

5.0 WATERSHED WATER QUALITY PLAN

The focus of the County's previous watershed assessments (i.e., Lower Bush and Ballenger Creeks) was largely upon programmatic recommendations to help refine the County's SWM program activities so that they could be used to address water quality impacts across the County and not just within a specific watershed. As these programmatic refinements take place, the focus of subsequent watershed assessments will be directed increasingly towards site-specific problems.

This plan for Lower Linganore Creek contains both programmatic and site-specific recommendations to address the watershed's top priority water quality problems, as identified in the previous section. In particular, improving SWM practices within the areas of older development around Lake Linganore presents specific challenges due to the myriad of stakeholders, each with differing levels of authority and responsibility.

5.1 INTEGRATION OF WATERSHED ASSESSMENT RESULTS

The water quality problems in Lower Linganore Creek watershed are the result of cumulative effects of both agricultural and urban development. SWMM results (Section 3) indicate that a substantial amount of TSS, nutrients, and other pollutants originate from agricultural areas. However, model results also demonstrate that current and future urban development contributes or will contribute a significant portion of the pollutant load. Therefore, any effective strategy for improving water quality in Linganore Creek (and Lake Linganore) must control both agricultural and urban nonpoint sources.

The Lower Linganore Creek watershed is characterized by the heavily rolling topography of the Piedmont Uplands. Agriculture is the dominant land use within the watershed; however, the south-central and western part of the watershed is heavily developed with residential subdivisions and PUDs. Given the long history of human habitation and agricultural land use in the region, streams are far from pristine; however, much of Lower Linganore Creek and its tributaries appear to be in moderately good condition at present. The creek supports a variety of fish and invertebrate biota, including several sportfish species. Remaining forest and wetland areas support good biological diversity. As no individual industrial or municipal dischargers were identified in the watershed, pollutants stem almost entirely from nonpoint sources.

Development pressures are strong in Frederick County, and in order to protect natural resources, growth has been targeted to selected areas of the County in an effort to minimize overall environmental impacts. The Lake Linganore and Spring Ridge PUDs are developing quickly, and projections indicate that medium density residential land uses in Lower Linganore Creek watershed will increase more than three-fold from current levels of about 5 percent. A major challenge in managing the Lower Linganore Creek watershed is to minimize environmental impacts within the rapidly growing areas, while also preserving the natural character of other sensitive resource areas.

An assessment and ranking of water quality problems (Section 4) confirms that reducing impacts of current and future development, as well as those from agriculture, are key issues within the watershed. The identification of these issues provides an opportunity to develop measures to improve existing water quality in Lower Linganore Creek, as well as pro-actively address future issues.

5.2 RECOMMENDED ACTIONS TO IMPROVE WATER QUALITY

From a list of water quality problems and potential opportunities to improve water quality in Lower Linganore Creek, the most promising opportunities (shaded problems in Tables 4-1 through 4-3) were selected as part of this watershed plan. Implementation of these opportunities depends upon cost, available funding, jurisdiction, feasibility, and the likelihood of success in improving or sustaining stream habitat and water quality. Recommended actions (including both programmatic and site-specific opportunities) are presented below. These recommended actions have been developed to address the primary threats to water quality, as identified in the watershed assessment, and include fixing inadequate SWM controls, improving maintenance of existing structures, avoiding and minimizing hydrologic modifications, limiting livestock access to streams, reducing agricultural runoff, and minimizing impacts from new construction and development. Table 5-1 outlines a suggested implementation schedule for these recommendations.

5.2.1 Programmatic Opportunities

Programmatic refinements to Frederick County's stormwater management activities are expected to be important because their potential benefits extend beyond the watershed under study to encompass the entire County. The Countywide focus of these approaches is also likely to build public and institutional support for stormwater management programs.

For example, the County's adoption of the 2000 Maryland Stormwater Design Manual as its new standard for developing on-site stormwater pollution controls is a major programmatic step towards improved stormwater management. The County's Sediment and Erosion Control conference planned for Fall 2002 is another example of efforts to work with the local development and construction community. Frederick County will continue to work with the development community so that incentives for Innovative Site Planning approaches to reduce the need for structural BMPs may be used. County staff will continue to meet with the development community every other month to discuss issues and new policies. In addition, staff members will continue to encourage developers to attend pre-submittal meetings in which stormwater management options and approaches are discussed prior to the design phase.

