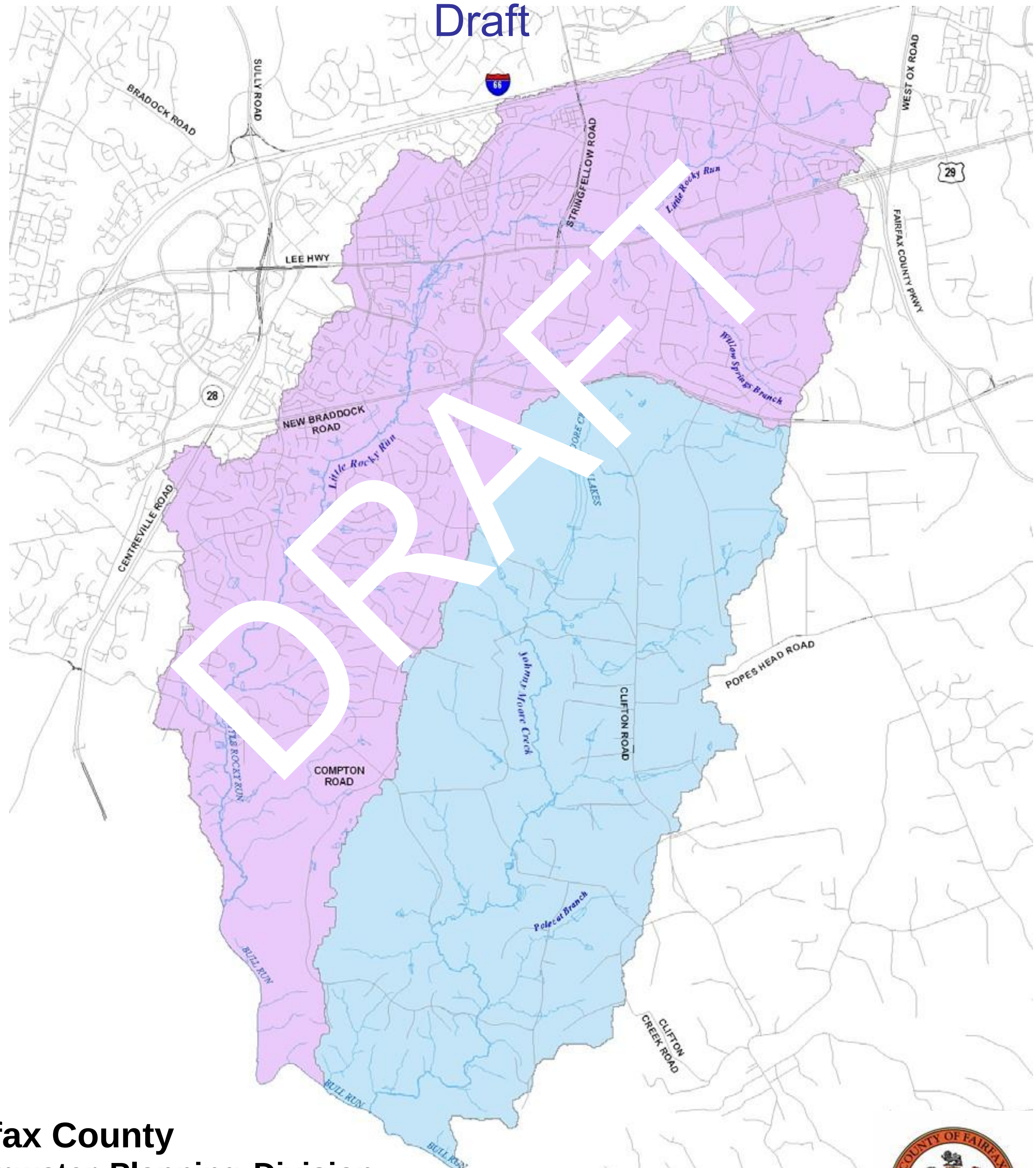
Appendix A – Draft Watershed Workbook

The Draft Watershed Workbook provides background on existing studies on the Little Rocky Run and Johnny Moore Creek watersheds. The draft document was published in October 2008 for the Issues Scoping Forum held October 1, 2008. It was not intended to be updated past this point in the characterization process. Please note that the modeling and mapping information provided in this workbook has since been updated.

Little Rocky Run
Johnny Moore Creek

Watershed Workbook

Draft



Fairfax County

Stormwater Planning Division

Department of Public Works and Environmental Services

October 2008

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Preface

The Little Rocky Run – Johnny Moore Creek Watershed Management Plan is a strategic plan that will protect and improve the water quality within the watershed over the next 25 years. The planning process is in its early stages and will include the participation and recommendations of a watershed advisory group.

Chapter 1 of the plan provides a summary of the data currently available for the watersheds, the policy documents that impact the watershed planning process and proposed projects and improvements that have been identified in the watersheds during previous County studies.

Chapter 2 of the plan provides details about the subwatershed characterization. The information is organized per Watershed Management Area (WMA) and these sections provide more detail about the current watershed conditions. The preliminary modeling that has been performed by the County at this point in the planning process is also summarized. The subwatersheds are ranked based on various indicators and the preliminary results are available to begin the identification of problem areas in the watershed.

When complete, the Little Rocky Run – Johnny Moore Creek Watershed Management Plan will provide strategies for protecting the watersheds and mitigating adverse stream impacts that have occurred, such as stream bank erosion and poor water quality.

Chapter 1: Compilation of Overall Watershed Condition Data

1.1 Introduction

The Little Rocky Run and Johnny Moore Creek watersheds drain into Bull Run and eventually to the Chesapeake Bay, and are located in the southwestern part of Fairfax County, Virginia, as shown on Figure 1-1. They are bounded to the east by the Popes Head Creek watershed and to the west and north by the Cub Run watershed.

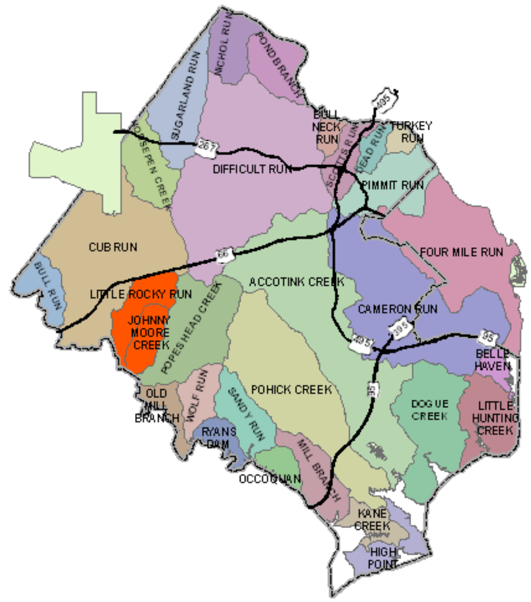


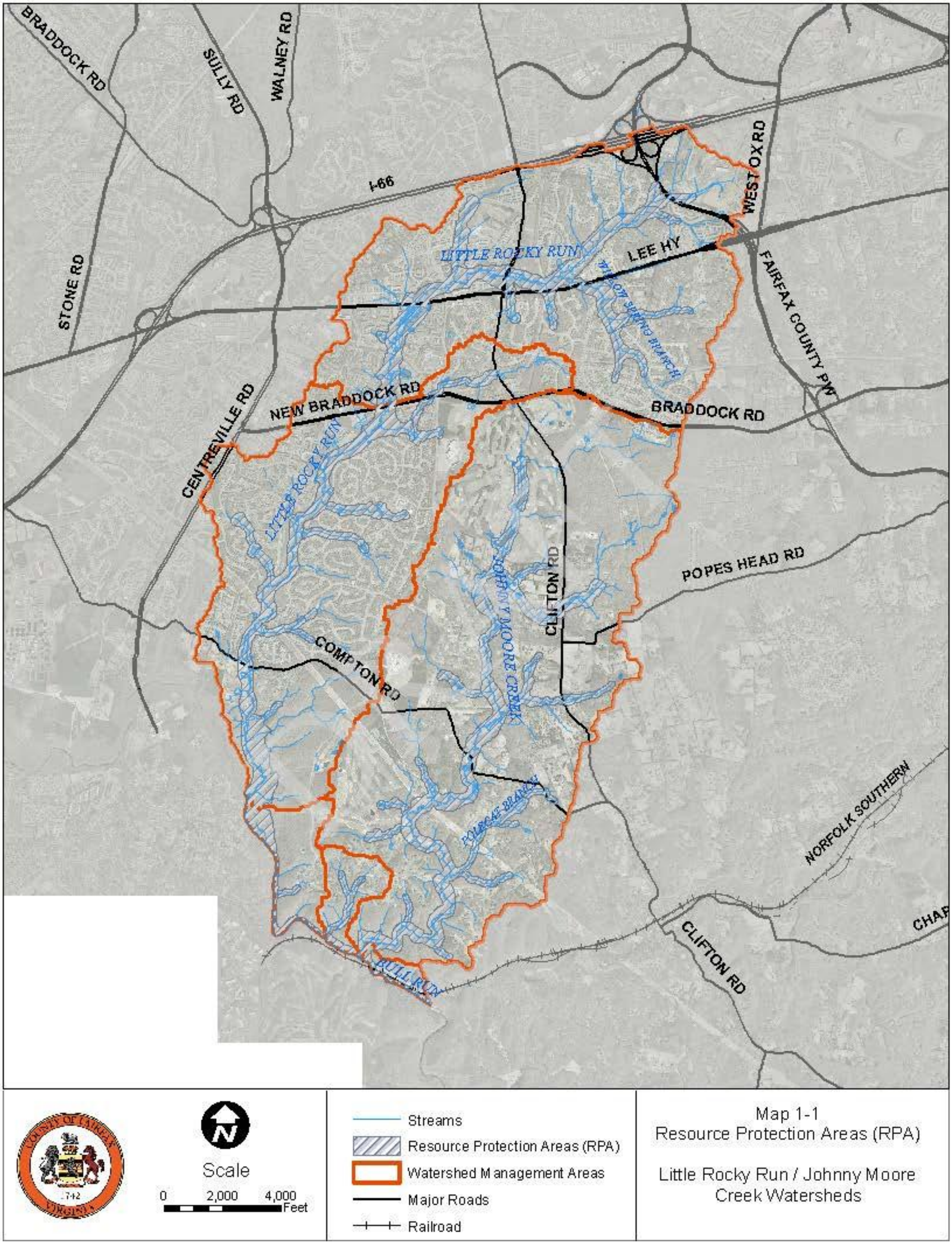
Figure 1-1: Location of the Little Rocky Run and Johnny Moore Creek Watersheds

The Little Rocky Run watershed encompasses 4,605 acres (7.2 square miles) and the Johnny Moore Creek watershed encompasses 3,374 acres (5.3 square miles). Both watersheds are located in the piedmont physiographic province, a region characterized by gently rolling hills, deeply weathered bedrock, and very little solid rock at the surface.

The headwaters of Little Rocky Run are located near the intersection of West Ox Road and Lee Highway. The creek flows in a southwesterly direction to its confluence with Bull Run. The headwaters of Johnny Moore Creek are located along Braddock Road near its intersection with Clifton Road. The creek flows in a southerly direction to its confluence with Bull Run. Major roads in the watersheds include: Interstate 66, Lee Highway (Route 29), Braddock Road, and Clifton Road.

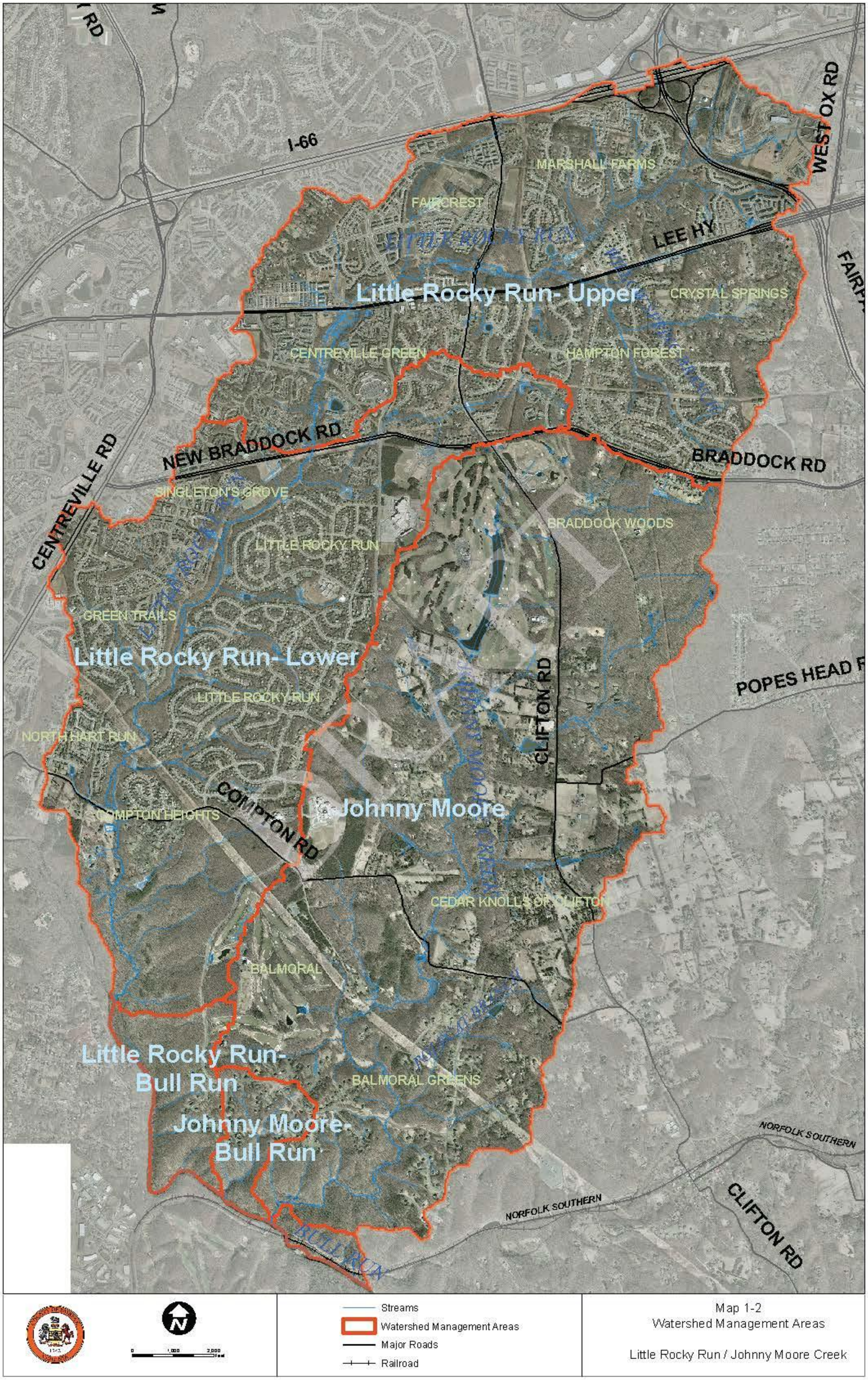
The Little Rocky Run and Johnny Moore Creek watersheds are part of the Chesapeake Bay Preservation Area (CBPA) and both main stream corridors are located in the County's designated Resource Protection Area (RPA). The RPA is designated around all water bodies with perennial flows to protect the quality of water flowing to the Chesapeake Bay. The RPA totals approximately 683 acres (1.1 square miles) in the Little Rocky Run watershed and totals approximately 463 acres (0.7 square miles) in the Johnny Moore Creek watershed. The remainder of the watershed area is part of the County's designated Resource Management Area (RMA), which is designed to protect water quality by preserving or enhancing the functional value of the RPA. Map 1-1 shows the RPA areas in both watersheds.

The Little Rocky Run and Johnny Moore Creek watersheds have been subdivided into watershed management areas. The watershed management areas will be used to evaluate portions of the watershed with similar land use and development characteristics. Map 1-2 shows the watershed management areas that will be used for Little Rocky Run and Johnny Moore Creek.



Map 1-1
Resource Protection Areas (RPA)

Little Rocky Run / Johnny Moore Creek Watersheds



Map 1-2
Watershed Management Areas

Little Rocky Run / Johnny Moore Creek

1.2 Land Use

A large portion of the Johnny Moore Creek watershed consists primarily of large lot residential development. On July 26, 1982, the Fairfax County Board of Supervisors approved a rezoning of more than 41,000 acres in the Occoquan watershed, which includes the Johnny Moore Creek watershed and a portion of the Little Rocky Run watershed, in order to protect the Occoquan Reservoir, which supplies drinking water to the County. Land in the rezoned area is classified as a Residential-Conservation (R-C) District, designating a maximum density of one dwelling unit per 5 acres. The entire Johnny Moore Creek watershed is located in the R-C District. The portion of Little Rocky Run south of Compton Road and the area south of Braddock Road and east of Union Mill Road are in the R-C District.

The predominant existing land use in the Little Rocky Run watershed is open space, as shown in Table 1-1, with 31 percent of the watershed area designated as open space. The next major land use is medium-density residential at 23 percent. The future land use designations show that only 4 percent of the watershed is expected to change. The amount of open space in the watershed will decrease by 186 acres. The amount of residential acreage will increase by 199 acres and high-intensity commercial development will increase by ten acres.

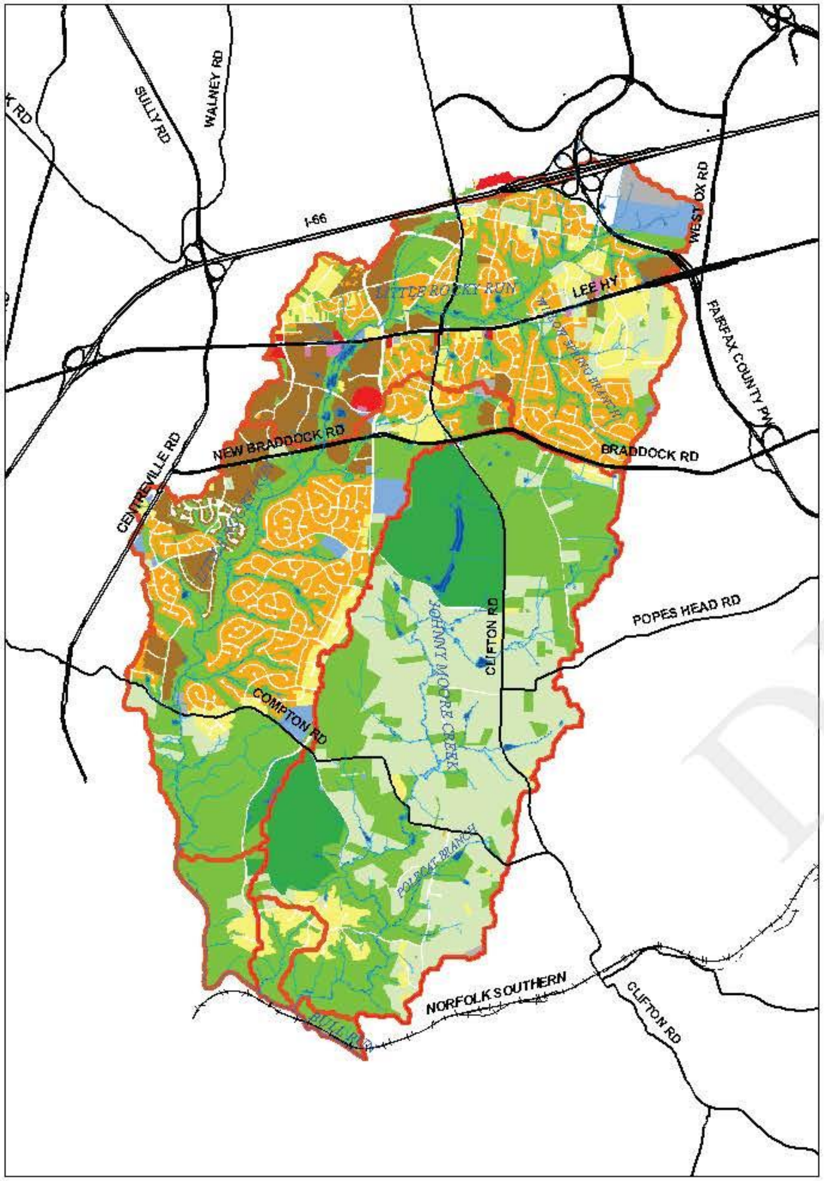
The predominant existing land use in the Johnny Moore Creek watershed is estate residential (39 percent) closely followed by open space (37 percent). In the future, open space will decrease 50 percent from 1,243 acres to 620 acres. The amount of estate residential in the watershed will increase from 39 percent of the watershed in existing conditions to 57 percent in the future. Map 1-3 shows the existing and future land use designations for each watershed.

Table 1-1 Existing and Future Land Use in the Little Rocky Run and Johnny Moore Creek Watersheds

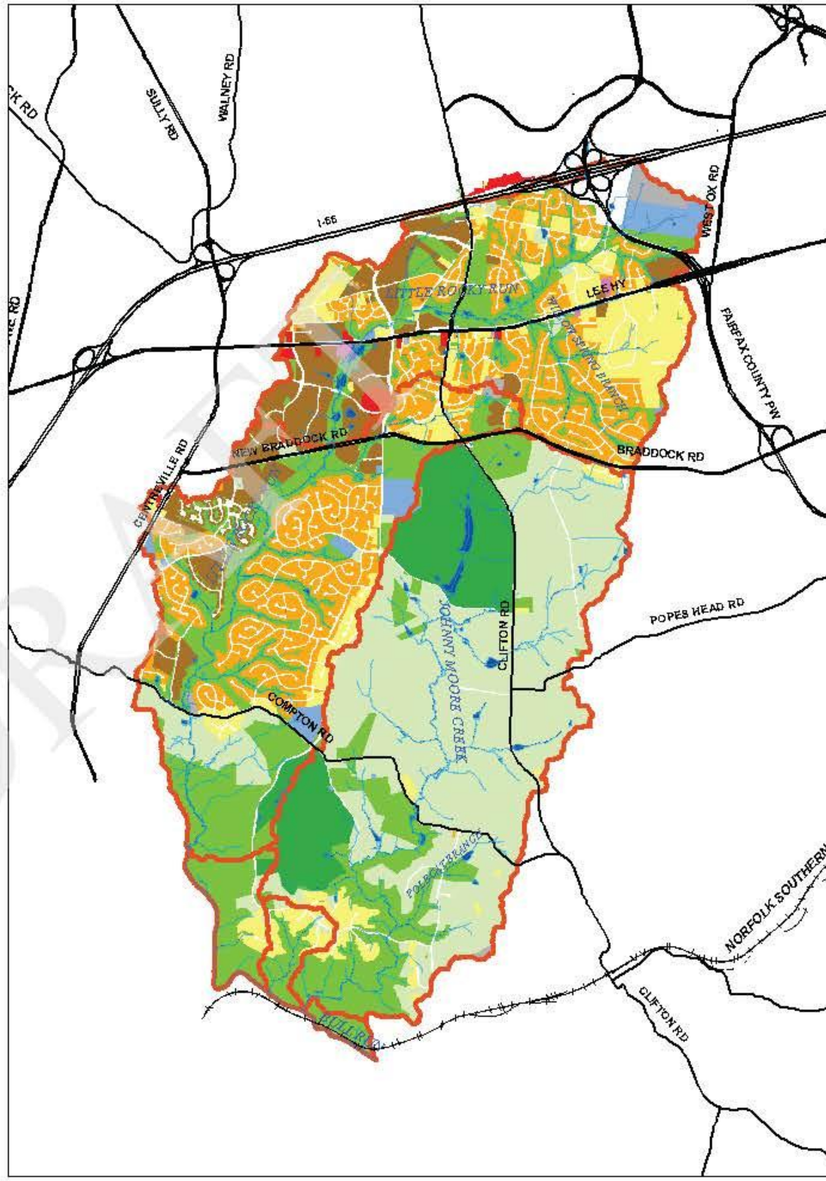
Land Use Description	Little Rocky Run				Johnny Moore Creek			
	Existing		Future		Existing		Future	
	Area (acres)	%	Area (acres)	%	Area (acres)	%	Area (acres)	%
Open space	1,433	31	1,247	27	1,243	37	620	19
Golf Course	41	1	41	1	535	16	535	16
Estate residential	207	4	191	4	1,305	39	1,928	57
Low-density residential	372	8	520	11	141	4	141	4
Medium-density residential	1,054	23	1,078	24	1	0	1	0
High-density residential	542	12	569	12	0	0	0	0
Low-intensity commercial	13	0	10	0	0	0	0	0
High-intensity commercial	38	1	48	1	0	0	0	0
Institutional	141	3	137	3	2	0	2	0
Industrial	51	1	51	1	10	0	10	0
Transportation	668	15	668	15	87	3	87	3
Water	45	1	45	1	50	1	50	1
TOTAL	4,605	100	4,605	100	3,374	100	3,374	100

Map 1-3: Existing and Future Land Use

Existing Conditions Land Use Map



Future Conditions Land Use Map



Map 1-3
Existing and Future Land Use Maps

Little Rocky Run / Johnny Moore Creek Watersheds

Legend

- Streams
- Major Roads
- Railroad
- JMwatershed
- Watershed Management Areas

Land Use

- Estate Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Low Intensity Commercial
- High Intensity Commercial
- Industrial
- Institutional
- Golf Course
- Open Space
- Water
- Transportation

Scale

4,000 2,000 0 4,000

Feet

1.3 Little Rocky Run and Johnny Moore Creek - Review of Previous Studies and Data

Fairfax County has collected data and prepared reports on its watersheds for over 20 years. These reports were prepared by various agencies within the County with different missions and goals; therefore, the documents focus on a multitude of issues. In this chapter, the data and reports are summarized and their context and purpose is described.

Table 1-2 provides a listing of the available reports grouped according to their main topic area and presented in chronological order.

Table 1-2 List of Reports Reviewed by Topic and Date

Report	Date	Prepared By
Topic: Data		
Occoquan Environmental Baseline Report	February 1978	Parsons, Brinckerhoff, Quade & Douglas
Fairfax County Stream Water Quality Reports	Annually 1997-2002	Fairfax County Health Department
Fairfax County Stream Protection Strategy Baseline Study	January 2001	Fairfax County Department of Public Works & Environmental Services, Stormwater Planning Division
Fairfax County Stream Physical Assessment	August 2005	CH2M Hill
Annual Report on Fairfax County's Streams	November 2005 October 2006	Fairfax County Department of Public Works & Environmental Services, Stormwater Planning Division
Virginia Department of Environmental Quality Data: • Virginia 2006 305(b)/303(d) Water Quality Assessment Integrated Report, October 2006 • Benthic TMDL Development for Bull Run, Virginia, June 2006 • Bacteria TMDLs for Popes Head Creek, Broad Run, Kettle Run, South Run, Little Bull Run, Bull Run and the Occoquan River, Virginia, October 2006		Various: VA Department of Environmental Quality The Louis Berger Group, Inc. George Mason University
Virginia Natural Heritage Resource Database	Continuously updated	VA Department of Conservation and Recreation
Topic: Policy		
Infill and Residential Development Study	July 2000	VA Department of Planning & Zoning VA Department of Public Works & Environmental Services VA Department of Transportation
Fulfilling the Promise: The Occoquan Watershed in the New Millennium	January 2003	New Millennium Occoquan Watershed Task Force
Fairfax County Park Authority, Natural Resource Management Plan, 2004-2008	October 2004	Fairfax County Park Authority Natural Resource Management Project Team
Topic: Proposed Projects and Improvements		

Report	Date	Prepared By
Proposed Drainage Plan, The Occoquan Watersheds	April 1979	Parsons, Brinckerhoff, Quade & Douglas
Fairfax County Master Plan Drainage Projects	Continuously Updated	Fairfax County Department of Public Works and Environmental Services
Regional Stormwater Management Plan	January 1989	Camp Dresser & McKee
The Role of Regional Ponds in Fairfax County's Watershed Management	March 2003	Fairfax County Environmental Coordinating Committee, Regional Pond Subcommittee

The previous studies conducted by Fairfax County and others indicate that the Little Rocky Run and the Johnny Moore Creek watersheds are in fair to good condition. The studies recommended the use of innovative Best Management Practices (BMPs) and new Low Impact Development (LID) techniques, the preservation of trees and open space, and identified the need to update the Public Facilities Manual (PFM). The studies also identified opportunities to educate and involve the public, and to promote regional cooperation between agencies, citizens, and nongovernmental organizations.

1.3.1 DATA

Occoquan Environmental Baseline Report, 1978

The *Occoquan Environmental Baseline Report* was written by Parsons, Brinckerhoff, Quade & Douglas in February 1978, based on data collected in 1976. The report presented a comprehensive review of the environmental baseline conditions for the 11 watersheds in the southern area of the County that drain into Bull Run and the Occoquan Reservoir. The baseline water quality of the 11 watersheds in the study was rated "very good." Two sites were sampled on Little Rocky Run at Lee Highway and Compton Road and one site was sampled on Johnny Moore Creek at Compton Road. The yearly log average fecal coliforms in 1976 (Table E-4 in the report) were 35 fecal coliforms per 100 milliliters of water (35/100 ml) and 24/100 ml for the Little Rocky Run site and 33/100 ml for the Johnny Moore Creek site.

The report also assessed the aquatic environment by surveying the aquatic fauna at two sites in the Little Rocky Run watershed and at two sites in the Johnny Moore Creek watershed (Table 7 and Figure 13 in the report). The sites along Little Rocky Run were at Braddock Road and at Compton Road, and the sites along Johnny Moore Creek were at Twin Lakes Road and near the confluence with Polecat Branch. The stream fauna quality was ranked "good" to "very good" on Little Rocky Run at Compton Road and on Johnny Moore Creek near Polecat Branch, "good" on Little Rocky Run at Braddock Road, and "fair" to "good" on Johnny Moore Creek at Twin Lakes Road.

Severe erosion was noted at several locations on Little Rocky Run, Johnny Moore Creek, and their tributaries. Along Little Rocky Run, severe erosion was noted in four areas upstream of Lee Highway, two areas upstream of Compton Road, and one area downstream of Compton Road. Along Willow Spring Branch, severe erosion was noted in one area slightly upstream of Lee Highway. An unnamed tributary to Little Rocky Run located south of Interstate 66 and west of Stringfellow Road was also experiencing one area of severe erosion. Along Johnny Moore Creek, severe erosion was noted in one location downstream of Twin Lakes Drive, two locations downstream of Compton Road and the power line, and one location near the confluence with Polecat Branch.

The *Occoquan Environmental Baseline Report* noted severe sedimentation at three locations in the Little Rocky Run watershed and one location in the Johnny Moore Creek watershed. Two locations were noted along Little Rocky Run, one upstream of Lee Highway and one upstream of Compton Road. One location within the Little Rocky Run watershed was noted along Willow Spring Branch, upstream of Lee Highway. The one location within the Johnny Moore Creek watershed was noted on Polecat Branch, upstream of the power line.

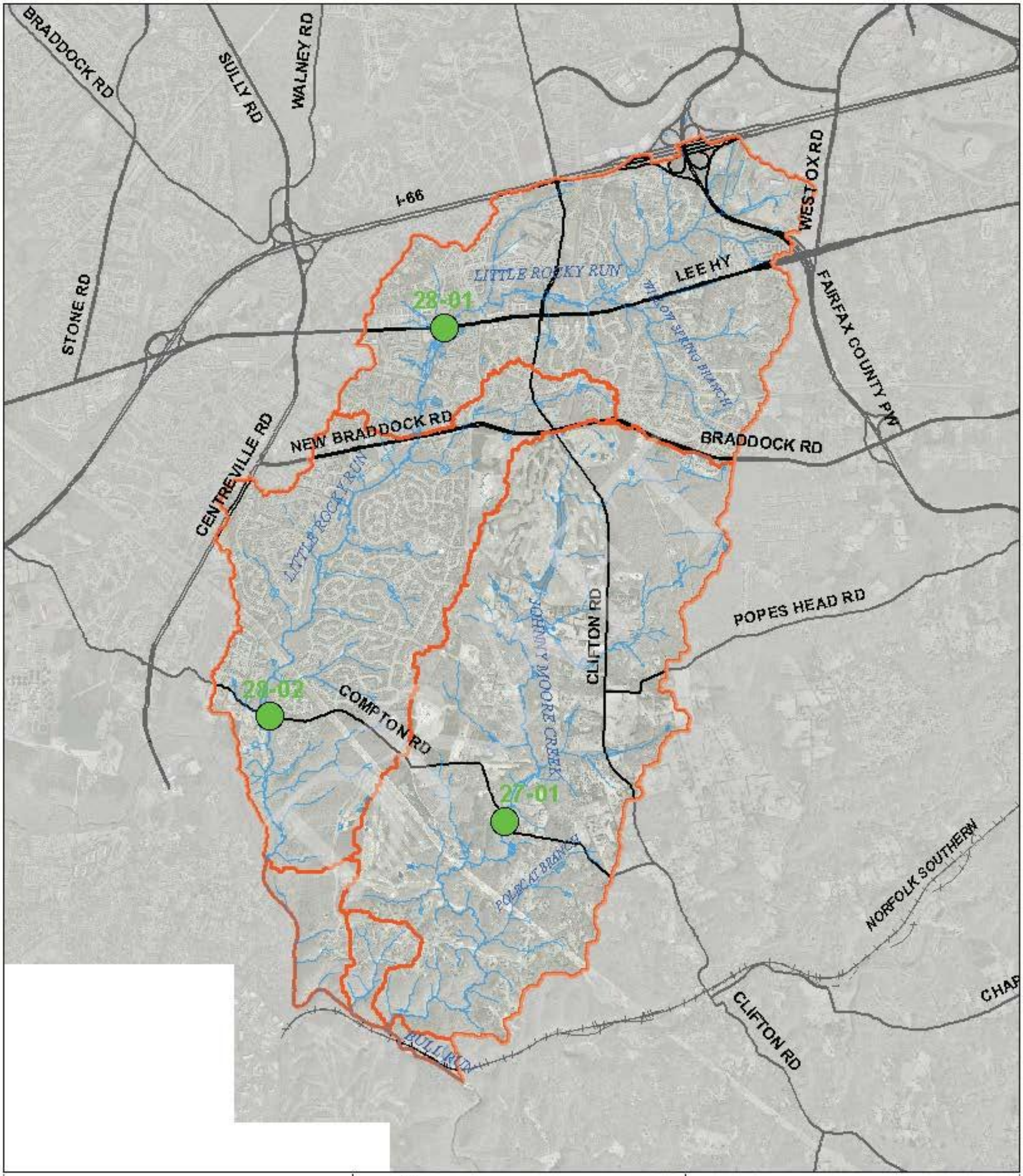
The data in this report provide baseline information that can be compared to more recent data collected for the *Stream Physical Assessment* and the *Stream Protection Strategy* reports. Little Rocky Run and Johnny Moore Creek have more recent stream physical assessments that were performed in 2003 (*Fairfax County Stream Physical Assessment*, 2005). The more recent assessments and field observations conducted as part of this watershed planning study will be used to identify erosion and sedimentation areas for mitigation in the Watershed Management Plans.

Fairfax County Annual Stream Water Quality Reports, 1997 through 2002

The Fairfax County Health Department monitored stream water quality at 72 sampling sites throughout the County from 1986 to 1999. In 2000, 13 new sites were added, totaling 85 sampling sites. In 2001 and 2002, only 84 sites were sampled. The water quality sampling program was transferred to the Department of Public Works and Environmental Services in 2002 (see the *Annual Report on Fairfax County's Streams*). Reports from 1997 to 2002 were reviewed in preparation of this document.

Two water quality sampling sites were located in the Little Rocky Run watershed and one water quality sampling site was located in the Johnny Moore Creek watershed. The locations of the sampling sites are shown on Map 1-4. Site 27-01 is located on Johnny Moore Creek, and sites 28-01 and 28-02 are located on Little Rocky Run. The three sampling stations from the *Occoquan Environmental Baseline Report* are approximately in the same locations as those used in the *Stream Water Quality* reports. In 2002, 15 water samples were collected from site 27-01, 16 water samples were collected from site 28-01, and 18 water samples were collected from site 28-02. These samples were evaluated for fecal coliform, dissolved oxygen, nitrate, nitrogen, pH, total phosphorous, temperature, and heavy metals. These parameters indicate the amount of pollution contributed from manmade sources and help to evaluate the quality of the aquatic environment. Information regarding the parameters and data collected for the *Fairfax County Annual Stream Water Quality Reports* (1997-2002) can be found on the Fairfax County website at http://www.fairfaxcounty.gov/hd/streams/.

The average dissolved oxygen concentration for all three sites in the two watersheds was between 6 and 10 milligrams per liter (mg/l). This is above the minimum standard of 4.0 mg/l considered suitable for aquatic life. None of the samples from site 27-01 on Johnny Moore Creek or site 28-02 on Little Rocky Run had dissolved oxygen concentration less than 4.0 mg/l. However, 18 percent of samples collected from site 28-01 on Little Rocky Run showed a dissolved oxygen concentration of less than 4.0 mg/l. The 2002 report states that 54 percent of the samples measured below 4 mg/l were collected during the



0 2,000 4,000 Feet

Monitoring Sites

Streams

Watershed Management Areas

Major Roads

Railroad

Map 1-4
Water Quality Monitoring Sites

Little Rocky Run / Johnny Moore Creek Watersheds

months of June and July, and that the summer water temperatures may be a contributing factor in the low dissolved oxygen levels. The three samples from site 28-01 that measured below 4 mg/l were taken in June and July.

For sites 27-01, 28-01, and 28-02, fecal coliform counts in 2002 were in the “good” range for 13 percent, 31 percent, and 17 percent of the samples, respectively. Countywide, 17 percent of the samples collected in 2002 were in the “good” range. In the 2002 report, a fecal coliform count less than 200/100 ml (geometric mean) was considered “good” water quality and a count of 250,000/100 ml was indicative of a direct sewage discharge. Figure 1-2 shows the values for the geometric mean of fecal coliforms from 1993 to 2002. The geometric mean is used to measure the central tendency of the data.

The data collected for the *Annual Stream Water Quality Reports* indicated a higher concentration of fecal coliforms at the three sampling sites than the fecal coliform data collected for the *Occoquan Environmental Baseline Report*. Data from 1976 and 2002 are compared in Table 1-3.

Figure 1-2: Yearly Geometric Mean of Fecal Coliforms for Little Rocky Run and Johnny Moore Creek

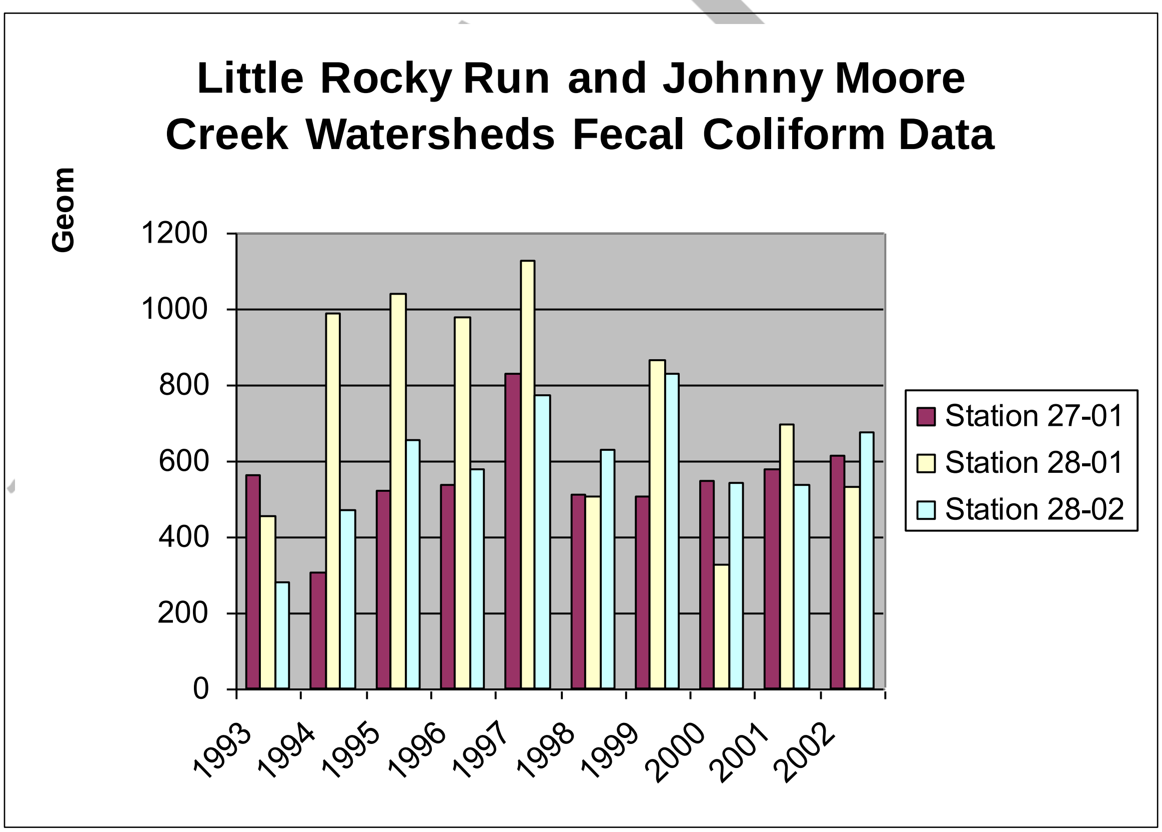


Table 1-3 Comparison of Fecal Coliform Levels – Occoquan Environmental Baseline Report and Stream Water Quality Reports

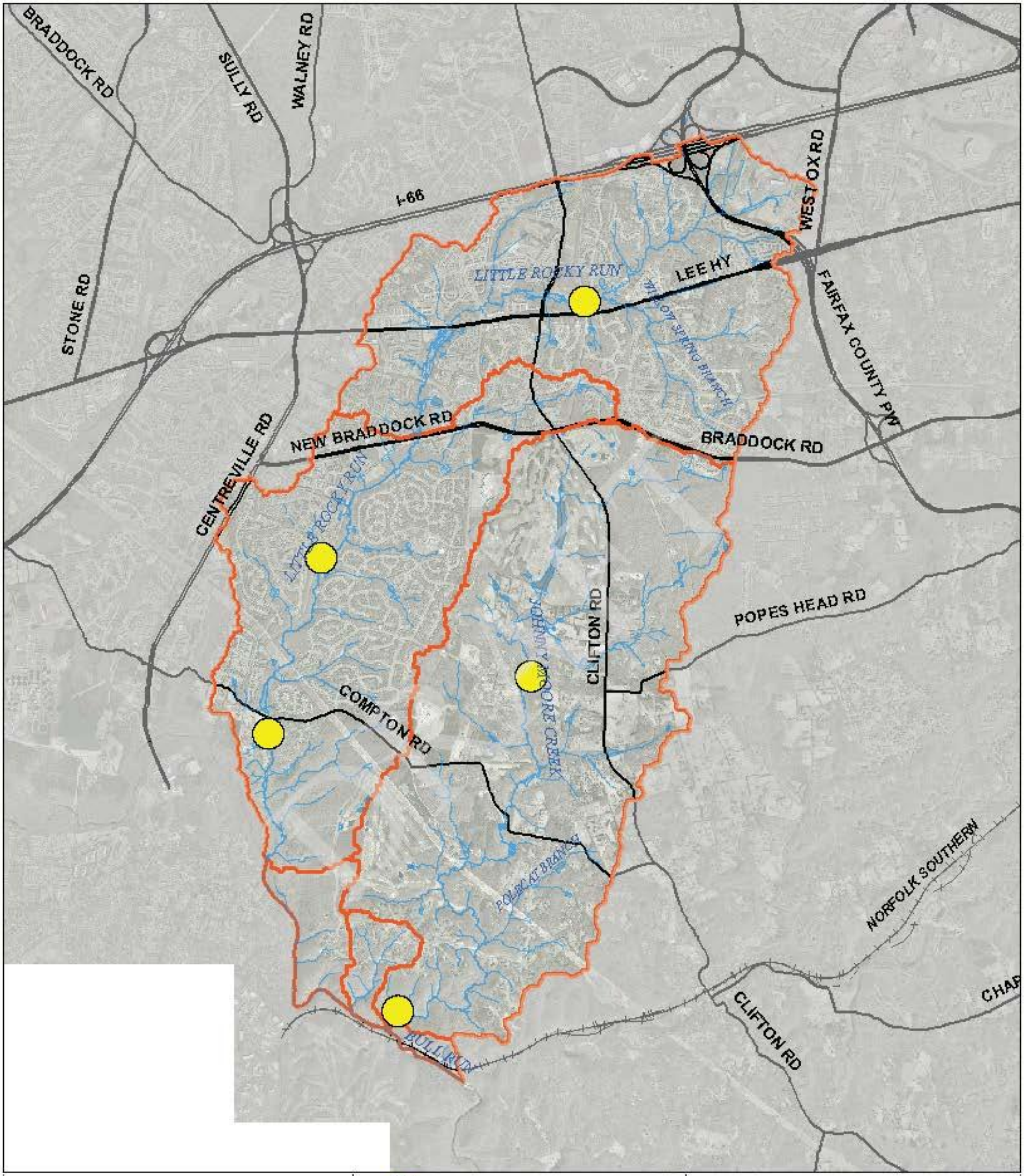
Sample Location	1976 Yearly Log Average Fecal Coliforms per 100 ml	2002 Geometric Mean Fecal Coliforms per 100 ml
Johnny Moore Creek at Compton Road (27-01)	33	615
Little Rocky Run at Lee Highway (28-01)	35	535
Little Rocky Run at Compton Road (28-02)	24	676

The stream water quality reports included analyses of sampling data that provide valuable information about the water quality in the Little Rocky Run and Johnny Moore Creek watersheds. These data will be used in conjunction with other County data to identify problem areas.

Fairfax County Stream Protection Strategy Baseline Study, 2001

The *Fairfax County Stream Protection Strategy (SPS) Baseline Study* evaluated the quality of streams throughout the County. The purpose of the SPS was to assess the continuing stream degradation within the ecosystem as evidenced by increasing stream channel erosion, loss of riparian buffers, decreased aquatic life, and poor water quality. The general objectives of the SPS program were to provide “recommendations for protection and restoration activities on a subwatershed basis, prioritization of areas for allocation of limited resources, establishment of a framework for long-term stream quality monitoring, and support for overall watershed management.”

Little Rocky Run received “fair” composite site condition ratings in the upper and lower watershed, and a “good” rating in the central portion of the watershed. Johnny Moore Creek received “excellent” composite site condition ratings at both sites in the watershed. These ratings were based on the numeric scores of four components of stream/watershed conditions (environmental parameters): an index of biotic integrity; a general evaluation of watershed features, and a specific evaluation of 10 habitat quality parameters (habitat assessment); fish taxa richness (number of fish species); and percent imperviousness. Table 1-4 provides information regarding the macroinvertebrate and fish species and percent impervious surfaces at the five testing sites according to the *SPS Baseline Study Data Summary*. Faunal quality results at similar locations from the *Environmental Baseline Report* are also shown. Map 1-5 shows the location of the five SPS sampling sites.



SPS Sampling Sites

Streams

Watershed Management Areas

Major Roads

Railroad

Map 1-5
Stream Protection Strategy
Sampling Sites

Little Rocky Run / Johnny Moore
Creek Watersheds

Table 1-4 Macroinvertebrate Assessment and Fish Species

Stream Name and Location	Composite Site Condition Rating	Macro-invertebrate Assessment	Number of Fish Species	1978 Faunal Quality	2001 Percent Impervious Surfaces
Little Rocky Run upstream of Stringfellow Road	Fair	Poor	High	No data available	14.6
Little Rocky Run downstream of New Braddock Road (and Springstone Drive)	Good	Fair	High	Good	17.7
Little Rocky Run downstream of Compton Road	Fair	Poor	Moderate	Good to Very Good	19.1
Johnny Moore Creek downstream of Johnny Moore Lane	Excellent	Good	High	Fair to Good	2.6
Johnny Moore Creek upstream of the confluence with Bull Run	Excellent	Poor	High	Good to Very Good	2.4

The Little Rocky Run watershed differs from the Johnny Moore Creek watershed in terms of level of development. The Johnny Moore Creek watershed has a greater percentage of forested land and fields/pastures than the Little Rocky Run watershed. Little Rocky Run has a greater percentage of low intensity residential, high intensity residential, and commercial/ industrial development than Johnny Moore Creek. This is evident in the difference in percent imperviousness in the two watersheds. Johnny Moore Creek has a substantially lower percent imperviousness than Little Rocky Run.

Polluted stormwater runoff affects the number and diversity of macroinvertebrate and fish species. Twenty-one individual species of fish were found in each of the two watersheds, accounting for the high fish taxa richness. The generally poor rating for the benthic macro-invertebrate community for both watersheds was due to aquatic worms and/or midges (organisms generally considered tolerant of degraded conditions) dominating the community. The volunteer monitoring conducted by the Northern Virginia Soil and Water Conservation District indicated a generally healthy benthic community at four sites within the Johnny Moore Creek main stem. For the macroinvertebrate assessment, the number of unique species and the balance between pollution-tolerant and intolerant species were measured. The SPS rankings ranged between excellent, good, fair, poor, and very poor. A fair rating indicates a marked decrease in intolerant species and a shift to an unbalanced community; a poor rating indicates decreased diversity with intolerant species being rare or absent. For the number of unique fish species collected, the SPS ratings were high, moderate, low, or very low.

Sediment deposition and bank stability ratings negatively impacted overall habitat rankings. Specifically, active channel widening was identified on some reaches of Little Rocky Run, indicating bank instability. Little Rocky Run was considered a semi-degraded aquatic system with the potential for improvement. Sediment deposition and bank stability ratings also lowered overall habitat scores across the region; however, in-stream and riparian zone conditions were generally "good" throughout both watersheds (some exceptions being portions of Little Rocky Run with evidence of instability, often in the form of active channel widening). The Little Rocky Run and Johnny Moore Creek watersheds still contain some of the higher quality stream systems found within the Piedmont Upland Region in Fairfax County.

In the *SPS Baseline Study*, the central portion of Little Rocky Run watershed and all of Johnny Moore Creek watershed were classified as Watershed Protection Areas, with the goal of preserving biological integrity by taking active measures to identify and protect, as much as possible, the conditions responsible for the current high-quality rating of these streams. The upper portion of Little Rocky Run watershed was classified as a Watershed Restoration Area Level I, with the goal of reestablishing healthy biological communities by taking active measures to identify and remedy causes of stream degradation. The lower portion of Little Rocky Run watershed was classified as a Watershed Restoration Area Level II, with the goal of maintaining areas to prevent further degradation and implementing measures to improve water quality to comply with Chesapeake Bay initiatives, Total Maximum Daily Load (TMDL) regulations, and other water quality measures. It was also designated as an Assessment Priority Area, indicating a need to select sites and implement monitoring within that area. This reflects the uncertainty over the dramatic change in condition between monitoring sites along the system's main stem. These designations were based on the composite biological ranking and estimated imperviousness (future development potential based on current zoning information). The Countywide representation in each of the management categories was as follows:

- Watershed Protection: 31.5 percent of the County
- Watershed Restoration Level I: 7.2 percent of the County
- Watershed Restoration Level II: 61.3 percent of the County

The entire Johnny Moore Creek watershed and a portion of the Little Rocky Run watershed are under the zoning ordinance of the Water Supply Protection Overlay District (WSPOD) to protect the quality of water draining directly into the Occoquan reservoir. The Centreville area within the Little Rocky Run watershed is exempt from the ordinance, a fact that explains the abrupt differences in land use and imperviousness between the two watersheds.

Based on the SPS goals of protecting and restoring stream quality within Fairfax County, a diverse management approach will be necessary. It will require active and ongoing stream monitoring, targeted restoration projects, public outreach and education, enhanced stormwater controls, and improved communication with the development community.

The recommendations generated by the baseline study were as follows:

- Promote use of innovative BMPs and reduction of imperviousness for infill and redevelopment.
- Conduct public education in stream stewardship.
- Promote programs like Adopt-A-Stream to increase public involvement.

Additional recommendations are discussed in the Executive Summary and Chapter 5 of the *SPS report* which can be found on the Fairfax County website at: http://www.fairfaxcounty.gov/dpwes/environmental/sps_main.htm.

The SPS report provides data on a number of factors affecting the quality of Little Rocky Run and Johnny Moore Creek. The watershed characterization level from the SPS will guide the types of improvements recommended for the watershed management areas.

Fairfax County Stream Physical Assessment, 2005

The County initiated a stream physical assessment for all of its watersheds in August 2002, resulting in the final *Stream Physical Assessment Report* dated August 2005. The report included a habitat assessment, infrastructure inventory, stream characterization, and stream geomorphologic assessment. The assessment data are described for each of the subwatersheds in the following sections.

Habitat Assessment

As part of the assessment, the following characteristics were evaluated to determine the stream habitat quality for each stream reach:

- In-stream cover (fish)
- Epifaunal substrate (benthic)
- Embeddedness
- Channel/bank alteration
- Frequency of riffles
- Channel flow status (drought & normal flow)
- Bank vegetative protection
- Bank stability
- Vegetated buffer zone width

The scores assessed for the various physical parameters representing the stream habitat conditions were combined for each stream segment to obtain a total habitat score. The majority of the stream habitat was assessed as “fair” for both watersheds. The score of 102 for Little Rocky Run watershed is considered in the lower middle range of quality as compared with the rest of the County, and the score of 104 for Johnny Moore Creek watershed is considered in the middle range of quality as compared with the rest of the County. Tables 1-5 and 1-6 describe the percentage of length for each habitat quality rating for the streams according to the total score.

Table 1-5 Summary of Stream Habitat Quality for Little Rocky Run Watershed

Stream	Percent of Stream Length				
	Very Poor	**Poor**	**Fair**	**Good**	**Excellent**
Little Rocky Run	0%	11%	60%	21%	8%
Tributary to Bull Run	0%	0%	100%	0%	0%
Tributary to Little Rocky Run	0%	76%	24%	0%	0%
Willow Springs Branch	0%	0%	100%	0%	0%
Total Watershed	**0%**	**19%**	**62%**	**14%**	**5%**

Table 1-6 Summary of Stream Habitat Quality for Johnny Moore Creek Watershed

Stream	Percent of Stream Length				
	Very Poor	**Poor**	**Fair**	**Good**	**Excellent**
Johnny Moore Creek	0%	0%	53%	47%	0%
Polecat Branch	0%	35%	65%	0%	0%
Tributary to Bull Run	0%	0%	0%	100%	0%
Tributary to Johnny Moore Creek	2%	28%	66%	4%	0%
Tributary to Polecat Branch	0%	0%	100%	0%	0%
Total Watershed	**1%**	**15%**	**60%**	**24%**	**0%**

Vegetative Buffer Zone Width

Vegetative buffers filter pollutants entering a stream from runoff and minimize erosion along the stream. Approximately 37 percent of stream buffers in the Little Rocky Run watershed have a severe impact score, while 21 percent have a moderate to severe impact score, and 42 percent have a minor to moderate impact score. Approximately 5 percent of stream buffers in the Johnny Moore Creek watershed have a severe impact score, while 36 percent have a moderate to severe impact score, and 59 percent have a minor to moderate impact score.

Bank Stability

Stable stream banks have minimal erosion and gently sloping banks while unstable banks have steep slopes with evident erosion and bank failure. In the Little Rocky Run watershed, 46 percent of the banks were classified as moderately unstable and 54 percent were classified as moderately stable. In the Johnny Moore Creek watershed, 89 percent of the banks were classified as moderately unstable and 11 percent were classified as moderately stable.

Embeddedness

The assessment documented the degree of streambed embeddedness. Embeddedness, the degree to which cobbles and gravel on the streambed are covered with or sunken into sediment, is a measure used to quantify the impact of sedimentation on stream habitat. As the streambed becomes more embedded, the habitat of bottom dwelling organisms is increasingly impaired. In the Little Rocky Run watershed, embeddedness rankings were: 4 percent poor, 61 percent marginal, 32 percent suboptimal and 3 percent optimal. In the Johnny Moore Creek watershed, embeddedness rankings were: 8 percent poor, 65 percent marginal, and 27 percent suboptimal.

Infrastructure Inventory

The assessment identified and characterized the following significant characteristics and features within the watersheds:

- Deficient buffer vegetation
- Dumpsites
- Erosion locations
- Head cuts
- Obstructions
- Pipe and ditch outfalls
- Public utility lines
- Roads and other crossings

An impact score was assigned to those inventory items causing a negative impact to the stream. Based on the impact score, the degrees of impact were classified into four groups: minor, moderate, severe, and extreme. Table 1-7 describes the classifications for each of the stream inventory items. These impacts are further categorized by watershed management area in Chapter 2.

Table 1-7 Description of Impacts

Impact	Description
Deficient Buffer Vegetation (within 100 feet of stream bank)	
Extreme	Impervious/commercial area in close proximity to a stream. The stream banks may be modified or engineered. The stream character (bank/bed stability, sediment deposition, and/or light penetration) is obviously degraded by adjacent use.
Severe	Some impervious areas and/or turf located up to the bank and water. Very little vegetation aside from the turf exists within the 25-foot zone. Home sites may be located very close to the stream. The stream character is probably degraded by adjacent use.
Moderate	Encroachment mostly from residential uses and yards. There is some vegetation within the 25-foot zone, but very little aside from turf exists within the remainder of the 100-foot zone. The stream character may be changed slightly by adjacent use.
Minor	Vegetated buffer primarily consists of native meadow (not grazed).
Dumpsites	
Severe to Extreme	Active and/or threatening sites. The materials may be considered toxic or threatening to the environment (concrete, petroleum, empty 55-

Impact	Description
	gallon drums, etc.) or the site is large (greater than 2,500 square feet) and appears active.
Moderate	Dumpsite less than 2,500 square feet with non-toxic material. It does not appear to be used often, but clean-up would definitely be a benefit.
Minor	Dumpsite appears small (less than 1,000 square feet) and the material stable (will not likely be transported downstream by high water). This site is not a high priority.
Erosion Locations	
Extreme	Impending threat to structures or infrastructure
Severe	Large area of erosion that is damaging property and causing obvious in-stream degradation. The eroding bank is generally five feet or greater in height.
Moderate	A moderate area of erosion that may be damaging property and causing in-stream degradation. The eroding bank is generally two feet or greater in height.
Minor	A minor area of erosion that is a low threat to property and causes no noticeable in-stream degradation.
Head Cuts	
Severe to Extreme	Greater than two-foot head cut height
Moderate	One- to two-foot head cut height
Minor	One-half to less than one-foot head cut height
Obstructions	
Severe to Extreme	The blockage is causing a significant erosion problem and/or the potential for flooding that can cause damage to infrastructure. The stream is usually almost totally blocked (more than 75% blocked).
Moderate to Severe	The blockage is causing moderate erosion and could cause flooding. The stream is partially blocked, but obstructions should probably be removed or the problem could worsen.
Minor to Moderate	The blockage is causing some erosion problems and has the potential to worsen. It should be looked at and/or monitored.
Pipes and Ditch Outfalls	
Severe to Extreme	Stormwater runoff from a ditch or pipe is causing a significant erosion problem to the stream bank or stream. Discharge that may not be stormwater is coming from the stormwater pipe.
Moderate	Stormwater runoff from a ditch or pipe is causing a moderate erosion problem and should be fixed; it may get worse if left unattended. Discharge is coming from the pipe. It is probably stormwater, but it will be uncertain without further investigation.
Minor	Stormwater runoff from a ditch or pipe is causing a minor erosion problem and some discharge is occurring.

Public Utility Lines	
Extreme	A utility line is leaking.
Severe	An exposed utility line is causing a significant erosion problem and/or obstruction (blockage). The potential for the sanitary line to burst or leak appears high.
Moderate	A partially exposed utility line is causing a moderate erosion problem. The line is partially visible (mostly buried in a stream bed with little if any erosion).
Minor	A utility line is exposed but stabilized with concrete lining and stable anchoring into the bank.
Road and other Crossings	
Extreme	The condition of debris, sediment, or erosion poses an immediate threat to the structural stability of the road crossing or other structure. Major repairs will be needed if the problem is not addressed.
Severe	The condition probably poses a threat to a road crossing or other structure. The problem should be addressed to avoid larger problems in the future
Moderate	The condition does not appear to pose a threat to a road crossing or other structure but should be addressed to enhance stream integrity and the future stability of the structures.
Minor	The condition is noticeable but may not warrant repair.

Source: *Fairfax County Stream Physical Assessment Protocols*, December 2002

Stream Geomorphologic Assessment
The geomorphologic assessment of the stream channels in the Little Rocky Run and Johnny Moore Creek watersheds was based on the conceptual incised channel evolution model (CEM) developed by Schumm, et al. (1984). Based on visual observation of the channel cross section and other morphological observations of the channel segment, the CEM type was assigned for the channel segment. The CEM types are summarized in Table 1-8. The CEM type for the stream segments is shown on maps in Chapter 2.

Table 1-8 Summary of CEM Types

CEM Type	Description
1	Stable stream banks and developed channel
2	Deep incised channel
3	Unstable stream banks and actively widening channel
4	Stream bank stabilizing and channel developing
5	Stable stream banks and widened channel

The data obtained from the stream physical assessment will be used as a starting point to determine problem areas in the watersheds. The assessment data will be field verified and projects to mitigate the problem areas will be recommended as part of the *Watershed Management Plan*.

Annual Report on Fairfax County's Streams, 2005 and 2006

In 2004, the County's biological sampling strategy was reevaluated and long-term goals were established. The Fairfax County Stormwater Planning Division developed the *2005*

Annual Report on Fairfax County's Streams. It was determined that annual Countywide conditions and trends were best determined from a probability-based sampling procedure, rather than the targeted sampling approach employed in the *Stream Protection Strategy Baseline Study*. The biological monitoring program focused on bacteria levels, biotic integrity, and stream quality. Three biological monitoring sites were located within the Little Rocky Run watershed. Additionally, there were three coliform bacteria monitoring sites located within Little Rocky Run and Johnny Moore watersheds. There were also six sites monitored by Audubon Naturalist Society (ANS) and Northern Virginia Soil and Water Conservation District (NVSWCD) volunteer groups within the two watersheds. The index scores and condition ratings for the 2004 sampling locations based on benthic macroinvertebrate and fish data are shown in Table 1-9.

Table 1-9 Table 1-9: Benthic and Fish Indices from 2004 Sampling

Sampling Site ID	Stream Order	Benthic Index Score	Rating	Fish Index Score	Rating
Little Rocky Run (LR0401)	3	27.36	Poor	25	Fair
Little Rocky Run (LR0402)	1	30.80	Poor	No fish sampling	
Little Rocky Run (LR0403)	1	15.56	Very Poor	No fish sampling	

In 2006, Fairfax County Stormwater Planning Division published the *2006 Annual Report on Fairfax County's Streams*. The 2005 and 2006 reports can be found on the Fairfax County website at:
http://www.fairfaxcounty.gov/dpwes/stormwater/streams/streamreports.htm
The biological monitoring program focused on bacteria levels (fecal-related), benthic macroinvertebrates, fish communities, and water chemistry. There was one randomly selected biological and bacteriological monitoring site located within the Little Rocky Run watershed. Additionally, there was one ANS volunteer monitoring site located on Little Rocky Run. Page 38 of the 2006 annual report contains a detailed map showing monitoring results from 1999 through 2005.
Data from this report provided further documentation of water quality and habitat issues in the watershed and will provide additional focus in development of the Watershed Management Plan.

Virginia Department of Environmental Quality Water Quality Data

None of the stream segments in either the Little Rocky Run watershed or the Johnny Moore Creek watershed are listed as Category 5 impaired water bodies in the 2006 305(b)/303(d) Water Quality Assessment (WQA) Integrated Report prepared by the Virginia Department of Environmental Quality (DEQ). United States Environmental Protection Agency (EPA) Category 5 impaired water bodies are defined as "impaired or threatened and a TMDL is needed." Two segments from the watersheds are listed in the *2006 Integrated List of All Assessed Waters in Virginia*. A 4.98-mile segment of Little Rocky Run (VAN-A23R_LIP01A06) is designated as a Virginia Category 2B, which is a subcategory to EPA Category 2. EPA Category 2 waters meet some of their designated uses, but there are insufficient data to determine if remaining designated uses are met. Virginia Category 2B waters are of concern to the state, but no water quality standards exist for an identified pollutant, or the water exceeds a state screening value. The waters are considered fully supporting their uses with observed effects. Map 1-6 shows the location of the 303(d) impaired waters.

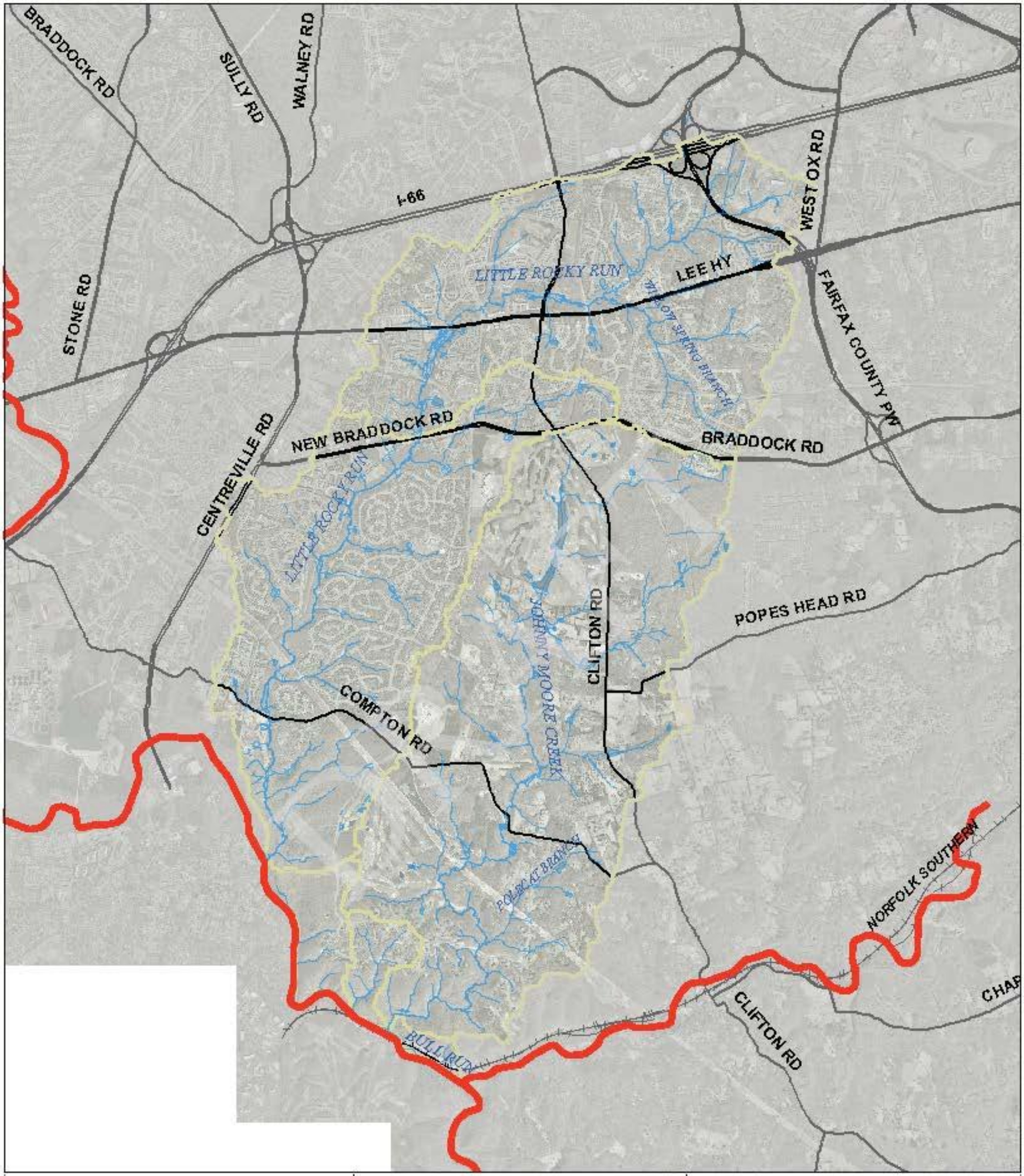
A 3.78-mile segment of Johnny Moore Creek (VAN-A23R_JOH01A02) is listed as a Virginia Category 3C, which is a subcategory to EPA Category 3. EPA Category 3 waters are defined as those that have insufficient data to determine whether any designated uses are met. Virginia Category 3C waters may have data collected by a citizen monitoring group or other organization which indicate water quality problems, but the methodology or data quality has not been approved for a determination of attainment of designated uses. These waters are considered to have insufficient data with observed effects. These waters will be prioritized for follow-up monitoring.

There have been changes in the criteria for identifying impaired waters since the 2002 assessment. One significant change was the assessment of fish tissue data. In order to protect human health, waters were listed as impaired when two or more of the human health surface water criteria were exceeded in samples collected at the same station. In addition, Virginia Department of Health (VDH) approved a trigger value for mercury.

Once a water body has been listed as impaired, DEQ must develop a TMDL report identifying the sources causing the water quality problem and the reductions needed to resolve it, and submit the report to the EPA for approval. Upon approval, DEQ must develop a TMDL Implementation Plan to restore water quality. Once the TMDL report is approved by EPA, the loading reductions are incorporated into Fairfax County's Virginia Stormwater Management Program (VSMP) permit to discharge stormwater into waters of the state. As a result, the loading reductions become mandatory for the County.

A report titled *Benthic TMDL Development for Bull Run, Virginia* was prepared by the Louis Berger Group, Inc. in June 2006 and submitted to DEQ. EPA Region III approved the TMDL for aquatic life use impairments on Bull Run (VAN-A23R-01) on September 26, 2006. Bull Run was first listed on Virginia's Section 303(d) list in 1994, and again in 1998 and 2002. It was listed more specifically as an impaired water, due in part to benthic impairment, on the 2004 WQA 305(b)/ 303(d) Integrated Report. It was also listed in the 2004 WQA Integrated Report due to exceedances of the water quality standards for fecal coliform bacteria and PCB concentrations in fish tissue samples. DEQ conducted bioassessments at the DEQ monitoring station located at the intersection of Bull Run and Route 28, which indicated a moderately impaired benthic macroinvertebrate community, resulting in the 303(d) listing.

The June 2006 report documented efforts to determine and identify the stressors (causal pollutants) and sources within the watershed. Several candidate stressors were reviewed in the report, including: dissolved oxygen, temperature, pH, metals, organic chemicals, nutrients, toxic compounds, and sediments. These were evaluated based on available monitoring data, field observations, and consideration of potential sources in the watershed. Sedimentation, caused by higher runoff flows, was identified as a primary stressor impacting benthic macroinvertebrates in this segment of Bull Run. Potential sources of sediment loading in the watershed included urban stormwater runoff, stream bank erosion, and sediment loss from habitat degradation associated with urbanization. The report suggested that reducing sediment loadings through stormwater control and restoring instream and riparian habitat to alleviate the impacts of urbanization on the river were key to improving the benthic community.



Virginia 303(d) Impaired Waters

Streams

Watershed Management Areas

Major Roads

Railroad

0 2,000 4,000 Feet

Map 1-6
Virginia 303(d) Impaired Waters

Little Rocky Run / Johnny Moore Creek Watersheds

The report indicated that the overall sediment load in the Fairfax County municipal separate storm sewer system (MS4) area contributing to Bull Run should be decreased by 77.1 percent. The Fairfax County MS4 area includes the Virginia Department of Transportation (VDOT) and Fairfax County Public Schools as permit holders. The *Watershed Management Plan* will focus on reducing sediment loading in the watershed by addressing stormwater control, stream bank erosion, and riparian buffers.

