Deer Creek Watershed Characterization

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In support of Harford County's Watershed Restoration
Action Strategy for the Deer Creek Watershed

Montgomery Business Park Center
1800 Washington Boulevard, Suite 540
Baltimore MD 21230-1718

Product of the Maryland Department of the Environment
In Partnership with Harford County

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CONTRIBUTORS

Local

Pat Pudelkewicz, Harford County.

State and Federal

Maryland Department of Natural Resources (MDNR): Lynn Davidson, Paul Miller, and Ken Shanks.

Maryland Department of the Environment (MDE): Denise Clearwater.

Maryland Department of Planning, staff.

Primary Authors and Editors: Rita Bruckler, Kathleen Ellis, Danielle Lucid, MDE; Ken Shanks, MDNR, (Green Infrastructure and other contributions).

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ACRONYMS

303(d) list – List of impaired waters
ANC – acid-neutralizing capacity
APG – Aberdeen Proving Grounds
BMP – Best Management Practices
C2K – Chesapeake 2000 Agreement
COMAR – Code of Maryland Regulations
CREP - Conservation Reserve Enhancement Program
CRP - Conservation Reserve Program
DFIRM – Digital Flood Insurance Rate Map
DO – Dissolved Oxygen
EPA – Environmental Protection Agency
EPSC – Environmental Permits Service Center
EQIP - Environmental Quality Incentive Program
FEMA – Federal Emergency Management Agency
FIDS - Forest interior dwelling species
FIRM – Flood Insurance Rate Map
GIS – Geographic Information Systems
HLS – Habitats of Local Significance
IBI – Index of Biotic Integrity
MACS - Maryland Agricultural Cost-Share program
MBSS – Maryland Biological Stream Survey
MDE – Maryland Department of the Environment
MDNR – Maryland Department of Natural Resources
NPDES - National Pollution Discharge Elimination System
NTU – nephelometric turbidity unit
PFA – Priority Funding Areas
RTE – Rare, Threatened or Endangered species
SCA – Stream Corridor Assessment
SRBC – Susquehanna River Basin Commission
SSPRA – Sensitive Species Project Review Area
STORET - STOrage and RETrieval
TMDL – Total Maximum Daily Load
TSS – Total Suspended Solids
USGS – United States Geological Survey
WRAS – Watershed Restoration Action Strategy
WSSC – Wetlands of Special State Concern

INTRODUCTION

Watershed Planning Background

As a foundation for watershed monitoring, analysis and planning, the State of Maryland defined over 130 watersheds that cover the entire State in the 1970s. In 1998, the Maryland Clean Water Action Plan presented an assessment of water quality conditions in each of these watersheds. Based on these assessments, it also established State priorities for watershed restoration and protection. In 2000, the Watershed Restoration Action Strategy (WRAS) Program was initiated as one of several new approaches to implementing water quality and habitat restoration and protection. The WRAS Program solicits local governments to focus on priority watersheds for restoration and protection. Since inception of the program, local governments have received grants and technical assistance for 25 WRASs in which local government, with input from citizens, identifies local watershed priorities for restoration, protection and implementation.

Deer Creek WRAS Project

Harford County is one of five counties participating in the 2005 WRAS program and has selected the Deer Creek Watershed (Basin number: 02120202) for protection and restoration. The Harford County Master Plan and Land Use Element Plan has identified the preservation and protection of the County's natural environment as a major goal, and has identified watershed planning as an important strategy to accomplish this goal. The Plan also cites protection and preservation of the County's agricultural heritage and continued viability of agriculture as an equally important goal. The Deer Creek watershed is the largest and most significant agricultural area of the County (Harford County Department of Planning and Zoning).

Deer Creek Watershed is prioritized in Maryland's Clean Water Action Plan (1998) as both a Category 1 watershed indicating that it is in need of restoration and as a Category 3 watershed indicating that it is a pristine or sensitive watershed in need of protection. Because the selection criteria used for Category 1 (Restoration) and Category 3 (Preservation) watersheds are not the same and because land use and related factors may vary considerably within such a large watershed, many of the State's watersheds are identified as both Category 1 and 3 watersheds. These watersheds show signs of stress or degradation but still contain pristine or sensitive natural resources. Deer Creek has the added distinction of being designated a "Select" Category 3 watershed, which indicates a more pristine or sensitive watershed in need of an extra level of protection.

Deer Creek is a tributary of the Susquehanna River and is part of the Upper Western Shore Tributary Strategy Basin (Maps 1 & 2: Deer Creek Watershed and WRAS Project Area). Lying within the Piedmont Region, Deer Creek extends across the northern portion of the County from the Susquehanna River into Baltimore County, with the headwaters in Pennsylvania. This predominantly rural watershed covers approximately 36% of the land area of the County.

The County is working on the Deer Creek WRAS which will be completed in 2006. Harford County's project is intended to dovetail with existing efforts. The Harford County WRAS will identify and prioritize local restoration and protection needs associated with water quality and habitat. To support this effort, the Maryland Department of the Environment (MDE) has provided grant funding and technical assistance, which includes production of this Watershed Characterization.

Purpose of the Characterization

In support of the WRAS development, the Watershed Characterization helps to meet several objectives:

- Summarize available information and issues,
- Provide preliminary findings based on this information,
- Identify sources for more information or analysis,
- Suggest opportunities for restoration work, and
- Provide a common base of knowledge about the watershed for government, citizens, businesses and other interested groups.

The Watershed Characterization adds to other efforts that are important for the County's WRAS project:

- Local investigation by the County,
- Stream Corridor Assessment, in which State personnel physically walk selected streams and record existing conditions,
- Synoptic water quality survey in which water samples are collected and analyzed for nutrients, pH, temperature, and specific conductivity,
- Technical assistance and assessment by partner agencies or contractors.

More Sources of Information

The reference section provides more detailed information that is only very briefly summarized here. The WRAS Program Internet home page has additional information on the program and an index of available electronic copies of WRAS-related documents that can be downloaded free of charge. Available documents include detailed program information, completed WRAS strategies, stream corridor assessments, synoptic surveys and watershed characterizations. Please visit the WRAS Home Page at: http://www.dnr.state.md.us/watersheds/wras/

Additional information on over 130 watersheds in Maryland is available on the Maryland Department of Natural Resources' (MDNR) Internet page Surf Your Watershed at: http://www.dnr.state.md.us/watersheds/surf/index.html

The Maryland Clean Water Action Plan is available at: www.dnr.maryland.gov/cwap/

WATER QUALITY

Designated Uses For Waterbodies

Maryland's water quality standards address the federal requirements "to restore and maintain the chemical, physical and biological integrity of the Nation's waters" (Clean Water Act, Section 101). Standards have been established to support beneficial uses such as fishing, aquatic life, contact recreation, boating, drinking water supply, and terrestrial wildlife that depend on water. This expanded view of water quality is reflected in current approaches to monitoring, data gathering, and regulation of water bodies as reflected in this watershed characterization.

Streams and other water bodies in Maryland are each assigned a "designated use" in the Code of Maryland Regulation (COMAR) 26.08.02.08 (Map 3, Uses). An area's designated use refers to a water body's function. The designated uses are associated with sets of water quality criteria necessary to support the uses. Together, the designated use and the criteria are commonly referred to as "Water Quality Standards".

In the Deer Creek watershed, Use III-P designation, (Natural Trout Waters) Nontidal Cold Water and Public Water Supply, is applied to all bodies of water above Eden Mill Dam and the following streams below the dam:

- Kellogg Branch and all tributaries
- North Stirrup Run and all tributaries
- South Stirrup Run and all tributaries
- Gladden Branch and all tributaries
- Rock Hollow Branch and all tributaries

Use IV-P, Recreational Trout Waters and Public Water Supply, is applied from the mouth of Deer Creek to Eden Mill Dam with the exception of the streams listed above.

Source Water Area

As the "Designated Use" category indicates, Deer Creek is used as a source of public drinking water supply for about 12,000 people in the Aberdeen Area of Aberdeen Proving Ground (APG). This area of APG is served by the Chapel Hill Water Treatment Plant, which is owned and operated by the City of Aberdeen. Up until 2000 it was operated by the Department of the Army. The plant was designed for six million gallons per day. MDE's Water Appropriation and Use Permit (#HA1978S028-05) permits a daily average withdrawal of 3.27 million gallons on a yearly basis and a maximum daily withdrawal of 4.9 million gallons from Deer Creek.

In July 2005, MDE prepared the Source Water Assessment for Deer Creek at the Chapel Hill Water Treatment Plant, which evaluates the vulnerability of a source of public drinking water to contamination. This report indicates that both point and non-point

sources of contamination exist in the watershed; however, non-point sources are the most significant, including transportation, agriculture and runoff from developed areas. From a public drinking water supply perspective, the report indicates that turbidity (sediment), disinfection byproduct precursors and pathogenic microorganisms are the contaminants of most concern. High turbidity levels are associated with erosion and sediment transport during storm flows. *E. coli* and fecal bacteria were present consistently in Deer Creek during a two-year sampling program, with the highest concentrations occurring in association with rainfall.

The report also notes the network of State highways and County roads throughout the watershed as a potential source of contamination. Concerns included deicing compounds and hazardous materials. They note that the Colonial Pipeline, an interstate carrier of petroleum products, crosses the watershed above the Deer Creek Pumping Station.

Community Systems

There are three groundwater-based community systems in the watershed averaging over 10,000 gallons per day: Campus Hills Water Works, Darlington Mobile Home Park, and the Community of Darlington. Source water assessment reports have been prepared for these systems through the Maryland Department of Environment. These reports provide detailed delineations of the areas that contribute water to the wellfields, potential sources of contamination, and susceptibility of the water supplies to contamination. Three small groundwater-based community systems (averaging less than 10,000 gallons per day) also occur within the watershed.

Use Impairments

Some streams or other water bodies in the WRAS project area do not meet the full extent of their designated use defined in Maryland regulation. These areas, known as "impaired waters", are tracked by MDE under Section 303(d) requirements of the Federal Clean Water Act. The list of impairments for waterbodies in the Deer Creek watershed are summarized below. More information on the 303(d) list can be found at: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index_new.asp

Biological

Deer Creek was added to the 303(d) list for the first time in 2002 for biological impairments with unknown causes. The listing was based on 1997 data on fish and benthic macroinvertebrate populations collected by the Maryland Biological Stream Survey (MBSS). MBSS data from 2000-2002 was used to list subbasins within Deer Creek individually.

In the 2004 updated 303(d) list, several of the subwatersheds listed in 2002 were delisted based on the results of additional biological sampling. In addition, several new subwatersheds were added to the list. The following subwatersheds are listed for biological impairments from unknown sources: 0330, 0332.

Total Maximum Daily Loads (TMDL)

Maryland Department of the Environment uses the 303(d) list of impaired waters to determine the need for establishing Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of pollutant that a waterbody can assimilate and still meet its designated use. A waterbody may have multiple impairments and multiple TMDLs to address them. MDE is responsible for establishing TMDLs. In general, TMDLs have two key parts:

1- Maximum pollutant load that the water can accept while still allowing the waterbody to meet its intended use.
2- Allocation of the maximum pollutant load to point and nonpoint pollutant sources.

TMDLs are required for biological impairment in two subwatersheds in Deer Creek but have not been completed at this time. The priority is listed as low.

Water Quality Monitoring

Overview

The streams in Maryland's part of the Deer Creek watershed are sampled by MDE's Synoptic Survey and Stream Corridor Assessment, MDNR's Core/Trend Program, the Maryland Biological Stream Survey and its volunteer program, Stream Waders, and the Susquehanna River Basin Commission (SRBC). MDE's Field Monitoring Program (In-House Monitoring Data) collected data until 1999 in the Deer Creek watershed for use in TMDL modeling. The In-House sites will be monitored again in 2006. Data from 1999 and earlier can be found on the EPA's STORET data site: http://www.epa.gov/storet/dbtop.html. Map 4, Water Monitoring and Fish Blockages, shows site locations for the Core/Trend Program, MDE In-House Data, and the SRBC. Data were provided by MDNR and the U.S. EPA STORET database.

Synoptic Survey

The Synoptic Survey Report, produced by MDE, is a water chemistry analysis (nutrients, temperature, conductivity, pH), based on *in situ* water quality sampling at 104 sites throughout the Deer Creek watershed. Sampling was conducted during April 2005. Local governments and MDE staff collaboratively choose the sites that MDE will sample. The results of the Survey will be presented in a separate report.

Stream Corridor Assessment (SCA)

The Stream Corridor Assessment (SCA) survey was developed by MDNR's Watershed Restoration Division as a tool to help environmental managers identify environmental problems and prioritize restoration opportunities on a watershed basis. Trained personnel walked selected stream segments and recorded information on a variety of environmental

problems that can be easily observed within the stream corridor. Common environmental problems documented in the survey included: eroding stream banks, inadequate stream buffers, exposed pipes, altered stream channels, fish migration barriers, pipe outfalls, in-stream construction sites and trash dumping locations (MDNR Stream Corridor Assessment Manual). The results of the SCA will be presented in a separate report.

Core/Trend Monitoring

The ambient fixed station water quality monitoring program (Core/Trend) is used to assess state-wide water quality status and trends. Sampling locations are distributed throughout the state with particular attention to the Potomac River. Determination of status is based upon the median concentration for the most recent three years (2002-2004) compared to a benchmark data set of all measured concentrations in the nontidal Core/Trends database for all sites in Maryland from 1986-1996. To determine the cut-off values, the benchmark data are divided into thirds so the lower third cut-off value is at the 33rd percentile and the cut-off for the middle third is at the 67th percentile. Trends are a measure of how the system has been changing over time. More information on the assessment methods and details on each parameter are available on the MDNR site: http://www.dnr.state.md.us/streams/status_trend/index.html

The Deer Creek station is located at Stafford Bridge Road about 1.5 miles upstream from the confluence with the Susquehanna River (Map 4: Water Monitoring and Fish Blockages). Data from this site are summarized in the table below. The status of the nutrient parameters appears consistent with an agricultural watershed that is beginning to urbanize. Dissolved nitrate plus nitrite is relatively high with a median value of over 2mg/L. Chlorophyll *a* levels are low and continue to decline. Dissolved oxygen (DO) in Deer Creek is well above the standard of 5 mg/L (lowest recorded value for 2002-2004 was above 7 mg/L).

More roads and driveways tend to increase conductivity and more concrete infrastructure contributes to increases in total alkalinity. Increases in total suspended solids usually accompany increased building activity but does not seem to be the case in the Deer Creek watershed. Turbidity, a parameter that is highly correlated with total suspended solids (TSS), may be declining because of the decrease in chlorophyll.

Table 1. Core/Trend data for Deer Creek Watershed.

Parameter	Status 2002-2004*	Trend 1986-2004	Status compared with the benchmark data set 1985-1996*
Chlorophyll a	≤2.66 µg/L	Decreasing	low
Conductivity	≤185.3 µmhos/cm	Increasing	low
DO	9.9<DO≤10.52 mg/L	Decreasing	middle
Ammonium (NH4)	≤0.029 mg/L	No trend	low
Nitrate (NO3)	>2.1 mg/L	No trend	high
Nitrite (NO2)	≤0.011 mg/L	Decreasing	low
Nitrate + Nitrite	>1.92 mg/L	No trend	high
Total Kjeldahl Nitrogen (TKN)	≤0.48 mg/L	Decreasing	low
pH	7.11<pH≤7.62	No trend	middle
Orthophosphate (PO4)	0.013<PO4≤0.034mg/L	No trend	middle
SO4	No samples taken		
Total Alkalinity (TALK)	24.44<TALK≤57.37 mg/L	Increasing	middle
Total organic carbon (TOC)	2.35<TOC≤3.30 mg/L	No trend	middle
Total nitrogen (TN)	>2.64 mg/L	No trend	high
Total phosphate (TP)	0.036<TP≤0.073 mg/L	No trend	middle
Total suspended solids (TSS)	≤5.44 mg/L	No trend	low
Turbidity (TURB)	≤5.53 NTU	Decreasing	low
Water temperature (WATEMP)	>55.4^{o}F	No trend	high

* Status levels are the 33rd and 67th percentiles as described in the text.

Maryland Biological Stream Survey/Stream Waders

The Maryland Biological Stream Survey, started in 1994, samples nontidal wadable streams in all of the watersheds in the state on a five year rotation. MBSS samples fish, benthic macroinvertebrates, water chemistry and habitat. An index of biointegrity (IBI) is calculated for fish and benthic macroinvertebrates. The IBI score is a quantitative rating of the health of the fish or benthic macroinvertebrate assemblage found at each site. The IBI scale is: poor (1.0-2.9), fair (3.0-3.9), and good (4.0-5.0). The survey is based on a probabilistic stream sampling approach where random selections are made from all sections of streams in the state that can physically be sampled. The approach supports statistically-valid population estimation of variables of interest (e.g., largemouth bass densities, miles of streams with degraded physical habitat, etc.) (MDNR MBSS). In 2000, MBSS started a volunteer program, Stream Waders, to increase the density of samples

taken in sub-watersheds of about 8 sq. miles. Stream Waders sample in the same watersheds as the MBSS program but sample only benthic macroinvertebrates. More information on the MBSS/Stream Waders programs can be found at: http://www.dnr.state.md.us/streams/mbss/index.html

The MBSS program sampled 33 stream sites in Deer Creek in Round 1, the 1994-97 sampling cycle, and 28 sites in Round 2, the 2000-04 cycle (MDNR MBSS on-line database). IBIs were not available for some sites in Round 1. In Round 2, the assessments based on fish IBIs were distributed as follows: good – 11 (39%), fair – 9 (32%), and poor – 8 (29%). The assessments based on benthic IBIs in Round 2 were as follows: good – 22 (79%), fair – 4 (14%), and poor – 2 (7%) (MDNR MBSS on-line database: http://mddnr.chesapeakebay.net/mbss/search.cfm).

Water quality data from Round 1 for the Lower Susquehanna River Basin, which includes Deer Creek, indicated that dissolved oxygen levels were good (all above the state water quality standard of 5 mg/L) and all sites were well buffered against acid rain (acid neutralizing capacity (ANC) greater than 200 μeq/L). However, nitrate was high in 94% of the streams (>1 mg/L) (MDNR MBSS Lower Susquehanna River Basin fact sheet and report: http://www.dnr.state.md.us/streams/mbss/mbss_fs_table.html).

In 2001, the Stream Waders volunteer program sampled 60 sites in Deer Creek. The sites were not randomly selected and volunteers sampled upstream of road crossings. Of those, 17 (28%) were rated as good, 28 (47%) were rated as fair and 15 (25%) were rated as poor. In 2004, Stream Waders sampled an additional 61 sites in Deer Creek. Of those, 16 (26%) were rated as good, 35 (57%) were fair and 10 (17%) were poor (Stream Waders on-line database: http://mddnr.chesapeakebay.net/mbss/streamwaders.cfm).

