PRETTYBOY WATERSHED

Source Water Stewardship
Exchange Team Report

AUGUST, 2003

TABLE OF CONTENTS

INTRODUCTION

THE STEWARDSHIP EXCHANGE WEEK AND TEAM MEMBERS

The Trust for Public Land (TPL), in partnership with the University of Massachusetts and the USDA Forest Service, is conducting Source Water Stewardship Projects in four pilot watersheds throughout the Eastern United States to demonstrate land conservation and forest management practices for source water protection. This project is designed to integrate and build upon work already underway in each of the four watersheds, such as state source water assessments and other local planning efforts. Although the partners have been funded to provide technical project support, the Source Water Stewardship Project in each watershed is locally led and driven.

The Source Water Stewardship Project consists of three phases:

- Phase I: Analysis and Assessment
- Phase II: Stewardship Exchange
- Phase III: Implementation

During Phase II of the Source Water Stewardship Project, a team of five experts with the backgrounds requested by the local committee volunteered to participate in a one-week Stewardship Exchange in the Prettyboy Watershed. (Biographies for each of the Exchange Team Members can be found in Appendix A.) The purpose of the exchange, which was held the week of April 6, 2003 was to:

- Conduct a broad assessment of the watershed,
- Identify actual and potential impacts to water quality, and
- Develop suggested strategies and actions to address existing and possible future impacts.

Participants in the Exchange Team included:

Patricia Engler, a Resource Conservationist with the USDA Natural Resources Conservation Service in Maryland.
Mark Gutshall, president of the Pennsylvania-based LandStudies Inc., who has a diverse professional background in ecological restoration and community-based planning.
Paul Jacobson, Ph.D. in Limnology, is a co-founder and the managing partner of Langhei Ecology, a consulting firm specializing in the application of ecology and quantitative methods to environmental management and regulatory compliance.
Jeffrey Nield, a Senior Environmental Planner in the Sustainable Watersheds Office of the Rhode Island Department of Environmental Management.
John Potter, a forester with the New York City Department of Environmental Protection's Bureau of Water Supply, currently the Director of Land Management in the Division of Watershed Lands and Community Planning.

In addition to the five exchange team members, ***Julie Enger,*** Project Manager with the Trust for Public Land's Chesapeake Bay Office, and ***Will Abberger,*** Associate Director with the Trust for Public Land's Conservation Finance Department, served as resources to the team throughout the week, assisting with the formation of recommendations relating to land conservation and finance.

The local committee coordinated roundtables and meetings during the week that exposed the team members to extensive information on source water issues affecting the watershed. Throughout the week,

local committee members met with Exchange Team members for in-depth public discussions of watershed issues in areas such as agriculture, land use/development and forestry. The team members also reviewed locally-supplied maps and written materials (listed below under "Background"). At the weeks' end they developed specific recommendations to address key problems identified through the week of information gathering. The Exchange Team's recommendations will be the basis for Phase III, the implementation of recommended strategies by local groups and agencies, in cooperation with TPL and various state and federal agencies.

A PREAMBLE FROM THE TEAM

The identity of the Prettyboy Watershed exists in the minds of the people that live within it. Its identity represents something special to the people who drink the water that collects in it, as well as those people who manage the watershed. We might then say it has many identities: Like the rain that falls on the land in its headwaters, the identity of the Prettyboy Watershed changes character as the topography changes.

The Prettyboy Watershed is many things to many people: It is a workplace – soils, crops, and pastures – making up the farms and the places to raise animals for the sake of livelihoods and to maintain a way of life. It is a place of recreation; a place to walk, run, bike, hike, fish, swim, and pick flowers. It is a place to live…a place where daily lives unfold. It is a backdrop for raising families, maintaining and building homes, for settling down. It is also a basin that collects precious water, filters it, and stores it (with the help of a formidable dam!) in a marvelous reservoir. At this point, it becomes the basis for a healthy life and productive commerce for 1.2 million people in the Baltimore metropolitan area, in addition to its visitors, tourists, commuters, hospital patients, and businesses.

We equate good health with a good quality of life. And, it is indisputable when we say that we all want a good quality of life. Clean water is a foundation of good health. So, if you live in the Baltimore metropolitan area and you drink the water that originates in the Prettyboy, you want the watershed to be in good health; you want there to be enough clean water for you and your family. If you live in the watershed, you too want it to be in good health because you want it to keep its beauty. You want its streams to support swimming and fishing. You want its land to produce and to support your family and your animals. You, too, want there to be enough clean water for you and your family.

One of the overarching project goals that the Exchange Team kept returning to was to help ensure that there is enough clean and safe water for everyone in the watershed and throughout the Baltimore metropolitan area.

This report represents our observations and a series of recommendations to help protect and manage the Prettyboy Watershed. During our one-week visit, we covered many miles, met many people, learned many things. However, it is fair to say that much remains to be learned and to be done.

THE WATERSHED

The Prettyboy Watershed, an 80 square-mile watershed with its headwaters in York County, Pennsylvania, Carroll County, Maryland and Baltimore County, where it flows into the Prettyboy Reservoir. The Prettyboy Reservoir is one of three reservoirs in the Baltimore Metropolitan System that collectively provide water to 1.8 million consumers in Baltimore City, Baltimore County, Howard County, Harford County and Anne Arundel County. The City of Baltimore's Department of Public Works manages the system. The Prettyboy and Loch Raven Reservoirs, which are both located in the Gunpowder Watershed and are managed as an integrated system, serve approximately 1.2 million people. Raw water is not withdrawn from Prettyboy. Prettyboy provides additional capacity for Loch Raven, located to the southeast, which is the site of the raw water intake.

In addition, throughout the watershed there are both public and private wells that are hydrologically linked to the Prettyboy Reservoir. There are two public water systems in Carroll County that supply groundwater to residents in Manchester and Hampstead. In the York County portion of the watershed, there are no community water systems.

Current land use reflects more than three centuries of social, economic and demographic change. At present, the watershed has about 15 percent developed land, 47 percent agricultural land (dominated by cropland at 37 percent) and 38 percent forests, wetlands, and water (dominated by forests at 34 percent). The largest contiguous block of forest borders the Prettyboy Reservoir and is on land owned by Baltimore City; the remainder is fragmented into patches by agricultural and low-density residential land use.

Land use is converting from farms and forests to home sites, as residential development spreads out from the Baltimore suburbs and along the Route 30, primarily in Manchester and Hempstead and further north in Pennsylvania. The loss of forests, farms and riparian vegetation, coupled with increased stormwater runoff, septics, the impacts of roads and increasing deer populations, has caused concerns about water quality and the future protection of this vital source of drinking water.

