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.

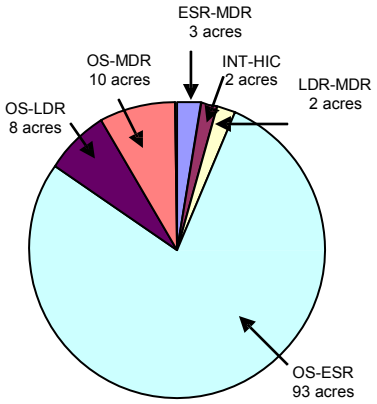


Table 2-8. Existing and Future Land Use in Little Rocky Run – Lower and Little Rocky Run – Bull Run

Little Rocky Run - Lower WMA

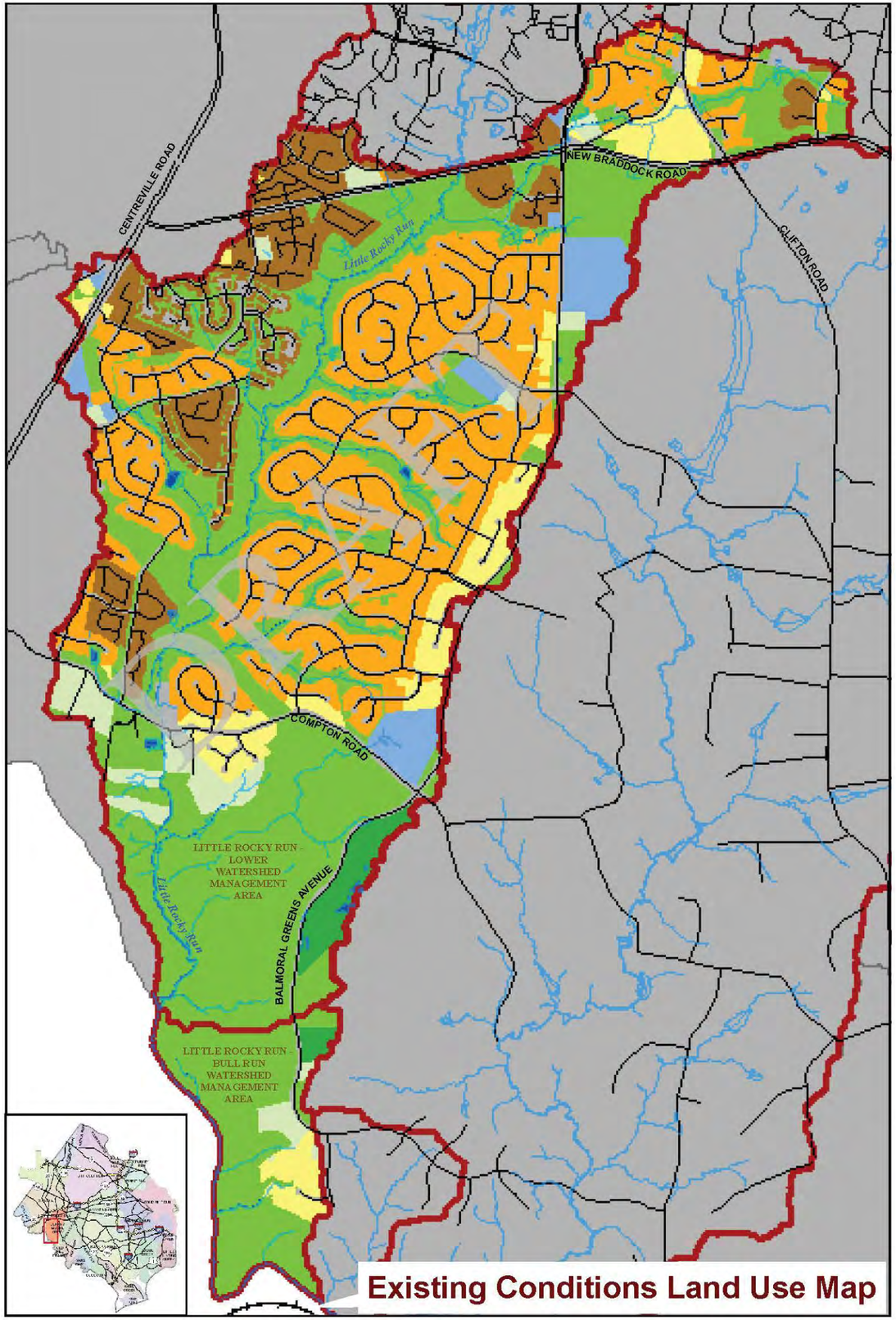
Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	67	3%	157	7%	90	4%
Low Density Residential (LDR)	114	5%	120	6%	6	0%
Medium Density Residential (MDR)	552	26%	567	26%	15	1%
High Density Residential (HDR)	226	11%	226	11%	0	0%
Low Intensity Commercial (LIC)	0	0%	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