A report titled *Bacteria TMDLs for Popes Head Creek, Broad Run, Kettle Run, South Run, Little Bull Run, Bull Run and the Occoquan River, Virginia* was prepared by George Mason University and the Louis Berger Group, Inc. in August 2006. EPA Region III approved this TMDL on November 12, 2006. Segments of the streams covered by the TMDL were listed as impaired on Virginia's 1998 303(d) TMDL Priority List and Report because of violations of the state's water quality standard for fecal coliform bacteria. These segments were also included on Virginia's 2002 303(d) Report on Impaired Waters and the 2004 305(b)/303(d) WQA Integrated Report. The impaired segment of Bull Run (VAN-A23R-01) begins at the confluence with Cub Run and continues to the confluence with Popes Head Creek. Four out of 34 samples (11.8 percent) collected between January 1, 1998 and December 31, 2002 were recorded as exceeding the instantaneous fecal coliform bacteria criterion of 400/100 ml.

At the time of the TMDL listings, the Virginia bacteria standard was expressed in fecal coliform bacteria. However, the standard has recently changed and is now expressed in *E. coli*. Virginia's current bacteria water quality standard currently states that *E. coli* bacteria shall not exceed a geometric mean of 126 *E. coli* counts per 100 ml of water for two or more samples within a calendar month, or an *E. coli* concentration of 235 counts per 100 ml of water at any time. The TMDL was expressed in *E. coli* by converting modeled daily fecal coliform concentrations to daily *E. coli* concentrations using an in-stream translator.

The report indicated that the overall *E. coli* load in the Fairfax County MS4 area (including VDOT and the Fairfax County Public School permit holders) contributing to Bull Run should be decreased by 89 percent. The report suggested possible methods for reducing *E. Coli* such as: septic tank education, septic system repair/replacement program, sanitary sewer inspection and management, more restrictive ordinances on pet waste, improved garbage collection and control, and improved street cleaning. The *Watershed Management Plan* will consider recommendations for reducing *E. coli* in the Little Rocky Run and Johnny Moore Creek watersheds.

Virginia Natural Heritage Resource

The Virginia Natural Heritage Resources Database describes the status and rank of rare plant and animal species for subwatersheds in Virginia. Little Rocky Run and Johnny Moore Creek are both located within the Lower Bull Run subwatershed, which is within the Middle Potomac – Anacostia -Occoquan watershed. Two resources were listed in the database for the Lower Bull Run subwatershed. The Manassas stonefly was given a state ranking of SH (possibly extirpated). The trailing stitchwort vascular plant was given a state ranking of S1 (critically imperiled). Neither of these resources was given a federal or state status for endangerment.

1.3.2 POLICY

Infill and Residential Development Study, 2000

The *Fairfax County Infill and Residential Development Study, Draft Staff Recommendations Report* was released by the County in July 2000. Any residential development occurring proximate to or within already established neighborhoods is referred to as infill development. The primary focus of this study was the identification of recommendations to better address issues associated with the impacts of new residential development on its immediate surroundings. The issues that have been cited most frequently as problems associated with infill development with respect to the immediate environs were divided into four main categories on which staff presented recommendations: Site Design and Neighborhood Compatibility (SC), Traffic and Transportation (TR), Tree Preservation (TP), and Stormwater Management and E&S Control (SW). Problems associated with infill development may negatively impact upper parts of the Little Rocky Run watershed where the most development has taken place.

The following recommendations from the report which address water quality and stormwater management may be evaluated as part of the *Little Rocky Run and Johnny Moore Creek Watershed Management Plan*.

- TP 1: Reduce grading to increase tree preservation;
- TP 3: Request conservation easements where appropriate;
- SW 1: Improve the awareness, planning, and financial resolution capability of the County for land disturbing projects upstream of sensitive sites;
- SW9: Require additional conditions associated with stormwater detention/water quality waivers to address potential problems associated with land disturbance;
- SW10: Require reports from applicants that identify baseline data for properties downstream, corrective measures planned for implementation in the event that impacts occur, and a commitment to implement those measures;
- SW11: Enhance the use of Best Management Practices (BMP) through additional guidance on BMP selection and enhanced design standards in the PFM; and,
- SW13: Modify requirements and procedures as they relate to the consideration of stormwater management during the zoning process.

Fulfilling the Promise: The Occoquan Watershed in the New Millennium , 2003

The New Millennium Occoquan Watershed Task Force prepared a report titled *Fulfilling the Promise: The Occoquan Watershed in the New Millennium* in January 2003. The Board of Supervisors established the Task Force to provide an assessment of issues facing the Fairfax County portion of the Occoquan watershed; to examine gaps in programs not being carried out by local, State and regional agencies; to define the role of volunteer organizations that have interests in the watershed; and to provide a vision for the future management of the watershed. The report presented recommendations on: the reservoir, streams and ecosystems, land use and open space, tree preservation, erosion and sediment control and stormwater management, onsite sewage disposal, citizen involvement, and regional coordination.

The following recommendations from the report which address water quality and stormwater management may be evaluated as part of the *Little Rocky Run and Johnny Moore Creek Watershed Management Plan*.

Occoquan Reservoir Recommendations:

1. Promote existing programs and policies aimed at maintaining acceptable levels of water quality in the Reservoir;
2. Reduce nutrient and sediment contributions to the Reservoir above and beyond those being achieved through existing policies and ordinances; and,
3. Actively participate in State and Federal regulatory and/or policy initiatives that might result in requirements for additional nutrient and sediment reductions.

Streams and Ecosystems Recommendations:

1. Rigorously maintain the integrity of the Occoquan downzoning;
2. Continue regular long-term stream assessments by the Stream Protection Strategy staff;
3. Fully develop and implement the Stormwater Planning Division's watershed management planning process in the Occoquan watershed;
4. Study and adopt new stormwater management designs that have been demonstrated to protect or improve the health of stream ecosystems; and,
5. Encourage the use of those LID techniques that have been proven effective under local conditions, both where new development is planned and, to the extent feasible, for retrofitting of existing development.

Land Use and Open Space Recommendations:

1. Continue the County's commitment to the successful strategy for water quality protection of Occoquan Reservoir;
2. Establish a broad-based advisory committee, to include stakeholders, County staff, and one or more members of the County's Planning Commission, to review standards and guidelines associated with Special Permit, Special Exception, and public uses that may be approved in the R-C District in the Occoquan watershed and to report its findings and recommendations to the Board of Supervisors;
3. Establish a more proactive easements program that provides for outreach efforts to owners of land in the Occoquan watershed that contains environmentally sensitive resources;
4. Fully fund watershed management planning efforts as well as the implementation of adopted plan measures; and,
5. Complete the ongoing review of impediments to the application of low impact site design techniques and identify disincentives and policy/regulatory conflicts associated with the implementation of these techniques.

Tree Preservation Recommendations:

1. Continue to press for tree preservation and preservation enabling legislature;

2. Establish tree canopy goals for the Occoquan watershed and determine appropriate implementation measures for attaining those goals; and,
3. Encourage the revegetation of lost riparian stream buffers with native woody vegetation by identifying potential reforestation areas, providing citizen education, and encouraging citizen reforestation efforts.

Citizen Involvement Recommendations:

1. Strengthen partnerships with public and citizen organizations to broaden participation in education and stewardship activities;
2. Encourage growth of the network of organizations and citizen groups concerned with and/or actively involved in watershed and water quality issues, and seek assistance on methods of reaching more citizens to seek participation in stewardship activities;
3. Sponsor programs, meetings, seminars and festivals on water quality and natural resource protection that attract people who may become active volunteers in existing or new programs and help to educate others on the value of good stewardship;
4. Support the expansion of existing outreach and education programs, such as those sponsored by the Northern Virginia Soil and Water Conservation District, the Audubon Naturalist Society, and the Fairfax County Park Authority;
5. Investigate proactive outreach to property owners who have property in or abutting Resource Protection Areas (RPAs) and/or other stream valley areas; and,
6. Develop a strategy for strengthening the role of citizens in code and ordinance enforcement.

Fairfax County Park Authority Natural Resource Management Plan, 2004-2008

The *Natural Resource Management Plan* was prepared by the Fairfax County Park Authority in January 2004, and describes the system-wide resource preservation vision of the Park Authority for 2004 through 2008. The plan recognized that the impacts from urbanization and development place tremendous stress on natural areas. Among those impacts are stormwater runoff, water and air pollution, invasive plants, wildlife conflicts, and encroachment by adjoining property owners. The plan contains strategies for seven elements: Natural Resource Management Planning, Vegetation, Wildlife, Water Resources, Air Quality, Human Impacts on Parklands, and Education.

The following recommendations from the report which address water quality and stormwater management may be evaluated as part of the *Little Rocky Run and Johnny Moore Creek Watershed Management Plan*.

Plan Element: Natural Resource Planning

Issue 1: Natural Resource Inventories and Planning

- Strategy 1.9: Promote partnerships and volunteer participations in resource management inventories, plans and management.

- Strategy 1.12: Pursue opportunities through open space easements, proffered dedications, acquisitions and partnerships to preserve and protect additional open space – particularly land with significant natural, cultural or horticultural resources. Educate citizens about their opportunities to participate in these programs and to protect natural resources on their land.
- Strategy 1.13: Participate in County revitalization projects to identify areas appropriate for resource and open space preservation, as well as passive recreation.
- Plan Element: Wildlife

Issue 3: Resolving Conflicts with Wildlife

- Strategy 3.3: Provide information to increase citizen and staff awareness of the benefits and dangers of wildlife, the role of wildlife management and methods to peacefully coexist with wildlife.

Plan Element: Water Resources

Issue 2: Baseline Inventories for Water Resources

- Strategy 2.1: Continue to expand partnerships with DPWES, NVSWCD, ANS, DEQ, Fairfax County Public Schools and others to involve Park Authority volunteers in producing certified water quality monitoring data from park sites. Seek expanded coordination of data and information among participating organizations and volunteers.
- Strategy 2.2: Complete inventory and assessment of stormwater management facilities on parklands to determine their condition and effectiveness, as well as maintenance actions required and responsibility for ongoing maintenance.
- Strategy 2.3: For parks with water bodies, include water quality physical and biological assessments in natural resource baseline inventories as part of park master plans.
- Strategy 2.4: In cooperation with DWPES, begin an assessment of stormwater outfalls on or directly adjacent to parkland to identify locations of greatest concern for erosion and related damage. Explore options to mitigate damage at the sites of greatest concern.
- Strategy 2.5: Review the stream assessment data compiled by DPWES that are available for park stream valleys, identify problem areas on parklands, and develop a prioritized action plan for the most critical needs (including cost estimates for each project).

Issue 3: Protecting Water Resources

- Strategy 3.1: Participate in and closely monitor the Fairfax County Watershed Planning process being coordinated by DPWES.
- Strategy 3.2: As Fairfax County Watershed Plans are adopted by the Board of Supervisors, incorporate their requirements and recommendations in park master planning, design and construction in those watersheds and as may be applicable countywide.
- Strategy 3.5: Seek partnership opportunities and volunteer projects with the Potomac Conservancy, the Virginia Department of Forestry, the Northern Virginia Conservation Trust, DPWES, Department of Planning and Zoning, the

Northern Virginia Regional Park Authority, the Fairfax County Tree Commission, and others to enhance riparian buffers and other aquatic habitats.

- Strategy 3.6: Pursue opportunities to utilize Best Management Practices (BMPs) and Low-Impact Development (LID) such as green buildings, rain gardens, and other innovative techniques to reduce water quality and other impacts of new or renovated Park Authority facilities.

1.3.3 PROPOSED PROJECTS AND IMPROVEMENTS

Proposed Drainage Plan, The Occoquan Watersheds, 1979

The *Proposed Drainage Plan, The Occoquan Watersheds* report was written by Parsons, Brinckerhoff, Quade & Douglas in April 1979. The report identified 12 projects for the Little Rocky Run watershed at an estimated cost of $905,000, and one project for the Johnny Moore Creek watershed at an estimated cost of $22,000. The various projects included 12 culvert/road improvement projects and one stream stabilization project. The purpose of these projects includes protecting houses, alleviating roadway flooding, and abating bank erosion. The status of the projects is shown in Table 1-10. The location of the projects is shown on Map 1-7.

Table 1-10 Little Rocky Run-Johnny Moore Creek Drainage Plan Project Status

Project Number	Description	Status
Willow Springs Segment – Little Rocky Run		
WS-1	Raise Road and Replace Culvert at Stringfellow Road	Inactive
WS-2	Lower Invert and Replace Culvert at Lee Highway	Inactive
WS-3	Lower Invert and Replace Culvert at Lee Highway	Completed
Centreville Segment – Little Rocky Run		
CV-1	Install Riprap Bank Protection in Vicinity of Stringfellow Road	Inactive
CV-2	Realign Channel and Install Culverts at Braddock Road	Completed
CV-3	Install Berm and Replace Culvert at Clifton Road	Completed
CV-4	Raise Road and Replace Culvert at Braddock Road	Completed
CV-5	Lower Invert and Replace Culvert at Lee Highway	Inactive
CV-6	Add Culvert to Existing Bridge at Lee Highway	Inactive
CV-7	Channelize Stream and Replace Culvert at Private Drive	Completed
CV-8	Lower Invert and Replace Culvert at Leland Road	Deleted
Little Rocky Segment – Little Rocky Run		

Project Number	Description	Status
LR-1	Replace Culvert at Compton Road	Completed
Johnny Moore Creek Watershed		
JM-1	Lower Invert and Replace Culvert at Compton Road	Inactive

The inactive projects will be evaluated to determine if they are viable and needed, and will be included in the Watershed Management Plan as appropriate.

Fairfax County Master Plan Drainage Projects

Fairfax County currently has 34 master plan drainage projects designated for the Little Rocky Run and Johnny Moore Creek watersheds. This list includes the projects identified in the *Proposed Drainage Plan Report* and the *Regional Stormwater Management Plan*.

The 34 projects include the 13 projects from the *Proposed Drainage Plan*, 14 regional ponds from the *Regional Stormwater Management Plans*, and 7 other projects: two active dam repair projects, the completed Landfill Downshoot drainage system design, the deleted flood protection project at Battle Rock Drive, the inactive floodproofing project at 5410 Stringfellow, and two watershed studies (Little Rocky Run and Johnny Moore Creek).

Regional Stormwater Management Plan, 1989

In January 1989, the Fairfax County Board of Supervisors adopted a plan prepared by the engineering firm of Camp, Dresser and McKee. The plan, intended to be a pilot program, consists of a network of 134 detention facilities to directly control 35 square miles of drainage area. Many regional ponds described in the *Regional Stormwater Management Plan* already have been constructed. Several more facilities are in various stages of implementation. There are potential facilities that are in the final design phase either as County managed projects or by developers through rezoning. A summary of the regional pond facilities in the Little Rocky Run watershed is provided in Table 1-11 and the location of the facilities is shown on Map 1-7.

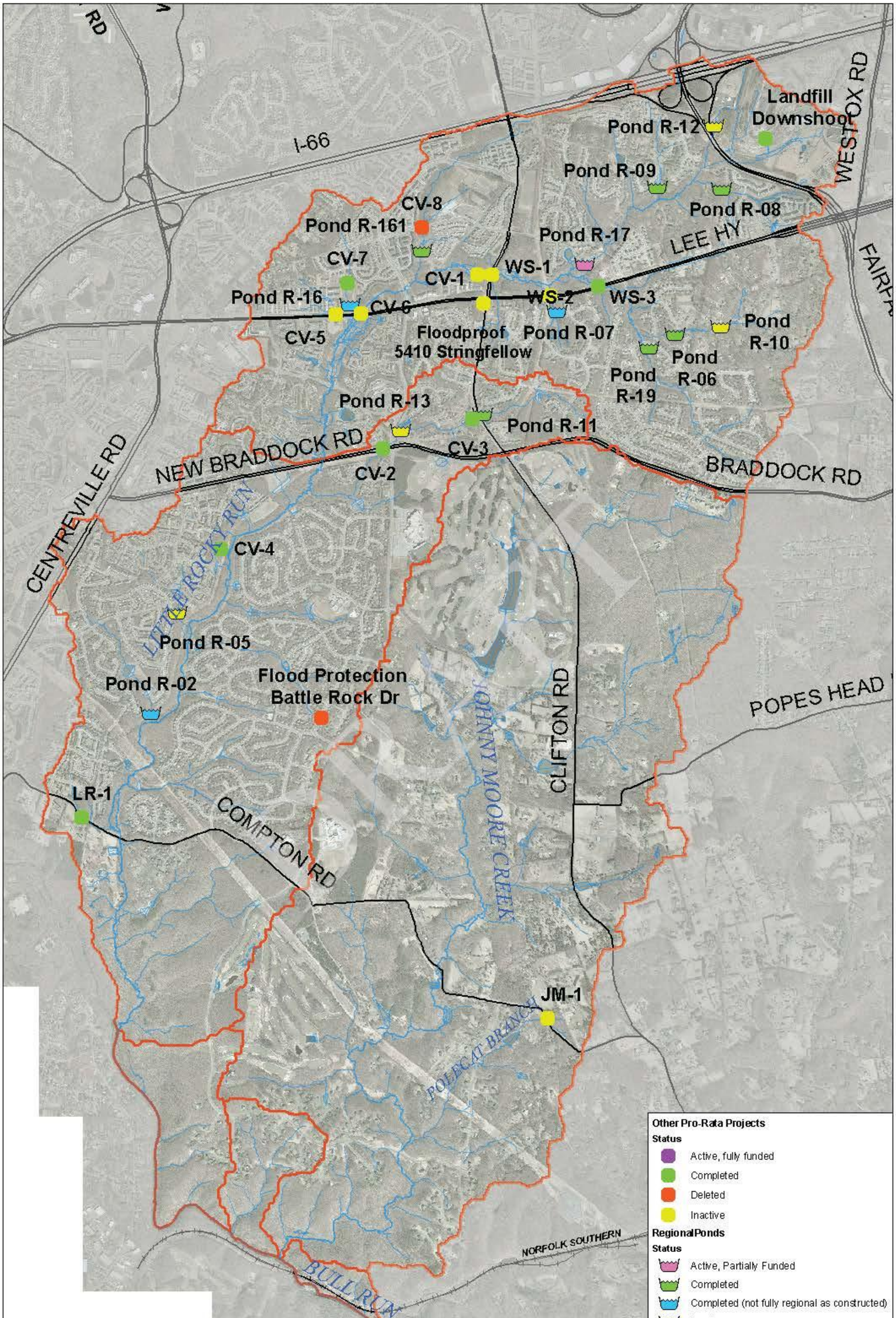
Table 1-11 Regional Pond Status

Regional Pond Identifier	Status	Taxmap Id
Clifton Manor R-11	Completed	66-1
Faircrest R-161	Completed	55-3
Pond R-02	Completed (not fully regional as constructed)	65-4
Pond R-05	Inactive	65-2
Pond R-06	Completed	55-4
Pond R-07	Completed (not fully regional as constructed)	55-3
Pond R-08	Completed	55-4
Pond R-09	Completed	55-2
Pond R-10	Inactive	55-4
Pond R-12	Inactive	55-2

Regional Pond Identifier	Status	Taxmap Id
Pond R-13	Inactive	66-1
Pond R-16	Completed (not fully regional as constructed)	55-3
Pond R-17	Active, partially funded	55-3
Pond R-19	Completed	55-4

This *Stormwater Management Plan* has been reevaluated, and recommendations for changes have been made by the Regional Pond Subcommittee, which is an ad hoc subcommittee of the Fairfax County Environmental Coordinating Committee. One of the objectives of this *Watershed Management Plan* will be to evaluate ponds in all phases while incorporating watershed protection and restoration goals, allowing for innovative management techniques to be utilized throughout the watersheds.

The inactive regional pond sites in the Little Rocky Run watershed will be evaluated for incorporation of a variety of stormwater management techniques that will provide the water quality and stormwater detention that would have been provided by the regional ponds.



Map 1-7
Current County Projects and Status

Little Rocky Run / Johnny Moore Creek Watersheds

Chapter 2: Subwatershed Characterization

2.1 Introduction

A **watershed** is an area of land and an associated network of steams or drains that convey stormwater downstream, generally to a single outlet point. A watershed acts like a funnel, channeling all water that falls within its boundaries into a waterway. Each watershed is separated from other watersheds by a physical barrier such as a ridge, hill or mountain and as a result water quantity and quality in an area depend upon the land use and land cover that exists within that watershed.

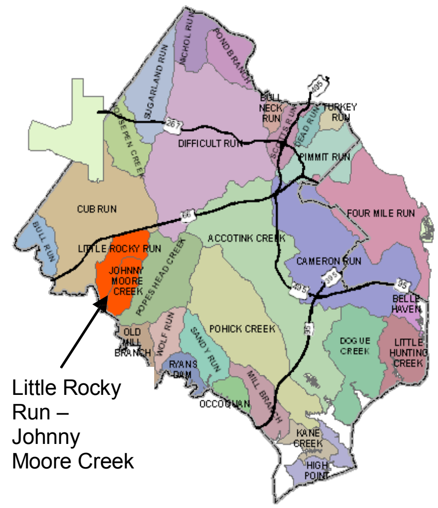


Figure 2-1: Location of Little Rocky Run and Johnny Moore Creek Watersheds in Fairfax County

Watersheds drain into other watersheds based on a geomorphological hierarchy, meaning that a larger watershed can be broken down into numerous subwatersheds based on the topography of an area. The Little Rocky Run watershed and the Johnny Moore Creek watershed are each divided into smaller **Watershed Management Areas** (WMAs) to make it easier to evaluate the characteristics of a portion of the watershed with similar land use and development characteristics. Using the WMAs, goals and objectives for the watershed can be refined to meet the needs of different problems and development types in the watershed.

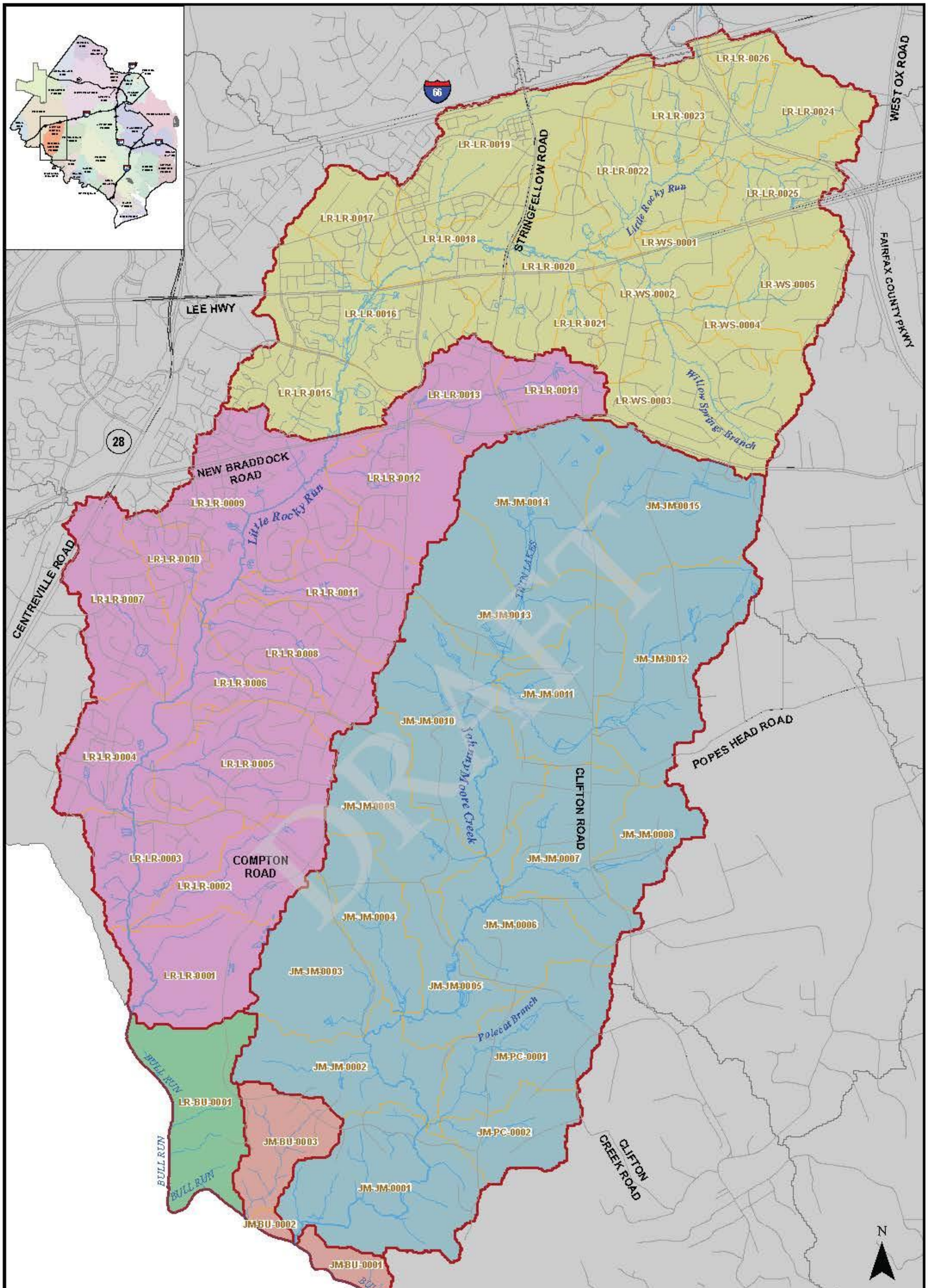
Little Rocky Run watershed is divided into three WMAs: Little Rocky Run-Upper, Little Rocky Run-Lower and Little Rocky Run-Bull Run. Johnny Moore Creek watershed is similarly divided into two WMAs, Johnny Moore and Johnny Moore-Bull Run. Both the Little Rocky Run-Bull Run and Johnny Moore-Bull Run WMAs are smaller areas that drain directly to Bull Run and are located in the southern part of the respective watersheds.

WMAs are generally about 4 square miles in area and are further broken down for this study into **subwatersheds** of between 100 and 300 acres. The subwatersheds provide further detail about the WMAs, especially the water quality and quantity issues of smaller tributaries and land use patterns that are not covered at the WMA scale. By examining data at the subwatershed level, drainage patterns, problem areas and possible solutions can be assessed in manageable work units. The information gained from the subwatershed assessment will be used to help prioritize possible future investments in water quality. Map 2-1 shows the WMAs and subwatersheds used in our water quality examination.

Sections 1-2 of this Chapter provide an introduction and a description of the methodologies used to assess the stream conditions in the watersheds. Sections 3-5 provide a summary of the stream conditions in the WMAs as follows:

- Section 3 Johnny Moore Creek and Johnny Moore Creek – Bull Run WMAs
- Section 4 Little Rocky Run – Lower and Little Rocky Run – Bull Run WMAs
- Section 5 Little Rocky Run – Upper WMA

Section 6 provides a summary of the subwatershed characterization results.



Map 2-1
Little Rocky Run - Johnny Moore Creek Subwatersheds

Watershed Management Areas

- Johnny Moore
- Johnny Moore- Bull Run
- Little Rocky Run- Bull Run
- Little Rocky Run- Lower
- Little Rocky Run- Upper

0 500 1,000 2,000 Feet

2.2 Watershed Characterization Approach

The successful development of a Watershed Management Plan (WMP) requires the assessment of the interaction between pollutant sources, watershed stressors and conditions within streams and other water bodies. Each watershed must be evaluated in light of its unique conditions. Management opportunities should then be identified based on the effects of pollutants and stressors on watershed functions, both in the immediate vicinity of these stressors, as well as farther downstream. Watershed characterization was performed using consistent methods for evaluating watershed management needs while ensuring that the WMPs are developed with appropriate attention to watershed-specific conditions.

The County has developed goals and objectives to be applied to all watersheds during the WMP development process. The countywide goals and objectives will allow WMP recommendations to be linked to a Countywide Watershed Assessment. The countywide watershed planning goals are to:

1) Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology.
2) Protect human health, safety and property by reducing stormwater impacts.
3) Involve stakeholders in the protection, maintenance and restoration of County watersheds.

The countywide objectives are linked to the above goals. These objectives were consolidated from a list of over 50 stakeholder-defined objectives from previous WMPs. The shorter list of objectives allows for a countywide evaluation that addresses stakeholder concerns while providing an efficient and effective means of assessment. The final objectives are presented in the Table 2-1. This table also shows how each objective is linked to the three watershed planning goals. The countywide goals and objectives will be applied to all WMP assessments and recommendations. Additional watershed-specific goals and objectives that are recommended by local stakeholders may also be incorporated into the WMP development process. The objectives listed under Category 5 (Stewardship) will be considered during countywide watershed assessment but are not addressed in the ranking approach used in development of this workbook.

Table 2-1. Fairfax County Watershed Planning Final Objectives

Objective		Linked to Goal(s)
CATEGORY 1. HYDROLOGY		
1A.	Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat and support biota.	1
1B.	Minimize flooding to protect property, human health and safety.	2
CATEGORY 2. HABITAT		
2A.	Provide for healthy habitat through protecting, restoring and maintaining riparian buffers, wetlands and instream habitat.	1
2B.	Improve and maintain diversity of native plants and animals in the County.	1
CATEGORY 3. STREAM WATER QUALITY		
3A.	Minimize impacts to stream water quality from pollutants in stormwater runoff.	1, 2

Objective		Linked to Goal(s)
CATEGORY 4. DRINKING WATER QUALITY		
4A.	Minimize impacts to drinking water sources from pathogens, nutrients and toxics in stormwater runoff.	2
4B.	Minimize impacts to drinking water storage capacity from sediment in stormwater runoff.	2
CATEGORY 5 STEWARDSHIP		
5A.	Encourage the public to participate in watershed stewardship.	3
5B.	Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives.	3
5C.	Improve watershed aesthetics in Fairfax County.	1, 3

2.2.1 Watershed Impact Indicators

The purpose of the subwatershed ranking approach is to provide a systematic means of planning management implementation countywide that will achieve the County‟s watershed management goals and objectives. Since the objectives cannot be directly measured, the methods require measurable indicators that are directly linked to the objectives. One or more indicators for each objective were selected, including predictive and non-predictive, or observed, indicators. Predictive indicators, such as simulated data, can be used to compare existing and future conditions. Non-predictive indicators cannot measure future conditions but will still be useful in assessing existing watershed impacts within Fairfax County.

The watershed impact indicators used in the subwatershed ranking approach are described below:

Benthic Communities: Benthic communities consist of aquatic insects that are good indicators of watershed health. The scoring for this indicator is based on the 1999 *Fairfax County Stream Protection Strategy Baseline Study* that provided scoring based on the number and diversity of the benthic community at sampling sites.

Fish Communities: The scoring for this indicator is based on the 1999 *Fairfax County Stream Protection Strategy Baseline Study* that provided scoring based on the number and diversity of the fish community at sampling sites.

Aquatic Habitat: The scoring for this indicator is based on the *Fairfax County Stream Physical Assessment* that provided scoring based on a number of stream features that provide data about the diversity of the habitat and its ability to support a diverse aquatic community.

Channel Morphology: The scoring for this indicator is based on the *Fairfax County Stream Physical Assessment* and the *Fairfax County Stream Protection Strategy Baseline Study*. A channel evolution model (CEM)-based geomorphic assessment was performed in these studies to assess the evolutionary stage of the stream reaches. The CEM was used to identify stream successional stages from an early stable system through an unstable changing environment to a stable system.

Instream Sediment: The scoring for this indicator is based on bank vegetative protection and bank stability assessment from the *Fairfax County Stream Physical Assessment* and the *Fairfax County Stream Protection Strategy Baseline Study*.

Residential Building Hazards: The scoring for this indicator is based on the number of residential buildings in the floodplain per square mile. This number was generated using the County‟s Geographic Information System (GIS) data.

Non-residential Building Hazards: The scoring for this indicator is based on the number of non-residential buildings in the floodplain per square mile. This number was generated using the County‟s GIS data.

Flood Complaints: The scoring for this indicator is based on the number of flood complaints per square mile. This indicator was based on data from the County‟s Drainage Complaints database.

Resource Protection Area (RPA) Riparian Habitat: The scoring for this indicator is based on the percentage of riparian habitat in the regulated Chesapeake Bay RPA. The riparian habitat was based on the National Wetlands Inventory, George Mason tidal wetland data and the Virginia Department of Forestry‟s (VDOF) 2005 Virginia Forest Cover Map.

Headwater Riparian Habitat: The scoring for this indicator is based on the percentage of forest or wetland areas within 100-feet of streams for the riparian areas upstream of the RPA boundaries.

Wetland Habitat: The scoring for this indicator is based on the percentage of wetland habitat. The wetland habitat was based on the National Wetlands Inventory and George Mason tidal wetland data.

Terrestrial Forested Habitat: The scoring for this indicator is based on the percentage of forested habitat based on the VDOF forested cover classifications.

***E. Coli*:** The scoring for this indicator is based on the average of all reported *E. coli* concentrations per 100 mL. This data was based on the number of *E. coli* per 100 milliliter (#/100mL) as reported in the EPA STORET database and fecal coliform per 100 milliliter (#/100mL). Additional bacteria data were obtained from available Fairfax County Health Department data. To maximize the amount of data employed for this metric, fecal coliform data were converted to *E. coli* concentrations using the Virginia Department of Environmental Quality (VADEQ) in-stream translator equation (VDEQ, 2003).

Upland Sediment: The scoring for this indicator is based on the modeled average annual sediment load in tons/acre/yr.

Nitrogen: The scoring for this indicator is based on the modeled average annual nitrogen load in pounds/acre/yr.

Phosphorus: The scoring for this indicator is based on the modeled average annual phosphorus load in pounds/acre/yr.

Table 2-2 lists the selected indicators, noting the indicator type and the objective(s) each indicator is linked to.

Table 2-2. Countywide Watershed Impact Indicators

Indicator	Predictive	Linked to Objectives
Benthic Communities	No	1A, 2B, 3A
Fish Communities	No	1A, 2B, 3A
Aquatic Habitat	No	1A, 2A
Channel Morphology	Yes	1A
Instream Sediment	No	1A, 3A, 4B
Residential Building Hazards	Yes	1B
Non-residential Building Hazards	Yes	1B
Flood Complaints	No	1B
RPA Riparian Habitat	Yes	2A
Headwater Riparian Habitat	Yes	2A
Wetland Habitat	Yes	2A
Terrestrial Forested Habitat	Yes	2A
E. Coli	No	3A, 4A
Upland Sediment	Yes	3A, 4A, 4B
Nitrogen	Yes	3A, 4A
Phosphorus	Yes	3A, 4A

2.2.2 Source Indicators

The watershed impact indicators provide information on how endpoints of watershed processes are impacted by adverse watershed conditions. The source indicators will assist in the evaluation of the sources and stressors that impact these watershed endpoints as well. The recommended source indicators are described below:

- Channelized/Piped Streams – percent channelized/piped by stream length
- Directly Connected Impervious Area (DCIA) (predictive) - % DCIA
- Impervious Surface (predictive) - % Impervious
- Stormwater Outfalls – number of stormwater outfalls per mile of stream length
- Parcels Served by Septic Tanks – number of parcels served per square mile
- Streambank Buffer Deficiency - % buffer area disturbed (non-forest buffer area)
- Total Nitrogen Load (predictive) – see watershed impact indicator for nitrogen
- Total Phosphorus Load (predictive) – see watershed impact indicator for phosphorus

- Total Suspended Sediment Load (predictive) – see watershed impact indicator for sediment
- Total Urban Land Cover (predictive) – % urban land cover (low, medium and high density residential; low and high intensity commercial; institutional; industrial; and transportation)
- Virginia Pollutant Discharge Elimination System (VPDES) Permitted Point Sources – number of point sources per square mile

These indicators were scored and combined to determine objective composite scores and overall composite scores. These scores were used to compare the subwatersheds with respect to the objectives.

2.2.3 Programmatic Indicators

A third set of indicators, termed "Programmatic Indicators," will also be used to help evaluate watershed management needs. These indicators illustrate the extent and location of existing and past management efforts. The following types of management in each watershed will be inventoried in the WMA:

- Detention Facilities
- Stream Restoration
- Riparian Buffer Restoration
- BMP Facilities
- Low Impact Development
- Inspection and Maintenance of Stormwater Management Facilities
- Inspection and Repair of Stormwater Infrastructure and Outfalls
- Dumpsite Removal
- Regional Ponds
- Volunteer Monitoring
- Subarea Treatment (used in watershed modeling studies)

Data for these indicators will be considered during identification and evaluation of watershed management needs, but were not considered in the composite scoring described above.

2.3 Johnny Moore Creek Watershed (Johnny Moore Creek and Johnny Moore Creek – Bull Run WMAs)

2.3.1 WMA Characteristics

The Johnny Moore Creek and Johnny Moore Creek – Bull Run WMAs are combined in this summary. The Johnny Moore Creek –Bull Run WMA drains directly into Bull Run and is adjacent to and surrounded on three sides by the Johnny Moore Creek watershed. It is relatively undeveloped and much smaller than the Johnny Moore Creek WMA. The Johnny Moore Creek WMA has an area of approximately 3,213 acres (5.0 mi^2) and the Johnny Moore Creek –Bull Run WMA has an area of approximately 161 acres (0.25 mi^2). The Johnny Moore Creek watershed is located in southern Fairfax County and is bounded to the north by Braddock Road and to the south by Bull Run. Union Mill Road is its approximate western boundary and its eastern boundary extends from the intersection of Colchester Road and Braddock Road to the southern end of Balmoral Forest Road.

The Johnny Moore Creek WMA includes 19.0 miles of perennial streams and the Johnny Moore Creek – Bull Run WMA includes 0.7 miles of perennial streams. The streams flow generally in a southwest direction through predominantly open space and low density residential areas. Johnny Moore Creek flows into Bull Run upstream of the Norfolk Southern Railway Crossing of Bull Run.

In the *Occoquan Environmental Baseline Report (February 1978)* severe erosion was noted in one location downstream of Twin Lakes Drive, two locations downstream of Compton Road and the power line and one location near the confluence with Polecat Branch. The report also noted severe sedimentation on Polecat Branch upstream of the power line. In the erosion areas noted by the *Occoquan Environmental Baseline Report* in 1978 at Twin Lakes Drive, Compton Road and the power line, the banks remain moderately unstable with scattered vegetation; however these areas were not flagged for severe erosion in 2005. The *Stream Physical Assessment (August 2005)* data reflects erosion areas downstream of Polecat Branch and near the confluence with Bull Run. The severe sedimentation on Polecat Branch upstream of the power line noted in the 1978 *Occoquan Environmental Baseline Report* is consistent with the 2005 *Stream Physical Assessment* that also noted severe sedimentation on Polecat Branch upstream of Balmoral Forest Road and also on three other tributaries to Johnny Moore Creek.

2.3.2 Existing and Future Land Use

The existing land use in the Johnny Moore Creek and Johnny Moore Creek – Bull Run WMAs consists primarily of open space and estate residential. This is because both of the WMAs are located in the Residential-Conservation (R-C) District where development is limited to one dwelling unit per 5 acres. This area was rezoned by the Fairfax County Board of Supervisors in 1982 to protect the Occoquan Reservoir. The Johnny Moore Creek WMA is currently 40 percent estate residential development and 36 percent open space. The Johnny Moore Creek – Bull Run WMA is currently 63 percent open space and 26 percent low density residential development. Most of the Twin Lakes Golf Course and the Westfields Golf Course at Balmoral are located in the Johnny Moore Creek WMA. A summary of the land use in the WMAs can be found in Table 2-3.

Comparing existing land use to future land use, 614 acres or 19% of the WMA shifts from open space to estate residential in Johnny Moore Creek. In the Johnny Moore Creek – Bull Run WMA, 4 acres or 2% of the WMA shifts from open space to estate residential. Map 2-2 shows the existing and future conditions land use in the Johnny Moore Creek watershed.

Table 2-3. Existing and Future Land Use in Johnny Moore Creek

Johnny Moore Creek WMA

Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	1291	40%	1905	60%	614	19%
Low Density Residential (LDR)	100	3%	100	3%	0	0%
Medium Density Residential (MDR)	0	0%	0	0%	0	0%
High Density Residential (HDR)	0	0%	0	0%	0	0%
Low Intensity Commercial (LIC)	0	0%	0	0%	0	0%
High Intensity Commercial (HIC)	0	0%	0	0%	0	0%
Industrial (IND)	4	0%	4	0%	0	0%
Institutional (INT)	2	0%	2	0%	0	0%
Golf Course (GC)	534	17%	534	17%	0	0%
Open Space (OS)	1137	36%	523	16%	-614	-19%
Water (W)	49	2%	49	2%	0	0%
Transportation (T)	79	2%	79	2%	0	0%
Total	**3200**	**100%**	**3200**	**100%**		**0%**

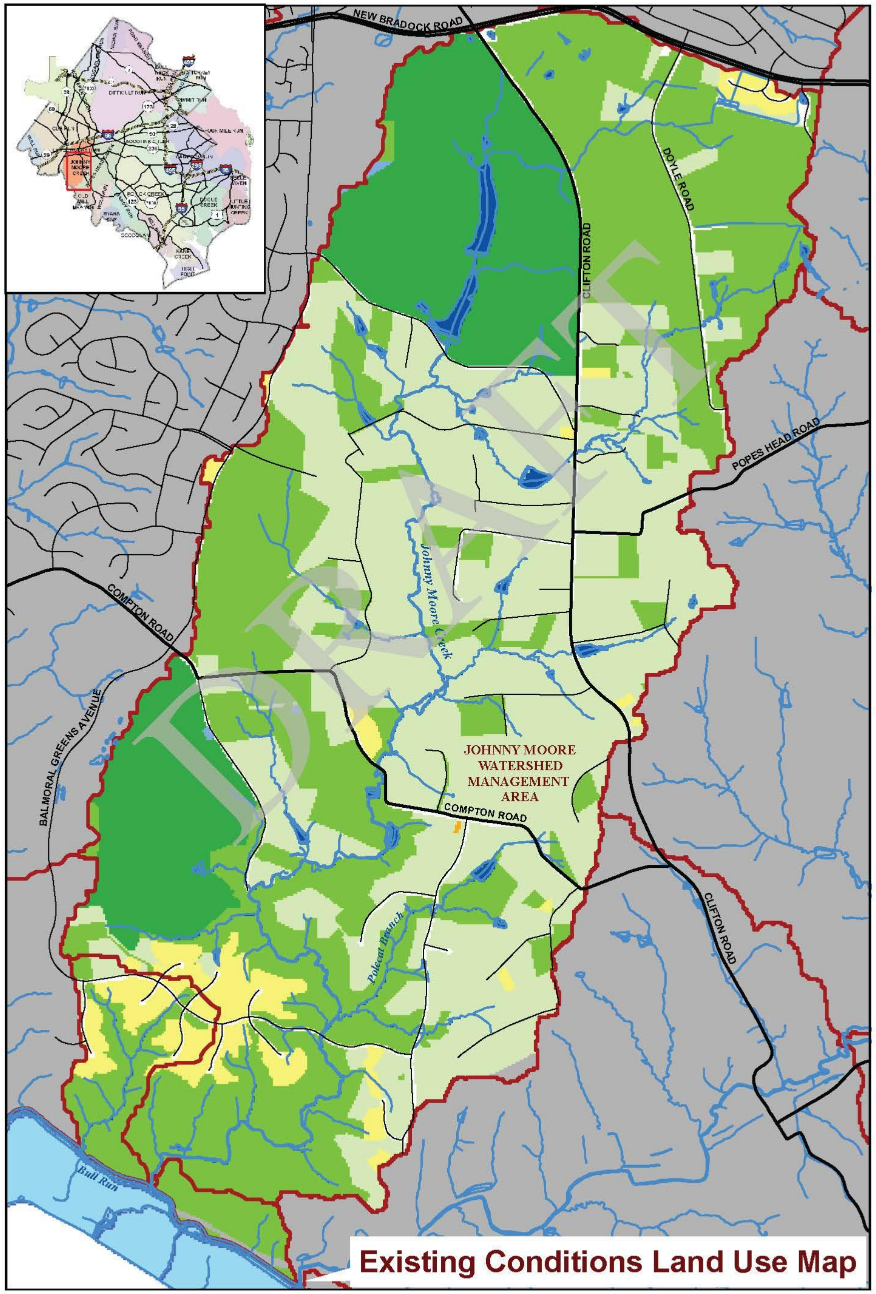
Johnny Moore Creek - Bull Run WMA

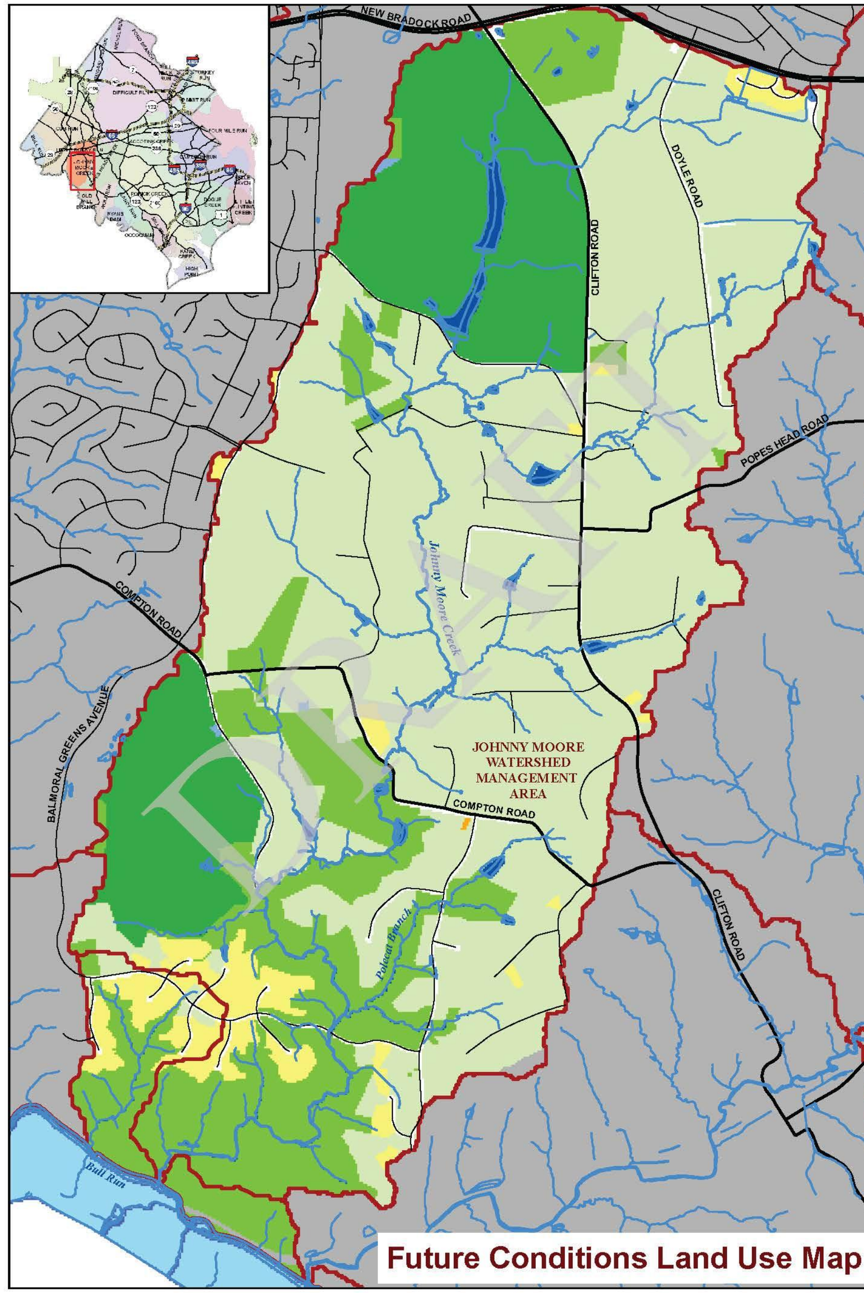
	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	4	3%	8	5%	4	2%
Low Density Residential (LDR)	40	26%	40	26%	0	0%
Medium Density Residential (MDR)	0	0%	0	0%	0	0%
High Density Residential (HDR)	0	0%	0	0%	0	0%
Low Intensity Commercial (LIC)	0	0%	0	0%	0	0%
High Intensity Commercial (HIC)	0	0%	0	0%	0	0%
Industrial (IND)	4	3%	4	3%	0	0%
Institutional (INT)	0	0%	0	0%	0	0%
Golf Course (GC)	0	0%	0	0%	0	0%
Open Space (OS)	99	63%	95	61%	-4	-2%
Water (W)	1	1%	1	1%	0	0%
Transportation (T)	7	5%	7	5%	0	0%
Total	**156**	**100%**	**156**	**100%**		**0%**

The total impervious area (includes all paved areas and building rooftops) for the Johnny Moore Creek WMA is 117 acres or 3.6 percent of the WMA and for the Johnny Moore Creek – Bull Run WMA the total impervious area is 8 acres or 4.9 percent of the WMA. In general, low amounts of impervious surface indicate good stream water quality.

Map 2-2
Existing and Future Land Use Maps

Johnny Moore Creek and Johnny Moore Creek - Bull Run Watershed Management Areas





Legend

- Streams
- Major Roads

Watershed Management Areas

WMA

- Johnny Moore WMAs
- Other WMAS

Land Use

- Estate Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Low Intensity Commercial
- High Intensity Commercial
- Industrial
- Institutional
- Golf Course
- Open Space
- Water
- Transportation

N

Scale

0 1,000 2,000 Feet

2.3.3 Stormwater Infrastructure

Stormwater infrastructure in the WMAs consists of stormwater management facilities, storm sewer and other manmade stormwater conveyances. Stormwater management facilities provide control of stormwater runoff in two ways; by reducing the quantity of stormwater runoff and providing treatment to reduce pollution and thereby improve the quality of stormwater runoff. Stormwater management facilities are designed to improve water quality by reducing the erosive effects of stormwater runoff and by filtering or capturing pollutants in the facility. Earlier facilities (prior to 1980 in the Occoquan basins and prior to 1994 in the rest of the County) provide only water quantity reduction, while facilities constructed later may provide both water quantity and quality treatment or provide quality treatment alone.

There are 47 stormwater management facilities in the County records for the Johnny Moore Creek WMAs: 10 of these are dry ponds and 3 are wet ponds. From field reconnaissance and desktop assessment, it was determined that: 2 are not stormwater facilities, 1 appears to be a constructed wetland, 5 are golf course wet ponds, 14 are small farm ponds that were not designed for stormwater management, 3 are larger wet ponds or farm ponds on private property that were not designed for stormwater management and 9 are unknown because they were inaccessible to field staff. Map 2-3 shows the location of these facilities, locations of drainage complaints and the parcels covered by stormwater management.

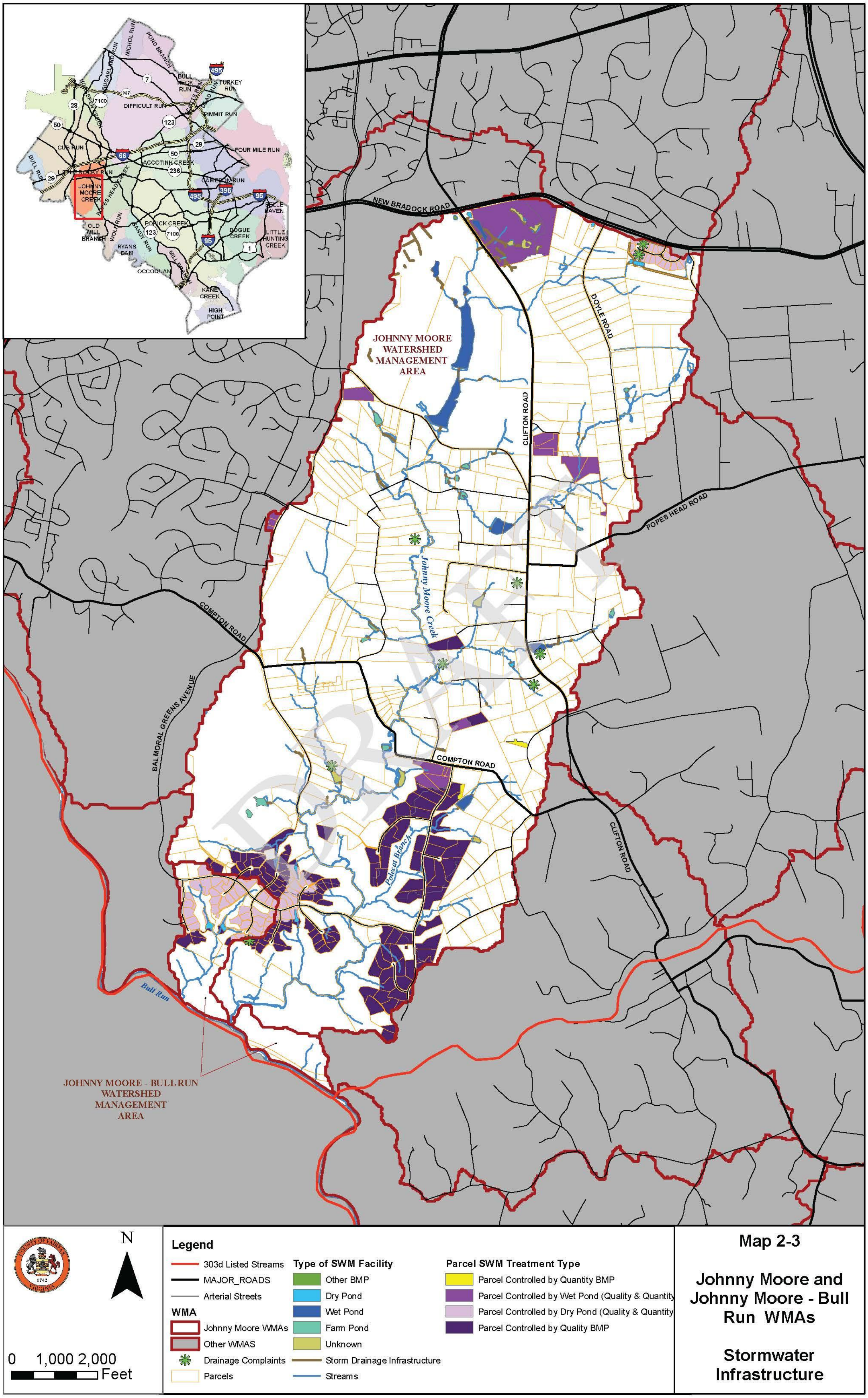
The primary land use in the WMAs is estate residential, where the lots are typically developed independently and may not have traditional stormwater management facilities. The stormwater treatment data for the WMAs is summarized in Table 2-4. Future estate residential development in the WMAs should be designed with adequate stormwater control in order to prevent water quality impacts downstream.

Table 2-4. Stormwater Treatment Types in the Johnny Moore Creek WMAs

WMA Name	Current Percent Impervious	Current Treatment Types			
		Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Johnny Moore	3.6	2	188	114	2909
Johnny Moore – Bull Run	4.9	0	42	5	113
Total		2	230	119	3022

There were 9 complaints related to stormwater in the County‟s complaints database in the WMAs. The classification of these complaints is summarized below:

- 8 Citizen Responsibility
- 1 Unclassified, but described as a cave-in by a pond



Map 2-3

Johnny Moore and Johnny Moore - Bull Run WMAs

Stormwater Infrastructure

2.3.4 Stream Condition

The County conducted a *Stream Physical Assessment* (SPA) in August 2005 that assessed the habitat, stream geomorphology and impacts to the streams from crossings, ditches, pipes, headcuts, dump sites, utilities and obstructions. Map 2-4 shows a summary of the SPA data.

11.7 miles of stream habitat in the Johnny Moore WMAs were assessed for the SPA. The results for this study are summarized below:

- Very Poor: 0.1 miles or 1%
- Poor: 1.8 miles or 15%
- Fair: 7 miles or 60%
- Good: 2.8 miles or 24%
- Excellent: 0 miles

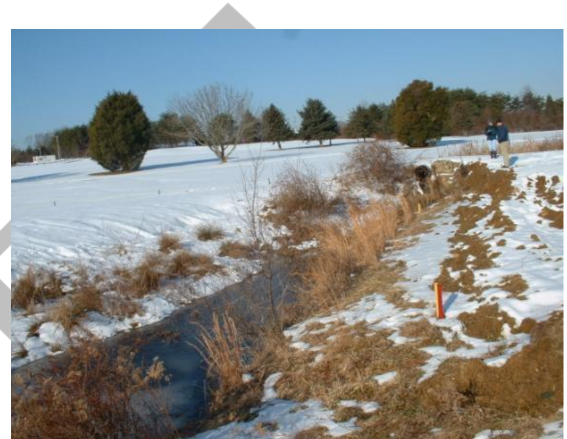
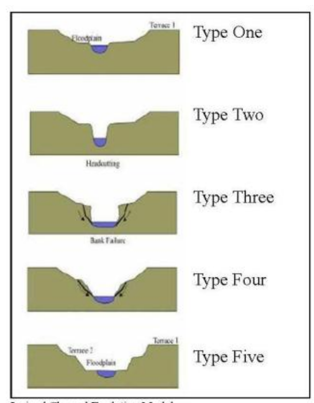


Figure 2-2: Very poor stream habitat segment – Twin Lakes Golf Course

The stream habitat segment classified as very poor in the above list (shown in Figure 2-2) is located within the Twin Lakes Golf Course and is an altered channel with little to no vegetated buffer. Stream segments with sections classified as "poor" for stream habitat are located on various tributaries to Johnny Moore Creek, but none are on the Johnny Moore Creek main stem.

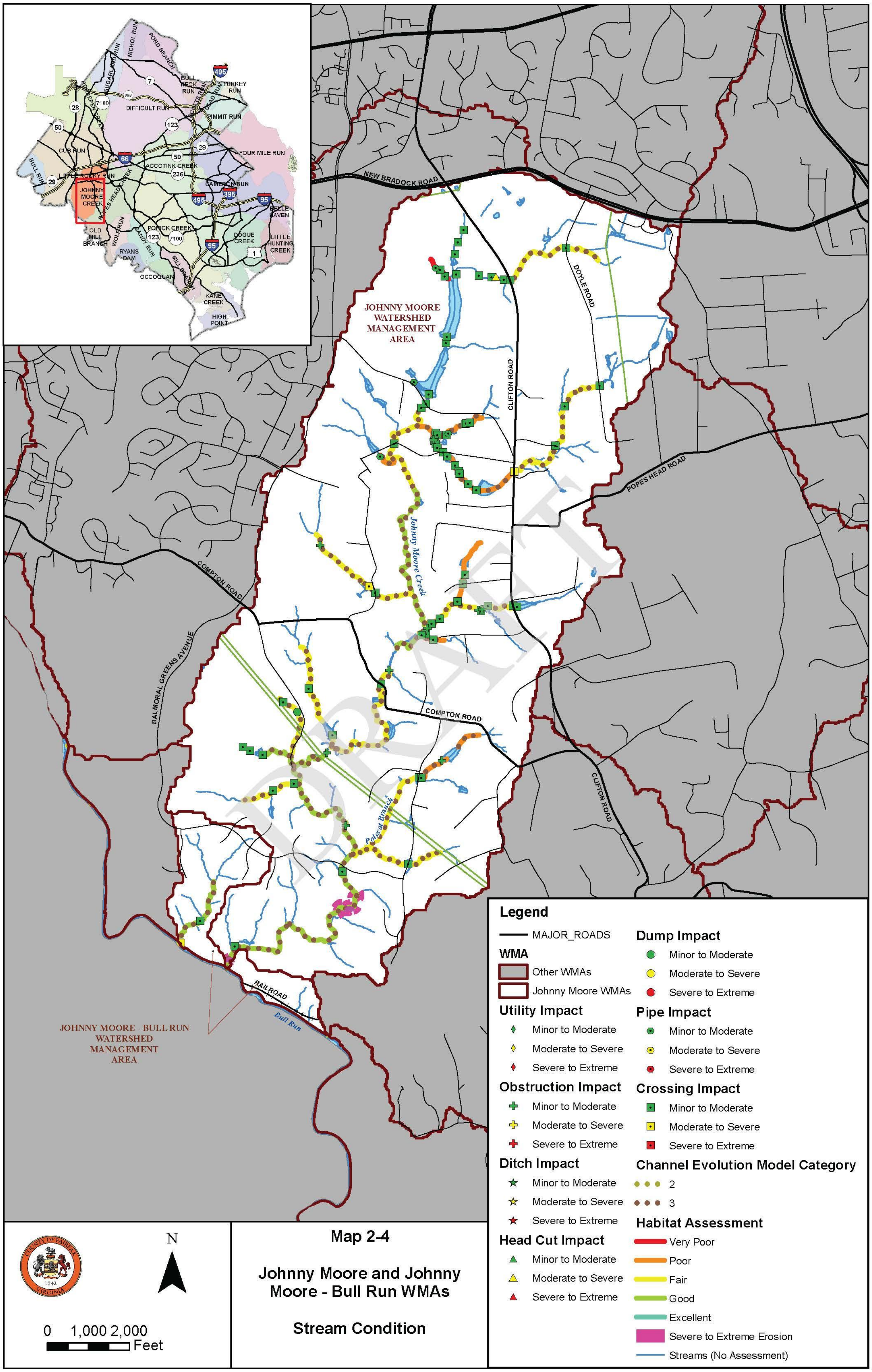
The geomorphological assessment of the stream channels in the WMAs were performed in 2003 and was based on the conceptual incised channel evolution model (CEM) developed by Schumm et al (1984). The CEM provides information about the evolution of a stream channel in response to disturbance. Based on visual observation of the channel cross section and other morphological observations of the channel segment, the CEM type was assigned for the channel segment. The CEM types are summarized below.

CEM Type	Description
1	Stable stream banks and developed channel
2	Deep incised channel
3	Unstable stream banks and actively widening channel
4	Stream bank stabilizing and channel developing
5	Stable stream banks and widened channel



Incised Channel Evolution Model
(Schumm, Harvey, and Watson, 1984)

The CEM Types 2 and 3 are shown on the stream condition map because these types are considered the most unstable. In the WMAs, all of the assessed reaches are CEM Type 3, except for the tributary that crosses Fox Shadow Lane, which is a CEM Type 4.



Map 2-4

Johnny Moore and Johnny Moore - Bull Run WMAs

Stream Condition

The SPA noted two areas of moderate to extreme erosion on Johnny Moore Creek. One near the confluence with Bull Run and one approximately 800 feet downstream of Balmoral Greens Avenue. Photos of the two areas are shown in Figures 2-3 and 2-4 below.

Figure 2-3: Erosion area near confluence with Bull Run

Figure 2-4: Erosion area downstream of Balmoral Greens Avenue

The other impacts found in the SPA are summarized in Table 2-5.

Table 2-5. SPA Impacts in the Johnny Moore Creek WMAs

Impact Type	Number	Comment
Utility	0	
Obstruction	9	All minor to moderate, includes 4 beaver dams
Ditch	0	
Headcut	1	2" Headcut on tributary in Twin Lakes Golf Course
Dump	1	Appliances, Trash on tributary along Union Mill Rd (minor to moderate)
Pipes	4	Minor to Moderate
Crossings	67	3 bridges, 4 box culverts, 32 circular culverts, 2 fords and 26 foot bridges 3 have moderate to severe impact (one ford, one box culvert and one circular pipe)

The following pictures show some of the impacts found in the WMAs during the 2005 SPA.

Figure 2-5: Headcut on tributary located on Twin Lakes Golf Course

Figure 2-6: Dump Site on tributary along Union Mill Road (no longer there – see below)

Figure 2-7: Pipe Impact near confluence with Bull Run

2.3.5 Field Reconnaissance

Field reconnaissance was conducted to update/supplement existing Fairfax County geographic data so current field conditions were accurately represented. Once this data was acquired, spatial analysis was performed to characterize County watersheds as they currently exist using the County‟s geographic information system (GIS). The reconnaissance effort included the identification of pollution sources, current stormwater management and potential restoration opportunities across the various watersheds.

During the field reconnaissance performed in June 2008, several areas of concern from 2005 were re-visited and were found to no longer exist. Most of the debris obstructions noted in 2005 had been removed or washed out. Prior to the 2008 field reconnaissance the area received unusually heavy rainfall. The rainfall likely contributed to the washing out of many beaver dams and natural stream obstructions that had previously existed. Evidence of this was observed throughout the watershed with large piles of branches and debris pushed to the side of channels. No evidence of dump sites observed in 2005 existed in 2008. A dump site identified in 2005 on a tributary along Union Mill Road where a hot tub was abandoned is no longer present.

Additionally, many new areas of concern were identified and inspected during the field reconnaissance. Bank erosion was one of the most common and significant impact types identified. Bank erosion was found to occur throughout the watershed and ranged from minor to severe in condition.

Severe erosion was observed on tributaries as well as the main stem of Johnny Moore Creek. The tributary located near the intersection of Clifton Road and Cedar Ridge Drive is experiencing severe erosion and headcuts. The following pictures show the erosion near the intersection.

Figure 2-8: Bank erosion in excess of 3ft on small tributary near Cedar Ridge Drive

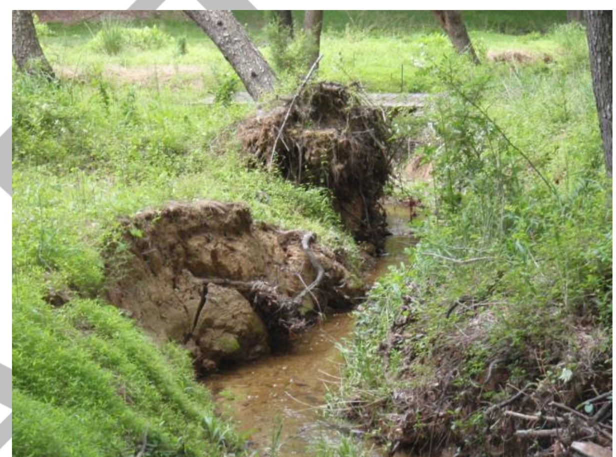


Figure 2-9: Bank erosion in excess of 3ft on small tributary near Cedar Ridge Drive

Severe bank erosion was also observed along the main channel of Johnny Moore Creek near the Balmoral Greens neighborhood in the same location as noted in the 2005 SPA. The following pictures show an update of erosion occurring in this area.

Figure 2-10: Bank erosion in excess of 3ft on Johnny Moore Creek near Balmoral Greens Subdivision

Figure 2-11: Bank erosion in excess of 3ft on Johnny Moore Creek near Balmoral Greens Subdivision

A summary of the new impacts found in the 2008 field reconnaissance are displayed in Table 2-6.

Table 2-6. New Impacts Identified in 2008 Field Reconnaissance

Impact Type	Number of Sites	Comment
Bank Erosion	7	Minor to sever erosion throughout watershed, effecting small tributaries to main channels
Obstruction	4	Minor to moderate, three man made and one natural, causing erosion and head cuts
Headcut	1	Minor cause by natural debris blockage
Wet Ponds	25+	Primarily privately owned, several in poor health due to overgrown vegetation, over fertilization and heavy sedimentation
Pipes	2	Minor to Moderate
Encroachments	2	Standing water is encroaching on Compton Rd and Doyle Rd at tributary crossings, these areas also provides a mosquito habitat

The following pictures show examples of other significant impacts found in the watershed.

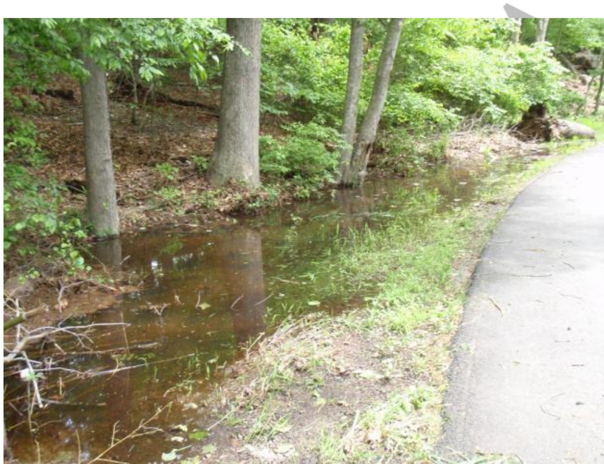


Figure 2-12: Standing water encroachment along Compton Rd.

Figure 2-13: Debris obstruction and headcut near Clifton Rd. and Cedar Ridge Dr.

Figure 2-14: Manmade obstruction near Clifton Rd. and Cedar Ridge Dr.

Figure 2-15: Pipe Impact near Clifton Rd. and Cedar Ridge Dr.

2.3.6 Modeling Results

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50% chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10% chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or „runs off") from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- Hydrologic models take into account several factors; the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that is transported by the runoff.

- Hydraulic models represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can both predict the ability for man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

The table below shows three storm events and the rationale for being modeled:

Storm Event	Rationale for being Modeled
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

The County is using a customized version of the Environmental Protection Agency‟s (EPA‟s) Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL). This customized program (STEPL-FFX) was built in Microsoft (MS) Excel Visual Basic for Application (VBA). It provides a user-friendly interface to create a customized spreadsheet-based model in MS Excel. It employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development (LID) practices for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus and 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. The land uses considered are user-defined land uses from Fairfax County. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using BMP efficiencies.