BACKGROUND

The team reviewed a number of studies, reports and other documents and was briefed by a wide range of local officials and other stakeholders in developing its assessment. It should be noted that the team was impressed with the level of cooperation, support, openness, and leadership from local organizations and individuals associated with the Stewardship Exchange week, and appreciated the level of preparation and involvement demonstrated prior to and during the week of study. A summary list of the information provided to the team included:

- "Reservoir Watershed Benthic Macroinvertebrate Monitoring and Stream Habitat Assessment, Stream Data Summary Report," City of Baltimore, Department of Public Works, Bureau of Water and Wastewater Environmental Services Division, Reservoir Natural Resources Section. January 2002.
- "Reservoir Water Quality Assessment for Loch Raven, Prettyboy and Liberty Reservoirs." City of Baltimore Department of Public Works, Bureau of Water and Wastewater, Environmental Services Division, Water Quality Management Section. June 2001.
- "Prettyboy Watershed, Source Water Issues Report," Prepared by the Trust for Public Land, University of Massachusetts and USDA Forest Service for the Source Water Stewardship Project. December 2002.
- Permits and Development Management Policies Nos. II.a Through II.g, Baltimore County.
- Concept Plan Requirements. Baltimore County, Department of Permits and Development Management.
- "Environmental Resources Element of the Manchester Comprehensive Plan." Prepared by Carroll County Department of Planning. Adopted June 10, 1997.
- "Stewardship Exchange Briefing: Land Development Characteristics in Baltimore and Carroll Counties." Prepared by Baltimore County DEPRM, March 2003.
- "A comprehensive forest conservation plan for long-term watershed protection on the City of Baltimore's reservoirs." 2001. MD Department of Natural Resources.
- "Water quality functions of riparian forest buffer systems in the Chesapeake Bay watershed." 1995. EPA 903-R-95-004.
- Forest statistics of Maryland: 1986 and 1999. 2001 USDA Forest Service, NE-154.

- "Drinking water from forests and grasslands: a synthesis of the scientific literature." 2000. USDA Forest Service, SRS-39.
- "State Forest Conservation Technical Manual." 1997. MD Department of Natural Resources.
- "A guide to Maryland regulation of forestry and related practices." 2001. MD Department of Natural Resources.
- "Forest harvest operations and best management practices." 1992. MD Department of Natural Resources.
- Soil Survey: Baltimore County MD. 1976. USDA Soil Conservation Service.
- Soil Survey: Carroll County MD. 1969. USDA Soil Conservation Service.
- Maps of the stream network and reservoirs in Baltimore and Carroll Counties.
- Maps of current land cover, zoning, city watershed property and easement property.

FINDINGS

Although the Prettyboy Watershed remains more rural than the Loch Raven or Liberty Watersheds, land use in the watershed is undergoing change that will degrade water resources over time if protective action is not taken now. The Maryland Department of the Environment has characterized the Prettyboy Reservoir as impaired by nutrients and more than 50 percent of samples exceed the phosphorous criterion for eutrophication. Current data reveals signs of stress and degradation from land use in some tributaries; however, there is a lack of water quality data for many tributaries. According to "Reservoir Watershed Benthic Macroinvertibrate Monitoring and Stream Habitat Assessment," Graves Run and Georges Run, rated lowest on the habitat assessment, with an overall rating of 'Fair;' however, the monitoring stations used for this study are fixed on the main tributary and may not reflect conditions upstream.

As development continues along Route 30 and on the outskirts of the Baltimore metropolitan area, the impact on the health of the Prettyboy Watershed could be significant. Given current zoning, over 3,000 more homes could be built in the watershed, mostly in Carroll County, where development rates have exceeded Baltimore County for decades.

There is much reason to be optimistic that action can be taken now to maintain and improve water quality in the Prettyboy Watershed. As the most rural of the three reservoir watersheds, the Prettyboy Watershed remains at a threshold where further development could have significant impacts on water quality, and where protection and restoration strategies remain cost effective.

- Land protection strategies are less costly in rural areas (fewer dollars can be stretched further), and can be more effective because there are larger parcels and fewer landowners. Protection can also have greater tangential benefits to the ecosystem in a less developed watershed.
- The greater number of forested and undeveloped parcels in the watershed offers protection opportunities that can have a significant long-term contribution to water quality and lower treatment costs.[1]
- The protected forest adjacent to the Reservoir provides an excellent buffer to the Reservoir and several of its major tributaries, and offers opportunities for improving forest management in the watershed on a large scale.

In general, restoring a degraded watershed is more expensive than protecting a clean one, and addressing stormwater management (runoff from developed areas) is even more expensive than protecting or restoring

[1] Multiple studies have shown that forests play a significant role in maintaining water quality and thereby reducing treatment costs, including the following recently released report: *Running Pure: The importance of forest protected areas to drinking water,* The World Bank/WWF Alliance, August, 2003.

undeveloped land, as it often requires costly structural improvements. In order to make the most of limited dollars, opportunities should be pursued to protect existing natural resources before they are degraded.

The political climates in Carroll and Baltimore Counties are conducive to a more progressive approach to land protection and growth management. Furthermore, the City's Department of Public Works has a history of being proactive and is receptive to taking on an even broader role in watershed protection strategies to protect its reservoirs. Additionally, Baltimore County has exceptional spatial data and data-analysis capabilities. Baltimore County personnel are a potential technical resource for watershed-wide data analysis, supporting targeted and effective action on the ground.

Although communities in the headwaters may not be as interested in protecting water resources for the benefit of drinking water, as they do not drink surface water, they may be interested in protecting environmental resources to protect their quality of life and community character, which are equally threatened by the conversion of farms and forests to new development. Eventually, their use of the waterways for fishing and swimming may be limited due to pollution concerns, but it would be irresponsible to wait for such an incentive to protect critical community resources.

Currently, all of the local jurisdictions are undertaking actions that protect the watershed. In particular, agricultural preservation programs have been very successful. These actions, however, are undertaken on a county-by-county basis, and it does not appear that there is a coordinated effort to use land protection to achieve water quality goals. The Reservoir Agreement, an inter-jurisdictional agreement that outlines actions for protecting the reservoirs, provides a framework for coordination; however, additional inter-jurisdictional collaboration and leadership is still needed.

There is no known water quality crisis at the moment; however, the reservoir agreement, the desire to protect rural resources, the benefits of lower treatment costs, and impending federal TMDL requirements, which are expected to be adopted in the near future, provide incentives for local governments to work together proactively to protect water resources. Land protection, growth control, forest management and riparian restoration will be key components of a future multiple-barrier approach to protecting source water.

OVERARCHING THEMES

PUBLIC EDUCATION AND AWARENESS

Implementing successful watershed protection strategies, whether regulatory or voluntary, requires a high degree of public awareness of basic watershed functions and threats to water quality and quantity. People living and/or working in the watershed need to know that their actions and land management practices affect watershed health; and people who drink the water need to know where their water comes from and to understand the threats to that source.

