A summary description of each ESA is provided in the Appendix B.

The Ecologically Significant Area boundaries should be considered as guidance maps rather than "hard" or unchanging boundaries. In fact, these boundaries are updated regularly as additional information is learned about the locations of rare species in areas that perhaps had not been surveyed previously. Also, the prioritized BioNet Tier rankings will change as new information becomes available on the resources and the viabilitiy of the resources within each area.

Species of Greatest Conservation Need (GCN)

In addition to the rare species discussed above, the Department of Natural Resources also keeps track of species that are uncommon and declining, as these are likely to become rare and in need of conservation efforts in the foreseeable future. As part of a congressional mandate to develop a State wildlife action plan in order to obtain federal funding for nongame wildlife conservation,

DNR and numerous conservation partners developed the list of Maryland's Wildlife of Greatest Conservation Need (GCN). This list is published online in the Department's Wildlife Diversity Conservation Plan (2005). Of the approximately 500 GCN animals listed in the plan, 300 were already considered rare, threatened, or endangered, and therefore were already being conserved by DNR through various efforts. Some of the remaining 200 GCN species are aquatic animals and were being monitored by the Department's Maryland Biological Stream Survey (see Section 3 for more information). Also, some of the remaining 200 GCN species were already being conserved through the State's Critical Area law and regulations. Two main groups of GCN species are regulated within the Critical Area: Colonial Waterbirds and Forest Interior Dwelling Species (FIDS). These are discussed below:

Colonial Waterbird Colonies

Maryland harbors a number of breeding birds collectively known as colonial waterbirds. These species usually breed in groups, or colonies, for increased protection from predators. Also, their natural habitat is often limited (e.g., islands with sandy beaches), so by nesting closely together they are able to make better use of the limited space.

Gulls, terns, skimmers, egrets, herons, and ibis are all examples of colonial nesting waterbirds that breed within Maryland. In Charles County, the only species of colonial waterbird known to nest recently is the great blue heron. In fact, during the 1980's and into the 1990's, the largest known great blue heron colony in Maryland was along Nanjemoy Creek. Much of this colony has now dispersed elsewhere (including across the Potomac River into Virginia), providing evidence of the dynamic condition of the natural world. Details on the colonies found within the Mattawoman Watershed in Charles County are provided in Section 2.

Forest Interior Dwelling Species (FIDS) Habitat

Some of the birds that breed in forests require large, unbroken tracts of forest for optimal breeding success. These birds are called Forest Interior Dwelling Species (FIDS). These species are considered a surrogate or "poster child" for many other species of wildlife that are known or likely to use the interior of forests as their optimal habitat. The protection of forested areas used by FIDS was mandated within the 1000-ft Chesapeake Bay Critical Area during the mid-1980's by passage of the Critical Area Law and Criteria. However, much of Maryland's forests are fragmented into smaller pieces than FIDS can successfully utilize. Therefore, the protection of this limited habitat outside of the Critical Area is strongly recommended by DNR. Section 2 provides details on the FIDS habitat that is found within the Mattawoman Watershed in Charles County.

Waterfowl Staging and Concentration Areas

The Critical Area Law and associated Criteria also provide that local jurisdictions include Historic Waterfowl Staging and Concentration Areas as one of the different types of habitats within their Plant and Wildlife Habitat Protection Program within the Critical Area. Historic Waterfowl Staging and Concentration Areas were identified by DNR and provided to the counties to assist them in fulfilling this part of their Critical Area program. Time of year restrictions on the construction of docks, piers, bulkheads, or other water-dependent facilities are in place to

minimize the disturbance that these activities would cause to this significant winter concentration of waterfowl.

Section 2: Detailed Assessment of the Watershed's Ecosystem Characteristics and Attributes

Three of the most significant watersheds within Charles County for the conservation of biodiversity within the State, as well as the County, are the Nanjemoy Creek, Zekiah Swamp, and Mattawoman Creek watersheds. In order to understand the significance of the Mattawoman Creek watershed, it is important to compare its various characteristics and qualities to these other very important watersheds. However, each watershed is significant for different types of species and habitats, so it is rather difficult to compare them in any meaningful way to determine which is more significant. Each one is significant for its own reasons.

As described in Section 1, Maryland's Biodiversity Conservation Network, or BioNet, is a digital map (GIS shapefile) that prioritizes areas for terrestrial and freshwater biodiversity conservation. It was developed as an additional tool for the Department of Natural Resources and its conservation partners to use for proactive land conservation activities, such as targeting for acquisitions and easements, locating appropriate areas for project mitigation or habitat restoration, and planning for areas that require management to sustain dwindling species and habitats.

According to Table 1, below, a little more than half of the Mattawoman Creek Watershed within Charles County provides significant habitat for Maryland's native plants, animals and natural communities. While portions of the northern end of this watershed have been developed, much of the southern end remains relatively undeveloped. A large portion of this area is protected by the State within Myrtle Grove Wildlife Management Area and Chapman State Park.

Table 1. Summary of BioNet priority areas for the Mattawoman Creek Watershed, Charles County.

BioNet Tier (Definition)	Acres	Hectares	Percent of Watershed
Tier 1 (Critically Significant)	265	107	0.6 %
Tier 2 (Extremely Significant)	6,460	2,614	14 %
Tier 3 (Highly Significant)	9,369	3,792	20 %
Tier 4 (Moderately Significant)	4,612	1,866	10 %
Tier 5 (Significant)	4,652	1,883	10 %
TOTAL	**25,358**	**10,262**	**55 %**

The various natural resources that BioNet contains are detailed below. The acreages described in each section are not additive because many fall within the same areas. For example, many of the Ecologically Significant Areas for the protection of rare species are forested habitats and, therefore, are often also identified as potential forest interior dwelling species habitat. The map of BioNet areas (see Appendix E) displays them hierarchically, so that the most significant areas are overlain on top of areas with lesser significance for biodiversity conservation.

One of the three Tier 1 areas within this watershed, Chapman's Forest, is mostly found to the west of this watershed and only overlaps slightly along watershed boundary. The others, Araby Bog

and Bryans Road Bog, are completely contained within this watershed. Both of these areas are ESAs and are Tier 1 BioNet areas because of rare habitats and rare species within them.

A cursory review of the BioNet data for Zekiah Swamp watershed shows that it contains 19,480 acres of Tier 1 habitat along the mainstem of the Zekiah, which is considerably more than the Mattawoman Creek watershed (265 acres). At 5,833 acres of Tier 1 habitat, the Nanjemoy Creek watershed also contains considerably more critically significant habitat for biodiversity conservation than the Mattawoman.

Ecologically Significant Areas (ESAs)

Ecologically Significant Areas are places where one or more rare species or habitat occurs that have been identified for some level of conservation attention. The Mattawoman Watershed within Charles County is home to 28 species of plants and animals considered rare, threatened, or endangered in Maryland by the Wildlife and Heritage Service: 20 plants, 1 freshwater mussel, 2 dragonflies, 1 butterfly, 2 fishes, 1 bird, and 1 mammal. Ten of these 29 species are legally regulated by the State of Maryland: 4 are listed as Endangered (E), 4 are listed as Threatened (T), and 2 are listed as In Need of Conservation (I). None are federally-listed as threatened or endangered. The list of species is included in Table 2, below. An explanation of the rank and status codes used in this table is provided in the Appendix A.

Table 2. Rare, Threatened, and Endangered (RTE) Species with current populations in the Mattawoman Creek Watershed.

Scientific Name	Common Name	Global Rank*	State Rank*	State Status*
	PLANTS			
Bidens coronata	Tickseed sunflower	G5	S2S3	
Carex digitalis var macropoda	Slender woodland sedge	G5	S1?	
Carex venusta	Dark green sedge	G4	S2	T
Castanea dentata	American chestnut	G4	S2S3	
Cyperus refractus	Reflexed cyperus	G5	S2?	
Cyperus retrofractus	Rough cyperus	G5	S2	
Ilex decidua	Deciduous holly	G5	S2	
Krigia dandelion	Potato dandelion	G5	S1	E
Ludwigia decurrens	Primrose willow	G5	S2S3	
Melica mutica	Narrow melicgrass	G5	S1	T
Myosotis macrosperma	Large-seeded forget-me-not	G5	S2S3	
Myriophyllum heterophyllum	Broadleaf water-milfoil	G5	S1	
Nelumbo lutea	American lotus	G4	S2	
Nemophila aphylla	Small-flowered baby-blue-eyes	G5	S1	
Paspalum fluitans	Floating paspalum	G5	S1	E
Platanthera flava	Pale green orchid	G4	S2	
Pluchea camphorata	Marsh fleabane	G5	S1	E
Scleria muehlenbergii	Muhelenberg's nutrush	G5	S1S2	
Smilax pseudochina	Halberd-leaved greenbrier	G4G5	S2	T
Utricularia inflata	Swollen bladderwort	G5	S1	E

	ANIMALS			
Ameiurus catus	White catfish	G5	SU	
Cordulegaster obliqua fasciata	Banded spiketail	G4T3Q	S1	
Helocordulia selysii	Selys' sunfly	G4	S2	T
Hermeuptychia sosybius	Carolina satyr	G5	S1S3	
Ixobrychus exilis	Least bittern	G5	S2S3	I
Lepisosteus osseus	Longnose gar	G5	S2?	
Leptodea ochracea	Tidewater mucket	G3G4	S1S2	
Lynx rufus	Bobcat	G5	S3	I

* See Appendix A for an explanation of the Rank and Status codes.

The locations of these 28 species are grouped into 12 Ecologically Significant Areas that are either contained within or that overlap the Mattawoman Watershed within Charles County.

Of the 12 Ecologically Significant Areas, 6 are wetland areas linked by forested stream valley corridors along the floodplain of the Mattawoman, primarily from below the head of tide and up the floodplain along the Creek and tributaries for about 16 miles. Four are located further southwest along the Creek on property owned by the Department of Defense at the Indian Head Naval Surface Warfare Center, Indian Head Division. The remaining two are located in upland areas at or near the watershed boundary, one on the west side of the watershed and the other on the east side.

Table 3, below, summarizes these 12 ESAs and provides information on their regulatory significance and sizes. Six of these areas are within the Chesapeake Bay Critical Area and have been provided to the County planning agency as Habitat Protection Areas within the County's Critical Area program since the late 1980's (see "CA Code" column in Table 3). Additionally, two of these areas are currently regulated by the Maryland Department of the Environment as Wetlands of Special State Concern (WSSC) and two other areas were recommended for designation as WSSCs in 2002. Finally, the "BioNet Tier" column provides the priority or relative conservation value of each area, ranging from Tier 1 as critically significant for biodiversity conservation through Tier 5 as significant for biodiversity conservation. More specific information on what is known about each of these ESAs, including why each is significant, the threats that they face, and the management actions that can help conserve them, have been compiled and provided in Appendix B. A map that shows the location of the ESAs within the watershed is provided in Appendix E.

Table 3. Ecologically Significant Areas of the Mattawoman Creek watershed within Charles County.

ESA Name	CA Code	WSSC	BioNet Tier	Acres	Hectares
Araby Bog		Proposed	Tier 1	184	74
Bryans Road Bog		Proposed	Tier 1	24	10
Bullitt Neck Point*	CH O-02		Tier 3	12	5
Chapman's Forest	CH L-11	YES	Tier 1	56	23
Clifton Mitigation Wetland			Tier 2	68	28

Cornwallis Neck Marshes*	CH O-03		Tier 3	33	13
Mattawoman Creek	CH L-01	YES	Tier 2	6389	2586
Mill Hill Woods			Tier 3	15	6
Old Woman's Run			Tier 3	978	396
Rum Point*	CH L-05		Tier 3	243	98
Sun Valley Wetlands			Tier 3	76	31
Thoroughfare Island*	CH O-06		Tier 3	15	6

* Located on Indian Head Naval Surface Warfare Center.

Summary of the Ecological Significance of Mattawoman Watershed

The extensive wetlands along Mattawoman Creek include high quality examples of open brackish tidal marshes (tidal mesohaline and polyhaline marshes), densely vegetated tidal freshwater marshes, intertidal shoreline, shrub swamps, tidal hardwood swamps and Coastal Plain bottomland forest. This diversity of community and habitat types supports a wide variety of plants and wildlife, including a number of rare species that thrive in the varied hydrology and physiognomy of these habitats.

The tidal freshwater marshes lining the creek that are open and thinly vegetated support a large population of the State Rare American lotus (*Nelumbo lutea*), a showy, aquatic flower. This area also provides food and cover for rare fish species including the Longnose gar (*Lepisosteus osseus*, potentially State Rare) and the White catfish (*Ameiurus catus*, Status Uncertain).

More densely vegetated tidal freshwater emergent marshes along the creek harbor a sizeable population of the State Rare Tickseed sunflower (*Bidens coronata*). Additionally, Least bittern (*Ixobrychus exilis*), a State Rare breeder listed as In Need of Conservation, was reported during the breeding season from a densely vegetated tidal freshwater marsh bordering the creek. Although this species most likely breeds here, further surveys may confirm that this rare marshbird nests in the tidal marshes along the creek.

Considered vulnerable to extinction due to their restricted ranges, tidal hardwood swamps border the fresh tidal marshes in some areas of the creek. The State Rare Pale green orchid (*Platanthera flava*) occurs on hardwood-dominated hummocks within these tidal swamps. These communities occur in tidal rivers of Virginia, Maryland and Delaware, and fewer than 100 occurrences have been documented worldwide (NatureServe 2009). Pumpkin ash (*Fraxinus profunda*) also grows in tidal hardwoods swamps of the Mattawoman, typically along the shoreline of the tidal freshwater emergent marsh. Pumpkin ash is rare on the western shore of the Chesapeake Bay, in part because its fresh tidal swamp habitat is restricted by topography to a narrow band at the head of fresh tidal marshes. This Globally Rare habitat is classified within the National Vegetation Classification Standard as Pumpkin ash -Swamp Tupelo - (Green Ash) / Common Winterberry / Halberd-leaf Tearthumb Forest (*Fraxinus profunda - Nyssa biflora - (Fraxinus pennsylvanica) / Ilex verticillata / Polygonum arifolium* Forest), and occurs at the upper, freshwater reaches of tidal rivers in Delaware, Maryland and Virginia.

Coastal Plain bottomland forest grows above tidal influence and is periodically flooded by the creek and its tributaries. The State Rare Deciduous holly (*Ilex decidua*) grows throughout the shaded shrub layer of the forested nontidal swamp and in the adjacent open shrub swamp. Wet

depressions and small side channels in the forested swamp support two State Endangered plants, the Floating paspalum (*Paspalum fluitans*) and Marsh fleabane (*Pluchea camphorata*). The State Rare Primrose willow (*Ludwigia decurrens*) dots the open marshes and shrub swamps within the bottomland forest. In open areas of beaver marshes, Swollen bladderwort (*Utricularia biflora*, State Endangered) and the butterfly, Carolina satyr (*Hermeuptychia sosybius*, State Rare) have been observed. The bottomland forests and the adjacent lower slopes of mesic mixed hardwood upland forest support the Highly State Rare, Small-flowered baby-blue-eyes (*Nemophila aphylla*), the State Rare Large-seeded forget-me-not (*Myosotis macrosperma*) and the State Threatened Narrow melicgrass (*Melica mutica*). The large block of surrounding forest helps to maintain the hydrology, water quality, and community composition of these rare species' habitats.

An unverified population of the Highly State Rare Slender woodland sedge (*Carex digitalis var. macropoda*) has also been observed on slopes of the mesic mixed hardwood forest. Potato dandelion (*Krigia dandelion*, State Threatened) has been documented in several locations in stands of mesic mixed hardwood forest in this watershed.

Small, spring-fed seeps and streams feeding the Mattawoman provide larval habitat for several rare dragonflies, Sely's sunfly (*Heliocordulia selysii*, State Threatened), Banded spiketail (*Cordulegaster obliqua fasciata*, Highly State Rare) and the Gray petaltail (*Tachopteryx thoreyi*, Watch List). These species depend on a constant flow of cool spring water to maintain larval habitat. The rare, forested wetland type that includes these seeps, known as an acidic seepage swamp, also supports two rare plant species, Bog fern (*Thelypteris simulata*, State Threatened) and Halberd-leaved greenbrier (*Smilax pseudochina*, State Threatened). Nutrient-poor and fed by groundwater, the forest type in this swamp occurs only in the mid-Atlantic. Considered Globally Vulnerable, few examples of this forest type remain due to clearing and filling for commercial and residential development in and around the wetlands

A Highly Globally Rare community known as a Fall Line Terrace Gravel Bog, a specific type of acidic seepage swamp, occurs within the Mattawoman watershed at two locations in the headwaters of small streams. These areas support populations of rare plants, including the State Threatened Halberd-leaved greenbrier (*Smilax pseudochina*) and Reticulated nutrush (*Scleria reticularis*). Additionally, the State Threatened Dark green sedge (*Carex venusta*) was found along the southern reaches of this wetland in 2001. That location was not surveyed in 2009, and this species may persist at the site.

Bordering the acidic seepage swamps are dry, sandy or gravelly ridges that support a habitat called mixed oak-heath forest. The highly permeable soils of these ridges provide the water source to the groundwater-fed seepage wetlands. Sunny openings in this forest canopy often support rare plant species that will not thrive in shade. Historically, it is likely that these openings were created by fire, but due to fire suppression practices today, these openings are typically artificial, maintained for utility lines.

Species of Greatest Conservation Need (GCN)

At least 39 species on Maryland's Watch List (state rank of S3 or S3S4) and/or list of wildlife of Greatest Conservation Need are known from the Mattawoman Watershed. Twenty of these are birds regulated in the Chesapeake Bay Critical Area as Forest Interior Dwelling Species (FIDS). Conservation of their forested habitat is required within the Critical Area and strongly recommended and encouraged beyond the Critical Area.

PLANTS

Cat-tail sedge	*Carex typhina*
Coolwort	*Pilea fontana*
Louisiana sedge	*Carex louisianica*
Twisted spikerush	*Eleocharis tortilis*
Wafer-ash	*Ptelea trifoliata*

ANIMALS

Acadian flycatcher	*Empidonax virescens*
Alewife floater	*Anodonta implicata*
American redstart	*Setophaga ruticilla*
Bald eagle	*Haliaeetus leucocephalus*
Barred Owl	*Strix varia*
Black-and-white warbler	*Mniotilta varia*
Blue-faced meadowhawk	*Sympetrum ambiguum*
Blue-spotted sunfish	*Enneacanthus gloriosus*
Gray petaltail	*Tachopterys thoreyi*
Great blue heron	*Ardea herodias*
Hairy woodpecker	*Picoides villosus*
Hooded warbler	*Wilsonia citrina*
Kentucky warbler	*Oporornis formosus*
King rail	*Rallus elegans*
Least brook lamprey	*Lampetra aepyptera*
Louisiana waterthrush	*Seiurus motacilla*
Northern parula	*Parula americana*
Northern red salamander	*Pseudotriton ruber ruber*
Ovenbird	*Seiurus aurocapillus*
Pileated woodpecker	*Dryocopus pileatus*
Prothonotary warbler	*Protonotaria citrea*
Red-eyed vireo	*Vireo olivaceus*
Red-shouldered hawk	*Melanerpes erythrocephalus*
Rosyside dace	*Clinostomus funduloides*
Scarlet tanager	*Piranga olivacea*
Southeastern shrew	*Sorex longirostris*
Spotted turtle	*Clemmys guttata*
Summer tanager	*Piranga rubra*
Uhler's sundragon	*Helocordulia uhleri*
Warmouth	*Lepomis gulosus*
Whip-poor-will	*Caprimulgus vociferus*
Wood thrush	*Hylocichla mustelina*
Worm-eating warbler	*Helmitheros vermivorus*
Yellow-throated vireo	*Vireo flavifrons*

Conservation of the habitat for FIDS also helps to conserve numerous other forest species that are declining due to habitat fragmentation and loss. Most animals need large forests and forest patches connected by forested corridors because they need to move during some part of their lives. Whether to find mates or better food sources or young dispersing to find their own territories, animal movement is a significant challenge that must be met if we are to stabilize populations and reverse the declines of species such as Eastern box turtle (*Terrapene carolina*) and Northern Red Salamander.

Other than FIDS, the remaining half of the list of GCN species primarily includes species dependent upon wetland habitats or aquatic species that live within Mattawoman Creek. These aquatic species, such as Rosyside dace and Alewife floater, are discussed in Section 3 of this document.

Additional GCN species are probably found within this watershed; however, we currently have not identified which ones are present and we lack sufficient data to pinpoint their locations or make specific recommendations regarding their conservation.

Colonial Waterbird Colonies

Colonial waterbirds gather in nesting assemblages known as colonies during the breeding season and most or all of their diet consists of aquatic organisms (fish, frogs, invertebrates, etc). Herons, egrets, gulls, terns and skimmers are all types of colonial waterbirds. These species are protected under the U.S. Migratory Bird Treaty Act. During the early 1900s many colonial waterbird species experienced dramatic population declines as a result of habitat loss, shooting, nesting colony disturbance by humans and increased nest predation. While most colonial waterbird populations have increased with improved conservation measures since about 1950, their populations are no where near as large as they were prior to the decline of the late 1800s-early 1900s.

Waterbirds establish nesting colonies in wetland areas that are relatively predator and disturbance free. Colony sites are usually islands and tidal wetlands. Colony sites are rare, and all of Maryland's 20,000 pairs of waterbirds nest at fewer than 125 locations. As Maryland continues to grow and develop, secure nest sites for waterbirds will become scarcer. Whenever possible, waterbird colony sites should be conserved as part of responsible land stewardship. Many colonial waterbird nesting sites are provided added conservation protection by critical area regulations.

Charles County is home to at least eight recently documented Great blue heron colonies. Of these, four were within Zekiah Swamp watershed, one within the Mattawoman watershed, and one each within Nanjemoy, Port Tobacco and middle Potomac River watersheds. Also, two additional recent Great blue heron colonies are known from the Mattawoman watershed within Prince Georges County.

Great blue herons are large wading birds that breed and nest from approximately February 15th-July 31st. These herons gather in large colonies called rookeries for the purpose of courtship, nest building, egg-laying and chick-rearing. Generally, great blue herons return to rookeries each year, and colonies often grow over time. Excessive disturbance to the rookery, or within close proximity to the rookery, during the breeding season could result in herons shifting to another location and experiencing complete nest failure (Buckley and Buckley 1978). Significant mortality of chicks or eggs resulting from disturbance of the colony during the breeding season is a violation of the U.S.

Migratory Bird Treaty Act. Disturbance includes actions such as cutting nest trees, cutting nearby trees or nearby construction that causes abandonment of chicks by the adults. Conservation of great blue heron rookeries that are located in the Chesapeake Bay Critical Area is required by state law (§ 8-1801/1806).

In 2001, the Mattawoman Creek colony within Charles County had 172 nesting pairs; triple the number of pairs seen in 1997. The size of this colony has fluctuated throughout the years, and although no pairs were seen in 2003, it is very possible that Great blue herons will return to the site or somewhere nearby in suitable habitat. This colony lies outside the Chesapeake Bay Critical Area (see Appendix E for a map of this colony). As with FIDS, conservation of colonial waterbird colonies is required within the Critical Area and strongly recommended and encouraged beyond the Critical Area. Specific protection recommendations can be found in Appendix C.

Potential Forest Interior Dwelling Species (FIDS) Habitat

The amount and potential quality of FIDS habitat in the Charles County portion of the Mattawoman Creek watershed can be found in the Table 4, below. Of the total area of the Mattawoman Creek watershed that is within Charles County, roughly 56% is considered FIDS habitat. Also, about 70% of the FIDS habitat within the watershed still exists as "core habitat" or the largest blocks of unfragmented forests containing at least 500 ac of interior forest.

Within the Chesapeake Bay Critical Area, habitat protection for forest interior dwelling birds was mandated through regulations authorized by the Chesapeake Bay Critical Area Law (Natural Resources Article 8-1808, Annotated Code of Maryland). The regulations require that management programs be developed to protect and conserve riparian and upland forests used for breeding by FIDS within the Critical Area. DNR strongly encourages that protection programs for FIDS be extended beyond the Critical Area. Guidelines for determining FIDS habitat and conserving these areas are referenced in Appendix C. A map that shows the extent and quality of FIDS habitat within the watershed is provided in Appendix E.

Table 4. Amount of Potential Forest Interior Dwelling Species (FIDS) Habitat within the Charles County portion of the Mattawoman Creek watershed.

Category (Defn.)	Acres	Hectares	Percent of Total
Class 1 (Core FIDS habitat)	18,146	7,343	69 %
Class 2 (High Quality habitat)	6,013	2,433	23 %
Class 3 (other FIDS habitat)	1,957	792	8 %
TOTAL	**26,116**	**10,569**	

Because so much of the watershed contains large blocks of unfragmented forest, it was targeted for additional surveys and data collection, which ultimately lead to the identification and designation of the Mattawoman Creek Important Bird Area. One of 14 Important Bird Areas (IBAs) across Maryland, it is designated by the National Audubon Society's MD/DC Chapter for providing habitat for a significant assemblage of Forest Interior Birds. Other IBAs for FIDS in Charles County include Nanjemoy IBA and Chapman State Park IBA. The latter is adjacent to and overlaps extensively with the Mattawoman Creek watershed. More information about the IBA is provided in Appendix D.

Waterfowl Concentration and Staging Areas

In the 1980's and early 1990's, the tidal waters at the mouth of the Mattawoman Creek supported overwintering and/or migrant populations of at least six documented species of waterfowl: bufflehead, canvasback, Canada goose, mallard, greater/lesser scaup, and tundra swan. Other species of waterfowl were likely to use this area as well. More recent surveys of this area have found it to be a significant concentration area for waterfowl. A map of the location of the Waterfowl Concentration and Staging Area at the mouth of the Mattawoman Creek is in Appendix E.

Part 2: Recommended Watershed Resource Protection and Enhancement Initiatives, Implementation Measures and Actions

Protection Recommendations

- Utilize Maryland's Biodiversity Conservation Network, BioNet, to prioritize Mattawoman watershed locations for terrestrial and freshwater biodiversity conservation activities and as a tool for targeting acquisitions and easements, locating appropriate areas for project mitigation or habitat restoration, and planning for areas that require special considerations to sustain declining species and habitats.

- Target overall protection efforts within the Mattawoman watershed on the BioNet tiered sites because of the ecological services they provide and the rare species and habitats they support.

- Work with Maryland DNR to institute measures to protect the 12 Ecologically Significant Areas (ESA's) that are either contained within or that overlap the Mattawoman Watershed within Charles County.

- Reduce forest loss and fragmentation to conserve and protect habitat for Forest Interior Dwelling Species (FIDS). Follow the specific protection measures and guidelines included in Appendix C.

- Protecting the headwaters wetlands and intermittent and perennial tributaries is vital to maintaining the hydrology and water quality of the rare species' aquatic and wetland habitats downstream. Headwater wetlands and their upland buffers regulate stream flow and maintain the hydrology of downstream wetland and aquatic habitats. Headwater wetlands and their upland buffers are also vital to the aquatic food chain. Specific measures pertaining to hydrological and water quality protections can be found in Appendix C.

- Avoid unnecessary disturbance and land use activities near the Mouth of the Mattawoman Creek to maintain the integrity of the Waterfowl Staging and Concentration Areas found there. In order to avoid disturbance to wintering waterfowl, significant construction or development work should not be conducted during the November 15 through March 1 time period of any given year.

