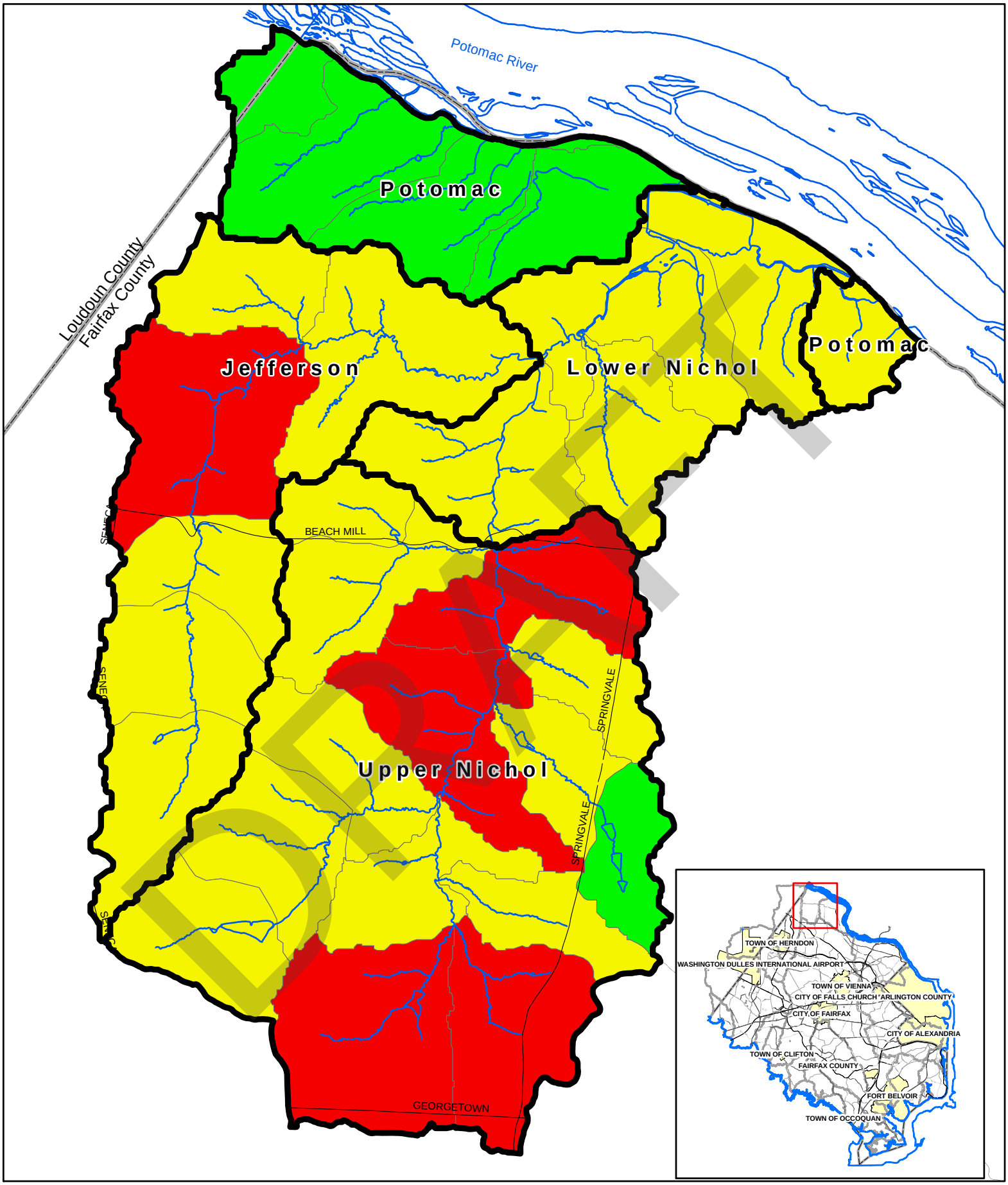


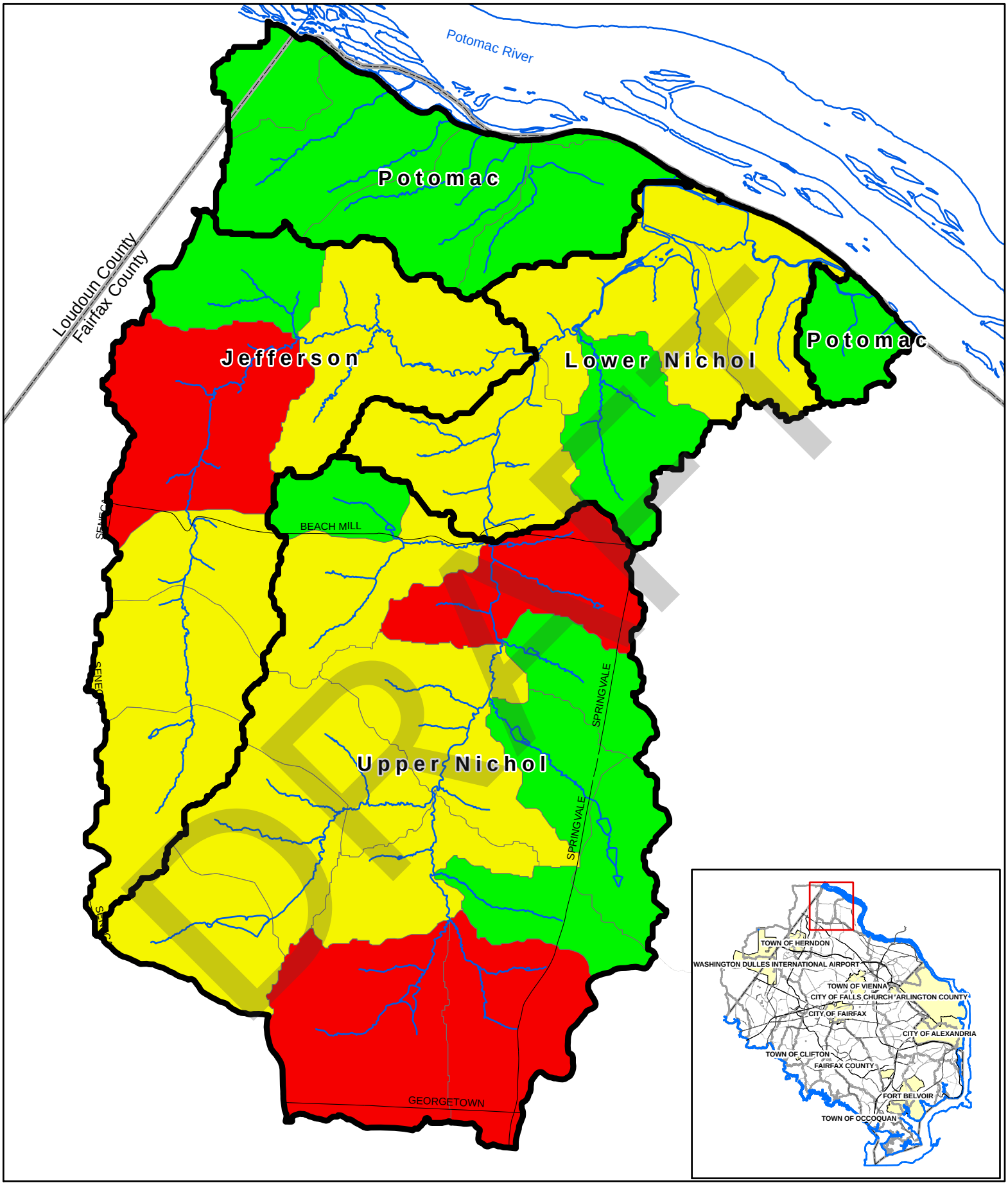
N

0 0.1 0.2 0.4 Miles

Perennial Streams
Roads
WMA Boundary
County Boundary

Total Nitrogen
38.04 - 281.51 lb/yr
281.51 - 548.89 lb/yr
548.89 - 1007.78 lb/yr

Figure 3.6
Total Nitrogen Map for Nichol Run Watershed



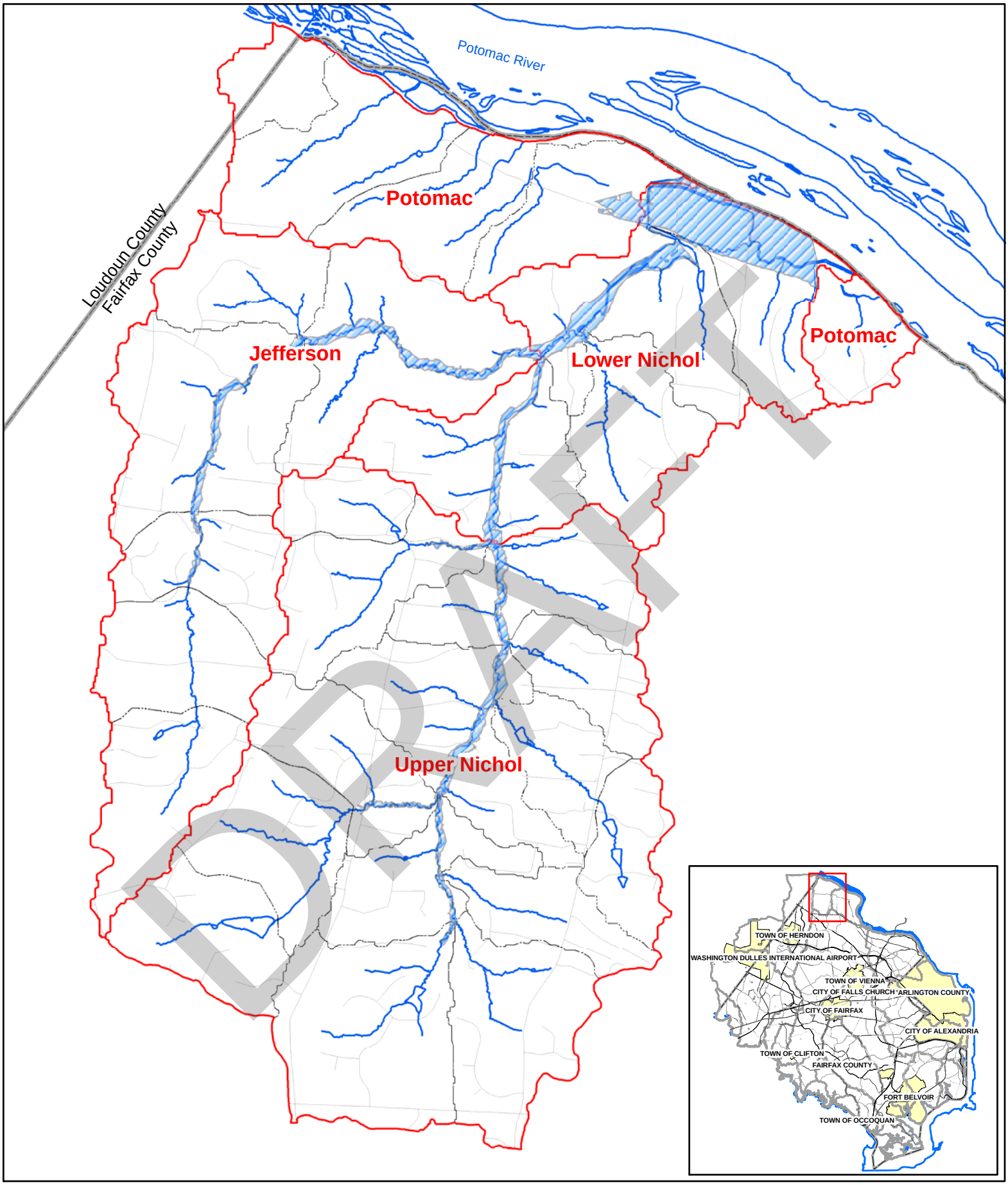