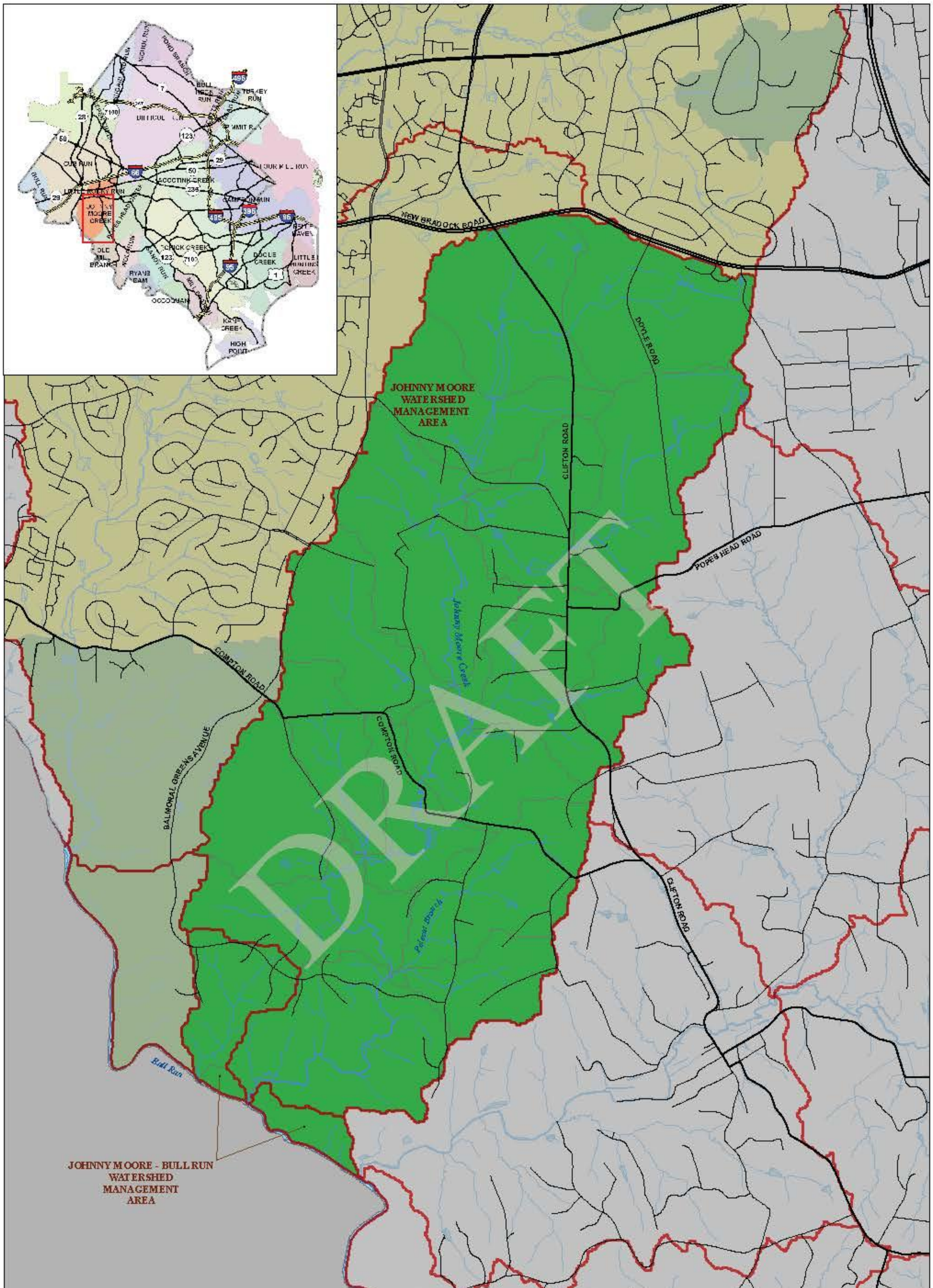
Existing Conditions water-quality data from the STEPL-FFX is shown on Maps 2-5, 2-6 and 2-7. The color gradient map symbols for pollutant loadings are the same for both the Johnny Moore and Little Rocky Run watersheds. Therefore, for Total Nitrogen (TN), Total Phosphorous (TP) and Total Suspended Solids (TSS), the Johnny Moore subwatersheds are producing relatively low loads. The water-quality analysis is driven by land use and the watershed is predominantly open space and low density/estate residential. With less impervious areas and more natural cover, the results are consistent with expectations. One item to note is that the field reconnaissance effort identified several gulley formations throughout the Johnny Moore Creek watershed, which will be included in an updated STEPL analysis for more accurate TSS loadings. While some open space will be converted to estate residential in the future, no changes associated with the County"s 25-yr Comprehensive Plan will significantly impact pollutant loadings for this watershed.

Table 2-7 provides a summary of runoff peak values and pollutant loadings at the outlet of the WMA. The second table is normalized by contributing drainage area.

Table 2-7. Johnny Moore Creek Stormwater Peak Values and Pollutant Loadings

WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs)	10-yr storm (cfs)	TSS (tons/yr)	TN (lbs/yr)	TP (lbs/yr)
Johnny Moore Creek	542	1591	249.6	7102.5	1255.7
NORMALIZED BY DRAINAGE AREA					
WMA	**Stormwater Runoff Peak Values**		**Pollutant Loadings**		
	2-yr storm (cfs/acre)	**10-yr storm (cfs/acre)**	**TSS (tons/acre/ yr)**	**TN (lbs/acre/ yr)**	**TP (lbs/acre /yr)**
Johnny Moore Creek	0.169	0.495	0.078	2.211	0.391

The preliminary hydraulic model for Johnny Moore was developed using United States Army Corps of Engineers (USACE) Hydrologic Engineering Centers River Analysis System (HEC-RAS) to compute water surface profiles. The preliminary model results were used to analyze the water surface elevation and flooding of inline structures.



N

0 1,000 2,000 Feet

Legend

MAJOR_ROADS
Arterial Streets

WMA

Johnny Moore WMAs
Other WMAS
Streams

STEPL Existing

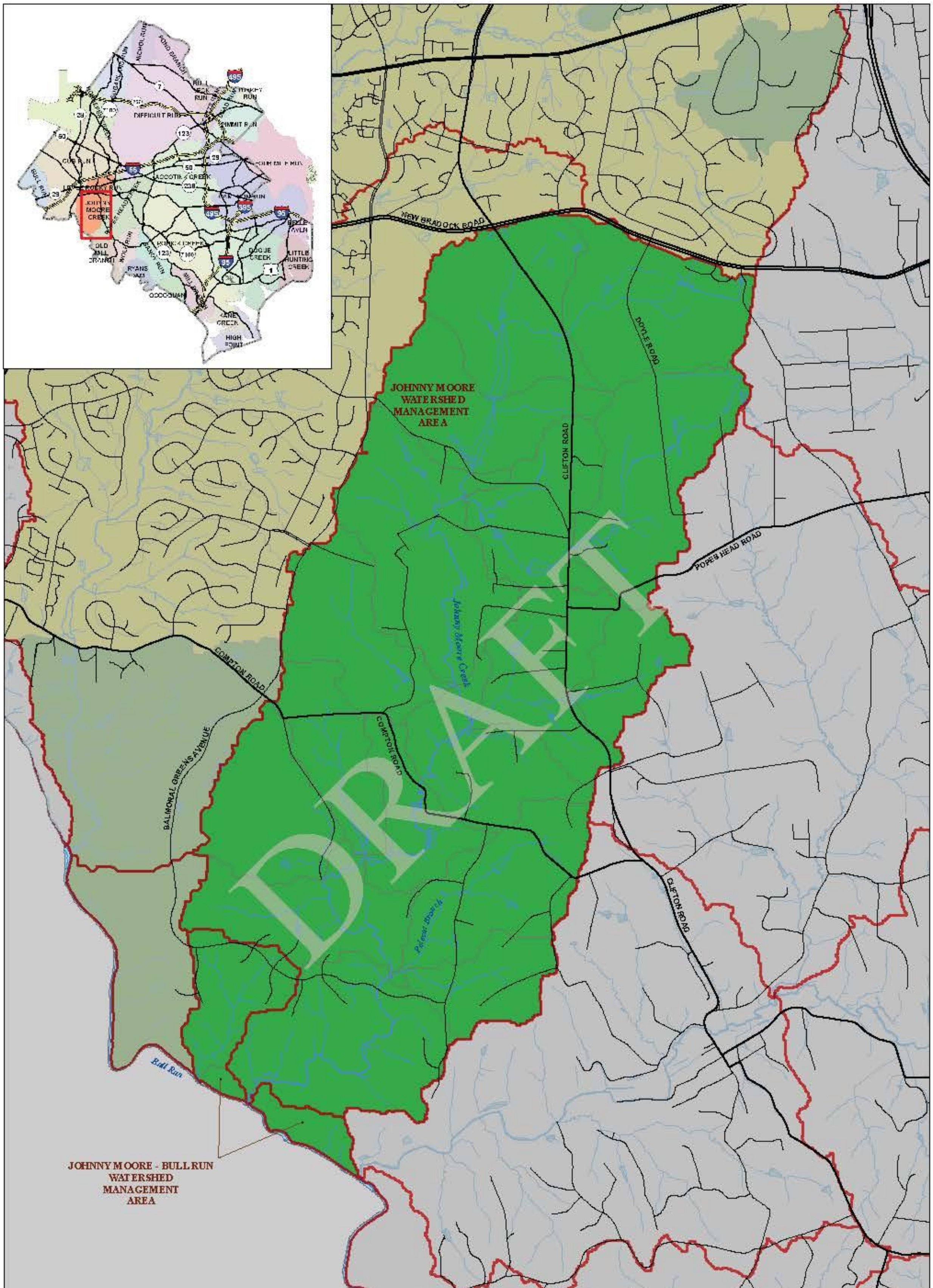
Total Nitrogen lbs/ac/yr

0.987500 - 4.287116
4.287117 - 9.069964
9.069965 - 17.802404

Map 2-5

Johnny Moore and Johnny Moore - Bull Run WMAs

Total Nitrogen



N

0 1,000 2,000 Feet

Legend

MAJOR_ROADS

Arterial Streets

WMA

Johnny Moore WMAs

Other WMAS

Streams

STEPL Existing

Phosphorous lbs/ac/yr

0.246100 - 0.645884

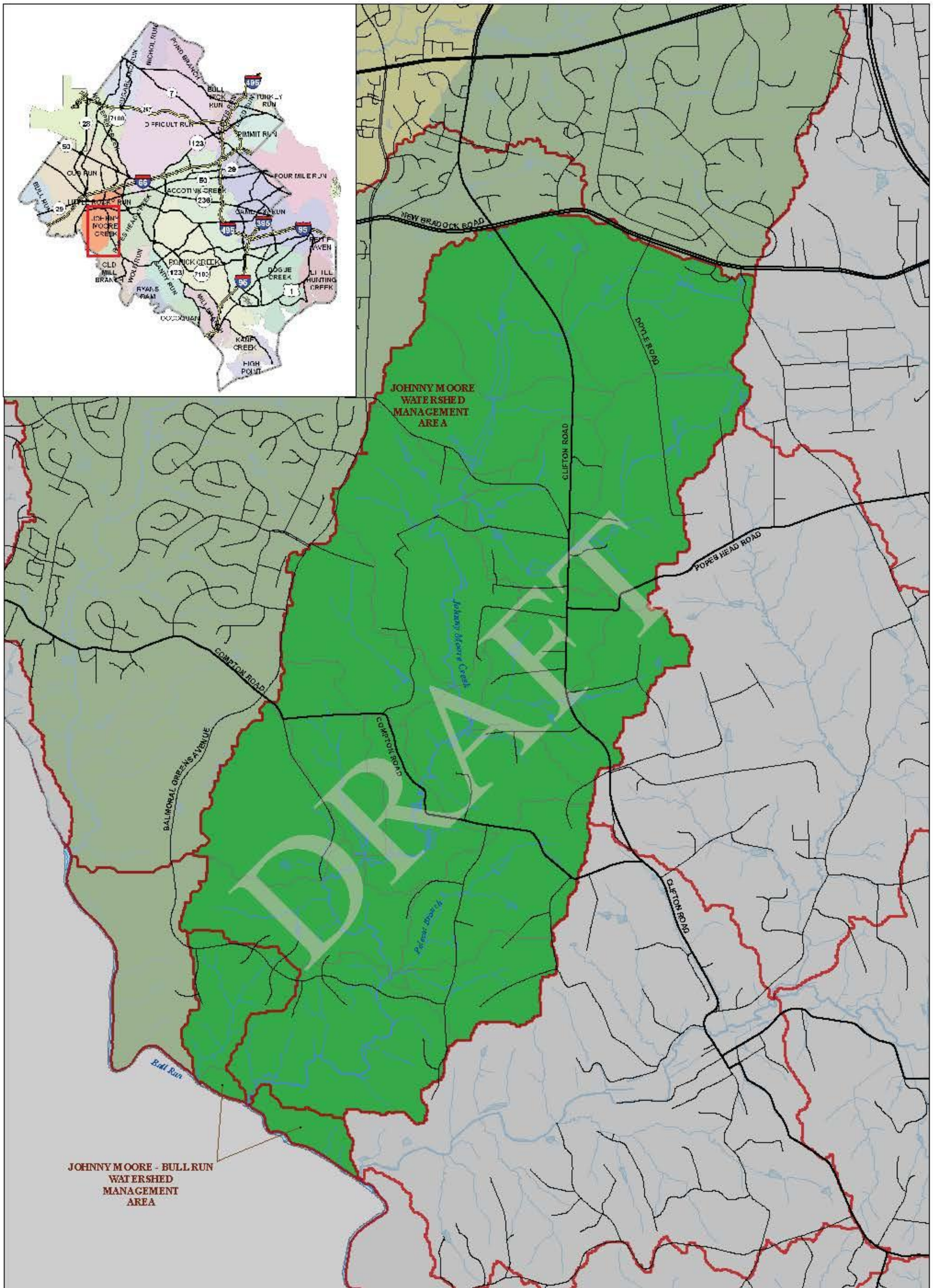
0.645885 - 1.441817

1.441818 - 2.874638

Map 2-6

Johnny Moore and Johnny Moore - Bull Run WMAs

Total Phosphorous



N

0 1,000 2,000 Feet

Legend

MAJOR_ROADS
Arterial Streets

WMA

Johnny Moore WMAs
Other WMAS
Streams

STEPL Existing

TSS t/ac/yr

0.045347 - 0.180933
0.180934 - 0.316520
0.316521 - 0.452106

Map 2-7

Johnny Moore and Johnny Moore - Bull Run WMAs

Total Suspended Solids

The input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County‟s GIS, specifically as it pertains to physical features such as stream geometry and flowpath so that these features can be represented in the model. HEC-RAS models were developed for study streams within Johnny Moore watershed using a naming convention unique for each reach. The study streams were defined as having a drainage area of at least 200 acres.

Bridge and Culvert crossings were coded according to available County or Virginia Department of Transportation (VDOT) engineering documents that depict the facility as it was actually built. Where not available, limited field reconnaissance was performed to obtain the crossing data. The crossing elevation data was determined relative to a point where the elevation could be estimated accurately from the County‟s topographic data.

Manning‟s „n‟ values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The flow change locations were extracted from the EPA Storm Water Management Model (SWMM) developed to estimate preliminary stormwater runoff flow values. The 2-yr, 10-yr and 100-yr storm flows were determined at several locations in order to provide a detailed flow profile for the hydraulic model. Map 2-8 provides a graphical representation of the SWMM results for the 10-year storm discharge.

The 2-year storm discharge is regarded as the channel-forming or dominant discharge for the purposes of this study. This discharge is the flow value that transports the majority of a stream‟s sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

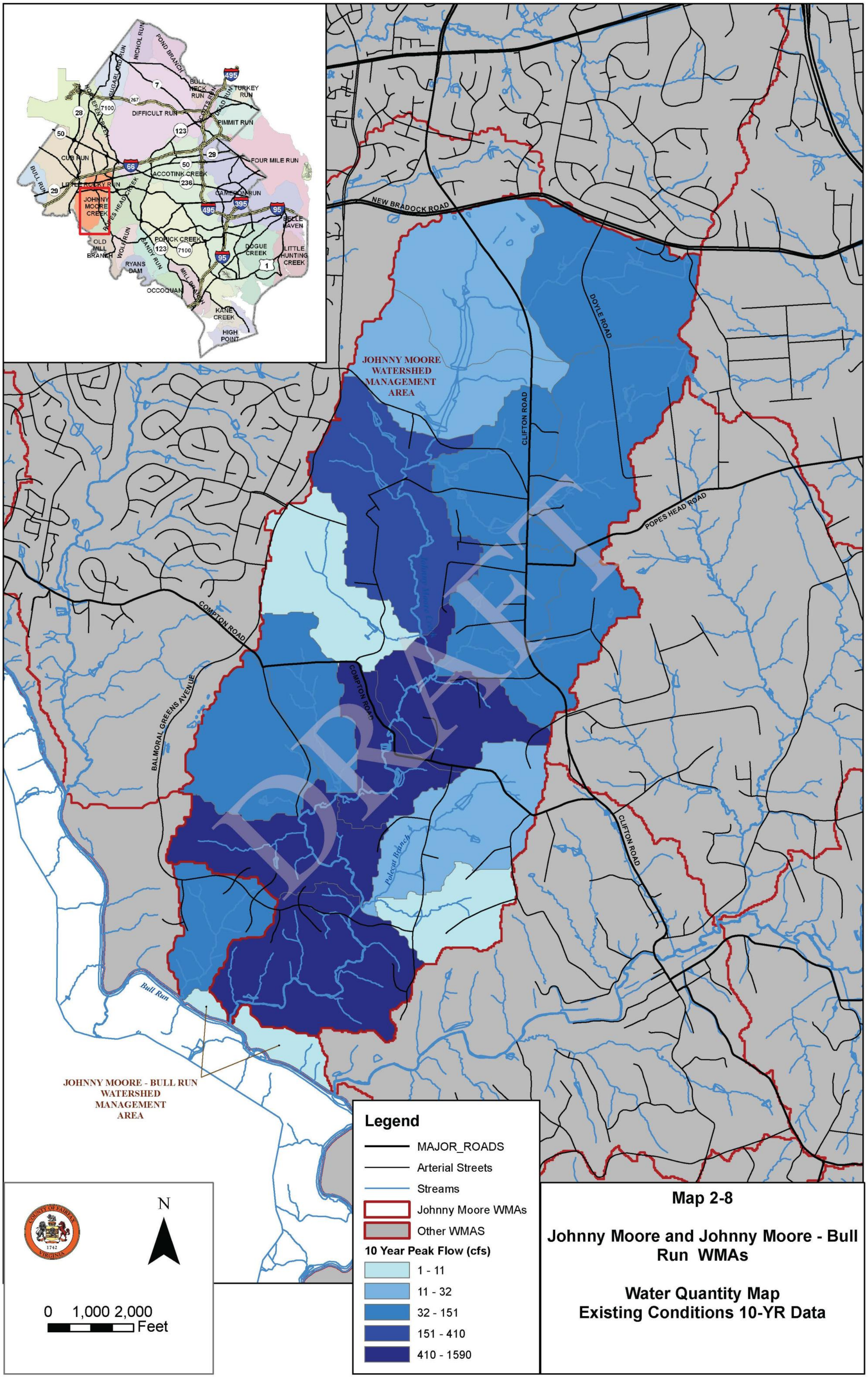
The 10-year storm discharge is being included to analyze the level of service of stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) will be analyzed against this storm to see if they are performing at a level that safely passes this storm.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to map floodplain inundation zones and establish flood insurance rates. This provides a means to assess which properties are at risk to flooding and determine the appropriate insurance requirements for these at risk properties. The models developed to analyze the system for watershed planning have been built in compliance with FEMA standards in order to update the Flood Insurance Rate Maps for Fairfax County where appropriate.

In summary, the preliminary results for HEC-RAS are as follows:

- 3 stream road crossings in the watershed do not have the capacity to pass the 10-year storm without the road being over topped.
- The 2-year storm exceeds the channel banks in several locations.
- No residential structures are within the modeled 100-year flood inundation zone.

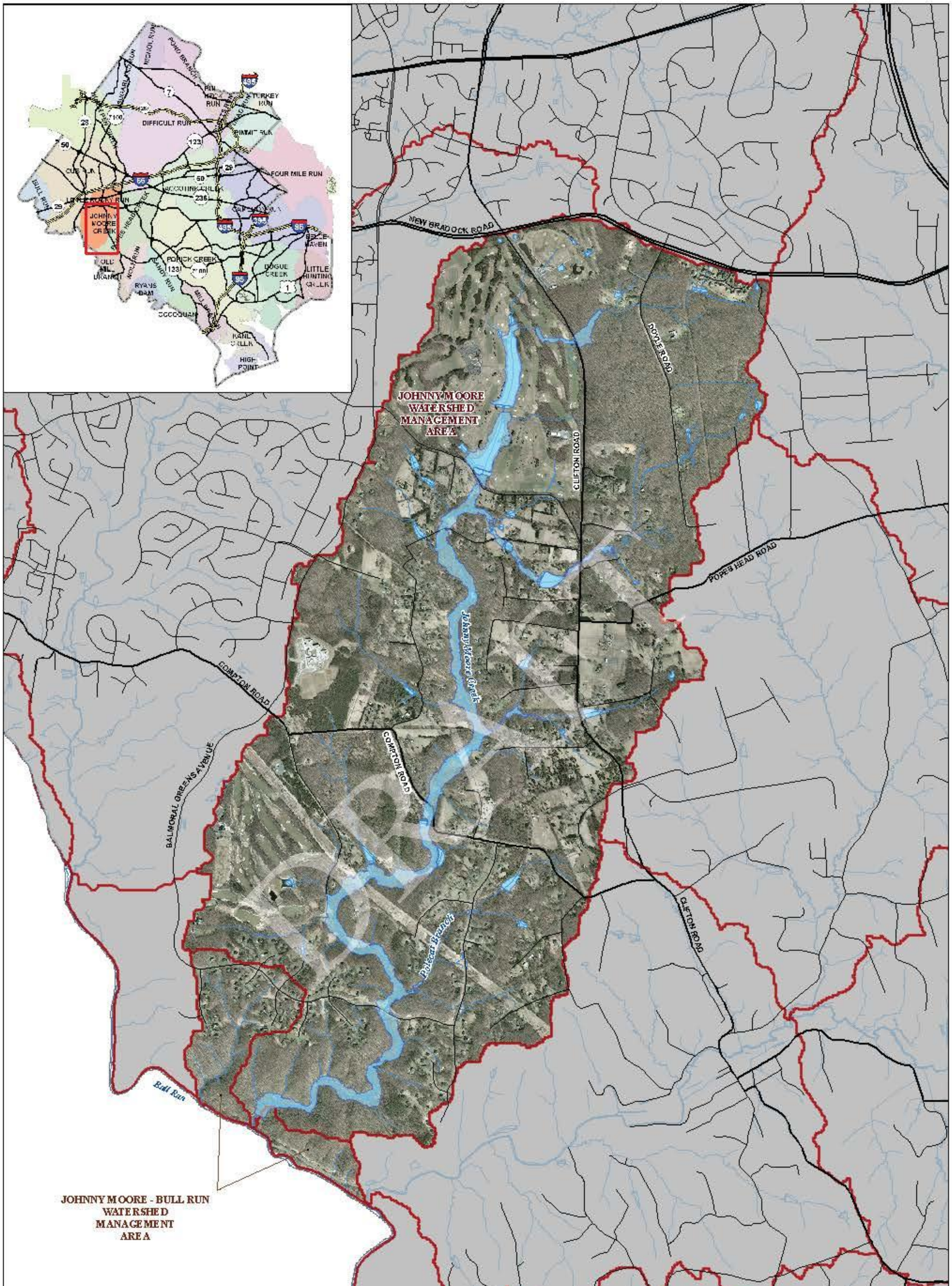
The limit of the 100-year flood is graphically represented in Map 2-9.



Map 2-8

Johnny Moore and Johnny Moore - Bull Run WMAs

Water Quantity Map
Existing Conditions 10-YR Data



N

0 1,000 2,000 Feet

Legend

- Preliminary 100 YR Floodplain Boundary
- Major Roads
- Arterial Streets

WMA

- Johnny Moore WMAs
- Other WMAS
- Streams

Map 2-9

Johnny Moore and Johnny Moore - Bull Run WMAs

Preliminary 1% Annual Chance Floodplain Boundary

2.3.7 Subwatershed Ranking

It should be noted that all designations of the preliminary ranking results are relative to the area studied for this report. In other words, a „low quality‟ designation does not necessarily indicate a poor quality subwatershed, only relative to the 51 other subwatersheds in the Little Rocky Run/Johnny Moore Creek watersheds.

The Johnny Moore Creek WMA contains mostly high quality subwatersheds as summarized on maps 2-33 (Objective Composite Score) and 2-34 (Source Composite Score). Maps 2-26 to 2-32 describe more specific objective criteria, which have been weighted to determine the objective composite score. Please refer to section 2.2 for a more detailed description of impact, source and programmatic indicators and how they are being used to characterize the subwatersheds.

The main stressors in this WMA come from two golf courses, which tend to result in higher pollutant loadings while also having a negative impact on natural stream buffers. Also, noted in the SPA and in the field reconnaissance, there are many gulley formations and unstable banks throughout this watershed, which will increase sediment load, impacting aquatic life throughout the watershed. Otherwise, this watershed is of higher quality than its Little Rocky Run counterparts because of significant land use differences. The predominant Low Density Residential/Open Space watershed results in more natural measures protecting watershed health.

More specifically, the color gradient for Map 2-26 reflects that Lower Little Rocky is rated higher for „Stormwater Runoff‟ than Johnny Moore, which is atypical. Stormwater Runoff is determined from equal weights of 5 indicators, including Benthic Communities, Fish Communities, Aquatic Habitat, ICEM Class and Instream Sediment Loading. One item contributing to this WMA scale anomaly is the Fish Communities Indicator. Though community values were similar (ranging from 25 to 31 across 5 sites), the threshold value of 28 used in the ranking gave the Johnny Moore sites a lower score than Little Rocky Run Lower. Also, as noted previously, the SPS/SPA study revealed several reaches in Johnny Moore are experiencing streambank sloughing and are in an active erosive state. Lower scores for ICEM and Instream Sediment are recorded as a result. The remaining two attributes (Benthic Communities and Aquatic Habitat) were comparable.

2.4 Little Rocky Run - Lower and Little Rocky Run – Bull Run WMAs

2.4.1 WMA Characteristics

The Little Rocky Run - Lower and Little Rocky Run – Bull Run WMAs are combined in this summary. The Little Rocky Run – Bull Run WMA drains directly into Bull Run and is adjacent to the Little Rocky Run - Lower watershed. It is relatively undeveloped and much smaller than the Little Rocky Run - Lower WMA. The Little Rocky Run - Lower WMA has an area of approximately 2,141 acres (3.3 mi^2) and the Little Rocky Run – Bull Run WMA has an area of approximately 188 acres (0.3 mi^2). Its approximate northern boundary is New Braddock Road and it is bounded to the south by Bull Run. Union Mill Road and Balmoral Greens Avenue are its approximate eastern boundary and its western boundary extends approximately from the intersection of New Braddock Road and Route 28 (Centreville Road) to its confluence with Bull Run.

The Little Rocky Run - Lower WMA includes 12.5 miles of perennial streams and the Little Rocky Run – Bull Run WMA includes 0.5 miles of perennial streams. The streams flow generally in a southwest direction through predominantly medium density and high density residential areas in the upper portion of the WMA and open space and low density residential areas in the lower portion. Little Rocky Run flows into Bull Run between Compton Road and the Norfolk Southern Railway Crossing of Bull Run.

In the *Occoquan Environmental Baseline Report (February 1978),* severe erosion was noted in two areas upstream of Compton Road and one area downstream of Compton Road. The *Stream Physical Assessment (August 2005)* data reflects an area of erosion in the same site downstream of Compton Road and another location on a small tributary near the confluence with Bull Run. In the erosion areas noted in 1978 upstream of Compton Road, the banks remain moderately unstable with scattered vegetation; however these areas were not flagged for erosion in 2005. There was also severe sedimentation noted in 1978 on Little Rocky Run upstream of the power line; however, the 2005 assessment did not find excessive sedimentation in this location.

2.4.2 Existing and Future Land Use

The existing land use in the Little Rocky Run - Lower consists primarily of open space and medium density residential. The Little Rocky Run - Lower WMA is currently 37 percent open space and 26 percent medium density residential development. Approximately 530 acres (25 percent) of the Little Rocky Run – Lower WMA is located in the Residential-Conservation (R-C) District where development is limited to one dwelling unit per 5 acres. This area was rezoned by the Fairfax County Board of Supervisors in 1982 to protect the Occoquan Reservoir. In the Little Rocky Run – Lower WMA, the areas east of Union Mill Road and south of Braddock Road and the area south of Compton Road are in the R-C District.

Little Rocky Run – Bull Run WMA consists primarily of open space. The Little Rocky Run – Bull Run WMA is currently 76 percent open space and 12 percent low density residential development. All of the Little Rocky Run – Bull Run WMA is located in the Residential-Conservation (R-C) District where development is limited to one dwelling unit per 5 acres. This area was rezoned by the Fairfax County Board of Supervisors in 1982 to protect the Occoquan Reservoir. The Twin Lakes Golf Course and the Westfields Golf Course at Balmoral are located partially in the Little Rocky Run - Lower and partially in the Little

Rocky Run – Bull Run WMAs. A summary of the land use in the WMAs can be found in Table 2-8.

Comparing existing land use to future land use in Little Rocky Run - Lower, 93 acres or 4% is expected to shift from open space to estate residential, with other shifts shown at right. Shifts from open space to residential development account for the majority of the shifts; however, the future development in the WMA is predicted to remain fairly stable. In the Little Rocky Run – Bull Run WMA, 2 acres or 1% of the WMA is expected to shift from open space to estate residential. Map 2-10 shows the existing and future conditions land use in the Little Rocky Run – Lower and Little Rocky Run – Bull Run WMAs.

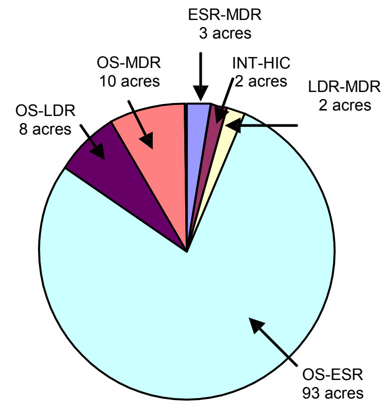


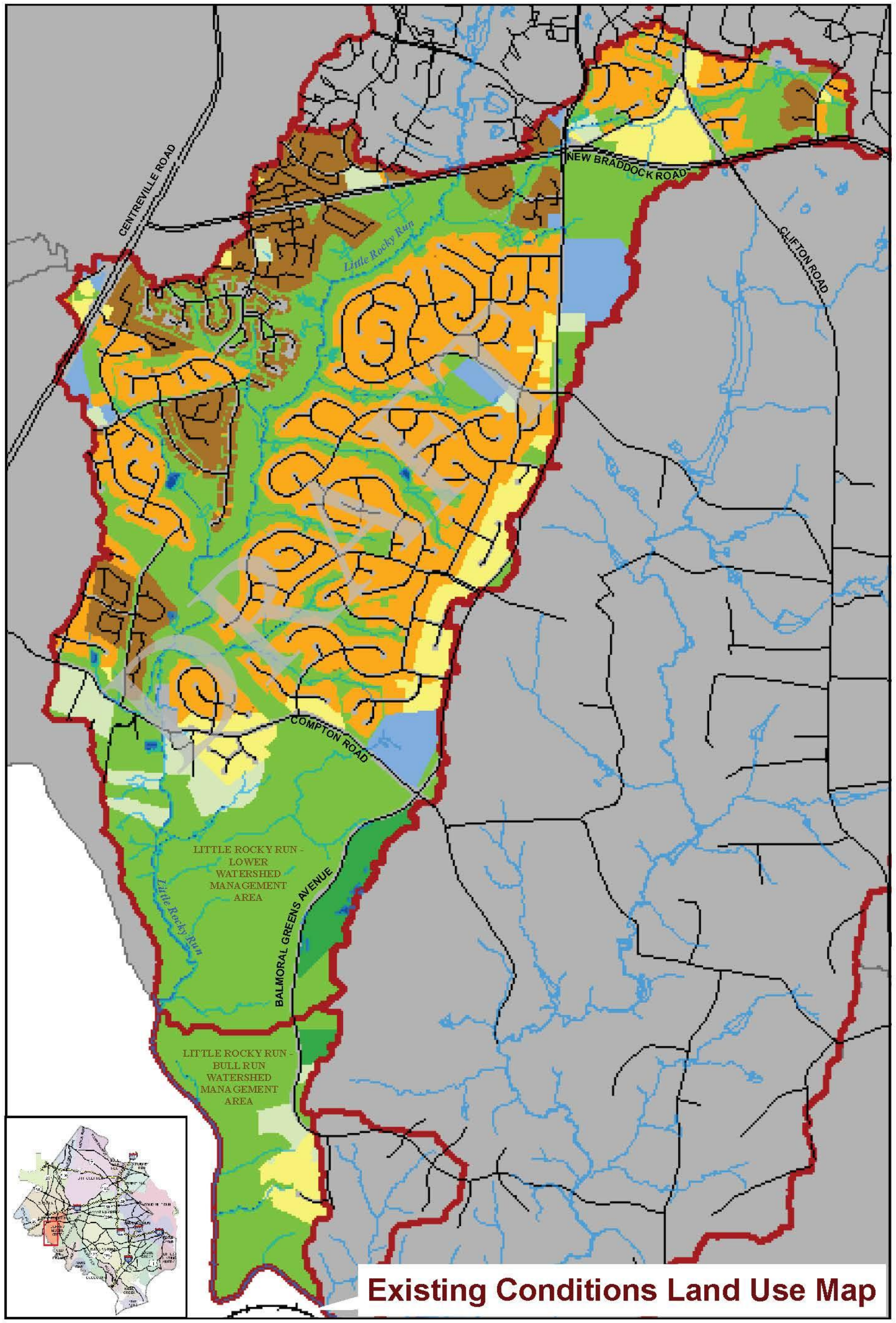
Table 2-8. Existing and Future Land Use in Little Rocky Run – Lower and Little Rocky Run – Bull Run

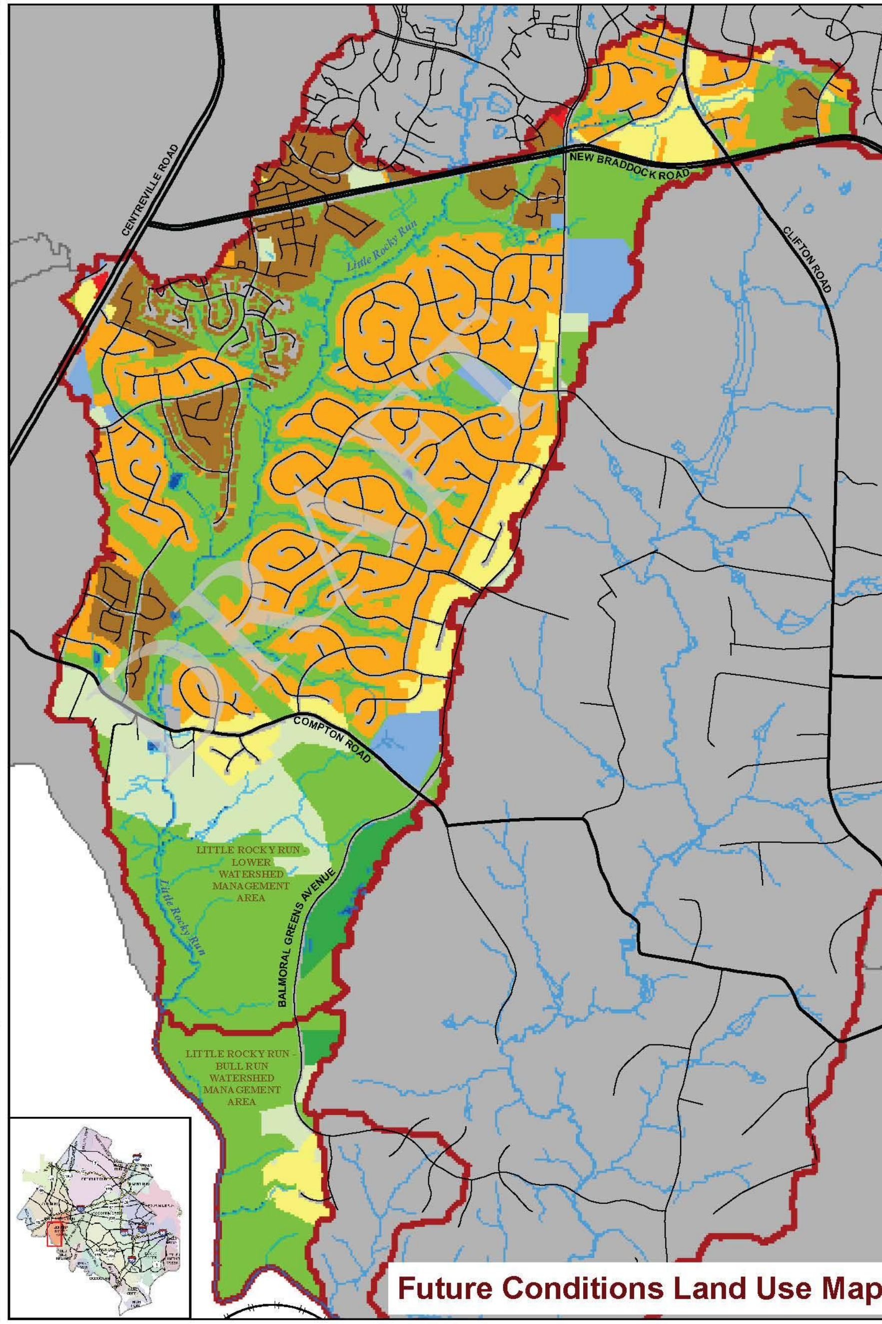
Little Rocky Run - Lower WMA

Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	67	3%	157	7%	90	4%
Low Density Residential (LDR)	114	5%	120	6%	6	0%
Medium Density Residential (MDR)	552	26%	567	26%	15	1%
High Density Residential (HDR)	226	11%	226	11%	0	0%
Low Intensity Commercial (LIC)	0	0%	0	0%	0	0%
High Intensity Commercial (HIC)	0	0%	3	0%	3	0%
Industrial (IND)	9	0%	9	0%	0	0%
Institutional (INT)	71	3%	69	3%	-2	0%
Golf Course (GC)	34	2%	34	2%	0	0%
Open Space (OS)	797	37%	687	32%	-111	-5%
Water (W)	17	1%	17	1%	0	0%
Transportation (T)	254	12%	254	12%	0	0%
Totals	**2141**	**100%**	**2141**	**100%**		**0%**

Little Rocky Run - Bull Run WMA

Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	11	6%	13	7%	2	1%
Low Density Residential (LDR)	22	12%	22	12%	0	0%
Medium Density Residential (MDR)		0%		0%	0	0%
High Density Residential (HDR)		0%		0%	0	0%
Low Intensity Commercial (LIC)		0%		0%	0	0%
High Intensity Commercial (HIC)		0%		0%	0	0%
Industrial (IND)		0%		0%	0	0%
Institutional (INT)		0%		0%	0	0%
Golf Course (GC)	7	4%	7	4%	0	0%
Open Space (OS)	144	76%	142	76%	-2	-1%
Water (W)	0	0%	0	0%	0	0%
Transportation (T)	4	2%	4	2%	0	0%
Totals	**188**	**100%**	**188**	**100%**		**0%**





Map 2-10 Existing and Future Land Use Maps

Little Rocky Run - Lower and Little Rocky Run - Bull Run Watershed Management Areas

Legend

- Streams
- Major Roads
- Railroad

WMA

- Little Rocky Run - Lower WMAs
- Other WMAs

Land Use

Existing Land Use

- Estate Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Low Intensity Commercial
- High Intensity Commercial
- Industrial
- Institutional
- Golf Course
- Open Space
- Water
- Transportation

N

Scale

0 1,000 2,000 Feet

The total impervious area (includes all paved areas and building rooftops) for the Little Rocky Run - Lower WMA is 493 acres or 23 percent of the WMA. The high levels of impervious surface in certain areas of the Little Rocky Run – Lower WMA is significant and negatively affects water quality by contributing large quantities of stormwater runoff to area streams.

The total impervious area (includes all paved areas and building rooftops) for the Little Rocky Run – Bull Run WMA is 3.6 acres or 1.9 percent of the WMA. The total amount of impervious surface in Little Rocky Run – Bull Run is relatively low and is not expected to significantly affect water quality or quantity.

2.4.3 Stormwater Infrastructure

Stormwater infrastructure in the WMAs consists of stormwater management facilities, storm sewer and other manmade stormwater conveyances. Stormwater management facilities provide control of stormwater runoff in two ways; by reducing the quantity of stormwater runoff and providing treatment to reduce pollution and thereby improve the quality of stormwater runoff. Stormwater management facilities are designed to improve water quality by reducing the erosive effects of stormwater runoff and by filtering or capturing pollutants in the facility. Earlier facilities (prior to 1980 in the Occoquan basins and prior to 1994 in the rest of the County) provide only water quantity reduction, while facilities constructed later may provide both water quantity and quality treatment or provide quality treatment alone.

There are 44 stormwater management facilities in the County records for the Little Rocky Run – Lower and Little Rocky Run – Bull Run WMAs: 38 of these are dry ponds and 3 are wet ponds. From field reconnaissance and desktop assessment it was determined that: 2 are golf course wet ponds and 1 is a larger wet pond or farm pond on private property that was not designed for stormwater management. Map 2-11 shows the location of these facilities, locations of drainage complaints and the parcels covered by stormwater management.

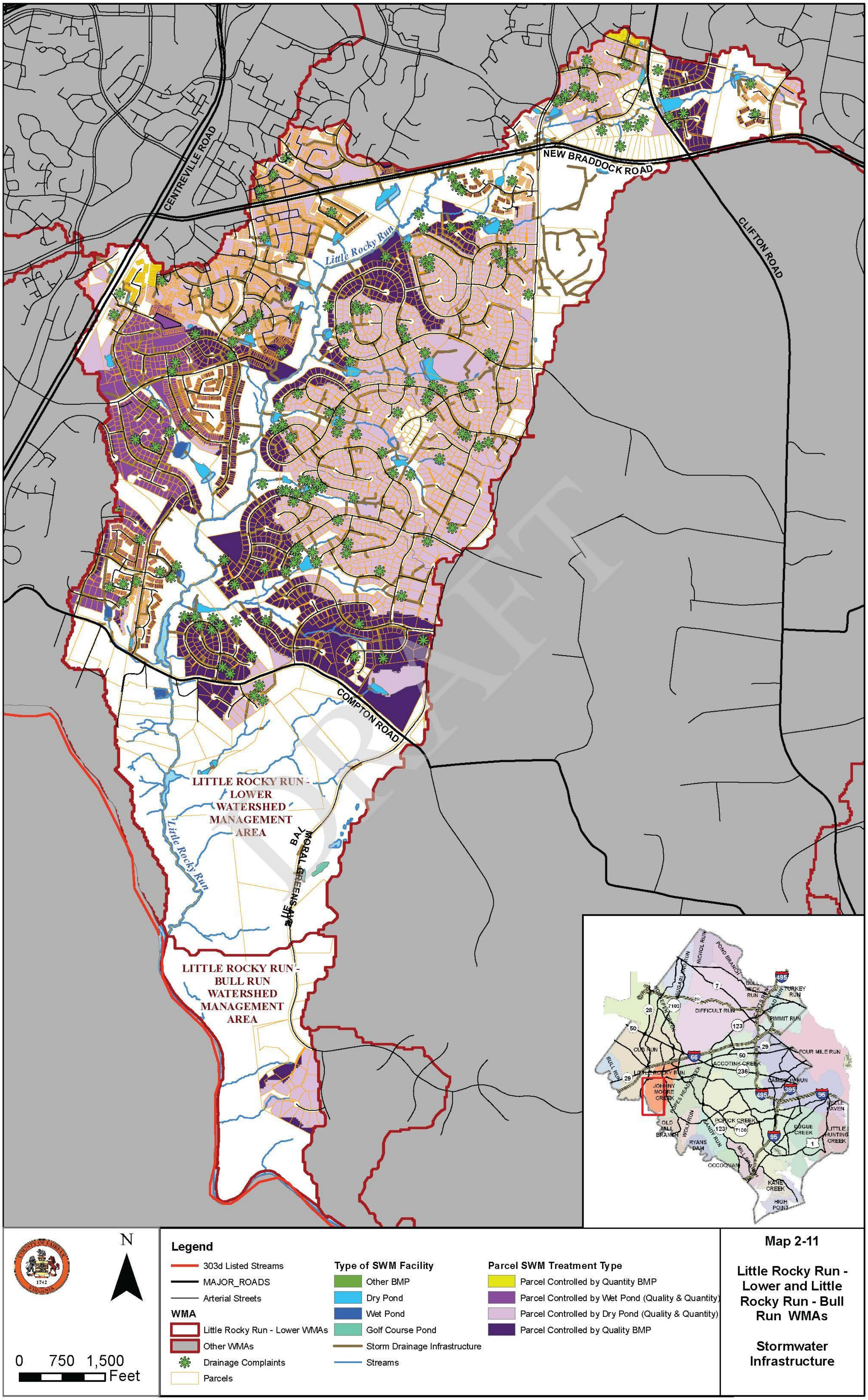
Table 2-9 shows the treatment type breakdown for the stormwater management facilities.

Table 2-9. Stormwater Treatment Types in the Little Rocky Run – Lower WMAs

WMA Name	Current Percent Impervious	Current Treatment Types			
		Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Little Rocky Run - Lower	23	6	253	679	1204
Little Rocky Run – Bull Run	1.9	0	4	19	165
Total		6	257	698	1369

There were 171 complaints related to stormwater in the County‟s complaints database in the WMAs. The classification of these complaints is summarized below:

- 62 Citizen Responsibility
- 54 Storm Drainage
- 49 Stormwater Management/BMP
- 3 Unclassified
- 2 Planning & Design Division
- 1 Walkway



Map 2-11

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Stormwater Infrastructure

2.4.4 Stream Condition

The County conducted a *Stream Physical Assessment* (SPA) in August 2005 that assessed the habitat, stream geomorphology and impacts to the streams from crossings, ditches, pipes, headcuts, dump sites, utilities and obstructions. Map 2-12 summarizes the SPA data.

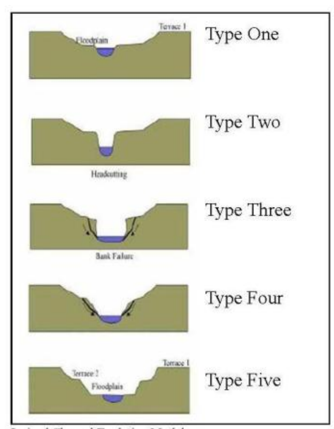
6.7 miles were assessed for stream habitat condition in these WMAs. The study results are summarized below:

- Very Poor: 0 miles
- Poor: 1.2 miles or 18%
- Fair: 3.0 miles or 45%
- Good: 1.8 miles or 27%
- Excellent: 0.7 miles or 10%

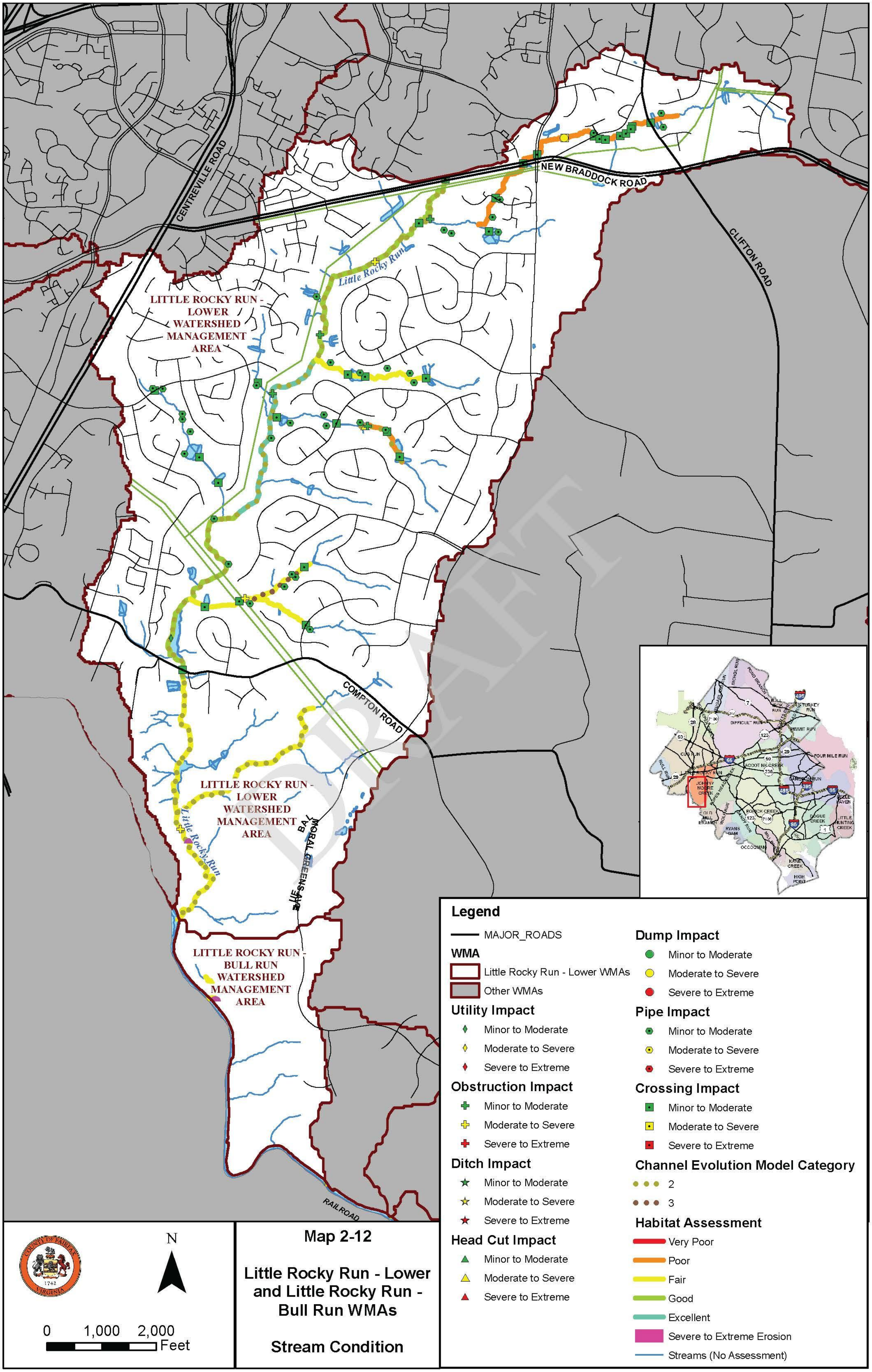
The longest segment of stream that was assessed as poor is on a tributary to Little Rocky Run that flows near the intersection of Union Mill Road and Braddock Road. This segment runs through an area developed with medium and high density residential zoning and in many areas the buffer is poorly vegetated. Another poor segment is located upstream of South Springs Drive. No poor segments were located on the main stem of Little Rocky Run.

The geomorphological assessment of the stream channels in the WMA was performed in 2003 and was based on the conceptual incised channel evolution model (CEM) developed by Schumm et al (1984). The CEM provides information about the evolution of a stream channel in response to disturbance. Based on visual observation of the channel cross section and other morphological observations of the channel segment, the CEM type was assigned for the channel segment. The CEM types are summarized below.

CEM Type	Description
1	Stable stream banks and developed channel
2	Deep incised channel
3	Unstable stream banks and actively widening channel
4	Stream bank stabilizing and channel developing
5	Stable stream banks and widened channel



Incised Channel Evolution Model
(Schumm, Harvey, and Watson, 1984)



Map 2-12

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Stream Condition

The CEM Types 2 and 3 are shown on the stream condition map because these types are considered the most unstable. In the WMAs, 4.6 miles (69%) is Type 2, 1.9 miles (28%) is Type 4 and 0.2 (3%) miles is Type 3.

There were two noted areas of moderate erosion, one on Little Rocky Run approximately 1,800 feet upstream of the confluence with Bull Run and one on a tributary in the Little Rocky Run – Bull Run WMA. A photo of the Little Rocky Run – Bull Run erosion area is shown below.

Figure 2-16: Erosion area on tributary in Little Rocky Run - Bull Run

The other impacts found by the SPA are summarized in Table 2-10.

Table 2-10. SPA Impacts in the Little Rocky Run – Lower WMAs

Impact Type	Number	Comment
Utility	1	Minor impact – sanitary line crossing above base flow
Obstruction	7	3 moderate to severe, 4 minor to moderate (3 beaver dams)
Ditch	0	
Headcut	1	Moderate to Severe 1.5" headcut on tributary upstream of South Springs Drive
Dump	1	Moderate to Severe – trash, lawn waste on tributary upstream of Union Mill Rd
Pipes	34	All Minor to Moderate impact
Crossings	31	1 bridge, 4 box culverts, 20 circular culverts, 3 elliptical and 3 foot bridges 1 has moderate to severe impact (one circular pipe upstream of Union Mill Road – see photo)

The following pictures show some of the more significant impacts found in the watershed during the SPA.

Figure 2-17: Headcut on tributary located upstream of South Springs Drive

Figure 2-18: Dump Site on tributary along Union Mill Road

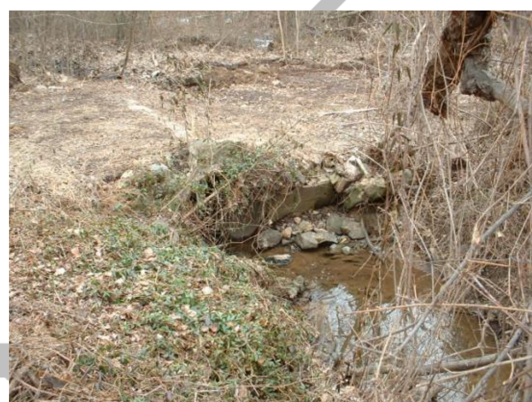


Figure 2-19: Pipe Impact upstream of Union Mill Road

2.4.5 Field Reconnaissance

Field reconnaissance was conducted to update/supplement existing Fairfax County geographic data so current field conditions were accurately represented. Once this data was acquired, spatial analysis was performed to characterize County watersheds as they currently exist using the County"s geographic information system (GIS). The reconnaissance effort included the identification of pollution sources, current stormwater management and potential restoration opportunities across the various watersheds.

During this field reconnaissance performed in June 2008, several areas of concern from the 2005 SPA were re-visited. The stream segments previously identified as poor still have existing issues.

The tributary segment observed as poor in 2005 near South Springs Dr. is currently experiencing severe erosion problems. The following photos show the severe erosion and headcuts occurring at several different locations in this area. This erosion is affecting several smaller tributaries, however the main channel of the tributary appears fairly stable.

Figure 2-20: Severe erosion occurring at the end of a concrete trickle ditch in the Little Rocky Run subdivision (Battle Rock Drive)

Figure 2-21: Severe erosion occurring in small tributary channel in the Little Rocky Run subdivision (Stonehaven Court)

Figure 2-22: Headcut occurring in small tributary behind homes in the Little Rocky Run subdivision (Bluestone Court)

The poor tributary segment observed in 2005 near the intersection of Union Mill Road and Braddock Road has poorly vegetated and swampy buffers as well as several obstructions. These problems exist in areas downstream of the intersection and past the tributary‟s confluence with Little Rocky Run. The following photos show two debris blockages located in this area.

Figure 2-23: Major debris obstruction at the confluence of a tributary and Little Rocky Run behind the Little Rocky Run subdivision

Figure 2-24: Debris obstruction in main stem of Little Rocky Run

A summary of new impacts found in the 2008 field reconnaissance are summarized in Table 2-11.

Table 2-11. New Impacts Identified in Little Rocky Run – Lower during 2008 Field Reconnaissance

Impact Type	Number of Sites	Comment
Erosion	6	Minor to sever erosion throughout watershed, effecting tributaries
Obstruction	5	Minor to moderate, multiple debris obstructions
Headcut	3	Minor to moderate, affecting tributaries

The following pictures show examples of other significant impacts found in the watershed.

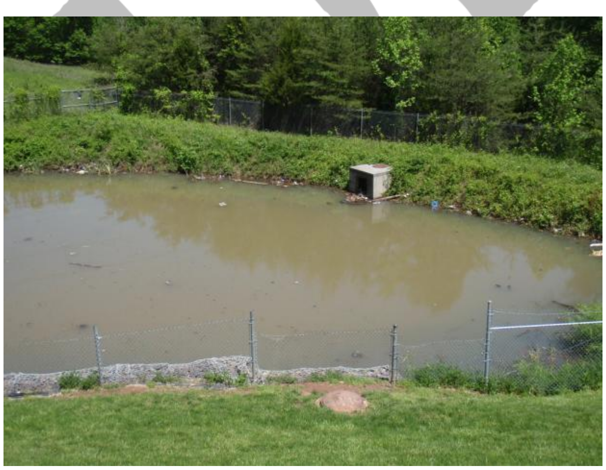


Figure 2-25: Wet Pond with significant amount of litter near Compton Valley Way

Figure 2-26: Pond riser structure is covered with debris near Compton Heights Circle

2.4.6 Modeling Results

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50% chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10% chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or „runs off") from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- Hydrologic models take into account several factors; the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that is transported by the runoff.

- Hydraulic models represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can both predict the ability for man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

The table below shows three storm events and the rationale for being modeled:

Storm Event	Rationale for being Modeled
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

The County is using a customized version of the Environmental Protection Agency‟s (EPA‟s) Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL). This customized program (STEPL-FFX) was built in Microsoft (MS) Excel Visual Basic for Application (VBA). It provides a user-friendly interface to create a customized spreadsheet-based model in MS Excel. It employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development (LID) practices for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus and 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. The land uses considered are user-defined land uses from Fairfax County. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

Existing conditions water-quality data from the STEPL-FFX are shown on Maps 2-13, 2-14 and 2-15. The color gradient map symbols for pollutant loadings are the same for both the Johnny Moore and Little Rocky Run watersheds. Therefore, for Total Nitrogen (TN), Total Phosphorous (TP) and Total Suspended Solids (TSS), the subwatersheds located in Little Rocky Run – Lower are producing relatively high pollutant loadings in the northern portion of the WMA and relatively low pollutant loadings in the southern portion. The water-quality analysis is driven by land use and while the northern portion of the WMA is predominantly medium to high density residential and commercial, the southern portion contains a large portion of Fairfax County Park Authority land, which explains the discrepancy. Areas with more impervious areas and small or non-existent buffer areas will generate more pollutants than undisturbed areas, which is consistent with expectations.

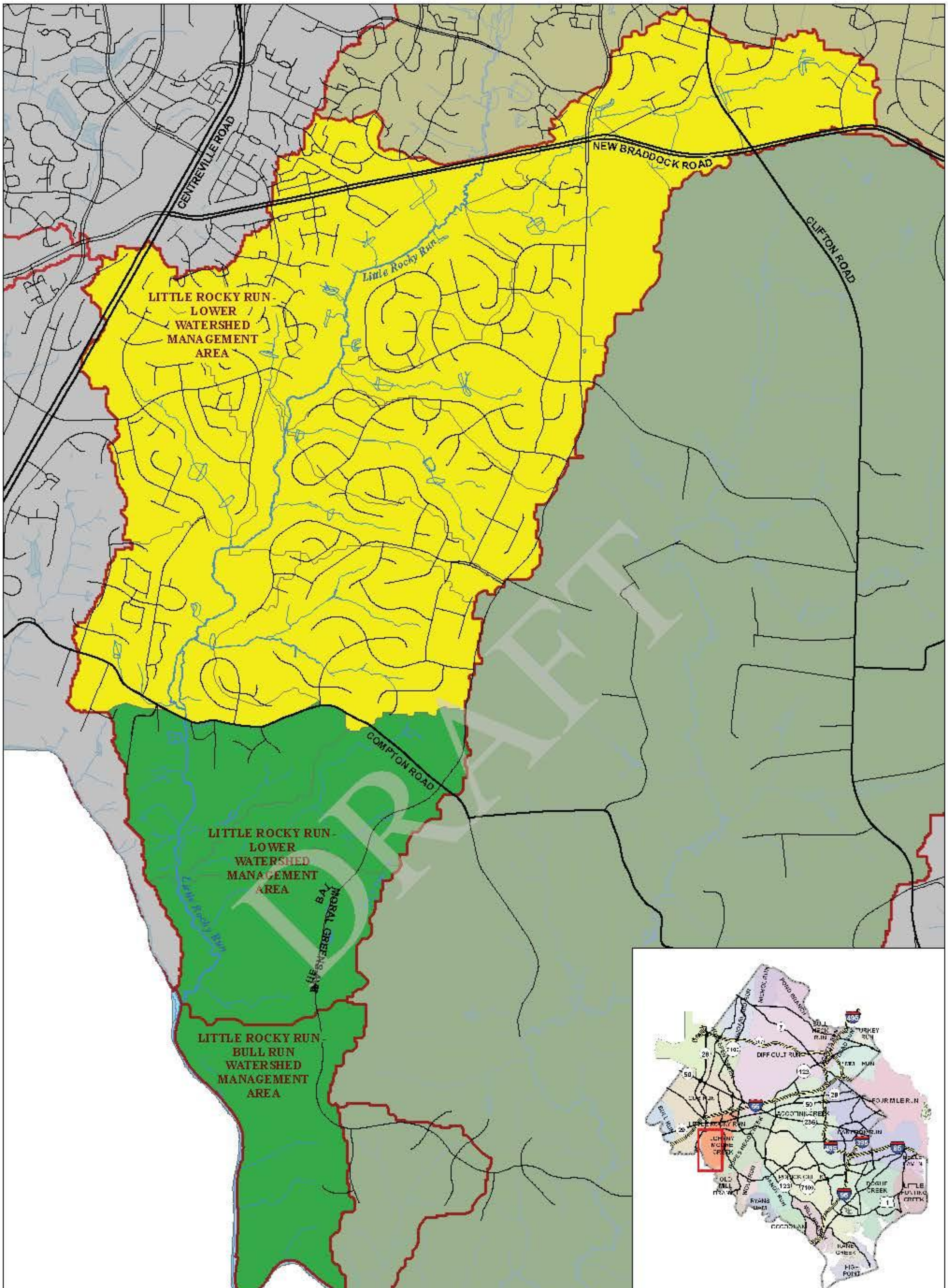
Table 2-12 provides a summary of runoff peak values and pollutant loadings at the outlet of the WMA. The second table is normalized by contributing drainage area.

Table 2-12. Little Rocky Run – Lower Stormwater Peak Values and Pollutant Loadings

WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs)	10-yr storm (cfs)	TSS (tons/yr)	TN (lbs/yr)	TP (lbs/yr)
Little Rocky Run - Lower	998	2538	650.4	27796.6	4093.8
NORMALIZED BY DRAINAGE AREA					
WMA	**Stormwater Runoff Peak Values**		**Pollutant Loadings**		
	2-yr storm (cfs/acre)	**10-yr storm (cfs/acre)**	**TSS (tons/acre /yr)**	**TN (lbs/acre/ yr)**	**TP (lbs/acre/yr)**
Little Rocky Run - Lower	0.429	1.090	0.128	5.412	0.792

The preliminary hydraulic model for Little Rocky Run was developed using United States Army Corps of Engineers (USACE) Hydrologic Engineering Centers River Analysis System (HEC-RAS) to compute water surface profiles. The preliminary model results were used to analyze the water surface elevation and flooding of inline structures.

The input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County‟s GIS, specifically as it pertains to physical features such as stream geometry and flowpath so that these features can be represented in the model. HEC-RAS models were developed for study



Legend

- MAJOR_ROADS
- Arterial Streets

WMAs_all_061208

WMA

- Little Rocky Run - Lower WMAs
- Other WMAs
- Streams

STEPL Existing

Total Nitrogen lbs/ac/yr

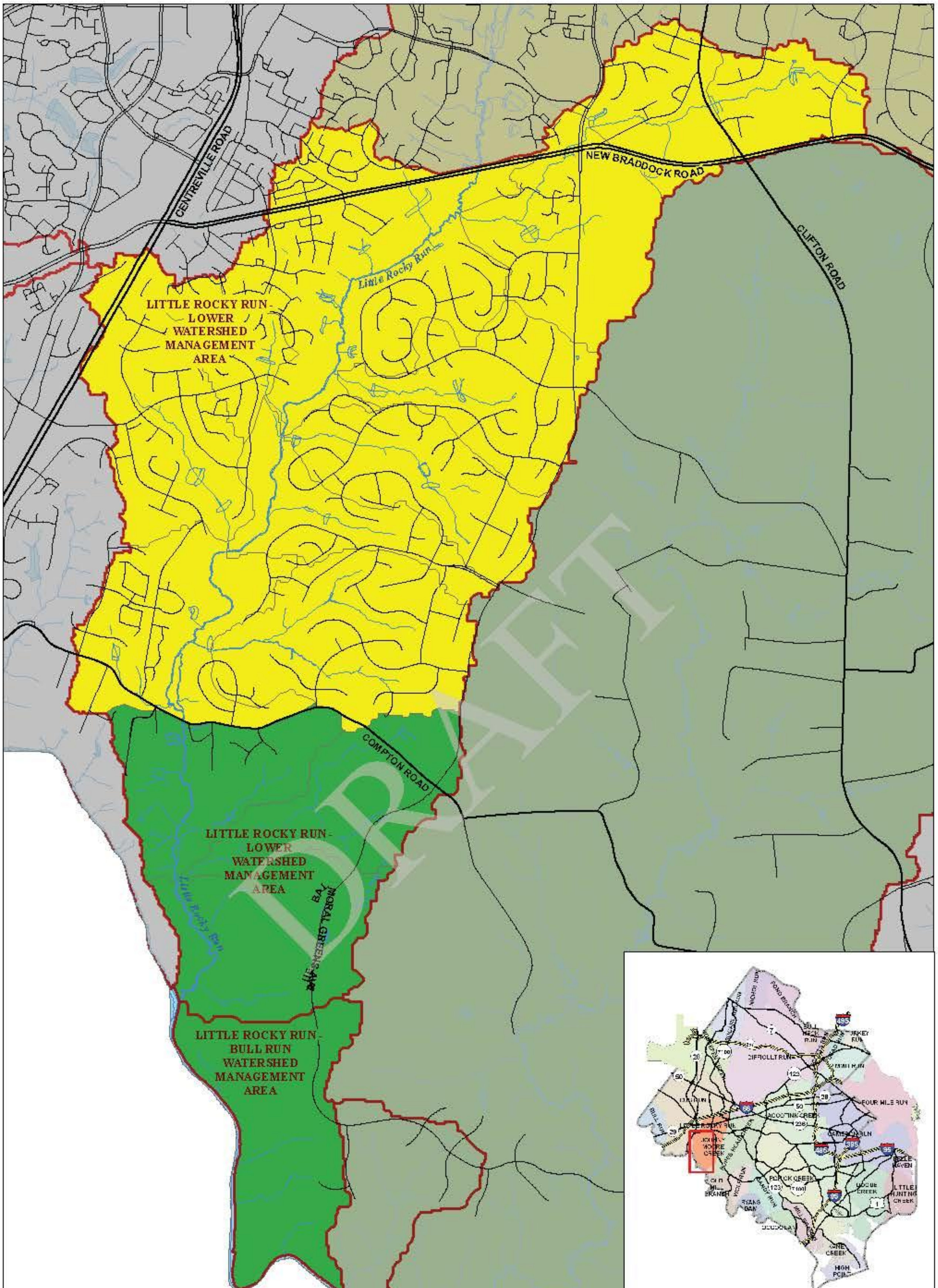
- 0.987500 - 4.287116
- 4.287117 - 9.069964
- 9.069965 - 17.802404

N

0 1,000 2,000 Feet

Map 2-13 Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Total Nitrogen



Map 2-14

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Total Phosphorous

Legend

- MAJOR_ROADS
- Arterial Streets

WMAs_all_061208

WMA

- Little Rocky Run - Lower WMAs
- Other WMAs
- Streams

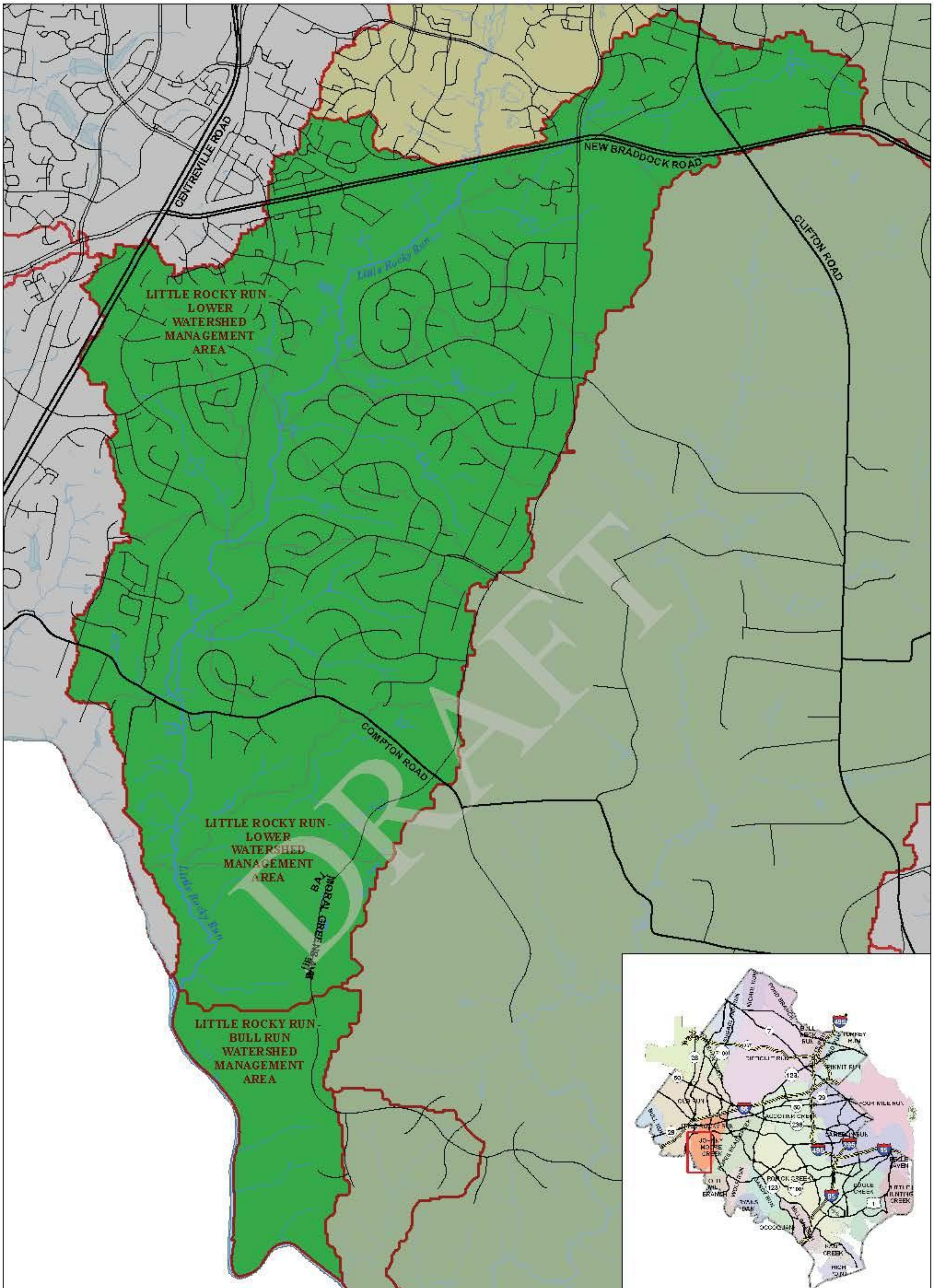
STEPL Existing

Phosphorous lbs/ac/yr

- 0.246100 - 0.645884
- 0.645885 - 1.441817
- 1.441818 - 2.874638

N

0 1,000 2,000 Feet



N

0 1,000 2,000 Feet

Legend

- MAJOR_ROADS
- Arterial Streets

WMAs_all_061208

WMA

- Little Rocky Run - Lower WMAs
- Other WMAs
- Streams

STEPL Existing

TSS t/ac/yr

- 0.045347 - 0.180933
- 0.180934 - 0.316520
- 0.316521 - 0.452106

Map 2-15

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Total Suspended Solids

streams within Little Rocky Run - Lower using a naming convention unique for each reach. The study streams were defined as having a drainage area of at least 200 acres.

Bridge and Culvert crossings were coded according to available County or Virginia Department of Transportation (VDOT) engineering documents that depict the facility as it was actually built. Where not available, limited field reconnaissance was conducted to obtain structure dimensions, inverts and material. The crossing elevation data was determined relative to a point where the elevation could be estimated accurately from the County"s topographic data.

Manning"s „n" values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The flow change locations were extracted from the EPA Storm Water Management Model (SWMM) developed to estimate preliminary stormwater runoff flow values. The 2-yr, 10-yr and 100-yr storm flows were determined at several locations in order to provide a detailed flow profile for the hydraulic model. Map 2-16 provides a graphical representation of the SWMM results for the 10-year discharge.

