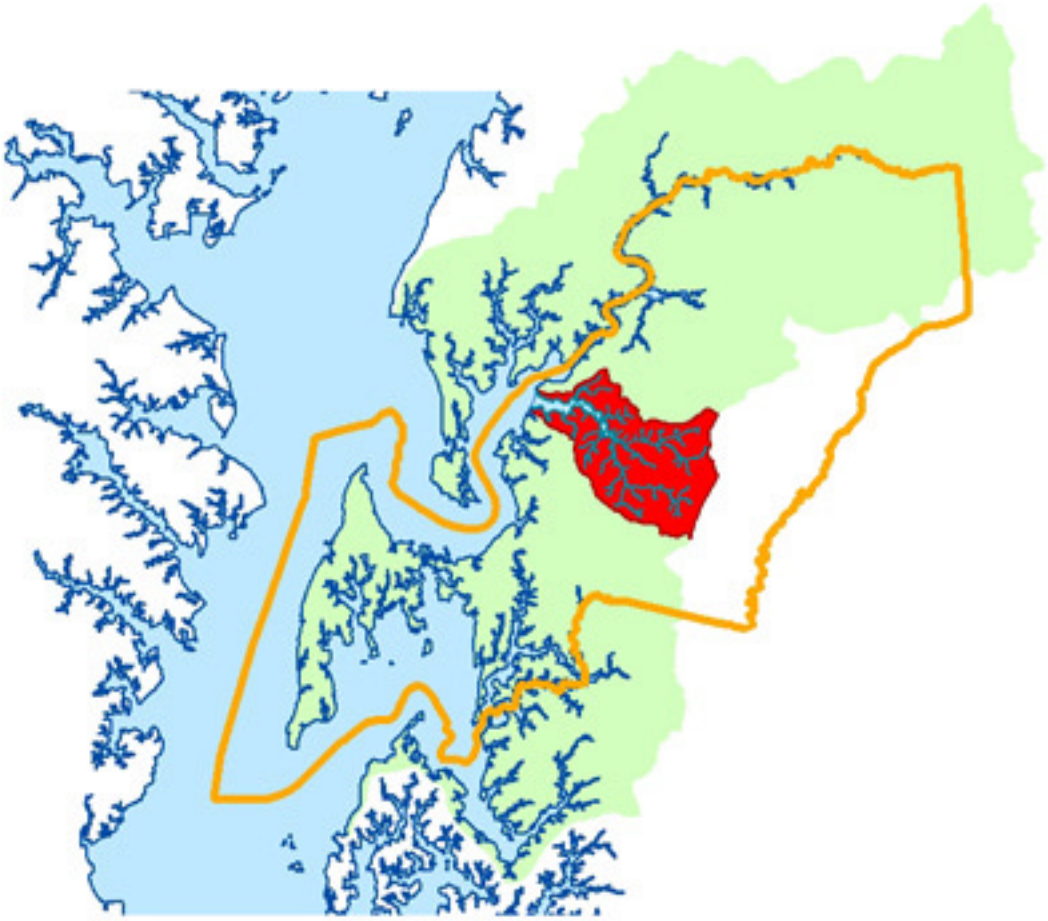
Corsica River
Watershed Characterization

October 2003

In support of Centreville and Queen Anne's County's
Watershed Restoration Action Strategy
for the Corsica River Watershed



Product of the Maryland Department of Natural Resources Watershed Services
In Partnership with Centreville and Queen Anne's County

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EXECUTIVE SUMMARY
For the Corsica River Watershed Characterization

The Town of Centreville is receiving a Federal grant funding to prepare a Watershed Restoration Action Strategy (WRAS) for the Corsica River Watershed. The Town is an incorporated municipality and is the county seat of Queen Anne's County, Maryland. In the WRAS project, the Town of Centreville is working closely with Queen Anne's County and other stakeholders to consider local priorities for protection and restoration of water quality and habitat.

The WRAS project area encompasses nearly 25,300 acres including nearly 1,400 acres of open water. The Town of Centreville is located at the head of tide on the Corsica River. The lower, tidal portion of the Corsica River enters the Chester River near Town Point in the oligohaline salinity zone. Depths of the tidal portions of Corsica River range from 1-2 feet in the upper tidal waters to greater than 15 feet near its confluence with the Chester River.

As part of WRAS project, the Maryland Department of Natural Resources (DNR) is providing technical assistance, including preparation of a watershed characterization (compilation of available water quality and natural resources information and identification of issues), a stream corridor assessment (uses field data to catalog issues and rate severity) and a synoptic survey (analyzes benthic macroinvertebrates, fish and water samples with focus on nutrients). The Town of Centreville, with Queen Anne's County and other stakeholders, will use this information to help assess the watershed and to help generate the Watershed Restoration Action Strategy.

Water Quality

The tidal portion of the Corsica River is mostly designated Use II for shellfish harvesting and the remaining tributary streams are Use I for recreation and aquatic life. Impairments to these uses include nutrients (nitrogen and phosphorus), fecal coliform bacteria which led to shellfish harvesting limitations, sediment, biological limitations (poor or very poor fish or benthic organism populations/conditions) and toxics (PCBs, Dieldrin and methylmercury) which led to current fish consumption advisories issued in January 2003.

A Total Maximum Daily Load (TMDL) approved for both nitrogen and phosphorus in the Corsica River sets load limits for both nutrients. The TMDL reports that the primary source for both nutrients in the watershed is agriculture. The point source nutrients contribution is relatively small and is anticipated to be significantly reduced when land application of treated sewage effluent from Town of Centreville's Wastewater Treatment Plant begins in 2004.

The Landscape

Land in the Corsica River watershed is nearly 64% agricultural, over 28% forest/scrub shrub and over 7% developed. Wetlands identified by DNR comprise less than 0.5% of the landscape. The watershed has low population density (0.15 people/acre) and has little impervious cover except in and around the Town of Centreville.

Natural resource lands of statewide or regional significance, identified as Green Infrastructure Hubs, occur in four areas. Connections between these hubs are mostly forest and agricultural land. Land protected from development encompasses 8% of the the Corsica River watershed including conservation easements, agricultural easements and County Parks/open spaces.

About two-thirds of the watershed is prime agricultural land and about one-fifth is hydric soil. All other soils amount to about 13% of the watershed.

Of the nearly 2,600 acres of wetlands that are identified in the watershed, about 81% are palustrine forested wetlands.

Living Resources and Habitat

Anadromous fish spawning areas for white perch, yellow perch and herring are identified in the Corsica River mainstem and three major tributaries. Nontidal fish species identified in the watershed are mostly tolerant and moderately tolerant of poor or variable water quality and habitat conditions. However, two intolerant species, roseyside dace and least brook lamprey, found in limited stream segments indicate that good water quality and good habitat conditions coincide in these small areas.

Natural oyster beds that were documented shortly after the turn of the century in the Corsica River no longer exist there.

Submerged aquatic vegetation (SAV) in the Corsica River has only been identified using aerial photography in a few limited areas near its confluence with the Chester River. Its most frequent location since 1990 has been in Middle Quarter Cove.

The bald eagle is the only sensitive species tracked by Maryland that is currently identified in the Corsica River watershed.

Restoration Targeting Tools

Using GIS, potential opportunities for habitat protection, stream buffer restoration and wetland restoration have been identified. These computer-generated assessments supplement the field information being collected during 2003 in the two field assessments: the Stream Corridor Assessment which catalogs and rates conditions found along and in streams, and the Synoptic Survey that will contribute water quality data, including nutrients, and assessment of fish and benthic communities at selected sampling sites.

CONTRIBUTORS TO THE WATERSHED CHARACTERIZATION

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Key for Cover Map
- Red Area: Corsica River watershed
- Green Area: Chester River watershed (includes Corsica River watershed
- Orange Outline: Queen Anne's County Boundary
- Blue Area: portion of the Chesapeake Bay

INTRODUCTION

Background

In 1998, Maryland completed an assessment of all 134 of the state's watersheds in order to identify high priorities for restoration action based on impaired waters and high priorities for conservation action based on high or unique natural resource value. The assessment, called the Unified Watershed Assessment, was conducted by the Maryland Department of Natural Resources (DNR) under the direction of the US Environmental Protection Agency's Clean Water Action Plan initiative with assistance from the Maryland Departments of Environment, Agriculture and Planning and the University of Maryland. It moved beyond consideration of water quality in the streams in the state, which had been assessed regularly since the early 1970's, to a larger consideration of living resources in the streams and the landscape conditions which could impact both water quality and living resources.[1,2]

In response to the findings of the Unified Watershed Assessment, DNR offers technical and financial assistance to local governments who are willing to develop and implement Watershed Restoration Action Strategies (WRAS) addressing needs for restoration and conservation in priority watersheds. One of these projects is the Corsica River Watershed in Queen Anne's County, where the Town of Centreville, the County, DNR and other local cooperators, both public and private, are engaged in developing a watershed management strategy.

Location

Corsica River Watershed Acreage Summary MDP 2000 Land Use/Land Cover

Land	Water	Total
23,903	1,395	25,298

The Corsica River Watershed is located within the Chester River basin as shown in Map 1 Location. The Corsica River Watershed's geographic location entirely within Centreville and Queen Anne's County is highlighted in Map 2 WRAS Project Area. This area is the focus of the Watershed Restoration Action Strategy and this Watershed Characterization. DNR subdivides the Corsica River Watershed into three "12-digit" subwatersheds for analytical purposes as depicted in Map 2. The table Subwatersheds summarizes acreage statistics for these subwatershed areas.

Purpose of the Characterization

One of the earliest steps in devising a Watershed Restoration Action Strategy is to characterize the watershed using immediately available information. This Watershed Characterization is intended to meet several objectives:

– briefly summarize the most important or relevant information and issues;
– provide preliminary findings based on this information;
– identify sources for more information or analysis;
– suggest opportunities for additional characterization and restoration work; and

– provide a common base of knowledge about the Corsica River Watershed for local governments, citizens, businesses and other organizations.

Additional Characterization Work

The Watershed Characterization is intended to be one starting point that can be updated as needed. It is part of a framework for a more thorough assessment involving an array of additional inputs:

– self-investigation by Centreville and Queen Anne's County
– targeted technical assistance and assessment by partner agencies or contractors
– input from local citizens
– completion of a Stream Corridor Assessment, in which DNR personnel physically walk the streams and catalogue important issues.
– completion of a synoptic water quality survey, i.e. a program of water sample analysis, that can be used to focus on local issues like nutrient hot spots, point source discharges or other selected issues. This is also part of the technical assistance offered by DNR. Findings of the 2002 synoptic survey of the streams in the Corsica River Watershed are reported in Appendix D.

Identifying Gaps in Information

It is important to identify gaps in available watershed knowledge and gauge the importance of these gaps. In assessing data gaps, we have found it helpful to review information in four categories:

– Habitat: physical structure, stream stability and biotic community (including the riparian zone)
– Water Quantity: high water–storm flow and flooding; low water–baseflow problems from dams, water withdrawals, reduced infiltration
– Water Quality: water chemistry; toxics, nutrients, sediment, nuisance odors/scums, etc.
– Cumulative effects associated with habitat, water quantity and water quality.

Because restoration is an active evolving process, the Watershed Characterization and the resulting Watershed Restoration Action Strategy should be maintained as living documents within an active evolving restoration process. These documents will need to be updated periodically as new, more relevant information becomes available and as the watershed response is monitored and reassessed.

Subwatersheds In The Corsica River Watershed DNR and MDP 2000 Data				
Number 02130507- XXXX	Name "12-Digit" Subwatershed	Area in Acres		Description
		With Water	Land Only	
0395	Corsica Direct Drainage	8,382	7,053	All tributary areas that drain directly to the estuarine portion of the Corsica River
0396	Mill Stream Branch	9,384	9,560	Includes south and west portions of Centreville
0397	Three Bridges Branch and Gravel Run	7,533	7,491	Includes north and east portions of Centreville
02130507	**Corsica River Watershed**	25,299	24,104	Entire "8-Digit" watershed

WATER QUALITY

Water quality is in many respects the driving condition in the health of Maryland's streams. Historically, efforts to protect water quality have focused on chemical water quality. More recently, additional factors are being considered like measurements of selected biological conditions and physical conditions that affect habitat quality in streams and estuaries . This developmental path is reflected in the ways in which streams have been monitored, the types of data gathered, and the regulatory approach taken.

Water Quality Standards and Designated Uses

All streams and other water bodies in Maryland are assigned a "designated use" in the Code of Maryland Regulation (COMAR) 26.08.02.08, which is associated with a set of water quality criteria necessary to support that use. Map 3 Designated Uses and Use Restrictions depicts the distribution of surface waters in each category. (COMAR or MDE should be consulted for official regulatory information.) [3,5] The Corsica River Watershed is assigned two uses:

Use I: Water Contact Recreation, and Protection of Aquatic Life
- all waters not otherwise designated as Use II below.

Use II: Shellfish Harvesting Waters
- All estuarine portions of Corsica River except above Earl Cove

Use Impairments and Restrictions[4]

Some streams or other water bodies in the WRAS project area cannot be used to the full extent envisioned by their designated use in Maryland regulation due to water quality or habitat impairments. Tracking of these "impaired waters" is required under Section 303(d) of the Federal Clean Water Act. Each impairment that is identified in the list of impaired waters may require preparation of a Total Maximum Daily Load (TMDL) to address the water quality and/or habitat impairment in the affected water body.[5] Maryland's list of impaired waters for the Corsica River watershed includes several types of water quality or habitat problems:

- Nutrients (nitrogen and phosphorus)
- Fecal Coliform Bacteria
- Sediment
- Biological Limitations (poor or very poor fish or benthic organism populations/conditions)
- Toxics – PCBs, Dieldrin and Fish Consumption Advisory

These impairments affecting portions of the Corsica River watershed are addressed below. Each water body listed may require preparation of a Total Maximum Daily Load (TMDL) to address the water quality and/or habitat impairment.[4]

1. Nutrients

The tidal portion of the Corsica River is listed for impairment by nutrients in the 1996 303(d) list. The origins of these nutrients were listed: as natural and two types of human sources: point sources and nonpoint sources.

According to the April 2000 report *Total Maximum Daily Loads of Nitrogen and Phosphorus for Corsica River*, impairment by both nitrogen and phosphorus contribute to excessive algal blooms and concentrations of dissolved oxygen below the minimum State standard of 5.0 milligrams per liter (mg/l). The algae and dissolved oxygen problems impair local conditions and interfere with the designated uses of the Corsica River. (Also see section on TMDL.)

Nutrients, phosphorus and nitrogen, are essential to support aquatic life but excess nutrients can cause problems. In Maryland, most water bodies naturally have low levels of the nutrients nitrogen and phosphorus. However, in the tidal waters of the Corsica River either nitrogen or phosphorus can become too readily available. When this occurs under certain conditions with warm weather, sufficient light, etc., algae populations can grow to excessive levels. These algae can then crowd out other small organisms, cloud the water limiting light penetration, and eventually die-off consuming the dissolved oxygen that other aquatic life needs to survive.

Nutrient pollution or over-enrichment problems may arise from numerous sources including all types of land and from the atmosphere. Residential land can be an important contributor of nutrients depending on fertilizer use, extent of lawn and the status of septic systems. Farmers apply nutrients using different approaches, so nutrients entering waterways from crop land vary greatly depending on management techniques. Typically, streams and other surface waters receive relatively small amounts of nutrients from forest land and relatively large amounts from land uses that involve soil disturbance and application of fertilizer.

2. Fecal Coliform Bacteria and Shellfish Harvesting Restrictions

The tidal portion of the Corsica River is listed for impairment by fecal coliform bacteria in the 1996 303(d) list. The origins of these bacteria were listed: as natural and two types of human sources: point sources and nonpoint sources.

Fecal coliform bacteria are a class of bacteria typically found in the digestive tract of warm-blooded animals, including humans. They are always found in animal waste and human sewage unless it is treated to kill them. In unpolluted streams and tidal waters, it is common for water samples to contain very few of these bacteria. Water samples exhibiting significantly larger fecal coliform bacteria populations are "indicators" of contamination by animal, including human, waste. Depending on local conditions, sources of fecal contamination may include any combination of the following: inadequately treated sewage, failing septic systems, wild or domestic animals, urban stormwater carrying pet waste and similar sources.

When fecal coliform bacteria levels are too high in tidal waters containing shellfish, harvesting is restricted to prevent consumption of contaminated food. Map 3 Designated Use and Use Restrictions, shows that portions of Corsica River are affected by shellfish harvesting restrictions. Tidal waters closest to Centreville are "restricted" which "means that no harvesting of oysters and clams is allowed at any time." This restriction applies to all the waters of the Corsica River east of a line extending in a northeasterly direction from Wash Point (39E04'51.2"

North Latitude, 76E06'42.2" West Longitude) to Cedar Point (39E04'57.9" North Latitude, 76E06'29.6" West Longitude).

These restrictions are applied by the Maryland Dept. of the Environment (MDE) to protect public health because elevated fecal coliform counts are commonly found in this area of the River estuary. The elevated counts suggest the presence of contamination by animal or human waste. Restrictions are necessary because oysters and clams are filter feeders that readily absorb pathogens in animal or human waste.

3. Sediment

The tidal portion of the Corsica River is listed for impairment due to suspended sediments in the 1996 303(d) list. The origins of these suspended sediments were listed: as natural and two types of human sources: point sources and nonpoint sources.

Suspended sediment can cause water quality and habitat problems in several ways. Most unpolluted streams and tidal waters naturally have limited amounts of sediment moving "suspended" in the water. Excessive amounts of suspended sediment in waterways are considered pollution because they can inhibit light penetration, prevent plant growth, smother fish eggs, clog fish gills, etc. Sediment in streams tends to arise from stream bed and bank erosion and from land that is poorly vegetated or disturbed. Suspended sediment pollution may arise from construction sites, crop land, bare ground and exposed soil generally. The amount of sediment contributed varies greatly site to site depending upon stream stability, hydrology, management controls and other factors.

4. Biological Impairment

One segment of the nontidal stream Gravel Run in the Corsica River watershed is listed for biological impairment in the draft 2002 303(d) list based on poor ratings for fish and benthic organisms (population and/or habitat).

In selected stream segments statewide, populations of benthic macroinvertebrates and fish and their associated physical habitat have been assessed by the Maryland Biological Stream Program. Based on criteria developed for each physiographic/ecological zone in Maryland, each stream segment is rated as either good, fair, poor or very poor. Ratings of poor and very poor were listed as biological impairment for the first time in Maryland in the draft 2002 303(d) list of impaired waters. In the Corsica River watershed, one stream site appears in the list because of biological impairment. Gravel Run is listed based on 1995 sampling of the stream in the Town of Centreville. See the section on Maryland Biological Stream Survey Findings for additional details.

5. Toxics – PCBs, Dieldrin, Methylmercury and Fish Consumption Advisory

The tidal portion of the Corsica River is listed as an impaired water body for toxic compounds because fish tissue sampling conducted in 2000 by MDE and the University of Maryland Center for Estuarine Studies found elevated concentrations of Polychlorinated Biphenyls (PCBs) and Dieldrin.

PCBs are listed as the cause for listing of the Corsica River area for impairment by toxic compounds. PCBs are a category of synthetic organic compounds that were widely used for several decades but they are now banded from use in the United States. Their resistence to high

temperatures and generally very stable chemical characteristics made them popular for use in high voltage electrical equipment like transformers including the type previously used in local electricity distribution networks. PCBs' stability and organic characteristics in the environment allow them to accumulate in the food chain including in fish that humans eat and in humans. These compounds are associated with toxic and carcinogenic effects.

Dieldrin is mentioned in the 303(d) list as a toxic compound found in Corsica River area channel catfish tissue but it was not listed as a factor in the river's listing for impairment. Dieldrin is a synthetic organic herbicide that was once widely used but is now no longer in use in the United Stated. It is known to accumulate in the food chain including in fish that humans eat and in humans. This compound is associated with toxic and carcinogenic effects.

The Fish Consumption Advisory for channel catfish in the Chester River/Corsica River area arose because of the elevated levels of PCBs and/or dieldrin found in the fish that were tested. Based on these findings, there is a risk that health problems could occur in people who eat these local fish too frequently. Fish tissue sampling conducted in 2001 by MDE led to issuance of a fish consumption advisory in late 2001 and an update to the advisory was issued by MDE in January 2003. The purpose of the advisory is to recommend that human consumption of channel catfish from the Chester River/Corsica River area be limited as described in the table below. For more information on the fish consumption advisory see www.mde.state.md.us/CitizensInfoCenter/FishandShellfish

2003 Advisory On Fish Consumption for Corsica River Area Waterbodies
Recommended Maximum Allowable Meals Per Month
(unless noted as meals per year)

Species	Area	General Population 8oz meal	Women 6oz meal	Children 3oz. meal	Contaminant
Channel Catfish	Chester River (Corsica Creek)	< 18" 1/mo.	11 per year	11 per year	PCBs, Pesticides
		>18" 11/yr.	9/year	7 per year	
White Perch	Chester River mainstem	1	1	1	
Smallmouth & Largemouth Bass, Pickerel, Northern Pike, Walleye	Lakes and other impoundments	4	4	2	Methyl-mercury
	Rivers and streams	no advisory	8	8	
Bluegill	Lakes and other impoundments	8	8	8	

Total Maximum Daily Loads for Corsica River Nutrients

The Maryland Department of the Environment (MDE) uses the 303(d) list to determine the need for establishing Total Maximum Daily Loads (TMDLs). A TMDL is the 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 Maryland. In general, TMDLs include several key parts:

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

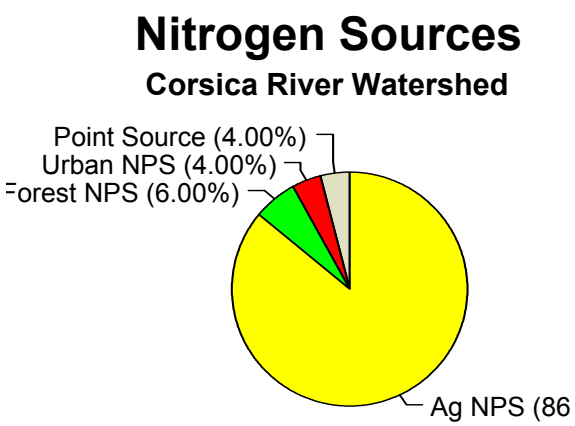
As of March 2003, one approved TMDL directly affects the Corsica River watershed. The report *Total Maximum Daily Loads of Nitrogen and Phosphorus for Corsica River* was completed by Maryland Department of the Environment (MDE) in April 2000 and was approved by US EPA in May 2000. It established Corsica River TMDLs for both nutrients as listed below.