N

0 0.1 0.2 0.4 Miles

Perennial Streams
Roads
WMA Boundary
County Boundary

Total Phosphorus
8.63 - 51.99 lb/yr
51.99 - 90.36 lb/yr
90.36 - 158.47 lb/yr

Figure 3.7
Total Phosphorus Map for Nichol Run Watershed

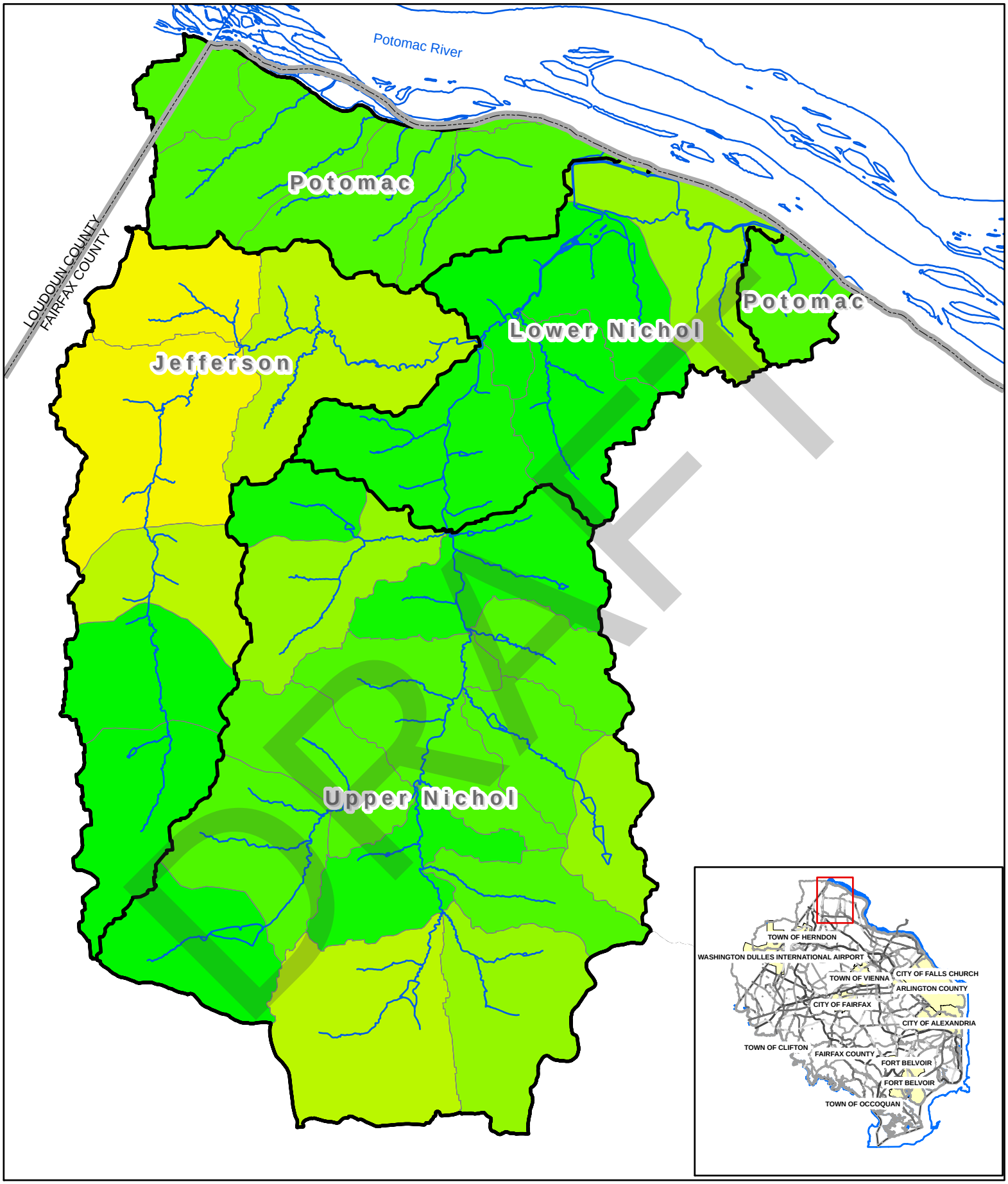


N

0 0.1 0.2 0.4 Miles

100-Year Flood Zone
