The Breton Bay Watershed Restoration Action Strategy

Prepared for

St. Mary's County and The Town of Leonardtown

Prepared by

The Center for Watershed Protection

In cooperation with The Maryland Department of Natural Resources

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Section 1.0 Introduction

The Breton Bay watershed encompasses over 55 square miles of land lying on Maryland's Coastal Plain between the Potomac and Patuxent Rivers (Figure 1). The watershed includes some of the most ecologically diverse and sensitive biological communities in the Chesapeake Bay region. McIntosh Run, the largest tributary to Breton Bay, has not only been designated a Natural Heritage Area by the State of Maryland, but has been identified as a significant forest block by the Nature Conservancy in the *Chesapeake Bay Lowlands Ecoregional Plan* (Figure 2) (TNC, 2002). The Nature Conservancy found that this 10,480 acre forest block had the lowest road density of any forest block in the State of Maryland and that it was one of only three that exceeded 80% overall forest cover. McIntosh Run also supports a significant population of dwarf wedge mussels, a federally endangered, globally rare species. In addition to the dwarf wedge mussels, the Breton Bay watershed also supports seven plant species classified by the State of Maryland as rare, threatened, or endangered (RTE) (Figure 3) (Shanks, 2002)

Despite possessing these attributes, Breton Bay exhibits some of the same impairments that affect more urbanized watersheds in the State, namely non-point source (NPS) pollution. Non-point source pollution encompasses a wide array of pollutants and pollutant sources, ranging from nutrient and pesticide runoff from agricultural fields, pastures and lawns to heavy metals, hydrocarbons, and sediments running off roads, parking lots and driveways.

The purpose of this document is to present a strategy to reduce NPS pollution and related impairments in the watershed, while at the same time conserving the unique, high quality natural resources. This strategy was developed through the combined efforts of the general public, watershed stakeholders, local and county governments, non-profit organizations and State and Federal agencies. This document outlines the conditions in the watershed, the potential sources of pollution and impairments, and actions that can be taken to address these issues through the Watershed Restoration Action Strategy (WRAS)Program.

Section 2.0 Watershed Restoration Action Strategy Program

Maryland's 1998 Clean Water Action Plan (MDDNR, 1998) called for the assessment of all State waters to determine the degree of NPS impairment and to establish restoration priorities. The resulting Unified Watershed Assessment (UWA) looked at all 134 watersheds in the State in terms of both watershed impairments and significant water resource values. The assessment categorized watersheds as either in need of protection, restoration, or, in some instances, both. The full assessment report can be found at http://www.dnr.state.md.us/cwap/cwap.htm

The UWA assessed Breton Bay using several landscape indicators and three water quality criteria: nitrogen load, phosphorus load, and whether or not the water was listed as impaired on the States 303(d) list. Based upon land use indicators Breton Bay ranked in the top (best) 25% of watersheds in the State. For this reason the watershed was considered a priority protection watershed. At the same time, the watershed was listed as an impaired water on the 303(d) list for failure to meet its designated use as shellfish harvesting waters. For this reason the watershed was also listed as a priority restoration watershed. The complete 2002 Maryland 303(d) list can be found at:
http://www.mde.state.md.us/assets/document/TMDL/303(d)_List_by_Impairment.pdf

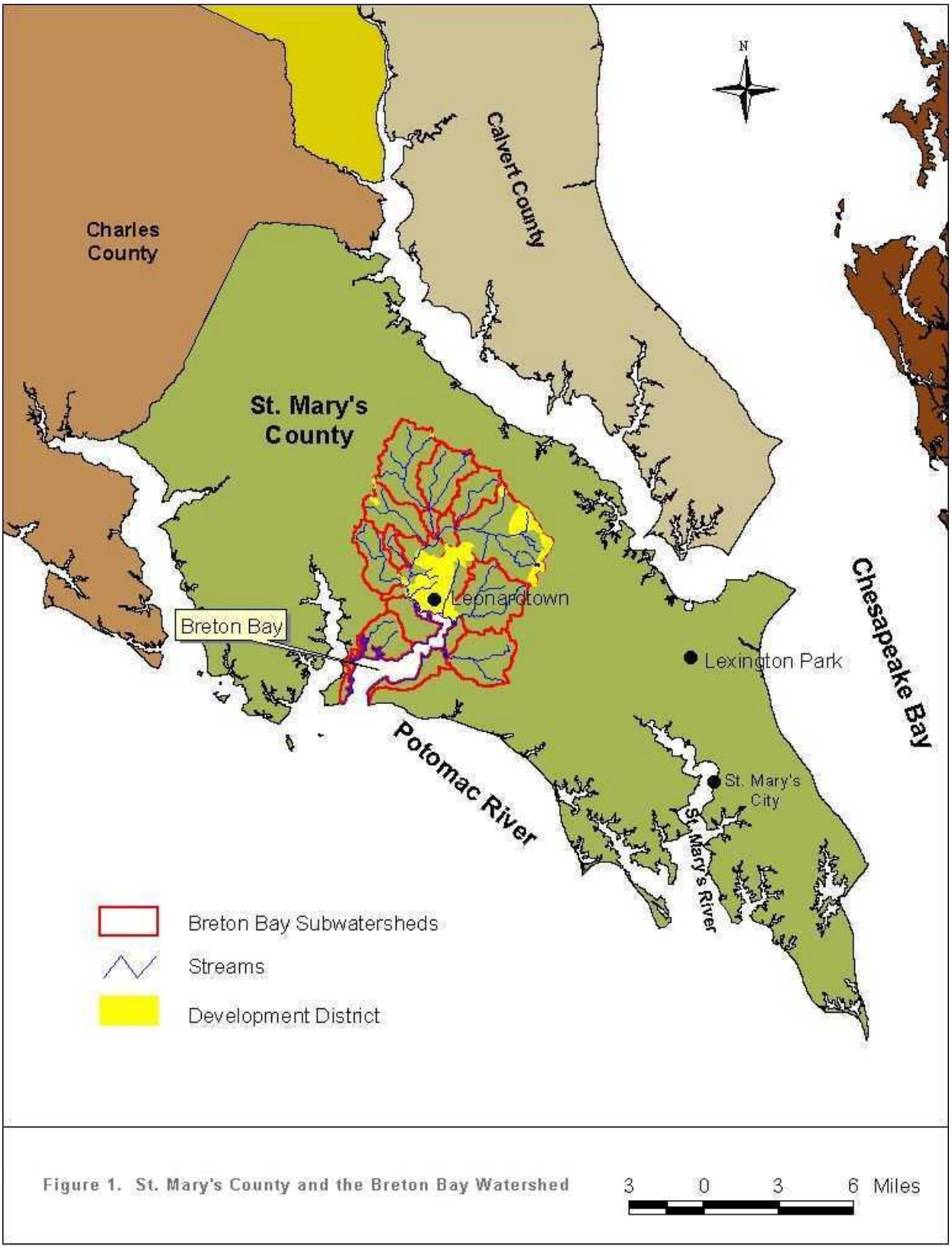

Figure 1. St. Mary's County and the Breton Bay Watershed

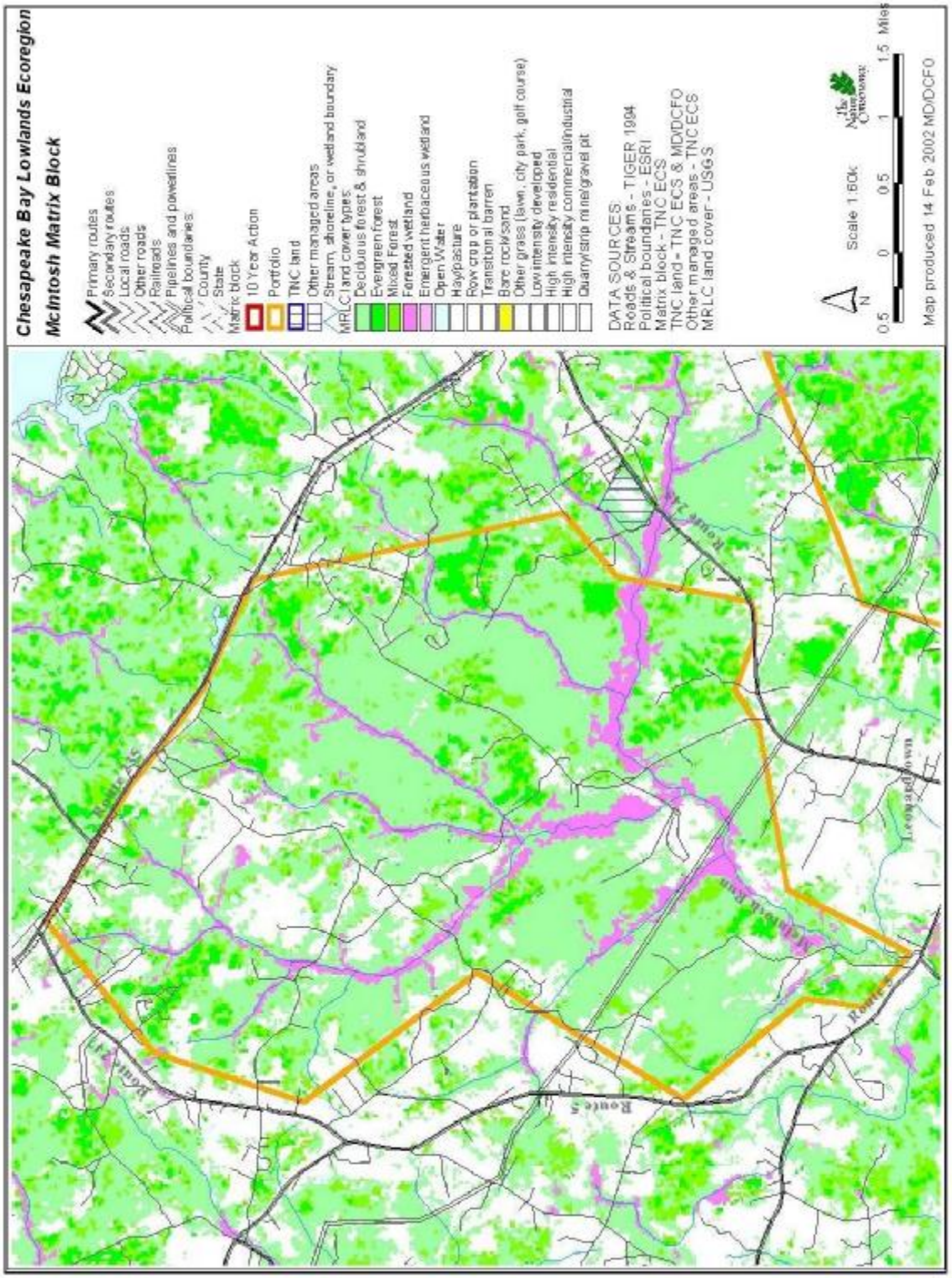

Figure 2. The Nature Conservancy McIntosh Run Forest Matrix Block

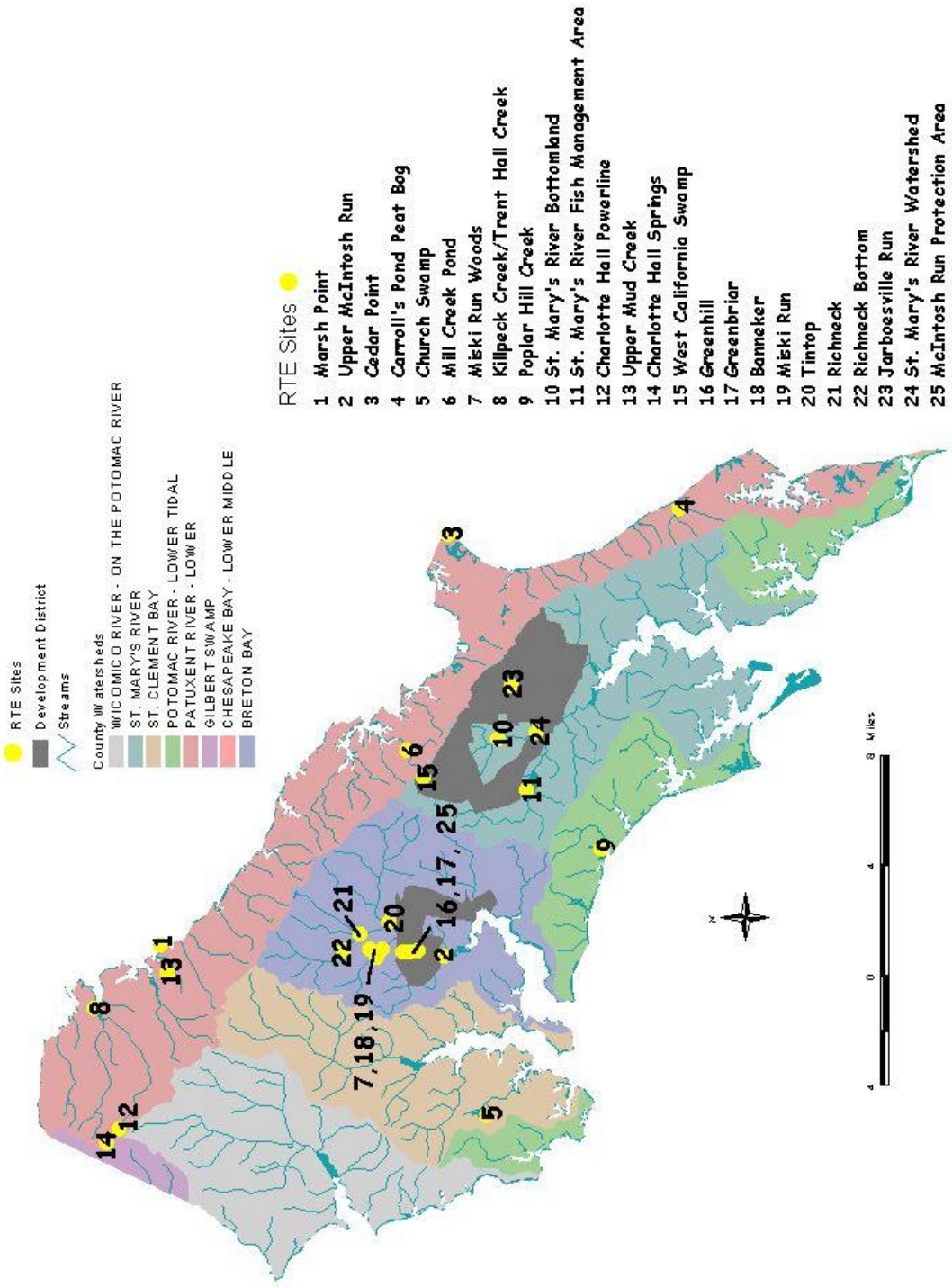

Figure 3. Sensitive Species Habitat in St. Mary's County, MD (Source: CWP, 2002)

The primary reason Breton Bay has been listed as an impaired water is that elevated bacteria counts have closed the upper portion of Breton Bay to shellfish harvesting, while a large portion of central Breton Bay has only conditional approval that restricts shellfish harvesting after larger rainfall events. No other human health issues have been identified in the watershed.

The Watershed Restoration Action Strategy (WRAS) program was created to develop and implement plans to restore and protect watersheds identified as priorities in the UWA. Federal grant monies provide for the development and implementation of WRASs.

The development of a WRAS for an individual watershed is a local government led process. Watershed management and planning is primarily the function of county/town governments with assistance or input from other partners, such as Soil Conservation Districts, the public, local watershed associations, the Department of Natural Resources (DNR) and other State agencies. The WRAS Partnership Program recognizes that most decisions regarding land use, zoning, open space, etc., are the responsibility of local governments and that local governments possess the specific local knowledge needed to develop and implement watershed management plans.

A completed WRAS is a set of goals and a means of achieving them based on an assessment of natural resource conditions and monitoring data, land use and planning information, stakeholder input, public participation, and local government capability. The strategy identifies the most important causes of water pollution and resource degradation, and details actions and responsible parties for addressing these problems. It also provides milestones for measuring progress.

The process of developing the Breton Bay WRAS began with the formation of a WRAS Technical Committee made up of stakeholders from the local community, St. Mary's County, Leonardtown, Maryland DNR, U.S. Fish and Wildlife Service (USFW), Natural Resource Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), and Potomac River Association. This committee met monthly to review data and findings and to guide the strategy development process. Public input was sought during three public meetings held between November, 2002 and March of 2003. The input at these meetings was critical in determining the WRAS goals, outstanding issues and the level of support in the community.

Section 3.0 Watershed Assessment

WRASs utilize the services of the Maryland DNR and information from various other State agencies to provide technical assistance and funding, with the participation of other partners such as the Soil Conservation District, watershed associations, citizen groups, land owners, and consultants. These partners provide technical assistance, community support, volunteers, and stewardship opportunities. The Maryland DNR prepared three research reports to aid in the development of the Breton Bay WRAS; 1) a watershed characterization, 2) a synoptic survey of nutrients, aquatic insects, and fish, and 3) an assessment of stream corridor conditions. Each of these is discussed in the following sections.

Section 3.1 Watershed Characterization

The Breton Bay Watershed Characterization (Shanks, 2002) compiled available water quality and natural resources information to create an overall picture of the watershed. Only a brief summary is presented here, the full document can be viewed or downloaded at: http://www.dnr.state.md.us/watersheds/surf/proj/brbay_char.html

Breton Bay is a 38,500 acre watershed lying on Maryland's Coastal Plain between the Potomac and Patuxent Rivers in St. Mary's County, Maryland. Breton Bay itself is an approximately 3,000 acre tidal body of water. The largest tributary stream to Breton Bay is McIntosh Run, encompassing approximately 22,000 acres of the overall Breton Bay watershed. In its entirety the Breton Bay Watershed is approximately 60% forested, with more than 40% of the watershed supporting high quality forest interior habitat. The largest block of forest in the watershed lies in the McIntosh Run subwatershed. The McIntosh Run subwatershed is nearly 80% forested. Of the non-forested land in the Breton Bay watershed about 14% (5,390 acres) is developed with about 25% (9,625 acres) in agricultural production (Table 1). Figure 4 depicts the land use in the Breton Bay watershed. While the majority of the watershed is undeveloped and forested, less than 1% of the watershed is currently protected from development activities.

