Section 3
Description of Subwatershed Conditions

3.1 Introduction

This section provides an overview of conditions for the major subwatersheds in the Cub Run and Bull Run watersheds. The following assesses and evaluates the drainage characteristics, land use, impervious area, existing stormwater controls, stream habitat, water quality, stream geomorphology, concerns identified by the public and stormwater modeling results for the major subwatersheds. These descriptions are based on data contained in various sources described in Section 2 supplemented with information from the public information program, field observations, GIS data and model results.

Section 3.2 provides an overview of land use, impervious area and results of modeling evaluations for the Cub Run watershed, excluding the Bull Run watersheds. The modeled nutrient loads produced by the watershed plan recommendations are compared to the nutrient loading targets previously set for the Occoquan Reservoir watershed and the loadings set by the latest Chesapeake Bay Tributary Strategy loading projections. These results will be used to set the overall nutrient reduction targets for this watershed plan.

Sections 3.3 through 3.9 describe the six major subwatersheds organized from north to south or upstream to downstream. These major subwatersheds are shown on Figure 3-1 and include:

- Upper Cub Run subwatersheds, including Dead Run, Sand Branch, Cain Branch, Schneider Branch and the Cub Run main stem upstream from the confluence with Elklick Run – Section 3.3
- Elklick Run subwatershed – Section 3.4
- Flatlick Branch subwatershed, including Frog Branch and Oxlick Branch – Section 3.5
- Big Rocky Run and Round Lick Branch subwatersheds – Section 3.6
- Lower Cub Run downstream from Elklick Run subwatersheds – Section 3.7
- Bull Run tributaries subdivided into Bull Run East and Bull Run West subwatersheds– Section 3.8

Land Use Descriptions

Existing and future land use are key to characterizing subwatershed conditions and used to relate stream conditions to upstream sources of stormwater runoff and pollutants. The land use data sources and their application in the watershed plan are described below.

