

## **6.0 WATERSHED WATER QUALITY PLAN**

This watershed water quality plan integrates the results of the entire watershed assessment and provides recommendations for water quality improvements that focus largely on preventative measures. The Plan includes both programmatic actions intended to encourage the design of appropriate SWM facilities, as well as site-specific recommendations. To be most effective, actions should be taken at both scales to protect Ballenger Creek from the impacts of existing land use and future development. In particular, the watershed's underlying limestone and karst features present specific challenges to designing SWM facilities because hydrologic characteristics, site conditions, and potential stormwater contaminants vary greatly.

### **6.1 Integration of Watershed Assessment Results**

The Ballenger Creek watershed is characterized by rolling topography of the Western Division of the Piedmont Physiographic Province, with an area of limestone beneath the eastern third of the watershed exhibiting karstic features. Agriculture is the dominant land use within the watershed; however, the north-central and eastern third of the watershed is heavily developed with residential subdivisions, as well as commercial/industrial corridors along main roads. Given the long history of human habitation and agricultural land use in the region, streams are far from pristine; however, much of Ballenger Creek and its tributaries appear to be in moderately good condition at present. The stream supports a variety of fish and invertebrate biota, including several sportfish species. Remaining forest and wetland areas support good biological diversity. Potential pollutant sources are most likely to stem from nonpoint sources; currently development, especially in karst areas, is expected to pose the most significant threat to water quality, while agricultural sources also affect the creek and its tributaries.

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. Ballenger Creek has been designated as a Growth Area, and projections indicate that by 2020 the watershed will be approximately 62 percent urban, up dramatically from its current level of about 25 percent. A major challenge in managing the Ballenger Creek watershed is to minimize environmental impacts within the designated Growth Area, while also preserving the natural character of other sensitive resource areas.

An assessment and ranking of water quality problems shows 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 Ballenger Creek, as well as pro-actively address future issues.

### **6.2 Recommended Actions to Improve Water Quality**

From a list of water quality problems and potential opportunities to improve water quality in Ballenger Creek, the most promising opportunities (shaded problems in Table 5-1) were selected

as part of this watershed plan. Further implementation depends upon cost, available funding, feasibility, and the likelihood of success in improving or sustaining stream habitat and water quality. Recommended actions (including both programmatic and site-specific opportunities) address the primary threats to water quality, as identified in the watershed assessment. These include stormwater runoff from existing development, stormwater management issues in karst areas, livestock access to streams, agricultural runoff, and future construction and development.

### **6.2.1 Programmatic Opportunities**

The benefits of programmatic refinements to Frederick County's SWM activities are expected to be particularly important because they address water quality impacts across the County and not just in Ballenger Creek watershed. For example, refinements to address the karst issues in Ballenger Creek would also help other karst areas in the County that have yet to be assessed, thereby bringing improvements to these areas earlier than otherwise would occur through the current watershed assessment schedule. The County-wide focus of these approaches would also help build public and institutional support for SWM programs.

It is also recognized that the County's opportunities for action at a particular site may be limited, especially with regard to existing SWM structures. However, programmatic changes can shape the way stormwater is managed in the future, in particular, through better site designs, construction of new BMPs, and maintenance of existing SWM facilities. For instance, developers can be encouraged (or required) to use low-impact development approaches, while the process of completing a permit application can be used to promote proper management strategies.

The following programmatic approaches are recommended:

**County NPDES management committee:** The formation of an interagency NPDES Management Committee, as Baltimore County has done, would help coordinate and disseminate information between representatives from involved County agencies. The group would formalize the interaction between Frederick County's Division of Public Works (i.e., Development Review and Highways and Transportation), Division of Planning, and other agencies, allowing agency staff to work together to address stormwater management activities. Building upon existing programs will also facilitate more cost-effective solutions.

SCHEDULE:                    Initiate assessment of feasibility by December 2001

PRELIMINARY  
COST ESTIMATE:    \$5,000

**Karst:** Limestone karst underlies much of Ballenger Creek watershed, particularly the eastern and central portions where current residential, commercial, and industrial developments are concentrated and where future development is likely to occur. Because standard BMPs used generally may not function properly in karst terrain, specialized approaches are needed to address unique issues involving water quantity and quality, as well as structural integrity and public safety problems.