Table 5-1. Timetable for the recommended actions to improve water quality in the Lower Linganore Creek Watershed, starting after plan approval

Event	Plan Approval	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6	
		1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half	1 st Half	2 nd Half
Programmatic Opportunities													
- Source water protection plan for Linganore Creek		on-going											
- Continued Interagency Coordination		on-going											
- Monitor Agricultural Preservation Districts													
- Easement and site maintenance agreements													
- Retrofit and restoration feasibility analysis													
<i>Select watersheds and subwatersheds</i>													
<i>Conduct feasibility analysis in first subwatershed</i>													
Best Management Practices													
- Facilitate local SWM control efforts in older developments near lake			on-going										
- Reduce livestock access to streams		on-going											
- Maintenance issues													
- Opportunities to improve water quality on County-owned properties													
<i>Inquiries to ES3 (Linganore High School)</i>													
<i>Retrofit to ES3 (Linganore High School)</i>													
<i>ES2 (County public safety training facility) project</i>		on-going											
- Unpaved construction roads		on-going											
Stream Corridor Restoration													
- Bens Branch across from Millime Court													
<i>Feasibility evaluation</i>													
<i>Design</i>								†					
<i>Construction</i>										‡			
- Bens Branch at Gas House Pike													
<i>Feasibility evaluation</i>													
<i>Design</i>								†					
<i>Construction</i>										‡			
Further Investigations at Specific Sites													
- (ICD1) Countryside Auto Parts													

Notes:

† - schedule begins with approval of feasibility evaluation

‡ - schedule begins with approval of designs

In addition to the continued support and implementation of programmatic recommendations presented in the County's previous two watershed assessments, the following measures are recommended:

Source Water Protection Plan For Linganore Creek: DPW is strongly recommended to continue its participation with the development of this plan. The Task Force formulating the plan is currently discussing development, stormwater management, drinking water, land use planning, riparian buffer, and other issues that directly affect the County. Participation in this Task Force and its working committees will help ensure that DPW's interests and concerns are adequately addressed before the plan is implemented. Plan development potentially offers other resources that could be capitalized upon to facilitate existing DPW efforts in the watershed and elsewhere in the County. Active participation would likely involve regular attendance at meetings, participation in developing plan components, and support during plan implementation and possible downstream impacts.

SCHEDULE: On-going
ESTIMATED COST: Nominal

Continued Interagency Coordination: A number of local agencies have programs in place to address issues that either directly or indirectly affect nonpoint pollution and stormwater management (e.g., the review and approval of Erosion and Sediment Control Plans (E&S Plans) by SCD and Planning and Zoning's riparian restoration projects). As the County's lead agency for the NPDES Municipal Stormwater Permit, DPW can play a critical role in coordinating these individual efforts into a comprehensive management program, as well as serve as the County's experts in stormwater management. To this end, DPW should increase coordination with other agencies participating in relevant programs. The recent appointment of a Planning and Zoning liaison and his attendance at regular DPW NPDES meetings brings critical knowledge and other resources to the County's stormwater and watershed management efforts. Coordination will facilitate the development of specific strategies with the NRCS and SCD to address issues such as cropland runoff (i.e., CR1, Tables 4-1 through 4-3) and riparian buffer restoration (e.g., along Bens Branch). Because active construction sites can be large sources of nonpoint pollution, DPW is strongly encouraged to establish regular dialog and meetings with SCD staff who review and approve E&S Plans. Additional strategies should be established with the Department of Highways and Transportation to continue to address issues such as nonpoint pollution from roads (i.e., HM1), and the Division of Utilities and Solid Waste to use the review process for siting future sewer and water lines to avoid or minimize repeated stream crossings and floodplain disconnection, as well as develop strategies to minimize nonpoint pollution generated during sewer and water line installation and maintenance activities.

SCHEDULE: On-going
ESTIMATED COST: Nominal

Monitor Agricultural Preservation Districts: Agricultural landowners who have volunteered to designate their prime farmlands as Agricultural Preservation Districts under the Maryland Agricultural Land Preservation Foundation (MALPF) Program are required, under the terms of their contract with the state, to implement soil and water conservation plans. Visits to several District farms by County Planning and Zoning staff revealed that a number of farms have not kept up with the BMPs specified in their conservation plans. As such, efforts to monitor these farms to ensure that they comply with the terms of their contracts may be inadequate. Frederick County should bring this issue to the attention of the MALPF program staff, determine what measures may be taken, and identify personnel, and a schedule, to carry out these measures. Frederick County should also contact the local NRCS staff and request that they target additional outreach and other conservation efforts to the Agricultural Preservation Districts, especially those farms known to be out of compliance with their conservation plans.