Any effort to build public involvement in water resource protection in headwater communities would need to take into consideration the interests of the residents living in the watershed. They have not in the past, and will not likely in the future, be interested in protecting water resources for the benefit of people drinking the water in the Baltimore metropolitan area. However, they may be interested in protecting their own drinking water or in protecting water resources for the health of their livestock, for safe and high quality fishing and swimming, and for the sake of protecting their environment and the quality of their lives. The issues that resonate most with local voters must be the issues that drive local watershed protection strategies.

Increased public awareness and education is a necessary component of each recommendation in this report. Without awareness of the issues and threats, citizens are less likely to take responsibility for and ownership of their watershed by implementing best management practices on their land, supporting funding or regulatory measures, participating in conservation programs or volunteering to monitor or make improvements to their watershed.

WORKING ON A SMALLER SCALE

In order to educate and mobilize citizen groups, local governments and existing nonprofit organizations need to find ways to involve residents in an area of the watershed to which they are most likely to relate – a sub-watershed, stream, lake or even pond. In general, citizens are more likely to take ownership of efforts to protect areas closest to their home and most familiar to them. Where people share the same school, churches and stores, and are involved with similar community and civic activities, they have sense of place and a greater connection to the land.

Smaller, sub-watersheds often provide the most effective scale for management and citizen action, such as the Graves Run sub-watershed. On a sub-watershed scale, residents can organize with their neighbors to protect their shared resource through landowner outreach, education and coordination, private funding, and volunteer restoration and monitoring efforts.

Implementation efforts can also benefit from action focused at the scale of a small sub-watershed, where resources can be focused and monitoring can be implemented to demonstrate measurable changes. Measurable results will, in turn, lead to additional resources and more effective targeted action throughout the broader Prettyboy watershed. Successful action on the part of a few citizen-led watershed groups will provide a stimulus for the proliferation of additional efforts.

TEAM RECOMMENDATIONS

The team organized its recommendations into four sections: (1) Understanding the Watershed, (2) Inter-jurisdictional Coordination and Partnership Building, (3) Land Conservation, and (4) Land Management. The team based its recommendations on the strengths of local agencies and organizations, and attempted to build on existing efforts. Their ideas stemmed from the wealth of information made available to them. The team limited itself to making strategic and action-oriented recommendations on issues about which they felt informed and for which they had the necessary expertise; however, the recommendations are, by necessity, based on the information and observations from only one week of study. The recommendations are intended to offer a fresh, outside perspective, integrating a variety of national best practices, but the team and the Trust for Public Land assume that local participants will review the recommendations and choose to implement those that they feel are most important and implementable, based on their knowledge.

Maps prepared by the University of Massachusetts for the stewardship exchange, are included in Appendix C. (If you are downloading this report from the web, all maps are included in a document that can be downloaded separately from the same web location.) These maps identify priority areas for land protection, restoration and stormwater management in the Prettyboy Watershed. The darkest hues on the maps are the areas with the greatest potential importance for source water pollution prevention or mitigation. These maps were created with publicly available data layers that could be consistently applied across all three counties, including soils, slopes and land use, among others.

A map prepared by Baltimore County for their portion of the watershed is included in Appendix D. This map differs from the University of Massachusetts maps in that conservation and restoration priorities are combined in a matrix and each parcel is scored simultaneously for its value for each. Also, these maps include zoning, tax parcel boundaries and protected land, and do not include soils.

As is always the case with mapping and modeling efforts, the results must be ground-truthed, meaning that identified parcels must be physically inspected to ascertain their value. The high-priority areas identified on the maps are intended to focus on-the-ground efforts in the specific areas of the watershed having the greatest potential importance for source water protection.

UNDERSTANDING THE WATERSHED

OBSERVATIONS

Substantial technical capability exists in the jurisdictions encompassed and served by the Prettyboy Reservoir Watershed, particularly at the county and state level. As a result, a great deal of data has been collected and analysis has been completed on the watershed since the signing of the original Reservoir Agreement in 1979. Furthermore, the Reservoir Agreement has fostered technical collaboration across jurisdictional lines. Because of the importance of the three reservoirs as the primary source of drinking water for the Baltimore metropolitan area, state and federal resources have also been committed to understanding these regionally significant watersheds.

As is often the case with many watersheds that cross multiple local and state boundaries, the availability and quality of data is not consistent across jurisdictions. This makes it more difficult to estimate the quantitative relationships between actions on the land, such as development, forest loss and land management, and their impacts on water quality. Additionally, existing monitoring is not sufficient to document current conditions and changes in the health of the many tributaries that feed the reservoir.

In order to make land protection and land management decisions that will yield the greatest benefit to water quality, local communities need to have a better understanding of the biophysical system and of the threats to beneficial functioning of that system. Effective assessment and management must be undertaken within a spatially-explicit, or landscape, framework.

RECOMMENDATIONS

The following recommendations focus on the need for further analysis of existing information and for the collection and analysis of additional information, in order to facilitate targeted action strategies.

1. **Enhance the analysis of existing information** -- Enhance and apply quantitative tools to improve the understanding of the connection between land cover and land management and their impact on water quality. In order to identify where and how land protection, restoration and improved management can contribute most significantly to improving water resources, there needs to be a better understanding of how existing land cover, land use and management practices are affecting water quality. The counties and City of Baltimore should collect additional information and recommend that the Maryland Department of Environment make use of it in TMDL models.

   One example would be to expand on the analysis of the relationship between forest cover and dry weather total phosphorous concentrations in reservoir tributaries (Figure A; Baltimore DPW 2001[2]). The existing analysis shows that total phosphorus concentrations are lower in tributaries draining catchments with higher percentages of forested land cover. This analysis is extremely valuable in showing the critical role that forests play in maintaining water quality; however, it could be greatly enhanced by including wet-weather conditions and flow information to rigorously quantify effects of forest cover on phosphorus loading. Information on the spatial relationship between forest cover and surface waters is also relevant. Additional analysis of these factors will help communities make more informed decisions about how much forest cover is "enough" and where the highest-priority areas are for protection in order to reach specific water quality goals

2. **Enhance monitoring and assessment efforts**. A water quality baseline needs to be established in order to document future changes as a result of land conversion (forest to residential) and land management (buffers, BMPs). Without a baseline it will be difficult to track if and when changes in land use and land management are either improving or degrading water quality.

   Technical tools need to be strengthened in order to better document land-water interactions. This includes improved input data and parameterization of watershed models appropriately scaled for management of sub-watersheds. Technical tools, such as in-stream/in-lake dataloggers can be installed with weather/flow gauging stations to monitor daily, weekly and monthly changes in the system and to provide long-term baseline data.

