

# Acknowledgments

## Community Advisory Committee

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Kim Angeli - Volunteer Stream Monitor

Courtney Caldwell - Canoe Cruisers

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Joanna Cornell - Northern Virginia Soil and Water Conservation District

Rodney Follin -Member at large

Debbie Foster - Gate Post Estates

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Sully District Supervisor Michael R. Frey's Office  
Virginia Eller and Meaghan Keifer

Springfield District Supervisor Elaine McConnell's Office  
Marlae Schnare

**Technical Advisory Committee**

The following individuals also contributed a significant part of their time and technical knowledge as members of the project Technical Advisory Committee:

Clinton Abernathy – Fairfax County Department of Public Works and Environmental Services

Todd Bolton - Virginia Department of Transportation

Mark Holsteen – Fairfax County Park Authority

Heather Melchior – Fairfax County Park Authority

Leon Nawojchik - Fairfax County Park Authority

Greg Prelewicz & Traci Kammer Goldberg - Fairfax Water

Mike Rolband – Wetland Studies and Solutions, Inc.

Chris Ruck & Joe Ivers - Virginia Water and Wetlands, Inc.

Tammy Schwab – Fairfax County Park Authority

Charles Smith – Fairfax County Park Authority

Ron Tuttle – Fairfax County Stormwater Planning Division

## **Fairfax County Staff**

The Cub and Bull Run Watershed Management Plan was initiated by the Fairfax County Stormwater Planning Division:

Carl E. Bouchard, P.E. - Director - Stormwater Planning Division

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## **Project Team**

The Watershed Plan was performed by the following companies and individuals:

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### **Biohabitats, Inc.**

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# Executive Summary

The Cub Run and Bull Run watersheds are among the largest and fastest developing watersheds in Fairfax County and have a wide range of development densities and stream conditions. The Cub Run and Bull Run Watershed Management Plan documented herein provides strategies both for mitigating adverse stream conditions caused by such growth and development, and for protecting the watersheds from future impacts. Figure ES-1 shows the watersheds and major subwatersheds. The Cub Run watershed area is 53 square miles, which include 14 square miles in eastern Loudoun County. The Bull Run watershed area is approximately 10 square miles and includes the small, unnamed streams or tributaries that drain directly into Bull Run. Part of this watershed, 1.3 square miles, also lies within Loudoun County.

## Purpose

The primary goals of watershed plans for Fairfax County are summarized as follows:

1. Restore and protect the county's streams
2. Meet state and federal water quality standards by identifying strategies to prevent and remove pollution
3. Support Virginia's commitment to the Chesapeake 2000 Agreement to restore the Chesapeake Bay by 2010
4. Update the current watershed plans to include modern technologies and community concerns
5. Take a comprehensive approach in addressing multiple regulations, commitments and community needs
6. Meet the community watershed vision and goals developed by the project Community Advisory Committee (CAC)
7. Meet nutrient loading and reduction goals for the Occoquan Reservoir and the Chesapeake Bay Tributaries.

With input from the CAC and other members of the community, this plan addresses these needs and requirements while providing a strategy for restoring and protecting the watershed.

## Watershed Overview

Before 1980, the watersheds were largely undeveloped open space with few areas of residential development and little commercial development. The population has increased fivefold from 20,000 in 1980 to nearly 100,000 in 2000. This has led to an increase in land surface covered by buildings, parking lots, roads, driveways and sidewalks (impervious area) from 7 percent in 1980 to 15 percent today.



Figure ES-1  
Major Subwatersheds in  
the Cub Run and Bull Run Watersheds

Fairfax County has required stormwater ponds to control peak flows from new development since 1972. Since 1980, the county has required stormwater controls that reduce nutrient concentrations from new development within the Occoquan Reservoir watershed by 50 percent to protect the water quality in the reservoir - the drinking water source for more than one million Northern Virginia residents.

These regulations, combined with the time development occurred in the watershed, give the Cub Run and Bull Run watersheds one of the greatest density and degree of coverage of stormwater controls within Fairfax County. More than 420 stormwater ponds, serving 26 percent of the total watershed area and most of the developed area, reduce peak flows and pollutant runoff for nearly all of the existing development. Only a few isolated developed residential areas do not have stormwater controls. This is in stark contrast to watersheds in eastern Fairfax County where large areas of residential development lack stormwater controls.

Loudoun County also requires stormwater controls to reduce peak runoff rates and limit pollutant runoff. In response to these requirements, Loudoun County relies on several large wet ponds to manage runoff from the existing development in the Cub Run and Bull Run watersheds, and future development will have stormwater control facilities.