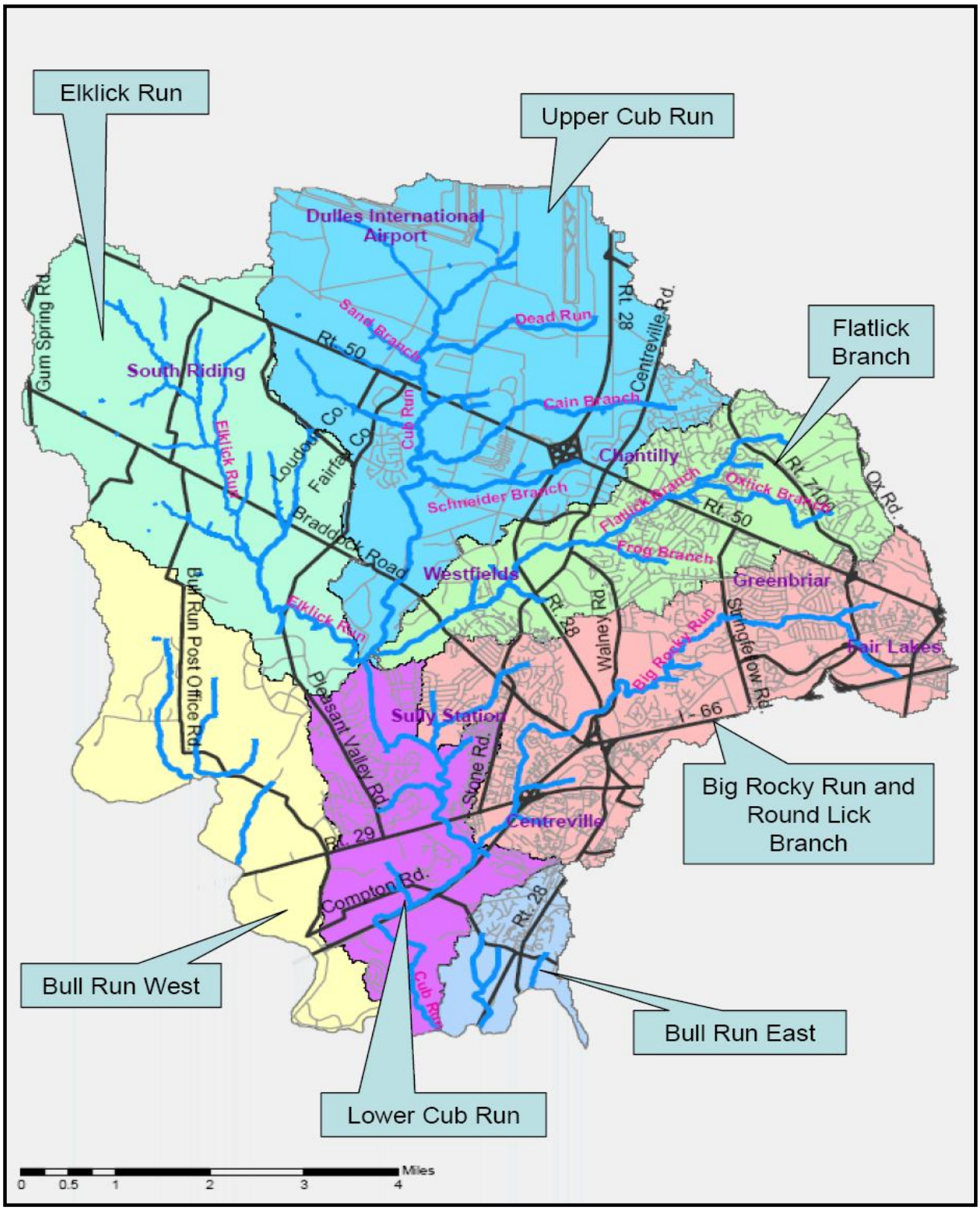


Figure 3-1
Location of Major Subwatersheds

Existing land use is based on the Department of Tax Administration land use records (2003) for each parcel. The study area is developing rapidly. There are several reasons for the plan not including more recent land use data. A lag exists between when development occurs and when it appears in the county GIS data files. The county aerial photography and associated GIS data files are updated roughly every five years. This project used the most recent data available when the study was initiated in 2004. From a watershed planning perspective, it is not imperative that the existing land use is current. Small changes in land use have small incremental changes in watershed conditions. The future land use scenario includes development that may have already occurred and therefore accurately evaluates the cumulative impact of those changes on the watershed.

The future land use describes build-out development conditions, assuming that the land is developed as described by the county's comprehensive plans. These data are based on a GIS layer of parcel land use designation maintained by the Fairfax County Department of Tax Administration edited to represent existing and future land use conditions as described in the county comprehensive land use plans. In some cases, adjustments were made to accurately describe future development. In developing the future land use, if the planned development density is less than the existing development density, the property will not be redeveloped at a lower density.

The accuracy of the existing and future land use descriptions is appropriate for watershed planning. However, they do not include details in the county comprehensive plans. The Fairfax County Comprehensive Plan and Loudoun County General Plan provide accurate and up-to-date descriptions of the planned land use.

The following classifications are used in this watershed plan to describe the land use in both Fairfax and Loudoun counties:

Open Space (OS) – For existing conditions, open space includes parkland, privately owned open space, golf courses and vacant developable land. For future conditions, developable open space is set to the planned land use.

Estate-Residential (ESR) – Single-family detached homes with more than two acres per residence.

Low-Density Residential (LDR) – Single-family detached homes with 0.5 to 2 acres per residences.

Medium-Density Residential (MDR) – Single-family detached homes with less than 0.5 acres per residence and attached multi-family residential with fewer than eight dwelling units per acre.

High-Density Residential (HDR) – Single-family and multi-family residential with more than eight dwelling units per acres.

Low-Intensity Commercial – Office, commercial and public facilities, including schools, libraries and county office buildings. This category includes institutional land uses.

High-Intensity Commercial (HIC) – Retail including shopping centers, strip malls, automobile dealerships and restaurants.

Industrial (IND) – Industrial land use. Within the Cub Run portions of Loudoun and Fairfax counties, this land use includes industrial, commercial, office, retail and some residential as well as conference centers, restaurants and hotels. This land use primarily exists within Dulles International Airport noise impact areas.

