3.1 Sugarland Run Watershed

The Sugarland Run Watershed consists of seven watershed management areas (WMAs) as listed below:

1. Folly Lick
2. Headwaters
3. Lower Sugarland
4. Lower Middle Sugarland
5. Potomac
6. Upper Sugarland
7. Upper Middle Sugarland

WMAs in the Sugarland Run Watershed are shown in Figure 3.1. As shown in the figure, most of the Folly Lick WMA is located in Fairfax County, about half of the Lower Middle Sugarland WMA is located in Fairfax County, and only small portions of the Potomac WMA and the Lower Sugarland WMA are located within Fairfax County. Only areas within Fairfax County were evaluated as part of this study; however, information on stormwater structures and stream crossings near the county border was gathered and evaluated to determine how it would affect stormwater flows in Fairfax County. The following information is provided for each WMA in the subsequent sections of this chapter:

1. WMA Characteristics
2. Existing and Future Land Use Information
3. Field Reconnaissance and Stream Physical Assessment Information
4. WMA Characterization
5. STEPL Modeling
6. HEC-RAS Modeling
7. Subwatershed Ranking

Table 3.1 illustrates the total area of each WMA, the current impervious conditions and the extent and type of stormwater treatment within each WMA.

Table 3.1 Sugarland Run Watershed WMA Summaries

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Folly Lick	1813.7	547.3	30%	156.72	41.29	9.53	1606.15
Headwaters	929	315.13	34%	242.2	8.9	18.1	659.8
Lower Sugarland	3742.7	403.95	11%	135.8*	28*	6.4*	679.7*
Lower Middle Sugarland	3503.1	501.3	14%	391.7*	77.2*	866.5*	676.7*
Potomac	1053	42	4%	0*	43.7*	2.71*	23.9*
Upper Sugarland	1391	677.5	49%	294.7	85.73	18	992.57
Upper Middle Sugarland	1975.1	561.4	28%	125.8	63.9	172.9	1612.5
Watershed Totals	**14,408**	**3,048.6**	**21%**	**1346.92**	**348.72**	**1094.14**	**6251.32**

* Treatment only within Fairfax County

Figures for Chapter 3 are provided in the beginning of the chapter and are followed by a detailed discussion of each WMA in Sections 3.1 through Section 3.7. Section 3.8 includes a discussion of SWMM modeling results, including a SWMM Peak Flow Map for the 2-year storm event.

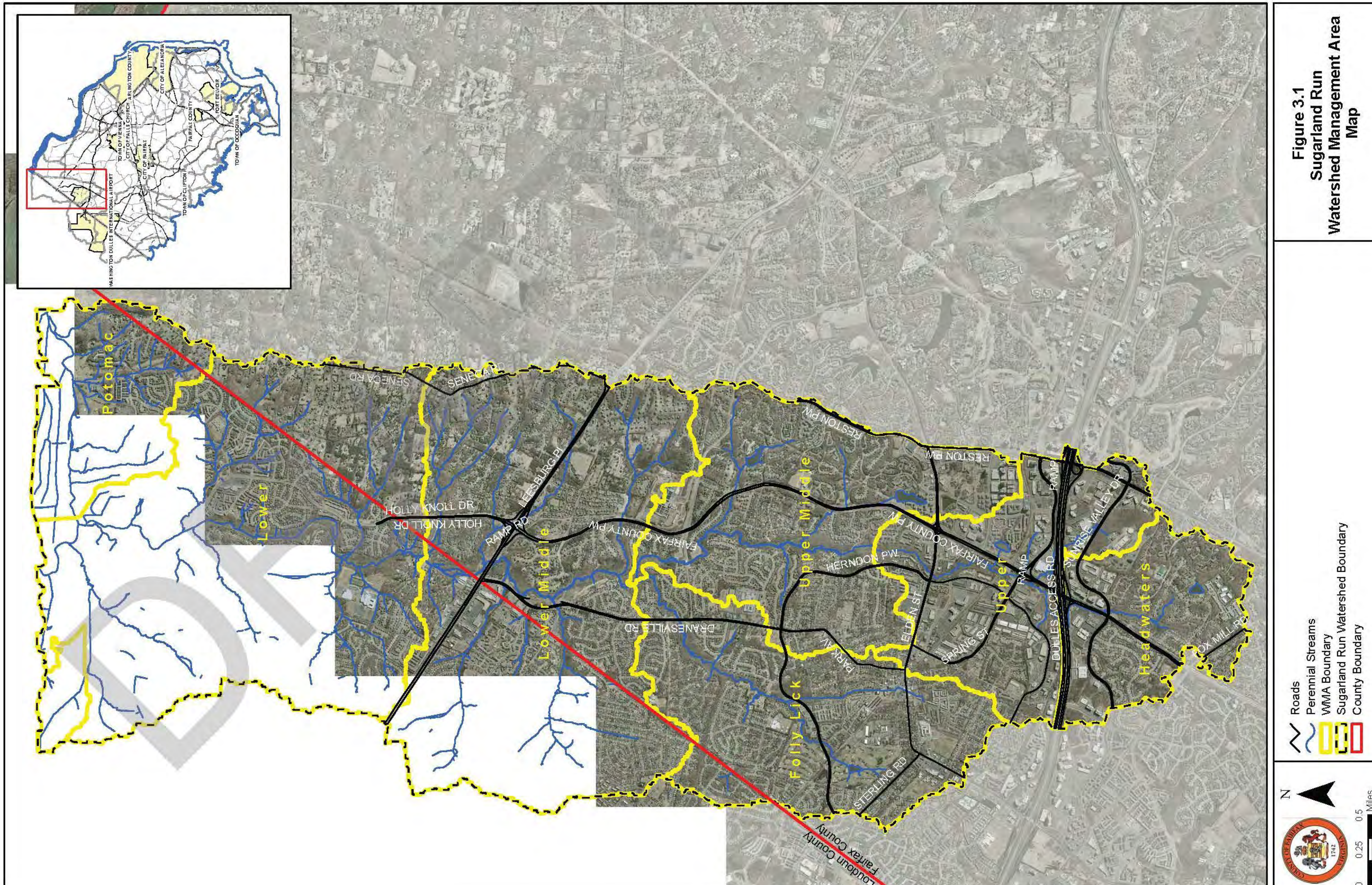

Figure 3.1
Sugarland Run
Watershed Management Area
Map
Roads
Perennial Streams
WMA Boundary
Sugarland Run Watershed Boundary
County Boundary
N
0 0.25 0.5 Miles
Potomac
Lower
Lower Middle
Upper Middle
Folly Lick
Upper
Headwaters
SENECA RD
RESTON PW
LEESBURG PI
HOLLY KNOLL DR
RAMP RD
FAIRFAX COUNTY PW
HERNDON PW
DRANESVILLE RD
ELDEN ST
SPRING ST
DULLES ACCESS RD
SUNRISE VALLEY DR
FOX MILL RD
STERLING RD
RAMP
Fairfax County
Loudoun County