Stream conditions in the Cub and Bull Run watersheds vary. Most of the stream habitat is rated as good to fair. The high density of stormwater ponds is partially responsible for the streams' having higher quality than would be expected for the watershed's development densities.

Potential for future growth in the watersheds varies:

- The Cub Run watershed has approximately 14 percent impervious area. Future development as described in the Fairfax County Comprehensive Plan, Loudoun County General Plan and Dulles International Airport expansion plans will increase the impervious area to roughly 25 percent. Impervious area - land surface covered by rooftops, pavement and similar areas that prevent rainfall from infiltrating into the soil - represents the amount of development in the watershed and its potential impact on the streams.
- The Bull Run watershed has approximately 4.2 percent impervious area and is estimated to be 11 percent impervious at build-out based on the planned land use.
- Parkland and other preserved open space make up about 11 square miles or 23 percent of the total project study area within Fairfax County.
- Eastern portions of the Cub Run watershed have a high density of development with little potential for additional development.
- Southwestern portions of the watershed are within the Residential-Conservation (R-C) District where the maximum development density is limited to one house per

five acres. The R-C District is an effective low-impact development program adopted by Fairfax County through major rezoning in 1982 to protect Occoquan Reservoir water quality. This area further protects the watershed since 5,174 of the 11,716 acres (44 percent) within the R-C District in Cub and Bull Run is preserved as parkland and golf courses.

- Areas of Fairfax County near Dulles International Airport (Chantilly and Westfields) are developing rapidly. The County Comprehensive Plan calls for a mix of commercial, light industrial, office and residential land uses.
- The Loudoun County portion of the watershed includes the South Riding community developed in recent years. These portions of Loudoun County have planned land uses that include residential, commercial/business and industrial. The Loudoun County General Plan calls for higher densities north of Braddock Road and lower densities south of Braddock Road.
- In addition to this residential and non-residential development, several transportation projects in various stages of planning will potentially affect the Cub Run and Bull Run watersheds:
  - Dulles International Airport expansion projects, including two new runways, associated taxiways and a new midfield terminal
  - Potential routes for the Tri-County Parkway. The selected West Two alternative lies outside the watershed.
  - All identified routing alternatives for the Manassas National Battlefield Park Bypass
  - Route 28 interchange improvements. Several of these have been constructed, and the planned Willard Road interchange is within the Cub Run watershed.
  - Widening of Walney Road from two to four lanes at Flatlick Branch
  - Widening of Pleasant Valley Road from two to four lanes
  - Widening of Braddock Road east of Pleasant Valley Road and a new four-lane road from this location to Old Lee Road

Growth has stabilized in the eastern and southern portions of the watershed. However, growth in the northern and western portions is a concern for future watershed conditions. New development will include stormwater facilities to meet both Fairfax County and Loudoun County requirements to control both peak flows and stormwater quality.

## Public Involvement

The Cub Run and Bull Run watershed plan incorporates input from residents and businesses of the two watersheds collected through an extensive public involvement and outreach process.

The watershed plan's CAC is a diverse group from the local community, including members of homeowner associations, conservation organizations, local businesses, recreation groups, neighboring local and federal jurisdictions, and other local interests groups. The CAC met with the project team roughly 20 times to prepare this watershed plan.

In addition to the CAC meetings, four public forums allowed residents to identify watershed issues, evaluate alternatives to address these issues and comment on the proposed watershed plan elements.

Public involvement was important to the development of the plan. This information was combined with engineering, cost-benefit analyses and other evaluations to identify the recommendations to be implemented and monitored to meet the watershed vision and goals effectively and efficiently.

## Watershed Vision

The CAC prepared the following overall vision for the Cub Run and Bull Run watersheds:

**Waterways in the Cub Run and Bull Run watersheds are valued pieces of the community fabric. Community members, as trustees of the waterways for succeeding generations, recognize their responsibility to sustain, restore and enhance the waterways. Educational efforts enrich the community's understanding of waterways, the associated riparian areas and their importance to both the local community and the region. Stream corridors contribute to community vibrancy and economic health while providing water quality, stormwater management, flood control, habitat and recreational benefits. Waterways are a clean and safe source of the region's drinking water.**

This vision provides the foundation for a comprehensive approach to improving existing conditions and reducing impacts from future land use changes within the watersheds.