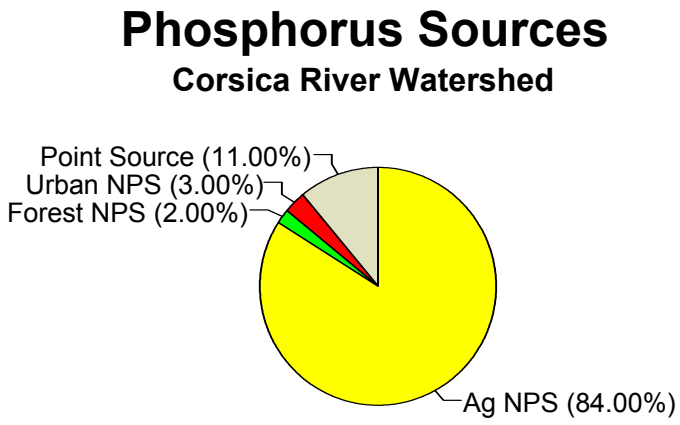
Nitrogen	low flow TMDL	1,379 pounds per month, May 1 through October 31
	annual TMDL	287,670 pounds per year
Phosphorus	low flow TMDL	202 pounds per month, May 1 through October 31
	annual TMDL	22,244 pounds per year

These TMDLs mean that water quality impairment can be eliminated in the Corsica River if the total loads of nitrogen and phosphorus reaching the river are both reduced to this level or less. Collectively, these TMDLs are intended to meet two specific goals: a) avoiding harmful algae blooms (i.e., algae population density greater than 50 milligrams per liter (mg/l) of chlorophyll-a), and; b) maintaining adequate oxygen to support aquatic life (i.e. dissolved oxygen concentrations above of 5.0 mg/l as required by State regulation).

MDE's computer model results indicate that nonpoint sources of nutrients are a most significant contributor as shown on the next page. The pie charts were adapted from MDE's report. In both cases, agricultural land is the largest nutrient source in the watershed. Based on the assumption that atmospheric deposition of nutrients is evenly distributed across the watershed, these relative load estimates associate nutrients arriving from the atmosphere into the land use type where they are deposited. To meet TMDL requirements, MDE anticipates two general approaches to controlling nutrients:

– Nonpoint source nutrients will be controlled through existing programs, like implementing best management practices, and
– Point source nutrients will be controlled at the Centreville Wastewater Treatment Plant (WWTP).





The allocations listed will be used by MDE in drafting NPDES permits for dischargers in the Corsica River watershed. For example, that the nutrients discharged from the Centreville WWTP, plus any other point sources in the watershed, must be less than the point source load allocations for the annual and the summer low flow load allocations. Based on the computer model results, MDE anticipates that point source low flow requirements can be met by applying NPDES permit requirements on the Centreville Wastewater Treatment Plant. The annual point source load allocations were based on projected maximum design flow at the Centreville Wastewater Treatment Plant assuming biological nitrogen removal and chemical phosphorus removal. MDE intends to monitor progress toward meeting the TMDLs through routine monitoring and additional TMDL evaluations. The estimated annual nonpoint source loads for both the nitrogen and the phosphorus TMDLs were based on Year 2000 land use projections. Additional details on nonpoint sources are presented in table Average Annual Nonpoint Source Load Estimates.

Summer Low Flow Load Allocations for Point Sources and Nonpoint Sources		
	Total Nitrogen (lb/month)	Total Phosphorus (lb/month)
Nonpoint Source	427	13
Point Source	625	117

Annual Load Allocations for Point Sources and Nonpoint Sources		
	Total Nitrogen (lb/month)	Total Phosphorus (lb/month)
Nonpoint Source	268,211	19,380
Point Source	7,598	1,424

Average Annual Nonpoint Source Load Estimates (Adapted from April 2000 TMDL)							
Land Use Category	**Area**	**Nitrogen**			**Phosphorus**		
	acre	lb/per/ac	lb/year	Percent	lb/per/ac	lb/year	Percent
Agriculture	15,603	14.36	224,015	83.5	1.11	17,346	89.5
Forest	6,722	2.36	15,873	5.9	0.47	317	1.6
Urban	1,367	7.16	9,787	3.7	0.502	687	3.6
Open Water	1,381	13.42	18,535	6.9	0.75	1,030	5.3
Total	25,073		268,211	100		19,380	100

Water Quality Indicators–Setting Priority for Restoration and Protection

This comparison using indicators was first created to support the Clean Water Action Plan's 1998 *Unified Watershed Assessment* which established priorities for watersheds in the State for restoration and protection. In the Plan, there were two categories for priority action: highest priority for restoration, and priority for protecting valued resources.

As the basis for the prioritization, indicators of water quality, landscape and living resources were developed for all watersheds in Maryland. Other approaches to assessing water quality have been in use for several years and are further described below. In general they do not look comparatively at watersheds as the Unified Assessment did in an effort to set priorities. The Unified Assessment also considered a range of living resource and landscape indicators described a little later.

Water Quality Indicator Summary Corsica River Watershed From: 1998 *Unified Watershed Assessment*	
Indicator Name	**Finding**
Modeled Load: TP	0.66 lbs/acre
Modeled Load: TN	8.63 lbs/acre

Comparison with similar Maryland watersheds
Green shading: goal or benchmark was met.
Orange shading: goal or benchmark not met.

The Unified Assessment looked at five water quality indicators to compare the State's 138 "8-digit" watersheds though not all watersheds had information to allow generation of each indicator.

1. Modeled Loads for Phosphorus and Nitrogen

In comparison to the other watersheds that drain to the Chesapeake Bay in Maryland, it is estimated that the Corsica River watershed receives 0.66 pounds of total phosphorus (TP) per acre in the watershed and 8.63 lbs/acre total nitrogen (TN). The TN yield meets Maryland's

benchmarks for these nutrients used in the *Unified Watershed Assessment* but the TP yield does not.

Two of the most important pollutants in the Chesapeake Bay system are the nutrients nitrogen and phosphorus, deemed this because of their contribution to excessive growth of algae, speeding the processes of eutrophication. To estimate how much TP and TN reaches the streams and how much of each is available for transport to the Bay, computer models are used. For the computer modeling used to generate the yield estimates reported in the Unified Assessment, the following information was used for the models: 1) monitoring data of point source nutrient discharges; 2) estimated nonpoint sources loads, based on 1996 land use and estimates of selected land management practices, and 3) consideration of other factors like deposition from the air.

2002 modeling conducted by DNR using 2000 data shows that the average yields for the Corsica River watershed are 0.759 pounds per acre annually of total phosphorus and 11.71 pounds per acre annually of total nitrogen. These load estimates may differ from the estimates used in the *Unified Watershed Assessment* for several reasons: changes in point source discharges and land use, and differing consideration of best management practices and septic system loads.

An additional gauge of nutrient loads will be available in the results of the synoptic survey conducted in 2003.

Water Quality Monitoring

1. Intensive Surveys 1992 and 1993

Intensive water quality surveys were conducted in 1992 and 1993 near the Centreville Wastewater Treatment Plant discharge and downstream to the Watson Road Bridge. This data was not used in the Corsica River nutrient TMDLs because the geographic coverage was too limited to characterize the entire tidal area of the Corsica River.[5]

2. 1997 Monitoring for the TMDL

Two water quality surveys were conducted in the Corsica River watershed in the summer of 1997 to support work on the TMDL at locations shown in Map 4 Monitoring Water Quality. The summer represents critical conditions for the Corsica River. This is because there is less water flowing in the channel, higher concentrations of nutrients, and the water temperatures are usually warmer creating good conditions for algal growth. Data from these 1997 surveys was used to develop the nutrient TMDLs for the Corsica River.[5]

3. Long Term Monitoring in Tidal Waters

Long term monitoring of tidal waters has been conducted in the Chester River at two locations. Similar long term water quality monitoring has not been conducted in the Corsica River. Based on interpretation of 1997 Corsica River water quality data, influence of the Chester River on Corsica River water quality conditions is not clear. Status and trends information for the Chester River long term monitoring stations is available on the Internet at http://www.dnr.maryland.gov/bay/tribstrat/index.html .

National Academy Press, Clean Coastal Waters (2000)
What Are the Effects of Nutrient Over-Enrichment? [6]

The productivity of many [lake, estuary and] coastal marine systems is limited by nutrient availability, and the input of additional nutrients to these systems increases primary productivity [microscopic organisms including algae]. In moderation in some systems, nutrient enrichment can have beneficial impacts such as increasing fish production; however, more generally the consequences of nutrient enrichment for [lake, estuarine and] coastal marine ecosystems are detrimental. Many of these detrimental consequences are associated with eutrophication.

The increased productivity from eutrophication increases oxygen consumption in the system and can lead to low-oxygen (hypoxia) or oxygen-free (anoxic) water bodies. This can lead to fish kills as well as more subtle changes in ecological structure and functioning, such as lowered biotic diversity and lowered recruitment of fish populations.

Eutrophication can also have deleterious consequences on estuaries even when low-oxygen events do not occur. These changes include loss of biotic diversity, and changes in the ecological structure of both planktonic and benthic communities, some of which may be deleterious to fisheries. Seagrass beds are particularly vulnerable to damage from eutrophication and nutrient over-enrichment.

Harmful algal blooms (HABs) harm fish, shellfish, and marine mammals and pose a direct public health threat to humans. The factors that cause HABs remain poorly known, and some events are entirely natural. However, nutrient over-enrichment of coastal waters leads to blooms of some organisms that are both longer in duration and of more frequent occurrence.

Although difficult to quantify, the social and economic consequences of nutrient over-enrichment include aesthetic, health, and livelihood impacts

Water Quality Analysis

The water quality analysis presented here is based on two water quality surveys conducted in summer 1997 by the State of Maryland for the TMDL. This limited data set allows for identification of warm weather problems but does not provide a complete understanding of variability throughout the year. Locations referenced in this section are shown on Map 4 Monitoring Water Quality.

1. Dissolved Oxygen

Based on the 1997 water quality monitoring, dissolved oxygen concentrations in the lower Corsica River from the mouth to Miller Creek were consistently higher than the minimum 5.0 mg/l standard which indicates good water quality. Upstream of Miller Creek dissolved oxygen concentrations were commonly near or below the 5.0 milligrams per liter (mg/l) minimum standard. As dissolved oxygen concentrations decline below 5.0 mg/l, aquatic life has increasing difficulty respiring and must leave the area or face suffocation. Violations of this standard in estuarine waters, accompanied by high algae populations, indicate that poor water quality (eutrophic conditions) are present.

2. Algae

Upper reaches of the Corsica River experience persistent season algae blooms. Based on the two water quality surveys conducted in the summer of 1997, chlorophyl-a concentrations in the Corsica River upstream of Miller Creek occasionally reached between 50 micrograms per liter (Fg/l) and 146 Fg/l. These chlorophyl-a concentrations indicate significant eutrophication existed in this part of the river. Downstream of Miller Creek, chlorophyl-a concentrations were consistently less than 50 Fg/l which suggests a relatively less significant concern for eutrophication.

3. Phosphorus

Inorganic phosphorus concentrations measured in the Corsica River in 1997 ranged between 0.02 mg/l and 0.10 mg/l in most areas. However, in the vicinity of the Mill Stream Branch confluence with the Corsica River inorganic phosphorus concentrations slightly higher that 0.10 mg/l were measured. Though there is no water quality standard for phosphorus, concentrations higher than 0.10 mg/l total phosphorus are commonly considered to be an indication of eutrophication in estuarine waters.

In the Corsica River downstream of Miller Creek, inorganic phosphorus concentrations of 0.05 mg/l and less were typical. This finding of lower inorganic phosphorus concentrations near the Chester River compared to upstream areas of the Corsica River suggests that the sources of the elevated phosphorus concentrations within the Corscia River watershed are more important than those potentially entering from the Chester River.

4. Nitrogen

Total nitrogen concentrations in the upper tidal waters of the Corsica River (upstream of Emory Creek) ranged from around 1.0 mg/l to over 3.0 mg/l based on monitoring conducted in 1997. The tidal waters around Centreville exhibited total nitrogen concentrations greater than 2.0

mg/l. Though there is no water quality standard for total nitrogen, concentrations of 1.0 mg/l and higher in estuarine water are commonly considered to be an indication of eutrophication.

Between the mouth of the Corsica River and Emory Creek, total nitrogen concentrations for summer 1997 ranged between 0.5 mg/l and 1.0 mg/l. The concentrations of less than 1.0 mg/l suggests less concern about eutrophication in the lower tidal waters of the Corsica River.

5. Toxics

In 2000, MDE collected fish across Maryland, including the Corsica River, so that their tissue could be sampled for contamination by toxic materials as described in the prior section Use Impairments and Restrictions.

A 1999 report by the Chesapeake Bay Program listed the Chester River (including tributary areas like the Corsica River) as an *Area of Emphasis*.[14] This designation means that available data indicate that there is significant potential for a chemical contaminant-related problem. The monitoring data used to support this finding was collected in the Chester River mainstem in the vicinity of the Corsica River in both water column and sediment sampling stations. However, none of these sampling sites were in the Corsica River.

Sources of Pollution

Since European settlement of North America there has been an explosive growth in human population, supported by more intensive agriculture and the growth of industry. The entire continent has been crisscrossed and made mutually interdependent by vast transportation systems. All of this contributes to the decline in water quality and other natural resources. Sources of water pollution, which are grouped into two broad categories point sources and nonpoint sources, and nutrient pollution loads associated with these sources are discussed below.

1. Point Sources

Pollution arising from discharges through 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 or microbes that consume oxygen (measured as Biochemical Oxygen Demand (BOD)) reducing oxygen available for other aquatic life. Industrial point sources may contribute various forms of pollution. Some understanding of point source discharges in a watershed can be useful in helping to identify and prioritize potential restoration measures.

The Corsica River Watershed has four permitted discharges, based on information from the Maryland Department of the Environment (MDE) permit data base. Summary information is presented in the MDE Permits Summary Table and on Map 5 MDE Permits:

– The Corsica River's upper tidal waters and the lower Mill Stream Branch may have a localized impairment associated with the Centreville Wastewater Treatment Plant (WWTP) according on MDE's interpretation of 1997 water quality monitoring data. This interpretation arises because 1997 monitoring of these tidal waters found that dissolved oxygen concentrations fell below 5.0 mg/l under some conditions and that total nitrogen

concentrations ranged between 1.0 mg/l to 3.0 mg/l. No other facilities with MDE permits appear to be contributing to these water quality problems.

– The Town of Centreville anticipates that land application of treated sewage effluent could begin as early as 2004. This change could significantly reduce point source nutrient contributions to the river.

Characteristics of permitted discharges (volume, temperature, pollutants, etc.) are tracked by MDE through the permit system. This information is accessible to the public and can be obtained from MDE.

MDE Permits -- Surface Water – Corsica River Watershed (2/2003 MDE Data)			
Facility Type / Name		**MD Permit / NPDES Permit**	**Receiving Stream / Street / Description**
Surface Water Discharge	Centreville Wastewater Treatment Plant	97DP0116 MD0020834	Corsica River, Johnson Lane, treated sewage effluent
	Tidewater Publishing Corp.	95DP0211	Gravel Run, Tidewater Drive, wash water
	SHA Centreville Shop	97SW1315	Three Bridges Branch, Safety Drive, stormwater
Ground Water Discharge	Centreville Wastewater Irrigation Facility	00DP3323	Hope Road, This discharge of treated sewage effluent is anticipated to begin in 2004.

2. Diffuse or Nonpoint Sources

Sources of pollution that include areas of land and other sources that do not have a specific point of origin are called nonpoint sources. Nonpoint sources are commonly significant contributors of pollutants, particularly nutrients and sediment. These diffuse sources include rain water that runs off roofs, streets and parking lots (sometimes via storm drains) into nearby surface waters, as well as run-off from farm fields and, to a much lesser extent, forests. Also included in nonpoint source pollution is deposition from the atmosphere and contributions from ground water, where septic systems are a factor.

a. Nutrients

According to computer modeling presented in MDE's April 2000 nutrient TMDL report for the Corsica River watershed, nutrients from nonpoint sources dominate the average nutrient load to the river based on 1997 water quality data and projected land use data for the Year 2000:

– Nitrogen from nonpoint sources accounts for about 96% of the entire nitrogen load to the Corsica River (268,211 lb/yr total nitrogen).
– Phosphorus from nonpoint sources accounts for about 89% of the entire phosphorus load to the Corsica River (19,380 lb/yr total phosphorus).

These nonpoint source estimates do not distinguish between naturally occurring nonpoint nutrients and those caused by human activity. Both types are accounted for in the load estimates. (Naturally occurring nutrient loads, also called background loads, are the loads that would be generated if the entire watershed was in undisturbed forest and no other human-generated nutrients were contributed through atmospheric deposition.)

Given the current understanding of nutrient loads and related problems in the Corsica River, it is reasonable for WRAS partners to identify and prioritize projects with the intention of reducing nutrient loads for several reasons:

– Elevated nutrient levels in the Corsica River, which is an indicator of eutrophication, may persist after upgrades to the Centreville WWTP envisioned in MDE's TMDL computer modeling. Elimination of the Corsica River's water quality impairments will likely require reduction of nutrient loads from nonpoint sources in the watershed.
– Reduction of nonpoint source nutrient loads can be accomplished, in part, through existing programs that implement best management practices and through education of land managers.

b. Sediment

Nonpoint source sediment loads have not been estimated for the Corsica River Watershed. However, several current sources of information identify sediment as a problem:

– The Corsica River is listed for impairment by sediment / suspended solids in Maryland's 303(d) list.
– Phosphorus, which tends to be transported in association with soil particles, is identified as an impairment in the Corsica River.

c. Shoreline Erosion

Wherever land and open water meet, change in the form of erosion or accretion of land is the inevitable result of natural processes. Human activity in these areas often either inadvertently accentuates these natural processes or purposefully attempts to control movement of water and/or loss of land. Erosion of shorelines can contribute significant amounts of nutrients (mostly phosphorus) and sediment (water column turbidity, habitat loss.) The table Queen Anne's County Shore Erosion Rate Summary provides a brief overview of local conditions. [7]

Queen Anne's County Shore Erosion Rate Summary [7] (Miles of Shoreline)				
Total Shoreline	Total Eroding Shoreline	Erosion Rate		
		0 to 2 feet / year	2 to 4 feet / year	4 or more feet / year
323	95 (29%)	64	12	2

Maps of historic shoreline change were produced in 1999 by the Maryland Geological Survey (MGS) in a cooperative effort between DNR and the National Oceanic and Atmospheric Administration (NOAA). These maps included digitized shorelines for several different years in Queen Anne's County. The maps show that extensive changes have occurred adjacent to large bodies of open water. Copies of these 1:24000 scale maps are available from the MGS.

Currently, DNR is working to improve the ability to predict areas of high-rate shoreline erosion. In addition to considering historic erosion rates, contributory effects of land subsidence and sea level rise are being considered. To help generate predictive tools, two pilot areas have been selected: Queen Anne's County and Dorchester County. Results from this work are not currently available but information will be shared with local jurisdictions and other interests when they become available.

Groundwater and Water Supply

In the Corsica River Watershed, ground-water is the source for all water supplied to community use. The Town of Centreville operates the only community water supply system in the watershed under MDE permit QA1967G002. The Town's wells are all in the immediate vicinity of the community that they serve as shown in Map 5 MDE Permits. Much of the town is close enough to the wellheads to potentially affect them so it may be anticipated that the wellhead protection areas will encompass the majority of the town..

In general, community water supply systems employ confined aquifers in order to avoid the potential of local near-surface pollution. Therefore, community wells are not likely to affected by near-surface goundwater nutrient loads.

LANDSCAPE

Water quality, particularly in streams and rivers, is affected by the land in the riparian zone and by soils, vegetative cover and the land use throughout the watershed. In an effort to gauge the affects of land use on water quality, and to allow comparison between watersheds, DNR has developed a series of Landscape Indicators. These indicators can be used to portray landscape conditions on a watershed scale that tend to support good water quality or that tend to degrade water quality.

Landscape Indicators

The 1998 *Maryland Clean Water Action Plan* included a unified watershed assessment that used a number of landscape indicators to assess the State's 138 watersheds.[2] Most indicators are relative measures by which Maryland's watersheds can be compared. The following sections identify the findings for the Corsica River Watershed from the 1998 Plan, with the exception of the population density, which is based on Year 2000 Census data.

Landscape Indicator Summary
Corsica River Watershed
From: 1998 *Unified Watershed Assessment*

Indicator Name	Finding
Year 2000 Population Density	**0.15 people/acre**
Historic Wetland Loss	**4,192 acres**
Unbuffered Streams	**37 %**
Soil Erodibility	**0.32 value/acre**

Comparison with similar Maryland watersheds
Green shading: goal or benchmark was met.
Orange shading: goal or benchmark not met.

1. Population Density

Based on the Year 2000 Census, the population density in the Corsica River Watershed was 0.15 people per acre of land. This is similar to the in the *Unified Watershed Assessment* estimate 0.17 people/acre based on 2000 population projections.

As human population increases, the effects of human activity that degrades, displaces, or eliminates natural habitat also tend to increase. Watersheds with higher populations, assuming other factors are equal, tend to exhibit greater impacts on waterways and habitat. However, growth can be directed in ways to reduce negative impacts. A comparison with other watersheds in the state has not been completed using the 2000 census data.[2]

2. Historic Wetland Loss

DNR mapping indicates that there are nearly 2,600 acres of wetlands in the Corsica River watershed now. However, assuming that all nonwetland hydric soils in the watershed were once wetlands, the estimated loss of wetlands over the years is 4,192 acres. This interpretation is based on the assumption that the hydric soils in the watershed were all, at one time, wetlands. Thoughtful selective restoration of historic wetland areas can be an effective WRAS component. In most of Maryland's watersheds, extensive wetland areas have been converted to other uses by draining and filling. This conversion reduces or eliminates the natural functions that wetlands provide.[2]

3. Unbuffered Streams

Approximately 37% of streams in the Corsica River Watershed were not buffered with trees, based on 1998 information. Corridors 100 feet wide (50 feet either side) along streams were combined with forest cover to develop this indicator. This estimate of streams lacking forested buffer was generated for the 1998 Maryland Clean Water Action Plan by using Maryland Department of State Planning GIS data for streams and for 1994 land use. The finding for the Corsica River watershed compares well with other Maryland watersheds.[2]

In most of Maryland, trees are key to healthy natural streams. They provide numerous essential habitat functions: shade to keep water temperatures down in warm months, leaf litter "food" for aquatic organisms, roots to stabilize stream banks and vegetative cover for wildlife. In general, reduction or loss of riparian trees / stream buffers degrades stream habitat while replacement of trees / natural buffers enhances stream habitat. (For this indicator, only streams that appear on USGS Topographical Maps, sometimes called "blue line streams," were considered in this estimate).