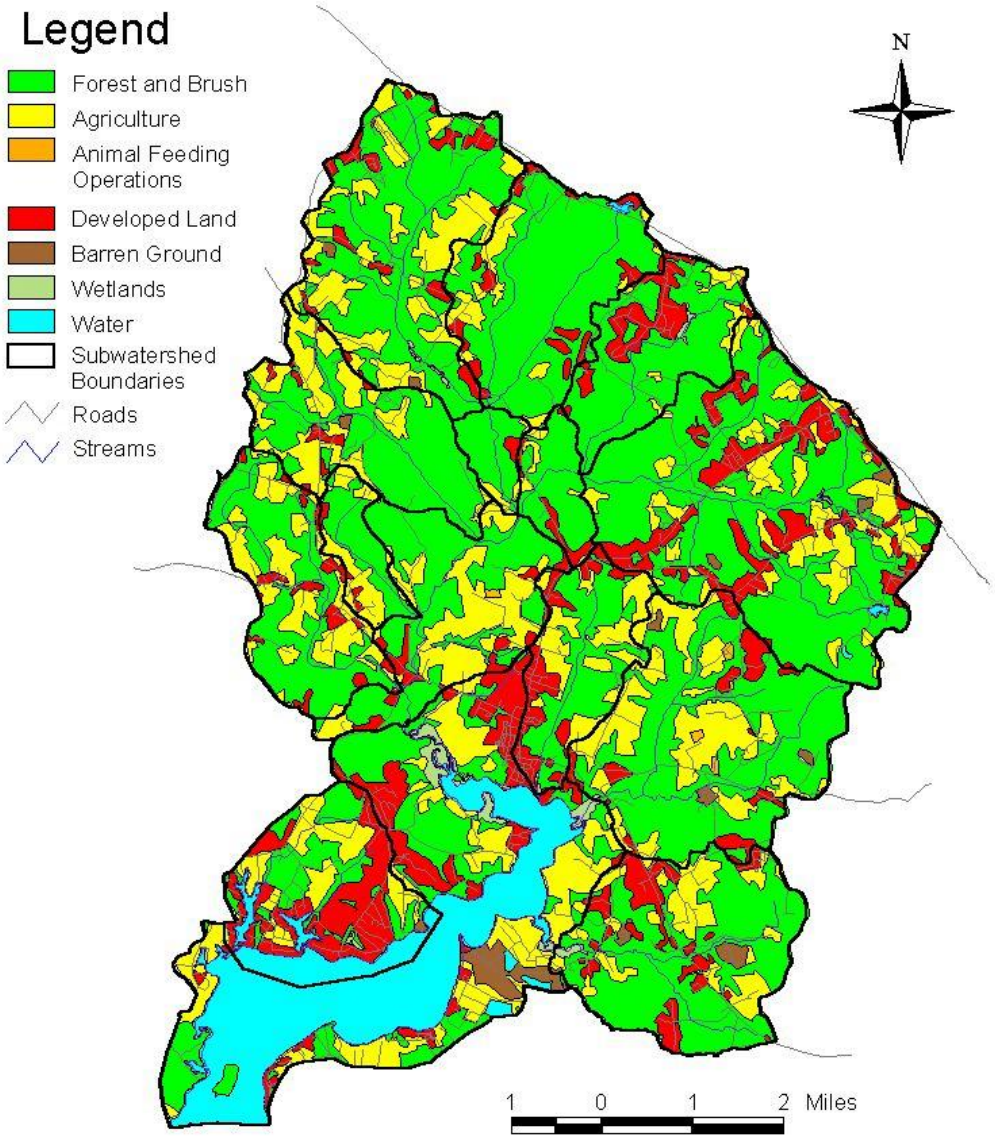

Figure 4. Land Use in the Breton Bay Watershed (Source: Shanks, 2002)Table 1. Land Uses in Breton Bay Subwatersheds

Subwatershed	Total Acres	% Impervious	% Developed	Acres Developed	% Agricultural	Acres Agricultural	% Forest	Acres Forest
Breton Bay DD*	4141	5.5%	19.7%	815	34.1%	1412	34.2%	1415
Brooks Run	5558	3.4%	17.1%	952	17.7%	985	64.0%	3555
Burnt Mill Creek	3439	1.7%	8.0%	275	28.8%	990	62.0%	2131
Cherry Cove/Combs Creek	1804	10.5%	41.5%	749	25.7%	463	31.2%	563
Glebe Run	3768	1.9%	7.3%	276	27.8%	1049	62.7%	2361
Greenhill Run	596	2.7%	4.0%	24	38.1%	227	57.8%	345
Lower Burnt Mill Creek	380	0.2%	6.6%	25	12.0%	46	81.4%	309
McIntosh Run DD* A	2257	3.0%	7.8%	176	34.3%	773	57.4%	1295
McIntosh Run DD* B	610	2.0%	11.8%	72	8.9%	54	79.3%	484
Miski Run	2079	0.9%	3.1%	65	32.4%	674	63.0%	1311
Moll Dyers Run	2906	3.7%	13.6%	394	18.9%	550	63.8%	1854
Nelson Run	2030	3.2%	8.4%	170	33.0%	669	56.8%	1154
Tom Swamp/Rich Neck Creek	2565	1.4%	8.5%	217	11.1%	284	79.9%	2050
Town Run	1507	7.7%	22.0%	332	29.4%	443	48.2%	726
Upper McIntosh Run	1676	3.0%	19.2%	321	6.8%	115	73.1%	1225
Totals	**35316****	**3.5%**	**13.8%**	**4862**	**24.7%**	**8735**	**58.8%**	**20778**

* Direct Drainage – Areas that drain directly to the mainstem of Macintosh Run

**Breton Bay itself occupies approximately 3000 acres not included in Table 1

The State-designated use of Breton Bay is Shellfish Harvesting Waters (Use II). Upper Breton Bay, near Leonardtown is “restricted”, in that no harvesting of shellfish is permitted. The central portion of Breton Bay is conditionally restricted in that shellfish harvesting is prohibited for three days after heavy rains (one inch or greater in 24 hours). These restrictions are due to elevated fecal coliform bacteria levels in Upper Breton Bay. The sources of these bacteria are generally broken down into two categories, human and non-human. Human sources can include leaking sewer pipes, illicit sewer connections to stormdrains, failing septic systems, and improper disposal of waste (i.e., recreational vehicles, boats, and septic pump-out). Non-human sources generally include domestic pets, livestock, and wildlife. Unless there is an inappropriate sewage discharge present in a watershed, most of the bacteria present in stormwater are generally assumed to be of non-human origin.

Even small levels of development (agricultural, residential, or commercial) can greatly increase bacteria levels in receiving waters (Schueler, 1999). And it is unlikely that a single source is the cause of elevated levels in Breton Bay. Pet waste, livestock, geese, wildlife, stormwater, and road runoff, all contribute to the bacteria levels.

An additional factor that likely contributes to elevated bacteria levels in upper Breton Bay is the potential for poor tidal flushing and circulation. The length and shape of the upper Bay may be a contributing factor. In calm waters, bacteria can settle out of the water column onto the bottom sediments, where they may remain viable for extended periods of time. These bacteria can then become re-suspended during storm events. The upper bay is also where the largest tributary stream enters the bay, making transported sediments, bacteria and nutrients from the watershed first available. With poor circulation/flushing, these elements may remain in the upper Bay, promoting algae growth and higher turbidity and bacteria levels.

Aside form bacteria levels, other pollutants were found at relatively low levels in Breton Bay. In the Breton Bay watershed, there is only one permitted wastewater discharge to surface waters, the Leonardtown wastewater treatment plant (WWTP). There are two groundwater discharges (St Clements and Forrest Farm WWTPs). The Leonardtown WWTP, the largest point source in the watershed, is currently being upgraded with biological nutrient removal (BNR) capability to reduce nutrient loading to the bay. The remaining sources of pollutants in the Breton Bay watershed are non-point source runoff related.

In terms of living resources, the Unified Watershed Assessment ranked the Breton Bay watershed in the top quartile (25%) statewide for the non-tidal benthic macroinvertebrate Index of Biotic Integrity (IBI), the non-tidal fish IBI, the length of small headwater streams located within high quality interior forest, and the amount of habitat for forest interior dwelling species (FIDS). An index of submerged aquatic vegetation (SAV) habitat and abundance ranked tidal Breton Bay in the lower 50% of watersheds statewide.

The benthic macroinvertebrate and fish IBIs compare samples collected within the Breton Bay watershed to reference conditions established for minimally impacted streams. Small headwater streams are important habitat areas for both aquatic and terrestrial species and are highly sensitive to impacts from agriculture, forestry and land development practices. High quality habitat for interior forest dwelling species is defined as mature forest tracts of at least 100 acres in size unbroken by roads, power line rights-of-way, or other open areas. Overall, the UWA found that less than 10% of streams in the watershed lacked wooded buffers.

A survey of two Breton Bay oysters bars in 2001 showed mortality rates of 74% and 76%. Based on this and past surveys, it appears that while improvements were observed in the 1990's, oysters in Breton Bay are few in number and, like many areas within Chesepeake Bay, are significantly impacted by disease (Shanks, 2002).

The watershed also supports seven rare, threatened, or endangered (RTE) species. All seven are known to occur in the McIntosh Run subwatershed (Table 2).

Table 2. Rare, Threatened, or Endangered Species Identified In the Breton Bay Watershed

Common Name	Scientific Name	Status
Dwarf Wedge mussel	*Alasmidonta heterodon*	Federal endangered
Purple cress	*Cardamine douglassii*	State watch list
Cat-tail sedge	*Carex typhina*	Highly state rare
Red turtlehead	*Chelone obliqua*	State threatened
Deciduous holly	*Ilex decidua*	State threatened
Large-seeded forget-me-not	*Myosotis macrosperma*	State threatened
Climbing dogbane	*Trachelospermum difforme*	State endangered

Section 3.2 Synoptic Survey

In April of 2002, the Maryland DNR Chesapeake and Coastal Watershed Services Division conducted a synoptic survey of nutrients and macroinvertebrates (aquatic insects) within the Breton Bay watershed (Primrose, 2002). This survey divided the watershed into 39 catchments. Water quality samples were collected for nutrient analysis within 34 of the catchments. Five of the catchments were not sampled due to either a lack of access or low/no baseflow. In addition,

stream discharge, water temperature, dissolved oxygen, pH, and conductivity were measured at the time samples were collected. Benthic macroinvertebrate samples were collected at 12 of the 34 sample sites. Fish were sampled at one site.

Water quality samples were analyzed for nitrogen (nitrate/nitrite) and phosphorus (orthophosphate) concentrations. In forested watersheds, nitrogen generally enters the streams through shallow groundwater, while phosphorus is generally washed into streams attached to sediment particles. The nutrient sampling was conducted in early spring to coincide with expected maximum baseflow and groundwater levels and thus the maximum expected background nutrient concentrations. In addition to a specific nutrient concentration for each sample, per hectare loads were calculated based on stream discharge at the time of sampling and the drainage area upstream of each sample point.

The nutrient sampling is meant to represent a "snapshot" of nutrient concentrations/loads in the watershed and is intended to identify areas with higher relative nutrient contributions. To fully assess water quality conditions in the watershed, multiple sampling events under differing stream flow conditions would be required.

The sampling results indicated that nutrient concentrations and loads are very low in the Breton Bay watershed. The Chesapeake Bay Program uses a 1mg/L nitrate/nitrite (NO_2/NO_3) threshold to indicate a potential elevated pollutant concentration (Primrose, 2002). Only two of the 34 nitrate/nitrite samples exceeded this 1mg/L threshold, one in upper Moll Dyers Run and one in Upper Brooks Run. Samples collected downstream of these catchments did not exceed the 1mg/L threshold, indicating a downstrem influx of low Nitrate/Nitrite concentration groundwater. Per hectare loads of Nitrate/Nitrite did not exceed the threshold of .01 kilograms per hectare per day (Kg/Ha/day). This value is based on the expected nutrient export from forested watersheds (Frink, 1991)

Orthophosphate (PO_4) concentrations were slightly elevated within several catchments (11 of 34). None of these elevated concentrations resulted in per hectare orthophosphate loads greater than a threshold of 0.0005 Kg/Ha/day (Frink, 1991). The elevated orthophosphate concentrations were generally found in areas where significant agricultural or construction activities were occurring, or downstream of these areas. Moderate rains several days prior to sampling produced sediment from these areas that persisted in the water column leading to the elevated orthophosphate levels (Primrose, 2002). Table 3 compares the nutrient sampling results from the Breton Bay watershed to other WRAS watersheds in the State.

Table 3. Average and Annual Nutrient Concentrations from Other Nutrient Synoptic Surveys

	Watersheds							
	Piney Run	**German Branch**	**Pocomoke River**	**Bush River**	**Breton Bay**	**Patuxent River**	**Choptank River**	**Liberty Res.**
Spring NO_2/NO_3	3.742	3.832	3.734	1.944	**0.223**	0.439	2.892	3.410
Spring PO_4	0.800	0.043	0.028	0.006	**0.004**	0.012	0.023	0.004

Macroinvertebrates were collected within 12 of the 34 catchments. All 12 were rated as "Fair" or "Good". The range of possible ratings includes "Very Poor", "Poor", "Fair", or "Good". The four "Good" sites were located within McIntosh Run watershed (McIntosh Run DD A, Lower Burnt Mill Creek, and Tom Swamp/Rich Neck Creek subwatersheds). Figure 5 depicts the synoptic survey sample station locations and the IBI results.

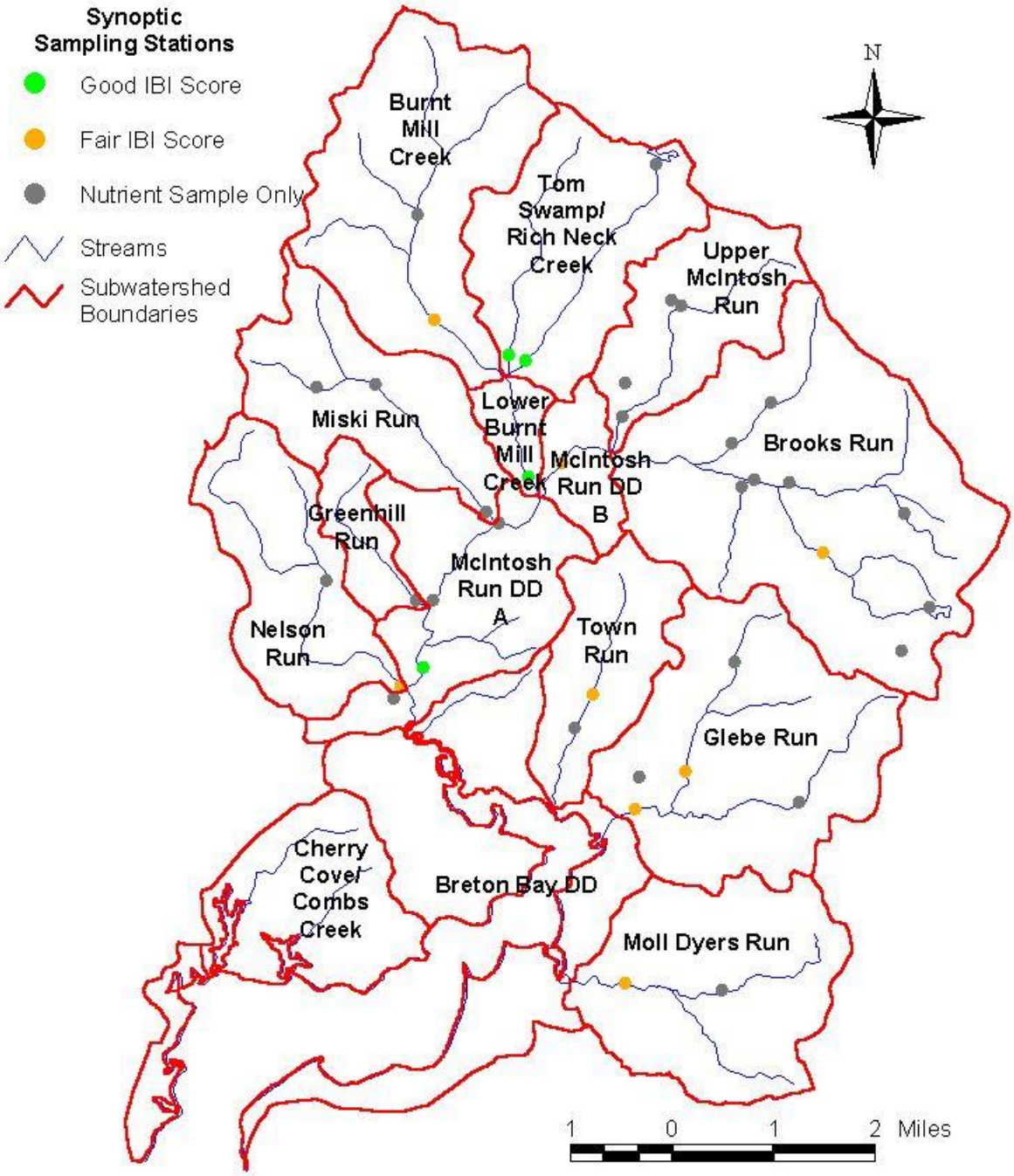

Figure 5. Synoptic Survey Sampling Locations and IBI Results

In addition to macroinvertebrate samples, qualitative habitat assessments were completed at each sample site. Eleven of the 12 sample stations were assessed as "supporting", with the 12th station assessed as "comparable to reference". The range of possible ratings includes non-supporting, supporting, or comparable (to reference). These ratings reflect the ability of the stream to support a healthy aquatic community.

The overall results of the synoptic survey indicate "Good" conditions within the Breton Bay watershed. Nutrient concentrations and yields are low compared to other watersheds in the State, the biological community was found to be in fair to good condition, and physical habitat within the streams was supporting of healthy aquatic communities. What impacts were observed appear related to non-point source stormwater runoff. The complete synoptic survey report can be downloaded at: http://dnrweb.dnr.state.md.us/download/bays/brbay_char_appd.pdf

Section 3.3 Stream Corridor Assessment

In 2002, a Stream Corridor Assessment (SCA) of the Breton Bay watershed was conducted. The SCA was developed by the Maryland DNR Watershed Restoration Division as a tool for identifying obvious impairments within and adjacent to stream channels. The information collected can be used to prioritize and target future restoration and management efforts.

There are approximately 196 miles of ephemeral, intermittent, and perennial stream channel in the watershed. Trained personnel from the Maryland DNR assessed 172 miles (88%) of these stream channels. Impairments were broken down into five categories; stream channel erosion, inadequate streamside buffers, channel alterations, fish migration barriers, pipe outfalls, trash dumping, unusual conditions, and instream/nearstream construction sites. Each observed impairment was rated on a scale of one to five as to how severe, correctable and accessible the impairment site was. In addition to identifying impairment sites, the field teams also collected information at intervals of one-half to one mile regarding overall stream habitat conditions (representative sites).

