Chapter 2:

Watershed Group Condition

2.1 General Watershed Group Information

The Middle Potomac Watershed Group is located in the Chesapeake Bay Watershed in the northeast part of Fairfax County, Virginia, and comprises five separate watersheds: Bull Neck Run, Scotts Run, Dead Run, Turkey Run and Pimmit Run (Figure 2.1). A portion of the Pimmit Run Watershed is located in Arlington County, Virginia, while the other four watersheds are entirely within Fairfax County.

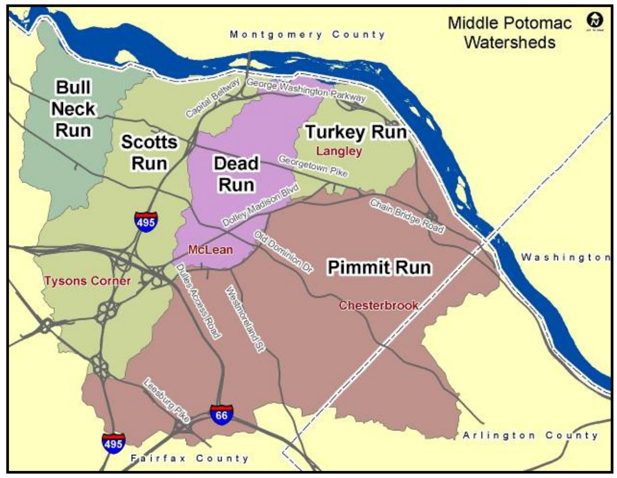

Figure 2.1 Middle Potomac Watersheds

The group is bounded to the west by the Difficult Run Watershed, to the south by the Cameron Run Watershed, and to the southeast by the Four Mile Run Watershed. The Potomac River is located to the north and northeast of the watershed group. The small areas of land located between the watersheds that drain directly into the Potomac River are also included as part of this group. The Middle Potomac Watershed Group covers an area of approximately 26 square miles (16,672 acres). The watersheds are primarily located within the Dranesville magisterial district with a small portion to the south in the Providence district.

The streams of the Middle Potomac Watershed Group generally flow from the southwest to the northeast towards the Potomac River, which eventually flows into the Chesapeake Bay. There are no tidal effects from the Potomac River because of the steep slope of the streams near their outfalls. The mouth of Pimmit Run, however, is in the tidal waters and is located below Little Falls dam.

Interstate 495, also known as the Capital Beltway, traverses the southwest portion of the Pimmit Run Watershed and continues to the northwest through the Scotts Run Watershed. It is the most heavily traveled roadway in the Middle Potomac Watershed Group. The George Washington Memorial Parkway is the second most heavily traveled roadway. It is located along the northeastern boundary of the watershed group through the Scotts Run, Dead Run, Turkey Run, and Pimmit Run Watersheds and parallel to the Potomac River. The Dulles Toll Road, Georgetown Pike, and Dolley Madison Boulevard are other major roadways located within the Middle Potomac Watershed Group. The federal government owns a large portion of land in the Turkey Run Watershed with the Central Intelligence Agency and the Federal Highway Administration located in the northeastern portion of the watershed.

The Middle Potomac Watershed Group is part of the Chesapeake Bay Preservation Area (CBPA) and the main stream corridors are located in the Resource Protection Area (RPA). The RPA is designated around all water bodies with perennial flows to protect the quality of water flowing to the Chesapeake Bay. The RPA totals approximately 1,801 acres in the watershed group. The remainder of the watershed area is part of the Resource Management Area (RMA) and if improperly used or developed could cause significant harm to water quality or diminish the functional value of the RPA. The National Wetlands Inventory map shows a total of 1,528 acres of wetlands in the Middle Potomac Watersheds. The county has performed an analysis to identify additional potential wetland areas based on soil types and ground slopes and it appears that there may be significantly more wetlands than are mapped in the National Wetlands Inventory.

2.2 History of the Watershed

The Middle Potomac Watershed Group is situated in the Piedmont Plateau, a major geological zone and an area of very old crystalline rocks. As European migration to northern Virginia increased, the stress on the natural environment also increased. Large tracts of land between Great Falls and Little Falls were granted to settlers from 1716 to 1719 and may have been cleared for farming soon thereafter. The plantations and small settlements of the colonial period were connected by a crude network of roads and trails.

As the need for large markets grew and as development moved inland from the Potomac River, several roads such as Great Road (now Leesburg Pike) and Sugarlands Rolling Road (now Georgetown Pike) were established through the Middle Potomac Watershed Group area. By the end of the 18th century, most of the land in the upper parts of the Middle Potomac Watershed Group was probably cleared and farmed although the precipitous cliffs located along the river were likely untouched.

By the mid-1800s, after a period of agricultural depression and an influx of northerners seeking inexpensive farm land, two villages called Langley and Lewinsville had taken form. Both of these villages were surrounded by tracts of very fertile land that were devoted primarily to fruit growing, general farming, and dairy farming. By the end of the century, Langley and Lewinsville had become complete villages with facilities such as a church, school, general store, blacksmith shop, post office and town hall. Until the late 1800s, only portions of the Pimmit Run Watershed had commercial development. Other areas began to develop after an electric rail line, the Great Falls and Old Dominion, was constructed between Georgetown and Great Falls. The railroad spurred growth in this area for 20 to 30 years after its construction.

By 1950, when the railroad operations were terminated, several villages had been established. New roads had been built, most notably Westmoreland Street and Great Falls Road, and the older ones, Leesburg Pike and Georgetown Pike, were significantly improved. The Pimmit Hills subdivision, built in the 1950s, was the area's first residential subdivision developed in response to the extensive population migration to the suburbs. Further subdivision development, namely Chesterbrook Gardens and Kent Gardens, occurred in the central portion of the Middle Potomac Watershed Group and in areas located along the Arlington County and the City of Falls Church borders with Fairfax County.

By the mid-1960s, major roadway development such as the Capital Beltway, the George Washington Memorial Parkway, Dolley Madison Boulevard, and the Dulles Toll Road had all been constructed. Also during this time, the CIA constructed a large office facility on a site adjacent to the Bureau of Public Roads tract, which is today the Federal Highway Administration facility. After the 1960s, the focus of residential development shifted from the single-family home subdivision to multi-family home developments and townhouse complexes. Commercial and industrial activities in the watershed area grew rapidly between 1965 and 1970 owing to the extensive development in the Tysons Corner area. The Tysons Corner Regional Shopping Center was built and in operation by 1969. It is the largest single commercial development in this area, occupying an 85-acre site within the triangle formed by Route 7, Route 123, and I-495. Approximately 1,000,000 square feet of leased retail and commercial space are located here as well as approximately 4,700 parking spaces.

2.3 Existing and Future Land Use

Impervious land cover consists of surfaces such as building roofs, asphalt pavement, or concrete pavement for roads, parking lots, driveways, and sidewalks. Additional impervious surface is added as an area is developed to its proposed build out conditions and can continue to increase as areas are redeveloped. Build out occurs when no additional capacity exists for development according to planned land uses and densities in the currently adopted *Comprehensive Plan*. Based on 2002 land use data and recent updates to the building layer, the total impervious area in the watershed is approximately 4,068 acres (24 percent of the total area) which includes Arlington County. The distribution of impervious area for general land use categories is shown in Table 2.1. The impervious area was calculated from the county's most recent geographic information system (GIS) data showing the paved area and rooftops (2002) and recent updates to the building layer. This information was used primarily for the hydrologic and hydraulic modeling.

Table 2.1 Middle Potomac Watershed Group Imperviousness

Land Use	Total Area (Acres)	% of Total Area	Impervious Area (Acres)	% of Total Impervious Area
Commercial/Industrial	2,337	14%	967	24 %
Residential	8,905	53%	1,681	40 %
Roads/Sidewalks	2,861	17%	1,420	36 %
Total	**14,103**	**84%**	**4,068**	**100%**

The Scotts Run and Pimmit Run Watersheds include some of the oldest developed areas in Fairfax County. The predominant existing land use in the Middle Potomac Watershed Group is medium-density, single-family residential with an average lot size of 1/8 acre and an average imperviousness of 24 percent. The next most common land use in the watersheds is roads and right of ways, which comprises 17 percent of the overall land area. Currently 94 percent of the developable land within the five watersheds has been developed. The existing and future land use in the watersheds is shown on Maps 2.2 and 2.3.

Table 2.2 Existing and Future Land Use in the Middle Potomac Watershed Group

Land Use Description	Land Use			
	Existing		Future	
	Area (Acres)	%	Area (Acres)	%
Open space, parks, and recreational areas	1,929	12%	1,905	11%
Estate residential	1,152	7%	412	2%
Low-density residential	2,768	17%	3,407	20%
Medium-density residential	4,266	26%	4,938	30%
High-density residential	719	4%	759	5%
Low-intensity commercial	2,015	12%	1,728	10%
High-intensity commercial	234	1%	485	3%
Industrial	88	1%	164	1%
Other	0	0%	0	0%
Unknown	14	0%	13	0%
Vacant/Undeveloped	626	4%	0	0%
Road right-of-way (including shoulder areas)	2,861	17%	2,861	17%
TOTAL	**16,672**	**100%**	**16,672**	**100%**

Please see the glossary for a definition of each land use category.