- Protect known Colonial Waterbird Nesting locations or areas documented for use by Great Blue Herons as identified in this report. As these colonies move over time it is important to monitor them and document new nesting locations as they develop. Specific protection measures for these colonies can be found in Appendix C.

- Protect known Wetlands of Special State Concern (WSSC) and any which are considered potential WSSC's. These wetlands are regulated by the Maryland Department of the Environment under the authority of COMAR.

- Prevent and eliminate the spread of invasive plant and animal species. Because these organisms can displace native species and reduce overall biodiversity, they present an on-

going management challenge. Specific recommendations to combat these serious ecological threats can be found in Appendix C.

Appendix A: Explanation of Species Rank and Status Codes

The global and state ranking system is used by all 50 state Natural Heritage Programs and numerous Conservation Data Centers in other countries in this hemisphere. Because they are assigned based upon standard criteria, the ranks can be used to assess the range-wide status of a species as well as the status within portions of the species' range. The primary criterion used to define these ranks is the number of known distinct occurrences, with consideration given to the total number of individuals at each locality. Additional factors considered include the current level of protection, the types and degree of threats, ecological vulnerability, and population trends. Global and state ranks are used in combination to set inventory, protection, and management priorities for species at the state, regional, and national levels.

GLOBAL RANK

G1 Highly globally rare. Critically imperiled globally because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Globally rare. Imperiled globally because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or distributed locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences.

G4 Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery.

GH No known extant occurrences (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).

GU Possibly in peril range-wide, but its status is uncertain; more information is needed.

GX Believed to be extinct throughout its range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? The species has not yet been ranked.

_Q Species containing a "Q" in the rank indicates that the taxon is of questionable or uncertain taxonomic standing (i.e., some taxonomists regard it as a full species, while others treat it at an infraspecific level).

_T Ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species.

STATE RANK

S1 Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation. Species with this rank are actively tracked by the Natural Heritage Program.

S2 State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by the Natural Heritage Program.

S3 Watch List. Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Natural Heritage Program.

S3.1 A species that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences. For instance, a G3 S3 species is globally rare to uncommon, and although it may not be currently threatened with extirpation in Maryland, its occurrences in Maryland may be critical to the long term security of the species. Therefore, its status in the State is being monitored.

S4 Apparently secure in Maryland with typically more than 100 occurrences in the State or may have fewer occurrences if they contain large numbers of individuals. It is apparently secure under present conditions, although it may be restricted to only a portion of the State.

S5 Demonstrably secure in Maryland under present conditions.

SA Accidental or considered to be a vagrant in Maryland.

SE Established, but not native to Maryland; it may be native elsewhere in North America.

SH Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

SP Potentially occurring in Maryland or likely to have occurred in Maryland (but without persuasive documentation).

SR Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., no voucher specimen exists).

SRF Reported falsely (in error) from Maryland, and the error may persist in the literature.

SU Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above.

SX Believed to be extirpated in Maryland with virtually no chance of rediscovery.

SYN Currently considered synonymous with another taxon and, therefore, not a valid entity.

SZ A migratory species which does not inhabit specific locations for long periods of time.

S? The species has not yet been ranked.

-B This species is migratory and the rank refers only to the breeding status of the species. Such a migrant may have a different rarity rank for non-breeding populations.

-N This species is migratory and the rank refers only to the non-breeding status of the species. Such a migrant may have a different rarity rank for breeding populations.

Ranks that are depicted as ranges (e.g., S1S2) are generally rounded up to the first rank for discussion and analysis purposes.

STATE STATUS

This is the status of a species as determined by the Maryland Department of Natural Resources, in accordance with the Nongame and Endangered Species Conservation Act. Definitions for the following categories have been taken from Code of Maryland Regulations (COMAR) 08.03.08.

E Endangered; a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.

I In Need of Conservation; an animal species whose population is limited or declining in the State such that it may become threatened in the foreseeable future if current trends or conditions persist.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

X Endangered Extirpated; a species that was once a viable component of the flora or fauna of the State, but for which no naturally occurring populations are known to exist in the State.

* A qualifier denoting the species is listed in a limited geographic area only.

PE Proposed Endangered; a change is COMAR is pending that would list the species as Endangered (see definition above).

PT Proposed Threatened; a change is COMAR is pending that would list the species as Threatened (see definition above).

PX Proposed Endangered Extirpated; a change is COMAR is pending that would list the species as Endangered Extirpated (see definition above).

PD Proposed to be deleted or removed from the State Threatened & Endangered Species list within COMAR.

FEDERAL STATUS

This is the status of a species as determined by the U.S. Fish and Wildlife Service's Office of Endangered Species, in accordance with the Endangered Species Act. Definitions for the following categories have been modified from 50 CRF 17.

LE Taxa listed as endangered; in danger of extinction throughout all or a significant portion of their range.

LT Taxa listed as threatened; likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

PE Taxa proposed to be listed as endangered.

PT Taxa proposed to be listed as threatened.

C Candidate taxa for listing for which the Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

Appendix B: Ecologically Significant Area Summaries

Introduction

Included in this Appendix is a summary description of each of the 12 Ecologically Significant Areas (ESAs) within the Mattawoman Watershed in Charles County. Each summary provides information on the ecological significance of the area, a list of the rare species and communities, a description of the area, and highlights of some of the most important threats and management needs.

Ecologically Significant Areas contain the locations of rare species and significant natural communities. ESAs may harbor one or more rare plant, animal, or ecological community occurrences. The size and configuration of the ESA are based upon proximity of the occurrences, life history needs of the species, and the type and extent of the supporting habitats. Many rare species occur within declining or limited habitats, such as bogs or seepage swamps. Others live in high-quality remnants of more common habitats. ESAs are designed to contain not only the rare resource itself, but also their habitats and appropriate buffers (i.e., adjacent lands needed to conserve the species and habitats). Thus, they are intended to be used as conservation boundaries for the resources within them. ESAs are then assigned to prioritized BioNet Tiers based on the rarity and viability of the species and habitats, as well as the number of these resources within them.

The Ecologically Significant Area boundaries should be considered as guidance maps rather than "hard" or unchanging boundaries. In fact, these boundaries are updated regularly as additional information is learned about the locations of rare species in areas that perhaps had not been surveyed previously. Also, the prioritized BioNet Tier rankings will change as new information becomes available on the resources and the viability of the resources within each area.

The following Ecologically Significant Areas are described in this Appendix:

1. Araby Bog
2. Bryans Road Bog
3. Bullitt Neck Point
4. Chapman's Forest
5. Clifton Mitigation Wetland
6. Cornwallis Neck Marshes
7. Mattawoman Creek
8. Mill Hill Woods
9. Old Woman's Run
10. Rum Point
11. Sun Valley Wetlands
12. Thoroughfare Island

Araby Bog

BioNet Tier: 1
USGS Quad: Port Tobacco
Critical Area: No

Summary of Ecological Significance

From sandy, gravelly upland ridges freshwater springs emerge, form pools, and flow into small, free-flowing streams that meander through Araby Bog. This rare, forested wetland is known as an Acidic Seepage Swamp. Nutrient-poor and fed by groundwater, the forest type in this swamp occurs only in the mid-Atlantic. The roughly 6 acre Araby Bog has been classified as a Southern Red maple – Black gum Swamp Forest due to the dominance of these trees in the canopy. Considered Globally Vulnerable, few examples of this forest community type remain due to clearing and filling for commercial and residential development in and around the wetlands Within the northern section, the small, groundwater fed stream snakes through an open area dominated by graminoid and fern species. This sunny area supports a small population of the State Rare Carolina satyr (*Hermeuptychia sosybius*). Maryland represents the northeastern extent of this species' range, and only eight other sites are known to harbor this species in Maryland.

Further south, the wetland becomes larger and exhibits sphagnous hummocks bearing trees and shrubs. This area contains a Highly Globally Rare community known as a Fall Line Terrace Gravel Bog. This forested wetland has a canopy of Sweetbay magnolia *(Magnolia virginiana)* and Red maple (*Acer rubrum*) with a dense layer of Sweet pepperbush (*Clethra alnifolia*) underneath. This area also supports a small population of the State Threatened Halberd-leaved greenbrier (*Smilax pseudochina*). Additionally, the State Threatened Dark green sedge (*Carex venusta*) was found along the southern reaches of this wetland in 2001. That location was not surveyed in 2009, and this species may persist at the site.

Due to the presence of the extremely rare Fall Line Terrace Gravel Bog, Araby Bog is classified as a BioNet Tier 1 site.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	Dark green sedge	*Carex venusta*	Threatened	
	Twisted spikerush	*Eleocharis tortilis*	Watch List	
	Halberd-leaved greenbrier	*Smilax pseudochina*	Threatened	
Animals	Carolina satyr	*Hermeuptychia sosybius*	Rare	
	Gray petaltail	*Tachopteryx thoreyi*	Watch List	
Habitats	**Key Wildlife Habitat**			**MD Status**
	Bog and Fen Wetland Complexes			
	• Fall Line Terrace Gravel Bog			Highly Rare
	Forested Seepage Wetlands			
	• Acidic Seepage Swamp			Watch List

Other Values and Significance

The large, forested wetland provides essential habitat for a variety of species of Greatest Conservation Need (GCN). Several odonate species including the Watch List Gray petaltail

(*Tachopteryx thoreyi*) and the Ebony jewelwing were seen throughout during the visit as well as avian species such as Pileated woodpeckers. This area also supports the Watch List Twisted spikerush (*Eleocharis tortilis*). Portions of the swamp with standing water in the spring are capable of supporting breeding amphibian species.

The contiguous forest which makes up Araby Bog and its uplands has also been identified as habitat for Forest Interior Dwelling Species (FIDS). Most FIDS are Neotropical migrants or birds that travel long distances to breed in North America and winter in Central and South America. These species include some of our most brilliantly colored songbirds such as the Scarlet tanager and Prothonotary warbler. These species and others play many important roles in our forests such as insect control, seed dispersal and providing food to other predators. Unfortunately, populations of many FIDS are declining. These declines have been attributed largely to the loss and fragmentation of forests in the eastern United States by urbanization, agriculture and some forest management practices. The key to maintaining breeding habitat for FIDS and halting their decline is to protect extensive, unbroken forested areas throughout the region.

Seepage wetlands and their underlying groundwater help maintain water quality in adjacent streams. These areas help slow surface flow as well as trap and transform nutrients, provided vegetated buffers remain intact along the site borders. Araby Bog, in particular, helps maintain water quality within the larger Mattawoman watershed. Due to the quality of the wetlands at Araby Bog and the species it supports, this site was proposed to be listed as a Wetland of Special State Concern (WSSC) in 2002.

Threats and Management Needs

Since the discovery of Araby Bog in 2001, a large housing development has been constructed to the northeast. The Bog appeared to be much drier in 2008 and 2009 than described in the first reports of the site. It is possible that the construction of the development and its associated roads have altered groundwater recharge, and ultimately, the hydrology of the site. Logging and further development of the swamp and adjacent lands may further change the hydrology of this sensitive area by changing surface flow patterns and groundwater recharge. In turn, this alteration would result in a shift in the rare community composition by favoring species found in drier areas and in floodplains. Due to this issue, logging and further development in the vicinity should be discouraged unless careful review and planning determines little impact will occur to the site. At a minimum, a 100ft vegetated, undisturbed upland buffer should be maintained around the wetlands. A 300ft upland buffer is recommended to provide better protection to the hydrology and water quality of these groundwater-fed wetland habitats, to discourage the encroachment of weeds and maintain the vegetation composition of these wetlands, and to provide adequate upland habitat for amphibians such as salamanders that frequent seepage wetlands. The effects of the adjacent development on the rare plant communities and rare species should be monitored.

Site Description Summary

Araby Bog is relatively free of exotic species and contains a mix of native plants. The northern section of the swamp contains an Acidic Seepage Swamp assemblage of Sweetbay magnolia, Red maple (*Acer rubrum*) and Green ash (*Fraxinus pennsylvanica*). The shrub layer is quite diverse and dominated by species such as Possum-haw (*Viburnum nudum*), Swamp azalea (*Rhododendron viscosum*) and Fringetree (*Chionanthus virginicus*). Ferns such as Netted chain fern (*Woodwardia areolata*) and Cinnamon fern (*Osmunda cinnamomea*) cover much of the herbaceous layer while other species such as Lizard's tail (*Saururus cernuus*) can also be seen. Some sphagnous hummocks occur in this area along with species such Green wood orchid (*Platanthera clavellata*).

A small, open section of swamp can also be found here with little woody cover and an abundance of ferns and sedge species (*Carex spp.*). This area supports the rare Carolina satyr.

Further south, the swamp becomes more open and surrounded by a dry, mature forest. This section is the Fall Line Terrace Gravel Bog. Many of the species found here are also present in the northern section; however, species such as Lizard's tail are absent while graminoids such as Fowl mannagrass (*Glyceria striata*) and Whitegrass (*Leersia virginica*) become more abundant. Black gum (*Nyssa sylvatica*) also becomes more prevalent in the canopy while Green ash is less abundant. The canopy cover is more sparse and while the shrub layer is more dense and diverse. This area contained a distinct hummock and hollow microtopography, but many of the hollows have seemingly become dry. Dried sphagnum moss matted the hummocks while Ground pine (*Lycopodium obscurum*) dominated the hollows. A small, gravelly stream with incised banks cuts through a section of this area, though water levels were very low. This area supported Halberd-leaved greenbrier, the Gray petaltail, Twisted spikerush and Dark green sedge.

Bryans Road Bog

BioNet Tier: 1
USGS Quad: Mount Vernon
Critical Area: No

Summary of Ecological Significance

Bryan's Road Bog contains a Coastal Plain Acidic Seepage Bog, known as a Fall Line Terrace Gravel Bog, under a powerline right-of-way. These saturated woodlands are recognized from a limited area at and just east of the Fall-line in Maryland and northern Virginia. Because of its limited distribution and occurrences, these communities are considered Highly Globally Rare. Fall Line Terrace Gravel Bogs occupy gravelly soils fed by spring water. These characteristics cause Fall Line Terrace Gravel Bogs to vary from typical bogs both geologically and hydrologically. Fewer than ten Fall Line Terrace Gravel Bogs are known to exist, and many are highly degraded (NatureServe 2009). In the open section of the bog, a large population of the Highly State Rare Muehlenberg's nutrush (*Scleria muehlenbegii*) can be found flourishing with other herbaceous species. This area contains a few small shrubs and a variety of graminoid species. Historically it is likely that fire maintained the open canopy that this sun-loving vegetation requires. The control of woody species under the powerline now keeps the canopy open.

A forested seep on the western side of the open, sphagnous section contains another rare community assemblage known as an Acidic Seepage Swamp. A small stream, gravel-bottomed stream snakes through this section, and a single State Rare American chestnut (*Castanea dentata*) grows at its border. This tree species was once a major component of forests within the Eastern United States until an invasive fungus, Chestnut blight (*Cryphonectria parasitica*), virtually eliminated all mature trees. A small population of the State Threatened Halberd-leaved greenbrier (*Smilax pseudochina*) occurs within this Acidic Seepage Swamp, near the transition between the forested and open sections.

The presence of the extremely rare Fall Line Terrace Gravel Bog community has led to this site being designated as a BioNet Tier 1 site.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	American chestnut	*Castanea dentata*	Rare	
	Muehlenberg's nutrush	*Scleria muehlenbegii*	Highly Rare	
	Halberd-leaved greenbrier	*Smilax pseudochina*	Threatened	
Animals	Blue-faced meadowhawk	*Sympetrum ambiguum*	Watch List	
Habitats	**Key Wildlife Habitat**			**MD Status**
	Bog and Fen Wetland Complexes			
	• Fall Line Terrace Gravel Bog			Highly Rare
	Forested Seepage Wetlands			
	• Acidic Seepage Swamp			Watch List

Other Values and Significance
The open, sphagnous section of the bog provides habitat for a variety of odonate species including the Watch List Blue-faced meadowhawk (*Sympetrum ambiguum*) and Spangled skimmers (*Libellula cyanea*).

Shrub species such as Winterberry (*Ilex verticillata*), Highbush blueberry (*Vaccinium corymbosum*) and Possum-haw (*Viburnum nudum*) were abundant at the site and provide food sources for mammal and songbird species throughout the year.

Threats and Management Needs
Hydrological alterations to the area are the largest threat to this rare community and its associated species. Development activity that increases the impervious surface area in the bog watershed and reduces groundwater recharge would shift the rare community composition by favoring species found in drier areas and in floodplains. At a minimum, a 100ft vegetated, undisturbed upland buffer should be maintained around the wetlands. A 300ft upland buffer is recommended to provide better protection to the hydrology and water quality of these groundwater-fed wetland habitats, to discourage the encroachment of weeds and maintain the vegetation composition of these wetlands, and to provide adequate upland habitat for amphibians such as salamanders that frequent seepage wetlands. The effects of the adjacent development on the rare plant communities and rare species should be monitored. Reducing impervious surface area to well below 10% of the watersheds of seepage wetlands and locating impervious surface areas as far as possible from the wetlands will help to reduce the detrimental effects on the wetlands. Methods to reduce impervious cover are outlined in the Maryland Department of the Environment stormwater management manual, available online at their website: http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Pages/programs/waterprograms/sedimentandstormwater/stormwater_design/index.aspx. In addition to these methods, options to pursue include the use of pervious materials wherever possible.

Logging or further development of the uplands could not only alter surface water flows and groundwater recharge but also could increase sedimentation within the bog. All of these changes would negatively impact the rare species, and development and logging projects proposed in the vicinity should be designed to minimize these potential impacts. Given the sensitivity and significance of the habitat, supplemental measures beyond those typically required for wetlands are likely to be needed to adequately assure habitat protection.

Management of woody species within the powerline right-of-way should occur during the late fall and winter months, when most of the rare species are dormant. If herbicide is use, it should be applied selectively to target species.

Due to the rare bog community at Bryans Road and the species it supports, this site was proposed to be listed as a Wetland of Special State Concern (WSSC) in 2002.

Site Description Summary

Within the Acidic Seepage Swamp, Red maple (*Acer rubrum*) and Sweetbay magnolia (*Magnolia virginiana*) are the dominant canopy species. The shrub layer is quite diverse and contains species such as Swamp azalea (*Rhododendron viscosum*), Winterberry (*Ilex verticillata*), American holly (*Ilex opaca*), Possum-haw (*Viburnum nudum*) and Highbush blueberry (*Vaccinium corymbosum*). Cinnamon fern (*Osmunda cinnamomea*), Netted chain fern (*Woodwardia areolata*) and Sphagnum moss (*Sphagnum spp.*) dominate the understory of the seep. Occasional species within the seep include Jack-in-the-pulpit (*Arisaema triphyllum*), Lady fern (*Athyrium filix-femina*), Sweet woodreed (*Cinna arundinacea*) and Small green wood orchid (*Platanthera clavellata*). A small spring-fed stream snakes through this seep which connects it to the open area and another forested seep. Gravelly soil deposits and sphagnum-covered hummocks are prominent in this area.

The Fall Line Terrace Gravel Bog under the powerline is dominated by a dense herbaceous layer. Cinnamon fern (*Osmunda cinnamomea*) is prevalent as well as Maryland meadow-beauty (*Rhexia mariana*), Whitegrass (*Leersia virginica*), Fringed sedge (*Carex crinita*), Three-way sedge (*Dulichium arundinaceum*) and Brownish beaksedge (*Rhynchospora capitellata*). The hillside about the wet section contains more meadow-type species such as Broomsedge (*Andropogon spp.*).

Bullitt Neck Point

BioNet Tier: 3
USGS Quad: Indian Head
Critical Area: Yes

Summary of Ecological Significance

Bullitt Neck Point Protection Area Neck is nearly surrounded by the tidal waters of Mattawoman Creek. While this area does not contain any currently state-listed rare species, Bullitt Neck Point does support a population of Pumpkin ash (*Fraxinus profunda*) which grows along the shoreline of the tidal freshwater emergent marsh. Pumpkin ash is rare on the western shore of the Chesapeake Bay, in part because its fresh tidal swamp habitat is restricted by topography to a narrow band at the head of fresh tidal marshes. This Globally Rare habitat is classified as Pumpkin ash -Swamp Tupelo - (Green Ash) / Common Winterberry / Halberd-leaf Tearthumb Forest (*Fraxinus profunda - Nyssa biflora - (Fraxinus pennsylvanica) / Ilex verticillata / Polygonum arifolium* Forest), and occurs at the upper, freshwater reaches of tidal rivers in Delaware, Maryland and Virginia. Many sites containing Pumpkin ash are at risk due to both sea level rise and the Emerald ash borer (*Agrilus planipennis*).

Threats and Management Needs

Two of the main threats to this site include sea level rise and the Emerald ash borer. The elevations of Bullitt Neck Point are estimated to range from sea level to ten feet. In 2007, the Intergovernmental Panel on Climate Change (IPCC) estimated global average sea levels will rise by 7- to 23-inches by the 2090s, with an additional 4 to 8 inches possible due to the current rate of ice flow from Greenland and Antarctica. This change in sea levels would place much of Bullitt Neck Point underwater. The Bullitt Neck population should be surveyed periodically to determine if this species continues to persist along the margin of the fresh tidal marsh. Avoiding disturbance to adjacent non-tidal wetlands and to a minimum 300 foot wide upland buffer will provide protection for areas for potential migration of this tidal habitat as sea level rises. No other specific management actions are recommended to address the threat of sea level rise.

In 2003, several ash (*Fraxinus* spp.) trees were found infested with Emerald ash borers at a nursery in Prince George's County. Despite eradication and quarantine efforts, the Emerald ash borers have now established in other areas throughout the State. While effective control measures for the ash borers have not been developed, the spread of this invasive species can be reduced by limiting the transport of firewood and other raw wood products to the county where they originate.

This site has been protected as a Listed Species Site under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). Due to the delisting of Pumpkin ash, this site has been proposed to be protected as a plant and wildlife habitat of local significance [COMAR 27.01.09.04.B.(4) and C.(2)(a)(vi)]. The proposed Protection Area includes tidal wetlands and a 300 foot upland buffer to these wetlands.

Site Description Summary

The fringe of the tidal freshwater emergent marsh along the northeastern shoreline of Bullitt Neck supports a population of Pumpkin ash. As with many tidal freshwater marshes, the community contains a large number of plant species. Cattails (*Typha* spp.) and Big cordgrass (*Spartina cynosuroides*) are abundant, mixed with stands of River bulrush (*Schoenoplectus fluviatilis*). Virginia dayflower (*Commelina virginica*) grows along the perimeter with Pumpkin ash.

Chapman State Park

BioNet Tier: 1
USGS Quad: Indian Head, Port Tobacco
Critical Area : Yes

Summary of Ecological Significance

Chapman State Park and the associated properties to the South include outstanding examples of key wildlife habitats that support more than 20 rare species. These combined areas sustain acres of mature forest, non-tidal wetlands, shore-line habitat and forested seeps. It is important to note that, although there is some overlap of this area into the Mattawoman Watershed, most of the property lies outside of the Watershed.

On the dry uplands, an Oak-Beech-Heath forest grows on gravelly soils of an ancient river terrace. In the ravines, ancient shell deposits are exposed, adding calcium to the soil and creating a soil type that is neutral to basic rather than the typical, acidic Coastal Plain soils. This rich soil supports species normally found in the Piedmont and western regions of the state. The Basic Mesic forest on these slopes is dominated by American beech (*Fagus grandifolia*), Tulip poplar (*Liriodendron tulipifera*) and Bitternut hickory (*Carya cordiformis*). The forest is impressive for its age and condition, with little evidence of disturbance and several state champion trees. A large population of State Threatened Glade fern (*Diplazium pycnocarpon*) grows along some of these slopes. Along the floodplain of Mattawoman Creek, the bottomland forest is dominated by oaks (*Quercus spp*.) and Red maple (*Acer rubrum*). A rich, cove forest borders the shoreline. This area contains the State Rare Butternut hickory (*Juglans cinerea*). The low-lying areas bordering the Potomac form an extensive wetland complex that contains species such as the State Endangered American frogbit (*Limnobium spongia*).

The southern section of Chapman State Park, below Route 210, is also ecologically significant and drains into the Mattawoman Creek before entering the Potomac. Details on that property have been included within the Protection Area Summary for Mattawoman Creek.

The rich diversity of rare species within Chapman State Park and its high quality communities have led to this site being classified as a BioNet Tier 1 site.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	American chestnut	*Castanea dentata*	Rare	
	American frogbit	*Limnobium spongia*	Endangered	
	American ginseng	*Panax quinquefolius*	Watch List	
	Angular-fruited milkvine	*Matelea gonocarpos*	Highly Rare	
	Burr-reed sedge	*Carex sparganioides*	Highly Rare	
	Butternut	*Juglans cinerea*	Rare	
	Deciduous holly	*Ilex decidua*	Rare	
	Few-flowered panicgrass	*Dichanthelium oligosanthes*	Rare	
	Flat spike sedge	*Carex planispicata*	Highly Rare	
	Glade fern	*Diplazium pycnocarpon*	Threatened	
	Hitchcock's sedge	*Carex hitchcockiana*	Endangered	
	Large-seeded forget me not	*Myosotis macrosperma*	Rare	
	Narrow melicgrass	*Melica mutica*	Threatened	

	Pubescent sedge	*Carex hirtifolia*	Watch List	
	Reflexed sedge	*Cyperus refractus*	Rare	
	Rough cyperus	*Cyperus retrofractus*	Rare	
	Shumard's oak	*Quercus shumardii*	Threatened	
	Single-headed pussytoes	*Antennaria solitaria*	Threatened	
	Small-flowered baby-blue eyes	*Nemophila aphylla*	Highly Rare	
	Veined skullcap	*Scutellaria nervosa*	Endangered	
	Virginia heartleaf	*Hexastylis virginica*	Endangered	
	White bear sedge	*Carex albursina*	Watch List	
Animals	Arrowhead spiketail	*Cordulegaster obliqua*	Rare	
	Bald Eagle	*Haliaetus leucocephalus*	Watch List	
	Brown spiketail	*Cordulegaster bilineata*	Watch List	
	Cylindrically ornate wood snail	*Vertigo ventricosa*	Uncertain	
	Tiger spiketail	*Cordulegaster erronea*	Watch List	
Habitats	**Key Wildlife Habitat**			**MD Status**
	Dry Oak- Pine Forests			
	• Coastal Plain Oak-Beech Forest			Apparently Secure
	Forested Floodplains			
	• Coastal Plain Bottomland Forest			Apparently Secure
	Mesic Deciduous Forest			
	• Basic Mesic Forest			Apparently Secure
	• Mesic-Mixed Hardwood Forest			Apparently Secure
	Non-tidal Shrub Wetlands			
	• Swamp loosestrife semi-permanently flooded shrubland			Secure

Other Values and Significance

The widespread, contiguous forests provide important habitat for species that are vulnerable to habitat fragmentation. Blocks of forest provide quality habitat for Forest Interior Dwelling Species (FIDS), species that require large forest tracts in order breed successfully. These species are declining in the mid-Atlantic due in part to forest fragmentation caused by the clearing of forests for agriculture and development. Breeding bird studies conducted at Chapman's Forest reveal that two-thirds of the species identified by DNR as FIDS are breeding on this property. Also documented as breeding here are eight of the ten species of concern identified by Maryland Partners in Flight due to declining numbers in Maryland. Conservation of these forests maintains vital habitat for these declining species.