Overall, 375 problem sites were noted within the surveyed streams. The majority (86%) of these sites were rated as moderate severity, low severity, or minor problems. Only 52 sites were rated as severe or very severe.

Stream erosion was the most common problem identified. A total of 136 stream erosion sites were noted. Twenty severe and five very severe stream erosion sites were identified (Figure 6). Inadequate buffers were noted as the second most common problem. An inadequate buffer is one that is nonforested and/or less than 50 feet wide on each side of the stream. Sixteen inadequate buffer sites, comprising four miles of stream, were rated as severe or very severe (Figure 7). Cropland or pastureland adjacent to the stream was noted as the most common reason to rate a buffer as inadequate. Channel alteration was noted at 42 sites, with three sites rated as severe for a total of 2,400 feet. No very severe occurrences were noted. The three severe sites consisted of rip-rap channels. Thirty-four fish barriers were identified with none rated as severe or very severe. The majority of these fish barriers were the result of road crossings. Table 4 presents a summary of the problem sites identified.

Table 4. Problem Sites identified During the Stream Corridor Assessment						
Problem Identified	**Severity**					
	Very severe	**Severe**	**Moderate**	**Low Severity**	**Minor**	**Total Number**
Channel Erosion	5	20	65	32	14	**136**
Inadequate Buffer	12	4	33	18	30	**97**
Channel Alterations	0	3	11	7	21	**42**
Fish Barriers	0	0	12	11	11	**34**
Pipe Outfalls	0	1	8	0	15	**24**
Trash Dumping	1	2	12	5	4	**24**
Unusual Conditions	0	1	8	4	1	**14**
In/Near stream construction	1	2	1	0	0	**4**
Total	**19**	**33**	**150**	**77**	**96**	**375**

The 116 “representative sites” sampled generally indicate that Breton Bay streams are in good condition. Ten channel condition parameters were assessed as either optimal, suboptimal, marginal, or poor. The parameters include substrate, embeddedness, shelter for fish, channel alteration, sediment deposition, velocity/depth, flow, instream vegetation, bank condition, riparian vegetation. Each parameter is assessed individually with no overall total score generated. The majority of parameters were rated as optimal and suboptimal indicating good overall stream conditions in the watershed. Figure 8 shows the results for the parameter *Streambank Condition*. The complete Stream Corridor Assessment report for the Breton Bay watershed can be downloaded at: http://www.dnr.state.md.us/watersheds/surf/proj/brbay_sca.html .

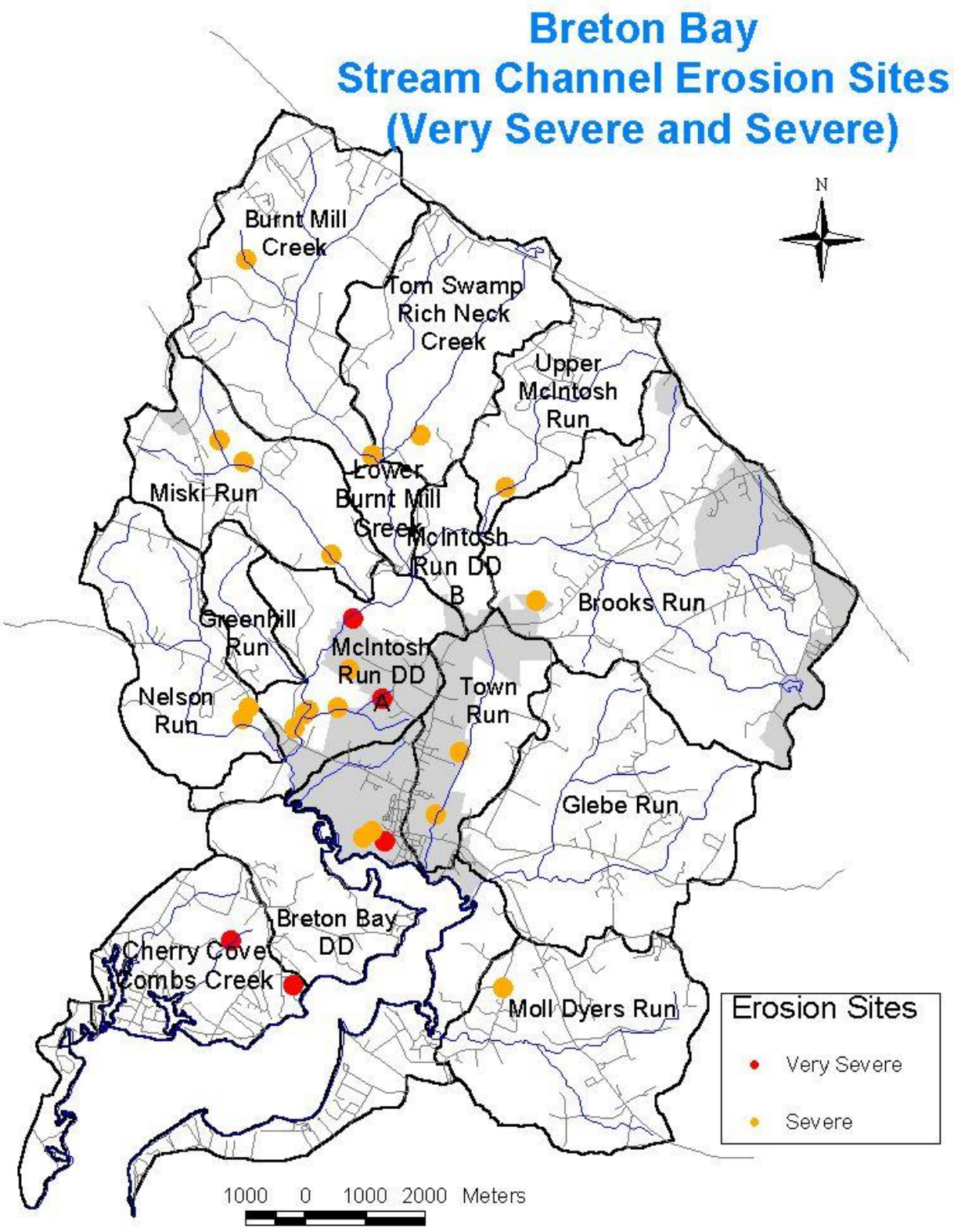

Figure 6. Severe and Very Severe Stream Erosion Sites

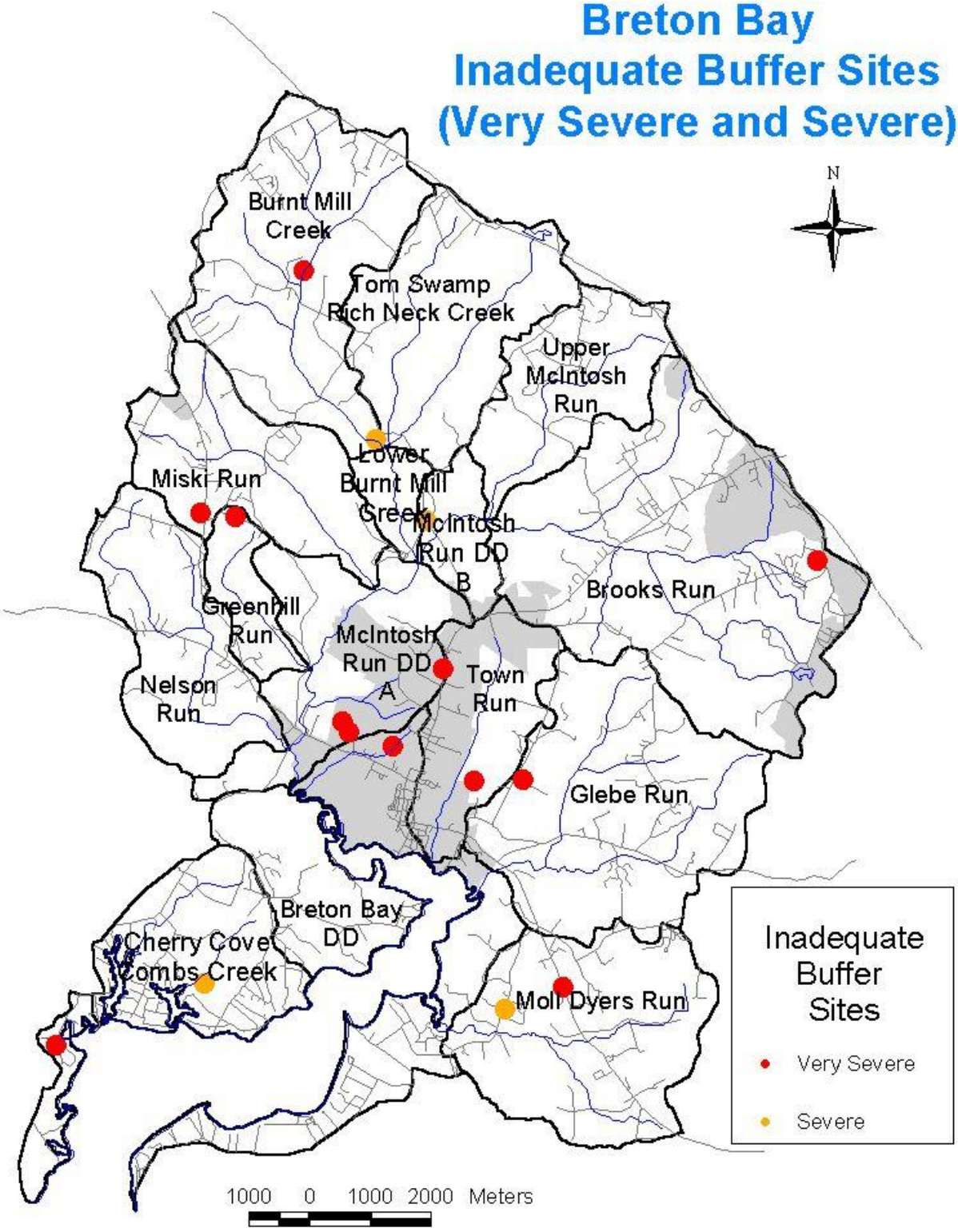

Figure 7. Severe and Very Severe Inadequate Buffer Sites

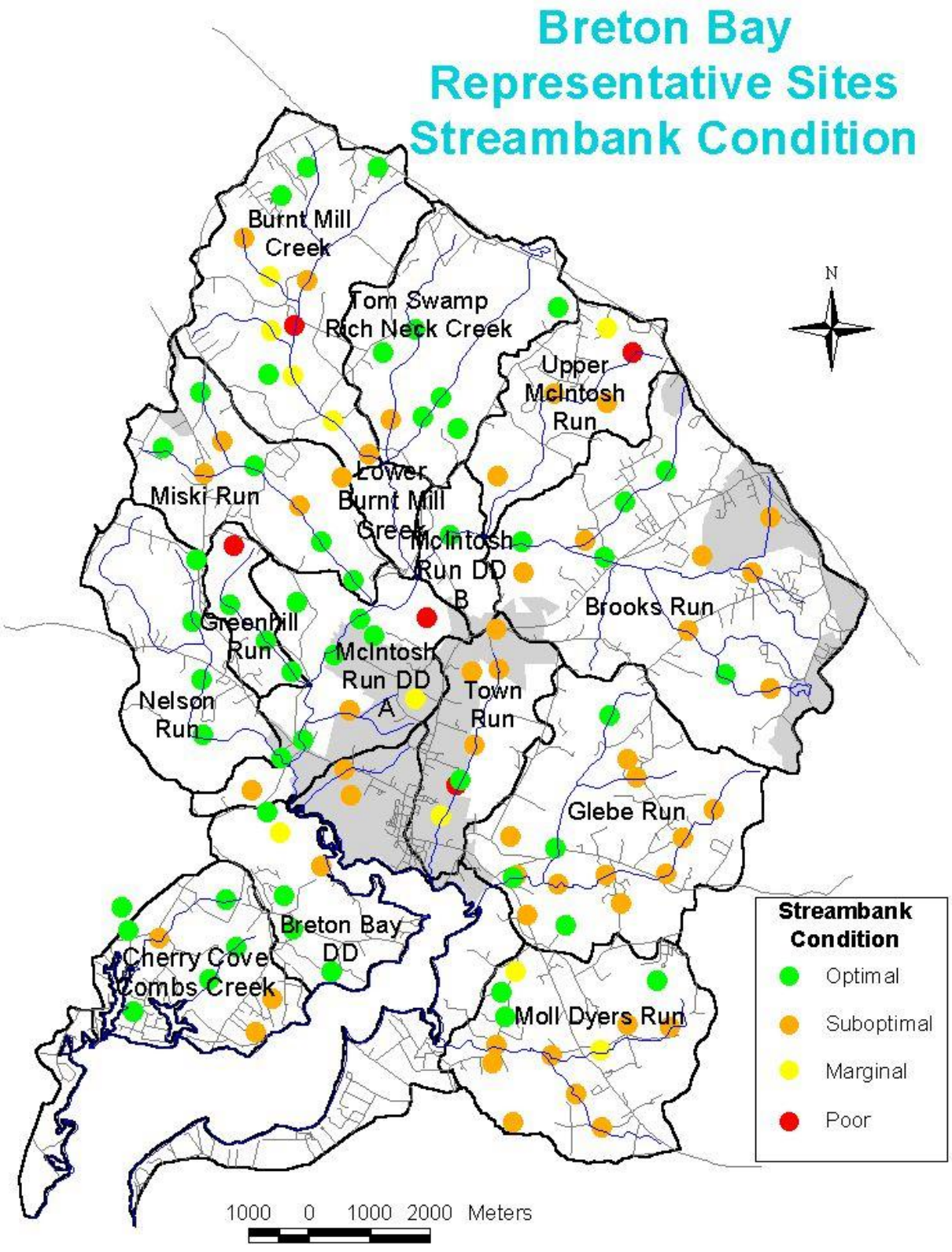

Figure 8. Representative Sites for Streambank Condition

Section 3.4 Summary of Findings

Based on the information presented in the Maryland DNR watershed characterization, the synoptic survey, and the stream corridor assessment, the Breton Bay watershed possess many high quality attributes including extensive forests, sensitive living resources, low pollutant loads, and a rural character. Few watersheds in the State possess these attributes in the quantity that Breton Bay does. Yet, there are occurrences of elevated bacteria levels, algal blooms, and low dissolved oxygen in Upper Breton Bay. Pollutant loads entering the bay from the watershed are relatively low, but a lack of tidal flushing/circulation, the relatively shallow waters, and the proximity of developed areas generating non-point source pollution along the upper bay are likely causing these occurrences. While little can be done to alter the tidal patterns of the Bay and the Leonardtown WWTP (point source) is currently being upgraded, individuals, businesses and local government can reduce the potential for non-point source pollution to enter the bay. The purpose of the WRAS is to develop a strategy that can be undertaken to reduce or eliminate potential pollutant sources. While the watershed was found to be in good condition, there is room for improvement.

Based on the above findings, The Center for Watershed Protection (CWP) conducted additional assessments to identify potential non-point sources and possible measures to mitigate these sources. The assessments consisted of a pollution prevention and awareness (PPA) survey of residential neighborhoods and commercial areas and a survey of two streams identified by stakeholders and the Maryland DNR Stream Corridor Assessment as being in need of restoration/stabilization.

The purpose of the PPA survey was to identify behaviors and activities that may result in avoidable non-point source pollution. The PPA survey involved visiting a number of commercial areas and residential neighborhoods in Leonardtown and around Breton Bay. The survey looked for activities, or evidence of activities, that had the potential to result in non-point source pollution, as well as evidence of stewardship activities and community involvement. The survey found that within residential neighborhoods there was little or no trash/debris along roadsides, vacant lands, or along the shoreline. It was apparent from the survey that residents are involved in the community and that people were taking an active stewardship role. Photos 1 through 3 depict some of the observations made during the survey of residential areas.

Photo 1. Breton Bay Civic Association meeting announcement

Photo 2. Stewardship within Residential Community

Photo 3. Storm Drain Stenciling in Leonardtown

The residential survey indicates that the community currently supports stewardship activities and is likely to do so in the future. Providing additional training, materials and support for these activities will benefit Breton Bay.

Within commercial areas, little evidence of poor maintenance practices was observed. A key indicator in commercial areas is dumpster/waste storage. Open dumpsters or dumpsters placed over or near storm drains can be a significant source of pollution. In the commercial areas visited, no dumpsters were found to be open or obviously leaking, nor was there any evidence of excess trash and debris around dumpsters. This indicates that commercial operators/business owners are making efforts to prevent pollution and may be willing to undertake further stewardship/good housekeeping efforts if materials and support are provided.

Public input and the Maryland DNR Stream Corridor Assessment identified two streams that may be in need of restoration/stabilization activities. The two streams identified were Town Run and an unnamed tributary to McIntosh Run in the McIntosh Run "A" subwatershed (Figure 9).

A significant sandbar has formed at the mouth of Town Run as it enters Breton Bay. Citizens have noted that this sandbar has been growing at an accelerated rate over the last few years. The unnamed tributary to McIntosh Run was identified as experiencing severe or very severe channel erosion in three locations. CWP confirmed that Town Run is experiencing accelerated channel erosion along its entire length and that the unnamed tributary has several large slope failures along the stream valley. Both of these streams are candidates for restoration/stabilization activities that could help reduce the input of sediment to Breton Bay. While there were other locations identified in the watershed as experiencing channel erosion, these streams are located in areas where future growth will likely result in an increase in stormwater runoff, and this runoff may exacerbate current channel erosion.

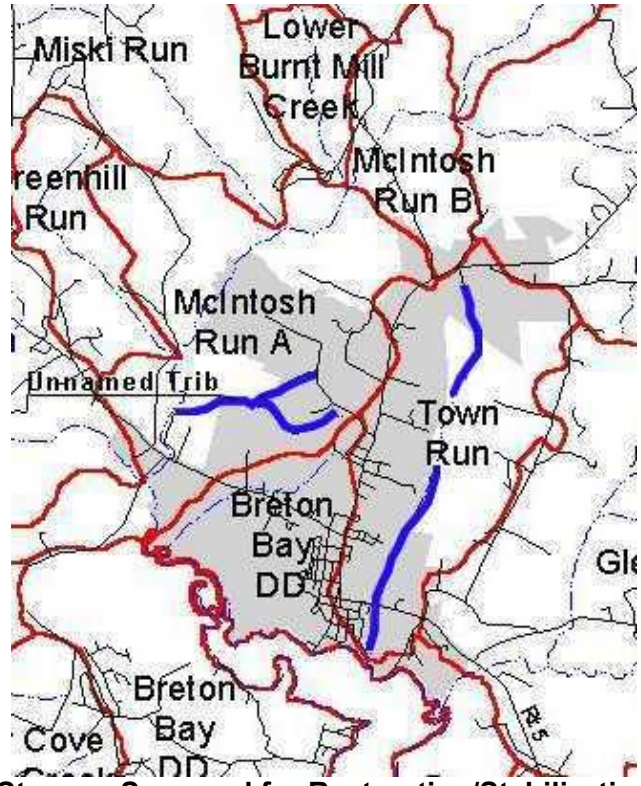

Figure 9. Streams Surveyed for Restoration/Stabilization Activities

Photo 4. Channel Erosion along Town Run

Photo 5. Slope failure along Unnamed Tributary

Section 4.0 Watershed Restoration Action Strategy (WRAS) Elements

The WRAS is intended to be a guide to implementing initiatives and programs to restore and protect the Breton Bay watershed. Based on the information generated by the studies referenced above and input from the public, five strategy elements were developed. These elements represent broad goals under which specific programs can be focused. While some of these elements require County and/or Town funding, many can be funded through existing State and Federal grant programs, private donations, and foundation support. Specific funding options will need to be explored as elements are selected for implementation. The WRAS elements are:

1 **Reduce current sediment and nutrient inputs to Breton Bay by addressing point and non-point pollution sources** through infrastructure upgrades, riparian buffer and stream enhancements, stormwater management retrofits and municipal pollution prevention.