Residential Planned Community (AVRES) – A planned community that includes a variety of housing types, employment and commercial. The Cub Run and Bull Run subwatersheds contain little residential planned community land use.

The following sections summarize the subwatershed area within each of these land uses, Dulles International Airport and the Upper Occoquan Sewage Authority (UOSA) advanced wastewater treatment plant.

Existing and Future Impervious Area Estimates

The following sections estimate existing and future impervious area. Impervious area represents the percentage of the land surface covered by roads, parking lots, buildings and sidewalks. These impervious areas prevent rainfall from infiltrating into the soil, and increase the runoff peak flow and volume. Impervious area is therefore a good indicator of the development density and the potential impact the development may have on the streams.

Geographic Information System (GIS) layers containing buildings, roadway pavement, sidewalks and parking lots were used to estimate existing impervious area. These data are based on 1997 aerial photography, the most recent available when this watershed study was initiated. Again, it is not imperative that the watershed plan evaluates current impervious area estimates. These estimates should be considered approximate. Small changes in impervious area associated with recent development produce small changes in overall watershed conditions, though the changes may be more pronounced in local streams near the development. Finally, the watershed plan evaluations consider future land use, including development that can occur based on the county land use plans. Changes that may have occurred as the plan was being developed are accounted for in this future land use scenario.

Underutilized parcels were identified where the existing development density is significantly less than the density allowed by the Loudoun County and Fairfax County land use plans. To estimate the future impervious area, undeveloped and underutilized parcels are assumed to be developed at the planned land use density.

Table 3-1 presents the factors used to estimate the increase in impervious area produced by the various land uses. These were estimated by sampling the impervious

area for areas, including roads, with these land uses within the Fairfax County portions of the watershed. The factors used to estimate increases in impervious area are conservative since they assume a high development density for all future land uses.

The impervious area percentage for the open space and estate residential land use classifications account for roads and institutional uses within these areas. These values represent conservative high estimates of the impervious area that may overestimate the actual impervious area in portions of the watershed. The net result is that the modeling may over-predict the peak flow, flow volume and pollutant runoff from these watershed areas. However, these values do not affect the overall results and conclusions of this watershed plan.

Table 3-1
Impervious Area Estimates Used to Project Impervious Area Increases

Land Use Classification	**Total Impervious Areas (Percent)**
Open Space	5.5
Estate Residential	13
Low-Density Residential	18
Medium-Density Residential	29
High-Density Residential	37
Low-Intensity Commercial	46
High-Intensity Commercial	57
Industrial	58

3.2 Cub Run Watershed

Overview of Conditions in the Cub Run Watershed

- **Drainage area = 34,100 acres (53 square miles)**
- **Approximately 5,400 acres (8.4 square miles) or 16 percent of the watershed is open space preserved in parkland and golf courses.**
- **Undeveloped vacant land (open space) has a potential to decrease by 24 percent in the future based on the Comprehensive Plan. Approximately 50% of this decrease will result from the potential conversion of existing open space to 5-acre lot Estate-Residential land use within the R-C District.**
- **Existing impervious area = 14 percent**
- **Potential Future impervious area = 25 percent**

The following sections summarize the land use, estimates of impervious area and model simulation results for the entire Cub Run watershed, excluding the Bull Run watersheds.

3.2.1 Existing and Future Land Use

Table 3-2 provides an overview of the existing and future land use within the Cub Run watershed. The following bullets summarize the major changes in land use between existing and future conditions as identified by the Loudoun County and Fairfax County land use plans:

- Approximately 5,400 acres (8.4 square miles) or 16 percent of the watershed is open space preserved in parkland and golf courses.
- Undeveloped vacant land (open space) can decrease by 24 percent in the future based on the comprehensive plan. Approximately 50% of this decrease will result from the potential conversion of existing open space to 5-acre lot Estate-Residential land use within the R-C District.
- The next largest change in land use is the development of open space in the Fairfax County portion of the watershed to the land use identified as industrial that includes office, commercial, industrial and residential.