Chapman State Park supports a diversity of plant communities and animal species. Along the shoreline, Bald eagles and Ospreys have been found nesting. The extensive wetlands support water birds and two Watch List odonates: the Brown spiketail (*Cordulegaster bilineata*) and the Tiger spiketail (*Cordulegaster erronea*). Amphibian diversity is high in this area with species such as Gray treefrogs, Green treefrogs, Green frogs, Southern leopard frogs, American toads and Wood frogs spotted during the 2009 survey. Additionally, the forest supported an array of colorful songbird species from Hooded warblers to Scarlet tanagers.

Within the forests, the Watch List Pubescent sedge (*Carex hirtifolia*) can be found alongside a trail and growing in moist, sandy-loam soil. The richer sections of woods contain the Watch List White

bear sedge (*Carex albursina*). Within the rich ravines, four potential State Champion trees can be found: an American basswood (*Tilia americana*) which may be both a National and State Champion; two Pagoda oaks (*Quercus pagoda*) which may be Co-State Champions and a Chinquapin oak (*Quercus muehlenbergii*) which qualifies as State or State Co-Champion.

This area is also a great recreational spot where hikers can enjoy expansive views across the Potomac and a variety of wildflowers typically found in the Piedmont region.

Threats and Management Needs

Invasive plant species threaten to alter the forest composition at Chapman's State Park. An invasive plant management plan has been developed by the Wildlife and Heritage Service in consultation with the Park Service in order to identify the priorities for control efforts and recommend methods for control for the northern portion of the property. Highest priority for control is assigned to garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) due to the severity of the potential impacts to the rare plant populations and the forest communities, the speed with which they are encroaching, and the potential difficulty of control if action is not taken soon. Wineberry (*Rubus phoenicolasius*) is assigned the next level in priority for control due to its potential impacts to the shell marl ravine forest. English ivy (*Hedera helix*) is assigned the same level of priority as Wineberry due to the need to eliminate fruiting plants to control further spread and to minimize the impact to rare plants in the immediate vicinity. Other species of concern include the Beefsteak plant (*Perilla frutescens*) and Tree-of-Heaven (*Ailanthus altissima*).

Abundant deer at the site also present a problem for native species. The State-Rare Glade fern (*Diplazium pycnocarpon*) and American ginseng (*Panax quinquefolius*) populations have been reduced in size due to excessive browse (Simmons 2009). Managed hunting has been underway at the park, but has not reduced the herd size sufficiently to reduce the detrimental browse on both rare and common wildflowers.

This site has been proposed for protection as a Listed Species Site under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). The wetlands and the 100 foot upland buffer are also regulated wetlands of special state concern (WSSC) by the Maryland Department of the Environment (COMAR 26.23.06).

Site Description Summary
North of Route 210, the forests include several ecological community groups. Because of the shell-marl soil layer found in this tract, the vegetative communities include several rare species. The Basic Mesic Forest dominates the shell-marl soils. This association had a canopy of American beech (*Fagus grandifolia*), Tulip poplar (*Liriodendron tulipifera)* and Bitternut hickory (*Carya cordiformis*) within the sheltered ravines and slopes. Northern red oak (*Quercus rubra),* Black walnut (*Juglans nigra),* Slippery elm *(Ulmus rubra),* White oak *(Quercus alba),* Chinquapin oak *(Quercus muehlenbergii)* and White ash (*Fraxinus americana)* can also be found throughout. The stands have dense understories dominated by Paw-paw (*Asimina triloba)* and Spicebush (*Lindera benzoin*). Herb layers are lush and contain May-apple (*Podophyllum peltatum*), Jack-in-the-pulpit *(Arisaema triphyllum),* Broadleaf enchanter's nightshade (*Circaea lutetiana ssp. canadensis)* and Christmas fern (*Polystichum acrostichoides)*. Within these rich woods, several rare species grow including Single-headed pussytoes, Glade fern, Large-seeded forget-me-not, Veined skull cap, Flat-spiked sedge and Hitchcock's sedge.

The Chestnut Oak (*Quercus prinus*) Forest occurs along the steep terrace bordering the Potomac River. The ground surface has exposed mineral substrate, and soils are dry, sandy, acidic and infertile. Chestnut oak dominates the canopy along with several other oaks: Northern red oak, White oak, Scarlet oak (*Quercus coccinea)* and Post oak (*Quercus stellata)*. Red maple (*Acer rubrum),* Sassafras (*Sassafras albidum),* Common serviceberry (*Amelanchier arborea*) and American beech are characteristic of the understory. Patches of Deerberry (*Vaccinium stamineum),* Black huckleberry (*Gaylussacia baccata),* Maple-leaf viburnum (*Viburnum acerifolium)* and Common greenbrier (*Smilax rotundifolia)* can be found in the shrub layer. The herb layer is species-poor with Wavy hairgrass (*Deschampsia flexuosa*) and Poverty oatgrass (*Danthonia spicata*) as common species.

The site also supports a Coastal Plain Oak-Beech Forest. This community is dominated by Chestnut oak, Black oak (*Quercus velutina)* and American beech. This is a mixed hardwood forest of usually north-facing bluffs and steep ravine slopes with acidic, nutrient-poor soils. American holly (*Ilex opaca*) grows throughout the understory as well as patches of herbaceous species including Partridgeberry (*Mitchella repens),* Striped wintergreen *(Chimaphila maculata)* and Poverty oatgrass.

Chapman State Park also contains a Mesic Mixed Hardwood Forest, which is a hardwood forest of infertile habitats throughout the Coastal Plain and Piedmont. Forests in this group occupy acidic, relatively nutrient-poor soils. The tree canopies contain mixtures of American beech, oaks (*Quercus spp*.), Tulip poplar and hickories (*Carya spp*.). The understory is open to fairly dense with species such as American holly, blueberries, Spicebush and Paw-paw. The herbaceous layer is very sparse with occasional Christmas fern, Indian cucumber (*Medeola virginica)* and Jack-in-the-pulpit. One section of this forest contains a fruiting American chestnut.

Another large community is the Coastal Plain – Piedmont Bottomland Forest. This community is a diverse group of temporarily and seasonally flooded forests, encompassing floodplains. These areas are dominated by combinations of Green ash (*Fraxinus pennsylvanica*), Red maple, Sweetgum (*Liquidambar styraciflua*) and Willow oak (*Q. phellos*). Paw-Paw, Spicebush and Ironwood (*Carpinus caroliniana*) can be found in the shrub layer over a diverse herbaceous layer. The dominant species for this community association is Sweet woodreed (*Cinna arundinacea*), which in many cases exceeds 50% cover. Because of the rich alluvial soils, invasive species tend to be more of an issue in these habitats. In some areas the infestation is high, especially of

Japanese honeysuckle (*Lonicera japonica)* and Japanese stiltgrass *(Microstegium vimineum).* Within this area, the largest population of Small-flowered baby blue-eyes can be found.

Wetlands are also abundant throughout Chapman's State Park from forested seeps to non-tidal complexes along the Potomac River. Forested seeps occur throughout the mesic and bottomland forest communities. In these areas, the rare dragonflies and Deciduous holly occur. Bordering the Potomac shoreline is a 25 acre wetland that contains a high diversity of wetland shrubs and herbaceous plants. Parts of this wetland are dominated by Buttonbush (*Cephalanthus occidentalis*) and Swamp loosestrife (*Decodon verticillatus*). Towards the center of this vast wetland, a large population of the rare American frogbit occurs as well as Dense-flowered knotweed (*Polygonum densiflorum*).

Clifton Mitigation Wetland

BioNet Tier: 2
USGS Quad: Piscataway
Critical Area: No

Summary of Ecological Significance

Clifton Mitigation Wetland contains a shallow wetland surrounded by a wet grassland and a young Sweetgum (*Liquidambar styraciflua*) and Virginia pine woods (*Pinus virginiana*).

Swaths of shrubby species line the edges of the wetland while the interior contains many herbaceous emergent plants. Freely floating throughout the sandy-bottomed wetland is the State Endangered Swollen bladderwort (*Utricularia inflata*). This carnivorous, aquatic species is only known to exist at fewer than ten other sites throughout the state. Bladderworts use air-filled sacs (bladders) to attract and capture unsuspecting prey. Bladderwort bladders are considered to be the most sophisticated trapping mechanism in the plant world!

This site has been designated as a BioNet Tier 2 site based on the presence of the Endangered Swollen bladderwort.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	Swollen bladderwort	*Utricularia inflata*	Endangered	

Other Values and Significance

In addition to providing wildlife habitat, non-tidal wetlands function as important natural filters for runoff entering the Chesapeake Bay and flood control systems for surrounding lands. Wetlands and their associated buffers help trap and transform excess nutrients before entering the Bay. These areas also can help reduce the rate of surface water flow and can hold large stores of water.

Threats and Management Needs

New development activities within the Protection Area could adversely alter the hydrologic regime of the wetlands by changing surface flow patterns. This is especially true for these non-tidal wetlands because they are fed by surface flow and rainfall. Development projects should be reviewed prior to construction, and plans should be developed to minimize negative impacts. An undisturbed, naturally forested buffer should be designated around the perimeter of the wetland.

Site Description Summary

The edges of the wetland are lined with young Black willow (*Salix nigra*), River birch (*Betula nigra*) and Buttonbush (*Cephalanthus occidentalis*). The uplands contain a young woods consisting of Sweetgum (*Liquidambar styraciflua*) and Virginia pine (*Pinus virginiana*).
The wetland contains patches of open water ranging from two to eight inches deep. Hummocks of graminoid species such as Soft rush (*Juncus effusus*), Squarestem spikerush (*Eleocharis quadrangulata*) and Canada rush (*Juncus canadensis*) grow throughout.

To the East is a small, wet grassland. This area contains the invasive Sericea lespedeza (*Lespedeza cuneata*) as well as the native Daisy fleabane (*Erigeron strigosus*), Indianhemp (*Apocynum cannabinum*) and a variety of grasses.

Cornwallis Neck Marshes

BioNet Tier: 3
USGS Quad: Indian Head
Critical Area: Yes

Summary of Ecological Significance

Cornwallis Neck Marshes includes two tidal, emergent marshes bordering Cornwallis Neck. Within both marshes grows a sizeable population of the State Rare Tickseed sunflower (*Bidens coronata*). Tickseed sunflower is an annual, so its population size and distribution may vary from year to year. It has large yellow flowers and blooms in late September and October. Tickseed sunflower occurs in high-quality freshwater tidal marshes and in portions of tidal marshes that are only irregularly tidally-influenced. This species is found at only seven other sites in Maryland, mostly in coastal areas which are threatened by sea level rise.

This site has been designated as a BioNet Tier 3 site based on the presence of the Tickseed sunflower.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	Coolwort	*Pilea fontana*	Watch List	
	Tickseed sunflower	*Bidens coronata*	Rare	

Other Values and Significance

In addition to the Tickseed sunflower, the western marsh supports a large population of the Watch List Coolwort (*Pilea fontana*). Hundreds of plants with mature fruit were observed in the marsh. This species looks very similar to the common Clearweed (*Pilea pumila*) but can be distinguished by its stems and seeds (achenes). The stems are less translucent than the common species and its achenes are black rather than green.

Threats and Management Needs

This site has been proposed for protection as an area of Local Significance under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). The proposed boundary includes non-tidal wetlands and a 100 foot upland buffer to these wetlands.

Site Description Summary

Both tidal freshwater emergent marshes in the Cornwallis Neck Habitat Protection Area support the State Rare Tickseed sunflower. In addition, the western marsh supports a Watch List species, Coolwort. The latter is being monitored in the State principally because of insufficient survey records.

The eastern marsh is a relatively extensive cove marsh with a well-defined mouth at Mattawoman Creek. This area is a very diverse tidal freshwater marsh with species such as Wild rice (*Zizania aquatica*), Swamp Rose-mallow (*Hibiscus moscheutos*), Cattail (*Typha* spp.), Larger bur-marigold (*Bidens laevis*), asters (*Aster* sp.), Big cordgrass (*Spartina cynosuroides*), Sweetflag (*Acorus calamus*), pickerelweed (*Pontederia cordata*) and Arrow arum (*Peltandra virginica*) being prominent. The western marsh is similar in vegetation, but is a relatively narrow fringe marsh with fewer species.

Mattawoman Creek

BioNet Tier: 2
USGS Quad: Indian Head, Mount Vernon, Port Tobacco
Critical Area: Yes

Summary of Ecological Significance

The extensive wetlands along Mattawoman Creek include high quality examples of open brackish tidal marshes, densely vegetated fresh tidal marshes, shrub swamps, tidal hardwood swamps and Coastal Plain bottomland forest. This diversity of community and habitat types supports a wide variety of plants and wildlife, including a number of rare species that thrive in the varied hydrology and physiognomy of these habitats.

The tidal, open marshes lining the creek support a large population of the State Rare American lotus (*Nelumbo lutea*), a showy aquatic flower. This area also provides food and cover for rare fish species including the Longnose gar (*Lepisosteus osseus*, State Rare) and the White catfish (*Ameiurus catus*, Status Uncertain).

Additionally, a Least bittern (*Ixobrychus exilis*), a State Rare breeder listed as In Need of Conservation, was reported during the breeding season from a densely vegetated, tidal freshwater marsh bordering the creek. Further surveys may reveal that this rare marshbird nests in the tidal marshes along the creek.

The State Rare Deciduous holly (*Ilex decidua*) grows throughout the shaded shrub layer of the forested nontidal swamp and in the adjacent open shrub swamp. Wet depressions and small side channels in the forested swamp support two State Endangered plants, the Floating paspalum (*Paspalum fluitans*) and Marsh fleabane (*Pluchea camphorata*). The State Rare Primrose willow (*Ludwigia decurrens*) dots the open marsh and shrub swamp while the State Rare Pale green orchid (*Platanthera flava*) occurs on hardwood-dominated hummocks within the Tidal Hardwood Swamps. Tidal Hardwood Swamps are considered vulnerable to extinction due to their restricted ranges. These communities occur in tidal rivers of Virginia, Maryland and Delaware, and fewer than 100 occurrences have been documented worldwide (NatureServe 2009).

The Coastal Plain Bottomland forest is periodically flooded by the creek. The Bottomland forests and the adjacent lower slopes of the uplands support the Highly State Rare Small-flowered baby-blue-eyes (*Nemophila aphylla*), the State Rare Large-seeded forget-me-not (*Myosotis macrosperma*) and the State Threatened Narrow melic grass (*Melica mutica*). The large block of surrounding forest helps to maintain the hydrology and water quality of these rare species' habitats.

Small, spring-fed seeps and streams feeding the Mattawoman provide larval habitat for a Highly State Rare odonate, the Banded spiketail (*Cordulegaster obliqua fasciata*). This species depends on a constant flow of cool spring water to maintain larval habitat.

The diversity of rare, threatened and endangered species within Mattawoman Creek has resulted in this site being designated as a BioNet Tier 2 site.

Rare and Uncommon Species and Habitats

Common Name	Scientific Name	MD Status	US Status
American lotus	*Nelumbo lutea*	Rare	

Plants	Broadleaf watermillfoil	*Myriophyllum heterophyllum*	Highly Rare
	Marsh fleabane	*Pluchea camphorata*	Endangered
	Cat-tail sedge	*Carex typhina*	Watch List
	Deciduous holly	*Ilex decidua*	Rare
	Floating paspalum	*Paspalum fluitans*	Endangered
	Large-seed forget-me-not	*Myosotis macrosperma*	Rare
	Louisiana sedge	*Carex louisianica*	Watch List
	Narrow melicgrass	*Melica mutica*	Threatened
	Pale green orchid	*Platanthera flava*	Rare
	Primrose willow	*Ludwigia decurrens*	Rare
	Small-flowered baby-blue-eyes	*Nemophila aphylla*	Highly Rare
Animals	Bald eagle	*Haliaeetus leucocephalus*	Watch List
	Banded spiketail	*Cordulegaster obliqua fasciata*	Highly Rare
	Blue-spotted sunfish	*Enneacanthus gloriosus*	Watch List
	Brown spiketail	*Cordulegaster bilineata*	Watch List
	Gray petaltail	*Tachopteryx thoreyi*	Watch List
	King rail	*Rallus elegans*	Watch List
	Least bittern	*Ixobrychus exilis*	In Need of Conservation
	Longnose gar	*Lepisosteus osseus*	State Rare
	Warmouth	*Lepomis gulosus*	Watch List
	White catfish	*Ameiurus catus*	Uncertain
Habitat	**Key Wildlife Habitat**		**MD Status**
	Floodplain Forest		
	• Coastal Plain Bottomland Forest		Apparently Secure
	• Tidal Hardwood Swamp		Apparently Secure

Other Values and Significance

The forest bordering Mattawoman Creek is recognized as an Important Bird Area by the National Audubon Society due to the extraordinary number of forest interior dwelling bird species (FIDS) that have been documented to breed in the large block of forest centered on the Creek. During a 2009 Bird Blitz survey coordinated by the National Audubon Society, 20 of the 24 potentially occurring FID species were recorded breeding in this area. Most FIDS are Neotropical migrants or birds that travel long distances to breed in North America and winter in Central and South America. These species include some of our most brilliantly colored songbirds such as the Scarlet tanager and Prothonotary warbler. These species and others play many important roles in our forests such as insect control, seed dispersal and providing food to other predators. Unfortunately, populations of many forest interior dwelling birds are declining. These declines have been attributed largely to the loss and fragmentation of forests in the eastern United States by urbanization, agriculture and some forest management practices. Deforestation of tropical wintering grounds also is an important factor. The key to maintaining breeding habitat for FIDS and halting their decline is to protect extensive, unbroken forested areas throughout the region.

The extensive marshes and forested wetlands along Mattawoman Creek supported a large colony of Great blue herons (*Ardea herodias*). In 2001, 172 nesting pairs were seen; triple the number of pairs seen in 1997. The size of this colony has fluctuated throughout the years, and although no pairs were seen in 2003, it is very possible that Great blue herons will return to the site.

This site is valuable as a part of the larger forested corridor which surrounds Mattawoman Creek. A natural corridor such as this is important to many types wildlife because of the extensive loss of habitat to clearing for residential and commercial development and agriculture. Pools in the wetland complex provides excellent breeding habitat for amphibians and odonate species. A wide variety of reptiles and amphibians have been documented in the watershed. The Watch List Gray petaltail (*Tachopteryx thoreyi*) and Brown spiketail (*Cordulegaster bilineata*) have been observed in a forested seep. During the 2009 site visit, Great blue herons, Red-tailed hawks, Red-eyed vireos, Stream bluets, Dragonhunters and Wood ducks were seen. In a previous survey, the Watch List King Rail (*Rallus elegans*) was observed with the State Rare Least bittern. Evidence of beavers, foxes and raccoons were also noted. Bald eagles (*Haliaeetus leucocephalus*) have been found nesting along the creek.

Mattawoman Creek is among the most important of the Potomac Basin spawning areas, because its associated tidal and non-tidal wetlands provide essential nursery habitat for many fish species. The seasonally flooded forest of this site may be significant in the development of several fish species which use these areas for spawning and feeding during flooding periods. Among the fish species found in the upper Mattawoman Creek are the Watch List Warmouth (*Lepomis gulosus*) and the Watch List Blue-spotted sunfish (*Enneacanthus gloriosus*). Additional fish species within the creek include game fish such as Bluegill, Largemouth bass, Pickerel, Catfish and White perch.

Relatively large and widespread populations of the Watch List Louisiana sedge (*Carex louisianica*) and Watch List Cat-tail sedge (*Carex typhina*) occur in the shrub swamp.

In addition to wildlife and plant values, the bottomland forest and its associated wetlands provide natural filtration for the surrounding watershed. These areas help slow stormwater run-off and capture excess nutrients before entering larger systems such as the Potomac River and ultimately the Chesapeake Bay.

Threats and Management Needs

Extensive commercial and residential development has occurred within the Mattawoman Creek watershed which has caused sedimentation in some wetland and aquatic habitats, has contributed excessive nutrients in some wetlands and waterways, and has altered the hydrology in portions of the stream system. In order to avoid further habitat degradation, future development activity should be focused in existing growth centers; forest clearing, construction of impervious surface areas; and disturbance to steep slopes should be strictly minimized; and environmental site design should be applied fully. Sediment and erosion control measures should be strictly enforced and monitored frequently, both before and after storm events, and problems should be corrected immediately (within 24 hours). The effects of adjacent development on rare plant communities and rare species should be monitored.

The wetlands and their 100 foot upland buffers are regulated as wetlands of special state concern (WSSC) by the Maryland Department of the Environment (COMAR 26.23.06). However, a 300ft

upland buffer is recommended to provide better protection to the hydrology and water quality of the groundwater-fed wetland habitats within the site, to discourage the encroachment of weeds and maintain the vegetation composition of the wetlands, and to provide adequate upland habitat for amphibians such as salamanders that frequent seepage wetlands

While logging has already occurred on parts of this site and adjacent areas, further logging could have an adverse effect on the shrub swamp and sections of the bottomland forest. Logging equipment may rut the soil and create changes to hydrologic patterns which not only affect the rare plant species but also the rare fish species. Also, disturbance of the soils due to logging could allow further invasion of non-native plants. Future plans for logging should be thoroughly reviewed to assess their impacts on the rare species and their associated habitat. Best management practices must be followed within the wetlands in order to control sediment and maintain the natural hydrology of these wetlands.

The canopy openings and soil disturbance from past logging, development and from right-of-way maintenance for the railroad and utility lines promote the growth on non-native, weedy species, including Perfoliate tearthumb (*Polygonum perfoliatum*), Japanese knotweed (*Polygonum cuspidatum*), Japanese stiltgrass (*Microstegium stamineum*) and Japanese honeysuckle (*Lonicera japonica*). The encroachment of these species should be controlled in order to maintain the natural composition of the plant communities within this area. A plan to control these invasive species within and immediately adjacent to rare species populations should be developed and implemented to promote the growth and reproduction of these rare species

Casual public visitation to the Great blue heron rookery during the breeding season (February 15th-July 31st) is discouraged. Nesting birds are known to be sensitive to noise, and even minor disturbances during breeding season can result in nesting failure and low reproduction rates. Nest trees also should remain intact as many times these birds will re-nest in the same areas. No logging should occur within the confines of the rookery. Excessive disturbance to the rookery, or within close proximity to the rookery, during the breeding season could result in herons shifting to another location and experiencing complete nest failure (Buckley and Buckley 1978). Significant mortality of chicks or eggs resulting from disturbance of the colony during the breeding season is a violation of the U.S. Migratory Bird Treaty Act.

Least bitterns and King rails are also protected under the Migratory Bird Treaty Act of 1918. It is unlawful to pursue, hunt, take, capture, kill or sell birds determined to be migratory. The statute does not discriminate between live or dead birds and grants full protection to any avian part including feathers, eggs and nests.

The western portion of this site is protected as a Listed Species Site under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). The Listed Species Site boundary includes nontidal wetlands, tidal wetlands and a 100 foot upland buffer to these wetlands.

Site Description Summary

Much of the site contains tidal marshes dominated by emergent wetland species. A band of Wild rice (*Zizania aquatica*), Rice cutgrass (*Leersia oryzoides*), Pickerelweed (*Pontederia cordata*) and Arrowhead species (*Sagittaria spp*.) lines most of the banks. The occasionally exposed mud flats contain a mix of Yellow water lily (*Nuphar lutea*) and the rare American lotus (*Nelumbo lutea*). The rare Least bittern and King rail were observed within the westernmost marshes.

Tidal Hardwood Swamps line edges of the Creek. These areas are dominated by hummocks of Pumpkin ash (*Fraxinus profunda*) and Swamp tupelo (*Nyssa biflora*). Smooth alder (*Alnus serrulata*) and other ash species (*Fraxinus spp*.) grow on some of the hummocks with patches of Pale green orchids.

The open canopy wetlands are dominated by a layer of emergent plants interspersed with shrubby hummocks. A number of scattered live and fallen trees remain in the area from past logging. Flooding due to beaver activity has caused some tree mortality in some areas, leaving a number of snags. The herbaceous layer is diverse, including: several sedges (*Carex* spp.), White grass (*Leersia virginiana*), a smartweed (*Polygonum* sp.), Lizard's tail (*Saururus cernuus*), Small water plantain (*Alisma subcordatum*) and Climbing hempweed (*Mikania scandens*). Scattered shrubs and trees include Buttonbush (*Cephalanthus occidentalis*), Winterberry (*Ilex verticillatus*), Persimmon (*Diospyros virginiana*), Sweetgum (*Liquidambar styraciflua*), White ash (*Fraxinus americana*) and several oak species (*Quercus* spp.). Primrose willow can be seen lining some of these areas.

The Coastal Plain Bottomland forest is dominated by Red maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*). Occasional Eastern sycamore (*Platanus occidentalis*) and River birch (*Betula nigra*) can be found in this area as well as Ironwood (*Carpinus caroliniana*) and Spicebush (*Lindera benzoin*). There are intermittent shrubby hummocks and sedge meadows adjacent to the Creek. These depressions flood seasonally and are most likely used as larval habitat for the rare odonates. An abundance of vines, including Poison ivy (*Toxicodendron radicans*) and Common greenbrier (*Smilax rotundifolia*) make passage difficult through parts of the woods. In some areas, Small-flowered baby blue-eyes dominates the understory while other rare species, such as Large-seeded forget-me-nots and Narrow melic grass, are occasional. The main stem of the Mattawoman Creek twists through the woods, leaving alternating cut banks and gravelly point bars. Along the banks of the Creek grows Virginia dayflower (*Commelina virginica*) as well as the rare Camphorweed and Floating paspalum.

A sewer line right-of-way cuts across the site creating a weedy forest edge on either side. Upon crossing the right-of-way to the east there are open pools that appear to be wet throughout much of the year. The pools are connected, though interspersed with forested hummocks. Along the edge of these pools are expanses of sedges, including the Watch List Cat-tail sedge and the Watch List Louisiana sedge. In deeper water, there are several aquatic plant species, including Mermaid weed (*Proserpinaca palustris*).

Mill Hill Woods

BioNet Tier: 3
USGS Quad: Port Tobacco
Critical Area: No

Summary of Ecological Significance
Dry, open oak woodlands and roadsides support a population of the State Endangered wildflower, Potato dandelion (*Krigia dandelion*). This small, dandelion-like flower is so named because it has an underground, potato-like stem that stores nutrients. Typically a plant of mid-western prairies, in Maryland this species is at the northeastern edge of its range. Potato dandelion grows in sunny openings in acidic soils on the Coastal Plain and Piedmont in our state. The population in the Mill Hill area occurs in a stand of older forest and extends along the open roadside.

This site has been designated as a BioNet Tier 3 site based on the presence of the State Endangered Potato dandelion.

Threats and Management Needs
Once part of an expansive dry-mesic upland forest, this woodland is now fragmented by residential development. The several patches of Potato dandelion that occur in this area of the county were historically connected by upland forest. Growing transportation needs for the expanding development activity in the area have led to proposals for new roads and/or road widening. Further forest fragmentation will occur as a result of some of these proposals. Road widening could destroy this population of Potato dandelion. At a minimum, any proposed widening should be modified to avoid direct impacts. Ideally a minimum buffer of 100ft should be maintained around the population in order to reduce the risk of inadvertent destruction. Focusing future development activity in areas with existing infrastructure would avoid further forest fragmentation.