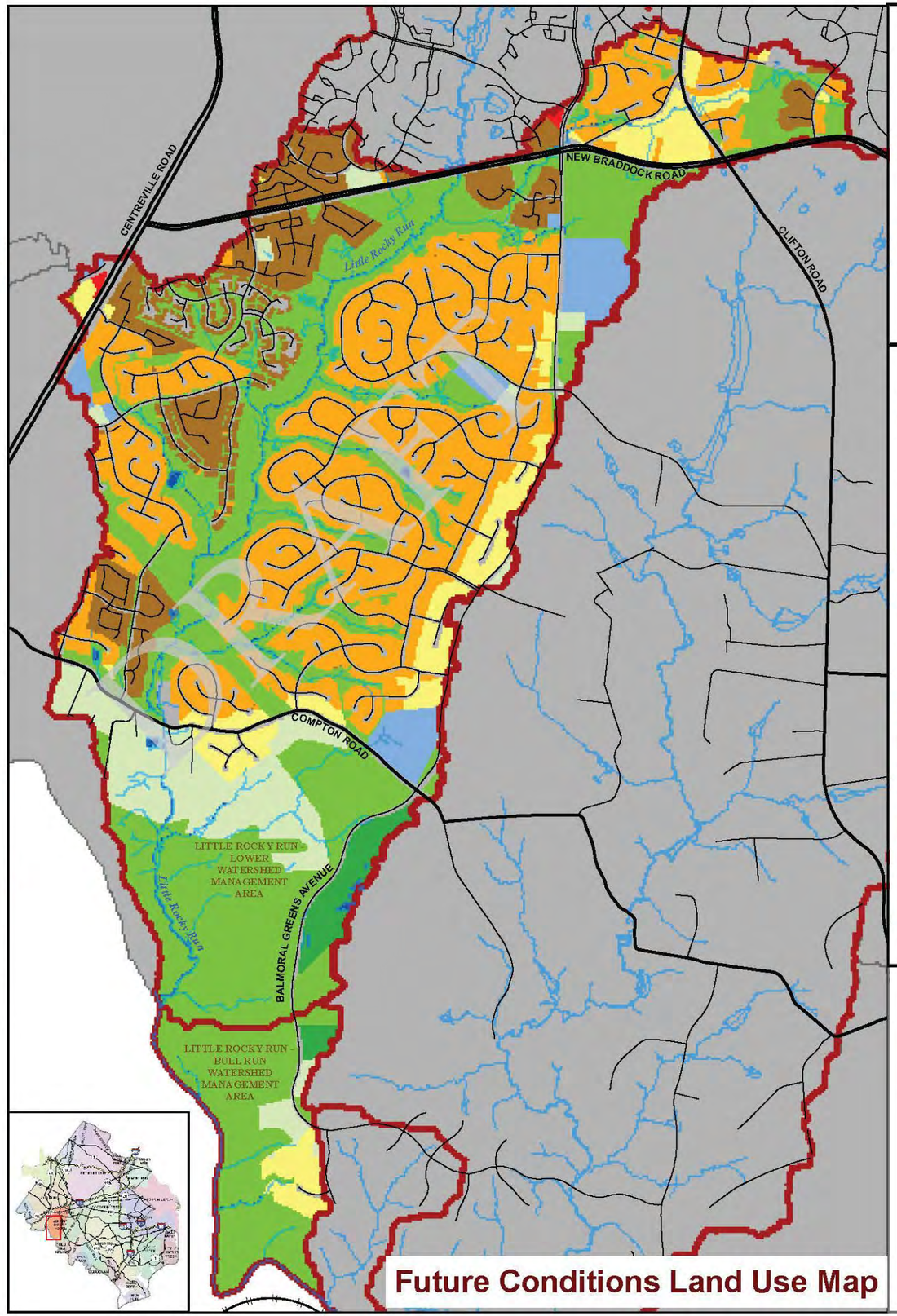
Land Use Type	Existing		Future		Change	
	Acres	%	Acres	%	Acres	%
Estate Residential (ESR)	11	6%	13	7%	2	1%
Low Density Residential (LDR)	22	12%	22	12%	0	0%
Medium Density Residential (MDR)		0%		0%	0	0%
High Density Residential (HDR)		0%		0%	0	0%
Low Intensity Commercial (LIC)		0%		0%	0	0%
High Intensity 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