In 2005, MBSS and Stream Waders sampled in the five WRAS watersheds. MBSS will present their data in a separate report along with all previous MBSS/Stream Waders data for those watersheds.

Watershed Indicators

MDNR has developed rating scales for a number of watershed indicators (MDNR Watershed Indicators web site). The Migratory Fish Spawning Areas indicator was developed using MDNR Fisheries Service information and Habitat Requirements for Chesapeake Bay Living Resources. This living resources indicator rates watersheds based on the diversity of spawning habitat for American Shad, Hickory Shad, Alewife, Blueback Herring, White Perch, Striped Bass, and Yellow Perch. This indicator scores watersheds based on the number of migratory fish species from 0 - 7 that spawn within the watershed. The Migratory Fish Spawning Area indicator for Deer Creek watershed was three out of a possible seven (seven being the best) for migratory fish spawning habitat. For more information on watershed indicators, see: http://www.dnr.state.md.us/watersheds/surf/indic/md/md_indic.html

The Trout Spawning Areas Indicator was developed using Maryland Biological Stream Survey data and information provided by the Fisheries Service. This indicator scores

watersheds based on the diversity of trout spawning areas within the watershed. Because brook trout are the only native trout (Salmonidae) species that spawn in Maryland waters, they were weighted more heavily than either rainbow or brown trout. The indicator for Trout Spawning Areas was nine (10 is best) for Deer Creek (MDNR Watershed Indicators, Trout Spawning Area data 1998).

Susquehanna River Basin Commission

The Susquehanna River Basin Commission has water monitoring sites in the Conowingo area which includes the Deer Creek watershed. From 1985 to 2004, the trend in the Conowingo area has been a decrease in total nitrogen, total phosphorus and suspended sediments. Data from 2004 taken at three sites in Deer Creek watershed were evaluated in a 2005 report (SRBC 2005). The three SRBC sites are shown on Map 4 (BBDC 4.1, FBDC 4.1 and DEER 44.2). All were rated as unimpaired for their biological condition based on benthic macroinvertebrate samples with a habitat rating of excellent. In an earlier report based on 2003 data, site FBDC 4.1 was rated as slightly impaired based on the benthic samples (SRBC 2004).

Groundwater Quality

Harford County produces an annual water quality report which provides information on test results and is available on their web site: http://www.harfordcountymd.gov/dpw/ws/waterquality.html . In addition, Harford County Department of Public Works and the Harford County Health Department set up an extensive groundwater monitoring network in 2000 to determine perched water level conditions. Perched water tables occur when a low permeability material, located above the water table, blocks the downward flow of water from the land surface. Water accumulates above the impermeable material, creating another saturated zone above the water table (Harford County Health Department web site). Perched water can contain pollutants from surface runoff or sewage which can contaminate surface water. More information on the Ground Water Monitoring Network can be found at: http://www.harfordcountymd.gov/health/ER/gwnetwork.htm#bac

Point Sources

Discharges from pipes or other “discrete conveyances” are called “point sources.” Point sources may contribute pollution to surface water or to groundwater. For example, wastewater treatment discharges may contribute nutrients that reduce oxygen available for aquatic life. Stormwater discharges may contribute excessive flow of water and/or seasonally high temperatures. Industrial point sources may contribute other forms of pollution. Some understanding of point source discharges in a watershed targeted for restoration is useful in helping to prioritize potential restoration projects.

Many types of point sources operate under permits issued by the MDE. MDE’s Environmental Permits Service Center (EPSC) data indicate that there are nineteen permitted discharges in Maryland’s part of the rural Deer Creek watershed (Map 5: MDE

Permits and Table 2). None of these is listed as a major discharge. Only one wastewater treatment plant is located in the Maryland portion of the watershed. For more information on discharge permits, see MDE's Customer Service Center web page: http://www.mde.state.md.us/BusinessInfoCenter/enviroPermits/index.asp

Table 2. Deer Creek MDE Permits.

Municipal Surface Discharge (Sewage Treatment)				
Permit No.	NPDES No.	Facility Name	Address	City
88DP1456	MD0055549	DEER CREEK PUMPING STATION	CRAIGS CORNER	DARLINGTON
98DP0870	MD0024953	SPRING MEADOWS WWTP	1411 DALEWOOD DRIVE	JARRETTSVILLE

Industrial Surface Discharge				
Permit No.	NPDES No.	Facility Name	Address	City
04DP3465	MD0069221	SHA - CHURCHVILLE SHOP	3050 CHURCHVILLE ROAD	CHURCHVILLE
00DP3272	MD0068071	HARFORD COUNTY MAINTENANCE FACILITY - JARRETTSVILL	1348 COOPTOWN ROAD	FOREST HILL
90DP2224	MD0061387	TRANSCONTINENTAL GAS PIPE LINE - HARKINS	FAWN GRUVE, 1/4 MI DOWN FROM BRIDG	HARKINS
00DP3234	MD0067890	HARFORD WASTE DISPOSAL CENTER	3241 SCARBORO ROAD	STREET

Industrial Groundwater Discharge				
Permit No.	NPDES No.	Facility Name	Address	City
94DP3104		HARFORD SOD FARMS	MD ROUTE 24	FOREST HILL
04DP3263		MCGILL FARMS, LLC	2628 ROCKS ROAD	FOREST HILL

Municipal Groundwater Discharge				
Permit No.	NPDES No.	Facility Name	Address	City
03DP3451		BULL ON THE BEACH RESTAURANT	2306 CHURCHVILLE ROAD - LOT 3	CHURCHVILLE
04DP3274		HARFORD COMMUNITY COLLEGE	401 THOMAS RUN ROAD	BEL AIR
02DP3414		THE ARENA CLUB	2304 CHURCHVILLE ROAD	CHURCHVILLE
03DP1014		HABONIM CAMP ASSOCIATION	615 CHERRY HILL ROAD	STREET

General Industrial Stormwater				
Permit No.	NPDES No.	Facility Name	Address	City
02SW1330		SHA - CHURCHVILLE SHOP	3050 CHURCHVILLE ROAD	CHURCHVILLE
02SW1243		COMER CONSTRUCTION COMPANY, INC. - FOREST HILL	2100 SLADE LANE	FOREST HILL
02SW0028		HARFORD WASTE DISPOSAL CENTER	3241 SCARBORO ROAD	STREET

General Permits				
Permit No.	NPDES No.	Facility Name	Address	City
01SI6060	MDG766060	HARFORD COMMUNITY COLLEGE	401 THOMAS RUN ROAD	BEL AIR
01SI6682	MDG766682	BELLE MANOR HOA	2015-A POINTVIEW CIRCLE	BEL AIR
01SI6894	MDG766894	CAMP WO-ME-TO	1200 KNOPP ROAD	JARRETTSVILLE
00MM9742		MARYLAND CONCRETE SEPTIC TANK, INC.	21616 YORK ROAD	MARYLAND LINE

LIVING RESOURCES AND HABITAT

Living resources, including all the animals, plants and other organisms require water to survive. They and their habitats are intimately connected to water quality and availability. Water is an integral component of life. The availability and quality of water systems directly impact habitats and the living resources that exist therein. Living resources respond to changes in water and habitat conditions in specific ways. By studying the status of water bodies and the effects of watershed conditions we may draw conclusions as to the quality and health of these species and their habitats. In some cases, water quality is measured in terms of its ability to support specific living resources like trout or shellfish. Information on living resources is presented here to provide a gauge of water quality and habitat conditions in the watershed. It is also a potential measure of efforts to manage water quality and watersheds for the living resources that depend on them.

Fish

Assessments

As mentioned in the Water Quality section, the MBSS sampled fish in the Deer Creek watershed in their 2000-04 cycle. Stream health ratings, based on the fish IBIs, were distributed as follows: good – 11 (39%), fair – 9 (32%), and poor – 8 (29%) (MDNR MBSS on-line database). Data from their 2005 sampling will be presented in a separate report.

Fish Blockages

Many fish species migrate between freshwater and marine environments to complete their life cycles. Anadromous fish, such as American shad, hickory shad and alewife herring, spawn and hatch from eggs in free flowing streams but live most of their lives in estuarine or ocean waters. Catadromous fish, like the American eel, reproduce in the ocean and mature in estuaries or freshwater. Blockages in streams can inhibit or prevent these fish species from reaching habitats needed for breeding or development. Dams, culverts, and exposed sewer pipes can become barriers to fish migration. MDNR's Fish Passage Program maintains a database of fish blockages and works to eliminate them or provide passage over the barrier. The Fish Passage Program has completed 61 projects, reopening a total of 349 miles of upstream spawning habitat across the state (MDNR Fisheries, Fish Passage Program). In 1998, MDNR committed 200,000 dollars for construction of a fish lift at the Wilson Mill Dam to allow fish to spawn in the Lower Deer Creek for the first time in 200 years. Map 4, Water Monitoring and Fish Blockages, shows that Deer Creek watershed has 7 fish blockages that have been identified by MDNR's Fish Passage Program. MDE's Stream Corridor Assessment will locate additional migration barriers in the Deer Creek watershed and prioritize them for removal or mitigation.

Fish Consumption Advisories

Almost all fish have traces of mercury or other toxins. Maryland Department of the Environment is responsible for determining how much of a given species caught in Maryland's waters can be safely consumed. Fish Consumption Advisories by species for the entire State can be found at: http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/home/index.asp . Although there are no advisories specifically for Deer Creek, the following species have advisories for all streams and rivers in Maryland: small and largemouth bass. In addition, the following species have advisories for the Susquehanna River (the receiving body for Deer Creek): Channel catfish and Yellow perch.

Benthic Macroinvertebrates

An assessment of the current condition of the benthic macroinvertebrate communities will be provided by the Maryland Biological Stream Survey in a separate report. Results from the MBSS benthic macroinvertebrate assessments from previous years are summarized in the Water Quality section. In the last MBSS sampling cycle (Round 2) less than 10% of the samples were impaired based on the benthic macroinvertebrates (MDNR MBSS searchable database). A current assessment of the fish, amphibian, and reptile communities will also be covered in the MBSS report.

Sensitive Species

Sensitive species are generally recognized as being the plants or animals that are most at risk in regards to their ability to maintain healthy population levels. Perhaps the most widely known in the Deer Creek watershed are State and Federally-listed endangered and threatened animals such as the bald eagle, bog turtle and the Maryland Darter. The United States Fish and Wildlife Service and the MDNR work through their respective Federal and State programs to protect a wide variety of declining non-game animals, rare plants, and the unique natural communities that support them. For the purposes of watershed restoration, it is important to account for the known or potential habitats of sensitive species. Protecting or expanding these habitats helps to conserve biodiversity and is an effective component of a watershed restoration program.

MDNR's Wildlife and Heritage Service identifies important areas for sensitive species conservation in different ways. Several sensitive species overlays were created by the State of Maryland to identify potential habitat areas associated with these sensitive species. One overlay is the Sensitive Species Project Review Areas (SSPRA). The SSPRA are generalized areas enclosing ecologically significant areas (areas that harbor or could potentially harbor rare, threatened or endangered species) (MDNR Natural Heritage Program, SSPRA). Map 6, Sensitive Species, shows the SSPRA locations in Maryland's portion of the Deer Creek watershed.

There are State and Federal laws and regulations that address land use in areas where listed species occur. In addition, Harford County has incorporated safeguards for areas

associated with sensitive species into their project and permit review processes. In all instances, property owners are encouraged to follow the guidance that is provided by these agencies in protecting the sensitive species/habitat that occur on their property. MDNR's Natural Heritage Program has provided a list of rare, threatened and endangered (RTE) species for the Deer Creek watershed which can be found in Appendix A. In addition, a list of RTE for each county is available at: http://www.dnr.state.md.us/wildlife/espaa.asp

Perhaps the most well known endangered species in the Deer Creek Watershed is the Maryland Darter (*Etheostoma sellare*). The Maryland Darter was discovered in 1912 in Swan Creek, near Havre de Grace (MDNR Natural Heritage Program). In 1962, another Maryland Darter was found in Gashey's Run, also near Havre de Grace, and a healthy population was found in Deer Creek. Since 1965, all sightings have been confined to Deer Creek (MDNR Natural Heritage Program). The Maryland Darter's scarcity might be due to its extremely specialized habitat requirements. Maryland Darters seem to thrive only in the last riffles of a stream where the water flows out of the hills onto the relatively flat coastal plain (MDNR Natural Heritage Program).

Chesapeake Bay Critical Area Act

The Chesapeake Bay Critical Area Act, passed in 1984, designated as "Critical Areas" all lands within 1,000 feet of tidal waters or adjacent tidal wetlands (MDNR Critical Areas). The lands contained within this area are subject to development guidelines that attempt to minimize the impacts of development and to preserve valuable natural resources. The local jurisdiction has the duty to enforce its local regulations in these areas but the law also created a statewide Critical Area Commission to oversee the development and implementation of local land use programs in the Critical Areas. Map 6, Sensitive Species, shows the Critical Areas within the Deer Creek watershed. More information on Critical Areas can be found at: http://www.dnr.state.md.us/criticalarea/

Of specific importance to the Deer Creek WRAS is the delineation of Habitats of Local Significance (HLS) through the Critical Area Program. These areas are targeted for protection because they provide habitats that support rare, threatened or endangered species or they provide a unique natural community. Specific recommendations are made within the Critical Area Program for management goals for these areas. Within the Deer Creek watershed, there are five Habitat areas that were mapped as HLS. They include the Deer Creek Hillside, Stafford Road Slopes, the Northern Susquehanna Canal, Elbow Branch, and the Deer Creek Pumping Station.

Nontidal Wetlands of Special State Concern (WSSC)

Nontidal wetlands containing rare, threatened, endangered species or unique habitat are identified as nontidal Wetlands of Special State Concern (WSSC) in MDE regulations (COMAR 26.23.06). Two sites, covering 40 acres, were designated as Nontidal Wetlands of Special State Concern in this watershed as shown on Map 6, Sensitive Species. Site descriptions, as found in MDNR Natural Heritage Program documents for rare,

threatened and endangered (RTE) species are as follows (MDNR Natural Heritage Program, 1991):

Deer Creek Serpentine Barren – This is one of the largest and most ecologically significant serpentine rock formations in Maryland. Historically, serpentine areas support a mosaic of prairie-like grasslands and rocky openings harboring species uniquely adapted to the dry nutrient-poor soils. These diverse habitat types were kept relatively free of woody species by Native American fire-hunting. Since European civilization, Virginia Pine (*Pinus virginiana*), Eastern Red Cedar (*Juniperus virginiana*), and Common Greenbriar (*Smilax rotundifolia)* have overgrown many of the prairie-like grasslands. This area also supports a population of a State Threatened wildflower which occurs at only four other sites in Maryland.

Deer Creek (WSSC located in the Critical Area) – The remaining WSSC areas located within the Deer Creek Watershed are contained within the Critical Area. Refer to that section for more details.

LANDSCAPE

Land Use

Land use has pronounced impacts on water quality and habitat. A forested watershed absorbs nutrients and slows the flow of water into streams. Roads, parking areas, roofs and other human constructions are collectively called impervious surface. Impervious surfaces block the natural seepage of rain into the ground. Unlike many natural surfaces, impervious surfaces typically concentrate stormwater runoff, accelerate flow rates and direct stormwater to the nearest stream. This can cause bank erosion and destruction of in-stream and riparian habitat. Watersheds with small amounts of impervious surface tend to have better water quality in local streams than watersheds with greater amounts of impervious surface. Agricultural land, if not properly managed, can cause substantial increases in nutrients and coliform bacteria in streams.

Maryland's portion of the Deer Creek watershed has an area of approximately 93,000 acres based on 2002 data from the Maryland Department of Planning (Map 7: Land Use/Land Cover). Harford County's portion is 85,938 acres. The predominant land use in Harford County's part of the watershed is agriculture (54%) (Map 7, Table 3). Forest and brush cover 31% of the land and only 15% of the watershed is covered by developed land. Baltimore County has approximately 7000 acres of land in the Deer Creek watershed. In that section, 33% is forest and brush, 57% is agriculture, and 10% is developed land. Pennsylvania has approximately 16,250 acres of land that lie within Deer Creek's watershed. Similar to Maryland, agriculture is the predominant land use (57%), forest and brush (23%), and developed land (20%) respectively.

Table 3. Land Use Distribution for Deer Creek Watershed. (MDP data 2002)

Land Use Description	Harford Co. Area (Acres, %)	Baltimore Co. Area (Acres, %)	Total (Acres, %)
Forest/Brush	27,078 (31)	2,403 (33)	29,481 (32)
Agriculture	46,128 (54)	4,052 (57)	50,180 (54)
Barren Land	97 (<1)	0 (0)	97 (<1)
Developed Land	12,635 (15)	694 (10)	13,329 (14)
Total land area	85,938 (100)	7,149 (100)	93,087 (100)

Priority Funding Areas

The Maryland Planning Act and Smart Growth Initiatives required local jurisdictions to map specified growth areas where State infrastructure dollars would be targeted. These growth areas are referred to as Priority Funding Areas (PFA). In Harford County, the primary PFA is the County's Development Envelope, which is that area serviced by public water and/or sewer and targeted for development. This area was originally designated in 1977 as the focus of development in the County. It occurs along the Route 24, 40 and I-95corridor, and has received over 80% of the new development since its inception. The vast majority of the Deer Creek watershed lies outside of the Development Envelope in the northern rural area of the County. Less than 1% of this watershed lies within the Development Envelope (Harford County, Department of Planning and Zoning – Land Use Plan).

Within the rural area of the County are nine Rural Villages, also designated as PFAs. The Rural Villages are the focal areas for social, employment and commercial activity in the rural area. One of the Villages is located entirely within the watershed, and five others are located on the edge of the watershed. These villages have specific, designated PFA boundaries.

Growth Projections in the Watershed

There are currently 8,810 households and 24,750 persons residing in the Deer Creek Watershed; this represents 10.5 percent of the County's population. The population in the Deer Creek Watershed has increased 13.2 percent between 1990 and 2000. In 1990, the population was 21,100. By 2000, it had increased to 23,880, an average annual growth rate of 1.3 percent. The number of households increased from 7,170 in 1990 to 8,300 in 2000, an average annual growth rate of 1.6 percent. The population of the watershed is projected to be 27,100 by 2015, an increase of 2,350 persons from 2005; and the number of households projected by 2015 is 9,950, an increase of 1,140 households or 13 percent from 2005 (Harford County Department of Planning and Zoning).

Table 4. Deer Creek Watershed. Population / Households: 1990 to 2015.

YEAR	1990	2000	2005 (projected)	2015 (projected)
Population	21,100	23,880	24,750	27,100
Households	7,170	8,300	8,810	9,950

Residential Development

One indicator of the growth in the watershed is the amount of residential building permit activity. There were 2,304 new residential permits issued between 1988 and 2004, an average of 135 permits annually. Countywide, there were 31,338 permits issued during the same time period. The Deer Creek permit total represents 7.3 percent of the countywide total (Harford County Department of Planning and Zoning). The pattern of residential development in the Deer Creek watershed is depicted in a map prepared by the Maryland Department of Planning using Maryland Property View data (Appendix C).