Degradation of groundwater quality is also a key concern in karst areas, particularly with stormwater runoff from roads, large parking lots, and other commercial/industrial areas. As shown in highway and other studies, fractures, sinkholes, and sinking streams provide little filtration of surface water; therefore, sub-surface flows can transport surface contamination to groundwater resources as they are rapidly recharged. The effects of this contamination on groundwater may also persist over long periods. Therefore, Office of Development Review staff should be knowledgeable about hydrogeology and karst issues in order to provide adequate review of submitted plans. This may require extra training or additions to staff.

A programmatic strategy for addressing stormwater issues in karst areas could include:

- ! Development of a Karst Ordinance to supplement Frederick County's stormwater ordinance. The karst ordinance could require lined structures or the diversion of stormwater away from known sinkholes to prevent groundwater contamination. Other locales have successfully implemented karst ordinances that require a multi-phased geotechnical study by permit applicants that includes an on-site evaluation of karst features and site hydrology. Applications are reviewed by the permitting agency (or their geotechnical consultant) to identify potential problems early in the process. Elements include review of existing data, aerial photo interpretation, geological site reconnaissance (collecting site-specific data), agency review/comment following karst BMP guidelines, and a construction inspection. Results and recommendations become part of the site plan and plan approval process. The Town of Walkersville, Maryland, has a karst ordinance that may serve as a local example.

SCHEDULE: Draft by Spring 2002

PRELIMINARY  
COST ESTIMATE: \$20,000

! Development of a karst overlay zone to identify areas where special stormwater management procedures, such as those in a Karst Ordinance, are required.

SCHEDULE: - Obtain and evaluate Maryland Geologic Survey karst maps, which are scheduled for completion in mid-2001, by FY03  
- Propose overlay zone by FY04

PRELIMINARY

COST ESTIMATE: \$10,000

**Coordination procedures:** Stormwater management in neighboring jurisdictions, as well as those in the domain of the agricultural community, can affect Frederick County's watersheds. Therefore, the County should contact staff from the City of Frederick, neighboring counties, Natural Resource Conservation Service (NRCS), and local Soil Conservation District (SCD) to develop an improved process to coordinate regional activities, relay concerns about specific locations (e.g., using a phased approach to limit exposed soils at active construction sites or identifying sites where livestock have access to stream), and follow-up to see how SWM concerns have been addressed.

SCHEDULE: Initiate contact by March 2001

PRELIMINARY

COST ESTIMATE: \$4,000

**Roads:** Continue current initiatives with the County's Department of Highways and Transportation to develop a road maintenance program that reduces the amount of sediment, gravel, de-icing agents, and other materials that are washed directly from road right-of-ways into the County's streams. Also contact Maryland Department of Transportation to discuss how their projects and roads in Frederick County affect stormwater. (Note: additional recommendations may result from the road maintenance evaluation required under the County's NPDES stormwater permit, to be conducted in 2001.)

SCHEDULE: As needed

PRELIMINARY

COST ESTIMATE: \$4,000

**Combined program activities:** In conjunction with capital improvement projects (e.g., stream restoration and structural BMPs), multiple program activities such as educational/outreach activities and street sweeping/drain clean-out efforts can be combined to address stormwater management issues in older areas of development. The intent of this concerted effort would be to increase the success and long-term stability of restoration efforts, while also capitalizing on the opportunity for public education and involvement. It is worth noting that Baltimore County, Maryland uses this combination of approaches in areas that do not have adequate controls.

SCHEDULE: Proposal by December 2001

PRELIMINARY

COST ESTIMATE: During 2001: \$5,000  
Future: \$10,000

**Forest resources:** Forests are a valuable resource in the County and when off-site mitigation is being considered under the County's Forest Resource Ordinance, plantings to replace lost trees may be targeted in riparian areas to restore forested stream buffers. Efforts to replant riparian forests can also be combined with a state-wide Stream ReLeaf program to restore or enhance forested stream buffers in the Chesapeake Bay watershed.

SCHEDULE: As needed

PRELIMINARY

COST ESTIMATE: Nominal

## **6.2.2 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 restoration. A third category contains recommendations for further study, where insufficient information was available to fully assess impacts or develop recommendations.