3.2.2 Existing and Future Impervious Area

Table 3-3 provides an overview of the existing and future impervious area estimates for the Cub Run watershed.

The total future watershed impervious area nearly doubles from the existing 13.8 percent to 24.7 percent.

Table 3-2
Summary of Existing and Future Land Use
for the Cub Run Watershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	14,044	41.2	5,811	17.1
Estate-Residential	1,580	4.6	4,129	12.1
Low-Density Residential	949	2.8	2,276	6.7
Medium-Density Residential	5,969	17.5	7,811	22.9
High-Density Residential	2,223	6.5	2,281	6.7
Low-Intensity Commercial	2,229	6.5	2,615	7.7
High-Intensity Commercial	391	1.1	429	1.3
Industrial	1,728	5.1	3,716	10.9
Residential Planned Community	-	-	45	0.1
Dulles International Airport	4,738	13.9	4,738	13.9
Upper Occoquan Sewerage Authority Advanced Wastewater Treatment Plant	228	0.7	228	0.7

Excludes Bull Run watersheds

Table 3-3
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Cub Run Watershed

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Cub Run Watershed	34,080	4,703	13.8	8,418	24.7

3.2.3 Existing Stormwater Controls

Table 3-4 summarizes the number of existing dry and wet ponds and the total subwatershed area upstream from these ponds in the Cub Run watersheds. These values include both Fairfax and Loudoun counties. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Table 3-4
Summary of Number of Ponds and Cumulative
Drainage Area for Cub Run Watershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	174	5,072 acres
Wet Ponds	104	5,419 acres
Total	278	10,491 acres

* - *Includes ponds in both Fairfax and Loudoun counties*

The number of ponds is approximate and represents a best estimate of existing ponds in the spring of 2002 based on aerial photography, county GIS coverages, databases, field inspections and other data sources. The regional ponds within each subwatershed are identified in subsequent sections of this report.

The drainage area upstream from these ponds includes 26 percent of the total watershed area, including most of the developed land area. Existing ponds protect a higher percentage of the total drainage area in the developed watersheds (i.e., Flatlick Branch, Round Lick Branch and Big Rocky Run) than less-developed watersheds. Stormwater ponds are not required within the R-C District where the development is 5-acre Estate Residential Land Use. Developed areas within Loudoun County (South Riding) include 10 wet ponds that serve virtually all of the developed area.

3.2.4 Future Stormwater Controls

Under current Fairfax County and Loudoun County stormwater requirements for new development, much of it will have stormwater controls, primarily on-site wet and dry ponds, to control the peak flows and reduce the stormwater pollution runoff. Evaluation of future development suggests that 19,700 acres or nearly 50 percent of the watershed will be upstream from stormwater controls once development is complete. Areas without controls include development within the R-C District, undeveloped parkland and areas that currently do not have stormwater controls.

3.2.5 Modeling Results

Figure 3-2 presents stormwater modeling results for existing and future conditions for the Cub Run watershed. The existing condition scenario includes existing stormwater controls. The future scenario includes existing stormwater controls plus stormwater controls required by Fairfax County and Loudoun County for new development. The significant increase in impervious area produces smaller relative increases in peak

flows and total phosphorous loads. The total suspended solids (TSS) decrease because BMPs reduce TSS effectively.