Non-Residential Development

The Deer Creek Watershed is predominantly agricultural, with some limited residential and commercial development. Based on site plan approvals during the 1988 to 2004 period the non-residential uses that have developed include the following type and number: convenience stores (7); churches (2 new, 2 additions); shopping centers (1 strip center and 1 redevelopment of existing center); office (3); institutional, e.g. schools, parks, libraries, and recreation (6); commercial vehicle/equipment storage (4) and other miscellaneous small-scale commercial uses (15) (Harford County Department of Planning and Zoning).

Land Inventory

Residential

Based on data derived from the Harford County Agricultural Land Inventory completed in 2002, the estimated remaining residential development capacity of the Deer Creek Watershed is approximately 3,940 units. This figure includes planned approved lots that have not been built and the development right potential of vacant parcels that have not been subdivided since 1977. This figure does not include potential family conveyance lots, which have traditionally accounted for about 29 percent of the total lots created. Family conveyance lot potential is difficult to estimate because it involves multiple factors, including, but not limited to; parcel ownership as of February 8, 1977; the number of potential family members eligible; and the propensity of landowners to use family conveyances when creating lots (Harford County Department of Planning and Zoning).

Non-residential

According to data that was derived from the Harford County commercial land inventory, there is an existing inventory of 339 acres of commercially zoned developed land in the watershed. In addition, there are currently 416 acres of commercially zoned vacant land that is undeveloped. Vacant land is defined as parcels that are either vacant or underutilized with development potential (Harford County Department of Planning and Zoning).

Protected Lands

"Protected land" includes any land with some form of long-term limitation on conversion to urban/developed land use. This protection may be in various forms: public ownership for natural resource or low impact recreational intent, private ownership where a third party acquired the development rights or otherwise acquired the right to limit use through the purchase of an easement, etc. The extent of "protection" varies greatly from one situation to the next. Therefore, for some protected land, it may be necessary to explore the details of land protection parcel-by-parcel through the local land records office to determine the true extent of protection.

For purposes of watershed management, an understanding of existing protected lands can provide a starting point in prioritizing potential protection and restoration activities. In some cases, protected lands may provide opportunities for restoration projects because owners of these lands may value natural resource protection or enhancement goals. More information on watershed protection can be found in: *The Practice of Watershed Protection* (Schueler and Holland 2000).

Map 8, Protected Lands, shows the status of protected lands in the Deer Creek watershed. Data were provided by Baltimore County, Harford County, MDNR and MDP. Some land parcels may be affected by more than one type of protection. For example, government-owned parkland may also have a conservation easement on it.

Public Lands

The Federal government holds 209 acres of land in Maryland's part of the Deer Creek watershed for a Tank Proving Center which is part of the Aberdeen Proving Grounds (Map 8). Three state parks are in the watershed: Rocks State Park (with Hidden Valley and Falling Branch areas), Palmer State Park and Susquehanna State Park. These three parks comprise 2,673 acres of land. County Parks occupy another 801 acres of land bringing the acreage of parkland to 3,474 acres or 4% of the total land area in Maryland's portion of the Deer Creek watershed.

Private Lands

On private land, the largest protected land category is agricultural easements which total 22,875 acres in Harford County and 499 acres in Baltimore County (Map 8). These

easements are scattered throughout the watershed. Conservation easements cover 479 acres in Harford County and 1,818 acres in Baltimore County. The total area of easements in Maryland's part of the watershed is 25,671 acres or 28% of the total land area.

Rural Legacy

Development in Maryland is consuming land at an unprecedented rate. Maryland's Rural Legacy Program was established to protect those areas that represent the state's most valuable agricultural, forestry, natural, and cultural resources (MDNR Rural Legacy Program). The Program encourages local governments and private land trusts to identify Rural Legacy Areas and to competitively apply for funds to protect the land, complementing existing land preservation efforts. Easements or fee estate purchases are sought from willing landowners in order to protect these vulnerable areas from development.

In 1999 the Lower Deer Creek Valley Rural Legacy Area was established. Since that time over 1,500 acres have been protected through conservation easements. The Rural Legacy program helps to preserve the historic and cultural resources of the Deer Creek valley and protect water quality and habitat in the watershed. Portions of the Rural Legacy area shown on Map 8, Protected Land, have been protected; work continues on obtaining conservation easements in the area.

Soils

Soil type and moisture conditions greatly affect how land may be used and the potential for vegetation and habitat on the land. Soil conditions are also one determining factor for water quality in streams and rivers. Soils are an important factor to incorporate in targeting projects aimed at improving water quality or habitat.

Local soil conditions vary greatly from site to site. Soils data were provided by Harford County and the U.S. Department of Agriculture. A summary of this information is shown for the WRAS watershed in Map 9, Soils:

- Overall, about 31,487 acres (34%) of Maryland's portion of Deer Creek watershed is prime agricultural soil that does not require drainage or irrigation. Another 4,424 acres (5%), requiring either drainage or irrigation, are also potentially prime agricultural soil.

- Nearly 4,344 acres of Maryland's part of the watershed exhibit hydric characteristics. Hydric soils adjacent to streams or wetlands may offer opportunities for restoration of natural vegetated buffers or wetlands that could intercept nitrogen moving in groundwater before it reaches surface waters.

Green Infrastructure

MDNR has mapped a Statewide network of ecologically important lands across the State called “Green Infrastructure”. This network is comprised of large blocks of important natural resource lands called hubs and corridors that connect the hubs. These areas are primarily large blocks of contiguous forest but also include wetlands and other naturally vegetated lands. These lands provide significant environmental benefits, such as cleaning the air, filtering and cooling water, and storing and cycling nutrients. Appendix B provides a detailed assessment of the Green Infrastructure in the Deer Creek watershed.

Large Forest Blocks

Forest interior dwelling species (FIDS) require large blocks of forest habitat with relatively little influence from open-areas species or from humans (MDNR 2003). FIDS habitat is a forest block at least 50 acres in size with at least 10 acres of forest interior (forest edge is at least 300 feet away). High quality FIDS habitat is either mature hardwood or mixed hardwood-pine forest at least 100 acres in size of which forest interior habitat comprises at least 25% of the total forest area. This habitat also must contain one or more of the following:

- Contiguous forest acreage of greater than 50 acres;
- Riparian forest bordering a perennial stream or river and, on average, at least 300 feet in width;
- At least one highly area-sensitive species or Black-and-white Warbler, as a probable or confirmed breeder;
- Mature river terrace, ravine, or cove hardwoods, located at least 300 feet from the nearest forest edge;
- At least 5 contiguous acres of old growth forest (as defined in the 1989 MD Department of Natural Resources report "Old Growth Forest Ecosystems") located at least 300 feet from the nearest forest edge (MDNR 2003).

The forest interior assessment map differs from the Green Infrastructure assessment in that forest interior areas are more numerous and more widely distributed because the forest interior size threshold is lower (MDNR 2003). Map 10, Large Block Forest Habitat, shows that Maryland’s part of the Deer Creek watershed contains 12,099 acres of high quality FIDS habitat which makes up 41% of the total forest area. Other Large Block Forest Habitat occupy 5,151 acres (18%) and other forest land comprises 12,168 acres (41%) (MDNR, Natural Heritage Program and MDP 2002).

Wetlands

The U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency define wetlands as follows (EPA Office of Wetlands, Oceans and Watersheds web site):

“Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do

support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wetland Functions

The State of Maryland Nontidal Wetlands Protection Act of 1989 designates statutory wetland functions which are summarized in the table below from the MDE Wetlands web site and Tiner and Burke (1995).

Table 5. Wetland Functions.

Function	Definition
Ground Water Recharge and Discharge	The capacity of processes in a wetland to influence the amount of water and the rate at which it moves between the ground water system and the surface water system
Stormwater and Flood Control	The capacity of a wetland to store large volumes of water during floods; wetlands modify the flow in streams by decreasing peak discharge (volume of water over a given time) and increasing time of concentration (time between rainfall/flood event and release of water to streams)
Improved Water Quality Toxic Retention Nutrient Removal Transformation	Removal of suspended and dissolved solids and nutrients from surface and ground water and conversion into other forms, such as plant and animal biomass or gases
Sediment Stabilization and Retention	The capacity of processes in a wetland to cause the deposition and retention of inorganic and organic sediments from the water column, primarily through physical processes
Aquatic Diversity and Habitat	The capacity of a wetland to produce an abundance and diversity of hydrophytic plant species and communities, and aquatic habitats for animals
Wildlife Diversity and Habitat	The capacity of a wetland to produce large and/or diverse populations of animal species and communities that spend part or all of their life cycle in wetlands

Wetland Categories

Palustrine wetlands are freshwater wetlands that are not associated with flowing water or lakes. In general, palustrine wetlands are associated with freshwater, high water tables, intermittent ponding on land or floodplains. These wetlands are found on floodplains along the freshwater tidal and nontidal portions of rivers and streams, in upland depressions, and in broad flat areas between otherwise distinct watersheds. Riverine wetlands are wetlands found along rivers and streams. (Adapted from Wetlands of Maryland, Tiner and Burke, 1995.)

Based on data provided by Maryland Department of Natural Resources, the Federal Emergency Management Agency (FEMA), and the U.S. Fish and Wildlife Agency, wetland acreage in the Deer Creek watershed is shown on Map 11, Wetlands and Floodplains, and summarized in the table below. These numbers are a very conservative estimate of total nontidal wetlands in the watershed.

Table 6. Wetland Types in Deer Creek Watershed. (Published: 1993)

Type of Wetland	Harford Acreage	Baltimore Acreage	Total
Aquatic Bed	1	0	1
Palustrine, Emergent	66	22	88
Palustrine, Forested	28	1	29
Palustrine, Scrub/Shrub	6	1	7
Palustrine, Unconsolidated bottom	255	18	273
Unconsolidated shore	1	0	1
Farmed	6	0	6
Riverine Wetlands, Unconsolidated Shore	5	0	5
Total for watershed	368	42	410

Tracking Wetlands

Oversight of activities affecting wetlands involves several regulatory jurisdictions. MDE is the lead agency for the State and cooperates with MDNR, the Army Corps of Engineers and other Federal and local agencies. MDE tracks State permitting of permanent impacts on wetlands and mitigation projects. Based on the permit data, Deer Creek watershed has had a small net gain (1.12 acres) of nontidal wetlands for the period from 1991 to 2005 (Walbeck 2005).

Floodplains

Floodplains, particularly those that contain hydric soils, tend to present conditions that limit intensive use. These conditions also present opportunities for maintenance or restoration of natural vegetation, habitat and water quality. Targeting of water quality-related projects, like stream buffers, or habitat-related projects like Green Infrastructure enhancement, should consider local floodplain conditions. Map 11 shows that the 100-year Floodplain for Deer Creek watershed covers 3,121 acres in Harford County and 430 acres in Baltimore County. These floodplain acreages are based on FEMA's Flood Insurance Rate Map (FIRM) data (1:12,000 scale Digital Flood Insurance Rate Map (DFIRM) data for the part of the Deer Creek watershed in Harford County and 1:24,000 scale Q3 data for the Baltimore County portion since the finer mapped DFIRM data were not yet available for Baltimore County).

Stream Buffers

Benefits of Stream Buffers

Natural vegetation in stream riparian zones, particularly forest, provides numerous valuable environmental benefits:

- Reducing surface runoff,
- Preventing erosion and sediment movement,
- Using nutrients for vegetative growth and moderating nutrient entry into the stream,
- Moderating temperature, particularly reducing warm season water temperature,
- Providing organic material (decomposing leaves) that are the foundation of natural food webs in stream systems,
- Providing overhead and in-stream cover and habitat,
- Promoting high quality aquatic habitat and diverse populations of aquatic species.

Land Use Adjacent to Streams

Map 12, Land Use/Land Cover at Stream's Edge, shows the general land use adjacent to the streams in the Deer Creek watershed using GIS. Data were provided by Harford County, Maryland Department of Planning, U.S. Department of Agriculture and the U.S. Environmental Protection Agency. This method of assessing land use at the stream's edge can be used in the absence of field data collected by stream corridor assessment. Deer Creek has 261 miles of perennial, flowing streams when mapped at the 1/24,000 scale; very small streams do not appear at this scale. The distribution of land use at the stream's edge is shown in the following table.

Table 7. Land Use/Land Cover at Stream's Edge in Deer Creek Watershed. (Published: 2002)

Type of Coverage	Harford Stream miles	Baltimore Stream miles	Total Stream miles
Developed Land	17	<1	17
Forest, Wetlands and Brush	121	11	132
Agricultural Land	102	10	112
Agricultural Land on Hydric Soil (subset of Ag Land)	(25)	(3)	(28)
Total for watershed	240	21	261

PROJECTS RELATED TO THE WRAS PROCESS

Deer Creek Scenic River

In 1973 Deer Creek was designated a Scenic River by the Maryland legislature. In 1978 the Deer Creek Scenic River district was established in the County Code to preserve Deer Creek as a free flowing stream and to preserve and protect its natural and cultural values for present and future generations. An appointed Deer Creek Scenic River advisory board reviews proposals for new development within 150 feet of the banks of the Creek, and makes recommendations concerning management and preservation of Deer Creek (MDNR 1979).

Lower Deer Creek Rural Legacy Area

The Lower Deer Creek Valley Rural Legacy Area was established in 1999 and awarded its first funds for acquisition of perpetual easements in 2000. The area covers 40,092 acres stretching between the Susquehanna River and Rocks State Park. To date 23 properties, totaling over 1500 acres have been preserved with Rural Legacy funds. Over 45% of the land within the Rural Legacy Area is protected (18,219 acres) with the largest contiguous block of protected land totaling 11,090 acres (Harford County Department of Planning and Zoning).

The goal of the Lower Deer Creek Rural Legacy Area is to preserve the historic rural character of the valley while helping to protect the water quality of Deer Creek. The focus of the program is on acquiring perpetual easements on properties that adjoin Deer Creek, one of its tributaries or properties that are adjacent to other protected properties (Harford County Department of Planning and Zoning).

Lower Susquehanna Heritage Greenway

A portion of the Lower Susquehanna Heritage Greenway lies within the eastern portion of the Deer Creek watershed. This is the most notable greenway in Harford County. It was designated by the State of Maryland as a Certified Maryland Heritage Area in 1997. This greenway is a series of trails that connects cultural, historical and natural resources along both sides of the Susquehanna River from the Conowingo Dam to the head of the Chesapeake Bay. The LSHG is managed by a non-profit corporation (Harford County Department of Planning and Zoning).

Agricultural Section 319 Targeted Watershed

The Deer Creek watershed has been the recipient of Section 319 funds as the result of it being designated a Maryland Agricultural Water Quality Priority Watershed due to its potential for nutrient loading. The Harford County Soil Conservation District has been the recipient of Section 319 funds to support the preparation of soil conservation and water quality plans on farms within the watershed. Substantial progress has been made

to-date, with over sixty percent of the watershed now under a plan. Six of the twelve 12-digit subwatersheds in the basin are at over eighty percent plan completion. The target date for the entire watershed to be covered by plans is 2020 (Harford County Department of Planning and Zoning).

Deer Creek Water Availability Study - SRBC

The Susquehanna River Basin Commission is currently undertaking a comprehensive assessment of the available water resources of the Deer Creek watershed in southern Pennsylvania and Harford and Baltimore Counties in Maryland. The study will provide an inventory and assessment of key water resources in the watershed, provide an estimated sustainable yield from the watershed, inventory current water uses, project demands for the different use sectors, and evaluate potential issues and problems related to future water availability. The ability of the watershed to meet anticipated needs over the next 25 years will be addressed. The study is expected to be completed in 2007 (Harford County Department of Planning and Zoning).

RESTORATION TARGETING TOOLS

Stream Corridor Assessment

Using the Stream Corridor Assessment, valuable information can be compiled to assist in targeting restoration activities. This information will complement existing watershed-related information and may explain cause and effect relationships between what is occurring in the watershed and how those activities are impacting the stream systems. Trained teams walked along streams to identify and document potential problems and restoration opportunities such as pipe outfalls, fish blockages, erosion, trash, pond sites, and exposed pipes. The subwatersheds selected by Harford County for assessment include subwatersheds: 0321 – Elbow Branch; 0322 - Cool Branch Run, Tobacco Run, Mill Brook, Graveyard Creek, Hopkins Branch and Hollands Branch; 0324 – unnamed tributary to Deer Creek; 0328 – Little Deer Creek; 0330 – unnamed tributary to Deer Creek; and 0331 - Big Branch.

Synoptic Survey and MBSS

Based on Synoptic Survey sampling in the Deer Creek watershed, MDE staff reported on water quality in nontidal streams to supplement knowledge of local conditions. Based on selected parameters (dissolved oxygen, nitrogen, phosphorus, pH, conductivity, temperature), the survey findings will help identify problem areas and relative conditions among local streams. It will also help rank subwatersheds by their nutrient load contributions to the waterbodies. For the same 2005 sampling sites, the MBSS survey results describe the benthic organism populations in nontidal streams as a gauge of water quality and habitat conditions. MDNR’s report of 2005 findings will include assessment of water quality, benthic organism populations and the potential relationships that may be drawn from the data.

Agricultural Conservation Programs

The Harford County Soil Conservation District works with farmers and landowners in the development of Soil Conservation and Water Quality plans. These plans recommend best management practices that will prevent nutrient and sediment impact on surface and ground water. Some of the conservation practices that can be used are grassed waterways, riparian herbaceous and riparian forested buffers, conservation cover, cover crops, shallow water wildlife areas and grade stabilization structures. The Maryland Agricultural Cost-Share program (MACS), the Conservation Reserve Program (CRP and CREP) and the Environmental Quality Incentive Program (EQIP) are some of the state and federal programs promoted and administered by the Soil Conservation District. Farmers in the watershed who are already using good management practices that benefit water quality could provide examples to promote adoption of similar practices by other farmers.

Fish Blockage Removal

Many fish species need to move from one stream segment to the next in order to maintain healthy resilient populations. Blockages in streams may inhibit or prevent many fish species from moving up stream to otherwise viable habitat. To help prioritize stream blockages for mitigation or removal, the MDNR's Fish Passage Program maintains a database of significant blockages to fish movement. The listings in this database should be considered supplemental information to the Stream Corridor Assessment. Based on experience in other watersheds, it is likely that the assessment will identify additional potential fish blockage problems. Some blockages to fish movement may be structural components of stream gauging weirs, farm ponds, drainage ditches, etc. If a blockage is found to be in this category, circumstances such as requirements for drainage control, ease of removing the obstruction, accessibility to the site and public or landowner needs are considered in determining the potential for a restoration project. Fish blockages are shown on Map 4.

Stream Buffer Restoration

Natural vegetation in stream riparian zones function as stream buffers that can provide numerous valuable environmental benefits such as reducing surface runoff, preventing erosion, and providing overhead cover and habitat.