The CAC identified the following functions of waterways and stream valleys to be recognized and protected by the watershed plan:

- Filtering water- and air-borne pollutants
- Keeping water temperatures cool



- Storing floodwaters
- Reducing floodway velocities
- Serving as groundwater recharge areas
- Improving and maintaining water quality
- Providing wildlife habitat to include nesting, resting, roosting, feeding and watering areas
- Providing appropriate recreational opportunities
- Providing educational opportunities
- Enhancing community aesthetics

The CAC also recommended the plan should:

- Foster and promote co-existence and constructive beneficial use among people, waterways and riparian areas to enable the widest range of beneficial uses without environmental degradation, risk to health or safety, or other undesirable and unintended consequences to the human community, environment or wildlife
- Improve and maintain inter-jurisdictional coordination and collaboration at all levels (federal, state, regional, local) to protect and improve watershed health, integrate services and avoid duplication of effort and expense
- Protect the quality of the Occoquan Reservoir – a major drinking water source for the Northern Virginia region
- Specify stormwater management, best management practices, low-impact development and other watershed management policies that will restore and maintain watershed health
- Include educational strategies to enrich the community's understanding of watershed ecological processes and their importance
- Establish clear mechanisms for restoring degraded waterways within the watershed
- Promote stormwater control projects that intercept flows and treat the stormwater runoff as far upstream in the watershed as possible before stream conditions are affected
- Promote the preservation of open space and support adherence to R-C zoning to minimize impervious surface area, and protect headwaters and stream corridors

- Promote the mitigation of impacts to streams and wetlands within the local watershed where the impacts occur

The CAC also defined the following watershed-wide recommended guidelines for future decisions regarding regional and onsite stormwater ponds:

- Ponds should be used as a last resort and, if possible, located off-channel.
- Alternatives to ponds should be considered, including installation of smaller controls further upstream and natural stormwater controls such as wetland projects. As part of this strategy, wetland mitigation sites in the watershed should be identified.

## **Watershed Plan Implementation**

This report provides an implementation schedule (Section 7) for the watershed plan actions. Additional factors, however, may affect the implemented projects and schedule:

- Projects, programs and policy items will undergo review by county staff and the Board of Supervisors before implementation. Board adoption of the watershed plan will not mean automatic implementation of the plan recommendations.
- The watershed plan is a master list of recommended nonstructural actions and structural projects. Each fiscal year, staff will prepare and submit to the board a detailed spending plan that will describe the projects and explain their ranking, benefit and need to meet a defined watershed or water quality goal.
- Availability of funding and other resources will affect the implementation of watershed plan projects.
- The initial project implementation phases will include outreach to the community near the proposed projects. The recommended plan elements may become infeasible or need to be modified as a result of this outreach.
- Projects will be value-engineered at the time of implementation to ensure cost-effectiveness. Using volunteers or alternative funding sources will be considered to reduce implementation costs.
- The watershed plan considers visions, goals, issues and needs only within the Cub Run and Bull Run watersheds. Fairfax County will consider stormwater needs and priorities across the entire county when implementing the recommendations included in this plan and other watershed plans.
- The county budget for stormwater improvements will not fund stream-crossing improvements unrelated to protection of streambeds or banks, or prevention of structure flooding.

- Stream restoration, buffer restoration and other projects on private land will be evaluated to determine means for cost sharing with the landowners.

## Watershed Plan Elements

The plan includes three major project types:

- **Nonstructural actions** – These include education and outreach programs, and other actions that do not require construction to complete. These actions, described in Section 4, can be performed under current county policies and have a defined implementation schedule.
- **Policy Recommendations** – These include recommended changes to county policy. Proposals may require amendments to the county code and other supporting documents such as the county Public Facilities Manual.
- **Structural Actions** - These include projects to be constructed in the watersheds to improve stream conditions. Projects range from simple actions such as the restoration of stream buffers to restore and protect habitat to major construction of a regional stormwater facility to control stormwater flows and reduce pollutant runoff.

## Nonstructural Actions

### Description

The watershed vision and goals recognize that the plan must address more than just providing stormwater controls. It must also promote education, recreation, cooperation and collaboration so streams and stream valleys remain a valuable resource for the community.

Nonstructural actions include community outreach and educational actions as well as land management strategies such as proper lawn-care maintenance.

The nonstructural actions are grouped as follows to provide unique one-to-one correlation between the actions and the corresponding category:

- A- Public Outreach and Education
- B - Interjurisdictional Cooperation
- C - Recreation
- D - Existing Development
- E - New and Infill Development
- F - Open Space

As described in Section 4, the plan includes 21 objectives and 59 recommended nonstructural actions that will help to achieve the watershed vision and goals.