For ultimate future build out of the watersheds, low-density residential land use may increase from 17 percent to 20 percent (Table 2.2). The future watershed group imperviousness is predicted to increase to 27 percent. There are 626 acres of vacant land and 680 acres of underutilized land in the watershed group. Underutilized parcels have a *Comprehensive Plan* density greater than the existing land use for the parcel. The majority of the underutilized parcels are currently estate residential and have a planned land use of low-density residential. The vacant and underutilized parcel information was obtained from the county's 2003 GIS data.

The Fairfax County *Comprehensive Plan* is used as a guide for county staff and the public in the planning process for land use, urban design, and transportation. The Pimmit, Bull Neck, Scotts, Dead, and Turkey Run Watersheds are all located in the Area Plan II McLean and Tyson Corner districts. The overall major objective for future planning of transportation is to balance the growth of the areas with internal and external traffic demands. There are future plans to improve interchanges, widen roadways, install new trails, or extend mass transit rail through all of the five watersheds. The road widening and mass transit rail expansion projects occur within the existing right-of-ways; therefore the amount of road right-of-way area does not change in the future. The detailed future transportation plans for each watershed can be found in Chapters 4 through 8 under the land use sections.

2.4 Watersheds

The Bull Neck Run Watershed is approximately 1,559 acres, with 1,142 acres draining to Bull Neck Run and the remaining 417 acres draining to unnamed tributaries of the Potomac River. The Bull Neck Run main stem originates near Old Dominion Drive and flows in a northeasterly direction for nearly two miles towards its confluence with the Potomac River in the vicinity of Yellow Falls. The Madeira School and neighborhoods such as Spring Hill and Bull Neck Hundred are located in the Bull Neck Run Watershed.

The Scotts Run Watershed is approximately 3,860 acres and was divided into two subwatershed areas for this watershed management plan. The area draining to Scotts Run is 3,335 acres and 525 acres drain to unnamed tributaries of the Potomac River. Tysons Corner, Scotts Run Nature Preserve, and neighborhoods such as Swinks Mill, McLean Station, Timberly, and The Commons are located in the Scotts Run Watershed. The main stem of Scotts Run flows in a northerly direction for approximately four and a half miles from its source near the Tysons Corner shopping center to its confluence with the Potomac River near Stubblefield Falls.

The Dead Run Watershed is approximately 1,922 acres, with 1,737 acres draining to Dead Run and the remaining 186 acres draining to an unnamed tributary to the Potomac River. The Dead Run main stem flows in a northerly direction from Dolley Madison Boulevard for about three miles through a heavily developed residential area before joining the Potomac River immediately downstream of Cabin John Bridge. A portion of McLean's downtown and neighborhoods such as Evans Farm, the Cloisters, and Langley Forest are located in the Dead Run Watershed.

The Turkey Run Watershed is approximately 1,248 acres, with 704 acres draining to Turkey Run and 544 acres draining to unnamed tributaries of the Potomac River. The Turkey Run main stem is formed by the joining of two small tributaries. Claude Moore Colonial Farm, the Central Intelligence Agency, and Langley are located in the Turkey Run Watershed. The run flows mainly through undeveloped woodlands from its headwaters north of Georgetown Pike in a northerly direction to the Potomac River.

The Pimmit Run Watershed is the largest in the Middle Potomac Watershed Group, consisting of approximately 8,083 acres including 1,356 acres in Arlington County and 335 acres draining to unnamed tributaries of the Potomac River. McLean's downtown, the Potomac School, and neighborhoods such as Pimmit Hills and Marshall Heights are located in the Pimmit Run Watershed. Pimmit Run has six named tributaries and seven unnamed tributaries. The Pimmit Run main stem flows in a northeasterly direction for about eight miles, from its headwaters just beyond the Capital Beltway toward its confluence with the Potomac River immediately downstream of Chain Bridge in Arlington County. For the purposes of this watershed plan, the Pimmit Run Watershed was divided into four subwatersheds to make it easier to evaluate the characteristics of each watershed. Detailed information on the condition of each watershed is provided in Chapters 4 through 8.

2.5 Summary of Existing Reports and Data

2.5.1 Environmental Baseline Report

The *Pimmit Run Environmental Baseline Report* was written by Parsons, Brinkerhoff, Quade and Douglas in June 1975. The report presented a comprehensive view of the environmental baseline conditions for the five watersheds that constitute the Middle Potomac Watershed Group. The stream water quality and the wildlife habitat quality in the Middle Potomac Watershed Group were assessed using a range of “poor” to “excellent.”

The *Environmental Baseline Report* states that all of the stream beds in the Pimmit Run Watershed are composed of soils with high erodibility. Erosion and siltation were described as severe in many areas because construction activities during the 1970s had stripped much of the protective vegetation from the stream banks. In Dead Run, stream bed erodibility varied from high near the Potomac River to moderate throughout the upper reaches of the watershed. The Bull Neck Run stream habitat was described as being in good condition due to a minimal amount of development. However, the main stem of this stream is susceptible to erosion because of the highly erodible soils in the area. Turkey Run was described as having poor channel definition and locations of severe erosion due to its soils being highly erodible. The *Environmental Baseline Report* attributed excessive turbidity and high suspended solids concentrations in Scotts Run to ongoing construction activity. Some bank erosion was evident along the reaches downstream of the interchange of the Dulles Toll Road with Interstate 495 to Old Dominion Drive.

2.5.2 Immediate Action Plan Report

The *Immediate Action Plan (IAP) Report for the Pimmit Run, Turkey Run, Dead Run, Scotts Run and Bullneck Run Watersheds* was written by Parsons Brinckerhoff, Quade and Douglas in April 1978. The report identified 42 projects for the Middle Potomac Watershed Group with an estimated cost of $2,960,000. The various projects included piping of channels, adding or replacing culverts, raising roads, and installing riprap bank protection. The purpose of these projects included protecting commercial facilities and residences from flooding, alleviating road flooding, and abating bank erosion. Five of the projects have been constructed, three have been deleted, and three projects are active and fully funded. Twenty-nine projects are inactive with no current funding and the status of two projects is unknown. The completed projects consisted of replacing culverts, stabilizing stream banks, and channelizing streams. The active projects consist of floodproofing houses and stabilizing and restoring streams. The deleted and inactive projects consist of stream stabilization and restoration, floodproofing houses, and replacing culverts. The projects for each watershed are shown in tables in Chapters 4 through 8.

2.5.3 Future Basin Plan Report

The *Future Basin Plan (FBP) Report for the Pimmit Run, Turkey Run, Dead Run, Scotts Run and Bullneck Run Watersheds* was also written by Parsons, Brinckerhoff, Quade and Douglas in April 1978. This report, in conjunction with the *IAP*, specified the watershed group’s projected needs up to the year 2000. The report identified 36 projects with an estimated cost of $2,005,000. Five projects have been completed, four projects are active with partial funding, two are deleted, and twenty-two projects are inactive with no current funding. The status of three projects is unknown. The completed projects consisted of replacing culverts, stabilizing stream banks, and channelizing streams. The active projects consist of floodproofing houses and stabilizing and restoring streams. The deleted and inactive projects consist of stream stabilization and restoration, floodproofing houses, and replacing culverts. The projects for each watershed are shown in tables in Chapters 4 through 8.

2.5.4 Fairfax County Master Plan Drainage Projects

As of January 2005, Fairfax County currently has 64 master plan drainage projects for the Middle Potomac Watershed Group. The projects include those identified in the *IAP* and *FBP*, along with additional projects from other sources. Thirty-three of the original master plan drainage projects have been completed and are not listed in the plan. The *Middle Potomac Watershed Management Plan* is one of the master plan drainage projects that is currently underway. The 64 master drainage projects listed in the plan consist of floodproofing houses, stabilizing and restoring streams, and replacing culverts. Thirty-four of the projects have been totally or partially incorporated into projects proposed by this plan, 24 of the projects will remain the same, and six projects require further evaluation to determine if they should be kept or eliminated. The master plan drainage projects for each watershed are shown in tables in Chapters 4 through 8.

2.5.5 Infill and Residential Development Study

The Fairfax County *Infill and Residential Development Study, Draft Staff Recommendations Report* was written by the county in July 2000. Any residential development that will occur proximate to or within already established neighborhoods is referred to as infill development. The recommendations from this study included policies for tree preservation, stormwater management, and erosion and sediment control. The recommended policies will be used to help make decisions regarding the actions recommended in this watershed plan.

