

**Corsica River Watershed
Section 319
National Monitoring Program Project**

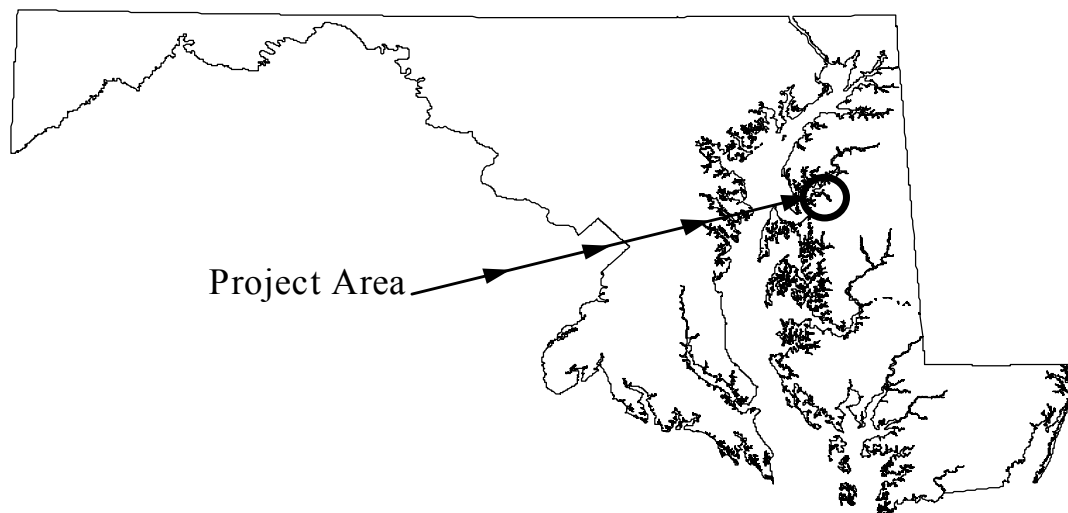
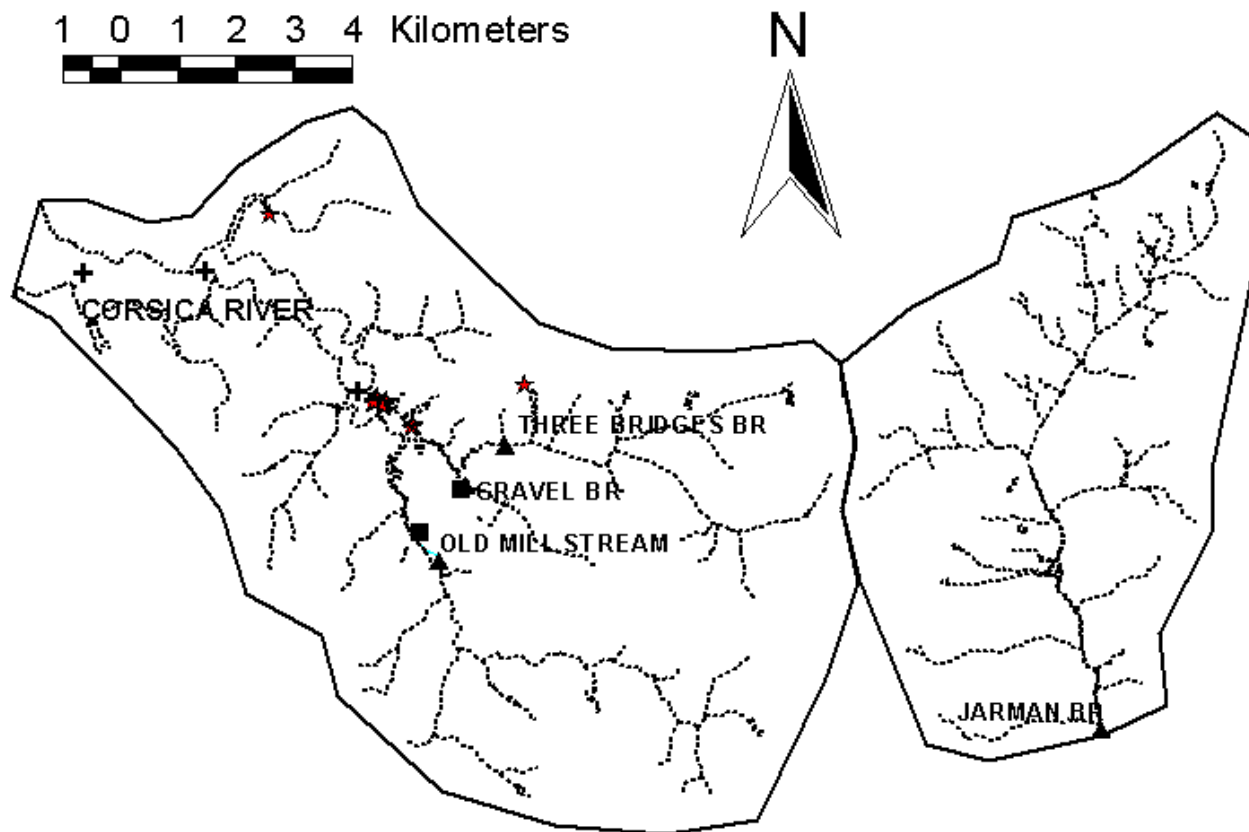