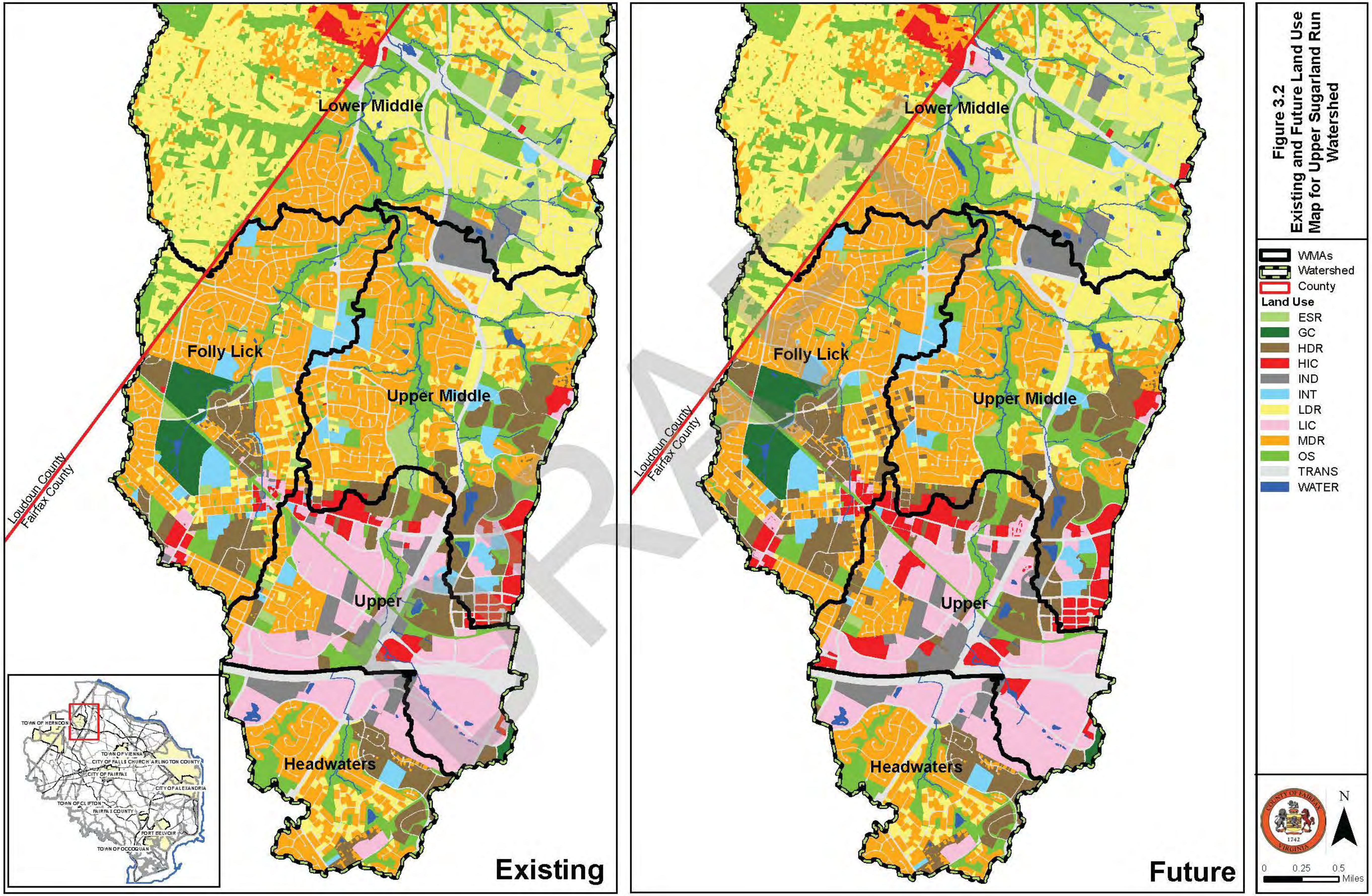

Figure 3.2
Existing and Future Land Use Map for Upper Sugarland Run Watershed

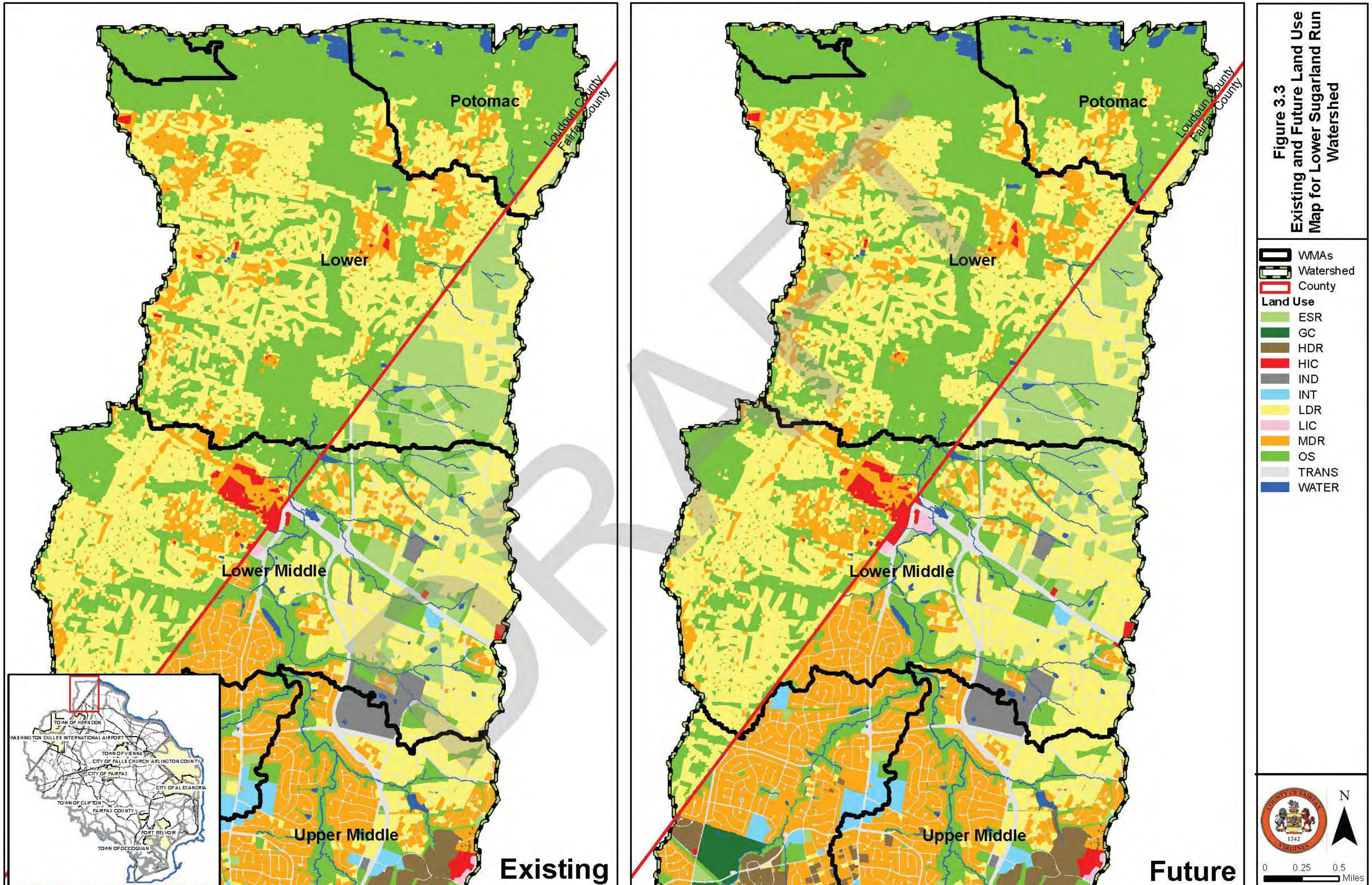

Figure 3.3 Existing and Future Land Use Map for Lower Sugarland Run Watershed

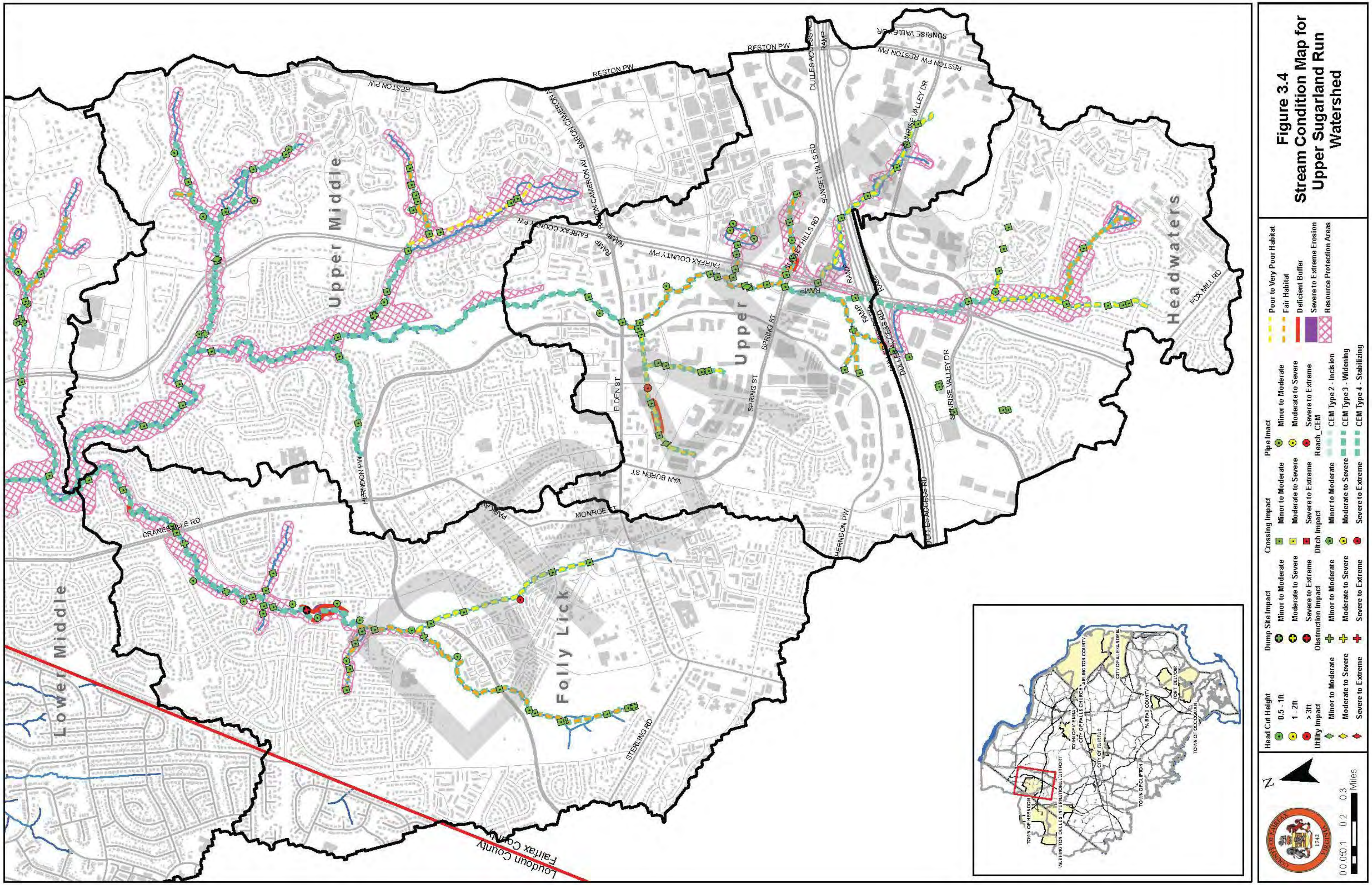

Figure 3.4 Stream Condition Map for Upper Sugarland Run Watershed

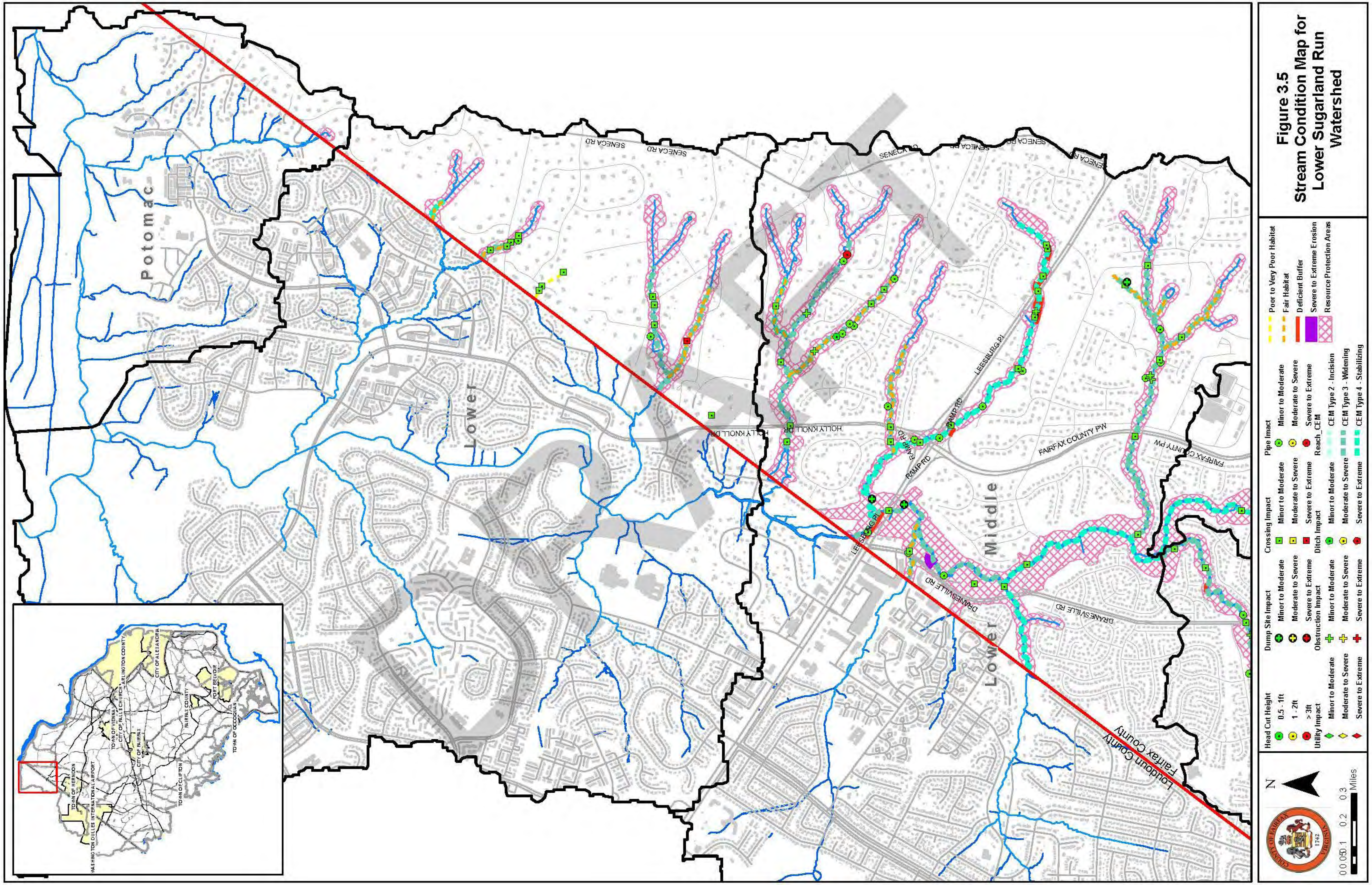
Figure 3.5
Stream Condition Map for
Lower Sugarland Run
Watershed
Head Cut Height
0.5 - 1ft
1 - 2ft
> 3ft
Utility Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Dump Site Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Obstruction Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Crossing Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Ditch Impact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Pipe Imact
Minor to Moderate
Moderate to Severe
Severe to Extreme
Reach_CEM
CEM Type 2 - Incision
CEM Type 3 - Widening
CEM Type 4 - Stabilizing
Poor to Very Poor Habitat
Fair Habitat
Deficient Buffer
Severe to Extreme Erosion
Resource Protection Areas
N
0 0.050.1 0.2 0.3
Miles
Potomac
Lower
Middle
Lower
SENECA RD
HOLLY KNOLL DR
LEESBURG PI
RAMP RD
FAIRFAX COUNTY PW
DRANESVILLE RD
Fairfax County
Loudoun County
DRAFT

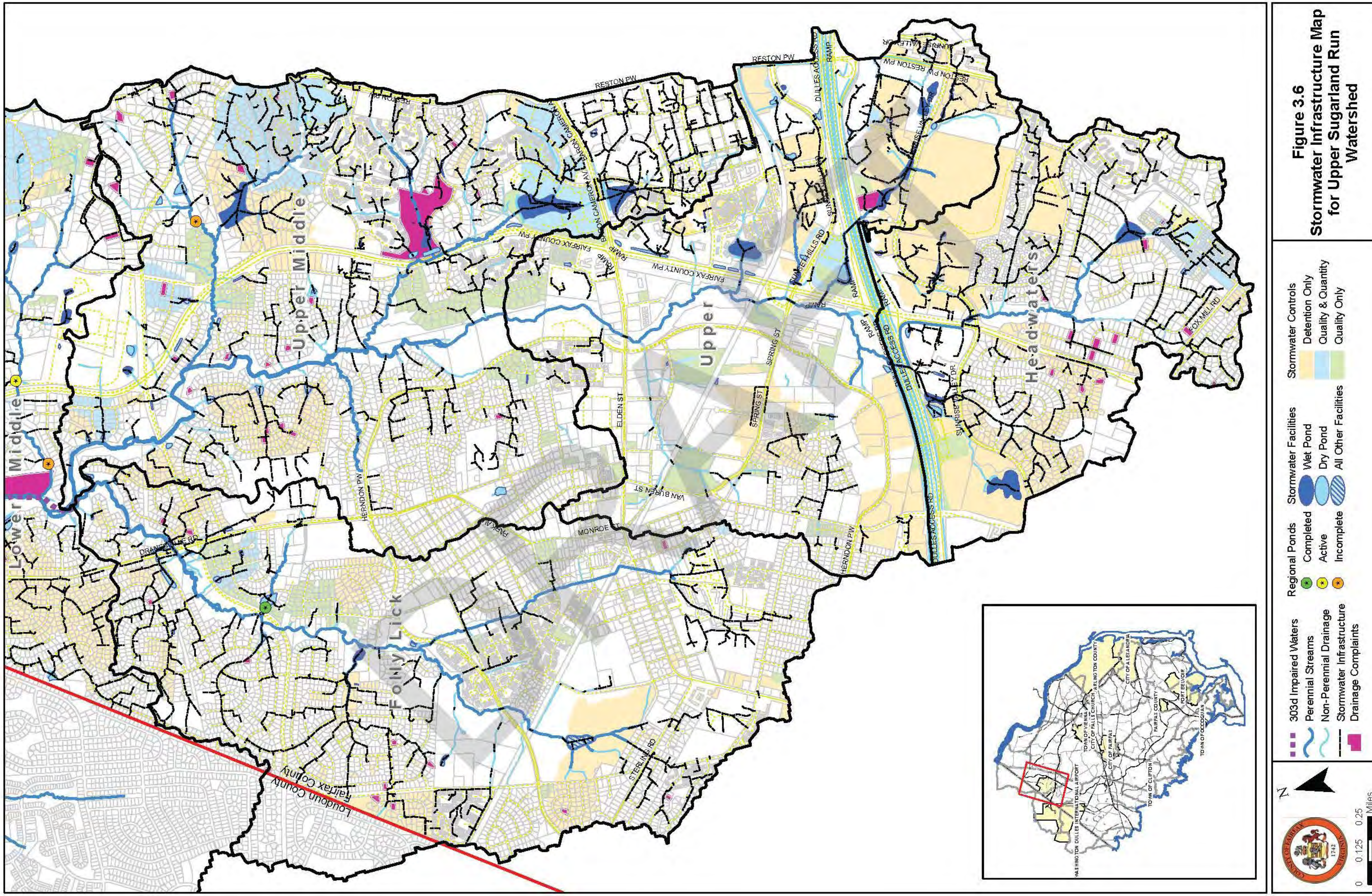
Figure 3.6
Stormwater Infrastructure Map for Upper Sugarland Run Watershed
303d Impaired Waters
Perennial Streams
Non-Perennial Drainage
Stormwater Infrastructure
Drainage Complaints
Regional Ponds
Completed
Active
Incomplete
Stormwater Facilities
Wet Pond
Dry Pond
All Other Facilities
Stormwater Controls
Detention Only
Quality & Quantity
Quality Only
N
0 0.125 0.25 Miles
Upper Middle
Lower Middle
Upper
Headwaters
Folly Lick
Fairfax County
Loudoun County
RESTON PW
FAIRFAX COUNTY PW
DULLES ACCESS RD
HERNDON PW
ELDEN ST
SPRING ST
VAN BUREN ST
MONROE
STERLING RD
SUNRISE VALLEY DR
FOX MILL RD
WASHINGTON DULLES INTERNATIONAL AIRPORT
CITY OF FAIRFAX
CITY OF FALLS CHURCH
ARLINGTON COUNTY
CITY OF ALEXANDRIA
FAIRFAX COUNTY
FORT BELVOIR
TOWN OF CLIFTON
TOWN OF OCCOQUAN