Headwater Streams

Headwater streams are the smallest and most numerous in Maryland watersheds. These streams at the "top" of the watershed are the type and size that are most affected by development. Typically, headwater streams drain the majority of the land within the entire watershed; therefore, stream buffers restored along headwater streams tend to have greater potential to intercept nutrients and sediments than stream buffers placed elsewhere. Vegetated buffers provide nutrient removal in spring and headwater areas. In

targeting stream buffer restoration projects, giving higher priority to headwater streams is one approach to optimizing nutrient and sediment retention. Restoring headwater stream buffers can also provide habitat benefits that can extend downstream of the project area. Forested headwater streams provide important organic material, like decomposing leaves, which "feed" the stream's food web. They also introduce woody debris which enhances in-stream physical habitat. The potential for riparian forest buffers to significantly influence stream temperature is greatest in headwater regions. These factors, in addition to positive water quality effects, are key to improving aquatic habitat.

Optimizing Water Quality Benefits by Combining Priorities

Strategic targeting of stream buffer restoration projects may promote many different potential benefits. To maximize multiple benefits, site selection and project design need to incorporate numerous factors. For example, finding a site with a mix of attributes like those in the following list could result in the greatest control of non-point source pollution and enhancement to living resources:

– land owner willingness and the availability of incentive programs,
– marginal land use in the riparian zone,
– headwater stream,
– hydric soils,
– selecting appropriate woody/grass species,
– adjacent to existing wetlands / habitat.

Additionally, selecting restoration projects that are likely to produce measurable success is an important consideration in prioritizing projects for implementation. In the early stages of a watershed restoration program, measurable water quality improvement can be one of the strongest ways to demonstrate project success. In general, targeting restoration projects to one or a few selected tributaries or small watersheds will tend to offer the greatest probability of producing measurable water quality improvement.

Wetland Restoration

Wetlands serve important environmental functions such as erosion control, habitat and nursery areas for many organisms and nutrient uptake/recycling. However, most watersheds in Maryland have significantly fewer wetland acres today than in the past. This loss due to draining or filling has led to habitat loss and negative water quality impacts in streams and in the Chesapeake Bay. Reversing this historic trend is an important goal of wetland restoration. Staff from MDE's Waterways and Wetlands Program and the WRAS program can provide assistance to local governments in targeting wetland restoration efforts.

POTENTIAL BENCHMARKS FOR WRAS GOAL SETTING

Several programs designed to manage water quality and/or living resources have existing or proposed goals that are relevant to setting goals for the Deer Creek WRAS. The goals from these other programs tend to overlap and run parallel to potential interests for developing WRAS goals. Therefore, to assist in WRAS development, selected goals from other programs are included here as points of reference.

Water Quality Standards and TMDLs

Water quality standards represent minimum legal goals for managing the physical, chemical and biological integrity of the Nation's waters. Achieving these standards will necessitate the restoration and protection of habitat and living resources within the watershed.

In order to meet water quality standards, Total Maximum Daily Loads (TMDLs) have been established for pollutants in many impaired waterbodies. TMDLs represent pollutant loading goals. In watershed management plans designed to implement TMDL goals, Best Management Practices (BMPs) are often included. BMPs are management practices (such as nutrient management) or structural practices (such as terraces) designed to reduce the quantities of pollutants. Thus, water quality standards, TMDLs, and BMPs reflected in implementation plans provide a set of benchmarks, which are linked together via a systematic water quality management framework.

Existing water quality impairments, water quality goals, and loading goals for the Deer Creek are documented in the TMDL(s) for that waterbody. Watershed plans should focus on implementation actions that have a high likelihood of improving these specific water quality impairments.

Chesapeake 2000 Agreement

The Chesapeake 2000 Agreement (C2K) includes several significant commitments pertaining to local watershed management planning and implementation. These are the load reduction goals for nitrogen and phosphorus, and the watershed management planning goal.

The C2K Agreement called for the refinement of water quality standards in the Bay, and the assignment of nutrient load reductions to each major tributary. The Agreement also called for the revision of Tributary Strategy implementation plans to "achieve and maintain the assigned loading goals." This process is analogous to the process by which TMDLs have been established at a more refined geographic scale. Thus, watershed management plans that strive for either goal are ensured to complement the other.

The goal in the C2K Agreement that is directly related to the development of watershed management plans and action strategies is:

> "By 2010, work with local governments, community watershed groups and watershed organizations to develop and implement locally supported watershed management plans in two-thirds of the Bay watershed covered by this Agreement. These plans would address the protection, conservation and restoration of stream corridors, riparian buffers and wetlands for the purposes of improving habitat and water quality, with the collateral benefits for optimizing flow and water supply."

Four common elements of watershed management planning were adopted by the Chesapeake Bay Program member jurisdictions to be applied Bay-wide. Those elements support the WRAS components which were also identified as common Bay-wide criteria for watershed management planning. The four approved C2K Agreement watershed-planning elements are as follows:

1. Does the plan "address the protection, conservation and restoration of stream corridors, riparian forest buffers and wetlands?" Each watershed management plan needs to be based on site-specific assessments of natural resources within the watershed. At a minimum, the assessment will evaluate the condition of stream corridors, riparian buffers and wetlands within the watershed.

2. Does the plan reflect the goals and objectives of "improving habitat and water quality?" The plan should reflect the issues that the stakeholders feel are important, and, at a minimum, exhibit a benefit to habitat and water quality within the watershed. The goals should be based on priority issues identified by the watershed assessment.

3. Does the plan identify implementation mechanisms? Capacity to implement the plan will be demonstrated by identifying:

- What are the specific management actions?
- What are the resources necessary for implementation?
- Who will implement the plan?
- When will the actions be implemented?

4. Does the plan have demonstrated local support? Every effort should be made to demonstrate a diversity of local support. At a minimum, local governments, community groups and watershed organizations should be encouraged to participate in developing and implementing the watershed management plan.

Water Quality Improvement Act of 1998

The Water Quality Improvement Act of 1998 presents many challenges for agricultural in Maryland. It represents a major change in our approach to controlling agricultural nutrient pollution. The Act requires nutrient management plans for both nitrogen and phosphorus for virtually all Maryland farms. The Maryland Agricultural Water Quality Cost-Share (MACS) Program offers cost-share assistance for the development of nutrient management plans. The Manure Transport Program helps poultry, dairy, beef and other

livestock producers cover the costs of transporting excess manure identified by their nutrient management plans off their farms. Implementation of projects assisted by this funding has the potential to move nutrients to sites where they are needed and reduce nutrient input to Maryland's waters (University of Maryland 1998; Maryland Department of Agriculture 2003).

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APPENDIX A: Current Rare, Threatened, and Endangered Species of Deer Creek Watershed (02120202) as of January 5, 2006

Scientific Name	Common Name	G-rank	S-rank	MD	US
Antennaria solitaria	Single-headed Pussytoes	G5	S2	T	
Carex davisii	Davis' Sedge	G4	S1	E	
Clemmys muhlenbergii	Bog Turtle	G3	S2	T	LT
Euphorbia purpurea	Darlington's Spurge	G3	S1	E	
Haliaeetus leucocephalus	Bald Eagle	G4	S2S3B	T	LT
Hasteola suaveolens	Sweet-scented Indian-plantain	G3	S1	E	
Juglans cinerea	Butternut	G3G4	S2S3		
Linum sulcatum	Grooved Flax	G5	S1	E	
Matteuccia struthiopteris	Ostrich Fern	G5	S2		
Panicum flexile	Wiry Witch-grass	G5	S1	E	
Percina caprodes	Logperch	G5	S1S2	T	
Sagittaria longirostra	Long-beaked Arrowhead	GNRQ	SU		
Sanguisorba canadensis	Canada Burnet	G5	S2	T	
Scutellaria leonardii	Leonard's Skullcap	G4T4	S2	T	
Sorex fumeus	Smoky Shrew	G5	S2S3	I	
Sorex hoyi winnemana	Southern Pygmy Shrew	G5T4	S2		
Sperchopsis tessellatus	A Hydrophilid Beetle	GNR	S2		
Stenanthium gramineum	Featherbells	G4G5	S1	T	
Strophitus undulatus	Creeper	G5	S2	I	
Talinum teretifolium	Fameflower	G4	S1	T	
Valeriana pauciflora	Valerian	G4	S1	E	

OTHER Biological Resources of Concern to DNR's Wildlife & Heritage Service:
Forest Interior Dwelling Species Habitat

Historical Rare, Threatened, and Endangered Species of Deer Creek Watershed (02120202)

Asplenium bradleyi	Bradley's Spleenwort	G4	SH	X
Asplenium pinnatifidum	Lobed Spleenwort	G4	S1	E
Aster concinnus	Steele's Aster	G5T4	SH	X
Aster depauperatus	Serpentine Aster	G2	S1	E
Aster radula	Rough-leaved Aster	G5	S1	E
Bartramia longicauda	Upland Sandpiper	G5	S1B	E
Boltonia asteroides	Aster-like Boltonia	G5	S1	E
Bromus latiglumis	Broad-glumed Brome	G5	S1	E
Carex planispicata	A Sedge	G4Q	S1S2	
Castilleja coccinea	Indian Paintbrush	G5	S1	E
Clematis occidentalis	Purple Clematis	G5	S1	E
Clemmys muhlenbergii	Bog Turtle	G3	S2	T
Coreopsis tripteris	Tall Tickseed	G5	S1	E
Cyperus retrofractus	Rough Cyperus	G5	S2	
Desmodium pauciflorum	Few-flowered Tick-trefoil	G5	S1	E
Desmodium rigidum	Rigid Tick-trefoil	GNRQ	S1	E

Diplazium pycnocarpon	Glade Fern	G5	S2	T	
Empidonax alnorum	Alder Flycatcher	G5	S2B	I	
Equisetum fluviatile	Water Horsetail	G5	S1	E	
Erynnis martialis	Mottled Duskywing	G3G4	S1	E	
Erythronium albidum	White Trout Lily	G5	S2	T	
Etheostoma sellare	Maryland Darter	GH	SH	E	LE
Festuca paradoxa	Cluster Fescue	G5	SH	X	
Gentiana andrewsii	Fringe-tip Closed Gentian	G5?	S2	T	
Graptemys geographica	Map Turtle	G5	S1	E*	
Hypericum pyramidatum	Great St. John's-wort	G4	SH	X	
Pedicularis lanceolata	Swamp Lousewort	G5	S1	E	
Platanthera psycodes	Small Purple Fringed Orchid	G5	SU	X	
Pycnanthemum virginianum	Virginia Mountain-mint	G5	S2		
Silene nivea	Snowy Campion	G4?	S1	E	
Speyeria idalia	Regal Fritillary	G3	SH	X	
Stellaria alsine	Trailing Stitchwort	G5	S1	E	
Triphora trianthophora	Nodding Pogonia	G3G4	S1	X	

EXPLANATION OF RANK AND STATUS CODES FOR RTE LIST
January 26, 2003
(From MDNR Natural Heritage Program)

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 criteria used to define these ranks are 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 both at the state as well as regional level.

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 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.

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

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

PX Proposed 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.

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

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:

Green Infrastructure

Green Infrastructure Assessment
Harford County Deer Creek Watershed

Final Draft
August 2005

Maryland Department of Natural Resources
Watershed Services Center, Ecosystem Analysis Center

Introduction

Large blocks of natural resource lands in Harford County's portion of the Deer Creek watershed provide valuable water quality and habitat benefits. These areas are primarily large blocks of contiguous forest but also included are wetlands and other naturally vegetated lands. In general, actions taken to prevent conversion to other land uses, to avoid forest fragmentation, and to restore forest in areas that have been cleared will contribute significantly to maintaining and improving the water quality in this watershed and to conserving Maryland's biodiversity.

To assist in protection and tracking of natural resource areas that are important at the landscape scale, DNR has mapped a Statewide network of ecologically important lands collectively called "Green Infrastructure." This Green Infrastructure provides the bulk of the state's natural support system. It delivers ecosystem services, such as cleaning the air, filtering and cooling water, storing and cycling nutrients, conserving and generating soils, pollinating crops and other plants, regulating climate, protecting areas against storm and flood damage, and maintaining hydrologic function.

Green Infrastructure, as defined by Maryland Department of Natural Resources represents natural resource conditions on the ground. In general, the Green Infrastructure network is comprised of large blocks of important natural resource lands called hubs and corridors that link the hubs. Hubs contain one or more of the following:

- Areas containing sensitive plant or animal species;
- Large blocks of contiguous interior forest (at least 250 contiguous acres, plus the 300 foot transition zone);
- Wetland complexes with at least 250 acres of unmodified wetlands;
- Streams or rivers with aquatic species of concern, rare coldwater or blackwater ecosystems, or important to anadromous fish, and their associated riparian forest and wetlands; and
- Conservation areas already protected by public (primarily DNR or the federal government) and private organizations like The Nature Conservancy or Maryland Ornithological Society.

For more information on how Maryland's Green Infrastructure was identified and previously published reports that reflect conditions in the 1990s, see www.dnr.maryland.gov/greenways/

Local Findings

Across Maryland, new development, land management changes and other on-the-ground activities are changing Green Infrastructure in measurable ways compared to conditions in the 1990s when it was originally identified. Until a fully updated Green Infrastructure assessment can be preformed to comprehensively account for these changes, an interim approach has been devised to gauge current conditions in the Green Infrastructure. The interim approach employs the existing Green Infrastructure boundaries for hubs and corridors like cookie cutters on Maryland Department of Planning 2002 land use data.

This approach acknowledges land use changes that have occurred within Maryland's Green Infrastructure since it was initially identified.

The map *Green Infrastructure – 2002* shows several findings for Harford County's portion of the Deer Creek watershed:

- Hubs contain nearly 8800 acres of forest and other naturally vegetated lands
- Hubs also encompass about 2000 acres of gaps in the Green Infrastructure that are either in agriculture, development or other land uses.
- Corridors that link the hubs contain over 5500 acres of forest and other naturally vegetated lands. However, about half of these corridors are agriculture or development gaps.
- The location and type of gap in the Green Infrastructure (generally development or agricultural) contributes or detracts from the overall natural resource value and function of the hubs and the corridors.

Change Over Time

Using the same approach described for 2002 data, the existing Green Infrastructure hub and corridor boundaries are applied like cookie cutters on Maryland Department of Planning (MDP) 1973 land use data. The map *Green Infrastructure – 1973* shows the results. By comparing the differences within the corridor boundaries for 1973 and 2002, an estimate of land use change in the hubs and corridors for over nearly 30 years can be generated. Several findings from the comparison are summarized below:

- In hubs, forest and other naturally vegetated area cover about the same acreage in 1973 and 2002. Additionally, gaps in the Green Infrastructure for both years cover about the same acreage. However, within the acreage coverage by these gaps, development has expanded at the expense of agricultural land. Four of the five highest ranked hubs in the Deer Creek watershed have experienced residential development in the past 30 years based on a comparison of MDP data for 2002 and 1973. This trend suggests that the rural character of Deer Creek's hubs is diminishing and human activity/disturbance in and around naturally vegetated areas is probably increasing.
- In corridors, forest and other naturally vegetated area lost nearly 500 acres between 1973 and 2002. At the same time, agricultural acreage in the corridors declined 760 acres. These losses are accounted for by the great expansion of developed area from less than 200 acres to 1400 acres. This increase in development suggests that the natural habitat connections between Green Infrastructure hubs diminished significantly in the past 30 years.

Interpreting Hub Ranking

The map *Green Infrastructure Hub Rank* shows that there are fifteen Green Infrastructure hubs in the Deer Creek Watershed. From the perspective of the statewide analysis that was used to identify the hubs, all hubs identified in Maryland's Green Infrastructure are important in the State's network of natural resource areas.

The ecological values associated with each hub differ in ways that can be used to compare and prioritize them for potential management action. The "Eco-Region Percent Rank" shown in the map presents one of many possible views for comparing the hubs. To interpret this ranking effectively, it is important to understand what this ranking represents. In general, larger hubs are ranked closer to "1" and smaller hubs are ranked closer to "100". The relative size of the GI hubs is one measure of their importance regionally in Maryland network of natural areas. The smaller hubs are important on the local scale by contributing to conditions in local streams. Numerous other measurements of environmental integrity also contribute to this ranking.

For all Green Infrastructure hubs, two important management objectives generally apply:

- Maintaining/enhancing integrity of the large block natural area already in the hub.
- Maintaining/enhancing connectivity between two or more hubs so that they can function collectively in the natural resource network.

For larger hubs, maintaining hub integrity tends to be relatively important. For smaller hubs, enhancing connectivity, i.e. allowing two hubs to function as one larger hub, is an increasing important management objective.

Local Hub Findings

Findings for individual Green Infrastructure (GI) hubs are presented in the three tables at the end of this section. The table includes a suggested name for each hub based on one or two attributes identified during the analysis including park names, stream names or nearby roads.

Findings that apply to more than one hub in the Deer Creek watershed are summarized in the following list:

- The majority of land in GI hubs within the Deer Creek watershed is privately owned. Most of this private land does not have protection from conversion to development or other land uses.
- Forest interior habitat is found in all GI hubs in the Deer Creek watershed to varying degrees. Larger hubs tend to encompass the more significant forest interior habitat.
- Sensitive Species habitat is found in all GI hubs in the Deer Creek watershed. This habitat is associated with Wetlands of Special State Concern in two hubs.
- Public land ownership in a park or conservation area is found mostly in larger GI hubs and these hubs tend to rank closer to "1".
- Fourteen of the fifteen GI hubs in the Deer Creek watershed have some parcels of land that have one or more protections against conversation of land use to development. In most cases, the extent and type of existing protection is not sufficient to maintain the integrity of the GI hub if the unprotected land in the hub is developed.
- The most common form of protection against land use conversion to development found in smaller hubs is agricultural easement. While this form of protection

limits the potential for development, the capability of agricultural easement to protect or enhance the natural resource values of the GI hub is uncertain.