SCHEDULE: Complete within 6 months of plan approval
ESTIMATED COST: Nominal

Easement and Site Maintenance Agreements: Complete a County-wide review of SWM facilities to identify facilities that 1) are not covered by Easement and Site Maintenance Agreements, 2) do not need agreements, 3) are covered by outdated agreements that do not meet current needs, or 4) are covered by adequate agreements. Meet with County legal staff to determine what can be done to establish Easement and Site Maintenance Agreements with SWM facilities that are not covered by agreements, and ways to upgrade outdated agreements that might not meet current needs. Develop an approach and schedule to upgrade or establish agreements with property and SWM facility managers.

SCHEDULE: Complete within 1 year of plan approval
ESTIMATED COST: Nominal

Retrofit and Restoration Feasibility Analysis: Identify and prioritize structural BMPs to better manage urban stormwater through implementation of a Retrofit and Restoration Feasibility Analysis. Opportunities may include retrofits of existing SWM facilities, establishing new County-owned or private facilities in uncontrolled areas, and engaging in watershed restoration projects. Efforts should be targeted to selected watersheds (and subwatersheds), based on their need for water quality improvements, potential opportunities, current and future growth patterns, and other factors. For each selected study area, the analysis would involve an evaluation of current SWM facilities and their sufficiency for controlling water quantities and qualities (specific to pollutants of interest). The analysis would also investigate opportunities for new structures in areas where stormwater is not currently controlled. The objective of the analysis would be to identify specific structures or locations where improvements could be implemented. Efforts within the Lower Linganore Creek watershed should be coordinated with those in other County watersheds, depending on priorities.

SCHEDULE:	Within 2 years of plan approval – select watersheds or subwatersheds Within 1 year of watershed selections – conduct Feasibility analysis in first (pilot) subwatershed (other watersheds may follow according to a yet to be determined schedule)
ESTIMATED COST:	Nominal – select pilot study area \$30,000 – feasibility analysis of pilot subwatershed with analysis of approximately 10 BMPs

5.2.2 Site-Specific Opportunities

A number of opportunities to improve water quality were identified at various locations in the watershed and site-specific approaches were developed to address these issues. These opportunities have been grouped into two categories; BMPs and stream corridor restoration. A third category contains recommendations for further study, where insufficient information was available to fully assess impacts or develop recommendations. As discussed in Section 3, results from the SWMM modeling were used to prioritize subwatersheds and this prioritization should be used as a guide when implementing the following recommendations. Further application of the SWMM model to evaluate the effectiveness of potential new or retrofit BMPs can provide more detailed recommendations.

5.2.2.1 Best Management Practices

The cumulative impact of individual stressors to Lake Linganore (CI1) was given the highest priority in the ranking of water quality problems. Many of the individual stressors contributing to the problems identified in the Lake are addressed by the following BMPs recommended in the Lower Linganore Creek watershed:

Facilitate local SWM control efforts in older developments near Lake Linganore:

To address inadequate SWM controls at IC1, IC2, and IC3, as well as other opportunities that may be identified, contact local citizens groups in the Lake Linganore Community to explore opportunities for collaboration on common goals, such as improvements of riparian buffers around the lake, reduction of sediment inputs into the lake, and coordinated stormwater education efforts which may also have site-specific benefits. Options include County support for these community activities by offering grant, matching grant, in-kind service, or other incentive-based programs. In addition, continue to collaborate with LLCS on their on-going road and SWM design study for the Lake Linganore CDA and other community efforts (e.g., leading community partnerships on grant applications and other activities).

SCHEDULE:	Initiate within 6 months of plan approval
ESTIMATED COST:	\$5,000 – educational outreach \$5,000 – trees/shrubs for volunteer planting

Limit livestock access to streams: To address stream destabilization and water quality issues associated with unrestricted livestock access to streams at LA1 and LA2, implement coordination procedures (see Ballenger Creek Watershed Water Quality Plan; Roth et al. 2001a) by notifying NRCS and SCD staff of problems at these locations.

SCHEDULE: On-going
ESTIMATED COST: Nominal

Maintenance issues: At ES1, a vegetated swale and SWM facility were observed to have erosion and headcutting issues. DPW should check to see if there is an easement and maintenance agreement for this facility; if an agreement is in place, appropriate action should be taken to remedy these issues. If an agreement does not exist, DPW should encourage the developer to reestablish vegetation along the swale and make improvements to the intake structure that would prevent additional headcutting and possible downstream impacts.