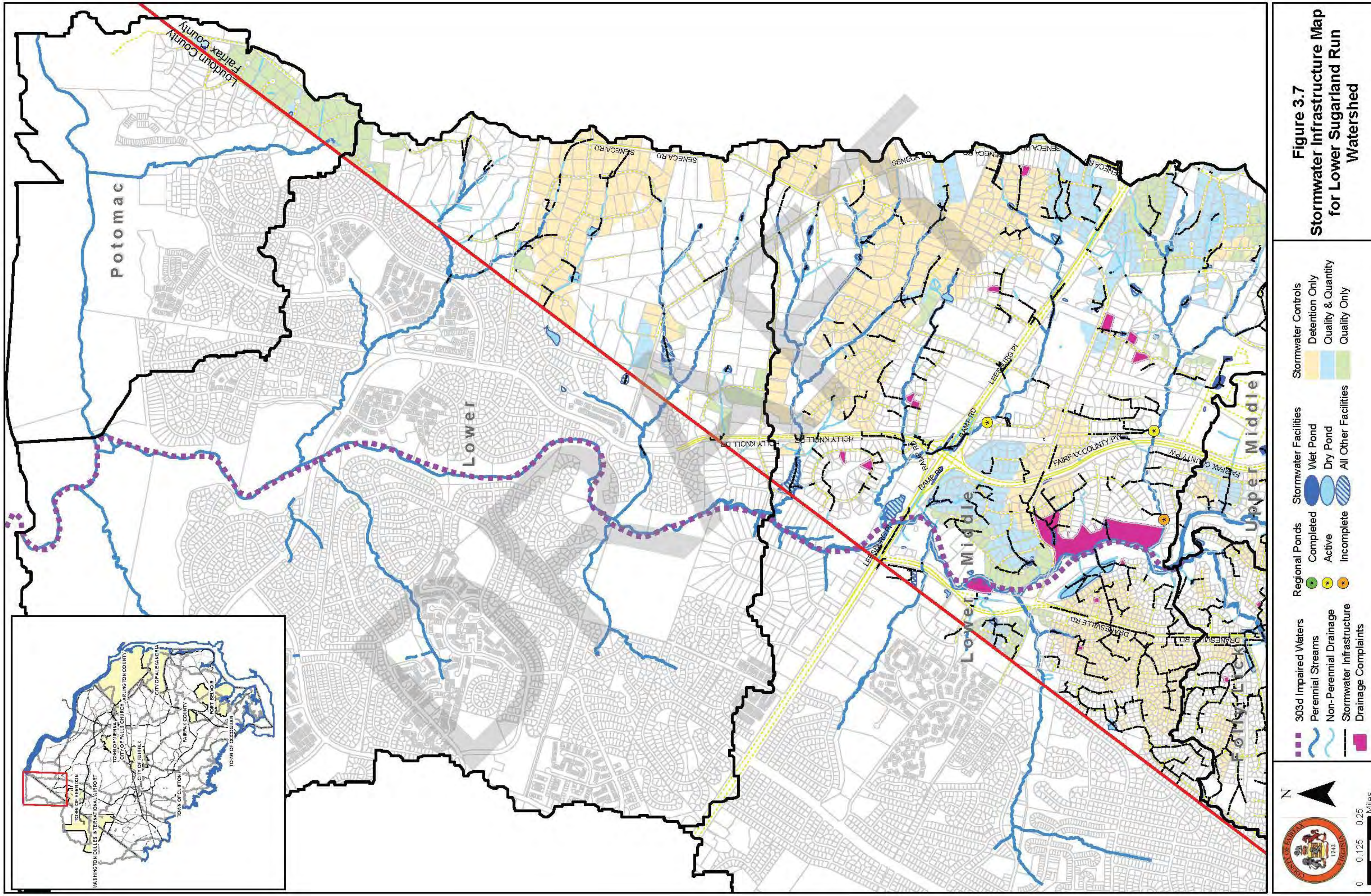

Figure 3.7
Stormwater Infrastructure Map for Lower Sugarland Run Watershed

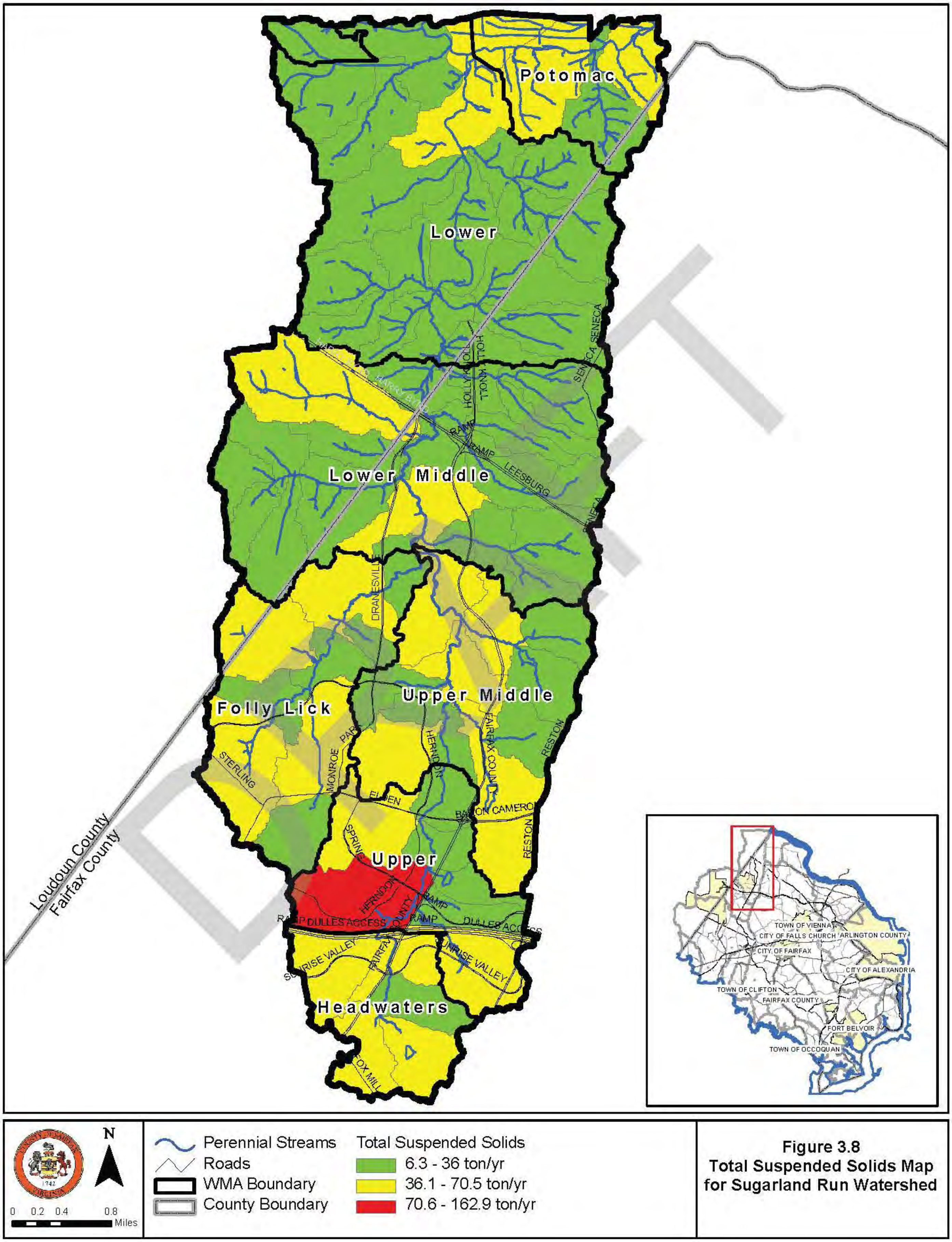

Figure 3.8
Total Suspended Solids Map for Sugarland Run Watershed

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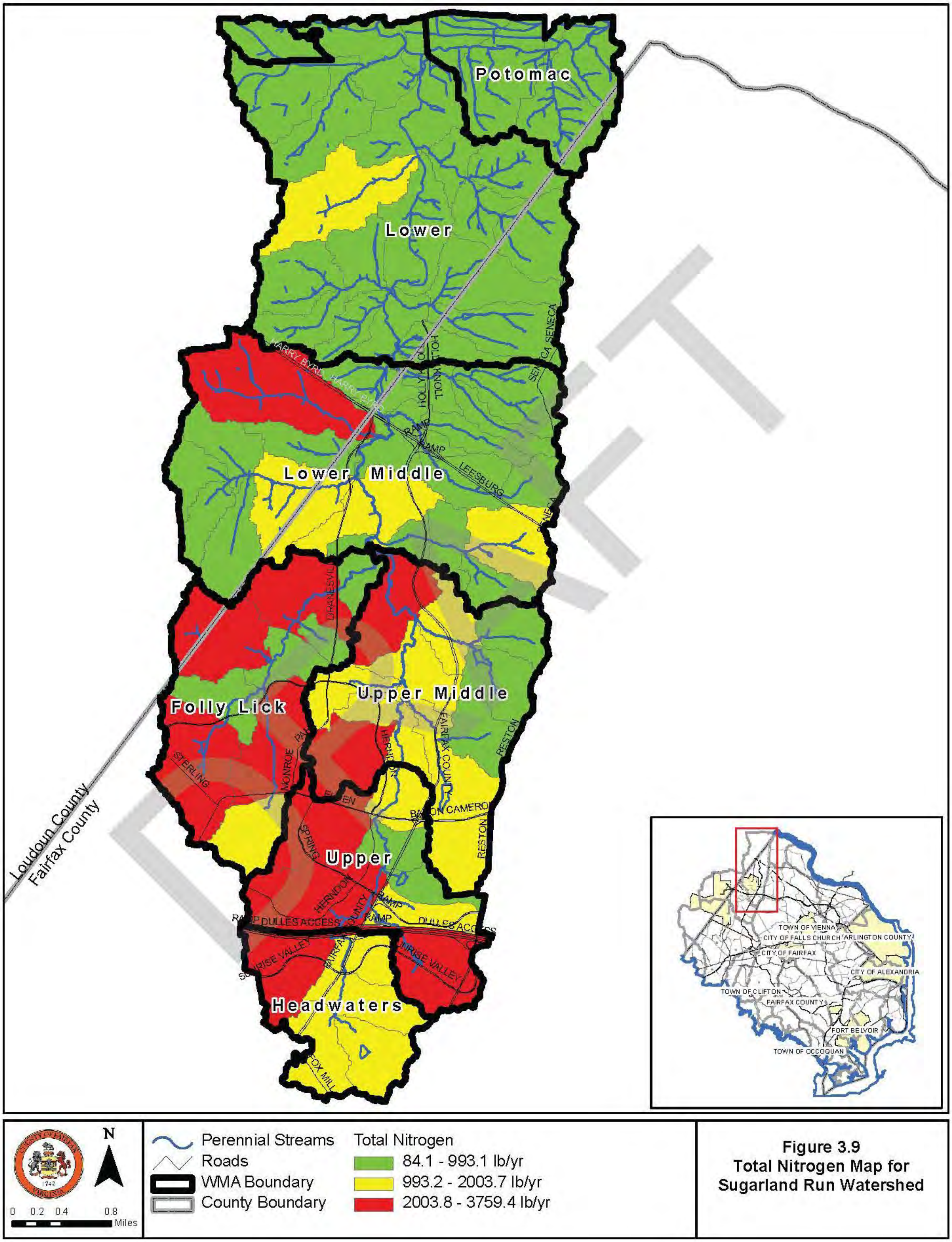

Figure 3.9
Total Nitrogen Map for Sugarland Run Watershed

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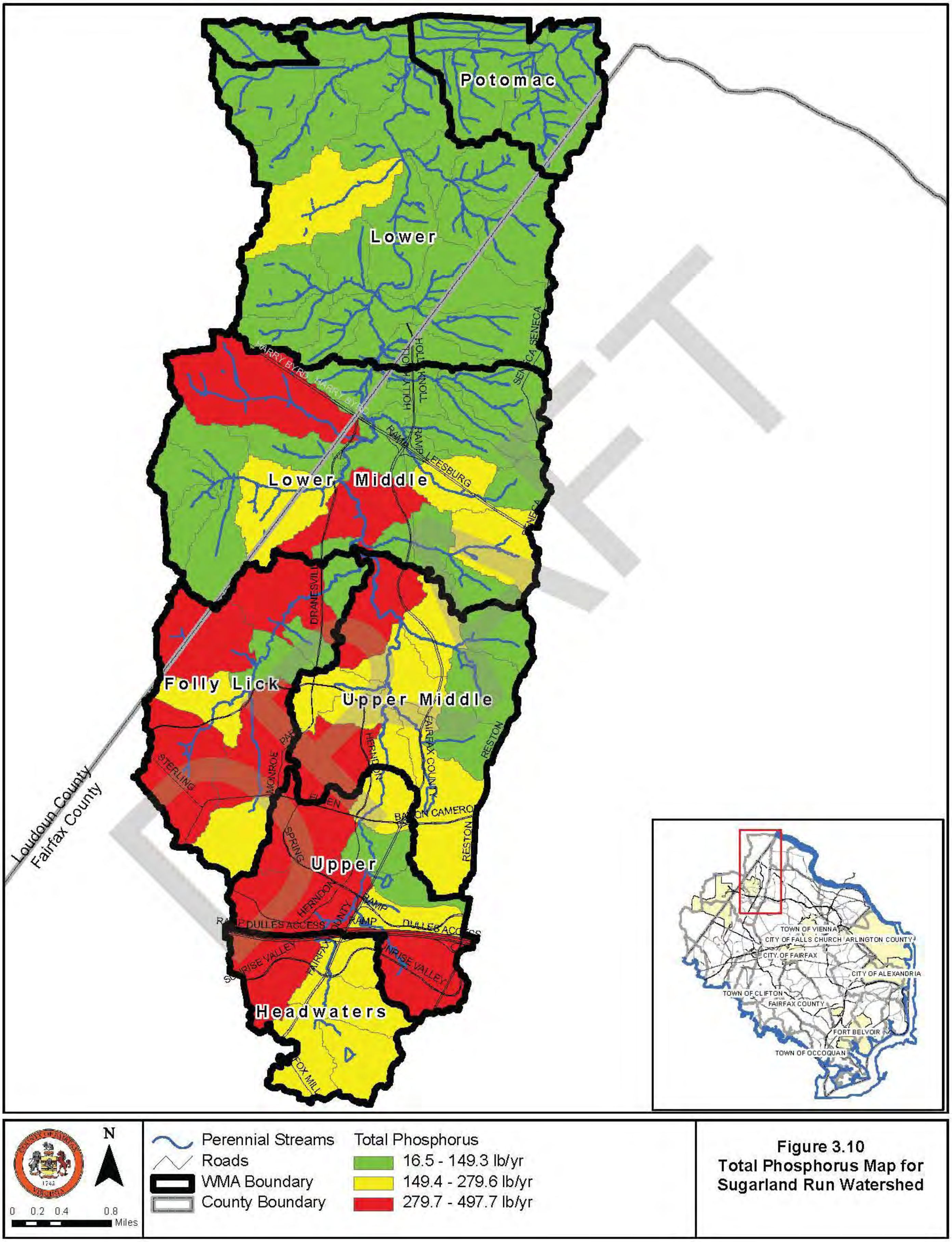