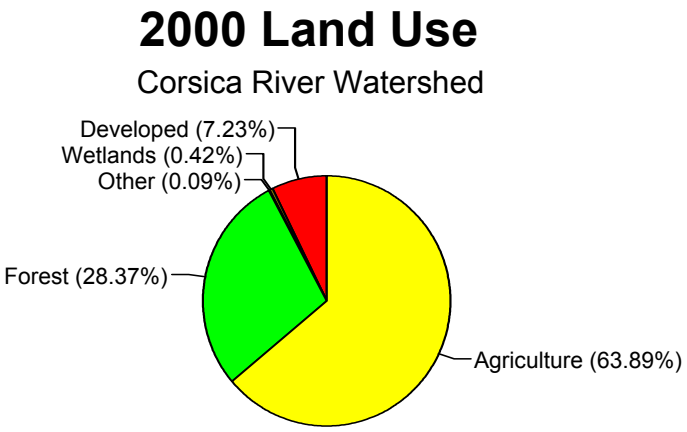
4. Soil Erodibility

Soil erodibility for the Corsica River Watershed is represented by what is known as the K factor, in this case estimated to be 0.32.[2] The K factor normally varies from approximately zero to about 0.6. A K value of 0.17 has a very low erosion potential, a value of 0.32 has a moderate erosion potential, a value of 0.37 has a high erosion potential, and a value of 0.43 has a very high erosion potential. This watershed's erodibility is moderate, although its ranking among all watersheds in the state was fairly high.

Watersheds with more highly erodible soils are naturally more susceptible to surface erosion, sedimentation, streambank erosion and other problems related to soil movement. These negative effects of soil erodibility on water quality can be minimized through careful management. The soil erodibility indicator accounts for natural soil conditions but not for management of the land. (Existing cropland management was not considered.) The naturally erodible soils in the watershed are addressed by techniques called Best Management Practices (BMPs) to prevent soil loss, practices that are typically in use on local farms. BMPs like no-till or reduced till cropping, planting cover crops, field strips, or retiring erodible soils from production can significantly reduce erosion and sediment movement. These BMPs can be seen in use in many places in the watershed.

Because soils can vary significantly within very small areas, a generalized erodibility indicator must be used with caution and supplemented with site-specific evaluation prior to implementing any management action.

Land Use / Land Cover



The following table and pie chart summarize 2000 land use / land cover for the Corsica River Watershed. They are based on categories established by the Maryland Department of Planning.

Nearly 64% of the land in the Corsica River Watershed is agriculture. About 28% is in some form of forest and about 7% is covered with some type of developed or urban use. All other types of land together amount to less than 1% of the watershed.

Viewing these general land use categories as potential nonpoint sources of nutrients, agricultural lands are likely to contribute the greatest loads to local waterways. Urban lands may also contribute significant nutrient loads. Map 6 Land Use / Land Cover shows the distribution of these land use categories in the watershed.

Since this land use / land cover categorization was completed in 2000, significant land use change continues to occur in the watershed. For example, acreage to the east of Rt. 213 north of the Three Bridges Branch is shown as agricultural on the map. Some of this area was annexed by the town of Centreville several years ago and a housing development called North Brook now occupies some of this land.[15]

Land Use / Land Cover In Corsica River Subwatersheds
Acres / Percent, MDP 2000 Data

Watershed	Agriculture	Forest	Developed	Wetland	Other	Total
Corsica Direct Drainage	3,968 56%	2,376 34%	633 9%	76 1%	0	7,053
Mill Stream Branch	6,495 70%	2,370 25%	470 5%	2 --	22 --	9,359
Three Bridges Branch and Gravel Run	4,809 65%	2,036 27%	624 8%	22 --	0	7,491
Corsica River Watershed (land only)	**15,272**	**6,782**	**1,727**	**100**	**22**	**23,903**
Corsica River Watershed including open water						**25,298**

Looking at land use / land cover in the three subwatersheds of the Corsica River watershed, several characteristics can be ascertained from the map and the table below:

– Corsica Direct Drainage subwatershed has the greatest percentage of forest and brush cover. It also has the greatest percentage of developed land even though it does not include a town center. Additionally, it has the smallest percentage of agricultural land use. Taken together, it appears that development is the least concentrated in this subwatershed compared to the other two.
– Mill Stream Branch subwatershed has the greatest percentage of agricultural land and the smallest percent developed land even though in encompasses part of Centreville. This suggests that development is relatively concentrated in this subwatershed compared to the other two subwatersheds.
– Three Bridges Branch and Gravel Run exhibits a mid-range percent of each major land use / land cover category compared to the other two watersheds. It also encompasses part of Centreville.

Impervious Surface

Roads, parking areas, roofs and other human constructions are collectively called impervious surface. Impervious surface blocks the natural seepage of rain into the ground. Unlike many natural surfaces, impervious surface typically concentrates stormwater runoff, accelerates flow rates and directs stormwater to the nearest stream without significant opportunity for stormwater infiltration into the ground. Watersheds with small amounts of impervious surface tend to have better water quality in local streams than watersheds with greater amounts of impervious surface.

Urbanization and the increase in impervious surfaces that accompanies development can significantly impact stream health. Increases in the extent of upstream impervious surface are strongly associated with a decrease in stream quality. As impervious surfaces cover more of the landscape, less water infiltrates the soil and more water enters stream systems through runoff or stormwater discharge. This increased stormwater runoff from impervious surfaces contributes to stream quality degradation by introducing more non-point source pollution, higher temperatures, reduced stream baseflow and more erosive flood flow.

The table Upstream Impervious Cover Thresholds shows the relationship between upstream impervious land cover and in-stream quality. These thresholds are based on extensive biological monitoring conducted by the Maryland Biological Stream Survey:[10]

Upstream Impervious Cover Thresholds	
Percent	**Affects on Stream Quality**
Less Than 2	Imperviousness is relatively insignificant compared to other factors affecting habitat quality. In cold-water habitats, brook trout may be found.
Above 2	Negative impacts to stream health begin. Brook trout are never found in streams with watershed imperviousness above this threshold.
Above 15	Stream health is never rated good, based on a combined fish and benthic macroinvertebrate Index of Biotic Integrity.
Above 25	Only hardy, pollution-tolerant reptiles and amphibians can thrive, while more pollution-sensitive species are eliminated.

Map 7 Impervious Surface Corsica River Watershed reflects data developed by the University of Maryland's Regional Earth Sciences Application Center (RESAC).[11] The map is color coded to show the relative amount of impervious cover in various areas of the watershed.

Overall, there is relatively little impervious surface in the Corsica River watershed. Each of the three subwatersheds have average impervious cover of less than two percent. In appears that impacts associated with impervious surfaces are limited to small localized areas. Some of the local concentrations of impervious surface are in Centreville and adjacent to major roads. These concentrations of impervious surface may be generally suited to stormwater management control. Stormwater management retrofits and other forms of restoration could be targeted to these areas.

Lands With Significant Natural Resource Value and Large Area

1. Green Infrastructure

DNR has mapped a network of ecologically important lands, comprised of hubs and linking corridors collectively called Green Infrastructure. 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 cold water 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.

This Green Infrastructure provides the bulk of the state's natural support system and 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. For more information on the Green Infrastructure identification project in Maryland, see www.dnr.maryland.gov/greenways/

Protection of Green Infrastructure lands may be addressed through various existing programs including Rural Legacy, Program Open Space, conservation easements and others. Within Program Open Space, the Green Print program helps to target funds to protect Green Infrastructure areas.

Map 8 Green Infrastructure shows that there is a significant amount of Green Infrastructure in the Corsica River watershed:
– Four Green Infrastructure hubs are identified in the Corsica River watershed.
– Only a small portion of one hub has some form of environmental resource protection.

2. Large Forest Blocks

Large blocks of forest provide habitat for species that are specialized for conditions with relatively little influence by species from open areas or humans. For example, forest interior dwelling birds require forest interior habitat for their survival and they cannot tolerate much human presence. Map 9 Forest Interior shows blocks of contiguous forest that are at least 50 acres in size with at least 10 acres of forest interior (forest edge is at least 300 feet away) that may be important locally within the Corsica River Watershed. This size threshold was chosen to help ensure that the forest interior is probably large enough to provide locally significant habitat for sensitive forest interior dwelling species. The assessment shown in Map 9 differs from the Green Infrastructure assessment which considered only large blocks of forest land cover at least 250 acres in size that are likely to have state or regional importance.

Protected Lands

Map 10 Protected Land shows the distribution of protected lands in the Corsica River watershed. As used in the context of watershed restoration, "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 another party acquired the development rights or otherwise acquired the right to limit use through the purchase of an easement, and other approaches. The extent of "protection" varies greatly from one circumstance 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.

Protected Land Summary
Corsica River Watershed

	Acres	%
MET / ESLC Easements	810	3
Agricultural Easements	909	4
County Parks, Open Space	239	1
Protected Land Total	**1,958**	**8**
Watershed Land Total	23,903	100

The map also shows some land in the watershed is within a Rural Legacy Area. This land encompasses 564 acres or about 2% of the watershed. The Rural Legacy Area designation has the potential to target Program Open Space funds to help protect additional land from development. Some of this land is already protected by easement and/or by County ownership. The land shown on the map that is not currently under easement or County ownership is open to land use change consistent with local zoning and comprehensive plan requirements.

An additional area of land identified on the map is encompassed by the Priority Funding Area. Within these areas, State funding is more likely to be available in support of local development projects. This area closes about 1,441 acres which is about 6% of the watershed. These areas are one of several ways to anticipate where new development or redevelopment is likely to occur.

For purposes of watershed restoration, a knowledge of existing protected lands and likely areas for new development can provide a starting point in prioritizing potential 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.

Soils of the Corsica River Watershed

1. Interpreting Local Conditions with Natural Soil Groups

Soil conditions like 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 one determining factor for water quality in streams and rivers. Local soil conditions vary greatly from site to site as published information in the Soil Survey for Centreville and Queen Anne's County shows. This information has been summarized into Natural Soil Groups to help identify useful generalizations about groups of soils.

Map 11 Soils By Natural Soils Groups shows the distribution of natural soils groups in the Corsica River Watershed as described in the table below.

2. Soils and Watershed Planning

Local soil conditions are a useful element for watershed planning and targeting restoration. Soils with limitations like wetness or slope naturally inhibit active use for farming or development and may then be available as restoration project sites. By comparing Map 11 Soils By Natural Soils Groups with the preceding maps Map 6 Land Use / Land Cover and Map 8 Green Infrastructure, it may be possible to discern how patterns of active or passive land use relate to soil conditions.

Natural Soils Groups and other soils assessments can be used to help identify potential areas for restoration projects or habitat protection. Hydric soils, for example, are more easily restored as wetlands than soils that were never saturated with water. See the chapter Restoration Targeting Tools for additional information.

Natural Soil Group Area Summary for the Corsica River Watershed			
	Soil Group Description	**Acres and Percent of Total**	
Prime Agricultural Soils	B1a - Well drained, moderate erodibility.	14,812	15,974 67%
	E1 - Moderately well drained, low erodibillity.	641	
	E3 - Moderately well drained, high erodibility.	521	
Soils With Limitations for Farming	A1a - Sandy, excessively well drained.	117	3,132 13%
	B2a - Well drained with slowly permeable sublayers. Strongly to very strongly acid.	2,327	
	E2 - Seasonally wet or dry, perched watertable, strong acidity.	688	
Hydric Soils	F2 - Poorly or very poorly drained, strongly to extremely acid, low erodibility.	1,079	4,907 20%
	F3 - Poorly drained to various extents – clayey, sticky and plastic when wet. Very high erodibility.	2,626	
	G2 - Poorly and very poorly drained floodplains subject to flooding, seasonally wet.	1,202	

Wetlands

1. Wetland Categories

The Coastal Plain Province likely has the highest diversity of emergent estuarine and palustrine (fresh water) wetland communities relative to other Maryland physiographic regions because both tidal and nontidal freshwater marshes occur here. Wetlands are most abundant in the Coastal Plain due to the low topographic relief and high ground water table characteristic of the region.

Estuarine Wetlands are abundant throughout the Coastal Plain. These systems consist of salt and brackish tidal waters and contiguous wetlands where ocean water is occasionally diluted by freshwater runoff from the land. These wetlands may extend far upstream in tidal rivers to freshwater areas. Differences in salinity and tidal flooding within estuaries have a significant effect on the distribution of these wetland systems. Salt marshes occur on the intertidal shores of tidal waters in areas of high salinity. Brackish marshes are the predominant estuarine wetland type in Maryland. They are found along the shores of Chesapeake Bay, mostly on the Eastern Shore, and for considerable distance upstream in coastal rivers. Estuarine shrub swamps are common along the Maryland coastal zone. Aquatic beds, comprised mostly of submerged aquatic

vegetation (SAV), were historically abundant in shallow water zones of Maryland's estuaries, especially Chesapeake Bay and its tributaries.

Palustrine wetlands are freshwater wetlands that are not associated with streams or lakes. In general, they are associated with freshwater, high water tables or intermittent ponding on land. Forested wetlands are the most abundant and widely distributed palustrine wetland type on the Coastal Plain. 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. Tidal freshwater swamps occur along coastal rivers in areas subject to tidal influence. Scrub-shrub swamps are represented in the Corsica River Watershed. Emergent wetlands on the Coastal Plain are characterized by a wide range of vegetation, depending on water regime. (Adapted from *Wetlands of Maryland*, Tiner and Burke, 1995.)

2. Tracking Wetlands

Oversight of activities affecting wetlands involves several regulatory jurisdictions. The Maryland Department of the Environment (MDE) is the lead agency for the State and cooperates with DNR, the Army Corps of Engineers and other Federal and local agencies. As part of its responsibility, MDE tracks State permitting and the net gain or loss of wetlands over time.

As the table Tracking Nontidal Wetland Change shows, the State regulatory program has measured a small net decrease of wetland acreage in the Corsica River Watershed over the past 11 years. This slowing of wetland loss in the watershed contrasts significantly with the estimated historic 4,192 acre wetland loss in the watershed as described in the Landscape Indicators section.

Tracking Nontidal Wetland Change For The Corsica River Watershed In Acres 1/1/1991 through 12/31/2002 [9]				
Permanent Impacts	**Permittee Mitigation**	**Programmatic Gains**	**Other Gains**	**Net**
-0.95	0.45	0	0	-0.49

Notes: 1) Regulatory tracking for authorized nontidal wetland losses began in 1991. Comprehensive tracking of voluntary wetland gains began in 1998. Only nontidal wetland changes are shown; tidal wetland changes are excluded. Acreage presented represents changes for the entire watershed.
2) "Permanent Impacts" refers to acres altered (e.g., filled, drained) under permit from MDE.
3) "Permittee Mitigation" refers to acres restored by a permit holder as required by terms of the permit from MDE.
4) "Programmatic Gains" refers to acres restored by MDE using fees paid into a compensation fund by a permit holder in lieu of undertaking mitigation himself.
5) "Other Gains" refers to acres of wetlands restored when not required as mitigation for permitted losses

3. Interpreting Wetland Distribution

Map 12 Wetlands and Wetland Acreage Summary Table summarize distribution and categories of wetlands in the Corsica River Watershed. Two wetland categories account for all of the wetlands in the watershed:

– Estuarine wetlands of all types account for slightly over 7% of all watershed wetlands, and
– Palustrine wetlands account for the remaining 93% of watershed wetlands. Forested Palustrine wetlands alone account for over 81% of all watershed wetlands.

In comparing the wetlands map to Map 6 Land Use / Land Cover, it can be seen that many of the nontidal wetland areas are depicted as forest on the land use map. And most of the estuarine wetlands are not identified on the land use map These differences are simply the result of two differing views of the landscape. For example, wooded nontidal wetlands can be viewed as "wetlands" from a habitat / regulatory perspective and they can be viewed as "forest" from a land use perspective. Similarly, most of the estuarine wetlands shown on the wetlands map are considered open water on the land use map.

In the Corsica River watershed, differing perspectives on counting wetlands are significant for watershed management. From a land use perspective, 100 acres of wetlands are identified by the Maryland Department of Planning. From a habitat / regulatory perspective, there are at least 2,592 acres of wetlands in the watershed.

In the context of the Watershed Restoration Action Strategy (WRAS), wetlands serve valuable water quality and habitat functions that may not be provided by other land uses. Therefore, protection and enhancement of existing wetlands, and restoration of past wetland areas, can be a valuable element in the WRAS. (Also see the Wetland Restoration section.)

Wetland Acreage Summary Table
Corsica River Watershed

Wetland Class		Acres
Estuarine	tidal emergent	159
	scrub shrub	6
	unconsolidated bottom	4
	unconsolidated shore	17
Palustrine	emergent	102
	flooded semipermanently	56
	forested	2,104
	scrub shrub	54
	unconsolidated bottom	90
Total Wetlands (DNR mapped wetlands)		2,592

Wetlands of Special State Concern (WSSC)
None of the wetlands in the table above are subject to WSSC regulations. See the Sensitive Species Section.

Floodplains

Flooding was identified as a local issue early in the WRAS project. Flooding of public roads crossing streams is a particular concern. Map 13 Floodplain and Sea Level Rise shows that the 100-year floodplain extends far up tributaries beyond Centreville. In recent years, stormwater management requirements have provided a means to limit impacts of new development and impervious area that would otherwise contribute to stream degradation and flooding. However, these requirements may not significantly improve water quality or quantity problems that are driven by systemic watershed factors. For existing development and impervious area, retrofitting controls to enhance water quality and limit peaks in stormwater runoff may offer an additional way to protect waterways.

Low Elevation Areas Subject to Sea Level Rise

The average rate of sea level rise along Maryland's coastline has been 3-4 mm/yr or approximately on foot per century. Such rates are nearly twice those of the global average (1.8 mm/yr), a result most likely influenced from land subsidence. The rate of sea level rise is expected to accelerate in response to global warming, resulting in a rise of 2-3 feet by the year 2100.

The low-lying coastal plains such as those along the eastern shore are vulnerable to impacts associate with rising sea level. Sea level rise threatens to exacerbate erosion and flooding, making areas more vulnerable to land loss, permanent inundation, and storm surge. Recognizing the need for advanced planning, the Department of Natural Resources developed a response strategy in 2000 and has been aggressively acquiring high-resolution elevation data (LIDAR) in the most vulnerable areas. Partial coverage of Queen Anne's County including the Corsica River has been acquired as select areas were defined as being less than 1.5 meters (5 feet) above sea level. Accurate elevation data will significantly improve the State and County's ability to define the most vulnerable areas and determine the most appropriate management measures to mitigate the impacts.[8]

LIVING RESOURCES AND HABITAT

Living resources, including all the animals, plants and other organisms in the Corsica River Watershed are being affected by human activity. The information summarized here suggests that some of the significant stresses on living resources in the watershed are associated with alteration and destruction of habitat, excessive movement of sediment and excessive availability of nutrients.

In the Corsica River watershed, information is available for fish, oysters, submerged aquatic vegetation, sensitive species. However, other forms of aquatic life, woodland communities, terrestrial habitats, and others should be considered as watershed restoration decisions are being made. Therefore, it is recommended that stakeholders in the watershed identify important living resource issues or priorities so that additional effort can be focused where it is most needed. New information should be added or referenced as it becomes available.

Living Resource Indicators

Aquatic organisms are sensitive, in varying degrees, to changes in water quality and aquatic habitat. They are also sensitive to landscape changes. This association offers two perspectives that are important for watershed restoration. First, improvements for living resources offer potential goals, objectives and opportunities to gauge progress in watershed restoration. Second, the status of selected species can be used to gauge local conditions for water quality, habitat, etc. This second perspective is the basis for using living resources as an "indicator."

Living Resource Indicator Summary
Corsica River Watershed
From: 1998 *Unified Watershed Assessment*

Indicator Name	Finding
SAV Abundance	**1.0**
SAV Habitat Requiremts	**3.0**
Nontidal Fish Index	**7.9**
Nontidal Benthic Index	**5.8**
Nontidal Habitat Index	**4.3**

Comparison with similar Maryland watersheds
Green shading: goal or benchmark was met.
Orange shading: goal or benchmark not met.

The *Maryland Clean Water Action Plan's Unified Watershed Assessment,* published in 1998, included a number of living resource indicators for the Corsica River Watershed.[2] Several of these indicators rely on extrapolations from a limited number of sampling sites which were then generalized to represent entire watersheds. Some are indices comprising several conditions. Considering this limitation on field data, it would be beneficial to conduct additional assessments to provide a more complete understanding of local conditions.

1. SAV Abundance

For tidal areas of the Corsica River Watershed, the abundance of submerged aquatic vegetation (SAV) scored "1.0" for the Abundance Indicator, which means that SAV covered 10% or less of the potential SAV habitat. This indicator is designed to allow comparison of watersheds based on actual SAV acreage versus potential SAV acreage. To generate the score for this indicator, two measurements of SAV area were used: 1) area covered by SAV in the year 1996 was estimated using aerial survey data, and 2) the potential SAV area based on water depth (up to two meters deep), physical characteristics and historic occurrence of SAV.

The benchmark used in the *Unified Watershed Assessment* of the *Clean Water Action Plan* for the SAV Abundance indicator was 10%. If less than 10% of the potential SAV area in a watershed was covered by SAV in 1996, then the watershed was listed in the category "needs restoration". If more than 10% of the potential SAV area in a watershed was covered by SAV in 1996, then the watershed was listed in the category "needs preventative action" to protect or enhance SAV abundance. No watershed in the State scored higher than 2, reflecting a maximum observed coverage of 20%.

2. SAV Habitat Index

For tidal areas of the Corsica River Watershed, the abundance of submerged aquatic vegetation (SAV) scored 3.0 for the Index, which means that SAV habitat requirements were not met based on 1994-1996 data. This index is designed to allow comparison of watersheds based on several measurements of habitat conditions: water clarity as measured by secchi depth, dissolved inorganic nitrogen where applicable, dissolved inorganic phosphorus, abundance of algae as measured by Chlorophyll *a* and total suspended solids.