Existing Conditions Land Use Map



Future Conditions Land Use Map

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

CENTREVILLE ROAD

NEW BRADDOCK ROAD

CLIFTON ROAD

Little Rocky Run

COMPTON ROAD

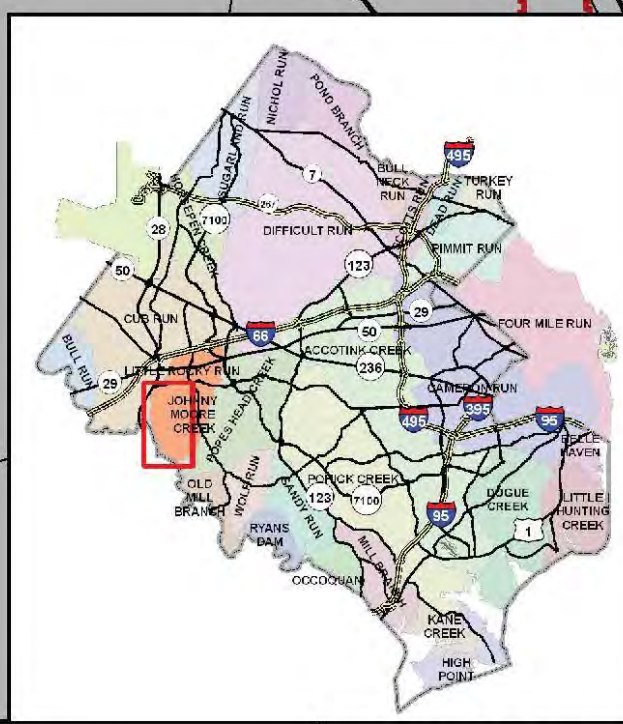
LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA

Little Rocky Run

BALL GREENS DR

MOBAL



N

0 750 1,500 Feet

Legend

- 303d Listed Streams
- MAJOR_ROADS
- Arterial Streets

WMA

- Little Rocky Run - Lower WMAs
- 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 2-11

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.

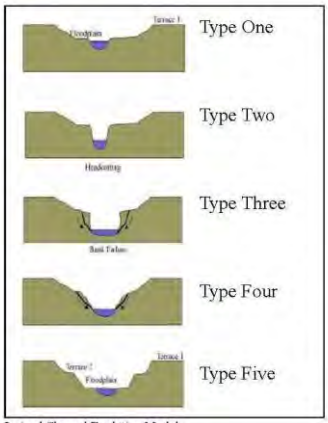
6.7 miles were assessed for stream habitat condition in these WMAs. The study results are summarized below:

- 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)

CENTREVILLE ROAD

NEW BRADDOCK ROAD

CLIFTON ROAD

COMPTON ROAD

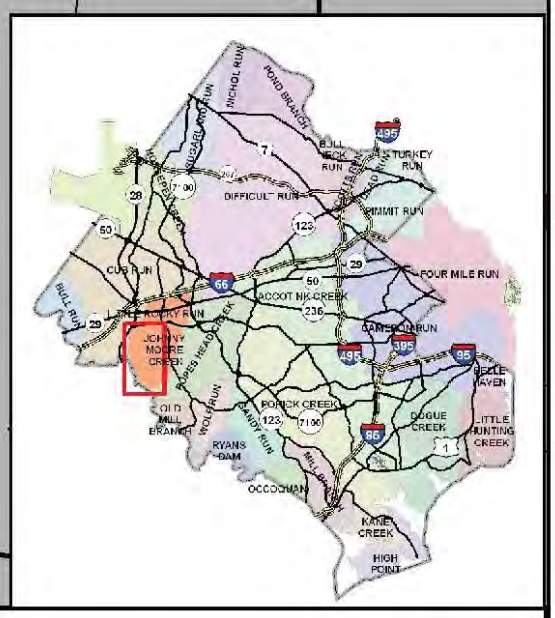
RAILROAD

Little Rocky Run

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA



Legend

- MAJOR_ROADS

WMA
- Little Rocky Run - Lower WMAs
- 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)