Figure 19: Corsica River Watershed (Maryland) Project Location



- Streams and Shoreline -----
- Watershed Boundary _____
- Long Term Nontidal WQ Monitoring Stations ▲
- OSDS Monitoring Sites ★
- Storm Water Monitoring Sites ■
- Tidal Continuous Monitoring Sites +

Corsica River Watershed (treatment) and adjoining Jarman Branch (control).

PROJECT OVERVIEW

The Corsica River Watershed Restoration Project is the restoration of a 24,000 acre watershed, leading to estuarine water quality that meets all water use and quality criteria noted in the State's Integrated 305(b)/303(d) Report. The overarching monitoring objective is to demonstrate the response of non-tidal and estuarine surface water nutrient loads, and by extension the TMDL end points of dissolved oxygen and phytoplankton (chlorophyll *a*) levels, to watershed management decisions and associated implementation activities. Implementation activities are not prescribed or mandated, but based on the market place and life style changes. Specific monitoring objectives include documenting tidal and non-tidal surface water nutrient concentrations and loads, effectiveness of cover crops, effectiveness of nitrogen removing onsite sewage disposal systems, and effectiveness of urban stormwater management retrofits. This project is unique for the State of Maryland. It is the first time that five major state agencies, the Departments of Environment (MDE), Natural Resources (DNR), Agriculture (MDA), Transportation (MDOT), and Planning (MDP), have collaborated on funding, implementation, and monitoring in an attempt to remove a Chesapeake Bay sub-watershed from the 303d list of impaired waters. Further collaboration and partnerships with the University of Maryland, local county and town governments, and local environmental and citizen groups have made this a very all-encompassing work group. Management plan implementation activities have begun. Initial non-tidal nutrient loading analysis has been completed for the first six-month period of flow record to establish a benchmark for future comparisons. Depressed dissolved oxygen and elevated chlorophyll levels continue to impact the tidal portion of the river.

PROJECT BACKGROUND

Project Area

Corsica River watershed @ 24,000 acres (treatment)

Jarman Branch watershed @ 12,000 acres (control)

Relevant Hydrologic, Geologic, and Meteorologic Factors

The project area is in the upper portion of Maryland's Eastern Shore of the Chesapeake Bay (Queen Anne's Co.). There is an estuarine tidal portion of the watershed that has salinities ranging from 5 to 15 parts per thousand, and a tidal range of 18 to 24 inches. The upland free flowing portion of the watershed is gently rolling coastal plain hills with maximum relief of approximately 60 feet. Approximately 67% of the watershed is prime loamy agricultural soils and about 20% is hydric soil. All other soils amount to about 13% of the watershed. There is no exposed bedrock in these watersheds. Wetlands identified by Maryland Department of Natural Resources (DNR) comprise less than 0.5% of the landscape.

Annual average rainfall is on the order of 40 to 42 inches per year. Average annual temperature is approximately 55°F and there are approximately 220 frost-free growing days.

Land Use

Land use in the 24,000+ acre Corsica River watershed is approximately 16,000 acres (64%) agricultural, 6,700 acres (28%) forest/scrub shrub and 1,700 acres (7%) developed. The Jarman Branch watershed has 8,259 acres (68%) as cropland, approximately 1,450 acres (12%) as

upland forests, and upland and wooded wetlands total 1,650 acres (14%).