Perennial Streams
Roads
Subwatershed Boundary
WMA Boundary
County Boundary

Figure 3.8
Preliminary 100-Year Storm Event Map for Nichol Run Watershed



N

0 0.1 0.2 0.4 Miles

Legend

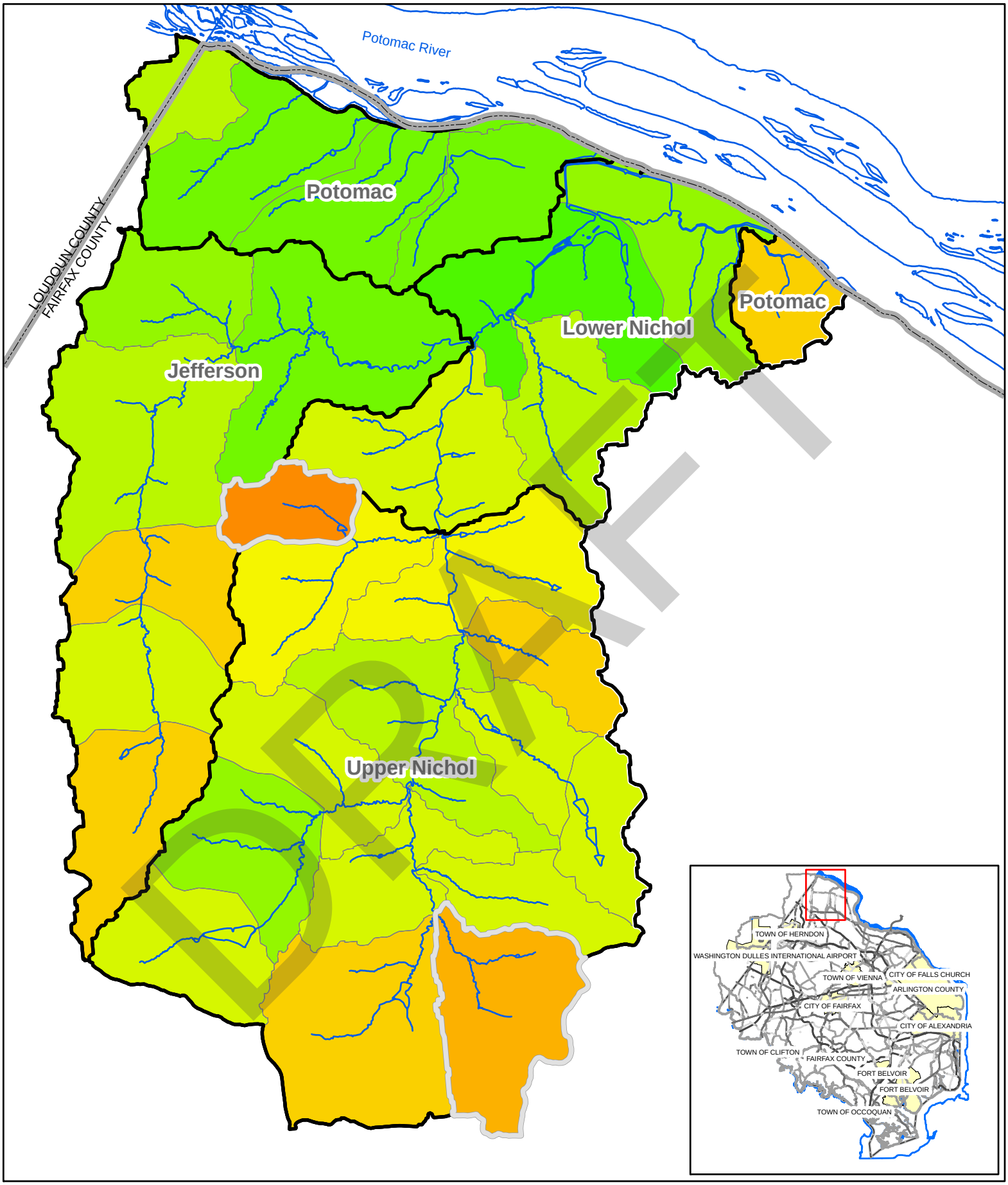
- Perennial Streams
- WMA Boundaries
- Watershed Boundary
- County Bndry
- Watershed Impact Problem Areas