N

0 1,000 2,000 Feet

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

CENTREVILLE ROAD

NEW BRADDOCK ROAD

CLIFTON ROAD

Little Rocky Run

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

COMPTON ROAD

MORAL GREENS LN

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA

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

Total Nitrogen lbs/ac/yr

0.987500 - 4.287116

4.287117 - 9.069964

9.069965 - 17.802404

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

Total Nitrogen

CENTREVILLE ROAD

NEW BRADDOCK ROAD

CLIFTON ROAD

Little Rocky Run

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

COMPTON ROAD

MORAL GREEN BAY

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA

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 Phosphorous lbs/ac/yr

0.246100 - 0.645884

0.645885 - 1.441817

1.441818 - 2.874638

Map 2-14

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

Total Phosphorous

CENTREVILLE ROAD

NEW BRADDOCK ROAD

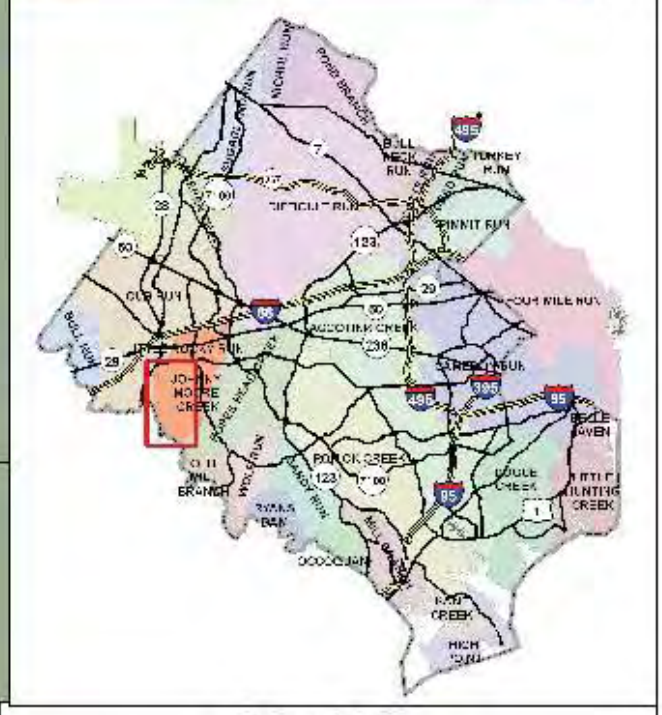
CLIFTON ROAD

COMPTON ROAD

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA



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.