Water Resource Type and Size

The Corsica River is a tidal tributary to the Chester River, and the Chester River is a tidal tributary of the Chesapeake Bay. The tidal portion of the Corsica River covers approximately 1,200 acres of open water. The tributary streams to the Corsica range from first to third order. The largest, Old Mill Stream Branch, is approximately 10 feet wide with a discharge ranging from 1 to 600 cubic feet per second. USGS currently gauges Three Bridges Branch. Jarman Branch is a third order stream with discharges ranging from 2 to 1,200 cubic feet second.

Water Uses and Impairments

The tidal and free flowing portion of the Corsica watershed are classified as suitable for water contact recreation and fishing with some restrictions as noted below.

A Total Maximum Daily Load (TMDL) approved for both nitrogen and phosphorus in the tidal portion of the Corsica River sets load limits for both nutrients. The low flow TMDL for nitrogen is 1379 lbs/month, and the low flow TMDL for phosphorus is 202 lbs/month. These TMDLs apply during the period May 1 – October 31, and will be implemented through NPDES permits. The annual TMDL for nitrogen is 287,670 lbs/yr, and the annual TMDL for phosphorus load is 22,244 lbs/yr. Although the TMDL sets nutrient goals, no nutrient criteria have been established for fresh or estuarine waters. In lieu of nutrient criteria, chlorophyll *a* concentrations in the estuary are used as a surrogate measure of nutrients, with a goal of 50 micrograms per liter to meet the estuarine water clarity goal and satisfy the TMDL.

A TMDL has also been written for bacteria in the tidal portion of the river. Fecal coliform concentrations in portions of the Corsica River are high enough to trigger shellfish harvesting regulations. The tidal waters closest to Centreville are “restricted” which means that no harvesting of oysters and clams is allowed at any time. No restrictions have been placed on water contact recreation or fishing.

The tidal portion of the Corsica River also suffers from legacy polychlorinated biphenyls (PCBs) and dieldrin. A TMDL has not been written for these substances at this time. The PCBs and dieldrin are associated with toxic and carcinogenic effects in humans. Since there is a risk that health problems could occur in people who eat these local fish too frequently, fish consumption advisories were issued in late 2001 and an update to the advisory was issued by MDE in January, 2003.

Several of the free flowing tributaries have been noted as being biologically impaired and put on the 303d list of impaired waters.

Pollutant Sources

Nonpoint sources of pollution are row crop agricultural activities, stream bank erosion, and pet waste.

Pre-Project Water Quality

Nutrient concentrations vary between the three major tributaries, but have remained relatively constant over the past 10 to 15 years as noted below.

	TN mg/L	TP mg/L
Jarman Br	3 – 6	.02 - .45
Old Mill Stream	3 – 6	.04 - .16

Gravel Branch	2 – 5	.03 - .27
Three Bridges Br	1 – 5	.04 - .43
Corsica tidal	.5 – 2	

Water Quality Objectives

The overall goal of this project is to work in an appropriate size watershed where, given sufficient resources, the State, County and local governments could demonstrate the ability to implement sufficient point and non-point source management activities to significantly improve habitat and water quality for living resources and maintain those improvements. To this end, the State's overall water quality management goal for the Corsica River watershed is to meet all specific water use and quality criteria noted in the State's Integrated 305(b)/303(d) Report. This task can be broken into four subcategories:

- Address tidal Corsica River TMDL for nitrogen and phosphorus designed to meet dissolved oxygen and water clarity standards for Use II - Shallow and Open Water uses. The low flow TMDL for nitrogen is 1379 lbs/month, and the low flow TMDL for phosphorus is 202 lbs/month. These TMDLs apply during the period May 1 – October 31, and will be implemented through NPDES permits. The annual TMDL for nitrogen is 287,670 lbs/yr, and the annual TMDL for phosphorus load is 22,244 lbs/yr.
- Address the sediment impairment in the tidal Corsica River and reduce suspended sediment levels to meet Use II - Shallow Water criteria for water clarity due to excess turbidity.
- Address the bacterial impairment in the tidal Corsica River and reduce bacterial levels to meet Use II - Shellfish Harvesting criteria and minimize any human-source bacteria levels that would limit shellfish harvesting in available waters (excepting permanently-closed WWTP discharge safety zone).
- Address the biological impairments in the non-tidal waters of the Corsica River watershed to meet Use I (water contact recreation) criteria and improve necessary water and habitat quality issues so that aquatic life communities will meet reference conditions.