   There needs to be a long-term commitment to monitoring that is consistent across jurisdictions and integrated into existing programs. The results of the monitoring must be physically and conceptually accessible to all parties, including the lay public, in order to encourage land protection and management strategies that can be linked to water quality goals.

   Monitoring by citizen volunteers, particularly of surface water, is an excellent way to educate the public on the link between land use and water quality, in order to build a constituency that can advocate for water resource protection and help with restoration efforts. Volunteer groups, such as watershed

[2] City of Baltimore, Department of Public Works. June 2001. Reservoir Water Quality Assessment for Loch Raven, Prettyboy and Liberty Reservoirs.

watchers or stream teams, can cover vast lengths of streams with seasonal water quality monitoring to serve as long-term baseline testing.

a) **Surface water monitoring** – Currently, lake water quality is relatively well-understood; however, there is insufficient high-quality data for the tributaries. A surface water monitoring program should incorporate the following:
   - Watershed-wide: Monitoring should be conducted throughout the watershed and consistently across jurisdictions to provide a clear picture of the condition of each sub-basin, and thereby target restoration and protection efforts more effectively.
   - Probability-based AND fixed station components: Probability-based sampling (random selection of sampling locations) will support statistical inferences beyond the sample sites, while fixed-station sampling will allow monitoring of changes over time at key locations that can be identified as a priority.
   - Physical, chemical and biological monitoring: Physical monitoring assesses the stability of the channel and the streams vulnerability to erosion. Chemical monitoring provides data on the instantaneous concentrations of pollutants of interest at the time the sampling occurs – a snapshot of water quality. Biological monitoring assesses how water quality is affecting the condition of the stream over time, by examining the macro invertebrate or fish community to assess the aggregate impact of all stressors potentially affecting the stream.
   - Dry AND wet-weather monitoring: Most loading of pollutants to surface waters occurs during brief episodes of wet weather; therefore, chemical monitoring that is limited to dry weather may not capture the most significant pollutant loads.

b) **Ground water monitoring** -- A ground water monitoring effort should include the following, some of which may already be monitored:
   - All existing and new community wells.
   - Residential areas with old and potentially failing septic systems: Lineboro was identified as potential focus for further analysis.
   - Spray irrigation sites: These sites are potentially significant contributors of nutrients.

3. **Develop consistent GIS data layers across political jurisdictions**. Excellent data layers have been developed for Baltimore County, but not for Carroll or York Counties. These layers are important to creating consistent maps that can guide conservation and restoration activities throughout the watershed. Greater benefits will accrue from developing data layers for Carroll and York Counties comparable to those already developed for Baltimore County than from further development of Baltimore County's database. Improved knowledge of the Carroll County and York County portions of the watershed would also benefit Baltimore City and Baltimore County.

   Some of the key data layers that need to be developed for all jurisdictions include:
   - Digital parcel data, i.e. digital tax maps that show every lot.
   - Natural resources coverage, including all water resources, forest resources, soils, etc.
   - Updated protected areas and 'program lands' coverage, i.e. what is protected, has an easement or is under some sort of conservation program.

4. **Ground truth existing maps and assessment results**. Watershed maps generated by this project point to potential areas of high priority for protection and restoration, but these areas need to be inspected on the ground to verify land uses, stream condition and health, and to identify specific sites for action.

5. **Implement a stream channel stability study.** Upstream migration of channel instabilities can undercut riparian forest restoration efforts, both literally and figuratively. Channel erosion is also a source of sedimentation and nutrient loading. A stream channel stability survey will identify stream segments in need of stabilization and restoration measures.

INTER-JURISDICTIONAL COORDINATION AND PARTNERSHIP BUILDING

OBSERVATIONS

Prettyboy Reservoir Watershed communities are fortunate to have a high level of agency knowledge and history of coordination in the watershed. These assets create a foundation for building stronger partnerships focused on water resource protection in the future.

Among local government and nonprofit stakeholders in the watershed, there is a great deal of institutional knowledge, experience and wisdom. In particular, the lessons learned from the management of Liberty and Loch Raven Reservoirs can provide an excellent starting point for the protection and management of the Prettyboy Reservoir.

The Reservoir Watershed Management Agreement is an excellent "point of departure" for inter-jurisdictional coordination. The Reservoir Watershed Protection Committee and the Reservoir Technical Group currently serve as inter-jurisdictional forums for information exchange and coordination. These groups can be built upon to include a broader network of stakeholders.

As the primary source of drinking water for the residents of the Baltimore metropolitan area, communities in the reservoir watersheds can benefit from having the City of Baltimore Department of Public Works (DPW) as a major stakeholder and resource for watershed improvements. Baltimore DPW has an interest in managing water quality and has shown in the past that it has the capacity to protect and manage water resources in partnership with county and state governments. Because Baltimore County receives water revenues from the system, they should also be looked to as a resource for watershed investments.

According to surveys, citizen interest and awareness is on the rise; however, public education and awareness-building remain critical to protecting the reservoir through better land management.

RECOMMENDATIONS

The following recommendations focus on the need to build on the Reservoir Agreement to increase the involvement of a wider network of key stakeholders, to build public involvement in the management of the Prettyboy Reservoir Watershed and to strengthen the City of Baltimore's role as a leader and resource in protecting the watershed.

1. **Amend the Reservoir Agreement to expand its membership --** As the primary mechanism for coordination it may be amended to include other partners and stakeholders, such as York County, the Towns of Westminster, Manchester and Hampstead, newly-formed and existing watershed organizations, user groups (Trout Unlimited, etc), citizens and landowner groups (Prettyboy Mason Dixon Conservancy), and representatives from the farming community (including animal operations and crops, Farm Bureau or Agricultural Commission).

2. **Create a Prettyboy Watershed Management Group --** The purpose of this group would be to create a forum for expanded citizen and private sector involvement in and ownership of the management of

the Prettyboy Watershed. Over time, these strategies could contribute to an increased watershed identity among local residents. This group could be a subcommittee to the Reservoir Watershed Protection Committee and could consist of landowners, particularly farmers and woodlot owners, developers, watershed associations, land trusts, as well as representatives from towns in the watershed and county and state governments. In particular, this group should reach out to additional individuals and organizations from York County, Pennsylvania, who are willing to collaborate, such as the York Watershed Alliance. This entity could be called a "management group," "council," or "committee" – whatever title is most appropriate.

3. **Identify a Coordinator(s) --** Communication, information exchange and team-building would be the primary roles of the coordinator. This person may be governmental or non-governmental, but should be skilled facilitator/coordinator, not necessarily an engineer. Although it would help to have the position fully-funded with support staff, that could be provided by a governmental entity, such as the City of Baltimore DPW or Baltimore Metropolitan Council, or through public funding to a nonprofit. The coordinator would be the primary liaison for the Prettyboy Watershed Management Group and the rest of the watershed community.