CENTREVILLE ROAD

NEW BRADDOCK ROAD

CLIFTON ROAD

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

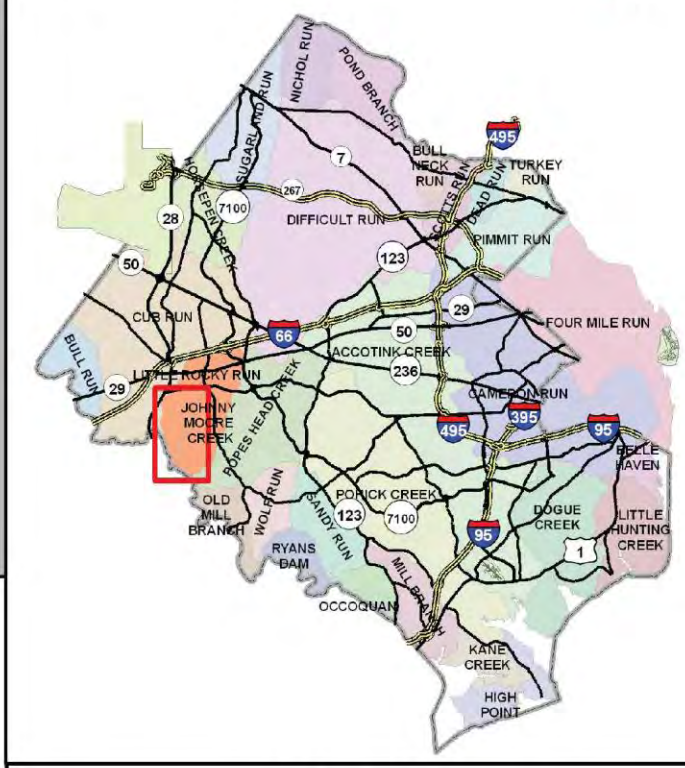
COMPTON ROAD

LITTLE ROCKY RUN - LOWER WATERSHED MANAGEMENT AREA

Little Rocky Run

BALMORAL GREENS AVENUE

LITTLE ROCKY RUN - BULL RUN WATERSHED MANAGEMENT AREA



Legend

MAJOR_ROADS

Arterial Streets

WMA

Other WMAs

Little Rocky Run - Lower WMAs

10 Year Peak Flow (cfs)

25 - 72

72 - 108

108 - 384

384 - 2218

2218 - 2606

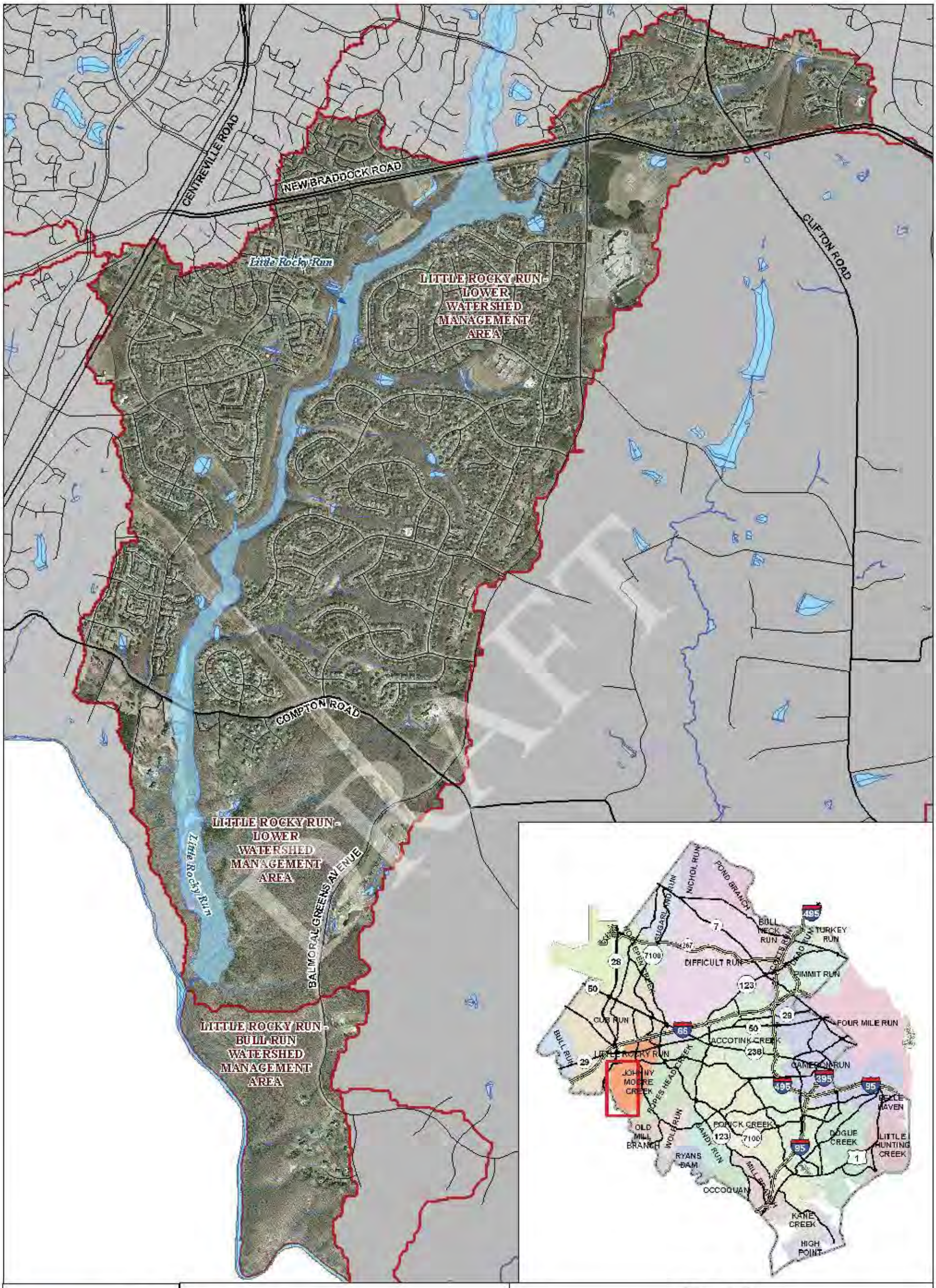
N

0 1,000 2,000 Feet

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.