The 2-year storm discharge is regarded as the channel-forming or dominant discharge for the purposes of this study. This discharge is the flow value that transports the majority of a stream"s sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year storm discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

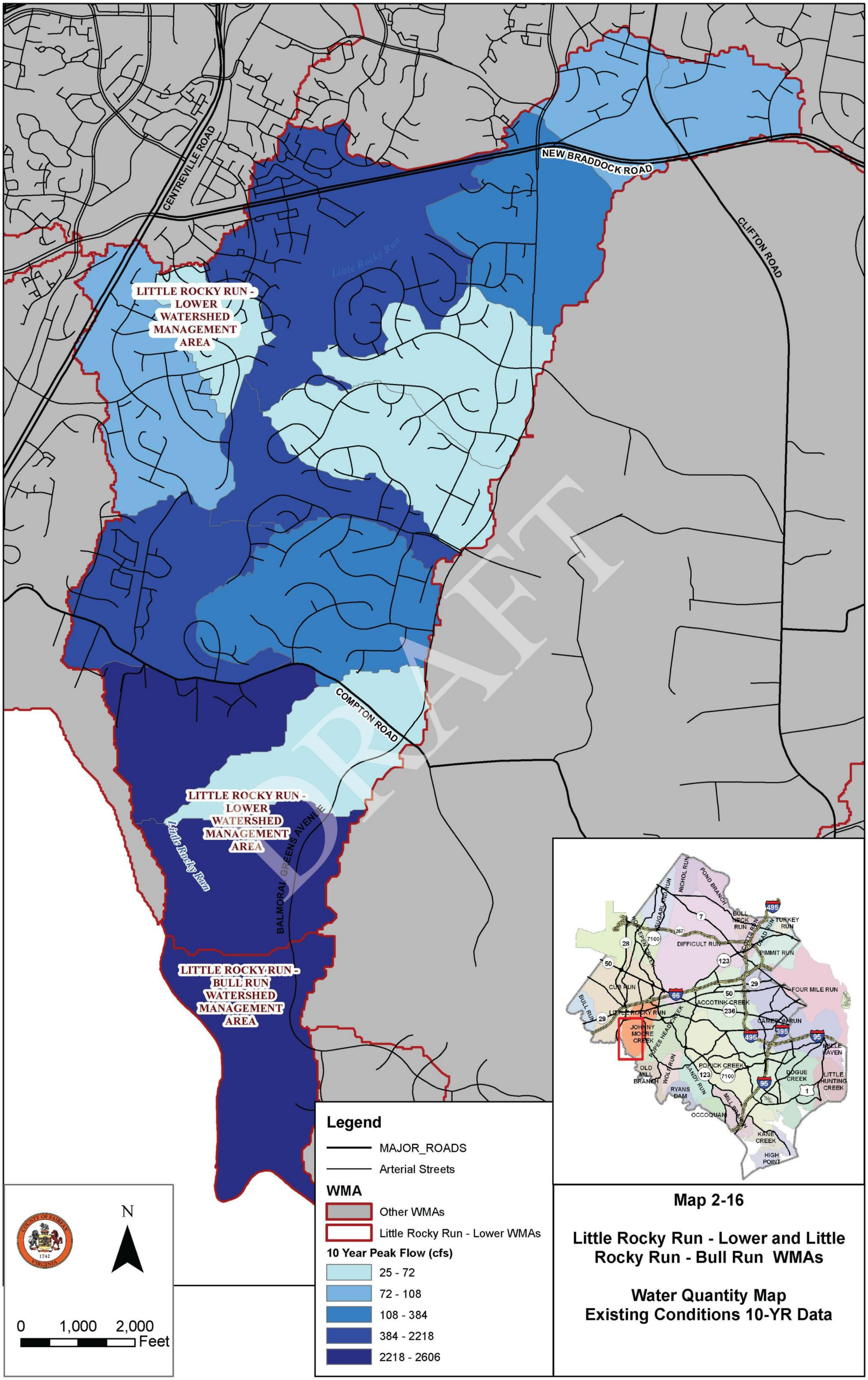
The 10-year storm discharge is being included to analyze the level of service of stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) will be analyzed against this storm to see if they are performing at a level that safely passes this storm.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to map floodplain inundation zones and establish flood insurance rates. This provides a means to assess which properties are at risk for flooding and determine the appropriate insurance requirements for these properties. The models developed to analyze the system for watershed planning have been built in compliance with FEMA standards in order to update the Flood Insurance Rate Maps for Fairfax County where appropriate.

In summary, the preliminary results for HEC-RAS are as follows:

- 1 of 3 structures identified for analysis in the Little Rocky Run – Lower watershed does not have the capacity to pass the 10-year discharge.
- The 2-year discharge exceeds the channel banks in several locations.
- There is very little if any evidence of flooding impacts to residential/commercial structures within the 100 year flood inundation zone.

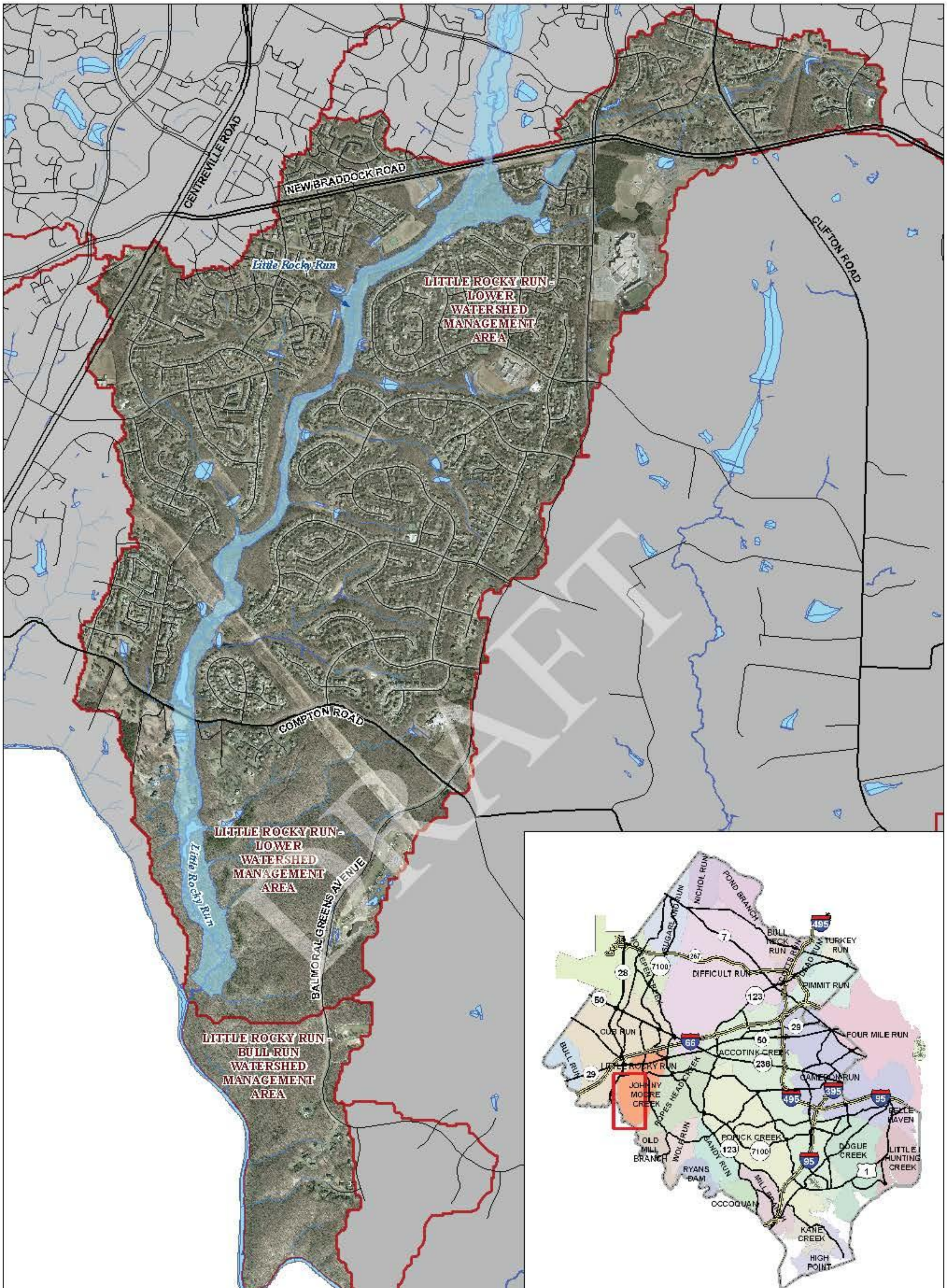
The limit of the 100-year flood is graphically represented in Map 2-17.



Map 2-16

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Water Quantity Map
Existing Conditions 10-YR Data



N

0 1,000 2,000 Feet

Legend

- Preliminary 100 YR Floodplain Boundary
- Major Roads
- Arterial Streets

WMA

- Little Rocky Run - Lower WMAs
- Other WMAs
- Streams

Map 2-17

Little Rocky Run - Lower and Little Rocky Run - Bull Run WMAs

Preliminary 1% Annual Chance Floodplain Boundary

2.4.7 Subwatershed Ranking

It should be noted that all designations of the preliminary ranking results are relative to the area studied for this report. In other words, a „low quality" designation does not necessarily indicate a poor quality subwatershed, only relative to the 51 other subwatersheds in the Little Rocky Run/Johnny Moore Creek watersheds.

Maps 2-26 to 2-32 describe more specific objective criteria, which have been weighted to determine the objective composite score. Please refer to section 2.2 for a more detailed description of impact, source and programmatic indicators and how they are being used to characterize the subwatersheds.

Little Rocky Run - Lower is the one WMA where subwatershed ranking results are not homogenous, which is reflected on maps 2-33 (Objective Composite Score) and 2-34 (Source Composite Score). The northern portion of this WMA has similar characteristics to Little Rocky Run - Upper. A sizeable area located in the southern portion of the WMA is located in Fairfax County Park Authority land is therefore undisturbed or very nearly so. Those subwatersheds are generally of high quality.

The northern portion of Little Rocky Run - Lower is predominantly comprised of medium/high density residential. The stream corridor remains forested, but buffers have been impacted by the development. Unlike Little Rocky Run - Upper, most of the development occurred nearly two decades ago, allowing for the system to stabilize. Although it contains subwatersheds with low quality composite scores, many of them can be described as fair quality for this relative comparison. This portion of Little Rocky Run - Lower is relatively built out and was fairly stable between 2005 (SPA) and the 2008 field reconnaissance. This stability, along with the fact that there is no VPDES point source or commercial/industrial landuse, explain why the subwatersheds in this WMA are on the average rated slightly higher than those in the Little Rocky Run - Upper WMA.

2.5 Little Rocky Run Upper WMA

2.5.1 WMA Characteristics

The Little Rocky Run - Upper WMA has an area of approximately 2,212 acres (3.5 mi^2). The Little Rocky Run - Upper WMA is located in southern Fairfax County and it is bounded to the north by Interstate 66 and its approximate southern boundary is Braddock Road where it adjoins the Little Rocky Run – Lower WMA. Gunpowder Road is its approximate eastern boundary and its approximate western boundary lies west of Pickwick Road and Little Rocky Run Circle.

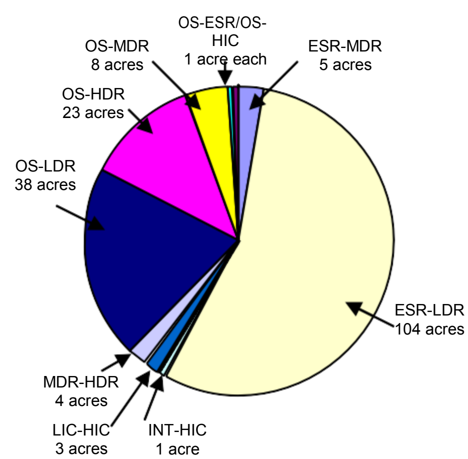
The Little Rocky Run - Upper WMA includes 12.5 miles of perennial streams. Beginning west of the Fairfax County Parkway and south of Interstate Route 66, Little Rocky Run flows generally in a western direction to Lee Highway (Route 29) and then turns and flows south to Bull Run. The land use in the WMA is predominantly medium density and high density residential areas and open space.

In the *Occoquan Environmental Baseline Report (February 1978)* severe erosion was noted in four areas upstream of Lee Highway on Little Rocky Run and along Willow Spring Branch and severe erosion was noted in one area slightly upstream of Lee Highway. An unnamed tributary to Little Rocky Run located south of Interstate 66 and west of Stringfellow Road was also experiencing one area of severe erosion. The *Stream Physical Assessment (August 2005)* data reflects severe erosion on Little Rocky Run upstream of the confluence with Willow Spring Branch that is consistent with one of the erosion sites found in 1978. The other 1978 sites were not flagged for erosion in 2005, although the streams in the WMA were assessed as having moderately unstable to moderately stable banks.

The *Occoquan Environmental Baseline Report* also noted severe sedimentation on Little Rocky Run upstream of the confluence with Willow Springs Branch and on Willow Springs Branch upstream of Lee Highway. This is consistent with the 2005 SPA, although sedimentation effects are more widespread in the later assessment.

2.5.2 Existing and Future Land Use

The existing land use in the Little Rocky Run - Upper consists primarily of medium density residential and open space. Approximately 10 acres (0.5 percent) of the Little Rocky Run – Upper WMA is located in the Residential-Conservation (R-C) District where development is limited to one dwelling unit per 5 acres. This area was rezoned by the Fairfax County Board of Supervisors in 1982 to protect the Occoquan Reservoir. The small areas located south of Braddock Road are in the R-C District. The Little Rocky Run - Upper WMA is currently 23 percent medium density residential development and 22 percent open space. Arrowhead Park is located in the WMA west of Stringfellow Road along Centreville Farms Road. A summary of the land use in the WMAs can be found in Table 2-13.



Comparing existing land use to future land use in Little Rocky Run - Upper, 104 acres or 5% of the WMA experiences a future shift from estate residential to low density residential, 38 acres shift from open space to low density residential and 23 acres shift from open space to high density residential. Other smaller shifts occur as shown in the pie chart above. This table shows that the amount and density of residential development is predicted to increase in the WMA. Map 2-18 shows the existing and future conditions land use in the Little Rocky Run – Upper watershed.

Table 2-13. Existing and Future Land Use in Little Rocky Run – Upper

Little Rocky Run - Upper WMA

Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	128	6%	21	1%	-107	-5%
Low Density Residential (LDR)	236	11%	378	17%	141	6%
Medium Density Residential (MDR)	501	23%	511	23%	9	0%
High Density Residential (HDR)	315	14%	342	15%	27	1%
Low Intensity Commercial (LIC)	13	1%	10	0%	-3	0%
High Intensity Commercial (HIC)	28	1%	33	1%	5	0%
Industrial (IND)	42	2%	42	2%	0	0%
Institutional (INT)	69	3%	68	3%	-1	0%
Golf Course (GC)	0	0%	0	0%	0	0%
Open Space (OS)	490	22%	418	19%	-72	-3%
Water (W)	27	1%	27	1%	0	0%
Transportation (T)	370	17%	370	17%	0	0%
	2220	**100%**	**2220**	**100%**		**0%**

The total impervious area (includes all paved areas and building rooftops) for the Little Rocky Run- Upper WMA is 518 acres or 23 percent of the WMA. The large amount of impervious surface in the Little Rocky Run – Upper WMA may negatively affect water quality by contributing large quantities of stormwater runoff and pollution to area streams.

2.5.3 Stormwater Infrastructure

Stormwater infrastructure in the WMA consists of stormwater management facilities, storm sewer and other manmade stormwater conveyances. Stormwater management facilities provide control of stormwater runoff in two ways; by reducing the quantity of stormwater runoff and providing treatment to reduce pollution and thereby improve the quality of stormwater runoff. Stormwater management facilities are designed to improve water quality by reducing the erosive effects of stormwater runoff and by filtering or capturing pollutants in the facility. Earlier facilities (prior to 1980 in the Occoquan basins and prior to 1994 in the rest of the County) provide only water quantity reduction, while facilities constructed later may provide both water quantity and quality treatment or provide quality treatment alone.

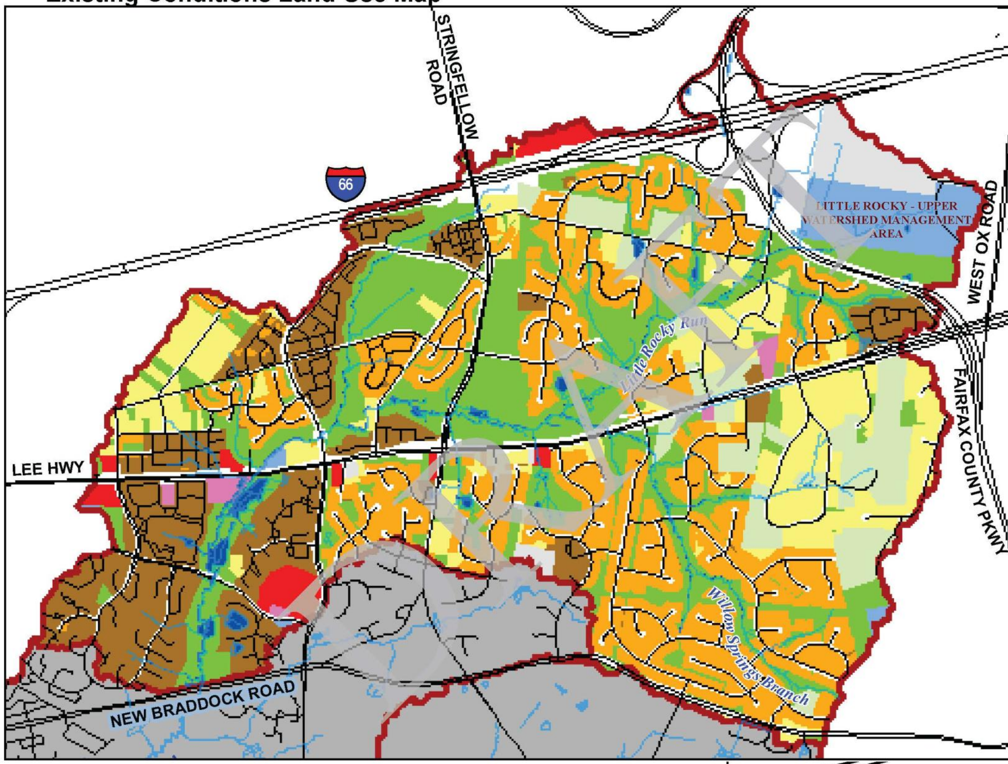
There are 48 stormwater management facilities identified in the County records for the Little Rocky Run – Upper WMA: 24 of these are dry ponds, 11 are wet ponds and 7 are other BMP types (manufactured, underground, etc.). From field reconnaissance and desktop assessment, it was determined that: 3 are not facilities. The three remaining facilities are unknown because they were inaccessible during the field reconnaissance.

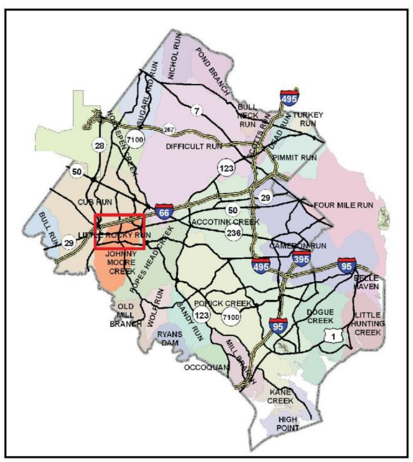
Little Rocky Run-Upper WMA

Map 2-18
Existing and Future Land Use Maps

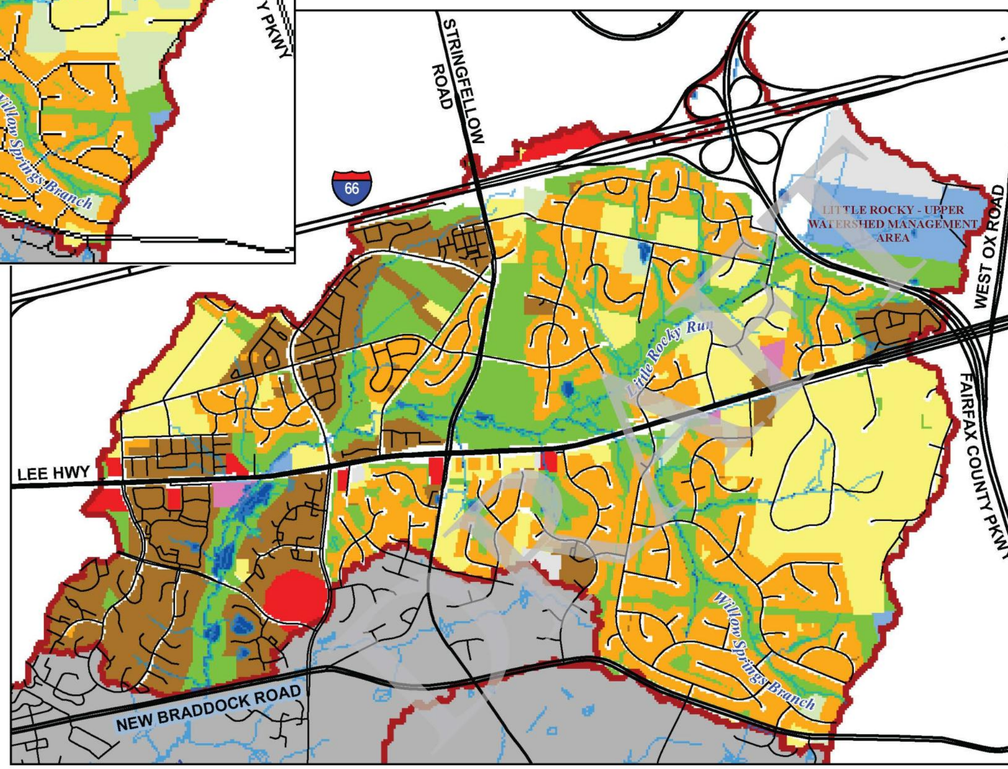
Little Rocky Run - Upper Watershed Management Area

Existing Conditions Land Use Map





Future Conditions Land Use Map



Legend
Existing and Future Land Use

- Streams
- Major Roads
- Railroad

WMA

- Little Rocky Run- Upper
- Other WMAs

Land Use

- Estate Residential
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Low Intensity Commercial
- High Intensity Commercial
- Industrial
- Institutional
- Golf Course
- Open Space
- Water
- Transportation

COUNTY OF FAIRFAX 1742 VIRGINIA

N

0 1,000 2,000 Feet

Map 2-19 shows the location of these facilities, locations of drainage complaints and the parcels covered by stormwater management.

Table 2-14 shows the treatment type breakdown for the stormwater management facilities per the County‟s GIS data. This table does not include treatment by Regional Ponds R-16 and R-17.

Table 2-14. Stormwater Treatment Types in the Little Rocky Run – Upper WMA

WMA Name	Current Percent Impervious	Current Treatment Types			
		Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Little Rocky Run - Upper	23	15	464	276	1457

There were 112 complaints related to stormwater in the County‟s complaints database in the WMA. The classification of these complaints is summarized below:

- 49 Citizen Responsibility
- 44 Storm Drainage
- 14 Stormwater Management/BMP
- 2 Unclassified
- 1 County Right-of-Way
- 1 Planning & Design Division
- 1 Walkway

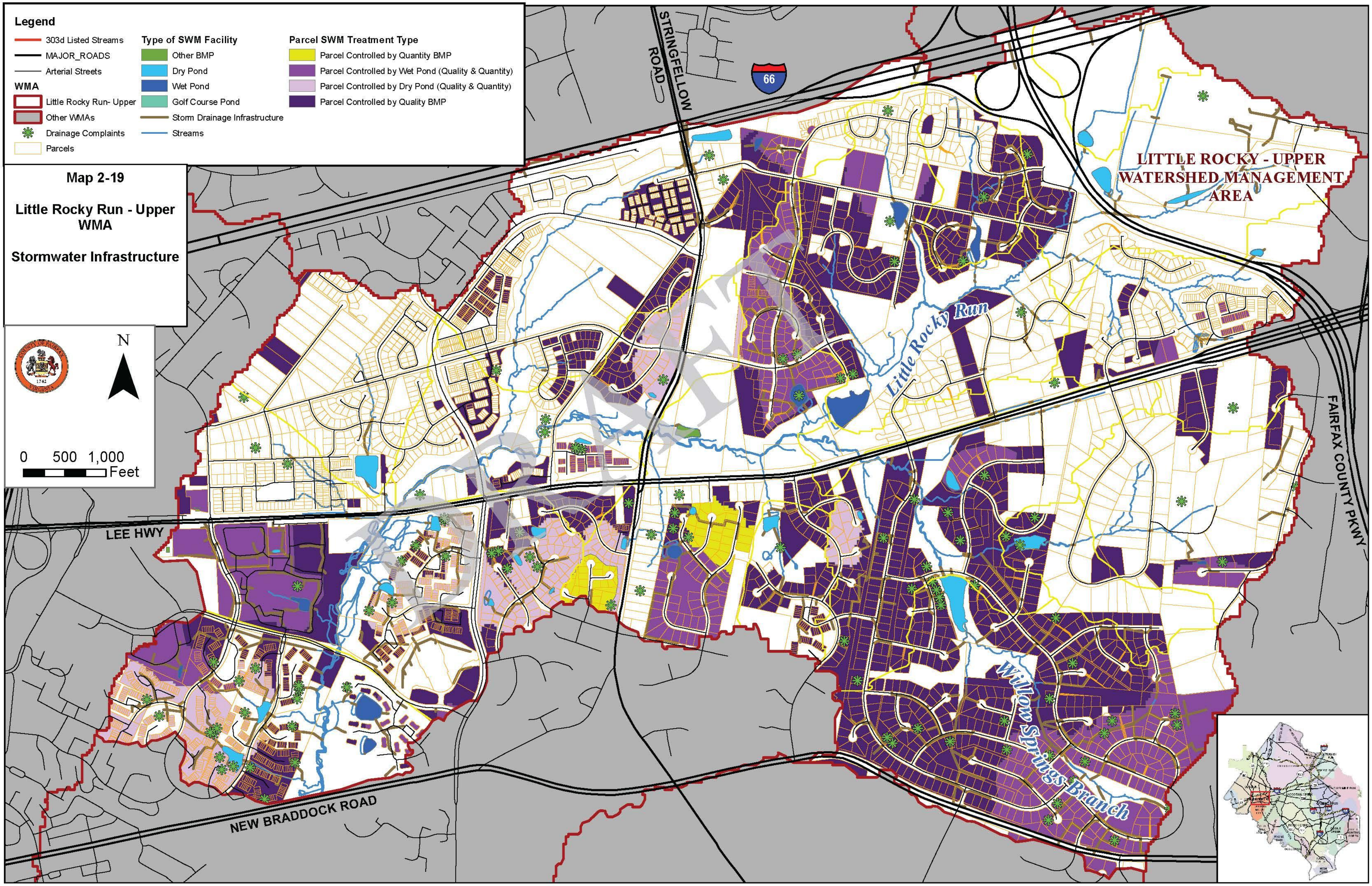
2.5.4 Stream Condition

The County conducted a *Stream Physical Assessment* (SPA) in August 2005 that assessed the habitat, stream geomorphology and impacts to the streams from crossings, ditches, pipes, headcuts, dump sites, utilities and obstructions. Map 2-20 shows a summary of the SPA data.

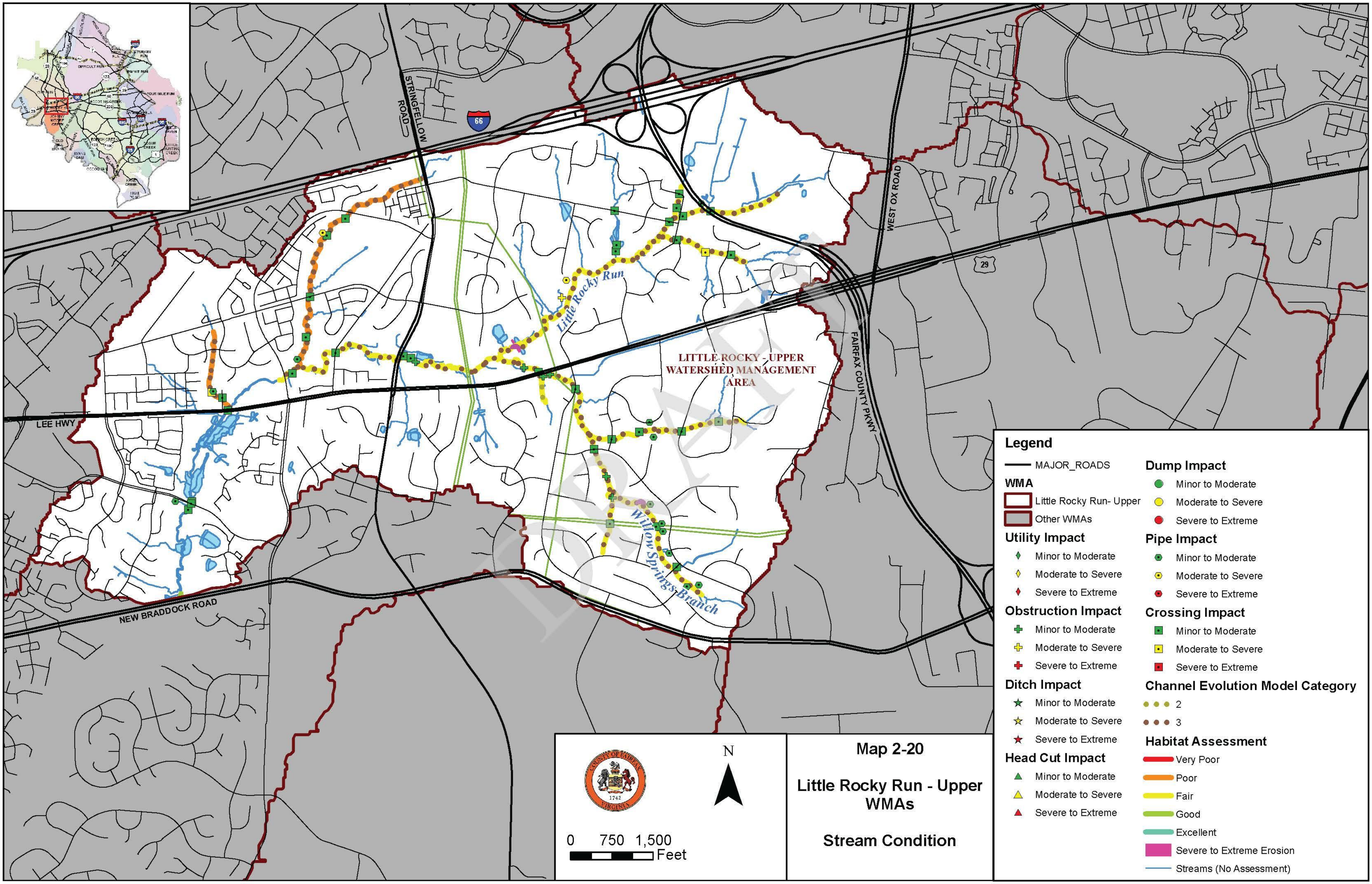
6.5 miles of the WMA, were assessed for stream habitat condition. The results for this study are summarized below:

- Very Poor: 0 miles
- Poor: 1.3 miles or 20%
- Fair: 5.2 miles or 80%
- Good: 0 miles
- Excellent: 0 miles

The longest segment of stream that was assessed as poor is on a tributary to Little Rocky Run that flows through the loop of Centreville Farms Road. This segment runs through an area developed with medium and high density residential development. It appears from the photos taken that this area was undergoing development at the time of the 2005 SPA. Another poor segment is a tributary to Little Rocky Run that flows into the main stem just



Legend
303d Listed Streams
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Drainage Complaints
Parcels
Type of SWM Facility
Other BMP
Dry Pond
Wet Pond
Golf Course Pond
Storm Drainage Infrastructure
Streams
Parcel SWM Treatment Type
Parcel Controlled by Quantity BMP
Parcel Controlled by Wet Pond (Quality & Quantity)
Parcel Controlled by Dry Pond (Quality & Quantity)
Parcel Controlled by Quality BMP
Map 2-19
Little Rocky Run - Upper WMA
Stormwater Infrastructure
N
0 500 1,000
Feet
STRINGFELLOW ROAD
66
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
FAIRFAX COUNTY PKWY
LEE HWY
Willow Springs Branch
NEW BRADDOCK ROAD
DRAFT

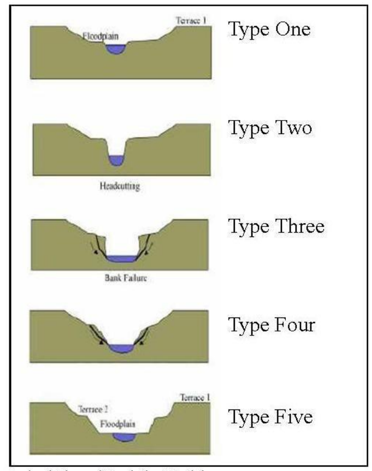


Map 2-20
Little Rocky Run - Upper WMAs
Stream Condition
Legend
MAJOR_ROADS
WMA
Little Rocky Run- Upper
Other WMAs
Utility Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Obstruction Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Ditch Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Head Cut Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Dump Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Pipe Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Crossing Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Channel Evolution Model Category
2
3
Habitat Assessment
Very Poor
Poor
Fair
Good
Excellent
Severe to Extreme Erosion
Streams (No Assessment)
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
Willow Springs Branch
STRINGFELLOW ROAD
WEST OX ROAD
FAIRFAX COUNTY PKWY
LEE HWY
NEW BRADDOCK ROAD
66
29
DRAFT
N
0 750 1,500
Feet

upstream of the Lee Highway crossing. Both reaches were assessed as having poor bank vegetative protection and buffer zone width. No poor segments were located on the main stem of Little Rocky Run.

The geomorphological assessment of the stream channels in the WMA was performed in 2003 and was based on the conceptual incised channel evolution model (CEM) developed by Schumm et al (1984). The CEM provides information about the evolution of a stream channel in response to disturbance. Based on visual observation of the channel cross section and other morphological observations of the channel segment, the CEM type was assigned for the channel segment. The CEM types are summarized below.

CEM Type	Description
1	Stable stream banks and developed channel
2	Deep incised channel
3	Unstable stream banks and actively widening channel
4	Stream bank stabilizing and channel developing
5	Stable stream banks and widened channel



Incised Channel Evolution Model
(Schumm, Harvey, and Watson, 1984)

The CEM Types 2 and 3 are shown on the stream condition map because these types are considered the most unstable. In the WMA, 6.2 (95%) miles is Type 3, 0.2 miles (3%) is Type 4 and 0.1 miles (2%) is Type 2.

A severe erosion site was located on Little Rocky Run just upstream of its confluence with Willow Springs Branch. The picture below shows that this is a dam that appears to have failed. There was also an area of moderate erosion noted on Willow Springs Branch approximately 1,400 feet upstream of Ashleigh Road.

Figure 2-27: Erosion area on Little Rocky Run upstream of Willow Springs Branch

Figure 2-28: Erosion area on Willow Springs Branch upstream of Ashleigh Road

The other impacts found in the SPA are summarized in Table 2-15.

Table 2-15. SPA Impacts in the Little Rocky Run – Upper WMA

Impact Type	Number	Comment
Utility	0	
Obstruction	7	1 moderate to severe, 6 minor to moderate (5 beaver dams)
Ditch	0	
Headcut	0	
Dump	0	
Pipes	14	12 minor to moderate, 2 moderate severe (1 construction related)
Crossings	35	2 bridges, 10 box culverts, 16 circular culverts, 3 fords and 4 foot bridges 2 have moderate to severe impact (ford on tributary downstream of Muddler Way and circular pipe on tributary that confluences with Little Rocky Run just upstream of Lee Highway)

The following pictures show some of the more significant impacts found in the watershed during the SPA.

Figure 2-29: Moderate to Severe Obstruction on Little Rocky Run

Figure 2-30: Moderate to Severe Pipe Impact on Little Rocky Run

Figure 2-31: Crossing Impact on Tributary downstream of Muddler Way

Figure 2-32: Crossing Impact on Tributary upstream of Lee Highway

2.5.5 Field Reconnaissance

Field reconnaissance was conducted to update/supplement existing Fairfax County geographic data so current field conditions were accurately represented. Once this data was acquired, spatial analysis was performed to characterize County watersheds as they currently exist using the County‟s geographic information system (GIS). The reconnaissance effort included the identification of pollution sources, current stormwater management and potential restoration opportunities across the various watersheds.

During this field reconnaissance performed in June 2008, several new areas of concern were identified. Two particular sites have a number of existing issues impacting the health of the watershed. These areas are located on the main stem of Little Rocky Run upstream of Stringfellow Road and a tributary to Little Rocky Run upstream of Regional Pond R17.

Little Rocky Run upstream of Stringfellow Road is experiencing erosion and beaver activity, negatively impacting the health of the watershed. The following photographs show these impacts.

Figure 2-33: Severe erosion on Little Rocky upstream of Stringfellow Road

Figure 2-34: Beaver activity on Little Rocky upstream of Stringfellow Road

Figure 2-35: Beaver activity on Little Rocky Run upstream of Stringfellow Road

The area of the watershed upstream of regional pond R17 is experiencing impacts from man-made obstructions, beaver activity, bank erosion and headcuts. The following photos show several examples from this area.

Figure 2-36: Approximately 2ft headcut in tributary upstream of regional pond R17

Figure 2-37: Man made obstruction in tributary upstream of regional pond R17

Figure 2-38: Major beaver activity in tributary upstream of regional pond R17

A summary of the new impacts found in the 2008 field reconnaissance are summarized in Table 2-16.

Table 2-16. New Impacts Identified in Little Rocky Run – Upper during 2008 Field Reconnaissance

Impact Type	Number of Sites	Comment
Erosion	5	Minor to sever erosion throughout watershed affecting primarily tributaries
Obstruction	8	Minor to moderate, one man made, the rest due to debris and beaver activity
Headcut	1	Moderate

The following pictures show examples of other impacts found in the WMA.

Figure 2-39: Obstruction in small tributary next to Village Drive

Figure 2-40: Obstruction in pond near Tractor Lane

Figure 2-41: Erosion and heavy sedimentation in several ponds southeast of the intersection of I-66 and Fairfax County Parkway

2.5.6 Modeling Results

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50% chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10% chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or „runs off") from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- Hydrologic models take into account several factors; the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that is transported by the runoff.

- Hydraulic models represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can both predict the ability for man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

The table below shows three storm events and the rationale for being modeled:

Storm Event	Rationale for being Modeled
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

The County is using a customized version of the Environmental Protection Agency‟s (EPA‟s) Spreadsheet Tool for the Estimation of Pollutant Loads (STEPL). This customized program (STEPL-FFX) was built in Microsoft (MS) Excel Visual Basic for Application (VBA). It provides a user-friendly interface to create a customized spreadsheet-based model in MS Excel. It employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs), including Low Impact Development (LID) practices for urban areas. It computes surface runoff; nutrient loads, including nitrogen, phosphorus and 5-day biological oxygen demand (BOD); and sediment delivery based on various land uses and management practices. The land uses considered are user-defined land uses from Fairfax County. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (from sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

Existing Conditions water-quality data from the STEPL-FFX is shown on Maps 2-21, 2-22 and 2-23. The color gradient map symbols for pollutant loadings are the same for both the Johnny Moore and Little Rocky Run watersheds. Therefore, for Total Nitrogen (TN), Total Phosphorous (TP) and Total Suspended Solids (TSS), the subwatersheds located in Little Rocky Run – Upper WMA are producing relatively high pollutant loadings. The water-quality analysis is driven by land use and the watershed is predominantly medium to high density residential and commercial. With more impervious areas and small or non-existent buffer areas, the results are consistent with expectations. The I-66 Transfer Station Complex is located in the headwaters of this WMA and is the only recognized VPDES point source in the Little Rocky Run watershed. This WMA has undergone the most significant development over the past 10 years, owing to medium/high density residential and commercial areas replacing open space and low density residential areas. The field reconnaissance revealed that this system is still responding to these recent changes.

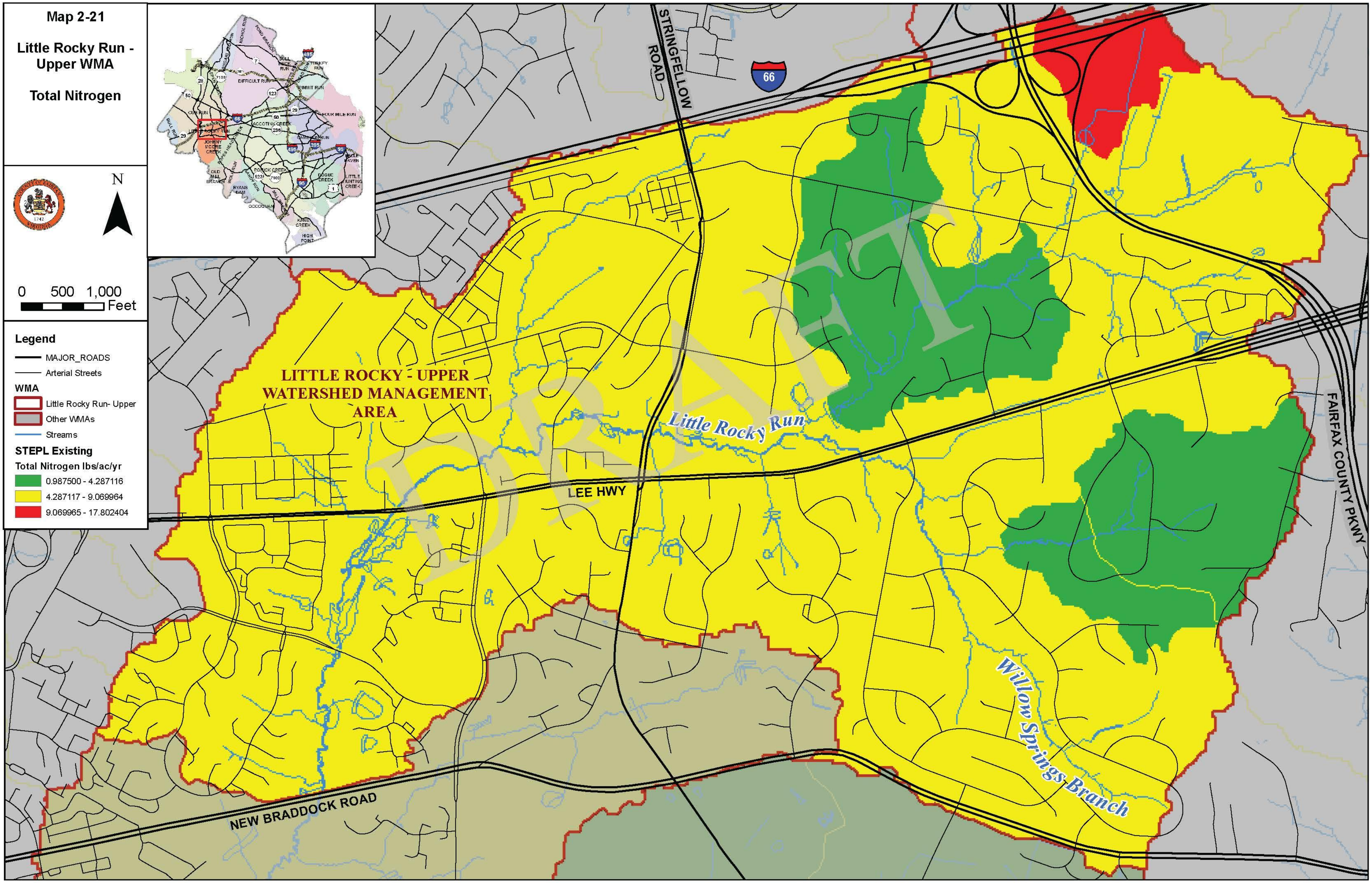
Table 2-17 provides a summary of runoff peak values and pollutant loadings at the outlet of the WMA. The second table is normalized by contributing drainage area.

Table 2-17. Little Rocky Run - Upper Stormwater Peak Values and Pollutant Loadings

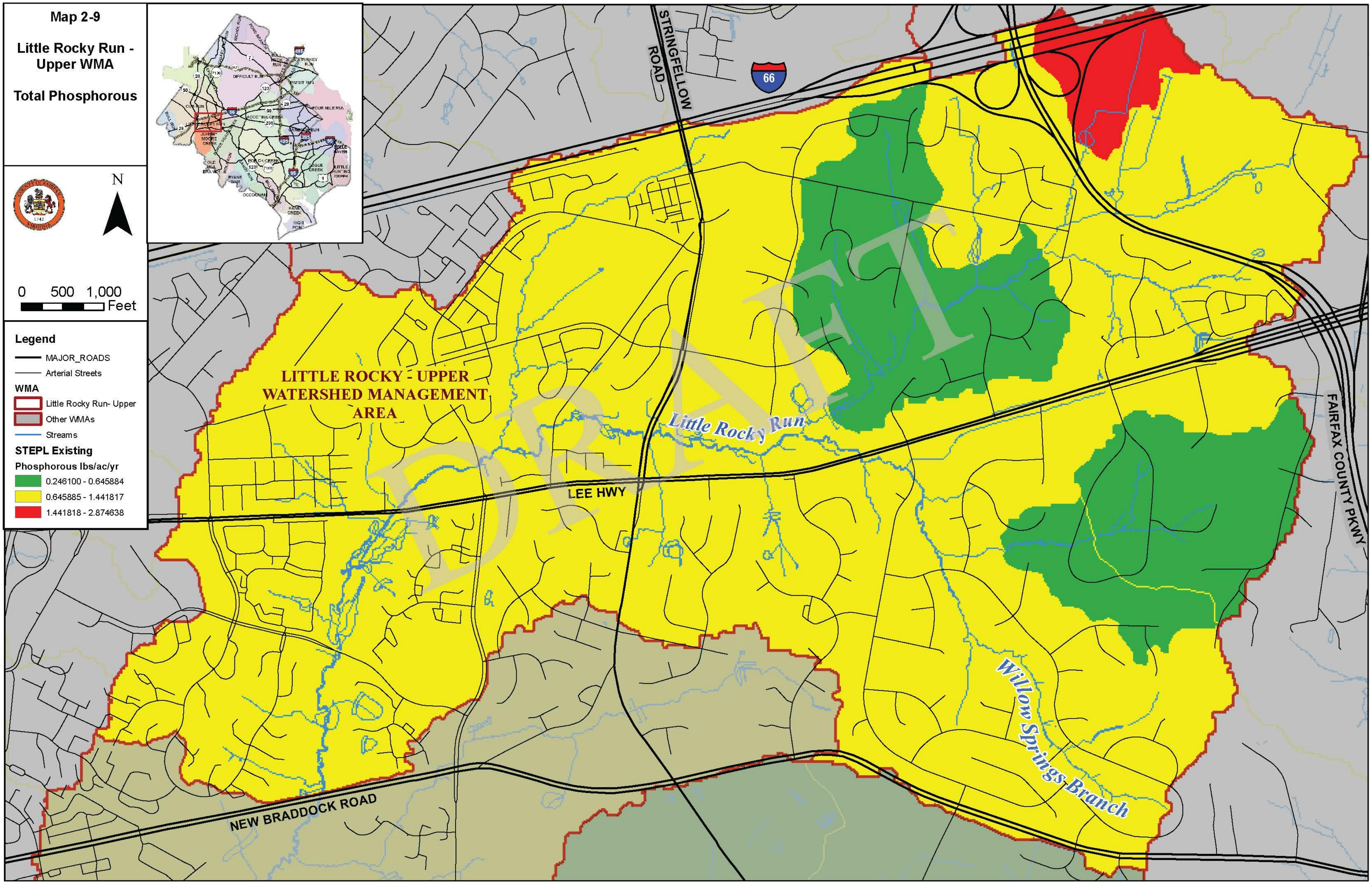
WMA	Stormwater Runoff Peak Values		Pollutant Loadings		
	2-yr storm (cfs)	10-yr storm (cfs)	TSS (tons/yr)	TN (lbs/yr)	TP (lbs/yr)
Little Rocky Run - Upper	515	1312	352.9	15196.7	2250.2
NORMALIZED BY DRAINAGE AREA					
WMA	**Stormwater Runoff Peak Values**		**Pollutant Loadings**		
	2-yr storm (cfs/acre)	**10-yr storm (cfs/acre)**	**TSS (tons/acre /yr)**	**TN (lbs/acre /yr)**	**TP (lbs/acre/ yr)**
Little Rocky Run - Upper	0.233	0.594	0.160	6.871	1.017

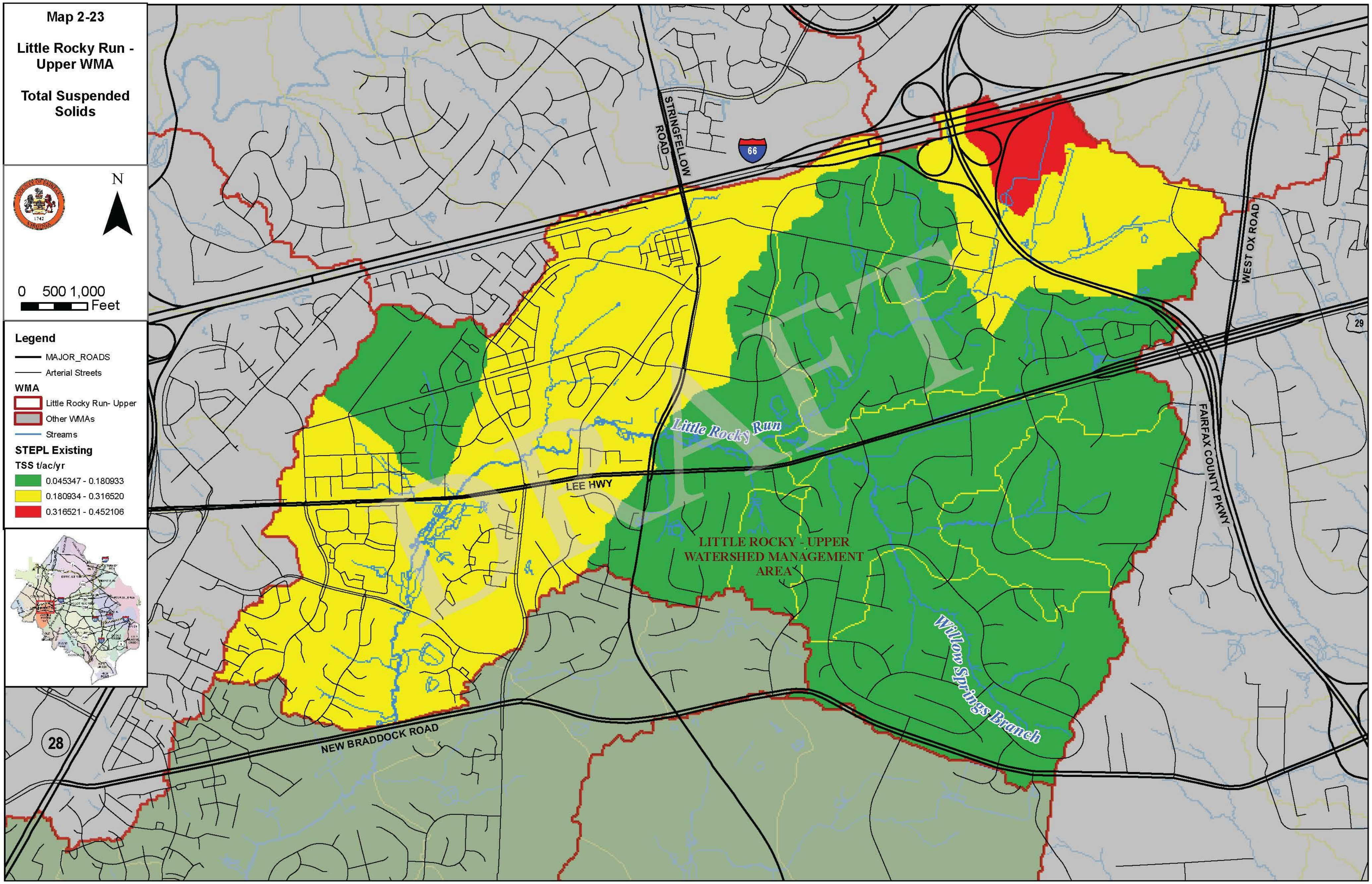
The preliminary hydraulic model for Little Rocky Run - Upper was developed using United States Army Corps of Engineers (USACE) Hydrologic Engineering Centers River Analysis System (HEC-RAS) to compute water surface profiles. The preliminary model results were used to analyze the water surface elevation and flooding of inline structures.

The input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County"s GIS, specifically as it pertains to physical features such as stream geometry and flowpath so that these features can be represented in the model. HEC-RAS models were developed for study



Map 2-21
Little Rocky Run - Upper WMA
Total Nitrogen
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
Total Nitrogen lbs/ac/yr
0.987500 - 4.287116
4.287117 - 9.069964
9.069965 - 17.802404
LITTLE ROCKY - UPPER
WATERSHED MANAGEMENT
AREA
STRINGFELLOW
ROAD
66
Little Rocky Run
LEE HWY
FAIRFAX COUNTY PKWY
Willow Springs Branch
NEW BRADDOCK ROAD
DRAFT


Map 2-9
Little Rocky Run - Upper WMA
Total Phosphorous
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
Phosphorous lbs/ac/yr
0.246100 - 0.645884
0.645885 - 1.441817
1.441818 - 2.874638
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
STRINGFELLOW ROAD
66
LEE HWY
Little Rocky Run
Willow Springs Branch
FAIRFAX COUNTY PKWY
NEW BRADDOCK ROAD
DRAFT



Map 2-23
Little Rocky Run - Upper WMA
Total Suspended Solids
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
STEPL Existing
TSS t/ac/yr
0.045347 - 0.180933
0.180934 - 0.316520
0.316521 - 0.452106
STRINGFELLOW ROAD
66
WEST OX ROAD
29
FAIRFAX COUNTY PKWY
Little Rocky Run
LEE HWY
LITTLE ROCKY - UPPER
WATERSHED MANAGEMENT
AREA
Willow Springs Branch
NEW BRADDOCK ROAD
28
DRAFT

streams within Little Rocky Run using a naming convention unique for each reach. The study streams were defined as having a drainage area of at least 200 acres.

Bridge and Culvert crossings were coded according to available County or Virginia Department of Transportation (VDOT) engineering documents that depict the facility as it was actually built. Where not available, limited field reconnaissance was performed to obtain the crossing data. The crossing elevation data was determined relative to a point where the elevation could be estimated accurately from the County‟s topographic data.

Manning‟s „n‟ values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The flow change locations were extracted from the EPA Storm Water Management Model (SWMM) developed to estimate preliminary stormwater runoff flow values. The 2-yr, 10-yr and 100-yr storm flows were determined at several locations in order to provide a detailed flow profile for the hydraulic model.. Map 2-24 provides a graphical representation of the SWMM results for the 10-year storm discharge.

The 2-year storm discharge is regarded as the channel-forming or dominant discharge for the purposes of this study. This discharge is the flow value that transports the majority of a stream‟s sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

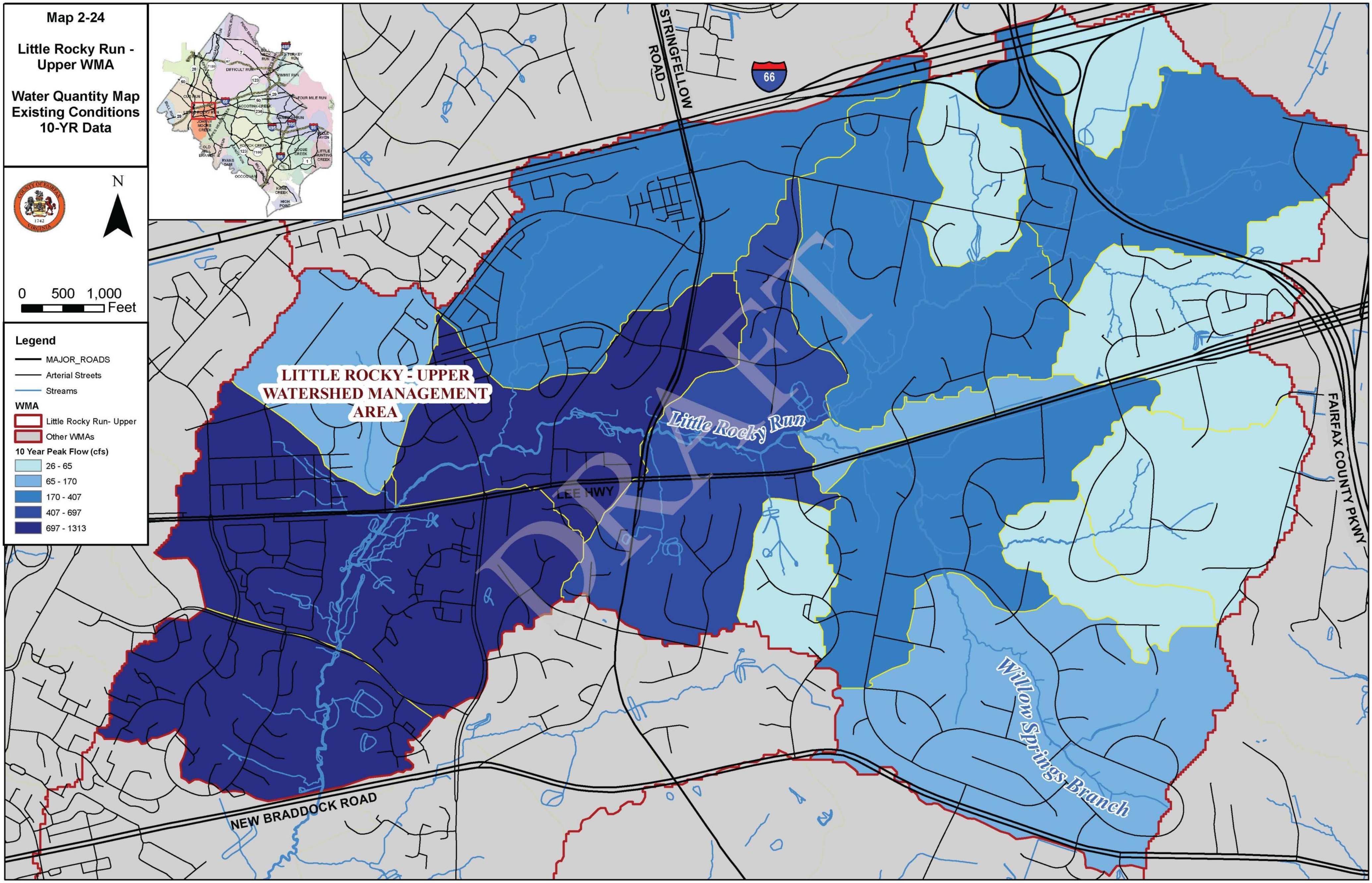
The 10-year storm discharge is being included to analyze the level of service of stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) will be analyzed against this storm to see if they are performing at a level that safely passes this storm.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to map floodplain inundation zones and establish flood insurance rates. This provides a means to assess which properties are at risk to flooding and determine the appropriate insurance requirements for these at risk properties. The models developed to analyze the system for watershed planning have been built in compliance with FEMA standards in order to update the Flood Insurance Rate Maps for Fairfax County where appropriate.

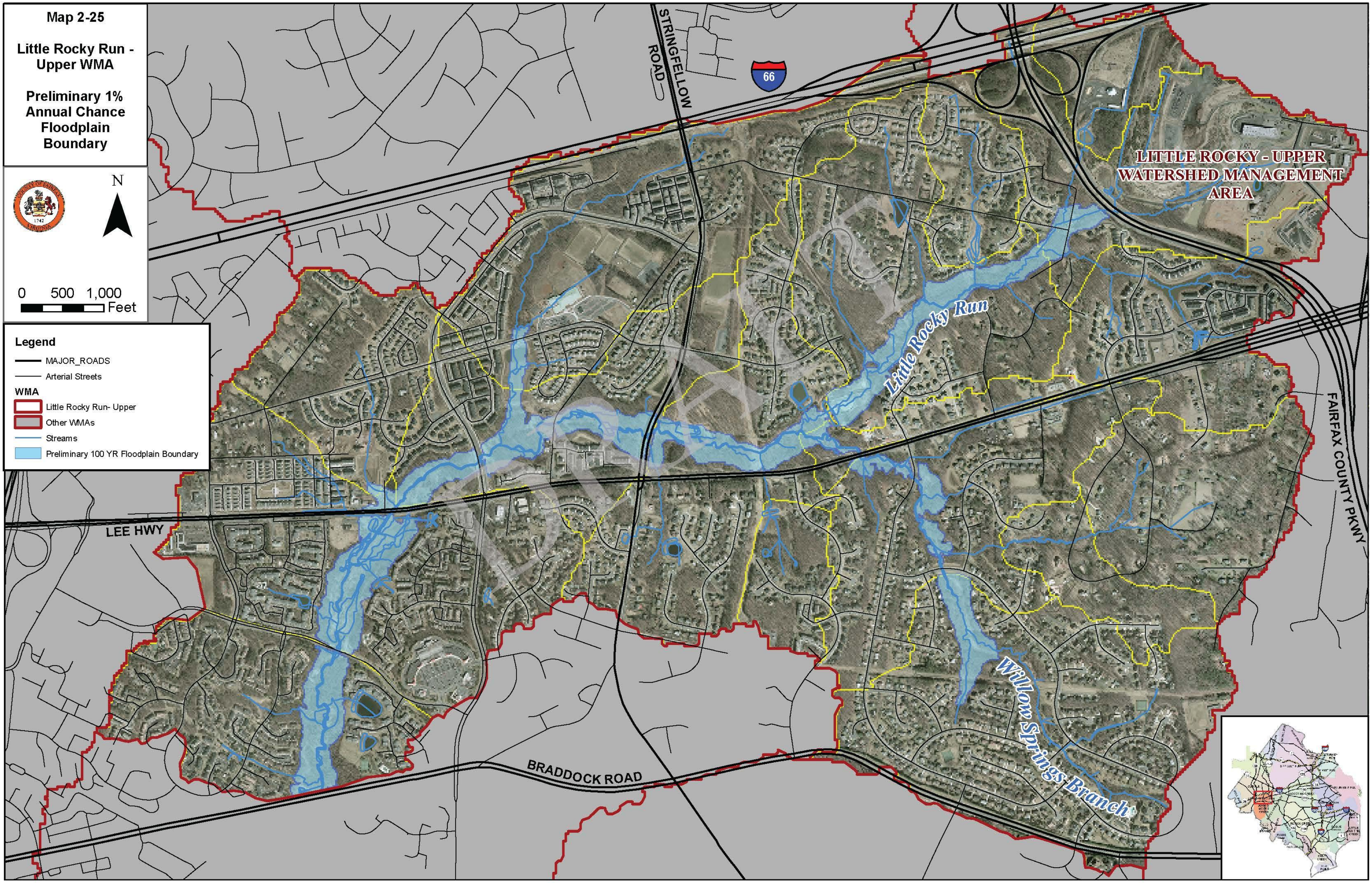
In summary, the preliminary HEC-RAS model results indicate:

- 3 of 10 structures identified for analysis in the Little Rocky Run – Upper watershed do not have the capacity to pass the 10-year discharge.
- The 2-year discharge exceeds the channel banks in several locations
- There is very little if any evidence of flooding impacts to residential/commercial structures within the 100 year flood inundation zone.

The limit of the 100-year flood is graphically represented in Map 2-25.



Map 2-24
Little Rocky Run - Upper WMA
Water Quantity Map
Existing Conditions
10-YR Data
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
Streams
WMA
Little Rocky Run- Upper
Other WMAs
10 Year Peak Flow (cfs)
26 - 65
65 - 170
170 - 407
407 - 697
697 - 1313
LITTLE ROCKY - UPPER
WATERSHED MANAGEMENT
AREA
Little Rocky Run
Willow Springs Branch
STRINGFELLOW
ROAD
66
LEE HWY
NEW BRADDOCK ROAD
FAIRFAX COUNTY PKWY
DRAFT


Map 2-25
Little Rocky Run - Upper WMA
Preliminary 1% Annual Chance Floodplain Boundary
N
0 500 1,000
Feet
Legend
MAJOR_ROADS
Arterial Streets
WMA
Little Rocky Run- Upper
Other WMAs
Streams
Preliminary 100 YR Floodplain Boundary
STRINGFELLOW ROAD
66
LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA
Little Rocky Run
FAIRFAX COUNTY PKWY
LEE HWY
BRADDOCK ROAD
Willow Springs Branch
DRAFT

2.5.7 Subwatershed Ranking

It should be noted that all designations of the preliminary ranking results are relative to the area studied for this report. In other words, a „low quality‟ designation does not necessarily indicate a poor quality subwatershed, only relative to the 51 other subwatersheds in the Little Rocky Run/Johnny Moore Creek watersheds.

Little Rocky Run - Upper contains the majority of „low quality‟ subwatersheds. This is best summarized on maps 2-33 (Objective Composite Score) and 2-34 (Source Composite Score). Maps 2-26 to 2-32 describe more specific objective criteria, which have been weighted to determine the objective composite score. Please refer to section 2.2 for a more detailed description of impact, source and programmatic indicators and how they are being used to characterize the subwatersheds.

Little Rocky Run - Upper contains all but one of the low quality subwatersheds shown on map 2-33. The objective composite scores are based on measures of environmental condition. Some indicators (Benthic and Fish Communities) were only sampled at a handful of sites, the results of which were applied for several subwatersheds (based on several factors). The rest were determined using the best available GIS data. A more detailed analysis of individual results will accompany any proposed plan controls for a subwatershed. At the time sampling was performed, a significant portion of the watershed was undergoing development, the impact of which is accurately reflected at the sampling sites. The remaining impact indicators are consistent with a nearly built-out watershed, namely that riparian, wetland and terrestrial forested habitat have been compromised, while pollutant loads are relatively high.

Little Rocky Run - Upper contains the highest percentage of medium/high density residential, commercial/industrial and impervious surfaces, as well as the only VPDES permitted point source. Therefore, its relatively low scores for source indicators, as shown on Map 2-34, appear reasonable. It contains all but two of the low quality subwatersheds.

The only consistent discrepancy from the overall trends described above in Little Rocky Run - Upper is subwatershed LR-WS-0005, which is a headwater subwatershed comprised of Low Density Residential land use, the majority of which is forested. This explains why it often stands out as a high quality subwatershed within the WMA.

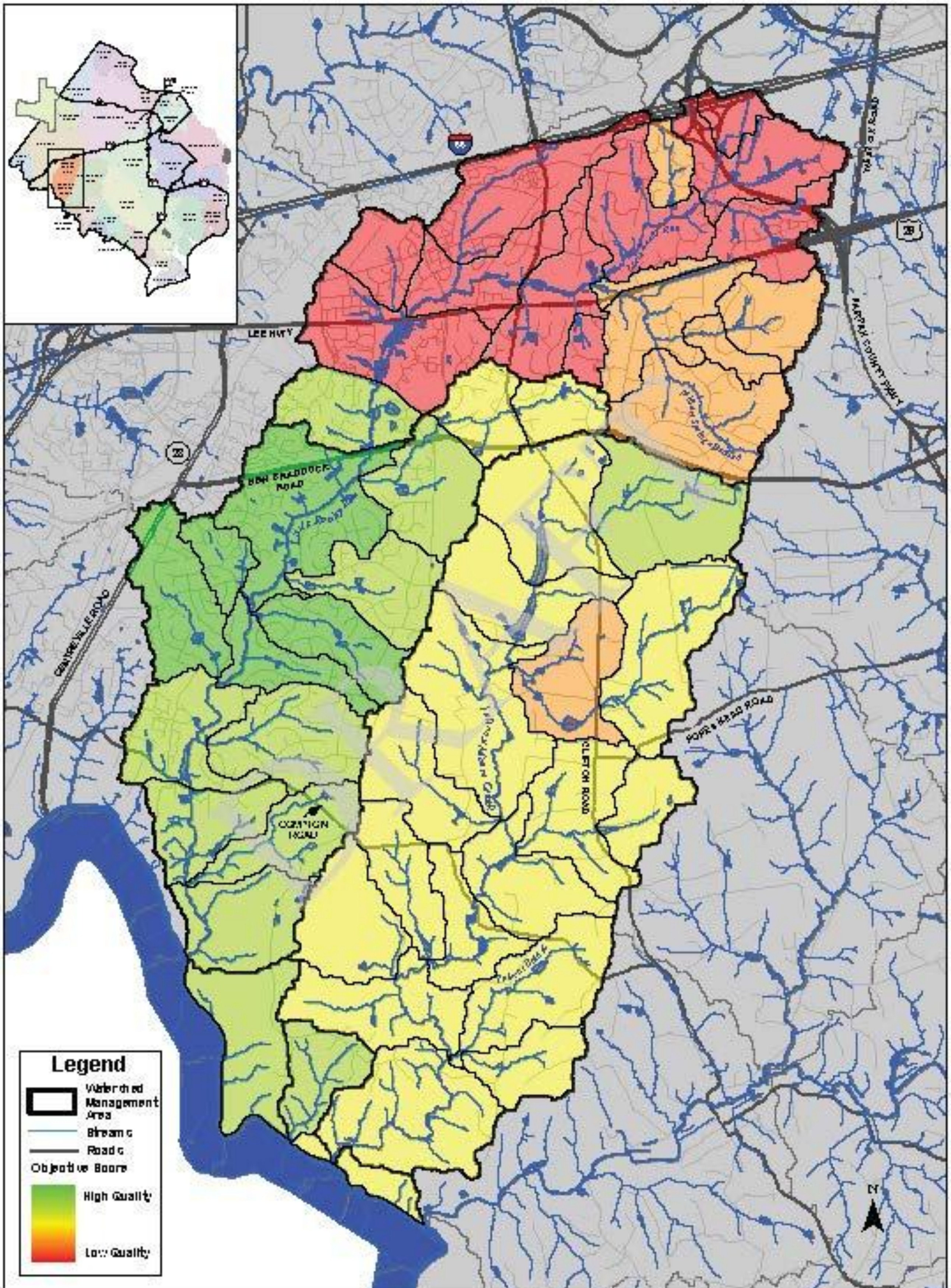
2.6 Subwatershed Characterization

The purpose of the subwatershed ranking approach is to provide a systematic means of compiling available water quality and natural resources information. Ranking subwatersheds based on watershed characterization and modeling results provides a tool for planners and managers to use as they consider which subwatersheds should undergo further study and/or set priorities. The ranking will be updated based on issues and problem areas identified during the introductory and issues scoping forum and advisory group meetings. The resultant data is then utilized to identify key issues and proceed with projects that will achieve the County‟s watershed management goals and objectives.