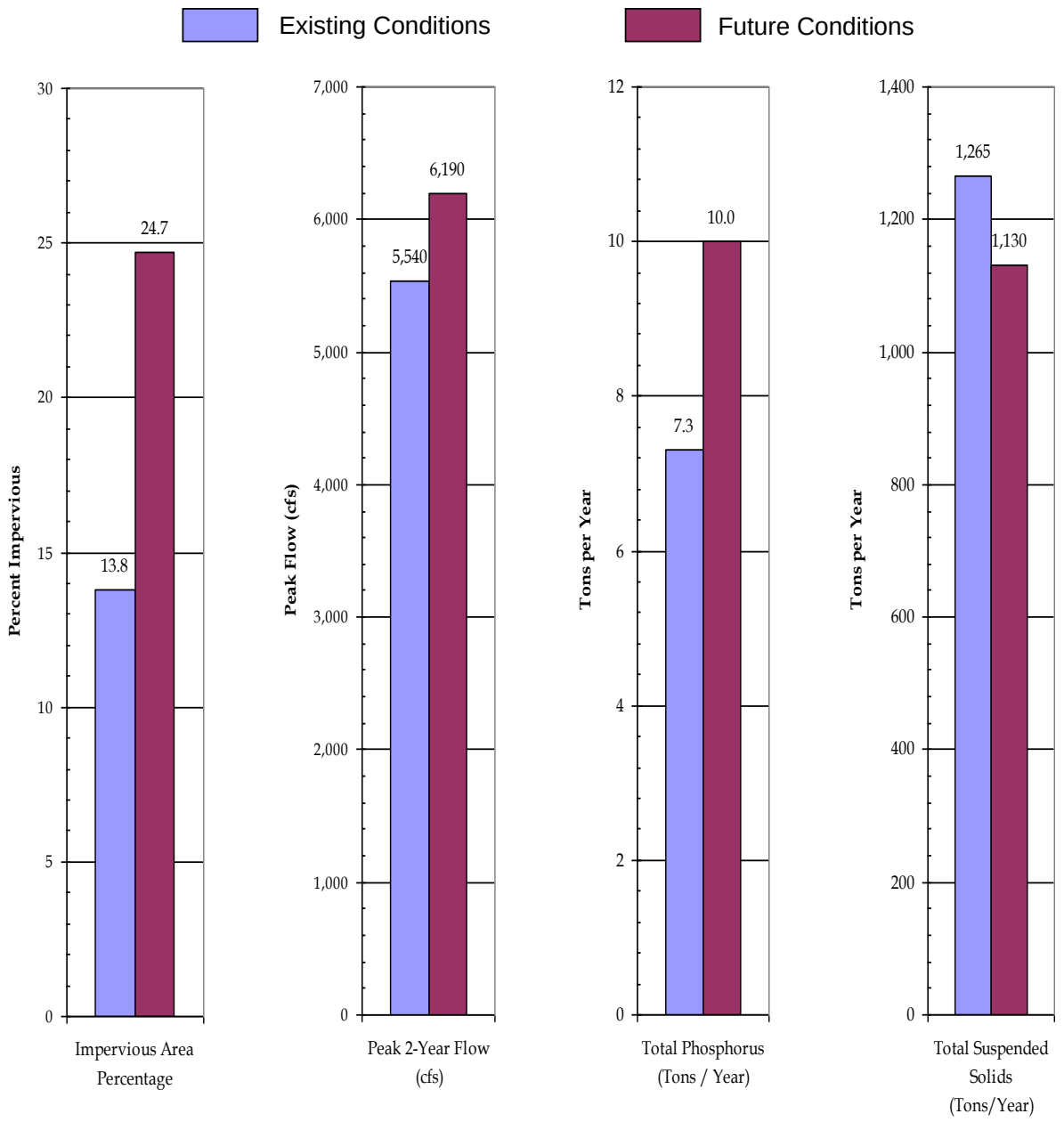
The following sections present simulated loads from Fairfax and Loudoun counties and compare these results with Occoquan Reservoir and Chesapeake Bay Tributary Strategy loading targets.

3.2.5.1 Loads from Fairfax and Loudoun Counties

Table 3-5 presents the total phosphorus loadings for the Fairfax County and Loudoun County portions of the watersheds. This includes the two scenarios presented in Figure 3-2. Simulation results for existing and future land use without stormwater controls are added to demonstrate the benefits of these controls. A fifth scenario is added that presents the loads with the recommended watershed plan dry pond wetland retrofit projects, regional ponds (or alternative stormwater controls) and Low-Impact Development (LID) retrofit projects as described in Section 6 of this report. As summarized in Section 6, the 130 proposed dry pond retrofit projects further reduce the total phosphorus loads by approximately 234 pounds per year. Proposed regional ponds (or alternative projects) will reduce total phosphorus loads by an additional 133 pounds per year. LID retrofit projects at county facilities remove 14 pounds of phosphorus per year.