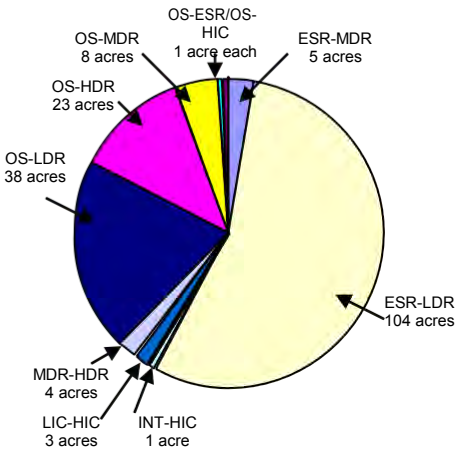
The Little Rocky Run - Upper WMA includes 12.5 miles of perennial streams. Beginning west of the Fairfax County Parkway and south of Interstate Route 66, Little Rocky Run flows generally in a western direction to Lee Highway (Route 29) and then turns and flows south to Bull Run. The land use in the WMA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

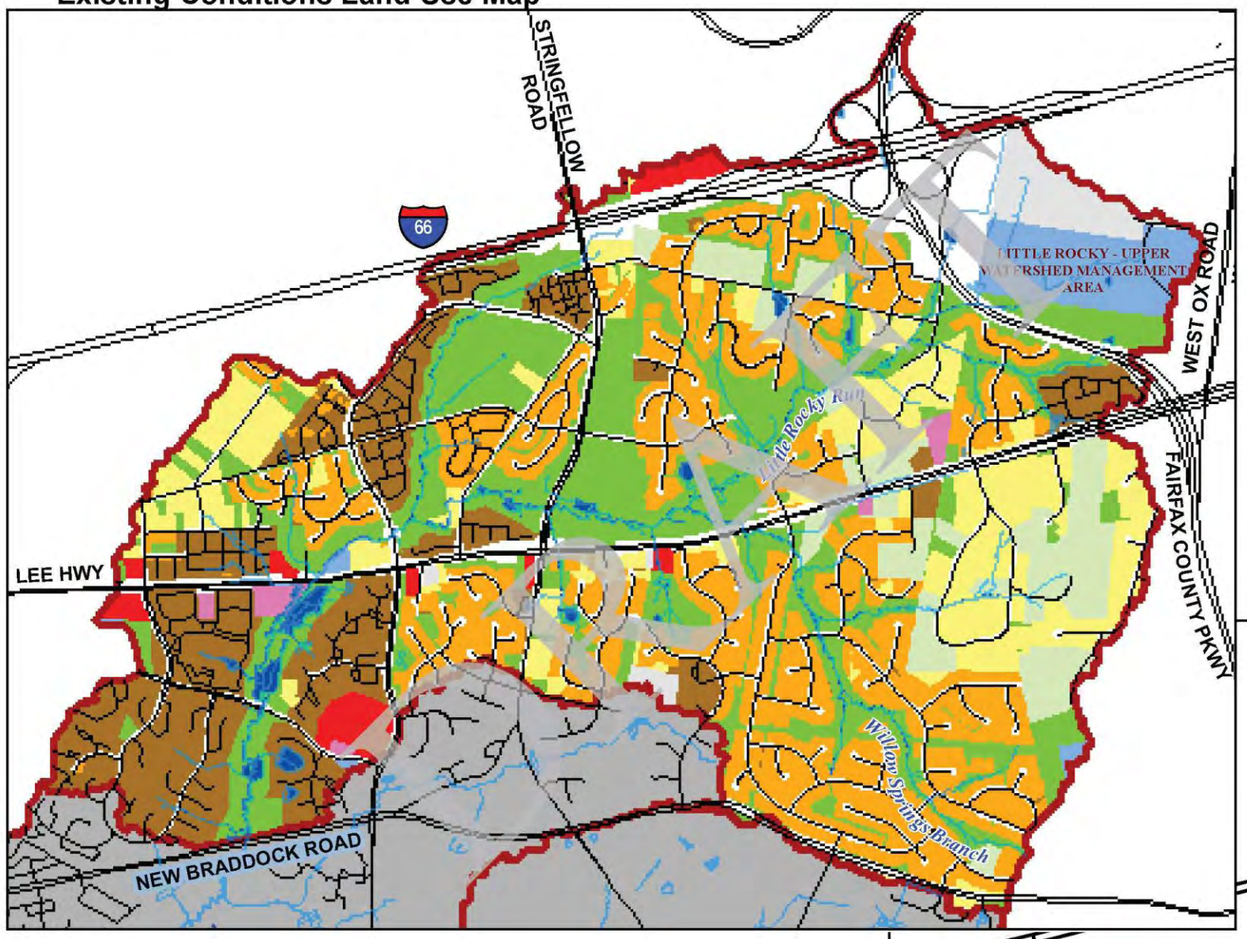
2.5.3 Stormwater Infrastructure

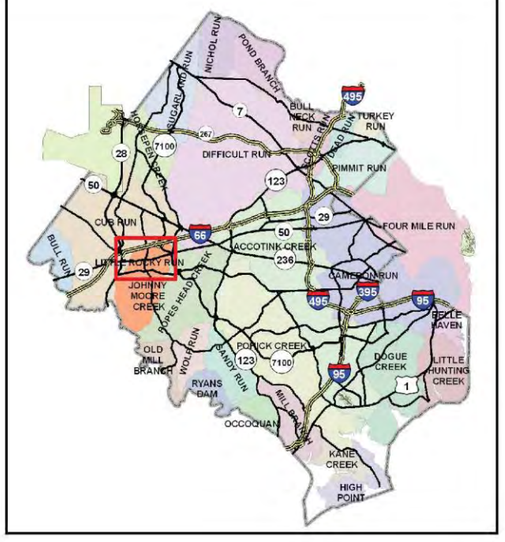
Stormwater infrastructure in the WMA consists of stormwater management facilities, storm sewer and other manmade stormwater conveyances. Stormwater management facilities provide control of stormwater runoff in two ways; by reducing the quantity of stormwater runoff and providing treatment to reduce pollution 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.