2 **Encourage sound agricultural and forestry practices that maintain income and the rural landscape while protecting sensitive natural resources and unique plant and wildlife habitats** by promoting land conservation, protection, and stewardship programs.

3 **Increase the understanding and awareness of watershed issues and promote active stewardship among commercial and residential stakeholders** by developing education/outreach programs targeting watershed awareness, pollution prevention, and resource conservation.

4 **Enhance programs and development review to minimize Impacts from future growth** through investment in continuing education and training for planning and review staff and the local development community. Promote development techniques that protect sensitive natural resource areas while achieving desired growth.

5 **Enhance the community's aesthetic and recreational interactions with Breton Bay** by integrating Town, County, civic, and homeowner association projects and activities with the Bay and by promoting canoeing, fishing and other recreational uses.

These elements represent broad watershed goals to guide the development and implementation of specific watershed protection, restoration, and stewardship activities.

Section 4.1 WRAS Element #1

Reduce current sediment and nutrient inputs to Breton Bay by addressing point and non-point pollution sources *through infrastructure upgrades, riparian buffer and stream enhancements, stormwater management retrofits and pollution prevention.*

This strategy element focuses on management actions that County and local agencies can undertake to reduce point and non-point source inputs to Breton Bay. Six specific areas of focus have been identified and are described below.

1.1 Leonardtown Wastewater Treatment Plant Biological Nutrient Removal (BNR) Upgrade - The Leonardtown Waste Water treatment Plant (WWTP) has been upgraded with (BNR) capability. Previously, there was no specific requirement for nitrogen removal at the 680,000 gallon per day facility. This upgrade will reduce the annual average nutrient

concentrations to 8 mg/L for nitrogen and 1 mg/L for phosphorus. This equals an approximate 60% reduction in the amount of phosphorus leaving the plant and a 30% reduction in the nitrogen load, based on year 2000-2001 data. (Klein, 2001). The upgrade project had a cost of approximately 3.8 million dollars and was completed in the spring of 2003.

At the first public meeting in November, 2002, many citizens expressed beliefs that the Leonardtown WWTP was a significant problem and had a major negative impact on Breton Bay. Flooding of the plant and subsequent release of untreated sewage was noted as an issue. The public perception was that the Leonardtown WWTP is a problem. Yet, the upgrade to the wastewater treatment plant represents the most significant achievable point source reduction for nutrients.

The plant should undertake a public outreach/education effort to make people aware of the role of the plant, how it works, and that it is an important aspect in protecting Breton Bay. As long as people solely blame the WWTP for nutrient issues in Breton Bay, they may fail to recognize their own and other peoples roles in nutrients entering Breton Bay.

Items such as signs telling of the BNR upgrade, what BNR is and how it works, a sign/map that identifies the parts of the plant at the entrance or along the fence (i.e., viewing location), tours of the plant for school and civic groups (kids). The goal is to make people aware of the benefit and the protection afforded the bay by the WWTP and how they can help the plant function better through activities at home (i.e., what not to flush down a toilet, water conservation, etc.).

At the same time, the plant operators should pursue/achieve an award or certification level at the plant. Operational goals for the plant should be established that the public can understand and support.

1.2 Leonardtown Stormwater Management Retrofits - A planned stormwater management retrofit of the County's government center is currently being undertaken to reduce non-point source pollution to Town Creek. This represents a model/demonstration area for others to follow. While there are not many retrofit opportunities due to the small size and nature of development in Leonardtown, small scale retrofits and upgrades to existing facilities can and should be pursued as opportunities present themselves in the future.

1.3 Stream Restoration/Stabilization (Town Run, Unnamed Tributary in McIntosh Run DD "A" Subwatershed) - The DNR stream corridor survey identified stream impairments across the Breton Bay watershed. The majority of these problems are of moderate or low severity and scattered across many subwatersheds. Yet two streams, Town Run and an unnamed tributary in McIntosh Run DD "A", had several severe and very severe problems. These two streams are likely to receive more stormwater runoff in the future, as Leonardtown and the area surrounding it grow, and are in need of restoration/stabilization to prevent significant releases of sediment to Breton Bay.

> **Town Run -** A large sediment deposit (sand bar) in Breton Bay at the mouth of Town Run has been an area of concern for many years. The most likely source of this sediment is elevated rates of stream channel erosion along Town Run. Town Run is not a highly developed urban watershed where one would expect high levels of channel erosion and sediment export. The channel erosion is most likely the result of long-term adjustments in the channel grade (vertical adjustment) and planform (horizontal adjustment) due to past agricultural land uses and the development of Leonardtown. Stream channels adjust to changes in land use and runoff by adjusting their physical

dimensions to maintain a balance between stream flow and sediment transport. Over time, through the stream's natural recovery process, the rate of channel adjustment and sediment transport will decrease, but in the meantime large volumes of sediment can potentially be released. The goal in Town Run should be to aid the channel along its adjustment process. This is not a simple task and a specific plan for this is outside the scope of this report. A detailed study and analysis of the stream planform and grade is necessary to determine specific restoration/stabilization strategies.

Unnamed Tributary in McIntosh Run DD "A" Subwatershed - Several severe and very severe erosion problems were identified along an unnamed tributary to McIntosh Run in McIntosh Run DD "A" subwatershed. This situation is somewhat different from that found in Town Run, in that rather than grade adjustment, lateral adjustment is the primary adjustment mechanism. Increases in stream flow from both agricultural and urban land uses have caused the stream to expand the width of the migration corridor (i.e., the stream valley bottom were the stream naturally meanders back and forth). In doing this, the stream has come in contact with the valley side slopes, which in some areas are very steep. Where the stream has contacted these steep slopes, erosion has undermined the slopes and led to slope failure, sometimes with dramatic results. These events can release large volumes of sediment downstream to McIntosh Run. Along this tributary, it is recommended that the toe (lowermost portion) of these large slope failures be stabilized to stop further slope erosion, but leave the majority of the stream free to migrate within the stream valley bottom (Figure 10).

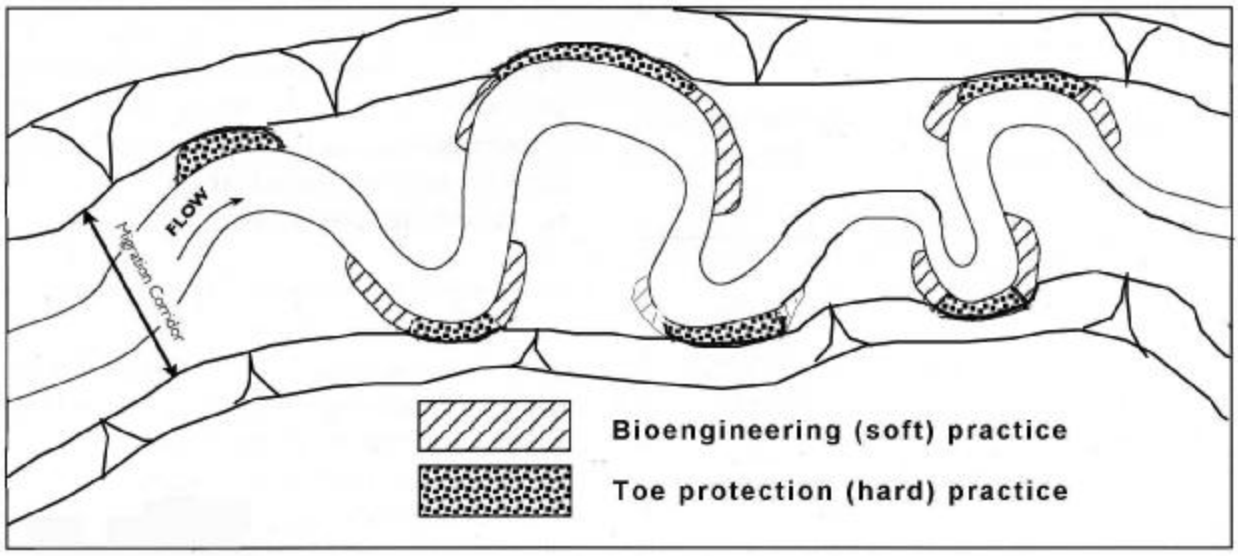

Figure 10. Stream valley Side Slope Stabilization with Hard and Soft Practices

1.4 Municipal pollution prevention/education - The County and Leonardtown should set the example for pollution prevention/education at their own facilities first. An audit of pollution prevention practices at County/Town facilities in the watershed should be undertaken. The audit should look at pollution prevention programs and practices that local government now undertakes or could undertake. These programs and practices include things such as runoff management from public facilities, grounds maintenance, material handling and storage, vehicle maintenance, road maintenance, etc. If people know their local government is doing something to prevent pollution, they are more likely to consider their own actions

1.5 Commercial Outreach/Education Program - Establish a commercial outreach/education program to promote "bay friendly" business practices. Businesses can achieve a "Breton Bay friendly" status by implementing a basic good housekeeping/pollution prevention program. There are several existing programs around the country upon which to model a program. An award or placard could be given to businesses or industries that demonstrate investment in pollution prevention practices that protect the quality of Breton Bay.

Section 4.2 WRAS Element #2

Encourage sound agricultural, forestry, and development practices that maintain income and the rural landscape while protecting sensitive natural resources and unique plant and wildlife habitats in the Breton Bay Watershed *by promoting land conservation, protection, and stewardship programs.*

2.1 Agricultural Best Management Practices - Agriculture accounts for 25% of the land use in the Breton Bay watershed. At this time, about 50% of agricultural operations have management plans in place. Yet there are some cultural and social issues preventing more farms from taking advantage of existing programs and incentives. Many farmers are reluctant to accept direct government subsidies/support. The Chesapeake Bay Foundation has been working with farmers to install/create stream buffers and to fence cattle out of streams and wetlands. This program has been successful in Pennsylvania and Northern Maryland (Antietam Creek) and allows farmers to install these practices without receiving direct government support and at little or no cost to the farmer. Establishing such a program in Breton Bay will enable many more farmers to implement such conservation practices. Figure 11 highlights agricultural lands identified during the DNR Stream Corridor Assessment as having inadequate stream buffers.

2.2 McIntosh Run Land Conservation Partnership (MRLCP) - This new land conservation partnership has a goal of protecting land within the McIntosh Run watershed through conservation easements, land purchases, and stewardship activities. The most pressing need of this new program is to get the word out to local landowners about incentives and opportunities to protect their land. A concerted effort is needed to make landowners aware of the opportunities to protect their land while maintaining ownership and current uses. The County and Town will take a lead role in this effort by completing a direct mailing and follow-up to all landowners with greater than fifty acres in the McIntosh Run watershed informing them not only of the MRLCP, but of other conservation organizations, such as the Patuxtent Tidewater Trust, that are working to preserve land in the Breton Bay watershed. In addition, County Planning and Zoning reviewers will have information on hand for landowners/developers regarding the role MRCP and other organizations could have in establishing/maintaining potential conservation areas on new developments (i.e., forest conservation areas, floodplains, open space)

2.3 Natural Resource Management Guidance for Rural Homeowners - The majority of the Breton Bay watershed is zoned as *Rural Preservation District* (RPD). There are many opportunities to preserve natural features and protect natural resources on the larger building lots that predominate in this zone, but most developers and homeowners are not aware of what they can and should do on individual lots to protect the quality of the natural resources within the watershed. Practices to manage stormwater runoff, protect stream, forest, and shoreline habitats, prevent the establishment of invasive plant species, provide soil stabilization and sediment control, and plant bay-friendly landscaping, are important topics for rural homeowners and developers to understand and implement.

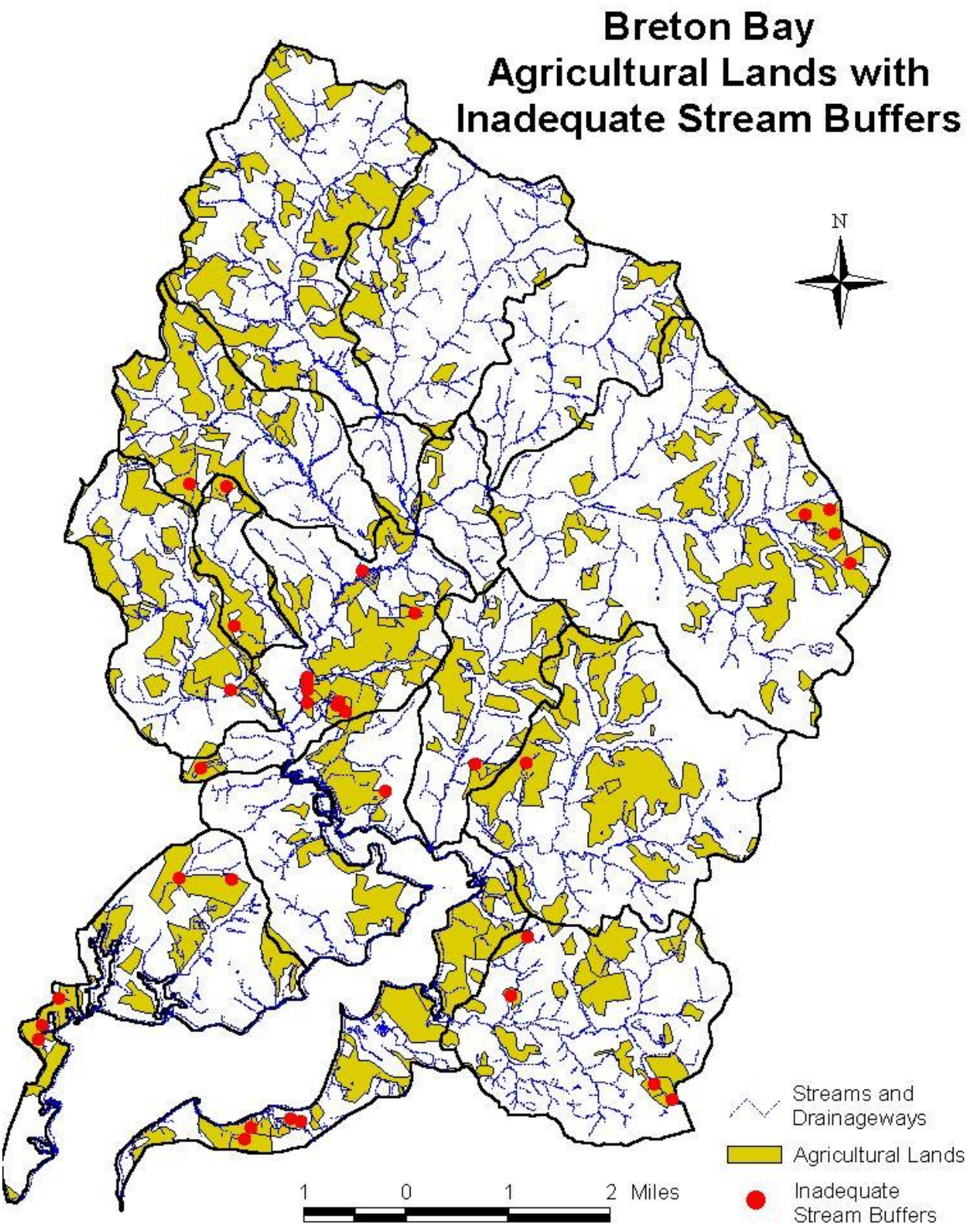

Figure 11. Agricultural Lands with Inadequate Buffers

Developing a pamphlet/brochure for rural homeowners on resource management/conservation issues, programs that are available to assist them, and how they can manage their properties will aid in protecting the watershed and Breton Bay. This pamphlet/brochure will be given to each homeowner/builder at the time of initial building permit application and made available to real estate agents for distribution to potential homebuyers.

Section 4.3 WRAS Element #3

Increase the understanding and awareness of watershed issues and promote active stewardship among residential stakeholders *by developing education/outreach programs targeting watershed awareness, pollution prevention, and resource conservation.*

3.1 "Entering the Breton Bay Watershed" signs - In many instances a person can drive through the watershed and never see Breton Bay. Increasing awareness of Breton Bay is an important aspect of stewardship. To increase awareness and stewardship, the County in cooperation with the State Highway Administration should erect "Entering the Breton Bay Watershed" signs on major roads entering the watershed. A community contest, perhaps school or civic organization based, could be used to choose a style/emblem for the signs. Business and/or civic groups should be actively encouraged to sponsor future maintenance and additional signs.

3.2 Storm drain stenciling - St. Mary's County and Leonardtown should encourage school clubs, business/civic groups, and homeowner associations to stencil "Don't Dump – Breton Bay Drainage" (or similar language) on storm drain inlets around the bay. This has been a very popular and effective awareness tool for the Chesapeake Bay watershed. Several storm drains in Leonardtown have been stenciled in the past with "Chesapeake Bay drainage", but these are now faded. This would be an excellent public/community service project.

3.3 Residential pollution prevention/education campaign - Residential behavior can have a significant impact on non-point source pollution entering Breton Bay. Initial efforts should focus on two things; 1) creating a public education/outreach program and 2) pollution prevention demonstration projects sponsored by civic and homeowner associations, specifically in the Cherry Cove/Combs Creek subwatershed. Specific education program topics should include septic system care and maintenance, lawn care, pet waste management, car maintenance, boat care and maintenance, and homeowner/backyard best management practices (rain gardens/rain barrels). This program should utilize existing outreach mechanisms such as community association newsletters, local newspapers, and civic events to make homeowners aware of the program and demonstration projects. For example, the *St. Mary's County Master Gardener's* have expressed interest in conducting a demonstration "rain barrel" and "rain garden" project at the County Fairgrounds. This project could act as a model for homeowners and businesses who may be interested, but reluctant, to undertake such a project on their own. The first step in establishing a program is to determine current public attitudes in order to establish a baseline and determine the interest/needs of the community. This would involve conducting a survey of residential attitudes. The next step then would be use this information to make people aware of how there behavior affects the Bay and then direct them to where information and resources can be found on alternative behaviors. Appendices A and B include detailed information on understanding watershed behavior and developing pollution prevention/education programs.