Figure 3.10
Total Phosphorus Map for Sugarland Run Watershed

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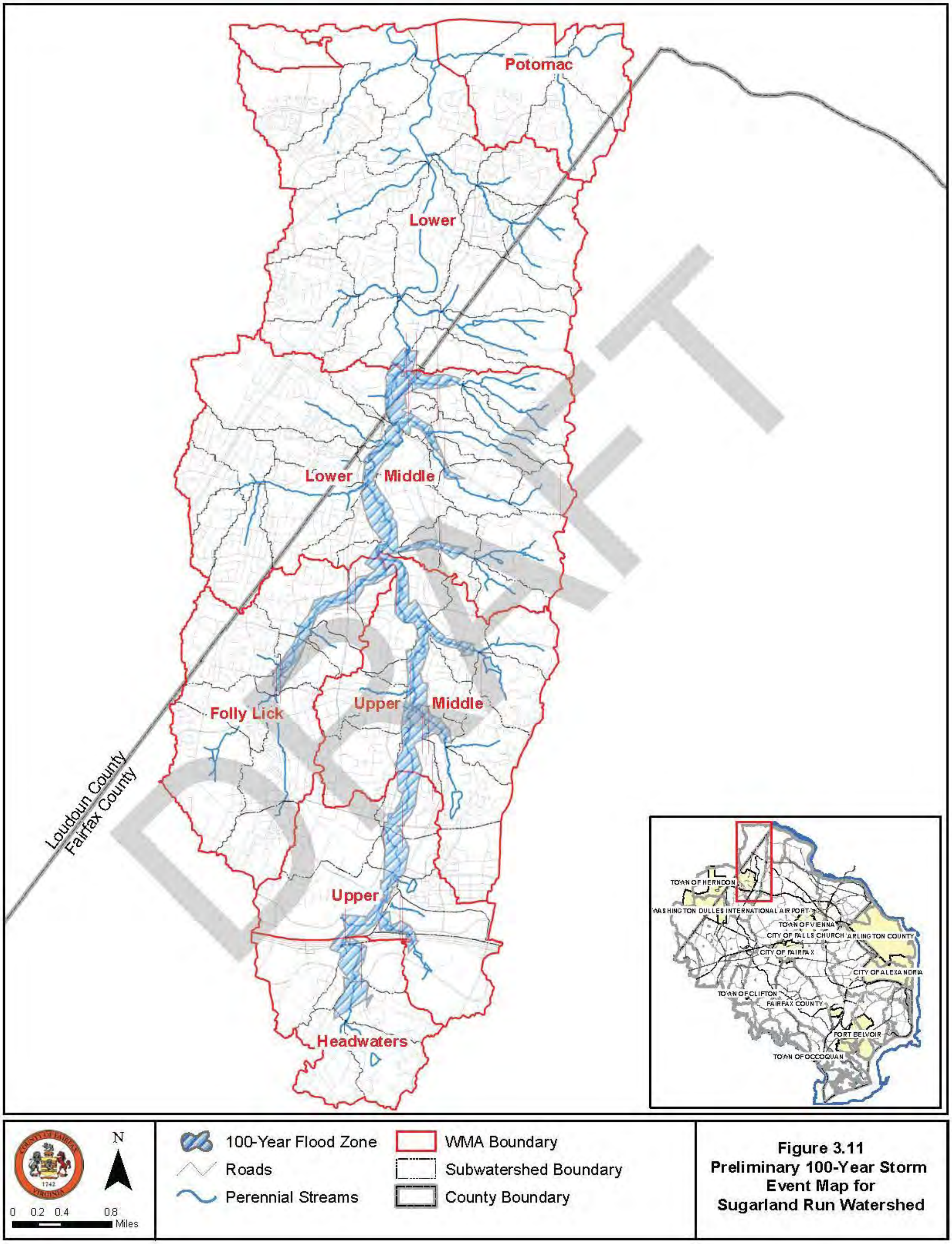

Figure 3.11
Preliminary 100-Year Storm Event Map for Sugarland Run Watershed

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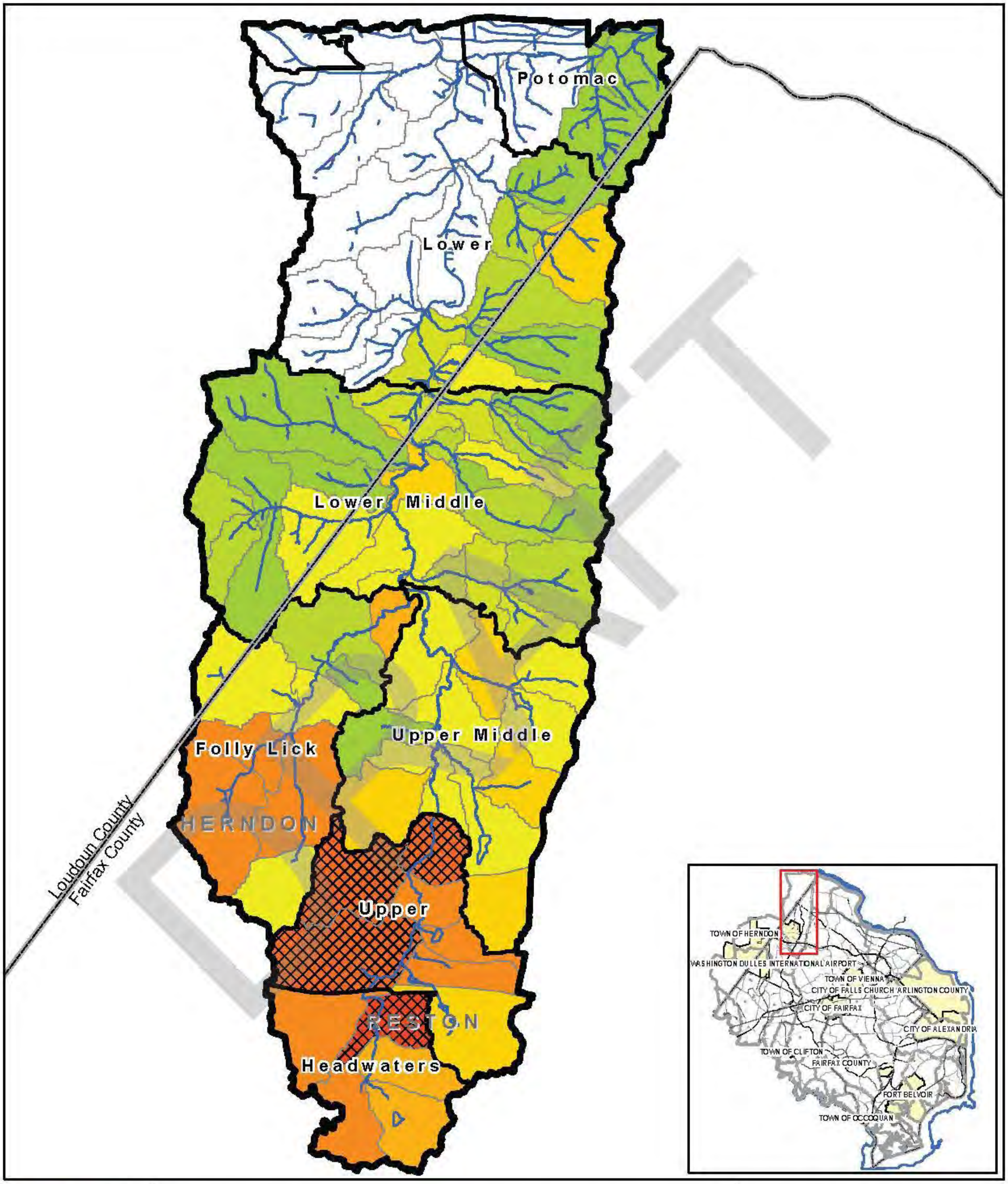

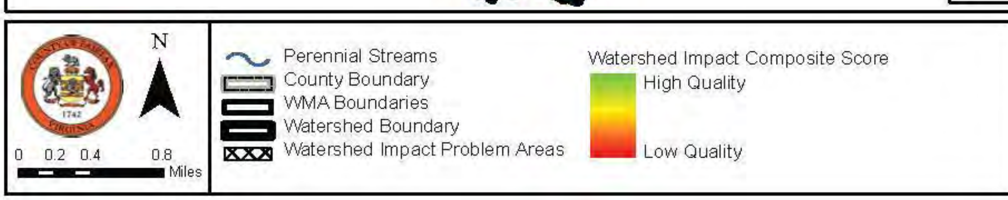

Figure 3.12
Preliminary Watershed Impact Map for Sugarland Run Watershed

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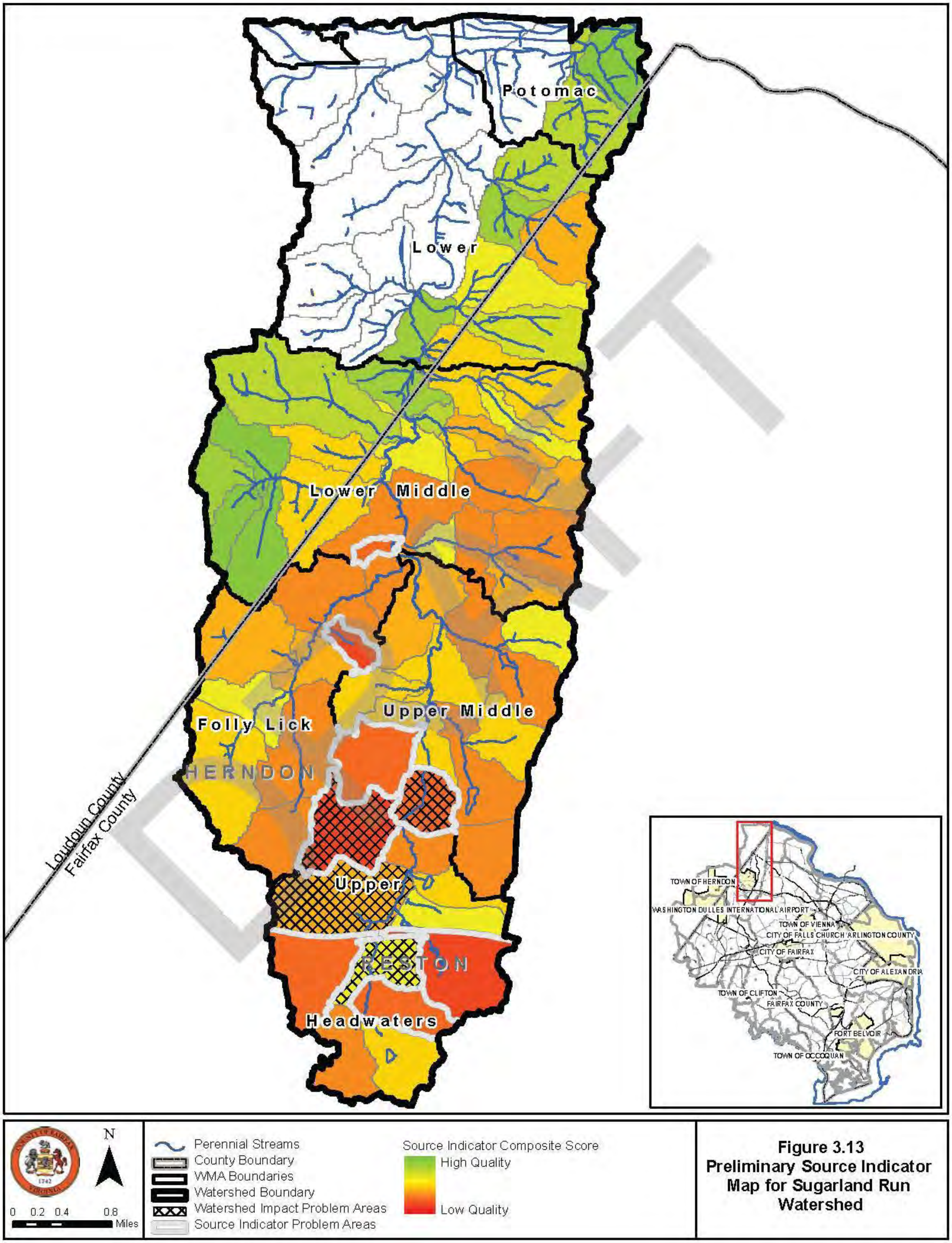

Figure 3.13
Preliminary Source Indicator Map for Sugarland Run Watershed

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3.1 Folly Lick WMA

3.1.1 Folly Lick WMA Characteristics

The Folly Lick WMA is located in the western portion of the Sugarland Run Watershed. The watershed comprises 1,813 acres (2.83 square miles). Approximately half of the watershed is contained within the Herndon Parkway and the other half of the watershed lies north of the parkway. Figure 3.1 shows the location of the Folly Lick WMA.

Approximately 5.3 miles of perennial streams are located within the Folly Lick WMA. The streams range from poor to fair condition in the Herndon section to good condition in the northern section. The streams flow northeast toward the confluence with Sugarland Run, and flow primarily through medium density residential and open space areas. The headwaters of the eastern portion of the WMA travel though a golf course while the streams in the eastern portion of the WMA travel through an industrial/commercial land use area.

3.1.2 Existing and Future Land Use

The southern half of the Sugarland Run Watershed is highly developed, including the Folly Lick WMA. Approximately 77 percent of the WMA is urbanized, primarily consisting of medium density residential (40 percent), open space (13 percent) and transportation networks (15 percent) land uses, as shown in Table 3.2. The open space is primarily clustered around the stream corridors.

Table 3.2 Existing and Future Land Use for Folly Lick WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	1.8	1.1
High Density Residential	9.1	11.3
Medium Density Residential	36.9	37.8
Low Density Residential	6.5	5.0
Industrial	0.4	0.2
Low Intensity Commercial	1.3	0.8
High Intensity Commercial	1.5	2.3
Institutional	6.8	6.7
Open Space	12.7	11.9
Golf Course	7.4	7.4
Transportation	15.0	15.0
Water	0.7	0.7
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.2 and Figure 3.2 show expected changes in land use as the Folly Lick WMA continues to develop. A slight increase in high density residential and high intensity commercial land use, with a corresponding decrease in open space, low density residential and low intensity commercial areas within the Folly Lick WMA are projected.

3.1.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Folly Lick WMA to evaluate projects proposed by the county, identify problems areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Folly Lick WMA:

1. Evaluated drainage complaints.
2. Evaluated proposed projects by the county.
3. Evaluated existing stormwater facilities.
4. Evaluated on-site septic systems.
5. Conducted a neighborhood source assessment.
6. Conducted a hotspot investigation.
7. Conducted a stream physical assessment.

The results of each of the field reconnaissance surveys are briefly described below.

Drainage Complaints

One hundred and nineteen (119) drainage complaints have been documented within the Folly Lick WMA between 2001 and 2006. Of those, seven representative complaints were chosen for field investigation. The complaints included cave-ins and sinkholes around stormwater management facilities and on properties.