Green Infrastructure Hub Rank For the Deer Creek Watershed Scale for Rank is from 1 (important larger hubs) To 100 (also important but smaller hubs)		
Map Key	Percent Rank	Green Infrastructure Hub Description
1	9	*Rocks State Park GI Hub* includes upstream private forestland in vicinity of Wet Stone Branch and Rock Hollow Branch. Within this GI hub, land that is not in the State Park is typically unprotected private land. This GI hub is outside of Harford County's Rural Legacy areas.
2	9.7	The *Grier Nursery Road/Rt 543 GI Hub* is on the north side of Deer Creek. This GI hub is entirely unprotected private land and it is within the Lower Deer Creek Rural Legacy Area.
3	11	The *Rt 23/Hidden Valley Girls Camp GI Hub* is along Deer Creek. Most of this hub is unprotected private land but it includes a small part of Rocks State Park. This GI hub is outside of Harford County's Rural Legacy areas.
4	11.6	*Susquehanna State Park GI hub* extends beyond the Deer Creek watershed. Most of the hub is private unprotected land within the Lower Deer Creek Rural Legacy Area.
5	22.6	*Plumtree Branch Vicinity GI Hub* is upstream of Rt 23 and includes Harford County's Parker Conservation Area. Most of this GI hub is unprotected private land.
6	25.2	*Forge Hill Road Vicinity GI Hub* is around Deer Creek and includes portions of the Thomas Run drainage. This GI hub is entirely unprotected private land and it is within the Lower Deer Creek Rural Legacy Area.
7	32.3	*Thomas Run Headwaters GI Hub* is northeast of Bel Air bounded by Rt 1 on the west and Prospect Mill Road on the south. It is partly in the Lower Dreek Creek Rural Legacy Area and is partly protected by two Rural Legacy properties. The majority of this GI hub is unprotected private land.
8	49.7	*Rocks Road/4-H Camp GI Hub* is across Deer Creek from Rocks State Park. A small portion of this hub is in Rocks State Park and some of it is under agricultural easement. This entire GI hub is in the Lower Deer Creek Rural Legacy Area and most of it is unprotected private land.
9	65.2	*Hopkins Branch Headwaters GI Hub* is partly in the Lower Deer Creek Rural Legacy Area. It is entirely unprotected private land.
10	69.7	About half of the *Falling Branch GI Hub* is under agricultural easement. The reminder of this GI hub tends to be unprotected private land.

11	73.5	*South Stirrup Run Headwaters GI Hub #1* is generally between Rt 23 and Bailey Road on the mainstem of South Stirrup Run. It is partly protected by an agricultural easement and the rest is unprotected private land.
12	74.8	*South Stirrup Run Headwaters GI Hub #2* is generally between Rt 23 and Sharon Road on an unnamed tributary to the mainstem. It is entirely unprotected private land.
13	81.3	*Little Deer Creek GI Hub* is partly under agricultural easement and the remainder is unprotected private land.
14	98.1	*Stout Bottle Branch GI Hub* is between Chestnut Hill Road and Deer Creek. It is entirely unprotected private land in the Lower Deer Creek Rural Legacy Area.
15	98.7	*Saint Omer Branch GI Hub* is between Rt 1 and Saint Omer Branch. It is entirely unprotected private land, which is partly in the Lower Deer Creek Rural Legacy Area.

Protection Summary For Green Infrastructure Hubs
In The Deer Creek Watershed In Harford County
Based On DNR GIS Data June 2004

Map Key Hub #	Public Ownership			Private Ownership				
	Federal Park	State Park	County Park	Ag Easmt	Rural Legacy		MET Easmt	Other Conserv Easmt
					In Area	Easmt		
1	-	Y	-	Y	-	-	-	-
2	-	-	-	Y	A	-	-	-
3	-	Y	-	Y	-	-	-	-
4	-	Y	-	Y	A	Y	-	-
5	-	-	Y	Y	-	-	-	-
6	-	Y	-	-	A	-	-	-
7	-	-	-	Y	P	Y	-	-
8	-	-	-	Y	A	-	-	-
9	-	-	-	-	P	-	-	-
10	-	-	-	Y	-	-	-	-
11	-	-	-	Y	-	-	-	-
12	-	-	-	-	-	-	-	-
13	-	-	-	Y	-	-	-	-
14	-	-	-	-	A	-	-	-
15	-	-	-	-	P	-	-	-

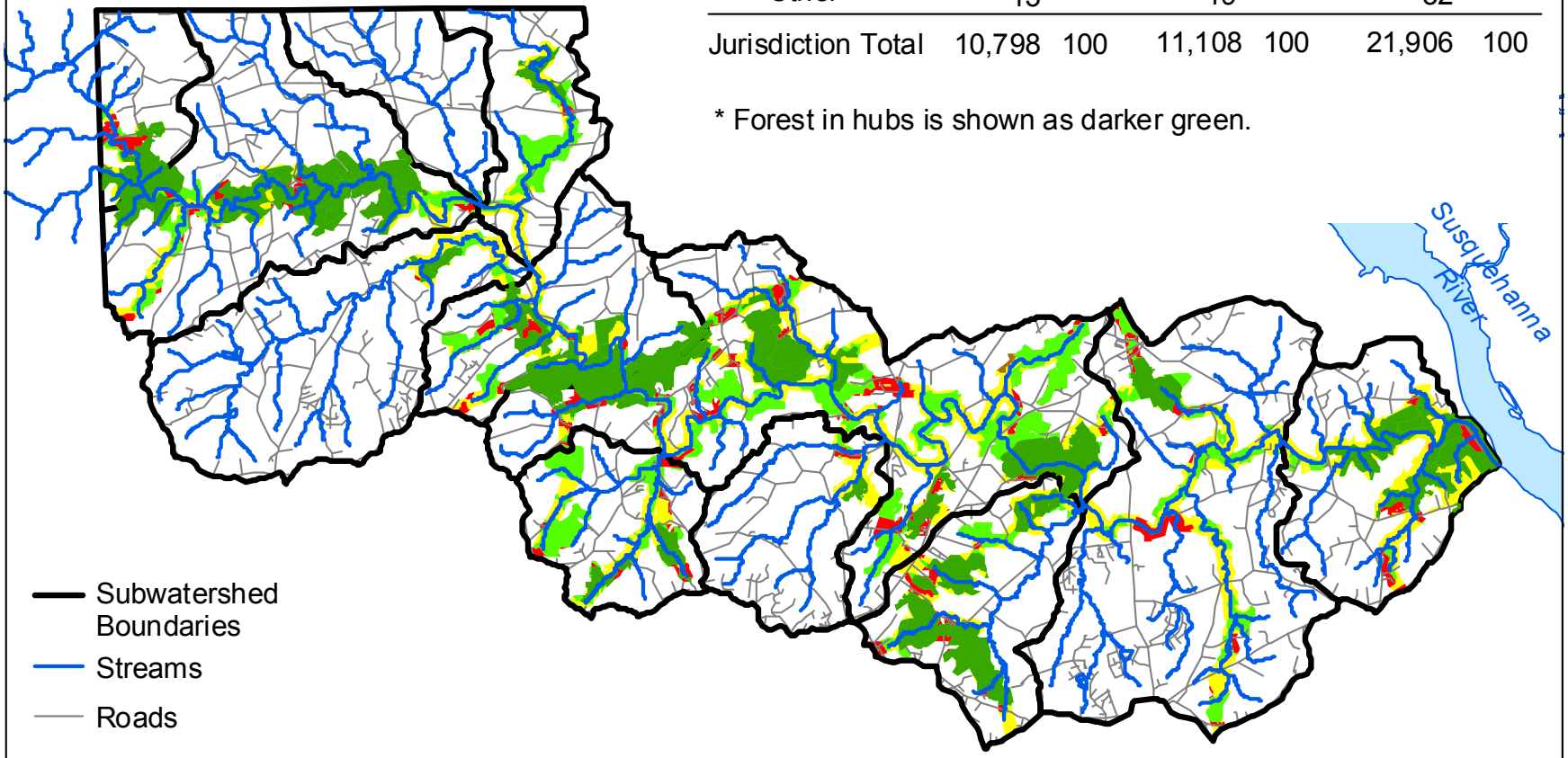
Key: Y – yes; A – all in area; P- part in area; "-" represents no or absence
MET – Maryland Environmental Trust

Resource Summary For Green Infrastructure Hubs In The Deer Creek Watershed In Harford County Based On DNR GIS Data June 2004				
Map Key Hub #	Forest Interior	Floodplain	SSPRA	WSSC
1	Y	Y	Y	-
2	Y	E	Y	Y
3	Y	Y	Y	-
4	Y	Y	Y	Y
5	Y	Y	Y	-
6	Y	Y	Y	-
7	Y	-	Y	-
8	Y	E	Y	-
9	Y	-	Y	-
10	Y	-	Y	-
11	Y	-	Y	-
12	Y	-	Y	-
13	Y	Y	Y	-
14	Y	Y	Y	-
15	Y	Y	Y	-
Key: Y – yes; E – edge of area; "-" represents no or absence SSPRA – Sensitive Species Project Review Area WSSC – Wetlands of Special State Concern				

Green Infrastructure - 2002
Deer Creek Watershed
In Harford County

Land Use/Cover	Hubs Acres	Hubs %	Corridors Acres	Corridors %	Total Acres	Total %
Forest*	8,773	81	5,539	50	14,312	66
Agriculture	1,621	15	4,150	37	5,771	26
Developed	391	4	1,400	13	1,791	8
Other	13	–	19	–	32	–
Jurisdiction Total	10,798	100	11,108	100	21,906	100

* Forest in hubs is shown as darker green.



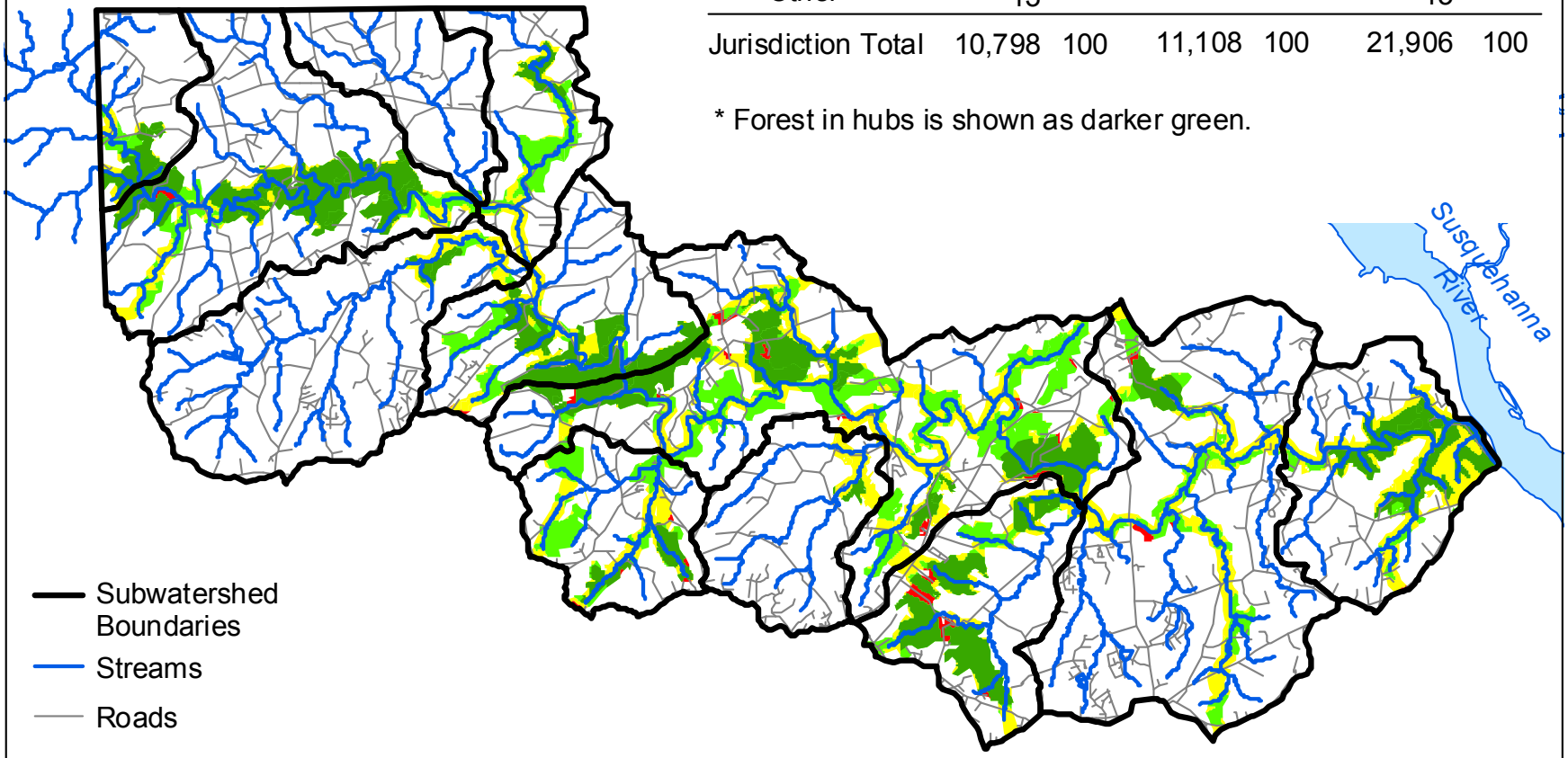
Maryland Dept. of Natural Resources
Watershed Services Center EAC, Aug. 2005
Land Use Data: MDP 2002

0 1 2 4 Miles
1:175,000

Green Infrastructure - 1973
Deer Creek Watershed
In Harford County

Land Use/Cover	Hubs Acres	Hubs %	Corridors Acres	Corridors %	Total Acres	Total %
Forest*	8,763	81	6,007	54	14,770	67
Agriculture	1,856	17	4,910	44	6,766	31
Developed	166	2	191	2	357	2
Other	13	–	–	–	13	–
Jurisdiction Total	10,798	100	11,108	100	21,906	100

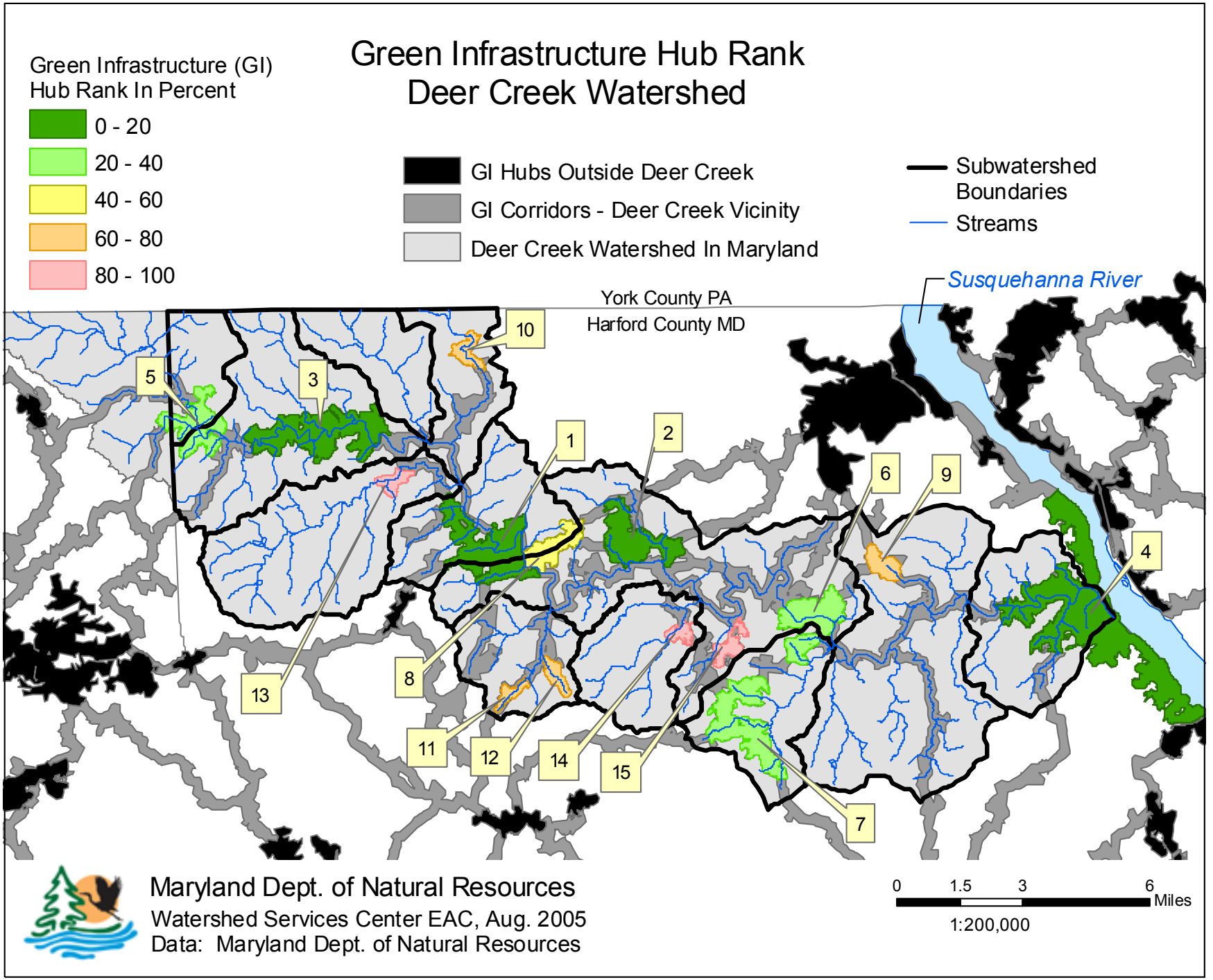
* Forest in hubs is shown as darker green.