Infill development is expected to occur more frequently in the future in the Middle Potomac Watershed Group because the majority of the watershed area is already developed. The average lot size for medium density residential development is 1/8 acre with an average imperviousness of 24 percent. It is anticipated that the percent imperviousness will increase in residential areas as additions are made to existing houses or existing houses are replaced with larger houses. This trend of tearing down smaller houses and replacing them with much larger houses, as well as adding large additions to existing houses that are out of character with the surrounding homes, is called mansionization. Mansionization will increase the imperviousness in the watersheds by one percent, for a total imperviousness of 28 percent for the Middle Potomac Watershed Group.

2.5.6 Fairfax County Virginia Pollutant Discharge Elimination System Permit Data

As part of the Virginia Pollutant Discharge Elimination System (VPDES) permit for its municipal separate storm sewer system (MS4), Fairfax County has initiated a program to monitor its streams on a routine basis and to identify and eliminate illicit discharges. Illicit discharges include sanitary, car wash, or laundry wastewater; radiator flushing; or improper disposal of oil and toxic materials. They are detected by monitoring the flow in the drainage system during dry weather conditions for pH, chlorine, copper, phenol, and detergents. No VPDES illicit discharge screening sites have been established in the Middle Potomac Watershed Group and as a result, there are no illicit discharge data available for this watershed group. A VPDES permit for a wastewater treatment plant has been issued to the Madeira School located at 8328 Georgetown Pike in the Bull Neck Run Watershed.

2.5.7 Stream Water Quality Reporting

The water quality in streams depends on the amount and type of pollutants in the water. Salts, chemicals, metals, oils, nutrients, sediments and other pollutants are washed into streams with stormwater runoff. Nutrients typically include nitrogen and phosphorous which are washed off from lawns that are over fertilized. Pollution of streams with bacteria may be caused by pet waste; waste from wildlife such as ducks, deer and geese; overflowing or broken sanitary sewer pipes; and poorly functioning on-site septic systems.

Virginia Department of Environmental Quality

The Virginia Department of Environmental Quality's (DEQ's) 2006 305(b)/303(d) Water Quality Assessment Integrated Report (found at www.deq.virginia.gov/wqa/ir2006.html) states that the recreation use goal for Pimmit Run is not supported due to exceedances of the fecal coliform bacteria water quality standard recorded at two DEQ water quality monitoring stations located on this stream. In addition to the bacteria impairment, DEQ's 2006 Integrated Report states that Pimmit Run is also impaired for fish consumption due to polychlorinated biphenyls (PCBs), chlordane, and heptachlor epoxide. These contaminants were found in American Eel specimens collected in 2001 and 2004 at DEQ's downstream Pimmit Run water quality monitoring station, located at the bridge at Glebe Road. The aquatic life use in Pimmit Run is fully supported with observed effects due to exceedances of the sediment screening value at the downstream portion of the stream. The 2004 DEQ Integrated Report listed Scotts Run as a Water of Concern based on citizen monitoring stations that revealed medium probability of adverse conditions for aquatic life.

Fairfax County Health Department

The Fairfax County Health Department monitored stream water quality at 84 sampling sites throughout the county in 2002. Eight of those water quality sampling sites were located in the Middle Potomac Watershed Group: four in the Pimmit Run Watershed and one in each of the other watersheds. In 2002, fifteen water samples were collected from each of these sites and evaluated for fecal coliform, dissolved oxygen, nitrate nitrogen, pH, phosphorous, temperature, and heavy metals. These parameters indicate the amount of non-point source pollution contributed from manmade sources and help to evaluate the quality of the aquatic environment. The year 2002 was a drought year which could give the worst case assessments for the water quality samples if the dominant pollution source is a point source because nonpoint source pollution is reduced during a drought. Information regarding the parameters and data collected for the *Fairfax County 2002 Stream Water Quality Report* can be found at www.fairfaxcounty.gov/service/hd/strannualrpt. The Fairfax County Department of Public Works and Environmental Services, Stormwater Planning Division, is now monitoring the stream water quality instead of the Health Department.

Almost eight percent of samples collected from site 10-02 in the Pimmit Run Watershed showed a dissolved oxygen concentration of less than 4.0 mg/l, which is the minimum standard considered suitable for aquatic life. The average dissolved oxygen concentration for site 09-01 in the Turkey Run Watershed was 10.4 mg/l and for site 06-02 in the Bull Neck Run Watershed, it was 10.1 mg/l, both well above the daily average standard of 5.0 mg/l. For the state's current instantaneous fecal coliform standard, no more than 10 percent of the samples collected in a month shall exceed 400 fecal coliforms per 100 milliliter of water. As shown in Table 2.3 for site 10-05, 93 percent of the samples had fecal coliform counts greater than 400/100 ml, for sites 08-02 and 10-02 67 percent of the samples had fecal coliform counts greater than 400/100 ml, and for sites 06-02, 10-03, and 10-04 53 percent of the samples had fecal coliform counts greater than 400/100 ml. For fecal coliform, a count less than 200/100 ml is considered good water quality and a count of 250,000/100 ml can be considered a direct sewage discharge.

Table 2.3 Summary of Fecal Coliform Sampling in the Middle Potomac Watershed Group

Number of Fecal Coliform Samples for Each Sampling Site				
Sample Station	Total Samples Collected	<200/100ml	200-400/100ml	>400/100ml
Bull Neck Run (06-02)	15	3	4	8
Scotts Run (07-01)	15	6	2	7
Dead Run (08-02)	15	2	3	10
Turkey Run (09-01)	15	3	5	7
Pimmit Run 1 (10-02)	15	3	2	10
Pimmit Run 2 (10-03)	15	2	5	8
Pimmit Run 3 (10-04)	15	3	5	8
Pimmit Run 4 (10-05)	15	0	1	14

Source: Fairfax County 2002 Stream Water Quality Report

From 2001 to 2002, Scotts Run showed a 29 percent improvement in the number of fecal coliform sample results meeting the water quality criteria. From 2001 to 2002, the geometric mean[1] of fecal coliform rose from 612 to 715 for site 10-05 and dropped from 696 to 328 for site 07-01.

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[1] The geometric mean is used to measure the central tendency of the data. The geometric mean is calculated by multiplying a series of numbers and taking the *nth* root of the product where *n* is the number of items in the series.

The Fairfax County Health Department's *2002 Stream Water Quality Report* concluded that the overall water quality of the watersheds in the Middle Potomac Watershed Group is considered fair for fecal coliform and good for the other chemical and physical parameters that were sampled. The physical and chemical parameters that were measured included fecal coliform, dissolved oxygen, nitrate nitrogen, pH, phosphorous and heavy metals.

Volunteer Water Quality Monitoring

Within the Middle Potomac Watershed Group, there are currently five active volunteer monitoring stations. Three stations are located in the Pimmit Run Watershed and one in the Scotts Run Watershed. These stations are coordinated by the Northern Virginia Soil and Water Conservation District. There is also a site located on Bull Neck Run which is coordinated by the Audubon Naturalist Society. The data collected from all of the sites generally support the findings of the *Fairfax County Stream Protection Strategy Baseline Study*, which is described in more detail in section 2.5.9. The data from the site at Bull Neck Run indicated the presence of a more diverse benthic community, while the data from the site on Scotts Run highlighted significant biological impairment. The data from Pimmit Run showed significant impairment at all three monitoring stations. Data from volunteer efforts generally highlighted low biological integrity throughout the watersheds with most locations being rated in the lower categories of the county's ranking system.

2.5.8 Virginia Natural Heritage Resource

The Virginia Natural Heritage Resources Database describes the status and rank of rare plant and animal species throughout the state. The natural heritage resources found in the Middle Potomac Watershed Group are shown in Table 2.4.

Table 2.4 Natural Heritage Resources in the Middle Potomac Watershed Group

Common Name	State Rank
Birds	
Upland Sandpiper	Extremely Rare
Bald Eagle	Very Rare
Common Moorhen	Extremely Rare
Yellow-crowned Night-heron	Very Rare
Mussels	
Yellow Lance	Very Rare
Yellow Lampmussel	Very Rare
Green Floater	Very Rare
Brook Floater	Extremely Rare
Amphipods, Isopods & Decapods	
Northern VA Well Amphipod	Extremely Rare
Pizzini's Amphipod	Extremely Rare
Groundwater Amphipod	Extremely Rare
Rock Creek Groundwater Amphipod	Historically known but not verified in 15 years

Common Name	State Rank
Reptiles	
Wood Turtle	Very Rare
Vascular Plants	
Yellow Nailwort	Extremely Rare
Blue Scorpion-weed	Extremely Rare
Virginia Mallow	Extremely Rare
Small Whorled Pogonia	Extremely Rare
Torrey's Mountain Mint	Very Rare

2.5.9 Stream Protection Strategy

The *Fairfax County Stream Protection Strategy (SPS) Baseline Study* from January 2001 evaluated the quality of streams throughout the county. Pimmit Run and its tributaries, Scotts Run, and Dead Run received "very poor" composite site condition ratings, whereas Bull Neck Run and Turkey Run received "excellent" ratings. These ratings were based on a range of environmental parameters including an index of biotic integrity, stream physical assessment, habitat assessment, fish taxa richness, and percent imperviousness. Table 2.5 provides information regarding the macroinvertebrate assessment and the diversity of fish species found in the Middle Potomac Watershed Group streams as part of the *SPS Baseline Study*.

