Monitoring the Corsica River Watershed
Water Quality from Field to Estuary
A National Nonpoint Source Monitoring Program Project Update.

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Jennifer Jaber
Maryland Dept of the Environment
Science Services Administration
319 Program

Multi-stakeholder and multi-year project

Queen Anne’s County
Corsica River Conservancy
Chester River Association
## Corsica Watershed % Land use

<table>
<thead>
<tr>
<th>Land use</th>
<th>Acres</th>
<th>% Cover</th>
<th>% Nitrogen Contribution</th>
<th>% Phosphorus Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>6,675</td>
<td>26</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>15,302</td>
<td>60</td>
<td>86</td>
<td>84</td>
</tr>
<tr>
<td>Suburban</td>
<td>453</td>
<td>2</td>
<td>&lt; 1?</td>
<td>&lt; 1?</td>
</tr>
<tr>
<td>Urban</td>
<td>1,471</td>
<td>6</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Open water</td>
<td>1,394</td>
<td>6</td>
<td>NA</td>
<td>NA</td>
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</table>
Corsica River has an approved TMDL for nitrogen and phosphorus that is intended to:

1. Assure minimum dissolved oxygen of 5 mg/l is maintained throughout the tidal Corsica River system.

2. Reduce peak chlorophyll-a levels (a surrogate for nutrients) below 50 µg/l in tidal waters\(^1\).

\(^1\) MDE establishes permit limits based on maintaining chlorophyll-a concentrations below a maximum level of 100µg/l, with an ideal goal of less than 50µg/l.

**Direct Goals of this Monitoring Program**

- Demonstrate the impact of a comprehensive watershed restoration program on non-tidal surface water nutrient concentrations and loads.

- Demonstrate effectiveness of onsite sewage disposal systems (OSDS) with nitrogen removal technology at reducing nutrient concentrations delivered to ground water and subsequently tidewater.

- Demonstrate effectiveness of urban storm water management retrofits at reducing nutrient and contaminant loads discharged to surface waters.

- Demonstrate effectiveness of cover crops at reducing soil pore and shallow ground water nutrient concentrations under agricultural fields.

- Demonstrate the response of estuarine phytoplankton (chlorophyll \(\alpha\)) and dissolved oxygen levels to changes in non-tidal surface water nutrient loads.
Monitoring activities to measure progress

**MD Department of the Environment (MDE)**
- Water quality of three main non-tidal tributaries to the tidal Corsica and one neighboring control watershed. (Watershed outlet concentrations and loads)
- Semi-annual nutrient synoptic survey at ~45 sites throughout the non-tidal watershed. (Subwatershed concentrations and loads)
- Efficiencies of denitrifying septic system retrofits.
- Efficiency of Centreville storm water management retrofits and efficacy of public education program.

**Monitoring activities to measure progress (continued)**

**University of Maryland (UMD)**
- In field cover crop efficiencies.
- Jarman Br. automated monitoring.

**MD Department of Natural Resources (DNR)**
- Estuarine nutrient, dissolved oxygen, and chlorophyll a concentrations.
Potential 2006 - 2007 Cover Crop Enrollment

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acres</th>
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<tbody>
<tr>
<td>Corn</td>
<td>5,270</td>
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<tr>
<td>Soybeans</td>
<td>6,004</td>
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<tr>
<td>Vegetables</td>
<td>636</td>
</tr>
<tr>
<td>Total</td>
<td>11,909</td>
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</tbody>
</table>

Courtesy of MD Dept. of Agriculture
MDE Watershed Outlet Monitoring

- Automated stage height recording to estimate cumulative stream discharge.
- Weekly surface grab samples.
- Continuous flow weighted composite samples.
- Water samples analyzed for TN, TP, NO$_2$, NO$_2$+NO$_3$, NH$_4$, PO$_4$, TSS.
Typical setup for automated sampling

Corsica Tribs and Jarman Br. Weekly grab samples, TN concentrations (mg/l)

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<thead>
<tr>
<th>Date</th>
<th>TN (mg N/l)</th>
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<tr>
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<tr>
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<tr>
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<tr>
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OMS  GVL  TBB  JB
MDE Nutrient Synoptic Survey

- Sampling conducted semiannually – February and August.
- ~ 45 sites sampled during dry weather.
- Whole and filtered surface grab samples (TN, TP, NO$_2$+NO$_3$,
  PO$_4$).
- Insitu measurements of temp., pH, spec. cond., dissolved O$_2$.
- Discharge measured for loading calculation.
- Data used to locate nutrient hotspots and provide data for
  pending nutrient criteria.
MDE OSDS Retrofit Monitoring

- Three treatment scenarios to be sampled.
  - Treatment 1 - Two systems sampled prior to and after denitrifying retrofit.
  - Treatment 2 (planned) - Two new homes with retrofit systems.
  - Treatment 3 - Control
    - One home with traditional OSDS with no planned retrofit.
    - Row crop field edge > 500 m from nearest house
    - Woodland with low N > 500 m from nearest house
    - Undeveloped lot in Treatment 1 subdivision
MDE OSDS Retrofit Monitoring (cont.)