Site Description Summary
A population of Potato dandelion occurs under an old snag in an open oak (*Quercus* spp)-dominated woodland and extends to the roadside. Several small populations of Potato dandelion occur in this portion of the County. Historically they were likely part of one large population in a large contiguous block of dry to mesic upland forest.

Old Woman's Run

BioNet Tier: 3
USGS Quad: La Plata, Port Tobacco
Critical Area: No

Summary of Ecological Significance

Old Woman's Run is a tributary from Mattawoman Creek that runs parallel to a former railroad bed in Charles County. This area contains Coastal Plain Bottomland forest that surrounds the tributary as well as a network of forested seeps fed by groundwater.

The exceptionally high water quality of the site along with the associated non-tidal wetlands along the Run creates habitat for a number of rare odonate species including the State Threatened Sely's sunfly (*Helocordulia selysii*).

This site has been designated as a BioNet Tier 3 site based on the presence of the State Threatened Sely's sunfly.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Animals	Brown spiketail	*Cordulegaster bilineata*	Watch List	
	Blue-spotted sunfish	*Enneacanthus gloriosus*	Watch List	
	Sely's sunfly	*Helocordulia selysii*	Threatened	
	Uhler's sundragon	*Helocordulia uhleri*	Watch List	
	Warmouth	*Lepomis gulosus*	Watch List	

Other Values and Significance

In addition to supporting quality habitat for the State Threatened Sely's sunfly, Old Woman's Gut also supports healthy populations of the Watch List Uhler's Sundragon (*Helocordulia uhleri*) and the Watch List Brown spiketail (*Cordulegaster bilineata*). A diversity of macroinvertebrates within the area provides a food resource for a number of other organisms.

Old Woman's Run also provides habitat for two Watch List fish species including the Warmouth (*Lepomis gulosus*) and the Blue-spotted sunfish (*Enneacanthus gloriosus*). In addition to these species, 20 other fish species were identified for this site, giving it a high fish diversity index.

The contiguous forest around Old Woman's Run has also been identified as potentially high quality habitat for Forest Interior Dwelling Species (FIDS). Most FIDS are neotropical migrants, or birds that travel long distances to breed in North America and winter in Central and South America. These species include some of our most brilliantly colored songbirds such as the Scarlet tanager and Prothonotary warbler. These species and others play many important roles in our forests such as insect control, seed dispersal and providing food to other predators. Unfortunately, populations of many FIDS are declining. These declines have been attributed largely to the loss and fragmentation of forests in the eastern United States by urbanization, agriculture and some forest management practices. The key to maintaining breeding habitat for FIDS and halting their decline is to protect extensive, unbroken forested areas throughout the region.

Non-tidal wetlands such as Old Woman's Gut are increasingly valued for their role in protecting the water quality of the rivers they feed and ultimately, the Chesapeake Bay.

Threats and Management Needs

Currently, construction of a new waterline near the right-of-way threatens Old Woman's Run. Disturbance and sedimentation within the stream and its associated wetlands would negatively alter the habitat and may render it unsuitable for the rare species. For the proposed waterline, Old Woman's Run crossings and stream sections adjacent to the right-of-way should be protected at the time of construction. The water pipe should be installed under the streams using a jack-and-bore approach (or equivalent) to minimize damage at these locations. Locating the proposed reclaimed water line on the opposite side of the right-of-way from Old Woman's Run would greatly reduce the potential for sediment from the construction to enter the stream.

Logging and clearing of the uplands surrounding the site as well as within the non-tidal wetlands would also be detrimental to these species. Both activities could alter the hydrology of the area by changing surface flow patterns as well as increasing sediment and run-off entering the aquatic system.

Site Description Summary

Old Woman's Run consists of a network of small streams and short permanent/semi-permanent rivulets. These areas are part of a non-tidal wetland complex fed by the Run. A bottomland forest surrounds the stream proper and contains occasional groundwater fed seeps. These forested seeps are very likely used as larval habitat for the Brown spiketail. The areas with the more sustained water flow are used by the Sely's sunfly as well as the uncommon fish species. Much of Old Woman's Run is parallel to a former railroad bed and a powerline right-of-way.

Rum Point

BioNet Tier: 3
USGS Quad: Indian Head
Critical Area: Yes

Summary of Ecological Significance

Rum Point Protection Area is comprised of several distinct habitat types that have high species diversity and support rare species and species uncommon on the Coastal Plain of Maryland. The area includes an expansive ravine system and contiguous shoreline and cliff habitats.

The Tulip poplar (*Liriodendron tulipifera*) forest in the ravine system supports the State Threatened Narrow melicgrass (*Melica mutica*). Narrow melicgrass, a perennial grass, occurs at two locations. In both locations, several individuals were verified in flower growing on the steep slopes. Along the edges and bottomland of the ravine, two rare wildflowers grow: the Highly State Rare Small-flowered baby blue-eyes (*Nemophila aphylla*) and the State Rare Large-seeded forget-me-not (*Myosotis macrosperma*). An unverified population of the Highly State Rare Slender woodland sedge (*Carex digitalis var. macropoda*) has also been observed within this ravine system. Further surveys should be conducted to confirm the identity of this species.

The Tulip poplar forest within the ravine is developing two characters of old-growth forests: pit-mound topography and standing dead and fallen decaying trees exceeding three feet in diameter. In addition, the forest appears to have a high level of species diversity. For example, at least 41 species of woody plants were noted during a May 1991 rare species survey. Many more herbaceous species undoubtedly are supported by the system.

One bobcat (*Lynx rufus*), State listed as In Need of Conservation, was observed in May 1992. The sighting occurred along the dirt road to Rum Point. If this individual is part of a native resident population, then its occurrence here is highly significant.

In the open habitats and along the beaver marshes, the State Rare Carolina satyr (*Hermeuptychia sosybius*) has been observed. Yellow blooms from the State Rare Primrose willow (*Ludwigia decurrens*) can also be seen within the marshes.

The tidal freshwater marsh along the inside of the Rum Point spit and south of the spit is a small but excellent example of a tidal, freshwater marsh. It has high species diversity and supports a small but apparently stable population of Tickseed sunflower (*Bidens coronata*), a State Rare species.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	Large-seeded forget-me-not	*Myosotis macrosperma*	Rare	
	Narrow melicgrass	*Melica mutica*	Endangered	
	Primrose willow	*Ludwigia decurrens*	Rare	
	Slender woodland sedge	*Carex digitalis var. macropoda*	Highly Rare	
	Small-flowered baby blue eyes	*Nemophila aphylla*	Highly Rare	
	Tickseed sunflower	*Bidens coronata*	Rare	
	Wafer ash	*Ptelea trifoliata*	Watch List	
Animals	Bald eagle	*Haliaetus leucocephalus*	Watch List	
	Bobcat	*Lynx rufus*	In Need of Conservation	
	Carolina satyr	*Hermeuptychia sosybius*	Highly Rare	
	Southeastern shrew	*Sorex longirostris*	Watch List	

Other Values and Significance

In addition to supporting Narrow melicgrass, the ravine system provides habitat for plant species that are rarely found on the Coastal Plain. Hop hornbeam (*Ostrya virginiana*) and Foamflower (*Tiarella cordifolia*) are species chiefly found in rich woods of the Piedmont and mountains. This Protection Area could be used for environmental educational purposes emphasizing its unusual Piedmont characters.

The number of Forest Interior Dwelling Species (FIDS) detected during 1991 and 1992 surveys was greater in this area than in any other area on the Stump Neck Annex. Eleven species were detected at three listening stops and were located within the Protection Area boundary, including: Hairy woodpecker, Acadian flycatcher, Yellow-throated vireo, Red-eyed vireo, Northern parula, Worm-eating warbler, Ovenbird, Louisiana waterthrush, Kentucky warbler, Hooded warbler and Scarlet tanager.

Of the eleven FIDS found, eight were recorded from the first few hundred yards at the head of the ravine. Multiple members of three separate guilds were included: ground nesters, mid-canopy nesters and upper canopy nesters. The presence of all three guilds reflects the well-developed forest structure and the overall high quality of this area.

A Bald eagle (*Haliaetus leucocephalus*) nest is located in these woods along the slope of the ravine not far from the shoreline. Bald eagles build bulky stick nests in the crotches of large coniferous or deciduous trees and will return to the same site for many years. Several Southeastern shrews (*Sorex longirostris*), a Watch List small mammal, have also been spotted within the ravine system.

Several small, narrow forested seeps and pools occur about 30 feet inland from the shoreline about 0.75 mi. southwest of the tip of the peninsula. Non-tidal wetlands are uncommon at the Indianhead sites, and they provide important habitat for amphibians, dragonflies and damselflies and many other species.

Three shrubs of Wafer-ash (*Ptelea trifoliata*) were found growing in a clump just above the shoreline. Wafer-ash is also ranked as a Watch List species and is more commonly found along the Potomac River near Great Falls in Montgomery County and in western Maryland. This site is the only known Charles County location for this species.

Threats and Management Needs

The vast majority of the site is unsuitable for development activities because of physical and ecological constraints imposed by steep slopes and hydric soils. Gently sloping areas that are part of the drainage system also should not be developed, to allow for an ecologically intact and functioning ecosystem.

Logging is the most obvious direct threat to the ravine forest. In contrast to early successional plant communities, logging is incompatible with the maintenance and enhancement of older-growth forests. Logging within the Protection Area could also increase sedimentation in the marsh, increase erosion along the cliffs and decrease available FIDS habitat. Extensive logging operations, such as the clearcut formerly completed in the western upland section of this area, are highly detrimental to FIDS. Not only has this area been eliminated for the birds which bred there, but most species of FIDS will not recolonize the regenerated forest for at least twelve years (Bushman and Therres 1988). It may take many more years to reestablish successfully reproducing populations. A large area of the remaining mature forest is also unsuitable for many FIDS because of edge avoidance. Species which are most sensitive to forest fragmentation typically do not breed within about 300 ft. of the forest edge. This distance varies for each species; however, increased predation and parasitism rates occur near the forest edge.

The greatest threats to FIDS in this area are deer browsing and extensive logging operations. The amount of damage to the herbaceous layer and understory from deer browsing is not as great in this area as in other areas on the Stump Neck Annex or on the Main Site. Birds which breed on or near the ground, including the Ovenbird and Louisiana waterthrush, are highly susceptible to the loss of understory cover caused by excessive deer browsing. The deer population in this area should be reduced in order to maintain this important habitat component. Attempts should be made to permanently reduce the deer population by hunting, allowing the long, cleared corridor that parallels the ravine system to the east to revert to forest and otherwise reducing forest fragmentation and reducing edge habitat. Reduction of forest fragmentation would also greatly increase and improve FID habitat.

The dirt road to Rum Point should remain unimproved to minimize sediment runoff and to minimize fragmentation by retaining trees close to road.

The habitats and species that occur at this site are occasionally exposed to high energy storm conditions, but they are adapted to natural disturbance regimes. Boat wakes can cause excessive wave action and increased shoreline erosion, but no significant species are directly affected except Tickseed sunflower growing along the shoreline.

Aggressive non-native vines are degrading native plant communities in several areas, but no rare species are immediately threatened. Extensive stands of Japanese honeysuckle (*Lonicera japonica*) are hindering the development of quality forest in the scrubby woods south of the tidal marsh. Another large patch of Japanese honeysuckle and other vines is inhibiting forest establishment on the slope above the shoreline about one mile southwest of the tip of the peninsula. Japanese clematis (*Clematis terniflora*) is commonly found covering vegetation along

the shoreline. Porcelainberry (*Ampelopsis brevipedunculata*) is established near the end of the peninsula. Both Porcelainberry and Asiatic bittersweet are capable of invading forests and climbing and killing saplings and trees. Japanese honeysuckle and other exotic plants should be removed from the forested area within the 100-ft. buffer south of the tidal marsh to increase the quality of the forest. Manual clearing and pulling followed by spot spraying of re-growth with glyphosate herbicide during warm periods during the dormant season should result in minimal impacts to non-target species. Asiatic bittersweet, porcelain berry, and dense stands of Japanese honeysuckle and Japanese clematis should be removed along the shoreline. Cutting and stump treatment with glyphosate followed by spot spraying of re-growth with glyphosate should result in minimum impacts to non-target species. The invasive Hydrilla (*Hydrilla verticillata*) completely fills the cove formed inside the curved tip of the peninsula and also occurs in dense stands offshore. Managing this species may not be possible.

This site has been proposed for protection as a Listed Species Site under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). The proposed boundary includes non-tidal wetlands and a 100 foot upland buffer to these wetlands.

Site Description Summary

Rum Point Protection Area is comprised of a series of ravines and contiguous shoreline and riverine cliff habitats.

The ravine system is characterized primarily by steep slopes and hydric soils. Although most upland soils are a shallow gravelly loam, a "rich woods" condition has developed and is in transition to an old-growth state. Relatively flat areas flank the steep slopes and consist of loamy sand or silt loams. The bottom of the ravine system, i.e., the beaver-impounded area, is covered with mucky silt loam characteristic of tidal, freshwater wetlands. Steep slopes of the ravine system support the State threatened Narrow melicgrass. The ravine system also provides habitat for plant species that are rarely found in the Coastal Plain. If protected from anthropogenic disturbance, the ravine system will continue to develop into a highly diverse, old-growth forest with unusual characteristics for the Coastal Plain.

The curving tip of the Rum Point peninsula supports a sand spit and strand natural community. Due to the spit's exposed location, it is periodically subjected to high energy natural disturbances that maintain a dynamic and diverse community of early successional woody and herbaceous species. Hydrilla and other submerged aquatic vegetation species fill the shallow cove inside the spit and also form mats offshore.

A narrow tidal freshwater fringe marsh extends along the inside of the spit and a broader tidal freshwater marsh extends east from the base of the spit. Tickseed sunflower grows in these diverse marshes.

About 0.3 mi. south of Rum Point, the intermittent stream that drains Rum Point ravine was impounded a few years ago by beavers. Dead trunks of ash trees stand in a small pond separated from the shoreline by a sandy berm.

South and west of the beaver pond, steep slopes and cliffs rise above the shoreline. In most sections, level land between the shore and the base of the slopes is narrow, and herbaceous vegetation is rare. However, a high diversity of woody plants with low population numbers is found along this section of shoreline. Woody species include Pumpkin ash (*Fraxinus profunda*),

Green ash (*Fraxinus pennsylvanica*), Red maple (*Acer rubrum*), Tulip poplar, Eastern sycamore (*Platanus occidentalis*), Basswood (*Tilia americana*), Wafer-ash and Witch hazel (*Hamamelis virginiana*). Several of these species are uncommon on the Coastal Plain of Maryland.

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Sun Valley Wetlands

BioNet Tier: 3
USGS Quad: Piscataway
Critical Area: No

Summary of Ecological Significance

Sun Valley Wetlands contains a small depressional wetland along a snaking section of Piney Branch West. This wetland is lined by woody species such as Red maple (*Acer rubrum*) and contains herbaceous, mostly graminoid species. Within the gravelly-substrate, the State Endangered Swollen bladderwort (*Utricularia inflata*) was seen flowering. This carnivorous, aquatic species is only known to exist at only seven other sites throughout the state.

This site has been designated as a BioNet Tier 3 site based on the presence of the State Endangered Swollen bladderwort.

Rare and Uncommon Species and Habitats

	Common Name	Scientific Name	MD Status	US Status
Plants	Swollen bladderwort	*Utricularia inflata*	Endangered	

Other Values and Significance

Depressional wetlands provide offer excellent breeding and feeding habitat for amphibians, reptiles and invertebrates. The contiguous forest surrounding Sun Valley Wetlands has also been indentified as potential habitat for Forest Interior Dwelling Species (FIDS). These species include many Neotropical migrants such as the colorful Prothonotary warbler. FIDS are important for insect control, seed dispersal and as food for other predators.

In addition to providing wildlife habitat, non-tidal wetlands function as important natural filters for runoff entering the Chesapeake Bay and flood control systems for surrounding lands. Wetlands and their associated buffers help trap and transform excess nutrients before entering the Bay. In addition, these areas can help reduce the rate of surface water flow and can hold large stores of water.

Threats and Management Needs

Currently, a section of the proposed US 301 Waldorf Bypass goes through this area. New development activities within the Protection area could adversely affect the hydrologic regime of the wetlands by changing surface flow pattern. This is especially true for these non-tidal wetlands since they are fed by surface flow and rainfall. Development projects should be reviewed prior to construction, and plans should be developed to minimize negative impacts. An undisturbed, naturally forested buffer should be designated around the perimeter of the wetland.

Site Description Summary

This site contains a gravel-bottomed wet depression along a toe slope on the edge of Piney Branch West floodplain. Lining the wetland are trees such as Red maple (Acer rubrum) and Sweetgum (*Liquidambar styraciflua*). Graminoids such as Three-way sedge (*Dulichium arundinaceum*), catch-fly grasses (*Leersia spp*.) and bulrushes (*Scirpus spp*.) dominate much of the depression. However, species such as bur-reeds (*Sparganium spp*.), Lizard's tail (*Saururus cernuus*) and Arrowleaf tearthumb (*Polygonum sagittatum*) were also present.

Thoroughfare Island

BioNet Tier: 3
USGS Quad: Indian Head
Critical Area: Yes

Summary of Ecological Significance
While Thoroughfare Island is not known to support any currently state-listed rare species, a population of Pumpkin ash (*Fraxinus profunda*) grows along its southwestern shoreline at the edge of the tidal freshwater emergent marsh. Pumpkin ash is rare on the western shore of the Chesapeake Bay, in part because its fresh tidal swamp habitat is restricted by topography to a narrow band at the head of fresh tidal marshes. This Globally Rare habitat is classified as Pumpkin ash -Swamp Tupelo - (Green Ash) / Common Winterberry / Halberd-leaf Tearthumb Forest (*Fraxinus profunda - Nyssa biflora - (Fraxinus pennsylvanica) / Ilex verticillata / Polygonum arifolium* Forest), and occurs at the upper, freshwater reaches of tidal rivers in Delaware, Maryland and Virginia. Many sites containing Pumpkin ash are at risk due to both sea level rise and the Emerald ash borer (*Agrilus planipennis*).

Threats and Management Needs
Two of the main threats to this site include sea level rise and the Emerald ash borer. In 2007, the Intergovernmental Panel on Climate Change (IPCC) estimated global average sea levels will rise by 7- to 23-inches by the 2090s, with an additional 4 to 8 inches possible due to the current rate of ice flow from Greenland and Antarctica. This change in sea levels would place much of Thoroughfare Island underwater. The Thoroughfare Island population should be surveyed periodically to determine the status of the population. Avoiding disturbance to adjacent non-tidal wetlands and to a minimum 300 foot wide upland buffer will provide protection for areas for potential migration of this tidal habitat as sea level rises. No other specific management actions are recommended to address the threat of sea level rise.

In 2003, several ash (*Fraxinus* spp.) trees were found infested with Emerald ash borers at a nursery in Prince George's county. Despite eradication and quarantine efforts, the Emerald ash borers have now established in other areas throughout the State. While effective control measures for the ash borers have not been developed, the spread of this invasive species can be reduced by limiting the transport of firewood and other raw wood products to the county where they originate.

This site is protected as a Listed Species Site under the Chesapeake Bay Critical Area Regulations (COMAR 27.01.09.04). Due to the delisting of Pumpkin ash, this site has been proposed to be protected as a plant and wildlife habitat of local significance [COMAR 27.01.09.04.B.(4) and C.(2)(a)(vi)]. The proposed Protection Area includes tidal wetlands and a 300 foot upland buffer to these wetlands.

Site Description Summary
Tidal freshwater emergent marsh along the southwestern shoreline of Thoroughfare Island supports a small population of Pumpkin ash. Most of the trees are distributed near the ecotone between marsh and upland. Like many tidal freshwater marshes, a large number of plant species comprise the marsh. Typical species at this site include Big cordgrass (*Spartina cynosuroides*), Swamp rose mallow (*Hibiscus moscheutos*), Arrow arum (*Peltandra virginica*), Wild rice (*Zizania aquatica*), Cattails (*Typha* spp.) and Larger bur-marigold (*Bidens laevis*).

Appendix C: Specific Protection Measures for Wildlife and Rare Species Habitats

Water Quality and Hydrological Protection Measures

Many of the Ecologically Significant Areas harbor rare species and habitats that are directly dependent on wetlands or aquatic systems. The following recommendations pertain to maintaining the hydrology and water quality of the rare species' habitats found throughout the watershed. Pursuing these measures regarding stormwater management, the extent and location of impervious surfaces, forest retention and sediment/erosion control is very important to the conservation of the rare species' wetland and aquatic habitats.

1. Pursue environmentally sensitive design to address stormwater runoff by promoting the use of nonstructural best management practices to the maximum extent. The goal is to mimic natural infiltration patterns across the site in order to maintain natural hydrology.
    a. Methods to pursue include the use of sheet flow to buffers, vegetated channels to convey road runoff (i.e. roadside swales), disconnection of roof and non-roof runoff, methods of bioretention such as rain gardens.
    b. Reduce impervious cover as outlined in the MDE stormwater management manual section 5.1.3.1, which is available online at their website: (http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Documents/www.mde.state.md.us/assets/document/Design%20Manual%20Chapter%205%2003%2024%202009.pdf). In addition to these methods, options to pursue include the use of shared parking/driveways and pervious materials wherever possible.
    c. Locate impervious surfaces as far as possible from permanent and intermittent streams and their floodplains.
2. In order to minimize risk of sedimentation in the aquatic and wetland habitats and to minimize changes to the hydrology of these habitats:
    a. Minimize clearing and retain forest - The limits of disturbance should be the minimum needed to build homes, allow access and provide fire protection. Conduct clearing and construction in phases in order to avoid having large areas cleared at one time. Pursue clustered development in order to allow retention of large blocks of contiguous upland forest along streams and wetlands.
    b. Stabilize soil - Stabilization should occur immediately (within 24 hours). Special effort should be made to retain fine particle silt, sand and clay sediments including the incorporation of redundant/additional control measures in the sediment and erosion control plan to ensure maximum filtration of any sediment-laden runoff (e.g., accelerated stabilization, super silt fence instead of silt fence, etc.).
    c. Inspect frequently - All measures should be inspected daily to ensure that they are functional from the very initial stages through final construction, and any problems should be corrected immediately.
    d. Provide a minimum 100 ft undisturbed forested upland buffer to permanent and intermittent streams and nontidal wetlands.

    e. Avoid disturbing steep slopes (15% slope or greater) and areas of highly erodible soils.
3. Where instream work is unavoidable, provide adequate passage for fish, reptiles and amphibians. Further consultation with the Natural Heritage Program should be sought in order to minimize impacts from instream work in or upstream from rare species' aquatic and wetland habitats.

Colonial Waterbird Nesting

To protect great blue heron rookeries, we recommend the following guidelines:

1. Establish a protection area of ¼ mile radius from the rookery's outer boundary. Within this area establish three zones of protection:
    a. Zone 1 extends from the outer boundary of the rookery to a radius of 330 feet
    b. Zone 2 extends from 330 feet to 660 feet in radius
    c. Zone 3 extends from 660 feet to ¼ mile (1,320 feet).
2. During the breeding season, all human entry into Zone 1 should be restricted to only that essential for protection of the rookery. Human disturbance of rookery sites that results in significant mortality of eggs and/or chicks is considered a prohibited taking under various state and federal regulations.
3. No land use changes, including development or timber harvesting, should occur in Zone 1.
4. Construction activities, including clearing, grading, building, etc., should not occur within Zones 1 and 2.
5. Selective timber harvesting may occur in Zone 2, but clear cutting should be avoided.
6. No construction or timber harvesting activities should occur within the ¼ mile protection area (Zone 3) during the breeding season.

Potential Forest Interior Dwelling Species (FIDS) Habitat

Within the Chesapeake Bay Critical Area, habitat protection for forest interior dwelling birds is mandated through regulations authorized by the Chesapeake Bay Critical Area Law (Natural Resources Article 8-1808, Annotated Code of Maryland). The regulations require that management programs be developed to protect and conserve riparian and upland forests used for breeding by FIDS within the Critical Area. DNR strongly encourages that protection programs for FIDS be extended beyond the Critical Area. Guidelines for determining FIDS habitat and conserving these areas are found in two publications:

Bushman, E. S., and G. D. Therres. 1988. Habitat management guidelines for forest interior breeding birds of coastal Maryland. Maryland Department of Natural Resources, Wildlife Technical Publication 88-1. 50pp.

Jones, C., J. McCann, and S. McConville. 2000. A guide to the conservation of forest interior dwelling birds in the Chesapeake Bay Critical Area. Chesapeake Bay Critical Area Commission, Annapolis, Md. 58pp.

In addition, the following specific protection measures should also be considered when development projects are being evaluated for potential ecological impacts to FIDS habitat:

1. Restrict development to nonforested areas.
2. If forest loss or disturbance is unavoidable, concentrate or restrict development to the following areas:
   a. the perimeter of the forest (i.e., within 300 feet of existing forest edge)
   b. thin strips of upland forest less than 300 feet wide
   c. small, isolated forests less than 50 acres in size
   d. portions of the forest with low quality FIDS habitat, (i.e., areas that are already heavily fragmented, relatively young, exhibit low structural diversity, etc.)
3. Maximize the amount if forest "interior" (forest area >300 feet from the forest edge) within each forest tract (i.e., minimize the forest edge:area ratio). Circular forest tracts are ideal and square tracts are better than rectangular or long, linear forests.
4. Minimize forest isolation. Generally, forests that are adjacent, close to, or connected to other forests provide higher quality FIDS habitat than more isolated forests.
5. Limit forest removal to the "footprint" of houses and to that which is necessary for the placement of roads and driveways.
6. Minimize the number and length of driveways and roads.
7. Roads and driveways should be as narrow and as short as possible; preferably less than 25 and 15 feet, respectively
8. Maintain forest canopy closure over roads and driveways.
9. Maintain forest habitat up to the edges of roads and driveways; do not create or maintain mowed grassy berms.
10. Maintain or create wildlife corridors.
11. Do not remove or disturb forest habitat during April-August, the breeding season for most FIDS. This seasonal restriction may be expanded to February-August if certain early nesting FIDS (e.g., Barred Owl) are present.
12. Landscape homes with native trees, shrubs and other plants and/or encourage homeowners to do so.
13. Encourage homeowners to keep pet cats indoors or, if taken outside, kept on a leash or inside a fenced area.
14. In forested areas reserved from development, promote the development of a diverse forest understory by removing livestock from forested areas and controlling white-tailed deer populations. Do not mow the forest understory or remove woody debris and snags.
15. Afforestation efforts should target a) riparian or streamside areas that lack woody vegetative buffers, b) forested riparian areas less than 300 feet wide, and c) gaps or peninsulas of nonforested habitat within or adjacent to existing FIDS habitat.

Invasive Species

Invasive species are non-native species that cause economic and environmental problems. Invasive species have been ranked as the second greatest threat to biodiversity because many invasives can displace native species. In the United States, it is estimated that the current 50,000 non-native species cause economic losses totaling $120 billion per year. Furthermore, it has been estimated that 57% of all imperiled plant species are affected by invasive species. Common invasive species in southern MD include common reed grass (*Phragmites australis*) and virile crayfish (*Orconectes virilis*). Many times, managing established invasives is costly and time consuming. Therefore, the best way to control invasive species is by preventing invasion and through early detection and response.