Table 2.5 Macroinvertebrate Assessment and Fish Species

Stream Name	Macroinvertebrate Assessment	Diversity of Fish Species
Bull Neck Run	Good	Low
Scotts Run 1 (Upper Scotts Run)	Poor	Very Low
Scotts Run 2 (Lower Scotts Run)	Poor	Very Low
Dead Run	Poor	Very Low
Turkey Run	Excellent	High
Pimmit Run 1 (Upper Pimmit Run)	Poor	Very Low
Pimmit Run 2 (Middle Pimmit Run)	Fair	Low
Pimmit Run 3 (Lower Pimmit Run)	Poor	Very Low
Little Pimmit Run	Poor	Very Low

Polluted stormwater runoff affects the number and diversity of macroinvertebrate and fish species. For the macroinvertebrate assessment, the number of unique species and the balance between pollution-tolerant and intolerant species were measured. The rankings ranged from excellent to very poor. A poor rating indicates decreased diversity with intolerant species being rare or absent; a very poor rating indicates that the stream is degraded with a small number of tolerant species. The fish were assessed based on the total number of unique fish species collected at each site. For the number of unique fish species collected, the ratings were high, moderate, low, or very low. Collectively, the watersheds in this group clearly highlight the impact that variations in land use can have on aquatic systems. Those watersheds with the most development, such as the Pimmit Run Watershed, ranked among the poorest quality streams in the county while those with the least amount of development, such as the Bull Neck Run Watershed, ranked among the best.

In the *SPS Baseline Study*, Pimmit Run, Scotts Run, and Dead Run were classified as Watershed Restoration Level II areas with the goals of maintaining areas to prevent further degradation and implementing measures to improve water quality and comply with Chesapeake Bay initiatives, TMDL regulations, and other water quality initiatives and standards. Although Bull Neck Run and Turkey Run are classified as Watershed Protection Areas due to high biological integrity and habitat quality, regular monitoring within both watersheds will be continued. The *Middle Potomac Watershed Management Plan* is based on the county's stream protection strategy recommendations to help achieve the goal of preserving and restoring stream quality.

2.5.10 Stream Physical Assessment

The county initiated a Stream Physical Assessment (SPA) for all of its watersheds in August 2002 to systematically characterize the existing conditions of stream corridors. This data has provided invaluable details of the conditions of streams as a "snap-shot" in time. However, it is recognized that conditions are changing and in some cases, may have changed significantly since the initial SPA was conducted. Due to the dynamic nature of streams as they adjust to the continual impact of development, it is believed that reassessment of physical conditions will be needed to determine the exact need before the implementation of any recommended projects.

The SPA included a habitat assessment, infrastructure inventory, stream characterization, and stream geomorphologic assessment. The SPA data are summarized for the entire watershed group in this section and results for each watershed are discussed in detail in Chapters 4 through 8. As part of the SPA, the following items were identified and characterized:

- Stream geomorphology
- Obstructions
- Stream habitat condition
- Pipe and ditch outfalls
- Riparian buffer condition
- Public utility lines
- Erosion locations
- Road and other crossings
- Head cuts
- Dumpsites

The inventory items with a negative impact on the stream were assigned an impact score and the inventory items that did not impact the stream were not scored. Based on the impact score, the degrees of impact were classified as "minor to moderate", "moderate to severe", or "severe to extreme". Buffer condition was only noted where it was deficient and was categorized as moderate, severe, or extreme. Table 2.6 describes the impact ranges for each of the stream inventory items.

Table 2.6 Description of Impacts

Impact	Description
Deficient Buffer Vegetation (within 100 feet of stream bank)	
Extreme	Impervious/commercial area in close proximity to a stream. The stream banks may be modified or engineered. The stream character (bank/bed stability, sediment deposition, and/or light penetration) is obviously degraded by adjacent use.
Severe	Some impervious areas and/or turf located up to the bank and water. Very little vegetation aside from the turf exists within the 25-foot zone. Home sites may be located very close to the stream. The stream character is probably degraded by adjacent use.
Moderate	Encroachment mostly from residential uses and yards. There is some vegetation within the 25-foot zone, but very little aside from turf exists within the remainder of the 100-foot zone. The stream character may be changed slightly by adjacent use.
Minor	Vegetated buffer primarily consists of native meadow (not grazed).
Dumpsites	
Severe to Extreme	Active and/or threatening sites. The materials may be considered toxic or threatening to the environment (concrete, petroleum, empty 55-gallon drums, etc.) or the site is large (greater than 2,500 square feet) and appears active.
Moderate to Severe	Dumpsite less than 2,500 square feet with non-toxic material. It does not appear to be used often, but clean-up would definitely be a benefit.
Minor to Moderate	Dumpsite appears small (less than 1,000 square feet) and the material stable (will not likely be transported downstream by high water). This site is not a high priority.
Erosion Locations	
Severe to Extreme	Impending threat to structures or infrastructure.
Moderate to Severe	Large area of erosion that is damaging property and causing obvious instream degradation. The eroding bank is generally five feet or greater in height.
Minor to Moderate	A moderate area of erosion that may be damaging property and causing instream degradation. The eroding bank is generally two feet or greater in height.
Head Cuts	
Severe to Extreme	Greater than two-foot head cut height.
Moderate to Severe	One to two-foot head cut height.
Minor to Moderate	One-half to less than one-foot head cut height.
Obstructions	

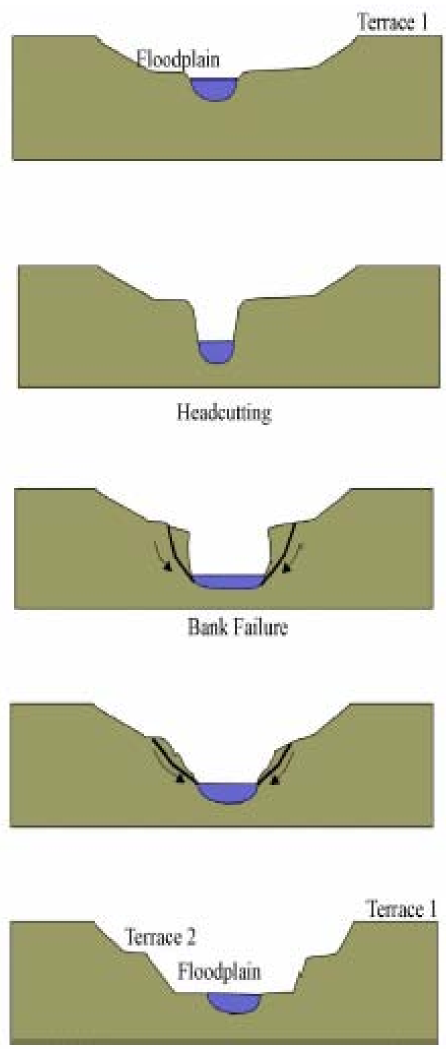
Impact	Description
Severe to Extreme	The blockage is causing a significant erosion problem and/or the potential for flooding that can cause damage to infrastructure. The stream is usually almost totally blocked (more than 75% blocked).
Moderate to Severe	The blockage is causing moderate erosion and could cause flooding. The stream is partially blocked, but obstructions should probably be removed or the problem could worsen.
Minor to Moderate	The blockage is causing some erosion problems and has the potential to worsen. It should be looked at and/or monitored.
Pipes and Ditch Outfalls	
Severe to Extreme	Stormwater runoff from a ditch or pipe is causing a significant erosion problem to the stream bank or stream. Discharge that may not be stormwater is coming from the stormwater pipe.
Moderate to Severe	Stormwater runoff from a ditch or pipe is causing a moderate erosion problem and should be fixed; it may get worse if left unattended. Discharge is coming from the pipe. It is probably stormwater, but it will be uncertain without further investigation.
Minor to Moderate	Stormwater runoff from a ditch or pipe is causing a minor erosion problem and some discharge is occurring.
Public Utility Lines (includes sanitary sewer, water, stormwater, gas, telephone, and electric lines)	
Severe to Extreme	A utility line is leaking.
Moderate to Severe	An exposed utility line is causing a significant erosion problem and/or obstruction (blockage). The potential for the sanitary line to burst or leak appears high.
Minor to Moderate	A partially exposed utility line is causing a moderate erosion problem. The line is partially visible (mostly buried in a stream bed with little if any erosion).
Road and Other Crossings	
Severe to Extreme	The condition of debris, sediment, or erosion poses an immediate threat to the structural stability of the road crossing or other structure. Major repairs will be needed if the problem is not addressed.
Moderate to Severe	The condition probably poses a threat to a road crossing or other structure. The problem should be addressed to avoid larger problems in the future.
Minor to Moderate	The condition does not appear to pose a threat to a road crossing or other structure but should be addressed to enhance stream integrity and the future stability of the structures.