Subwatershed Composite Score

High Quality

Low Quality

Figure 3.9
Preliminary Watershed Impact Map for Nichol Run Watershed



N

0 0.1 0.2 0.4 Miles

Legend

- Perennial Streams
- WMA Boundaries
- Watershed Boundary
- County Bndry
- Watershed Impact Problem Areas
- Source Indicator Problem Areas

Subwatershed Composite Score

High Quality

Low Quality

Figure 3.10
Preliminary Source Indicator Map for Nichol Run Watershed

3.1 Jefferson WMA

3.1.1 Jefferson WMA Characteristics

The Jefferson WMA is located in the western portion of the Nichol Run Watershed. The watershed comprises 1,185 acres (1.85 square miles). The WMA is almost split in half by Beach Mill Road. Figure 3.1 shows the location of the Jefferson WMA.

Approximately 6.7 miles of perennial streams are located within the Jefferson WMA. The majority of the streams are in good to excellent condition, with a few small portions in fair condition. The streams flow northeast toward the confluence with Nichol Run, and flow primarily through estate and low density residential areas. The lower portion of the stream within the WMA travels though an expansive open space area before entering Nichol Run.

3.1.2 Existing and Future Land Use

The southern half of the Nichol Run Watershed is more developed than the northern half of the watershed, which is also true within the Jefferson WMA. Approximately 19 percent of the WMA is urbanized, primarily consisting of estate residential (63 percent), open space (17 percent) and low density residential (16 percent) land uses, as shown in Table 3.1. The open space is primarily clustered around the lower section of the stream corridor.

Table 3.2 Existing and Future Land Use for Jefferson WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	63.3	69.3
High Density Residential	0	0
Medium Density Residential	0	0
Low Density Residential	15.9	15.9
Industrial	0	0
Low Intensity Commercial	0	0
High Intensity Commercial	0	0
Institutional	0.1	0.1
Open Space	17.2	11.1
Golf Course	0	0
Transportation	2.7	2.7
Water	0.9	0.9
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.2 and Figure 3.2 show expected changes in land use as the Jefferson WMA continues to develop. A slight decrease in open space, with a corresponding increase in estate residential areas within the Jefferson WMA is projected.

DRAFT

3.1.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Jefferson 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 Jefferson WMA:

1. Evaluated existing stormwater facilities.
2. Conducted neighborhood source assessments.
3. Reviewed a stream physical assessment inventory point.

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

Existing Stormwater Facilities
Eight stormwater management facilities were evaluated within the Jefferson WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Four of the eight facilities were found to provide minimal or no stormwater management functions. The remaining facilities were functioning as designed, but most presented some opportunity for retrofit.

Neighborhood Source Assessment (NSA)
Two representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Jefferson WMA. The chosen neighborhoods consisted of single family attached or detached houses on one acre or larger lots. Two stormwater management facilities were identified, and they were both dry ponds. 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 Jefferson WMA.

Stream Physical Assessment (SPA) Inventory Points
Inventory points identified during the original stream physical assessment that received an impact score of five or greater were field verified. A stream crossing was identified as impacting the stream channel. The pipes had been recently replaced, but further stabilization or improvement may be required in the future.

3.1.4 Jefferson WMA Characterization

Approximately 4.5 miles of streams were assessed within the Jefferson WMA to determine the overall stream conditions in the WMA. As shown in Figure 3.3, the stream length assessed has good habitat conditions in the upper portion and excellent habitat conditions in the lower portions. All of the perennial streams in the Jefferson WMA are protected by the resource protection areas as described in Chapter 1. The main stem was designated as protected in 1993, whereas the tributaries were not added until 2003 and 2005. The stream crossing of Beach Mill Road and the Jefferson Branch was identified as causing impairments to the stream system. The entire assessed portion of stream is in Channel Evolution Model Stage 3, which means it is an unstable channel that is experiencing significant bank erosion.

DRAFT

As shown in Figure 3.4, the Jefferson WMA contains a few stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. These facilities are primarily farm ponds, with a few dry ponds. Based on Table 3.3, stormwater runoff from about 24 percent of the impervious area in the WMA is treated. Which means, approximately 76 percent of the stormwater runoff generate within the Jefferson WMA is not treated. The stormwater runoff that receives treatment is primarily only treated for quantity and not water quality. Therefore, more stormwater management is needed within the Jefferson WMA.

Table 3.3 Jefferson WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition		Current Treatment Types			
		Percent (%)	Acres	Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Jefferson	1,184.9	4.4	51.7	12.1	-	0.4	1172.4

3.1.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.5, 3.6 and 3.7 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 Jefferson WMA. According to the STEPL model results, the Jefferson WMA contributes approximately 20 percent of the total suspended solids, 25 percent of the total nitrogen, and 24 percent of the total phosphorous annual loads to Nichol Run Watershed. Pollutant loadings normalized to the acres within the drainage area of Jefferson 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 Jefferson WMA as compared with unit area loads for the entire watershed.

Table 3.4 Summary of Pollutant Loadings for Jefferson WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Jefferson	57.7	2,611.9	397.6
WS Totals	**286.8**	**10,410.3**	**1,629.6**

Table 3.5 Pollutant Loadings Normalized by Drainage Area for Jefferson WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Jefferson	0.049	2.204	0.336
WS Totals	**0.055**	**1.983**	**0.310**

3.1.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Jefferson 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 3.8, a 100-year storm in the Jefferson 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.