Maryland Dept. of Natural Resources
Watershed Services Center EAC, Aug. 2005
Land Use Data: MDP 1973

0 1 2 4 Miles
1:175,000

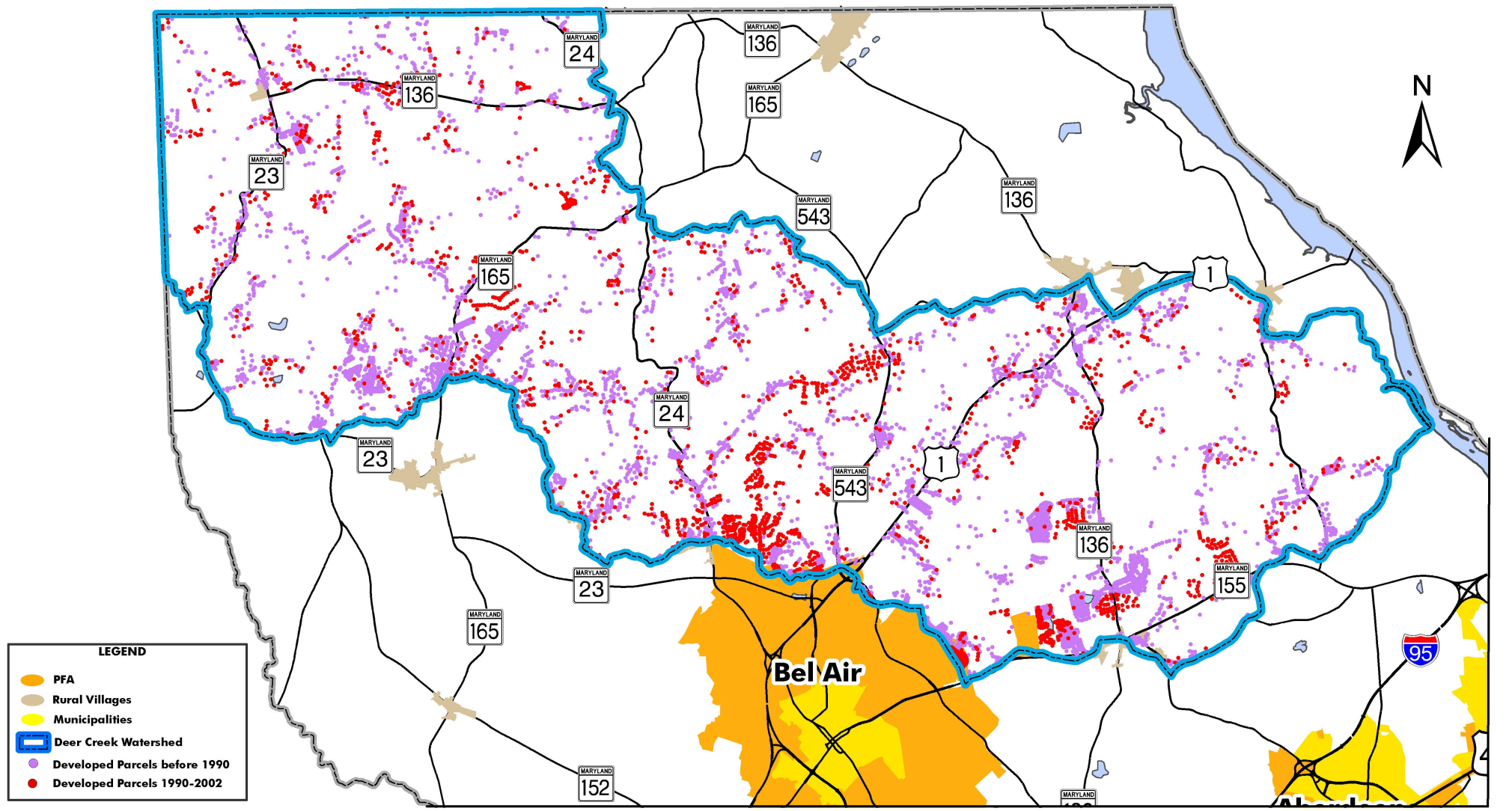
Green Infrastructure Hub Rank
Deer Creek Watershed



Appendix C

Deer Creek Watershed: Developed Parcels

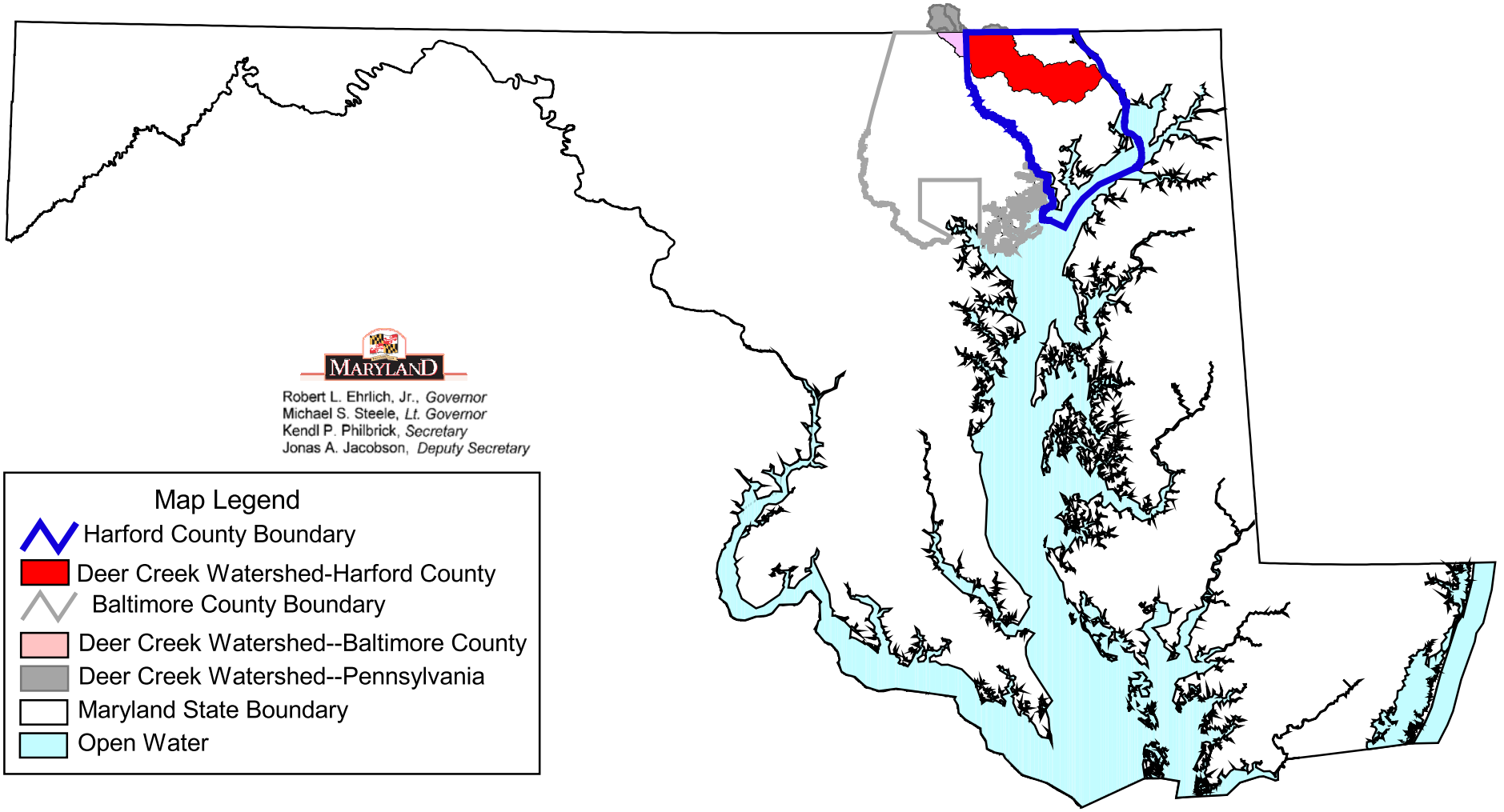
DEER CREEK WATERSHED - DEVELOPED PARCELS



Source: Maryland Property View 2004 Edition
Prepared by the Maryland Department of Planning, October 2005

0 0.5 1 2 3 4 Miles

Map 1: Deer Creek Watershed WRAS Project Area
Harford County, Maryland



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Map Legend

- Harford County Boundary
- Deer Creek Watershed-Harford County
- Baltimore County Boundary
- Deer Creek Watershed--Baltimore County
- Deer Creek Watershed--Pennsylvania
- Maryland State Boundary
- Open Water

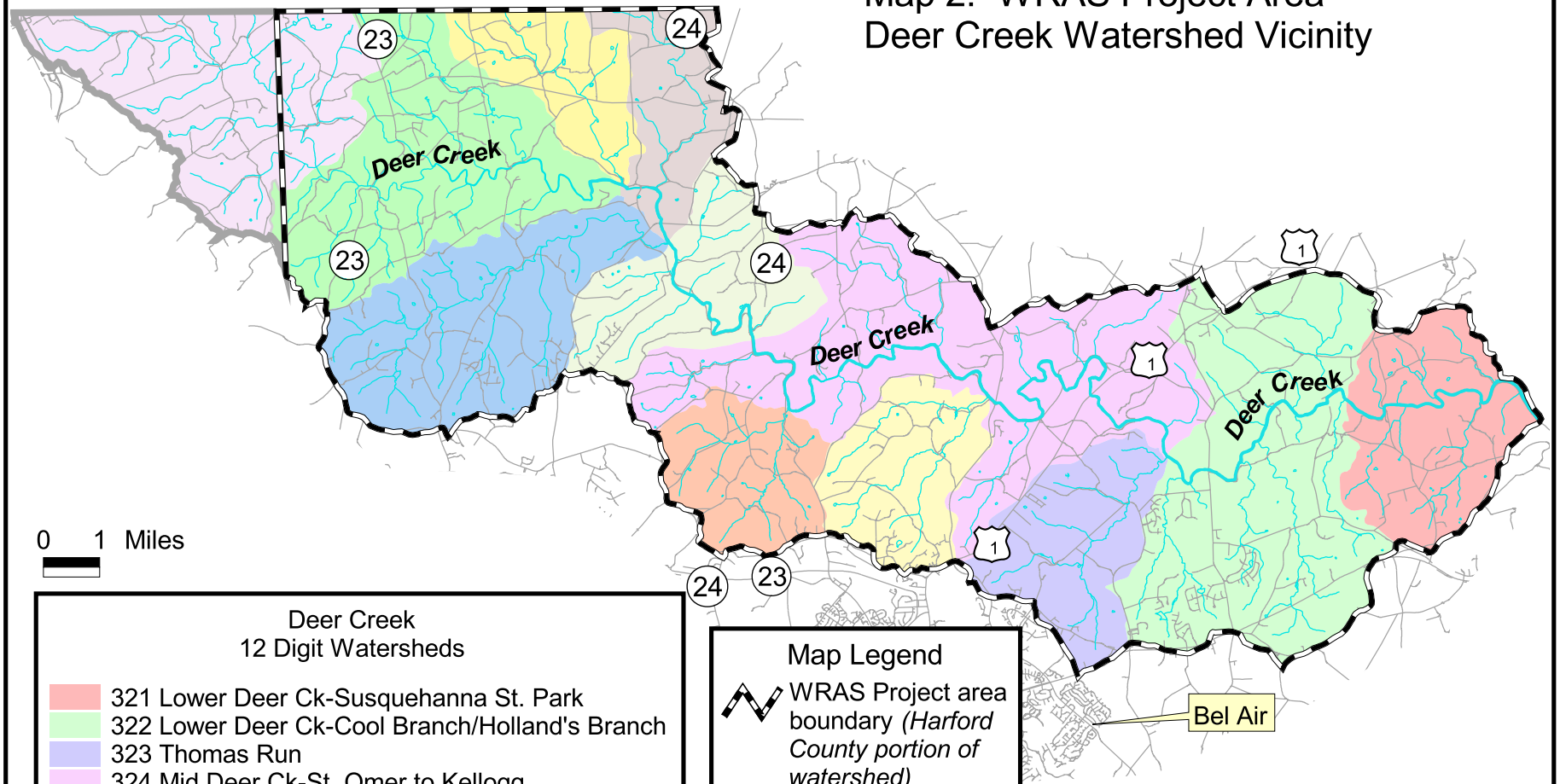
MDE

Map prepared by the Maryland Department of the Environment using data supplied by the Maryland Department of Natural Resources. The boundary layer is from the Maryland State Highway Administration. For more information contact TARSA at 410-537-3906. (KFE 2005)

N

0 25 50 Miles

Map 2: WRAS Project Area
Deer Creek Watershed Vicinity



0 1 Miles

Deer Creek
12 Digit Watersheds

- 321 Lower Deer Ck-Susquehanna St. Park
- 322 Lower Deer Ck-Cool Branch/Holland's Branch
- 323 Thomas Run
- 324 Mid Deer Ck-St. Omer to Kellogg
- 325 Stout Bottle/Cabbage Run
- 326 Stirrup Run
- 327 Mid Deer Ck-Rock Hollow/Wet Stone
- 328 Little Deer Ck
- 329 Falling Branch
- 330 Upper Deer Ck-Island Branch
- 331 Big Branch
- 332 Upper Deer Ck-Plumtree

Map Legend

- WRAS Project area boundary *(Harford County portion of watershed)*
- Roads
- Streams

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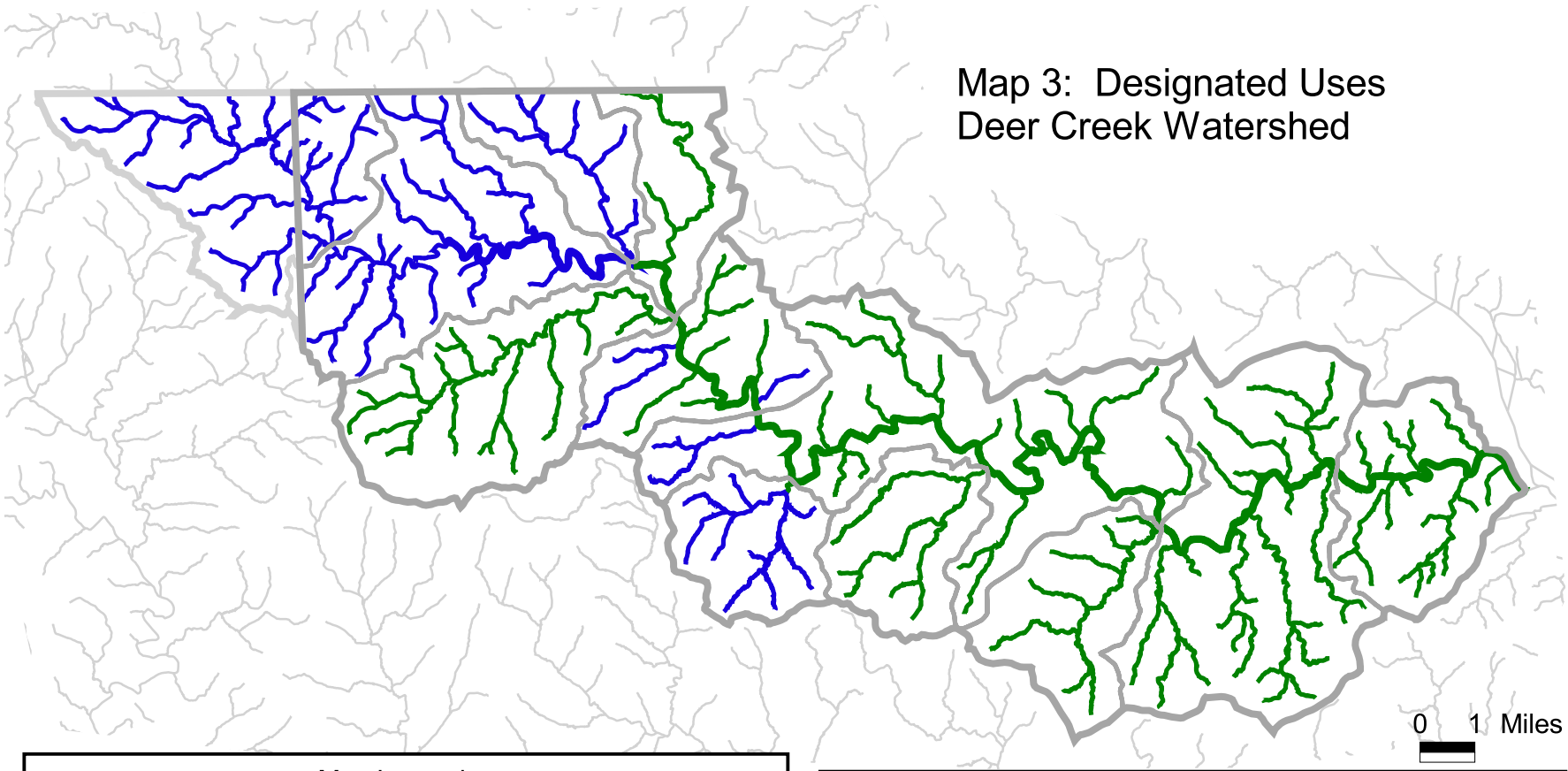
N

Map 3: Designated Uses
Deer Creek Watershed



Map Legend

- Harford County Portion
- Baltimore County Portion
- 12 Digit Watersheds (Harford County Portion)
- 12 Digit Watersheds (Baltimore County Portion)
- Streams Outside Watershed

COMAR Uses

- III-P: Nontidal Cold Water and Public Water Supply
- IV-P: Recreational Trout Waters and Public Water Supply

Note: Heavier line is Deer Creek mainstem

Map prepared by the Maryland Department of the Environment using the National Hydrological Dataset supplied by the United States Geological Survey in conjunction with uses delineated in the Code of Maryland. The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 410-537-3906. (KFE 2005)

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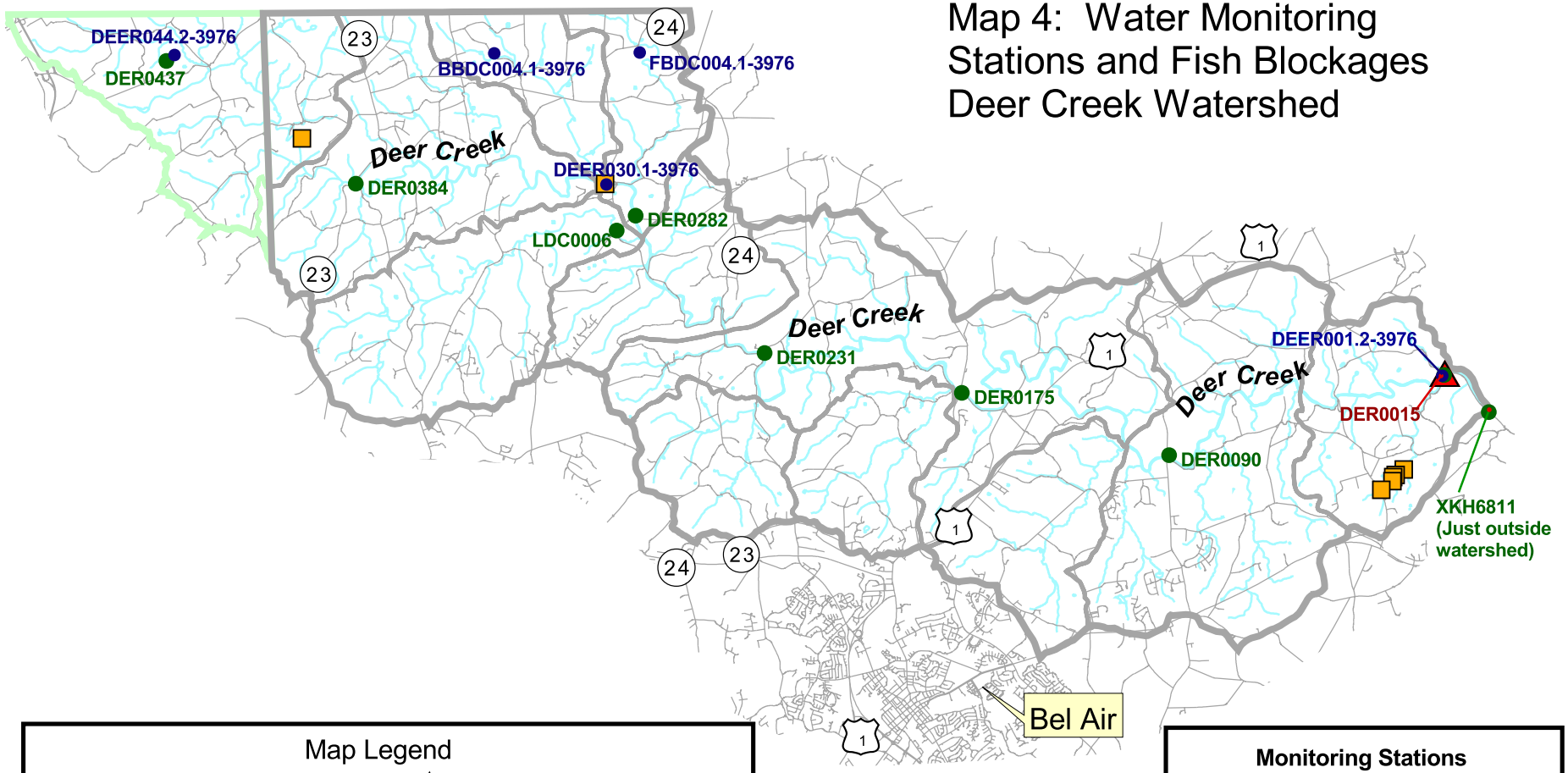
Map 4: Water Monitoring Stations and Fish Blockages Deer Creek Watershed