The benchmark used in the Unified Watershed Assessment for the SAV Habitat Index was 7. A score less than 7 means that the watershed's habitat conditions were not favorable for SAV and the watershed was listed as being in need of restoration (Category 1). A score of 7 or higher means that 1994 through 1996 data showed that habitat conditions for SAV in a watershed were sufficient and the watershed was listed in the category for "restoration needed". The Corsica River watershed is among the lowest scoring half of watersheds statewide on this indicator.

3. Nontidal Fish Index of Biotic Integrity

With an IBI score of 7.9, the Corsica River Watershed met the benchmark set for the Nontidal Fish Index of Biotic Integrity (IBI).

The Fish Index of Biotic Integrity (fish IBI) for fishes have been developed for small (first- to third-order) non-tidal streams. Several characteristics of the fish community are measured: numbers of native species, of benthic species and of tolerant individuals; the percent of tolerant species, of dominant species, and of generalists, omnivores and insectivores; the number of individuals per square meter; biomass in grams per square meter; percent of lithophilic spawners; and percent insectivores. These characteristics are scored and summed to calculate a fish IBI for each sampled stream. Each watersheds score is an average of stream scores within the watershed. These watershed scores were ranked 1 (most degraded) through 10 (best condition). A score of less than 6 does not meet the benchmark set for this index. A score of 6 or greater meets the benchmark.

4. Nontidal Benthic Index of Biotic Integrity

With an IBI score of 5.8, the Corsica River watershed does not meet the benchmark set for the Nontidal Benthic Index of Biotic Integrity (IBI).

The nontidal benthic IBI looks at the insects and other invertebrates, like crayfish, living on the bottoms of streams, considering the overall community composition, the number and diversity of species and the presence of sensitive species. To calculate the benthic IBI, for the *Unified Watershed Assessment*, reference conditions were established for minimally-impacted streams. IBI values are relative to conditions in these minimally-impacted streams. An index of 6.0 or less means that restoration is recommended and an index of 8.0 or higher means that protection is recommended.

5. Nontidal Habitat Index of Biotic Integrity (IBI)

The Corsica River watershed's low overall index of 4.3 for habitat biotic integrity suggests that this watershed has significant physical habitat concerns relative to similar Maryland watersheds. This rank corresponds to an Maryland Biological Stream Survey's score of 2.8 which is in the "poor" range. A rank less than 6 means that restoration is recommended.

This physical habitat indicator is developed for small (first- to third-order) non-tidal streams. It is based on several measures of in-stream habitat quality that are scored for each site based on observations of habitat condition in streams during sampling visits. The habitat measures rate the quantity and quality of physical habitat available in the stream for fish and benthic macroinvertebrate colonization and rate the degree to which the stream channel has been altered due to changes in watershed landscape.

The physical habitat characteristics are measured, scored, weighted, and summed to calculate the indicator for each sampled stream. A low score, or a decline in score over time, reflects both natural disturbances and human-induced alterations of the stream habitat relative to minimally-disturbed reference sites. The mean habitat score for watersheds is reported on a scale of 1 (most degraded) to 10 (best condition). The ranked scores were divided into four groups each containing 25% of the watersheds (quartiles). Watersheds with the best conditions ranked in the highest three quartiles and, thereby, met the benchmark. The watersheds with the worst conditions ranked in the lowest quartile (25% of the watersheds) and "exceeded" the benchmark.

Physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing the area of impervious land cover. Other major influences are channelization, encroachment by livestock, and blockages to upstream/downstream movements of fish.

Biological Monitoring In Streams

The Maryland Biological Stream Survey (MBSS) sampled stream conditions in the Corsica River watershed in 1995 and 2000. Additionally, citizen volunteers in the Stream Waders program, which is associated with MBSS, assessed the benthic macroinvertebrate community at several sites in the watershed in 2000.

Results from these sampling efforts address three broad categories of stream conditions as listed below. The findings in each of these categories, which are each summarized on a separate map, allow comparison of stream conditions across the watershed:

– Fish as summarized in Map 14 MBSS Fish Index
– Benthic macroinvertebrates (benthos or stream bugs) Map 15 MBSS Benthic Index
– Physical habitat Map 16 Physical Habitat Index
– Table MBSS Findings for 2000 and 1995

Additionally, overall conditions in a stream or subwatershed may be interpreted by considering fish, benthos and physical habitat together. Several interpretations are offered below.

– Conditions that underlie the indices are complex and apply primarily to a local stream segment. No streams ranked as good or very poor for all indices. Typically, a stream segment ranks as a mix of good, fair, poor and/or very poor for the three indices.
– There is a tendency for good/fair conditions to be associated with watersheds with the least disturbance (natural vegetation, forest) and for poor/very poor conditions to be assoiciated with greater disturbance (impervious area, agriculture, construction sites).

Prior to creation of the MBSS method of assessment and random site selection technique, DNR used a biological assessment approach in nontidal steams known as rapid bio-assessment. While results of this assessment is not directly comparable to the current day MBSS data, it does provide a way to compare stream conditions during the early 1990s. The table DNR Rapid Bio-Assessment Data Summary lists these results.

DNR Rapid Bio-Assessment Data Summary [12]					
Location	**Sample Yr**	**Benthic**	**Habitat**	**Water Quality**	**Comments**
Old Mill Stream at Taylors Mill Road	1990, 92, 94, 96	good	good	fair/good	Excellent riparian area; heavy sediment load
Three Bridges Br. at Rt 213	1990. 92, 94, 96	poor/fair	poor/fair	fair/good	Good riparian area, heavy sediment load

Why Look at Benthos in Streams?

Unimpaired natural streams may support a great diversity of species like bacteria, algae, invertebrates like crayfish and insects to fish,birds, reptiles and mammals. All these groups of organisms have been extensively assessed relative to water quality and habitat quality. One group, benthic invertebrates, was found to serve as a good indicator of stream condition including water quality and habitat quality.

Benthic invertegrates are sometimes called "stream bugs" though that name overly simplifies the diverse membership of this group. This group includes mayflies, caddisflies, crayfish, etc., that inhabit the stream bottom, its sediments, organic debris and live on plant life (macrophytes) within the stream. Benthic macro-invertebrates are an important component of a stream's ecosystem.

The food web in streams relies significantly on benthic organisms. Benthos are often the most abundant source of food for fish and other small animals. Many benthic macroinvertebrates live on decomposing leaves and other organic materials in the stream. By this activity, these organisms are significant processors of organic materials in the stream. Benthos often provide the primary means that nutrients from organic debris are transformed to other biologically usable forms. These nutrients become available again and are transported downstream where other organisms use them.

Assessment of benthic organisms is a valuable tool for stream evaluation. This group of species has been extensively used in water quality assessment, in evaluating biological conditions of streams and in gauging influences on streams by surrounding lands. These organisms serve as good indicators of water resource integrity because they are fairly sedentary in nature and their diversity offers numerous ways to interpret conditions. They have different sensitivities to changing conditions. They have a wide range of functions in the stream. They use different life cycle strategies for survival.

MBSS Findings for 2000 and 1995 * Corsica River Watershed				
Watershed/Stream	Station #	Score		
		Fish	Benthos	Physical
Mill Stream Branch	QA-N-014-219-95	4.75	3	65
	QA-N-014-204-95	4.5	3	75
	CORS-106-R-2000	4.25	2.1	--
	CORS-205-R-2000	4.75	3.9	--
Three Bridges Branch and Tributaries	QA-N-079-308-95	3.75	4	59
	QA-N-079-316-95	4	4	59
	CORS-107-R-2000	3.5	2.7	--
	CORS-108-R-2000	4	4.7	--
Gravel Run	QA-N-042-116-95	4	2	21

Key for MBSS Data Table					
Index of Biotic Integrity	Ranges for Index	Very Poor	Poor	Fair	Good
Fish	1.0 (worst) to 5.0 (best)	1.0 - 1.9	2.0 - 2.9	3.0 - 3.9	4.0 - 5.0
Benthic	1.0 (worst) to 5.0 (best)	1.0 - 1.9	2.0 - 2.9	3.0 - 3.9	4.0 - 5.0
Physical Habitat	0 (worst) to 100 (best)	0 - 11.9	12 - 41.9	42 - 71.9	72 - 100

* Additional details are available at http://www.dnr.maryland.gov/streams/mbss/index.html
– Click on “Search Online Data” (button on left)
– Enter “Lower Monocacy” in dialog box for “8 Digit watershed name” and click on search

Fish and Oysters

1. Tidal Areas

Map 17 Fish Spawning and Oysters shows that at least three anadromous fish species are known to spawn in several streams within the Corsica River watershed:

– Corsica River mainstem, Emory Creek and Three Bridges Branch: yellow perch and white perch
– Mill Stream Branch: yellow perch, white perch and herring

Natural oyster beds were historically found in the Corsica River as also shown in Map 17 Fish Spawning and Oysters.[13] Currently, there are no oyster beds or oyster leases designated by DNR in the Corsica River. The closest oyster beds currently designated by DNR are in the Chester River mainstem immediately outside of the Corsica River as shown in the map. The closest oyster lease areas are in the Chester River well downstream of the Corsica River in the vicinity of Kent Island. The reasons why the Corsica River oyster beds disappeared have not been established but sedimentation is likely to have been a factor.

2. Nontidal Areas

Information on fish in nontidal streams is primarily gathered as part of the Maryland Biological Stream Survey. See Biological Monitoring In Streams for summary information. Additional information on fish populations and related recreational activities will be incorporated as it becomes available.

Maryland Fisheries Service does not monitor freshwater fish populations in tributaries to the Corsica River, in part, due to an absence of public demand. Public access for freshwater fishing is unavailable on Corsica River tributaries according to the *Maryland Guide to Freshwater Fishing* (1992).

Sampling of fish populations was conducted in selected stream segments of the Lower Monocacy River watershed in 1995 and 2000 by the Maryland Biological Stream Survey (MBSS). A complete listing of fish species that were identified are listed in table MBSS Fish Species Findings For County Subwatersheds. While these findings are limited and they are aggregated by County subwatershed, they do offer some insights summarized below:

– Portions of stream networks draining to Mill Stream Branch and Three Bridges Branch support Roseyside Dace and Least Brook Lamprey. These "intolerant" fish species require good water quality and habitat to survive in the long term.
– The majority of the fish found throughout the Corsica River watershed are tolerant and "moderately tolerant of poor or variable water quality and/or habitat conditions.

MBSS Fish Species Findings For Corsica River Subwatersheds

Key For Color/Font Code* for fish species in the table below (white: no data)	**Tolerant** Fish that tend to survive greater pollution and poorer habitat conditions	*Moderate Tolerance Fish with mid-range ability to co-exist with pollution and varied habitat conditions*	**Intolerant** Fish that require good water quality and good habitat conditions

Key for table: U means that at least one MBSS site identified the presence of this species.

Fish Species By Subwatershed/Stream MBSS Data	Corsica Direct Emory Creek Tributaries	Mill Stream Branch and Tributaries	Three Bridges Branch and Tributaries	Gravel Run
American Eel	U	U	U	U
Banded Killfish				U
Bluegill		U	U	U
Brown Bullhead		U	U	U
Creek Chubsucker		U	U	U
Eastern Mudminnow	U	U	U	U
Fallfish		U	U	
Golden Shiner		U	U	U
Largemouth Bass		U	U	U
Least Brook Lamprey		U	U	
Margined Madtom		U		
Mummichog				U
Pirate Perch		U	U	U
Pumpkinseed		U	U	U
Redbreast Sunfish		U		
Redfin Pickerel	U	U	U	U
Rosyside Dace		U		

Fish Species By Subwatershed/Stream MBSS Data	Corsica Direct Emory Creek Tributaries	Mill Stream Branch and Tributaries	Three Bridges Branch and Tributaries	Gravel Run
Satinfin Shiner			U	
Spotfin Shiner			U	
Spottail Shiner			U	U
Swallowtail Shiner			U	
Tessellated Darter		U	U	U
White Perch			U	
White Sucker		U		
Yellow Perch			U	U

* Rating of nontidal fish by tolerance level is adapted from the following document: *Maryland Biological Stream Survey, Ecological Status of Nontidal Streams in Six Basins Sampled in 1995.* Maryland Dept. of Natural Resources, Chesapeake Bay and Watershed Programs, Monitoring and Nontidal Assessment. CBWP-MANTA-EA-97-2. May 1997.

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. The most widely known are perhaps the State and Federally-listed Endangered or Threatened animals such as the bald eagle and Delmarva fox squirrel. In addition to well known animals such as these however, both the United States Fish and Wildlife Service and the Maryland DNR 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 valuable to account for the known locations and areas of potential habitat for sensitive species in a given area. They are often indicators, and sometimes important constituents, of the network of natural areas which form the foundation for many essential natural watershed processes. In fact, in addition to conserving biodiversity in general, protecting these species and/or promoting expansion of their habitats can be an effective component for a watershed restoration program.

1. Habitat Conservation Measures

DNR's Wildlife and Heritage Service identifies important areas for sensitive species conservation in different ways. The geographic delineations most commonly used are described in the text box Marylands Sensitive Species Conservation Areas. As shown in Map 18 Sensitive Species, there are four Ecological Significant Areas (ESAs) identified by the State of Maryland in the Corsica River watershed. The purpose of utilizing these delineations is to help protect sensitive species by identifying the areas in which they are known to occur. Doing so allows DNR to work toward the conservation of these sensitive resources by evaluating potential impacts of proposed actions that may affect them. Specifically, working within an established procedural framework, the Wildlife and Heritage Service reviews projects and provides recommendations for activities falling within these overlays.

The geographic areas covered by these overlays are course filters that allow for uncertainty by incorporating buffers around habitat areas. Accurate on the ground information regarding species locations and habitat delineations for a specific area can be obtained from DNR's Natural Heritage Program. It is also important to note that outside of the Chesapeake Bay Critical Area, DNR generally only places requirements on projects requiring a permit/approval or utilizing State funds. However, there are more broadly applied State and Federal laws and regulations which address "takings" of listed species. In addition, many counties have incorporated safeguards for areas associated with sensitive species into their project and permit review processes as well as adopting ordinances to protect them. In all instances, property owners are encouraged to seek advice on protecting the sensitive species / habitat within their ownership.

2. Rare, Threatened and Endangered Species List

In the Corsica River watershed, the bald eagle *Haliaeetus leucocephalus* is the only species tracked in Maryland's rare, threatened and endangered species lists. Additionally, at least one colonial waterbird nesting area is found in the watershed. In general, these species are located within area on the Sensitive Species Map labeled as Ecologically Sensitive Area (ESA).

Sensitive Species Protection Areas In the Corsica River Watershed

Ecologically Sensitive Area (ESA)

At least four ESAs are identified in the Corsica River watershed as shown in Map 18 Sensitive Species. Each ESA contains one or more sensitive species habitats. However, the entire ESA is not considered sensitive habitat. The ESA is an envelope identified for review purposes to help ensure that applications for permit or approval in or near sensitive areas receive adequate attention and safeguards for the sensitive species / habitat they contain.

Natural Heritage Area (NHA)

No NHAs are located in the Corsica River Watershed. In general, NHAs have been designated as such because they represent rare ecological communities. These are areas which provide important sensitive species habitat. They are designated in State regulation (COMAR 08.03.08.10) and are afforded specific protections in the Critical Area Law criteria. For proposed projects that could potential affect a particular NHA, recommendations and/or requirements may be put in place during the permit or approval process. These would be specifically aimed at protecting the ecological integrity of the NHA itself. To help ensure that proposed projects which may affect a given NHA are adequately reviewed, an ESA is always designated to encompass each NHA and the area surrounding it.

Wetlands of Special State Concern (WSSC)

No WSSCs are designated in the Corsica River Watershed. These selected wetlands, which generally represent the best examples of Maryland's nontidal wetland habitats, are afforded additional protection in state law beyond the permitting requirements that apply to wetlands generally. The Maryland Department of the Environment may be contacted for more information regarding these regulations. To help ensure that proposed projects that may affect a WSSC are adequately reviewed, an ESA is always designated to encompass each WSSC and the area surrounding it. For a listing of designated sites see COMAR 26.23.06.01 at www.dsd.state.md.us

Submerged Aquatic Vegetation

The well-defined link between water quality and submerged aquatic vegetation (SAV) distribution/abundance make SAV communities good barometers of the health of estuarine ecosystems. SAV is not only important as an indicator of water quality, but it is also a critical nursery habitat for many estuarine species. For example, blue crab "post-larvae" are up to 30 times more abundant in SAV beds than in adjacent unvegetated areas. Additionally, several species of waterfowl depend on SAV for food when they over-winter in the Chesapeake region.

Map 19 Submerged Aquatic Vegetation and the adjacent table show that SAV has intermittently appeared in the Corsica River during the 1980s and 1990s based on interpretation of aerial photography.

In 1985 and 1987, SAV appeared only on the north side of the river near River Estates. For the decade of the 1990s, SAV appeared in Middle Quarter Cove five out of ten years. Only in 1994 did SAV beds extend outside of Middle Quarter Cove to the Corsica River area near the cove's mouth and at Town Point Also see SAV Abundance and SAV Habitat Index.

Note 1: Using aerial photography to track the presence of SAV is designed to cover large areas and tends to miss small patches of SAV.

Note 2: A complete SAV data set is available for download from the Virginia Institute of Marine Science.

SAV Presence in the Corsica River By Year (Years not listed – No data Available)	
1980 and 1984	absent
1985	near River Estates
1986	absent
1987	near River Estates
1989 through 1992	absent
1993	in Middle Quarter Cove
1994	in Middle Quarter Cove, near mouth of Middle Quarter Cove and at Town Point
1995	in Middle Quarter Cove
1996 and 1997	absent
1998 and 1999	in Middle Quarter Cove

RESTORATION AND CONSERVATION TARGETING

There are a number of programs and tools available to assist in implementing goals for protection of valued watershed resources and for targeting restoration of those that have become degraded or otherwise function less than optimally.

2003 Stream Assessments Conducted By DNR

During 2003 in partnership with the Town of Centreville and Queen Anne's County, DNR conducted two types of assessment of selected streams in Corsica River watershed. The reports are available at www.dnr.maryland.gov/watersheds/surf/proj/wras.html.

A Stream Corridor Assessment focused on several subwatersheds selected by Queen Anne's County. DNR uses trained teams who walk up to about 100 miles of streams to document potential problems and restoration opportunities. The kinds of issues identified include: channel alteration, erosion sites, exposed pipes, fish barriers, inadequate buffers, livestock in the stream, near-stream construction, pipe outfalls, unusual conditions, and reference conditions which are cataloged at regular intervals as a way to define typical stream conditions.

In the Synoptic Survey and Aquatic Community Assessment, DNR staff collected water quality samples and assessed fish and benthic macroinvertebrates in selected nontidal streams. The water quality findings in the report can help identify problem areas and relative conditions among local streams based on measurements of dissolved oxygen, pH, nutrients (phosphorus and nitrogen), conductivity and flow. The nutrient yields estimated at each sampling site allow ranking the subwatersheds based on the nutrient load estimates. For some of these nontidal stream sampling sites, DNR staff has also assessed fish and benthic organism populations. These assessments provide additional perspectives to gauge local water quality and habitat conditions.

Agricultural Conservation Programs

Many farmers in Queen Anne's County willingly implement management systems that address nutrient runoff and infiltration, erosion and sediment control, and animal waste utilization. Some of the best management practices identified in Soil Conservation and Water Quality Plans for implementation on individual farms include 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 Queen Anne's SCD and Natural Resource Conservation Service (NRCS). [28]

Marina Programs

In the Corsica River watershed, the only marina listed in DNR's Marina database is Centreville Public Landing. According the information available from the database, this marina does not offer pumpout facilities and it is not participating in Maryland's Clean Marina Program.

Discharges of sewage from boats are a concern for water quality because they release nutrients, biochemical oxygen demand and pathogens. This type of discharge to the Corsica River probably contributes to the problems identified in the River associated with nutrients and bacteria. At this time, the relative contribution of boat discharges to these problems has not been quantified.

The Clean Marinas Program is a way for marina owners to gain certification and public recognition for voluntarily undertaking a number of actions related to marina design, operation, and maintenance intended to properly manage all kinds of marine waste, by-products and activities. DNR also funds installation and maintenance of marine pumpout facilities, including those at certified Clean Marinas. Information is available at DNR's website, www.dnr.maryland.gov/boating.

Stream Buffer Restoration

1. Benefits and General Recommendations

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.

To realize these environmental benefits, DNR generally recommends that forested stream buffers be at least 100 feet wide , i.e. natural vegetation 50 feet wide on either side of the stream. Therefore, DNR is promoting this type of stream buffer for local jurisdictions and land owners who are willing to go beyond the minimum buffer standards. The DNR Watershed Services and other programs like Conservation Reserve Enhancement Program (CREP), managed by the DNR Forest Service, are available to assist land owners who volunteer to explore these opportunities.

2. Headwater Stream Buffers

For many watersheds, headwater streams (first order streams) drain the majority of the land within the entire watershed. Therefore, stream buffers restored along headwater streams (First Order) tend to have greater potential to intercept nutrients and sediments than stream buffers placed elsewhere. 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, that "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.

Since the Corsica River Watershed has a substantial percentage of its headwater streams in interior forests, protection of these forests against impacts from development may be an important part of WRAS strategies, along with reforestation where necessary.

3. Land Use and Stream Buffers

One factor that affects the ability of stream buffers to intercept nonpoint source pollutants is adjacent land use. Nutrient and sediment loads from different land uses can vary significantly as shown in the adjacent table. By restoring naturally vegetated stream buffers adjacent to lands producing the highest pollutant loads, nutrient and sediment loads can be reduced most efficiently. Map 20 Stream Buffer Scenario focuses on the crop and pasture lands within 50 feet of a stream and identifies stream segments that lack naturally vegetated stream buffers. DNR encourages creating stream buffers at least 50 feet wide on each side of the stream, which is significantly greater than minimum buffer requirement, to enhance nutrient and habitat benefits beyond minimum buffer requirements.