Proposed County Project

Based upon past evaluations and reports, multiple stormwater projects have been proposed within the Folly Lick WMA. Field investigations were used to determine whether the projects were still viable. The projects included stream restoration and stabilization projects on Folly Lick Branch, raising the road and installing culverts, construction of a regional pond and replacement of a storm sewer on Fantasia Drive.

Existing Stormwater Facilities

Nine stormwater management facilities were evaluated within the Folly Lick WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Three of the nine facilities were found to not provide stormwater management functions. The remaining facilities were functioning as designed and only a few presented some opportunity for retrofit.

On-site Septic Systems

Portions of the Sugarland Run watershed still use on-site septic systems. Properties using on-site systems were chosen for field reconnaissance if problems were noted in the area. Three on-site septic systems were visited in the Folly Lick WMA. Two of those sites showed no visible signs of problems and one site was an abandoned farm that was not accessible due to fenced properties around its perimeter.

Neighborhood Source Assessment (NSA)
Two representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Folly Lick WMA. The chosen neighborhoods consisted of single family detached houses on quarter-acre lots. Two stormwater management facilities were identified, including one wet pond and one dry pond. The NSA indicated that there is the potential for stormwater management facility retrofits as well as a need for better lawn and landscaping practices in the Folly Lick WMA.

Hot Spot Investigation (HSI)
Seven representative facilities with the potential to generate concentrated stormwater pollution were chosen within the Folly Lick WMA for the HSI. An investigation was conducted of each facility and the corresponding property to identify sources of pollution. Two schools were targeted for the HSI: one revealed a potential hotspot and the other did not. The Herndon Golf Course was also investigated, resulting in the detection of a potential hotspot. A review of the stormwater pollution plan is recommended along with an onsite visit for that facility. Three commercial categories and one apartment building were targeted as the final four facilities, all of which were classified as potential hot spots. This indicated the need for future education efforts and the need for review of the stormwater pollution prevention plan for each facility.

Stream Physical Assessment (SPA)
A supplemental stream physical assessment was conducted on 1.3 miles of stream within the Folly Lick WMA. This stream segment was chosen for re-assessment because two county stream restoration and stabilization projects were located in the stream segment, two additional projects were proposed, and it drains to a 303(d) impaired stream. The stream was found to be in good habitat condition. There were 11 bank erosion problems, five obstructions and four pipes/drainage ditch erosion problems.

3.1.4 Folly Lick WMA Characterization

Approximately 5.3 miles of streams were assessed within the Folly Lick WMA to determine the overall stream conditions in the WMA. As shown in Figure 3.4, the stream length assessed has good habitat conditions in the upper portion and fair to poor habitat conditions in the lower portions. Most of the streams in the Folly Lick WMA are protected by the resource protection areas as described in Chapter 1. The Folly Lick main stem was designated as protected in 1993. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings, but some also occurred in riparian buffers, pipes and deficient buffer areas. A portion of the stream has been straightened and channelized through Herndon. This section has a severe headcut and moderate to severe buffer deficiency. At the confluence where the tributaries join, a few areas of moderate to severe erosion were also identified. The main stem of Folly Lick is in Channel Evolution Model Stage 3, which means it is an unstable channel that is experiencing significant bank erosion. The headwaters are in Channel Evolution Model Stage 4, which indicates the stream is attempting to stabilize by developing a bankful and floodplain channel.

As shown in Figure 3.6, the Folly Lick WMA contains a few stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. These facilities are all dry ponds with the largest being approximately two acres and the remaining between one-third and one acre in size. One regional pond project is being considered for the area. Based on Table 3.3, stormwater runoff from only about 12 percent of the area in this WMA is treated. Stormwater runoff from approximately 88 percent of the area in this WMA is not treated by any means. Stormwater runoff from most of the area that does receive treatment is only treated for quantity and not water quality. Therefore, more stormwater management facilities are needed in the Folly Lick WMA. Drainage complaints made by residents consisted of cave-ins and sinkholes.

Table 3.3 Folly Lick WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Folly Lick	1813.69	547.30	30%	156.72	41.29	9.53	1606.15

3.1.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.4 below shows the total pollutant loading to the endpoint of Folly Lick WMA. According to the STEPL model results, the Folly Lick WMA contributes approximately 16 percent of the total suspended solids, 17 percent of the total nitrogen, and 17 percent of the total phosphorous annual loads to the Sugarland Watershed. Pollutant loadings normalized to the acres within the drainage area of Folly Lick WMA are presented in Table 3.5. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Folly Lick WMA as compared with unit area loads for the entire watershed.

Table 3.4 Summary of Pollutant Loadings for Folly Lick WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Folly Lick	343.9	13,535.44	2,073.57
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.5 Summary of Pollutant Loadings Normalized by Drainage Area for Folly Lick WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Folly Lick	0.190	7.466	1.144
WS Totals	**0.151**	**5.529**	**0.827**

3.1.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Folly Lick WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Folly Lick WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope.

One bridge and one culvert are located within the Folly Lick WMA. The bridge and culvert were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that the bridge does not carry the 100-year stormflow and will overtop, nor does it carry the 2- or 10-year stormflows. The culvert does not carry the 100-year stormflow and water will pond upstream of the culvert structure. The existence of the ponded water will extend the time period of maximum flow through the culvert. When the ponded water is fully drained, the flow elevation will begin to drop.

3.1.7 Folly Lick WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of watershed impacts; the lowest scoring subwatersheds were identified as potential problem areas. None of the subwatersheds within the Folly Lick WMA have been identified as a potential problem area. Based upon existing conditions, most of the northern portion of the WMA is in good condition, but traveling south toward the headwaters of Folly Lick Branch the conditions deteriorate.

The Folly Lick WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources, as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. One of the subwatersheds within the Folly Lick WMA has been identified as a potential problem area. Most of the Folly Lick WMA shows high levels of stressors and pollutant sources.

3.2 Headwaters WMA

3.2.1 Headwaters WMA Characteristics

The Headwaters WMA is located in the southern portion of the Sugarland Run Watershed. The watershed is comprised of 929 acres (1.45 square miles) and is located south of the Dulles Access Road, as shown in Figure 3.1.

Approximately 1.4 miles of perennial streams exist within the Headwaters WMA, and a majority of these streams range from poor to fair condition. The streams flow north toward the confluence with the main stem of Sugarland Run. The streams travel primarily through medium density residential and open space areas. The northern portion of the stream travels though a low intensity commercial land use area.

3.2.2 Existing and Future Land Use

The southern half of the Sugarland Run Watershed is highly developed, and the Headwaters WMA falls within that portion. Approximately 86 percent of the Headwaters WMA is urbanized, primarily consisting of medium and high density residential (38 percent), commercial and industrial (21 percent), and transportation networks (19 percent) land uses, as shown in Table 3.6. The open space is primarily clustered around the stream corridors.

Table 3.6 Existing and Future Land Use for Headwaters WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
High Density Residential	11.7	11.7
Medium Density Residential	26.5	26.8
Low Density Residential	5.4	5.4
Industrial	5.0	5.0
Low Intensity Commercial	16.2	16.1
Institutional	1.7	1.7
Open Space	13.8	13.6
Transportation	18.5	18.5
Water	1.2	1.2
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.6 and Figure 3.2 show expected changes in land use as the Headwaters WMA continues to develop. A slight increase in medium density residential areas and a slight decrease in open space areas are projected within the Headwaters WMA.

3.2.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Headwaters WMA to evaluate projects proposed by the county, to identify problems areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Headwaters WMA:

1. Evaluated drainage complaints.
2. Evaluated proposed projects by the county.
3. Evaluated existing stormwater facilities.
4. Conducted a neighborhood source assessment.
5. Conducted a hotspot investigation.

The results of each of the above evaluations are briefly described below.

Drainage Complaints

One hundred and three (103) drainage complaints have been documented within the Headwaters WMA between 2001 and 2006. Of those, four representative complaints were chosen for field investigation. The complaints included erosion and sediment buildup around stormwater management facilities. Field verifications showed no evidence of erosion or sediment at three locations and minor erosion at the stormwater management facility in one location.

Proposed County Project

Based upon past evaluations and reports, two stormwater projects have been proposed within the Headwaters WMA. Field investigations were used to determine whether these projects were still viable. The projects included a stream restoration and stabilization project on the Headwaters Branch and raising the road and installing a culvert at Fox Mill Road. The streambank stabilization project has been completed and the area was stabilized with rip-rap. The road raising project was not located.

Existing Stormwater Facilities

Twelve (12) stormwater management facilities were evaluated within the Headwaters WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Seven of the 12 facilities were wet ponds. They were functioning as designed and one of them presented some opportunity for retrofit. The remaining five facilities did not provide stormwater management functions or were not present at the location specified.

Neighborhood Source Assessment (NSA)

Three representative neighborhoods were chosen for NSAs to help identify potential improvement projects throughout the Headwaters WMA. The chosen neighborhoods consisted of one low intensity commercial classification and three single-family detached houses on quarter- half-acre lots. Three stormwater management facilities were identified as wet ponds on the commercial property. One single-family property contained a dry pond, one contained a wet pond and the third did not have a stormwater management facility. The NSA indicated the potential for a stormwater management facility retrofit at the dry pond location; all assessments showed a need for better lawn and landscaping practices.

Hot Spot Investigation (HSI)

Six representative facilities with the potential to generate concentrated stormwater pollution were chosen within the Headwaters WMA for the HSI. An investigation was conducted of the facilities and the corresponding properties identifying sources of pollution. All facilities were commercial classifications. One facility was confirmed as not a hotspot, but should be included in future education efforts. Four other facilities were potential hot spots and one was a confirmed hotspot. The confirmed hotspot was located off Sunrise Valley Road and should be followed up with an onsite visit. A review of the stormwater pollution plan is recommended for all of the sites along with future education efforts.

3.2.4 Headwaters WMA Characterization

Approximately 1.4 miles of stream were assessed within the Headwaters WMA to determine the overall stream conditions in the WMA. As shown in Figure 3.4, the stream length assessed had poor to fair habitat conditions. Most of the streams in the Headwaters WMA are protected by the resource protection areas as described in Chapter 1. The Headwaters main stem was designated as protected in 2003. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings, but erosion also occurred in deficient buffer areas. One stream segment revealed a moderate to severe erosion level at a deficient buffer area. All of the Headwaters WMA is in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion.

As shown in Figure 3.6, the Headwaters WMA contains multiple stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. The majority of these facilities are wet ponds. Table 3.7 indicates that stormwater runoff from approximately 29 percent of the area in this WMA is treated, and approximately 71 percent of the area in this WMA is not treated by any means. Stormwater runoff from most of the area that does receive treatment is only treated for quantity and not water quality. Therefore, more stormwater management facilities are needed in the Headwaters WMA. Drainage complaints made by residents consisted of erosion and sediment build-up around stormwater treatment facilities.

Table 3.7 Headwaters WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Headwaters	929.00	315.13	34%	242.2	8.9	18.1	659.8

3.2.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.8 below shows the total pollutant loading to the endpoint of Headwaters WMA. According to the STEPL model results, the Headwaters WMA contributes approximately nine percent of the total suspended solids, 10 percent of the total nitrogen, and 10 percent of the total phosphorous annual loads to Sugarland

Watershed. Pollutant loadings normalized to the acres within the drainage area of Headwaters WMA are presented in Table 3.9. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Headwaters WMA as compared with unit area loads for the entire watershed.

Table 3.8 Summary of Pollutant Loadings for Headwaters WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/yr)	**Total Nitrogen (pounds/yr)**	**Total Phosphorus (pounds/year)**
Headwaters	204.5	8,216.82	1,198.13
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.9 Summary of Pollutant Loadings Normalized by Drainage Area for Headwaters WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/yr)	**Total Nitrogen (pounds/acre/yr)**	**Total Phosphorus (pounds/acre/yr)**
Headwaters	0.220	8.845	1.290
WS Totals	**0.151**	**5.529**	**0.827**

3.2.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Headwaters WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Headwaters WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope.

Two culverts are located within the Headwaters WMA. The culverts were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that both culverts do not carry the 100-year stormflow and will overtop. Water will pond upstream of the culvert structures. The existence of the ponded water will extend the time period of maximum flow through the culverts. When the ponded water is fully drained, the flow elevations will begin to drop.

3.2.7 Headwaters WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of the watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. One subwatershed within the Headwaters WMA has been identified as a potential problem area. Based upon existing conditions, all of the WMA is in very poor condition.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. One additional problems area was identified within the Headwaters WMA. Most of the WMA shows high levels of stressors and pollutant sources.

3.3 Lower Sugarland WMA

3.3.1 Lower Sugarland WMA Characteristics

The Lower Sugarland WMA is located in the northern portion of the Sugarland Run Watershed. The watershed comprises 3,742 acres (5.85 square miles) and is located north of Leesburg Pike. It is intersected by the Loudoun County border, as shown in Figure 3.1. The portion within Fairfax County is less than one-third of the total Lower Sugarland WMA, comprising 691 acres square miles).

Approximately 13.8 miles of perennial streams exist within the Lower Sugarland WMA, which range from fair to good condition. The streams flow west into Loudoun County, traveling primarily through estate residential and open space areas.

3.3.2 Existing and Future Land Use

The southern half of the Sugarland Run Watershed is highly developed, while the northern half is far less developed. The Lower Sugarland WMA falls within the less developed half of the watershed. Approximately 60 percent of the Lower Sugarland WMA is urbanized, consisting of low density residential (38 percent), open space (40 percent) and medium density residential (11 percent), as shown in Table 3.10.

Table 3.10 Existing and Future Land Use for Lower Sugarland WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	9.9	11.1
Medium Density Residential	10.5	10.5
Low Density Residential	37.8	37.8
High Intensity Commercial	0.2	0.2
Open Space	39.5	38.3
Transportation	1.3	1.3
Water	0.8	0.8
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.10 and Figure 3.3 show expected changes in land use as the Lower Sugarland WMA continues to develop. A very slight decrease in open space areas and an increase in estate residential areas within the Lower Sugarland WMA are projected.

3.3.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Lower Sugarland WMA to evaluate projects proposed by the county, to identify problem areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Lower Sugarland WMA:

1. Evaluated project proposed by the county.
2. Evaluated existing stormwater facilities.
3. Evaluated on-site septic systems.
4. Conducted a neighborhood source assessment.

The results of each of the above evaluations are briefly described below.

<u>Proposed County Project</u>
Based upon past evaluations and reports, one stormwater management project had been proposed within the Lower Sugarland WMA. Field investigations were used to determine whether the project was still viable. The project included raising the road and installing a new culvert. The field investigations concluded that the existing culvert is undersized, road flooding was evident, erosion was visible downstream of culvert and that the culvert does need to be replaced.