Map Legend

- WRAS Project Area Boundary
- Baltimore County Portion
- Fish Blockages (DNR Fisheries Service)
- Subwatershed Boundary
- Roads
- Streams

Monitoring Stations

- MANTA Core Trends Stations

Storet Data

- MD Dept. of the Environment In-House Water Data
- Susquehanna River Basin Commission

Map prepared by the Maryland Department of the Environment using data supplied by the Maryland Department of Natural Resources and from the U. S. Environmental Protection Agency's STORET database. The Roads layer is from Maryland State Highway Administration grid files.
For more information contact TARSA at 410-537-3906. (KFE 2005)

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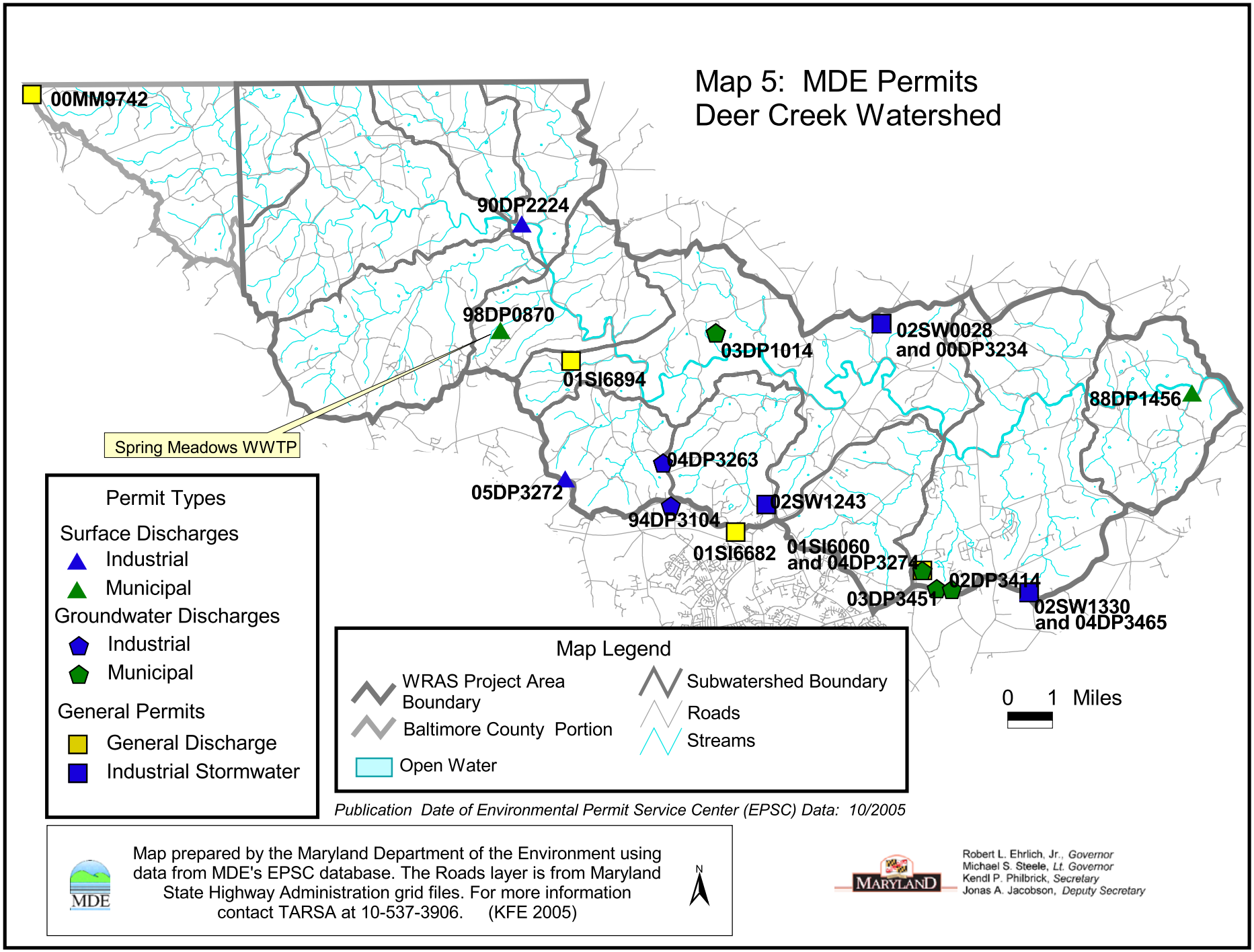
0 1 Miles


Map 5: MDE Permits
Deer Creek Watershed
00MM9742
90DP2224
98DP0870
03DP1014
02SW0028
and 00DP3234
01SI6894
88DP1456
Spring Meadows WWTP
04DP3263
05DP3272
02SW1243
94DP3104
01SI6682
01SI6060
and 04DP3274
02DP3414
03DP3451
02SW1330
and 04DP3465
Permit Types
Surface Discharges
Industrial
Municipal
Groundwater Discharges
Industrial
Municipal
General Permits
General Discharge
Industrial Stormwater
Map Legend
WRAS Project Area Boundary
Baltimore County Portion
Open Water
Subwatershed Boundary
Roads
Streams
0 1 Miles
Publication Date of Environmental Permit Service Center (EPSC) Data: 10/2005
Map prepared by the Maryland Department of the Environment using data from MDE's EPSC database. The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 10-537-3906. (KFE 2005)
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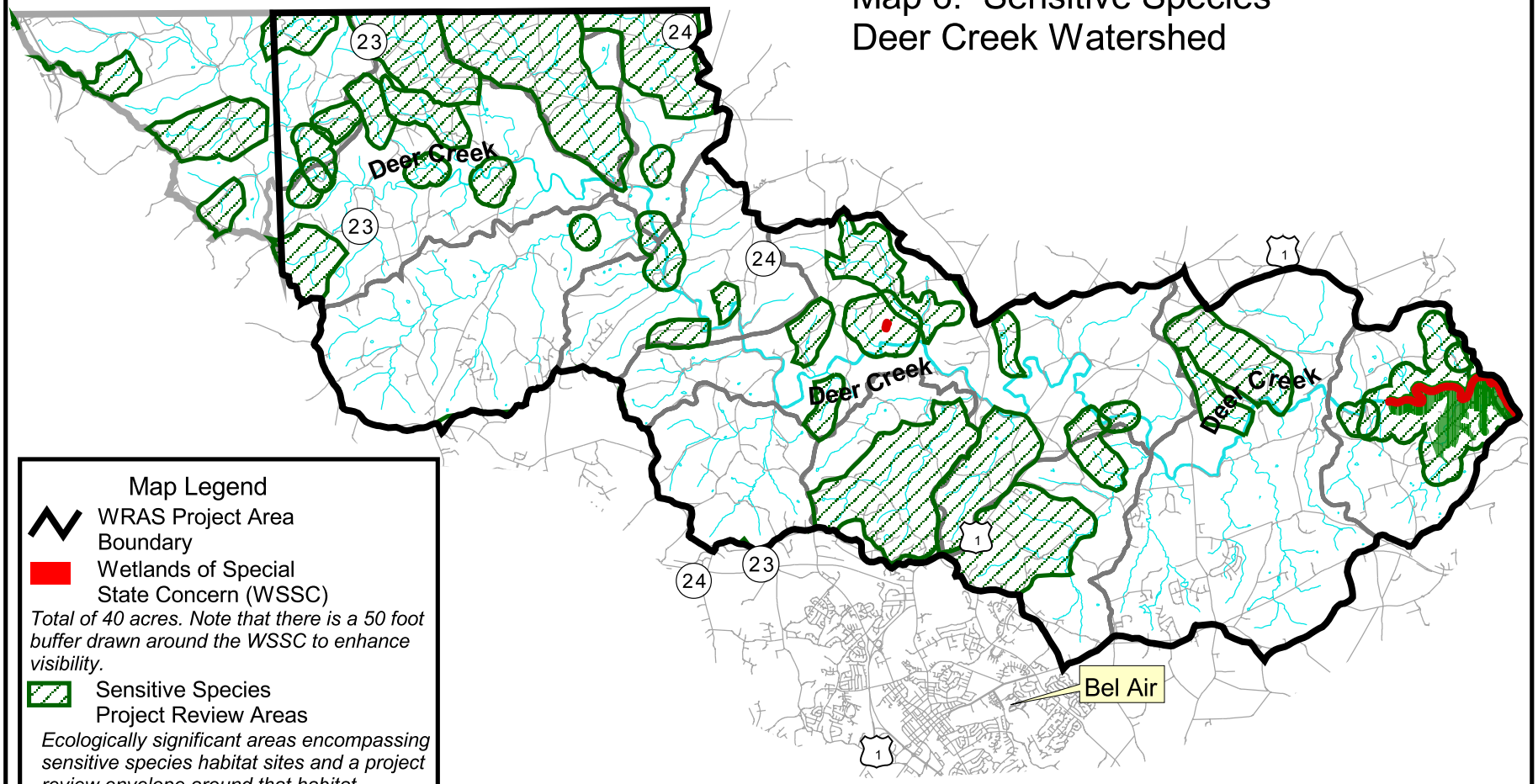
Map 6: Sensitive Species
Deer Creek Watershed



Map Legend

- WRAS Project Area Boundary
- Wetlands of Special State Concern (WSSC)

Total of 40 acres. Note that there is a 50 foot buffer drawn around the WSSC to enhance visibility.

- Sensitive Species Project Review Areas

Ecologically significant areas encompassing sensitive species habitat sites and a project review envelope around that habitat

- Critical Area
- Subwatershed Boundary
- Roads
- Streams
- Baltimore County Portion of Watershed

No Wetlands of Special State Concern exist within the Baltimore County portion.

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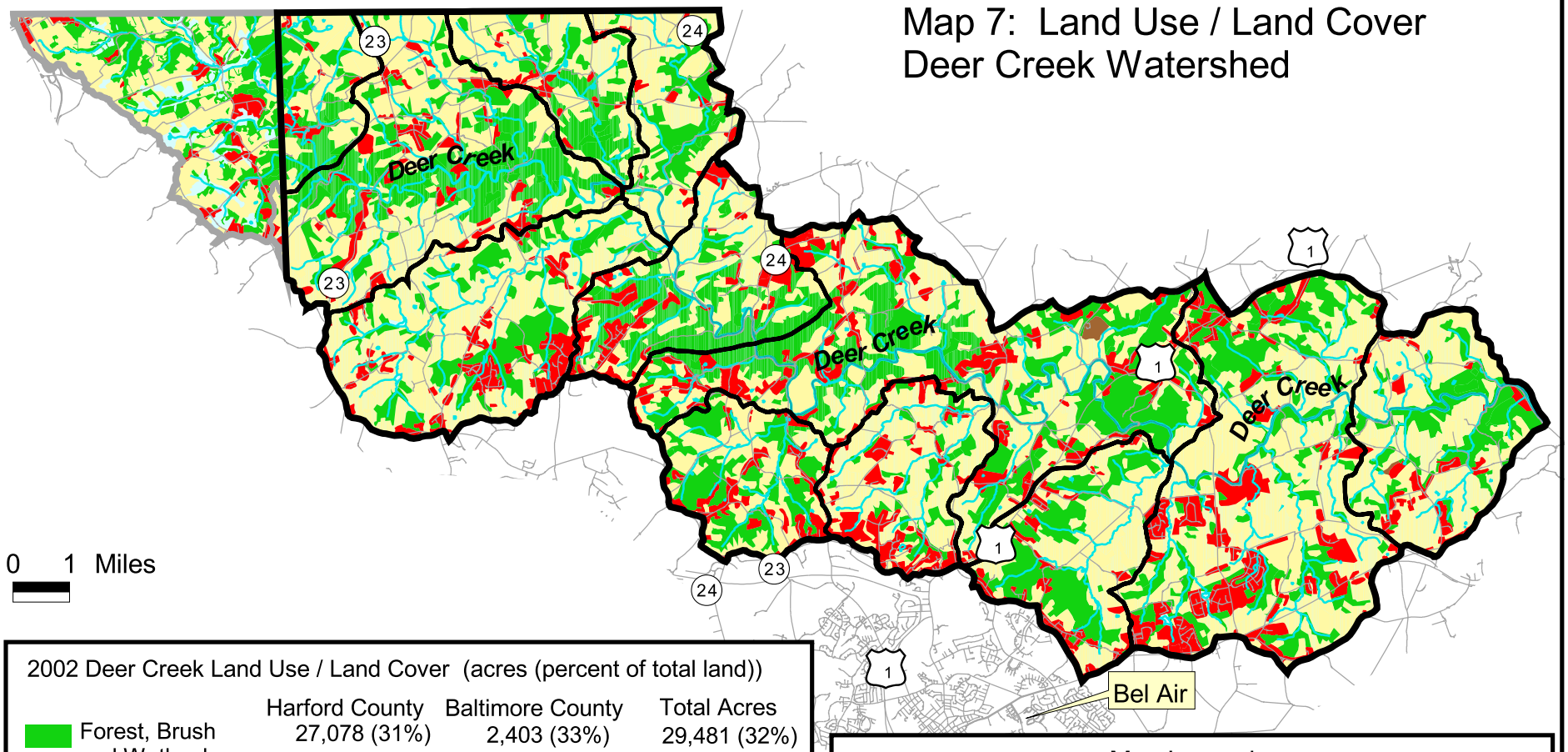
N

0 1 Miles

Map 7: Land Use / Land Cover
Deer Creek Watershed



2002 Deer Creek Land Use / Land Cover (acres (percent of total land))

	Harford County	Baltimore County	Total Acres
Forest, Brush and Wetlands	27,078 (31%)	2,403 (33%)	29,481 (32%)
Agriculture	46,128 (54%)	4,052 (57%)	50,180 (54%)
Bare Ground	97 (<1%)	0 (0%)	97 (<1%)
Developed Land	12,635 (15%)	694 (10%)	13,329 (14%)
Total Land (acres)	85,938	7,149	93,087
Total Including Water (acres)	86,008	7,155	93,163

Map Legend

- WRAS Project Area Boundary
- Baltimore County Portion
- Subwatershed Boundary
- Roads
- Streams
- Open Water

Map prepared by the Maryland Department of the Environment using data supplied by the Maryland Department of Planning and the Maryland Department of Natural Resources. The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 410-537-3906. (KFE 2005)

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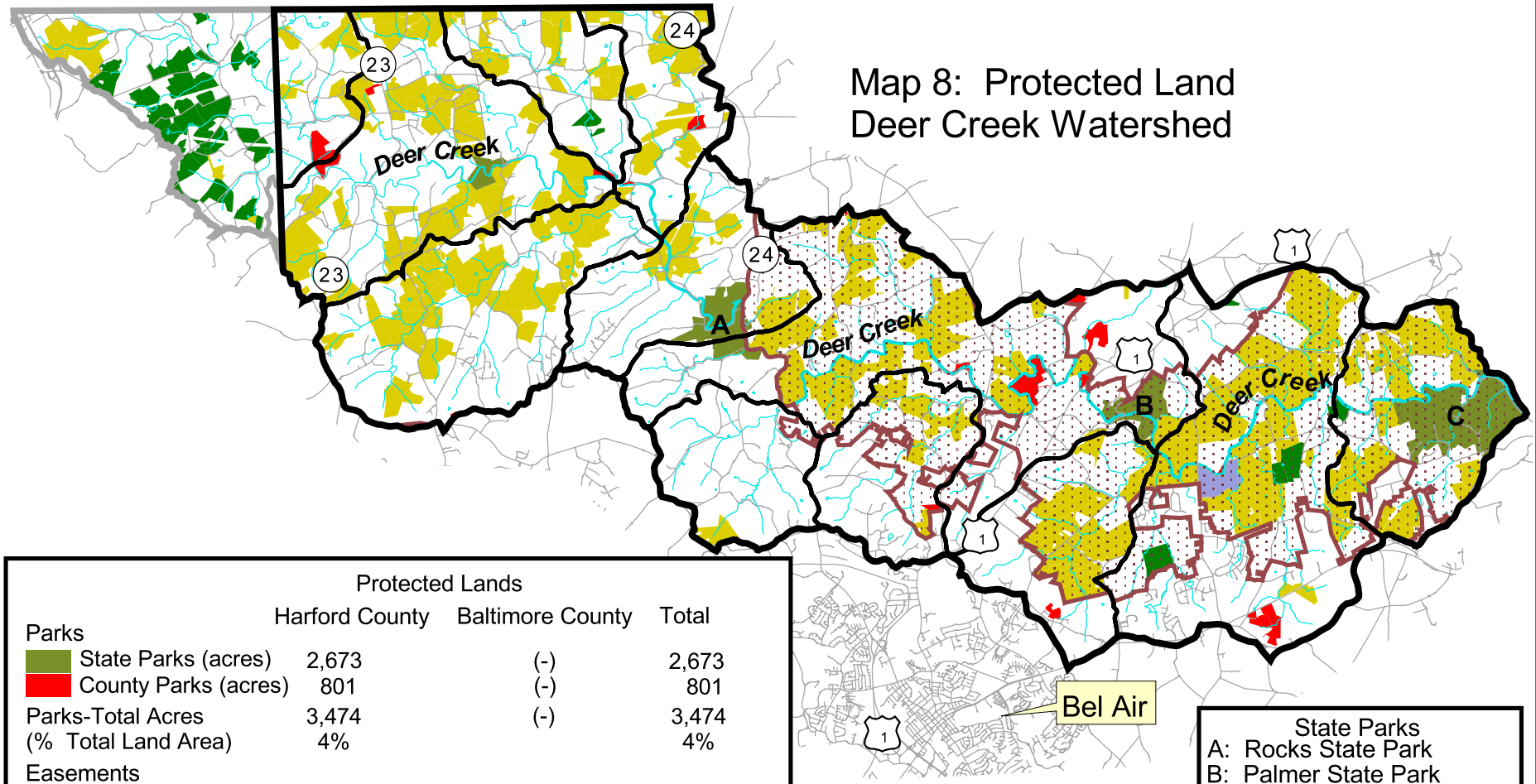

Protected Lands

	Harford County	Baltimore County	Total
Parks			
State Parks (acres)	2,673	(-)	2,673
County Parks (acres)	801	(-)	801
Parks-Total Acres	3,474	(-)	3,474
(% Total Land Area)	4%		4%
Easements			
Conservation	479	1818	2,297
Agricultural	22,875	499	23,374
Easements-Total Acres	23,354	2,317	25,671
(% Total Land Area)	27%	32%	28%
Total Land Area (Based on MDP 2002 LU/LC)	*85,938*	*7,149*	*93,087*