Annual Nonpoint Source Pollution Load Rates By Land Use Chesapeake Bay Watershed Model (2000)

Land Use	Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Sediment (tons/ac)
Crop land	17.11	1.21	0.74
Urban	7.5	0.7	0.09
Pasture	8.40	1.15	0.30
Forest	1.42	0.00	0.03

4. Nutrient Uptake from Hydric Soils in Stream Buffers

In general, the nutrient nitrogen moves from the land into streams in surface water runoff and in groundwater with a significant percentage of nitrogen entering streams in groundwater. Stream buffers can be used to capture nitrogen moving in groundwater if buffer restoration projects have several key attributes:

– Plants with roots deep enough to intercept groundwater as it moves toward the stream
– Plants with high nitrogen uptake capability, and
– Targeting buffer restoration projects to maximize groundwater interception by buffer plants.

Hydric soils in stream riparian areas can be used as one factor to help select stream buffer restoration sites. Siting buffer restoration on hydric soils would offer several benefits:

– Plant roots are more likely to be in contact with groundwater for longer periods of time
– Hydric soils tend to be marginal for many agricultural and urban land uses
– Natural vegetation in wet areas often offers greater potential for habitat.

Map 20 Stream Buffer Scenario identifies lands that are adjacent to streams that meet three criteria: hydric soil is present, the riparian area is used for crops or pasture and naturally vegetated stream buffers are absent. In these areas, restoration of stream buffers would be most likely to intercept nitrogen, control sediment and phosphorus movement, and improve stream water quality and habitat in general. Additional assessment and field evaluation should be used to determine land owner interest, the practical implications of creating naturally vegetated stream buffers in areas identified and to evaluate any hydrologic modification of these soils, such as ditching or draining activities.

5. Optimizing Water Quality Benefits by Combining Priorities

Strategic targeting of stream buffer restoration projects may provide many different 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 nonpoint source pollution and enhancement to living resources:

– land owner willingness / incentives
– 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 general, targeting restoration projects in selected tributaries or small watersheds will tend to offer the greatest probability of producing measurable water quality improvement in the short term. By selecting small areas like a small first order stream for restoration, there is greater likelihood that local water quality will improve with relatively limited investment. In addition, local water quality improvements will likely contribute to downstream improvements.

Wetland Restoration

Wetlands serve important environmental functions such as providing habitat and nursery areas for many organisms, facilitating nutrient uptake and recycling, providing erosion control. However, most watersheds in Maryland have significantly fewer wetland acres today than in the past. This loss due to draining, filling, etc., 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. One approach to identifying candidate wetland restoration sites involves identifying “historic” wetland areas based on the presence of hydric soils. This process can be

accelerated by using GIS to manipulate soils information with other data like land use. The GIS products can then assist in initiating the candidate site search process, targeting site investigations and helping to identify land owners.

Map 21 Wetland Restoration Scenario indicates that there is potential for wetland restoration based on identifying agricultural fields (crop or pasture) on hydric soil. This is one of many potential scenarios for finding opportunities for wetland restoration. The steps and priorities used to generate the map are listed below:

– Data used: Hydric soils (Maryland Dept. of Planning Data), existing wetlands (DNR Wetlands), land use (Maryland Dept. of Planning, 2000).
– Identify candidate hydric soil areas based on land use. Hydric soils used in agricultural fields are selected for consideration. Hydric soils used for development or underlying natural vegetation are not considered in this scenario.
– Explore hydric soils based on land use / land cover and proximity to existing wetlands or streams.

The potential wetland restoration sites suggested in the scenario can be filtered further by using more accurate wetlands and soil information and by considering land ownership or other factors like like habitat enhancement opportunities, sensitive species protection, targeting specific streams or subwatersheds for intensive restoration, and using Conservation Reserve Enhancement Program (CREP) information.

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GLOSSARY

303(d)	A section of the federal Clean Water Act requiring the states to report which waters of the state are considered impaired for the uses for which they have been designated, and the reasons for the impairment. Waters included in the "303(d) list" are candidates for having TMDLs developed for them.
319	A section of the federal Clean Water Act dealing with non-point sources of pollution. The number is often used alone as either a noun or an adjective to refer to some aspect of that section of the law, such as grants.
8-digit watershed	Maryland has divided the state into 138 watersheds, each comprising an average of about 75 square miles, that are known as 8-digit watersheds because there are 8 numbers in the identification number each has been given. These nest into the 21 larger 6-digit watersheds in Maryland which are also called Tributary Basins or River Basins. Within the Chesapeake Bay drainage, 8-digit watersheds also nest into 10 Tributary Team Basins.
Anadromous fish	Fish that live most of their lives in salt water but migrate upstream into fresh water to spawn.
Benthic	Living on the bottom of a body of water.
CBIG	Chesapeake Bay Implementation Grant Program, a DNR-administered program that awards grants from the Chesapeake Bay Program to reduce and prevent pollution and to improve the living resources in the Chesapeake Bay.
CBNERR	The Chesapeake Bay National Estuarine Research Reserve in a federal, state and local partnership to protect valuable estuarine habitats for research, monitoring and education. The Maryland Reserve has three components: Jug Bay on the Patuxent River in Anne Arundel and Prince Georges' Counties, Otter Point Creek in Harford County and Monie Bay in Somerset County.
COMAR	Code Of Maryland Regulations (Maryland State regulations)
CREP	Conservation Reserve Enhancement Program, a program of MDA. CREP is a federal/state and private partnership which reimburses farmers at above normal rental rates for establishing riparian forest or grass buffers, planting permanent cover on sensitive agricultural lands and restoring wetlands for the health of the Chesapeake Bay.

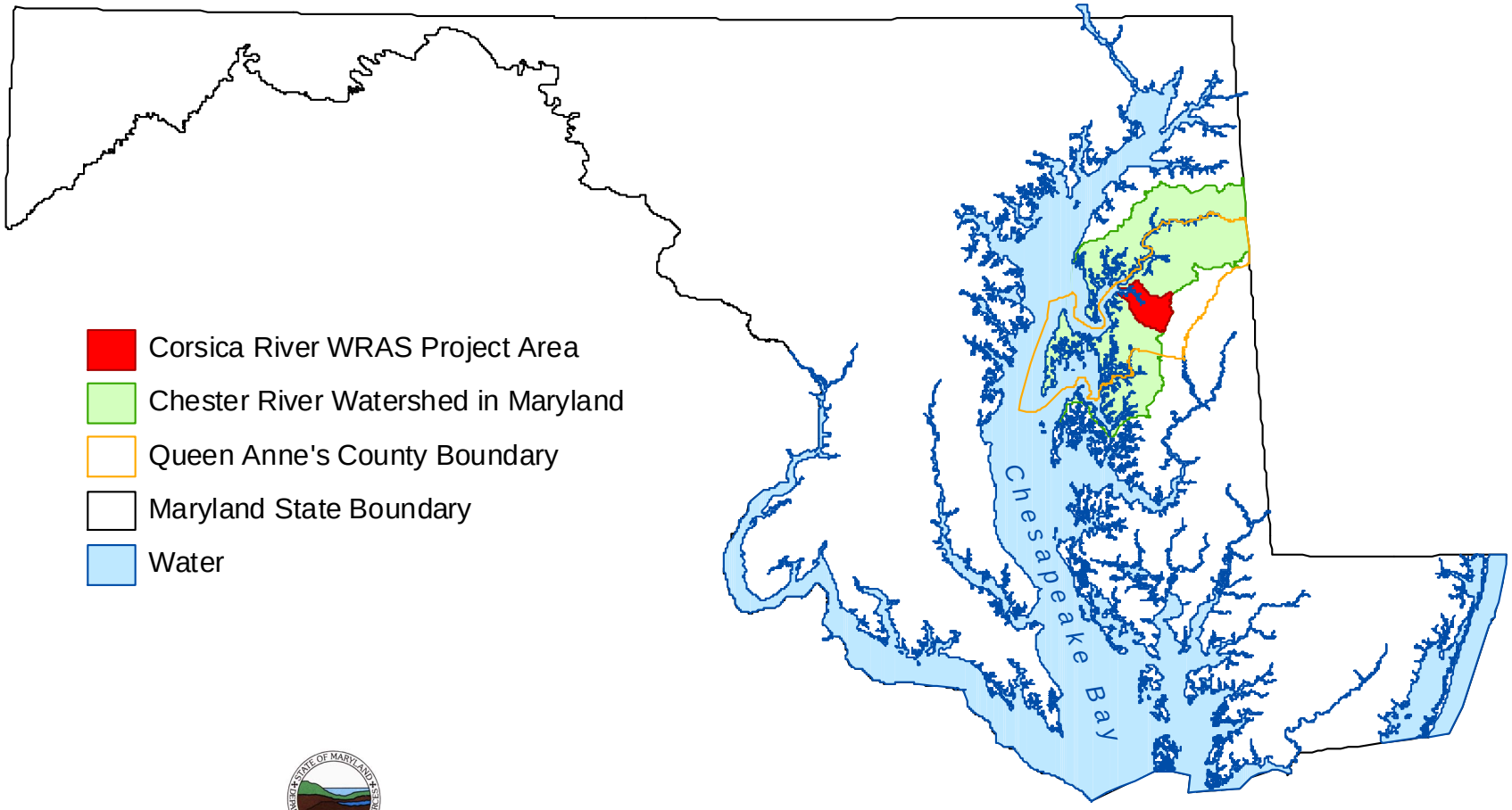
CRP	Conservation Reserve Program, a program of Farm Service Agency in cooperation with local Soil Conservation Districts. CRP encourages farmers to take highly erodible and other environmentally-sensitive farm land out of production for ten to fifteen years.
CWAP	Clean Water Action Plan, promulgated by EPA in 1998. It mandates a statewide assessment of watershed conditions and provides for development of Watershed Restoration Action Strategies (WRASs) for priority watersheds deemed in need of restoration
CWiC	Chesapeake 2000 Agreement watershed commitments. CWiC is a shorthand phrase used in the Chesapeake Bay Program.
CZARA	The Coastal Zone Reauthorization Amendments of 1990, intended to address coastal non-point source pollution. Section 6217 of CZARA established that each state with an approved Coastal Zone Management program must develop and submit a Coastal Non-Point Source program for joint EPA/NOAA approval in order to "develop and implement management measures for NPS pollution to restore and protect coastal waters".
CZMA	Coastal Zone Management Act of 1972, establishing a program for states and territories to voluntarily develop comprehensive programs to protect and manage coastal resources (including the Great Lakes). Federal funding is available to states with approved programs.
Conservation Easement	A legal document recorded in the local land records office that specifies conditions and/or restrictions on the use of and title to a parcel of land. Conservation easements run with the title of the land and typically restrict development and protect natural attributes of the parcel. Easements may stay in effect for a specified period of time, or they may run into perpetuity.
DNR	Department of Natural Resources (Maryland State)
EPA	Environmental Protection Agency (United States)
ESA	Ecologically Significant Area, an imprecisely defined area in which DNR has identified the occurrence of rare, threatened and/or endangered species of plants or animals, or of other important natural resources such as rookeries and waterfowl staging areas.
Fish blockage	An impediment, usually man-made, to the migration of fish in a stream, such as a dam or weir, or a culvert or other structure in the stream

GIS	Geographic Information System, a computerized method of capturing, storing, analyzing, manipulating and presenting geographical data.
MBSS	Maryland Biological Stream Survey, a program in DNR that samples small streams throughout the state to assess the condition of their living resources.
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MET	Maryland Environmental Trust, an organization that holds conservation easements on private lands and assists local land trusts to do similar land protection work.
MGS	Maryland Geological Survey, a division in DNR.
NHA	Natural Heritage Area, a particular type of DNR land holding, designated in COMAR.
NOAA	National Oceanic and Atmospheric Administration, an agency of the US Department of Commerce that, among other things, supports the Coastal Zone Management program, a source of funding for some local environmental activities, including restoration work.
NPS	Non-Point Source, pollution that originates in the landscape that is not collected and discharged through an identifiable outlet.
NRCS	Natural Resources Conservation Service, formerly the Soil Conservation Service, an agency of the US Department of Agriculture that, through local Soil Conservation Districts, provides technical assistance to help farmers develop conservation systems suited to their land. NRCS participates as a partner in other community-based resource protection and restoration efforts.
PDA	Public Drainage Association
Palustrine Wetlands	Fresh water wetlands, including bogs, marshes and shallow ponds.
RAS	Resource Assessment Service, a unit of DNR that carries out a range of monitoring and assessment activities affecting the aquatic environment.

Riparian Area	1. Land adjacent to a stream. 2. Riparian areas are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas through which surface and subsurface hydrology connect waterbodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (i.e. a zone of influence). Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes, and estuarine-marine shorelines. (National Research Council, *Riparian Areas: Functions and Strategies for Management*. Executive Summary page 3. 2002)
SAV	Submerged Aquatic Vegetation, important shallow-water sea grasses that serve as a source of food and shelter for many species of fin- and shell-fish.
SCA[M]	Stream Corridor Assessment is an activity carried out by DNR Watershed Services in support of WRAS development and other management needs, in which trained personnel walk up stream channels noting important physical features and possible sources of problems.
SCD	Soil Conservation District is a county-based, self-governing body whose purpose is to provide technical assistance and advice to farmers and landowners on the installation of soil conservation practices and the management of farmland to prevent erosion.
Synoptic survey	A short term sampling of water quality and analysis of those samples to measure selected water quality parameters. A synoptic survey as performed by DNR in support of watershed planning may be expanded to include additional types of assessment like benthic macroinvertebrate sampling or physical habitat assessment.
TMDL	Total Maximum Daily Load, a determination by MDE of the upper limit of one or more pollutants that can be added to a particular body of water beyond which water quality would be deemed impaired.
Tributary Teams	Geographically-focused groups, appointed by the Governor, oriented to each of the 10 major Chesapeake Bay tributary basins found in Maryland. The teams focus on policy, legislation, hands-on implementation of projects, and public education. Each basin has a plan, or Tributary Strategy.
USFWS	United States Fish and Wildlife Service, in the Department of Interior.
USGS	United States Geological Survey

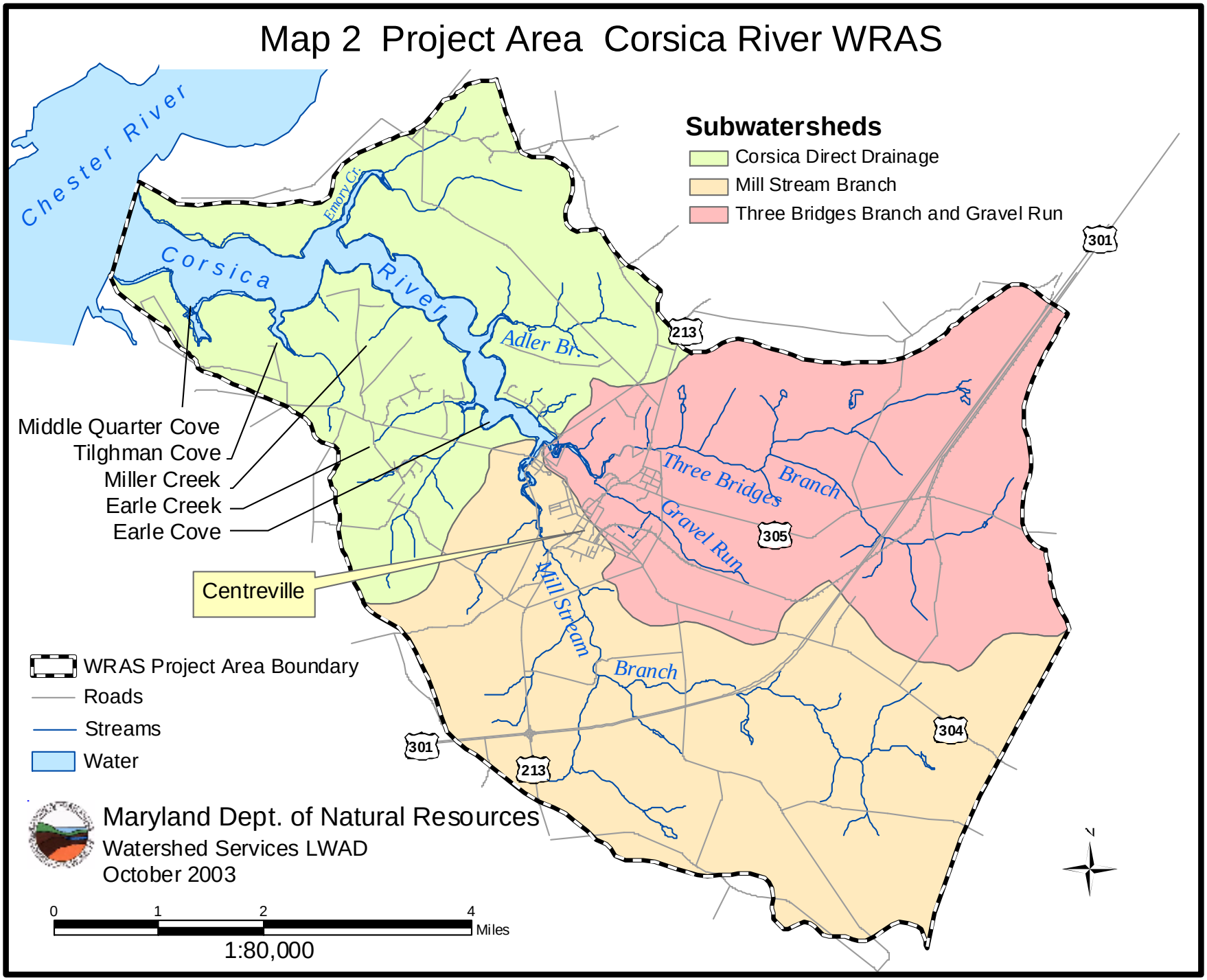
Water Quality Standard	Surface water quality standards consist of two parts: (a) designated uses of each water body; and (b) water quality criteria necessary to support the designated uses. Designated uses of for all surface waters in Maryland (like shell fish harvesting or public water supply) are defined in regulation. Water quality criteria may be qualitative (like "no objectionable odors") or quantitative (toxic limitations or dissolved oxygen requirements).
Watershed	All the land that drains to an identified body of water or point on a stream.
WRAS	Watershed Restoration Action Strategy, a document outlining the condition of a designated watershed, identifying problems and commiting to solutions of prioritized problems.
WSSC	Wetland of Special State Concern, a designation by MDE in COMAR.

Map 1 Location
Corsica River WRAS Project Area



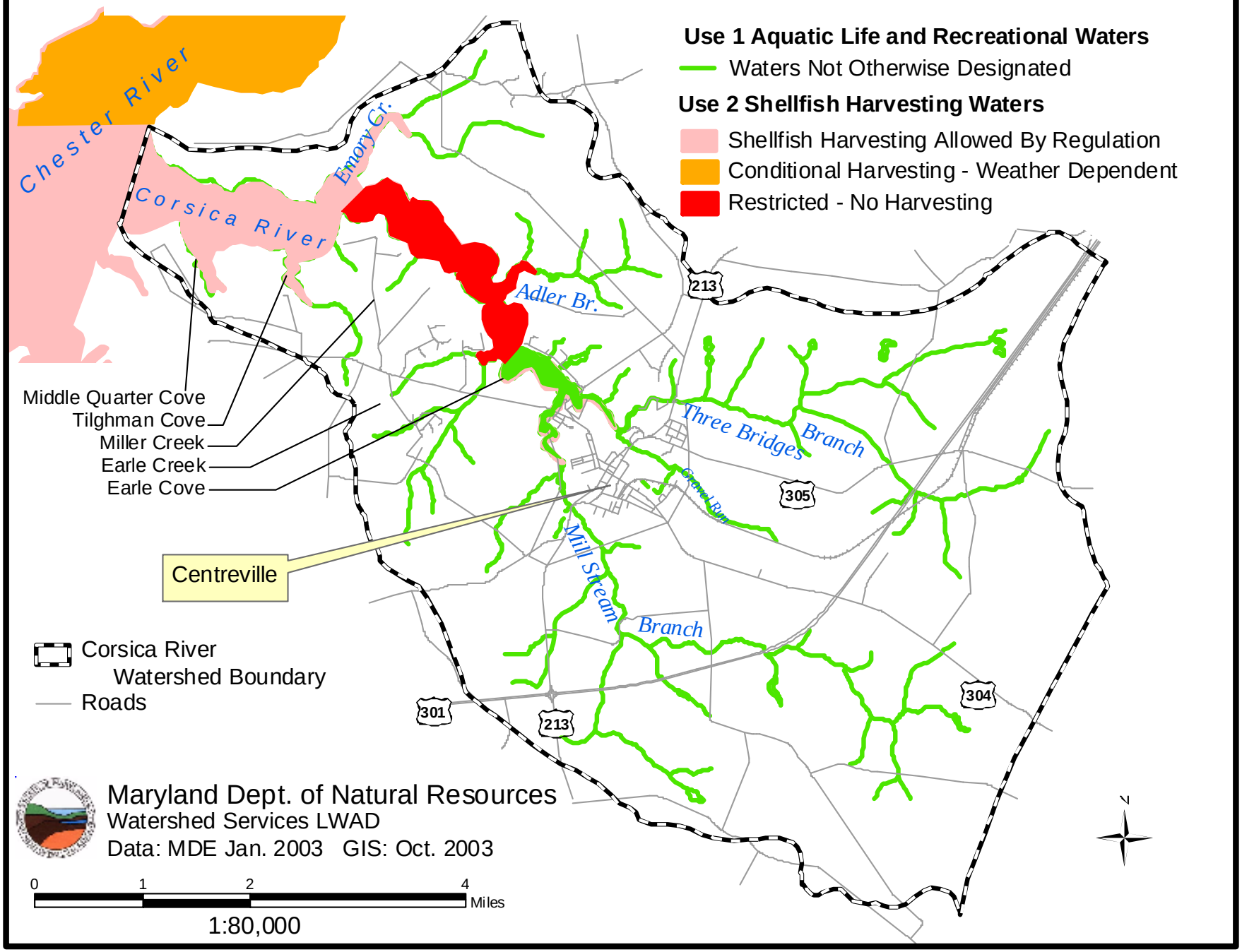
Maryland Dept. of Natural Resources
Watershed Services
Landscape and Watershed Analysis Division
October 2003