Three basic indicator categories as described in Section 2.3 are used to rank subwatershed conditions:

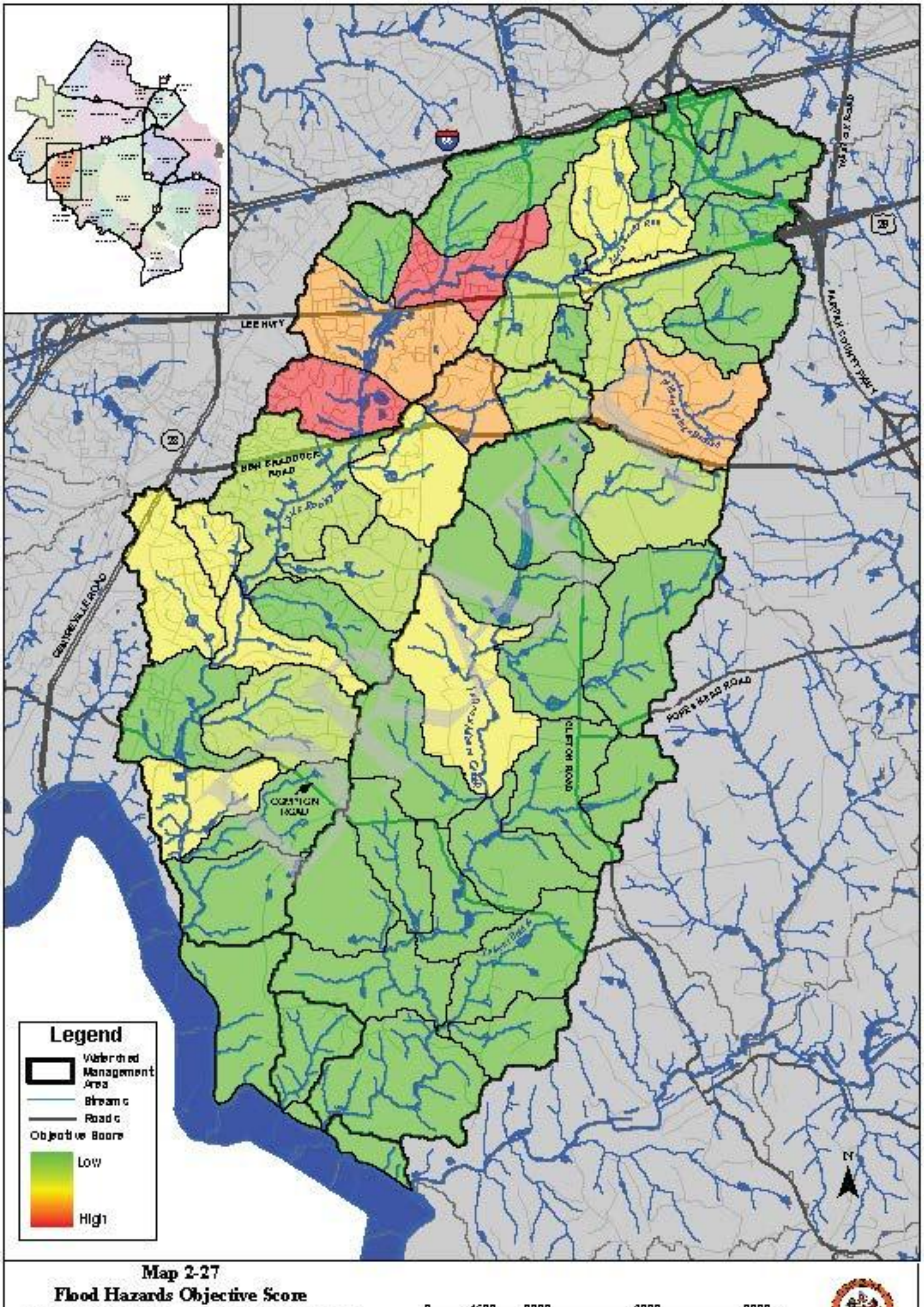
Indicator Type	Description
Watershed Impact	Diagnostic measures of environmental condition (e.g. water quality, habitat health, biotic integrity) which are linked to the County‟s goals and objectives
Programmatic	Reports the existence, location or benefits of stormwater management facilities or programs
Source	Quantifies the presence of stressors and/or pollutant sources

These scores are rolled up into composite scores which are used in the prioritization and subwatershed ranking process. The following sample maps (2-26 through 2-34) display preliminary results.

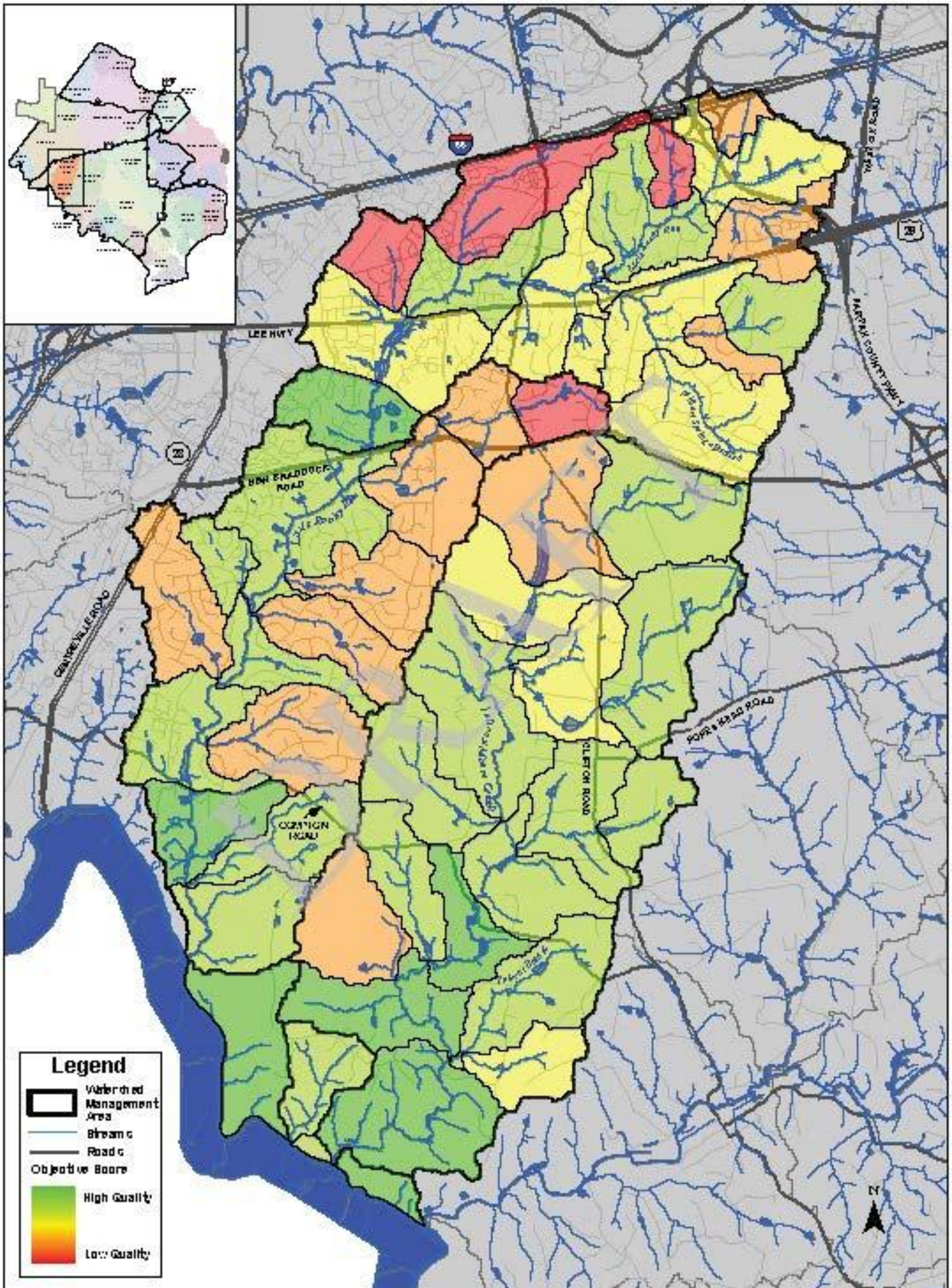


Map 2-26
Stormwater Runoff Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

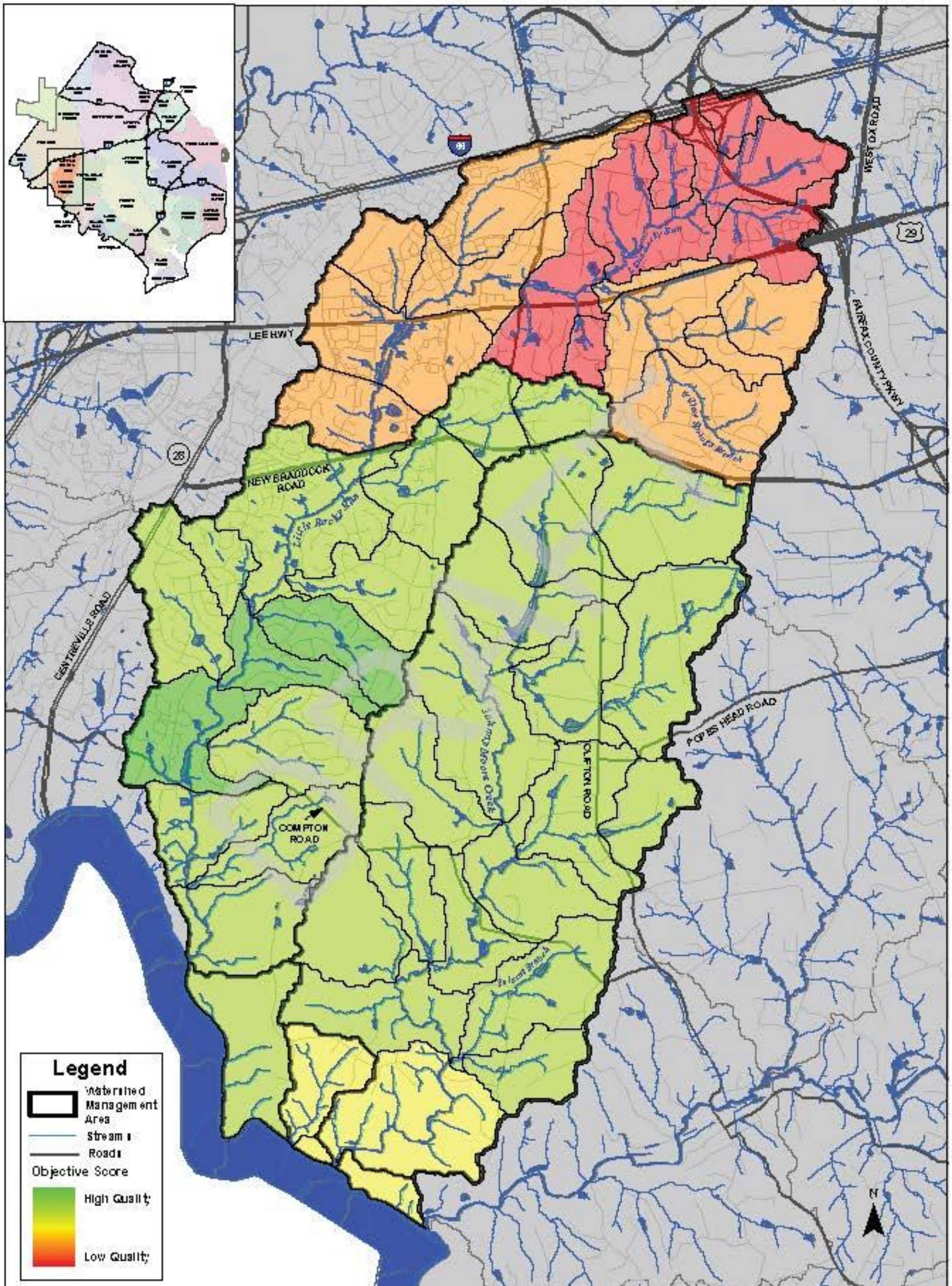
0 1500 3000 6000 9000 Feet



Map 2-27
Flood Hazards Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

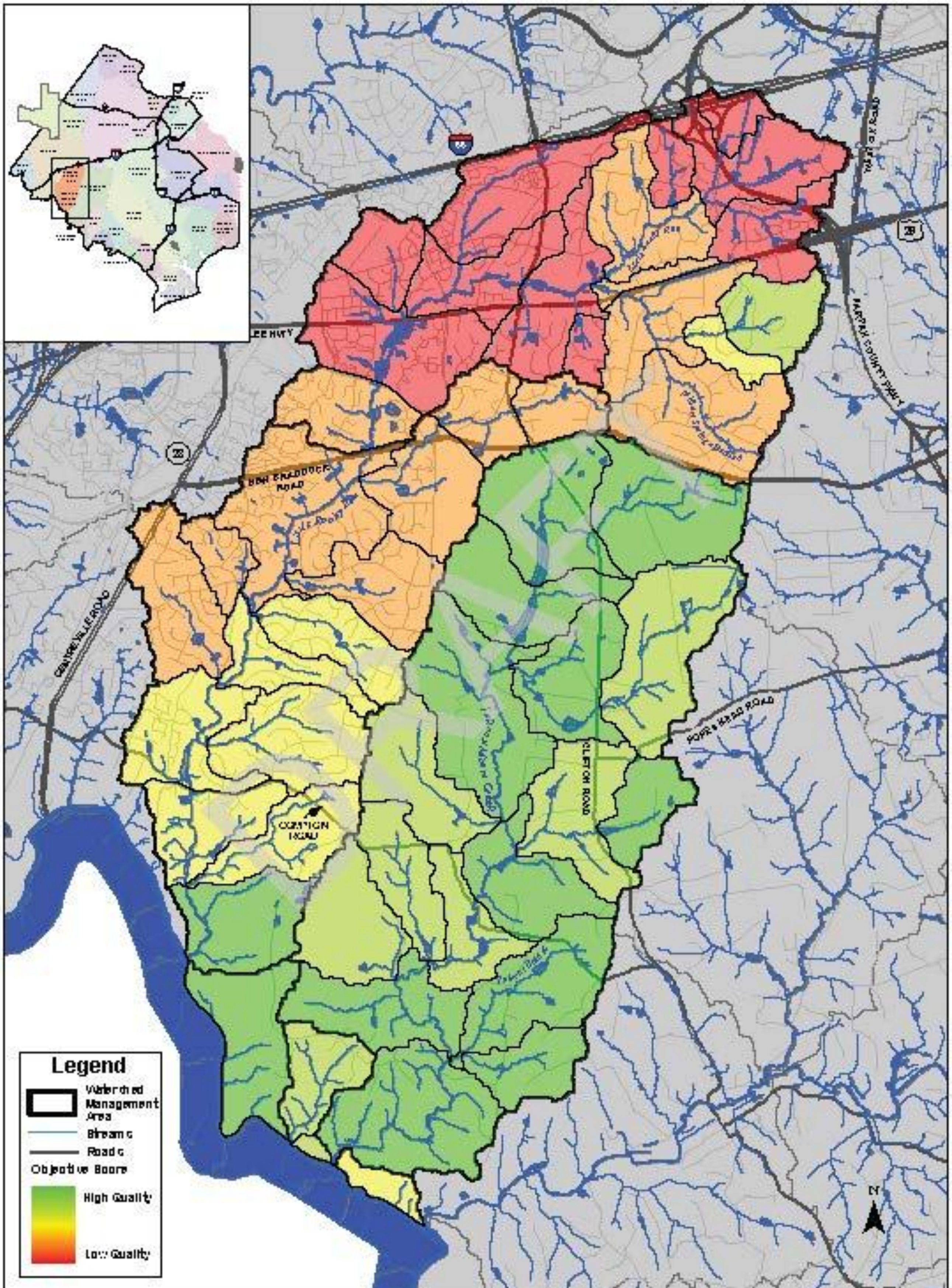


Map 2-28
Habitat Health Objective Score
Little Rocky Run - Johnny Moore Creek
Watersheds



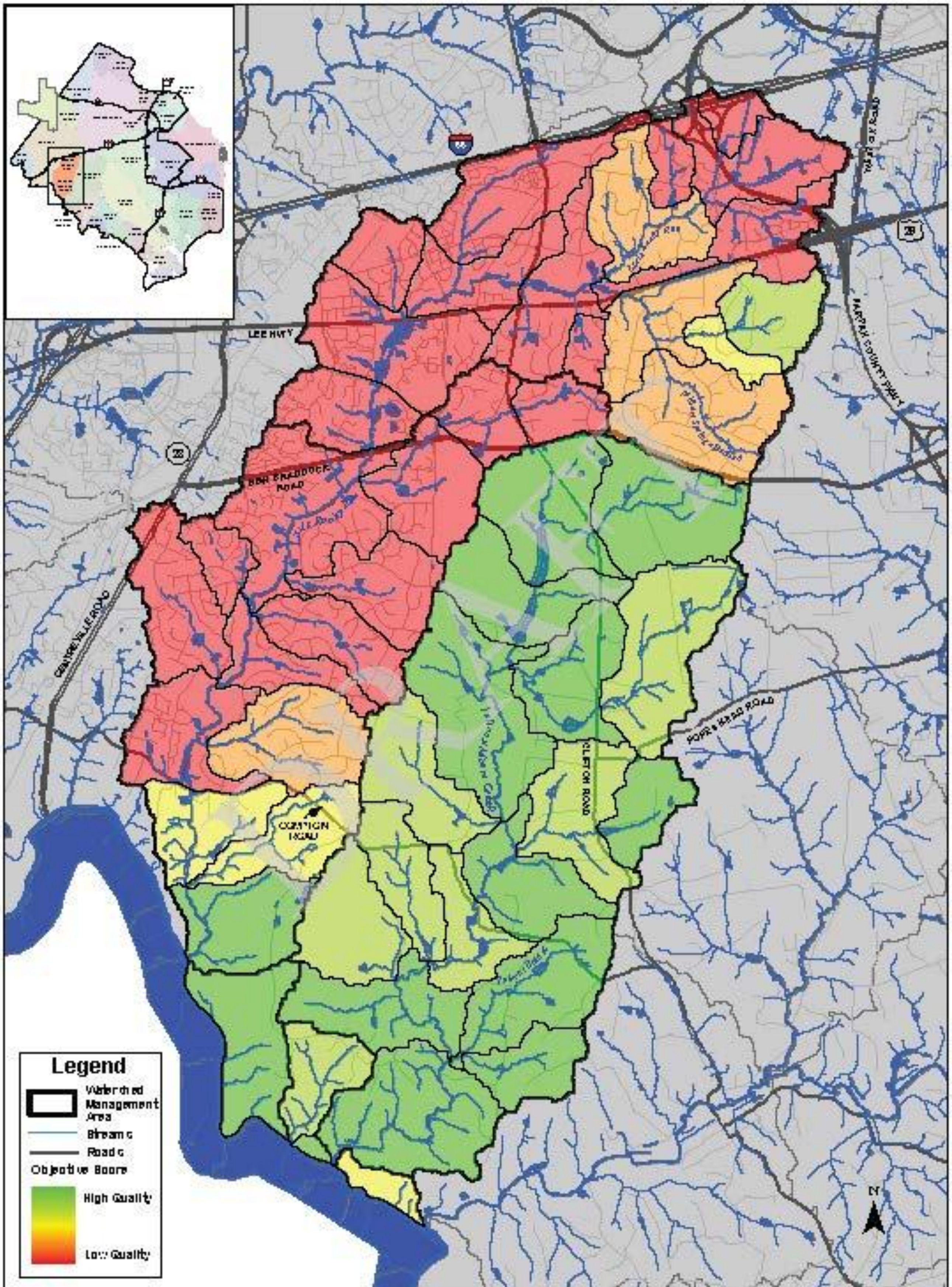
Map 2-29
Habitat Diversity Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1500 3000 6000 9000 Feet

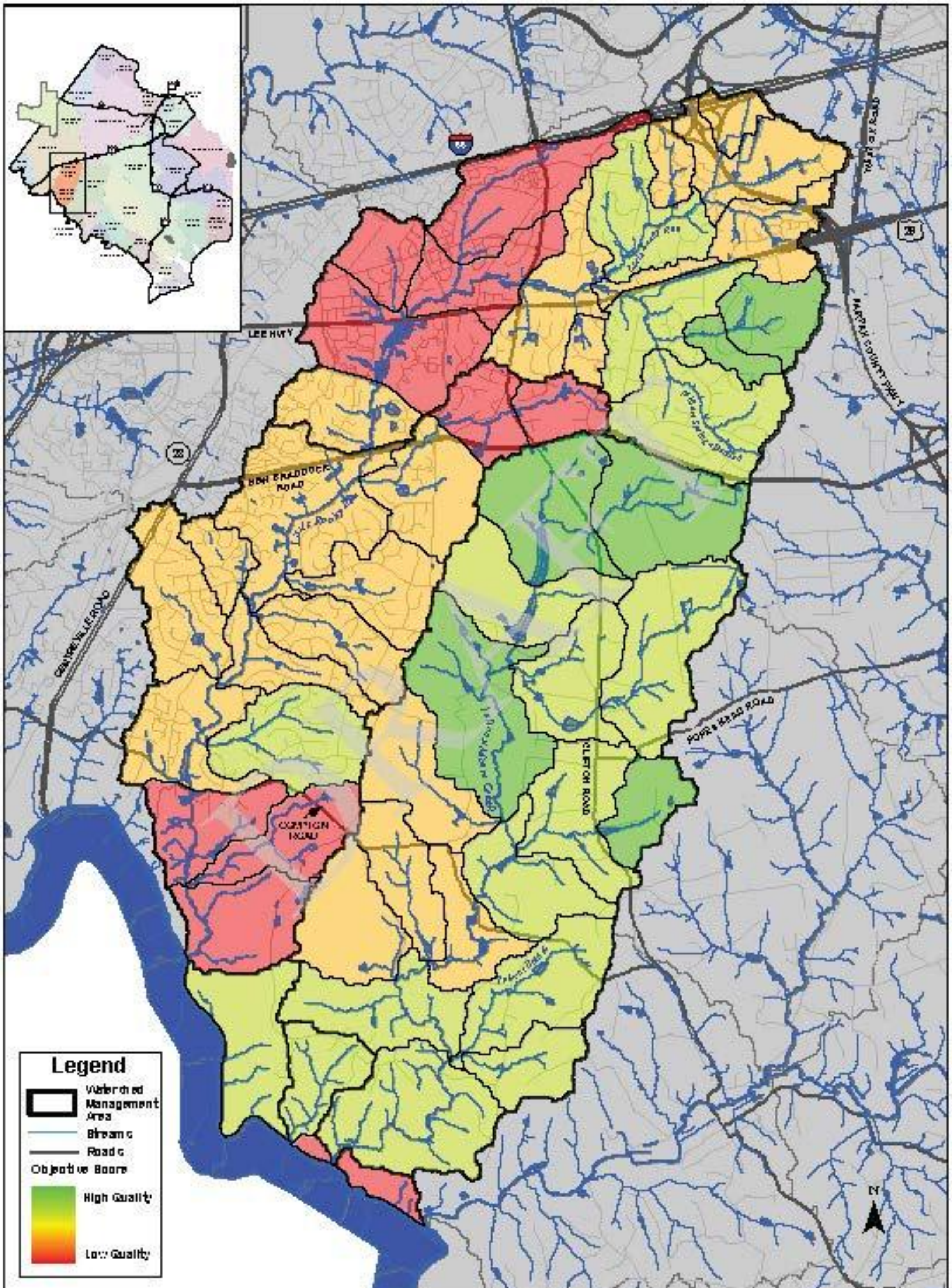


Map 2-30
Stream Water Quality Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1600 3000 6000 8000 Feet

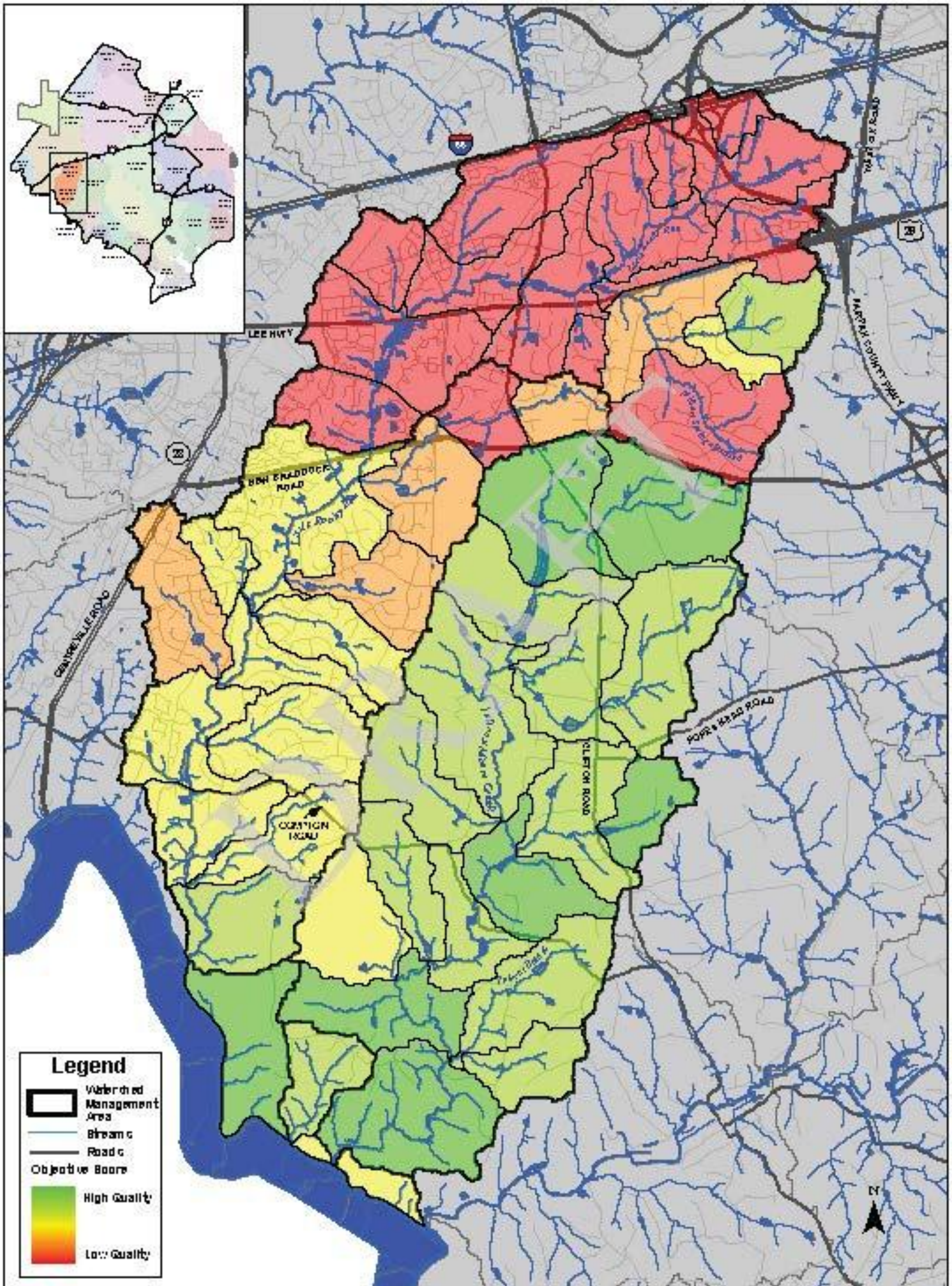


Map 2-31
Drinking Water Quality Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

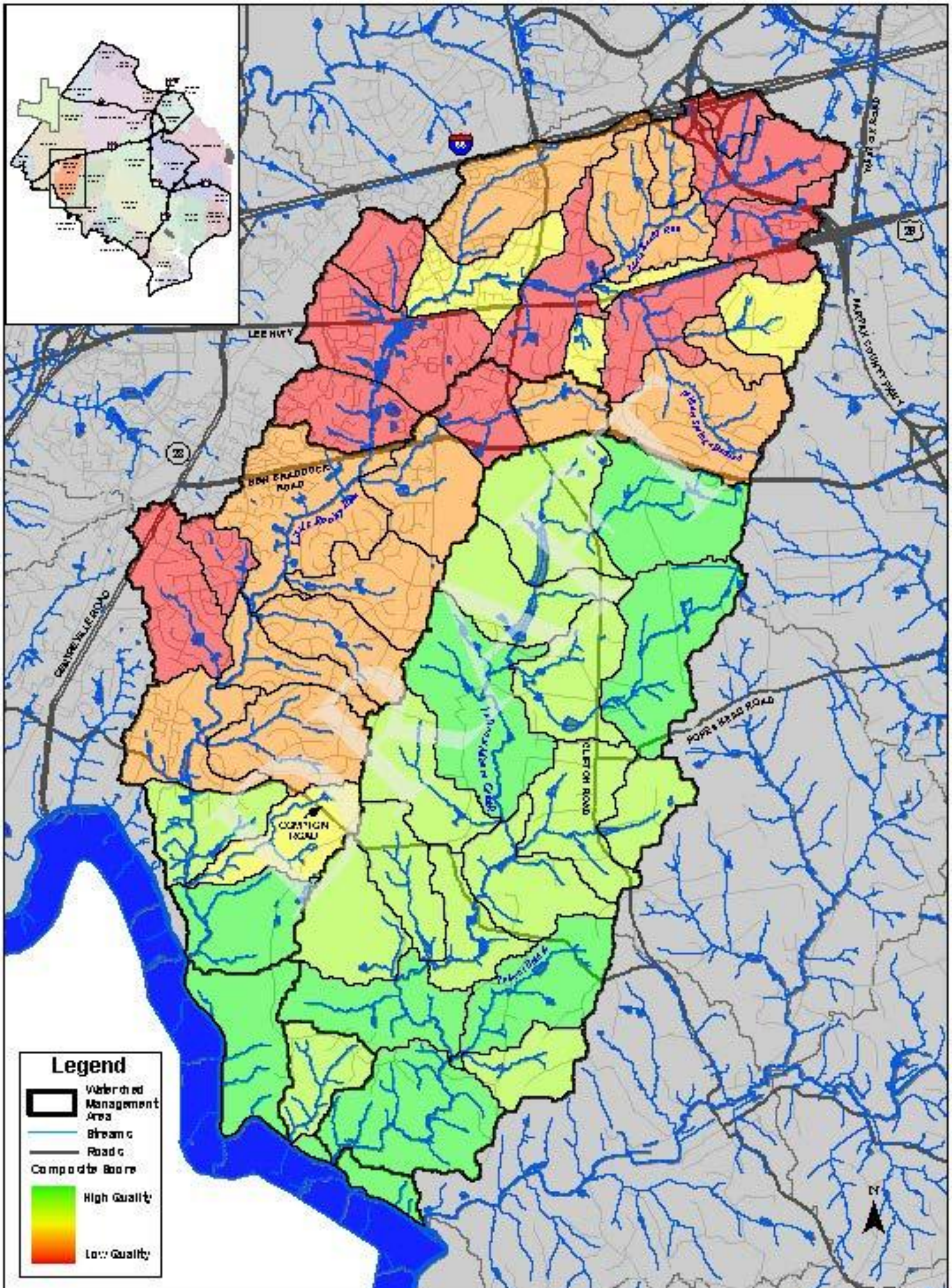


Map 2-32
Storage Capacity Objective Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1600 3000 6000 9000 Feet



Map 2-33
Objective Composite Score
Little Rocky Run - Johnny Moore Creek Watersheds



Map 2-34
Source Composite Score
Little Rocky Run - Johnny Moore Creek Watersheds

0 1500 3000 6000 9000 Feet

Appendix B – Technical Documents

This appendix contains two technical memorandums prepared during the watershed management plan preparation process. The first is the Subwatershed Strategies Technical Memorandum, dated June 11, 2009. This memo provides detail on the project selection process.

The second memorandum is the Project Prioritization Technical Memorandum, dated January 7, 2011. This memo provides detail on the project prioritization and cost benefit analysis.

Memo

To	**Eric Forbes, Fairfax County, SWPD**	File no	
From	**Lynne Mowery, PE, AMEC Earth and Environmental, Inc.**	cc	
Tel	**703-488-3773**		
Fax	**703-488-3701**		
Date	**June 11, 2009**		

Subject **Little Rocky Run/Johnny Moore Creek Subwatershed Strategies Technical Memorandum**

Introduction

Subtask 3.2 requires that subwatershed strategies be developed as a precursor to identifying candidate projects. Once strategies are in place, selection of candidate projects from the 'universe' of potential projects becomes more straightforward. Subwatershed strategies were developed utilizing the subwatershed ranking (Subtask 2.7), SPA priority elements, WAG input, and field reconnaissance data.

Watershed Restoration Strategies

Strategies for restoration of the watershed were presented to the Watershed Advisory Group (WAG) and have been condensed into categories:

- Stream/Buffer Restoration
- Pond Retrofits
- New Stormwater Management (SWM) Facilities – LID, Ponds, Culvert Retrofits, Outfall Treatment

Another strategy not yet discussed with the WAG but important in meeting the County's goals and objectives is flooding mitigation. Flooding mitigation will address both structural flooding and road crossing flooding. Table 3 shows the relationship between the County's goals and objectives and the restoration strategies.

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Table 1 - Restoration Strategies

County Goals & Objectives	Restoration Strategies: Stream/ Buffer Restoration	Pond Retrofits	New SWM Facilities	Flooding Mitigation
Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat, and support biota – Stormwater Runoff	■	■	■	
Minimize flooding to protect property, human health, and safety -				■
Provide for healthy habitat through protecting, restoring, and maintaining riparian buffers, wetlands, and instream habitat	■			
Improve and maintain diversity of native plants and animals in the County	■			
Minimize impacts to stream water quality from pollutants in stormwater runoff		■	■	
Minimize impacts to drinking water sources from pathogens, nutrients, and toxics in stormwater runoff		■	■	
Minimize impacts to drinking water storage capacity from sediment in stormwater runoff	■	■	■	
Encourage the public to participate in watershed stewardship	■	■	■	■
Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives	■	■	■	■
Improve watershed aesthetics in Fairfax County	■	■	■	■

The restoration strategies encompass many different project types. Table 2 provides a summary of project types for each restoration strategy.

Table 2 - Project Types

Restoration Strategy	Project Type
Stream/Buffer Restoration	Stream/Bank Stabilization Stream Realignment Pipe Outfall Stabilization Buffer Reforestation
Pond Retrofits	Regrade pond to provide more storage Remove concrete trickle ditches Redesign pond to include micropools and wetland areas Redesign quantity only ponds to provide water quality storage
New SWM Facilities	Bioretention areas Grassed swales Green roofs Underground storage Manufactured BMPs Stormwater Ponds – extended detention dry ponds, wet ponds Constructed wetlands Tree box filters Rain barrel programs
Flooding Mitigation	Resize road crossing structures to convey design discharge Floodproof or purchase structures located in the floodplain

Candidate Project Selection Procedure

In general, the watersheds were analyzed using the subwatershed ranking results. Those subwatersheds with a poor overall composite score are likely to be deficient for at least one, if not more, county-defined objectives. At this point, individual objectives were analyzed more closely to determine those which were not being achieved. Each objective score is comprised of a combination of individual metrics. Those metrics contributing to a poor objective score help define the strategy for that particular subwatershed as well as bringing to light potential project sites. A similar technique is used when evaluating potential stressors. The overall source composite score was considered initially, in order to address subwatersheds clearly contributing to watershed degradation, but individual source metrics were also analyzed to ensure that any specific stressors were identified.

The Johnny Moore Creek WMA will be provided as an example of the candidate project selection. Table 3 shows the objective composite scores as well as the overall and source composite scores for the Johnny Moore WMA. Scores have been assessed on a scale of 10 in quartiles (0-2.5 registering "very low", 2.5-5.0 "low", and so on). The lowest Overall Impact Composite score occurs in JM-JM-0001. Inspection of the Objective Composite scores reveals deficient areas. For the purpose of this example, we will focus on the lowest Objective score –

which is Storage Capacity. Storage Capacity is a measure of the sediment contribution to the Occoquan reservoir and is comprised of two metrics, In-stream Sediment and Upland Sediment. Though this subwatershed scores in the high quartile for Source Composite (see Table 4), this score is tied for the lowest in this WMA.

Table 3 – Composite Summary for Johnny Moore

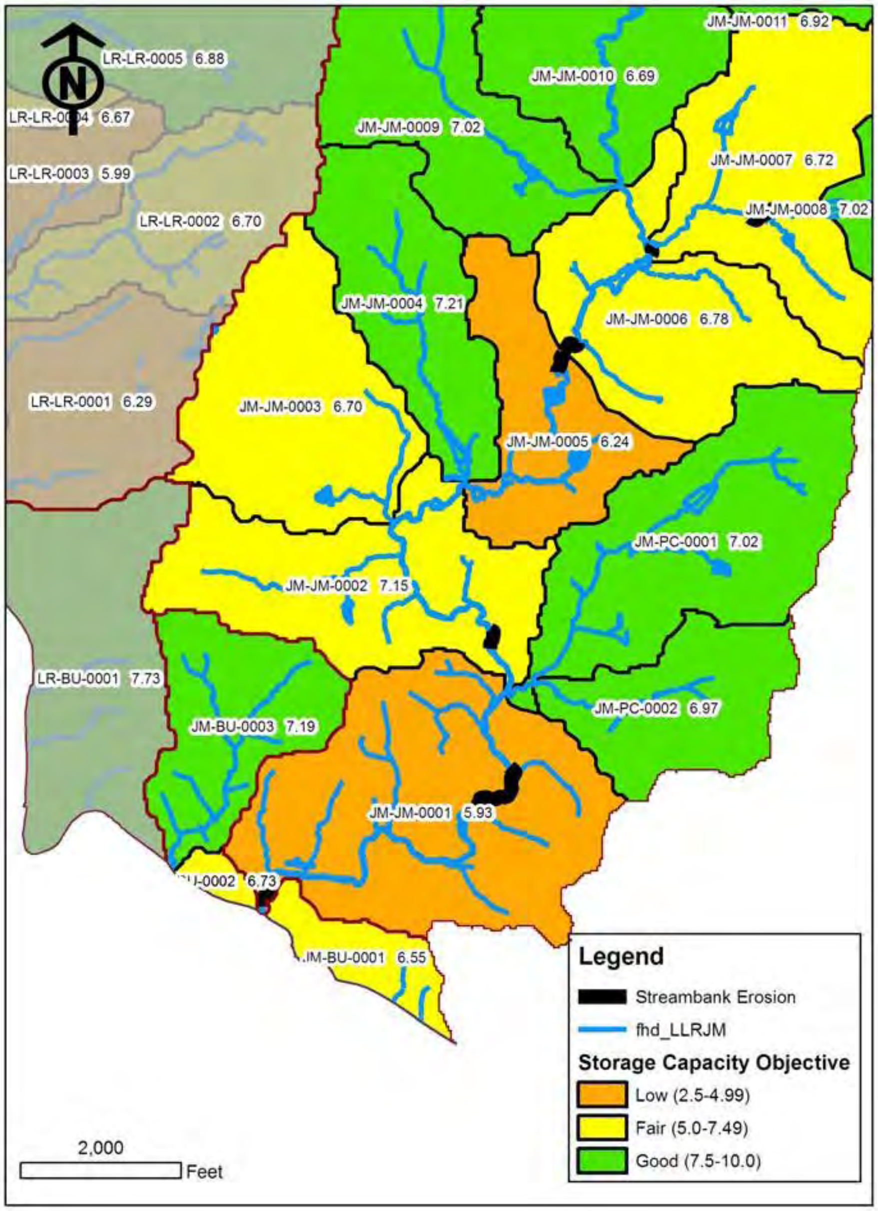
Subwater-shed ID	Stormwater Runoff	Flooding Hazards	Habitat Health	Habitat Diversity	Stream WQ	Drinking WQ	Storage Capacity	Overall Impact Composite
JM-BU-0001	6.17	10	7.6	6	6	6.25	5	6.94
JM-BU-0002	6.17	10	8	6	6.36	6.88	5	7.12
JM-BU-0003	5.75	10	6.4	6	6.71	6.88	8.75	7.40
JM-JM-0001	4.92	8.5	7.2	6	4.93	4.38	3.75	5.86
JM-JM-0002	5.25	10	6.8	7	7	7.5	6.25	7.31
JM-JM-0003	4.92	10	4	7	6.64	6.88	6.25	6.76
JM-JM-0004	5.33	10	6.8	7	7	7.5	7.5	7.48
JM-JM-0005	4.92	8	7.2	7	5.57	5	3.75	6.06
JM-JM-0006	4.92	10	6.4	7	6.29	6.25	6.25	6.95
JM-JM-0007	5.33	10	5.6	7	6.29	6.25	6.25	6.90
JM-JM-0008	4.92	10	5.6	7	6.64	6.88	7.5	7.14
JM-JM-0009	5.33	10	6	7	6.64	6.88	7.5	7.25
JM-JM-0010	5.33	9	6	7	6.64	6.88	7.5	7.05
JM-JM-0011	5.42	9.5	5.2	7	6.64	6.88	7.5	7.05
JM-JM-0012	5.75	10	6.4	7	6.64	6.88	7.5	7.36
JM-JM-0013	5.42	9	4.8	7	8.07	8.75	8.75	7.51
JM-JM-0014	5.42	10	4	7	8.07	8.75	8.75	7.60
JM-JM-0015	5.75	8.1	6.4	7	8.07	8.75	8.75	7.58
JM-PC-0001	5.33	10	6	7	6.64	6.88	7.5	7.25
JM-PC-0002	4.92	10	5.6	7	6.64	6.88	7.5	7.14

A closer inspection shown in Table 4 reveals that the Source Composite score is being weighed down by poor scores for Upland Sediment. The Upland Sediment metric is a combination of the TSS output from STEPL (nutrient loading spreadsheet model), and the sediment contribution of streambank erosion sites (a combination of SPA sites and those identified during Task 2 field reconnaissance). The STEPL results are driven by soil type and landuse, neither of which is distinct in these two subwatersheds when compared to their surroundings. A closer inspection of the Map 1 reveals two significant streambank erosion sites contributing to the high sediment load for these two subwatersheds.

Table 4 – Source Metrics for Johnny Moore

SITE_CODE	DCIA	Total Imp.	Stream Buffer Deficiency	SW Outfalls	VPDES	Total Urban Area	Upland Sediment	Total Nitrogen	Total Phosphorus	Septic	Channelized/ Piped Streams	Composite Score
JM-JM-0001	10.00	10.00	10.00	10.00	10.00	10.00	**2.50**	7.50	2.50	2.50	10.00	7.73
JM-JM-0002	10.00	10.00	10.00	10.00	10.00	10.00	7.50	10.00	7.50	2.50	10.00	8.86
JM-JM-0003	10.00	10.00	7.50	2.50	10.00	10.00	7.50	10.00	5.00	10.00	10.00	8.41
JM-JM-0004	10.00	10.00	10.00	2.50	10.00	10.00	10.00	7.50	7.50	5.00	10.00	8.41
JM-JM-0005	10.00	10.00	10.00	7.50	10.00	10.00	**2.50**	7.50	5.00	2.50	10.00	7.73
JM-JM-0006	10.00	10.00	10.00	2.50	10.00	10.00	7.50	7.50	5.00	2.50	10.00	7.73
JM-JM-0007	10.00	10.00	10.00	2.50	10.00	10.00	7.50	7.50	5.00	2.50	10.00	7.73
JM-JM-0008	10.00	10.00	10.00	2.50	10.00	10.00	10.00	7.50	5.00	2.50	10.00	7.95
JM-JM-0009	10.00	10.00	10.00	2.50	10.00	10.00	10.00	7.50	5.00	5.00	10.00	8.18
JM-JM-0010	10.00	10.00	10.00	7.50	10.00	10.00	10.00	7.50	5.00	2.50	10.00	8.41
JM-JM-0011	10.00	10.00	7.50	2.50	10.00	10.00	10.00	7.50	5.00	2.50	10.00	7.73
JM-JM-0012	10.00	10.00	10.00	7.50	10.00	10.00	10.00	7.50	5.00	5.00	10.00	8.64
JM-JM-0013	10.00	10.00	2.50	2.50	10.00	10.00	7.50	10.00	7.50	7.50	10.00	7.95
JM-JM-0014	10.00	10.00	2.50	2.50	10.00	10.00	10.00	7.50	5.00	10.00	10.00	7.95
JM-JM-0015	10.00	10.00	10.00	2.50	10.00	10.00	10.00	7.50	5.00	7.50	10.00	8.41
JM-PC-0001	10.00	10.00	10.00	10.00	10.00	10.00	10.00	7.50	5.00	2.50	10.00	8.64
JM-PC-0002	7.50	7.50	10.00	10.00	10.00	10.00	10.00	7.50	5.00	2.50	10.00	8.18
JM-BU-0001	10.00	10.00	10.00	10.00	10.00	10.00	5.00	7.50	7.50	10.00	5.00	8.64
JM-BU-0002	10.00	10.00	10.00	10.00	10.00	10.00	5.00	10.00	7.50	10.00	10.00	9.32
JM-BU-0003	7.50	7.50	10.00	10.00	10.00	7.50	10.00	7.50	5.00	2.50	10.00	7.95

Map 1 – Storage Capacity Objective



In this example, we used the indicators to help identify potential stressors. The streambank erosion sites will be investigated for stream restoration opportunities. In addition to addressing the Storage Capacity Objective by reducing the sediment load, stream restoration projects are directly related to habitat improvements, see Table 1 – Restoration Strategies for a link between objectives and strategies.

By all accounts, the Johnny Moore watershed is in relatively good condition and is classified as a Watershed Protection Area in the Stream Protection Strategy report. The limited habitat data available shows Johnny Moore to be deficient in some locations and the majority of surveyed reaches are undergoing active channel widening. The link between channel degradation, sediment, and habitat is clear. In general, stream restoration will be investigated throughout the WMA as a way to not only address the source, but to minimize or negate the impact. Fortunately, the entire WMA is within a designated Occoquan downzoned area, meaning radical changes in land use are not expected. There are a number of subwatersheds in nearly pristine condition which will eventually be developed as Estate Residential. A non-structural recommendation for these subwatersheds could be to ensure that stormwater management measures are addressed as these areas are developed. One of the main obstacles throughout this WMA is access. Many ideal project locations are on privately owned land.

The subwatershed ranking results will be used in combination with 'severe' SPA inventory points, concerns identified by both the WAG and the public forum, and sites discovered during Task 2 field reconnaissance and subsequent field efforts to develop projects. Projects best justified by the subwatershed ranking will likely be identified as priority projects. Considering the relative small size of the watershed to be analyzed, threshold values were not established for strategy development. In other words, candidate projects were considered in all subwatersheds to address identified deficiencies not just those subwatersheds that ranked poorly. With only 3 fairly homogenous WMAs and a majority of subwatersheds classified as headwater subbasins, all 52 subwatersheds were analyzed for their restoration/protection potential using this procedure.

Candidate Projects

A description of the candidate projects selected using the procedure is provided below. The attached maps show the location of these candidate projects.

Id	Subwatershed	Type	Comments
1	JM-JM-0014	Stream Restoration	Very Poor SPA Habitat Score, issues with golf course, engineered channel
4	JM-JM-0011	Stream Crossing	Moderate to Severe Impact (SPA)
7	JM-JM-0014	Head Cut	No evidence, did it migrate to upstream crossing?
8	JM-JM-0009	New SWM	Facility Treating School, retrofit, educational opportunities?
9	JM-JM-0003 LR-LR-0001	New SWM	Golf Course clubhouse, parking lot, etc. confirm treatment
10	JM-JM-0003	Pond Retrofit	Golf Course Ponds
11	JM-JM-0014	New SWM	Daylight pipe - add bioretention, grassed swale
12	JM-JM-0013 JM-JM-0014	Buffer	Plant trees along stream and ponds where possible
13	JM-JM-0005 JM-JM-0006	Stream Restoration/Buffer Restoration/Culvert	Significant erosion identified - flooding noted during field investigation
14	JM-PC-0001	Road Culvert	Pro rata project - comment in WAG#2
15	JM-PC-0001	Buffer Restoration	Plant trees - private property
17	JM-JM-0001	Stream Restoration	Significant bank erosion - access issues
19	LR-LR-0003	Buffer/Stream Restoration	Buffer and stream erosion - on private property
20		Pond Retrofit	Pond not in stormnet - plantings, regrading to treat larger area
21	LR-LR-0005	Pond Retrofit	Clogging problem - review design to address problem - erosion issues north of pond. Recently retrofitted - sedimentation issues
22	LR-LR-0007	Bioretention	Bioretention to treat back side of townhouses
23	LR-LR-0007	New SWM	Add tree box filters or treatment at culvert outlet for untreated system
24	LR-LR-0006	New SWM	Combination of bioretention, tree box filters for untreated area
25	LR-LR-0010	New SWM	Treatment at culvert outlet, upstream opportunities - community not supportive of regional pond in area
26	LR-LR-0007	Culvert retrofit	Flooding complaint at WAG - retrofit area u/s of culvert for SWM
27	LR-LR-0007	New SWM	Retrofit opportunities at school
28	LR-LR-0009	New SWM	Add treatment for untreated system
29	LR-LR-0009	Pond Retrofit	Retrofit to add plantings - address erosion in pond ditch
30	LR-LR-0004	New SWM	Add treatments at inlets/outlet for untreated system

Id	Subwatershed	Type	Comments
31	LR-LR-0004	Litter Control	North Hart Run & Compton Valley Estates - Neighborhood cleanups to control litter - interior townhouse streets not VDOT - install gutter guards similar to Union Mills shopping center
38	JM-JM-0003	Dump Site	Hot tub couches in stream
39	JM-JM-0003	Pond Retrofit	Existing pond with dam break on golf course property near piplines - repair/retrofit to provide treatment
40	LR-LR-0003	Culvert Retrofit	Treat uncontrolled flow from subdivision
41	LR-LR-0003	New SWM	Bioretention/Grassed swale for uncontrolled area - on private property
42	LR-LR-0004	New SWM	Inlet treatment for uncontrolled area
43	LR-LR-0004	New SWM	Inlet/Outlet treatment for uncontrolled area
44	LR-LR-0008	New SWM	Inlet treatment for uncontrolled area
45	LR-LR-0006	New SWM	Inlet/outlet treatment for uncontrolled area
46	LR-LR-0008	Outfall Improvement	Erosion at transition from concrete ditch from field investigation - remove concrete ditch?
47	LR-LR-0008	Pond Retrofit	Remove trickle ditches, plantings, enlarge to improve downstream conditions
48	LR-LR-0008	Outfall Improvement	Erosion downstream of trail - WAG comment
49	LR-LR-0008	Stream Restoration	Erosion area with headcut
50	LR-LR-0008	Buffer/Stream Restoration	Restore buffer, remove paved and trickle ditches, add plantings to ponds
51	LR-LR-0011	Outfall Improvement	Stabilize outfall to reduce erosion
52	LR-LR-0011	Stream Stabilization	Erosion in area from issues forum
53	LR-LR-0011	Pond Retrofit	Remove trickle ditches, add micropools/plantings
54	LR-LR-0011	New SWM	Inlet/outlet treatment for uncontrolled area
55	LR-LR-0011	New SWM	Union Mill ES drains to dry pond, opportunities for LID onsite
56	LR-LR-0012	New SWM	Centreville HS drains to dry pond, opportunities for LID onsite
58	LR-LR-0011	Pond Retrofit	Remove trickle ditches, add micropools/plantings

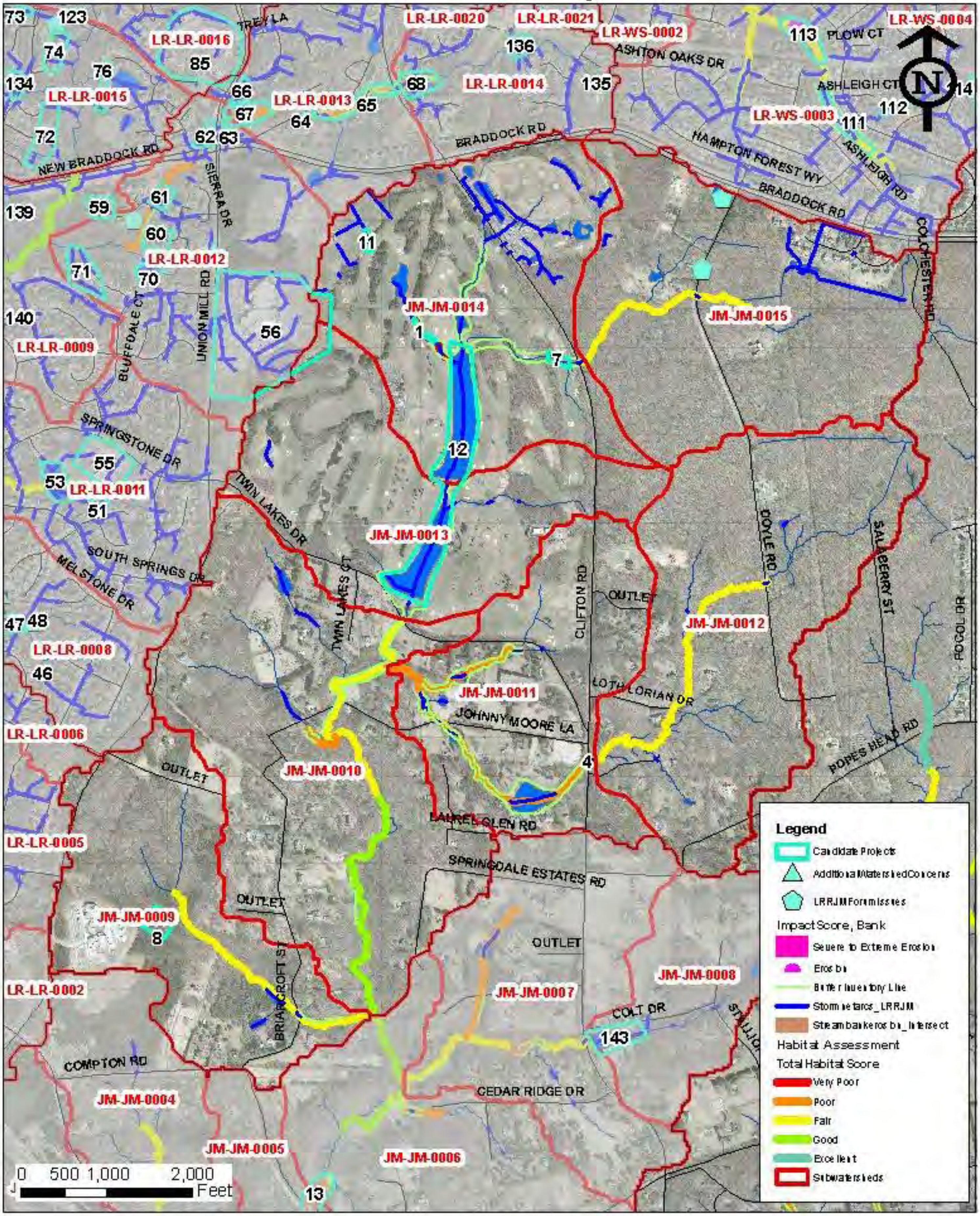
Id	Subwatershed	Type	Comments
59	LR-LR-0009	New SWM	Inlet/outlet treatment for uncontrolled area
60	LR-LR-0012	New SWM	Inlet/outlet treatment for uncontrolled area - WAG look at opportunities for porous paving/LID
61	LR-LR-0012	Pond Retrofit	Enlarge pond to provide more treatment in replacement of Regional R-13
62	LR-LR-0012	New SWM	New pond to provide treatment in replacement of Regional R-13
63	LR-LR-0012	New SWM/Stream Restoration	Culvert retrofit/grassed swale/stream restoration in replacement of Regional R-13
64	LR-LR-0013	Stream Restoration	Address erosion d/s of culvert - possible culvert resize needed
65	LR-LR-0013	Buffer Restoration	Restore buffer along stream - private property, houses close to stream issues
66	LR-LR-0013	Pond Retrofit	Remove trickle ditches, add micropools/plantings - stabilize upstream sinkhole (complaint)
67	LR-LR-0013	Alternatives to Regional Pond	R-13 - feasibility issues with grading, private property, house in pond area
68	LR-LR-0014	Pond Retrofit	Remove trickle ditches, add micropools/plantings - stabilize eroded areas
70	LR-LR-0012	Pond Retrofit	Remove trickle ditches, add micropools/plantings
71	LR-LR-0012	New SWM	Inlet/outlet treatment for uncontrolled area
72	LR-LR-0015	New SWM	Inlet/outlet treatment for uncontrolled area - WAG look at opportunities for porous paving/LID
73	LR-LR-0015	New SWM	Bioretention/LID for uncontrolled area - WAG look at opportunities for porous paving/LID
74	LR-LR-0015	New SWM	Inlet/outlet treatment for uncontrolled area - WAG look at opportunities for porous paving/LID
75	LR-LR-0016	Non-Structural	Sweeping, trash pickup in commercial shopping center - drains to wet pond d/s
76	LR-LR-0015	New SWM	Inlet/outlet treatment for uncontrolled area
77	LR-LR-0016	New SWM?	Confirm treatment by R-16 - if not incorporate LID
78	LR-LR-0016	Flooding	Structures in Floodplain
79	LR-LR-0018	Flooding	Structures in Floodplain

Id	Subwatershed	Type	Comments
80	LR-LR-0015	Pond Retrofit	Remove trickle ditches, add micropools/plantings
81	LR-LR-0016	New SWM	Inlet/outlet treatment for uncontrolled area
82	LR-LR-0016	New SWM	Inlet/outlet treatment for uncontrolled area
83	LR-LR-0016	Pond Retrofit	Remove trickle ditches, add micropools/plantings
84	LR-LR-0016	Pond Retrofit	Remove trickle ditches, add micropools/plantings
85	LR-LR-0016	Non-Structural	Illicit discharge education (noted in NSA) - sweeping/trash in commercial shopping center
86		Road Flooding	From Pro-rata
87	LR-LR-0017	Pond Retrofit	Pond had eroded areas - stabilize - add wetland plantings - adjust subarea to include Sully Manor - area still in construction
88	LR-LR-0016	Culvert Replacement	From Pro-rata - drainage divides in area have changed significantly - no longer needed?
89	LR-LR-0018	Flooding/Buffer	Structures in floodplain, buffer restoration
90	LR-LR-0018	New SWM	LID for uncontrolled area
91	LR-LR-0016	Pond Retrofit	Remove trickle ditches, add micropools/plantings
92	LR-LR-0018	Pond Retrofit	Remove trickle ditches, add micropools/plantings
93	LR-LR-0018	Stream Restoration/Road Flooding	Stabilize stream, Pro rata culvert project - confirm overtopping from RAS - WAG comment that culvert was replaced
94	LR-LR-0019	Pond Retrofit	Regional Pond R-161 - wetland plantings needed - at time of visit growth was sparse
95	LR-LR-0019	New SWM	Colin Powell ES drains to R-161 - opportunities for onsite LID
96	LR-LR-0019	Stream Restoration	Erosion noted during field visit
97	LR-LR-0020	Pond Retrofit	Trickle ditches, dry pond holding water during field visit, clogging and smell
98	LR-LR-0020	Stream Restoration	Erosion at pond outfalls
99	LR-LR-0021	Pond Retrofit	Regional R-7 - opportunity to regrade/plant/direct more flow to pond - clogged during field visit
100	LR-LR-0022	Stream Restoration	Erosion, head cut, oily sheen noted during field visit
101	LR-LR-0022	Pond Retrofit	Regional Pond R-17 Wetland areas, grassed spillways not stable during field visit - replanting and grading

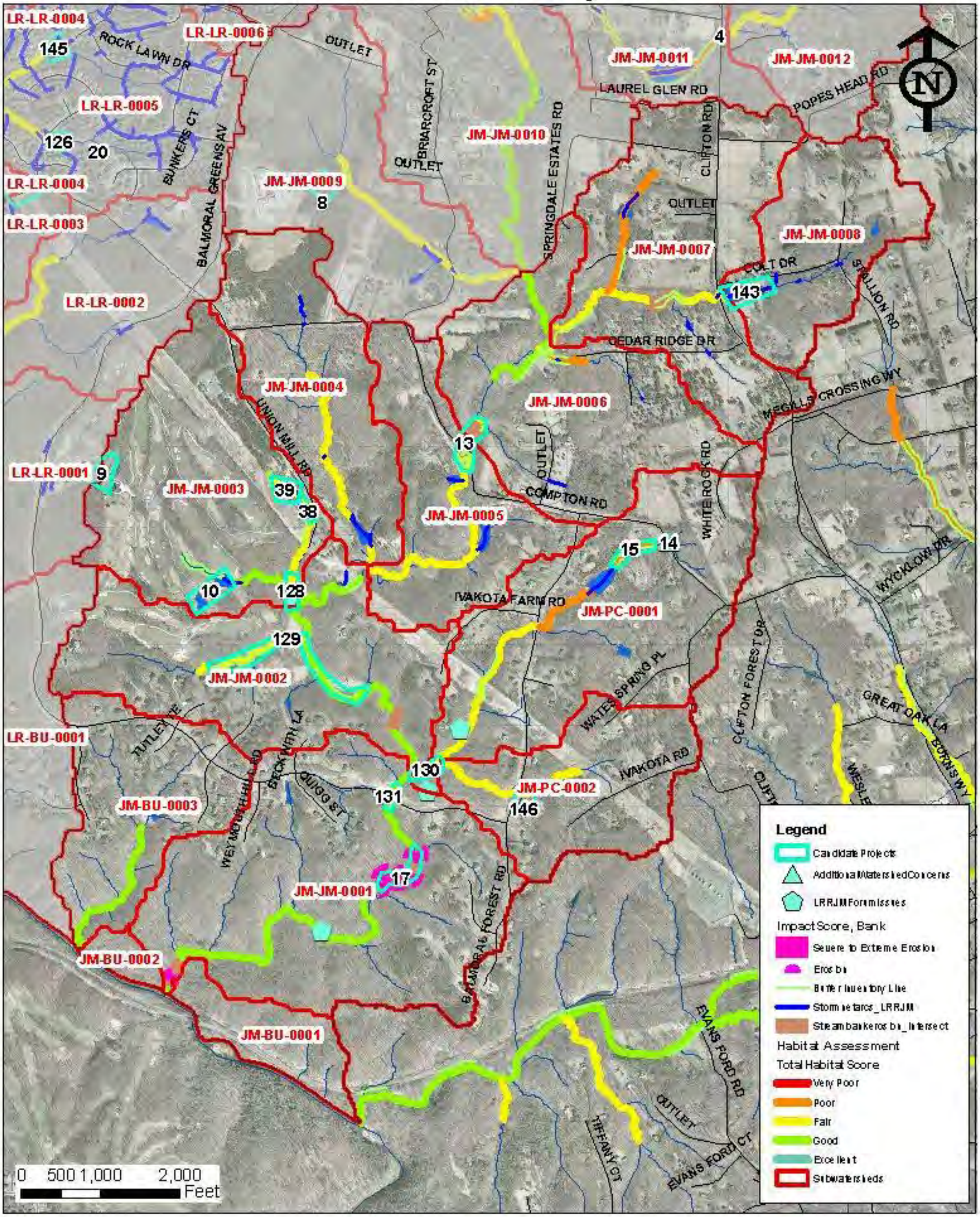
Id	Subwatershed	Type	Comments
102	LR-LR-0024	Non-Structural	Landfill - ensure required monitoring, on site practices are followed
104	LR-LR-0024	New SWM	New outfall treatment for Regional Pond R-12
105	LR-LR-0025	Non-Structural	Betty's Azalea Ranch - education about proper storage practices, investigate leaking fuel tanks
106	LR-LR-0025	New SWM	Missed facility? - opportunity for LID
107	LR-LR-0020	Pond Retrofit	Remove trickle ditches, add micropools/plantings
108	LR-WS-0002	Pond Retrofit	Existing dry pond not in StormNet - Remove trickle ditches, add micropools/plantings
109	LR-WS-0002	New SWM	Outlet treatment for uncontrolled area
110	LR-WS-0002	New SWM	Outlet treatment for uncontrolled area - culvert retrofit u/s of Tractor Lane?
111	LR-WS-0003	Stream Restoration	Stream in concrete channel being undermined - restore buffer and natural channel
112	LR-WS-0003	Stream Restoration/Road Flooding	Concrete channel - restore to natural channel - stabilize downstream erosion - address pipestem flooding
113	LR-WS-0003	Stream Restoration	Erosion from SPA and field visit
114	LR-WS-0003	New SWM	Willow Springs ES drains to dry pond - onsite LID opportunities
115	LR-WS-0004	Pond Retrofit	Remove trickle ditches, add micropools/plantings - enlarge in replacement of R-10?
116	LR-WS-0005	Buffer Restoration	Alternative to R-10?
117	LR-WS-0005	New SWM	Regional Pond R-10 - on private property - feasibility low - buffer restoration and culvert retrofits instead
118	LR-LR-0016	Non-Structural	Educate property owner about storage/junk on property - WAG comment
119	LR-LR-0009	Stream Restoration	WAG Comment - 100 yds of Creek severely degraded in this area - access issues
120	LR-LR-0003 LR-LR-0004	Non-Structural	Cable barriers at power cuts - deter dumping and ATV use - WAG comment
121	LR-LR-0004	Non-Structural	Cable barriers at power cuts - deter dumping and ATV use - WAG comment
123	LR-LR-0016	Debris	WAG Comment - Clean debris in woods at Bent Tree Apt Complex
124	LR-LR-0016	Non-Structural	WAG Comment - Keep parking lot clean - educate property owner - install trash diverters
125		Non-Structural	WAG Comment - Encourage participation in Adopt-a-Highway and stream cleanups
126	LR-LR-0005	Culvert Retrofit	Possible site for culvert retrofit

Id	Subwatershed	Type	Comments
128	JM-JM-0003	Stream Restoration	Issues Scoping Forum Comment - flooding and erosion
129	JM-JM-0002	Buffer Restoration	Buffer issue identified in SPA - unnecesary culverts? for removal - FCPA & HOA
130	JM-PC-0001	Stream Restoration	Issues Scoping Forum Comment - erosion, verified in field investigation
131	JM-JM-0001	Buffer Restoration	Buffer issue identified in SPA
132	LR-LR-0007	Stream Restoration	Erosion/poor flow in channel - comment from Kevin Morley - Green Trails HOA - phone conversation
133	LR-LR-0023	Buffer Restoration	SPA Identified buffer issue along and upstream of Regional Pond R-9
134	LR-LR-0015	Pond Retrofit	Space for modification, need for more plantings - WAG - pond in good shape what is achieved if enlarged or improved?
135	LR-LR-0014	Stream Restoration	Relace paved ditch with natural stream
136	LR-LR-0014	Pond Retrofit	Dry pond retrofit with wetland plantings, micropool
137	LR-LR-0010	Pond Retrofit	Modify pond to provide additional capacity, pollutant removal in replacement of Regional Pond R-5
138	LR-LR-0010	Stream Restoration	Remove paved ditch
139	LR-LR-0009	Pond Retrofit	Good access, space for modifications for wetland plantings, micropools to improve water quality treatment
140	LR-LR-0009	New SWM	Inlet/outlet controls for uncontrolled area
143	JM-JM-0008	Pond Retrofit	Retrofit pond to provide flow reductions, water quality benefit
144	LR-LR-0006	Pond Retrofit	Retrofit ponds to include wetland plantings
145	LR-LR-0005	Pond Retrofit	Retrofit to include wetland plantings
146	JM-PC-0002	Culvert Retrofit	Detention upstream of road - created wetland

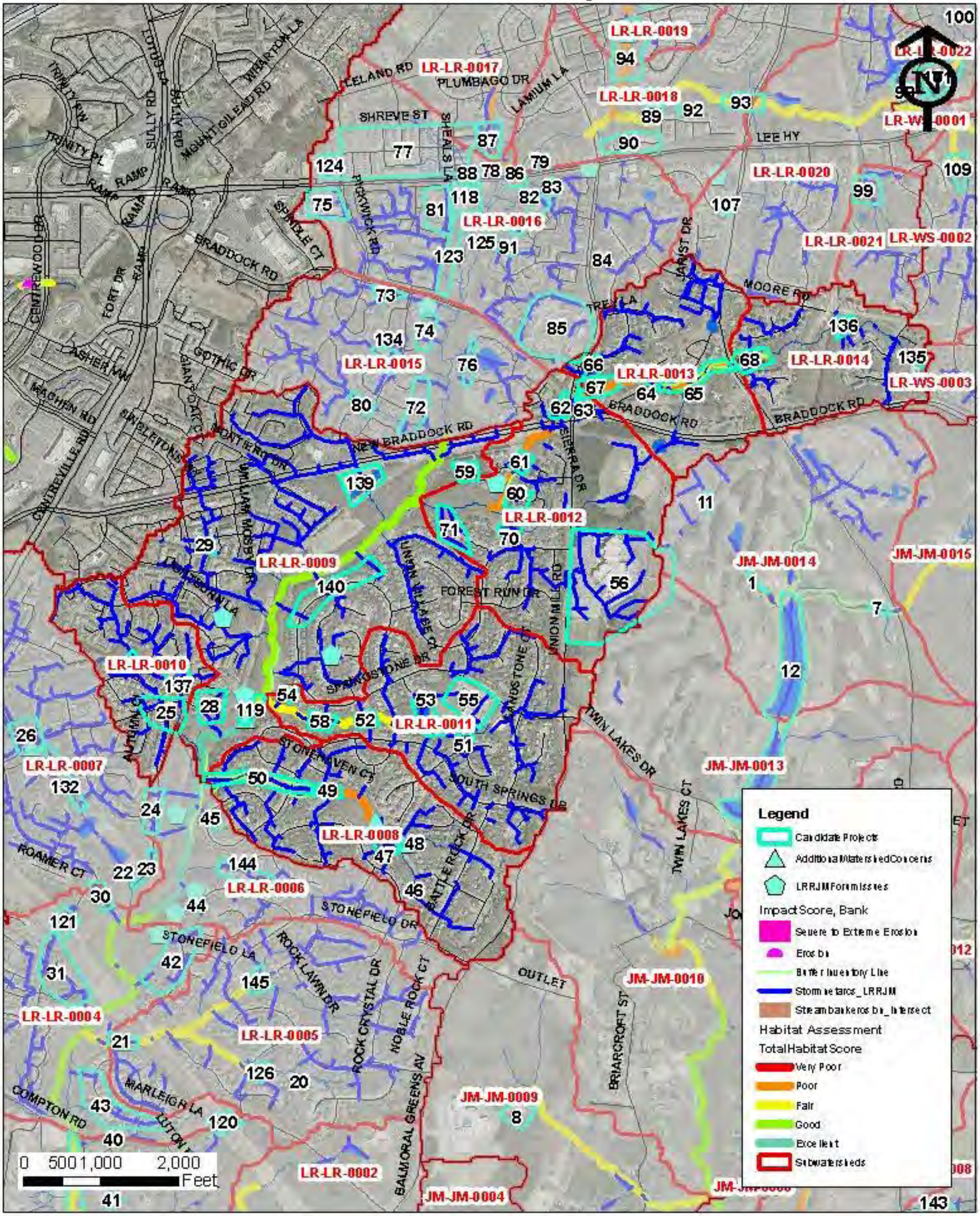
Johnny Moore Creek (1/2)
Candidate Projects