4. **Create a Watershed Assistance Grant Program --** The grant program would be designed to fund watershed protection, restoration and public education projects through the Prettyboy Watershed Management Group. Grant amounts do not need to be significant to raise public awareness, build a volunteer network, encourage private sector ownership and involvement in watershed management, and accomplish on-the-ground restoration activities in the sub-watersheds. Such grants can be used as seed money for newly- forming watershed groups and can encourage the growth of nascent associations. Drinking water revenues could be a potential source of funds for the grant program. A variety of activities could be funded, such as:
    - Volunteer stream and water quality monitoring
    - Small-scale restoration projects
    - Special research projects
    - Public education, outreach and participation campaigns such as the following:
        - Student exchange programs between urban and rural elementary and high school students;
        - Marketing of watershed-based agricultural and forestry products (in urban and densely-populated areas such as Baltimore City) or Baltimore Farmers' Markets for agricultural products grown in the watershed;
        - "Fresh Air" programs to bring urban kids to the watershed for tours of the reservoir.

5. **Increase water utility rates for use in watershed protection and management**. Even with recent water and wastewater utility rate increases, rates remain below the national average. Educational materials should be provided to users to explain purpose of increase and how the money would be used to protect their source waters. Funds could be used for:
    - Small grant program
    - Staffing in City of Baltimore and Carroll and Baltimore Counties for:
        - Additional monitoring
        - Outreach to newer and smaller landowners
        - Forester for reservation lands
        - Staff person for newly formed Prettyboy Watershed Management Group
        - Projects to stabilize and protect critical tributary streams in the watershed.

LAND CONSERVATION

PROTECTING FORESTS

OBSERVATIONS

Forest fragmentation and loss is one of the most critical threats to water quality and biotic integrity in the Prettyboy Watershed. Forests are primarily being removed to make way for new residential development. As many as 4,000 to 6,000 new homes could eventually be built in the watershed under existing zoning. Up to 80 percent of this land conversion will occur in the Gunpowder Falls, Georges Run and Graves Run subwatersheds, which comprise 64 percent of the watershed – primarily in Carroll and York Counties. Only 35 percent of the watershed is currently forested, most of which is in the city-owned forest reservation immediately surrounding the reservoir. The remaining forests in Carroll and York Counties are extremely fragmented.

Land conversion from forests to residential use is impacting water quality by increasing heavy metals (such as lead and cadmium), chlorides (road salt), sediment and potentially phosphorous. Sediment increases as a result of forest clearing, housing construction and increased runoff eroding stream banks. Increased sediment leads to in-fill, which decreases the capacity of the reservoir. Although sediment is not a public health concern by itself, pathogens and other pollutants adhere to sediment and, therefore, increase as sediment levels increase. Increased sediment and the pollutants that adhere to it can also lead to an increase in disinfection by-products (DBP) in the finished water. DBPs result from chlorine interacting with organic matter in the water during disinfection. Because DBPs are a public health concern, federal water quality standards limit the amount that can be in finished water.

RECOMMENDATIONS

Because of the critical role that forests have in maintaining water quality and quantity, and the small percentage of forested land remaining in the watershed, local communities should consider a goal of "no net loss of forest" in the Prettyboy Watershed and an increase in forested land in critical areas, such as riparian corridors.

1. **Identify high-priority forestland and reforestation areas watershed-wide** through additional GIS analysis that builds on existing maps and uses specific criteria for protection and restoration (i.e. slope, soil, adjacency to protected land, etc.) Baltimore County currently has the greatest capacity for implementing such analysis and could take the lead for the other jurisdictions.

2. **Revise criteria for county land preservation programs to prioritize land with forest cover or environmentally sensitive features, regardless of acreage.** All three counties have been very successful in targeting their efforts to protect agricultural land. Broadening the scope of existing programs to include farms with forested lands, woodlots, stream corridors and steep slopes, and adjusting the existing criteria so that such land could be ranked as higher priority for protection could result in additional forest land protection. All three counties have land protection programs that could benefit from revised criteria.

3. **Create "watershed forest" priority zoning overlays to discourage development in high-value forested areas.** In particular, Carroll County and York Townships need to revise zoning to incorporate these protections.

PROTECTING FARMS

OBSERVATIONS

In addition to forests, agricultural land is also being converted to residential use. Although high intensity agriculture can contribute to high pollutant loads, well-managed farms that incorporate best management practices are considered better for water quality than residential development. Watershed monitoring throughout all three reservoir watersheds clearly shows that urban land use is currently the greatest threat to watershed health. Conversion from farming to development can lead to an increase in urban pollutants, such as metals, that can be more difficult or expensive to treat; it can also have significant negative impacts in terms of the loss of community character, lack of sustainable agriculture and loss of open space, such as scenic roadways and historic sites.

Current state and local agricultural preservation programs are very successful. While protecting high-quality agricultural lands, these programs do not directly address land conservation from a water quality standpoint. Further, some agricultural conservation easements may not provide the level of protection that would ensure long-term water quality protection.

RECOMMENDATIONS

Existing agricultural preservation programs, although successful, need to be more consistent with source water protection goals within the Prettyboy Watershed and need to assure better long-term protection and management of easements for water resource protection.

1. **Form a team of agricultural preservation program staff and local land trusts** in order to facilitate information exchange and coordination of watershed protection strategies within the watershed. This could be implemented through the Prettyboy Watershed Management Group or coordinated more informally through an existing entity.

2. **Revise criteria for the Maryland Agricultural Land Preservation Fund (MALPF), and the Rural Legacy Program to prioritize farm land with forest cover or environmentally sensitive features, regardless of acreage.** Current acreage restrictions make most landowners in the Prettyboy ineligible for participation in state programs. Minimum lot size should be lowered or eliminated. Parcels with forest cover or other features beneficial to water quality should be eligible to receive highest priority.

3. **Easement holders (local and state governments) should investigate ways to have third-party protection on easement deeds and consistent monitoring at least annually**. Single-party easements have a greater chance of being violated by future landowners. Third-party protection on easement deeds will reduce the potential for future pressure to lead to modification or removal of protective measures incorporated into easements when they are created. Annual monitoring will ensure that the terms of the easement are met, so that the intended benefits of the easements will be realized.

4. **Conduct a community character inventory in the watershed** and map historic, cultural, recreational and natural resources on a watershed-wide map. The purpose of the inventory and mapping is to raise public awareness of community assets so that informed land use decisions can be made. Source water protection and the protection of community character are inextricably linked, especially in the Prettyboy, where watershed residents do not drink from the reservoir. Their primary motivation for protecting natural resources is to protect the character of their communities and quality of life.