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

Stream Geomorphology

The geomorphologic assessment of the stream channels in the Middle Potomac Watershed Group was based on the conceptual incised Channel Evolution Model (CEM) developed by

Schumm et al. (1984). Based on visual observation of the channel cross section and other morphological observations of the channel segment, a CEM type was assigned for the channel segment. A list of the CEM types is provided in Table 2.7 and the five stages of the channel evolution process are shown in Figure 2.2. The CEM type for the stream segments is shown on the stream geomorphology maps provided for each of the watersheds in Chapters 4 through 8.



Type 1: Well-developed base flow and bankfull channel; consistent floodplain features easily identified; one terrace apparent above active floodplain; predictable channel morphology; floodplain covered by diverse vegetation; stream banks less than or equal to 45°

Type 2: Head cuts; exposed cultural features (along channel bottom); sediment deposits absent or sparse; exposed bedrock (parts of reach); stream bank slopes greater than 45°

Type 3: Stream bank sloughing, sloughed material eroding; stream bank slopes greater than 60° or vertical/undercut; erosion on inside of bends; accelerated bend migration; exposed cultural features (along channel banks); exposed bedrock (majority of reach)

Type 4: Stream bank aggrading; sloughed material not eroded; sloughed material colonized by vegetation; base flow, bankfull, and floodplain channel developing; predictable channel morphology developing; stream bank slopes less than or equal to 45°

Type 5: Well-developed base flow and bankfull channel; consistent floodplain features easily identified; two terraces apparent above active floodplain; predictable channel morphology; stream banks less than or equal to 45°

Figure 2.2 Incised Channel Evolution Model (Schumm, Harvey, and Watson, 1984)

Table 2.7 Summary of CEM Types

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

Stream Habitat Assessment

The scores assessed for the various physical parameters representing the stream habitat conditions were combined for each stream segment to obtain a total habitat score with the majority of the stream habitat in the watershed group assessed as fair. Table 2.8 describes the percentage of length for each habitat quality rating for the streams according to the total score. The habitat quality of each stream segment is shown on the stream habitat quality maps provided for each of the watersheds in Chapters 4 through 8.

Table 2.8 Summary of Overall Stream Habitat Quality

Stream Name	Percent of Stream Length				
	Very Poor	Poor	Fair	Good	Excellent
Bull Neck Run	0%	0%	25%	44%	31%
Upper Scotts Run	0%	43%	57%	0%	0%
Lower Scotts Run	0%	0%	41%	28%	31%
Dead Run	0%	12%	61%	20%	7%
Turkey Run	0%	10%	30%	0%	60%
Upper Pimmit Run	0%	30%	29%	40%	0%
Middle Pimmit Run	0%	1%	42%	57%	9%
Lower Pimmit Run	0%	20%	17%	63%	0%
Little Pimmit Run	0%	16%	68%	16%	0%
Total Watershed Group	**0%**	**10%**	**40%**	**26%**	**24%**

Streams in their natural and stable condition experience some erosion and transport of sediments. This process is directly related to the stream's geometry, velocity, and amount of flow. Sediments will naturally deposit in areas of slower velocity, such as typically seen at the downstream end of a stream, and erosion will occur where the flow velocities are higher than the stream channel banks can withstand which can typically be found at stream bends. Higher instream velocities and flows from development result in larger amounts of sediment being transported and the transport of sediment of greater weight and size. Increases in instream velocities and flows result in a stream actively widening and transporting higher amounts of sediment.

The actively widening and unstable stream beds and banks found in the Middle Potomac Watersheds are the primary source of instream sediment. Other sources include stormwater runoff from areas with disturbed soils and sand placed on roads for traction during the winter. Sedimentation causes the formation of instream islands, point bars, and shoals as well as the filling in of pools. High levels of sediment deposition can smother aquatic organisms, and pollutants that attach to sediments can be harmful to them. Sediment can also block sunlight from reaching aquatic plants and prevent visual predators from seeing their prey. Table 2.9 summarizes the sedimentation assessment from the SPA for the Middle Potomac Watershed Group.

Table 2.9 Sedimentation Assessment

Watershed	Description of Sedimentation
Bull Neck Run	Sediment deposition was mainly sand and silt with 20% of the stream bottom affected in the downstream segments and 40% to 50% of the stream bottom affected in the upstream segments.
Scotts Run	Sediment deposition was mainly fine sediment and silt with 10% to 50% of the stream bottom affected. However, 70% to 80% of the stream bottom was affected in two of the segments in the tributaries to Scotts Run.
Dead Run	Sediment deposition was mainly sand and silt with 40% of the stream bottom affected in the downstream segments and 60% to 70% of the stream bottom affected in the upstream segments.
Turkey Run	No enlargements of islands or point bars were present. Less than 20% of the stream bottom was affected by sand or silt accumulation in the downstream segments and 40% to 50% of the stream bottom affected in the upstream segments.
Pimmit Run	Fine sediment and silt surrounds 50% of the living spaces around gravel, cobble and boulders. The dominant substrate in the stream reaches has a mixture of cobble and gravel stones.

Channel disturbance is caused when a stream channel is straightened, paved with concrete, lined with riprap (stone) or otherwise altered by human activity. The county's SPA estimated the amount of channel and bank alteration as approximately 24 percent of the assessed stream lengths in the Middle Potomac Watersheds. The lengths of piped streams and concrete channels were estimated during the SPA and totaled 14,764 feet, which is approximately seven percent of the total length of stream channels included in the assessment. All of the piped and concrete channelized sections for the Middle Potomac Watershed Group were recorded in the Pimmit Run Watershed.

Channel alteration reduces or eliminates habitat for fish and aquatic insects. Concrete channels can create higher flow velocities that increase erosion downstream. Concrete channels with no vegetation along the banks create higher water temperatures that may not be suitable for fish and aquatic insects. Based upon a review of previous mapping of the area, many of the natural drainage swales and streams appear to have been eliminated, piped underground, straightened, or otherwise altered during the development of the headwater areas of the Middle Potomac Watersheds, especially in the Pimmit Run and Scotts Run Watersheds. Although the SPA only recorded piped or concrete segments in Pimmit Run and its tributaries, other developed portions of the Middle Potomac Watersheds have streams that were altered in this way as well.

Riparian Buffer Condition

An adequate riparian buffer is a vegetated strip of land located adjacent to a stream with a minimum recommended width of 100 feet on each side of the stream. The riparian buffer should consist of a mix of native plants, including deep-rooted grasses, shrubs, and trees. Inadequate riparian buffers are those that do not meet the recommended width or have non-native, non-diversified, or insufficient vegetation.

The streams in the watershed have an average buffer zone width of 50 feet to 100 feet. The total length of deficient buffer zone along assessed streams is 133,800 feet, which is 29 percent of the total bank length that was sampled. The total length of deficient buffer zone was determined by evaluating both the left and right banks separately. The vegetative cover in the deficient buffer areas typically consists of lawn. The average impact score for the deficient buffer areas is 4.4 out of a scale of 1 to 10 with 10 as best. The results of the county's 2004 SPA riparian buffer assessment are presented for the Middle Potomac Watersheds in Table 2.10.

Table 2.10 Riparian Buffer Assessment

Watershed	Deficient Buffer Length (ft)	Length of Moderate to Extreme Buffer Deficiency	Percent of Deficient Buffer with Moderate to Extreme Deficiencies	Average Impact Score
Bull Neck Run	2,100	0	0%	3.3
Upper Scotts Run	7,950	6,170	65%	4.8
Lower Scotts Run	9,600	3,360	35%	4.1
Dead Run	23,400	4,450	19%	4.2
Turkey Run	4,000	2,400	60%	4.6
Upper Pimmit Run	34,260	15,070	44%	4.7
Middle Pimmit Run	36,040	19,820	55%	4.7
Lower Pimmit Run	4,000	1,440	36%	3.7
Little Pimmit Run	12,450	750	6%	3.3
Total Watershed Group	**133,800**	**53,460**	**39%**	**4.4**

According to statistics compiled by Virginia's Department of Conservation and Recreation (DCR), a 100-foot-wide strip of forest and grass can reduce sediment delivered to the stream by 97 percent, nitrogen by 80 percent and phosphorus by 77 percent. Deficient buffer zone width provides less filtering of pollutants in stormwater runoff. The stream banks are more likely to become unstable when bank vegetation is removed. Limited native plant diversity and density, combined with a large number of non-native plants, will not offer sufficient habitat and food for wildlife. Additionally, non-native species may out compete and replace native plants. There are conservation areas or parks adjacent to the main branches of the streams, and there are significant parklands adjacent to the streams in the lower reaches near their confluence with the Potomac River. The county's *Comprehensive Plan* proposes placing park or conservation areas around most of the streams in the watershed.