Map 2 Project Area Corsica River WRAS

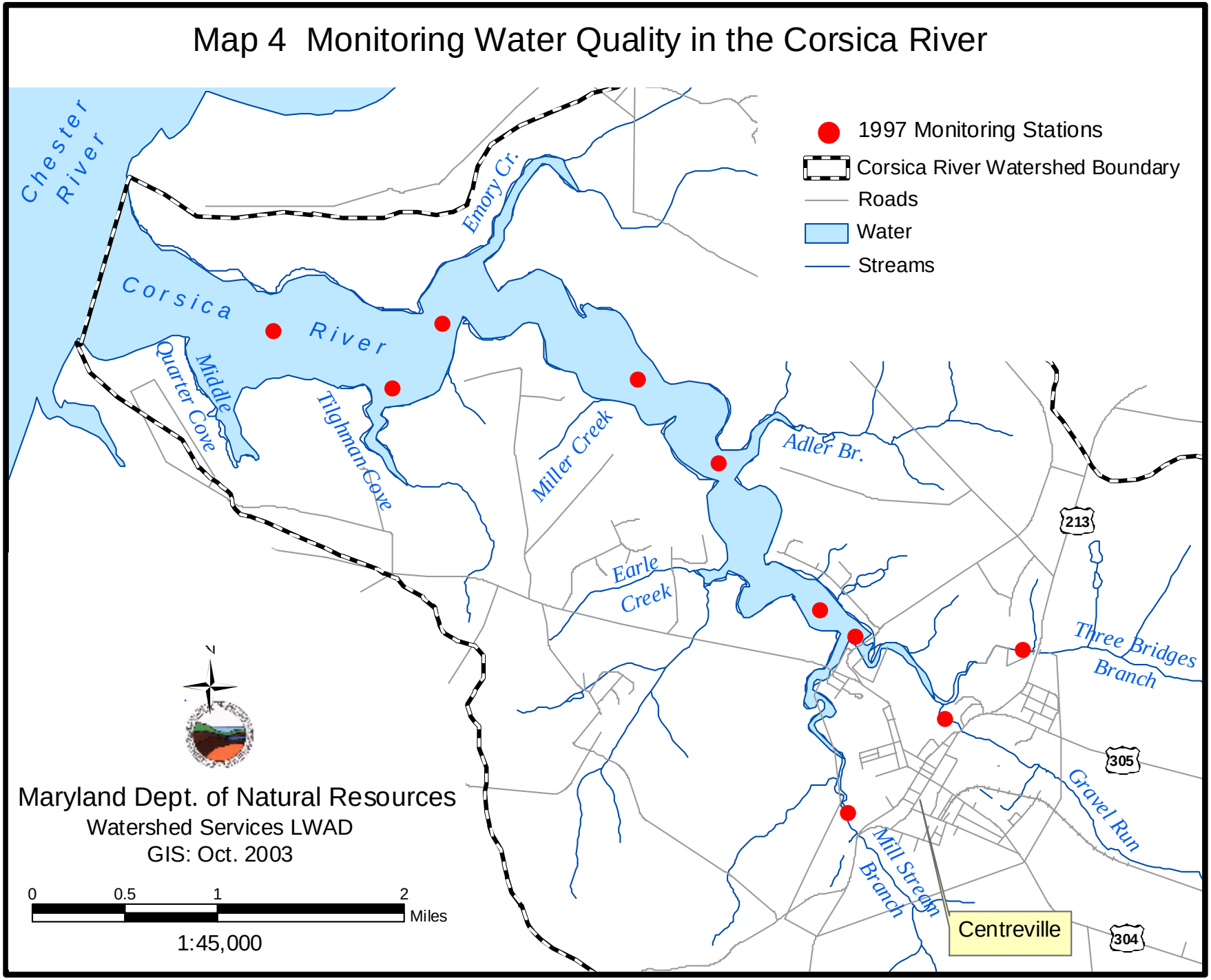


Maryland Dept. of Natural Resources
Watershed Services LWAD
October 2003

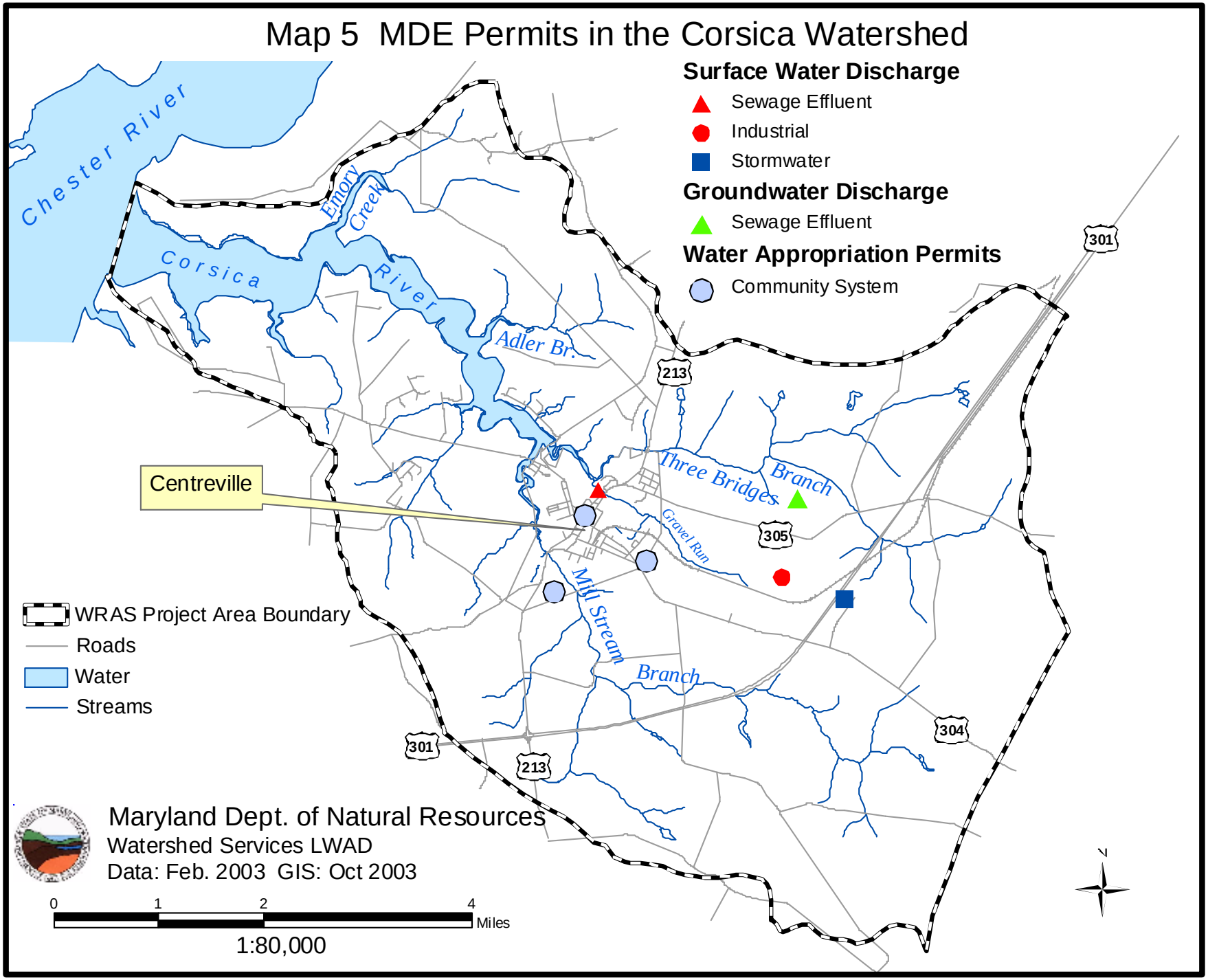
Map 3 Designated Use and Use Restrictions Corsica River WRAS



Map 4 Monitoring Water Quality in the Corsica River

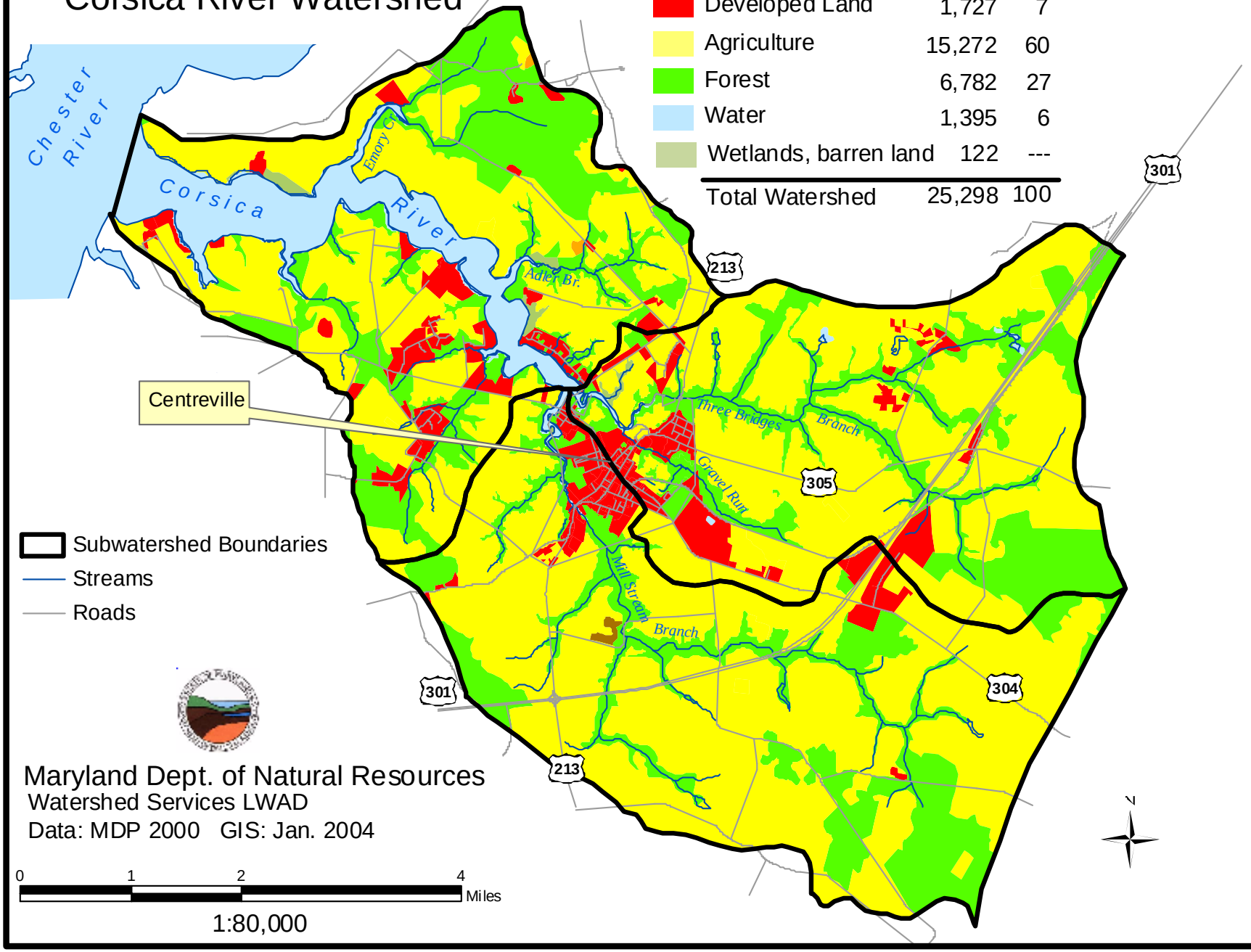


Map 5 MDE Permits in the Corsica Watershed



Map 6 Land Use / Land Cover
Corsica River Watershed

Land Use / Cover	Acres	Percent
Developed Land	1,727	7
Agriculture	15,272	60
Forest	6,782	27
Water	1,395	6
Wetlands, barren land	122	---
Total Watershed	25,298	100

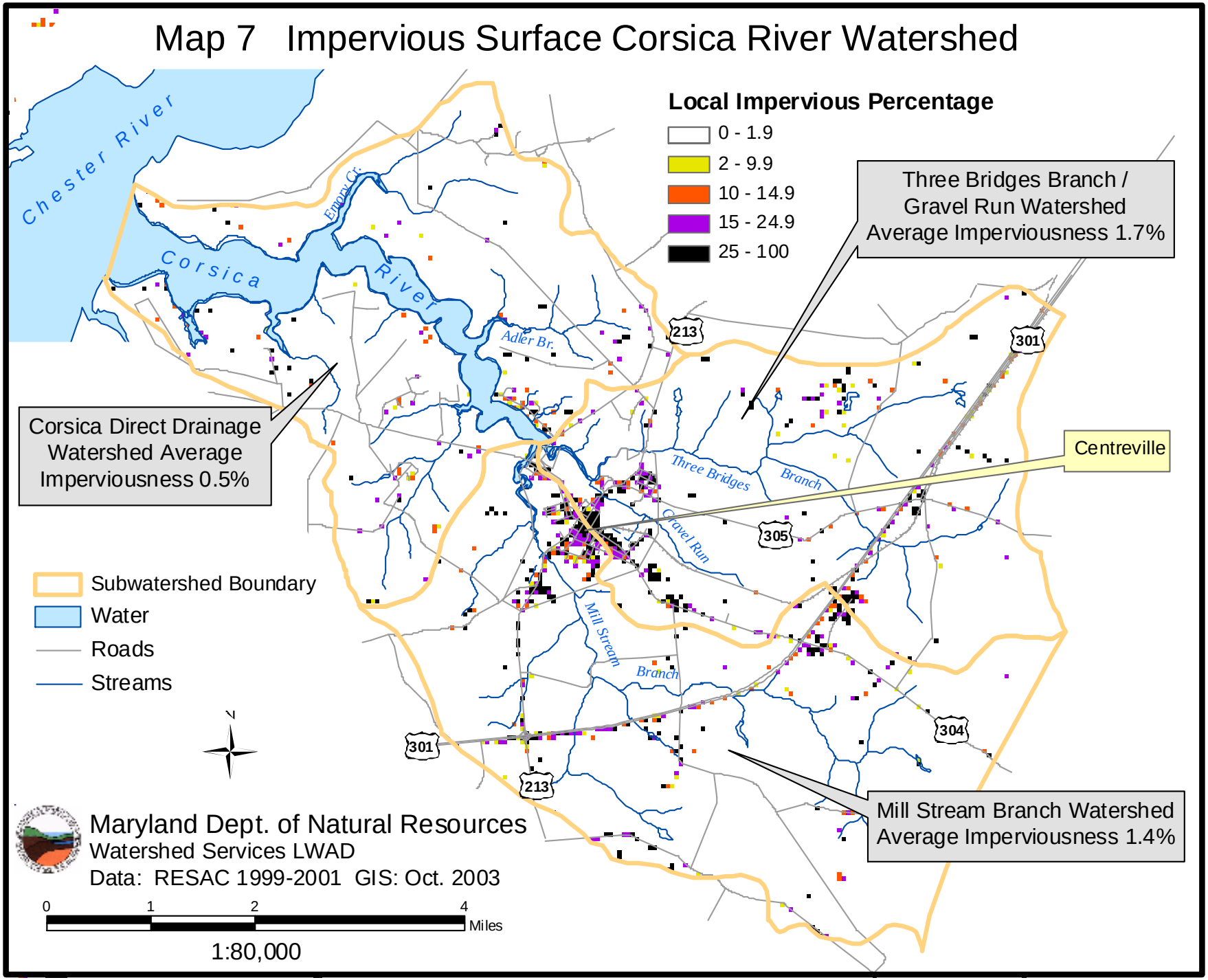


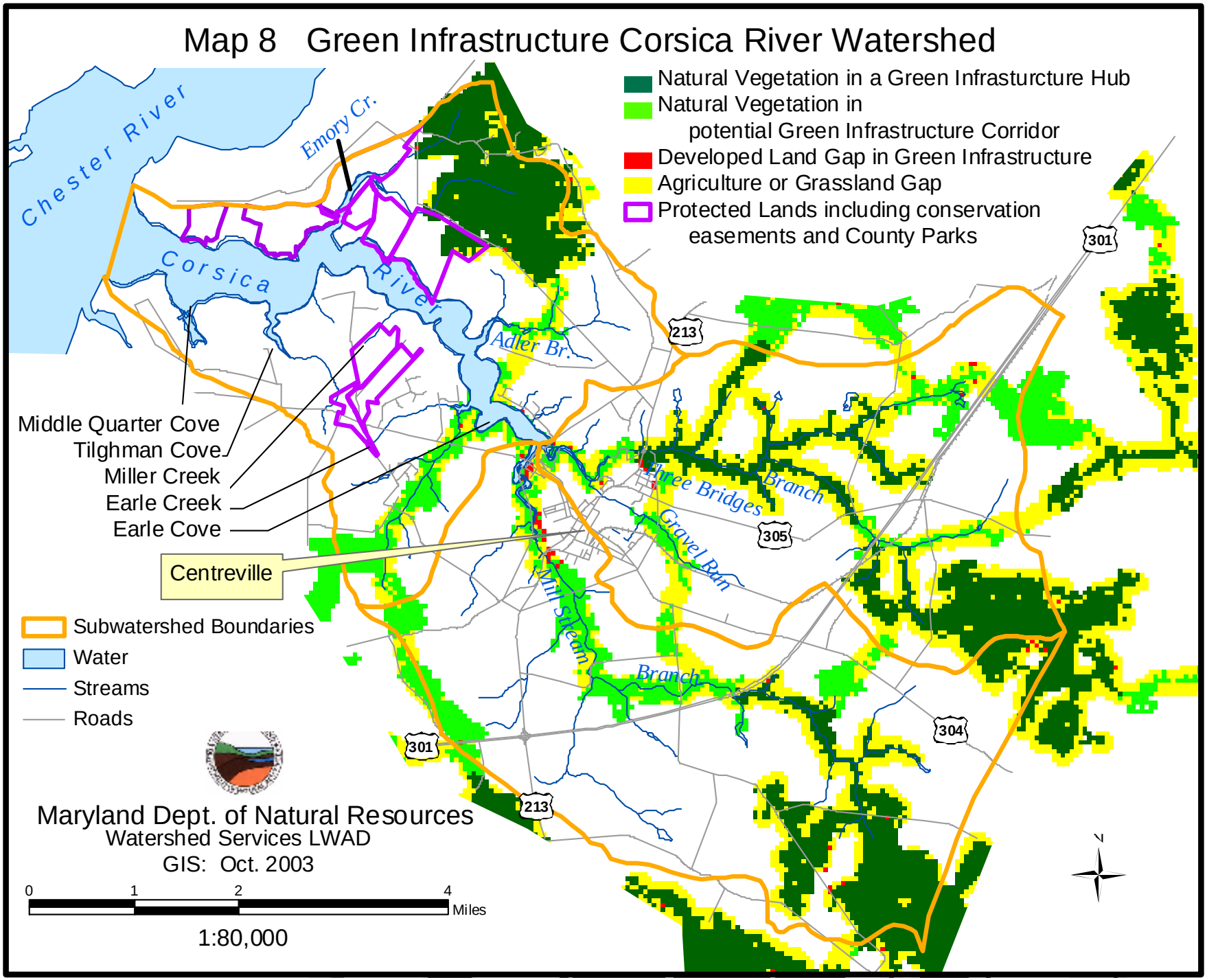
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: MDP 2000 GIS: Jan. 2004