### **Implementation Plan**

Section 7 of the watershed plan prioritizes the nonstructural actions and develops a recommended implementation program. The nonstructural actions were prioritized based on their effectiveness in meeting county policies, regulatory requirements, public support, location within the watershed and ease of implementation. The recommended plan assumes that all nonstructural actions will be considered within the first 15 years of the 25-year watershed plan.

Many nonstructural actions will be considered with similar recommendations from other watershed plans and will potentially be implemented across all watersheds. Also, many actions involve coordination with other agencies such as the Northern Virginia Soil and Water Conservation District and Virginia Department of Conservation and Recreation. Finally, some actions can be completed by county staff. When appropriate, additional staff resources, partner support or consultant services will be needed.

Funds and staff resources will be required to implement these recommendations. These resources will be estimated at the time a nonstructural action is being evaluated for implementation as part of the annual budget process. The watershed plan recommends that the county continues to use existing resources, partnerships and allocate adequate funds to implement these nonstructural actions.

### **Policy Objectives and Recommendations**

#### **Description**

The watershed plan also recommends changes to county policy that will improve watershed conditions, address watershed issues and meet the visions and goals for the Cub Run and Bull Run watersheds.

Policy recommendations include proposals that typically require amendments to the County Code and other supporting documents such as the Public Facilities Manual. The policy recommendations from the Cub Run and Bull Run watershed plan will be compared with similar recommendations in the Little Hunting Creek, Popes Head Creek, Cameron Run, Difficult Run and other watershed management plans. Based on this review, ordinance amendments and other changes in policy will be developed that consider other county initiatives and policies, and address the common ground between the policy recommendations from these completed watershed plans.

Funds and staff resources will be required to implement these policy recommendations. These resources will be estimated at the time a policy recommendation is being evaluated for implementation as part of the annual budget process. Existing resources and partnerships will be used when available. The

watershed plan recommends that the county implement the recommended changes in policy and allocate adequate funds as needed.

As with the structural and nonstructural actions, the watershed plan policy recommendations are placed into the following categories:

- A- Public Outreach and Education
- B - Interjurisdictional Cooperation
- C - Recreation
- D - Existing Development
- E - New and Infill Development
- F - Open Space

The Watershed Plan includes 13 objectives and 32 policy recommendations as described in Section 5 of this watershed plan.

### **Implementation Plan**

The policy recommendations are prioritized based on their effectiveness in meeting county policies, regulatory requirements, public support, location and ease of implementation. The watershed plan lays out these priorities and a recommended implementation plan. As previously described, these recommendations will be evaluated further with regard to greater county-wide implications before implementation. The policy recommendations will be considered within the first 15 years of the 25-year watershed plan program

## **Structural Actions**

### **Description**

The watershed plan includes structural actions to help achieve the watershed plan vision and goals. Structural actions refer to watershed plan elements that require construction to implement. The plan includes several classes of structural actions as summarized below.

#### ***Regional Ponds or Alternative Stormwater Controls***

Fairfax County adopted a Regional Stormwater Management Plan in 1989 that promoted large regional ponds with larger drainage areas that encompass one or more site-development projects. These ponds were designed to replace and eliminate numerous, smaller onsite stormwater facilities. Seventeen proposed regional ponds were constructed. Ten existing ponds are regional but were not part of the county regional pond program.

The Cub Run and Bull Run watershed plan reviews the status of 14 planned but not constructed regional ponds. Ponds within the R-C District provide little watershed benefit relative to their cost and impact. As a result, the seven ponds within the R-C District have been eliminated from the watershed plan, and alternative stormwater controls will be implemented instead.

Conditions have changed considerably since the regional ponds outside the R-C district were proposed. In several cases residential development has encroached, making it difficult or impossible to construct the pond as originally proposed. Also, smaller ponds were constructed upstream from the proposed ponds as development occurred. These smaller ponds lessen the effectiveness of the proposed regional ponds given the cost and impact to construct them. In some cases, the stormwater control provided by existing stormwater facilities and recommended alternative projects equals that of the proposed regional pond.

Table ES-1 summarizes the watershed plan recommendations regarding the proposed but not yet constructed regional ponds.

Table ES-1  
Summary of Watershed Plan Regional Pond Recommendations

Regional Pond	Recommendation
C19, C21, C23, C24, C28, C40, C53 and C54	Delete the proposed regional pond and implement alternative projects
C37, C35 and C62	Delete the proposed regional pond and no alternative projects are necessary
C20	Defer the proposed regional pond and implement a group of alternative projects. If the alternative projects cannot be implemented, a modified scope regional pond may be considered
C18 and C39	Implement a smaller or modified regional pond. If the pond still cannot be implemented, then implement alternative projects

***Dry Pond Retrofit Projects***

The watershed plan recommends retrofit of 94 dry ponds to improve the peak flow and water quality stormwater control provided. Various modifications will be considered to improve the function of selected dry ponds, including constructing wetlands, adding storage, modifying outlet control structures, correcting maintenance and safety concerns, and providing educational and recreational opportunities. The selected ponds provide the greatest improvements relative to their costs and are where stormwater management needs are greatest.