3.4 Tree Planting (Grow-Out Station) - The St. Mary's County Department of Public Works & Transportation (DPW&T) is working with the Lower Potomac Tributary Team to implement a Tree Grow-Out Station in support of the Chesapeake Bay 2000 Agreement and its goal to plant new forest buffers. Tree saplings were purchased by the Lower Potomac Tributary Team from the state nursery and are being nurtured at an irrigation facility to improve root structure and overall health. The increased root structure will improve the survival rate when the trees are transplanted. This grow-out station is intended to provide a long term source of plant materials for watershed enhancement projects. This effort should be coordinated with the pollution prevention/education program so that the public can be aware of the projects and volunteer to participate. Civic/school groups should be directly recruited to participate in the tree plantings and to identify suitable areas to conduct plantings.

3.5 Submerged aquatic vegetation (SAV) planting - The Potomac River Association (PRA) has completed two SAV planting projects along the shoreline of Breton Bay. The first took place in September of 2002 and the second in June of 2003. The difficulty in undertaking this is initially growing the grasses to a size large enough to plant outdoors. This initial growing is generally done indoors and requires a dedicated effort. The Potomac River Association is actively seeking volunteers to take on this initial task. Civic/school groups should be directly recruited to participate in the project. As with the tree planting, this effort should be coordinated with the pollution prevention/education program so that the public can be made aware of the projects and volunteer to participate. In addition, the State of Maryland offers assistance to shoreline property owners experiencing erosion problems. Detailed information on this program can be found at: http://www.dnr.state.md.us/grantsandloans/waterfrontpropertyownersguide.pdf

3.6 Golf Courses - The PGA's Environmental Leaders in Golf Award recognizes golf course superintendents and their courses for overall course management excellence in the areas of Resource Conservation, Water Quality Management, Integrated Pest Management, Wildlife/Habitat Management and Education/Outreach. The Great Hope Golf Course in Westover on Maryland's Eastern Shore was recently recognized as an award winner under this program. Golf Courses in the watershed should be approached about taking the necessary steps to achieve such an award. While this would require an individual effort on their part, support from the County/Town in terms of recognizing such an effort and encouraging others, may make the effort worthwhile. More information on this program can be found at: http://www.pga.com/Newsline/Industry_News/industrynews_detail.cfm?ID=3520

Section 4.4 WRAS Element #4

***Enhance programs and development review to minimize impacts from future growth** through investment in continuing education and training for planning and review staff and the local development community. Promote development techniques that protect sensitive natural resource areas while achieving desired growth.*

4.1 Builders for the Bay - Another program the County/Town will pursue, in conjunction with the development community, is the "Builders for the Bay" program. Builders for the Bay is a first-of-its-kind program aimed at reducing environmental impacts from residential and commercial construction within the Chesapeake Bay watershed. Under the leadership of the Alliance for the Chesapeake Bay, the Center for Watershed Protection and the National Association of Home Builders, Builders for the Bay encourages, through a consensus process, the voluntary adoption of site design principles that reduce the environmental effects of residential and commercial development. This program has already been undertaken in several Chesapeake Bay communities in MD, VA, and PA. with impressive results. Detailed information about the Builders for the Bay program can be found at the following link: http://www.cwp.org/builders_for_bay.htm .

4.2 Code and Ordinance Review - One of the most important elements of the Builders for the Bay program is a review of local development codes and ordinances. This review should look at existing development codes and ordinances and evaluate them as to the level of watershed protection and provide information on where improvements can be made. Such a review should be undertaken regardless of whether the County/Town wishes to initiate the Builders for the Bay program. An example code and ordinance review worksheet (COW) is included in Appendix C.

4.3 Seminars and Workshops - Recent changes in the State's stormwater management regulations and advancements in site design and land development techniques focus the need for County/Town officials, plan reviewers, and the development community to remain up to date on emerging techniques. Targeted seminars and workshops can help both the development community and County/Town officials and reviewers to incorporate these new design elements into development projects. The County/Town should sponsor local seminars and seek grant monies to sponsor continuing education workshops. Workshop topics can include Stormwater management design including ponds, infiltration, filtering and open channel systems. The workshops/seminars should emphasize techniques that focus on the challenges of designing development sites that minimize stormwater runoff while incorporating innovative stormwater management and the protection of natural features on development sites. The training should focus on practical, low-cost options to implement these techniques. The County/Town will sponsor two workshops seminars over the coming year, one on stormwater management techniques and one on environmentally sensitive site design techniques. These workshops should be open to both public and private sector attendees.

Section 4.5 WRAS Element #5

Enhance the community's aesthetic and recreational interactions with Breton Bay *by integrating Town, County, civic, and homeowner association projects and activities with the Bay and by promoting canoeing, fishing and other recreational uses of Breton Bay.*

5.1 Recreational Opportunities - Currently, public recreational access and opportunities are limited along Breton Bay. The Town of Leonardtown has initiated a waterfront revitalization program to increase access to the Bay for residents. The Town plans to develop a public waterfront park as part of the redevelopment along the Town's waterfront and increase recreational access along McIntosh Run below Route 5. The Town will ensure that public access is provided in any new bayside development projects.

5.2 Community Events - The Town and County should continue to sponsor community events such as Earth Day activities, The Oyster Festival, and others. Each of these events should have a Breton Bay component that incorporates elements of the public education program and promotes recreational opportunities on Breton Bay. For instance, the Earth Day celebration for 2003 included canoe tours on Breton Bay, kayak demonstrations, as well as information on environmental and conservation awareness, recycling, organic gardening and pesticide-free produce. By linking the health of Breton Bay with recreational activities, there is great potential to increase awareness of the Bay and at the same time give people a personal stake in maintaining the health of the Bay. The County and/or Town will incorporate more Breton Bay awareness activities into existing public events and programs.

5.0 WRAS Implementation Opportunities

Many of the WRAS elements and the activities/programs recommendations under the elements are intended to be implemented watershed-wide, while others are best targeted to specific areas, at least in the program development and initiation stage. Many of the activities/programs incorporate short and long-term goals. Table 5 highlights the long and short term goals of each activity/program.

The WRAS workgroup looked for opportunities in the watershed where the initiation of activities and programs would be most effective. These opportunities were either locations where specific impacts or needs were identified or where public involvement/stewardship activities currently exist or would be most likely to succeed.

The need to improve aquatic buffers, eliminate/reduce the dumping of trash and debris, and increase the conservation/protection of land was found throughout the watershed. Restoration/protection activities to address these issues should not be limited to any specific subwatershed within the watershed. Although, the need for land conservation/protection is most apparent in McIntosh Run, the McIntosh Run subwatershed makes up nearly 63% of the overall Breton Bay watershed and thus can be considered a watershed-wide issue.

Other activities/programs that relate to pollution prevention, stream restoration, stewardship, public participation, stormwater retrofits, and future development issues will initially be targeted in areas were the need and opportunities are greatest. This initial emphasis will allow programs/projects to be developed and implemented in smaller geographic areas and, once established, to be expanded to the watershed as a whole. Four subwatersheds have been identified as priority implementation areas (Figure 12). These subwatersheds are McIntosh Run DD "A", Town Run, Moll Dyers Run, and Combs Creek/Cherry Cove. Each of these subwatersheds had specific needs identified, as well as opportunities and existing local resources to address those needs.

McIntosh Run DD "A" – This subwatershed includes the lower mainstem of McIntosh Run. A significant portion of this subwatershed consists of floodplain and wetland areas along McIntosh Run and a portion lies within the development district (priority funding area) of Leonardtown. The mainstem of McIntosh Run in this subwatershed supports a large population of the federally endangered dwarf wedge mussel (*Alasmidonta heterodon*). A small tributary stream within this subwatershed was also found to have several severe and very severe channel erosion sites. New development within this subwatershed has the potential to directly impact the mainstem of McIntosh Run as well as this already impacted tributary. In order to protect the mainstem of McIntosh Run, wetland and stream restoration/stabilization activities are proposed in this subwatershed. In addition, to ensure that any future development activities incorporate the best techniques and practices available, workshop/seminars are recommended for development review staff, to provide the information/expertise necessary for adequate protection of natural resources.

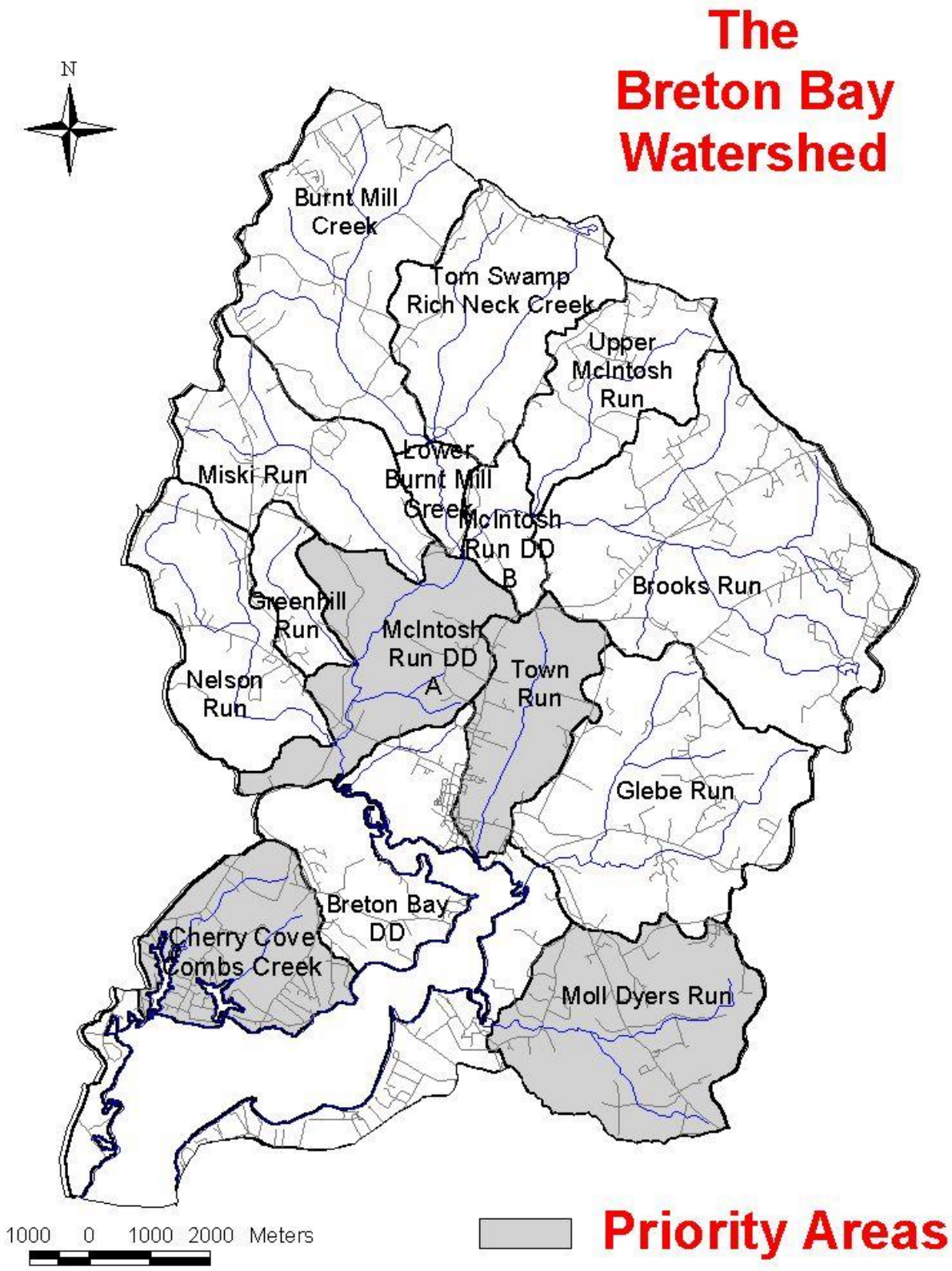

Figure 12. WRAS Priority Implementation Areas for Breton Bay

Town Run – This subwatershed incorporates a large proportion of the Leonardtown development district. For many years, a sandbar growing at the mouth of Town Run has been a concern to citizens. Active erosion and channel instability were identified along a large portion of the stream and this is likely the sediment source for the sandbar. In addition, much of the land development that has occurred in this subwatershed predates stormwater management requirements. Stream restoration/stabilization activities along Town Run and stormwater retrofit activities (Government Center) in the subwatershed are proposed to minimize current and future impacts on Breton Bay.

Moll Dyers Run – This subwatershed, while not experiencing major problems, had several moderate problems identified. Problems at this scale can often be addressed through citizen-based watershed stewardship projects. This subwatershed also includes the high school, middle school, and the Tech Center. These resources make this subwatershed a good candidate for developing citizen involvement and watershed stewardship projects such as tree planting, storm drain stenciling, and demonstration projects. Programs and activities developed here, such as *The Master Gardener's* rain barrel/rain garden project, can then be used as models for the remainder of the watershed.

Combs Creek/Cherry Cove – This subwatershed consists of numerous new and established residential neighborhoods, many of which lie along the bay shoreline. Homeowners can have a significant effect on Breton Bay through yard care, landscaping, car maintenance, and residential stormwater runoff. The strong sense of community involvement in this watershed, along with the existing civic and community organizations, offer an excellent opportunity for educating homeowners about residential pollution prevention. This presents an opportunity to develop and establish residential pollution prevention program that, once established, can be implemented watershed-wide.

6.0 Indicators of WRAS Effectiveness

The Ultimate test of the Breton Bay WRAS is the impact it will have on the health of the Bay and the watershed. Monitoring or a means of tracking WRAS performance is needed to evaluate program development and implementation and guide the WRAS in future years. Program effectiveness cannot be assessed without milestones and defined goals. Success of many of the WRAS activities/programs involves the changing of long held public attitudes and land development practices. Quantifying the actual water quality benefit of these individual activities and programs would be difficult, if not impossible. Rather, goals have been established by which the success of individual activities/programs can be measured. Table 5 highlights these goals for each activity/program.

The dwarf Wedge Mussel is the most endangered aquatic life in the watershed. This species can serve as an indicator of the overall strategy success. An increase in the mussel population in McIntosh Run would indicate that watershed management activities are improving conditions. A decrease in the population would indicate that more effort is required in terms of watershed management and conservation.

The primary reason Breton Bay did not achieve full attainment of the Use II (shellfish harvesting waters) criteria is elevated bacteria levels in the Upper Bay. Attainment of the Use II criteria would indicate significant improvement in water quality conditions. Attainment of the criteria is a long-term goal that will likely require many years to achieve. An appropriate short-term goal will be to see a decreasing trend in bacteria levels with strategy implementation over the coming years.

Table 5. Breton Bay Watershed Action Strategy Implementation Goals

WRAS Element	Activity/Program	Short-term Goal (1-2 yrs)	Long-term Goal (2-5 yrs)
#1 - Reduce current sediment and nutrient inputs to Breton Bay by addressing point and non-point pollution sources ***Potential Funding Sources:*** *County Funds* *State and federal Grants*	1.1 Leonardtown Wastewater Treatment Plant Biological Nutrient Removal (BNR) Upgrade	Complete the Upgrade, add signage and viewing area	Improve public perception and awareness of plants role in protecting Breton Bay. Achieve a certification level or award
	1.2 Leonardtown Stormwater Management Retrofits	Complete SW retrofit of Government Center. Identify two additional stormwater management retrofit opportunities	Utilize the Government Center SWM Retrofit as a demonstration area. Implement additional SW retrofit projects
	1.3 Stream Restoration/Stabilization	Stabilize slope failures along the unnamed tributary to McIntosh Run and initiate a geomorphic assessment of Town Run	Restore/Stabilize Town Run. Complete Geomorphic assessment of Town Run
	1.4 Municipal pollution prevention/education	Conduct an audit of municipal pollution prevention practices	Revise/adopt municipal practices to minimize pollution
	1.5 Commercial Education Outreach Program	Develop a commercial outreach/education	Implement commercial outreach/education program
#2 - Encourage sound agricultural and forestry practices that maintain income and the rural landscape while protecting sensitive natural resources and unique plant and wildlife habitats ***Potential Funding Sources:*** *State and federal Grants* *County Funds* *Private Donations* *Foundation Grants*	2.1 Agricultural Best Management Practices	Initiate a Buffer enhancement program in conjunction with CBF	Complete five buffer enhancement projects
	2.2 McIntosh Run Land Conservation Partnership (MRLCP) and Potomac Tidewater Trust	Inform property owners of the land conservation opportunities MRLCP and the Potomac Tidewater Trust	Enroll at least one property in a conservation program/easement
	2.3 Natural Resource Management Guidance for Rural Homeowners	Create an informational brochure for new homeowners/builders	Incorporate brochure into public education program (see #3)

Table 5. Breton Bay Watershed Action Strategy Implementation Goals (Cont.)			
WRAS Element	**Activity/Program**	**Short-term Goal (1-2 yrs)**	**Long-term Goal (2-5 yrs)**
#3 - Increase the understanding and awareness of watershed issues and promote active stewardship among commercial and residential stakeholders ***Potential Funding Sources:*** *State and federal Grants* *County Funds* *Private Donations* *Foundation Grants*	3.1 "Entering the Breton Bay Watershed" signs	Install Five "Entering the Breton Bay" signs along Rts. 234, 5 North, 5 South, 4, and Hollywood Rd.	Have community groups/businesses adopt signs and future maintenance
	3.2 Storm drain stenciling	Recruit a group/organization and initiate stormdrains stenciling	Stencil all stormdrains inlets in Leonardtown and watershed
	3.3 Residential pollution prevention/education campaign	Establish website, hire intern to develop program, and initiate program in Cherry Cove/Combs Creek Subwatershed	Expand program watershed-wide
	3.4 Tree Planting (Grow-out Station)	Establish grow-out station, Identify opportunities to plant in Moll Dyers run	Plant trees as public participation project in Moll Dyers Run
	3.5 SAV Planting	Recruit group/school to grow plants, Support a PRA planting day the following season	Establish growing program at local school. Establish planting program as a school program
	3.6 Golf Courses	Approach Golf Courses about stewardship programs	Promote golf course achievements to encourage others
#4 - Enhance programs and development review to minimize Impacts from future growth ***Potential Funding Sources:*** *County Funds* *Foundation Grants*	4.1 Builders for the Bay (BFB)	Initiate BFB program	Adopt BFB recommendations
	4.2 Codes and Ordinances Review	Conduct a codes and ordinances review	Amend codes and ordinances in the County and Leonardtown
	4.3 Seminars and Workshops	Conduct two seminars/workshops in the next year (Site Design and SWM)	Conduct a yearly seminar/workshop on SWM and design techniques
#5 - Enhance the community's aesthetic and recreational interactions with Breton Bay ***Potential Funding Sources:*** *County/Town Funds*	5.1 Recreational Opportunities	Incorporate recreational access into new waterfront development	Ongoing promotion of Breton Bay as a recreational resource
	5.2 Community Events	Include a Breton Bay recreation/awareness component in Town/ County events	Hold an annual Bay Day event

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Appendix A

Article 126

Feature article from Watershed Protection Techniques. 3(3): 671 - 679

Understanding Watershed Behavior

In short, twenty centuries of progress have brought the average citizen a vote, a national anthem, a Ford, a bank account, and a high opinion of himself, but not the capacity to live in high density without befouling and denuding his environment...Nor a conviction that such capacity, rather than such density, is the true test of whether he is civilized. **Aldo Leopold (1933), *Game Management***

Since Leopold wrote these words in 1933, over 50 million new households have formed in America. By conservative estimates, we have added 45 million yards, 125 million cars and trucks, 15 million septic systems, and 25 million dogs during the last half century. In his time, Aldo Leopold imagined that the foremost practitioner of the land ethic would be the farmer, the game warden or perhaps the woodlot owner. He simply could not have envisioned that the most important practitioner would ultimately become the suburban and rural landowner, who individually lords over a few hundred square feet, but cumulatively dominates the watershed.