FUNDING LAND CONSERVATION

OBSERVATIONS

There is a great need throughout the Prettyboy Watershed for additional investment in land protection and restoration. Existing programs have been successful, but have not necessarily targeted land with greatest water quality benefit, been sufficient to keep up with rapid growth in the region or addressed the needs of small landowners. There are also a number of funding sources that could potentially be used for conservation that have not been traditionally used for this purpose.

The following recommendations focus on ways to increase funding for existing programs, diversify the types of funding sources being used and create new funding sources.

RECOMMENDATIONS

Local Funding

1. **Create an Installment Purchase Agreement Program (IPA) backed by a dedicated revenue stream (recordation or property tax).** IPAs are used by a number of Maryland counties. Under an IPA, payments to the landowner for a permanent conservation easement are spread out over 20 – 30 years, with the landowner receiving semiannual, tax-exempt interest payments, and a final lump-sum principal payment. Payment of this annual interest requires the establishment of a dedicated revenue stream, most likely the recordation or property tax. In Baltimore County, a 50-cent increase in the recordation tax would raise $3.2 million and in Carroll County, the same increase would raise $800,000 per year. Baltimore County could raise $1 million annually via the property tax, at an average cost per household of $3.22. In Carroll County, raising $1 million annually would cost $20 per household.

2. **Pass General Obligation Bonds**. General obligation bonds are an alternative means to fund land conservation in the Prettyboy Watershed. Both Baltimore and Carroll Counties have used bonds to finance land conservation. In Baltimore County, bond issues require voter approval, whereas in Carroll County, approval by the state legislature is required. Both counties have ample debt-issuing capacity under their legal debt margin. In Baltimore County, a $35 million bond would require just over $3 million annually in debt service and cost the average homeowner $10 per year. In Carroll County, a $10 million bond would require $872,000 per year in debt service and cost the average homeowner $18 per year.

3. **Use Water Revenues to Conserve Land in the Watershed**. Water revenues should be used to protect lands important for drinking water protection in all jurisdictions in the watershed. As noted above, the City of Baltimore utility rates remain below the national average, so an increase in the utility rate may be possible. Educational materials should be provided to users to explain the purpose of the increase and how the money would be used to protect the source water.

State Funding and State Directed Federal Grants

1. **Apply jointly to the State of Maryland to designate Prettyboy Watershed a Rural Legacy Area.** The goal of the state's Rural Legacy Program is to strategically preserve large, continuous blocks of farmland and open space throughout the state. Local governments and land trusts identify Rural Legacy Areas, or rural areas in need of protection, and competitively apply for funds. Rural Legacy Program is a potential source of significant funds for agricultural preservation. The Prettyboy Watershed has not been designated by the state as a Rural Legacy Areas. Carroll and Baltimore Counties should apply jointly to be included in Maryland's Forest Legacy Program.

2. **Apply to the State of Maryland to designate the Prettyboy Watershed part of the Forest Legacy Program.** Forest Legacy provides federal funding through annual appropriations by Congress of Land and Water Conservation funds. Maryland participates in the Forest Legacy Program; however, the Prettyboy Watershed is not included in the program. The State Department of Natural Resources, which administers the program in Maryland, is revising its Forest Legacy plan in 2004, creating an opening for additional communities to apply to participate. The Forest Legacy Program is a potential source of significant funds for forest protection. Carroll and Baltimore Counties should apply jointly.

3. **Apply to Water Quality State Revolving Fund (Clean Water State Revolving Loan Fund) to support land conservation projects.** The Maryland Water Quality Finance Administration administers these federal grants, which allow states to use the funds for a wide range of projects that will improve water quality. Traditionally, Maryland has used these funds primarily for wastewater treatment, but many states, with encouragement from EPA, are using these funds to address nonpoint sources of pollution through land conservation and restoration. Since the WQSRF offers great flexibility to states, Maryland might choose to emulate Ohio EPA's program to pair wastewater treatment projects with land conservation/restoration projects. Under such an arrangement, municipalities pay a reduced interest rate for wastewater treatment projects if they pair up with a non-profit partner on a conservation or restoration project. Maryland could consider the Prettyboy as a demonstration project for such an initiative.

4. **Encourage state to list land acquisition as an allowed set-aside in its Intended Use Plan for the Drinking Water State Revolving Fund**. States have the ability to set aside up to 10% of their annual federal grant for land conservation that protects source water. Maryland has not done this. With an average of $8 million per year, setting aside 10% per year would total $800,000 statewide.

Federal Funding

1. **Apply to Farmland Protection Program (FPP) to fund land conservation projects**. The FPP offers a 50/50 match for Purchase of Development Rights and purchase of conservation easements. The 2002 Farm Bill provides for $600 million for this program over the next five years.

LAND MANAGEMENT

The team focused primarily on farm and forest management issues in the watershed. Although there are certainly land management issues related to residential development, in terms of managing stormwater from new and existing development, there appear to be adequate regulatory strategies for addressing stormwater at the local and state level. It is unclear whether there is sufficient oversight over the implementation and maintenance of stormwater best management practices (BMPs), based on the information the team reviewed. On-going monitoring of existing stormwater BMPs would be necessary to identify potential stormwater management concerns.

FOREST MANAGEMENT

OBSERVATIONS

Neither publicly or privately-owned forests in the watershed are being managed for long-term sustainability or water resource protection. Excessive deer populations (10 times historic levels) have cleared tree seedlings, leaving an "umbrella forest" with no regenerating ability and vulnerable to catastrophic loss of existing stands through disease, pests or fires. According to the forest conservation plan for the reservoir property, over 84 percent of plots have no seedlings, when there should be several thousand seedlings per acre. As a result, forests are generally 60 to 90 year old, even-aged stands of medium quality.

Although there has been some harvesting over the last 20 years on private lands, harvests have not been implemented with regeneration goals in mind. Harvesting has not taken place on the city-owned forest reservation with any consistency in recent years. In general, the minimal forest management that is taking place in the watershed is not being implemented with water quality objectives in mind.

Unhealthy forests do not necessarily present an immediate danger to drinking water supplies; however, they present a significant future danger. Significant loss of forest cover is likely to result in heavy sediment and pollutant loads to the reservoir, which would make the water difficult or impossible to treat safely and would decrease reservoir capacity.

RECOMMENDATIONS

Forest management practices should focus on improving the long-term health and sustainability of public and private forests throughout the watershed by diversifying forest stand age classes, structure and composition.

1. **Reduce number of deer on City-owned lands and possibly in conjunction with other landowners.** Baltimore City needs to take a leadership role in addressing deer population problems in the watershed. The counties will also need to address this problem, but that will require organized hunting on private land, since most of the forests outside of the reservation are privately owned. Deer are currently the greatest threat to the long-term sustainability of the forests. Aggressive measures are warranted to control their abundance. The City should look to program models from other communities that have successfully addressed this issue. Although the city's property is not the cause of the problem, they are in the best position to address the deer issue on a larger scale.