0 1 2 4 Miles

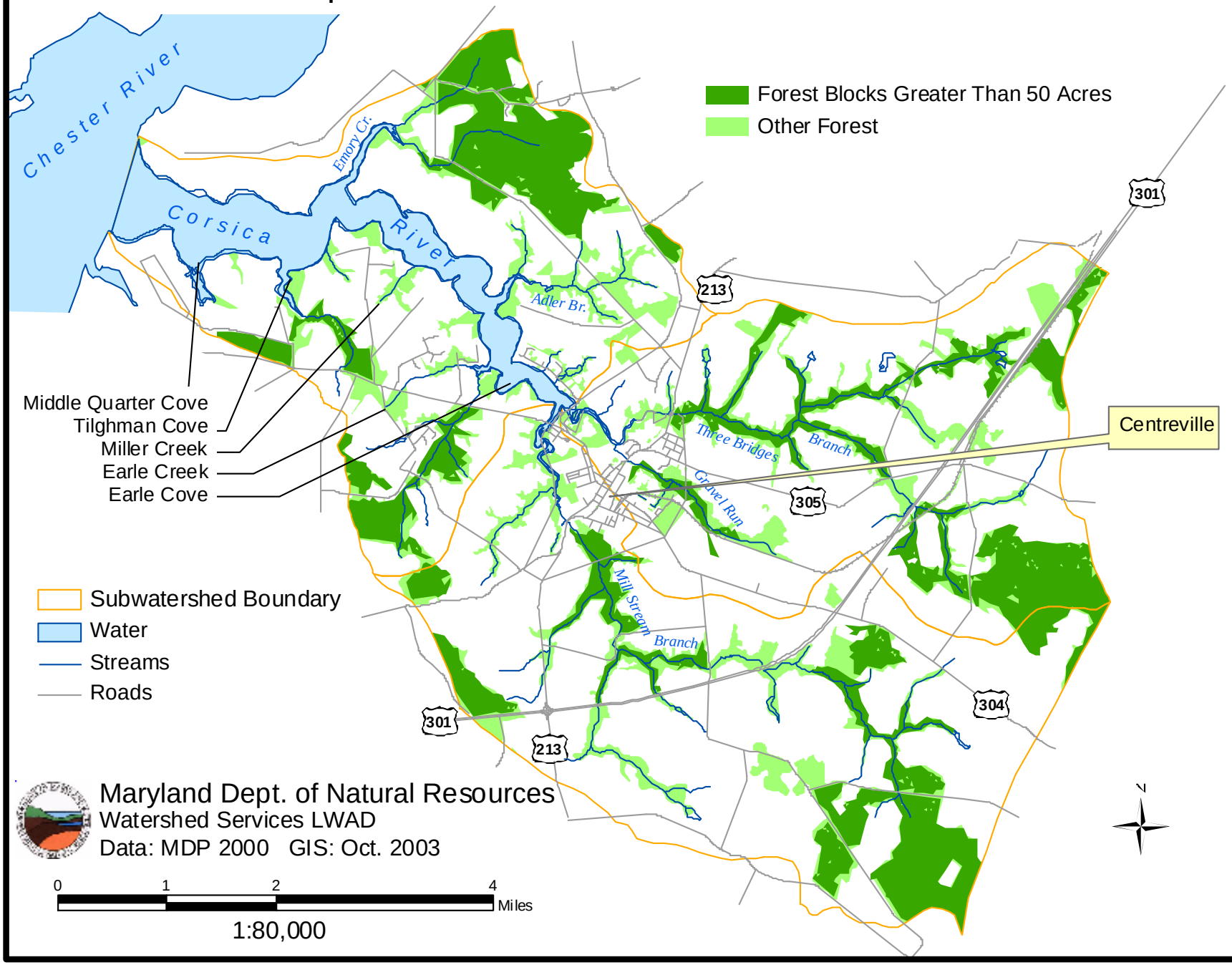
1:80,000

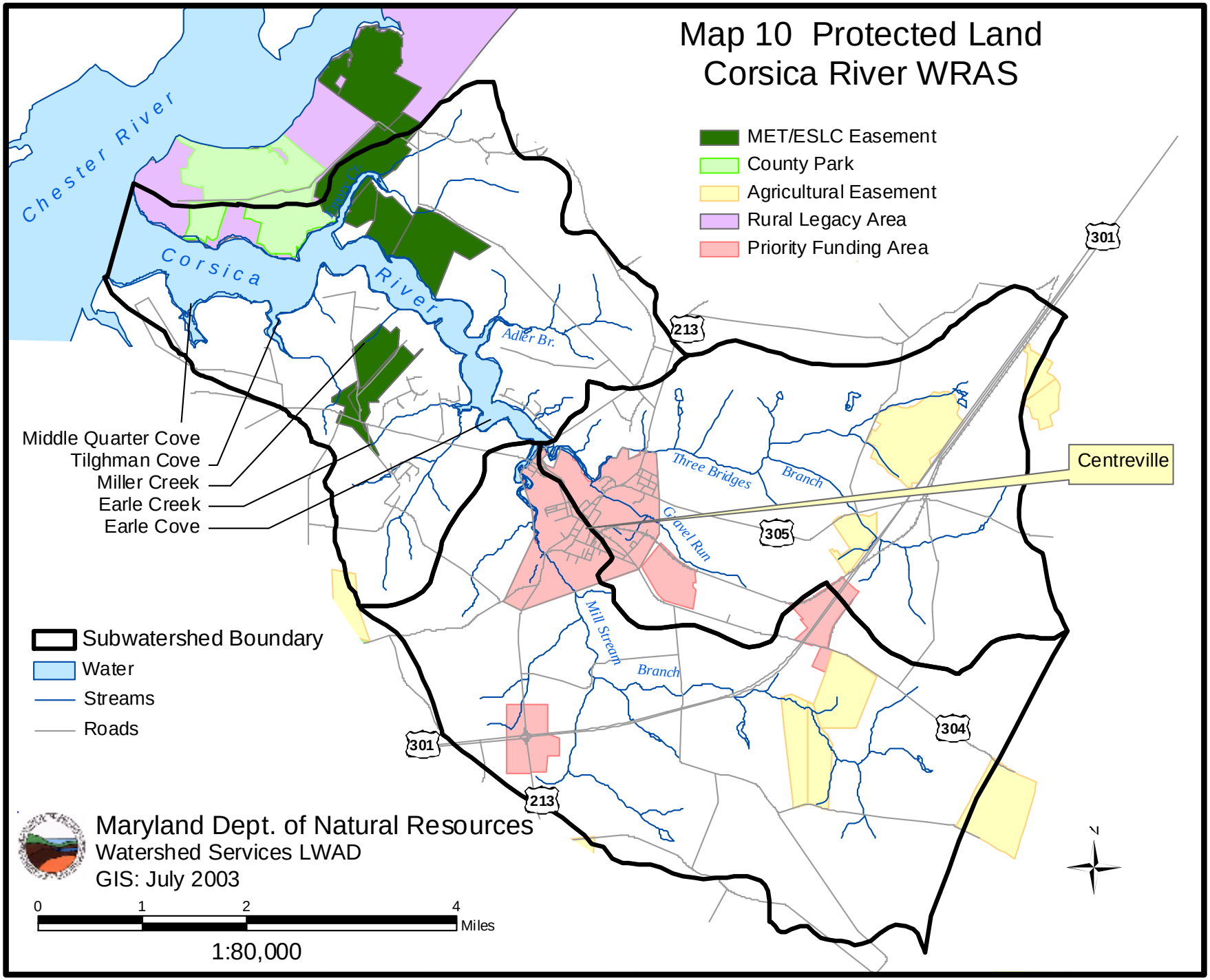
Map 7 Impervious Surface Corsica River Watershed



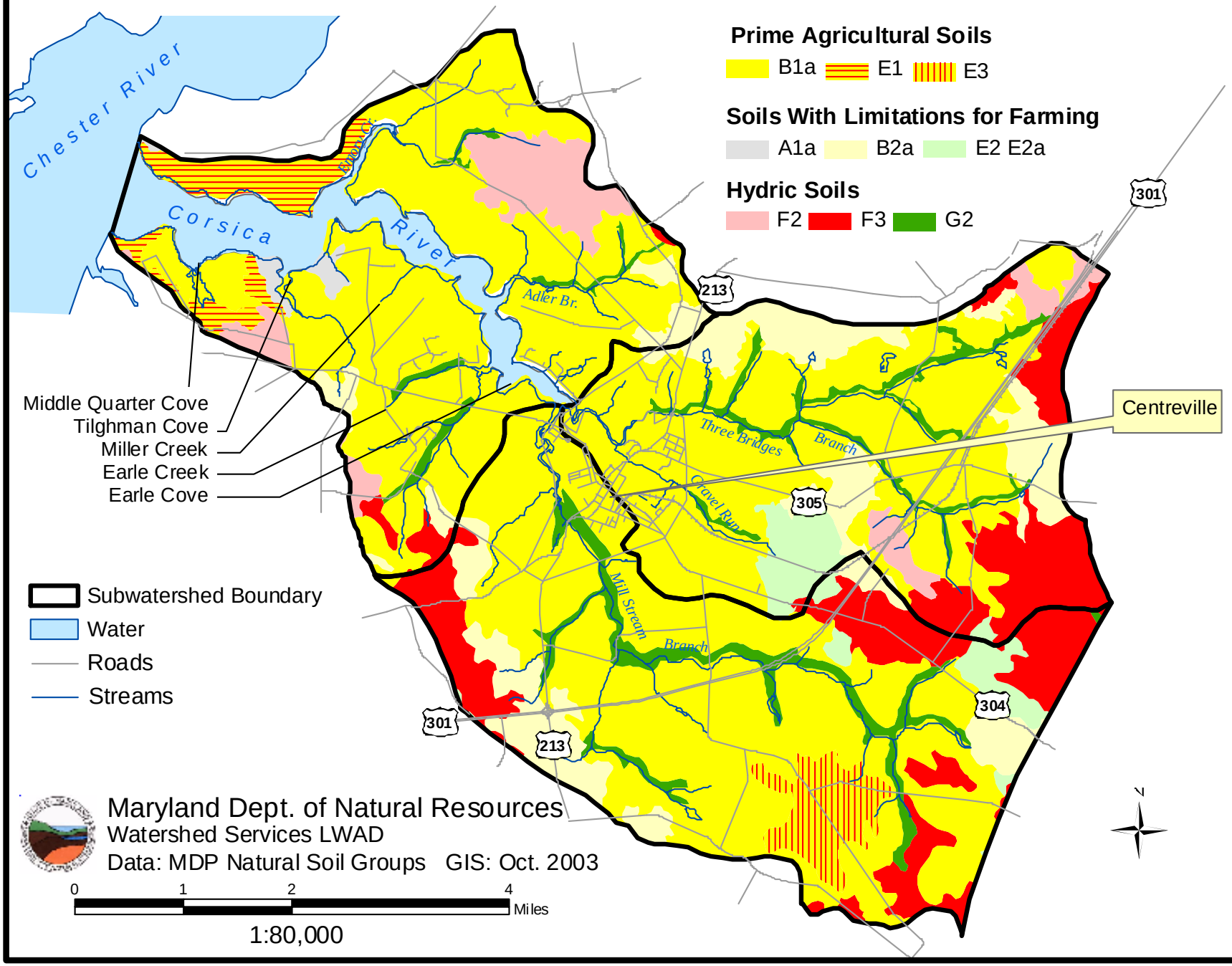

Map 8 Green Infrastructure Corsica River Watershed
Natural Vegetation in a Green Infrasturcture Hub
Natural Vegetation in potential Green Infrastructure Corridor
Developed Land Gap in Green Infrastructure
Agriculture or Grassland Gap
Protected Lands including conservation easements and County Parks
Chester River
Emory Cr.
Corsica River
Adler Br.
Middle Quarter Cove
Tilghman Cove
Miller Creek
Earle Creek
Earle Cove
Centreville
Three Bridges Branch
Gravel Run
Mill Stream Branch
301
213
305
304
Subwatershed Boundaries
Water
Streams
Roads
Maryland Dept. of Natural Resources
Watershed Services LWAD
GIS: Oct. 2003
0 1 2 4 Miles
1:80,000
N

Map 9 Forest Interior Corsica River Watershed

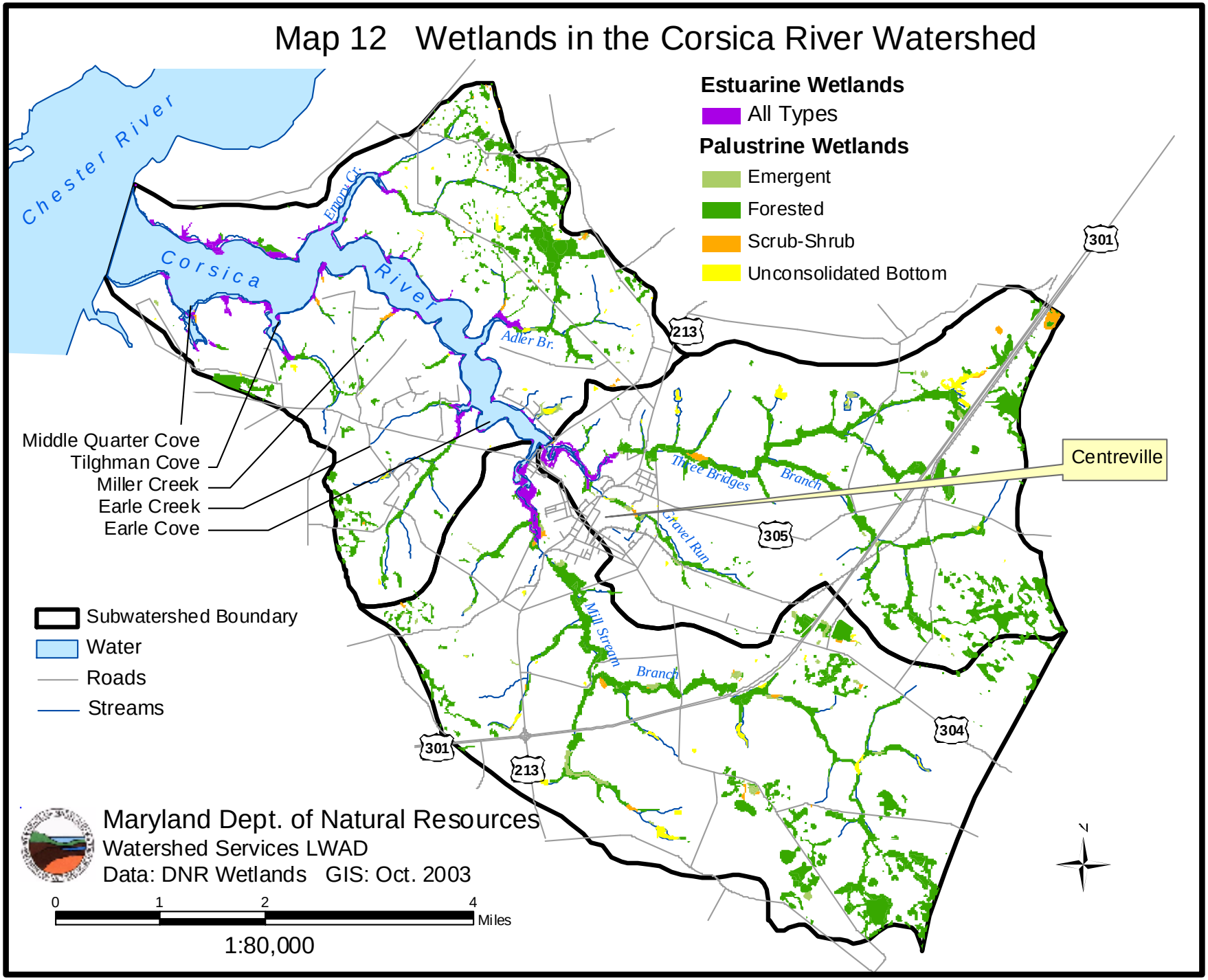



Map 10 Protected Land
Corsica River WRAS
MET/ESLC Easement
County Park
Agricultural Easement
Rural Legacy Area
Priority Funding Area
Chester River
Corsica River
Emmy Ct.
Adler Br.
Middle Quarter Cove
Tilghman Cove
Miller Creek
Earle Creek
Earle Cove
Three Bridges Branch
Gravel Run
Mill Stream Branch
Centreville
301
213
305
304
Subwatershed Boundary
Water
Streams
Roads
Maryland Dept. of Natural Resources
Watershed Services LWAD
GIS: July 2003
0 1 2 4
Miles
1:80,000
N

Map 11 Soils Corsica River Watershed

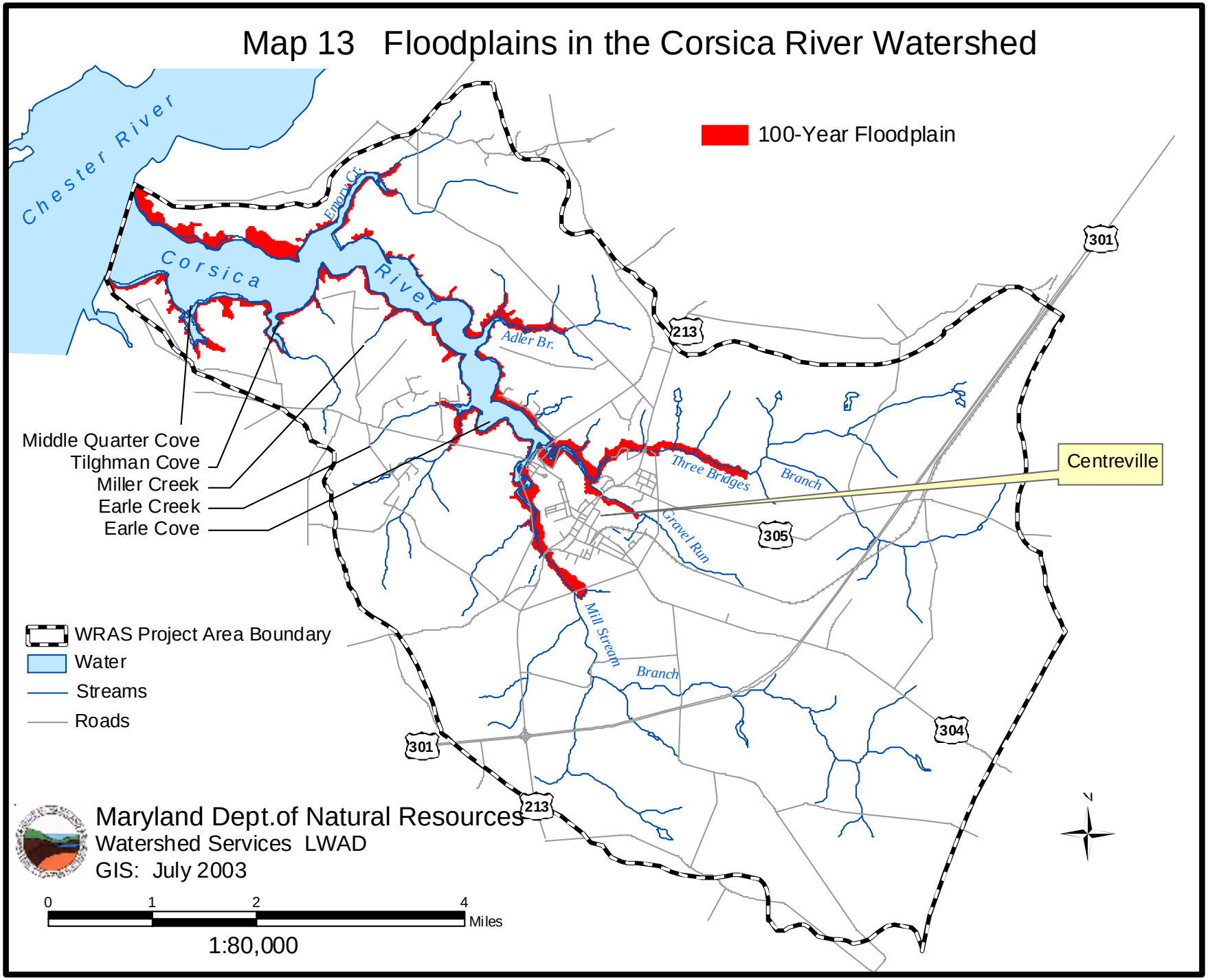


Map 12 Wetlands in the Corsica River Watershed

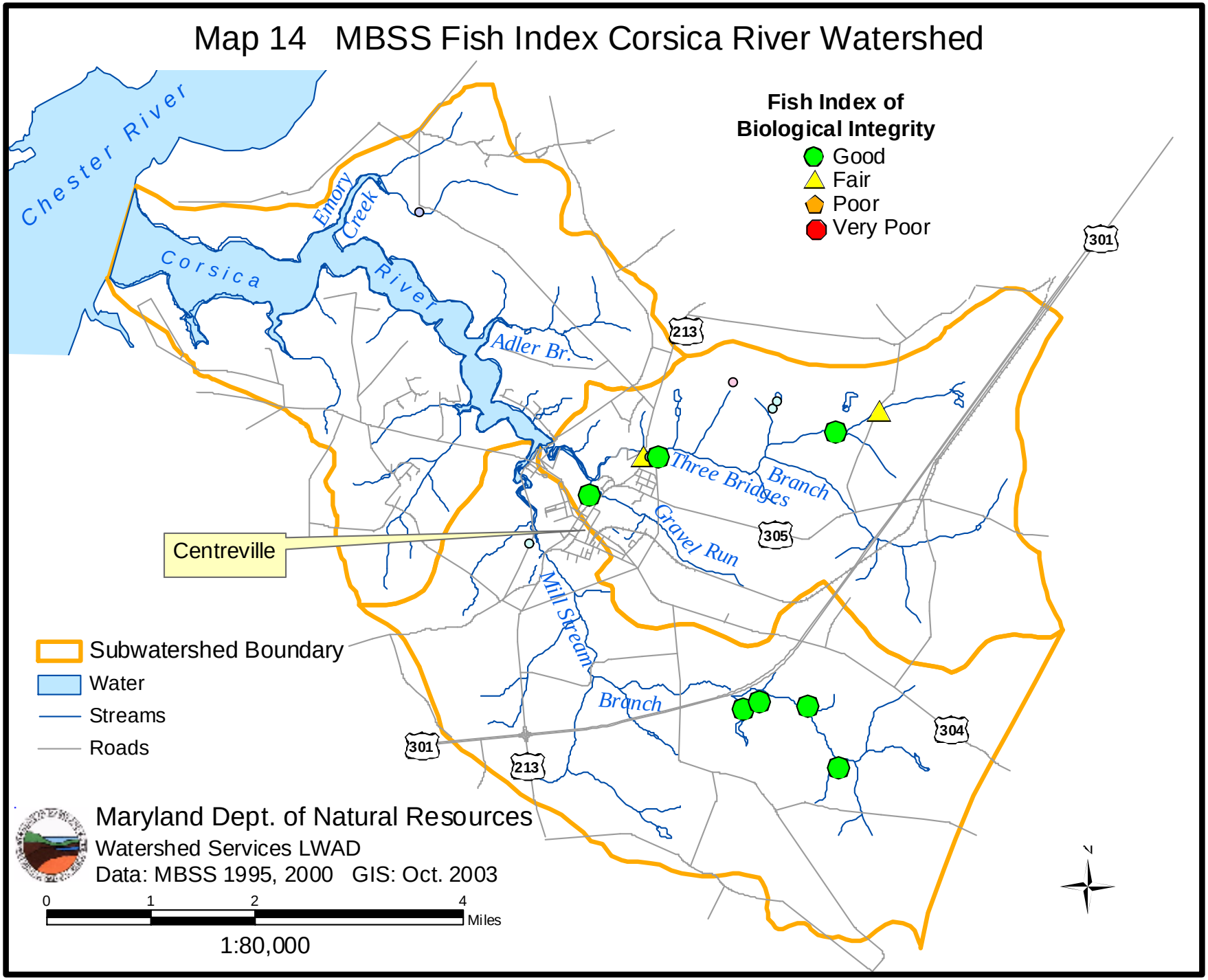


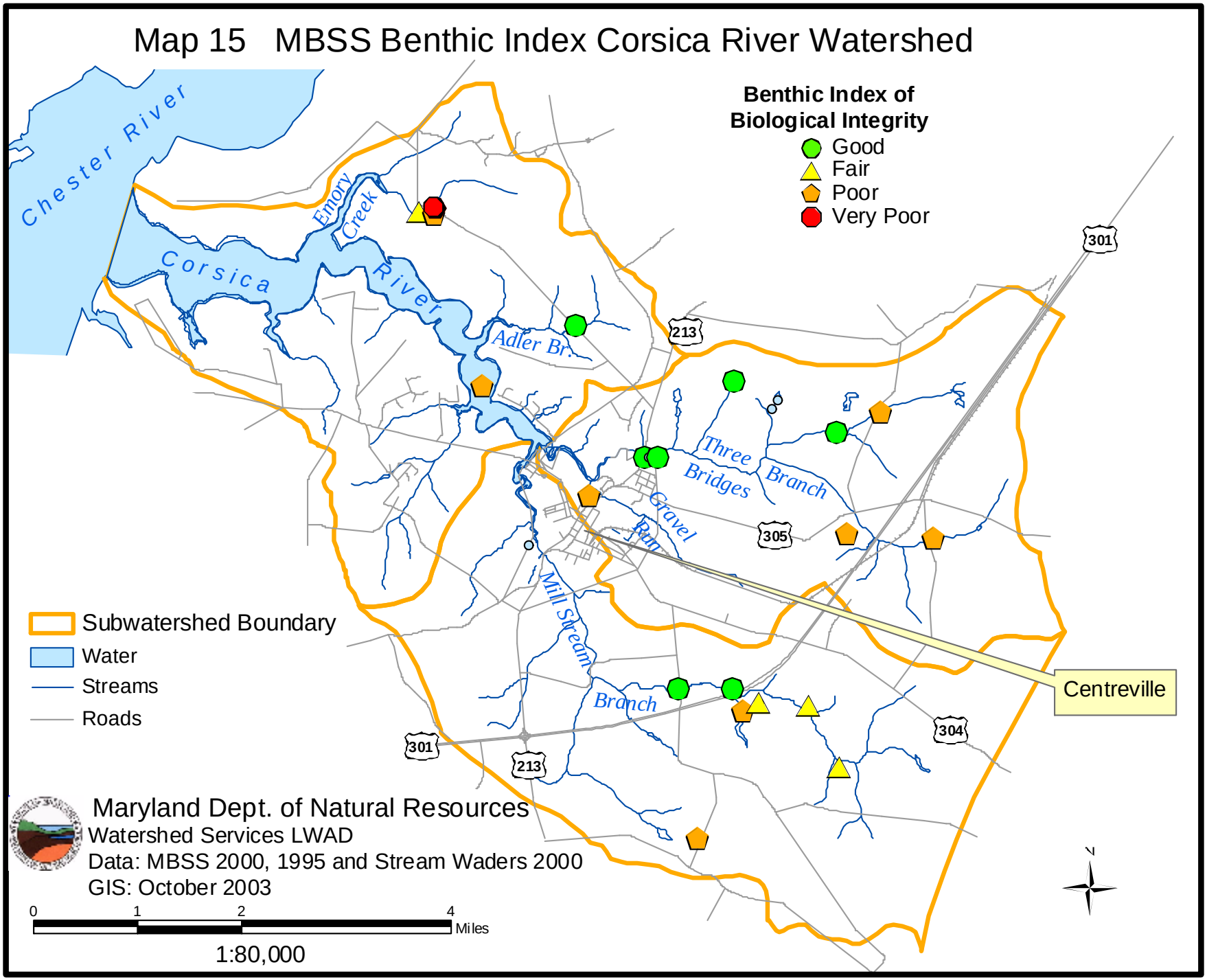
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: DNR Wetlands GIS: Oct. 2003