Prevention BMP's

If construction or logging equipment is to be used within 500 ft of a seepage wetland, then thorough washing of equipment offsite is recommended. Only non-weedy, native species and weed-free mulch and soils should be used for landscaping and gardening and for soil stabilization. Time logging and other land disturbance to avoid the fruiting/dispersal period of any highly invasive species that are common in the immediate area in order to reduce the spread of these species. Where possible, pursue control measures for highly invasive species that occur on site during the year prior to logging or clearing in order to further minimize spread. After logging or construction, it is recommended that bare soils are revegetated with non-weedy, native species. Survey lands occasionally to see if any invasive species have colonized, and attempt to eradicate any new populations to prevent further invasion.

1. When hiking to a new area, try to clean boots and bags to get rid of hitchhiking seeds and pests.

2. Don't move firewood into new areas as it can harbor invasive wood-boring insects such as the emerald ash borer.

3. Fishermen are advised to never release live, unused bait or to transport live fish or crayfish from one body of water to another. Similarly, never dispose of aquarium plants or fish or other pets into the wild.

Management BMP's

Species-specific control measures should be implemented to manage established invasive species. Herbicide applications should be limited and only chemicals approved for wetland use should be used. Through the use of wipers and droppers, managers can apply targeted chemical applications. After invasive plants have been removed, non-weedy native vegetation should be planted in any areas with exposed soil.

Useful Links:

- ***Recommended native species to plant; MD Native Plant Society*** http://www.mdflora.org/publications/natives2plant_lists.html
- ***Maryland Invasive Species Council (MISC)*** http://www.mdinvasivesp.org/
- ***Plant Invaders of Mid-Atlantic Natural Areas*** http://www.nps.gov/plants/alien/pubs/midatlantic/
- ***Rusty crayfish brochure*** http://www.dnr.state.md.us/invasives/RustyCrayfishBrochure.pdf
- ***Virile crayfish brochure*** http://www.dnr.state.md.us/invasives/virilecrayfish.pdf
- ***Emerald Ash Borer ID sheet*** http://www.goodcamper.info/files/E2944.pdf
- ***Landowner's Guide to Phragmites control*** http://www.michigan.gov/documents/deq/deq-ogl-Guide-Phragmites_204659_7.pdf
- ***Best Management Practices for Canary Reed Grass (Phalaris arundinacea* L.)** http://www.fws.gov/shorebirdplan/downloads/ReedCanaryGrassReport2004.pdf

Appendix D: Important Bird Area (IBA) for FIDS

Acccording to the Audubon Maryland-DC fact sheet about the Mattawoman Creek IBA:

> "Mattawoman Creek IBA is a site of statewide importance for bird conservation. Data from the 2nd Breeding Bird Atlas of Maryland and DC (Ellison 2010) and Bird Blitz surveys conducted by Audubon in 2009 demonstrate that the site supports one of the most diverse assemblages of Forest Interior Dwelling Species (FIDS) in Maryland's Coastal Plain, with 20 out of 24 potentially occurring species breeding regularly. Three declining at-risk bird species on the Audubon/American Bird Conservancy Watchlist (category Yellow) breed here in significant numbers. Prothonotary Warbler is a specialist of floodplain forests and nests in tree cavities, Kentucky Warbler requires forests with a dense shrub layer, and Wood Thrush inhabits a wide variety of forest types but has declined steadily across its range in recent decades. One other WatchList species (category Red), Red-headed Woodpecker, is regularly present at the site, and counts of up to 23 birds in winter 2011 indicate that it may sometimes occur in sufficient numbers to trigger the IBA criterion for this species."

Documented FIDS habitat within the Mattawoman Creek watershed of Charles County, within both the IBA boundaries of Mattawoman Creek IBA and Chapman State Park IBA, total 14,234 acres (5,760 ha). The IBA boundary incorporates 55% of all the *potential* FIDS habitat in the watershed.

The table below, also from the Audubon Maryland-DC fact sheet, provides detailed data gathered to support the designation of the Mattawoman Creek Important Bird Area.

Table 5. Qualifying IBA Criteria[1]

IBA Criterion	**Species**	**Data[2]**
Category 1: *At-risk species*	Prothonotary Warbler	111 pairs estimated; 7 of 9 Atlas blocks
Category 1: *At-risk species*	Kentucky Warbler	28 pairs estimated; 8 of 9 Atlas blocks
Category 1: *At-risk species*	Wood Thrush	284 pairs estimated; 9 of 9 Atlas blocks
Category 2: *Species assemblages*	Forest Interior Dwelling Species (FIDS): Red-shouldered Hawk, Barred Owl, Whip-poor-will, Hairy Woodpecker, Pileated Woodpecker, Acadian Flycatcher, Yellow-throated Vireo, Red-eyed Vireo, Wood Thrush, Northern Parula, Black-and-white Warbler, American Redstart, Prothonotary Warbler, Worm-eating Warbler, Ovenbird, Louisiana Waterthrush, Kentucky Warbler, Hooded Warbler, Scarlet Tanager, Summer Tanager	20 FIDS breed regularly out of 24 potentially regular breeders in the Coastal Plain; Mean FIDS per Atlas block (n=9) is 16.6, which represents the 88th percentile for Coastal Plain forests.

[1]AudubonMaryland-DC. 2011. Important Bird Areas Program criteria for site selection. Available online: http://mddc.audubon.org

[2]Data are from: Audubon Maryland-DC. 2009 Bird Blitz survey data and population estimates. Unpublished data; and Ellison, W.G., editor. 2010. Second atlas of the breeding birds of Maryland and the District of Columbia. Johns Hopkins University Press. 494 p.

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Appendix E: Maps of Wildlife and Rare Species Habitats

Maps of the resources of concern to DNR's Wildlife and Heritage Service are included in this appendix. Digital data that correspond to these various maps can be made available to Charles County Planning and Zoning staff. Some of these data are publicly available from DNR's GIS data download website (http://dnrweb.dnr.state.md.us/gis/data). Please contact Lynn Davidson (ldavidson@dnr.state.md.us) for additional information or to obtain a copy of the data used to produce these maps.

The maps included in this Appendix are:

1. Biodiversity Conservation Network (BioNet)
2. Ecologically Significant Areas (ESAs)
3. Colonial Waterbird Colonies
4. Potential Forest Interior Dwelling Species (FIDS) Habitat
5. Waterfowl Concentration and Staging Areas

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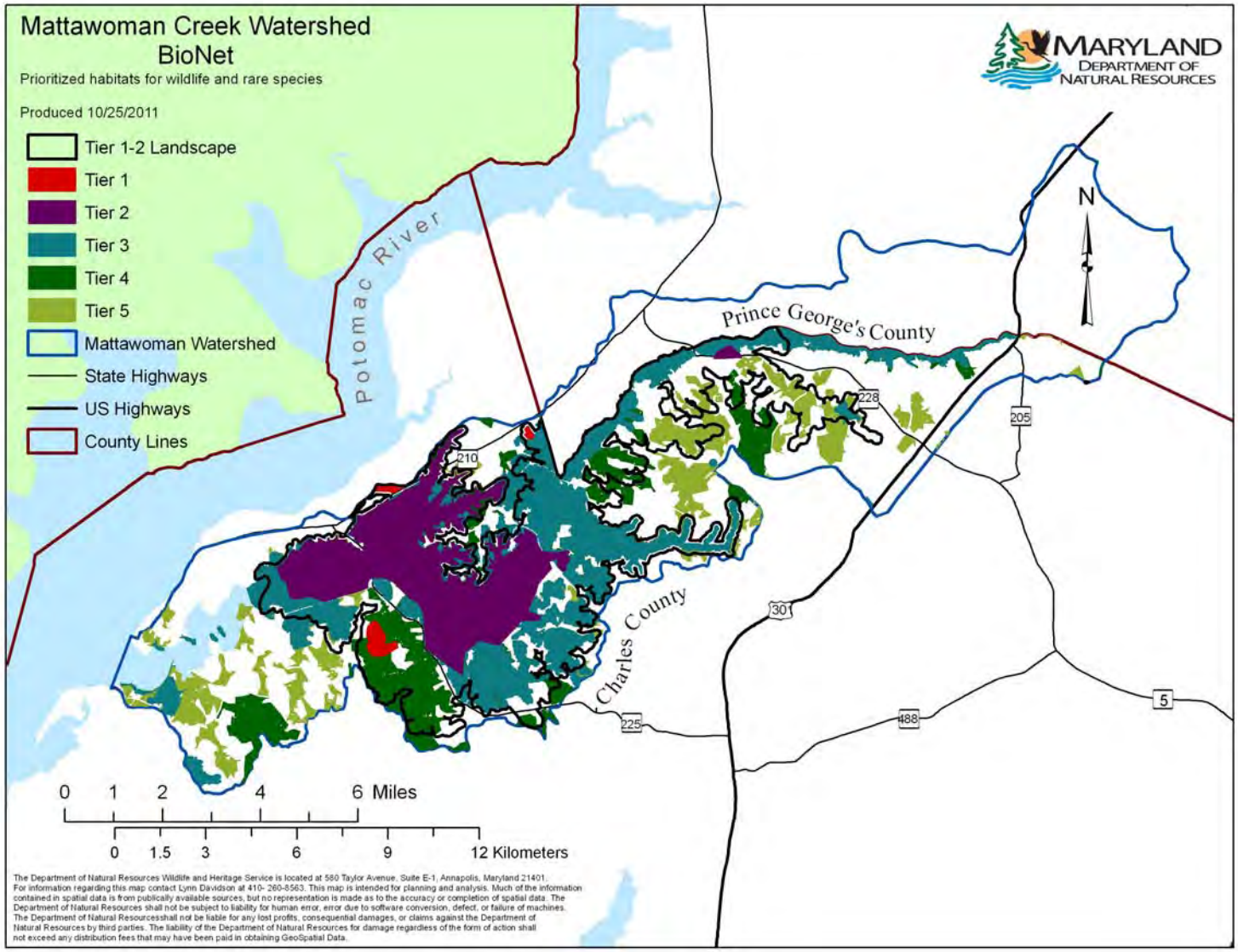
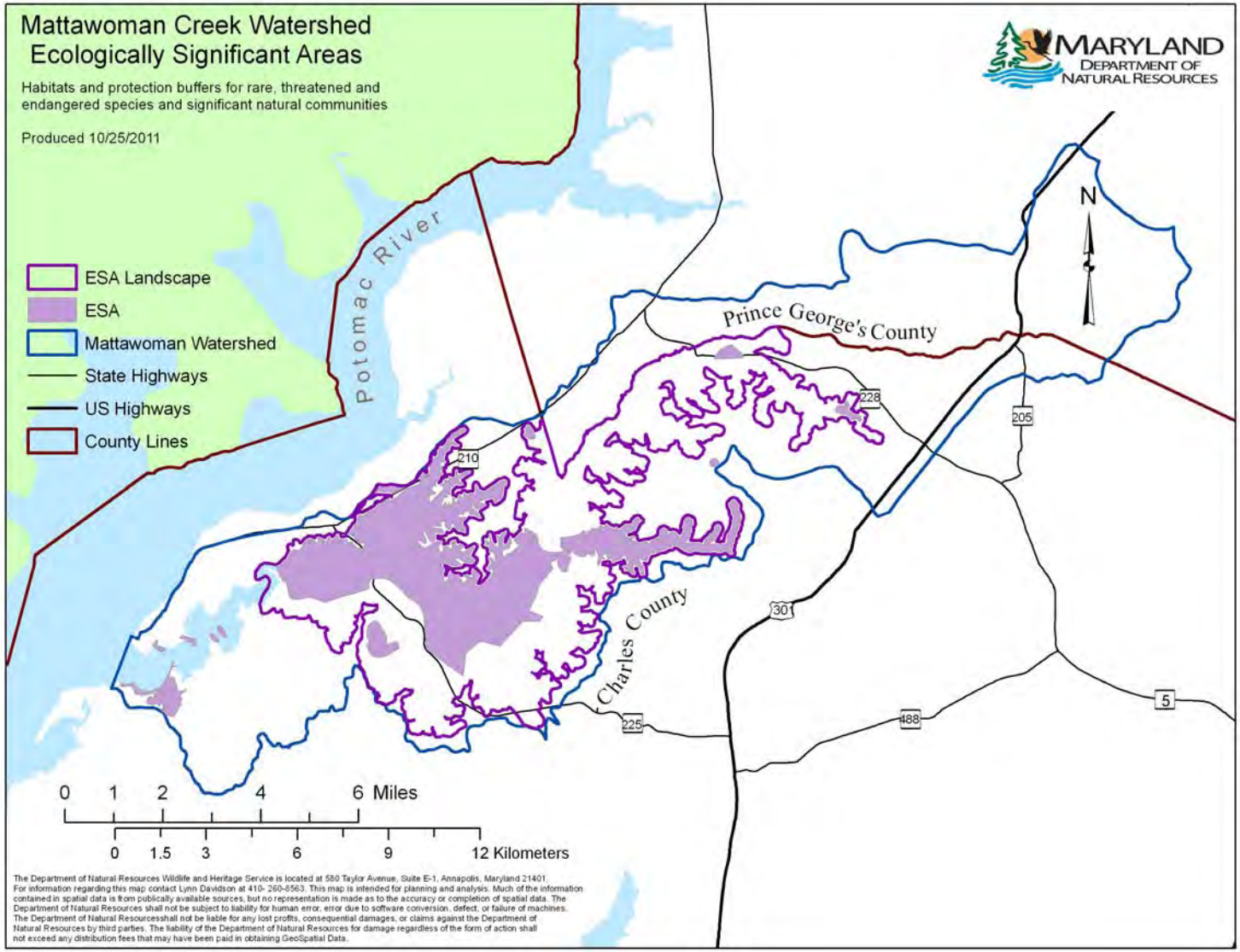

Mattawoman Creek Watershed
BioNet
Prioritized habitats for wildlife and rare species
Produced 10/25/2011
Tier 1-2 Landscape
Tier 1
Tier 2
Tier 3
Tier 4
Tier 5
Mattawoman Watershed
State Highways
US Highways
County Lines
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES
N
Potomac River
Prince George's County
Charles County
210
228
205
301
225
488
5
0 1 2 4 6 Miles
0 1.5 3 6 9 12 Kilometers
The Department of Natural Resources Wildlife and Heritage Service is located at 580 Taylor Avenue, Suite E-1, Annapolis, Maryland 21401.
For information regarding this map contact Lynn Davidson at 410- 260-8563. This map is intended for planning and analysis. Much of the information contained in spatial data is from publically available sources, but no representation is made as to the accuracy or completion of spatial data. The Department of Natural Resources shall not be subject to liability for human error, error due to software conversion, defect, or failure of machines. The Department of Natural Resourcesshall not be liable for any lost profits, consequential damages, or claims against the Department of Natural Resources by third parties. The liability of the Department of Natural Resources for damage regardless of the form of action shall not exceed any distribution fees that may have been paid in obtaining GeoSpatial Data.


Mattawoman Creek Watershed
Ecologically Significant Areas
Habitats and protection buffers for rare, threatened and endangered species and significant natural communities
Produced 10/25/2011
MARYLAND
DEPARTMENT OF NATURAL RESOURCES
ESA Landscape
ESA
Mattawoman Watershed
State Highways
US Highways
County Lines
Potomac River
Prince George's County
Charles County
N
210
228
205
301
225
488
5
0 1 2 4 6 Miles
0 1.5 3 6 9 12 Kilometers
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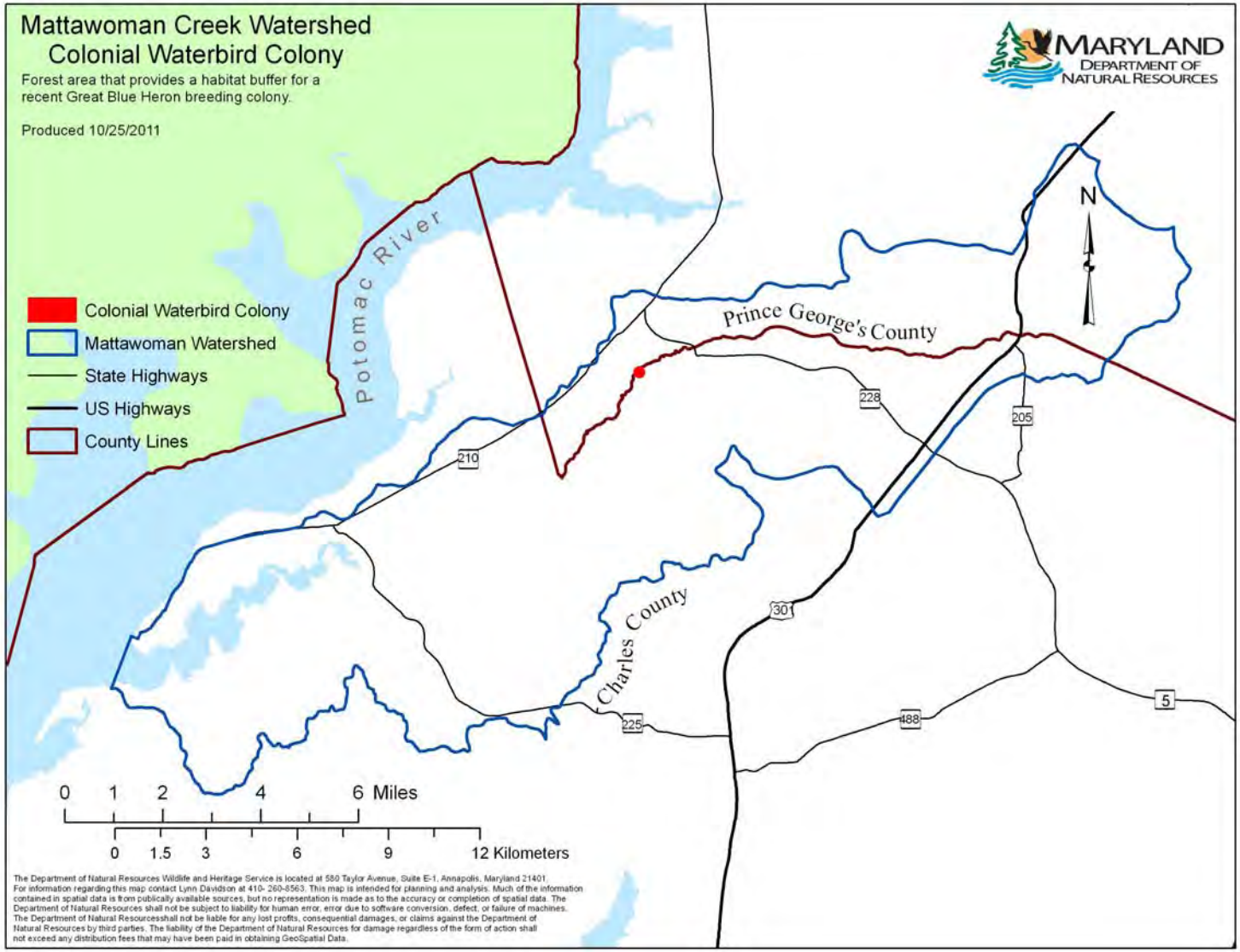
Mattawoman Creek Watershed
Colonial Waterbird Colony
Forest area that provides a habitat buffer for a recent Great Blue Heron breeding colony.
Produced 10/25/2011
MARYLAND
DEPARTMENT OF NATURAL RESOURCES
Colonial Waterbird Colony
Mattawoman Watershed
State Highways
US Highways
County Lines
Potomac River
Prince George's County
Charles County
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0 1 2 4 6 Miles
0 1.5 3 6 9 12 Kilometers
The Department of Natural Resources Wildlife and Heritage Service is located at 580 Taylor Avenue, Suite E-1, Annapolis, Maryland 21401.
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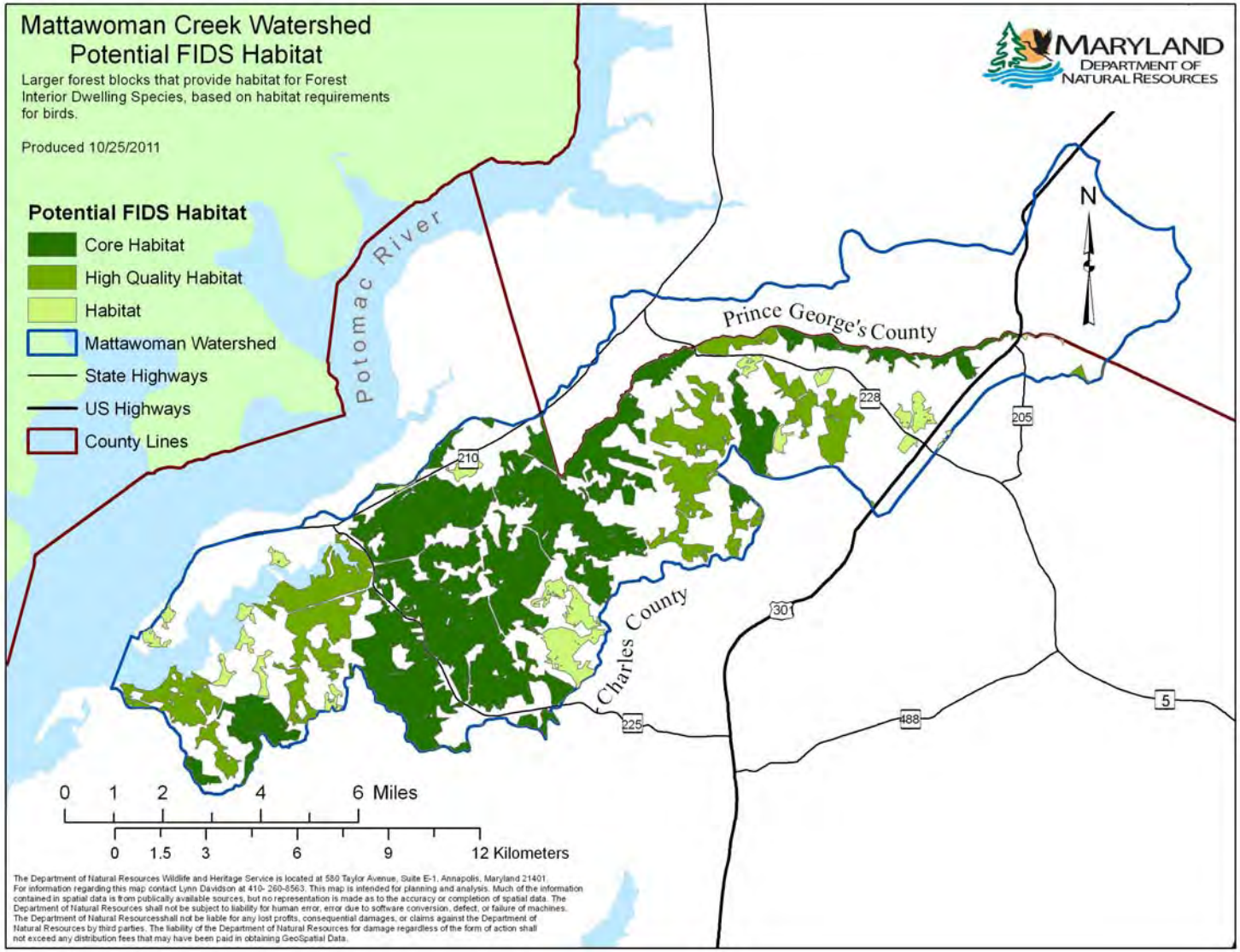
Mattawoman Creek Watershed
Potential FIDS Habitat
Larger forest blocks that provide habitat for Forest Interior Dwelling Species, based on habitat requirements for birds.
Produced 10/25/2011
Potential FIDS Habitat
Core Habitat
High Quality Habitat
Habitat
Mattawoman Watershed
State Highways
US Highways
County Lines
MARYLAND
DEPARTMENT OF NATURAL RESOURCES
N
Potomac River
Prince George's County
Charles County
210
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0 1 2 4 6 Miles
0 1.5 3 6 9 12 Kilometers
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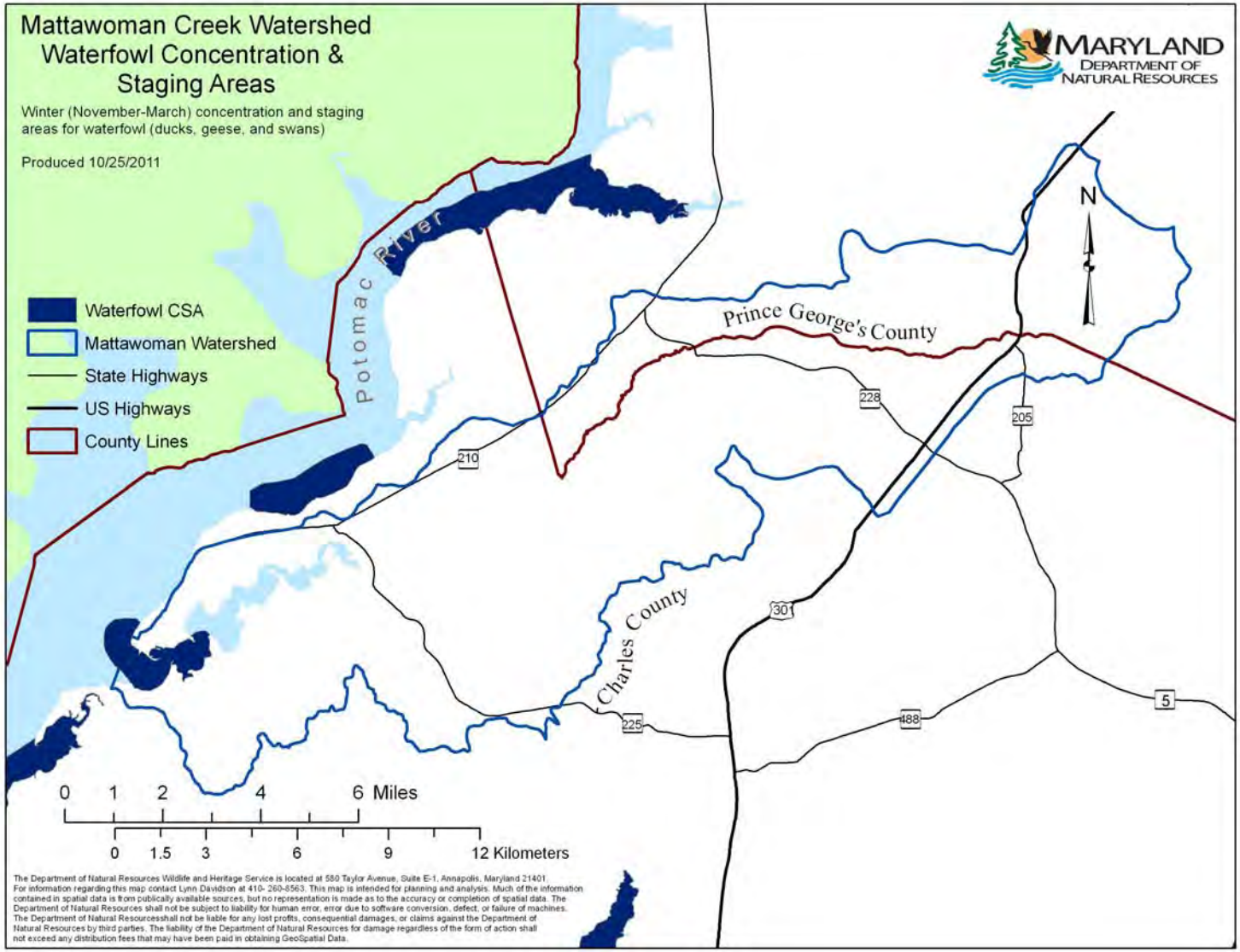
Mattawoman Creek Watershed
Waterfowl Concentration &
Staging Areas
Winter (November-March) concentration and staging areas for waterfowl (ducks, geese, and swans)
Produced 10/25/2011
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES
Waterfowl CSA
Mattawoman Watershed
State Highways
US Highways
County Lines
Potomac River
Prince George's County
Charles County
N
210
228
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0 1 2 4 6 Miles
0 1.5 3 6 9 12 Kilometers
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Section 7: Incorporating Resiliency into Water Resources Management: Strategies for a Future Climate in the Mattawoman Watershed

Recommendations to support County Planning Program Direction from the Water Resources Management for a Future Climate Section Workgroup

Marcus Griswold (MDNR)

Part 1: Summary of Watershed Characteristics, Ecological Values and Resource Protection needs

<u>The State of Water Resources in the Mattawoman Watershed</u>

The headwaters of the Mattawoman watershed lie in the most developed part of the county, including Waldorf. Between 1980 and 2000 Waldorf experienced 136% growth[1] and the county as a whole is expected to see a 45% increase in growth by 2030. Combined with steep stream valleys, many of which are greater than 15%[2], a multitude of challenges exist for managing water resources, especially stormwater. The control of runoff is especially critical given the regional importance of the watershed for ecosystem functioning. Both MDE and DNR have designated the Mattawoman as one of most important spawning and nursery areas for fish and birds in the Chesapeake Bay.[3,4] While the County has made strides in protecting natural resources, implementing stormwater retrofits, and ensuring safe water supplies, the impacts of future growth scenarios and a changing climate have the potential to limit the effectiveness of these efforts.