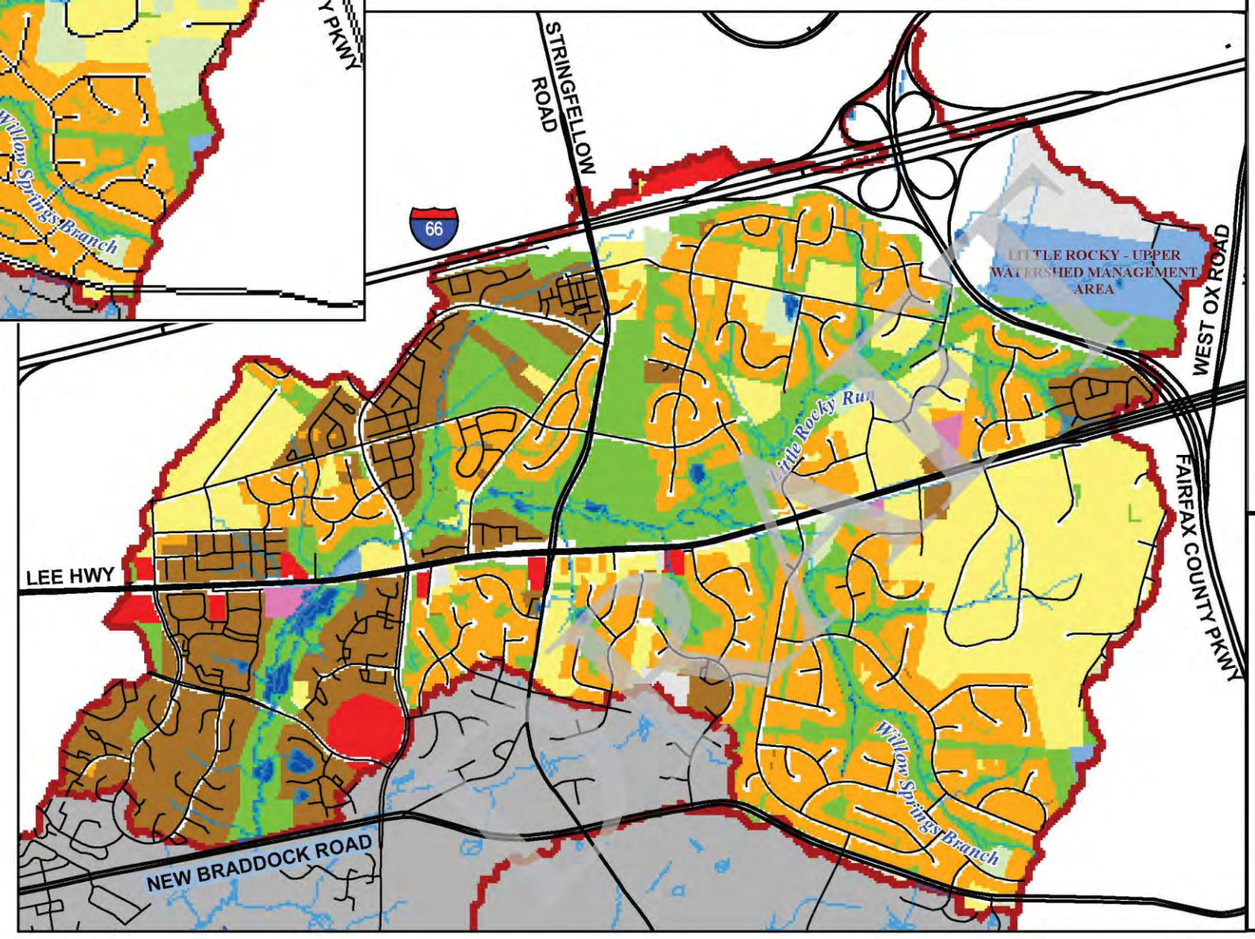
Little Rocky Run-Upper WMA

Existing Conditions Land Use Map





Future Conditions Land Use Map



Map 2-18
Existing and Future Land Use Maps

Little Rocky Run - Upper Watershed Management Area

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

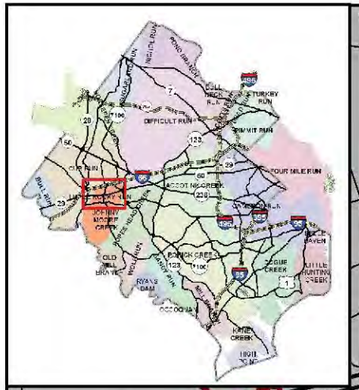
Little Rocky Run

FAIRFAX COUNTY PKWY

LEE HWY

NEW BRADDOCK ROAD

Willow Springs Branch



STRINGFELLOW ROAD

66

WEST OX ROAD

29

FAIRFAX COUNTY PKWY

Little Rocky Run

LITTLE ROCKY - UPPER WATERSHED MANAGEMENT AREA