The unit loading rates (lbs/acre/year) are higher for Fairfax County for existing land use conditions. The future loads for Fairfax County (with stormwater controls) increase by 33 percent whereas the loads for Loudoun County increase by 90 percent. Significant growth projected for Loudoun County causes this. The unit rates for future conditions are greater for Loudoun County in the future, but Fairfax County still produces most (74 percent) of the total phosphorus loads.

The following sections compare the modeled nutrient loads with loading targets developed for the Occoquan watershed and the Virginia portions of the Chesapeake Bay tributaries.



Peak flows and loads are from watershed models. Existing conditions includes existing stormwater controls. Future conditions include existing stormwater controls plus new controls required for new development.

Figure 3-2
Overview of Existing and Future Conditions in the Cub Run Watershed

Table 3-5
Summary of Total Phosphorus Loads From Fairfax and
Loudoun County Portion of the Cub Run and Bull Run Watershed

Scenario	Total Phosphorus Load			
	Units	**Fairfax County (47.7 sq. mi.)**	**Loudoun County (15.3 sq. mi.)**	**Total (63 sq. mi.)**
Existing Land Use No Stormwater Controls	Tons/Year Lbs/Acre/Year	8.0 0.53	1.9 0.38	9.9 0.49
Existing Land Use Existing Stormwater Controls	Tons/Year Lbs/Acre/Year	6.5 0.43	1.6 0.32	8.1 0.40
Future Land Use Existing Stormwater Controls	Tons/Year Lbs/Acre/Year	9.9 0.65	4.0 0.82	13.9 0.69
Future Land Use Future Stormwater Controls	Tons/Year Lbs/Acre/Year	8.5 0.56	3.0 0.61	11.4 0.57
Future Land Use Future Stormwater Controls and Watershed Plan Recommendations	Tons/Year Lbs/Acre/Year	8.1 0.53	3.0 0.61	11.1 0.56

3.2.6 Comparison with Occoquan Watershed Loading Targets

Over the past 25 years, watershed management plans for Occoquan Reservoir tributaries have focused on the control of annual total phosphorus loadings in stormwater runoff. Total phosphorus is used since it is the limiting nutrient for algae growth and eutrophication in the reservoir (OWML, 1998; Fairfax County Office of Comprehensive Planning, 1982; NVPDC, 1982).

For example, the 1982 Occoquan Basin rezoning by the Fairfax County Board of Supervisors was based on an annual total phosphorus loading goal to protect the Occoquan Reservoir water supply. Control of total phosphorus loadings is also important for the Chesapeake Bay tributary strategies, although the control requirements for Occoquan Reservoir loadings are more critical due to the proximity of the water supply and that the Cub Run and Bull Run watersheds compose approximately 10 percent of the reservoir watershed. Therefore, the performance standard for the Cub Run and Bull Run Watershed Management Plan should be based on control of total phosphorus loading goals for the Occoquan Reservoir.

The future land use plan for Cub Run and Bull Run watersheds increase the average annual loadings of total phosphorus in Fairfax County stormwater from 6.5 tons per year to 9.9 tons per year (i.e., a 54 percent increase) in the absence of new stormwater controls. The proposed watershed plan combined with stormwater controls required for new development reduces the future annual loadings of total phosphorus from Fairfax County to 8.5 tons/year (i.e., by 14 percent).

Table 3-6 summarizes the annual total phosphorus loading goals established for the county's 1983 Occoquan Basin rezoning. This rezoning designated approximately 11,700 acres within the Cub Run and Bull Run watersheds for 5-acre lot residential development. The rezoning affected at total of nearly 41,000 acres within Fairfax County. This was the first major application of what is currently known as smart growth or LID to control stormwater pollution loadings in the county and one of the most extensive applications of land use controls for watershed protection ever implemented in the U.S. The average-year rainfall used to set this performance standard is a sequence of more than 100 storm events, which produced 40.6 inches of rainfall during 1967 (NVPDC, 1982). Values in Table 3-6 have been prorated for the average rainfall for the 1967 through 1981 period included in the model simulations for this report (42.3 inches), providing a direct comparison.