Climate change will mean we all have to plan for more uncertainty (Figure 1). Marylanders will need to consider the impacts of rising temperatures, more rain in the fall and winter and less in the summer, and more extreme events, on their livelihoods. Some of these changes will be positive, such as more growing days, while others negative such as more flooding, impacting infrastructure, buildings, and public health. ***Local governments*** will need to assess the performance of engineering design standards, comprehensive plans, water and sewer plans, and hazard mitigation plans in light of climate change. ***Businesses*** should consider climate in their product supply chain and operations, an area that could be affected by both local and global impacts of climate change. ***Individuals and community organizations*** should implement and advocate for improved sustainability measures and protection of their homes and ecosystems. Those communities that prepare now for expected changes will be better adapted to the expected changes and positioned to benefit from the actions that will need to be taken to prepare for climate change.

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[1] Bencala, K. 2011. Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed. 201 pp.
[2] Bencala, K. 2011. Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed. 201 pp.
[3] MDE. 2006. Prioritizing sites for wetland restoration, mitigation, and preservation in Maryland. http://www.mde.state.md.us/assets/document/wetlandswaterways/ES.pdf.
[4] Weber, T. 2003. Maryland green infrastructure assessment: A comprehensive strategy for land conservation and restoration. www.dnr.state.md.us/greenways/gi/gidoc/gidoc.html

Planners have an opportunity to create more resilient communities that will respond positively to the expected impacts of climate change. As an initial first step, communities should utilize NOAA's climate normal as a way of looking at current trends in temperature and rainfall and ensure that designs and planning take these changes into account. Opportunities exist to adopt climate change adaptation strategies into comprehensive land use plans, hazard mitigation plans, permitting programs, watershed implementation plans, natural resource restoration priorities, building codes, monitoring plans, and source water protection plans.

Part 2: Analysis and Evaluation of Current and Anticipated Threats and Stressor to Key Resources

Climate Trends in Maryland

In the past 30 years, Maryland's climate has become wetter (particularly September and January) and hotter[5], resulting in more runoff and longer heat waves. August and September of 2011 were the wettest the state has seen in 117 years[6]. July of 2010 and 2011 were the hottest on record across much of the state and 2010 had the highest number of days over 90 degrees, at 59. Hurricane Irene set new records for stream gages in some parts of Maryland. Below a major dam (Conowingo) in Maryland, flooding in 2011 was the highest it has been since the dam was built[7]. Tens of thousands of gallons of sewage spilled into rivers in Baltimore during these storms. While these events cannot currently be attributed to climate change, they align with the expected impacts of a changing climate. Additionally, a report to be released in November 2011 by the IPCC will create a more substantive link between climate change and extreme events.

Climate Change alters flooding regimes and impacts of stormwater

It is well known that development alters watershed hydrology: as land becomes covered with surfaces impervious to rain, water is converted from groundwater recharge and evapotranspiration to stormwater runoff, and as the area of impervious cover increases, so does the volume and rate of runoff. An increase in the frequency and intensity of storm events resulting from climate change will likely amplify the impacts of development on stormwater runoff, further increasing the quantity of polluted runoff into our waterways. In Maryland, climate models predict more rain in the winter and less in the summer, which is likely to result in both more flooding events and more water shortages. Current projections indicate that flooding will increase: 100-year floods will increase by 10-20 %, 10-year storms will increase by 16-30 % and annual streamflows by as much as 50%. There is a greater likelihood that more powerful rain and windstorms will strike Maryland as ocean waters warm, accompanied by higher storm surges and rainfall.[8,9]

Urban and developing areas will be particularly at risk. An increased frequency and magnitude of

[5] www.nrcc.cornell.edu/
[6] Bencala, K. 2011. Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed. 201 pp.
[7] MDE. 2006. Prioritizing sites for wetland restoration, mitigation, and preservation in Maryland. http://www.mde.state.md.us/assets/document/wetlandswaterways/ES.pdf
[8] http://www.umces.edu/sites/default/files/pdfs/global_warming_free_state_report.pdf
[9] T.E. Johnson1, J.B. Butcher, A. Parker, and C.P. Weaver. In revision. Investigating the Sensitivity of U.S. Streamflow and Water Quality to Climate Change: The U.S. EPA Global Change Research Program's "20 Watersheds" Project. Journal of Water Resources Planning and Management.

floods in urban watersheds have implications not only for flood protection and water allocation, but also for the design of treatment plants, dams, and even culverts. Urban and urbanizing regions are already under great stress as a result of development in headwater source areas as well as aging water and wastewater distribution system infrastructure. Furthermore, stormwater and flood infrastructure in many older urban areas already is undersized by comparison with the flow volumes being generated from the upstream watershed, and flooding occurs more often than would be observed in a rural watershed. Due to a high level of impervious surface from development, storm events can lead to sanitary sewer overflows in those systems where sanitary and storm sewers are combined. Though cities are under a consent decree from EPA to fix these issues, the effects of increasingly intense storms should be evaluated in light of natural resources. These spills affect raw water overflowing sewers and septic systems, submerging wells and allowing pollutants such as salt, pathogens, petroleum and other chemical products to enter the water. In Charles County alone, 25.5 million gallons of sewage have overflowed into surface water systems since 2005. According to MDE, 99% of these were attributed to precipitation events, including heavy rain and tropical storms.[10] More intense storms and higher precipitation, already seen in September and January, will increase the likelihood of these overflows, threatening recreation, ecosystem functioning, and regulatory compliance. Ultimately, compliance with the Clean Water Act could become more difficult.

Climate Impacts on Drought and Water Supply

Groundwater is the primary source of water for Charles County. Much of the water currently being withdrawn in the Coastal Plain is from deep, confined aquifers, and represents many years' worth of storage rather than the more immediate connection between rain and surface water that exists in the unconfined aquifers of the fractured rock region. Therefore, these aquifers will be less directly affected by year-to-year variations in precipitation and more affected by long-term trends toward increased irrigation withdrawal by farmers and other landowners. In one way this potentially buffers the county from short-term droughts and water supply impacts associated with climate change. However, more intense storms and flooding have the potential to contaminate groundwater supplies, which could lead to human health risk and expensive remediation or use of resources to find alternate sources. This can happen (and did happen with Isabel in 2003) when wells flood and stormwater enters the aquifer through the well. Properly constructed wells with flood-proof caps can prevent this. This is most likely to occur in areas of high infiltration and inundation of potential sources of contamination that are not typically vulnerable.

Additionally, less summer rain and lower soil moisture would increase irrigation needs in residential and agricultural areas, a trend that is already occurring. Unaccounted for irrigation withdrawals and increased withdrawals from commercial or residential properties during droughts could exacerbate declining water tables in confined aquifers. Marylanders will likely become more familiar with drought and water shortages. During the summer months, water supplies may become more stressed, as demand peaks during this time. Both agricultural and non-agricultural irrigation are likely to increase as a result of decreased rainfall and higher temperatures. Projected rising temperatures will increase rates of evaporation. The ability of the water supply to meet future demand will vary locally and is shaped by water resource availability, development and growth patterns and the degree of interconnection and collaborative management among jurisdictions.

[10] MDE Maryland Reported Sewer Overflow Database, accessed November 7, 2011.

Charles County has addressed future water supply concerns in their updated Water Resources Element, however this does not take future climate into account. The updated version could begin to account for some of these current and expected changes. However, the County also cites that surface water supplies are already too saline to utilize and that additional allocations may be needed from WSSC during emergencies. Water managers will need to identify and develop options that enhance the resilience of Maryland's water resources and maintain a flexible, adaptive management approach under conditions of uncertainty. Meeting human and ecosystem needs will require integrated, regional planning efforts across county boundaries that are based on hydrogeology, access to water resources and infrastructure condition.

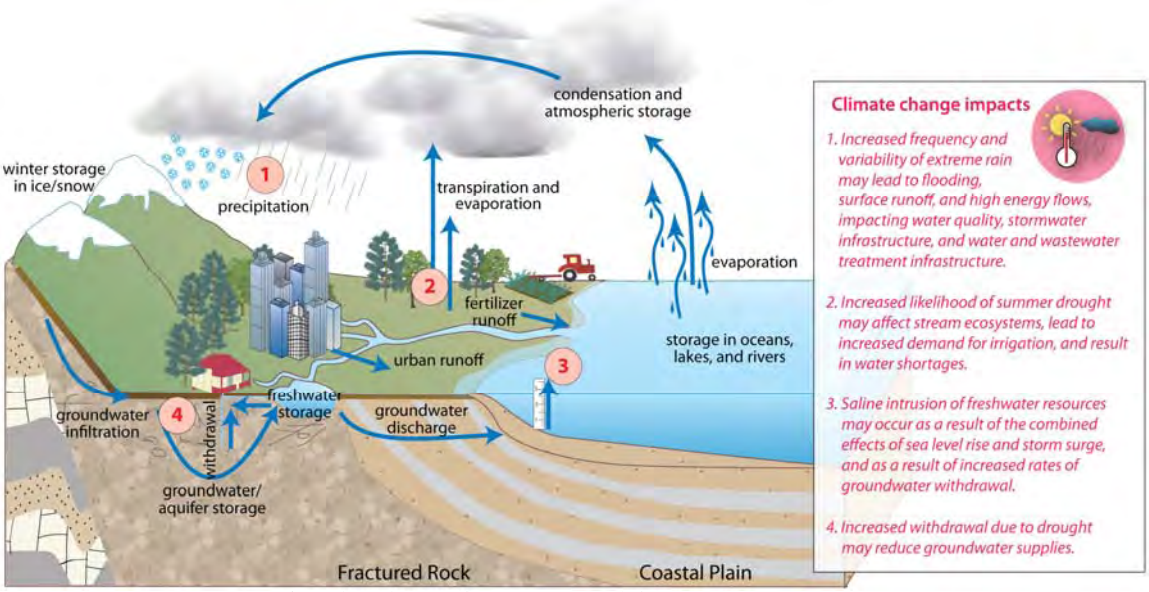

Figure 1. Expected impacts of climate change on water in Maryland. (IAN-UMCES 2011)

Part 3: Recommended Watershed Resource Protection and Enhancement Initiatives, Implementation Measures and Actions

Recommended Strategies

The following strategies, when adopted would reduce the risk of the county to future water quality degradation, and increase the resilience of the built water systems in light of the increase in fall and winter precipitation already occuring. Many of these recommendations originate from a multi-stakeholder effort to increase the resiliency of Maryland's water resources.[11]

1. **Coordination across sectors and regions to reduce potential risks associated with increasing fall and winter precipitation and lower summer precipitation.**

   Charles County depends primarily on groundwater for its drinking water supply. However, the recharge zones lie in other counties and high surface water salinity makes the treatment of surface water supplies challenging. Thus, the county receives water as needed from WSSC.[12] To address any potential water supply deficits, the county is encouraged to:

   - Integrate climate change adaptation strategies into long-range planning processes for infrastructure, housing, and transportation. Adopt a surface and aquifer watershed approach to engage multiple counties in the protection of water supplies.
   - Improve watershed planning and management to develop comprehensive strategies that rely on interjurisdictional partnerships and investments.
   - Promote consolidation and interconnections between and among water and wastewater utilities to improve system reliability. This is being promoted in the Bryan's Road district, but the County should ensure that growth from this effort will not place communities or ecosystems at risk.

2. **The first step in assessing any risk is to determine the vulnerability of the system to an increase in temperatures and fall and winter storms and a decrease in summer baseflows. The county is encouraged to assess the vulnerability of water infrastructure to impacts of climate change and utilize natural infrastructure such as wetlands, when possible, to address any deficits. For example, wetlands can be used to recharge groundwater, reduce downstream flooding, and in some cases store carbon. To move forward with this recommendation, the county is encouraged to:**

   - Conduct water supply studies that evaluate available water supplies, and the cumulative impacts of withdrawals on the resource, other users. The County should consider using climate change scenarios to model likely impacts during the development of water plans and WREs. Doing so will benefit the county by ensuring a sustained long-term water supply and reduced costs in the future for infrastructure upgrades and costs associated with flooding. Moving forward on this would involve coordination with MDE, DNR, and local universities. An initial evaluation of available climate data,

[11] Maryland Water Quality Advisory Committee. 2008. Water for Maryland's Future: What We Must Do Today. Final Report of the Advisory Committee on the Management and Protection of the State's Water Resources (Wolman Report). 52pp.
[12] Charles County Water Resources Element, 2010

including precipitation, temperature variability, and flows based on historic trends should be the first step. Communication with the state climatologist will expedite this process.

- Evaluate the costs and benefits of updating flood hazard, topographic maps, and design manuals based on future predictions, not historical data.
    - Periodically update estimates of high water profiles based on revised rainfall data.
    - This evaluation could lead to the protection of additional natural resources such as wetlands and forests to reduce the impacts of flooding.
-
- Identify at-risk stream-crossings and develop maintenance and high water contingency plans. We recommend using a 100 year flow event or a recent hurricane to assess at risk crossings.
- Given the importance of detecting changes, we recommend evaluating monitoring networks and opportunities to increase the likelihood of detecting changes in temperature, precipitation, and streamflows and develop a systematic approach to adaptation and assessment of the cumulative impacts on watersheds.
    - DNR's sentinel sites are meant to monitor changes in weather patterns and climate outside of population growth and can serve as the canaries in the coal mine for detecting climate change impacts on water resources. However, the sentinel site in the Mattawoman has lost the most cover of any sentinel site in the state between 2000 and 2009 (932 ac). [13] Efforts should be made to protect this site from additional land use change.

3. During revisions and creation of codes and regulations, examine potential barriers to adaptation and adjust for projected impacts associated with altered rainfall and temperature.

- Update codes for parking lot landscaping, perimeter site buffering, and/or open space preservation to incorporate tree canopy development, native species, xeriscaping, and integrated stormwater management.
- Incorporate energy efficiency and green infrastructure into building design standards.
- Evaluate floodplain maps in regards to sea level rise and increasing storm intensity.
- Engage in comprehensive hazards management planning and include climate change adaptation in hazards management mitigation plans, land use planning, natural resource conservation plans, development review, and community visioning.

4. Protect natural resources and drinking water sources

- Encourage comprehensive watershed management strategies that integrate water resource objectives with economic, environmental, cultural, and social goals.
    - Utilize the Water Resources Registry (WRR)[14] to prioritize sites that maintain natural flow attenuation and water quality and to restore sites with compromised

[13] Bencala, K. 2011. Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed. 201 pp.
[14] Bencala, K. 2011. Integrating Priorities and Achieving a Sustainable Watershed Using the Watershed Resources Registry in the Mattawoman Creek Watershed. 201 pp.

infrastructure in light of protecting high quality streams and waterways.[15] See the above references for an example of this work in Charles county and a selection of sites.
    - Protection of the stream valley as previously recommended by the Army Corps of Engineers would be an appropriate tool to reduce impacts from more intense storms.
- Implement measures to protect vulnerable drinking water sources, including implementation of source water assessments.[16] If during the development of the WRE, surface water sources are identified, the protection and conservation of upstream forests should be evaluated. Otherwise, source water protection is limited to identifying and properly abandoning any unused wells, and insuring that wells are properly constructed and resistant to flooding and/or storm damage to prevent any water from the land surface from entering the aquifers. During this process, future alternate sources of water supplies should be identified and contributing watersheds protected.
- Preserve and manage forested and vegetative areas, especially during construction
    - Evaluate the potential of a staged development approach on new developments or redevelopment by only disturbing a portion of the site at any point in time. Staging the development will limit the impact of the impacts, by reducing the amount of sediment being disturbed at any one point in time
- Restrict development and redevelopment in areas prone to significant risk from climate change to minimize future loss of human life and impacts to property. These include 500 year floodplains, areas affected by sea level rise[17], and roads that experience significant flooding. Enhance adaptive capacity and human and ecological benefits in these areas through activities such as floodplain restoration, groundwater recharge, and flood-compatible agriculture.
- Identify areas in watersheds near the impervious surface thresholds recommended by the DNR in Section 1: Recommended Land Use and Growth Management Initiatives to target restoration efforts. Impervious surface thresholds will become lower as the impacts of climate change are seen. These watersheds should receive priority funding to protect floodplains, remove impervious surfaces, reduce peak flows, and regulate surface and water temperatures.
- Minimize water runoff by increasing the construction of retention structures on existing properties
    - The design of green buildings and landscapes can improve the infiltration of water to recharge groundwater and can minimize runoff that results in flooding.
    - Allow green roofs and green walls to qualify as open space following environmental review.
- Restore and protect headwater streams and ephemeral habitats
    - Headwater streams and vernal pools have been identified as some of the most vulnerable habitats in a changing climate. Efforts should be made to develop standardized field protocol and mapping efforts for these resources and to protect them through the comprehensive planning process and other regulations.

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[15] The WRR is not suited to locate opportunities for ESD because they are small scale, but could assist with larger areas for directing sheetflow to conservation areas, protecting natural resources, and constructing veg swales.
[16] http://cfpub.epa.gov/safewater/sourcewater/sourcewater.cfm?action=Publications&view=filter&document_type_id=103
[17] http://www.dnr.state.md.us/ccp/coastalatlas/index.asp

- Small streams can be reestablished by daylighting the channels in appropriate situations to increase the infiltration and recharge of groundwater while slowing the downstream transport of water and dissolved nutrients from nonpoint sources.

- Restore and prevent the losses of wetlands to increase adaptive capacity of communities to resist the impacts of climate change. Wetlands are an essential tool for managing high water, providing flood storage capacity for overflowing streams and rivers, and precluding runoff that would occur if low-lying areas were to be developed. Designate these areas as flood storage areas on development and landuse maps.

5. Improve the resilience of water utilities

Charles County currently depends on groundwater for a majority of its supply, but has access to 1.5 MGD from WSSC with an expressed interest in seeking 5 MGD.[18] To build resilience into the water supply, the County is encouraged to:

- Diversify water supplies and identify alternative water sources. We realize the county is moving forward on this effort and encourage the work to evaluate potential impacts of climate change.
- Increase drinking water system storage to ensure that supplies are sufficient during extended dry periods
- Evaluate the risk of current and planned infrastructure (wastewater and drinking water treatment plants, pipes, culverts) to flooding and incorporate climate change criteria and design standards into engineering codes and standards.
- Upgrade buildings, distribution systems, and other infrastructure to withstand flooding events.
- Identify backup and alternative water sources
- Develop and implement comprehensive emergency response plans for utilities and wastewater treatment plants.

6. Reduce impacts of heat on human health and aquatic ecosystems

- Designate special heat reduction districts where data indicate that the heating of surface water temperatures may impact sensitive species. Implement design and performance standards that reduce heat and promote energy efficiency, including green/cool roofs and walls and tree plantings.
- Encourage green landscaping components, such as a set % canopy cover over parking lots.

7. Manage water demand

Average water consumption per dwelling in the county is 208 GPD and wastewater production is 250 GPD. This number includes inefficiencies in infrastructure and actual use as calculated by Charles County may be ~ 180 gpd per household.[19] Much of the wastewater

[18] Charles County Water Resources Element, 2010
[19] Charles County Water Resources Element, 2010

short circuits the watershed and is discharged at the mouth, meaning the County loses access to water it could potentially reuse. Ultimately water conservation and reuse can increase water savings by 10-20 %. Implementing water conservation and reuse as part of a restoration strategy could buffer the potential impacts of droughts and changes in rainfall. Incorporating water conservation through the following strategies will maintain resiliency and increase water storage in the watershed.

- Adaptation approaches for water should address water conservation and reuse[20,21], both to reduce water flow through sewers and to reduce energy consumption and the impacts of drought.
- Encourage water conservation for residential and commercial users in codes and ordinances
- Identify and implement ways to reduce industrial and agricultural water use and encourage accountability for water used through irrigation.
- Use pricing strategies to decrease demand, such as incentives for water use below a baseline standard and a sliding scale fee system.
- Promote beneficial reuse of reclaimed wastewater.
- Implement comprehensive programs to reduce water leaks through detection, repair, and replacement of inadequate distribution piping. Based on the 2010 Water Resources Element, 20-30 GPD per dwelling could be recouped in the County through this strategy.
- Encourage onsite water reuse.
- Broaden the capacity for rainwater harvesting as a supplement for local uses in watersheds and encourage the release during droughts to enhance baseflow in streams and waterways.

8. Take climate change into account during infrastructure upgrades and repairs

Incorporating resiliency into water infrastructure has the potential to save the County a large expense in the future, as increases in flooding and drought can overwhelm pipes. Incorporating climate impacts into infrastructure repairs can reduce long-term capital costs and prepare the County for impacts from population growth and changes in climate that the State is already experiencing.

- Develop post-disaster redevelopment plans that discourage the reconstruction of buildings and infrastructure in hazard zones following climate and weather related disasters.
- Upgrade urban storm drainage systems based on climate predictions.
    - Manage systems to minimize high flow volume impacts during high storm flows.
    - Assess impacts of high flow events on sewage treatment plant process viability, and evaluate impacts of bypassing high storm flows around the treatment plant's biological processes.
    - Flood-proof vulnerable buildings and infrastructure first in the 100 year floodplain and manage for the 500 year floodplain.

[20] http://www.mde.state.md.us/programs/Water/Water_Supply/Pages/programs/waterprograms/water_supply/home/water_reuse_info.aspx

[21] Howard County has adopted National Standard Plumbing Code 2009 edition Appendix G to allow for reuse of gray water

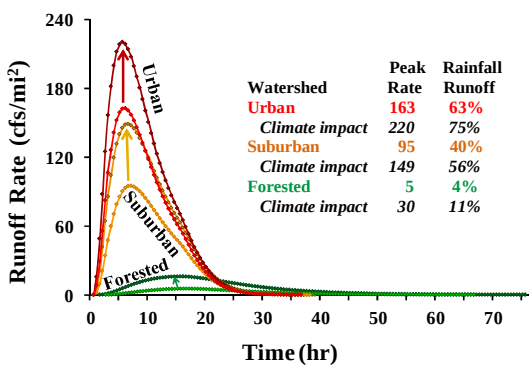
- Build capacity for drinking water quality emergency assessment and response.

- Reduce impacts on transportation infrastructure in light of altered precipitation and temperature regimes
  - Increase infiltration along all roads at appropriate locations and in medians during any construction process to reduce flooding but to also maintain structural integrity of the road.
  - Evaluate flood risk along roads and explore opportunities to increase infiltration.
  - Build roads and sidewalks from porous materials to adapt to more frequent flooding.
  - Consider sizing culverts to include a range of expected impacts of climate change on flows to reduce risks of upstream flooding and loss in built infrastructure. Efforts could incorporate recent climate data as well as account for potential increases in rainfall (e.g. include an additional 10-20% increase in rainfall in models).

9. Incorporate climate change into stormwater design principles and BMPs:

Climate change will reduce the ability to manage stormwater using current infrastructure and design systems. Based on anticipated impacts of climate change, it is reasonable to assume that pipe diameters and storage volumes will need to increase. However, other externalities and non- climate related issues must be considered as well. For example, aging infrastructure, population growth, and changing public perceptions and expectations may all impact stormwater management to an extent equal or greater than climate change.

Perhaps of greatest concern to stormwater designers is the change in rainfall intensity. Rain will probably come in more intense bursts, and changes in the peak intensity of rainfall can impact the design and storage characteristics of stormwater practices. In the comprehensive planning process, development should be reevaluated from a climate change perspective. Modeling in other eastern states suggests that climate will make runoff from suburban systems look like urban and dramatically increase runoff from urban systems.



- Examine existing design criteria and methodology in light of potential climate change and incorporate climate change as one of several uncertainties.
- Incorporate adaptive planning and design, providing some overcapacity in at risk areas.
- Establish trigger points and sliding scales for reevaluation or design alteration.
- Encourage consultants to design for more intense storms, anticipating that the trend in Maryland is toward wetter periods in September and January and lower summer baseflows. Evaluate the impacts of rainfall intensity on bypass of stormwater BMPs and facilities and the expected impacts on TMDLs and flooding.

- The Stormwater Management Act of 2007 requires ESD to maximum extent practicable. The Act states that if potentially negative downstream impacts are likely to occur, runoff from events larger than 10 year storms may need to be addressed. In addition, the County should address climate impacts in planning for downstream impacts based on the best available climate science at the time of evaluation. DNR is currently working with the University of Maryland to obtain higher resolution information and will communicate with the counties as new information becomes available.
- Examine recommended BMPs for their sensitivity to climate change, their adaptation potential, and their longevity. In general, the following practices are sensitive to climate change and when implemented will increase adaptive capacity, however the county should evaluate its own practices that may be sensitive to more intense precipitation, temperature changes, or storms. This is a preliminary list, for instance urban areas are generally more sensitive to more intense precipitation. The state is in the process of assessing existing best management practices that increase a community's resiliency to climate changes:

  POTWs Standards for Discharge Permits
  Stormwater Management - Filtering Practices
  Stormwater Management - Infiltration Practices
  Urban Stream Restoration
  Urban Riparian Tree Buffers

- Site designs should, at a minimum, use conservative assumptions when designing a conveyance system and should build a certain amount of additional freeboard into drainage and overland flow path designs. The core of this should involve implementing MDE's model floodplain ordinance.[22]
- Evaluate impacts of increased rainfall intensity on conversion of sheetflow to concentrated flow.
- Modify stormwater conveyance systems to be relative to sea level, considering also that Maryland is expected to experience at least 2 feet of sea level rise by 2050.
- View stormwater as a resource to investigate reuse opportunities

Additional Resources and References:

Maryland's Climate Change Website (www.green.maryland.gov/climate.html)

NE Regional Climate Center (www.nrcc.cornell.edu/)

Climate Resilience Evaluation and Awareness Tool
(http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm)

Climate Ready Water Utilities Toobox
(http://www.epa.gov/safewater/watersecurity/climate/toolbox.html)

[22]http://www.mde.state.md.us/programs/Water/FloodHazardMitigation/FloodPlainPermitting/Documents/www.mde.state.md.us/assets/document/flood_Hazards/RevOrdinance2010.pdf

BASINS Climate Assessment Tool (http://water.epa.gov/scitech/datait/models/basins/)

ICLEI Adaptation Tool (http://www.icleiusa.org/tools/adapt/)

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Section 8: Stormwater Management

Recommendations to support County Planning Program Direction from the Stormwater Management Section Workgroup

Ken Yetman (MDNR), Greg Golden (MDNR), Marcus Griswold (MDNR), Kevin Magerr (USEPA), Jim George (MDE), Donna Buscemi (SHA), Heather Lowe (SHA)

Part 1: Summary of Watershed Characteristics, Ecological Values and Resource Protection needs

Residential and commercial development not only reduces the amount of forest and agricultural land in a watershed, the runoff from these areas can have significant negative impacts on local streams, rivers and ultimately the Chesapeake Bay. Stormwater management practices are designed to reduce those impacts and protect downstream aquatic resources. While it is theoretically possible to install a sufficient number of stormwater practice so that all the direct and indirect negative impacts associated with the runoff are addressed, in practice it can be difficult to design a system that replicates the natural hydrology of woods in good condition.