Federal Lands
US Gov't Tank Proving Center (209 acres)

Other
Rural Legacy

State Parks
A: Rocks State Park
B: Palmer State Park
C: Susquehanna State Park

Map Legend
WRAS Project Area Boundary
Baltimore County Portion
Subwatershed Boundary
Roads
Streams

Map prepared by the Maryland Department of the Environment using data supplied by Baltimore County, Harford County, the Maryland Department of Natural Resources and the Maryland Department of Planning.
The Roads layer is from Maryland State Highway Administration grid files.
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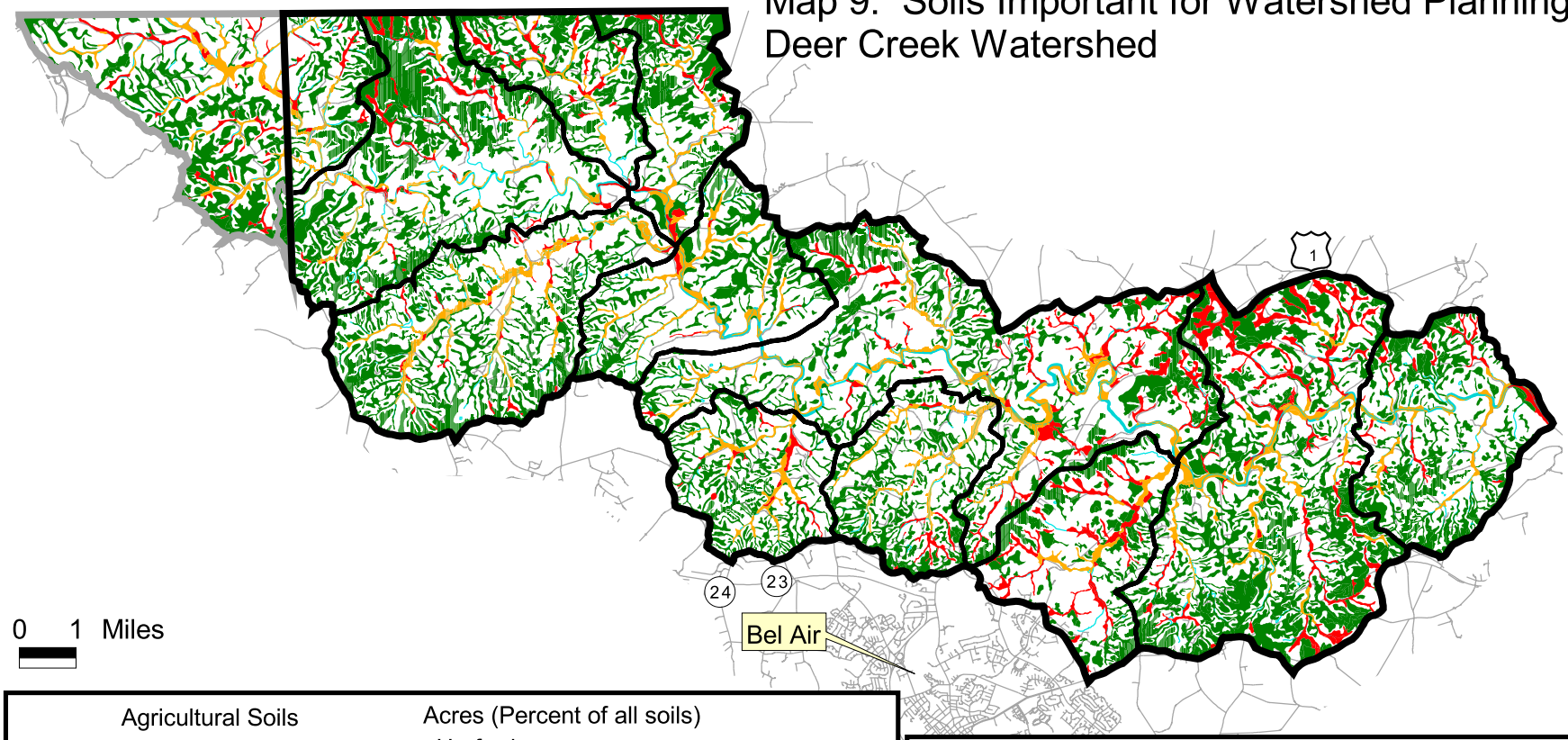
0 1 Miles

Map 9: Soils Important for Watershed Planning
Deer Creek Watershed



Agricultural Soils	Acres (Percent of all soils) Harford County	Baltimore County	Total
Prime Farmland: Does not need drainage or irrigation	29,049 (34%)	2,438 (34%)	31,487 (34%)
Prime Farmland if protected from flooding or not frequently flooded	3,989 (5%)	435 (6%)	4,424 (5%)
Hydric Soil	4,060 acres	284 acres	4,344 acres

Map Legend

- WRAS Project Area Boundary
- Baltimore County Portion
- Subwatershed Boundary
- Roads
- Streams
- Open Water

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Map prepared by the Maryland Department of the Environment using data supplied by Harford County, Maryland and the United States Department of Agriculture The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 410-537-3906. (KFE 2005)

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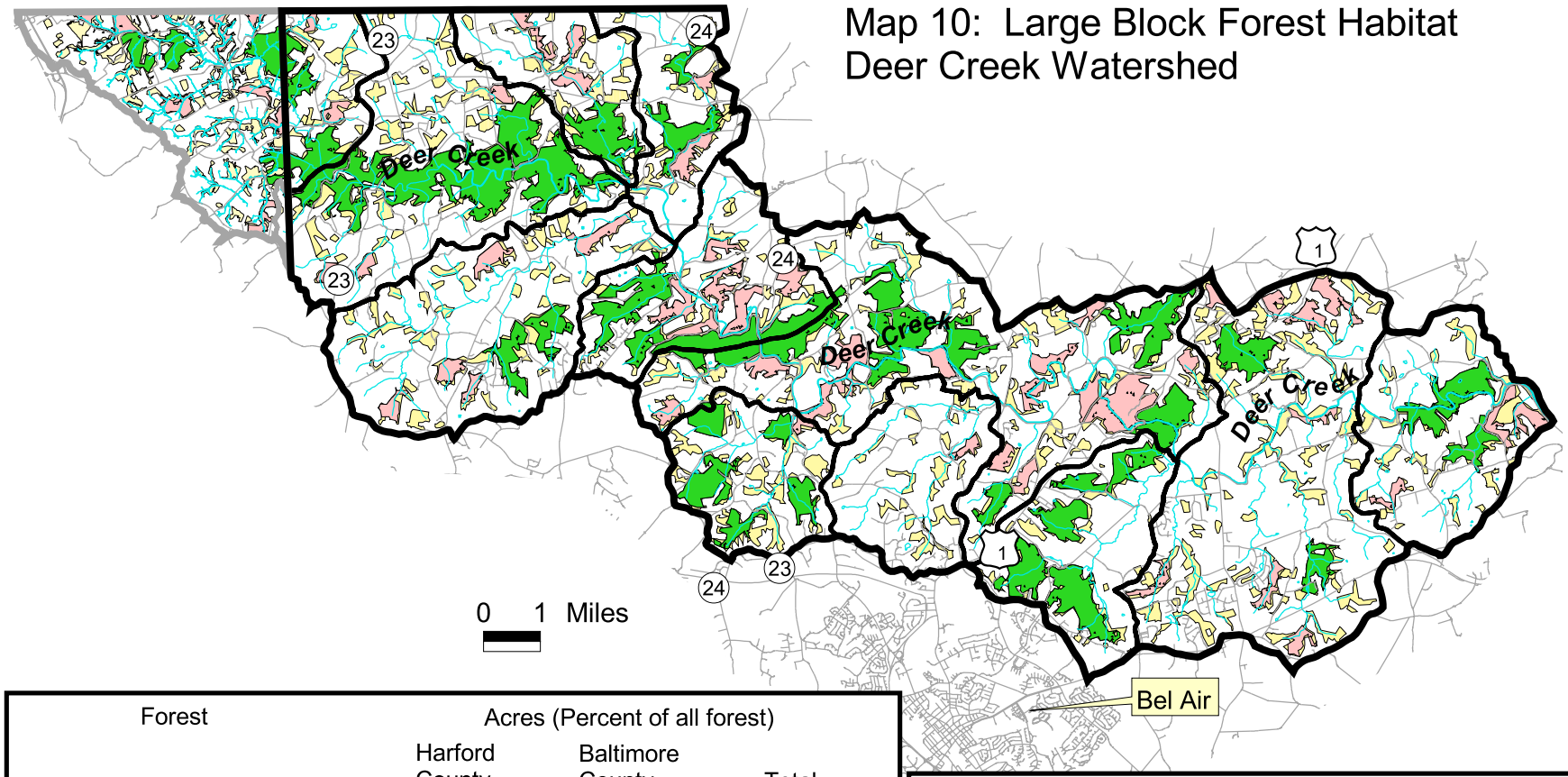
Map 10: Large Block Forest Habitat
Deer Creek Watershed



Forest	Acres (Percent of all forest)		
	Harford County	Baltimore County	Total
High Quality Forest Interior (FIDS) Habitat	11,513 (43%)	586 (25%)	12,099 (41%)
Other Large Block Forest	4,655 (17%)	496 (21%)	5,151 (18%)
All Other Forest	10,860 (40%)	1,308 (55%)	12,168 (41%)

Map Legend

- WRAS Project Area Boundary
- Baltimore County Portion
- Subwatershed Boundary
- Roads
- Streams

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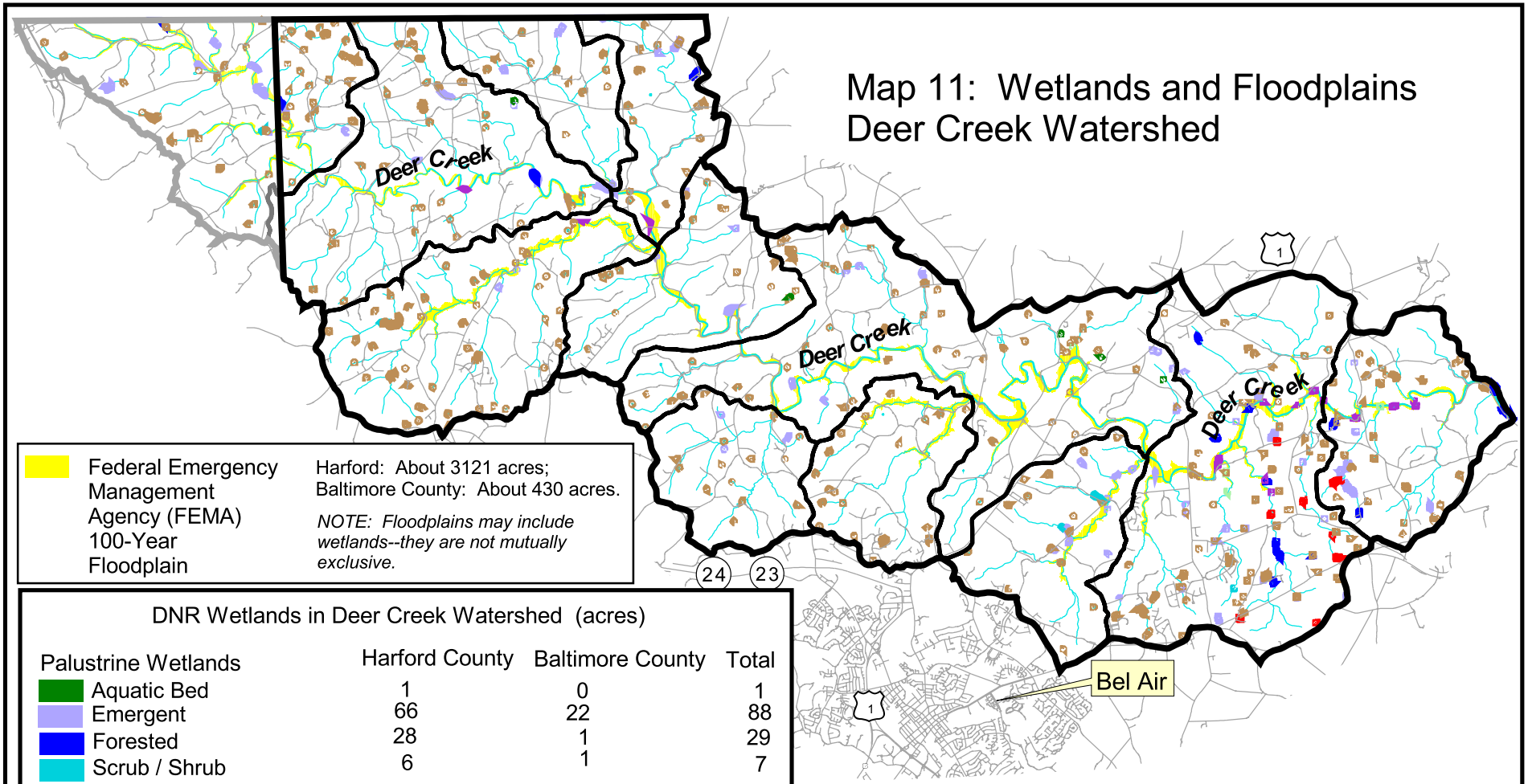
Map 11: Wetlands and Floodplains
Deer Creek Watershed



Federal Emergency Management Agency (FEMA) 100-Year Floodplain

Harford: About 3121 acres;
Baltimore County: About 430 acres.

NOTE: Floodplains may include wetlands--they are not mutually exclusive.

DNR Wetlands in Deer Creek Watershed (acres)

Palustrine Wetlands	Harford County	Baltimore County	Total
Aquatic Bed	1	0	1
Emergent	66	22	88
Forested	28	1	29
Scrub / Shrub	6	1	7
Unconsolidated Bottom	255	18	273
Unconsolidated Shore	1	0	1
Farmed (Drained / Ditched)	6	0	6
Riverine Wetlands			
Unconsolidated Shore	5	0	5
TOTAL Wetlands	368	42	410

Note: Wetlands size is enhanced in order to promote visibility.

Map Legend

- WRAS Project Area Boundary
- Baltimore County Portion
- Subwatershed Boundary
- Roads
- Streams

Map prepared by the Maryland Department of the Environment using data supplied by the Maryland Department of Natural Resources, the Federal Emergency Management Agency and the United States Fish & Wildlife Service. The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 410-537-3906. (KFE 2005)

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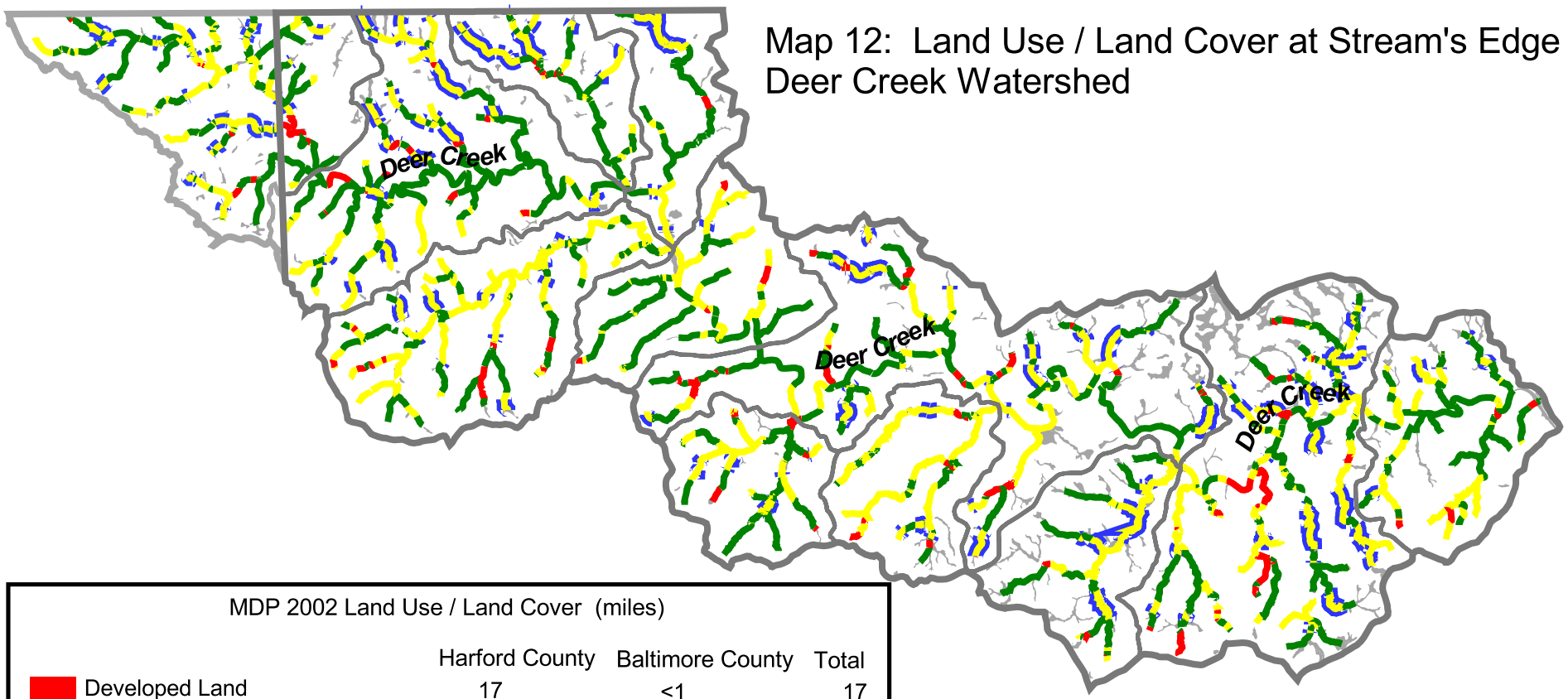
0 1 Miles

Map 12: Land Use / Land Cover at Stream's Edge
Deer Creek Watershed



MDP 2002 Land Use / Land Cover (miles)

	Harford County	Baltimore County	Total
Developed Land	17	<1	17
Forest, Wetlands & Brush	121	11	132
Agricultural Land	102	10	112
TOTAL MILES	240	21	261
Potential for restoration of stream buffers:			
Agricultural Land on Hydric Soil *Subset of Agricultural land buffers.*	25	3	28

Map Legend

- Hydric Soil
- WRAS Project Area Boundary
- Subwatershed Boundary
- Baltimore County Portion

0 1 Miles

Map prepared by the Maryland Department of the Environment using data supplied by Harford County, the Maryland Department of Planning, the U. S. Department of Agriculture and the U. S. Environmental Protection Agency. The Roads layer is from Maryland State Highway Administration grid files. For more information contact TARSA at 410-537-3906. (KFE 2005)

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