<u>Existing Stormwater Facilities</u>
Fourteen stormwater management facilities were evaluated within the Lower Sugarland WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Four of the 14 facilities were dry ponds and were functioning as designed, with no room for additional storage volume. The remaining 10 facilities were either not present at the location or

were old farm ponds. A few of these facilities had beneficial forested buffers and wetland vegetation around the perimeters.

On-Site Septic Systems

Portions of the Sugarland Run watershed still use on-site septic systems. Properties using on-site systems were chosen for field reconnaissance if problems were noted in the area. One on-site septic area was visited in the Lower Sugarland WMA. The site could not be accessed due to a locked and gated fence but did not show any visible problems from the perimeter.

Neighborhood Source Assessment (NSA)

Four representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Lower Sugarland WMA. The chosen neighborhoods consisted of single-family detached houses ranging from one-half-acre lots to over one-acre lots. Three dry pond stormwater management facilities were identified in one NSA, three farm ponds were located in one NSA and the remaining two NSAs each contained one farm pond. Two of the assessments showed buffers were present but encroachment was evident. The NSA indicated a need for better lawn and landscaping practices.

3.3.4 Lower Sugarland WMA Characterization

Approximately 13.8 miles of streams were assessed within the Lower Sugarland WMA, within the Fairfax County boundary, to determine the overall stream conditions. Some portions of the Lower Sugarland WMA were not assessed, including the portions within Loudoun County. As can be seen from Figure 3.5, the stream lengths were mainly assessed as fair to good condition, with one tributary ranked as poor condition. Most of the streams in the Lower Sugarland WMA are protected by the resource protection areas as described in Chapter 1. The Lower Sugarland main stem was designated as protected in 2003. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings and deficient buffer areas. One section had a moderate to severe erosion problem at a circular concrete crossing. Most of the Lower Sugarland WMA is in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion.

As shown in Figure 3.7, the Lower Sugarland WMA contains multiple stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. The majority of these facilities are farm ponds. Table 3.11 indicates that stormwater runoff from approximately 20 percent of the area in this WMA is treated, and 80 percent of the area in this WMA is not treated by any means. Stormwater runoff from most of the area that does receive treatment is only treated for quantity and not water quality. Therefore, more stormwater management is needed within the developed portion of the Lower Sugarland WMA. Approximately 11 percent of the area in the Lower Sugarland WMA is impervious.

Table 3.11 Lower Sugarland WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Lower Sugarland	3,743	403.95	11%	135.8*	28.0*	6.4*	679.7*

* Treatment only within Fairfax County

3.3.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10. present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA.. Table 3.12 below shows the total pollutant loading to the endpoint of Lower Sugarland WMA. According to the STEPL model results, the Lower Sugarland WMA contributes approximately 16 percent of the total suspended solids, 13 percent of the total nitrogen, and 14 percent of the total phosphorous annual loads to Sugarland Watershed. Pollutant loadings normalized to the acres within the drainage area of Lower Sugarland WMA are presented in Table 3.13. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Lower Sugarland WMA as compared with unit area loads for the entire watershed.

Table 3.12 Summary of Pollutant Loadings for Lower Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Lower Sugarland	340.7	10,864.18	1,684.90
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.13 Summary of Pollutant Loadings Normalized by Drainage Area for Lower Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Lower Sugarland	0.091	2.903	0.450
WS Totals	**0.151**	**5.529**	**0.827**

3.3.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Lower Sugarland WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Lower Sugarland WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope. There are no bridges or culverts on the modeled stream reaches in the Lower Sugarland WMA, so none were modeled.

3.3.7 Lower Sugarland WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. Most of the Lower Sugarland WMA lies outside Fairfax County, and therefore those subwatersheds were not scored. No subwatersheds within the Lower Sugarland WMA have been identified as potential problem areas. Based upon existing conditions, all of the scored WMA is in good condition.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. No additional problems areas were identified within the Lower Sugarland WMA. Most of the WMA indicates low levels of stressors and pollutant sources.

3.4 Lower Middle Sugarland WMA

3.4.1 Lower Middle Sugarland WMA Characteristics

The Lower Middle Sugarland WMA is located in the northern portion of the Sugarland Run Watershed. The watershed comprises 3,590 acres (5.61 square miles) and is located north of Wiehle Road. The WMA is intersected by the Loudoun County border as shown in Figure 3.1. The portion within Fairfax County is approximately half of the total Lower Middle WMA, comprising 2,012 acres (3.14 square miles).

Approximately 14.8 miles of perennial streams exist within the Lower Middle Sugarland WMA. These streams range from fair to good condition. The streams flow west into Loudoun County. The streams travel primarily through open space areas with medium density and low density residential areas on the perimeter.

3.4.2 Existing and Future Land Use

The southern half of Sugarland Run Watershed is highly developed, while the northern half is far less developed. The Lower Middle Sugarland WMA lies in the middle of the Sugarland Run Watershed, with both ends of the development spectrum represented. Approximately 75 percent of the Lower Middle Sugarland WMA is urbanized, consisting of low density residential (40 percent), open space (24 percent) and medium density residential (13 percent), as shown in Table 3.14.

Table 3.14 and Figure 3.3 show expected changes in land use as the Lower Middle Sugarland WMA continues to develop. A decrease in estate residential and open space areas and increase in low density residential and high intensity commercial areas within the Lower Middle Sugarland WMA are projected.

Table 3.14 Existing and Future Land Use for Lower Middle Sugarland WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	7.0	6.2
High Density Residential	.01	.01
Medium Density Residential	13.4	13.5
Low Density Residential	40.0	41.9
Low Intensity Commercial	0.1	0.3
High Intensity Commercial	1.5	1.7
Industrial	1.9	1.9
Institutional	0.2	0.2
Open Space	24.2	22.6
Transportation	8.2	8.2
Water	1.0	1.0
Total	100	100

Source: Fairfax County GIS, 2008

3.4.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Lower Middle Sugarland Watershed Management Area to evaluate projects proposed by the county, to identify problem areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Lower Middle Sugarland WMA:

1. Evaluated drainage complaints.
2. Evaluated projects proposed by the county.
3. Evaluated existing stormwater facilities.
4. Conducted a neighborhood source assessment.
5. Conducted a hotspot investigation.
6. Conducted a stream physical assessment

The results of each of the above evaluations are briefly described below.

Drainage Complaints

One hundred and two (102) drainage complaints have been documented within the Lower Middle Sugarland WMA between 2001 and 2006. Of those, three representative complaints were chosen for field investigation. The complaints included cave-ins and erosion around stormwater management facilities. No evidence was found in two of the locations and minor erosion was observed in one location.

Proposed County Projects

Based upon past evaluations and reports, multiple stormwater projects have been proposed within the Lower Middle Sugarland WMA. Field investigations were used to determine whether the projects were still needed. The projects included 11 stream restoration and stabilization projects. Four of those projects were not reviewed because of gated access restrictions. Seven of the projects showed evidence of moderate to severe erosion. Three regional pond projects were proposed in the Lower Middle Sugarland WMA. One pond was completed and the remaining two are not yet completed. Five projects were proposed to raise roads and install culverts. Two of those projects were completed and the remaining three were recommended to also be completed.

Existing Stormwater Facilities

Twenty-one (21) stormwater management facilities were evaluated within the Lower Middle Sugarland WMA to determine the need for repairs or the potential for retrofits to increase the benefit of the facilities. Four of the 21 stormwater facilities were dry ponds; three were functioning as designed and one was functioning as a wet pond due to a clogged structure. Ten of the stormwater facilities were in forested buffer areas; some had wetland vegetation and were functioning as farm or ornamental ponds. Three of the stormwater facilities were functioning as farm ponds but have the potential for retrofit. Two of the facilities were farm ponds that are in bad condition due to homeowner negligence. The remaining two locations did not contain a stormwater management facility.

Neighborhood Source Assessment (NSA)

Five representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Lower Middle Sugarland WMA. Three of the chosen neighborhoods consisted of single-family detached houses on on-half-acre to one-acre lots. All of the neighborhoods contained buffer areas with evidence of encroachment and either dry ponds or wet ponds for stormwater management. One neighborhood consisted of one-acre lots, and had two stormwater management facilities with the potential for additional volume. The remaining neighborhood consisted of one-quarter-acre lots with three dry ponds for stormwater management. The NSA indicated the potential for stormwater management facility retrofit as well as a need for better lawn and landscaping practices.

Hot Spot Investigation (HSI)

Three representative facilities with the potential to generate concentrated stormwater pollution were chosen within the Lower Middle Sugarland WMA to complete a HSI. An investigation was conducted of each facility and its corresponding property to identify sources of pollution. All three locations targeted for the HSI were commercial locations. One was not considered a hotspot and the other two were considered potential hotspots. This indicated the need for future education efforts and review of the stormwater pollution prevention plans for each facility.

Stream Physical Assessment (SPA)

A supplemental stream physical assessment was conducted on 2.5 miles of stream within the Lower Middle Sugarland WMA. The stream segment was chosen for re-assessment because several county stream restoration and stabilization projects were located on the stream, two additional projects were proposed and because the stream segment is listed as a 303(d) impaired stream. The stream was found to be in good to excellent habitat condition. The SPA identified 17 bank erosion problems, three obstructions and three pipes/drainage ditch erosion problems.

3.4.4 Lower Middle Sugarland WMA Characterization

Approximately 14.8 miles of streams were assessed within the Lower Middle Sugarland WMA to determine the overall stream conditions. As shown in Figure 3.5, the assessed stream segment had fair to good habitat conditions. Most of the streams in the Lower Middle WMA are protected by the resource protection areas as described in Chapter 1. The Lower Middle Sugarland main stem was designated as protected in 1993 and the other tributaries were added in 2003. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings and in deficient buffer areas. Mild to moderate obstructions and dumps were also identified. Two sections had moderate to severe erosion problems at deficient buffer areas. Approximately half of the Lower Middle Sugarland WMA is in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion. The remaining portions are in Stage 4, which indicates that the stream is attempting to stabilize by developing a bankful and floodplain channel.

As shown in Figure 3.7, the Lower Middle Sugarland WMA contains multiple stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. The majority of these facilities are farm ponds. Table 3.15 indicates that stormwater runoff from approximately 67 percent of the area in this WMA is treated, and approximately 33 percent of the area in this WMA is not treated by any means. Stormwater runoff from most of the area that does receive treatment is treated for quantity and water quality. Only about 14 percent of the watershed area is impervious. As development continues in Lower Middle Sugarland WMA, additional stormwater facilities should be installed. Since a significant portion of the watershed area in the Lower Middle Sugarland WMA is already treated with for quantity and water quality, the primary focus in this WMA should be to ensure that all of the existing stormwater treatment facilities are operated and maintained properly.

Table 3.15 Lower Middle Sugarland WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Lower Middle Sugarland	3,503	501.3	14%	391.7*	77.2*	866.5*	676.7*

* Treatment only within Fairfax County

3.4.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.16 below shows the total pollutant loading to the endpoint of Lower Middle Sugarland WMA. According to the STEPL model results, the Lower Middle Sugarland WMA contributes approximately 23 percent of the total suspended solids, 22 percent of the total nitrogen, and 23 percent of the total phosphorous annual loads to Sugarland Watershed. Pollutant loadings normalized to the acres within the drainage area of Lower Middle Sugarland WMA are presented in Table 3.17. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Lower Middle WMA as compared with unit area loads for the entire watershed.

Table 3.16 Summary of Pollutant Loadings for Lower Middle Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Lower Middle Sugarland	503.0	17,873.39	2,738.69
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.17 Summary of Pollutant Loadings Normalized by Drainage Area for Lower Middle Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Lower Middle Sugarland	0.140	4.979	0.763
WS Totals	**0.151**	**5.529**	**0.827**

3.4.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Lower Middle Sugarland WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Lower Middle Sugarland WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope.

One bridge and three culverts are located within the Lower Middle Sugarland WMA. The bridge was modeled to determine if the 100-year storm exceeded its capacity to carry the flow. The modeling shows that the bridge does not carry the 100-year stormflow. One culvert does not carry the 100-year stormflow and water will pond upstream of the culvert structure. The existence of the ponded water will extend the time period of maximum flow through the culvert. When the ponded water is fully drained, the flow elevation will begin to drop. The two other culverts carry the 100-year stormflow.

3.4.7 Lower Middle Sugarland WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. No subwatersheds within the Lower Middle WMA have been identified as potential problem areas. Based upon the evaluation, the majority of the WMA is in good condition. The exception was one subwatershed that scored fair.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. One additional problem area was identified within the Lower Middle Sugarland WMA. The rest of the WMA were ranked as low to moderate levels of stressors and pollutant sources.

3.5 Potomac WMA

3.5.1 Potomac WMA Characteristics

The Potomac WMA is located at the northern tip of the Sugarland Run Watershed. The watershed comprises 1,053 acres (1.64 square miles) and is located at the border of Loudoun County, as shown in Figure 3.1. The portion of the WMA within Fairfax County only contains 70 acres (0.1 square miles); the rest is in Loudoun County.

Approximately 3.0 miles of perennial stream exist within the Potomac WMA in Fairfax County, which range from fair to good condition. The stream flows west into Loudoun County, traveling through an estate residential area.

3.5.2 Existing and Future Land Use

The Potomac WMA falls within the less developed area of the Sugarland Run Watershed. Approximately 26 percent of the WMA is urbanized, consisting of low density residential (17 percent) and open space (74 percent) land uses, as shown in Table 3.18.

Table 3.18 Existing and Future Land Use for Potomac WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	0.8	0.8
Medium Density Residential	4.3	4.3
Low Density Residential	17.1	17.1
Open Space	73.7	73.7
Transportation	0.8	0.8
Water	3.3	3.3
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.18 and Figure 3.3 show that no changes are expected in land use as the Potomac WMA continues to develop.

3.5.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was conducted within the Potomac WMA to evaluate projects proposed by the county, to identify problems areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Potomac WMA:

1. Evaluated existing stormwater facilities.
2. Conducted a neighborhood source assessment.

The results of each of the above evaluations are briefly described below.

Existing Stormwater Facilities
Two stormwater management facilities were evaluated in the Potomac WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Both of the facilities were dry ponds and were functioning as designed.

Neighborhood Source Assessment (NSA)
One representative neighborhood was chosen for the NSA to help identify potential improvement projects throughout the Potomac WMA. The chosen neighborhood consisted of single-family detached houses on one-acre lots. Two stormwater management facilities were identified as dry ponds. The NSA indicated that buffers were present and encroachment was evident. Better lawn and landscaping practices are needed.