### ***Low-Impact Development Retrofit Projects at Public Facilities***

The watershed plan includes retrofits of 26 public facilities to include low-impact development (LID) stormwater controls. The project sites include schools, libraries, recreation centers, county office buildings, parks and commuter parking lots. The LID projects will minimize and control runoff from parking lots and rooftops. The full range of LID practices will be evaluated when these projects are implemented, including biofiltration rain gardens, manufactured biofiltration units, removal of impervious surfaces, grassed drainage swales, disconnection of impervious areas and other onsite practices.

A primary benefit of this action is that each facility will provide an opportunity to educate county residents about innovative stormwater controls such as bioretention and biofiltration facilities, rain gardens, etc., that they can use on their properties. The program will also demonstrate Fairfax County's commitment to implementing these measures throughout the watershed and, in turn, to improving stream conditions throughout the county.

### ***Stream Restoration Projects***

The watershed plan includes 22 stream restoration projects that cover 19.5 stream miles of actively eroding streams. Stream restoration will be performed using bioengineering techniques to reduce its visual and construction impacts. Hard armoring will be applied only where required to protect man-made structures threatened by stream erosion. These improvements will:

- Prevent further down-cutting of the streambed and raise the invert of the stream channel where appropriate
- Improve the stream buffer
- Reduce sediment and nutrient loads
- Address bank erosion by directing the flow and providing stable meander geometries
- Address stormwater outfalls within the project reaches
- Reconnect stream with floodplain to restore wetland systems and use floodplain storage effectively to reduce peak flows and nutrient loads

The above modifications together will improve the overall stream habitat within the restoration reaches and reduce sediment, nutrients, and other pollutants carried downstream.

The schedule for restoring these reaches considers additional factors besides the severity of existing erosion:

- Stream restoration will not be performed where the flow velocity and peak flows are uncontrolled. Stream restoration projects are phased with other watershed plan actions to ensure that flow control actions are implemented before stream restoration projects.
- Stream restoration will generally be performed within contiguous areas in the watershed to provide the greatest benefit and, where possible, in an upstream to downstream order.
- Finally, stream restoration should not be performed downstream from where significant development is occurring or will occur.

These selection criteria cause the larger stream restoration projects within the major streams to be implemented towards then end of the 25-year plan.

#### *Neighborhoods without Stormwater Controls*

Because of the county stormwater control requirement, much of the development in the watershed has dry and wet stormwater ponds, and other features that control the runoff peak flow and water quality. However, four neighbors totaling 1,500 acres and 4,280 single-family residences do not have stormwater controls:

- Greenbriar/Birch Pond
- Brookfield
- Country Club Manor
- Pleasant Valley

For the most part, these residential developments existed before stormwater controls were required.

These four neighborhoods are ideal for new controls that benefit the watershed by improving the water quality and controlling peak flow rates. The watershed plan includes structural actions to address the flows from these neighborhoods, including:

- Promoting LID for privately-owned commercial and residential property within these neighborhoods
- Retrofitting and upgrading stormwater outfalls to reduce their impact on the streams

Other structural projects identified in the plan, including stream restoration, buffer restoration, LID retrofit and dry pond retrofit projects, will be implemented to address stormwater runoff within these neighborhoods.

Opportunities to construct new ponds and to implement upstream culvert retrofit projects were evaluated but found to be infeasible due to the density of development, existence of closed conduit drainage systems and lack of undeveloped open space.



### ***Buffer Restoration Projects***

Stream or riparian buffers refer to the stream valley near the stream banks. A natural unimpaired stream buffer, containing native trees, plants and shrubs, provides valuable stream habitat protection and many other benefits. In many areas of the Cub Run and Bull Run watersheds, the natural stream buffer vegetation has been damaged or removed by residential and commercial development, lawns, mowed areas, old farm fields and utilities that cross the stream valleys. Buffer restoration projects will restore selected stream reaches to a natural condition and improve the overall health of the streams.

The watershed plan identifies 43 stream buffer restoration projects that include 54,480 feet (10.3 miles) of deficient stream buffer. Opportunities will be sought to partner with volunteer organizations to implement the buffer restoration projects. Buffer restoration will also be performed as part of the stream restoration projects.