Three culverts are located within the Jefferson WMA. The culverts were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that the culvert located furthest upstream on Jefferson Branch was able to carry the 100-year stormflow as well as the 10 and 2-year stormflows. The other two culverts located in this WMA were not able to 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 Jefferson 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 3.9 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 Jefferson WMA were identified as potential problem areas. Based upon existing conditions, the southern portion of the WMA is in good condition, but traveling north toward the confluence with Nichol Run the Jefferson Branch the conditions deteriorate slightly.

The Jefferson WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources, as shown in Figure 3.10. The lowest ranking subwatersheds were identified as additional potential problem areas. No additional problems areas were identified within the Jefferson WMA. The southern portion of the WMA shows moderate levels of stressors and pollutant sources.

DRAFT

3.2 Lower Nichol WMA

3.2.1 Lower Nichol WMA Characteristics

The Lower Nichol WMA is located in the northeastern portion of the Nichol Run Watershed. The watershed is comprised of 821 acres (1.28 square miles) and is bordered on the south by Beach Mill Road, as shown in Figure 3.1.

Approximately 7.6 miles of perennial streams exist within the Lower WMA, and a majority of these streams range from good to excellent condition. The streams flow northeast towards the confluence with the Potomac River. The streams travel primarily through open space and estate residential areas. Small portions of the stream travel though low intensity commercial land use areas.

3.2.2 Existing and Future Land Use

Much of the Lower Nichol WMA is designated as parkland. Only 10 percent of the Lower Nichol WMA is urbanized, which consists of primarily open space (48 percent) and estate residential (39 percent) land uses, as shown in Table 3.6. The open space is primarily clustered in the northern areas around the Potomac River.

Table 3.6 Existing and Future Land Use for Lower Nichol WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
High Density Residential	0	0
Medium Density Residential	0	0
Low Density Residential	8.6	8.6
Estate Residential	38.9	66.2
Industrial	0	0
High Intensity Commercial	0	0
Low Intensity Commercial	0	0
Institutional	0.4	0.4
Open Space	48.2	21.0
Transportation	1.4	1.4
Water	2.5	2.5
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.6 and Figure 3.2 show expected changes in land use as the Lower Nichol WMA continues to develop. A decrease in open spaces areas are projected within the Lower Nichol WMA, with corresponding increases in estate residential areas.

DRAFT

3.2.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Lower Nichol 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 Lower WMA:

1. Evaluated existing stormwater facilities.
2. Conducted neighborhood source assessments.

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

Existing Stormwater Facilities

Four stormwater management facilities were evaluated within the Lower Nichol WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. Two of the four facilities were functioning as designed and both offered some opportunity for retrofit. The remaining two facilities were unable to be assessed due to access restrictions.

Neighborhood Source Assessment (NSA)

Three representative neighborhoods were chosen for NSAs to help identify potential improvement projects throughout the Lower Nichol WMA. The chosen neighborhoods consisted of single-family detached houses on one acre or larger lots. Within the three neighborhoods, seven stormwater management facilities were identified, all of which were wet ponds. The NSAs indicated the potential for stormwater management facility retrofits and a need for better lawn and landscaping practices.

3.2.4 Lower Nichol WMA Characterization

Approximately 2.8 miles of stream were assessed within the Lower Nichol WMA to determine the overall stream conditions in the WMA. As shown in Figure 3.3, the stream length assessed had good to excellent habitat conditions, with the exception of one tributary with poor conditions. All of the perennial streams in the Lower Nichol WMA are protected by the resource protection areas as described in Chapter 1. The Lower Nichol main stem was designated as protected in 1993, and the smaller tributaries were added in 2003. Stream crossings, headcuts, obstructions and pipes were identified during field reconnaissance. Most of the problems that were identified were considered minor to moderate. One headcut was ranked moderate to severe which was approximately two feet high. All of the Lower Nichol WMA is in Channel Evolution Model Stage 3, which indicates an unstable channel that is experiencing significant bank erosion.

As shown in Figure 3.4, the Lower Nichol WMA contains a few stormwater management facilities that collect and treat stormwater runoff before it reaches the stream network. The majority of these facilities are wet or farms ponds. Table 3.7 indicates that stormwater runoff from approximately 17 percent of the impervious area in the WMA is treated. 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 in the Lower Nichol WMA, particularly as the WMA continues to develop.

DRAFT

Table 3.7 Lower Nichol WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition		Current Treatment Types			
		Percent (%)	Acres	Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Lower	820.5	3.2	25.9	4.4	-	-	816.1

3.2.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.5, 3.6 and 3.7 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 Lower WMA. According to the STEPL model results, the Lower Nichol WMA contributes approximately 17 percent of the total suspended solids, 12 percent of the total nitrogen, and 13 percent of the total phosphorous annual loads to the Nichol Run Watershed. Pollutant loadings normalized to the acres within the drainage area of the Lower Nichol 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 the Lower Nichol WMA as compared with unit area loads for the entire watershed.

Table 3.8 Summary of Pollutant Loadings for Lower Nichol WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/yr)	Total Nitrogen (pounds/yr)	Total Phosphorus (pounds/year)
Lower	48.5	1,249.4	207.4
WS Totals	**286.8**	**10,410.3**	**1,629.6**

Table 3.9 Pollutant Loadings Normalized by Drainage Area for Lower Nichol WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/yr)	Total Nitrogen (pounds/acre/yr)	Total Phosphorus (pounds/acre/yr)
Lower	0.059	1.523	0.253
WS Totals	**0.055**	**1.983**	**0.310**

DRAFT

3.2.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Lower Nichol 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 3.8, a 100-year storm in the Lower Nichol 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 culvert and one lower water bridge are located within the Lower Nichol WMA. These structures were modeled to determine if the 100-year storm exceeded their capacity to carry the flow. The modeling shows that both the culvert and the bridge do not carry the 100-year stormflow and will overtop. Water will pond upstream of the culvert structure. 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 Lower Nichol 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 3.9 illustrates the results obtained for the subwatershed ranking of the watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. No subwatersheds within the Lower Nichol WMA were identified as potential problem areas. Based upon existing conditions, the entirety 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 3.10. The lowest ranking subwatersheds were identified as additional potential problem areas. No additional problem areas were identified within the Lower Nichol WMA, with most of the WMA showing low to moderate levels of stressors and pollutant sources.