3.5.4 Potomac WMA Characterization

Approximately 3.0 miles of stream was assessed within the Fairfax County portion of the Potomac WMA to determine the overall stream conditions. Only about 7 percent of the Potomac WMA is located in Fairfax County; therefore, no stream information is available for the majority of the WMA.

As shown in Figure 3.7, the Potomac WMA contains two stormwater management facilities within the Fairfax County boundary that collect and treat stormwater runoff. The remaining stormwater treatment facilities outside of Fairfax County are not known. Table 3.19 indicates that stormwater runoff from approximately 66 percent of the area in this WMA is treated, and approximately 34 percent of the area in this WMA is not treated by any means. Stormwater runoff from most of the area that does receive treatment is treated for water quality and not quantity. Approximately 4 percent of the area in the Potomac WMA is impervious.

Table 3.19 Potomac WMA Summary (within Fairfax County)

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Potomac	1,053	42	4%	0*	43.7*	2.71*	23.9*

* Treatment only within Fairfax County

3.5.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.20 below shows the total pollutant loading to the endpoint of Potomac WMA. According to the STEPL model results, the Potomac WMA contributes approximately 8 percent of the total suspended solids, 3 percent of the total nitrogen, and 4 percent of the total phosphorous annual loads to Sugarland Watershed. Pollutant loadings normalized to the acres within the drainage area of Potomac WMA are presented in Table 3.21. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Potomac WMA as compared with unit area loads for the entire watershed.

Table 3.20 Summary of Pollutant Loadings for Potomac WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Potomac	167.5	2260.6	435.4
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.21 Summary of Pollutant Loadings Normalized by Drainage Area for Potomac WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Potomac	0.159	2.147	0.413
WS Totals	**0.151**	**5.529**	**0.827**

3.5.6 HEC-RAS Modeling

The Potomac WMA was not modeled using HEC-RAS since the majority of the WMA is located in Loudoun County.

3.5.7 Potomac WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. Approximately half of the Potomac WMA was not scored because it is located within Loudoun County. No subwatersheds within the Potomac WMA have been identified as potential problem areas. Based upon existing conditions, the scored portion of the WMA is in good condition.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. No additional problems areas were identified within the Potomac WMA. The WMA was ranked as having low levels of stressors and pollutant sources.

3.6 Upper Sugarland WMA

3.6.1 Upper Sugarland WMA Characteristics

The Upper Sugarland WMA is located in the southern portion of the Sugarland Run Watershed. The watershed comprises 1391 acres (2.71 square miles), and the WMA is located along the southern portion of Sugarland Run along the Dulles Access Road, as shown in Figure 3.1.

Approximately 3.5 miles of perennial streams exist within the Upper Sugarland WMA, which range from poor to good condition. The streams flow north through the watershed. The Upper Sugarland main stem travels primarily through estate residential land use, while the tributaries flow through low intensity commercial land use.

3.6.2 Existing and Future Land Use

The Upper Sugarland WMA lies within a highly developed area within the Sugarland Run Watershed. Approximately 82 percent of the Upper Sugarland WMA is urbanized, consisting of low intensity commercial (39.6 percent), transportation (18.1 percent), and high density residential (10 percent) land uses, as shown in Table 3.22.

Table 3.22 Existing and Future Land Use for Upper Sugarland WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	1.3	0.3
High Density Residential	10.0	11.9
Medium Density Residential	7.5	7.3
Low Density Residential	0.9	0.5
Low Intensity Commercial	39.6	34.5
High Intensity Commercial	5.3	10.6
Industrial	5.1	8.1
Institutional	1.5	0.8
Golf Course	0.7	0.7
Open Space	9.1	6.4
Transportation	18.1	18.1
Water	0.8	0.8
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.22 and Figure 3.2 show expected changes in land use as the Upper Sugarland WMA continues to develop. A decrease in estate, medium and low residential, open space and institutional land use is projected. This correlates with an increase in high density residential, industrial and high intensity commercial areas within the Upper Sugarland WMA.

3.6.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Upper Sugarland WMA to evaluate projects proposed by the county, to identify problems areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Upper Sugarland WMA:

1. Evaluated drainage complaints.
2. Evaluated projects proposed by the county.
3. Evaluated existing stormwater facilities.
4. Conducted a neighborhood source assessment.
5. Conducted a hotspot investigation.
6. Conducted a stream physical assessment

The results of each of the above evaluations are briefly described in the following sections.

Drainage Complaints
Nineteen (19) drainage complaints have been documented within the Upper Sugarland WMA between 2001 and 2006. Of those, one representative complaint was chosen for field investigation. The complaint was regarding erosion, but no evidence of erosion was found at this location.

Proposed County Project
Based upon past evaluations and reports, three stormwater projects have been proposed by the county within the Upper Sugarland WMA. Field investigations were used to determine whether these projects were still needed. The projects included a stream restoration and stabilization project of the Upper Sugarland WMA, which was completed, and one storm drain replacement, which was also completed. The third project, which was to raise the road and install a culvert, was not found.

Existing Stormwater Facilities
Fifteen stormwater management facilities were evaluated within the Upper Sugarland WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Four of the 15 facilities were dry ponds and were found to be functioning as designed. One dry pond was functioning properly and could have additional volume added. Four facilities were wet ponds and contained wetland vegetation and some water quality protection features. Three facilities were not stormwater facilities but over-widened stream channels, with possible retrofit capabilities. The remaining two locations did not contain any stormwater management facilities.

Neighborhood Source Assessment (NSA)
Three representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Upper Sugarland WMA. One of the chosen neighborhoods consisted of single-family detached houses and two consisted of commercial properties. The single-family detached neighborhood consisted of lots on one-half-acre properties and did not provide any stormwater treatment facilities. One commercial NSA contained stormwater inlets that were clean and free of debris. The remaining commercial NSA contained three wet ponds and one dry pond. The potential for a pond retrofit exists at the dry pond location. The NSA indicated the potential for stormwater management facility retrofits as well as a need for better lawn and landscaping practices.

Hot Spot Investigation (HSI)
Sixteen representative facilities with the potential to produce concentrated stormwater pollution were chosen within the Upper Sugarland WMA to complete a HSI. An investigation was conducted of the facilities and the corresponding property to identify sources of pollution. Three locations were reviewed and were not identified as hotspots. Eight facilities were identified as potential hotspots and were recommended for follow-up visits and permit checking. Five facilities were confirmed hotspots and were recommended for follow-up site inspections.

Stream Physical Assessment (SPA)
A supplemental stream physical assessment was conducted on 0.05 miles of stream within the Upper Sugarland WMA. This segment was chosen for re-assessment because two possible

project locations, including a stream restoration and stabilization project and a road/culvert project, were located in the Upper Sugarland WMA. The stream was found to be in fair habitat condition.

3.6.4 Upper Sugarland WMA Characterization

Approximately 3.5 miles of streams were assessed within the Upper Sugarland WMA to determine the overall stream conditions. As shown in Figure 3.4, the main stream lengths assessed were in fair to good habitat condition, while the tributaries were in poor condition. Most of the streams in the Upper Sugarland WMA are protected by the resource protection areas as described in Chapter 1. The Upper Sugarland main stem was designated as protected in 2003. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings, with some obstructions and deficient buffer areas. Most of the Upper Sugarland WMA is in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion. A few portions are in Stage 4, which indicates the stream is attempting to stabilize by developing a bankful and floodplain channel.

As shown in Figure 3.6, the Upper Sugarland WMA contains multiple stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. These facilities are wet ponds and dry ponds. Table 3.23 indicates that even though many stormwater facilities are in place, much of the stormwater generated within the Upper Sugarland WMA is untreated. Eighty-two percent of the Upper Sugarland WMA within Fairfax County is developed and only 26 percent of that area treats stormwater. Therefore, more stormwater management is needed within the developed portion of the Upper Sugarland WMA.

Table 3.23 Upper Sugarland WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Upper Sugarland	1391.0	677.5	49%	294.7	85.73	18.0	992.57

3.6.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.24 below shows the total pollutant loading to the endpoint of Upper Sugarland WMA. According to the STEPL model results, the Upper Sugarland WMA contributes approximately 15 percent of the total suspended solids, 17 percent of the total nitrogen, and 15 percent of the total phosphorous annual loads to Sugarland Watershed. Pollutant loadings normalized to the acres within the drainage area of Upper Sugarland WMA are presented in Table 3.25. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Upper Sugarland WMA as compared with unit area loads for the entire watershed.

Table 3.24 Summary of Pollutant Loadings for Upper Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Upper Sugarland	320.5	13,200.51	1,812.14
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.25 Summary of Pollutant Loadings Normalized by Drainage Area

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Upper Sugarland	0.230	9.490	1.303
WS Totals	**0.151**	**5.529**	**0.827**

3.6.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Upper Sugarland WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Upper Sugarland WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope.

Five culverts are located within the Upper Sugarland WMA. The culverts were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that the five culverts do not carry the 100-year stormflow. Three of these culverts will pond water upstream of the culvert structure. The existence of the ponded water will extend the time period of maximum flow through the culvert. When the ponded water is fully drained, the flow elevation will begin to drop. The other two culverts will overtop their structures.

3.6.7 Upper Sugarland WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for the subwatershed ranking of watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. Three subwatersheds within the Upper Sugarland WMA have been identified as potential problem areas. Based upon existing conditions, the condition of the entire WMA is moderate.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. Three additional problem areas were identified within the Upper Sugarland WMA. The WMA was ranked as having moderate to high levels of stressors and pollutant sources.

3.7 Upper Middle Sugarland WMA

3.7.1 Upper Middle Sugarland WMA Characteristics

The Upper Middle Sugarland WMA is located in the middle of the Sugarland Run Watershed. The watershed comprises 1,975 acres (3.09 square miles) and is located along the eastern portion of Sugarland Run. The WMA lies partially within Herndon, along the Fairfax Parkway as shown in Figure 3.1.

Approximately 6.8 miles of perennial streams exist within the Upper Middle Sugarland WMA. Most of these streams are in good condition with only one small tributary in poor condition. The streams flow north and northwest through the watershed. The stream travels primarily through open space areas with medium density and low density residential land use areas on the perimeter.

3.7.2 Existing and Future Land Use

The Upper Middle Sugarland WMA is in a highly developed area within the Sugarland Run Watershed. Approximately 82 percent of the Upper Middle Sugarland WMA is urbanized, consisting of medium density residential (29 percent), open space (15 percent) and transportation (16 percent), as shown in Table 3.26.

Table 3.26 and Figure 3.2 show expected changes in land use as the Upper Middle Sugarland WMA continues to develop. A decrease in estate residential, low density residential and institutional land use is projected. An increase in the high density residential industrial areas within the Upper Middle Sugarland WMA is also projected.

Table 3.26 Existing and Future Land Use for Upper Middle Sugarland WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	2.0	0.4
High Density Residential	11.9	13.6
Medium Density Residential	28.6	28.8
Low Density Residential	12.5	11.8
Low Intensity Commercial	1.1	1.1
High Intensity Commercial	4.8	4.8
Industrial	2.8	3.0
Institutional	4.9	3.9
Open Space	14.5	15.6
Transportation	15.5	15.5
Water	1.5	1.5
Total	100	100

Source: Fairfax County GIS, 2008

3.7.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was conducted within the Upper Middle Sugarland WMA to evaluate projects proposed by the county, to identify problem areas and to identify potential improvement projects. The following tasks were completed during the field reconnaissance surveys of the Upper Middle Sugarland WMA:

1. Evaluated drainage complaints.
2. Evaluated projects proposed by the county.
3. Evaluated existing stormwater facilities.
4. Conducted a neighborhood source assessment.
5. Conducted a hotspot investigation.
6. Conducted a stream physical assessment.

The results of each of the above evaluations are briefly described below.

Drainage Complaints

One hundred and seventy (170) drainage complaints have been documented within the Upper Middle Sugarland WMA between 2001 and 2006. Of those, 11 representative complaints were chosen for field investigation. The complaints included erosion, flooding and undermining. Five of the complaints observed showed no signs of disturbance, four of the complaints showed erosion and undermining and two of the complaint areas have been repaired.

Proposed County Projects

Based upon past evaluations and reports, multiple stormwater projects have been proposed by the county within the Upper Middle Sugarland WMA. Field investigations were used to determine whether projects were still needed. The projects included stream restoration and stabilization projects of Upper Middle Branch and raising the road and installing culverts. One of the culvert installation projects was not accessible. The other two were not completed but are recommended to be completed. One stream restoration project was not completed and is also recommended to be completed.

Existing Stormwater Facilities

Fifteen stormwater management facilities were evaluated within the Upper Middle Sugarland WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Ten of the 15 facilities were dry ponds and were functioning as designed. One facility was a farm/ornamental pond with no water quality features and no room for additional volume. Two stormwater management facilities were wet ponds and in good functioning condition. The remaining two locations did not have a facility present; however, they presented possible retrofit opportunities.

Neighborhood Source Assessment (NSA)

Five representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Upper Middle Sugarland WMA. Four of the chosen neighborhoods consisted of single-family detached houses and the other consisted of a multi-family complex. Two stormwater management facilities identified were located on single-family quarter-acre lots with dry pond stormwater facilities. They both had pond retrofit potential. Another neighborhood with single family homes on one-half-acre lots included three dry ponds and a pond retrofit potential. One single-family neighborhood had a dry pond with adequate buffers and no encroachment was visible. The neighborhood assessment with the multi-family complex had no stormwater facilities present at the location, but storm sewers were present and free of debris. The NSA indicated the potential for stormwater management facility retrofit as well as better lawn and landscaping practices.

Hot Spot Investigation (HSI)

Seven representative facilities with the potential to generate concentrated stormwater pollution were chosen within the Upper Middle Sugarland WMA to complete a HSI. An investigation was conducted of the facilities and the corresponding property to identify sources of pollution. Two schools were targeted for the HSI; one had a potential hotspot and the other had no hotspots. Two commercial buildings were evaluated; one revealed a potential hotspot and the other was not considered a hotspot. A review of the stormwater pollution plan is recommended for the potential hotspot site along with an additional site visit and a check to see if an NPDES permit is recorded. The Fairfax County Public Library was also evaluated as a potential hotspot. An on-site inspection of the storm drain system and a review of the storm water pollution prevention plan is recommended for the library. The remaining two facilities were not evaluated due to access denial.

Stream Physical Assessment (SPA)

A supplemental stream physical assessment was conducted on 1.1 miles of stream within the Upper Middle Sugarland WMA. This stream segment was chosen for re-assessment because a possible project location was identified, a stream restoration and stabilization project was located in the WMA and it drains to a 303(d) impaired stream. The stream was found to be in good to excellent habitat condition. The investigation identified 11 bank erosion problems, four obstructions and five pipes/drainage ditch erosion problems.