The improved and healthy stream buffers benefit the watershed as follows:

- Filter runoff from adjacent lands, removing pollutants and sediment delivered to the streams
- Provide natural habitat for plants and animals
- Shade the stream and lower water temperatures
- Provide food for animals living in the streams
- Reduce stream erosion by slowing overbank flow velocity during floods. Roots in a healthy stream buffer hold the soil together, further reducing erosion.
- Improve function of the riparian wetlands within the stream buffer
- Meet other county environmental goals by increasing forest cover and connecting habitat corridors

### ***Replace and Upgrade Road Crossings to Eliminate Flooding***

The watershed plan identifies 14 culverts and bridges that do not have capacity to convey peak stream flows during storms. The frequent roadway flooding is a public safety concern, has economic impacts, and damages the roadway, stream and property. Severe flooding can prevent emergency vehicles from responding.

Unless they have a severe impact, these projects will not be implemented using Fairfax County stormwater funds. The Virginia Department of Transportation maintains the roads in Fairfax County and these improvements will be implemented during planned roadway improvement projects.

### ***Evaluate and Retrofit Existing Headwater Drainage Systems***

Drainage systems in the headwaters of Cain Branch, Flatlick Branch, Oxlick Branch and Big Rocky Run (primarily north of Route 50) generally have little topographic relief. In some cases, drainage ditches have silted in and no longer have sufficient conveyance capacity. These systems will be updated and maintained where appropriate to prevent flooding and stream erosion.

In some headwater areas stormwater outfalls from curb-and-gutter drainage systems discharge directly to stream valleys with little or no attenuation. Prior to development, rainfall runoff was delivered to the streams as diffuse sheet flow. The constructed drainage systems concentrate flow into ditches that erode the stream valleys and create new drainage ditches. These stormwater outfalls will be evaluated and improvements made to reduce their impact on the stream valley. Improvements may include velocity dissipaters, flow spreading devices, stream restoration and buffer restoration. These issues are spread throughout the residential properties in these headwater areas, and many are on private property. Opportunities will be sought to share costs with property owners for projects that benefit the watershed.

The watershed plan does not identify specific projects but includes funds to address these issues as they are identified. Some projects will be identified during the public outreach program for the implementation of other structural projects in these headwater areas.

### ***Riparian Wetland Improvement Projects***

Development, past use and stream erosion have degraded riparian wetlands - wetlands within the stream valleys near the streams - in the Cub Run and Bull Run watersheds. As the streams down-cut, wetland inundation frequency decreases, adversely affecting the natural functions of these wetlands.

The watershed plan recommends implementing stream and wetland mitigation projects close to the disturbance. Having wetland improvement projects identified within the Cub Run watershed would help this recommendation become a reality. This action also potentially reduces the watershed implementation costs to Fairfax County by sharing costs with the developers of projects that require wetland mitigation.

Wetlands in the watershed will be identified and evaluated for restoration and mitigation. High-priority areas will be implemented within the context of the other watershed plan projects.

Restoring natural wetlands within the Cub Run and Bull Run watersheds provides various benefits, including:

- Restoring and protecting functions of natural wetland systems
- Providing habitat for plants and animals that depend on wetland systems

- Reducing sediment and nutrient loads
- Increasing infiltration and replenishing groundwater systems
- Reducing peak flows and velocities in downstream segments
- Meeting other county goals such as preserving forests, providing connected habitat corridors and protecting critical wildlife habitat

### **Implementation Plan**

The structural projects are prioritized based on their effectiveness in meeting county policies, regulatory requirements, public support, location and ease of implementation.

Structural projects were grouped to maximize the benefit to the watershed, limit neighborhood and environmental impacts, and reduce implantation costs. This will be achieved by implementing projects that affect a neighborhood at one time, either as a single project or as a set of projects. This approach also reduces costs associated with the public outreach programs when the projects are implemented. Finally, by implementing projects in a geographic area at one time, the net benefit to the stream may be greater than the sum of the benefits from individual projects.

The Fairfax County Stormwater Planning Division recognizes that appropriate public outreach and education is key to the successful implementation of these structural projects. The project costs include allowances for such programs.