It is a maxim of watershed science that each of us is personally responsible for contributing some of the pollutants that run off our lawns, streets and parking lots. Runoff pollution is the major cause of water quality problems in most urban watersheds. While runoff pollution is not usually sudden or dramatic, it leads to the gradual degradation of urban waters — degraded streams, eutrophic lakes, closed beaches and shellfish beds, and polluted drinking water supplies.

It is a curious tendency of our species, however, that when we study urban watersheds, we rarely study ourselves, despite the fact that these watersheds are our primary habitat. We seldom take the trouble to measure the cumulative impact of our individual behaviors on the watershed. In this article, we summarize our sketchy understanding of human behaviors in suburban and rural watersheds, based on an analysis of over twenty recent surveys of watershed residents. These surveys asked residents about their basic behaviors in six broad areas: lawn fertilization, pesticide application, dog walking, septic cleaning, car washing, and fluid changing. Prior research indicates that each of these behaviors are common in most watersheds and can have a strong impact on water quality.

Our early experience in trying to restore urban watersheds suggests that we can never meet our water quality goals for streams, lakes and estuaries until we can convince urban, suburban and rural landowners to change their behaviors and practice a better watershed ethic. Such a watershed ethic is critical if we are to protect or improve the quality of our urban watersheds. The article concludes by outlining some of the possible elements of a watershed ethic that might guide the actions of suburban and rural landowners.

The six watershed behaviors profiled in this article are not the only ones that can have a strong influence on watershed quality, but they are the ones we happen to know the most about. Other individual behaviors that can influence water quality are listed in Table 1.

The frequency of any individual behavior can differ from watershed to watershed, based on population density and the level of income, education, and awareness of its residents. What is particularly troubling, however, is that many of the most potentially polluting behaviors are practiced by affluent, well-educated and environmentally aware members of our society. These behaviors are rooted in our collective desire for a clean, well-manicured and tidy suburban environment – a nice green lawn, a shiny car, a pest-free yard or a clean driveway. Indeed, many watershed behaviors have become worse in recent years, driven by the rapid growth in the tools and products to improve and beautify the suburban landscape.

Lawn Fertilization

It has been estimated that there are 25 to 30 million acres of turf and lawn in the United States (Robert and

Table 1: Other Key Individual and Household Behaviors that Potentially Influence Watersheds

Leaf Disposal/Composting
Disposal of Household Hazard Wastes
Hosing and Power-washing
Landscaping Practices
Car Emissions Testing
De-icing
Watering/Irrigation
Sidewalk/Driveway Sweeping
Maintenance of Common Stormwater Facilities and Conservation Areas

Roberts, 1989, Lawn and Landscape Institute, 1999). To put this statistic in perspective, consider that if lawns were classified as a crop, they would rank as the fifth largest in the country on the basis of area, after corn, soybeans, wheat, and hay (USDA, 1992). In terms of fertilizer inputs, nutrients are applied to lawns at about the same application rates as those used for row crops (Barth, 1995a).

Research has indicated that nutrient runoff from lawns has the potential to cause eutrophication in streams, lakes, and estuaries (see Schueler, 1995b). Nutrient loads generated by suburban lawns can be significant, since recent research has shown that lawns produce more surface runoff than previously thought (see article 36).

Lawn fertilization is among the most widespread watershed behaviors we engage in. In our survey of resident attitudes in the Chesapeake Bay, 89% of citizens owned a yard, and of these, about 50% applied fertilizer every year (Swann, 1999). The average rate of fertilization in 10 other resident surveys was even higher, at 78%, although this could reflect the fact that these surveys were biased towards predominantly suburban neighborhoods, or excluded non-lawn owners (Table 2).

Several studies have measured the frequency with which we fertilize our yards. In the Chesapeake Bay survey, fertilizers were applied almost twice a year (1.7) with spring and fall being the most popular seasons for fertilization. In five other surveys, fertilizers were applied an average of 2.3 times year, and most frequently in the spring. It should be noted that the spring is not considered an optimal season to apply fertilizers from an agronomic standpoint.

A significant fraction of homeowners can be classified as "over-fertilizers" who apply fertilizers to their lawns two or more times a year. In the Chesapeake Bay survey, over-fertilizers comprised 52% of all those that applied fertilizers to their yard. Other studies have put the number of over-fertilizers at 65% to 70% of all

Table 2: Lawn Care Practices - A Comparison of 11 Homeowner Surveys

Study	Respondents	% Fertilizing	% Soil Testing	Other Notes
Chesapeake Bay *Swann, 1999*	656	50%	16%	1.73 times/year
Maryland *Smith, 1996*	100	88%	15%	58% grasscycle
Maryland *Kroll and Murphy, 1994*	403	87% *	na	
Virginia, *Aveni, 1998*	100	79%	> 20%	
Maryland, *HGIC, 1996*	164	73%	na	2.1 times/year
Michigan, *De Young, 1997*	432	75%	9%	1.9 times/year 69% grasscycle
Minnesota *Morris and Traxler, 1996*	981	75%	12%	2.1 times/year 40% grasscycle
Minnesota, *Dindorf, 1992*	136	85%	18%	78% grasscycle
Wisconsin, *Kroupa, 1995*	204	54%	na	2.4 times/year
Washington, *Hardwick,1997*	406	67%	na	
Florida, *Knox* et al., *1995*	659	82%	na	3.2 times/year 59% grass cycle

** Fertilization rates were significantly lower in small urban lots (less than 2500 square feet); survey results from these smaller lots were excluded from this table.*
na = not asked

fertilizers (Morris and Traxler, 1996; Knox *et al*., 1995). Clearly, many homeowners, in a quest for quick results or a bright green lawn, are applying more nutrients to their lawns than they actually need.

From a demographic standpoint, the primary fertilizer is a middle-aged man in the 45-54 age group (BHI, 1997). These individuals place a very high value on lawns. For example, when residents were asked their opinions on over 30 statements about lawns in a Michigan survey, the most favorable overall response was to the statement "a green attractive lawn is an important asset in a neighborhood" (De Young, 1997). Nationally, homeowners spend about 27 billion dollars each year to maintain their own yard or pay someone else to do it (PLCAA, 1999). In terms of labor, a majority of homeowners spend more than an hour a week taking care of the lawn (Aveni, 1994; De Young, 1997).

Unlike farmers, suburban and rural landowners are often ignorant of the actual nutrient needs of their lawns. According to surveys, only 10 to 20% of lawn owners take the trouble to perform soil tests to determine whether fertilization is even needed (Table 2). The majority of lawn owners are not aware of the phosphorus or nitrogen content of the fertilizer they apply (Morris and Traxler, 1996) or that leaving grass clippings on the lawn can reduce or eliminate the need to fertilize.

Our ignorance about lawn nutrients is not surprising given where we get our information on lawn care. Study after study indicates that product labels, store attendants and lawn care companies are the primary and almost exclusive source of lawn care information for the average consumer. Consumers also rely on direct mail and word of mouth as the primary factor when choosing a lawn care company (Swann, 1999; AMR, 1997).

Not many residents understand that lawn fertilizer can cause water quality problems – overall less than one fourth of residents rated it as a water quality concern (Syferd, 1995 and Assing, 1994), although ratings were as high as 60% for residents living adjacent to lakes (Morris and Traxler, 1996, MCSR, 1997). Interestingly, in one Minnesota survey, only 21% of homeowners felt their own lawn contributed to water quality problems, while over twice as many felt their neighbor's lawn did (MCSR, 1997).

In recent years, many communities have attempted to educate residents about lawn care and nutrients. The education message they send, however, is often ambiguous and complex, and typically is geared more to better turf management than better water quality. This is evident in outreach materials that consistently promote a message to use less fertilizer, fertilize in the right season, test soils, use slow-release fertilizer or grasscycle and keep clippings on lawn. This educational approach sometimes requires residents to understand a lot more about nutrient management than they can read off a label.

Conspicuously absent is a much stronger message that promotes a low or zero input lawn. It seems appropriate that watershed education programs strongly advocate no chemical fertilization, reduced turf area and the use of native plants adapted to the ecoregion (Barth, 1995), if only to balance the pro-fertilization message that is so effectively marketed by the lawn care industry.

Pesticide Application

When Rachel Carson first wrote *Silent Spring*, many Americans were alerted to the dangers of pesticides in the urban environment. Yet, pesticides are still frequently found in the waters of many urban streams, in settings as diverse as Georgia, Texas, California, Maryland, and Wisconsin. The pesticides of greatest concern are insecticides, such as diazinon and chloropyrifos, and a group of herbicides (CWP, 1999 and Schueler, 1995a). Even very low levels of these pesticides can be harmful to aquatic life. The major source of pesticides in urban streams are home applications to kill insects and weeds in the lawn and garden. Table 3 compares surveys on residential pesticide use in 11 different regions of the country in terms of insecticides and herbicides. At first glance, it appears that pesticide application rates vary greatly, ranging from a low of 17% to a high of 87%.

Some patterns do emerge, however. For example, insecticides tend to be applied more widely in warm weather climates where insect control is a year-round problem (such as Texas, California, and Florida). Anywhere from 50 to 90% of residents reported that they had applied insecticides in the last year in warm-weather areas. This can be compared to 20 to 50% levels of insecticide use reported in colder regions where hard winters can help keep insects in check.

In contrast, herbicide application rates tend to be higher in cold weather climates to kill the weeds that arrive with the onset of spring (60 to 75% in the Michigan, Wisconsin and Minnesota surveys). Resident surveys also indicate that many residents lack awareness that their lawn care program actually uses herbicides. This confusion stems from the recent growth of "weed and feed" lawn care products that combine weed control and fertilization in a single bag. In one Minnesota study, 63% of residents reported that they used weed and feed lawn products, but only 24% understood that they were applying herbicides to their lawn (Morris and Traxler, 1996). In addition, many residents are unaware of the pesticide application practices that their lawn care company applies to their yard, preferring to leave it up to the professionals (Knox *et al.*, 1995).

The widespread use of pesticides on urban lawns and gardens is somewhat curious since surveys tell us that the public has a reasonably good understanding of the potential environmental dangers of pesticides. Several surveys indicate that residents do understand envi-

Table 3: A Comparison of 11 Surveys of Residential Insecticide and Weedkiller Use					
Study	**N**	**Region**	**Use Insecticides**	**Use Herbicides**	**Notes**
Chesapeake Bay *Swann, 1999*	656	#	21%	- -	70% use private sector info
Maryland *Kroll and Murphy,1994*	403	#	42%	32%	
Virginia *Aveni, 1998*	100	#	66%	- -	
Maryland, *Smith, 1994*	100	#	23%	n/a	55% use product labels
Minnesota, *Morris and Traxler, 1997*	981	C	- -	75%	1.3 times/year
Michigan, *De Young, 1997*	432	C	40%	59%	
Minnesota, *Dindorf, 1992*	136	C	- -	76%	
Wisconsin, *Kroupa, 1995*	204	C	17%	24% **	63% use a weed and feed product
Florida, *Knox et al, 1995*	659	W	83%	- -	
Texas, *NSR, 1998*	350	W	87%	- -	
California, *Scanlin and Cooper, 1997*	600	W	50%	- -	

(#) Mid-Atlantic surveys, (C) Cold-weather surveys (W) Warm-weather surveys
*(**) Note difference in self reported herbicide use and those that use a weed and feed product.*

ronmental concerns about pesticides and consistently rank them as the leading cause of pollution in the neighborhood (Elgin DDB, 1996).

The education message sent about pesticides is often very complex. Outreach materials often promote a message to use less pesticides, apply them properly or practice integrated pest management. This approach requires residents to understand a lot more about pesticides than they are likely to read off a product label. As was the case with fertilizer, product labels are the primary and often dominant source of information about pesticides. Nearly 90% of homeowners rely on commercial sources of information to guide their pesticide use (Swann, 1999). From a watershed standpoint, it may be wise to articulate a simple but strong message that pesticides should be applied only as a last resort, or not at all.

Dog Walking

One biological index that never declines after a watershed develops is the dog population. In our survey of Chesapeake Bay residents, we found about 40% of households own a dog. A dog owner, however, is not always a dog walker. Just about half of all dog owners actually walk their dog. Of the half that do walk their dog, about 60% claim to pick up after their dog (Swann, 1999), which is generally consistent with other studies (Table 4). Men are also prone to pick up after their dog less often than women (Swann, 1999). The virtuous dog walkers that clean up after their dogs usually dispose of the fecal matter in the trash can, toilet, compost pile or down a storm drain inlet (Hardwick, 1997; HGIC, 1998).

Failure to clean up after a dog can cause both water quality and public health problems, and many commu-

Table 4: A Comparison of Three Resident Surveys About Cleaning Up After Dogs	
Maryland *HGIC, 1996*	62% always cleaned up after the dog; sometimes 23%; never 15%. Disposal method: trash can (66%); toilet (12%); other 22%
Washington Hardwick, *1997*	Pet ownership 58% 51% of dog owners do not walk dogs 69% claimed that they cleaned up after the dog 31% do not pick up Disposal methods: trash can 54%; toilet 20%; compost pile 4% 4% train pet to poop in own yard 85% agreed that pet wastes contribute to water quality problems
Chesapeake Bay *Swann, 1999*	Dog ownership 41% 44% of dog owners do not walk dogs Dog walkers who clean up most/all of the time 59% Dog walkers who never or rarely clean up 41% Of these, 44% would not clean up even with fine, complaints, collection or disposal methods 63% agreed that pet wastes contribute to water quality problems

nities have responded by adopting "pooper scooper" laws. Dogs have been found to be a major source of fecal coliform and pathogens in many urban watersheds (Schueler, 1999), which is not surprising given their population, daily defecation rate, and bacteria/pathogen production.

Residents seem to be of two minds when it comes to dog waste. While a strong majority agree that dog waste can be a water quality problem (Hardwick, 1997; Swann, 1999), they generally rank it as the least important local water quality problem (Syferd, 1995 and MSRC, 1997). This finding strongly suggests the need to dramatically improve watershed education efforts to increase public recognition about the water quality and health consequences of dog waste.

It is worth noting that many residents are very reluctant to change the way they handle dog waste. According to the Chesapeake Bay survey, 44% of dog walkers who do not pick up indicated they would still refuse to pick up even if confronted by complaints from neighbors or fines, or provided with more sanitary and convenient options for retrieving and disposing of dog waste. Table 5 lists factors that compel residents to pick up after their dog, along with some interesting rationalizations for not doing so.

This strong resistance to handling dog waste suggests that an alternative message may be necessary: to practice rudimentary manure management by training dogs to use areas that are not hydraulically connected to the stream or close to a buffer.

Car Washing

Outdoor car washing has the potential to result in high loads of nutrients, metals and hydrocarbons during dry weather conditions in many watersheds, when the detergent-rich water used to wash the grime off our cars flows down the street and into the storm drain. Not much is known about the water quality of car wash water, but it is very clear that car washing is a common watershed behavior. Three recent surveys have asked residents where and how frequently they wash their cars (Table 6).

According to the surveys, roughly 55 to 70% of households wash their own cars, with the remainder using a commercial car wash. A full 60% of residents could be classified as "chronic car-washers," i.e., they wash their car at least once a month (Smith, 1996 and Hardwick, 1997). Between 70 and 90% of residents reported that their car wash-water drained directly to the street, and presumably, to the nearest stream.

Residents are typically not aware of the water quality consequences of car washing, and do not understand the chemical content of the soaps and detergents they use. Car washing is also a very difficult watershed behavior to change, since it is hard to define a better alternative without asking people to pay to use

Table 5: Dog Owners Rationale for Picking Up or Not Picking Up After Their Dog (HGIC, 1996)	
Reasons for not picking it up:	**Reasons for picking up:**
Because it eventually goes away Just because Too much work On edge of my property It s in my yard It s in the woods Not prepared No reason Small dog, small waste Use as fertilizer Sanitary reasons Own a cat or other kind of pet	It s the law Environmental reasons Hygiene/health reasons Neighborhood courtesy It should be done Keep the yard clean

Table 6: A Comparison of Three Surveys About Car Washing	
Study	**Car Washing Behavior**
Maryland *Smith, 1996*	60% washed car more than once a month
California *Pellegrin, 1998*	73% washed their own cars 73% report that wash-water drains to pavement
Washington *Hardwick, 1997*	56% washed their own cars 44% used commercial car wash 91% report that wash-water drains to pavement 56% washed car more than once a month 50% would shift if given discounts or free commercial car washes

a commercial car wash that treats its wash water. Some potential alternative messages that might work are to wash cars less frequently, wash them on grassy areas, and to buy phosphorus-free detergents and non-toxic cleaners.