3.7.4 Upper Middle Sugarland WMA Characterization

Approximately 6.8 miles of streams were assessed within the Upper Middle Sugarland WMA to determine the overall stream conditions. As shown in Figure 3.4, the stream length assessed had fair to good habitat conditions, with the exception of one tributary in poor condition. Most of the streams in the Upper Middle Sugarland WMA are protected by the resource protection areas as described in Chapter 1. The Upper Middle Sugarland main stem was designated as protected in 1993 with the addition of Rosiers Branch in 2003. Mild to moderate erosion areas were identified during field reconnaissance. Most of the erosion occurred at road crossings and in piped locations. Most of the Upper Middle Sugarland WMA is in Channel Evolution Model Stage 4, which indicates the stream is attempting to stabilize by developing a bankful and floodplain channel. Two smaller tributaries in the Upper Middle Sugarland WMA are in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion.

As shown in Figure 3.6, the Upper Middle Sugarland WMA contains multiple stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. The majority of these facilities are dry ponds. Table 3.27 indicates that stormwater runoff from approximately 18 percent of the area in this WMA is treated, and approximately 82 percent of the area in this WMA is not treated by any means. Stormwater runoff from the areas that do receive treatment is treated for both quantity and water quality. Approximately 28 percent of the area in this WMA is impervious. More stormwater management facilities are needed in the Upper Middle Sugarland WMA.

Table 3.27 Upper Middle Sugarland WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition (acres)	Percent Impervious	Current Treatment Types			
				Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Upper Middle Sugarland	1975.1	561.4	28%	125.8	63.9	172.9	1612.5

3.7.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.8, 3.9 and 3.10 present the results of the STEPL model for total suspended solids, total nitrogen, and total phosphorus, respectively, which were used to estimate the pollutant loadings in each subwatershed and WMA. Table 3.28 shows the total pollutant loading to the endpoint of Upper Middle Sugarland WMA. According to the STEPL model results, the Upper Middle Sugarland WMA contributes approximately 20 percent of the total suspended solids, 20 percent of the total nitrogen, and 20 percent of the total phosphorous annual loads to the Sugarland Run Watershed. Pollutant loadings normalized to the acres within the drainage area of Upper Middle Sugarland WMA are presented in Table 3.29. The values in this table indicate the total nutrient and sediment load that results from stormwater runoff over one acre of Upper Middle Sugarland WMA as compared with unit area loads for the entire watershed.

Table 3.28 Summary of Pollutant Loadings for Upper Middle Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Upper Middle Sugarland	435.4	16,079.07	2,403.64
WS Totals	**2,185.08**	**80,136.31**	**11,991.66**

Table 3.29 Summary of Pollutant Loadings Normalized by Drainage Area for Upper Middle Sugarland WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Upper Middle Sugarland	0.220	8.137	1.216
WS Totals	**0.151**	**5.529**	**0.827**

3.7.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Upper Middle Sugarland WMA. Channel flow capacity was analyzed to determine if the 100-year storm event would overflow the channel and flood onto the floodplain. Additionally, the elevation of the flow was determined with reference to the topographic elevations in the stream valley.

As shown in Figure 3.11, a 100-year storm in the Upper Middle Sugarland WMA resulted in an overflow event with flooding onto the floodplain. The modeling showed that the 100-year stormflow elevation covered the entire floodplain and reached up the valley slope.

One bridge and six culverts are located within the Upper Middle Sugarland WMA. The bridge and six culverts were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that the bridge and two culverts carry the 100-year stormflow. Two culverts do not carry the 100-year stormflow and water will pond upstream of the culvert structure. The existence of the ponded water will extend the time period of maximum flow through the culvert. When the ponded water is fully drained, the flow elevation will begin to drop. Two other culverts do not carry the 100-year stormflow and will overtop.

3.7.7 Upper Middle Sugarland WMA Subwatershed Ranking

As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.12 illustrates the results obtained for subwatershed ranking of the watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. No potential problem areas were identified within the Upper Middle Sugarland WMA. Based upon existing conditions, the remainder of the WMA is in good condition.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.13. The lowest ranking subwatersheds were identified as additional potential problem areas. One additional problem area was identified within the Upper Middle Sugarland WMA. The remainder of the WMA was ranked as having moderate levels of stressors and pollutant sources.

3.8 SWMM Modeling for Sugarland Run Watershed

The Stormwater Management Model (SWMM) was used to determine the peak rate (maximum volume of water per second) of stormwater flows in stream channels during a storm. The 2-year and 10-year storm flows were modeled; these are the storm flows that, on average, occur once every 2-years or 10-years. Figure 3.14 shows peak rates of flow for the 2-year storm across the watershed. As shown in Figure 3.14, within each WMA, peak flows tend to increase downstream as more drainage area has more stormwater runoff to the stream channel. In a similar manner, an upstream, contributing WMA augments the flow in a downstream, receiving WMA. Because stormwater runoff flow carries pollutants, pollutant loadings also increase downstream within a WMA and from one WMA to the next.

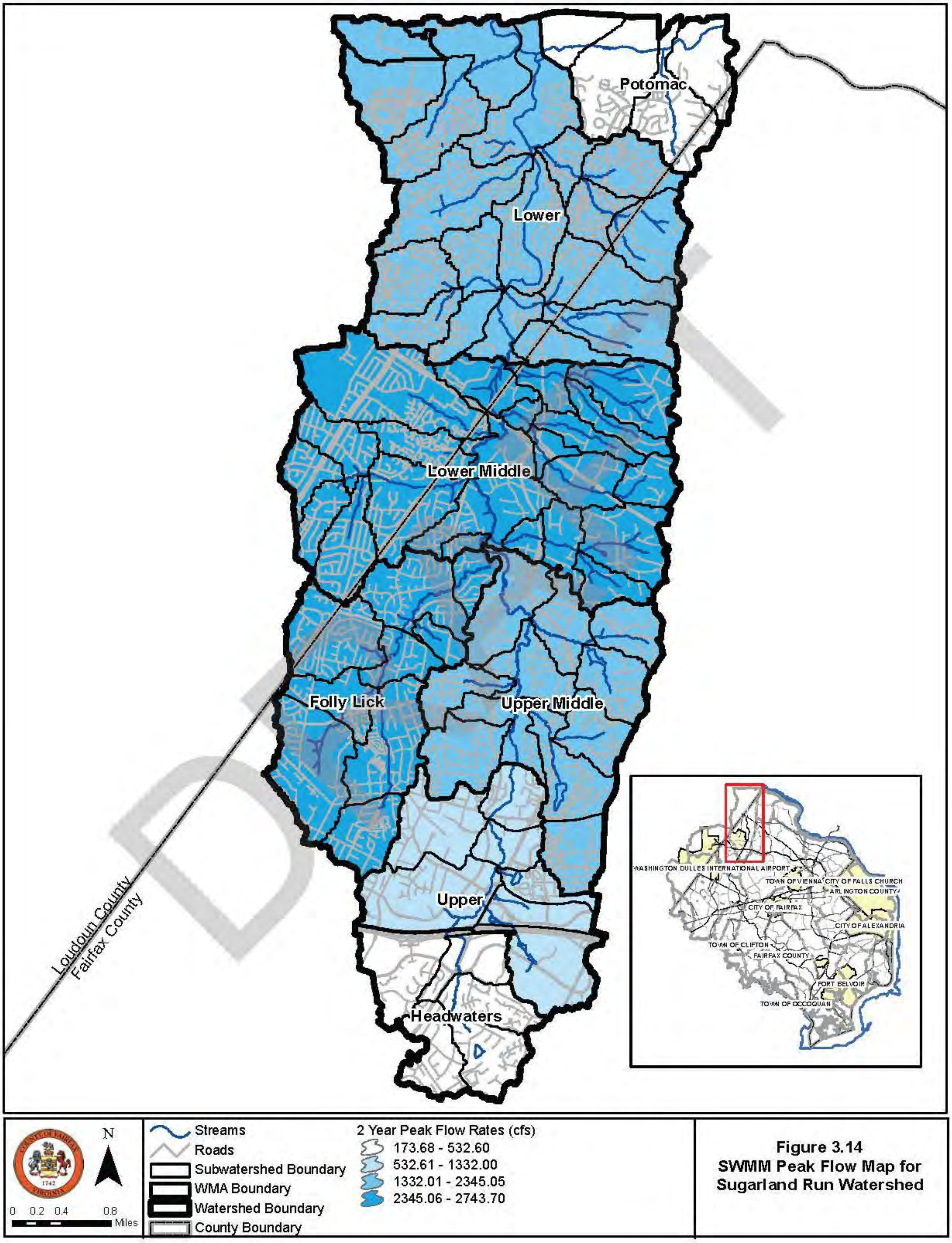

Figure 3.14
SWMM Peak Flow Map for Sugarland Run Watershed

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Table 3.30 shows peak flows for the 2-year and 10-year storms in the WMAs in the Sugarland watershed. The SWMM model shows that peak flows are generally increasing from the upstream, contributing WMAs to the downstream WMAs. The Lower and Lower Middle Sugarland WMA have the highest cumulative peak flows because they are the receiving WMAs for all the stormwater runoff in the watershed. Peak flows for the 10-year storm are approximately twice as large as the flows for the 2-year storm.

Table 3.30 Summary of SWMM and STEPL Results

		Stormwater Runoff Peak Flow Values		Pollutant Loadings		
WMA Name[1]	**Contributing WMA(s)[2]**	**2-yr storm (cubic ft/sec)**	**10-yr storm (cubic ft/sec)**	**Total Suspended Solids (tons/yr)**	**Total Nitrogen (pounds/yr)**	**Total Phosphorus (pounds/yr)**
Headwaters	Headwaters	532.6	1,034.82	204.53	8,216.82	1,198.13
Upper	Headwaters	1,332	2,631.39	524.98	21,417.33	3,010.27
Upper Middle	Upper, Upper Middle	2,331.66	4,596.55	960.33	37,496.40	5,413.91
Lower Middle	Upper Middle, Folly Lick, Lower Middle	2,743.7	5,246.56	1,807.20	68,905.23	10,226.16
Lower	Lower Middle, Potomac West, Lower	2,345.05	5,799.64	2,166.47	79,952.86	11,951.36
WS Totals		**2,345.05**	**5,799.64**	**2,166.47**	**79,952.86**	**11,951.36**
Potomac East	Potomac East	173.68	388.6	148.86	2,077.12	395.09
WS Totals		**173.68**	**388.6**	**148.86**	**2,077.12**	**395.09**

1. The "WMA Name" is the WMA for which there is a node that has the individual, cumulative peak flows (2 and 10 year) for the entire upstream drainage area. Example: The first WMA with such a node is the "Upper" WMA.
2. The "Contributing WMA(s)" are the upstream WMAs for which there is not a node that has the individual, cumulative peak flows (2 and 10 year) for the entire upstream drainage area. Example: The "Upper Middle" WMA includes all the stormwater draining from the Upper WMA and the Upper Middle WMA.

To determine which WMA has the greatest flows, the peak flows in Table 3.30 were recalculated based on WMA drainage area. Table 3.31 shows these flows normalized by WMA drainage area. Upper Sugarland WMA has the most stormwater runoff during the 2-year storm and Lower Sugarland WMA has the least. During the 10-year storm, the Sugarland Headwaters WMA has the most cumulative stormwater runoff per drainage area and the Lower Sugarland WMA the least. The eastern portion of the Potomac WMA drains directly into the Potomac River and the peak flow values resulting from this area were not considered to be contributions to the Sugarland Watershed.

The STEPL model was used to estimate the pollutant loadings for total suspended solids (sediments), total nitrogen, and total phosphorus for each WMA and the results are shown in Table 3.30. As stormwater flows accumulate downstream, so do the pollutant loadings carried by the flows. Pollutant loads pass from the upstream, contributing WMAs to downstream WMAs. The cumulative, downstream loadings may increase or decrease depending on the presence and magnitude of new sources and the relative increase in drainage area and associated flows. The Lower Sugarland WMA has the greatest cumulative pollutant loading and the Sugarland Headwaters WMA the least. The eastern portion of the Potomac WMA drains directly into the Potomac River and the pollutant loading resulting from this area do not contribute to the Sugarland Watershed stormflows.

Table 3.31 Summary of SWMM and STEPL Results Normalized by Drainage Area

			Stormwater Runoff Peak Flow Values		Pollutant Loadings		
WMA Name[1]	**Contributing WMA(s)**[2]	**Drainage Area (Acres)**	**2-yr storm (cubic ft/sec)**	**10-yr storm (cubic ft/sec)**	**Total Suspended Solids (tons/yr)**	**Total Nitrogen (pounds/yr)**	**Total Phosphorus (pounds/yr)**
Headwaters	Headwaters	929.00	0.573	1.114	0.220	8.845	1.290
Upper	Headwaters	2,320.00	0.574	1.134	0.226	9.232	1.298
Upper Middle	Upper, Upper Middle	4,296.00	0.543	1.070	0.224	8.728	1.260
Lower Middle	Upper Middle, Folly Lick, Lower Middle	9,699.00	0.283	0.541	0.186	7.104	1.054
Lower	Lower Middle, Potomac West, Lower	14,354.00	0.163	0.404	0.151	5.570	0.833
WS Totals		**14,354.00**	**0.163**	**0.404**	**0.151**	**5.570**	**0.833**
Potomac East	Potomac East	140.00	1.241	2.776	1.063	14.837	2.822
WS Totals		**140.00**	**1.241**	**2.776**	**1.063**	**14.837**	**2.822**

1. The "WMA Name" is the WMA for which there is a node that has the individual, cumulative peak flows (2 and 10 year) for the entire upstream drainage area. Example: The first WMA with such a node is the "Upper" WMA.
2. The "Contributing WMA(s)" are the upstream WMAs for which there is not a node that has the individual, cumulative peak flows (2 and 10 year) for the entire upstream drainage area. Example: The "Upper Middle" WMA includes all the stormwater draining from the Upper WMA and the Upper Middle WMA.

To determine if the pollutant loadings shown in Table 3.30 are increasing or decreasing with downstream flow, the loadings were recalculated based on WMA drainage area. Table 3.31 shows pollutant loadings normalized by the contributing drainage area. Pollutant loadings in the Sugarland Watershed decrease with downstream flow, indicating that the increase in flow is relatively greater than the increase in added pollutants. The one exception is the increase in pollutant loadings from the Headwaters WMA to the Upper WMA, which implies that the addition of flow is low relative to the addition of new pollutants in the Upper WMA.

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