Erosion, Head Cuts, and Obstructions

Excessive and sustained high velocities usually associated with high runoff volumes can cause erosion of the stream bed and bank material. Sediment eroded from banks and beds can smother aquatic life when it is deposited downstream and sediment suspended in the water can block light needed by aquatic plants. A head cut is a sudden lowering of the level of the streambed at a certain point, caused by erosion of the streambed. This point, also called a nick-point, will work its way upstream if the head cut is actively eroding. A stream obstruction is any flow blockage, such as fallen trees, located within a stream.

The county's SPA estimated the length of eroded stream bed or banks, identified specific erosion locations, and quantified the number and location of obstructions and their impact on the stream. The impact scores for erosion, head cuts and obstructions were evaluated on a scale of 1 to 10, with 1 as minor, 5 as moderate and 10 as extreme, and are presented for the Middle Potomac watersheds in Table 2.11.

Table 2.11 Erosion Data

Watershed	Length of Eroded Bed / Banks (ft.)	Erosion Locations	Impact Score	Number of Obstructions	Impact Score
Bull Neck Run	205	3	6.2	3	3.3
Upper Scotts Run	570	7	3.0	1	2.0
Lower Scotts Run	680	8	4.3	5	3.8
Dead Run	850	3	5.4	2	4.5
Turkey Run	680	4	4.8	2	3.0
Upper Pimmit Run	950	7	4.9	2	2.5
Middle Pimmit Run	2,275	15	5.6	7	4.2
Lower Pimmit Run	200	2	4.8	1	2.0
Little Pimmit Run	1,350	8	6.1	2	5.5
Total Watershed Group	**7,760**	**57**	**5.2**	**25**	**4.1**

The number of erosion points or obstructions in these watersheds is not unusually high for streams in a typical urbanized watershed, but their impact on the streams is still substantial. Although the impact scores are low, they can increase significantly if the obstructions are not cleared, which can lead to much more significant impacts on the streams. Erosion and obstructions have contributed to the water quality degradation of the Middle Potomac Watersheds' streams.

Pipe and Ditch Outfalls

Thirty-six pipes in the Pimmit Run Watershed showed minor to moderate stream impacts due to erosion. The other watersheds had a combined total of six pipes that had minor to moderate erosion impacts.

Public Utility Lines

Eleven utility lines in the Pimmit Run Watershed had minor to moderate stream impacts due to obstruction, erosion at stream crossings, or the loss of riparian buffer. Bull Neck Run and

Turkey Run did not show any impact from utility lines. There were two locations in Scotts Run that exhibited minor impacts and one location on Dead Run that showed moderate impact due to erosion.

Road and Other Crossings

There were three crossings in the Pimmit Run Watershed that showed moderate stream impacts due to debris, sediment, and erosion. One crossing in the Upper Scotts Run Watershed exhibited severe impacts based on the amount of debris found at the upstream end of the crossing.

Dumpsites

The county's stream physical assessment identified four dumpsites: one in Bull Neck Run, one in Dead Run and two in Little Pimmit Run. The dumpsites consisted of lawn waste such as leaves and grass, furniture, a camper shell, shopping carts, and trash. The dumpsites were located in the stream, on the bank, or in a floodplain. The volume of trash found in the stream was not measured.

2.5.11 Stormwater Management Facilities

If the runoff from developed areas is controlled by a properly designed stormwater management facility, there is a reduction in the impacts to the receiving streams. Prior to 1972, the county did not require stormwater quantity reduction from development and prior to July 1993, the county did not require water quality treatment of runoff. Because so much of the Middle Potomac Watersheds area was developed before stormwater controls were required, stormwater runoff has had considerable impacts on the streams in these watersheds. Table 2.12 describes the estimated area of each watershed that is controlled by stormwater management (SWM) facilities.

Table 2.12 Watershed Area Controlled by Stormwater Management Facilities

Watershed Name	Watershed Area Controlled by SWM Facilities (Acres)[1]	Percent of Watershed Area Controlled by SWM Facilities[1]
Bull Neck Run	271	24%
Upper Scotts Run	266	13%
Lower Scotts Run	449	33%
Scotts Run Total	*715*	21%
Dead Run	264	15%
Turkey Run	61	9%
Upper Pimmit Run	315	12%
Middle Pimmit Run	300	12%

Watershed Name	Watershed Area Controlled by SWM Facilities (Acres) [1]	Percent of Watershed Area Controlled by SWM Facilities[1]
Lower Pimmit Run	20	5%
Little Pimmit Run	42	6%
Pimmit Run Total	*677*	11%
Overall	**1,988**	**15%**

[1]Does not include SWM facilities in Arlington County or facilities in areas that drain directly to the Potomac River.

2.5.12 Stormwater Infrastructure Maintenance

Stormwater infrastructure requires consistent and periodic maintenance in order to function properly. Older infrastructure must be rehabilitated or replaced when it reaches the end of its service life of approximately 50 years. Fairfax County owns and maintains approximately 1,400 miles of pipe and over 40,000 storm drain inlets and manholes countywide. Limited maintenance data are available for the stormwater conveyance infrastructure in these watersheds because the majority of it is owned by the Virginia Department of Transportation (VDOT), which only has a formal maintenance plan for bridges and major culvert crossings. VDOT's Bridges and culverts are inspected regularly and any required maintenance is performed. Based on the county's GIS drainage complaint layer, approximately 1810 drainage complaints were received from 1984 to March 2006, with the majority of the complaints related to blockages, clogs, cave-ins, flooding, and erosion. Of these 1810 complaints, 154 were flooding or erosion complaints. These 154 complaints are shown on Maps 4.1, 5.1, 5.2, 6.1, 7.1, 8.1, 8.2, and 8.3.

There are over 2,200 privately owned stormwater facilities located in the county. The SWM facility data for privately and publicly owned facilities in the Middle Potomac Watersheds are presented in Table 2.13.

Table 2.13 Stormwater Management Facility Maintenance

Watershed Name	No. of Private SWM Facilities	No. of Private SWM Facilities with Major Problems	No. of Private SWM Facilities with Minor Problems	No. of Public SWM Facilities
Bull Neck Run	1	0	0	7
Scotts Run	39	9	2	13
Dead Run	41	10	3	7
Turkey Run	0	0	0	1
Pimmit Run	107	5	11	32
Overall	188	24	16	60

NOTE: This is the best available information based upon the county's four year inspection cycle and may not reflect current conditions or facilities that have been improved. This information does not include the facilities in Arlington County.

2.5.13 On-Site Wastewater Treatment

Wastewater is treated by on-site septic systems for a portion of the watershed group area. The county does not have all of the parcels with on-site septic systems mapped in their GIS database because these tend to be older parcels. Table 2.14 shows the developed land area that is not connected to the county's sanitary sewer system. These data do not include any properties in Arlington County that may have on-site wastewater treatment. Failing or poorly maintained on-site septic systems may discharge bacteria to the county's streams.

Table 2.14 On-Site Wastewater Treatment

Watershed Name	No. of Parcels with On-Site Wastewater Treatment	Land Area with On-Site Wastewater Treatment	Percent of Watershed Area with On-Site Wastewater Treatment
Bull Neck Run	551	751	47.9%
Scotts Run	354	363	9.4%
Dead Run	176	190	9.8%
Turkey Run	69	810	64.9%
Pimmit Run	412	688	8.5%
Overall	1,562	2,802	18.3%

2.5.14 Flooding

Flooding occurs when the capacity of a stream or drainage conveyance is exceeded during a rain event. Streams convey runoff from their surrounding watershed area and can accommodate excess runoff in their floodplain, which is the broad area just above the smaller stream channel and below the tops of the main banks. Table 2.15 presents the number of potential flooding locations in each watershed with respect to the 100-year storm as obtained from the county's GIS floodplain data. This table does not include information from Arlington County for the Pimmit Run Watershed.

Table 2.15 Potential Flooding Locations

Watershed Name	Building Flooding Locations	Roadway Flooding Locations
Bull Neck Run	0	2
Scotts Run	5	5
Dead Run	4	5
Turkey Run	No Data Available*	No Data Available*
Pimmit Run	61	14

*The majority of the Turkey Run Watershed area is comprised of the CIA facility and no floodplain mapping has been done by FEMA in this area.

With the exception of the streams located within the Pimmit Run Watershed, all other streams have relatively few flooding locations; however, their associated floodplains have been encroached upon significantly. Some areas noted by the Steering Committee as having flooding concerns are: the McLean Little League ball fields, Scotts Run below Tysons Corner, and a 247 acre property known as "The Reserve." It also appears that Spring Hill Road in the Bull Neck Run Watershed and Swinks Mill Road in the Scotts Run Watershed have experienced flooding in the past.