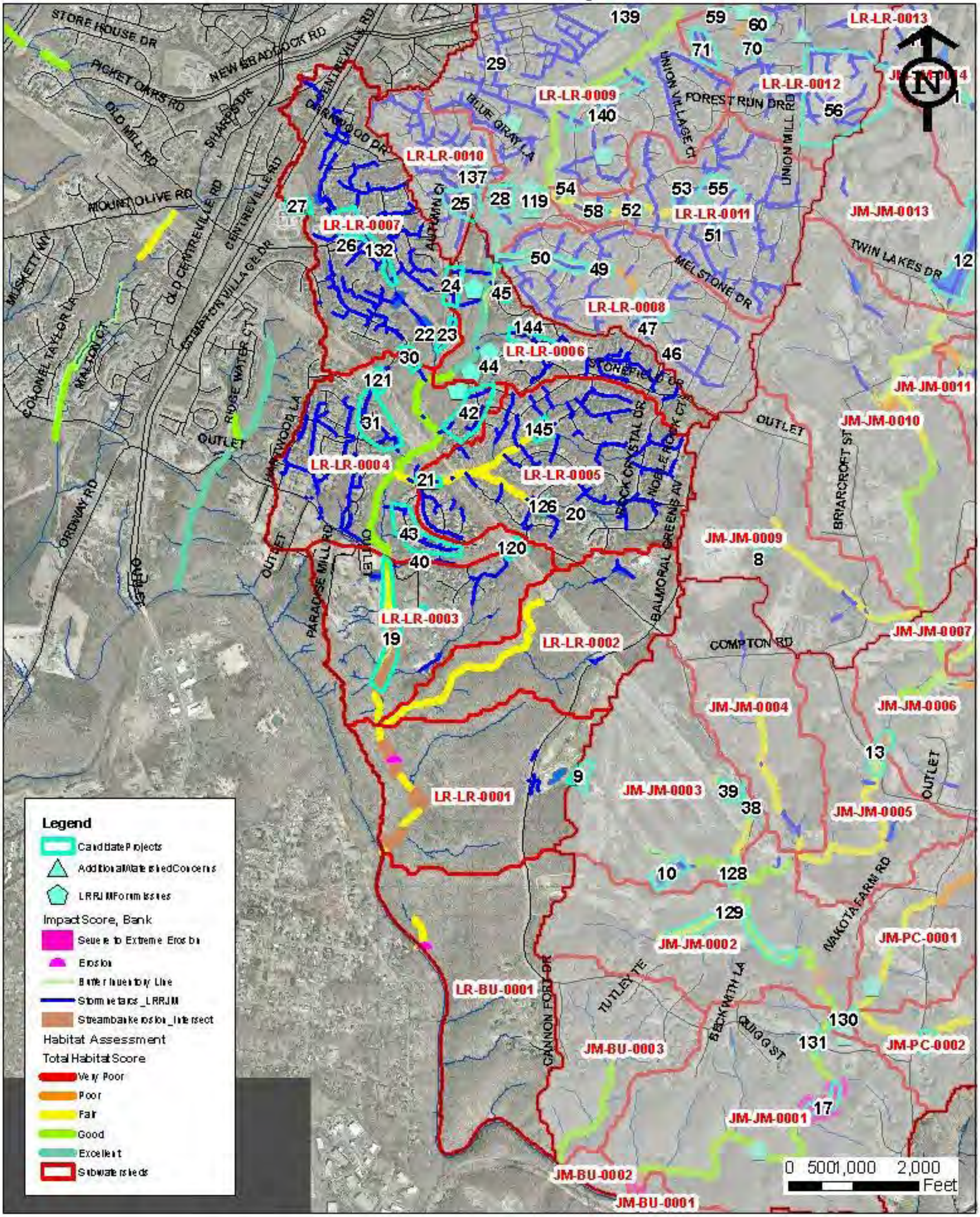
Johnny Moore Creek (2/2)
Candidate Projects



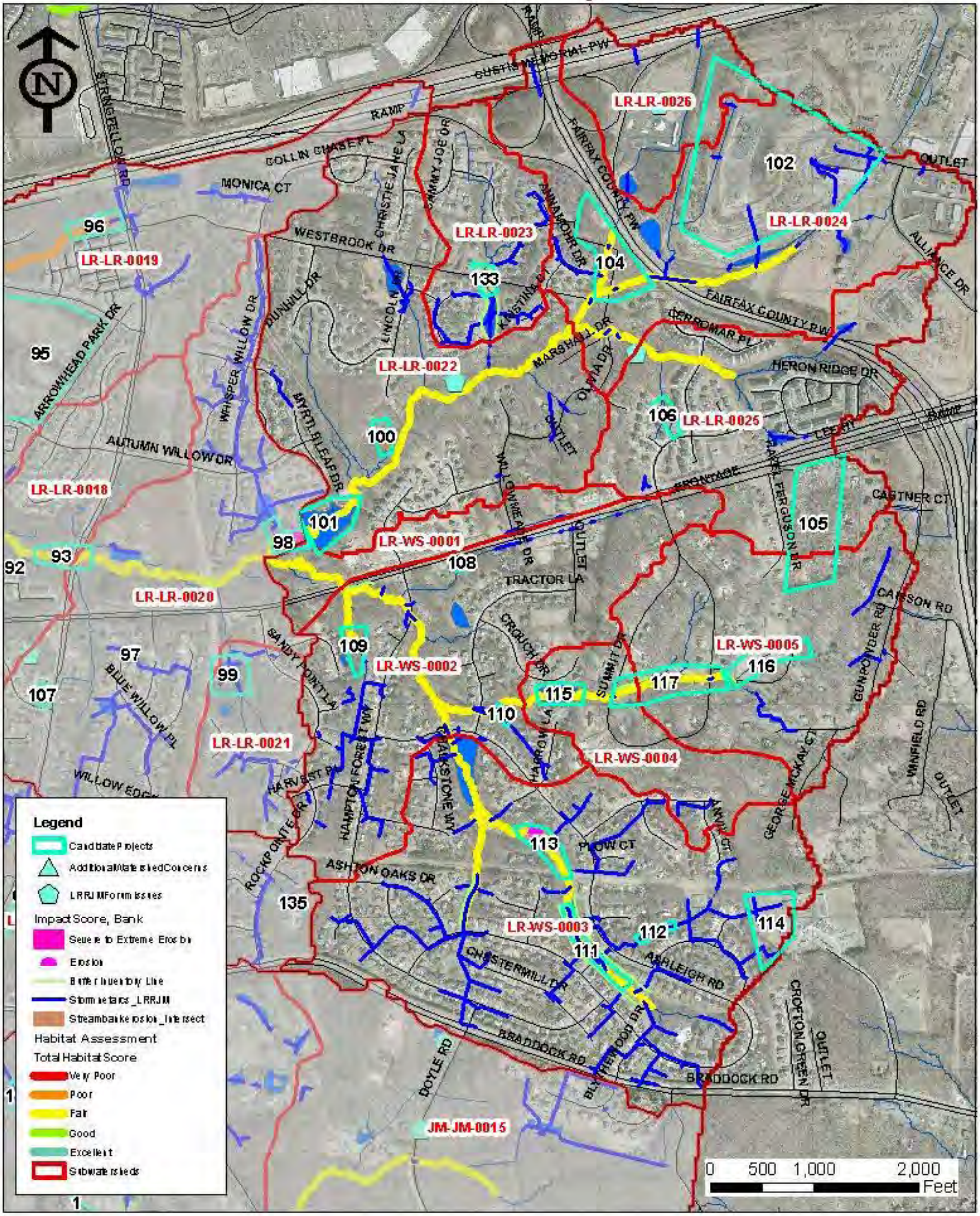
Little Rocky Run Lower (1/2)
Candidate Projects



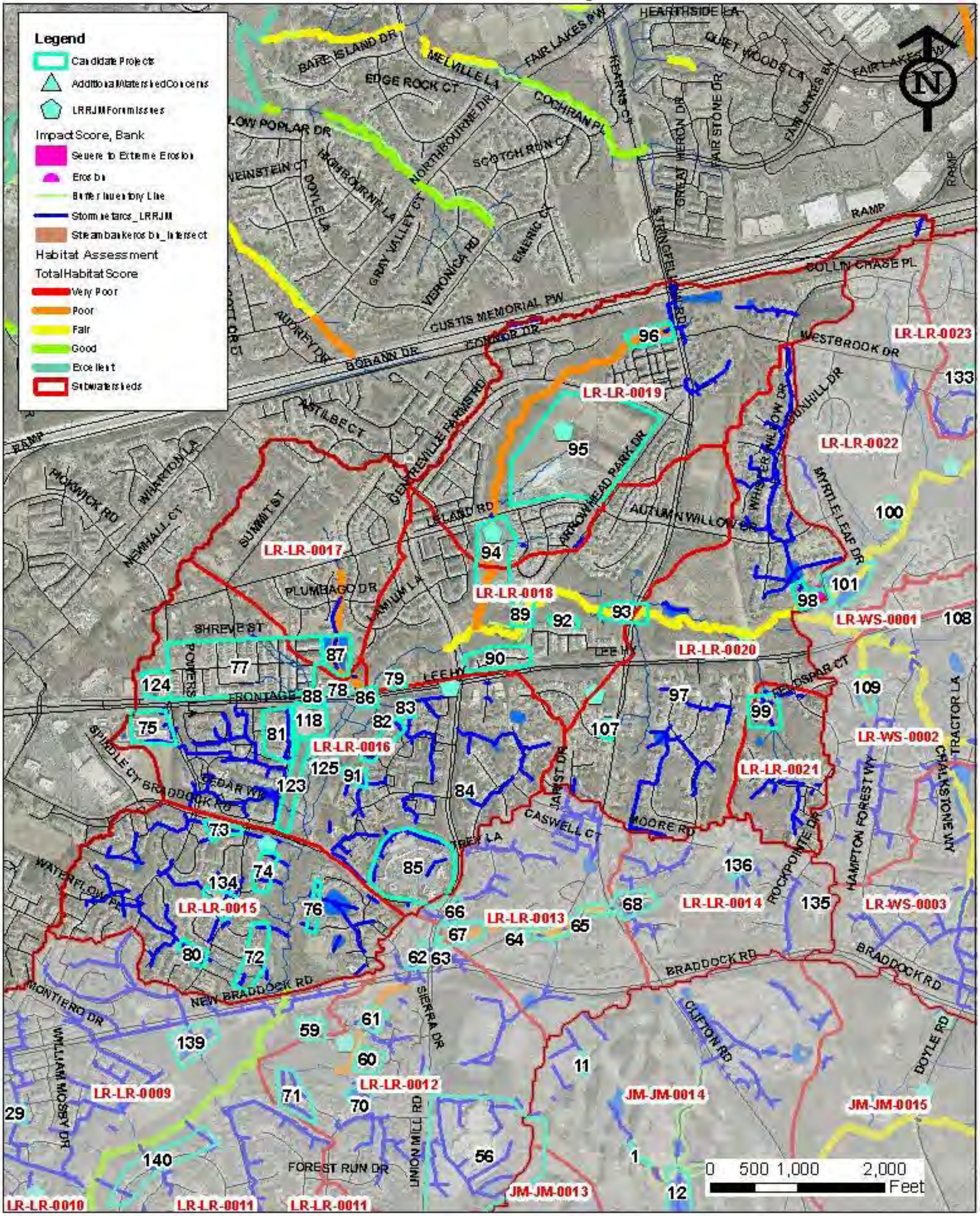
Little Rocky Run Lower (2/2)
Candidate Projects



Little Rocky Run Upper (1/2)
Candidate Projects



Little Rocky Run Upper (2/2)
Candidate Projects



Memo

To	**LeAnne Astin, Fairfax County, SWPD**	File no	
From	**Lynne Mowery, PE, AMEC Earth and Environmental, Inc.**	cc	
Tel	**703-488-3773**		
Fax	**703-488-3701**		
Date	**January 7, 2011**		

Subject **Little Rocky Run/Johnny Moore Creek Project Prioritization Technical Memorandum – FINAL**

SECTION 1.0 – Introduction

This memo bridges the gap between Technical Memorandum 3.2 and the selection of 40 projects to be included as part of the 10-yr implementation plan and the remaining projects to be included as part of the 25-year plan (the process covered in detail by this memorandum).

Watershed Advisory Group Input

The issues scoping forum and the watershed advisory group (WAG) provided valuable input about problem areas in the watershed. The WAG also reviewed the projects identified during the initial subwatershed strategies and provided feedback on project locations and feasibility. All comments from the scoping forum and the WAG were investigated and considered for project selection. Some of the issues identified were not feasible project sites or would have minimal impact on the flooding or water quality issues. Some comments were also more general and did not generate a specific project. The projects generated from the issues scoping forum and WAG are summarized below:

Comment	Project ID
Structural Projects	
Issues Scoping Forum – Erosion at Polecat Branch	JM9201
Issues Scoping Forum – Erosion at South Springs Drive	LR9103B
Issues Scoping Forum – Culverts eroding stream bed	LR9518, LR9519
Issues Scoping Forum – Erosion at Johnny Moore/Union Mill Road	JM9202
WAG #1 Comment – Erosion downstream of trail near Melstone Court	LR9102
WAG #2 Comment – Road Flooding	JM9400
Green Trails WAG Comment – Flooding, erosion	LR9509, LR9201
Non-Structural Projects	
WAG Comment – Trash in commercial shopping centers	LR9802, LR9803

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Comment	Project ID
WAG Comment – Junk removal, debris cleanup	LR9801
WAG Comment – Litter control	LR9800

Investigation of Candidate Projects

The projects identified during the initial subwatershed strategies were investigated in the field to evaluate the project feasibility and to gather other data such as site conditions, site constraints and potential construction considerations. Field staff noted any recommendations for the project and evaluated the feasibility of the project. Factors affecting the feasibility of a project included construction access, permitting issues, land ownership, utility conflicts, the topography of the site and other impacts on the stream, wetlands, trees or floodplain. A database summarizing the field information was developed (*CandidateProjectInvestigation Database_23June09.mdb*). A GIS file of the candidate project sites was also submitted (*CandidateProjects.shp*).

In order to develop a list of 80 projects for evaluation and prioritization, projects that were determined to be unfeasible or that would have minimal impact on the watershed were removed from the candidate project list. A table of the removed projects is shown below.

Removed Projects

Project ID	Description	Reason for Removal
1	Very Poor SPA Habitat Score, issues with golf course, engineered channel	Field investigation found no major issues with channel
7	Headcut from SPA	Identified in SPA - no evidence of head cut in field investigation
9	Golf Course clubhouse, parking lot, etc. confirm treatment	Field investigation verified that some treatment is provided in filters - feasibility of additions in private golf course low
10	Golf Course Ponds	Feasibility of modifications to private golf course ponds is low
12	Plant trees along stream and ponds where possible	Feasibility of planting buffer along golf course fairways is low
21	Clogging problem - review design to address problem - erosion issues north of pond. Recently retrofitted - sedimentation issues	Pond recently retrofitted - recent pond visit found no major problems
41	Bioretention/Grassed swale for uncontrolled area - on private property	Feasibility on private property low
51	Stabilize outfall to reduce erosion	Not viable from field investigation
53	Remove trickle ditches, add micropools/plantings	From field investigation - no trickle ditch, good plantings
66	Remove trickle ditches, add micropools/plantings - stabilize upstream sinkhole (complaint)	Field investigation - no trickle ditch, good plantings
87	Pond had eroded areas - stabilize - add wetland plantings - adjust subarea to include Sully Manor - area still in construction	Pond plantings have stabilized since previous field visit - pond recently constructed

Project ID	Description	Reason for Removal
88	From Pro-rata - drainage divides in area have changed significantly - no longer needed?	From pro rata - no longer an issue from field investigation
93	Stabilize stream, Pro rata culvert project - confirm overtopping from RAS - WAG comment that culvert was replaced	From field investigation - area is stable and has good habitat diversity
96	Erosion noted during field visit	2nd field visit found no major issues
119	WAG Comment - 100 yds of Creek severely degraded in this area - access issues	No major issues identified in field investigation
120	Cable barriers at power cuts - deter dumping and ATV use - WAG comment	Projects generated from WAG comment - will provide minimal benefit - add as general recommendation in WMP
121	Cable barriers at power cuts - deter dumping and ATV use - WAG comment	Projects generated from WAG comment - will provide minimal benefit - add as general recommendation in WMP
143	Retrofit pond to provide flow reductions, water quality benefit	Feasibility of modifications to pond on private property is low

Projects that were estimated to cost less than $80,000 were combined with other nearby projects. In addition, projects that were very close in proximity were combined for cost efficiency. A table reflecting these combined projects is shown below.

Combined Projects

Project Numbers	New Project ID	Project Types
14, 15	JM9400	Culvert Retrofit
22,23	LR9508	New BMP/LID
38, 39	JM9100	Pond Retrofit / Dump Site
47, 48	LR9102L	Pond Retrofit / Outfall Improvement
49, 50	LR9202	Stream Restorations / Buffer Restoration
52, 58	LR9104	Pond Retrofit / Stream Stabilization
64, 65	LR9013A	Stream Restoration / Buffer Restoration
72, 74, 76	LR9518	New BMP/LID
75, 77, 124	LR9802	New SWM / Non-structural
82, 83, 91	LR9521	Pond Retrofit / BMP/LID
84, 85	LR9112L	Pond Retrofit / Non-structural
118, 123	LR9801L	Debris Removal / Non-structural
90, 92	LR9112	Pond Retrofit / BMP/LID
97, 107	LR9114	Pond Retrofits

Prioritization

As noted in the Watershed Management Plan Development Standards, Version 3.2, previously identified structural/non-structural projects identified under Subtask 3.2 were to be evaluated and prioritized based on their overall benefit and feasibility in meeting the watershed goals and objectives. For the Little Rocky

Run/Johnny Moore Creek watersheds, AMEC followed County-provided guidance to set a baseline ranking. The baseline ranking process consisted of setting values in five categories that, when scored according to the provided weighted system, resulted in a preliminary project score. The five categories are described as:

1. Effect on Watershed Impact Indicators (30 percent)
2. Effect on Source Indicators (30 percent)
3. Location within Priority Subwatersheds (10 percent)
4. Sequencing (20 percent)
5. Implementability (10 percent)

Categories 3 (Location within Priority Subwatersheds) and 4 (Sequencing) are static. The provided guidance was followed and remains unchanged. Assumptions used to assign values to Category 5 are summarized separately in this memorandum and were based on input from the Watershed Advisory Group (WAG) and from the County. The two remaining categories required adjustments be made to the baseline conditions based on a consideration of the data collected to this point in the process, including but not limited to: field reconnaissance, professional experience in design, effectiveness, and implementability of the various project types, as well as WAG input. Justification is provided in this memorandum for adjustments that went beyond the scope of the provided prioritization scheme or accommodated specific project sites. The following section defines the baseline condition for Categories 1 and 2.

In order to determine individual project impacts to a subwatershed, „scenarios" were developed pairing no more than one proposed project per subwatershed at one time. There were two scenarios run for the Johnny Moore Creek watershed and seven for Little Rocky Run watershed. Once project selection was complete, a revised *future with project* profile was created that may include multiple projects in a single subwatershed.

SECTION 2.0 – Establishing a Baseline for Structural Projects

Impact Indicators

Attachment 1 defines which watershed impact indicators were evaluated for each project type. There are two kinds of impact indicators - those that are predictive and those that are not. The predictive impact indicators were evaluated with direct metric values assigned to the *future with project* watershed condition. These impact indicators have metric values for the existing condition, the *future without project condition* and the *future with project condition*. Therefore, they are quantifiable. Predictive indicators were scored according to the procedure outlined in the Watershed Management Development Standards and described below:

> *For predictive indicators, preliminary scores should be based on the percent change in impact score between future without and future with project conditions. Thresholds for project scoring should be based on quintiles (5 statistical percentiles) of the percent change values. The greatest positive percent change should receive a score of 5, and the lowest positive (or greatest negative) percent change should receive a score of 1. The percent change from existing to future should be reviewed to ensure that the preliminary project scores reflect benefits to existing as well as future conditions.*

The predictive impact indicators are Total Suspended Sediment (TSS), Total Nitrogen (TN) and Total Phosphorus (TP). A proposed project has a measurable effect on each of these indicators and quintiles were developed for each indicator regardless of project type. A table of loading rates and percent change for these indicators is shown in Attachment 2.

Benthic Communities, Fish Communities, Aquatic Habitat, Channel Morphology, Instream Sediment, Flood Complaints and E. coli are non-predictive. Scores for these indicators were assigned based on subwatershed need rather than a quantifiable impact a proposed project has on the impact indicator. Need in the subwatershed was assessed using existing conditions impact indicator scores, as determined by the subwatershed ranking protocol.

The remaining impact indicators fall into two groups: those that will become predictive when more data are available, and those that are predictive with an inadequate sample size. Indicators that will become predictive include Hydrology, Number of Road Hazards, Residential Building Hazards and Non-residential Building Hazards. At this stage, a *future with project* value is unavailable for these indicators. Best professional judgment was employed to assign project scores based on how well a particular type of project affected the presence of a watershed impact indicator.

For example, a project that increased the capacity of a culvert crossing would have a positive effect if upstream flooding hazards exist. It"s also possible a project of this type could exacerbate flooding downstream. These details were addressed in Subtask 3.6 utilizing HEC-RAS and SWMM modeling data. If a project was proposed specifically to address flooding issues, it was assigned a score of „5" for that impact indicator. These project/score associations were termed „score overrides" and are summarized in Attachment 3. They were applied generally and then revisited at the project level to determine whether the override accurately described the project impact for the linked indicator.

Best professional judgment was also employed for predictive indicators lacking sufficient data to support assigning project scores based on the percentile methodology. RPA Riparian Habitat, Headwater Riparian Habitat, Wetland Habitat and Terrestrial Forested Habitat are the impact indicators that fall into this category. Only a handful of projects impact these indicators, rendering the percentile methodology ineffective. Any project influencing these impact indicators was assigned a 5 (for the specific impact indicator affected). For example, a Buffer Restoration project received a project score of 5 where proposed planting efforts would have a positive effect on the Habitat indicators (Riparian, Headwater, Wetlands, and Terrestrial Forested). Actual computations were submitted for future analysis on a countywide basis but were not helpful at the watershed scale.

The overrides are summarized in Attachment 3. A score of 3 is best described as neutral. Some projects of a particular project type will have an impact on that indicator, but not necessarily all of them. They remain linked, but were assessed individually. Deviations from the provided overrides are explained separately in this memorandum. An impact indicator score was computed by averaging the scores of all the impact indicators affected by a specific project type.

A table showing the individual scores for each impact indicator is included as Attachment 4.

Source Indicators

Attachment 5 defines which watershed source indicators were evaluated for each project type. The procedure for predictive source indicators is identical to that of predictive impact indicators. The predictive source indicators are TSS, TN, and TP (detailed loading results are the same for Impact and

Source Indicators for TSS, TN, and TP, all of which is summarized in Attachment 2). It is noted that Stream Restoration projects were not linked to anything but the predictive source indicators. There is a clear disconnect between the location of the source and the proposed project location for stream restoration projects. Many of these projects are proposed along Little Rocky Run or Johnny Moore Creek, within in-line subwatersheds that mostly score well for several source indicators. This is attributed to the fact that many of the in-line subwatersheds contain a significant stream buffer and therefore do not contain as many source indicators (impervious areas, channelized/piped streams, outfalls, etc.) as the headwater subwatersheds. Otherwise, the matrix is the same as what was provided by the County.

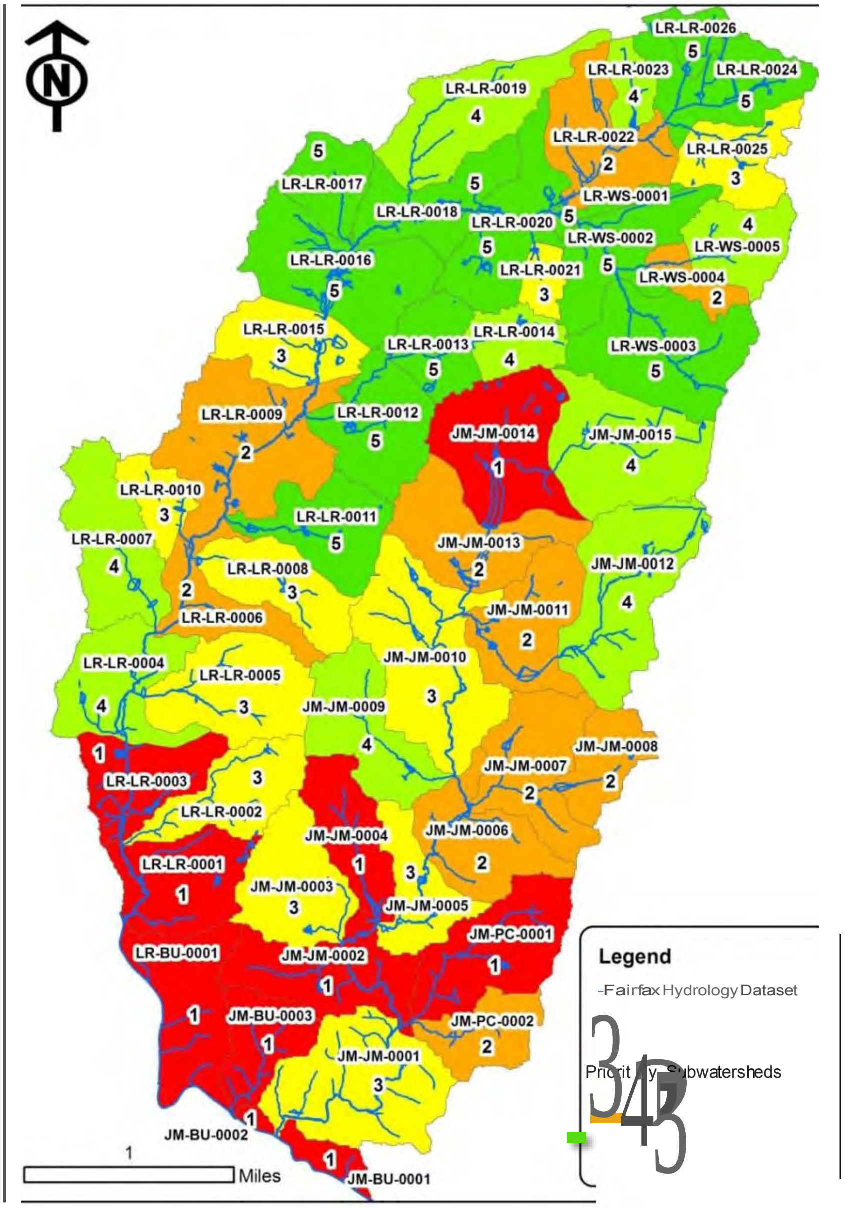
Channelized/Piped Streams, Directly Connected Impervious Area (DCIA), Impervious Surface and Stormwater Outfalls are non-predictive and were scored in the same fashion as non-predictive impact indicators. With few land use changes expected in either watershed, applying the percentile methodology on the difference between the *future without project condition* and the *existing condition* did not yield meaningful results. Therefore, existing conditions scores for source indicators were used to determine subwatersheds that contain more source indicators. A source indicator score was computed by averaging the scores of all the source indicators affected by a specific project type.

Attachment 6 shows the individual scores for each source indicator.

Location within Priority Subwatersheds

Priority subwatersheds were based on the impact indicator composite scores of the *future without project scenario*. Impact indicator composite scores represent an average score for every impact indicator per subwatershed. Quintiles were developed and scores were assessed based on need. In other words, the subwatersheds with the lowest impact composite score received the highest priority (5) score.

Priority Subwatersheds (10°/o)

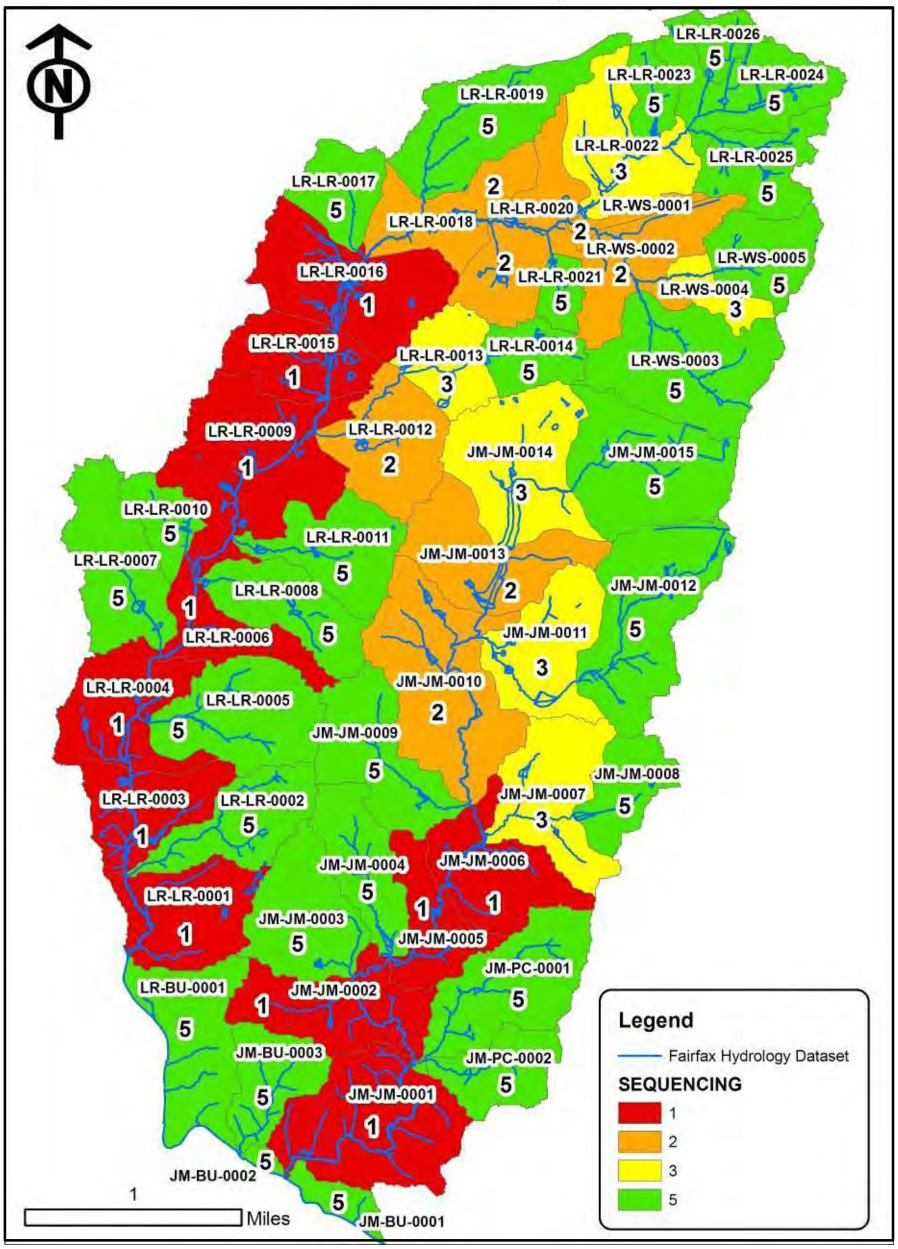


Sequencing

Sequencing scores were developed by first recording the upstream-downstream order of the subwatersheds. Headwater subwatersheds (any subwatershed where a stream originates) were given an order of 1. Subwatersheds just downstream of headwater subwatersheds were given an order of 2. This process continued until all subwatersheds are assigned an order, with the most downstream subwatersheds receiving the highest value. Where subwatersheds of different orders were upstream of a single subwatershed, that subwatershed received the next sequentially highest order.

Once the subwatershed order was established, quintiles were used to assign a project score to each subwatershed order. Those with the lowest subwatershed order were given the highest project score (5). A map showing the scores is below.

SEQUENCING (20%)



Implementability

Guidance from the Watershed Management Plan Development Standards Version 3.2 was used to assign scores for this rating component. This guidance is summarized below:

- High Implementability (5 points)
  - Tree buffer restoration
  - Debris/trash removal
  - SWM retrofits in County maintained facilities where no additional land rights are required
  - Stream restorations that do not require upstream runoff quantity reductions and are proposed on sites with significant land owner support
  - LID retrofits at schools and other County facilities
  - Other priority projects that have significant land owner support
- Moderate Implementability (3 points)
  - Other pond and LID retrofits and other stream restorations that do not require upstream runoff quantity reductions
- Low Implementability (1 point)
  - Projects that do not fit into the above categories and are likely to be less feasible than the majority of recommended projects

Projects with significant site constraints generally have an adjusted score to the next lower category. Projects that were given a 5 for implementability include: pond retrofits on HOA property, new SWM projects on school properties, buffer restorations and non-structural projects such as litter control and education projects. Most stream restoration projects were given a 3 because they are located in areas not owned by the County, would require tree removal and landowner support is unknown at this time. New SWM and culvert retrofits were also given a 3 as they are generally located in HOA areas or private property where landowner support is unknown. Projects given a 1 include: regional ponds, flooding mitigation projects, culvert projects to address road flooding and other projects located on private property where feasibility and access were identified as issues during the field investigations.

For example, for New BMP/LID projects, project LR9512 was given a 3 for implementability because the project is located on HOA property and the landowner issues are unknown, while project LR9516 was given a 5 for implementability because it is an LID retrofit at a school. All pond retrofits were given a 5 for implementability because they are County maintained facilities except for JM9100, which is a breached private facility, and LR9116, which is an existing regional facility that was stabilizing during the field inspection. Additional observance of this pond is needed to determine if this project is necessary at this time.

Assessing potential constraints was a large component of the field work conducted for the candidate projects: the data are available in the database and detailed in the final plan project fact sheets.

Project Scores

Using the weights described in the introduction of this memorandum, a final project score was computed. Attachment 7 includes the final scores for each of the five components that make up the project score. Overrides and project specifics were established using an iterative process and best professional judgment afforded AMEC‟s team from WAG input and knowledge of the watershed. Where baseline scores were adjusted, documentation is provided in Section 3.0.

SECTION 3.0 - Project Specifics and Assumptions

A map of proposed project locations is included as Map 1.

Stream Restoration

Projects were scored based on the baseline scores shown above with a few exceptions. Most of the stream restoration projects are located in areas with erosion problems identified in the County‟s Stream Physical Assessment (SPA). For these projects, the STEPL pollutants (TSS, TN and TP) calculated for the subwatershed were increased using the streambank erosion equation to account for this erosion. This erosion increase was removed in the *future with project condition* to account for the change in pollutant loads these projects would have.

Some projects were not located in previously identified erosion areas and were either identified by the WAG or during the field investigation process. These projects could not have the streambank erosion adjustment removed from the STEPL to determine the project‟s impacts on the STEPL pollutants. Therefore, for these projects the scores for TSS, TN and TP were manually adjusted to reflect an improvement. Adjustments were made for two different types of projects: removal of concrete channels, and stream restoration projects in newly identified eroded areas. For the removal of concrete channels, the scores for TSS, TN and TP were changed to 3. For stream restoration projects in eroded areas these scores were adjusted to 4. The projects for which these adjustments were made are identified below.

Stream Restoration Projects with Adjustments to TSS, TN, and TP Scores

Project ID	Project Type	Adjustment to TSS, TN and TP Scores
LR9208	Concrete channel removal	3
LR9203		
LR9209		
LR9204		
JM9202	Stream restoration in newly identified erosion area	4
LR9201		
JM9201		

Outfall Improvements

There were only two outfall improvement projects identified in the watersheds – no change was made to the baseline scores.

Culvert Retrofits

Only culvert projects that address road flooding were treated as a culvert retrofit - culvert projects that provide water quality improvements upstream of the project were treated as new stormwater management facilities. For this watershed plan, only one road crossing improvement was identified due to a WAG comment. There were no buildings upstream of this crossing, so the impacts on residential and non-residential hazards were removed for this project or it would have been incorrectly elevated in rank.

Flood Protection/Mitigation Projects

There was only one flood protection mitigation identified in the watershed. A residential structure is located in the floodplain of Little Rocky Run downstream of Arrowhead Park Drive. No change was made to the baseline scores for this project.

New BMP/LID and BMP/LID Retrofits

No BMP/LID retrofits were proposed. AMEC evaluated new BMP/LID projects by adjusting the subareas as appropriate and calculating new nutrient loadings. BMP/LID type was not considered in the revised calculations. Instead, subareas were converted where applicable to subarea „C", which represents average removal efficiencies for several different BMP/LID options. While in some cases the specific proposed BMP/LID is known, there were many site constraints and other unknowns that made it impossible to be specific in every case. In order to avoid introducing a bias, the subarea C removal efficiencies were used for all new BMP/LID projects.

The wetland habitat scores for the new stormwater management projects that are proposed to be tree box filters were reduced from the override value of 5 to 3 since these projects would not impact wetland habitat. The projects for which this adjustment was made are summarized below.

Projects with Adjustment to Wetland Habitat Override Values

LR9505B	LR9507	LR9515
LR9503	LR9103C	LR9518
LR9501	LR9513	LR9520
LR9502	LR9517	LR9512
LR9505		

New Stormwater Ponds and Stormwater Pond Retrofits

New stormwater ponds and stormwater pond retrofits were grouped together because they are linked to the same impact and source indicators. Only one new stormwater pond was considered.

Initially, retrofits to existing dry ponds were evaluated by adjusting removal efficiencies from standard „B2" values to removal efficiencies obtained from Table 7 of „Stormwater Loading Factors and BMP Efficiencies for Countywide SWMM Model Applications". The adjustments to the loadings are summarized below.

Retrofit Removal Efficiencies

	TN	TP	TSS
Original efficiency for B2 areas	0.30	0.40	0.80
Recommended efficiency for retrofitted B2 areas*	0.45	0.55	0.80
Efficiency used in ranking**	0.38	0.53	0.80

**From "Stormwater Loading Factors and BMP Effiencies for Countywide SWMM Model Applications," Table 7, Extended Dry Detention Basin with Stormwater Wetlands Bottom*

***Same as efficiency for C areas*

AMEC was not satisfied with the results of this adjustment as pond retrofit projects were heavily weighted. The main reason for this is that new SWM/BMP removal efficiencies were not customized to a specific treatment type. They were categorized using the removal efficiencies assigned to subarea type „C" as previously described. The removal efficiencies from Table 7 were higher across the board than subarea C efficiencies, causing many proposed new BMP/LID facilities to fall out of the proposed top 40 projects. To be consistent, pond retrofits were adjusted to subarea C removal efficiencies for TN and TP. TSS removal efficiency remained at 80 percent since the reviewed literature supports that figure for stormwater ponds.

Regional Ponds

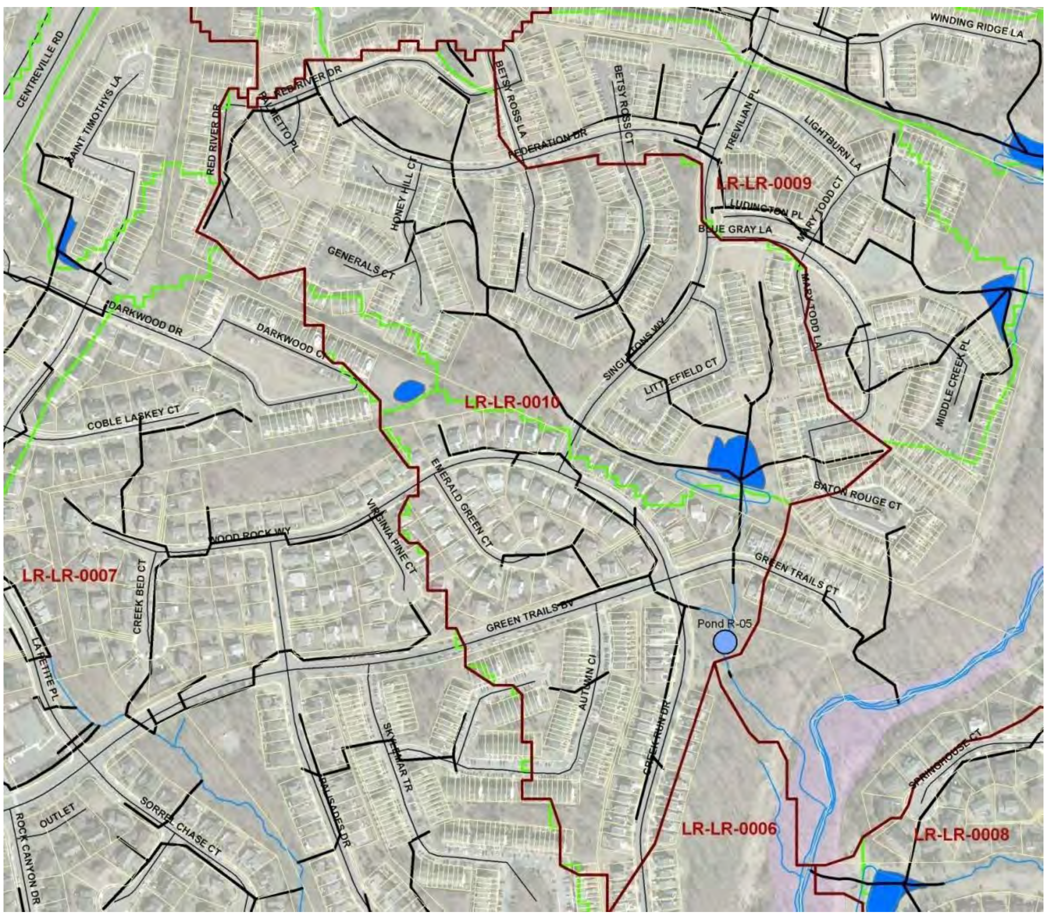
There are four inactive regional pond projects in the Little Rocky Run watershed. All of these have low feasibility because of their location on private property or other issues. The regional ponds were included as projects in the ranking and prioritization process to provide a comparison point for the impact and source scores. These ponds rank higher than they should, even with a low score for implementability, due to their positive scores for pollutant removal and their locations in headwater subwatersheds which gives them a high sequencing score. Although each regional pond was ranked, they are not shown in the final ranking table (Attachment 7) to avoid confusion with other projects that are more feasible. Each regional pond is summarized below along with the project alternatives. The table below links proposed projects and the associated Regional facility.

Project ID	Regional Pond Number
LR9005S*	R-05
LR9005A	R-05
LR9005B	R-05
LR9005C	R-05
LR9010S*	R-10
LR9010A	R-10
LR9010B	R-10
LR9013S*	R-13
LR9013A	R-13
LR9013B	R-13
LR9013C	R-13
LR9013D	R-13

** Hypothetical new regional ponds*

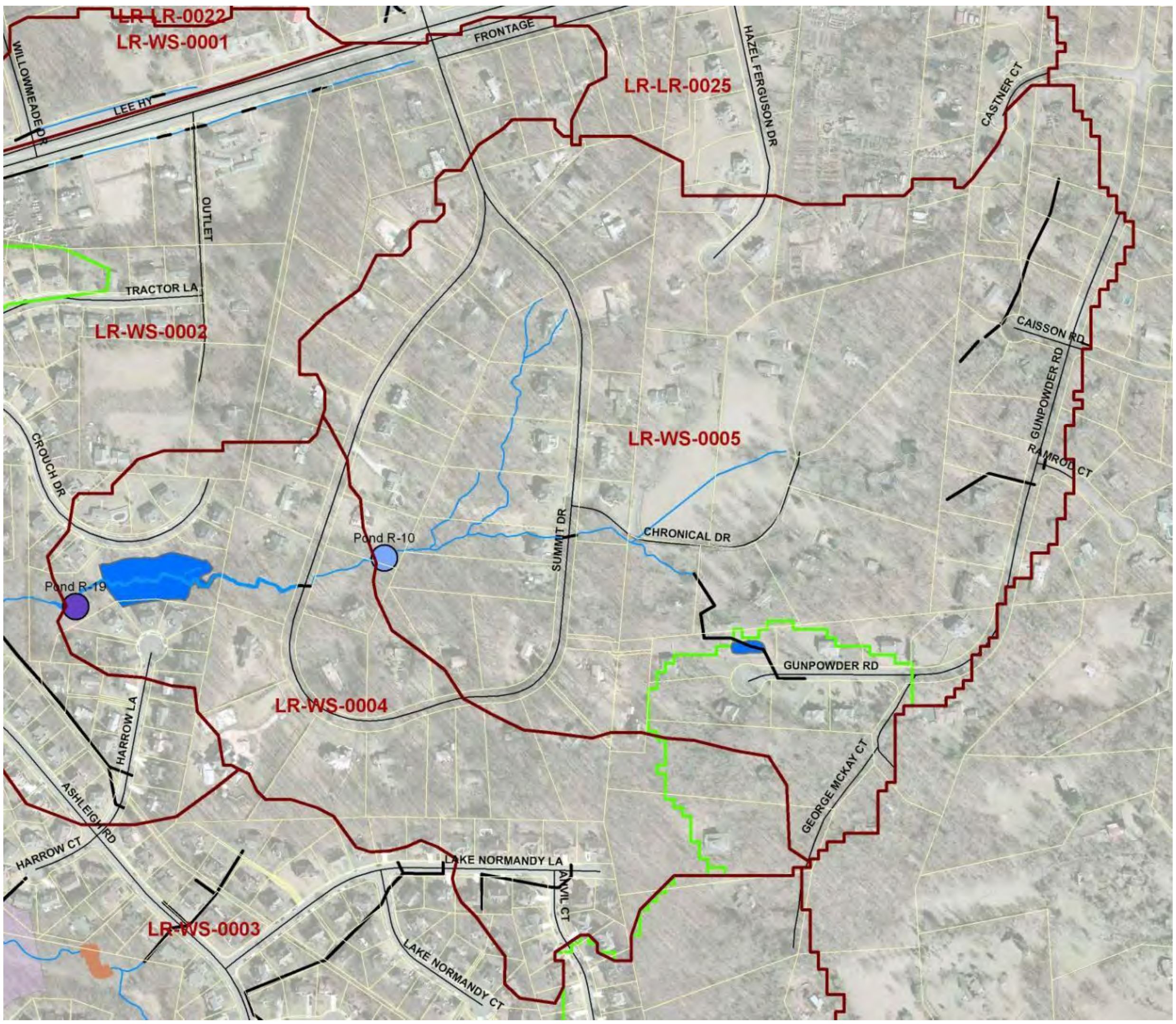
Regional Pond R-05

This pond is located in an area owned by the Green Trails Homeowner"s Association (HOA) in subwatershed LR-LR-0010. From discussions with the WAG, the HOA is not supportive of a pond in this location. The drainage area to the proposed pond site is 64 acres. Two dry ponds have been constructed upstream of the pond site, 0829DP and 1312DP, with subareas of 39 acres and two acres respectively. Because of these ponds, 64 percent of the regional pond area is controlled by stormwater management facilities. The proposed alternatives include providing treatment of the untreated storm sewer system to the west of the pond site, which would treat approximately 20 acres; providing treatment of the untreated storm sewer system to the east of the pond site, which would treat approximately seven acres; and retrofitting pond 0829DP to enhance the pond removal efficiency. A map of the pond area is below.



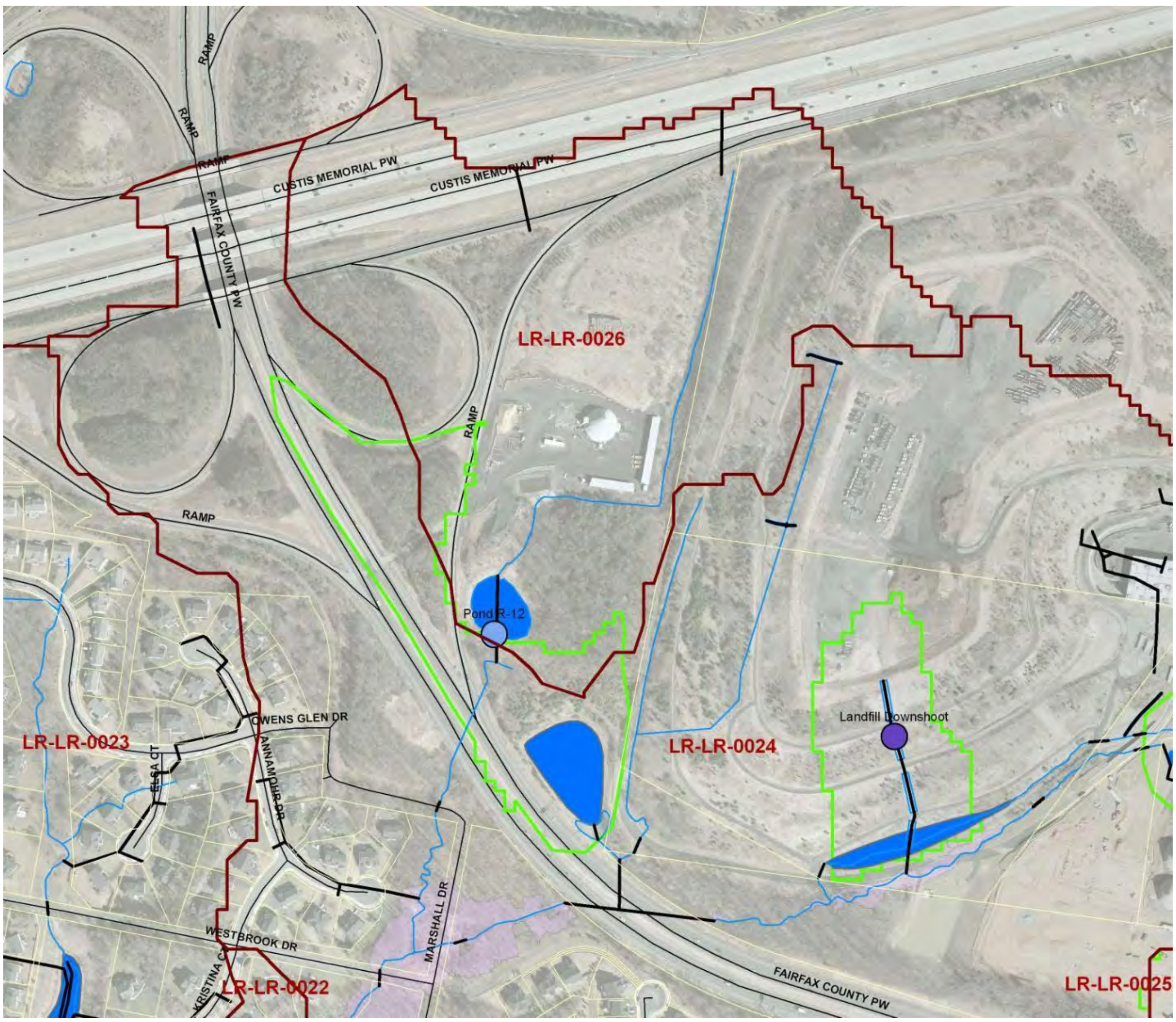
Regional Pond R-10

This pond is located on a number of large residential properties in subwatershed LR-WS-0005. The drainage area to the pond is 114 acres. Regional pond R-19 is located just downstream of the Pond R-10 site – the Regional Pond Plan included both of these ponds in series. There is a wet pond upstream of R-10 that treats approximately 14 acres. The feasibility of constructing pond R-10 is low because of the property issues involved. Another factor is that the low density of the development upstream of the pond site does not appear to warrant two regional ponds in series. The proposed alternatives include buffer restoration upstream of the pond site and retrofitting Pond R-19 to enhance the pond removal efficiency. A map of the pond area is below.



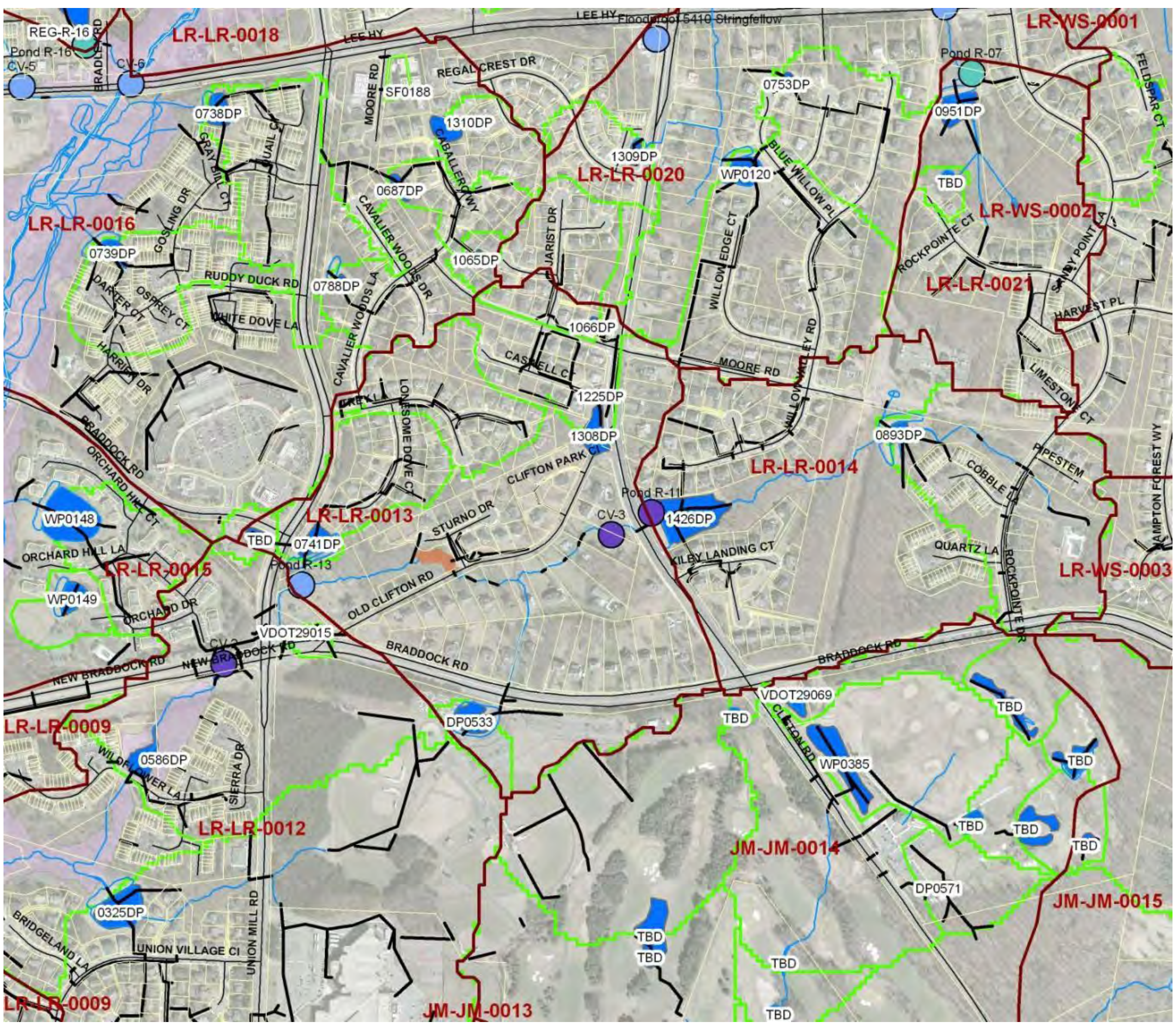
Regional Pond R-12

This pond is located on VDOT property at the intersection of the Fairfax County Parkway and Interstate 66. Although the regional pond was not constructed by the County, there is a VDOT pond (VDOT29016) at the site of the proposed regional pond that is treating all 46 acres draining to it. There is another VDOT pond (VDOT29017) just south of that is treating additional road drainage. These ponds provide the treatment originally proposed in Pond R-12. Additional treatment of the areas is proposed downstream of the Fairfax County Parkway. A map of the pond area is below.



Regional Pond R-13

This pond is located on private residential property in subwatershed LR-LR-0013. The drainage area to the proposed pond site is 183 acres. This includes the 82 acres upstream that are treated by Regional Pond R-11. The Regional Pond Plan includes these two ponds in series. The feasibility of this pond is low because of its location on private property and space and topography constraints. Four dry ponds have been constructed in the drainage area of Pond R-13 downstream of R-11: 1308DP (11 acres), 0741DP (21 acres); VDOT Pond (two acres) and DP0533 (eight acres). Because of these ponds, 42 percent of the regional pond area is controlled by stormwater management facilities. There is also an inline pond (0586DP) downstream of the R-13 site that treats 105 acres – including the R-13 area. The proposed alternatives include stream restoration of an eroded area downstream of Old Clifton Road; buffer restoration; new stormwater management of untreated system at the intersection of Braddock Road and Union Mill Road; storage upstream of the culvert at Union Mill Road; and retrofitting pond 0586DP to enhance the pond removal efficiency. A map of the pond area is below.



SECTION 4.0 – Non-structural Prioritization Criteria

In this watershed, there were two types of non-structural projects assessed: buffer restoration and other non-structural projects. Buffer restoration projects were identified through the SPA data that identified areas with insufficient buffer width. Buffer restoration projects were assessed using the baseline scoring for stream restoration, adjusted to remove channel morphology (CEM): hydrology, TSS, TN and TP from the Individual Impact Indicators and channelized/piped streams, stormwater outfalls, SS crossings, E. coli, TSS, TN and TP from the Source Indicators. Terrestrial forested habitat was added to the scoring for the Individual Impact Indicators. Thus the scoring indicators for buffer restoration include:

Individual Impact Indicators:

- Benthic Communities
- Fish Communities
- Aquatic Habitat
- Instream Sediment
- RPA Riparian Habitat
- Headwater Riparian Habitat
- Wetland Habitat
- Terrestrial Forested Habitat

Source Indicators

- Streambank Buffer Deficiency

Ranking Scores for Buffer Restoration Projects

Buffer Restoration Projects						
Project ID	**Impact 30%**	**Source 30%**	**Location within Priority Subwatershed 10%**	**Sequencing 20%**	**Implementability 10%**	**Project Weighted Score**
LR9010A	**5**	**1**	**4**	**5**	**5**	**3.625**
JM8801	**4**	**1**	**3**	**2**	**5**	**2.7375**
JM8800	**5**	**1**	**5**	**2**	**5**	**3.0125**
LR8800	**5**	**5**	**3**	**5**	**5**	**4.7625**

Three non-structural projects were identified through the Issues Scoping Forum and from WAG input. The WAG identified several areas that are usual sources of litter that would benefit from a targeted litter control education programs and cleanups to reduce floatables in the watershed. Project LR9800 is the result of WAG comments about litter in Compton Valley Estates. Project LR9801 is the result of WAG comments about debris at the Bent Tree Apartment complex. Project LR9802 resulted from WAG complaints about trash at two commercial shopping centers. Each of these projects would involve educating the property owners about trash removal and litter control requirements. Each would also be involved with targeted litter control projects such as installation of gutter guards and stream cleanups.

The WAG also identified other areas of concern that did not generate projects in the watershed plan. These include trails along Little Rocky Run to increase citizen access, monitoring of the landfill in the headwaters of the watershed, development in the watershed, access along the power line easement and encroachment into the RPA.

These non-structural projects were scored using a modified version of the system used for the structural projects. Instead of the five factors used in the structural scoring, four factors were used. Three of the factors are the same as those used in the structural scoring: location within priority subwatersheds, sequencing and implementability. The other indicator used to rank non-structural projects was a score based on the impact the projects would have on watershed health. Since these projects were similar, each was given a score of 4 for impact. The projects would address citizen concerns and help reduce the litter problem in the Little Rocky Run watershed. The weights and scores for the non-structural projects in the plan are shown below.

Ranking Scores for Non-Structural Projects

Non-Structural Projects					
Project ID	Impact 40%	Location within Priority Subwatershed 15%	Sequencing 30%	Implementability 15%	Project Weighted Score
LR9801	4	5	2	4	3.6
LR9802	4	5	2	4	3.6
LR9800	4	5	1	4	3.3

SECTION 5.0 – Project Modeling

The benefits of plan implementation were analyzed through the modeling. Projects in the 10-year implementation plan that could impact stormwater discharge rates through new or increased detention storage were modeled in the SWMM hydrologic model to determine the magnitude of this new or increased storage on discharge rates. These changes included some modifications to subareas draining to facilities.

These discharge changes were then input into the HEC-RAS hydraulic model to assess any changes to flooding elevations. The changes to flood elevations as a result of the projects were minimal.

The pollutant removal provided by each project was analyzed using the STEPL spreadsheet.

These changes were then incorporated into the project impact composite score to reassess the project ranking based on the SWMM results. The addition of the modeling output to project ranking resulted in an increase in rank for projects providing water quantity improvements. The ranking adjustments generated by the changes to the SWMM and HEC-RAS along with modified project IDs are shown in Attachment 8.

5.1 Design Storms

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50 percent chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10 percent chance of happening in a given year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or „runs off") from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- *Hydrologic models* take into account several factors: the particular rainfall event of interest; the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that are transported by the runoff.

- *Hydraulic models* represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can predict both the ability of man-made culverts/channels to convey stormwater runoff and the spatial extent of potential flooding.

The table below shows three storm events and the rationale for being modeling:

Modeling Rationale

Storm Event	**Modeling Rationale**
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

5.2 Selection of Projects

Ten projects from the 10-year implementation plan were selected for SWMM modeling. The projects analyzed in the SWMM were: JM9100, JM9500, LR9005A, LR9005C, LR9010B, LR9013D, LR9102, LR9110, LR9115, and LR9509.

Projects were selected based on the criteria established at the Technical Team Meeting #6 and in accordance with the guidance document entitled, Clarification of language from March 2009 WMP Standards Version 3.2 (Subtasks 3.4 & 3.6). Based on these criteria, projects that were capable of providing meaningful increased quantity control or reduced flooding were selected for additional modeling in subtask 3.6.

Seven of the projects selected for SWMM modeling are pond retrofits that include an increase in storage. The other three projects modeled in SWMM include new facilities and a culvert retrofit that will provide increased storage.

To be consistent with this guidance, the modeling effort in subtask 3.6 did not include modeling subarea type C facilities in the SWMM model. Projects of this type include rain gardens, water quality filters and infiltration basins. Projects of this class were generally smaller scale improvements to the local area, and although these projects have high water quality benefits, they provide no meaningful quantity control and have little to no impact on reducing flooding conditions.

Pond retrofits that did not include significant modifications in storage or changes to the riser configuration were not modeled in the SWMM. These projects will provide improved water quality benefits through the removal of trickle ditches and addition of plantings.

The HEC-RAS models for Little Rocky Run and Johnny Moore Creek contain only the main stem and major tributaries of the two watersheds. There are no proposed projects reflected in the HEC-RAS models due to project locations outside of the modeling area, the extent of the proposed changes to the stream channel, or other factors. Culvert retrofits, in-line ponds and stream restoration projects that are not located on a modeled channel could not be incorporated into the model. Stream restoration projects that did not propose alterations to the channel cross sections or significant changes to the morphology and planform of the stream were also excluded from the HEC-RAS modeling effort. Minor stream restoration projects, such as stream bank stabilization, do not significantly change the conveyance capability of the stream channel nor do they generally have a significant impact on channel velocities.

5.3 Setup and Calibration of Stormwater Models

As discussed in the previous section, modeling is a way to mathematically predict and spatially represent what will occur during a given rainfall event. Hydrologic and hydraulic models are the two types of models that are used to achieve this.

Hydrologic and hydraulic models were created for three distinct scenarios as listed below:

- Existing conditions
- Future conditions without projects
- Future conditions with projects

For *existing conditions*, the models simulated the condition of the watersheds at the time the models were created by incorporating information on land use, soils, existing stormwater management and best management practice facilities, previous stream and watershed assessments, and actual field reconnaissance and site visits. The *future conditions without projects* scenario simulated future conditions based on countywide future land use and development, derived from the County‟s comprehensive plan and build-out predictions. As the name implies, the *future conditions without projects* models do not contain any of the watershed restoration strategies or projects identified in this plan. The *future conditions with projects* scenario simulates the implementation of the projects discussed in the previous sections.

The *future conditions with projects* scenario uses the *future conditions without projects* models as a base on which proposed restoration strategies are added and evaluated. Comparison of modeling results from these three scenarios yielded pollutant loading and stormwater runoff reductions which are discussed below.

5.4 GIS Processing

A sequence of Geographical Information System (GIS) processing was required in preparation for pollution modeling with STEPL and hydrologic modeling with SWMM. The *future conditions with projects* scenario was evaluated in the STEPL. Each project was evaluated individually in order to assess the benefits of each individual project. In order to isolate project benefits, the projects were divided into multiple „runs" for modeling purposes. Each run contained no more than one project per subwatershed; projects with multiple subprojects were processed together in order to model the benefits of the entire group of projects. These results were used in the report to summarize plan benefits. A final composite subarea layer reflecting all projects and associated STEPL models were provided for future use (See Section 6).

For each run, drainage areas to each modeled project were delineated in GIS. Processing was conducted in GIS to break each subwatershed into subareas based on the existing and/or proposed stormwater controls. There are five distinct subareas, each representing a type of stormwater facility:

- Peak-shaving only (subarea A)
- Peak-shaving and water quality, wet pond (subarea B1)
- Peak-shaving and water quality, dry pond (subarea B2)
- Peak-shaving only (subarea C)
- No stormwater treatment (subarea D)

Subareas were delineated from subwatersheds to adequately characterize all of the stormwater treatment that was occurring in the subwatershed. In some cases, the *existing conditions* and *future conditions without projects* subareas were calculated incorrectly. The treatment by some ponds was not included in the appropriate subarea because the pond was not included in the County"s stormwater network and not identified until candidate project field reconnaissance, or because the drainage area to the pond did not contain any parcels included in the County"s controlled parcels GIS layer. The treatment of some other areas was overestimated, usually because the parcels were included in the County"s controlled parcels GIS layer but not located within the drainage area of an existing stormwater management facility. These inaccuracies inherent in the GIS processing methodology are minimal at the watershed scale; however, they are problematic at an individual project scale. For areas where the individual projects did not show a water quality benefit because of these discrepancies, the process described in Section 6.0 was used to quantify the project benefit.

5.5 Pollution Model

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) model developed for the U.S. EPA was used to quantify the nutrient and sediment loads generated by stormwater runoff. The STEPL model calculates nutrient and sediment loads using simple algorithms based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. Sediment and pollutant load reductions that result from the implementation of existing and/or proposed stormwater management facilities or best management practices (BMPs) are computed using known pollutant removal efficiencies.

5.5.1 Pollutant Model Setup

A STEPL model was developed for each of three conditions as described above. The model for each scenario was generally set up in the same manner. Local data such as state name, County name, precipitation information, Universal Soil Loss Equation (USLE) parameters and nutrient concentration in runoff were entered into the model.

Land use and soils tables were developed and imported into the STEPL model based on the distribution of each land use type or soil hydrologic group within each subarea. Pollutant loads and load reductions were automatically calculated for total nitrogen, total phosphorus, and sediment.

Because pollutant loads and load reductions were calculated at a subwatershed scale, each proposed project was modeled individually in order to show the water quality benefits for each specific project, and as a group to show the water quality benefits of watershed management plan as a whole.

Regional ponds were not modeled using the subarea classifications like smaller stormwater facilities because these facilities often drain larger areas that may include several subareas with additional stormwater controls. Therefore, regional facilities that were proposed for retrofit or construction were modeled by revising the regional pond pollutant removal efficiencies.

5.5.2 Streambank Erosion

The erosion areas were primarily identified through the County‟s SPA data with some areas added based on comments from the public or identified during the field reconnaissance conducted in June 2008.

Per the guidance document "Guidance for Representing Streambank Erosion and Regional Pond Efficiencies," dated 2/5/2009, the empirical equation was used to characterize the streambank erosion:

Annual Sediment Load from Streambank, ton = L*H*RR*DW* NCF

Where:

L = Streambank Length, ft

H = Streambank Height, ft

RR = Lateral Recession Rate, ft/year

DW = Soil Dry Weight, ton/ft^3, based on the soil texture (Values from February 2009 guidance document based on soil texture)

NCF = Nutrient correction faction, based on the soil texture (optional) (Values from February 2009 guidance document based on soil texture)

Load Reduction = Load * BMP Efficiency

Nutrient Load, lbs = Sediment Load * NC/100 (Sediment load based on the equation in the February 2009 guidance document)

Where NC = Nutrient concentration percentage (Calculation of loads based on percentages from STEPL)

Bank length was based on the eroded stream length from the SPA layers and reflects actual measurements performed in the field during the SPA analysis. AMEC visited most of the erosion areas and identified some new ones, so rough field measurements for bank height were used. In the event that a site wasn‟t visited (e.g., there was an erosion site in the middle of the FCPA that was considered inaccessible during the field reconnaissance), a judgment of height was made using the SPA data.

The lateral recession rate was based on SPA data and/or field reconnaissance data using the categories and descriptions from the Streambank Lateral Recession Rate table in the STEPL spreadsheet. The values for the recession rate are based on the default values recommended in the February 2009 posting from Tetra Tech. The posting was in the technical discussion STEPL template/Streambank Erosion thread.

A Microsoft Excel spreadsheet was used to calculate stream loadings in lieu of creating a separate STEPL model. The calculated loads were aggregated to the subwatershed level and incorporated with the land-based loadings generated in the previously loaded STEPL models to determine total loadings used in the project prioritization task.

5.5.3 Pollutant Model Results

The results of the STEPL model by WMA are summarized in the following table. It is estimated that the 10-year implementation plan would remove 283 tons per year (33 percent) of sediment, 1,583 pounds per year (5 percent) of nitrogen and 317 pounds per year (8 percent) of phosphorus. The pollutant removal of the entire plan is estimated at 348 tons per year (40 percent) of sediment, 2,374 pounds per year (8 percent) of nitrogen and 474 pounds per year (11 percent) of phosphorus.

Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TSS	TN	TP
			2 Year	10 Year	2 Year	10 Year	(lb/ac/yr)[2]	(lb/ac/yr)[2]	(lb/ac/yr)[2]
Johnny Moore Creek	3373.7	Existing Condition	1.23	2.93	0.15	0.43	236.16	1.91	0.35
		Future Without Projects	1.26	2.97	0.16	0.45	246.04	2.42	0.42
		Future With 10-year Projects	1.22	2.90	0.15	0.44	120.89	2.28	0.37
		Reduction (10-year Plan)	0.04 (3%)	0.07 (2%)	0.01 (3%)	0.01 (2%)	125.15 (51%)	0.14 (6%)	0.05 (11%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	120.87	2.28	0.37
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	125.17 (51%)	0.14 (6%)	0.05 (11%)
Little Rocky Run - Lower	2211.74	Existing Condition	1.69	3.60	0.30	0.84	157.56	5.34	0.67
		Future Without Projects	1.70	3.62	0.31	0.86	159.98	5.50	0.68
		Future With 10-year Projects	1.70	3.61	0.30	0.85	139.99	5.27	0.64
		Reduction (10-year Plan)	0.00 (0%)	0.01 (0%)	0.01 (1%)	0.01 (1%)	19.99 (12%)	0.23 (4%)	0.04 (6%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	97.03	5.12	0.61
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	62.95 (39%)	0.38 (7%)	0.07 (11%)
Little Rocky Run - Upper	2329.46	Existing Condition	1.37	3.04	0.14	0.41	229.23	4.59	0.66
		Future Without Projects	1.41	3.09	0.15	0.43	230.47	4.71	0.67
		Future With 10-year Projects	1.40	3.08	0.14	0.41	187.42	4.44	0.63
		Reduction (10-year Plan)	0.01 (0%)	0.01 (0%)	0.01 (2%)	0.02 (3%)	43.05 (19%)	0.27 (6%)	0.04 (7%)
		Future With 25-year Projects	N/A	N/A	N/A	N/A	172.79	4.26	0.61
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	57.68 (25%)	0.45 (10%)	0.06 (10%)

[1] Flow is cumulative
[2] Loads are representative of individual land area contributions
[3] 25-year projects were not evaluated in the hydrologic model

5.6 Hydrologic Model

The SWMM model was developed by the U. S. Environmental Protection Agency and was used to model rainfall runoff relationships in the Little Rocky Run and Johnny Moore Creek watersheds. Peak rate of runoff and total runoff volume values were generated from the SWMM models and describe the magnitude of stormwater runoff that results from each of the design storms.