2. **Implement small patch cuts on City-owned land to diversify forest stand age classes.** In order to encourage the growth of younger trees and a greater diversity of trees, the City should remove some of the older trees in small patches in targeted areas of the watershed. A strategy to consider in potentially optimizing water supply, would be to convert conifer plantations (especially white pine), over time, to

mixed species or deciduous stands. According to Dr. Paul Barten, at the University of Massachusetts, this could result in measurable increases in water yield.

3. **State Foresters should review and approve forest stewardship plans prepared for private landowners by forestry consultants to better incorporate water quality goals.** Currently, forestry consultants do plans for private landowners, but those plans are not reviewed and do not necessarily incorporate water quality goals. State Foresters could be involved in this process by reviewing plans for management strategies that benefit water quality.

4. **Hire a professional forester to oversee management of City-owned forests.** The City needs to create this position in order to actively manage its original investment in forest land surrounding the reservoir.

5. **Implement a demonstration forest management project with high visibility on City-owned land, in conjunction with public outreach efforts**. In order to encourage better forest management on private land and to improve public understanding of the importance of forest management and forest health on public land, the City should use its forest reservation for demonstration and education, as it is heavily used by residents throughout the area.

6. **Promote the use of the Reforestation Tax Credit**

FARM MANAGEMENT

OBSERVATIONS

Proper management of agricultural lands is critical to source water protection. About 47 percent of land in the Prettyboy Watershed is currently farmed, with 37 percent in crops. Although intensive agriculture on cropland is currently the greatest contributor of pollutants, the proliferation of small farms and non-traditional farm products bring new water quality concerns.

The impacts of farm practices on ground water and surface water differ. The primary threat to ground water quality from farming in the Prettyboy Watershed is nitrates, which come from fertilizers that infiltrate the ground or seep into wells. In surface water, phosphorus is currently the pollutant of greatest concern. In a study completed in 2000, phosphorus samples equaled or exceeded the standards set by the Reservoir Watershed Management Program 55 percent of the time. Phosphorus is likely coming from sediment erosion from farms, roads and construction sites, fertilizers applied to cropland, home lawns and gardens, and wastewater treatment plants. High phosphorus loading to the reservoir has caused excessive algal growth (i.e., eutrophication), leading to depressed oxygen levels in the reservoir. High algae levels cause taste and odor problems, making treatment of drinking water more difficult and expensive.

As a result of the large number of stream miles that are not buffered from crops and pastures, temperature impairment and turbidity are likely on many of the tributaries and small streams in the watershed. Higher water temperatures and turbidity can have significant impacts on biological communities and can make drinking water more difficult to treat safely.

RECOMMENDATIONS

Efforts to address improved management of agricultural lands should be targeted at reducing phosphorus loads through best management practices (BMPs) and increasing accountability on farm conservation planning and BMP implementation.

1. **Perform annual monitoring of conservation plan implementation on easement lands**. Although conservation plans are required on all easement lands, without monitoring by the Soil Conservation Districts it is impossible to say whether, or how effectively, these plans are being implemented.

2. **Tie implementation of BMPs to easement funding**. For example, a percentage of agricultural preservation money could be placed in escrow until it can be shown through monitoring that BMPs have been implemented.

3. **Map implementation and monitoring of BMPs in the watershed and use data to target riparian and floodplain restoration.** As BMPs are monitored, that data should be used to identify where additional actions are needed and to measure the impacts of existing practices. The data should either be collected by the Soil Conservation District (SCD) or the Maryland Department of Agriculture, but the mapping could be done either by Baltimore County or the Maryland Department of Agriculture.

4. **Fund a Soil Conservation District Technician to work in Baltimore County.** While there is a District Technician dedicated to Carroll County whose position is paid for by the City of Baltimore, there is currently no District Technician focused on Baltimore County. Water revenues are the most likely source of funding for this position.

5. **Increase the rate and implementation of nutrient management planning in the watershed.** Maryland's Department of Agriculture has certified private consultants, funded by DPW, to implement Nutrient Management Plans. The rate and implementation of these plans should be increased.

6. **Increase participation of small farmers and non-farmers in conservation planning and BMP installation using innovative funding mechanisms and targeted landowner outreach programs.**

7. **Apply to Section 319 Program under the Federal Clean Water Act to fund restoration projects, landowner outreach and technical assistance.** Section 319 Nonpoint Source Grant Program is funded by the federal government, but administered by the states.

8. **Use water revenues to fund BMPs in the watershed that do not qualify, or otherwise cannot be funded by the state-funded MACS Program.** Water users rely on water from the Prettyboy Watershed, even though much of the watershed lies in other jurisdictions; therefore, water revenues should fund BMPs throughout the watershed that cannot be funded by MACS. Educational materials should be provided to users to explain the purpose of the increase and how the money would be used to protect their source waters.

APPENDIX A: EXCHANGE TEAM BIOS

Patricia Engler is a Resource Conservationist with the USDA Natural Resources Conservation Service in Maryland. As a Resource Conservationist she oversees all technical aspects of the Conservation Reserve Program and the Conservation Reserve Enhancement Program (CREP) in Maryland; a program responsible for the establishment of nearly 60,000 acres of buffers in Maryland. She provides training and oversight on Conservation Planning activities. Prior to her work on the State Office Staff, she was a District Conservationist in Howard County Maryland. Patricia has managed two watershed projects: the Monocacy Watershed Water Quality Project in Frederick and Carroll Counties and the Linganore watershed project in Frederick County. She was a technical team member of the Riparian Forest Buffer Panel which was responsible for analyzing existing information on the presence of riparian forests in the Chesapeake Bay Watershed and analyzing scientific data to develop recommendations for the Chesapeake Bay Executive Council. She has a Bachelor of Science Degree in Agronomy from the University of Maryland. She is a Certified Crop Advisor and Certified Nutrient Management Consultant. She is also a Returned Peace Corp Volunteer having served 2 years in the Philippines.

Mark Gutshall, president of the Pennsylvania-based LandStudies Inc., has a diverse professional background that has emphasized ecological restoration and community based planning. He founded LandStudies in 1989 and Octoraro Native Plant Nurseries in 1990. Mark graduated from The Pennsylvania State University in 1984 with a B.S. in Forest Science. His technical, planning, and construction management expertise has been applied to numerous watershed planning and restoration projects throughout Pennsylvania and Maryland. Mark is committed to improving communities by integrating and implementing natural resource management and land planning principles. Mark is currently working on a nutrient and sediment pollution-trading program for the Conestoga River.