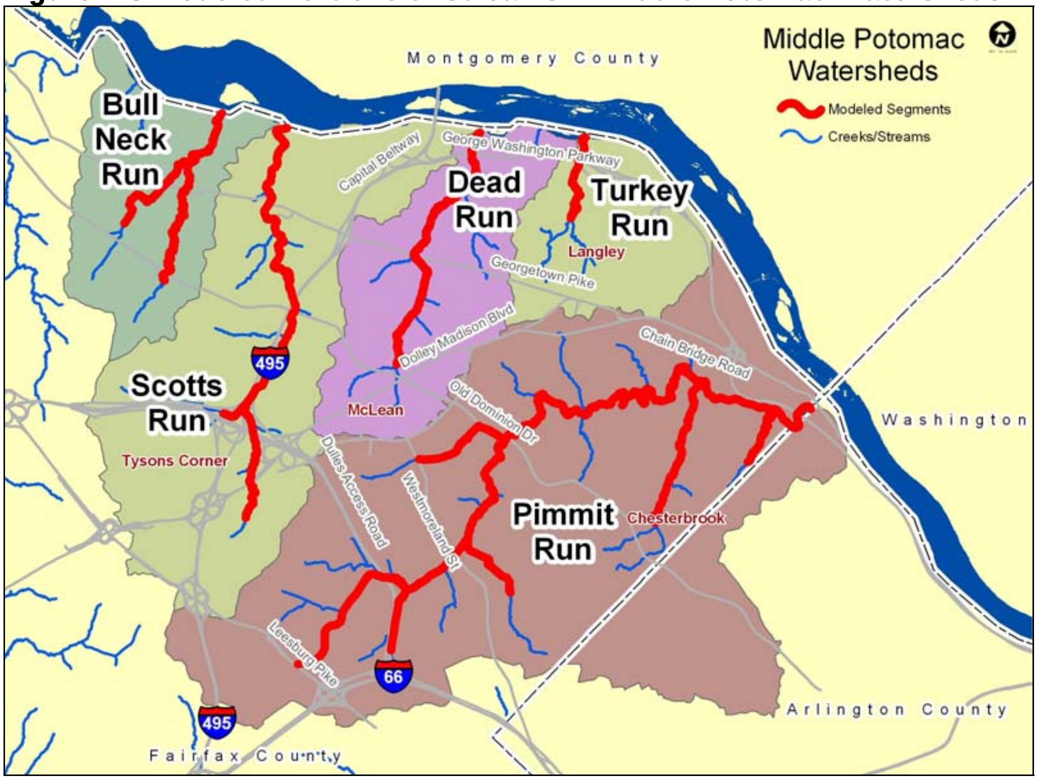
2.6 Modeling Approach and Summary

Planning level hydrologic, hydraulic, and water quality models were created for all five watersheds in the Middle Potomac Watershed Group to help identify potential for flooding, channel erosion, and to estimate pollutant loads in the watersheds. The hydrologic models calculated the amount of stormwater runoff generated by different storm events. The hydraulic models routed the stormwater runoff in the streams in order to calculate the water elevation and flow velocity. The water quality models calculated an estimated amount of pollutants generated by the different land uses in the watersheds. Current and anticipated ultimate development conditions (future) were modeled to evaluate the effects of development in the watersheds and estimate the benefits of proposed projects.

These planning level models were used to supplement the field data collected for the SPA, described in Section 2.5.10, and to evaluate the cause and effect relationship between land use, management strategies and actual stream conditions. The SPA data and subsequent field reconnaissance were the primary sources of identifying actual problem areas in the watersheds. The models were used primarily to aggregate the flow and pollutant reduction benefits of proposed improvement projects that would be achieved after project implementation.

The hydrologic and water quality models cover all 26 square miles contained in the Middle Potomac Watersheds. This area was divided into 86 subbasins that are the smallest watershed area units in the hydrologic model with an average size of approximately 194 acres. The subbasins are shown on Map 2.4 at the end of this chapter. Runoff and water quality data for existing and future conditions was generated for each of the subbasins. For the hydraulic models, all streams that traversed more than one subbasin were modeled. The hydraulic models start downstream of the headwater subbasins and continue to the Potomac River. Figure 2.3 below shows the stream segments in the hydraulic models as well as the extent of streams walked during the SPA.

Figure 2.3 Modeled Portions of Streams in Middle Potomac Watersheds



Part of project implementation will be using the planning level models created for this plan as a foundation to develop more detailed models which will support the design of projects such as stormwater ponds and stream restoration.

The modeling guidelines in the Technical Memorandum No. 3, Stormwater Model and GIS Interface Guidelines, provided by the county, were used in developing the models. Appendix D, Watershed Modeling Process, presents the details of the model setup and results.

The work to develop the models and analyze the results included the following steps:

- Selection of subbasin scale and delineation of subbasins
- Characterization of existing soils, land use, and impervious cover based on county GIS and other mapping sources
- Collection of stream channel and crossing data
- Prediction of ultimate land use conditions based on the county *Comprehensive Plan* and zoning
- Assessment of water quantity and quality impacts to identify existing and potential future problem areas

All of the watershed areas were included in the hydrologic model. The majority of the soils data for infiltration was developed from the National Resource Conservation Service State Soil Geographic database and the remainder of the soil data was developed from the county soil GIS data which were only available for part of the study area.

As described in Section 2.4 of Appendix D, the existing impervious cover for the model was developed from the county's GIS layers showing impervious land cover for roads, buildings, and parking areas. The paved area of sidewalks and driveways was estimated and added to the total impervious land cover calculations. The ultimate build-out land use conditions were developed from the county's *Comprehensive Plan* for underutilized and vacant parcels. The increase in residential imperviousness caused by adding on to existing houses was reflected in the future land use conditions for the hydrologic model.

The stream channel profiles and cross sections were developed from the county's topographical GIS data and the stream culvert and bridge crossing data were developed from field survey data. The hydraulic model includes approximately 22 miles of streams, as shown in Figure 4.1 in Appendix D, and 36 major road crossings over the various streams located within the Middle Potomac Watersheds. The small stream segments and tributaries near the headwaters of the major streams in the Middle Potomac Watersheds and the small streams draining directly into the Potomac River were not included in the hydraulic model. The existing stormwater management and best management practice facilities were simulated in the model to estimate the peak flow control for parcels developed from 1972 to 1993 and the peak flow control and water quality treatment for parcels developed after 1993. The county's inventory of stormwater management facilities was used to verify which parcels had stormwater controls.

The hydrologic and hydraulic models were calibrated to validate the model results. No historical stream gage data were available for the Middle Potomac Watersheds, so the calibration was based on historical flooding information for each watershed. The model parameters were adjusted during the calibration process to replicate the historical road flooding conditions. The calibrated hydrologic and hydraulic models were run for three rainfall events corresponding to the two-year return period, the ten-year return period, and the 100-year return period for both existing and future build-out conditions. Peak discharges for each subbasin were compared to evaluate the change in cumulative peak runoff flows in the streams as a result of the change in existing land use, and the results for the ten-year rainfall event are shown on Map 2.5. The subbasins with high peak runoff amounts are located in the highly developed areas of Tysons Corner and McLean. The cumulative effect of future development in Tysons Corner can be seen for the entire length of Scotts Run on Map 2.5. The cumulative peak flow amounts are described in the modeling summaries for each watershed in Chapters 4 through 8.

The model results were examined for the two- and ten-year peak rainfall events to determine the flooding locations. The results from the models were then compared to documented erosion and flooding within each subwatershed to further validate the hydraulic model. The model results for the 100-year peak rainfall event were also used to determine the boundaries of the 100-year flood limit. These boundaries were compared to the county's 100-year floodplain and found to be similar for all subwatersheds. The dwellings located in the 100-year flood limit were identified and the number of households is shown under the Flood Protection Projects in Chapters 5, 6, and 8. The county's 100-year floodplain for each watershed are shown on the Watershed Characteristics maps in Chapters 4 through 8.

The water quality model was used to determine the pollutant loading rates for the five-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), dissolved phosphorous (DP), total phosphorous (TP), total Kjeldahl nitrogen (TKN), total nitrogen (TN), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) for each watershed. The pollutant generation parameters used for the water quality model were developed by the county. The hydrologic model was run for a continuous time period to calculate the average annual contribution of each pollutant in units of pounds per acre per year for both existing and future land use conditions and the pollutant loading rates are shown in Table 2.16. The increase in the pollutant loading rates ranges from approximately two percent to 39 percent. The increases in the pollutant loading rates for total phosphorous, total nitrogen, and total suspended solids from existing development conditions to future development conditions for each subbasin are shown on Maps 2.6, 2.7, and 2.8.