5.6.1 Hydrologic Model Setup

SWMM models were generally created in the same manner for all three scenarios. Delineated subwatersheds were imported into the model and subareas were added depending on the type of stormwater facility/restoration strategy. Subwatershed and subarea parameters were input into the model from existing data, updated with field reconnaissance data and calibrated against real world flow and runoff information.

Subareas were delineated from subwatersheds to adequately characterize all of the stormwater treatment that was occurring in the subwatershed. Subareas were representative of all stormwater facilities or restoration strategies of a single type within a subwatershed. Therefore, the area draining to the facilities of each type were summed up and modeled as a single subarea
(i.e. sum of all areas draining to C type facilities are represented by a single C type subarea within the model).

Regional ponds listed in the 1989 County Regional Stormwater Management Plan have both the stage-area relationship and the orifice elevation and size available. These regional ponds were represented within the model separately from the subarea delineation described above. The stage-area table from the report was specified for the storage unit, and the sizes and crest heights were specified for the orifices.

SWMM models for the *existing conditions* and the *future conditions without project* scenarios were prepared by Tetra Tech, updated with field reconnaissance data and calibrated using discharge relationships developed in D. G. Anderson‟s 1970 Water Supply Paper and/or flood frequency methods detailed in U.S.G.S. Fact Sheet 023- 01.

The SWMM models for the *future conditions with projects* scenario were developed using the *future conditions without projects* as the base models into which the proposed 10-year structural projects would be added. The SWMM Updating Tool developed by Tetra Tech and the methodology outlined in the “Tutorial for using the SWMM Updating Tool” provided by Tetra Tech were used to build these SWMM models.

Subareas delineated in the GIS processing described above were manually entered into the SWMM models and subarea parameters such as subarea width and storage unit surface areas were calculated and adjusted in the models. Orifice sizes for the various stormwater facilities were calculated per the “Tutorial for Orifice Sizing” provided by Tetra Tech.

Calibrated infiltration values in subareas that had no change in area from the *future conditions without projects* models were copied into the *future conditions with projects* models and finalized.

5.6.2 Hydrologic Model Results

The hydrologic model results are summarized in the following table.

SWMM Modeling Results

Subbasin	Project ID	2-yr Total Flow (cfs)			10-yr Total Flow (cfs)		
		Future without Projects	Future with Projects	Difference	Future without Projects	Future with Projects	Difference
JM-JM-0003	JM9100	53.45	38.99	-27%	130	106.15	-18%
JM-PC-0002	JM9500	48.87	33.5	-31%	108.86	79.52	-27%
LR-LR-0007	LR9509	36.07	34.91	-3%	125.91	117.12	-7%
LR-LR-0008	LR9102	77.51	77.58	0%	154.9	155.01	0%
LR-LR-0010	LR9005A & LR9005C	46.58	42.13	-10%	103.12	85.7	-17%
LR-LR-0012	LR9013D	163.69	134.99	-18%	320.81	268.86	-16%
LR-LR-0014	LR9110	17.01	16.57	-3%	51.57	50.42	-2%
LR-LR-0021	LR9115	8.46	8.36	-1%	24.93	24.75	-1%
LR-WS-0004	LR9010B	36.33	36.33	0%	76.81	76.81	0%

5.7 Hydraulic Model

The Hydrologic Engineering Centers River Analysis System (HEC-RAS) hydraulic model was initially developed by the U.S. Army Corps of Engineers (USACE) in the early 1990s as a tool to manage the rivers and harbors in their jurisdiction. HEC-RAS has found wide acceptance as the standard for simulating the hydraulics of water flow through natural and/or manmade channels and rivers. HEC-RAS is commonly used for modeling water flowing through a system of open channels with the objective of computing water surface elevations.

5.7.1 Hydraulic Model Setup

The geographic input data for the HEC-RAS model were extracted using HEC-GeoRAS. HECGeoRAS is a tool that processes the geospatial data within the County‟s Geographic Information System, specifically as it pertains to physical features such as stream geometry and flow path so that these features can be represented in the model. The HEC-RAS models were limited to the major tributaries and the main stem of Little Rocky Run and Johnny Moore Creek and do not include intermittent streams in headwater areas. Low flows and undefined channels prevent the models from providing beneficial output in these areas. However, the flow contributions from these areas were considered in downstream areas within the model.

Using available County or Virginia Department of Transportation (VDOT) engineering data, bridge and culvert crossings were coded into the model to simulate the effect these facilities have on the water surface elevations or profile. Where data were not available, field reconnaissance was performed to obtain the crossing elevation data. These crossing data were determined relative to a point where the elevation could be estimated accurately from the County‟s topographic data.

Manning‟s „n‟ values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The hydrologic flow input data and the locations where the flows change were extracted from SWMM. The 2-yr, 10-yr and 100-yr storm flow outputs were determined at several locations in order to provide a detailed flow profile for input into the HEC-RAS hydraulic model.

As stated previously, the 2-year storm discharge is regarded as the channel-forming or dominant discharge that transports the majority of a stream‟s sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

The 10-year storm discharge was included to analyze the level of service of bridge and culvert stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) were analyzed against this storm to see if they performed at safe levels.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to delineate floodplain inundation zones in order to establish a Flood Insurance Rate Map (FIRM) for a given area. The 100-yr HEC-RAS models were built in compliance with FEMA standards and were included to map the limits of these floodplain inundation zones. This mapping provided a means to assess which properties are at risk to flooding by the 100-yr storm event.

The flow reductions from the *future conditions with projects* SWMM model produced no significant changes in water surface elevations.

SECTION 6.0 – Quantifying a Water Quality Benefit

Following prioritization and cost-benefit analysis, it was discovered that a number of projects did not produce a quantifiable water quality benefit. Primarily, these projects treat parcels that were classified as already having treatment (reflected as a Subarea type C) when in some cases they do not. In general, it is an indication that the watershed developed most significantly when stormwater quality regulations were already in place. As a result, a number of proposed projects are located upstream of other facilities or in areas where treatment was assumed because it was requirement at the time of development. In some cases, a neighborhood can be compliant with stormwater regulations without treating every parcel, essentially by overtreating parcels that drain to a designed facility. With a great deal of the developed parcels already draining to treatment facilities, AMEC favored treating parcels that run off directly to the storm sewer or stream – despite the fact that they were developed in compliance with regulations when considering the community as a whole.

In order to calculate pollutant removal in areas already classified as treated, AMEC reclassified these parcels (Subarea type D) so as not to claim treatment in the *existing conditions* and *future conditions without project* models. In doing so, a water quality benefit could be quantified for the proposed projects. These adjustments were made only within drainage areas to proposed new facilities.

Subareas classified as C located within the drainage areas of proposed retrofits to existing regional ponds were also reclassified as D. Pollutant reductions for proposed retrofits to regional ponds were calculated with the regional pond tool in STEPL. The existing and proposed pollutant removal efficiencies for regional ponds are as follows:

Regional Pond Removal Efficiencies

Existing/Future Without Projects Conditions			Future With Projects Conditions		
TN	TP	TSS	TN	TP	TSS
0.35	0.50	0.80	0.50	0.55	0.80
0.35	0.60	0.80	0.50	0.60	0.80

Project LR9116 (a retrofit of pond R-17) differed from other regional pond retrofit projects in the *future with projects condition* in TN removal efficiency – it was assigned an efficiency of 0.40.

While these subareas were being updated, AMEC also modified the existing conditions subareas in subwatersheds JM-JM-0009, LR-LR-0020, LR-WS-0002 and LR-WS-0003, which were discovered to have errors. SWMM orifice sizing was updated accordingly. These changes were carried through subsequent models as needed (*future with and without project* models).

In some cases (see Section 3.0), a project was proposed to restore an armored channel to a natural state. These projects were classified as stream restorations. Typically, stream restoration projects were assigned a water quality benefit based on restoring eroding banks to a stable state. Where channel banks were actively degrading, sediment and nutrient contributions were computed based on the soil type, lateral recession rate and area of bank eroding. The identified armored channels are stable and therefore not sloughing off sediment and nutrients from their banks. Instead, it was assumed that a measurable benefit would be gained because erosion downstream of the armored channel would be prevented. Low lateral recession rates were applied to the length of the concrete-lined ditch/channel slated to be restored.

Stream segments identified by the WAG that were not classified as erosion areas in the SPA were assumed to have a low recession rate and an average bank height of five feet in the absence of more detailed data.

Proposed projects were not re-prioritized based on these changes. The County wanted to compute the benefit for future analysis, but did not require that the prioritization be updated, due to time and budget constraints. Despite the fact that no pollutant removal was quantified at the time of prioritization for some stream restoration projects, AMEC used score overrides to assess these projects (see Section 3.0) based on their expected impact. It is unlikely that these changes would have significantly impacted the prioritization. AMEC produced revised *existing conditions*, *future without project conditions and future with project conditions* STEPL and SWMM models to account for all of these changes, so that future County efforts would be substantiated by the most up-to-date modeling data.

This process was initiated to target projects where no pollutant loading removal was shown, as previously described. However, it was determined to be much more tedious and costly to isolate only these projects for revised computations. Essentially, the *existing, future without project and future with project* nutrient loads were recomputed for every proposed project. In addition, because stormwater pond retrofits involved the removal of trickle ditches, plantings and internal geometry changes, it was reasoned that sedimentation would be slightly improved. Subarea „C" removal rates were used for stormwater pond retrofits, except where noted for retrofits to regional facilities – allowing for a slight improvement to TSS removal efficiencies (from 80 percent to 83 percent).

At the County"s request, AMEC produced an additional *future with project* STEPL model based on a composite subarea layer. Throughout the process, projects were analyzed for their individual contribution to a subwatershed. In other words, only one project per subwatershed could be analyzed in the STEPL at a time. In some cases there are multiple proposed projects for a given subwatershed with overlapping drainage areas. The combined impact in these instances would not be as great as the sum of the individual projects. Though a final STEPL model was produced that utilizes a composite subarea layer, the results reported are based on the individual project pollutant reductions. A SWMM model was produced with the same subarea allotment, despite the fact that peak flows are known to increase as a result. This model is also for future considerations and was not used in plan development.

SECTION 7.0 – Cost Benefit Analysis

The cost benefit analysis was performed as a simple ratio of the project benefit divided by a cost factor. The benefit value was the project composite score that was used in the project ranking. The project composite score represents a composite of environmental indicators and other factors such as pollutant removal. The composite score for some projects were adjusted to account for feasibility issues. The cost factor was calculated by scaling the project costs to match the numerical range of the project composite scores. The results of the cost-benefit analysis were compared to the adjusted composite scores. In situations where the cost-benefit rank differed from the adjusted composite rank by more than 25 percent a cost-based modification of +/- 0.25 was applied to the adjusted composite score and the projects were re-ranked. The table below summarizes adjustments made due to best professional judgment as well as due to the cost-benefit analysis.

Cost Benefit Analysis Results – 10-year Implementation Plan

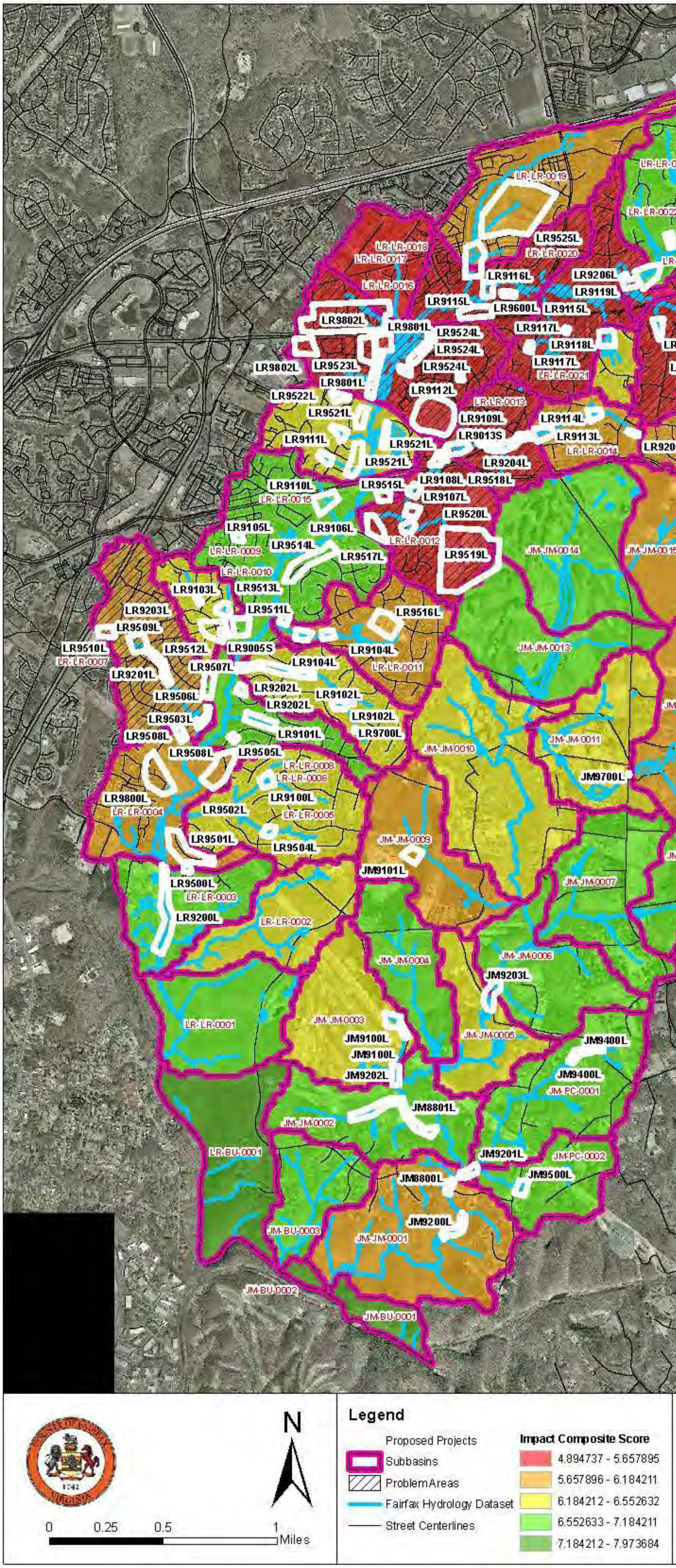
Project	Project Type	Final Adjusted Composite Score (B)	Project Cost	Scaled Cost Factor (C)	CBA: Final Score/ Scaled Cost Factor (B / C)	Rank adjusted for CBA
LR9005C	New BMP/LID	5.34	$350,000.00	2.52	2.118	1
LR9510	New BMP/LID	4.37	$260,000.00	2.45	1.784	2
LR9103	Pond Retrofit, Stream Stabilization	4.28	$560,000.00	2.69	1.590	3
LR9013D	Pond Retrofit	4.22	$180,000.00	2.38	1.770	4
LR9005A	Pond Retrofit	4.16	$230,000.00	2.43	1.717	5
LR9102	Pond Retrofit, Outfall Improvement	4.11	$220,000.00	2.42	1.702	6
LR9100	Pond Retrofit	4.07	$100,000.00	2.32	1.755	7
LR9516	New BMP/LID	3.99	$330,000.00	2.51	1.592	8
JM9202	Stream Restoration	3.97	$320,000.00	2.50	1.591	9
LR9110	Pond Retrofit	3.97	$120,000.00	2.34	1.700	10
LR9514	New BMP/LID	3.90	$100,000.00	2.32	1.681	11
LR9209	Stream Restoration, Flood Protection	3.87	$380,000.00	2.55	1.521	12
LR9115	Pond Retrofit	3.86	$290,000.00	2.47	1.562	13
LR9117	Pond Retrofit	3.83	$40,000.00	2.27	1.575	14
JM9201	Stream Restoration	3.77	$420,000.00	2.58	1.463	15
LR9522	New BMP/LID	3.77	$220,000.00	2.42	1.560	16
LR9508	New BMP/LID	3.76	$90,000.00	2.31	1.626	17
JM9100	Pond Retrofit, Dump Site	3.74	$200,000.00	2.40	1.556	18
LR9111	Pond Retrofit	3.69	$100,000.00	2.32	1.591	19
LR9204	Stream Restoration	3.69	$110,000.00	2.33	1.585	20
LR9527	New BMP/LID	3.69	$130,000.00	2.34	1.574	21
LR9201	Stream Restoration	3.66	$830,000.00	2.91	1.344	22

Project	Project Type	Final Adjusted Composite Score (B)	Project Cost	Scaled Cost Factor (C)	CBA: Final Score/ Scaled Cost Factor (B / C)	Rank adjusted for CBA
LR9010A	Buffer Restoration	3.63	$110,000.00	2.33	1.557	23
LR9208	Stream Restoration	3.62	$800,000.00	2.88	1.343	24
LR9109	Pond Retrofit, Non-Structural	3.62	$40,000.00	2.27	1.484	25
LR9106	Pond Retrofit	3.59	$190,000.00	2.39	1.498	26
LR9114	Pond Retrofit (x2)	3.56	$60,000.00	2.29	1.558	27
LR9205	Stream Restoration	3.53	$510,000.00	2.65	1.427	28
LR9203	Stream Restoration	3.45	$310,000.00	2.49	1.388	29
JM9400	Culvert Retrofit, Buffer Restoration	3.45	$120,000.00	2.34	1.476	30
LR9521	New BMP/LID, Pond Retrofit (x2)	3.44	$180,000.00	2.38	1.442	31
LR9526	New BMP/LID	3.44	$130,000.00	2.34	1.467	32
LR9207	Stream Restoration	3.42	$650,000.00	2.76	1.329	33
LR9010B	Pond Retrofit	3.41	$240,000.00	2.43	1.403	34
LR9202	Stream Restoration, Buffer Restoration	3.38	$820,000.00	2.90	1.166	35
LR9013C	New SWM	3.29	$90,000.00	2.31	1.424	36
LR9013A	Stream Restoration, Buffer Restoration	3.29	$280,000.00	2.47	1.335	37
JM9203	Stream Restoration, Buffer Restoration	3.28	$770,000.00	2.86	1.233	38
JM9200	Stream Restoration	3.25	$770,000.00	2.86	1.224	39
LR9524	New BMP/LID	3.22	$210,000.00	2.41	1.337	40
LR9523	New BMP/LID	3.12	$510,000.00	2.65	1.177	41
LR9013B	New BMP/LID, Stream Restoration	3.11	$210,000.00	2.41	1.291	42
LR9509	New BMP/LID	3.08	$140,000.00	2.35	1.309	43
LR9504	New BMP/LID	2.94	$80,000.00	2.30	1.276	44
JM9500	New BMP/LID	2.56	$120,000.00	2.34	1.096	45
LR9005B	New BMP/LID	2.54	$70,000.00	2.30	1.106	46
			$12,970,000			

The 25-year implementation plan cost benefit results are presented in the table below.

Cost Benefit Analysis Results – 25-year Implementation Plan

Project	Project Type	Final Adjusted Composite Score (B)	Project Cost	Scaled Cost Factor (C)	CBA: Final Score/ Scaled Cost Factor (B / C)	Rank adjusted for CBA
LR9515	New BMP/LID	3.33	$80,000.00	2.30	1.445	47
LR9107	Pond Retrofit	3.29	$80,000.00	2.30	1.426	48
LR9518	New BMP/LID (x3)	3.28	$80,000.00	2.30	1.423	49
LR9517	New BMP/LID	3.25	$80,000.00	2.30	1.410	50
JM9101	Pond Retrofit	3.21	$80,000.00	2.30	1.395	51
LR9108	Pond Retrofit	3.19	$80,000.00	2.30	1.386	52
LR9502	New BMP/LID	3.11	$80,000.00	2.30	1.350	53
LR9206	Stream Restoration	3.10	$80,000.00	2.30	1.345	54
LR9519	New BMP/LID	3.10	$90,000.00	2.31	1.341	55
LR9700	Outfall Improvement	3.10	$80,000.00	2.30	1.345	56
LR9112	Pond Retrofit, New BMP/LID	3.08	$80,000.00	2.30	1.336	57
LR9507	New BMP/LID	3.05	$80,000.00	2.30	1.324	58
LR9501	New BMP/LID	3.03	$80,000.00	2.30	1.315	59
LR9512	New BMP/LID	3.02	$90,000.00	2.31	1.306	60
LR9525	New BMP/LID	2.99	$1,120,000.00	3.14	1.031	61
LR9101	Pond Retrofit	2.95	$110,000.00	2.33	1.267	62
LR9520	New BMP/LID	2.94	$80,000.00	2.30	1.276	63
LR9113	Pond Retrofit	2.91	$400,000.00	2.56	1.235	64
LR9505	New BMP/LID	2.89	$80,000.00	2.30	1.254	65
LR9104	Pond Retrofit	2.86	$80,000.00	2.30	1.240	66
LR9105	Pond Retrofit	2.86	$90,000.00	2.31	1.236	67
LR9600	Flood Protection, Buffer Restoration	2.84	$800,000.00	2.88	0.986	68
LR9506	New BMP/LID	2.79	$80,000.00	2.30	1.211	69
LR9503	New BMP/LID	2.79	$80,000.00	2.30	1.215	70
LR9513	New BMP/LID	2.62	$80,000.00	2.30	1.137	71
JM9700	Outfall Improvement	2.46	$160,000.00	2.37	1.038	72
LR9500	New BMP/LID	2.24	$80,000.00	2.30	0.972	73
			$4,380,000			



Map 1
Proposed Project
Location Map

Attachment 1 – Project Type/Impact Indicator Association

	Regional Pond/ Alternatives	New/ Retrofit SWM Pond	Stream Restoration	Culvert Retrofit	New/Retrofit BMP/LID	Flood Protection/Mitigation	Outfall Improvement
Benthic Communities			X				X
Fish Communities			X				X
Aquatic Habitat			X	X			X
Channel Morphology	X	X	X			X	X
Instream Sediment	X	X	X				X
Hydrology	X	X			X	X	X
Number of Road Hazards				X		X	
Magnitude of Road Hazards				X		X	
Residential Building Hazards						X	
Non-residential Building Hazards						X	
Flood Complaints				X	X	X	
RPA Riparian Habitat			X		X		
Headwater Riparian Habitat			X		X		
Wetland Habitat			X		X		
Terrestrial Forested Habitat					X		
E. coli	X	X	X		X		X
TSS Concentration	X	X	X		X		X
TN Concentration	X	X			X		X
TP Concentration	X	X	X		X		X

Attachment 2 - Loading Rates

Loading Rates for Structural Projects

Project Number	Project Type	Subwatershed	TSS (ton/ac/yr)			TN (lb/ac/yr)			TP (lb/ac/yr)		
			Future w/o	Future with	% Reduction	Future w/o	Future with	% Reduction	Future w/o	Future with	% Reduction
JM9100L	1	JM-JM-0003	0.10	0.10	-0.17%	1.40	1.36	-2.84%	0.41	0.39	-4.55%
JM9101L	1	JM-JM-0009	0.07	0.07	0.18%	4.16	4.17	0.17%	0.62	0.62	0.18%
JM9200L	2	JM-JM-0001	0.75	0.06	-91.52%	2.57	1.47	-42.64%	0.67	0.25	-62.97%
JM9201L	2	JM-PC-0001	0.05	0.05	0.28%	2.10	2.11	0.29%	0.32	0.32	0.30%
JM9202L	2	JM-JM-0003	0.10	0.10	-0.17%	1.40	1.40	-0.13%	0.41	0.41	-0.16%
JM9203L	2	JM-JM-0005	0.17	0.08	-52.24%	1.95	1.82	-6.64%	0.37	0.31	-14.30%
JM9400L	4	JM-PC-0001	0.05	0.04	-10.16%	2.10	1.97	-6.54%	0.32	0.29	-8.85%
JM9500L	5	JM-PC-0002	0.06	0.03	-48.94%	2.27	1.66	-26.80%	0.33	0.21	-35.93%
JM9700L	7	JM-JM-0011	0.06	0.06	0.70%	2.31	2.33	0.73%	0.38	0.38	0.74%
LR9005S	0	LR-LR-0010	0.10	0.02	-80.00%	7.13	3.20	-55.15%	1.00	0.40	-60.40%
LR9010S	0	LR-WS-0005	0.07	0.00	-95.99%	3.75	1.18	-68.44%	0.57	0.11	-79.97%
LR9013S	0	LR-LR-0013	0.16	0.04	-75.38%	6.99	3.15	-54.94%	1.08	0.43	-59.87%
LR9100L	1	LR-LR-0005	0.02	0.02	0.08%	3.88	3.76	-3.15%	0.39	0.36	-7.00%
LR9101L	1	LR-LR-0006	0.11	0.11	0.02%	5.25	5.07	-3.45%	0.78	0.74	-5.10%
LR9102L	1	LR-LR-0008	0.11	0.11	0.01%	6.40	6.27	-1.93%	0.92	0.89	-3.02%
LR9103L	1	LR-LR-0010	0.10	0.10	-0.14%	7.13	6.78	-4.88%	1.00	0.92	-8.88%
LR9104L	1	LR-LR-0011	0.10	0.10	0.09%	6.34	6.26	-1.19%	0.91	0.89	-1.85%
LR9105L	1	LR-LR-0009	0.10	0.10	-0.11%	6.20	6.16	-0.68%	0.88	0.87	-1.08%
LR9106L	1	LR-LR-0009	0.10	0.10	-0.11%	6.20	6.14	-0.89%	0.88	0.87	-1.42%
LR9107L	1	LR-LR-0012	0.13	0.13	-0.24%	5.78	5.68	-1.74%	0.90	0.87	-2.37%
LR9108L	1	LR-LR-0012	0.13	0.13	-0.24%	5.78	5.76	-0.38%	0.90	0.89	-0.44%
LR9109L	1	LR-LR-0012	0.13	0.13	-3.71%	5.78	5.63	-2.53%	0.90	0.87	-2.85%
LR9110L	1	LR-LR-0015	0.11	0.11	-0.26%	6.98	6.83	-2.11%	0.95	0.92	-3.38%
LR9111L	1	LR-LR-0015	0.11	0.11	-0.26%	6.98	6.88	-1.40%	0.95	0.94	-1.31%
LR9112L	1	LR-LR-0016	0.15	0.15	-0.33%	8.23	8.20	-0.36%	1.13	1.13	-0.45%
LR9113L	1	LR-LR-0014	0.03	0.03	0.11%	4.12	2.66	-35.43%	0.42	0.38	-9.72%
LR9114L	1	LR-LR-0014	0.03	0.03	0.11%	4.12	4.08	-0.99%	0.42	0.41	-2.40%
LR9115L	1	LR-LR-0018	0.17	0.16	-0.80%	6.68	6.63	-0.72%	1.05	1.04	-0.66%
LR9116L	1	LR-LR-0019	0.04	0.04	0.34%	5.68	5.70	0.33%	0.50	0.50	0.35%
LR9117L	1	LR-LR-0020	0.21	0.21	-0.23%	5.54	5.51	-0.45%	0.90	0.89	-0.49%
LR9118L	1	LR-LR-0021	0.03	0.03	-2.33%	4.19	2.64	-36.97%	0.39	0.35	-11.88%
LR9119L	1	LR-LR-0022	0.02	0.02	0.11%	2.64	2.65	0.06%	0.23	0.23	0.10%
LR9120L	1	LR-WS-0002	0.10	0.10	0.05%	4.81	4.70	-2.30%	0.73	0.70	-4.04%
LR9121L	1	LR-WS-0004	0.01	0.01	0.00%	2.59	1.66	-35.84%	0.27	0.24	-10.11%
LR9200L	2	LR-LR-0003	0.34	0.07	-78.84%	3.55	3.12	-12.16%	0.65	0.48	-25.82%
LR9201L	2	LR-LR-0007	0.04	0.04	0.28%	5.61	5.62	0.23%	0.60	0.60	0.26%
LR9202L	2	LR-LR-0008	0.11	0.11	-1.23%	6.40	6.38	-0.33%	0.92	0.91	-0.76%
LR9203L	2	LR-LR-0010	0.10	0.10	0.00%	7.13	7.14	0.11%	1.00	1.01	0.08%
LR9204L	2	LR-LR-0013	0.16	0.15	-5.97%	6.99	6.99	-0.10%	1.08	1.07	-0.43%
LR9205L	2	LR-LR-0014	0.03	0.03	0.11%	4.12	4.12	0.14%	0.42	0.42	0.09%
LR9206L	2	LR-LR-0020	0.21	0.14	-33.72%	5.54	5.41	-2.38%	0.90	0.85	-5.21%
LR9207L	2	LR-LR-0022	0.02	0.02	-2.41%	2.64	2.64	-0.04%	0.23	0.23	-0.16%
LR9208L	2	LR-WS-0003	0.02	0.02	-4.61%	3.33	3.33	0.02%	0.35	0.35	-0.24%
LR9209L	2	LR-WS-0003	0.02	0.02	0.19%	3.33	3.33	0.18%	0.35	0.35	0.19%
LR9210L	2	LR-WS-0003	0.02	0.02	0.19%	3.33	3.33	0.18%	0.35	0.35	0.19%
LR9500L	5	LR-LR-0003	0.34	0.34	-0.77%	3.55	3.50	-1.34%	0.65	0.64	-1.71%
LR9501L	5	LR-LR-0004	0.12	0.12	-2.75%	5.10	5.05	-1.04%	0.75	0.74	-1.79%
LR9502L	5	LR-LR-0004	0.12	0.12	-3.24%	5.10	5.04	-1.25%	0.75	0.74	-2.12%

Attachment 2 - Loading Rates

Loading Rates for Structural Projects

Project Number	Project Type	Subwatershed	TSS (ton/ac/yr)			TN (lb/ac/yr)			TP (lb/ac/yr)		
			Future w/o	Future with	% Reduction	Future w/o	Future with	% Reduction	Future w/o	Future with	% Reduction
LR9503L	5	LR-LR-0004	0.12	0.12	-0.76%	5.10	5.10	-0.18%	0.75	0.75	-0.43%
LR9504L	5	LR-LR-0005	0.02	0.02	-13.92%	3.88	3.71	-4.35%	0.39	0.36	-7.33%
LR9505L	5	LR-LR-0006	0.11	0.11	-2.64%	5.25	5.19	-1.06%	0.78	0.76	-1.65%
LR9506L	5	LR-LR-0006	0.11	0.11	-3.98%	5.25	5.27	0.46%	0.78	0.77	-1.22%
LR9507L	5	LR-LR-0006	0.11	0.11	-3.59%	5.25	5.17	-1.43%	0.78	0.76	-2.24%
LR9508L	5	LR-LR-0007	0.04	0.04	-1.01%	5.61	5.60	-0.25%	0.60	0.60	-0.49%
LR9509L	5	LR-LR-0007	0.04	0.02	-35.01%	5.61	4.70	-16.17%	0.60	0.46	-23.34%
LR9510L	5	LR-LR-0007	0.04	0.04	-1.14%	5.61	5.58	-0.46%	0.60	0.60	-0.84%
LR9511L	5	LR-LR-0009	0.10	0.10	-0.18%	6.20	6.19	-0.07%	0.88	0.88	-0.09%
LR9512L	5	LR-LR-0010	0.10	0.08	-22.75%	7.13	6.73	-5.68%	1.00	0.91	-9.49%
LR9513L	5	LR-LR-0011	0.10	0.10	-0.81%	6.34	6.32	-0.26%	0.91	0.91	-0.41%
LR9514L	5	LR-LR-0009	0.10	0.10	-4.54%	6.20	6.11	-1.42%	0.88	0.86	-2.30%
LR9515L	5	LR-LR-0009	0.10	0.10	-0.73%	6.20	6.18	-0.31%	0.88	0.88	-0.41%
LR9516L	5	LR-LR-0011	0.10	0.10	-0.10%	6.34	6.32	-0.32%	0.91	0.91	-0.59%
LR9517L	5	LR-LR-0012	0.13	0.13	-1.58%	5.78	5.74	-0.69%	0.90	0.89	-0.94%
LR9518L	5	LR-LR-0012	0.13	0.13	-1.65%	5.78	5.73	-0.89%	0.90	0.89	-1.12%
LR9519L	5	LR-LR-0012	0.13	0.11	-16.19%	5.78	5.32	-7.97%	0.90	0.78	-12.46%
LR9520L	5	LR-LR-0012	0.13	0.13	-0.98%	5.78	5.74	-0.64%	0.90	0.89	-0.69%
LR9521L	5	LR-LR-0015	0.11	0.10	-11.32%	6.98	6.68	-4.23%	0.95	0.89	-6.23%
LR9522L	5	LR-LR-0015	0.11	0.11	-2.23%	6.98	6.91	-1.00%	0.95	0.94	-1.33%
LR9523L	5	LR-LR-0016	0.15	0.15	-0.41%	8.23	8.20	-0.30%	1.13	1.13	-0.33%
LR9524L	5	LR-LR-0016	0.15	0.15	-1.86%	8.23	8.14	-1.07%	1.13	1.12	-1.48%
LR9525L	5	LR-LR-0019	0.04	0.04	-2.91%	5.68	5.83	2.69%	0.50	0.51	1.04%
LR9526L	5	LR-WS-0002	0.10	0.09	-16.93%	4.81	4.50	-6.45%	0.73	0.66	-9.88%
LR9527L	5	LR-WS-0002	0.10	0.10	-1.73%	4.81	4.78	-0.69%	0.73	0.72	-1.06%
LR9528L	5	LR-LR-0024	0.04	0.04	-0.01%	6.11	6.11	0.00%	0.55	0.55	-0.04%
LR9529L	5	LR-LR-0025	0.03	0.02	-13.00%	3.89	3.65	-6.27%	0.43	0.39	-8.92%
LR9530L	5	LR-WS-0003	0.02	0.02	0.19%	3.33	3.33	0.18%	0.35	0.35	0.19%
LR9600L	6	LR-LR-0018	0.17	0.17	-0.07%	6.68	6.68	-0.05%	1.05	1.04	-0.05%
LR9700L	7	LR-LR-0008	0.11	0.11	0.01%	6.40	6.40	0.08%	0.92	0.92	0.06%

Attachment 3 - Impact Score Overrides

	Regional Pond/ Alternatives	New/ Retrofit SWM Pond	Stream Restoration	Culvert Retrofit	New/Retrofit BMP/LID	Flood Protection/ Mitigation	Outfall Improvement
Benthic Communities							
Fish Communities							
Aquatic Habitat							
Channel Morphology							
Instream Sediment							
Hydrology	5	5			5	5	3
Number of Road Hazards				5		5	
Magnitude of Road Hazards				5		5	
Residential Building Hazards						5	
Non-residential Building Hazards						5	
Flood Complaints							
RPA Riparian Habitat			3		3		
Headwater Riparian Habitat			3		3		
Wetland Habitat			3		5		
Terrestrial Forested Habitat					3		
E. coli							
TSS Concentration							
TN Concentration							
TP Concentration							

Attachment 4

Impact Indicator Scores for Structural Projects

Project Number	Project Type	Subwatershed	Benthic Communities	Fish Communities	Aquatic Habitat	Channel Morphology	Instream Sediment	Hydrology	Number of Road Hazards	Magnitude of Road Hazards	Number of Building Hazards	Non-residential Building Hazards	Flood Complaints	Riparian Habitat	Headwater Riparian Habitat	Wetland Habitat	Terrestrial Forested Habitat	E. coli	TSS Concentration	TN Concentration	TP Concentration	Sum	Score
JM9100L	1	JM-JM-0003	-	-	-	5	5	5	-	-	-	-	-	-	-	-	-	5	2	4	4	30	4.29
JM9101L	1	JM-JM-0009	-	-	-	5	5	5	-	-	-	-	-	-	-	-	-	5	1	1	1	23	3.29
JM9200L	2	JM-JM-0001	4	4	2	5	5	-	-	-	-	-	-	3	3	3	-	5	5	-	5	44	4.00
JM9201L	2	JM-PC-0001	2	4	5	5	5	-	-	-	-	-	-	3	3	3	-	5	4	-	4	43	3.91
JM9202L	2	JM-JM-0003	2	4	5	5	5	-	-	-	-	-	-	3	3	3	-	5	4	-	4	43	3.91
JM9203L	2	JM-JM-0005	2	4	5	5	5	-	-	-	-	-	-	3	3	3	-	5	5	-	5	45	4.09
JM9400L	4	JM-PC-0001	-	-	5	-	-	-	5	5	-	-	3	-	-	-	-	-	-	-	-	18	4.50
JM9500L	5	JM-PC-0002	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	5	5	5	42	4.20
JM9700L	7	JM-JM-0011	2	4	5	5	5	3	-	-	-	-	-	-	-	-	-	5	1	1	1	32	3.20
LR9005S	0	LR-LR-0010	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	5	5	5	31	4.43
LR9010S	0	LR-WS-0005	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	5	5	5	34	4.86
LR9013S	0	LR-LR-0013	-	-	-	3	5	5	-	-	-	-	-	-	-	-	-	5	5	5	5	33	4.71
LR9100L	1	LR-LR-0005	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	1	4	4	28	4.00
LR9101L	1	LR-LR-0006	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	2	4	4	26	3.71
LR9102L	1	LR-LR-0008	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	2	4	4	26	3.71
LR9103L	1	LR-LR-0010	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	2	4	5	27	3.86
LR9104L	1	LR-LR-0011	-	-	-	3	4	5	-	-	-	-	-	-	-	-	-	5	1	3	4	25	3.57
LR9105L	1	LR-LR-0009	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	2	3	3	24	3.43
LR9106L	1	LR-LR-0009	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	2	3	3	24	3.43
LR9107L	1	LR-LR-0012	-	-	-	3	4	5	-	-	-	-	-	-	-	-	-	5	3	4	4	28	4.00
LR9108L	1	LR-LR-0012	-	-	-	3	4	5	-	-	-	-	-	-	-	-	-	5	3	3	2	25	3.57
LR9109L	1	LR-LR-0012	-	-	-	3	4	5	-	-	-	-	-	-	-	-	-	5	4	4	4	29	4.14
LR9110L	1	LR-LR-0015	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	3	4	4	27	3.86
LR9111L	1	LR-LR-0015	-	-	-	2	4	5	-	-	-	-	-	-	-	-	-	5	3	4	3	26	3.71
LR9112L	1	LR-LR-0016	-	-	-	5	5	5	-	-	-	-	-	-	-	-	-	5	3	3	2	28	4.00
LR9113L	1	LR-LR-0014	-	-	-	3	5	5	-	-	-	-	-	-	-	-	-	5	1	5	5	29	4.14
LR9114L	1	LR-LR-0014	-	-	-	3	5	5	-	-	-	-	-	-	-	-	-	5	1	3	4	26	3.71
LR9115L	1	LR-LR-0018	-	-	-	5	5	5	-	-	-	-	-	-	-	-	-	5	3	3	3	29	4.14
LR9116L	1	LR-LR-0019	-	-	-	5	5	5	-	-	-	-	-	-	-	-	-	5	1	1	1	23	3.29
LR9117L	1	LR-LR-0020	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	2	3	2	26	3.71
LR9118L	1	LR-LR-0021	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	4	5	5	33	4.71
LR9119L	1	LR-LR-0022	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	1	1	1	22	3.14
LR9120L	1	LR-WS-0002	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	1	4	4	28	4.00
LR9121L	1	LR-WS-0004	-	-	-	5	4	5	-	-	-	-	-	-	-	-	-	5	2	5	5	31	4.43
LR9200L	2	LR-LR-0003	4	3	2	2	5	-	-	-	-	-	-	3	3	3	-	5	5	-	5	40	3.64

Attachment 4

Impact Indicator Scores for Structural Projects

Project Number	Project Type	Subwatershed	Benthic Communities	Fish Communities	Aquatic Habitat	Channel Morphology	Instream Sediment	Hydrology	Number of Road Hazards	Magnitude of Road Hazards	Number of Building Hazards	Non-residential Building Hazards	Flood Complaints	Riparian Habitat	Headwater Riparian Habitat	Wetland Habitat	Terrestrial Forested Habitat	E. coli	TSS Concentration	TN Concentration	TP Concentration	Sum	Score
LR9201L	2	LR-LR-0007	4	3	2	2	4	-	-	-	-	-	-	3	3	3	-	5	4	-	4	37	3.36
LR9202L	2	LR-LR-0008	2	3	5	2	4	-	-	-	-	-	-	3	3	3	-	5	3	-	3	36	3.27
LR9203L	2	LR-LR-0010	4	3	2	2	4	-	-	-	-	-	-	3	3	3	-	5	3	-	3	35	3.18
LR9204L	2	LR-LR-0013	4	3	5	3	5	-	-	-	-	-	-	3	3	3	-	5	4	-	2	40	3.64
LR9205L	2	LR-LR-0014	4	3	5	3	5	-	-	-	-	-	-	3	3	3	-	5	3	-	3	40	3.64
LR9206L	2	LR-LR-0020	5	5	5	5	4	-	-	-	-	-	-	3	3	3	-	5	5	-	4	47	4.27
LR9207L	2	LR-LR-0022	5	5	5	5	4	-	-	-	-	-	-	3	3	3	-	5	4	-	2	44	4.00
LR9208L	2	LR-WS-0003	5	4	5	5	4	-	-	-	-	-	-	3	3	3	-	5	4	-	2	43	3.91
LR9209L	2	LR-WS-0003	5	4	5	5	4	-	-	-	-	-	-	3	3	3	-	5	3	-	3	43	3.91
LR9210L	2	LR-WS-0003	5	4	5	5	4	-	-	-	-	-	-	3	3	3	-	5	3	-	3	43	3.91
LR9500L	5	LR-LR-0003	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	3	4	3	37	3.70
LR9501L	5	LR-LR-0004	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	4	3	3	35	3.50
LR9502L	5	LR-LR-0004	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	4	4	4	37	3.70
LR9503L	5	LR-LR-0004	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	3	2	2	32	3.20
LR9504L	5	LR-LR-0005	-	-	-	-	-	5	-	-	-	-	4	3	3	5	3	5	5	4	4	41	4.10
LR9505L	5	LR-LR-0006	-	-	-	-	-	5	-	-	-	-	5	3	3	3	3	5	4	3	3	37	3.70
LR9506L	5	LR-LR-0006	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	4	1	3	37	3.70
LR9507L	5	LR-LR-0006	-	-	-	-	-	5	-	-	-	-	5	3	3	3	3	5	4	4	4	39	3.90
LR9508L	5	LR-LR-0007	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	3	2	2	36	3.60
LR9509L	5	LR-LR-0007	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	5	5	5	44	4.40
LR9510L	5	LR-LR-0007	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	3	3	3	38	3.80
LR9511L	5	LR-LR-0009	-	-	-	-	-	5	-	-	-	-	4	3	3	3	3	5	2	2	2	32	3.20
LR9512L	5	LR-LR-0010	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	5	5	5	44	4.40
LR9513L	5	LR-LR-0011	-	-	-	-	-	5	-	-	-	-	4	3	3	3	3	5	3	2	2	33	3.30
LR9514L	5	LR-LR-0009	-	-	-	-	-	5	-	-	-	-	4	3	3	3	3	5	4	4	4	38	3.80
LR9515L	5	LR-LR-0009	-	-	-	-	-	5	-	-	-	-	4	3	3	3	3	5	3	2	2	33	3.30
LR9516L	5	LR-LR-0011	-	-	-	-	-	5	-	-	-	-	4	3	3	5	3	5	2	2	3	35	3.50
LR9517L	5	LR-LR-0012	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	4	3	3	35	3.50
LR9518L	5	LR-LR-0012	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	4	3	3	37	3.70
LR9519L	5	LR-LR-0012	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	5	5	5	42	4.20
LR9520L	5	LR-LR-0012	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	3	3	3	34	3.40
LR9521L	5	LR-LR-0015	-	-	-	-	-	5	-	-	-	-	5	3	3	3	3	5	5	4	4	40	4.00
LR9522L	5	LR-LR-0015	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	4	3	3	39	3.90
LR9523L	5	LR-LR-0016	-	-	-	-	-	5	-	-	-	-	3	3	3	3	3	5	3	2	2	32	3.20
LR9524L	5	LR-LR-0016	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	4	3	3	37	3.70

Attachment 4

Impact Indicator Scores for Structural Projects

Project Number	Project Type	Subwatershed	Benthic Communities	Fish Communities	Aquatic Habitat	Channel Morphology	Instream Sediment	Hydrology	Number of Road Hazards	Magnitude of Road Hazards	Number of Building Hazards	Non-residential Building Hazards	Flood Complaints	Riparian Habitat	Headwater Riparian Habitat	Wetland Habitat	Terrestrial Forested Habitat	E. coli	TSS Concentration	TN Concentration	TP Concentration	Sum	Score
LR9525L	5	LR-LR-0019	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	4	1	1	33	3.30
LR9526L	5	LR-WS-0002	-	-	-	-	-	5	-	-	-	-	4	3	3	5	3	5	5	5	5	43	4.30
LR9527L	5	LR-WS-0002	-	-	-	-	-	5	-	-	-	-	4	3	3	5	3	5	4	3	3	38	3.80
LR9528L	5	LR-LR-0024	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	2	2	1	32	3.20
LR9529L	5	LR-LR-0025	-	-	-	-	-	5	-	-	-	-	3	3	3	5	3	5	5	5	5	42	4.20
LR9530L	5	LR-WS-0003	-	-	-	-	-	5	-	-	-	-	5	3	3	5	3	5	1	1	1	32	3.20
LR9600L	6	LR-LR-0018	-	-	-	5	-	5	5	5	5	5	3	-	-	-	-	-	-	-	-	33	4.71
LR9700L	7	LR-LR-0008	2	3	5	2	4	3	-	-	-	-	-	-	-	-	-	5	2	1	1	28	2.80

Attachment 5 – Project Type/Source Indicator Association

	Regional Pond/ Alternatives	New/ Retrofit SWM Pond	Stream Restoration	Culvert Retrofit	New/Retrofit BMP/LID	Flood Protection/Mitigation	Outfall Improvement
Channelized/Piped Streams			X	X		X	X
Directly Connected Impervious Area	X	X			X	X	
Impervious Surface	X	X			X	X	
Stormwater Outfalls	X	X	X		X	X	X
Streambank Buffer Deficiency			X				
TSS Concentration	X	X	X		X		X
TN Concentration	X	X	X		X		X
TP Concentration	X	X	X		X		X

Attachment 6

Source Indicator Scores for Structural Projects

Project Number	Project Type	Subwatershed	Channelized/Piped Streams	Directly Connected Impervious Area	Impervious Surface	Stormwater Outfalls	Streambank Buffer Deficiency	TSS Concentration	TN Concentration	TP Concentration	Sum	Score
JM9100L	1	JM-JM-0003	-	1	1	5	-	2	4	4	17	2.83
JM9101L	1	JM-JM-0009	-	1	1	5	-	1	1	1	10	1.67
JM9200L	2	JM-JM-0001	-	-	-	-	-	5	5	5	15	5.00
JM9201L	2	JM-PC-0001	-	-	-	-	-	4	4	4	12	4.00
JM9202L	2	JM-JM-0003	-	-	-	-	-	4	4	4	12	4.00
JM9203L	2	JM-JM-0005	-	-	-	-	-	5	5	5	15	5.00
JM9400L	4	JM-PC-0001	3	-	-	-	-	-	-	-	3	3.00
JM9500L	5	JM-PC-0002	-	2	2	1	-	5	5	5	20	3.33
JM9700L	7	JM-JM-0011	3	-	-	5	-	1	1	1	11	2.20
LR9005S	0	LR-LR-0010	-	5	5	5	-	5	5	5	30	5.00
LR9010S	0	LR-WS-0005	-	2	2	1	-	5	5	5	20	3.33
LR9013S	0	LR-LR-0013	-	4	5	5	-	5	5	5	29	4.83
LR9100L	1	LR-LR-0005	-	4	5	5	-	1	4	4	23	3.83
LR9101L	1	LR-LR-0006	-	4	5	5	-	2	4	4	24	4.00
LR9102L	1	LR-LR-0008	-	4	5	5	-	2	4	4	24	4.00
LR9103L	1	LR-LR-0010	-	5	5	5	-	2	4	5	26	4.33
LR9104L	1	LR-LR-0011	-	4	5	5	-	1	3	4	22	3.67
LR9105L	1	LR-LR-0009	-	4	5	5	-	2	3	3	22	3.67
LR9106L	1	LR-LR-0009	-	4	5	5	-	2	3	3	22	3.67
LR9107L	1	LR-LR-0012	-	4	5	5	-	3	4	4	25	4.17
LR9108L	1	LR-LR-0012	-	4	5	5	-	3	3	2	22	3.67
LR9109L	1	LR-LR-0012	-	4	5	5	-	4	4	4	26	4.33
LR9110L	1	LR-LR-0015	-	5	5	5	-	3	4	4	26	4.33
LR9111L	1	LR-LR-0015	-	5	5	5	-	3	4	3	25	4.17
LR9112L	1	LR-LR-0016	-	5	5	5	-	3	3	2	23	3.83
LR9113L	1	LR-LR-0014	-	2	2	5	-	1	5	5	20	3.33
LR9114L	1	LR-LR-0014	-	2	2	5	-	1	3	4	17	2.83
LR9115L	1	LR-LR-0018	-	2	2	1	-	3	3	3	14	2.33
LR9116L	1	LR-LR-0019	-	4	5	5	-	1	1	1	17	2.83
LR9117L	1	LR-LR-0020	-	4	5	5	-	2	3	2	21	3.50
LR9118L	1	LR-LR-0021	-	2	2	5	-	4	5	5	23	3.83
LR9119L	1	LR-LR-0022	-	2	2	5	-	1	1	1	12	2.00
LR9120L	1	LR-WS-0002	-	4	5	5	-	1	4	4	23	3.83
LR9121L	1	LR-WS-0004	-	2	2	5	-	2	5	5	21	3.50
LR9200L	2	LR-LR-0003	-	-	-	-	-	5	5	5	15	5.00
LR9201L	2	LR-LR-0007	-	-	-	-	-	4	4	4	12	4.00
LR9202L	2	LR-LR-0008	-	-	-	-	-	3	2	3	8	2.67
LR9203L	2	LR-LR-0010	-	-	-	-	-	3	3	3	9	3.00
LR9204L	2	LR-LR-0013	-	-	-	-	-	4	2	2	8	2.67
LR9205L	2	LR-LR-0014	-	-	-	-	-	3	3	3	9	3.00
LR9206L	2	LR-LR-0020	-	-	-	-	-	5	4	4	13	4.33
LR9207L	2	LR-LR-0022	-	-	-	-	-	4	2	2	8	2.67
LR9208L	2	LR-WS-0003	-	-	-	-	-	4	1	2	7	2.33
LR9209L	2	LR-WS-0003	-	-	-	-	-	3	3	3	9	3.00
LR9210L	2	LR-WS-0003	-	-	-	-	-	3	3	3	9	3.00
LR9500L	5	LR-LR-0003	-	1	1	1	-	3	4	3	13	2.17
LR9501L	5	LR-LR-0004	-	4	5	5	-	4	3	3	24	4.00

Attachment 6

Source Indicator Scores for Structural Projects

Project Number	Project Type	Subwatershed	Channelized/Piped Streams	Directly Connected Impervious Area	Impervious Surface	Stormwater Outfalls	Streambank Buffer Deficiency	TSS Concentration	TN Concentration	TP Concentration	Sum	Score
LR9502L	5	LR-LR-0004	-	4	5	5	-	4	4	4	26	4.33
LR9503L	5	LR-LR-0004	-	4	5	5	-	3	2	2	21	3.50
LR9504L	5	LR-LR-0005	-	4	5	5	-	5	4	4	27	4.50
LR9505L	5	LR-LR-0006	-	4	5	5	-	4	3	3	24	4.00
LR9506L	5	LR-LR-0006	-	4	5	5	-	4	1	3	22	3.67
LR9507L	5	LR-LR-0006	-	4	5	5	-	4	4	4	26	4.33
LR9508L	5	LR-LR-0007	-	5	5	5	-	3	2	2	22	3.67
LR9509L	5	LR-LR-0007	-	5	5	5	-	5	5	5	30	5.00
LR9510L	5	LR-LR-0007	-	5	5	5	-	3	3	3	24	4.00
LR9511L	5	LR-LR-0009	-	4	5	5	-	2	2	2	20	3.33
LR9512L	5	LR-LR-0010	-	5	5	5	-	5	5	5	30	5.00
LR9513L	5	LR-LR-0011	-	4	5	5	-	3	2	2	21	3.50
LR9514L	5	LR-LR-0009	-	4	5	5	-	4	4	4	26	4.33
LR9515L	5	LR-LR-0009	-	4	5	5	-	3	2	2	21	3.50
LR9516L	5	LR-LR-0011	-	4	5	5	-	2	2	3	21	3.50
LR9517L	5	LR-LR-0012	-	4	5	5	-	4	3	3	24	4.00
LR9518L	5	LR-LR-0012	-	4	5	5	-	4	3	3	24	4.00
LR9519L	5	LR-LR-0012	-	4	5	5	-	5	5	5	29	4.83
LR9520L	5	LR-LR-0012	-	4	5	5	-	3	3	3	23	3.83
LR9521L	5	LR-LR-0015	-	5	5	5	-	5	4	4	28	4.67
LR9522L	5	LR-LR-0015	-	5	5	5	-	4	3	3	25	4.17
LR9523L	5	LR-LR-0016	-	5	5	5	-	3	2	2	22	3.67
LR9524L	5	LR-LR-0016	-	5	5	5	-	4	3	3	25	4.17
LR9525L	5	LR-LR-0019	-	4	5	5	-	4	1	1	20	3.33
LR9526L	5	LR-WS-0002	-	4	5	5	-	5	5	5	29	4.83
LR9527L	5	LR-WS-0002	-	4	5	5	-	4	3	3	24	4.00
LR9528L	5	LR-LR-0024	-	5	5	5	-	2	2	1	20	3.33
LR9529L	5	LR-LR-0025	-	4	5	5	-	5	5	5	29	4.83
LR9530L	5	LR-WS-0003	-	4	5	5	-	1	1	1	17	2.83
LR9600L	6	LR-LR-0018	3	2	2	1	-	-	-	-	8	2.00
LR9700L	7	LR-LR-0008	3	-	-	5	-	2	1	1	12	2.40

Attachment 7
Scores and Rankings

Name	Subwatershed	Type	Comments	Impact Indicators Score	Source Indicators Score	Priority Subwatersheds Score	Watershed Sequencing Score	Project Implement-ability Score	Composite Project Score	Rank
LR9509L	LR-LR-0007	New BMP/LID	Flooding complaint at WAG - retrofit area u/s of culvert for SWM	4.40	5.00	4	5	3	4.52	1
LR9512L	LR-LR-0010	New BMP/LID	Treatment at culvert outlet, upstream opportunities - community not supportive of regional pond in area	4.40	5.00	3	5	3	4.42	2
LR9118L	LR-LR-0021	Pond Retrofit	Regional R-7 - opportunity to regrade/plant/direct more flow to pond - clogged during field visit	4.71	3.83	3	5	5	4.36	3
LR9529L	LR-LR-0025	New BMP/LID	Missed facility? - opportunity for LID	4.20	4.83	3	5	3	4.31	4
LR9103L	LR-LR-0010	Pond Retrofit	Modify pond to provide additional capacity, pollutant removal in replacement of Regional Pond R-5	3.86	4.33	3	5	5	4.26	5
LR9510L	LR-LR-0007	New BMP/LID	Retrofit opportunities at school	3.80	4.00	4	5	5	4.24	6
LR9504L	LR-LR-0005	New BMP/LID	Possible site for culvert retrofit	4.10	4.50	3	5	3	4.18	7
LR9104L	LR-LR-0011	Pond Retrofit, Stream Stabilization	Erosion in area from issues forum/Remove trickle ditches, add micropools/plantings	3.57	3.67	5	5	5	4.17	8
LR9100L	LR-LR-0005	Pond Retrofit	Retrofit to include wetland plantings	4.00	3.83	3	5	5	4.15	9
LR9113L	LR-LR-0014	Pond Retrofit	Remove trickle ditches, add micropools/plantings - stabilize eroded areas	4.14	3.33	4	5	5	4.14	10
LR9102L	LR-LR-0008	Pond Retrofit, Outfall Improvement	Remove trickle ditches, plantings, enlarge to improve downstream conditions/Erosion downstream of trail - WAG comment	3.71	4.00	3	5	5	4.11	11
LR9519L	LR-LR-0012	New BMP/LID	Centreville HS drains to dry pond, opportunities for LID onsite	4.20	4.83	5	2	5	4.11	12
LR9516L	LR-LR-0011	New BMP/LID	Union Mill ES drains to dry pond, opportunities for LID onsite	3.50	3.50	5	5	5	4.10	13
JM9202L	JM-JM-0003	Stream Restoration	Issues Scoping Forum Comment - flooding and erosion	3.91	4.00	3	5	3	3.97	14
LR9528L	LR-LR-0024	New BMP/LID	New outfall treatment for Regional Pond R-12	3.20	3.33	5	5	5	3.96	15
LR9526L	LR-WS-0002	New BMP/LID	Outlet treatment for uncontrolled area	4.30	4.83	5	2	3	3.94	16
LR9201L	LR-LR-0007	Stream Restoration	Erosion/poor flow in channel - comment from Kevin Marley - Green Trails HOA - phone conversation	3.36	4.00	4	5	3	3.91	17
LR9525L	LR-LR-0019	New BMP/LID	Colin Powell ES drains to R-161 - opportunities for onsite LID	3.30	3.33	4	5	5	3.89	18
LR9508L	LR-LR-0007	New BMP/LID	Bioretention to treat back side of townhouses/Add tree box filters or treatment at culvert outlet for untreated system	3.60	3.67	4	5	3	3.88	19
LR9209L	LR-WS-0003	Stream Restoration	Stream in concrete channel being undermined - restore buffer and natural channel	3.91	3.00	5	5	3	3.87	20
LR9210L	LR-WS-0003	Stream Restoration, Flood Protection	Concrete channel - restore to natural channel - stabilize downstream erosion - address pipestem flooding	3.91	3.00	5	5	3	3.87	20
LR9114L	LR-LR-0014	Pond Retrofit	Dry pond retrofit with wetland plantings, micropool	3.71	2.83	4	5	5	3.86	22
LR9107L	LR-LR-0012	Pond Retrofit	Remove trickle ditches, add micropools/plantings	4.00	4.17	5	2	5	3.85	23
LR9513L	LR-LR-0011	New BMP/LID	Inlet treatment for uncontrolled area	3.30	3.50	5	5	3	3.84	24
LR9530L	LR-WS-0003	New BMP/LID	Willow Springs ES drains to dry pond - onsite LID opportunities	3.20	2.83	5	5	5	3.81	25
LR9206L	LR-LR-0020	Stream Restoration	Erosion at pond outfalls	4.27	4.33	5	2	3	3.78	26
JM9201L	JM-PC-0001	Stream Restoration	Issues Scoping Forum Comment - erosion, verified in field investigation	3.91	4.00	1	5	3	3.77	27
JM9500L	JM-PC-0002	New BMP/LID	Detention upstream of road - created wetland	4.20	3.33	2	5	3	3.76	28
LR9120L	LR-WS-0002	Pond Retrofit	Existing dry pond not in StormNet - Remove trickle ditches, add micropools/plantings	4.00	3.83	5	2	5	3.75	29
JM9100L	JM-JM-0003	Pond Retrofit, Dump Site	Hot tub couches in stream/Existing pond with dam break on golf course property near piplines - repair/retrofit to provide treatment	4.29	2.83	3	5	3	3.74	30
LR9205L	LR-LR-0014	Stream Restoration	Relace paved ditch with natural stream	3.64	3.00	4	5	3	3.69	31
LR9121L	LR-WS-0004	Pond Retrofit	Remove trickle ditches, add micropools/plantings - enlarge in replacement of R-10?	4.43	3.50	2	3	5	3.68	32
LR9208L	LR-WS-0003	Stream Restoration	Erosion from SPA and field visit	3.91	2.33	5	5	3	3.67	33
LR9108L	LR-LR-0012	Pond Retrofit	Enlarge pond to provide more treatment in replacement of Regional R-13	3.57	3.67	5	2	5	3.57	34
LR9117L	LR-LR-0020	Pond Retrofit (x2)	Trickle ditches, dry pond holding water during field visit, clogging and smell/Remove trickle ditches, add micropools/plantings	3.71	3.50	5	2	5	3.56	35
LR9524L	LR-LR-0016	New BMP/LID, Pond Retrofit (x2)	Inlet/outlet treatment for uncontrolled area/Remove trickle ditches, add micropools/plantings	3.70	4.17	5	1	5	3.56	36
LR9112L	LR-LR-0016	Pond Retrofit, Non-Structural	Remove trickle ditches, add micropools/plantings/Illicit discharge education (noted in NSA) - sweeping/trash in commercial shopping center	4.00	3.83	5	1	5	3.55	37
LR9109L	LR-LR-0012	New SWM	New pond to provide treatment in replacement of Regional R-13	4.14	4.33	5	2	1	3.54	38
LR9527L	LR-WS-0002	New BMP/LID	Outlet treatment for uncontrolled area	3.80	4.00	5	2	3	3.54	39

Attachment 7
Scores and Rankings

Name	Subwatershed	Type	Comments	Impact Indicators Score	Source Indicators Score	Priority Subwatersheds Score	Watershed Sequencing Score	Project Implement-ability Score	Composite Project Score	Rank
JM9203L	JM-JM-0005	Stream Restoration, Buffer Restoration	Significant erosion identified - flooding noted during field investigation	4.09	5.00	3	1	3	3.53	40
JM9200L	JM-JM-0001	Stream Restoration	Significant bank erosion - access issues	4.00	5.00	3	1	3	3.50	41
LR9110L	LR-LR-0015	Pond Retrofit	Remove trickle ditches, add micropools/plantings	3.86	4.33	3	1	5	3.46	42
LR9203L	LR-LR-0010	Stream Restoration	Remove paved ditch	3.18	3.00	3	5	3	3.45	43
LR9517L	LR-LR-0012	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.50	4.00	5	2	3	3.45	44
JM9400L	JM-PC-0001	Culvert Retrofit, Buffer Restoration	Pro rata project - comment in WAG#2/Plant trees - private property	4.50	3.00	1	5	1	3.45	44
LR9521L	LR-LR-0015	New BMP/LID (x3)	Inlet/outlet treatment for uncontrolled area	4.00	4.67	3	1	3	3.40	46
JM9101L	JM-JM-0009	Pond Retrofit	Facility Treating School, retrofit, educational opportunities?	3.29	1.67	4	5	5	3.39	47
LR9202L	LR-LR-0008	Stream Restoration, Buffer Restoration	Erosion area with headcut/Restore buffer, remove paved and trickle ditches, add plantings to ponds	3.27	2.67	3	5	3	3.38	48
LR9520L	LR-LR-0012	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.40	3.83	5	2	3	3.37	49
LR9111L	LR-LR-0015	Pond Retrofit	Space for modification, need for more plantings	3.71	4.17	3	1	5	3.36	50
LR9115L	LR-LR-0018	Pond Retrofit, New BMP/LID	LID for uncontrolled area/Remove trickle ditches, add micropools/plantings	4.14	2.33	5	2	5	3.34	51
LR9116L	LR-LR-0019	Pond Retrofit	Regional Pond R-161 - wetland plantings needed - at time of visit growth was sparse	3.29	2.83	4	5	1	3.34	52
LR9502L	LR-LR-0004	New BMP/LID	Inlet treatment for uncontrolled area	3.70	4.33	4	1	3	3.31	53
LR9518L	LR-LR-0012	New BMP/LID, Stream Restoration	Culvert retrofit/grassed swale/stream restoration in replacement of Regional R-13	3.70	4.00	5	2	1	3.31	54
LR9204L	LR-LR-0013	Stream Restoration, Buffer Restoration	Address erosion d/s of culvert - possible culvert resize needed/Restore buffer along stream - private property, houses close to stream issues	3.64	2.67	5	3	3	3.29	55
LR9522L	LR-LR-0015	New BMP/LID	Bioretention/LID for uncontrolled area	3.90	4.17	3	1	3	3.22	56
LR9101L	LR-LR-0006	Pond Retrofit	Retrofit ponds to include wetland plantings	3.71	4.00	2	1	5	3.21	57
LR9200L	LR-LR-0003	Stream Restoration, Buffer Restoration	Buffer and stream erosion - on private property	3.64	5.00	1	1	3	3.19	58
LR9507L	LR-LR-0006	New BMP/LID	Inlet treatment for uncontrolled area	3.90	4.33	2	1	3	3.17	59
LR9700L	LR-LR-0008	Outfall Improvement	Erosion at transition from concrete ditch from field investigation	2.80	2.40	3	5	3	3.16	60
LR9501L	LR-LR-0004	New BMP/LID	Inlet treatment for uncontrolled area	3.50	4.00	4	1	3	3.15	61
LR9514L	LR-LR-0009	New BMP/LID	Inlet/outlet controls for uncontrolled area	3.80	4.33	2	1	3	3.14	62
LR9207L	LR-LR-0022	Stream Restoration	Erosion, head cut, oily sheen noted during field visit	4.00	2.67	2	3	3	3.10	63
LR9523L	LR-LR-0016	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.20	3.67	5	1	3	3.06	64
LR9105L	LR-LR-0009	Pond Retrofit	Retrofit to add plantings - address erosion in pond ditch	3.43	3.67	2	1	5	3.03	65
LR9106L	LR-LR-0009	Pond Retrofit	Good access, space for modifications for wetland plantings, micropools to improve water quality treatment	3.43	3.67	2	1	5	3.03	65
LR9600L	LR-LR-0018	Flood Protection, Buffer Restoration	Structures in floodplain, buffer restoration	4.71	2.00	5	2	1	3.01	67
LR9505L	LR-LR-0006	New BMP/LID	Inlet treatment for uncontrolled area	3.70	4.00	2	1	3	3.01	68
LR9506L	LR-LR-0006	New BMP/LID	Combination of bioretention, tree box filters for untreated area	3.70	3.67	2	1	3	2.91	69
LR9503L	LR-LR-0004	New BMP/LID	Add treatments at inlets for untreated system	3.20	3.50	4	1	3	2.91	69
LR9119L	LR-LR-0022	Pond Retrofit	Regional Pond R-17 Wetland areas, grassed spillways not stable during field visit - replanting and grading	3.14	2.00	2	3	5	2.84	71
LR9515L	LR-LR-0009	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.30	3.50	2	1	3	2.74	72
LR9511L	LR-LR-0009	New BMP/LID	Add treatment for untreated system	3.20	3.33	2	1	3	2.66	73
JM9700L	JM-JM-0011	Outfall Improvement	Moderate to Severe Impact (SPA)	3.20	2.20	2	3	1	2.52	74
LR9500L	LR-LR-0003	New BMP/LID	Treat uncontrolled flow from subdivision	3.70	2.17	1	1	3	2.36	75

Attachment 8
Scores and Rankings after Modeling

Name	Subwatershed	Type	Comments	Impact Indicators Score	Source Indicators Score	Priority Subwatersheds Score	Watershed Sequencing Score	Project Implement-ability Score	Composite Project Score	Rank
LR9005C	LR-LR-0010	New BMP/LID	Treatment at culvert outlet, upstream opportunities - community not supportive of regional pond in area	4.40	5.00	3	5	3	4.42	1
LR9115	LR-LR-0021	Pond Retrofit	Regional R-7 - opportunity to regrade/plant/direct more flow to pond - clogged during field visit	4.71	3.83	3	5	5	4.36	2
LR9005A	LR-LR-0010	Pond Retrofit	Modify pond to provide additional capacity, pollutant removal in replacement of Regional Pond R-5	4.00	4.50	3	5	5	4.35	3
LR9526	LR-LR-0025	New BMP/LID	Missed facility? - opportunity for LID	3.80	4.83	3	5	3	4.19	4
LR9510	LR-LR-0007	New BMP/LID	Retrofit opportunities at school	3.40	4.00	4	5	5	4.12	5
LR9102	LR-LR-0008	Pond Retrofit, Outfall Improvement	Remove trickle ditches, plantings, enlarge to improve downstream conditions/Erosion downstream of trail - WAG comment	3.71	4.00	3	5	5	4.11	6
LR9103	LR-LR-0011	Pond Retrofit, Stream Stabilization	Erosion in area from issues forum/Remove trickle ditches, add micropools/plantings	3.14	3.83	5	5	5	4.09	7
LR9504	LR-LR-0005	New BMP/LID	Possible site for culvert retrofit	3.70	4.50	3	5	3	4.06	8
LR9516	LR-LR-0012	New BMP/LID	Centreville HS drains to dry pond, opportunities for LID onsite	3.80	4.83	5	2	5	3.99	9
LR9514	LR-LR-0011	New BMP/LID	Union Mill ES drains to dry pond, opportunities for LID onsite	3.10	3.50	5	5	5	3.98	10
LR9100	LR-LR-0005	Pond Retrofit	Retrofit to include wetland plantings	3.43	3.83	3	5	5	3.98	11
JM9202	JM-JM-0003	Stream Restoration	Issues Scoping Forum Comment - flooding and erosion	3.91	4.00	3	5	3	3.97	12
LR9110	LR-LR-0014	Pond Retrofit	Remove trickle ditches, add micropools/plantings - stabilize eroded areas	3.57	3.33	4	5	5	3.97	13
LR9201	LR-LR-0007	Stream Restoration	Erosion/poor flow in channel - comment from Kevin Marley - Green Trails HOA - phone conversation	3.36	4.00	4	5	3	3.91	14
LR9208	LR-WS-0003	Stream Restoration	Stream in concrete channel being undermined - restore buffer and natural channel	3.91	3.00	5	5	3	3.87	15
LR9209	LR-WS-0003	Stream Restoration, Flood Protection	Concrete channel - restore to natural channel - stabilize downstream erosion - address pipestem flooding	3.91	3.00	5	5	3	3.87	15
LR9525	LR-LR-0024	New BMP/LID	New outfall treatment for Regional Pond R-12	2.80	3.33	5	5	5	3.84	17
LR9523	LR-WS-0002	New BMP/LID	Outlet treatment for uncontrolled area	3.90	4.83	5	2	3	3.82	18
LR9205	LR-LR-0020	Stream Restoration	Erosion at pond outfalls	4.27	4.33	5	2	3	3.78	19
LR9207	LR-WS-0003	Stream Restoration	Erosion from SPA and field visit	3.91	2.67	5	5	3	3.77	20
JM9201	JM-PC-0001	Stream Restoration	Issues Scoping Forum Comment - erosion, verified in field investigation	3.91	4.00	1	5	3	3.77	20
LR9522	LR-LR-0019	New BMP/LID	Colin Powell ES drains to R-161 - opportunities for onsite LID	2.90	3.33	4	5	5	3.77	22
LR9508	LR-LR-0007	New BMP/LID	Bioretention to treat back side of townhouses/Add tree box filters or treatment at culvert outlet for untreated system	3.20	3.67	4	5	3	3.76	23
JM9500	JM-PC-0002	New BMP/LID	Detention upstream of road - created wetland	4.20	3.33	2	5	3	3.76	23
LR9114	LR-LR-0020	Pond Retrofit (x2)	Trickle ditches, dry pond holding water during field visit, clogging and smell/Remove trickle ditches, add micropools/plantings	4.00	3.83	5	2	5	3.75	25
JM9100	JM-JM-0003	Pond Retrofit, Dump Site	Hot tub couches in stream/Existing pond with dam break on golf course property near piplines - repair/retrofit to provide treatment	4.29	2.83	3	5	3	3.74	26
LR9511	LR-LR-0011	New BMP/LID	Inlet treatment for uncontrolled area	2.90	3.50	5	5	3	3.72	27
LR9111	LR-LR-0014	Pond Retrofit	Dry pond retrofit with wetland plantings, micropool	3.14	2.83	4	5	5	3.69	28
LR9204	LR-LR-0014	Stream Restoration	Relace paved ditch with natural stream	3.64	3.00	4	5	3	3.69	29
LR9527	LR-WS-0003	New BMP/LID	Willow Springs ES drains to dry pond - onsite LID opportunities	2.80	2.83	5	5	5	3.69	30
LR9106	LR-LR-0012	Pond Retrofit	Remove trickle ditches, add micropools/plantings	3.43	4.17	5	2	5	3.68	31
LR9117	LR-WS-0002	Pond Retrofit	Existing dry pond not in StormNet - Remove trickle ditches, add micropools/plantings	3.57	4.00	5	2	5	3.67	32
LR9202	LR-LR-0008	Stream Restoration, Buffer Restoration	Erosion area with headcut/Restore buffer, remove paved and trickle ditches, add plantings to ponds	3.36	3.33	3	5	3	3.61	33
LR9013D	LR-LR-0012	Pond Retrofit	Enlarge pond to provide more treatment in replacement of Regional R-13	3.57	3.67	5	2	5	3.57	34
LR9509	LR-LR-0007	New BMP/LID	Flooding complaint at WAG - retrofit area u/s of culvert for SWM	3.20	3.00	4	5	3	3.56	35
JM9203	JM-JM-0005	Stream Restoration, Buffer Restoration	Significant erosion identified - flooding noted during field investigation	4.09	5.00	3	1	3	3.53	36
LR9521	LR-LR-0016	New BMP/LID, Pond Retrofit (x2)	Inlet/outlet treatment for uncontrolled area/Remove trickle ditches, add micropools/plantings	3.40	4.33	5	1	5	3.52	37
LR9010B	LR-WS-0004	Pond Retrofit	Remove trickle ditches, add micropools/plantings - enlarge in replacement of R-10?	3.86	3.50	2	3	5	3.51	38
JM9200	JM-JM-0001	Stream Restoration	Significant bank erosion - access issues	4.00	5.00	3	1	3	3.50	39
LR9109	LR-LR-0016	Pond Retrofit, Non-Structural	Remove trickle ditches, add micropools/plantings/Illicit discharge education (noted in NSA) - sweeping/trash in commercial shopping center	3.71	3.83	5	1	5	3.46	40
LR9203	LR-LR-0010	Stream Restoration	Remove paved ditch	3.18	3.00	3	5	3	3.45	41
JM9400	JM-PC-0001	Culvert Retrofit, Buffer Restoration	Pro rata project - comment in WAG#2/Plant trees - private property	4.50	3.00	1	5	1	3.45	42
LR9524	LR-WS-0002	New BMP/LID	Outlet treatment for uncontrolled area	3.40	4.00	5	2	3	3.42	43
LR9013A	LR-LR-0013	Stream Restoration, Buffer Restoration	Address erosion d/s of culvert - possible culvert resize needed/Restore buffer along stream - private property, houses close to stream issues	3.73	3.00	5	3	3	3.42	44
LR9515	LR-LR-0012	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.10	4.00	5	2	3	3.33	45
LR9107	LR-LR-0015	Pond Retrofit	Remove trickle ditches, add micropools/plantings	3.29	4.33	3	1	5	3.29	46
LR9518	LR-LR-0015	New BMP/LID (x3)	Inlet/outlet treatment for uncontrolled area	3.60	4.67	3	1	3	3.28	47
LR9517	LR-LR-0012	New BMP/LID	Inlet/outlet treatment for uncontrolled area	3.00	3.83	5	2	3	3.25	48
JM9101	JM-JM-0009	Pond Retrofit	Facility Treating School, retrofit, educational opportunities?	2.71	1.67	4	5	5	3.21	49
LR9108	LR-LR-0015	Pond Retrofit	Space for modification, need for more plantings	3.14	4.17	3	1	5	3.19	50

Attachment 8
Scores and Rankings after Modeling

Name	Subwatershed	Type	Comments	Impact Indicators Score	Source Indicators Score	Priority Subwatersheds Score	Watershed Sequencing Score	Project Implement-ability Score	Composite Project Score	Rank
LR9200	LR-LR-0003	Stream Restoration, Buffer Restoration	Buffer and stream erosion - on private property	3.64	5.00	1	1	3	3.19	51
LR9013B	LR-LR-0012	New BMP/LID, Stream Restoration	Culvert retrofit/grassed swale/stream restoration in replacement of Regional R-13	3.30	4.00	5	2	1	3.19	52
LR9502	LR-LR-0004	New BMP/LID	Inlet treatment for uncontrolled area	3.30	4.33	4	1	3	3.19	53
LR9013C	LR-LR-0012	New SWM	New pond to provide treatment in replacement of Regional R-13	3.29	4.00	5	2	1	3.19	54
LR9112	LR-LR-0018	Pond Retrofit, New BMP/LID	LID for uncontrolled area/Remove trickle ditches, add micropools/plantings	3.57	2.33	5	2	5	3.17	55
LR9113	LR-LR-0019	Pond Retrofit	Regional Pond R-161 - wetland plantings needed - at time of visit growth was sparse	2.71	2.83	4	5	1	3.16	56
LR9501	LR-LR-0004	New BMP/LID	Inlet treatment for uncontrolled area	3.20	4.17	4	1	3	3.11	57
LR9206	LR-LR-0022	Stream Restoration	Erosion, head cut, oily sheen noted during field visit	4.00	2.67	2	3	3	3.10	58
LR9519	LR-LR-0015	New BMP/LID	Bioretention/LID for uncontrolled area	3.50	4.17	3	1	3	3.10	59
LR9700	LR-LR-0008	Outfall Improvement	Erosion at transition from concrete ditch from field investigation	2.60	2.40	3	5	3	3.10	59
LR9507	LR-LR-0006	New BMP/LID	Inlet treatment for uncontrolled area	3.50	4.33	2	1	3	3.05	61
LR9101	LR-LR-0006	Pond Retrofit	Retrofit ponds to include wetland plantings	3.14	4.00	2	1	5	3.04	62
LR9512	LR-LR-0009	New BMP/LID	Inlet/outlet controls for uncontrolled area	3.40	4.33	2	1	3	3.02	63
LR9520	LR-LR-0016	New BMP/LID	Inlet/outlet treatment for uncontrolled area	2.80	3.67	5	1	3	2.94	64
LR9505	LR-LR-0006	New BMP/LID	Inlet treatment for uncontrolled area	3.30	4.00	2	1	3	2.89	65
LR9104	LR-LR-0009	Pond Retrofit	Retrofit to add plantings - address erosion in pond ditch	2.86	3.67	2	1	5	2.86	66
LR9105	LR-LR-0009	Pond Retrofit	Good access, space for modifications for wetland plantings, micropools to improve water quality treatment	2.86	3.67	2	1	5	2.86	66
LR9600	LR-LR-0018	Flood Protection, Buffer Restoration	Structures in floodplain, buffer restoration	4.14	2.00	5	2	1	2.84	68
LR9506	LR-LR-0006	New BMP/LID	Combination of bioretention, tree box filters for untreated area	3.30	3.67	2	1	3	2.79	69
LR9503	LR-LR-0004	New BMP/LID	Add treatments at inlets for untreated system	2.80	3.50	4	1	3	2.79	69
LR9116	LR-LR-0022	Pond Retrofit	Regional Pond R-17 Wetland areas, grassed spillways not stable during field visit - replanting and grading	2.57	2.00	2	3	5	2.67	71
LR9513	LR-LR-0009	New BMP/LID	Inlet/outlet treatment for uncontrolled area	2.90	3.50	2	1	3	2.62	72
LR9005B	LR-LR-0009	New BMP/LID	Add treatment for untreated system	2.80	3.33	2	1	3	2.54	73
JM9700	JM-JM-0011	Outfall Improvement	Moderate to Severe Impact (SPA)	3.00	2.20	2	3	1	2.46	74
LR9500	LR-LR-0003	New BMP/LID	Treat uncontrolled flow from subdivision	3.40	2.33	1	1	3	2.32	75

Appendix C – Summary of Public Involvement

This appendix contains meeting summaries from the two public forums and the five Watershed Advisory Group (WAG) meetings in chronological order:

Issues Scoping Forum: 10/1/08

WAG #1: 12/1/08

WAG #2: 3/16/09

WAG #3: 5/18/09

WAG #4: 2/22/10

WAG #5: 6/29/10

Draft Plan Forum: 9/16/10

Little Rocky Run – Johnny Moore Creek Presentation Summary
Introductory and Issues Scoping Forum 10/1/08

Participants were welcomed by Fairfax County Stormwater Planning Division Staff, Supervisor Michael Frey (Sully District) and Supervisor Pat Herrity (Springfield)

A watershed primer was presented that described the characteristics of a watershed and the watershed planning units in Fairfax County. The watershed planning units were defined:

- A Watershed Management Area or WMA is a portion of a watershed with similar land use and development characteristics for evaluation and management. For this study, they are generally 3-5 square miles in area.
- A subwatershed is an even smaller area used for more detailed evaluation in the planning process. They vary in size for this study between 100 and 300 acres in area.