SCHEDULE: Address issue within 2 years of plan approval
ESTIMATED COST: Nominal

Opportunities to improve water quality management on County-owned properties: DPW should work with maintenance staff at Linganore High School (ES3) to retrofit existing stormdrains with appropriate BMPs to capture gravel, trash, and other materials washed from the parking lots. Structural BMPs that offer water quality treatment, such as SWM wetlands, should be considered because they also present valuable outdoor education and teaching opportunities. Because schools are community focal points, participation of the High School's Principal in retrofit planning discussions would help to maximize educational and outreach opportunities for students, teachers, and the community. In addition, a maintenance schedule that includes periodic cleanouts should be established for any retrofits implemented at ES3.

New development, currently under consideration, at the County Public Safety Training Facility (ES2) will be subject to the Maryland 2000 design criteria. As such, the County is encouraged to incorporate innovative site design approaches at this location that could be used as a local demonstration project to help the County and local development community gain hands-on experience with their design, construction, and maintenance.

SCHEDULE: (ES3) Inquiries within 6 months of plan approval
Retrofits within 6-8 years of plan approval
(ES2) On-going
ESTIMATED COST: (Both) To be determined

Unpaved construction roads: Considerable threats to water quality were noted from two unpaved construction roads associated with development in the Woodridge (i.e., NC1) and Westwinds (i.e., NC2) sections of Lake Linganore. Because these locations comply with erosion and sediment control restrictions, and they are private roads, DPW

opportunities are limited. DPW staff should continue to inspect these types of sites and encourage construction managers to reduce sediment and dust impacts from these roads while they are unpaved. Approaches laid out in the County's Road Maintenance Assessment Report (Versar 2002), in addition to unpaved road programs run by Pennsylvania and South Dakota (Penn State University 2002; Skorseth and Selim 2000), could provide site managers with low-cost construction and maintenance techniques to reduce nonpoint impacts from these roads.

SCHEDULE: On-going
ESTIMATED COST: Nominal

5.2.2.2 Stream Corridor Restoration

Flooding, excessive erosion and deposition, and poor physical habitat are common problems associated with destabilized stream channels. Stream corridor restoration is a valuable tool that can help return these streams to a more natural condition, and thereby prevent additional degradation of water quality, habitat, and biological resources. However, a number of major considerations must be addressed in order to achieve success, as discussed below.

Unmodified stream channels are the product of a dynamic equilibrium between erosional and depositional processes. This equilibrium fluctuates over time and, typically, stream channels are able to recover after disturbance events such as flood pulses or temporary influxes of excess sediment. However, changes in the underlying variables can force the equilibrium to re-establish itself (and the stream) differently. For example, development within a watershed typically results in a flashier streamflow regime as increased imperviousness causes stormwater to be conveyed more rapidly to stream channels. The channel may respond to flashier flows with geomorphic changes, evident in destabilized banks and altered channel structure. The new flow regime can be incorporated into stable restoration designs, recognizing that the resulting stream system may be quite different from that which existed prior to major disturbances.

New methods for rehabilitation of channelized rivers have emerged over the last few decades. These successful methods are based on emulating the natural form and processes that take place in an undisturbed, meandering channel (Brookes 1985, 1987; Newbury and Gaboury 1993). Advantages of rehabilitating stream systems via this approach include: increasing channel stability, because pools and riffles help dissipate energy; reducing disturbance to biotic systems through the maintenance of habitat diversity; and the improvement of many intangible benefits which arise from greater visual, aesthetic, and recreational potential (Brookes 1987; Keller 1975).

Rehabilitation projects attempt to re-create selected processes that shape natural systems, although often the results of these projects only approximate natural systems (NRC 1992). Fluvial ecosystems are very complex, and their reconstruction is often based on considerations of stream hydraulics. This approach is centered on the observation that organisms live where there is suitable habitat, and suitable habitat is formed by diversity in the stream's hydraulic conditions (Petts 1995). Under this approach, developing variability in hydraulic conditions will lead to increased morphological (habitat) diversity, and ultimately, to increased biotic diversity. The

variable nature of fluvial systems also necessitates that channel improvement plans be tailored to a particular site (Brookes 1985).

The natural linkages that exist between upland, riparian, and aquatic ecosystems must also be maintained for these ecosystems to function as they should. Therefore, restoration of riparian vegetation is fundamental to the success of stream rehabilitation projects (Kauffman et al. 1993, Brookes 1987). Kauffman et al. (1993) suggest that 100-foot (30 meter) forested buffers be preserved along both sides of rehabilitated streams.