### **6.2.2.1 Best Management Practices**

The following actions associated with BMPs are recommended in the Ballenger Creek watershed:

**Demonstration project:** Construct a structural BMP demonstration project to research karst issues related to stormwater management. An important objective of this project would be to prevent groundwater incursion by contaminant-laden runoff, and then facilitate the incorporation of these findings into the design and maintenance of future BMPs in the County.

SCHEDULE: Initiate design and land acquisition in FY06

PRELIMINARY  
COST ESTIMATE: \$500,000

**Re-inspections:** Problems were noted at three existing SWM structures during the watershed assessment (Table 5-1, Problem IDs ES1, ES2, and ES3) and efforts should be undertaken by the County to re-inspect these facilities, taking advantage of this opportunity to educate facility managers about the need and importance of the BMP and its continued upkeep.

SCHEDULE: Inspect by February 2001

PRELIMINARY  
COST ESTIMATE: Nominal

### **6.2.2.2 Stream Corridor Restoration**

Flooding, excessive erosion and deposition, and poor physical habitat are common problems associated with destabilized stream channels. Stream 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 than 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.

As such, restoration is proposed for the following stream reaches:

**Ballenger Creek at Ballenger Creek Elementary School:** Severely eroded and undercut banks were observed immediately downstream of an active livestock pasture. This site is located on publicly owned property and would provide unique educational opportunities for school students and the community.

SCHEDULE: - Initiate design study July 2001  
- Initiate construction July 2002

PRELIMINARY

COST ESTIMATE: Design: \$18,000  
Construction: \$80,000

**Ballenger Creek at Ballenger Creek Park:** Significant bank erosion, lateral channel migration, and grade adjustment were observed at this location. This site is located on publicly owned property and would provide unique educational opportunities for the community, especially if coordinated with the Ballenger Creek Trail Project.

SCHEDULE: - Initiate design study July 2001  
- Initiate construction July 2002

PRELIMINARY

COST ESTIMATE: Design: \$60,000  
Construction: \$250,000

**Ballenger Creek Park to the mouth of Ballenger Creek:** The County may be able to collaborate with the Ballenger Creek Trail Project and the state-wide ReLeaf program to restore lost or enhance existing riparian buffer along a large portion of the stream.

SCHEDULE: As needed

PRELIMINARY

COST ESTIMATE: \$5,000

**Ballenger Creek just upstream of New Design Road:** Significant bank erosion, lateral channel migration, and downcutting were observed at the confluence of King and Arundel Branches.

SCHEDULE: Feasibility to be determined; approach private landowners by FY06

PRELIMINARY

COST ESTIMATE: \$20,000

### 6.2.2.3 Further Investigations at Specific Sites

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

**Stormwater impacts to groundwater in karst areas:** To assess stormwater impacts to groundwater in karst areas, the County could evaluate surface and groundwater quality in the vicinity of existing SWM facilities within the karst area. This study should determine whether retrofits are needed to improve water quality, especially in areas where groundwater is still being used as a source of drinking water. A groundwater survey could rely, partially, upon data collected from existing domestic wells to reduce costs.

SCHEDULE: Design study by FY04

PRELIMINARY

COST ESTIMATE: \$50,000-\$100,000

**Scrapyard and truck repair facility:** These facilities located on Reichs Ford Road could pose serious threats to water quality if contaminants are washed off-site and into nearby streams. The area should be reviewed in greater detail to identify retrofit opportunities. In addition, facility managers, which include a private landowner and the City of Frederick, should be contacted to discuss methods for improving housekeeping practices.

SCHEDULE: Identify opportunities by May 2001

PRELIMINARY

COST ESTIMATE: \$5,000

### 6.3 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 six Ballenger Creek watershed monitoring stations (BALL-01 to BALL-06) be reevaluated every two years, using the procedures described in the Long-Term Monitoring Plan. Assessing these stations every other year will more effectively distribute the County's resources and save on monitoring costs, while still providing sufficient information to track changes in watershed conditions. Results from this assessment should 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 at least every two years 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 should be documented in a study report which discusses trends and also presents recommendations necessary to address major problems identified during the survey.