DRAFT

3.3 Potomac WMA

3.3.1 Potomac WMA Characteristics

The Potomac WMA is broken into two pieces, both of which lie along the northern border of the Nichol Run watershed. The watershed comprises 697 acres (1.09 square miles) and is located along the northern border of Fairfax County, flanking the Potomac River as shown in Figure 3.1. A small portion, 27.6 acres (0.04 square miles), lies within Loudoun County. Approximately 4.6 miles of perennial streams exist within the Potomac WMA. The streams flow north directly into the Potomac River, traveling primarily through and open space and park land areas.

3.3.2 Existing and Future Land Use

The eastern portion of the Potomac WMA is moderately developed, while the western portion is mostly undeveloped. Approximately 5 percent of the Potomac WMA is urbanized, which consists of open space (82 percent) and estate residential (12 percent), as shown in Table 3.10.

Table 3.10 Existing and Future Land Use for Potomac WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
High Density Residential	0	0
Medium Density Residential	0	0
Low Density Residential	4.1	4.1
Estate Residential	11.6	28.5
Industrial	0	0
High Intensity Commercial	0	0
Low Intensity Commercial	0	0
Institutional	0.1	0.1
Open Space	82.1	65.3
Transportation	1.1	1.1
Water	0.9	0.9
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.10 and Figure 3.2 show expected changes in land use as the Potomac WMA continues to develop. A slight decrease in open space areas and a corresponding increase in estate residential areas within the Potomac WMA are projected.

DRAFT

3.3.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Potomac 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 Potomac WMA:

1. Evaluated an existing stormwater facility.

The results of the above evaluation are briefly described below.

Existing Stormwater Facilities
One (1) stormwater management facility was evaluated within the Potomac WMA to determine the need for repair or the potential for retrofit to increase the benefit of the facility. The facility was not present at the indicated location.

3.3.4 Potomac WMA Characterization

Due to remote nature of the majority of the Potomac WMA and because the streams flow directly to the Potomac River, no stream assessments were completed within the Potomac WMA. As can be seen from Figure 3.3, all of the streams in the Potomac WMA are protected by the resource protection areas as described in Chapter 1. The main stems were designated as protected in 1993, and the headwaters were added in 2003.

As shown in Figure 3.4, the Potomac WMA contains only one small stormwater management facility that provides little to no stormwater treatment. Table 3.11 indicates that no stormwater runoff from the WMA is treated. Due to the undeveloped nature of the western potion of the Potomac WMA, stormwater management in this part of the WMA may not be required. In the eastern portion which contains more development, more stormwater management is needed.

Table 3.11 Potomac WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition		Current Treatment Types			
		Percent (%)	Acres	Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Potomac	696.5	1.2	8.7	-	-	-	696.5

3.3.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.5, 3.6 and 3.7 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 Potomac WMA. According to the STEPL model results, the Potomac WMA contributes approximately 20 percent of the total suspended solids, seven percent of the total nitrogen, and nine percent of the total phosphorous annual loads to the Potomac Watershed.

Pollutant loadings normalized to the acres within the drainage area of the Potomac 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 the Potomac WMA as compared with unit area loads for the entire watershed.

Table 3.12 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	58.6	768.6	153.8
WS Totals	**286.8**	**10,410.3**	**1,629.6**

Table 3.13 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	0.084	1.104	0.221
WS Totals	**0.055**	**1.983**	**0.310**

3.3.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was not completed for the Potomac WMA. The Potomac WMA is composed of small tributaries that drain directly to the Potomac River where stream segments and drainage areas are small and development is minimal. Hydraulic modeling of these areas would not yield any consequential information for the watershed.

3.3.7 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 3.9 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 Potomac WMA were identified as a potential problem area. Based upon existing conditions, the entirety of the WMA scored in good condition.

The WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources as shown in Figure 3.10. The lowest ranking subwatersheds were identified as additional potential problem areas. No additional problems areas were identified within the Potomac WMA. All of the WMA indicates low levels of stressors and pollutant sources.

DRAFT

3.4 Upper Nichol WMA

3.4.1 Upper Nichol WMA Characteristics

The Upper Nichol WMA is located in the southern portion of the Nichol Run Watershed. The Upper Nichol WMA is the largest in the watershed, comprising 2,549 acres (3.98 square miles). The WMA is border on the north by Beach Mill Road, to the east by Springvale Road and to the south by Georgetown Pike as shown in Figure 3.1.

Approximately 12.9 miles of perennial streams exist within the Upper Nichol WMA. These streams range from good to poor condition. The streams flow north into the Lower Nichol WMA. The streams travel primarily through estate and low density residential areas.

3.4.2 Existing and Future Land Use

The Upper Nichol WMA is moderately developed, and represents the typical development style within the Nichol Run Watershed. Approximately 22 percent of the Upper Nichol WMA is urbanized, consisting of estate residential (62 percent), low density residential (21 percent) and open space (11 percent), as shown in Table 3.14.

Table 3.14 Existing and Future Land Use for Upper Nichol WMA

Land Use Type	Existing Percent (%)	Future Percent (%)
Estate Residential	61.6	69.7
High Density Residential	0	0
Medium Density Residential	0.2	0.2
Low Density Residential	20.9	21.0
Low Intensity Commercial	0	0
High Intensity Commercial	0.2	0.2
Industrial	0	0
Institutional	0	0
Open Space	11.2	3.0
Transportation	4.5	4.5
Water	1.4	1.4
Total	100	100

Source: Fairfax County GIS, 2008

Table 3.14 and Figure 3.2 show expected changes in land use as the Upper Nichol WMA continues to develop. A decrease in open space areas, with a corresponding increase in estate and low density residential areas within the Upper Nichol WMA are projected.

3.4.3 Field Reconnaissance and Stream Physical Assessment

Field reconnaissance was completed within the Upper Nichol WMA to evaluate projects proposed by the county, to identify problem areas and to identify potential improvement projects.

DRAFT

The following tasks were completed during the field reconnaissance surveys of the Upper Nichol WMA:

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

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

Drainage Complaints

Thirty five (35) drainage complaints have been documented within the Upper Nichol WMA between 2001 and 2006. Of those, seven representative complaints were chosen for field investigation. The complaints included road and yard flooding, channel and drainage erosion and infrastructure issues. All of the complaints were validated, with the exception of one area of streambank erosion which had previously been fixed.

Proposed County Projects

Based upon past evaluations and reports, multiple stormwater projects have been proposed within the Upper Nichol WMA. Field investigations were used to determine whether the projects were still needed. The projects included six culvert replacement projects and one stream restoration and stabilization project. One of the culvert projects was not reviewed due to the inability to locate the project location and another one had already been completed. The other three culvert projects and the stream restoration project were validated.