Site Set-up

• Control sites
  – Array of 3 wells

• All house sites
  – Array of 4-6 wells installed up gradient (1), within (2), and down gradient (1 to 3) of drain fields

• Selected houses
  – Array of 3 sets of 3 wells in intertidal zone at depths of 2, 4, and 6 feet below soil surface.

• Samples collected monthly/site
Corsica OSDS Monitoring Groundwater Profile

Distance from Shoreline

- Up gradient
- Drain field
- Ground Elevation
- Water table
- Down gradient
- Beach

Elevation in meters

Corsica OSDS Monitoring Average TDN

Total Dissolved Nitrogen (mg/L)

- up gradient
- drain field 1
- drain field 2
- down gradient
- beach
MDE Urban Stormwater and Retrofit Monitoring

• Automated sampling at two existing stormwater outlets.
  (TN, TP, NO2, NO2+NO3, NH4, TSS, metals and oil and grease at a minimum)
• Automated sampling at retrofit wetland inlets and outlets.
  (TN, TP, NO2, NO2+NO3, NH4, TSS, metals and oil and grease at a minimum)
Storm Water Quality

• Nutrients
  – Base flow TN <1mg/L, TP <.08 mg/L
  – Storm TN >3mg/L, TP >.23 mg/L

• Metals
  – Base flow Cadmium .0025mg/L, Copper .005 mg/L, Lead .01 mg/L, Zinc .04 mg/L
  – Storm Cadmium .002mg/L, Copper up to .096 mg/L, Lead up to .076 mg/L, Zinc .07 mg/L

• Oil and Grease, Total Hydrocarbons
  – Base flow O&G <5, TPH <5
  – Storm O&G up to 9.9, TPH up to 6.1
UMD Tracking Changes in Subsurface Nitrate Levels in the Corsica River Watershed

- Baseline study (2004-2005) evaluated subsurface nitrate concentrations under cropland prior to cover crop implementation.
- 5 cm diameter cores collected from the soil surface to approximately 0.5 m below the water table in 15 cm increments and analyzed for nutrient content.
- Approximately 100 cores collected from 30 to 40 fields each year. A total of 1500-2000 individual samples is anticipated.
- Analysis results used to calculate profile water content, pore-water nitrate concentrations, and total nitrate and water storage. The water data will be useful for estimating vadose zone residence times.
- Edge-of-field well nests will be established at four sites in the watershed to track changes in groundwater nitrate concentrations leaving crop fields.

Corsica Watershed soil pore-water nitrate-N prior to cover crop applications

K. Staver, University of MD
Wye Research and Education
DNR Estuarine nutrient and phytoplankton (chlorophyll) concentration monitoring

• Three continuous monitoring sites chosen to be representative of the Corsica’s upstream and downstream conditions, monitored with YSI® 6600-EDS sondes.
• Biweekly vertical water quality profile.
• Biweekly fixed station grab sampling.
• Monthly water quality mapping cruises using a Garmin model GPSMAP168 sounder chartplotting receiver and depth-finder global positioning system (GPS), a YSI 6600 Sonde with a flow-through chamber.
Nutrients in Tidewater
Dissolved Inorganic Phosphorous (DIP)
Dissolved Inorganic Nitrogen (DIN)

DIP levels of <0.01 and DIN levels of <0.15 are listed as secondary SAV habitat requirements

Preliminary Report by P.M. Glibert, et. al.
Univ. of Maryland Center for Environmental Science
Horn Point Laboratory

47 samples were collected for chlorophyll and δ15N on October 11, 2006

Highest levels of δ15N corresponded with lowest levels of chlorophyll and vice versa

“These results are suggestive of different nitrogen sources upriver and down.”

“The low δ15N values are consistent with a sewage derived signal.”

“However… [it] may also be consistent with significant processing of nitrogen [by algae].”

Courtesy MD Dept. of Natural Resources

October 11, 2006
Conclusions

• Bureaucratic delays and market forces are significant players in BMP implementation scheduling and quantity.

• Quantity of BMP implementation to date is insufficient to produce detectable changes in nutrient concentrations or loads in free flowing or tidal portions of the Corsica.
To avoid getting mired in bureaucratic mud and have stakeholders running away -

We need to be creative in how we use the resources at our disposal
Monitoring the Corsica River Watershed Restoration: Water Quality from Field to Estuary - A National Non-point Source Monitoring Program

Project Update

Niles L. Primrose
Maryland Department. of the Environment
Baltimore, MD

The Corsica River Watershed Restoration Project is the restoration of a 24,000 acre watershed, leading to estuarine water quality meeting 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. 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 storm water 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, Natural Resources, Agriculture, Transportation, and Planning, 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.