The Corsica Watershed Project is a pilot program designed to develop best business and management practices and implement the processes, partnerships, assessment, and implementation tools needed to meet that threshold for restoring a single sub-watershed of the Chesapeake Bay to its designated uses.

The direct goals will be:

- Demonstrate the impact of a comprehensive watershed restoration program on non-tidal surface water nutrient and sediment concentrations and loads.
- Demonstrate effectiveness of cover crops at reducing soil pore and shallow ground water nutrient concentrations under agricultural fields.
- Demonstrate effectiveness of onsite sewage disposal systems with nitrogen removal technology at reducing nutrient concentrations delivered to ground water.
- Demonstrate effectiveness of urban storm water management retrofits at reducing nutrient and sediment loads discharged to surface waters.
- Demonstrate the response of estuarine phytoplankton (chlorophyll A) to changes in non-tidal surface water nutrient loads.

Project Time Frame

July, 2005 to July, 2010 (estimated)

PROJECT DESIGN

Activity	Pre-BMP	BMP Implementation*	Post-BMP
Outlet monitoring	7/05 – 9/07	Cover crops 9/07 – indefinite	9/07 – 9/10
Nutrient Synoptic Surveys	7/05 – 9/07	Cover crops 9/07 – indefinite	9/07 – 9/10
Subsurface nitrate	7/04 – 7/06	Cover crops 9/07 – indefinite	9/07 – 9/10
Urban stormwater	7/06 – 7/08	Wetland retrofit 7/08 – 10/08	10/08 – 9/10
Onsite sewage	7/06 – 1/08	Denitrifying OSDS 1/08 – 3/08	3/08 – 9/10
Estuarine monitoring	7/05 – 9/07	NA	9/07 – 9/10

Project Schedule

*As noted, the BMP implementation consists of a number of different activities. The timing for the cover crop implementation is open ended because this is an ongoing program with no specific end date. The goal of the cover crop program is to maintain a minimum of 4,000 acres per year in grass or small grain cover crops in perpetuity within the watershed. Sign-up for, and actual planting of cover crops is voluntary and subject to commodity market fluctuations and weather. The estuarine monitoring looks at the cumulative effect of all implementation activities within the watershed.

Nonpoint Source Control Strategy

The Corsica River Watershed Project was envisioned as the test of a management process. We are attempting to shift from the current and generally ineffective scattershot approach to watershed restoration to a coordinated life style changing program that results in significant water quality, habitat, and living resource improvements. BMP implementation is critical to program success, and monitoring is critical to determining if success has been achieved. In the context of the Chesapeake Bay restoration, the Corsica River Watershed Project is a test of a watershed management process that will further our understanding of, and ability to, limit non-point source pollution. Because this is a test of the management process more than any individual implementation activity, the market place and life style changes will dictate timing and extent of BMP implementation. The monitoring was begun in July 2005 prior to any significant implementation activities over and above ‘business as usual.’

Water Quality Monitoring

The non-tidal baseflow and storm flow monitoring will be a paired watershed trend study. The three major tributaries to the Corsica - Three Bridges Branch, Gravel Branch, and Old Mill Stream Branch -will be paired against Jarman Branch, an adjacent watershed in the Tuckahoe/Choptank watershed. Three Bridges Branch, Old Mill Stream Branch and Jarman Branch watersheds are similar in size (@ 8,000 to 10,000 acres) and dominated by agricultural land use. Although Gravel Branch is

considerably smaller at approximately 1,000 to 1,500 acres, a calibration period of sufficient length to establish a relationship should allow for appropriate comparisons. A 10-year nutrient discharge monitoring, and land treatment history in the Jarman Branch watershed was a prime consideration when choosing it as the pairing watershed. Jarman Branch had over 99% of the watershed under nutrient management plans in 1995, with BMP implementations being tracked by the county Soil Conservation District. During this 10 year period, there was limited nutrient sampling from the Corsica tributaries being sampled for the current study. While implementation activities will not be discouraged or prohibited in the Jarman Branch watershed, past experience has shown that ‘business as usual’ does not produce the level of implementation required to significantly effect nutrient exports from this watershed.