Table 2.16 Water Quality Pollutant Loading Rates

Pollutants[1]		Bull Neck Run	Upper Scotts Run	Lower Scotts Run	Dead Run	Turkey Run	Upper Pimmit Run	Middle PimmitRun	Lower Pimmit Run	Little Pimmit Run
BOD5	Existing (lb/ac/yr)	9.3	57.9	9.3	19.9	19.5	24.5	14.8	16.7	18.0
	Future (lb/ac/yr)	12.1	68.2	11.3	22.5	20.2	27.4	17.8	18.0	18.8
	% Load Increase	30%	18%	22%	13%	4%	12%	20%	8%	4%
COD	Existing (lb/ac/yr)	55.2	299.7	54.0	118.4	117.7	146.0	85.9	96.3	102.3
	Future (lb/ac/yr)	70.8	334.3	65.3	133.5	122.0	161.9	102.2	103.6	107.0
	% Load Increase	28%	12%	21%	13%	4%	11%	19%	8%	5%
TSS	Existing (lb/ac/yr)	39.9	213.3	30.8	70.8	110.6	83.5	53.3	51.5	60.8
	Future (lb/ac/yr)	48.3	231.4	36.4	76.6	113.7	91.0	61.7	55.1	63.2
	% Load Increase	21%	8%	18%	8%	3%	9%	16%	7%	4%
TDS	Existing (lb/ac/yr)	50	264	47	92	122	112	69	71	78
	Future (lb/ac/yr)	60	286	53	101	125	122	79	75	81
	% Load Increase	20%	8%	13%	10%	2%	9%	14%	6%	4%
DP	Existing (lb/ac/yr)	0.23	0.63	0.23	0.34	0.33	0.34	0.26	0.30	0.31
	Future (lb/ac/yr)	0.31	0.69	0.27	0.38	0.35	0.38	0.30	0.32	0.32
	% Load Increase	35%	10%	17%	12%	6%	12%	15%	7%	3%
TP	Existing (lb/ac/yr)	0.31	0.88	0.33	0.49	0.47	0.49	0.37	0.42	0.44
	Future (lb/ac/yr)	0.43	0.95	0.38	0.53	0.49	0.53	0.43	0.45	0.46
	% Load Increase	39%	8%	15%	8%	4%	8%	16%	7%	5%
TKN	Existing (lb/ac/yr)	1.8	4.7	1.8	2.7	2.8	2.7	2.1	2.4	2.5
	Future (lb/ac/yr)	2.4	5.0	2.1	3.0	2.9	3.0	2.4	2.5	2.6
	% Load Increase	33%	6%	17%	11%	4%	11%	14%	4%	4%

Pollutants[1]			Bull Neck Run	Upper Scotts Run	Lower Scotts Run	Dead Run	Turkey Run	Upper Pimmit Run	Middle PimmitRun	Lower Pimmit Run	Little Pimmit Run
TN		Existing (lb/ac/yr)	2.46	8.12	2.40	3.82	4.09	4.00	2.90	3.21	3.40
		Future (lb/ac/yr)	3.24	8.95	2.76	4.15	4.25	4.36	3.35	3.40	3.56
		% Load Increase	32%	10%	15%	9%	4%	9%	16%	6%	5%
Cadmium ($x\ 10^{-4}$)		Existing (lb/ac/yr)	2.0	3.8	2.3	2.8	2.7	2.6	2.2	2.4	2.4
		Future (lb/ac/yr)	2.5	3.7	2.4	3.0	2.8	2.8	2.4	2.5	2.5
		% Load Increase	25%	-3%	4%	7%	4%	8%	9%	4%	4%
Copper ($x\ 10^{-3}$)		Existing (lb/ac/yr)	13.4	87.4	6.5	21.3	46.0	30.6	14.8	9.5	13.4
		Future (lb/ac/yr)	15.0	88.9	7.3	22.1	47.0	32.4	15.9	10.3	13.7
		% Load Increase	12%	2%	12%	4%	2%	6%	7%	8%	2%
Lead ($x\ 10^{-3}$)		Existing (lb/ac/yr)	2.0	13.4	2.2	3.8	4.2	4.8	2.9	3.0	3.2
		Future (lb/ac/yr)	2.3	15.7	2.4	4.2	4.3	5.3	3.3	3.1	3.3
		% Load Increase	15%	17%	9%	11%	2%	10%	14%	3%	3%
Zinc ($x\ 10^{-2}$)		Existing (lb/ac/yr)	6.8	43.1	3.4	9.7	22.9	13.2	7.3	5.1	7.3
		Future (lb/ac/yr)	7.7	45.2	4.0	10.0	23.4	14.2	8.0	5.4	7.5
		% Load Increase	13%	5%	18%	3%	2%	8%	10%	6%	3%

[1]Does not include pollutant loadings from subbasins that drain directly to the Potomac River.

Nitrogen, phosphorus, and sediment are considered the major pollutants that compromise the health of the Chesapeake Bay and its tributaries. The main source of nitrogen in urban and suburban areas is the fertilizer used for lawns which readily dissolves in surface runoff. Phosphorus also comes from lawn fertilizer and is found attached to sediment particles that wash off the ground surface as well as dissolved in the surface runoff. Nitrogen and phosphorus are typically the limiting nutrients in water for algal growth. Large amounts of algae in the water block sunlight from reaching submerged aquatic vegetation, an important part of the aquatic ecosystem. When algae die and decay, they take essential oxygen from the water, further affecting the health of the aquatic system. The sediment in the runoff comes mainly from erosion of the land and stream channels. Excess sediment destroys aquatic habitat and, when suspended in the water, blocks sunlight from reaching the aquatic plants located at the stream bottom.

More detailed information about the existing and future conditions hydrologic and hydraulic modeling results for each watershed is presented in Chapters 4 through 8. Information on the benefits of the modeled alternatives is presented in Chapter 3.

2.7 Future Watershed Condition

Future development in Fairfax County will present a number of challenges to restoring and protecting the Middle Potomac Watersheds due to the estimated increase in impervious area in the watersheds.

Infill development is expected to occur more frequently in the future in the Middle Potomac Watersheds Group because the majority of the watershed area is already developed. It is anticipated that the percent imperviousness will increase in residential areas as additions are made to existing houses or existing houses are replaced with larger houses. This trend of tearing down smaller houses and replacing them with much larger houses, as well as adding large additions to existing houses that are out of character with the surrounding homes, is called mansionization. Policy Action A1.8, explained in Chapter 9, will address this issue.

VDOT projects will also have an impact on the imperviousness in the watersheds. VDOT has plans to improve interchanges and widen roadways, both of which could occur with minimal stormwater controls to diminish the effects of the increased imperviousness. The largest VDOT project in the watersheds is the construction of two new High Occupancy Toll (HOT) lanes along the Capital Beltway between Georgetown Pike and Springfield to be completed by 2010. Approximately half of this project goes through the Scotts Run and Pimmit Run Watersheds. HOT lanes are also being considered on other local highways, including Interstate 66, which goes through a small portion of the Pimmit Run Watershed. Policy Action A1.7 in Chapter 9 suggests an approach to manage this issue.

Another future development in the watersheds is the redevelopment of Tysons Corner in conjunction with the extension of Metro rail though the area. The Tysons Corner area will experience redevelopment as the Washington Metropolitan Area Transit Authority expands their rail lines and adds four rail stations to the area in the future. This redevelopment will further negatively impact Scotts Run unless a stormwater management strategy is implemented. The Tysons Corner Stormwater Strategy Project SC9845, outlined in Chapter 9, recommends that LID measures, new Best Management Practices (BMPs), BMP retrofits, and additional stormwater management requirements for developed properties without existing BMPs should be implemented to mitigate the effects of existing and future impervious areas. In addition, Fairfax County has initiated a Tysons Corner Transportation/Urban Design Study and appointed a Tysons Land Use Task Force to coordinate community participation and recommend changes to the 1994 Tysons Corner Comprehensive Plan. Coordination with the Tysons Land Use Task Force and the Department of Planning and Zoning will be essential in mitigating the impacts of the Tysons Corner redevelopment.

Changes in land use types will also affect the imperviousness of the watersheds. The future watershed group imperviousness is predicted to increase to 27 percent. Mansionization will increase the imperviousness in the watersheds by one percent, for a total imperviousness of 28 percent for the Middle Potomac Watersheds Group.

The main issue with increased impervious area in the watersheds is the resulting increase in stormwater runoff volumes. Reducing the runoff delivered to the streams is a priority of the plan because it will reduce the amount of stream bank erosion, increasing the likelihood of success for stream restoration projects downstream. Runoff reduction will be accomplished through BMP retrofits, new BMPs, new LID projects, and Neighborhood Stormwater Improvement Areas.

While we cannot stop future development in the watersheds from occurring, the plan goals and actions, as summarized in the next chapter, offer ways to lessen the impact of the increased imperviousness due to future development.