Fluid Changing

Dumping automotive fluids down storm drains can be a major water quality problem, since only a few quarts of oil or a few gallons of anti-freeze can have a major impact on small streams and wetlands during low flow conditions. Historically, the major culprit has been the backyard mechanic who changes his or her own automotive fluids. The number of backyard mechanics who change the oil and antifreeze in their cars, however, has been dropping steadily in recent decades. With the advent of the $20 oil change special, only about 30% of car owners change their own oil or anti-freeze anymore (Table 7).

Backyard mechanics have traditionally been the target of community oil recycling and storm drain stenciling programs. These programs appear to have been quite effective, since over 80% of backyard mechanics claim to dispose or recycle these fluids properly. Most backyard mechanics are more prone to recycle oil than antifreeze, and of those that have improperly disposed of either fluid, most used the trash can rather than the storm drain. It is important to keep in mind that any self-reported information on dumping or disposal methods needs to be taken with a grain of salt, given that people often feel the need to give the socially accepted or expected survey response. Nevertheless, it does seem clear that the previous watershed education efforts have made oil and antifreeze dumping socially unacceptable. By our estimates, only one to five percent of the general population now engages in such behavior.

Septic System Maintenance

About one in four American households relies on septic systems to dispose of their wastewater. Depending on soil conditions and other factors, septic systems have a failure rate ranging from five to 35%, with failure discharging untreated or partially treated wastewater into groundwater (Schueler, 1999). Even properly operating septic systems produce elevated nutrient levels in shallow groundwater, which can degrade coastal and lake water quality (Ohrel, 1995).

Until recently, homeowner awareness about septic system maintenance was poorly understood. The Chesapeake Bay survey was one of the first to examine how frequently residents maintain their septic systems. An interesting finding from the survey was the advanced age of the average septic system in the ground: about 27 years, or about seven years beyond the design life of an unmaintained system. Roughly half of the owners were classified as "septic slackers," as they indicated that they had not inspected or cleaned out their system in last three years (which is the minimum recommended frequency).

Septic systems are a classic case of "out of sight, out of mind." A small but significant fraction (12%) of septic system owners had no idea where their septic system was located on their property. In addition, only 42% of septic system owners had ever requested advice on how to maintain their septic system, and these owners relied primarily on the private sector for this advice (e.g., pumping service, contractors, and plumbers). Like many other watershed behaviors, there was a sharp difference between resident attitudes and their actual practice. For example, while 70% of septic system owners agreed with the statement that "inspection and routine clean out of septic systems is necessary to protect water quality in the Chesapeake Bay," more than half had not done so in the last three years (Swann, 1999).

A key element of the watershed ethic involves taking personal responsibility for the quality of home wastewater through regular inspections and pumpouts. The watershed ethic also includes the responsibility for rehabilitating and upgrading septic systems as they grow older. This can entail a costly investment every few decades or so, but is critical since many existing septic systems are approaching the end of their designed lives. Rural and suburban landowners may have to accept the notion that they must also pay the operating and capital costs for advanced sewage treatment that city dwellers have done for decades.

Articulating a Watershed Ethic for the Suburban and Rural Landowner

Despite the enormous growth of the environmental movement and a generation of universal environmental education in our schools, we have not articulated a

watershed ethic that applies to the suburban and rural landowner. As watershed professionals, we have been quite clumsy and timid in defining what it takes to live properly within a watershed. We need to come to some agreement about what personal responsibilities might comprise a watershed ethic for our time. With this in mind, we offer the following tentative list to stimulate more discussion:

- Inspect septic systems annually, and pump them out regularly
- Apply no fertilizer or pesticides to lawns
- Minimize turf area and avoid growing lawns in regions where the climate cannot sustain them without supplemental irrigation
- Gradually replace lawns with native trees, shrubs and ground covers
- Cultivate lawns with the primary goal of absorbing the runoff from roofs
- Take responsibility for disposing of the wastes of pets and hobby livestock
- Choose vehicles with low emissions and inspect them regularly
- Choose, in where we live, to reduce the miles we travel and prevent sprawl
- Be sensible in water use, as the cumulative demand for water during dry weather dramatically affects the flow of urban streams and rivers
- Use a commercial car wash, or at least wash cars on lawns using phosphorus-free detergents
- Avoid using hoses or leaf-blowers near the street or storm drain
- Maintain any stormwater practices, buffers or conservation areas present in neighborhoods

These simple steps help to minimize our collective impact on the watershed, but represent only the first steps of a watershed ethic. We can and should play an active stewardship role by advocating better local watershed protection and working together to restore degraded streams, lakes and estuaries. Stewardship takes many forms, whether it is a stream walk, a vote, citizen monitoring, storm-drain stenciling, tree planting or joining a local watershed organization.

Many elements of the watershed ethic run contrary to our current notions of suburban taste and social status, and may initially resist change. For example, it may be a few years before you hear, "Hey neighbor, I am really impressed by all the biodiversity you produced on your lawn," or, "The filthiness of your car really expresses your concern for the environment, Dad," or, "My, how well Rover is buffer-trained."

But it is also reasonably certain that our culture can learn to practice a much better watershed ethic than we do now, if we create a stronger watershed message and learn to deliver it more effectively. ***- TRS***

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Table 7: Comparison of Three Surveys of Fluid Changing by Backyard Mechanics

Study	Oil Changing	Antifreeze Changing
Maryland *Smith, 1996*	93% report oil recycling 7% did not recycle	83% reported oil recycling 17% did not recycle
California *Pellegrin, 1998*	30% do it yourselfers 12 to 15% report improper disposal, most put it in trash, but about 3 to 5% put it in storm drain system	18% do it yourselfers, 43% report improper disposal: 23% let it run to street 6% dump into storm drain
California *Assing, 1994*	28% do it yourselfers 17% report improper disposal (most in trash)	not asked

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Appendix B

Feature Article from Watershed Protection Techniques. 3(3): 680 - 686

On Watershed Education

While it may be true that old dogs cannot learn new tricks, there are some hopeful signs that our society will adopt new behaviors to protect the local environment. Witness the universally high rates at which we recycle bottles and newspapers, compost, and dispose of household hazardous wastes in the proper places, compared to a few decades ago. Littering and motor oil dumping are now much less socially acceptable behaviors than they once were. These dramatic social shifts occurred because a compelling case was made that changes were good for the environment (and reasonably convenient and inexpensive to make), and communities heavily invested in environmental education.

As the previous article establishes, the public does not always practice a very good watershed ethic, and continues to engage in many behaviors that are directly linked to water quality problems. Watershed education is the primary tool for changing these behaviors. The basic premise of watershed education is that we must learn two things: that we live in a watershed, and how to properly live within it.

A handful of communities have attempted to craft education programs in recent years to influence our watershed behaviors. These initial efforts have gone by a confusing assortment of names, such as public outreach, source control, watershed awareness, pollution prevention, citizen involvement, and stewardship, but they all have a common theme: educating residents on how to live within their watershed.

Many more communities will need to develop watershed education programs in the coming years to comply with pending EPA municipal stormwater National Pollutant Discharge Elimination System (NPDES) regulations. Indeed, half of the six minimum management measures prescribed under these regulations directly deal with watershed education: pollution prevention, public outreach and public involvement. Yet, many communities have no idea what kind of message to send, or in which medium to send it out.

This article reviews the prospects for changing our behaviors to better protect watersheds. We begin by outlining some of the daunting challenges that face educators seeking to influence deeply rooted public attitudes. Next, we profile research on the outreach techniques that appear most effective in influencing watershed behavior. Special emphasis is placed on media campaigns and intensive training programs. Lastly, recommendations are made to enhance the effectiveness of watershed education programs.

Challenges in Watershed Education

Watershed managers face several daunting challenges when they attempt to influence watershed behaviors:

Table 1: Provisional Estimates of Potential Residential Polluters in the United States

Watershed Behavior	Prevalence in Overall Population	Estimates of Potential Residential Polluters
Over-Fertilizers	35%	38 million
Bad Dog Walkers	15 %	16 million
Chronic Car washers	25%	27 million
Septic Slackers	15%	16 million
Bad Mechanics	1 to 5%	3 million
Pesticide Sprayers	40%	43 million
Driveway Hosers	15%	16 million

Note: Estimates are based on 1999 U.S. population of 270 million, 2.5 persons per household, and average behavior prevalence rates based on surveys in Understanding Watershed Behavior.

A Lot of Minds to Change

The most pressing challenge is that there are simply a lot of minds to change. Some notion of the selling job at hand can be grasped from Table 1, which contains provisional but conservative estimates of potential residential "polluters" in the United States in various categories. It is clear that we are not just dealing with a few bad actors or scofflaws, but rather the deeply rooted attitudes that are held by millions of people. While most people profess to support the environment, only a fraction actually practice much of a watershed ethic in their homes and yards.

Most Residents Are Only Dimly Aware of the Watershed Concept

It stands to reason that if citizens are asked to practice a watershed ethic, they need to know what a watershed is. Surveys indicate, however, that the average citizen is unaware of the watershed concept in general, and does not fully understand the hydrologic connection between the yard, the street, the storm sewer and the stream. Resident surveys also continue to show limited or incomplete understanding of terms such as "watershed," "stormwater quality" or "runoff pollution." For example, a recent Roper survey found that only 41% of Americans had any idea of what the term "watershed" meant (NEETF, 1999). The same survey found that just 22% of Americans know that stormwater runoff is the most common source of pollution of streams, rivers, and oceans.

At the same time, most of us claim to be very environmentally aware. For example, a Chesapeake Bay survey reported that 69% of respondents professed to be very active or at least somewhat active in helping to reduce pollution in the environment (SRC, 1994).

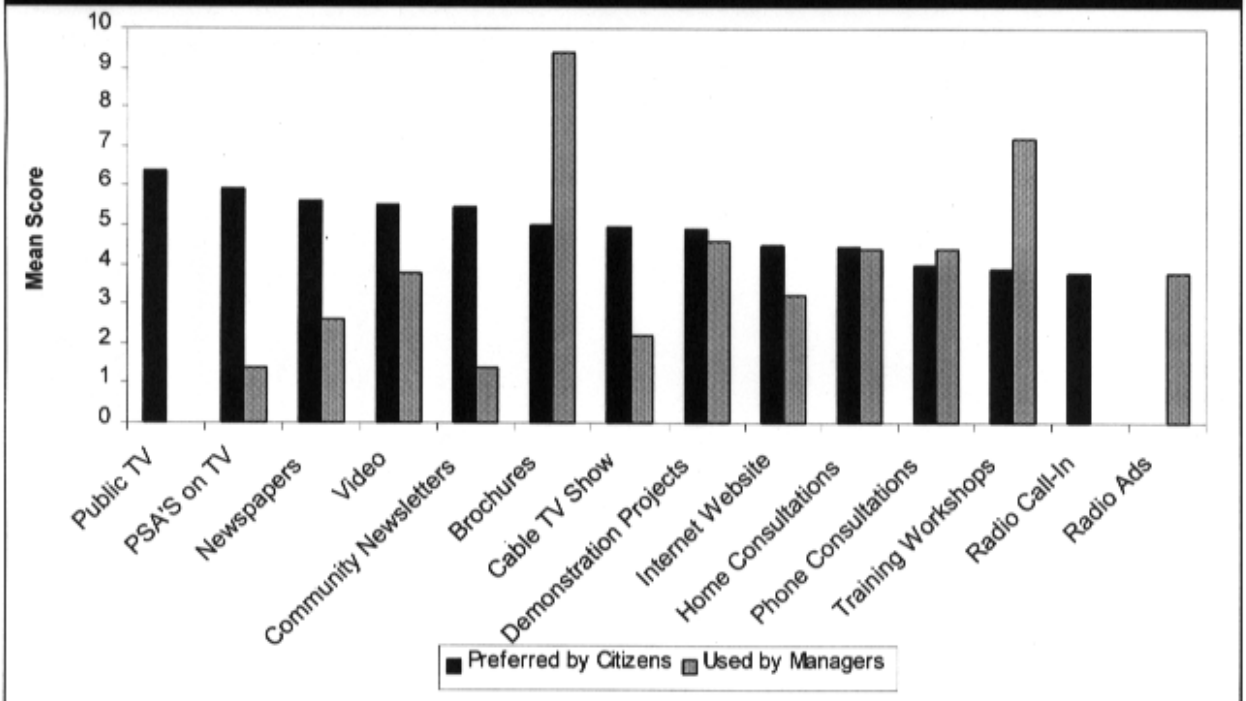
Resources Devoted to Watershed Education Are Inadequate

In recent years, several communities have developed education programs to influence the watershed behaviors practiced by their residents. Most of these efforts, however, are run on a shoestring. For example, CWP recently surveyed 50 local programs that have tried to influence lawn care, septic cleaning and pet waste behaviors (Swann, 1999). These education programs are typically run by the cooperative extension services, local recycling or stormwater agencies, or urban soil and water conservation districts. Most are poorly staffed (0.1 to 0.5 staff years), relatively new (within last five years), and have tiny annual budgets ($2,000 to $25,000). Given these limited resources, most watershed education programs have no choice but to practice retail, rather than wholesale, outreach techniques. Consequently, most watershed educators rely heavily on low cost techniques such as brochures, posters, workshops, and demonstration projects to disseminate their message.

Table 2: Most Influential Methods of Getting Messages to Citizens in Eight Citizen Surveys

	This Survey	WA (Elgin, 1996)	OR (AMR, 1997)	CA (Assing, 1994)	CA (PRG, 1998)	MI (PSC, 1994)	WI (Simpson, 1994)	MN (Morris, 1996)
Most Influence	TV	TV ad	Direct Mail	TV Ad	TV	TV	TV	Newspaper
	TV ad	TV	TV ad	Stencils	Newspaper	Newspaper	Newspaper	Direct Mail
⇩	Newspaper	Newspaper	Newspaper	Billboard	Radio	Cable TV	Newsletter	TV
	Local paper	Radio Ad	Radio	Local paper	Magazine	Local paper	Brochure	Neighbors
	Video	Brochure	TV	Brochure	Neighbors	Newsletter	Site Visit	Ext Service
Least Influence ⇩	Brochure	Radio news	Bill Insert	Radio Ad	School	Video	Video	Radio
	Local cable	Paper Ad	Newsletter	Bus Sign	Billboard	Meetings	Meeting	Meeting
	Meeting	Billboard	Local paper	Direct Mail	Brochure	Brochure	--	Local cable

Figure 1: Comparison of Outreach Methods Preferred by Residents to Those Used by Watershed Educators



The Marketing Techniques We Can Afford Don't Reach Many People

Watershed managers need to send a clear and simple educational message that can attract the attention of the average citizen, who is bombarded by dozens of competing messages every day. A number of surveys have asked residents which outreach techniques are most influential in attracting their attention (Table 2). Messages sent through television, radio and local newspapers are consistently more influential in reaching residents than any other technique, with up to 30% recall rates by the watershed population for each medium. In contrast, messages transmitted through meetings, brochures, local cable and videos tend to be recalled by only a very small segment of the watershed population.

One clear implication is that watershed education efforts must utilize a mix of outreach techniques if they are going to get the message across to enough residents to make a difference in a watershed. Most existing watershed education programs, however, cannot afford to use the more sophisticated "wholesale" outreach techniques that are most effective at reaching the public with their watershed message. This gap is evident in Figure 1, which compares the outreach methods actually used by local watershed education programs with the outreach methods that residents prefer, based on responses from the Chesapeake Bay survey (Swann, 1999).

Crafting Better Watershed Education Programs

The first step in crafting better watershed education programs is to compile some baseline information on local awareness, behaviors and media preferences. The following are some of the key questions watershed managers should consider:

- Is the typical individual **aware** of water quality issues in the watershed they live in?
- Is the individual or household **behavior** directly linked to **water quality problems**?
- Is the behavior widely prevalent in the watershed **population**?
- Do specific **alternative(s)** to the **behavior** exist that might reduce pollution?
- What is the most clear and direct **message** about these alternatives?
- What **outreach** methods are most effective in getting the message out?
- How much **individual behavior change** can be expected from these outreach techniques?

The best way to elicit this information is to conduct a market survey within the watershed. If money is tight, a watershed manager can consult other resident surveys that are profiled in article 126.

The next critical step in crafting a watershed education program is to select the right outreach techniques. Several communities have recently undertaken

before and after surveys to measure how well the public responds to their watershed education programs. From this research, two outreach techniques have shown some promise in actually changing behavior: media campaigns and intensive training. *Media campaigns* typically use a mix of radio, TV, direct mail, and signs to broadcast a general watershed message to a large audience. *Intensive training* uses workshops, consultation and guidebooks to send a much more complex message about watershed behavior to a smaller and more interested audience. Intensive training requires a substantial time commitment from residents of a few hours or more.

Both media campaigns and intensive training can produce a 10 to 20% improvement in selected watershed behaviors among their respective target populations (Tables 3 and 4). Both outreach techniques are probably needed in most watersheds, as each complements the other. For example, media campaigns cost just a few cents per watershed resident reached, while intensive training can cost a few dollars for each resident that is actually influenced. Media campaigns are generally better at increasing watershed awareness and sending messages about negative watershed behaviors. Intensive training, on the other hand, is superior at changing individual practices in the lawn, home and garden.

Both techniques work best when they present a simple and direct watershed message, are repeated frequently, utilize multiple media and are directly connected to local water resources that are most important in the community.

Other important considerations for effectively marketing a watershed message are outlined below:

Develop a stronger connection between the yard, the street, the storm and the stream. Outreach techniques should continually stress the link between a particular watershed behavior and the undesirable water quality it helps to create (i.e., fish kills, beach closure, algae blooms). Several excellent visual ads that effectively portray this link are profiled in our watershed outreach award winners.

Form regional media campaigns. Since most outreach programs operate on small budgets, they should consider pooling their resources together to develop regional media campaigns utilizing the outreach techniques proven to reach and influence residents. In particular, regional campaigns allow communities to hire the professionals needed to create and deliver a strong message through the media. Also, the campaign approach allows a community to employ a combination of media, such as radio, television, and print, to reach a wider segment of the population. It is important to keep in mind that since no single outreach technique will be recalled by more than 30% of the population at large, several different outreach techniques will be needed for an effective media campaign.