The nutrient synoptic survey will be a trend study (means separation, Kolmogorov/Smirnov) providing an ongoing systematic assessment of dry weather base flow nutrient concentrations and yields from up to 43 subwatersheds throughout the Corsica non-tidal watershed.

Tracking changes in subsurface nitrate levels of agricultural land with and without cover crops will be a trend study (means separation, Kolmogorov/Smirnov) providing an ongoing systematic assessment of nitrate leaching rates and nitrate concentrations in shallow groundwater throughout the Corsica River watershed.

The urban stormwater monitoring has been planned as a combined before/after and upstream/downstream monitoring study. The before/after aspect will monitor improvements to housekeeping (street sweeping, pet management, etc.), while the upstream/downstream portion will look at the effectiveness of storm water wetland retrofits.

The onsite sewage disposal system study will be a paired study with three treatment sites and three control sites.

The estuarine monitoring will be a trend study of nutrient, chlorophyll *a*, and sediment concentrations as they relate to documented loads delivered from non-tidal streams (means separation, Kolmogorov/Smirnov).

Variables Measured

Chemical and Other Non-tidal

- Total phosphorus
- Orthophosphate
- Total nitrogen
- Total dissolved nitrogen
- Nitrate+nitrite
- Ammonia
- Total suspended solids

Tidal

- Chlorophyll
- Water temperature
- Specific conductance
- Salinity
- Dissolved oxygen
- Turbidity (NTU)
- Fluorescence
- Total chlorophyll (used to estimate chlorophyll *a*)
- pH

Depth
 Total dissolved nitrogen
 Particulate nitrogen
 Nitrite
 Nitrite+nitrate
 Ammonium
 Total dissolved phosphorus
 Particulate phosphorus
 Orthophosphate
 Dissolved organic carbon
 Particulate carbon
 Silicic acid
 Total suspended solids
 Volatile suspended solids
 Particulate inorganic phosphorus

Covariates

Precipitation
 Discharge

Sampling Scheme

Non-tidal

Project 1. Base and storm flow water quality samples will be collected at the three Corsica tributary sites using ISCO®, Inc. automated samplers and flow meters. Flow weighted composite samples will be collected. Weighting criteria will be set based on a rating curve established for each stream. To define the relationship between dissolved and total nutrient concentrations, grab samples for whole and filtered water will be collected weekly just below the water surface at mid-stream at all stations including Jarman Branch. Filtered samples will be filtered through a 0.47 micron pore size Whatman 934/AH filter.

Project 2. Synoptic nutrient samples will be collected at approximately forty-five sites throughout the Corsica watershed. Sampling will be conducted during a base flow period of high ground water recharge in February and a period of minimal ground water recharge in August. Surface water grab samples will be collected just below the water surface at mid-stream at all sites. A stream discharge measurement will be taken at the time of sampling.

Project 3. The primary field activity for assessment of changes in nitrate leaching rates and nitrate concentrations in shallow groundwater will be the collection of soil cores from cropland throughout the Corsica River watershed. At each sampling site 5 cm diameter cores will be collected from the soil surface to approximately 0.5 m below the water table in 15 cm increments. Three cores will be collected in each field and GPS coordinates will be established for each sampling site. In addition to soil coring, edge-of-field well nests will be established at four sites in the watershed to track changes in groundwater nitrate concentrations leaving crop fields. These wells will be sampled quarterly at a minimum. Wells will be sampled using standard techniques and all samples will be analyzed for nitrate, sulfate, and chloride.

Project 4. Automated sampling equipment has been installed at storm water outfalls to Gravel Branch and Old Mill Stream Branch to capture first flush and composite storm flows to these tributaries. Stormwater discharge volumes will be calculated using a Mannings equation, or a V-notch weir, and the recorded stage heights at the pipe outfall. Samples will be collected from 12 to 16 storms per year beginning at least one year prior to storm water retrofit installation and continuing for one year after completion. After retrofit, samples will be collected from both retrofit inflow and outflow. At a minimum, samples will be analyzed for total nitrogen, total phosphorus and total suspended solids. Screening of initial samples will be done to identify other potential constituents that could be considered as contributing to existing water quality problems.