The general rules for preparing the project implementation program are described below (in no particular order):

- The projects should be implemented in an upstream to downstream order within a subwatershed. Implementing upstream projects first allows the peak flow reduction and water quality improvements to benefit a longer reach of stream.
- Stream restoration projects will not be implemented until upstream improvements have been completed. This criterion will increase the probability of success of the stream restoration project by stabilizing the flows before restoration.
- Stream restoration projects are implemented on small streams first, starting with upland stream segments and working downstream. Restoration on small streams has a higher probability of success than restoration on larger streams.
- The Fairfax County Department of Public Works and Environmental Services will not implement stream restoration projects where significant future development will occur. Even with the peak flow and water quality control, changes in flow volumes produced by the development will tend to destabilize the stream and produce additional erosion. Emergency measures may be necessary in these lower-priority stream segments if severe erosion must be addressed immediately.

- Structural projects receive higher priority where development densities will not change significantly.
- Structural projects downstream from significant projected development will be given low priority. Developers of these properties may implement downstream structural projects when appropriate, and/or cost sharing with the property owners will be sought. Pro-rata funds are also appropriate for these facilities.
- Projects that address conditions significantly affecting stream health are high priority.
- Projects very effective in meeting watershed vision and goals are high priority.

The watershed plan identifies 38 project groupings and develops a 25-year implementation schedule. The actual schedule may change for various reasons as discussed earlier.

### **Structural Action Costs**

Table ES-2 summarizes the estimated costs to complete the watershed plan structural actions. The improvements will be funded through a variety of sources, potentially including general and pro-rata funds. Pro-rata funds are paid by developers of property within the watershed to address off-site stormwater impacts. The payments are based on the impervious area within the development and the costs of improvements in the watershed stormwater plan.

Other funding sources and cost-reduction methods will be sought during implementation. For example, costs for projects on private property that benefit the watershed will be shared with the property owners. When appropriate, the county will team with volunteer organizations to implement stream buffer restoration projects. In short, the total costs to Fairfax County will be less those documented in Table ES-2 and summarized below.

The costs by project type are summarized below:

- Construct two regional ponds (C18 and C3) at a reduced size and impact from the proposed regional ponds - \$2,070,000. Cost for alternative projects to these and other regional ponds are included in the individual project types.
- Dry pond retrofit projects - \$9,985,000
- LID projects at public facilities - \$3,402,000

Table ES-2  
Summary of Structural Project Costs by Implementation Phase

Project Type	Estimate Project Cost
<b>Phase A Year 1-5</b>	
Region Ponds or Alternative Projects <sup>(1)</sup>	\$2,070,000
Dry Pond Wetland Retrofit	\$2,686,000
Low Impact Development Retrofit	\$187,000
Stream Restoration	\$3,866,000
Neighborhoods without Stormwater Controls <sup>(2)</sup>	\$1,137,000
Buffer Restoration	\$554,000
Upland Drainage System Improvements	\$600,000
Riparian Wetland Study	\$100,000
Dump Site Removal	\$55,000
<b>Total Phase A</b>	<b>\$11,255,000</b>
<b>Phase B Year 6-10</b>	
Dry Pond Wetland Retrofit	\$1,666,000
Low Impact Development Retrofit	\$908,000
Stream Restoration	\$4,682,400
Neighborhoods without Stormwater Controls <sup>(2)</sup>	\$1,546,000
Buffer Restoration	\$144,000
Upland Drainage System Improvements	\$600,000
<b>Total Phase B</b>	<b>\$9,546,400</b>
<b>Phase C Year 11-15</b>	
Dry Pond Wetland Retrofit	\$2,676,000
Low Impact Development Retrofit	\$1,377,000
Stream Restoration	\$1,101,300
Buffer Restoration	\$213,000
Upland Drainage System Improvements	\$600,000
<b>Total Phase C</b>	<b>\$5,967,300</b>

Table ES-2  
(Continued)  
Summary of Structural Project Costs by Implementation Phase

Project Type	Estimate Project Cost
<b>Phase D Year 16-20</b>	
Dry Pond Wetland Retrofit	\$1,267,000
Low Impact Development Retrofit	\$484,000
Stream Restoration	\$9,390,800
Buffer Restoration	\$238,000
Upland Drainage System Improvements	\$600,000
Total Phase D	\$11,979,800
<b>Phase E Year 21-25</b>	
Dry Pond Wetland Retrofit	\$1,690,000
Low Impact Development Retrofit	\$446,000
Stream Restoration	\$19,195,500
Buffer Restoration	\$169,000
Upland Drainage System Improvements	\$600,000
Total Phase E	\$22,100,500
Total for all Structural Projects	\$60,849,000

1 – Regional pond cost is for the construction of the two regional ponds that remain in the study (C18 and C39) and do not include alternative projects for these or other regional ponds. Costs for these alternative projects are included in the individual project types.