Use television wisely. Television is the most influential medium for influencing the public, but careful choices need to be made regarding the form of television that is used. Our surveys found that community cable access channels are much less effective than commercial or public television channels. Program managers should consider using cable network channels targeted

Table 3: Effectiveness of Media Campaigns in Influencing Watershed Behaviors – Four Surveys

Location and Nature of Targeted Campaign	Effectiveness of Campaign
San Francisco Radio, TV and Buses *BHI, 1997*	Awareness increased 10-15% Homeowners who reduced lawn chemicals shifted from 2 to 5%
Los Angeles Radio and Newspapers *PRG, 1998*	Best recall: motor oil and litter (over 40%) Worst recall: fertilizer and dog droppings (<10 %) Drop in car washing, oil changing, radiator draining of about 5 to 7% Greater self-reporting of polluting behaviors: dropping cigarette butts, littering, watering and letting water run on street, hosing off driveways into the street (10% or more)
Oregon Radio, TV *AMR, 1997*	19% reported a change in "behaviors"– changes included being more careful about what goes down drain, increasing recycling and composting, using more nature-friendly products etc.
Oakland County, MI Direct Mail *PSC, 1994*	44% of mail respondents recalled lawn care campaign 50% desired more information on lawn care and water quality 10% change in some lawn care practices as a result of campaign (grass recycling, fertilizer use, hand weeding). No change in other lawn care practices as a result of campaign

Table 4: Effectiveness of Intensive Training in Changing Watershed Behaviors	
Location and Nature of Training Campaign	**Effectiveness of Intensive Training**
Maryland Direct Homeowner (Smith, 1996)	10% shift from self to commercial car washing. No change in fertilizer timing or rates. Better claims of product disposal.
Florida Master Gardener (Knox *et al.*, 1995)	No significant change in fertilization frequency after program. Some changes in lower rates, labels, slow release (8 to 15%). Major changes in reduced pesticide use (10 to 40%).
Virginia Master Gardener (Aveni, 1998)	30 to 50% increase in soil testing, fertilizer timing and aeration. 10% increase in grass clippings and 10% decrease in fertilizer rate.

for specific audiences, and develop thematic shows that capture interest of the home, garden and lawn crowd (i.e., shows along the lines of "This Old Watershed"). Well-produced public service announcements on commercial television are also a sensible investment.

Understand the demographics of your watershed. The middle-aged male should usually be the prime target for watershed education, as he is prone to engage in more potentially polluting watershed behaviors than other sectors of the population. Indeed, the most attractive audience for the watershed message is generally composed of men in the 35 to 55 year age group with higher incomes and education levels. Specialized outreach techniques can appeal to this group, such as radio ads on weekend sports events.

Another target group worth reaching includes what the Pellegrin Research Group (1998) terms the "rubbish rebels"— 18 to 25 year olds that tend to have low watershed awareness, engage in potentially polluting behaviors and are often employed in lawn care and other service industries. This age group is hard to reach using conventional techniques, but may respond to ads on alternative radio shows, concerts, and other events.

As America becomes more diverse, watershed managers should carefully track the unique demographics of their watersheds. For example, if many residents speak English as a second language, outreach materials should be produced in other languages. Similarly, watershed managers should consider more direct channels to send watershed messages to reach particular groups, such as church leaders, African-American newspapers, and Spanish-speaking television channels.

Watershed educators should also be careful about using the traditional environmental education model in which schools educate children who, in turn, educate their parents. Although environmental education in the schools was instrumental in achieving greater rates of recycling, it may not be as effective in changing watershed behaviors. While it is important to educate the next generation of fertilizers, dog walkers, septic cleaners, and car washers, we need to directly influence the boomer generation now.

Keep the watershed message simple and funny. Watershed education should not be preachy, complex, or depressing. Indeed, the most effective outreach techniques combine a simple and direct message with a dash of humor. Some useful guidance on these techniques can be found in CSG, 1999.

Make information packets small, slick and durable. Watershed educators continually struggle with how to impart detailed information to residents on practicing the watershed ethic without losing their interest. The trick is to avoid the ponderous and boring watershed handbook that looks great to a bureaucrat but ends up lining a residential bird cage or litter box. One solution is to create small, colorful and durable packets that contain the key essentials about watershed behaviors and direct contact information to get better advice. These packets can be stuck on the refrigerator, the kitchen drawer or the workbench for handy reference when the impulse for better watershed behavior strikes. A particularly good example is provided in Figure 2.

Educate private sector allies. A wide number of private sector companies stand to potentially benefit from changes in watershed behavior. Better watershed behavior can drum up more sales for some companies, such as septic tank cleaners, commercial car washes, and quick oil change franchises, although these groups may need some help in crafting their watershed marketing pitch.

Clearly, the potential exists for lawn care companies and landscaping services to shift their customers toward more watershed-friendly practices. Nationally, lawn care companies are used by seven to 50% of consumers, depending on household income and lot size. Lawn care companies can exercise considerable authority over which practices are applied to the lawns

they tend, as long as they still produce a sharp looking lawn. For example, 94% of lawn care companies reported that they had authority to change practices, and that about 60% of their customers were "somewhat receptive to new ideas" according to a Florida study (Israel *et al.*, 1995). De Young (1997) also found that suburban Michigan residents expressed a high level of trust in their lawn care company.

Indeed, a small but rising proportion of lawn care companies feel that environmental advertising makes good business sense and can increase sales (Israel *et al.*, 1995). Clearly, intensive training and certification will be needed to ensure that watershed-friendly ads reflect good practice and not just slick salesmanship. It needs to be acknowledged that lawn care companies that are strongly committed to practices that reduce fertilizer and pesticide inputs need to be strongly endorsed by local government.

Right now, it is not likely that such companies are being chosen by the average consumer, who primarily relies on direct mail, word of mouth and cost when choosing a lawn care company (Swann, 1999 and AMR, 1997). For example, in the Chesapeake Bay survey, only 2% of residents indicated that they had chosen a lawn care company primarily on the basis that it was "environmentally friendly" (Swann, 1999).

Lawn and garden centers are another natural target for watershed education. Study after study indicates that product labels and store attendants are the primary and almost exclusive source of lawn care information for the average consumer who takes care of his or her own lawn. At first glance, national retail chains should be strongly opposed to better watershed behavior, since it could sharply cut into lawn and garden product sales and the lucrative profits they produce (even at the expense of the community and environmentally friendly image they often market). The key strategy is to substitute watershed-friendly products for ones that are not, and to offer training for the store attendants at the point of sale on how to use such products.

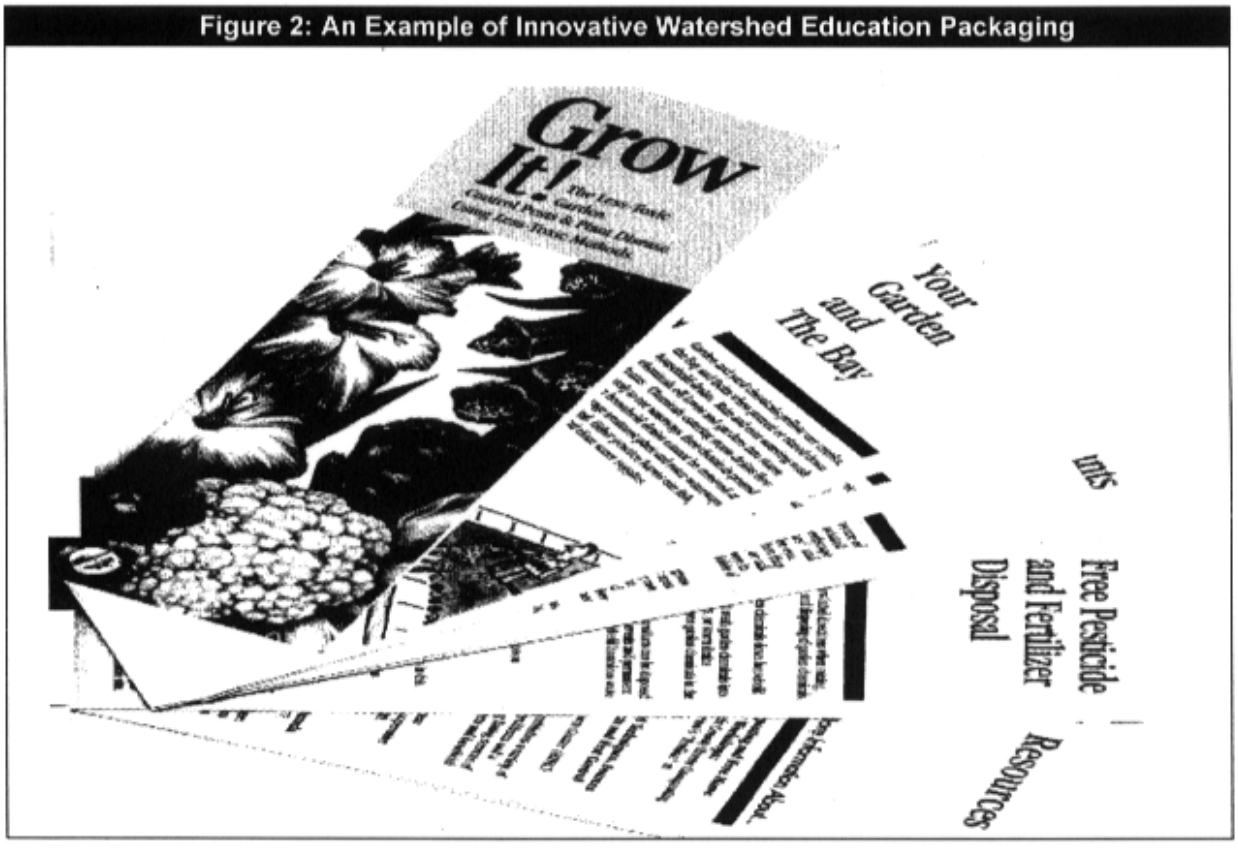
Summary

Aldo Leopold summed up his opinion of what he termed "conservation education" in a 1942 essay entitled *Land Use and Democracy*:

> *Conservation education, in facing up to its task, reminds me of my dog when he faces another dog too big for him. Instead of dealing with the dog, he deals with a tree bearing his trademark. Thus, he assuages his ego without exposing himself to danger.*

It can be said that our watershed education efforts are still in the "little dog" category. It is doubtful we can expect to protect or improve the quality of our urban watersheds until we shift our attention from the tree, and squarely confront the bigger dog. ***-TRS***

Figure 2: An Example of Innovative Watershed Education Packaging



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Appendix C

CHAPTER 3

CODE AND ORDINANCE WORKSHEET

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 4. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and may be hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their

Table 4: Key Local Documents that will be Needed to Complete the COW

Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable.

Table 5 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles.

The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule.

The questions require either a yes or no response or a specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This **"Time to Assess"** allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles.

Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Table 5: Local, State, and Federal Authorities Responsible for Development in Your Community

Development Responsibility		State/Federal	County	Town
Sets road standards	Agency:			
	Contact Name:			
	Phone No.:			
Review/approves subdivision plans	Agency:			
	Contact Name:			
	Phone No.:			
Establishes zoning ordinances	Agency:			
	Contact Name:			
	Phone No.:			
Establishes subdivision ordinances	Agency:			
	Contact Name:			
	Phone No.:			

Table 5: Local, State, and Federal Authorities Responsible for Development in Your Community (Continued)

Development Responsibility		State/Federal	County	Town
Reviews/establishes stormwater management or drainage criteria	Agency:			
	Contact Name:			
	Phone No.:			
Provides fire protection and fire protection code enforcement	Agency:			
	Contact Name:			
	Phone No.:			
Oversees buffer ordinance	Agency:			
	Contact Name:			
	Phone No.:			
Oversees wetland protection	Agency:			
	Contact Name:			
	Phone No.:			
Establishes grading requirements or oversees erosion and sediment control program	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves septic systems	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves utility plans (e.g., water and sewer)	Agency:			
	Contact Name:			
	Phone No.:			
Reviews/approves forest conservation/ tree protection plans?	Agency:			
	Contact Name:			
	Phone No.:			

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 average daily trips (ADT)? _____ feet

*If your answer is between **18-22 feet**, give yourself **4** points* **L** ☐

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)? YES/NO

*If your answer is **YES**, give yourself **3** points* **L** ☐

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length? YES / NO

*If your answer is **YES**, give yourself **1** point* **L** ☐

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street? _____ feet

*If your answer is **less than 45 feet**, give yourself **3** points* **L** ☐

Does the code allow utilities to be placed under the paved section of the ROW? YES / NO

*If your answer is **YES**, give yourself **1** point* **L** ☐

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs? _____ feet

*If your answer is **less than 35 feet**, give yourself **3** points* **L** ☐

*If your answer is **36 feet to 45 feet**, give yourself **1** point* **L**

Can a landscaped island be created within the cul-de-sac? YES / NO

*If your answer is **YES**, give yourself **1** point* **L** ☐

Are alternative turn arounds such as "hammerheads" allowed on short streets in low density residential developments? YES / NO

*If your answer is **YES**, give yourself **1** point* **L** ☐

Community Codes and Ordinances Worksheet *Subtotal Page 15* ☐

5. Vegetated Open Channels

Are curb and gutters required for most residential street sections? YES / NO

*If your answer is **NO**, give yourself **2** points* ***L*** ☐

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L*** ☐

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft^2 of gross floor area)? _____ spaces

*If your answer is **less than 3.0 spaces**, give yourself **1** point* ***L*** ☐

What is the minimum required parking ratio for shopping centers (per 1,000 ft^2 gross floor area)?

*If your answer is **4.5 spaces or less**, give yourself **1** point* ***L*** ☐

What is the minimum required parking ratio for single family homes (per home)? _____ spaces

*If your answer is **less than or equal to 2.0 spaces**, give yourself **1** point* ***L*** ☐

Are your parking requirements set as maximum or median (rather than minimum) requirements? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L*** ☐

7. Parking Codes

Is the use of shared parking arrangements promoted? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L*** ☐

Are model shared parking agreements provided? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L*** ☐

Are parking ratios reduced if shared parking arrangements are in place? YES / NO

*If your answer is **YES**, give yourself **1** point* **L**

If mass transit is provided nearby, is the parking ratio reduced? YES / NO

*If your answer is **YES**, give yourself **1** point* **L**

8. Parking Lots

What is the minimum stall width for a standard parking space? _____ feet

*If your answer is **9 feet or less**, give yourself **1** point* **L**

What is the minimum stall length for a standard parking space? _____ feet

*If your answer is **18 feet or less**, give yourself **1** point* **L**

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars? YES / NO

*If your answer is **YES**, give yourself **1** point* **L**

Can pervious materials be used for spillover parking areas? YES / NO

*If your answer is **YES**, give yourself **2** points* **L**

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots? YES / NO

*If your answer is **YES**, give yourself **1** point* **L**

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped? YES / NO

*If your answer is **YES**, give yourself **2** points* **L**

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed? YES / NO

*If your answer is **YES**, give yourself **2** points* **L**

@ **Time to Assess:** Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 15 _____ +Subtotal Page 16 _____ +Subtotal Page 17 _____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

11. Open Space Design

Are open space or cluster development designs allowed in the community? YES / NO

*If your answer is **YES**, give yourself **3** points* ***L***

*If your answer is **NO**, skip to question No. 12*

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Are the submittal or review requirements for open space design greater than those for conventional development? YES / NO

*If your answer is **NO**, give yourself **1** point* ***L***

Is open space or cluster design a by-right form of development? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g, setbacks, road widths, lot sizes) YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Community Codes and Ordinances Worksheet *Subtotal Page 18*

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L*** ☐

What is the minimum requirement for front setbacks for a **one half (½) acre** residential lot? _____ feet

*If your answer is **20 feet or less**, give yourself **1** point* ***L*** ☐

What is the minimum requirement for rear setbacks for a **one half (½) acre** residential lot? _____ feet

*If your answer is **25 feet or less**, give yourself **1** point* ***L*** ☐

What is the minimum requirement for side setbacks for a **one half (½) acre** residential lot? _____ feet

*If your answer is **8 feet or less**, give yourself **1** points* ***L*** ☐

What is the minimum frontage distance for a **one half (½) acre** residential lot? _____ feet

*If your answer is **less than 80 feet**, give yourself **2** points* ***L*** ☐

13. Sidewalks

What is the minimum sidewalk width allowed in the community? _____ feet

*If your answer is **4 feet or less**, give yourself **2** points* ***L*** ☐

Are sidewalks always required on both sides of residential streets? YES / NO

*If your answer is **NO**, give yourself **2** points* ***L*** ☐

Are sidewalks generally sloped so they drain to the front yard rather than the street? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L*** ☐

Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L*** ☐

Community Codes and Ordinances Worksheet *Subtotal Page 19* ☐

14. Driveways

What is the minimum driveway width specified in the community?

*If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2** points* ***L***

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Can a "two track" design be used at single family driveways? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Are shared driveways permitted in residential developments? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space? YES/NO

*If your answer is **YES**, give yourself **2** points* ***L***

Are open space areas required to be consolidated into larger units? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Does a minimum percentage of open space have to be managed in a natural condition? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Are allowable and unallowable uses for open space in residential developments defined? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Can open space be managed by a third party using land trusts or conservation easements? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas? YES / NO

*If your answer is **YES**, give yourself **2** points* **L**

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops? YES / NO

*If your answer is **YES**, give yourself **2** points* **L**

@ **Time to Assess:** Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 18 _____ +Subtotal Page 19 _____ +Subtotal Page 20 _____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

17. Buffer Systems

Is there a stream buffer ordinance in the community? YES / NO

*If your answer is **YES**, give yourself **2** point* **L**

If so, what is the minimum buffer width? _____ feet

*If your answer is **75 feet or more**, give yourself **1** point* **L**

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? YES / NO

*If your answer is **YES**, give yourself **1** point* **L**

Community Codes and Ordinances Worksheet *Subtotal Page 21*

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Does the stream buffer ordinance outline allowable uses? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Does the ordinance specify enforcement and education mechanisms? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Do reserve septic field areas need to be cleared of trees at the time of development? YES / NO

*If your answer is **NO**, give yourself **1** point* ***L***

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

Are there effective design criteria for stormwater best management practices (BMPs)? YES / NO

*If your answer is **YES**, give yourself **1** point* ***L***

Can stormwater be directly discharged into a jurisdictional wetland without pretreatment? YES / NO

*If your answer is **NO**, give yourself **1** point* ***L***

Does a floodplain management ordinance that restricts or prohibits development within the 100 year floodplain exist? YES / NO

*If your answer is **YES**, give yourself **2** points* ***L***

@ **Time to Assess:** Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of **24** points available for Principles 17 - 22. What was your total score?

Subtotal Page 21 _____ +Subtotal Page 22 _____ +Subtotal Page 23_____ =

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

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_____

To determine final score, add up subtotal from each **@ Time to Assess**

Community Codes and Ordinances Worksheet *Subtotal Page 23*

Principles 1 - 10 (Page 18)	
Principles 11 - 16 (Page 21)	
Principles 17 - 22 (Page 23)	
TOTAL	

SCORING (A total of **100** points are available):

See Page 10 to determine where your community's score places in respect to the site planning roundtable Model Development Principles:

Your Community's Score		
90- 100	L	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	L	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	L	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	L	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	L	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.