The watershed planning process was also described:

- Evaluate data to determine the state of the watersheds
- Identify issues that the plan will address
- Establish a vision for the watershed goals that will improve, enhance and protect the watershed
- To achieve these goals, develop specific actions
- Create a framework and timeframe for implementation.

Over the past year, previous studies have been reviewed and known data about the watershed has been compiled. The watersheds have been characterized and the information presented in a draft Watershed Workbook. After this Introductory and Issues Scoping Forum, subwatershed strategies will be developed and a draft Watershed Plan prepared. This draft plan will be presented in another public form. After feedback from the community, the final plan will be prepared and presented to the Board of Supervisors for adoption.

The plan will recommend various methods to address common watershed issues. These recommendations may include:

- retrofitting existing stormwater management ponds
- creating new Best Management Practices (BMPs)
- implementing Low Impact Development (LID) techniques
- revegetate stream buffers
- stabilize and restore streams
- implementing changes to policies and regulations.

The benefits of creating watershed plans were presented:

- to help restore and preserve the vital natural resources which form the basis of people's lives
- watershed impact our drinking water, our health and the health of the environment
- the watershed plans will help the County and its residents make informed decisions to help ensure a better future in regards to our watersheds and quality of life

A summary of the Watershed Workbook was also presented.

Chapter 1 of the workbook provides a summary of previous studies related to the watersheds. Studies and reports are presented by topic: reports that provide data, reports that discuss policy changes and those that recommend proposed projects and improvements.

Chapter 2 of the workbook provides the subwatershed characterization. The chapter is organized by the three WMAs in the watersheds: Johnny Moore Creek, Little Rocky Run – Lower and Little Rocky Run – Upper.

Examples of the maps that are included in Chapter 2 were presented:

Existing and Future Conditions Land Use

Highlighted the importance of the Resource Conservation (RC) District in these watersheds – this area was rezoned by the Board of Supervisors in 1982 to protect the Occoquan Reservoir. In this district, development is limited to one dwelling unit per 5 acres. All of Johnny Moore Creek and the southern portion of Little Rocky Run are located in this district.

Stormwater Infrastructure

This map shows the location of stormwater management facilities, parcels that are controlled by some type of stormwater management, stormwater complaints and the storm sewer system.

Stream Condition

This map is based on data from the County's Stream Physical Assessment performed in 2005. Impact areas such as obstructions, erosion, dumps, headcuts and crossings are shown on the map. The map also identifies stream reaches that are actively evolving and unstable based on the Channel Evolution Model (CEM). Habitat assessment scores are also reflected on the stream reaches to reflect if the habitat assessment was ranked as very poor, poor, fair, good or excellent.

Preliminary Modeling Results

Maps reflecting the results from preliminary modeling of pollutant loads, stream discharges, and floodplains were presented.

Pictures of problem areas found during the field reconnaissance were presented.

A summary of the methodology used in the subwatershed ranking was presented based on the County's watershed planning goals and planning objectives (hydrology, habitat, stream water quality, drinking water quality and stewardship). Examples of objective ranking maps as well as source composite and overall composite ranking maps were presented.

The use of this data in the watershed planning process was discussed. The rankings and maps are one tool to be used in the planning process and will provide a framework for identification of problem areas and to evaluate the effectiveness of proposed projects and policy changes. The County will also be able to use the ranking County-wide in order to prioritize projects.

Methods for public participation were presented:

- attend the public forum
- email comments to watersheds@fairfaxcounty.gov
- phone the County at 703-324-5500 TTY 711
- use the virtual forum on the web: www.fairfaxcounty.gov/dpwes/watersheds/johnnymoorecreek.htm

Following the workshop, a watershed advisory group (WAG) of 12 to 20 members will be formed. The WAG will include representative watershed interests, review plan ideas and projects and serve as a liaison to the community. If interested in serving on the WAG, contact karenfirehock@virginia.edu.

An open house where the participants were asked to provide comments at three WMA stations was held.

Fairfax County Issues Scoping Forum Notes: Oct. 1, 2008, Centreville Elementary School

(Note: see dots on maps for locations. AMEC has maps from the workshop.)

HOA = Homeowners Associate

LRR = Little Rocky Run

JMC = Johnny Moore Creek

As personal contact information is included here, this document must not be posted to any public sites unless names and numbers are first deleted.

Little Rocky Run – Upper

Recorder: Kate Bird, KBird@e2inc.com

1. Undercutting throughout this area of stream
   a. (Larry Baldwin)
2. Dump and municipal school bus lot may be impacting water quality – suggest water monitoring
   a. (Larry Baldwin)
3. Retention pond – large, smells bad & unsightly – poorly constructed and does not seem to drain adequately
   a. (Larry Baldwin)
4. Colin Powell Elementary location – add to land use map (Lynne Mowery)
5. Culvert eroding stream bed and causing flooding – overflow overwhelming habitat
6. Heavy water runoff from subdivision – ponds exist but possibly inadequate – need to investigate

Note: Culpepper Rift along where elementary school lies – alluvial soil with very little basalt. Meeting of low country and piedmont geology. Many upper drainages have been paved over time.

Little Rocky Run – Lower

Recorder: Michael Baker, mbaker@e2inc.com

1. Erosion control needed,
   a. South Springs Drive – Al Francese (703-818-8178)
2. Solid waste and trash dumping
   a. Entire watershed but especially the NE tributary under New Braddock Road
3. Construction along 29 corridor
   a. Route 29- Friends of Little Rocky Run
4. Maintenance/overhaul of most of the containment (dry) ponds needed
   a. Entire watershed – LRR HOA
5. Downcutting and channelizing
   a. See map illustration – Ned Foster
6. RPA Violations in backyards

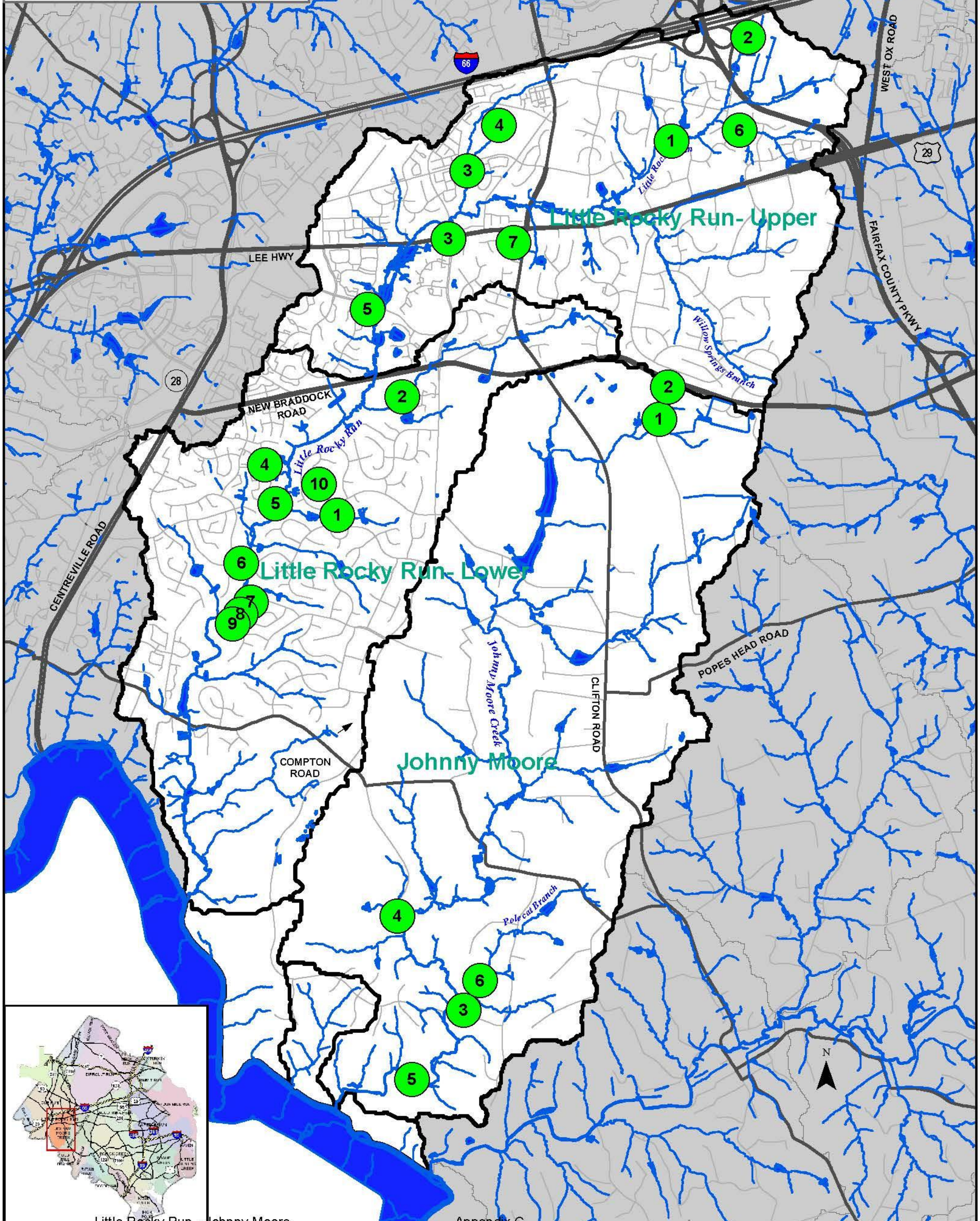
    a. All along LRR (both upper and lower) —Ned Foster
7. Need access to natural resources for recreation all along LRR
    a. East side of LRR – LRR HOA and Lynn Foster
8. Bridges and trails as a solution to #7 (same contact as #7 above)
9. Paving options for trails (mow, asphalt or natural?)
10. Drainage stormwater inlet sits at highest point on land (stays dry)
    a. Stonehunt Court on LRR – Paul Jensen at 13706 (571-643-6788)
    b. Best access to site is from Stonehurst Place

Johnny Moore Creek

Recorder: James Wilkinson, Jwilkinson@e2inc.com

1. Doyle Rd. Subdivision – watershed impacts from lack of water and sewer connections
    a. First house on right after turning onto doyle road from Braddock Road
    b. Charles Dayharsh – 5720 Doyle Rd., cdayhardsh@verizon.net
2. Ditches covered by asphalt Doyle Rd.
    a. Sedimentation and erosion along neighboring properties, ponds, JMC
    b. Interested in water quliaty testing for this portion of JMC – all resulting from construction activities on church property – lawsuit underway
    c. Location – Kings Chapel – 12925 Braddock Road
    d. Suzie Kochare – Doyle Rd. 703-267-1193
3. Polecat branch and JMC – erosion has increased sig. in the last few years – no new construction (see number 6 – upstream polecat branch)
    a. Paul Jensen – paul_jensen@cox.net 571-643-6788
4. Stream erosion at JCt of union hill rd. & JMC, regular flood events as well here
    a. Paul Jensen
5. Streambank erosion along JMC in southern part of watershed
    a. Location – general (also from Paul Jensen)

Forum Comments



Meeting Summary for Johnny Moore Creek and Little Rocky Run

Watershed Advisory Committee Meeting

Liberty Middle School, December 1, 2008

Purpose:

The purpose of the meeting was to orient the new watershed advisory group (WAG) members to the watershed planning process for Little Rocky Run (LRR) and Johnny Moore Creek (JMC) and to solicit any additional watershed issues to address in the plan.

Watershed Advisory Committee:

Karen Firehock welcomed participants and provided a brief overview of the participation guidelines. Each attendee received a watershed planning notebook with background materials and a CD containing the watershed workbook. Ms. Firehock explained that the role of the WAG members is to provide meaningful participation options for a diversity of stakeholders, incorporate community ideas into the scope of the watershed plans and to assist with the prioritization of projects to be implemented throughout Fairfax County's 30 watersheds over the next 25 years. The WAG will assist in identifying issues of community concern, highlight key community priorities for watershed plan goals and conduct outreach functions. The WAG will meet approximately four to six times over a 10-12 month period with the understanding that meeting timing depends upon the work being performed (e.g. meet when a new study or modeling report is ready for review). WAG members are also responsible for providing their constituency groups with updates about the project and enlist the participation of members in the draft plan review forum. This is an important facet of the WAG as one person may not be able to fully represent all the interests of their respective group.

Ms. Firehock explained that there is only one representative allowed per group to ensure balanced representation on the committee. However, members of the WAG may bring alternates. She also emphasized that all WAG meetings are open to the public and anyone may attend and address the group. Finally, she noted that there were a number of groups invited who did not respond, so if WAG members know those individuals (listed on the member list as "invited but not confirmed") they should encourage them to join. If WAG members notice there are any other key groups missing, they should ask those groups to contact Ms. Firehock so she can determine if they are within the watershed boundaries and could join the project.

The WAG members also asked if emails could be shared. Hearing no objections, Ms. Firehock agreed to send an email list to everyone. She also noted that team contact information would be shared (found at the end of this summary) and that it was included in the participation guidelines sent previously.

Two slide shows were presented. Copies are posted on the watershed website at <*http://www.fairfaxcounty.gov/dpwes/watersheds/*> under Little Rocky Run and Johnny Moore Creek webpage.

Watershed Primer:

Eric Forbes provided a watershed primer slide show to introduce participants to the watershed planning concept. He noted that the watersheds in LRR and JMC are in fairly good condition compared to some streams in the county. The county performed a number of studies to determine watershed condition including stream sampling and a physical assessment. One participant asked how the physical assessment was conducted. Mr. Forbes explained that this assessment was done by a consulting firm for the county and that they walked every stream in the watershed to determine channel condition. Another member asked about how to find the RPA boundaries. Mr. Forbes said they are available on line at <http://www.fairfaxcounty.gov/maps/gallery_WallMaps.htm> and then click on CBPA and watersheds map. There is also a digital map viewer available by clicking on Chesapeake Bay Map and the tax map panel.

Overview of Watershed Planning:

Fred Rose gave a brief overview of the watershed plans to date. He explained that many recommendations on policy have been collected and the county is evaluating how best to address them, most likely through a centralized stakeholder advisory committee that can look county-wide. He emphasized that the primary role of the LRR and JMC WAG is to address projects and the best locations for them to ensure suitable solutions to stormwater runoff.

One participant asked about regional ponds. Mr. Rose noted that some had been sited in the past but never built. A solution is still needed for these areas of the watershed, but new solutions arising from this effort may be more decentralized and smaller scale, since development in the area has made it more difficult to install large regional systems. On the plus side, he noted that these smaller scale systems often cost less and also can do a better job of treating water quality.

One participant asked who pays for the watershed plans. He noted that his HOA would be concerned that participation in the plan and siting projects in their community would result in a fee to the HOA. Staff responded that if there were an existing stormwater facility that was found to be malfunctioning or is in disrepair, the HOA would likely be required to repair it. However, Mr. Rose noted that this is the case regardless of whether a watershed planning effort is undertaken. Several HOA members agreed that their HOAs are indeed responsible for the upkeep of their HOA-owned facilities.

Mr. Rose also noted that the county is certainly open to cost sharing on any projects. If an individual installs their own private raingarden, the county would not be monitoring that or assessing any fees. Projects may be installed on private lands with permission as well as at public facilities, such as schools. If the county installs a project, the design and maintenance agreement would be developed in advance. Finally, staff noted that there would be more projects than funds and a key role of the group will be to help prioritize the preferred project list and suggested locations. All agreed that there is no desire to place projects where they are not wanted. An important role for the WAG is to advise the county on locations and to help find sites that are most suitable and desirable.

Lynne Mowery provided an overview of what is known about county streams and the comments received to date. First, she provided a description of the Watershed Workbook and the data provided on the maps in the Workbook. Problems in the watersheds identified in existing studies and issues identified at the Scoping Forum held on October 1, 2008 were presented. Existing studies and monitoring of the watershed show that benthic scores in the streams are low and that stream bank stability and buffer conditions are a concern on many of the stream reaches. Total Maximum Daily Load (TMDL) development for Bull Run for benthic and bacteria will also impact Little Rocky Run and Johnny Moore Creek because they flow into the impaired segment of Bull Run. Issues identified at the Scoping Forum were presented to the WAG for further discussion.

Ms. Mowery then presented some examples of structural projects that may be recommended as part of the watershed plan. Examples of stormwater pond retrofits, low impact development (LID), stream restoration, stream buffer restoration, road crossing projects and obstruction removal projects were presented.

Additional issues to research and investigate:

Participants reviewed maps to determine other issues that should be flagged.

- Compton Heights noted that they have a severe erosion issue.
- A participant asked if a volunteer monitoring program could be implemented to provide more consistent local data and to be able to evaluate the watershed plan in the future.
- North Hart Run area has a lot of large lawns (as do several of the subdivisions) that may be contributing significant amounts of fertilizer and other chemicals to streams. Community education is needed regarding environmentally-friendly lawn care practices.
- A creek walk will be conducted by residents to look for additional suspected erosion locations (new site 7 on JMC Map).
- One road improvement project is planned and should be noted by project engineers (new site 8 on JMC Map).
- Flooding issue downstream of Green Trails Boulevard adjacent to Sorrel Chase Court
- Erosion on tributary north of Compton Heights Circle
- Erosion at low point on hard surface trail near Melstone Court
- A participant recommended that dry ponds in the Little Rocky Run subdivision be investigated for retrofit Next Steps: Lynne Mowery

- AMEC will review any new watershed issues raised at the meeting and research those. Participants should send any additional comments by Dec. 15. Later comments can also be included but the engineers need as much lead time as possible so they can move from problem characterization to devising potential solutions.
- Next meeting for the WAG to review proposed solutions is likely in early spring 2008.
- A short article will be sent to attendees to use in their newsletters and other communications about the project.

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:

The Little Rocky Run and Johnny Moore Creek Watersheds have experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the waterways and their watersheds. The Watershed Advisory Group (WAG) provides input to Fairfax County. The WAG members serve as liaisons between their respective communities and the project team. AMEC Earth and Environmental, Inc. serves as the technical team lead and prepares watershed plan drafts and engineering studies and facilitates WAG and public meetings for the county. For more information please contact <Eric.Forbes@fairfaxcounty.gov> or visit *http://www.fairfaxcounty.gov/dpwes/watersheds/johnnymoorecreek.htm*

(see last page for contact information and attendee list)

To Contact Staff:

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Eric Forbes, Ecologist, Fairfax County Stormwater Planning Division, Eric.Forbes@fairfaxcounty.gov, (703)324-5717

Fairfax County Watershed Website: *http://www.fairfaxcounty.gov/dpwes/watersheds/johnnymoorecreek.htm*

Use this site for meeting dates, workshops and to read meeting summaries and reports.

Watershed Plans Comment Email Address: *watersheds@fairfaxcounty.gov*

Little Rocky Run and Johnny Moore Creek Watershed Advisory Committee					
Dec. 1, 2008 Meeting					
LRR	**JMC**	**Attended**	**Group**	**Name**	**Title**
x		yes	Westfields Golf Club	Tom Farris	Manager
x		yes	Friends of Little Rocky Run	Ned Foster	President
x	x	yes	Occoquan Watershed Coalition	Jim Bonhivert	President
		yes	Clifton Horse Society	Jean Voss	President
x		yes	Little Rocky Run HOA	Jeff Hummel	President
x		no	Compton Village HOA	Joseph F. Cottone	President
x		yes	Green Trails HOA	Jay Hurst	President
x		yes	North Hart Run HOA	Sara Dyer	
	x	yes	Cedar Knolls of Clifton HOA	Laurie Anderson	HOA rep
	x	no	Union Mills HOA	Gene Griffe	President
x		yes	Compton Heights HOA	William Ballou	Vice President

Staff and Guests Attending

Fairfax County Stormwater Management	Fred Rose	Chief, Assessment
Fairfax County Stormwater Management	Eric Forbes	Ecologist
AMEC Inc.	Lynne Mowery	Project Manager
AMEC Inc.	Matt Breen	Engineer
AMEC Inc.	Karen Firehock	Public Involvement
Springfield Supervisor Pat Herrity	Marlae Schnare	Staff
Sully Supervisor Michael L. Frey	Meghan Kiefer	Staff
Additional attendees	Al Francese Ann Farris	LRR HOA Alternate Guest

Meeting Summary for Johnny Moore Creek and Little Rocky Run

Watershed Advisory Committee Meeting

Little Rocky Run HOA Recreation Center, March 16, 2009

Purpose: The purpose of the meeting was to provide an overview of the problem areas identified in the subwatershed characterization and to introduce examples of solutions that may be recommended to address stormwater problems. The group also discussed additional specific focus areas for the watershed plan. Copies of the presentations are appended to this summary.

Countywide Goals and Objectives:

Eric Forbes provided a presentation of Countywide Goals and Objectives for the watershed plan (see attached presentation). He explained that since the planning effort has been underway across the county for several years, many of the goals and objectives created during the initial watershed planning projects were very similar. In order to reduce duplication and make the planning process more efficient, the county has created three overarching goals for all of the current plans under development which are:

1. Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology.
2. Protect human health, safety and property by reducing stormwater impacts.
3. Involve stakeholders in the protection, maintenance and restoration of county watersheds.

The county also has created standard categories for objectives:

1. Hydrology
2. Habitat
3. Stream Water Quality
4. Drinking Water Quality
5. Stewardship

He then explained that the county uses specific indicators to monitor these objectives. Indicators include watershed impact indicators such as sediment loading or phosphorus, and source indicators such as channelized streams, urban land cover or habitat quality.

Karen Firehock asked the committee if there were other concerns or objectives under the above categories specific to Little Rocky Run and Johnny Moore's Creeks that should be considered. Committee members noted that trash and debris seemed to be particularly problematic for Little Rocky Run and Johnny Moore Creeks.

Problem Areas identified by Subwatershed Characterization:

Matt Breen presented problem areas that were identified by the Subwatershed Characterization (see attached presentation). It was explained that the subwatershed ranking is used to identify currently impacted subwatersheds, those in danger of becoming impacted in the future and the potential stressors that may cause watershed impairment. He noted that the ranking system does not replace "common sense." A problem that is observed by a staff member or a resident will be investigated even if it is not on any existing list. He described the "overall watershed composite score map" as being comprised of rankings for hydrology, habitat, stream water quality and drinking water quality (related to the Occoquan Reservoir). He explained that lower ranked areas will require more attention in order to improve their scores. He explained that the source composite ranking is a combination of multiple stressors such as impervious cover, buffer deficiencies and concentrations of nutrients.

Discussion:

One participant asked if current data were used to create the evaluations. Mr. Breen explained that data sources included past studies such as the Stream Protection Study, the Stream Physical Assessment conducted in 2002 and 2003, and randomized in-stream sampling conducted by the county since 2004. Other sources of data include county maintenance records, citizen complaints and field observations by the team. He noted that while the maps show areas where we should focus, further field reconnaissance will still be needed. Once these maps are finalized and potential projects determined, a cost benefit analysis will be undertaken to help determine the priority for the project. He noted that projects may be suggested for HOA property or other private property, such as a church parking lot. He emphasized the importance of the committee in helping to suggest appropriate locations, once the engineering team has determined the focus areas in the subwatersheds.

He also explained that in some areas lacking stormwater management, it may be the case that a large pond was rejected or never built. Several members noted that there are existing ponds that also need to be retrofitted. On one example slide, members commented that the pond in question was the "watershed's worst" and was often filled with debris, including dumped furniture.   Mr. Breen noted that there was a regional pond proposed for the Green Trails HOA that was never built. He explained that the team would be determining other measures that could be taken instead of the pond to achieve better results.

Another member asked what measures would be installed in floodplain areas. The staff responded that those projects would likely consist of either buffer or channel restoration. They clarified that most of the low impact development (LID) measures would be located outside of the floodplain to prevent encroachment and to prevent damage to the technology. For example, during a flood event, a raingarden can be clogged with sediment and rendered inoperable. It was also noted that trails in the floodplain could be improved to ensure that they are not contributing to excess runoff or erosion. Ms. Mowery added that in some more remote areas where streams are eroding, the best approach may be to leave the stream alone in order to avoid damaging the buffer in trying to access the stream. She explained that if the sources of the problem are addressed, the stream may eventually repair itself but it may not be a high priority to fix now, if property and lives are not at risk.

Several members suggested specific issues for consideration in the watershed plan (in addition to those suggested at the last meeting).

- The bridge widening at Rt. 29 may impact some "swamp mallow" (*Hibiscus sp.*) habitat. Should make sure that VDOT replaces any plants that are disturbed.
- There is an area zoned C-8 (commercial) along Little Rocky Run that would be a great place for LID measures to be incorporated as part of any development.
- The Green Trails HOA has a multi-purpose court that needs renovation and this may be a good place to consider a low impact development approach, since it is located in the floodplain.
- The Union Mills HOA has applied for a FEMA grant on the west side of the Union Mills HOA property to address flooding of backyards. The watershed planning team should be aware of the project (if funded) and possibly collaborate on the solution and final design.
- Existing dry ponds should be restored and planted to improve water quality wherever possible. A participant noted that the Union Mills neighborhood has two good candidate ponds for this approach.

Map Review: Participants reviewed watershed maps and discussed possible issues and projects with the team.

Issues and Questions discussed during the map review included:

- The residents of the Cedar Knolls subdivision are averse to granting the county easements for stormwater management projects
- There is an area of stream erosion and flooding on Compton Road, approximately 1/8 mile west of Ivakota Road

- Existing facilities in the Union Mills subdivision could be enhanced by improving/expanding their water quality benefit. It was also noted that they are located in our lowest ranked subwatersheds (Overall Composite), which will be a targeted area for restoration

Problem Areas and Possible Solutions:

Lynne Mowery provided an overview of options for stormwater management and common areas that can be "retrofitted." For example, a parking lot can be redesigned to provide curb cuts to infiltrate water into a rain garden, or manufactured best management practices can be installed to detain and filter water to reduce stromwater volumes, velocities and contaminants. These are examples of a low impact development (LID) approach that seeks to duplicate the original hydrology of the watershed that allowed rainwater to slowly infiltrate and filter through the ground before reaching streams. Ms. Mowery explained that LID is based on five principles; conservation and minimization, storage, conveyance, landscaping and infiltration.

In some areas, simply removing practices that we now know don't work well is a simple solution. She provided the example of a "trickle ditch" consisting of a low-flow concrete channel across the stormwater pond. She said that these ditches do not slow velocities and they tend to accumulate sediment which is transported to surface waters during higher flows. Instead, she suggested that ditches be removed and ponds be planted to better slow stormwater and trap sediment.

She noted that AMEC staff would evaluate the watershed to determine where new approaches are needed and which measures to employ. Eric Forbes reminded everyone that a key role of the committee is to help make suggestions concerning the most appropriate areas to consider for these mitigation measures. Ms. Mowery explained that this would be part of the "homework" that the team will send to them in mid-April.

Next Steps:

- AMEC will begin identification of specific project areas and provide homework to WAG members regarding possible projects (likely by mid-April).
- Next meeting to be held in late April to discuss proposed solutions.

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:

The Little Rocky Run and Johnny Moore Creek Watersheds have experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the waterways and their watersheds. The Watershed Advisory Group (WAG) provides input to Fairfax County. The WAG members serve as liaisons between their respective communities and the project team. AMEC Inc. serves as the technical team lead and prepares watershed plan drafts and engineering studies and facilitates WAG and public meetings for the county. For more information please contact <Eric.Forbes@fairfaxcounty.gov> or visit *http://www.fairfaxcounty.gov/dpwes/watersheds/*

"The opinions represented herein do not necessarily represent those of Fairfax County or its agents."

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Fairfax County Watershed Website: *http://www.fairfaxcounty.gov/dpwes/watersheds/*

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Watershed Plans Comment Email Address: *watersheds@fairfaxcounty.gov*

Little Rocky Run and Johnny Moore Creek Watershed Advisory Committee					
		March 16, 2009 Meeting			
LRR	**JMC**	**Attended**	**Group**	**Name**	**Title**
x		no	Westfields Golf Club	Tom Farris	Manager
x		yes	Friends of Little Rocky Run	Ned Foster	President
x	x	no	Occoquan Watershed Coalition	Jim Bonhivert	President
x	x	no	Springfield Supervisor Pat Herrity	Marlae Schnare	Staff
x		yes	Sully Supervisor Michael L. Frey	Meghan Kiefer	Staff
x	x	alternate	Clifton Horse Society	Jean Voss	President
x		yes	Little Rocky Run HOA	Jeff Hummel	President
x		no	Compton Village HOA	Joseph F. Cottone	President
x		yes	Green Trails HOA	Jay Hurst	President
x		yes	North Hart Run HOA	Sara Dyer	
	x	yes	Cedar Knolls of Clifton HOA	Laurie Anderson	HOA rep
	x	alternate	Union Mills HOA	Gene Griffe	President
x		no	Compton Heights HOA	William Ballou	Vice President

Staff and Guests Attending

	Fairfax County Stormwater Management	Darold Burdick	Engineer
	Fairfax County Stormwater Management	LeAnne Astin	Ecologist
	Fairfax County Stormwater Management	Eric Forbes	County Project Manager
	AMEC Inc.	Lynne Mowery	Project Manager
	AMEC Inc.	Matt Breen	Project Engineer
	AMEC Inc.	Karen Firehock	Public Involvement
Alternate	Union Mills HOA	Mike Shipley	
Alternate	Sue	Clifton Horse Society	

Meeting Summary for Johnny Moore Creek and Little Rocky Run
Watershed Advisory Committee Meeting
Little Rocky Run HOA Recreation Center #3,
May 18, 2009

Purpose:
The purpose of the meeting was to review the proposed project locations and restoration strategies for the two watersheds and to provide feedback to inform project prioritization. Watershed Advisory Group (WAG) members were asked to consider if the project location is appropriate, if there are alternate locations, whether or not there are any conflicts that would prohibit certain projects and whether any projects are missing that should be added.

Project Schedule Overview:
Karen Firehock provided an overview of the schedule. The next meeting (WAG #4) was proposed for June 15 to review prioritized and ranked projects. Three WAG members noted that they will be out of town, so this date may need to be moved. Following the fourth WAG meeting, projects will be incorporated into the watershed plan and reviewed by the WAG at their fifth meeting (proposed for August). Once the plan has been reviewed by the WAG, any required changes will be made and the plan will be presented to the public at a final draft plan workshop for fall (possibly in September). The public's comments will inform development of the final draft plan which will be presented to the Board of Supervisors (BOS) in winter 2009 for adoption. Following adoption by the BOS, implementation will begin.

Process to develop the project list and strategies (presentation is on project website):
Lynne Mowery provided an overview of how the projects were selected. She reminded the WAG that the projects are intended to meet the established goals for the watershed plan. She explained that the subwatershed rankings were used to determine candidate projects from the "project universe". She noted that a project could be ranked as a high priority because the stream is impaired, but an area that is in good condition may need projects to ensure that its relative high quality is maintained. Ms. Mowery provided examples of projects done for the other county watershed plans (also provided as a handout).

One participant asked what percentage of spillways tend to fail. They noted that their HOA had to spend money to reconstruct their spillway. Darold Burdick responded that the technologies have improved, so hopefully there will be less failure in the future. He also noted that all systems require repair and replacement at some point. Another participant asked about who maintains ponds. County staff explained that dry ponds are maintained by the county and wet ponds are maintained by the HOAs generally.

Another participant asked why ponds that are recently constructed to county standards, or are still covered by their performance bond, had been added to the list. The participant questioned why these relatively new ponds, built to modern standards, would now need to be retrofitted. The project engineers responded that they did not have information for their field work on the age and bonding status of the ponds they visited. The team was simply looking for opportunities where existing structures could be improved. It was explained that a pond could be built to standards for controlling stormwater volume and velocities, but that it could still be possible to add water quality improvements.

Also, a pond may have been built to meet the runoff only for a particular development, but if there is a stormwater problem off site that could be met by expanding or altering an existing pond, then the engineering team would recommend the pond be modified. The team emphasized that existing structures or already disturbed areas are utilized whenever possible to maximize efficiencies, instead of constructing new best management practices. The engineers concluded that they still need to prioritize projects and that project types have not been finalized. This project list is a first pass and will be modified based on feedback received at this meeting.

Another question related to how Little Rocky Run – Johnny Moore Creek projects will be prioritized when they must compete for funds county-wide. Staff explained that all projects are ranked using the same objective system so a project with a high priority score for LRR or JMC would be ranked equally against a high scoring project in another watershed. Staff reminded everyone that projects will be implemented over a 25 year period based on their ranking and logical order for getting work done. Therefore, there is some flexibility in how and when projects are designed and implemented on the ground. It was noted also that projects would be completed both to protect existing good water quality as well as to restore impaired creeks. Fred Rose explained that the final countywide list of projects would not be a list of the worst water quality problems, but rather a mix of projects, so that good creeks do not decline while extreme problems are addressed. The ranking system will also factor in the expected benefits of a project such as, how much pollution can be removed or reduced and at what cost?

Projects' Review:
The group broke up to review the three watershed areas and the comments were noted on flip charts (listed below). Participants also were asked to email any other questions or feedback within a week so that the team could plan their field visits for the following week. At the fourth WAG meeting, project rankings will be provided and the final proposed refined list of project will be reviewed once more. Project #s refer to project # on maps found on the watershed web site at:
http://www.fairfaxcounty.gov/dpwes/watersheds/johnnymoorecreek_docs.htm

Notes from Flip Charts: LRR and JMC

#21: Significant erosion issues are occurring along power line easement just north of this location. Considering the facility at proposed project #21 is known to have sedimentation issues (it has been dredged twice recently and was recently retrofitted), this area needs to be visited. The area mentioned is thought to drain directly into Little Rocky Run.

LR-LR-0010:
#25: The site limits options here and the community does not want a pond here. Note that the regional pond (R-5), currently inactive, was proposed at one time for this location. The site needs to be visited to determine whether or not a group of smaller, decentralized projects can attain the same or similar benefits as the proposed regional facility. It may also be determined that there is no longer a need for treatment at this location. The HOA representative expressed concern over the possibility of a new pond for a number of reasons and suggested that any future proposed pond was likely to be opposed by residents. Alternatives to the pond will be explored.

40: Look at runoff problems from land to the west caused by grading done by the landowner, that is now causing road flooding and ice conditions (ask the North Hart Run HOA for details on the location).

LR-LR-0015:
Where applicable, Little Rocky Run HOA requested consideration of retrofitting the parking areas of some townhouses with porous paving/detention systems (similar to Providence Rain Garden system).

LR-LR-0004
#43 Downstream stream restoration isneeded (Located on map just under #"4" in 43). There are concerns over what type of project was being contemplated. A relatively small number of parcels (~30) are draining into the main stem of the Little Rocky without being treated. The options to be explored include treating the runoff at the outfall in the back of the neighborhood, but there are access issues and other site limitations at this location. Another option is to incorporate small stormwater management facilities in the neighborhood - tree-box filters, raingardens, infiltration trenches etc. A site visit will need to occur before a final strategy is developed. There are several similar locations throughout Lower Little Rocky where groups of parcels are untreated and will be addressed in a similar manner.

LR-LR-008:
#s 47, 49 and 50. This is a nice wooded area and would benefit from stream habitat and other improvements.

In LR-LR 0011:
#s 51, 52, 53, 54, 58: All are on a degraded creek, so they will be a high priority.

55: Union Mill Elementary has educational opportunities, so this would be a priority.

#60: Townhouse area – porous pavers for area (see note for project #15)

Ques. Re # 67: Is that property publicly owned?

LR-LR-0016
#82, 83: Union Mills neighborhood, there are concrete channels and no water quality treatment so this is a high priority.

#83, 84: Union Mills HOA is supportive of retrofit opportunities. The facilities are older. Trickle ditches need to be removed. Mike has witnessed visible pollution (oil, cleaning agents, etc.) ponding occurs in the facilities and is washed right into the stream. Filtering needs to be improved.

#86: New bridge on Lee Highway - -keep watch on design process since environmental issues (e.g. VDOT has been apprised of the Swamp Mallows there).

#87: Trash problem here – Health Department required cleanup and the "Friends of LRR" have cleaned it again.

#93: Note the culvert was replaced here.

#102: Monitoring information is needed.

#111: It is difficult to provide a forested buffer here since houses are already too close to stream (within 20 feet, so little room for a project).

#118: Site has old swimming pools filled with soil and buried. Should they be removed? Is this property abandoned?

LR-LR 0015:
Question regarding # 134: Are there habitat issues there that can be addressed by enlarging the pond? The pond is in good shape now, so just need to clarify what will be achieved if the pond is enlarged or improved.

Non-numbered Comments:

In LR-LR-0007. Green Trails Homeowner's association has potential project location to be evaluated. A multi-use court which is slated to be revamped may provide an opportunity to address watershed objectives and will be investigated. If that's the case, they are open to working with the County to find a layout that benefits the community as well as the watershed. HOA has a proposal for a green roof to be constructed on top of a pavilion to replace the tennis courts (see handout provided by Jay at the meeting). There are opportunities for more low impact development approaches around that site if needed.

Little Rocky Run HOA area: Positive feedback received for potential locations in Little Rocky Run HOA. The HOA is willing to work with the county for projects within the HOA, which is most of Lower Little Rocky Run.

Compton Heights HOA mentioned that there were some locations that were missed that had potential. Need more information from the HOA.

There are no comments for Johnny Moore Creek since those representatives did not attend meeting.

Next Steps:

1) Comments are requested from the committee by May 22 by email

2) The next meeting was proposed for June 15 to review a ranked list of projects, but this may need to be changed because three committee members were not able to make this date.

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:
The Little Rocky Run and Johnny Moore Creek Watersheds have experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the waterways and their watersheds. The Watershed Advisory Group (WAG) provides input to Fairfax County. The WAG members serve as liaisons between their respective communities and the project team. AMEC Inc. serves as the technical team lead and prepares watershed plan drafts and engineering studies and facilitates WAG and public meetings for the county. For more information please contact <Eric.Forbes@fairfaxcounty.gov> or visit ***http://www.fairfaxcounty.gov/dpwes/watersheds/***

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Eric Forbes, Ecologist, Fairfax County Stormwater Planning Division
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Fairfax County Watershed Website: *http://www.fairfaxcounty.gov/dpwes/watersheds/*
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Watershed Plans Comment Email Address: *watersheds@fairfaxcounty.gov*

Little Rocky Run and Johnny Moore Creek Watershed Advisory Committee					
		May 18, 2009 Meeting			
LRR	**JMC**	**Attended**	**Group**	**Name**	**Title**
x		no	Westfields Golf Club	Tom Farris	Manager
x		yes	Friends of Little Rocky Run	Ned Foster	President
x	x	no	Occoquan Watershed Coalition	Jim Bonhivert	President
x	x	no	Springfield Supervisor Pat Herrity	Marlae Schnare	Staff
x		yes	Sully Supervisor Michael L. Frey	Meghan Kiefer	Staff
x	x	no	Clifton Horse Society	Jean Voss	President
x		yes	Little Rocky Run HOA	Jeff Hummel	President
x		no	Compton Village HOA	Joseph F. Cottone	President
x		yes	Green Trails HOA	Jay Hurst	President
x		yes	North Hart Run HOA	Sara Dyer	
	x	no	Cedar Knolls of Clifton HOA	Laurie Anderson	HOA rep
	x	alternate	Union Mills HOA	Gene Griffe	President
x		yes	Compton Heights HOA	William Ballou	Vice President

Staff and Guests Attending

	Fairfax County Stormwater Management	Fred Rose	Engineer
	Fairfax County Stormwater Management	Darold Burdick	Engineer
	Fairfax County Stormwater Management	Eric Forbes	Ecologist and County Project Manager
	AMEC Inc.	Lynne Mowery	Project Manager
	AMEC Inc.	Hrushikesh Sandhe	Engineer
	AMEC Inc.	Matt Breen	Engineer
	AMEC Inc.	Karen Firehock	Public Involvement
Alternate	Green Trails HOA	Kevin Morely	
Alternate	Union Mills HOA	Mike Shipley	

Meeting Summary for Johnny Moore Creek and Little Rocky Run
Watershed Advisory Committee Meeting #4
Little Rocky Run HOA Recreation Center #3,
February 22, 2010

Purpose:

The purpose of the meeting was to review the proposed project rankings for the two watersheds and to provide feedback. Watershed Advisory Group (WAG) members were asked to consider if the ranking was appropriate based on their local knowledge.

Project Schedule Overview:

Karen Firehock provided an overview of the schedule. After comments and final reviews are incorporated from this meeting, there will be one more WAG meeting to review the final draft watershed plan. The plan will be available for public comment for 30 days. This will occur simultaneous to other agency reviews of the plan. The public forum to review the final draft of watershed plan will likely be scheduled for June, 2010. The plan will be edited over the summer and presented to the Board of Supervisors(BOS) in fall 2010 for review and possible adoption. Ms. Firehock reminded the group that the projects in the plan would still need to be budgeted and would receive all requisite public review and notice before implementation.

Fred Rose provided a brief overview of the watershed planning process to date and assured everyone that the planning effort for Little Rocky Run (LRR) and Johnny Moore Creek (JMC) is in the final stretch and will be completed this year. Fred Wilkins, who is a project engineer with the county, was in attendance to participate in the planning process which will facilitate improved project implementation once the plan has been adopted by the BOS.

Mr. Rose explained that the delays in completing the final project list had to do with the need to create a consistent county-wide ranking system that allows all projects in each watershed to be compared. This took some time to develop and test but is now in place. Thirteen plans have been completed to date. The LRR and JMC plans are part of the second round of watershed plans.

A participant asked if, in light of recent county budget challenges, whether funds were protected and would definitely be available for plan implementation. Mr. Rose responded that there was a penny of the real estate tax that had been dedicated in the past to fund the County's stormwater management program. The program is now funded by a stormwater service district shown as a separate item on the real estate tax bill.

Another participant asked if projects had been deleted and for clarification concerning whether all the previous projects were still on the list. Mr. Rose explained that the original list of 120 projects had to be paired down to the top 80 projects. Mr. Breen noted that if a project costs less than $80,000 it could be combined with another related project, so some projects had been collapsed into a project suite, but were not deleted. He explained that, as of now, there are a total of 79 projects, but four of those are regional ponds so the project list under consideration for the WAG and the county is actually only 75 projects.

A participant asked for an example of a type of project that may have been removed from the list. Lynne Mowery explained that if a project did not yield a significant benefit for pollution removal or address a serious problem, then it could have been removed. One that had been removed was the multi-purpose court that was proposed by an HOA to become an area for water infiltration. It was removed because its current location does not allow it to treat a very large drainage area and it is not in a place where there is a significant problem that needs remediation.

Ms. Mowery noted that some projects were removed because the benefits accrued would be mitigated by the difficulty of implementation. A good example for this was for some stream channels where there is existing erosion but, due to the remote location within a woodland, a great deal of disturbance would be required to allow heavy machinery to access the site. In that case, more harm than good would occur in attempting to get to the site to remediate it. There were also some instances in which homeowners were not receptive to having a county stormwater project on their private property, so those projects also were removed from the list.

Presentation of Candidate Project Investigation and Ranking (for presentation content see slide show in documents section of project website)

Lynne Mowery provided an overview of how the projects were investigated and ranked. She referenced the "Attachment Seven, Scores and Rankings Spreadsheet" that was emailed to the WAG and also made available at the meeting. She explained that the "source indicator" refers to the cause of the problem, whereas the "impact indicator" refers to the effect of the project, or how well it mitigates or eliminates the problem. The engineering team has calculated the pollution removal potential for each project. Those that scored a five had a high potential to remove pollution, while those that scored a one, had a low potential. She indicated that the top 20 best ranked projects had all scored a five for pollution removal or problem mitigation of total suspended solids (TSS), total nitrogen (TN) or total phosphorus (TP).

Several participants asked whether and how cost was factored into the ranking system. The engineering team explained that they were instructed to evaluate projects for this round of ranking solely on their ability to address an environmental problem as well as the practicality for doing so, as explained earlier. However, county staff noted that the projects will be evaluated for cost in the next step of the ranking process. A few participants responded that they felt cost should be considered now in case projects that are cost prohibitive would still make the final list even though they may be too expensive. County staff explained that it was not practical to fully calculate costs for every possible project and so they had instructed the engineering team to evaluate that once the final list had been proposed. It is possible that some projects could then drop down or move up on the list due to cost.

Mr. Breen of the engineering team clarified that it was not accurate to say that cost was not considered at all in the first round of evaluation. He explained that the engineering team did apply their existing professional knowledge of likely costs when they evaluated whether or not projects would likely be feasible and practical. Mr. Breen added that the feasibility of doing a project was an important factor in the ranking process. For example, those ponds that are owned by the county tended to score a ranking of five since it is easy to get access to add additional pollution mitigation features on the county's own property.

Ms. Mowery explained that 20 percent of the project's score was added if the project was located in the headwaters of the stream since it had a high potential for positive impacts the higher up in the watershed it was located. Those projects that are located in the headwaters can mitigate sources and stressors of stream problems that cause cumulative impacts downstream. For example, reducing the source of the problem, such as high flow velocities, can negate the need to repair eroding stream banks lower down in the watershed since the source of the problem has been abated. Staff also responded to a question that the degree of pollution removal, such as how much phosphorus could be removed, also was a factor in the ranking.

Review of Ranked Projects:

The group broke up to review the three watershed areas and the comments were noted on flip charts. Project #s refer to project # on maps found on the watershed web site at: http://www.fairfaxcounty.gov/dpwes/watersheds/johnnymoorecreek_docs.htm

Upper Little Rocky Run:

Representatives from this watershed expressed concern for the amount of debris that regularly piles up in the dry ponds located behind the Union Mills shopping center. Any conceptual level project design should include some measure to reduce floatables to these ponds if possible. Staff from AMEC researched this concern and let the representatives know that project LR9112 does include litter control at the shopping center.

Lower Little Rocky Run:

Three participants expressed concern about the Regional Pond shown on the map at Green Trails neighborhood. AMEC staff explained that that the regional pond was included as a project in order to compare the benefits to suggested alternatives. Green Trails HOA would like assurance that the regional pond will not be included as a project in the final plan.

North Hart Run HOA provided information on two areas of concern:

- Compton Road between Paradise Mill and Bay Valley - overland flow overtops road creating icy, dangerous conditions where several car accidents have occurred. This is likely due to recent re-grading of the adjacent property and an inadequate ditch along the road that regularly fills with debris causing overflows.

- An area along Little Rocky Run south of Laura Ratcliffe Court seems to be "wet and mucky," perhaps due to drainage problems.

Johnny Moore Creek:

There was concern expressed about flooding near project JM9500.

There was a question about whether projects at road crossings fall under VDOT jurisdiction. Eric Forbes responded that county staff work with VDOT to address problems but they have to clearly delineate who is responsible when problems are within the VDOT right of way or a VDOT-maintained culvert.

There was positive feedback that the #1 ranked project in Johnny Moore Creek was the JM9202 stream restoration.

Next Steps:

1. Comments were requested from the committee by March 1, 2010.
2. AMEC will incorporate comments and prepare the draft watershed plan.
3. Next WAG meeting in May to discuss the draft plan and plan for public Watershed Plan Forum to be held in summer 2010 (likely in June).

Meeting Attachments:

- Watershed Management Plan on Project Ranking
- Watershed Scores and Rankings (attachment 7)
- Watershed Maps

Meeting attendees are listed on the page following.

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:
The Little Rocky Run and Johnny Moore Creek Watersheds have experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the waterways and their watersheds. The Watershed Advisory Group (WAG) provides input to Fairfax County. The WAG members serve as liaisons between their respective communities and the project team. AMEC Inc. serves as the technical team lead and prepares watershed plan drafts and engineering studies and facilitates WAG and public meetings for the county. For more information please contact <Eric.Forbes@fairfaxcounty.gov> or visit *http://www.fairfaxcounty.gov/dpwes/watersheds/*

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Watershed Plans Comment Email Address: *watersheds@fairfaxcounty.gov*

Little Rocky Run and Johnny Moore Creek Committee Meeting 2/22/2010

LRR	JMC	Attended	Group	Name	Title
x		no	Westfields Golf Club	Colin Gooch	Manager (acting)
x		yes	Friends of Little Rocky Run	Ned Foster	President
x	x	no	Occoquan Watershed Coalition	Jim Bonhivert	President
x	x	no	Springfield Supervisor Pat Herrity	Marlae Schnare	Staff
x		yes	Sully Supervisor Michael L. Frey	Meghan Kiefer	Staff
x	x	yes	Clifton Horse Society	Beth Giorgiana	President
x		yes	Little Rocky Run HOA	Jeff Hummel	President
x		no	Compton Village HOA	Joseph F. Cottone	President
x		yes	Green Trails HOA	Jay Hurst	Representative
x		yes	North Hart Run HOA	Sara Dyer	Representative
	x	yes	Cedar Knolls of Clifton HOA	Laurie Anderson	HOA rep
	x	alternate	Union Mills HOA	Gene Griffe	President
x		no	Compton Heights HOA	William Ballou	Vice President

Staff and Guests Attending

	Group	Name	Title
	Fairfax County Stormwater Management	Fred Rose	Engineer, Chief, Stormwater Planning
	Fairfax County Stormwater Management (Implementation Branch)	Fred Wilkins	Engineer
	Fairfax County Stormwater Management	Eric Forbes	Project Manager
	Fairfax County Stormwater Management	Heather Ambrose	Ecologist
	AMEC Inc.	Lynne Mowery	Project Manager
	AMEC Inc.	Matt Breen	Engineer
	AMEC Inc	Thomas Williams	Engineer
	AMEC Inc.	Karen Firehock	Public Invol.
Guest	Green Trails HOA	Kristin Girardin	President
Alternate	Green Trails HOA	Kevin Morely	
Alternate	Union Mills HOA	Mike Shipley	

Meeting Summary for Johnny Moore Creek and Little Rocky Run
Watershed Advisory Committee Meeting #5
Little Rocky Run HOA Recreation Center #3,
June 29, 2010

Purpose:

The purpose of the meeting was to review the format of the draft watershed plan, to explain how the projects are proposed to be considered and possibly implemented and to thank the committee for their dedication over several years. Watershed Advisory Group (WAG) members were asked to review projects proposed for the watersheds and to provide any further comments by July 15, 2010 in order to include them in the version to be presented at the fall draft plan public forum.

Thanks for Service:

Karen Firehock opened the meeting by thanking the committee for the dedication, insights and ideas and for their patience in seeing the plan through to its completion. She then turned the meeting over to Fred Rose of Fairfax County's Stormwater Management Division, who thanked the committee for their work and commitment. He reminded everyone that this is not the end but the beginning. After the board adopts the plan, the real work begins to implement the projects designed to improve the watershed's health and to prevent the surface waters from declining in the future. He congratulated the group for making it to the final phase and reminded everyone that this project is part of a larger effort to restore and better manage all of the county's watersheds to help contribute to a cleaner Chesapeake Bay.

Presentation of the Watershed Plan:*

Lynne Mowery presented the draft watershed plan's organizational structure and key components. She noted that while the plan is extensive, the WAG has already reviewed and commented on most of the chapters, which were shared in earlier meetings. Therefore, if WAG members are short on time they do not have to re-read the entire plan. She suggested that WAG members should focus their review on chapter five as it contains the project fact sheets. She explained that every project that was selected for early implementation (within the first 10 year time period) has a detailed fact sheet. Projects were first prioritized based on their benefits for water quality. A subset of those projects were chosen based on this analysis. This was followed by a cost benefit analysis, resulting in the list proposed in the draft watershed plan.

Next, Eric Forbes provided an overview of the process to date and a reminder of the major project milestones. He described the process for moving from assessment of the watersheds' conditions to development of projects and ranking of projects to ensure the most effective solutions were included in the final plan. He noted that 150 projects were originally proposed and these were pared down to a candidate list of the best potential projects. Field reconnaissance was conducted to evaluate the projects and this helped the team to pare down the larger list of projects. Additional field visits and further modeling were then conducted to arrive at the final list. The cost benefit analysis helped the team to determine which projects to propose for the first 10 year block of time. He explained that those projects not included in the first ten years were still part of the plan, but they could be changed as the county determines the effectiveness of the first half of the watershed plan's implementation, as conditions change in the watershed, or as new technologies or ideas are proposed for addressing the watershed's issues. He also noted that regulations can and will change over time, and new regulations may require changes to how the plan is implemented.

Mr. Forbes described the process for moving the plan to adoption. In addition to review by the WAG, there is also a review by county agencies such as the Park Authority and the Department of Planning and Zoning to ensure that the projects are agreed upon and that there are no conflicts with other agency's plans. There also will be additional internal review and edits by the county that will be made prior to presenting the plan to the Board of Supervisors for review and adoption.

Ms. Firehock concluded the presentation by reviewing the options for commenting on the plan. She asked the committee to please provide their comments on the plan by July 15 so that there would be adequate time to incorporate any needed changes into the plan prior to the public forum. She noted that the committee also can comment during the public review process in the fall, but the team would like to ensure that the committee's concerns or corrections are included in the draft that is shared with the public. The public comment period will be open for 30 days.

Ms. Firehock noted that the public forum was rescheduled for September to avoid conflicts with vacation schedules and to increase the likelihood that the public could attend. However, the forum's date for September cannot yet be nailed down because both the high school and middle school are still revising their fall calendars so they are not yet able to confirm a date. It is hoped that they will be able to confirm the date within the next few weeks.

Ms. Firehock explained that every committee member will be asked to help recruit participation from their HOAs and other interested civic groups. Once the date is set, members will receive a flyer to distribute and to post at places where the community will see them, such as community centers, the library, grocery stores or other places visible to the public. Eric Forbes also noted that everyone whose property includes or adjoins a potential project will receive a post card inviting them to the draft plan forum. Ms. Firehock added that this mailing would not include everyone in the watershed, so it still is very important that the WAG promote the event to their constituents.

A committee member asked how the new emphasis on cleaning up the Chesapeake Bay though new mandatory regulations could affect the committee process. County staff responded that since the county has already begun improving their watershed analysis, management and restoration projects voluntarily, the county should be in a good position once new regulations are enacted. Staff noted that Fairfax County was setting an example for what should be done and that the county may become a model for other localities that need to improve watershed management. Regardless of what standards are set, the county has done a great deal of analysis through the watershed planning and implementation process so the county will be able to plug their watershed projects into a model and show how they are helping to meet Chesapeake Bay goals for nutrient reduction. County staff offered the caveat that no one knows for sure what the new regulations will require, or whether they will require more work by the county. County staff also noted that they have been very well aware that new regulations were likely and the current watershed plans have sought to anticipate these changes, so regardless of what happens within the new regulatory framework, the county will be in a good position to participate fully in the bay cleanup.

Participants then reviewed maps displayed and project fact sheets and asked questions of the team. Participants were again thanked for their service and rewarded with refreshments. Staff reminded them to send any additional comments by July 15 and thanked them again for their participation.

*A copy of the watershed plan presentation is appended to this meeting summary, so only a few discussion highlights were included herein.

Next Steps:

1) Comments on project fact sheets or the watershed plan requested from the committee by July 15, 2010.
2) AMEC will incorporate comments into the draft watershed plan.
3) Public forum scheduled for September and flyers mailed to WAG to help recruit participants.

Meeting Attachments:

- Watershed Management Plan Presentation
- Watershed Plan (posted to project website)

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:
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Meeting attendees are listed on the following page.

Little Rocky Run and Johnny Moore Creek Committee Meeting 6/29/2010					
LRR	**JMC**	**Attended**	**Group**	**Name**	**Title**
x		yes	Friends of Little Rocky Run	Ned Foster	President
x	x	no	Springfield Supervisor Pat Herrity	Marlae Schnare	Staff
x		yes	Sully Supervisor Michael L. Frey	Meghan Kiefer	Staff
x	x	no	Clifton Horse Society	Beth Giorgiani	President
x		yes	Little Rocky Run HOA	Jeff Hummel	President
x		no	Compton Village HOA	Joseph F. Cottone	President
x		no	Green Trails HOA	Jay Hurst	HOA Representative
x		yes	North Hart Run HOA	Sara Dyer	HOA Representative
	x	yes	Cedar Knolls of Clifton HOA	Laurie Anderson	HOA Representative
	x	yes	Union Mills HOA	Mike Shipley	Representative
x		no	Compton Heights HOA	William Ballou	Vice President

Staff and Guests Attending

Fairfax County Stormwater Planning	Fred Rose	Engineer, Chief, Stormwater Planning
Fairfax County Stormwater Planning	Darold Burdick	Engineer
Fairfax County Stormwater Planning	Eric Forbes	Project Manager
Fairfax County Stormwater Planning	LeAnne Astin	Ecologist
Fairfax County Stormwater Planning	Heather Ambrose	Ecologist
Fairfax County Stormwater Planning	Fred Wilkins	Engineer
AMEC Inc.	Lynne Mowery	Project Manager
AMEC Inc.	Hrushikesh Sandhe	Engineer
AMEC Inc.	Thomas Williams	Engineer
AMEC Inc.	Karen Firehock	Public Involvement

Meeting Summary for Johnny Moore Creek and Little Rocky Run
Draft Watershed Plan Forum
Centreville High School
September 16, 2010

Purpose:

The purpose of the meeting was to present the final draft of the watershed plan and solicit community input on proposed projects. Participants were welcomed by Supervisors Frey and Herrity. Staff presented a watershed planning primer and the contents of the watershed plan.

Following are comments received during the breakout sessions for Johnny Moore Creek and Little Rocky Run upper and lower portions. The public comment period remains open until October 16, 2010. Staff at the breakout sessions spent most of their time answering questions about the projects proposed. The comments below reflect any insights or recommendations that the community would like the county to consider.

Little Rocky Run Upper

LR9521 - Project is wonderful!

LR9525 – Near this project, a citizen believes that a waterline was constructed approximately 18 months ago. The site has never been stabilized: the trail is in disrepair, the silt fence has fallen into the stream, and the pipe has been crushed and abandoned. It was recommended that citizen contact Fairfax County about this issue.

LR9801 - This site next to Lee Highway was identified as having trash and junk storage problems by WAG members. The proposed non-structural project is to provide targeted education to the property owner. The landowner noted that it has been difficult to keep this site free of debris for several reasons. First, there is an apartment building that backs up to the property and residents throw trash, mattresses and other waste onto the land. Efforts to speak to management of that building have yielded no improvements. Second, there is a ditch that has been blocked and prior entrances onto the property have also been blocked. These obstructions cause water in the ditch to overflow across the property and to carry trash into the stream. VDOT is supposed to make some road improvements on Lee Highway and hopefully they will address the blocked ditch as part of that effort. The landowner would like to know more about how the county can assist with this problem. The landowner has spent a great deal of their own money hauling out waste dumped illegally by the public onto their land.

Little Rocky Run Lower

LR9101 – Pond retrofit is a great idea.

LR9514 – Union Mill Elementary School is right next to this project on the Little Rocky Run tributary. The school plans a building expansion which may impact water quality. The participants wanted to know how the school's the expansion impact watershed protection and planning. They also asked if there is coordination with the public schools. The county is coordinating with the public schools and seeks to implement projects on school sites whenever possible and necessary for stormwater management.

Buffering projects along streams in this watershed would be great!

A question about Stormwater Pond WP0283 was raised, however no project is planned for this facility. The question was whether or not the pond could be converted to a dry pond. A discussion about the hurdles arose, including the need to expand/change the footprint (facility was confirmed to be on-line after the meeting) and it was discussed that wet ponds achieve higher design pollutant removal efficiencies than dry ponds.

Johnny Moore Creek

JM9500 – This is a great location for a BMP/LID measure. Numerous trees have fallen into the creek downstream of JM9500 project site due to the eroding streambanks. There is severe undercutting of the streambanks along this section of the creek.

JM9201 – The proposed measure is a great idea and will help to address the unstable streambanks in this area.

JM9400 – This project should be a top priority for the county. The problems here pose a major public safety problem and need to be addressed as soon as possible. A big ditch is continuing to erode the roadside, creating a very dangerous situation.

JM9201 – Hikers and horse riders have a difficult time following the trail across the stream in this area due to the steep and eroding streambanks.

JM9400, JM8801, JM9201, JM9500, JM8800, JM9200 – These projects will affect hiking/horse trails - Coordinate with Northern Virginia Regional Parks and the Clifton Horse Society.

JM9200 – There are concerns about the impacts of establishing access to the stream restoration project site due to its remote location.

Comment not related to existing project:
Near 13724 Balmoral Greens Avenue there is a storm drain that flows into a settling pond which overflows and is eroded around the cement drain. This site collects all the water from Fairfax County Parks Cannon Mound. No vegetation is in the settling pond.

General questions
What is the Fairfax County Golf Course at the top of the watershed doing to manage their runoff? The water in the stream at the bottom (south) of the golf course appears to be colored green from the runoff. Is the golf course spraying something green on the land? (Note: This is likely due to excessive use of fertilizers.)

How do the proposed stormwater management projects correspond and coordinate with Master Plan requirements specified for the Johnny Moore Community Planning Sector?

How long will the proposed project list be relevant? Will the projects need to be revised every five years or so?

Does the County plan to approach community groups, such as schools, scouts, and local organizations, to assist with implementation? Local citizens would like the County to explore this option as a way to save money on implementation.

Meeting Attachments:

- Watershed Management Plan Presentations
- Watershed Plan (posted to project website)

The Little Rocky Run and Johnny Moore Creek Watersheds Management Plan:
The Little Rocky Run and Johnny Moore Creek Watersheds have experienced environmental degradation, mostly due to urbanization. A planning process initiated by Fairfax County is underway to improve the quality of the waterways and their watersheds. The Watershed Advisory Group (WAG) provides input to Fairfax County. The WAG members serve as liaisons between their respective communities and the project team. AMEC Inc. serves as the technical team lead and prepares watershed plan drafts and engineering studies and facilitates WAG and public meetings for the county. For more information please contact <Eric.Forbes@fairfaxcounty.gov> or visit ***http://www.fairfaxcounty.gov/dpwes/watersheds/***

"The opinions represented herein do not necessarily represent those of Fairfax County or its agents."

To Contact Staff:

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Eric Forbes, Ecologist, Fairfax County Stormwater Planning Division Eric.Forbes@fairfaxcounty.gov, (703)324-5717

Fairfax County Watershed Website: *http://www.fairfaxcounty.gov/dpwes/watersheds/*
Use this site for meeting dates, workshops and to read meeting summaries and reports.

Watershed Plans Comment Email Address: *watersheds@fairfaxcounty.gov*