Map 13 Floodplains in the Corsica River Watershed

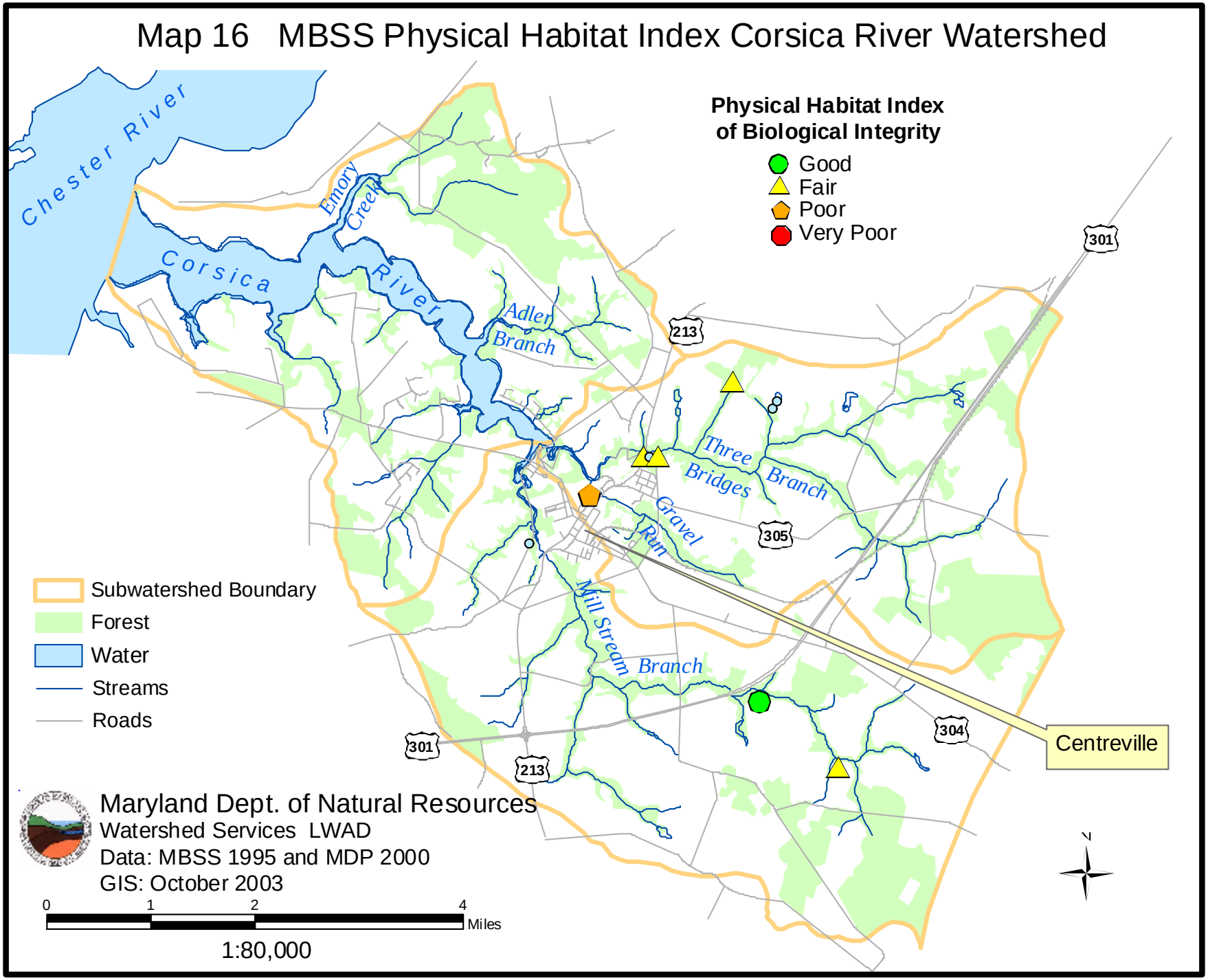


Map 14 MBSS Fish Index Corsica River Watershed

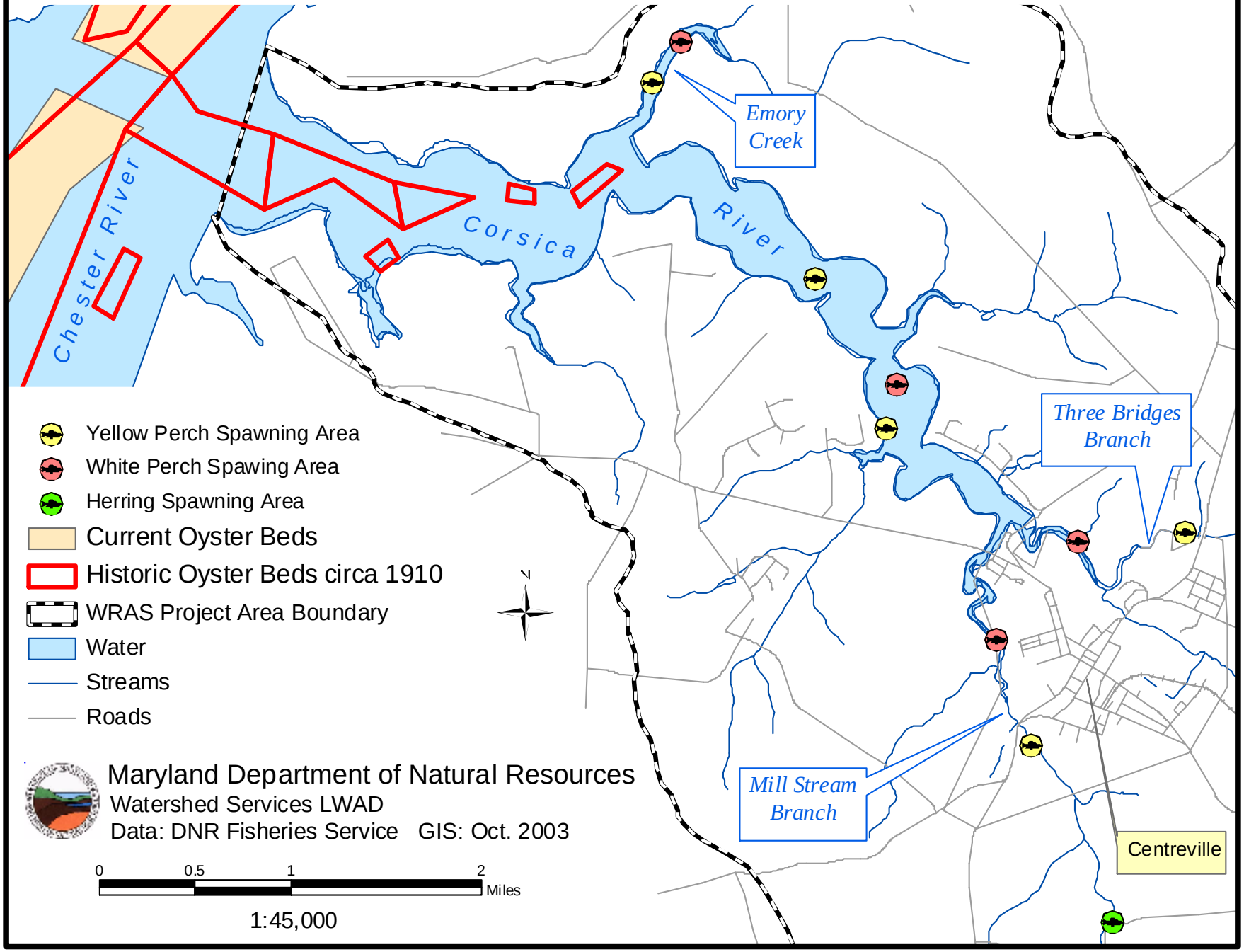


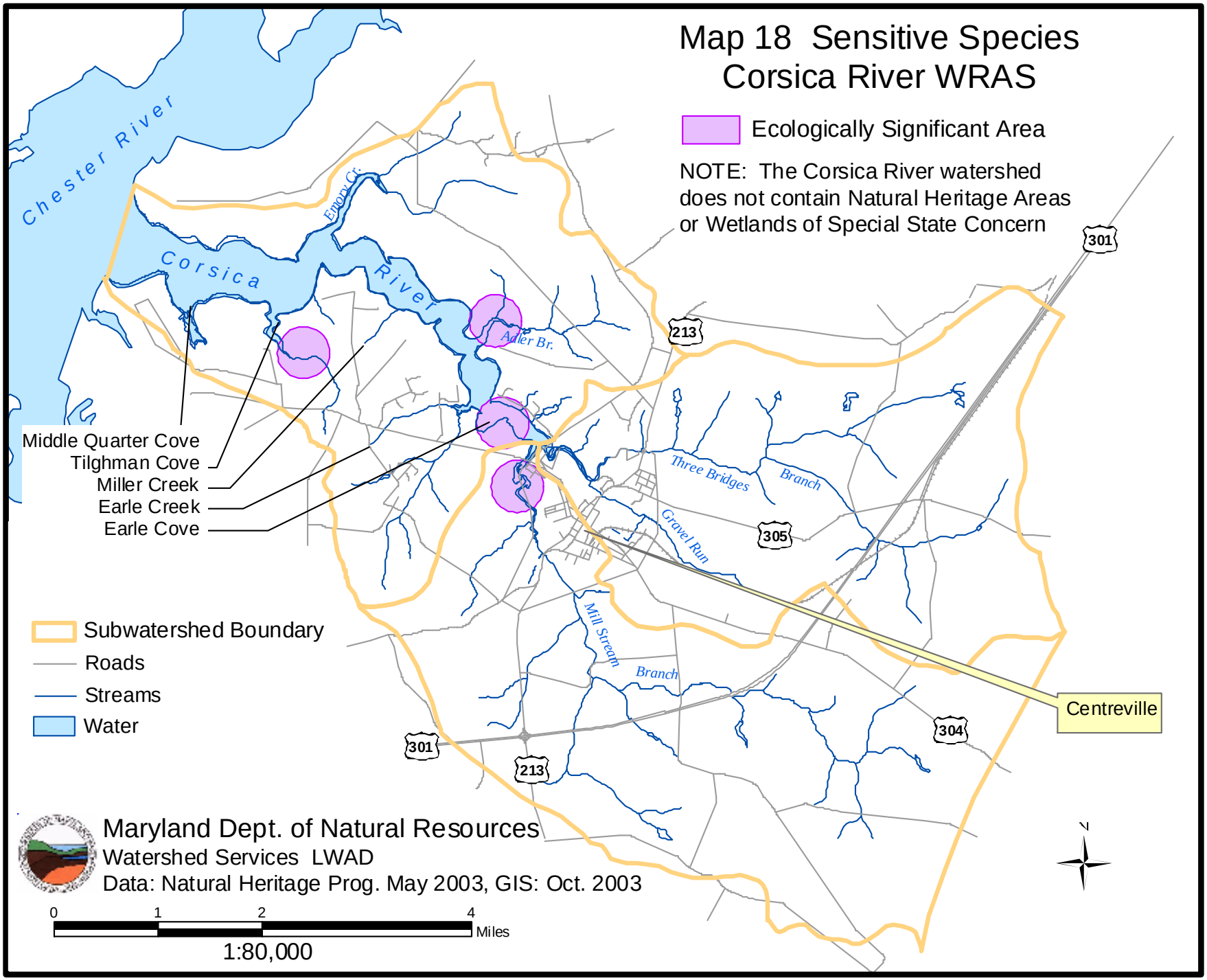

Map 15 MBSS Benthic Index Corsica River Watershed
Benthic Index of Biological Integrity
Good
Fair
Poor
Very Poor
Chester River
Corsica River
Emory Creek
Adler Br.
Three Bridges Branch
Gravel Run
Mill Stream Branch
301
213
305
304
Centreville
Subwatershed Boundary
Water
Streams
Roads
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: MBSS 2000, 1995 and Stream Waders 2000
GIS: October 2003
0 1 2 4
Miles
1:80,000
N

Map 16 MBSS Physical Habitat Index Corsica River Watershed

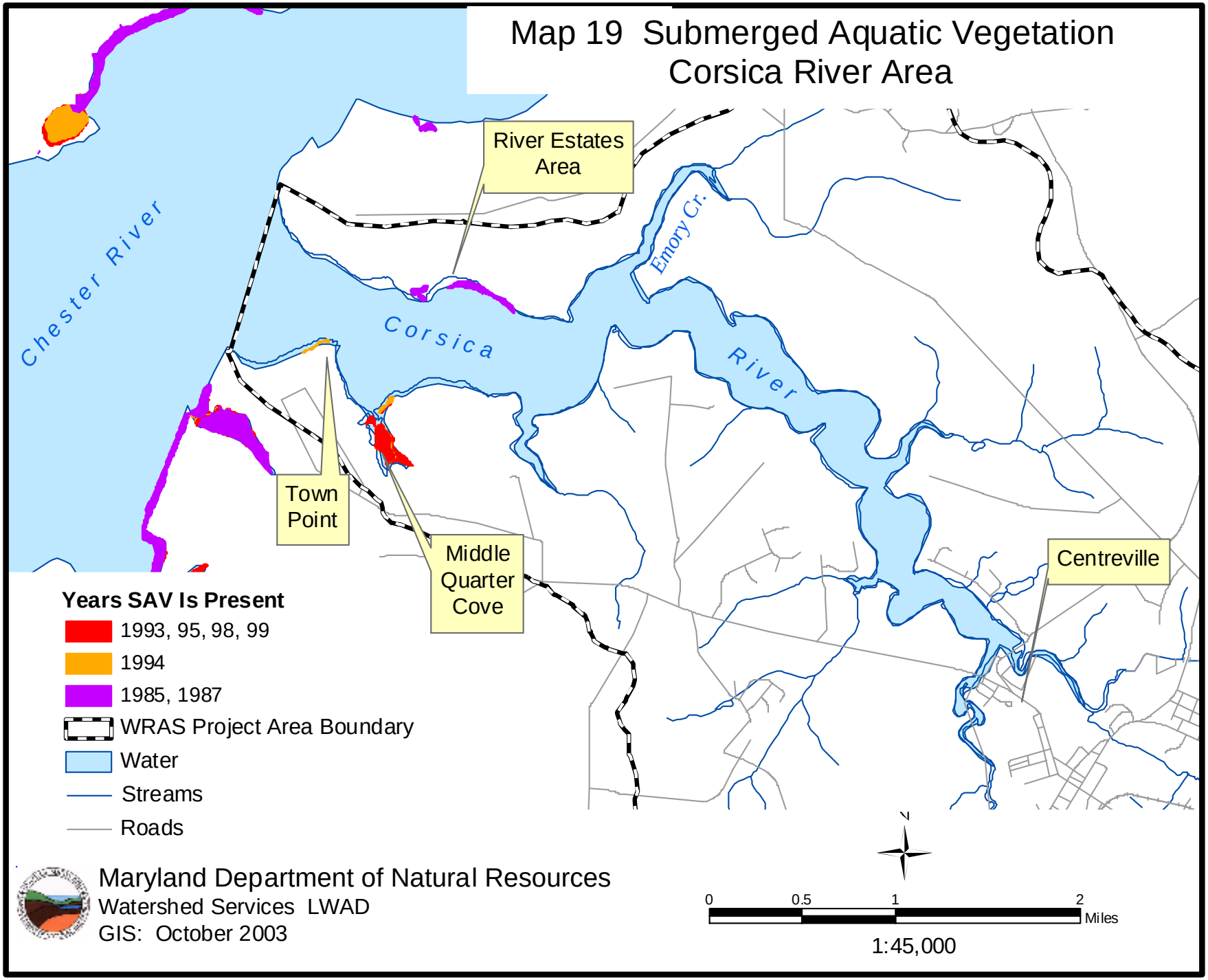


Map 17 Fish Spawning and Oysters - Corsica River Area



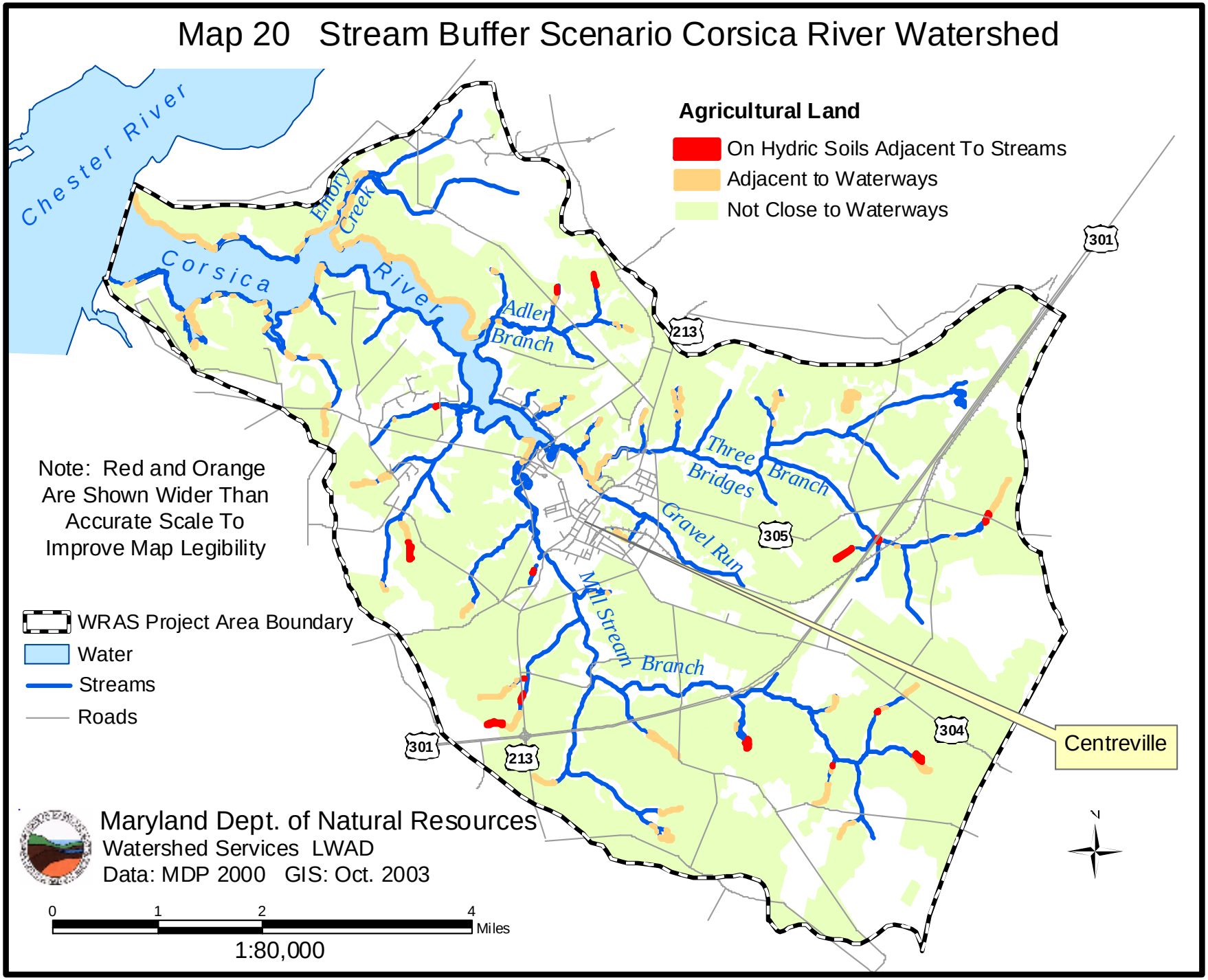

Map 18 Sensitive Species
Corsica River WRAS
Ecologically Significant Area
NOTE: The Corsica River watershed does not contain Natural Heritage Areas or Wetlands of Special State Concern
Chester River
Corsica River
Emory Cr.
Adler Br.
Middle Quarter Cove
Tilghman Cove
Miller Creek
Earle Creek
Earle Cove
Three Bridges Branch
Gravel Run
Mill Stream Branch
Centreville
301
213
305
304
Subwatershed Boundary
Roads
Streams
Water
Maryland Dept. of Natural Resources
Watershed Services LWAD
Data: Natural Heritage Prog. May 2003, GIS: Oct. 2003
0 1 2 4
Miles
1:80,000
N

Map 19 Submerged Aquatic Vegetation
Corsica River Area



Maryland Department of Natural Resources
Watershed Services LWAD
GIS: October 2003

Map 20 Stream Buffer Scenario Corsica River Watershed



Map 21 Wetland Restoration Scenario Corsica River Watershed