Paul Jacobson is a co-founder and the managing partner of Langhei Ecology, a consulting firm specializing in the application of ecology and quantitative methods to environmental management and regulatory compliance. His educational background includes a Ph.D. and M.S. in Oceanography and Limnology from the University of Wisconsin-Madison, with a minor in analytical and experimental methods. His professional interests include environmental assessment, and watershed-wide planning, including population and ecosystem ecology, landscape ecology, food web dynamics, ecological modeling, water quality standards, and ecological assessment design. He a member of the teaching faculty of Johns Hopkins University, where he has taught graduate–level courses on quantitative ecological assessment and landscape ecology. . Paul was a peer-reviewer and panel member for US EPA's 1994 Colloquium on Watershed Ecological Risk Assessment Issues. Paul recently completed his second three-year term on the Board of the Maryland Water Monitoring Council.

Jeff Nield is a Senior Environmental Planner in the Sustainable Watersheds Office of the Rhode Island Department of Environmental Management. Jeff has served in the capacity of the South County Watersheds Coordinator with project management and liaison duties for four watersheds in southwestern Rhode Island. In addition to his leadership role in the creation of community-based action teams to address stormwater management, water quality restoration, and riparian corridor protection, Jeff has managed two major watershed management projects: South County Technical Planning Assistance Project and South County Greenspace Project. These projects brought together nine municipalities and many state and federal stakeholders in order to develop practical strategies and useful techniques for protecting natural, cultural, and recreational resources, including creative land use techniques employed through the local planning process. Jeff holds a B.S. in Environmental Sciences from Union College and a M.A. in Environmental Studies from Brown University. He is also a Returned Peace Corps Volunteer having served over two years in Ecuador, South America.

John R. Potter has been a forester with the New York City Department of Environmental Protection's Bureau of Water Supply since 1998. He is currently the Director of Land Management in the Division of Watershed Lands and Community Planning. In this capacity, he is responsible for the management of over 119,000 acres of City-owned watershed lands and waters located across eight counties in upstate New York. He oversees forestry activities, public access and recreational use, preparation of lands for acquisition, land and easement monitoring, as well as various land management partnerships. Prior to this employment, Mr. Potter was the Land Superintendent at the Martha's Vineyard Land Bank Commission where he managed conservation lands in six towns in Dukes County, Massachusetts. He has also worked as a community and consultant forester in eastern Massachusetts. Mr. Potter received a Master of Forestry degree in silviculture and forest management from the Yale School of Forestry and Environmental Studies in 1989, and has an undergraduate degree in history from Williams College.

ADDITIONAL EXCHANGE WEEK RESOURCE TEAM MEMBERS:

Will Abberger is Associate Director of the Trust for Public Land's national Conservation Finance Program, helping state and local governments and citizen groups throughout the eastern United States gauge public support for open space and craft ballot and legislative initiatives that can generate new sources of funding for conservation. His previous position with the Trust for Public Land was Director of Florida Programs for the Florida Office, including government affairs, public affairs, development, and programmatic initiatives in Florida's major metropolitan areas. Will led TPL's efforts to secure legislative approval in 1999 of the Florida Forever Act, the nation's largest state conservation land acquisition program. In his twelve years with the Trust for Public Land, Will's responsibilities have also included directing the Conservation Services program for TPL's nine-state Southeast Region and directing TPL's southeast Land Trust program. Before coming to the Trust for Public Land, he served as Associate with World Wildlife Fund's Successful Communities Program in Washington, D.C.; Field Representative for the Successful Communities Program in Florida, in partnership with 1000 Friends of Florida; and Senior Cabinet Aide for environmental affairs in the Florida Treasurer's office. He is also a former employee of the natural resources unit of the Florida Governor's Office of Planning and Budgeting. Will received a Master's degree in Urban and Environmental Planning from the University of Virginia, School of Architecture, where he worked for the University's Institute for Environmental Negotiation, and a B.A. in English from Davidson College.

Julie Enger started working for the Trust for Public Land's New Jersey office in 1995 and came to Maryland in 1997. Now a resident of the city of Baltimore, she focuses her land preservation efforts in the state of Maryland. As a project manager for TPL, she works with local, state and federal agencies, land trusts and local communities to buy and permanently protect land for the public's benefit. Some of her projects in Maryland include the newly created 800-acre Hoyles Mill Conservation Park in Montgomery County, the 400-acre Looper property in Anne Arundel County and a 300-acre conservation easement on the Severn River.

APPENDIX B: ISSUES QUESTIONS

The following questions were developed by the local steering committee to identify the key issues that they wanted the stewardship exchange team to try to address, and TPL used this list of questions to identify the types of expertise needed by the team members. The exchange team reviewed these questions and attempted to answer those for which they had sufficient information, expertise and time to address.

1. *From the perspective of the entire drinking water supply system, source to the tap, what is the functional value of addressing land conservation in the Prettyboy watershed?*
   - Cost/benefit analysis – What is the methodology for demonstrating the benefits of source protection (through land conservation, etc.) to water suppliers?
   - What is the gap between current land use/practices and those needed to protect the lake?
   - Are there "thresholds" (maxima) for the extent of low-density residential development?
   - How should we set priorities for agricultural land preservation? Use of GIS maps?
   - What funding strategies should be used for agricultural land preservation?
   - What is the minimum area "threshold" for forested land in the watershed?

2. *Can we relate the suite of currently available land management options (e.g. riparian restoration) to possible phosphorus and sediment load reductions in the tributaries?*

3. *What are the relative source-water impacts (e.g. on phosphorus and sediment) of the various agricultural best management practices used in the watershed?*
   - What is the optimal level of BMP implementation needed to meet the phosphorus and sediment thresholds for the watershed, and on what basis do we set programmatic priorities?
   - How can we track the installation of and condition of BMPs?

4. *What are the ecological processes that interfere with the sustainability of the forested lands?*
   - What types of forest intervention are needed to mitigate or correct these problems?
   - What limits the attainment of the preferred forest uses and BMPs?
   - How can we manage forested areas for optimal water supply (minimum evapotranspiration)?
   - How can we track the completion of forest BMPs and restoration efforts?

5. *How can we create a "watershed identity" for Prettyboy that helps to promote community and individual action through the recognition of the need to protect drinking water sources?*
   - How do we identify strategies which will help us to engage landowners?
   - How do we expand the range, use and effectiveness of conservation practices so as to better engage landowners?
   - How do we link land protection with water quality protection in peoples' minds?
   - How can we integrate agricultural and open space preservation with active forest management?
   - What additional local environmental programs also benefit source-water- protection objectives?
   - How can we improve existing programs, incentives and policies to respond to changing patterns in land ownership in the watershed?
   - How do we sustain a community-based watershed conservation effort for Prettyboy?
   - In the course of protecting the watershed for the reservoirs, how do we demonstrate that these actions also benefit groundwater quality and the well-being of the local residents?

APPENDIX C: PRETTYBOY WATERSHED MAPS

APPENDIX D: BALTIMORE COUNTY MAP

In separate attachment