Existing Stormwater Facilities

Twenty-five (25) stormwater management facilities were evaluated within the Upper Nichol WMA to determine the need for repairs or the potential for retrofits to increase the benefit of the facilities. Of the 25 facilities, three were not evaluated due to the inability to access property or the facility did not exist. The remaining facilities were functioning as designed, with the exception of one dry pond which was not providing stormwater management. Most of the evaluated facilities provided some opportunity for retrofit.

Neighborhood Source Assessment (NSA)

Two representative neighborhoods were chosen for the NSA to help identify potential improvement projects throughout the Upper Nichol WMA. Both of the chosen neighborhoods consisted of single-family detached houses on one acre and larger lots. Eight stormwater management facilities were located within the neighborhoods, consisting of wet and dry ponds. The NSA indicated the potential for stormwater management facility retrofit, as well as a need for better lawn and landscaping practices.

Stream Physical Assessment (SPA) Inventory Points

Inventory points identified during the original stream physical assessment that received an impact score of five or greater were field verified. Four stream crossings were identified as

impacting the stream channel. One of the problems are already been corrected, but the other three warranted further evaluation and repair.

Stream Physical Assessment (SPA)
A supplemental stream physical assessment was conducted on 2 miles of stream within the Upper Nichol WMA. One of the stream segments was chosen for re-assessment because a county stream restoration and stabilization project and a culvert replacement project were located on the stream. The other two sections were chosen because they were not included in the original stream physical assessment and because they included two county culvert replacement projects. The stream was found to be in good habitat condition. The SPA identified 16 bank erosion problems, seven obstructions, three pipes/drainage ditch erosion problems, one utility line and two stream crossings.

3.4.4 Upper Nichol WMA Characterization

Approximately 6.3 miles of streams were assessed within the Upper Nichol WMA to determine the overall stream conditions. As shown in Figure 3.3, the assessed stream segment had poor to good habitat conditions. Most of the streams in the Upper Nichol WMA are protected by the resource protection areas as described in Chapter 1. The main stem and some of the tributaries were designated as protected in 1993 and the other tributaries and headwater sections were added in 2003 and 2005. Several pipes, deficient riparian buffer areas, obstructions, stream crossings, erosion, and a utility and headcut were identified during field reconnaissance, although the majority of the problems were considered minor to moderate. Three of the deficient riparian buffers and three of the erosion areas were considered moderate to severe; however the restoration potential for this area was moderate to low. There was one moderate to severe crossing, headcut and obstruction. The crossing was under Utterback Store Road, the headcut was two feet high and the obstruction is caused by riprap. Most of the assessed stream within the Upper Nichol 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 bankfull and floodplain channel, or Stage 2, which indicates the channel is cutting down and experiencing significant bed erosion.

As shown in Figure 3.4, the Upper Nichol 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 or ornamental ponds. Based on Table 3.15, stormwater runoff from approximately 27 percent of the impervious area in this WMA is treated. Stormwater runoff from most of the area that does receive treatment is treated for only quantity, and does not incorporate water quality. As development continues in the Upper Nichol WMA, additional stormwater facilities should be installed, particularly in the central portion of the WMA where no treatment exists.

DRAFT

Table 3.15 Upper Nichol WMA Summary

WMA Name	Total Area (acres)	Impervious Current Condition		Current Treatment Types			
		Percent (%)	Acres	Quantity (acres)	Quality (acres)	Quantity/Quality (acres)	None (acres)
Upper Nichol	2,547.7	5.6	144	36.7	-	2.6	2,508.4

3.4.5 STEPL Modeling

The STEPL model was used to estimate nutrient loadings in each subwatershed as described in Section 2.5. Figures 3.5, 3.6 and 3.7 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 Upper Nichol WMA. According to the STEPL model results, the Upper Nichol WMA contributes approximately 43 percent of the total suspended solids, 56 percent of the total nitrogen, and 53 percent of the total phosphorous annual loads to the Nichol Run Watershed. Pollutant loadings normalized to the acres within the drainage area of Upper Nichol 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 the Upper Nichol WMA as compared with unit area loads for the entire watershed.

Table 3.16 Summary of Pollutant Loadings for Upper Nichol WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/year)	Total Nitrogen (pounds/year)	Total Phosphorus (pounds/year)
Upper Nichol	122	5,780.4	870.8
WS Totals	**286.8**	**10,410.3**	**1,629.6**

Table 3.17 Pollutant Loadings Normalized by Drainage Area for Upper Nichol WMA

WMA Name	Pollutant Loadings		
	Total Suspended Solids (tons/acre/year)	Total Nitrogen (pounds/acre/year)	Total Phosphorus (pounds/acre/year)
Upper Nichol	0.048	2.269	0.342
WS Totals	**0.055**	**1.983**	**0.310**

DRAFT

3.4.6 HEC-RAS Modeling

HEC-RAS hydraulic modeling was completed for a 100-year storm event in the Upper Nichol 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 3.8, a 100-year storm in the Upper Nichol 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 three culverts located within the Upper Nichol WMA. All three of the culverts located in the Upper Nichol WMA do not carry the 100-year stormflow and water will pond upstream of the culvert structures. 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 Upper Nichol WMA Subwatershed Ranking