2 – Costs for neighborhoods without stormwater controls include only costs for community outreach for LID implementation and stormwater outfall retrofit projects. Costs of additional projects are included in the individual project types.

- Stream restoration - \$38,236,000. Stream restoration projects comprise 63 percent of the total costs of the watershed plan structural actions. A significant portion of these projects, comprising 32 percent of the total structural project costs, will not be implemented until 20 to 25 years into the watershed plan. Fairfax County will continue to monitor stream conditions within these reaches and is very likely that the extent and scope of these projects will change between now and the time they are implemented.
- Neighborhoods without stormwater controls - \$2,683,000. This cost includes community outreach to implement LID and stormwater outfall retrofit projects. Cost for other projects to be implemented within these neighborhoods are included in separate project types.
- Buffer restoration - \$1,318,000
- Headwater drainage systems - \$3,000,000
- Riparian wetland and stream study - \$100,000
- Dump site removal - \$55,000

The total cost of the identified structural projects equals \$60,849,000. An estimated 4.4 staff year equivalents (SYEs) are needed to implement these projects.

## **Benefits of Plan Actions**

The watershed plan vision and goals set by the CAC, project team and Fairfax County specify that the plan should preserve, protect and improve the watersheds and streams and largely relate to improving the functions of the watershed, water quality, habitat and aesthetics. The plan recognizes these watershed functions are important to residents and weighted them significantly in selecting nonstructural actions, policy recommendation and structural projects.

The watershed plan includes many nonstructural actions and policy recommendations. Many nonstructural actions are education and outreach that will reduce the watershed residents' impact on the Cub Run and Bull Run streams. Policy actions also modify the impacts of new and infill development on the watersheds. While these actions will improve the watershed health and reduce nutrient loads, their benefits are difficult to quantify.

The stream restoration structural projects will improve the stream conditions. The Stream Condition Index (SCI) is a numerical measure of the stream conditions, with values ranging from 1 to 5 (1 being a low-quality stream, 5 indicating a high-quality stream). The existing SCI for the stream restoration reaches ranges from 2.10 to 3.98 and averages 3.42. After restoration, SCI is projected to range from 3.60 to 4.11 and average 3.86, increasing the SCI by 13 percent overall. The restoration increases some reaches significantly and others only slightly. The SCI is just one measure of the

benefits provided by stream restoration. Other benefits not reflected in this SCI include reduction in pollutant and sediment loads, improved habitat conditions and improved aesthetics.

The watershed meets the water quality loading goals for the Occoquan Reservoir for both existing and future land use conditions (with future stormwater controls). It also meets or exceeds the requirements of the Virginia Chesapeake Bay Nutrient and Sediment Reduction Strategy for the Shenandoah and Potomac River Basin (March 2005). The many existing and new stormwater controls required for new development are largely responsible for meeting these goals.

Stream restoration projects reduce pollutant loads by reducing the amount of nutrients washed into the streams. The 20 miles of stream restoration removes 361 pounds of phosphorus per year.

Retrofitting dry ponds to include wetland bottoms improves the nutrient removal efficiency for phosphorus by 10 percent, from 40 to 50 percent annual reduction, and nitrogen by 25 percent. The recommended dry pond retrofit projects reduce the average annual phosphorus loads by approximately 365 pounds. These projects improve the efficiency of existing facilities reducing the need to construct new facilities.

The LID retrofit projects for county and other public facilities produce small changes in total nutrient loads because they serve a relatively small portion (36 acres) of the total watershed area (63 square miles). These controls, which benefit the watershed adjacent to the projects more, reduce the annual phosphorus load by approximately 24 pounds. These projects also provide educational benefits as well as demonstration opportunities for newer technologies.

Estimates of phosphorus reduction through retrofitting neighborhoods without stormwater controls (Greenbriar, Birch Pond, Brookfield, Country Club Manor and Pleasant Valley) assume LID and other stormwater controls are implemented for one percent of the watersheds.

Stream buffer restoration projects and retrofitting of drainage systems in headwater areas will further reduce nutrients, though the specific amount is difficult to quantify.

The total phosphorus average annual reduction produced by the structural projects equals 767 pounds per year. The total watershed load for the 48 square miles of the watershed in Fairfax County equals 17,000 pounds per year for future land use conditions with future stormwater controls. The watershed plan produces a documented 4.5 percent phosphorus load reduction. The reduction varies, with eight modeled basins having reductions greater than 30 percent and 35 having reductions greater than 10 percent. The cumulative reduction from structural and nonstructural actions, and policy recommendations will be greater than this amount.



*Executive Summary*

Together, these three major actions will greatly help meet the watershed vision and goals.

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