Project 5. This project chose two of the 30 proposed retrofit sites, and one traditional OSDS with no planned upgrade. Two new homes with nitrogen reducing OSDSs installed as original equipment are still planned, but are currently unavailable due to real estate market changes. Three off site controls have been established in areas unimpacted by septic effluent, one adjacent to agricultural land, a second in forest, and a third on an undeveloped subdivision lot. An array of 4 to 6 shallow wells will be installed within and down gradient of each drain field to monitor the nutrient (NO_2 , NO_3 , NH_4 , PO_4 and TDN) concentrations being discharged to the shallow ground water. Control sites have three wells. Samples are collected every four weeks from each test site.

Estuarine

Project 6. The Corsica River will be monitored using monthly water quality mapping cruises, two continuous monitoring sites, a vertical water quality profiler and fixed station grab sampling. The two continuous monitoring sampling stations are chosen to be representative of the Corsica's up-stream and downstream conditions, with two instruments deployed at the downstream station (surface and bottom). The continuous monitoring will be conducted year round at three sites within the estuarine portion of the Corsica at both the surface and bottom. Each continuous monitoring station deploy YSI© 6600-EDS sondes in the water column. At each station, one instrument will be floating 1 meter below the surface while a second instrument will be fixed 0.3 meters above the bottom. The monitoring sondes record nine water quality parameters every 15 minutes; water temperature, specific conductance, salinity, dissolved oxygen, turbidity (NTU), fluorescence and total chlorophyll (used to estimate chlorophyll *a*), pH and depth. During bi-weekly site visits for instrument replacement a discrete water sample will be collected for chlorophyll, turbidity and TSS calibration of sonde and a full suite of nutrients (total dissolved nitrogen, particulate nitrogen, nitrite, nitrite + nitrate, ammonium, total dissolved phosphorus, particulate phosphorus, orthophosphate, dissolved organic carbon, particulate carbon, silicic acid, total suspended solids, volatile suspended solids, and particulate inorganic phosphorus). In addition, secchi depth and photosynthetic active radiation (PAR) measurements are taken at calibration stations to calculate light attenuation (Kd). Water quality mapping (DataFlow) is a shipboard system of geospatial equipment and water quality probes that measure water quality parameters from a flow-through stream of water collected near the water's surface. The water quality mapping system samples water at approximate 0.5-m below the surface. Each water quality measurement is associated with a date, time, water depth, and GPS coordinate (NAD83).

Land Treatment Monitoring

BMP implementation on agricultural land is tracked by the local Soil Conservation District Office. Other urban and suburban implementation activities are tracked by direct observation and local contacts on a monthly basis.

Progress to Date

Implementation activities as of July, 2007 include increases in cover crop acreage from <10% of available crop land to > 50% of available crop land, and installation of 15 urban/suburban rain gardens. No significant changes have been noted in nutrient export to the estuary or changes in chlorophyll concentrations.

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Primary data management was done using in-house spreadsheets in MS Excel. Data transfer to EPA Storet will be on an annual basis. A data summary is unavailable at this time.

INFORMATION, EDUCATION, AND PUBLICITY

Technical transfer will be through several avenues. Quarterly and annual progress and data reports are part of the 319(h) grant requirement, as is submission of data to the EPA storet system. A comprehensive annual report compiled by DNR and Maryland Department of the Environment (MDE) with input from other participating agencies and organizations will detail all watershed activities and results associated with the project. Additionally, a web site dedicated to the Corsica River restoration will be established and maintained by the Maryland Department of Natural Resources with periodic postings on activities and progress, and of data and analysis. An existing website (<http://mddnr.chesapeakebay.net/eyesonthebay>) will have near time data from the continuous estuarine monitoring. Data, results, and analysis will also be presented at public and professional forums such as the National Non-point Source Workshop and the Maryland Water Monitoring Council Workshop. A major assumption of this project is that the implementation methods and lessons learned for watershed restoration would be transferable to other impaired Chesapeake Bay watersheds.

Stakeholder representatives from local and regional environmental groups, watershed associations, river keepers, etc., local and county government, and agency personnel attend monthly implementers/progress meetings. A synopsis of past months activities is provided and future plans discussed at each meeting. This forum can provide data useful for program goal and strategy corrections and refinements with associated refinements to the various monitoring programs.