In 2003, the Army Corp of Engineers developed a computer model to assess present and future pollution loading to Mattawoman Creek. In their report entitled, "Mattawoman Creek Watershed Management Plan," they had three specific recommendations:

1) The stream valley should be delineated and protected, through zoning category changes, acquisition or ordinance changes. This area could be used to develop a greenway or park system designed to connect the Mattawoman estuary to the Waldorf Central Business District Zone.
2) Site planning on future development should implement low impact design techniques, minimizing the amount of impervious surfaces and promoting stormwater disconnects. New housing developments should emphasize many small-scale stormwater management practices, rather than one single stormwater management pond and emphasize tree cover as a main stormwater management component.
3) Existing development should be examined for stormwater retrofit opportunities, including the retrofitting of existing commercial sites and housing developments in Waldorf. The technology exists to increase the stormwater management within small-scale housing and commercial areas. These techniques should be encouraged through ordinances, public workshops and redevelopment.

It is important to note that the Army Corp of Engineers model did indicate that implementing the three above recommendation would reduce the impact of new and presently developed areas on aquatic resources in Mattawoman Creek, but that they would not eliminate them. Specifically the Army Corp of Engineers report said, "Realistically, any development in the watershed will have negative impacts on the watershed. If this development is carefully coordinated and planned within the landscape of the Mattawoman Watershed it will be possible to mitigate these negative impacts and protect the Mattawoman. It cannot, however, be emphasized enough that impacts on hydrology and pollutant loading to stream systems should be minimized to the maximum extent feasible."

Part 2: Recommended Principles and Policies to Guide Watershed Protection and Restoration

Stormwater Management for New Development

The COE plan recommended that future development limit the amount of impervious surfaces and that low impact development technique be used to manage stormwater runoff. Since the COE plan was developed, there has been a major revision in Maryland's Stormwater Management regulations. The new regulations require that new development use Environmental Site Design to the Maximum Extent Practicable with the goal of replicating natural hydrology for woods in good condition. These are some of the most progressive stormwater regulations in the nation and if vigorously enforced could help to reduce the negative impacts of new development on aquatic resources in Mattawoman Creek. The new Maryland regulations went into effect in May of 2009 and have subsequently been adopted by Charles County. The regulation does allow for the grandfathering of projects that were in the review process prior to the new stormwater regulations taking effect. At present it is unclear how many projects could be grandfather under this provision of the law. Any grandfathered project will still need to meet the 2000 Maryland Stormwater Design Manual and regulations. When the 2000 Design Manual was introduced it was considered State of the Art and grandfathered projects will still need to meet requirements for water quality treatment, channel protection and groundwater recharge. The new 2009 Design Manual expands on the techniques and credits first introduced in 2000. It is suggested that grandfathered projects that have not yet been started should now be revised to incorporate the new 2009 standards.

Recommendation: Grandfathering is part of the minimum standards of the new regulations. When grandfathering is allowed, every effort should be made to improve the stormwater management to get as close to the new standards as possible.

Stormwater Management For Redevelopment

In addition to mandating state of the art stormwater management on new development, the new Maryland stormwater regulation also requires that redevelopment projects also incorporate some stormwater management. The standard for redevelopment projects is to use Environmental Site Design to the Maximum Extent Practicable to provide water quality treatment for at least 50 percent of the existing impervious area within the limit of disturbance. In the Mattawoman Creek Watershed, this means that the development project will be required to manage the first ½ inch of runoff. While this is a lower standard than the amount of stormwater management required on new development, it will provide some management in areas that presently have none. While some stormwater management is better than none, both Montgomery County and Prince George's County have enacted stormwater management ordinances that require a greater amount of stormwater management than the State minimum redevelopment management requirements, which may be an approach that Charles County could also adopt.

Recommendation: Charles County should evaluate opportunities to create partnerships and/or incentives to developers to provide greater stormwater management on redevelopment projects.

Stormwater Management for Existing Development

The third and final recommendation of the COE in their 2003 Mattawoman Watershed Plan was to look for opportunities to install stormwater management devices to manage the runoff from existing developments. Over the past 25 years, the 6 jurisdictions that make up the Chesapeake Bay watershed have perused a voluntary approach to restoring the Bay's water quality. While progress has been made, much more work still needs to be done. In recent years, Maryland and EPA have abandoned the voluntary approach and developed a more regulatory one. Charles County is presently negotiating with the State the terms of their new Municipal Separate Storm Sewer Systems (MS4) permit. It is anticipated that the County's new MS4 permit will follow the recent one issued to Montgomery County and will have a requirement to retrofit 20 % of the unmanaged impervious areas over a 5 year period. This is a very ambitious requirement and will require a significant increase in the County's retrofit activities.

Recommendation: Increase stormwater retrofit implementation to meet the new MS4 permit requirements and to be in alignment with any Watershed Implementation Plan TMDL.

General Recommendation:
In addition to the recommendations listed above that are linked to different phases of development, stormwater can be viewed as a resource to investigate reuse opportunities.

Funding For Stormwater Retrofits

At present Charles County funds its stormwater program from two main sources. The first is an "Environmental Service Fee" which is paid by all improved properties in the County. The second source of funding comes from a "Recordation Fee" that is assessed when properties are subdivided and new lots are recorded. In the last fiscal year these two funding sources generated $314,456 in revenue. Charles County issues bond base on this dedicated funding stream and its Capital Improvement Program budget for stormwater retrofits was $2,409,000 for fiscal year 2011. While the County's funding sources will fund several stormwater retrofit projects per year, the County will need to substantially increase in both funding and implementation to meet the 20% retrofit requirement that is anticipated in their new MS4 permit. One option that the County should consider is the establishment of a Stormwater Utility Fee. A Stormwater Utility Fee has several advantages including: 1) Allows you to tax the problem and can be structured so that the more stormwater that is generated from a property the more the a property owner will have to pay; 2) Since it is a fee and not a tax it can be paid by Federal and State properties; and 3) The fee can be structured so that if a property owners reduces the amount untreated stormwater coming from their property they will pay a lower fee.

***Recommendation*:** Develop a Stormwater Utility Fee or other dedicated funding source that will adequately fund the costly stormwater management program and meet the requirement of future MS4 permits.

Sediment Control

Another potential pollution source associated with new and redevelopment projects are sediment pollution. When land is cleared and the soil is exposed to the elements, the runoff from construction sites can carry sediment to local water bodies. Major changes in sediment supply to a stream can have significant impacts on both stream geomorphology and aquatic resources. It is very important that land clearing for new developments be staged and that a minimum amount of land is cleared and exposed to the elements at any time. Once an area has been cleared it should be stabilized quickly and all appropriate sediment control measures taken.

In Charles County, sediment control plans are reviewed and approved by the Charles Soil Conservation District. The County is responsible for enforcement of the approved plans. Maryland is presently working on revising its Erosion and Sediment Control Regulations and the Maryland Standards and Specifications for Soil Erosion and Sediment Control on construction projects. When this process is complete, sediment control methodologies to minimize the size and duration of exposed soils will be required on all future development projects.

Recommendation: State of the art sediment control technologies and methods should be required on all new and redevelopment projects in the Mattawoman Creek Watershed and should be in alignment with EPA's regulation for Construction Activity. It is important that the County have a robust sediment enforcement program that is adequately funded.

Stable Stormwater Conveyance Systems

Even when all construction activities are completed and the soils are stabilized, sediment pollution problems can persist. This is because changes in the stream's runoff hydrograph can cause streams to readjust and erode their banks. It is important to not only to control the rate that runoff is released from an area, but also to insure that the drainage system that is receiving the runoff is stable and able to accommodate it. When problems do occur, they should be dealt with quickly to minimize any adverse impacts.

Recommendation: The County should consider performing surveys of all the streams and drainage ways in the Mattawoman Creek Watershed to identify restoration opportunities associated with sediment pollution and erosion issues. Methods for doing such a survey include, but are not limited to, DNR's Stream Corridor Assessment Survey and the Center for Watershed Protection's Unified Stream Assessment Survey.

Part 3: Recommended Watershed Resource Protection and Enhancement Initiatives, Implementation Measures and Actions

Partnership Opportunities with Maryland State Highway Administration (SHA)

According to Maryland's Assessment and Scenario Tool for WIP development, SHA manages 843 acres of impervious surfaces and 1,792 acres of pervious surfaces. SHA's WIP requirements are to treat 30% of pre-1985 impervious surfaces by 2017 and SHA anticipates another 20% requirement to be treated by 2020. SHA's edge of stream loads in Charles County are as follows:

- TN (Total Nitrogen): 2,895 LBS/Yr reduction
- TP (Phosphorus): 619 LBS/Yr reduction
- TSS (Total Suspended Sediments): 106,773 LBS/Yr reduction

Installations of bioswales are planned within medians of three dualized highway corridors, MD 228, MD 210 and US 301. Portions of these project areas are within the Mattawoman watershed. These facilities will be designed to treat currently untreated SHA pavement to reduce pollutant loads. Since SHA has not initiated the design yet, SHA can not provide the total area of treatment or pollutant load reduction, but it will be available in the near future.

Approximately 32 acres of tree plantings were installed as part of SHA/DNR's Million Tree Initiative in 2011 within the Mattawoman Creek 8-digit watershed. SHA plans to get TMDL credit for these trees as part of its 2013 Milestone. Also approximately 8 acres of tree plantings has previously been planted (1 acre in 2007 and 7 acres in 2009) that SHA plans to take credit for.

Forest and Wetland Restoration Opportunities

Currently, SHA's Office of Environmental Design (OED) is reviewing potential tree planting sites within all of the MS4 counties, including Charles County, trying to identify extra or excess SHA owned land that may be viable for plantings. One parcel has been identified within the Mattawoman Creek watershed. It appears that there are approximately 50 acres that could potentially be planted on that site; however, SHA still needs to determine if this is a viable site based on environmental and real estate reviews. SHA's next steps will be to look for partners for additional tree plantings on public land in all the MS4 counties.

Regarding wetlands, SHA is waiting to conduct any site searches until they have a better understanding of the exact efficiency SHA can take credit for and the cost-benefit of this strategy. SHA will likely pursue this as a strategy in the future but nothing is planned at this point.

Based on some initial calculations, SHA is still far from meeting its targets in Charles County. According to some recent **preliminary** calculations, SHA is only about 7% to the Nitrogen Target, 9% to the Phosphorus Target and 49% to the Sediment Target in Charles County. SHA will most likely focus future efforts within Charles County, although this is true about most of the MS4 Counties at this time since it is so early in the process.

Addendum 1: Summary of all recommendations for the Mattawoman Creek Watershed

Section 1: Land Use and Growth Management

- Clarify Mattawoman protection policies and identify proposed strategies and actions to implement selected policies and objectives in the Comprehensive Plan update currently being prepared.

- Implement the recommendation to provide protection to the US Army Corps of Engineers designated Mattawoman Creek Stream Valley as identified in the 2003 Mattawoman Watershed Management Plan.

- Strengthen protection measures in the County's existing Resource Protection Zone (RPZ) overlay district

- Remove portions of the Mattawoman Watershed from the Development Service District including all lands designated as Deferred Development District.

- Downzone lands in the Mattawoman Watershed designated Rural Conservation to a maximum density of one residential unit per 10 acres in conjunction with designation as a TDR program sending area allocating rights that can be transferred or purchased and retired.

- Focus development within the Development Service District away from Mattawoman Resources. This includes building on past efforts to prepare specific Plans for within the Waldorf and Bryans Road areas that identify "core" and "activity center" areas to concentrate development. The notion here is to provide additional areas for smarter growth patterns at higher densities in certain locations to relieve pressure on other areas that are dominated by more sensitive resources in the Mattawoman.

- Provide greater incentives to redevelop/revitalize existing developed areas to absorb growth (Waldorf) to reduce development pressure on resource sensitive lands.

- Require development in Activity Centers or Town Centers to achieve Minimum Densities to assure efficient use of land in appropriate designated growth areas.

- Mandate cluster forms of development to protect resources in the Rural Conservation-Deferred (RC-D), Rural Conservation (RC) and Low Density Residential (RL) zone districts.

- Target portions of the watershed as a Rural Legacy Area and/or for easement acquisition.

Section 1: Land Use and Growth Management continued

- Re-evaluate Transferable Development Right (TDR) program opportunities for additional applications.

- Consider creation of a TDR Bank to enhance TDR program function and use.

- Modify TDR program provisions that allow re-purchase and transfer of development rights for use in sending areas. This condition creates unpredictablility and impermanence, which in turn results in some degree of loss of public trust given the uncertainty of the results that may counter to their expectations. This condition also makes difficult any County efforts to target long term planning for preservation of continguous blocks of farmland and forest land.

- Permit and possibly require use of TDR's for Commercial Development.

- Implement recommendations established by the US Army Corps of Engineers 2003 Mattawoman Creek Watershed Management Plan to implement low impact design techniques to minimizing the amount of impervious surfaces and promoting stormwater disconnects, and examining existing developments for stormwater retrofit opportunities.

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- Re-evaluate and revise lot coverage and impervious surface limits and standards established in the County Zoning Ordinance.

- Establish a County Purchase of Development Rights Program to supplement the TDR options and create a dedicated funding source to insure its successful operation over time.

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Section 2: Fisheries Resources

- Adopt the low development, natural resource protection scenario of the comprehensive plan (scenario 1 of the three scenarios outlined in late July 2011). This scenario is the option that is likely to impact fisheries and fish habitat the least.

- Innovative stormwater, flow, and sediment management will need to be applied to the watershed to reduce stream bank erosion and stream degradation associated with new and old development.

- Management and control of erosion from construction must be improved and vigorously enforced. Construction contributes a disproportionate load of sediment for the portion of the watershed it occupies.

- Additional measures such as wetland creation, water quality forestry, and expanded riparian buffers should be applied to further control erosion, manage flow, and improve water quality.

- Stream revitalization measures could follow if flow and sediment management succeeds.

- Environmental management measures should be paired with monitoring to evaluate success. Very little is known about how stormwater management impacts fish habitat and fisheries.

- De-icing of roads should minimize salt use and use alternative de-icers that are less toxic to aquatic organisms.

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Section 3: Non-Tidal Streams of the Mattawoman Creek Watersheds

- The County should continue to protect undeveloped areas of the Mattawoman Watershed from alteration, development and increases in impervious surface. Since restoring many aspects of a stream's physical and chemical condition can be challenging and expensive (Palmer et al. 2005), protecting streams from alteration is the most ecologically and economically cost effective alternative to attempting to restore stream health once it has been compromised (Stranko et al. 2011).

- Utilize the locations where stream dwelling rare, threatened and endangered species are present as the priority locations for the greatest levels of protection from development. As noted earlier in this section, stream dwelling rare, threatened, and endangered species tend to be more sensitive to altered conditions compared to other species (Stranko et al. 2010). The distribution of these imperiled species in the Mattawoman Creek watershed is consistent with this pattern. The eight sites where the MBSS found rare, threatened, or endangered fish or bivalves all had less than 22% urban land cover, less than 7% impervious land cover, more than 58% forested land cover, and pH values above 6.0.

- The County should recognize that certain highly sensitive species can be affected by even lower levels of urban and impervious land cover (under 7%) (Angermeier et al. 1995; Stranko et al. 2008; King et al. 2011), and target key watershed locations to achieve such higher levels of land protection to protect aquatic resources.

- The County should prioritize protection over restoration and strictly limit or control encroachment of additional urbanization within the watershed since several recent scientific investigations have also shown that the detrimental effects of urbanization are extremely difficult (maybe impossible) to reverse given current restoration practices and performance.

- Management recommendations for protection, restoration and stabilization for specific Mattawoman Creek streams, using DNR's Triage Systems Approach methodology or other similar approaches, should be considered by the County to prioritize the use of limited restoration and protection funding in order to achieve the maximum benefit to stream health (Section 3, Appendix A).

Section 4: Wetlands, Coastal Resources and Coastal Climate Change

Recommended Principles and Policies to Guide Watershed Protection and Restoration

- Continue to fully enforce existing regulations and policies
- Where possible, use 300-foot vegetated buffers along shorelines, streams and wetland and hydric soils
- Where feasible, implement living shoreline practices for shore erosion control management that is now required
- Protect forested and farmed land from fragmentation due to conversion to more intensive development
- Encourage and implement cluster development for new residential development in the watershed to protect open space and natural resources
- Pre-identify mitigation sites as part of capital improvement planning and include acquisition and construction costs in capital budgets
- Maintain the connectivity of existing natural lands as well as areas that may support wetland migration opportunities for inland retreat of our coastal and nearshore wetlands
- For growth and annexation areas, plan development to avoid wetland and stream impacts, and maintain contiguous green corridors
- Consider site design over multiple parcels to maintain contiguous wetland and stream corridors with minimum fragmentation from roads, buildings, or other structures
- Provide consideration of stream valleys as part of parcel development negotiations
- Protect high priority wetland areas to maintain natural protection for public and private infrastructure
- Where possible protect wetland migration areas from impervious surfaces, development and infrastructure that would impede the movement of coastal wetlands inland to increase the adaptability of coastal wetlands to sea level rise

Section 4: Wetlands, Coastal Resources and Coastal Climate Change continued

MS-4, Shoreline and Wetland Issues

- Related to the County's MS-4 plans and projects: update watershed restoration plans and goals for the Mattawoman Creek watershed in the County's MS-4 documents; incorporate stormwater management techniques in new development and retrofits for existing areas into the MS-4 plan; and include stream system restoration, rehabilitation and stabilization plans into MS-4 plans and capital projects.

- Identify the range and types of recommended restoration projects that may be considered to protect existing wetlands and floodplains.

- Adopt updated floodplain ordinances, including increased freeboard standards.

- Apply for shoreline restoration and living shoreline project implementation funding through the Chesapeake Bay Trust RFP process.

- Pursue opportunities to work with new partners and/or take better advantage of different funding sources to support implementation of recommended projects and activities.

- Take full advantage of pre-application and guidance support at the Maryland Department of the Environment for proposed activities in wetlands, waterways and floodplains.

- Where feasible, use 300-foot vegetated buffers along shorelines, streams and wetlands and hydric soils.

- Review overlap between tidal fresh wetlands and proposed zoning designations. As tidal fresh wetlands are difficult, if not impossible, to restore consideration should be given to avoid degradation of these wetland types wherever possible.

- Review proposed growth and resource areas to plan to increase utilization of existing floodplain wetland functions to take advantage of natural riverine hydrology to prevent the need for future restoration.

- Incorporate language about nontidal wetlands of special State concern that are in the planning, growth, or annexation areas into the comprehensive plan.

- Protect nontidal Wetlands of Special State Concern and their expanded 300 foot buffers.

- Restore wetlands associated with streams within the Chapman State Park and Governor Parris N. Glendening Natural Environment Area (DNR, 2003a).

- Protect and restore wetlands and streams within the headwaters, working with Prince George's County as necessary to accomplish this objective.

Section 4: Wetlands, Coastal Resources and Coastal Climate Change continued

- Protect tidal wetlands used as reference sites in the DNR tidal wetland vegetative community studies, since they are high-quality systems (Harrison, 2001; Harrison and Stango, 2003).

Land Conservation Strategies to Conserve Coastal Resources and Support Climate Adaptation

- Increase the County's land conservation efforts by partnering with DNR's Coastal Zone Program to apply for Coastal and Estuarine Land Conservation Program (CELCP) funding to protect key Mattawoman Creek coastal habitats and potential future wetland areas identified in GreenPrint. Utilize updated GreenPrint Targeted Ecological Area maps when partnering with DNR's Program Open Space on land conservation projects.

- Identify recommended easement acquisition initiatives and general locations where easement acquisition efforts should be targeted based on conservation priorities to ensure that high value aquatic and terrestrial resources are not further degraded and/or that enables coastal wetlands to adaptively respond to climate change stressors. Implementation opportunities and prospective partners will also be identified.

Land Use Strategies

- Identify and recommend land use planning objectives, initiatives and reforms that minimize long term impacts to coastal ecosystem resources in the Mattawoman.

- Identify prospective County regulatory reforms that might foster protection of the resources described in this chapter.
- Identify incentive programs, or other initiatives that might be taken to reduce the number, level and degree of likely future impacts that reduce biodiversity or impair watershed ecosystem resources. This may include assessment and analysis of the feasibility to institute a County Resource Protection TDR program and opportunities to stimulate markets to support transfer activity.

- Consider adopting provisions similar to those in the Baltimore County Code for plats and protective covenants (§33-3-110), and environmental protection and sustainability §33-3-114), which would dedicate forest buffers to the County when plats are recorded.

Section 5: Forest Resources

- Maintain 60 % or more of the Charles portion of the Mattawoman watershed land area in forest cover at build-out. (Note: Based on 2008 data, 72.5% of the watershed in Charles Co.was forested at that time.

- Maintain diversity in forest types including upland forest, riparian forest and forested wetlands.

- Extend forest cover protection measures currently in place in the Mattawoman Resource Protection Overlay Zone to all lands in the Mattawoman Stream Valley Corridor (defined as land between stream bottoms in the watershed to the top of surrounding slopes) to afford greater protection to approximately 12,900 acres or roughly 1/3 of the total area of the watershed in Charles County.

- Work with the Navy to encourage tree planting on Federally owned land, at the Indian Head Naval Surface Warfare Center Facility, to increase watershed forest cover and ecosystem services it provides.

- Reduce forest cover fragmentation caused by development. Maintain forest cover connections between larger forested areas to maintain water quality benefits and provide wildlife corridors between larger habitat areas. .

- Reduce potential for increases in invasive species including reducing incidents of forested areas becoming edges exposed to greater sunlight and more vulnerable to occupation by invasive species.

- Establish an on-the-ground, grassroots program to maintain and increase forest cover utilizing models described in this section of the report.. Focusing on the Mattwoman may serve as a pilot program that can later be extended to other watersheds Countywide.

Section 6: Wildlife and Rare Species Habitats

- Utilize Maryland's Biodiversity Conservation Network, or BioNet, (a digital map GIS shapefile) to prioritize Mattawoman watershed locations for terrestrial and freshwater biodiversity conservation activities and as a tool for targeting acquisitions and easements, locating appropriate areas for project mitigation or habitat restoration, and planning for areas that require management to sustain dwindling species and habitats.

- Target protection for portions of Chapman's Forest, along the Mattawoman watershed boundary and Araby Bog, which is completely contained within this watershed. Both of these areas are Environmentally Sensitive Areas and are Tier 1 BioNet areas because of rare species and habitats within them.

- Work with Maryland DNR to Institute measures to protect the 12 Ecologically Significant Areas (ESA's) that are either contained within or that overlap the Mattawoman Watershed within Charles County.

- Reduce forest fragmentation to conserve and protect the habitat for FIDS to conserve identified bird and animal species that are rare, threatened, endangered or identified and in need of conservation.

- Avoid permitting land uses or activities near the Mouth of the Mattawoman Creek that might impact Waterfowl Staging and Concentration Areas.

- Continue and enhance measures to protect the extensive diversity of wetlands along Mattawoman Creek which include high quality examples of open brackish tidal marshes (tidal mesohaline and polyhaline marshes), densely vegetated tidal freshwater marshes, intertidal shoreline, shrub swamps, tidal hardwood swamps and Coastal Plain bottomland forest. This diversity of community and habitat types supports a wide variety of plants and wildlife, including a number of rare species that thrive in the varied hydrology and physiognomy of these habitats.

- Protect known Colonial Waterbird Nesting locations or areas documented for use by Great Blue Heron as identified in this report.

Section 7: Water Resources Management Strategies for a Future Climate

Refer back to text for more specific details on the following generalized recommendations.

1. Coordination across sectors and regions to reduce potential risks associated with increasing fall and winter precipitation and lower summer precipitation.

2. The first step in assessing any risk is to determine the vulnerability of the system to an increase in temperatures and fall and winter storms and a decrease in summer baseflows. The county is encouraged to assess the vulnerability of water infrastructure to impacts of climate change and utilize natural infrastructure such as wetlands, when possible, to address any deficits. For example, wetlands can be used to recharge groundwater, reduce downstream flooding, and in some cases store carbon. To move forward with this recommendation, the county is encouraged to:

3. During revisions and creation of codes and regulations, examine potential barriers to adaptation and adjust for projected impacts associated with altered rainfall and temperature.

4. Protect natural resources and drinking water sources

5. Improve the resilience of water utilities

6. Reduce impacts of heat on human health and aquatic ecosystems

7. Manage water demand

8. Take climate change into account during infrastructure upgrades and repairs

9. Incorporate climate change into stormwater design principles and BMPs:

Section 8: Stormwater Management

- **Stormwater Management for New Development:** Grandfathering is part of the minimum standards of the new regulations. When grandfathering is allow, every effort should be made to improve the stormwater management to get as close to the new standards as possible.

- **Stormwater Management for Redevelopment:** Charles County should evaluate opportunities to create partnerships and/or incentives to developers to provide greater stormwater management on redevelopment projects.

- **Stormwater Management for Existing Development:** Increase stormwater retrofit implementation to meet the new MS4 permit requirements and to be in alignment with any Watershed Implementation Plan TMDL.

- **Stormwater as a Resource:** View stormwater as a resource to investigate reuse opportunities.

- **Funding for Stormwater Retrofits:** Develop a Stormwater Utility Fee or other dedicated funding source that will adequately fund your stormwater management program and meet the requirement of future MS4 permits.

- **Sediment Control:** State of the art sediment control technologies and methods should be required on all new and redevelopment projects in the Mattawoman Creek Watershed and should be in alignment with EPA's regulation for Construction Activity. It is important that the County have a robust sediment enforcement program that is adequately funded.

- **Stable Stormwater Conveyance Systems:** The County should consider performing surveys of all the streams and drainage ways in the Mattawoman Creek Watershed to identify restoration opportunities associated with sediment pollution and erosion issues. Methods for doing such a survey include, but are not limited to, DNR's Stream Corridor Assessment Survey and the Center for Watershed Protection's Unified Stream Assessment Survey.