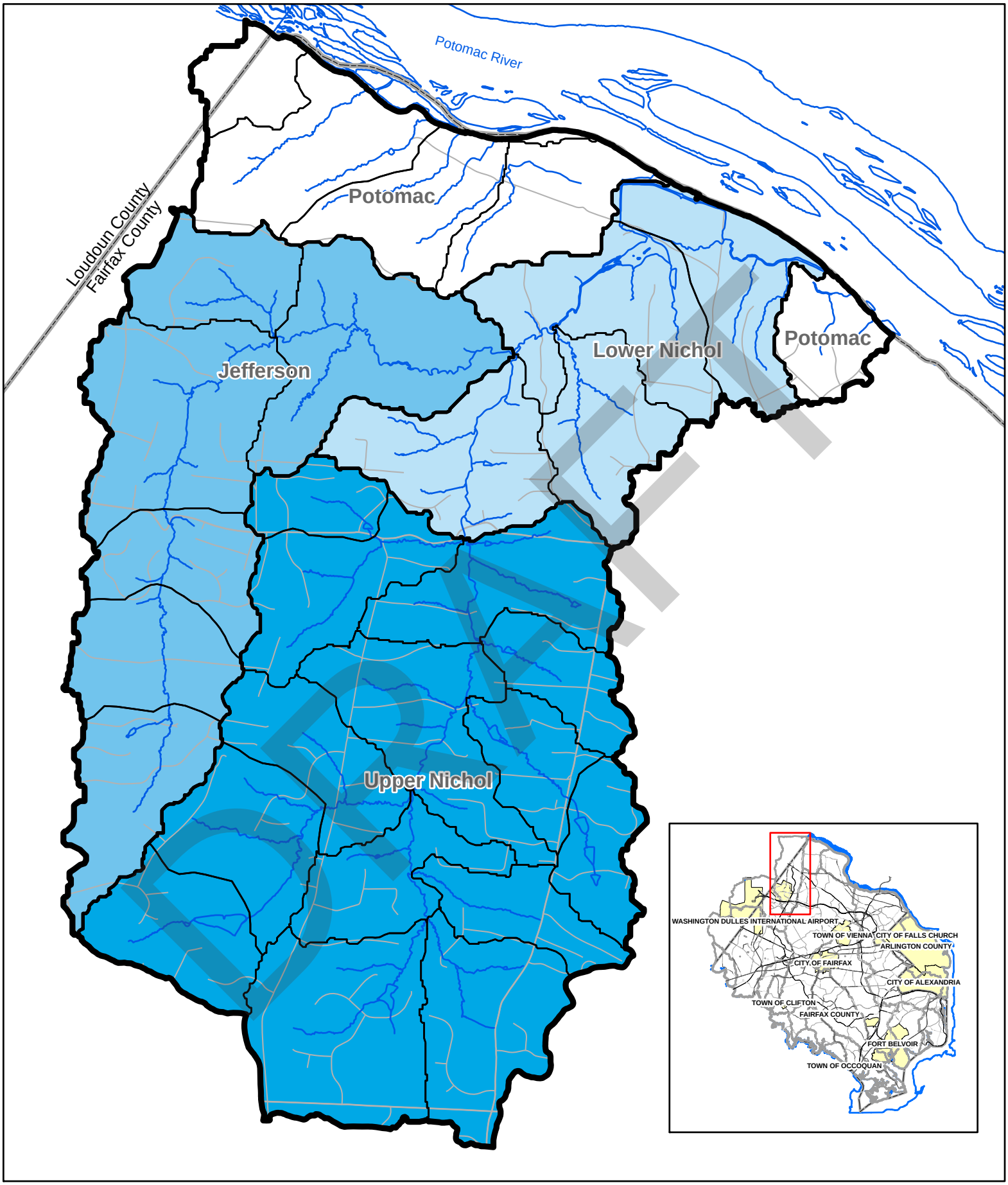
As indicated in Section 2.6, two indicator categories – watershed impact and source indicators - were used for ranking overall stream conditions in the subwatersheds. Figure 3.9 illustrates the results obtained for the subwatershed ranking of watershed impacts. The lowest scoring subwatersheds were identified as potential problem areas. No subwatersheds within the Upper Nichol WMA were identified as potential problem areas. Based upon the evaluation, 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 3.10. The lowest ranking subwatersheds were identified as additional potential problem areas. Two additional problem areas were identified within the Upper Nichol WMA. The WMA has a range of stressors and pollutant sources, ranging from low to moderate levels of stressors and pollutant sources.

3.5 SWMM Modeling for Nichol 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 3.11 shows peak rates of flow for the 2-year storm across the watershed. As shown in Figure 3.11, peak flows are the highest within the Upper Nichol WMA for both the 2-year and 10-year storms. The Potomac WMA has the lowest peak flows during the 2-year storm, but the Lower Nichol WMA has the lowest peak flows during the 10-year storm.

DRAFT



N

0 0.1 0.2 0.4 Miles

Streams
Roads
Subwatershed Boundary
WMA Boundary
Watershed Boundary
County Boundary

2 Year Peak Flow Rates
77.95 cfs
77.96 - 83.49 cfs
83.50 - 329.19 cfs
329.20 - 653.77 cfs

Figure 3.11
SWMM Peak Flow Map for Nichol Run Watershed

Table 3.18 shows peak flows for the 2-year and 10-year storms in the WMAs in the Nichol Run Watershed. The SWMM model shows that peak flows are the highest within the Upper Nichol WMA for both the 2-year and 10-year storms. The Potomac WMA has the lowest peak flows during the 2-year storm, but the Lower Nichol WMA has the lowest during the 10-year storm. This change can be attributed to the lack of stormwater treatment within the Potomac WMA. Peak flows for the 10-year storm are approximately two to four times as large as the flows for the 2-year storm.

Table 3.18 Summary of SWMM and STEPL Results

WMA Name[1]	Stormwater Runoff Peak Flow Values		Pollutant Loadings		
	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)
Jefferson	329.19	703.18	57.7	2,611.9	397.6
Lower Nichol	83.49	236.06	48.5	1,249.4	207.4
Potomac	77.95	305.70	58.6	768.6	153.8
Upper Nichol	653.77	1,402.79	122.0	5,780.4	870.8
WS Totals	**1,063.60**	**2,499.53**	**286.8**	**10,410.3**	**1,629.6**

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.

To determine which WMA has the greatest flows, the peak flows in Table 3.18 were recalculated based on WMA drainage area. Table 3.19 shows these flows normalized by WMA drainage area. The Jefferson and Upper Nichol WMAs have the most stormwater runoff during the 2-year storm and the Lower Nichol WMA has the least; the same was seen during the 10-year storm.

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 3.18. 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 Upper and Lower Nichol WMAs have the greatest cumulative pollutant loadings and the Potomac WMA has the least. The Potomac WMA drains directly into the Potomac River and the pollutant loading resulting from this area do not contribute to the Nichol Run Watershed stormflows.

DRAFT

Table 3.19 SWMM and STEPL Results Normalized by Drainage Area

WMA Name[1]	Drainage Area (Acres)	Stormwater Runoff Peak Flow Values		Pollutant Loadings		
		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)
Jefferson	1,184.9	0.278	0.593	0.049	2.204	0.336
Lower Nichol	820.5	0.102	0.288	0.059	1.523	0.253
Potomac	696.5	0.112	0.439	0.084	1.104	0.221
Upper Nichol	2,547.7	0.257	0.551	0.048	2.269	0.342
WS Totals	**5,249.6**	**0.203**	**0.476**	**0.055**	**1.983**	**0.310**

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.

DRAFT