While the success of any restoration project depends on a number of natural and human variables that must be accounted for in the planning, design, and construction phases, the following phased approach may be used to help avoid, minimize, or mitigate many of the obstacles facing projects. Brookes (1990) recommended a project framework consisting of seven phases: 1) establish detailed project objectives, 2) perform a feasibility/planning study, 3) develop project design and engineering plans, 4) implement project construction, 5) conduct post-construction clean-up, 6) perform on-going maintenance, and 7) perform post-project monitoring. The monitoring phase is critical to evaluating the success of the project as well as contributing to the overall knowledge base on rehabilitation of stream ecosystems (Brookes 1990, 1995; Toth et al. 1995; NRC 1992; Kondolf 1995; Kauffman et al. 1993). Kondolf (1995) also suggests that each project be considered an experiment in which findings may be used to improve subsequent projects.

Restoration is proposed at the following stream reaches:

Bens Branch across from Millime Court: As Bens Branch parallels Lime Kiln Road (i.e., HM2), the stream takes on a braided pattern with eroded vertical banks, which may indicate that the channel is in an unstable state. Historical disturbances, such as direct livestock access to the stream or channel modifications associated with the former limestone quarry may be responsible for this destabilization. Stream conditions at this location should be monitored to further evaluate channel stability, develop possible restoration approaches, and determine feasibility of restoration. Because this section of stream is located in pasture and oldfield habitat, it affords an opportunity to reestablish a riparian buffer and implement bioengineering approaches to stabilize the stream channel.

SCHEDULE:	Complete feasibility evaluation within 3 years of plan approval
	Complete design within 1 year of approved feasibility evaluation
	Complete construction within 1 year of design approval
ESTIMATED COST:	\$10,000 – feasibility evaluation
	To be determined in feasibility evaluation – design
	To be determined in feasibility evaluation – construction

Bens Branch at Gas House Pike: A section of Bens Branch (i.e., HM3), downstream from the braided section across from Millime Court and west of MD 75 showed channel instabilities (e.g., downcutting, bank slumping, excess sediment load) and a severe lack of riparian vegetation. This reach extends from approximately Old Lime Plant Road down to where Gas House Pike crosses Bens Branch. As with the upstream braided

section, stream conditions at this location should be monitored to further evaluate channel stability, develop possible restoration approaches, and determine feasibility of restoration. Adjacent land usage, pasture and oldfield habitat, also affords an opportunity to reestablish a riparian buffer and implement bioengineering approaches to stabilize the stream channel.

SCHEDULE: Complete feasibility evaluation within 3 years of plan approval
Complete design within 1 year of approved feasibility evaluation
Complete construction within 1 year of design approval

ESTIMATED COST: \$10,000 – feasibility evaluation
To be determined in feasibility evaluation – design
To be determined in feasibility evaluation – construction

5.2.2.3 Further Investigations at Specific Sites

Insufficient information was available to fully assess impacts associated with the following location, therefore further study is recommended.

Countryside Auto Parts: This large automobile scrapyards facility, ICD1, is located in the headwaters of Bens Branch. SWM controls were not apparent at this facility. Although standard illicit discharge tests (i.e., pH, phenol, chlorine, detergent, copper) collected by County inspectors above and below the facility were reported to be within acceptable limits, given the nature of the operation, the potential for fuel, metals, oil and grease, and other contaminants to be washed from the property by stormflows is high. Although not listed in the reviewed MDE and USEPA databases, DPW staff should contact these agencies to determine if additional investigation is warranted.

SCHEDULE: Complete within 6 months of plan approval
ESTIMATED COST: Nominal

5.3 MONITORING TO EVALUATE EFFECTIVENESS OF WATER QUALITY IMPROVEMENTS

Outlined here are proposed procedures to monitor and evaluate the effectiveness of water quality improvements as a result of project implementation. As set forth in the Long-Term Monitoring Plan (Southerland et al. 1999), water quality, physical habitat, and biological conditions should be monitored periodically. We recommend that conditions at the ten Lower Linganore Creek watershed monitoring stations (LING-01 to LING-10) be reevaluated approximately every three years using the methods described in Section 2.3.1. Results from these periodic assessments could be documented in a separate study report as well as summarized in the County's NPDES Annual Report.

In addition to stream monitoring data, we recommend that supplemental visual inspections and photographic documentation of specific site locations be conducted to monitor effectiveness of management actions. Because natural variability may make it difficult to detect trends in stream monitoring data until a long-term data set is amassed, visual inspection results

will help demonstrate whether management actions are beginning to achieve the desired benefit, or whether additional corrective measures are needed. Findings from each round of supplemental visual inspections could be documented in a study report that discusses trends and presents recommendations necessary to address major problems identified during the survey.