As shown in Table 3-6, the equivalent annual total phosphorus-loading goal for the Fairfax County watersheds is 13.1 tons/year, consisting of 8.9 tons/year for the Cub Run and Bull Run watersheds, and 4.2 tons/year for the other Fairfax County Occoquan tributary watersheds (e.g., Little Rocky Run, Johnny Moore Creek and Popes Head Creek).

Table 3-6
Annual Total Phosphorus Loading Goals for
Fairfax County's Occoquan Basin Rezoning

Fairfax County Watersheds (County Area)	**Annual Total Phosphorus Loading Goal (1) (2) (1996-2001 Rainfall)**	
Cub Run and Bull Run Watersheds (48 square miles)	Tons/Year 8.9	Lbs/Acre/Year 0.58
Other Fairfax County Occoquan Watersheds (53 square miles)	4.2	0.25
Totals (100.8 square miles)	13.1	0.41

Notes:

1. *"Annual loading goals" were developed for Fairfax County's "Occoquan Basin Study" (1982), which was the technical basis for the rezoning that was upheld by three major court cases (1985, 1991, 1995).*

2. *The Occoquan Basin Study loading goals were based upon water quality model simulations for "average-year" rainfall conditions (40.6 inches).The Cub Run/Bull Run watershed plans relied upon water quality model runs with a six-year rainfall record (1996-2001) resulting in a slightly greater average annual rainfall volume (42.3 inches). Therefore, the annual total phosphorus loading goals for the Cub Run and Bull Run Watershed Management Plan were increased by 4 percent based on the greater average rainfall (42.3/40.6 = 1.04).*

The annual total phosphorus loading target for the Cub Run and Bull Run study area (48 square miles) represents about two-thirds (8.9 tons/year) of the total loading goal for the county's portion of the Occoquan Basin (101 square miles), even though it covers about one-half of the total county areas in the basin. The "per acre" total phosphorus loadings goal is greater in the Cub Run and Bull Run study area because the county's Occoquan Basin rezoning restricted medium- and high-density development and non-residential development to the upper and middle Cub Run watershed. The other watersheds are almost entirely within the 5-acre residential R-C District.

This approach assumed that structural water quality controls could be most effectively applied to higher-density development in the Cub Run watershed, and that nonstructural LID controls (minimum 5-acre lots) could be effectively applied to lower Cub Run and most other areas in the basin (Occoquan Basin Study by Fairfax County Office of Comprehensive Planning, March 1982).

The future annual total phosphorus load (8.5 tons/year) projected for the Fairfax County portion of the Cub Run and Bull Run watersheds is less than the annual loading goal (8.9 tons/year). This indicates that the proposed Cub Run and Bull Run Watershed Management Plan actions combined with existing and future stormwater controls meet the stormwater management performance standards for Occoquan Reservoir protection as set for the 1982 rezoning and upheld by major court cases decided in the county's favor over the past 20 years.

3.2.7 Chesapeake Bay Tributary Strategy

The Virginia Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the Shenandoah and Potomac River Basin (March 2005) assumes urban stormwater management water quality controls will be applied to 42.5 percent of the treatable urban area (1,029 square miles).

Although it is not clear how the basin-wide urban stormwater management goals in the Tributary Strategy will be achieved, the watershed plan recommendations, combined with existing watershed management practices, meet or exceed future Chesapeake Bay nonpoint source management standards:

- Fairfax County's portion of the watershed includes more than 5,500 acres where the land use is zoned for 5-acre residential lots. This land use designation, which was implemented to preserve water quality in the Occoquan Reservoir, effectively reduces the nutrient runoff from the Cub Run watershed from what it might had been had this area developed as zoned prior to the 1982 rezoning action.

- The recommended watershed plan combined with existing and future stormwater controls provide water quality controls for 90 percent of the urban development in the county's portion of the watershed. (Water quality controls will serve 33 square miles out of a total 36.4 square miles in urban development.)

- The recommended watershed plan includes the retrofit of water quality controls to 7.2 square mile of watershed, which has no stormwater water quality controls. This represents 33 percent of the developed area outside the 5-acre residential development zone.