Willow Springs Branch

LEE HWY

NEW BRADDOCK ROAD

N

0 750 1,500 Feet

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

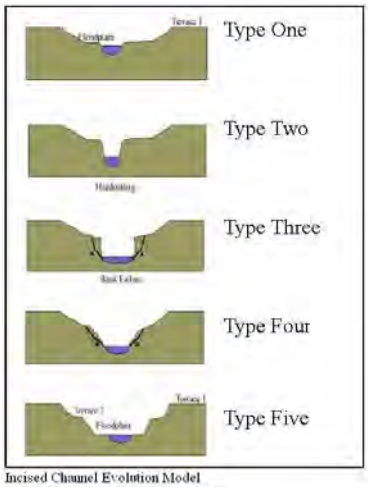
Channel Evolution Model Category
- 2
- 3

Habitat Assessment
- Very Poor
- Poor
- Fair
- Good
- Excellent
- Severe to Extreme Erosion
- Streams (No Assessment)

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.

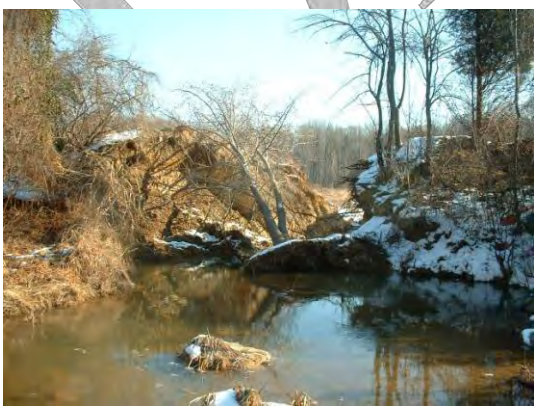


Figure 2-27: Erosion area on Little Rocky Run upstream of Willow Springs Branch


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