- **Partnership Opportunities with Maryland State Highway Administration (SHA):** Work with SHA to identify potential forest and wetland restoration opportunities on public and private land in anticipation of implementation activities SHA will initiate to fulfill their Watershed Implementation Plan (WIP) commitments once BMP efficiencies and crediting protocols have been refined.

Addendum 2: Successful Stream Protection Models

During the course of conversations among the Mattawoman Watershed Team and referenced in several reports, was a common theme that greater emphasis should be placed on the protection of headwater streams (whether mapped or not) and stream buffers. Two examples of successful approaches that Baltimore County and Carroll County have implemented were specifically noted as achieving a high degree of protection.

Baltimore County

Under Article 33 (Environmental Protection and Sustainability) Title 33 (Protection of Water Quality, Streams, Wetlands, and Floodplains), specific attention is directed to sections 33-3-110 (Plats and protective covenants) and 33-3-114 (Public and private improvements of development which confer county ownership of stream buffer areas which grants control and permanent access to the stream. The critical issues with this sort of acquisition of stream corridors are: 1) county access; 2) having management provisions for the buffer; and 3) defining and protecting the smallest headwater streams, even those that are unmapped.

This information can be accessed on-line at:
http://www.amlegal.com/nxt/gateway.dll/Maryland/baltimore_co/baltimorecountycode?f=templates$fn=default.htm$3.0$vid=amlegal:baltimoreco_md and is also provided here:

§ 33-3-110. PLATS AND PROTECTIVE COVENANTS.

(a) *In general.*

(1) (i) Any plat submitted to the county in accordance with Article 32, Title 4 of the Code shall be accompanied by irrevocable offers of dedication to the county of all forest buffer areas in fee or easements, in a form approved by the Bureau of Land Acquisition and the County Attorney.

(ii) The plat shall be marked with a notation indicating the offers of dedication.

(2) (i) The applicant may determine the scope of the dedication.

(ii) The dedication shall include at a minimum a right of access by the county for the purpose of inspecting and maintaining the forest buffer and providing for the abatement and correction of water pollution, erosion, and sedimentation of stream channels, wetlands, and riverine floodplains.

(b) *Protective covenants.*

(1) If an applicant retains any forest buffer, the applicant shall be required to submit for approval by the Office of Law a declaration of protective covenants.

(2) (i) The County Bureau of Land Acquisition may draft the declaration.

(ii) The declaration shall include at minimum the management requirements for forest buffers listed in § 33-3-112 of this title.

(3) The protective covenants shall be recorded in the land records of the county, and shall run with the land and continue in perpetuity.

(c) *Requirements for recorded plats.* In addition to the provisions of the development regulations concerning plats, all plats prepared for recording and all right-of-way plats shall clearly:

(1) Show the extent of any forest buffer on the subject property by metes and bounds;

(2) Label the forest buffer;

(3) Provide a note to reference any forest buffer stating: "There shall be no clearing, grading, construction or disturbance of vegetation in the forest buffer except as permitted by the Baltimore County Department of Environmental Protection and Sustainability"; and

(4) Provide a note to reference protective covenants governing any forest buffer stating: "Any forest buffer shown hereon is subject to protective covenants which may be found in the land records of Baltimore County and which restrict disturbance and use of these areas."

(d) *No public access implied.* An offer of dedication of a forest buffer area to the county may not be construed to convey automatically to the general public the right-of-access to the area.

(1988 Code, § 14-340) (Bill No. 224, 1990, § 1; Bill No. 94-02, § 2, 7-1-2004; Bill No. 122-10, § 13, 1-16-2011)

§ 33-3-114. PUBLIC AND PRIVATE IMPROVEMENTS OF DEVELOPMENT.

(a) *Required improvements.*

(1) In addition to complying with Article 32, Title 4 of the Code and § 33-3-107 of this title, the applicant shall provide improvements to the forest buffer and stream system in order to abate and correct:

(i) Water pollution;

(ii) Erosion and sedimentation of stream channels; and

(iii) Degradation of aquatic and riparian habitat.

(2) The county may participate in the cost of any improvement referenced in this subsection.

(b) *Forest buffer.* For any forest buffer or forest buffer easement:

(1) The applicant shall dedicate access easements to the county, the number, locations, and design standards of which shall be determined by the Department; and

(2) On request of the Department, the applicant shall install permanent boundary markers, in the form of monuments.

(1988 Code, § 14-344) (Bill No. 224, 1990, § 1; Bill No. 94-02, § 2, 7-1-2004)

DRAFT

Carroll County

Carroll County reviewed Baltimore County's approach and adapted it because the county did not want to take ownership for all of the buffers. Instead, the county uses a very restrictive easement on new development that keeps the buffer in private ownership but provides specific restrictions on what activities can and cannot take place in the buffer. The easement is recorded and remains with the property in perpetuity. It is also enforceable in a number of ways, even to the point where neighbors take violations seriously and their local policing helps to keep activities in check. This is another approach that is equally effective but demands less time and financial burdens on an already strapped local government staff. Model language for the deeds of easement for both forested and non-forested stream resources are provided here, along with a brochure the county has developed for education on Water Resource Protection.

DRAFT

FORESTED BUFFER WATER RESOURCE DEED OF EASEMENT

THIS DEED OF EASEMENT, made this _____ day of _____, 20__, by and between _____ ("Grantor") (in the event this document involves more than one grantor then Grantor shall include and mean the plural); and _____ and _____ ("Trustees"); and _____ ("Beneficiary"); and _____ ("Mortgagee"); and **THE COUNTY COMMISSIONERS OF CARROLL COUNTY, MARYLAND,** a body corporate and politic of the State of Maryland, including its successors and assigns ("Grantee").

WHEREAS, Grantor owns land which Grantor has expressed an intent to develop by subdividing the land or other development; and

WHEREAS, Grantor's land is in an area which is a tributary of a County reservoir, planned reservoir, other community water supply, or the Chesapeake Bay which needs to be protected from certain environmental changes based upon environmental and engineering studies; and

WHEREAS, Grantor's plans for development may adversely impact these existing or potential community water supply sources and the Chesapeake Bay without certain protective measures being taken; and

WHEREAS, Grantor is required to grant an easement as hereafter described as a condition of Grantor's authorization to develop; and

WHEREAS, Trustees and Beneficiary have secured a loan to Grantor on property which wholly or in part is set forth on a Subdivision Plat/Site Plan entitled "_____" (_ SHEETS) and intended to be recorded among the Land Records of Carroll County. The Deed of Trust is dated _____, ____, and recorded among the Land Records of Carroll County in Book No. ____, Page ___ &c.; and

WHEREAS, Mortgagee has secured a loan to Grantor on property which wholly or in part is set forth on a Subdivision Plat/Site Plan entitled "_____" (_ SHEETS) and intended to be recorded among the Land Records of Carroll County. The Mortgage is dated _____, ____, and recorded among the Land Records of Carroll County in Book No. _____, Page ___ &c.; and

WHEREAS, Trustees, Beneficiary and Mortgagee join for the purpose of assenting to this document and by such joinder agree to subject any sales of the property on foreclosure, to the legal operation and effect hereof.

NOW THEREFORE, THIS DEED OF EASEMENT WITNESSETH, that for and in consideration of the premises and other good and valuable consideration, the receipt whereof is hereby acknowledged, the Grantor, Trustees, Beneficiary and Mortgagee, do\does grant, release and confirm unto **THE COUNTY COMMISSIONERS OF CARROLL COUNTY, MARYLAND,** a body corporate and politic of the State of Maryland, its successors and assigns, a water resource protection easement in, on, over and under so much of Grantor's property as is shown on a Plat entitled "_____", and identified as **"Forested Water Resource Protection Easement",** which Plat is to be recorded among the Land Records of Carroll County simultaneously herewith at Plat Book No. _____, Page _____; so that said property is subject to the covenants, conditions, limitations and restrictions hereafter set forth, so as to constitute an equitable servitude upon the land.

BEING an easement over a portion of the land conveyed unto the Grantor by Deed from _____, dated _____, and recorded among the Land Records of Carroll County, in Book No. ____, Page ___ &c.

AND the Grantor covenants for and on behalf of Grantor and Grantor's respective personal representatives and assigns, with the Grantee and Grantee's successors and assigns, to do and refrain from doing upon the above described land all and any of the various acts hereafter set forth, it being the intention of the parties that the said land shall be preserved in a condition which acts to protect the water resource. Furthermore, it is the intent of the parties that these covenants be deemed to be and are construed as real covenants running with the land. All subsequent purchasers of the property burdened by the easement shall assume the position of "Grantor" for the purposes of this easement at the time of sale.

AND the parties, for themselves, their heirs, personal representatives, successors, and assigns further covenant and agree as follows:

1. That the following structures, practices, and activities are prohibited within the easement:

a. Soil disturbance by filling, grading, stripping of topsoil, plowing, cultivating, or other practices.

b. Storing or dumping of any material, including but not limited to yard waste, appliances, automobiles, garbage, trash, chemicals, pesticides, or construction debris.

c. Storing, maintaining, or operating motorized vehicles except on designated roads and driveways or for emergency use and maintenance; except as otherwise authorized herein.

d. Housing, grazing, or otherwise maintaining domestic animals to include activities involving the construction of kennels, stables, or barns; disposal of manure; or any other activity which would result in the destruction of vegetation and exposure of soil to erosion.

e. Cutting, clearing, or grubbing of trees except for normal maintenance of dead, wind-blown, or damaged trees; except as otherwise authorized herein.

2. That the following structures, practices and activities are permitted within the easement after review and approval by the Grantee:

a. Driveways, bridges and utilities if it is clearly proven that no other feasible alternative exists and that minimal disturbance takes place. These structures shall be located, designed, constructed, and maintained to provide maximum erosion control, to minimize impacts on wildlife and aquatic habitats, and to maintain hydrologic processes and water quality. Following any disturbance, the affected area shall be restored in accordance with methods approved by the Grantee.

b. Stream restoration projects and activities.

c. Scientific studies including water quality monitoring and stream gauging.

3. That the following structures, practices, and activities are permitted within the easement without review by the Grantee, provided that the general condition of the easement is maintained and any soil disturbance is kept to a minimum and immediately stabilized:

a. Horticultural practices used to maintain the health of individual trees.

b. Removal of trees which are in danger of falling on structures or causing blockage of streams.

c. Other timber management techniques deemed necessary and undertaken with advice and guidance from the Maryland Departments of Natural Resources and Agriculture to preserve the forest from extensive pest or disease infestation or threat from fire.

d. Clearing for one winding walking path, no wider than six feet. This path cannot be a straight line to the stream or water body as it would allow the water to channelize. The path must remain stabilized.

e. Pruning of live tree branches that are no higher than twelve feet from the ground if at least the top two-thirds of the tree canopy is maintained.

4. If a pond area is shown on the Plat, then the following shall apply:

a. Passive recreational activities are allowed within the pond area, including hiking, swimming, picnicking, wildlife viewing, and fishing.

b. Non-routine maintenance, such as dredging or dam and standpipe maintenance, is allowed in accordance with plans produced by a certified engineering firm or upon approval by the Carroll County Soil Conservation District.

c. The following routine maintenance is required within the pond area:

(i) overflows and emergency spillways shall be kept clean and free of woody

vegetation; and

(ii) dams shall be maintained as mowed grass and any trees or shrubs on the dam shall be removed; and

(iii) establishment of burrowing animals in the dam structure shall be prevented; and

(iv) eroded areas of the dam structure shall be restored within 30 days.

d. A winding walking path may be installed to allow for pedestrian access to the pond bank. The path may not encircle the pond.

e. A bank area may be installed within the pond area, but shall not exceed 15 feet of shoreline or 12 feet from the edge of the water and shall be maintained with non-erosive materials.

f. Only pesticides approved for use with the aquatic habitat are allowed.

g. One dock may be constructed.

5. Signage as shown on the Forest Conservation Plan or Grading Plan shall be perpetually maintained at 100 foot intervals around the perimeter of the easement.

6. That any activity within the easement shall be conducted to minimize disturbance of existing forest floor, leaf litter, and vegetation. Where the existing ground cover is disturbed and results in exposed soil, that area shall be immediately stabilized by Grantor to avoid soil erosion.

7. That any activity or use not specifically prohibited or authorized must be submitted to the Grantee for review and approval. The Grantee may authorize the harvest of individual trees. Unless an activity is approved by the Grantee, the activity is prohibited.

8. That the Grantor shall not violate all applicable federal, state, and local laws. When the provisions of this easement conflict with other laws, regulations, or policies, the more restrictive shall apply.

9. That the Grantee or its authorized representative shall have the right to enter on the Grantor's land from time to time for the sole purposes of inspection and enforcement of the easement, covenants, conditions, limitations, and restrictions herein contained; provided, however, that the Grantee shall have no right under this easement to inspect any land outside the easement. Any representative of the Grantee shall carry identification and shall access the easement from a publicly maintained road whenever possible.

10. That this easement does not grant the public in general any right of access to or any right or use of the above described land.

11. That nothing herein contained shall relieve the Grantor or its heirs, personal

representatives, successors, or assigns of the obligation to pay real estate taxes and to comply with all applicable State and County laws, ordinances, and regulations.

12. That this easement shall be in perpetuity, unless released by Grantee.

AS WITNESS the hand and seal of the Grantor herein.

_____(SEAL)
BY:
TITLE:
Grantor

_____(SEAL)
BY:
Trustee

_____(SEAL)
BY:
TITLE:
Beneficiary

_____(SEAL)
BY:
TITLE:
Mortgagee

NEED NOTARY FOR EACH SIGNATURE EXCEPT COUNTY SIGNATURES

ACCEPTED BY:
THE COUNTY COMMISSIONERS
OF CARROLL COUNTY, MARYLAND
a body corporate and politic of the State of Maryland

_____
Date:

_____
BY: CLAYTON R. BLACK, CHIEF
BUREAU OF DEVELOPMENT REVIEW

Approved for legal sufficiency:

_____

THIS IS TO CERTIFY that the within instrument has been prepared by or under the supervision of the undersigned Maryland attorney, or by a party to this instrument.

_____

PWA No. _____
Tax Account No.
date:
RETURN TO: Department of the County Attorney, 225 N. Center Street, Westminster, MD 21157

Use the following form when there are Non-Forested Water Resource Easements shown on plat.

NON-FORESTED BUFFER WATER RESOURCE DEED OF EASEMENT

THIS DEED OF EASEMENT, made this _____ day of _____, 20__, by and between _____ ("Grantor") (in the event this document involves more than one grantor then Grantor shall include and mean the plural); and _____ and _____ ("Trustees"); and _____ ("Beneficiary"); and _____ ("Mortgagee"); and **THE COUNTY COMMISSIONERS OF CARROLL COUNTY, MARYLAND,** a body corporate and politic of the State of Maryland, including its successors and assigns ("Grantee").

WHEREAS, Grantor owns land which Grantor has expressed an intent to develop by subdividing the land or other development; and

WHEREAS, Grantor's land is in an area which is a tributary of a County reservoir, planned reservoir, other community water supply, or the Chesapeake Bay which needs to be protected from certain environmental changes based upon environmental and engineering studies; and

WHEREAS, Grantor's plans for development may adversely impact these existing or potential community water supply sources and the Chesapeake Bay without certain protective measures being taken; and

WHEREAS, Grantor is required to grant an easement as hereafter described as a condition of Grantor's authorization to develop; and

WHEREAS, Trustees and Beneficiary have secured a loan to Grantor on property which wholly or in part set forth on a Subdivision Plat entitled "_____" and intended to be recorded among the Land Records of Carroll County. The Deed of Trust is dated _____, ____, and recorded among the Land Records of Carroll County in Book No. ____, Page ___ &c.; and

WHEREAS, Mortgagee has secured a loan to Grantor on property which wholly or in part is set forth on a Subdivision Plat entitled "_____" and intended to be recorded among the Land Records of Carroll County. The Mortgage is dated _____, ____, and recorded among the Land Records of Carroll County in Book No. _____, Page ___ &c.; and

WHEREAS, Trustees, Beneficiary and Mortgagee join for the purpose of assenting to this document and by such joinder agree to subject any sales of the property on foreclosure, to the legal operation and effect hereof.

NOW THEREFORE, THIS DEED OF EASEMENT WITNESSETH, that for and in consideration of the premises and other good and valuable consideration, the receipt whereof is hereby acknowledged, the Grantor, Trustees, Beneficiary and Mortgagee, do\does hereby grant, release and confirm, unto **THE COUNTY COMMISSIONERS OF CARROLL COUNTY, MARYLAND,** a body corporate and politic of the State of Maryland, its successors and assigns, a water resource protection easement in, on, over and under so much of Grantor's property as is shown on a Plat entitled "_____", and identified thereon as **"Non-Forested Water Resource Protection Easement"**, which Plat is to be recorded among the Land Records of Carroll County simultaneously herewith at Plat Book No. _____, Page _____; so that said property is subject to the covenants, conditions, limitations and restrictions hereafter set forth, so as to constitute an equitable servitude upon the land.

BEING an easement over a portion of the land conveyed unto the Grantor by Deed from _____, dated _____, and recorded among the Land Records of Carroll County, in Book No. ____, Page ___ &c.

AND the Grantor covenants for and on behalf of Grantor and Grantor's respective personal representatives and assigns, with the Grantee and Grantee's successors and assigns, to do and refrain from doing upon the above described land all and any of the various acts set forth below, it being the intention of the parties that the land shall be preserved in a condition which acts to protect the water resource. Furthermore, it is the intent of the parties that these covenants be deemed to be and are construed as real covenants running with the land. All subsequent purchasers of the property burdened by this easement shall assume the position of "Grantor" for the purposes of this easement at the time of sale.

AND the parties, for themselves, their heirs, personal representatives, successors, and assigns further covenant and agree as follows:

1. That the following structures, practices, and activities are prohibited within the easement:

a. Soil disturbance by filling, grading, stripping of topsoil, plowing, cultivating, or other practices.

b. Storing or dumping of any material, including but not limited to yard waste, appliances, automobiles, garbage, trash, chemicals, pesticides, or construction debris.

c. Composting or broadcast spreading of yard waste within fifty feet of the stream bank.

d. Storing, maintaining, or operating motorized vehicles except on designated roads and driveways or for emergency use and maintenance, except as otherwise authorized herein.

e. Housing, grazing, or otherwise maintaining domestic animals to include activities involving the construction of kennels, stables, or barns; disposal of manure; grazing of livestock which would result in the destruction of vegetation and soil disturbance; or any other activity which

would result in the destruction of vegetation and exposure of soil to erosion.

f. Burning of vegetation.

2. That the following structures, practices and activities are permitted within the easement after review and approval by the Grantee:

a. Driveways, bridges and utilities if it is clearly proven that no other feasible alternative exists and that minimal disturbance takes place. These structures shall be located, designed, constructed, and maintained to provide maximum erosion control, to minimize impacts on wildlife and aquatic habitats, and to maintain hydrologic processes and water quality. Following any disturbance, the affected area shall be restored in accordance with methods approved by the Grantee.

b. Stream restoration projects and activities.

c. Scientific studies including water quality monitoring and stream gauging.

3. That the following structures, practices, and activities are permitted within the easement without review by the Grantee, provided that the general condition of the easement is maintained and any soil disturbance is kept to a minimum and immediately stabilized:

a. Allowing forests to naturally regenerate or planting fields with trees. Reforestation projects should be undertaken with the advice and guidance of the Maryland Departments of Natural Resources and Agriculture and conducted pursuant to the Carroll County Forest Conservation Ordinance.

b. Maintaining the easement in a dense and vigorous cover of non-lawn vegetation which may be mowed or harvested no more than twice a year to a height of no less than six (6) inches. Control of noxious weeds and multiflora rose is permitted as long as soil exposed by the treatment process is immediately stabilized.

c. Clearing for one winding walking path, no wider than six feet. This path cannot be a straight line to the stream or water body as it would allow the water to channelize. The path must remain stabilized.

d. Composting or broadcast spreading of yard waste except as prohibited in 1.c.

4. If a pond area is shown on the Plat, then the following shall apply:

a. Passive recreational activities are allowed within the pond area, including hiking, swimming, picnicking, wildlife viewing, and fishing.

b. Non-routine maintenance, such as dredging or dam and standpipe maintenance, is allowed in accordance with plans produced by a certified engineering firm or upon approval by the Carroll County Soil Conservation District.

c. The following routine maintenance is required within the pond area:

(i) overflows and emergency spillways shall be kept clean and free of woody vegetation; and

(ii) dams shall be maintained as mowed grass and any trees or shrubs on the dam shall be removed; and

(iii) establishment of burrowing animals in the dam structure shall be prevented; and

(iv) eroded areas of the dam structure shall be restored within 30 days.

d. A winding walking path may be installed to allow for pedestrian access to the pond bank. The path may not encircle the pond.

e. A bank area may be installed within the pond area, but shall not exceed 15 feet of shoreline or 12 feet from the edge of the water and shall be maintained with non-erosive materials.

f. Only pesticides approved for use with the aquatic habitat are allowed.

g. One dock may be constructed.

5. Signage as shown on the Forest Conservation Plan or Grading Plan shall be perpetually maintained at 100 foot intervals around the perimeter of the easement.

6. That any activity within the easement shall be conducted to minimize disturbance of leaf litter and vegetation. Where the existing ground cover is disturbed and results in exposed soil, that area shall be immediately stabilized by Grantor to avoid soil erosion.

7. That any activity or use not specifically prohibited or authorized must be submitted to the Grantee for review. Unless an activity is approved by the Grantee, the activity is prohibited.

8. That the Grantor shall not violate all applicable federal, state, and local laws. When the provisions of this easement conflict with other laws, regulations, or policies, the more restrictive shall apply.

9. That the Grantee or its authorized representative shall have the right to enter on the Grantor's land from time to time for the sole purposes of inspection and enforcement of the easement, covenants, conditions, limitations, and restrictions herein contained; provided, however, that the Grantee shall have no right under this easement to inspect any land outside the easement. Any representative of the Grantee shall carry identification and shall access the easement from a publicly maintained road whenever possible.

10. That this easement does not grant the public in general any right of access to or any right

or use of the above described land.

11. That nothing herein contained shall relieve the Grantor or its heirs, personal representatives, successors, or assigns of the obligation to pay real estate taxes and to comply with all applicable State and County laws, ordinances, and regulations.

12. That this easement shall be in perpetuity, unless released by Grantee.

AS WITNESS the hand and seal of the Grantor herein.

_____(SEAL)
BY:
TITLE:
Grantor

_____(SEAL)
BY:
Trustee

_____(SEAL)
BY:
TITLE:
Beneficiary

_____(SEAL)
BY:
TITLE:
Mortgagee

NEED NOTARY FOR EACH SIGNATURE EXCEPT COUNTY SIGNATURES

ACCEPTED BY:
THE COUNTY COMMISSIONERS
OF CARROLL COUNTY, MARYLAND
a body corporate and politic of the State of Maryland

_____
Date:

_____
BY: CLAYTON R. BLACK, CHIEF
BUREAU OF DEVELOPMENT REVIEW

Approved for legal sufficiency:

_____

THIS IS TO CERTIFY that the within instrument has been prepared by or under the supervision of the undersigned Maryland attorney, or by a party to this instrument.

_____

PWA No. _____
Tax Account No.
date:
RETURN TO: Department of the County Attorney, 225 N. Center Street, Westminster, MD 21157

If you have additional questions regarding the Water Resources Protection Easement area or wish to determine if an activity is permitted within the easement area, please call the Carroll County, Bureau of Resource Management at 410-386-2321 or 410-386-2210.

There are two types of Water Resource Protection Easements: **Forested and Non-Forested**. Requirements for both types are almost identical except that non-forested easements require a dense and vigorous cover of non-lawn vegetation be maintained. These areas can be mowed or harvested no more than twice annually to a vegetation height of no less than six inches.

Many state and federal government programs exist to provide the interested landowner with financial and technical assistance to establish forested Stream Buffers. Contact the following agencies if you are interested in planting trees within a non-forested Water Resource Protection Easement:

1. Carroll Soil Conservation District, 410-848-8200
2. MD Department of Natural Resources, Forest Service, 410-848-9290
3. Carroll County Bureau of Resource Management; 410-386-2321

[CUSTOMER NAME]

Carroll County
Bureau of Resource Management
225 N. Center Street
Westminster, MD 21157

Water Resource Protection Easements

Carroll County
Department of Planning

Bureau of Resource Management

Phone: 410-386-2321 or 410-386-2210
Contact: hmurphy@ccg.carr.org

Prepared: May, 2008

For the Homeowner

This brochure provides information about the Water Resource Protection Easement Area on your property.

When your land was developed, one of the requirements of Carroll County for approval was a permanent Water Resource Protection Easement along the stream(s). This requirement among others is found in the Carroll County Water Resource Management Chapter 218 of the County Code adopted in 2004. The purpose of the Water Resource Management chapter is to protect the quality and quantity of ground and surface water resources.

Land within a Water Resource Protection Easement provides a buffer to the stream system from adjacent land use activities.

Stream Buffers provide many benefits to the stream as well as the watershed or drainage area that it resides within including:
1. Filtering runoff that could contain sediment and nutrients.
2. Moderating stream temperatures, and
3. Wildlife corridors.

The land within the Water Resource Protection Easement is preserved for your benefit and for the long-term benefits of the citizens of Carroll County as well as the Chesapeake Bay.

What can and can't take place in a Water Resource Protection Easement Area? What follows are three lists of activities permitted and prohibited within the easement area. Activities prohibited within the easement are known to compromise the quality of the Stream Buffer thereby reducing its effectiveness. Any activity within the easement must minimize soil and vegetation disturbance.

For a complete list of activities permitted and/or prohibited on your property, obtain a copy of the deed of easement agreement from the Carroll County Land Records, 55 North Court Street, Room G-80, Westminster, MD 21157. 410-386-2022.

Activities Allowed within the Easement:

1. Planting trees and other horticultural practices to maintain tree health.
2. Removing trees in danger of falling on structures
3. Removing dead, windblown, or damaged trees
3. Hunting
4. Applying timber management techniques necessary with the guidance from the MD Department of Natural Resources or Maryland Department of Agriculture to preserve forest from extensive pest or disease infestation or from threat of fire.
5. Clearing of one winding walking path no wider than six (6) feet. Path shall remain stabilized and it cannot be constructed in a straight line to the stream.

Activities Allowed within the Easement after County review and approval:

1. Constructing driveways, bridges and utilities if clearly proven that no feasible alternative exists and minimal disturbance to the easement area occurs during construction.
2. Conducting scientific studies or stream restoration.

Activities Not Allowed within the Easement:

1. Disturbing the soil by filling, grading, plowing, cultivating, or other practices
2. Storing or dumping any material (e.g., yard waste, appliances, automobiles, garbage, chemicals, pesticides, construction debris, etc)
3. Storing, maintaining, or operating motorized vehicles except on designated roads/driveways.
4. Housing, grazing, or otherwise maintaining domestic animals.
5. Cutting, or clearing of trees except for maintenance of dead or damaged trees.

Other Considerations:

1. Any activity not specifically prohibited or authorized must be approved by the Carroll County Bureau of Resource Management. Unless approved, the activity is prohibited.
2. This easement does not grant the public any right of access or use; however, Carroll County Government employees do have the right to enter periodically for the sole purpose of inspection and enforcement of the conditions of the easement agreement.