Other local communications initiatives will design and conduct a comprehensive outreach and education plan to target every resident in the watershed with particular focus on the residents of the Town of Centreville. Landowners will be targeted for increased technical assistance in the design and installation of best management practices (BMP's) that emphasize nutrient and sediment control throughout the urban landscape including innovative household water conservation and stormwater management, household and pet waste management strategies, street trees, and stream buffers. Tools for providing outreach and education support, which focus on sustainable site design and "Bay Scapes" for homeowners, will include educational programming distributed on DVDs, guidance materials, and workshops for developers.

PROJECT BUDGET

<u>Implementation Activity</u>	<u>Current 05 Annual \$\$ Level</u>	<u>Total Activity Cost (5 year budget)</u>
SCD support/Extension service support	\$63,448	\$634,480
Cover Crops	\$164,550	\$700,000
Small Grain Enhancement	\$50,000	\$250,000
Maryland Agricultural Cost Share	\$14,900	\$74,500
Buffers, Forest Cover and Conservation Landscaping Incentive payments (15-yr rental)	\$1,700	\$48,450
Buffer establishment	\$22,000	\$220,000
Horse Pasture Management	\$40,000	\$350,000
Point Source ENR	\$0	\$1,100,000
MDE, TARSA Project Coord 1 FTE		\$0 \$223,580
Stormwater Management	\$260,500	\$3,440,080
Homeowner pollution reduction	\$40,000	\$90,000

Septic Retrofits	\$0	\$255,000
Urban Forest Buffers	\$0	\$220,000
Urban Wetlands	\$0	\$1,000,000
SAV	\$0	\$160,000
Oysters	\$400,000	\$900,000
Stream Restoration	\$0	\$2,000,000
Project Coordination	\$0	\$750,000
SAV Monitoring	\$0	\$132,500
Tidal Water Quality Monitoring	\$0	\$551,725
Tidal Water Quality Monitoring Project Analysis	\$0	\$331,000
Oyster Monitoring	\$16,000	\$80,000
Imagery and data acquisition for implementation and progress tracking	\$0	\$632,750
Flow monitoring	\$0	\$50,000
Cropland conversion loading analysis	\$56,300	\$148,900
Soil Pore nitrogen and shallow ground water sampling under cover crops	\$96,000	\$264,000
Shallow ground water sampling adjacent to OSDS	\$44,000	\$212,000
Nontidal water quality sampling	\$189,000	\$910,000
Nontidal project analysis	\$55,000	\$300,000
Living resources and habitat monitoring	\$80,740	\$472,580
Bacterial Source tracking	\$0	\$75,000
updated 8/22/05	\$1,594,138	\$16,576,545

All estimates in current dollars

*Funding sources are federal, state, and local.

Focus	Responsible agency	Sampling type	Intensity	Parameters
Shellfish harvesting waters M	DE	tidewater surface grabs bacteria 2	sites biweekly	Enterococcus, insitu temp, pH, cond, D.O.
Oysters	DNR	population estimates	annual	Quality and quantity
Bacteria	MDE	Bacterial source tracking	watershed wide, seasonal	Scat, insitu temp, pH, cond, D.O.
SAV	DNR	population estimates/surveys	seasonal	Areal coverage, species
Centreville STP, spray irrigation	MES*/MDE	ground and surface water	monthly 7 sites	nutrients
Nontidal Biological	MDE/DNR	benthos, fish	every other yr	IBIs
Nontidal habitat	MDE	assessment	every other yr	quantitative measurements
Tidal/ anadromous fisheries	DNR	stock assessment	annual	species presence
Fish passage blockage removal	DNR	fish community	annual	species presence
Wetland/riparian restoration D	NR	assessment	annual	quantitative measurements

* Maryland Environmental Service

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

Additional Monitoring Activities Planned or Ongoing in the Corsica River Watershed

USDA agricultural BMP cost share programs are a significant part of the Corsica Watershed restoration program. USGS actively maintains a gauge at Three Bridges Branch. The US Fish and Wildlife Service and Maryland DNR Heritage have interest in the watershed due to the presence of a globally rare, threatened, endangered species. The MDE TMDL and 303(d) Programs have an interest in this watershed project.

OTHER PERTINENT INFORMATION

None.

PROJECT CONTACTS

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