- Twenty-three percent of the watershed is preserved as parkland and other open space. This represents a watershed management program that effectively reduces the nutrient loads from these portions of the watershed.

Further, the watershed plan achieves a delivered total phosphorus load per acre that compares favorably with the target in the Shenandoah-Potomac Tributary Strategy.

The latest Tributary Strategy allocation for total phosphorus nonpoint source loads from the Virginia portion (5,723 sq mi) of the Shenandoah-Potomac Basin is 1.12 million lbs/yr (March 2005). This allocation is equivalent to an annual unit area load of 0.31 lbs/acre/yr.

The nutrient trap efficiency in the Occoquan Reservoir is 54 percent for total phosphorus (OWML, 1998). Therefore, the nutrient load delivered to the Chesapeake Bay system by the Fairfax County portion of the Cub Run and Bull Run watersheds based on future land use conditions and the recommended control plan is 3.9 tons/year (8.5 tons/year X (1 - 0.54%) = 3.9 tons/year). This projected future delivered load is equivalent to 0.25 lbs/acre/yr of total phosphorus, which is 18 percent less than the overall Virginia Tributary Strategy target. This is especially important since Cub Run has a high development density.

3.3 Upper Cub Run Subwatersheds

Overview of Conditions in the Upper Cub Run Subwatershed

- **Drainage area = 10,644 acres (16.6 square miles)**
- **Thirty-three percent of the subwatershed is in Loudoun County. Forty-two percent of the subwatershed is within Dulles International Airport property spanning Fairfax and Loudoun counties.**
- **Existing impervious area = 11 percent**
- **Future impervious area = 34 percent**
- **Most of the land area within the Fairfax County portions of the Upper Cub Run subwatershed has planned land use that includes a mix of industrial, commercial, office, retail, conference centers, restaurants, hotels and some residential.**
- **Compared with other areas of the Cub and Bull Run watersheds, this area has very little residential development.**
- **The impervious area is projected to triple between existing and future land use. Fifty percent of the impervious area increase will result from planned development within Dulles Airport.**
- **The existing stream habitat is good to fair and exhibits few areas with active stream erosion.**
- **A primary consideration of the watershed plan will be to minimize impacts of the planned development on the local streams. Since this is a headwater area of the County, the development in this subwatershed may affect the entire Cub Run stream main stem through the Lower Cub Run subwatershed.**

The following sections summarize the conditions in the Upper Cub Run subwatershed.

3.3.1 Overview of Drainage Characteristics

Figure 3-3 shows the Upper Cub Run drainage boundaries and major streams in this subwatershed as well as the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds.

Cub Run's main stem flows north to south with its headwaters within Dulles International Airport property. Named tributaries within this subwatershed include Sand Branch, Dead Run, Cain Branch and Schneider Branch. There are also numerous unnamed tributaries.

The total subwatershed area is 10,644 acres. Thirty-three percent of the area is in Loudoun County. Dulles International Airport includes approximately 4,715 acres, roughly 44 percent of the total subwatershed area.

3.3.2 Existing and Future Land Use

Table 3-7 provides an overview of the existing and future land use in the Upper Cub Run subwatershed. Under existing conditions, the subwatershed includes large areas of open space that will be developed. These areas are west of Centreville Road, Walney Road and Westfields Boulevard, north of Braddock Road, east of Pleasant Valley Road, and south of Dulles International Airport. They include Westfields and parts of Chantilly.

Table 3-7
Summary of Existing and Future Land Use in the Upper Cub Run Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	2,288	21.5	853	8.0
Estate-Residential	532	5.0	582	5.5
Low-Density Residential	245	2.3	276	2.6
Medium-Density Residential	373	3.5	482	4.5
High-Density Residential	149	1.4	149	1.4
Low-Intensity Commercial	947	8.9	947	8.9
High-Intensity Commercial	85	0.8	85	0.8
Industrial	1,309	12.3	2,554	24.0
Residential Planned Community	-	-	-	-
Dulles Airport	4,715	44.3	4,715	44.3

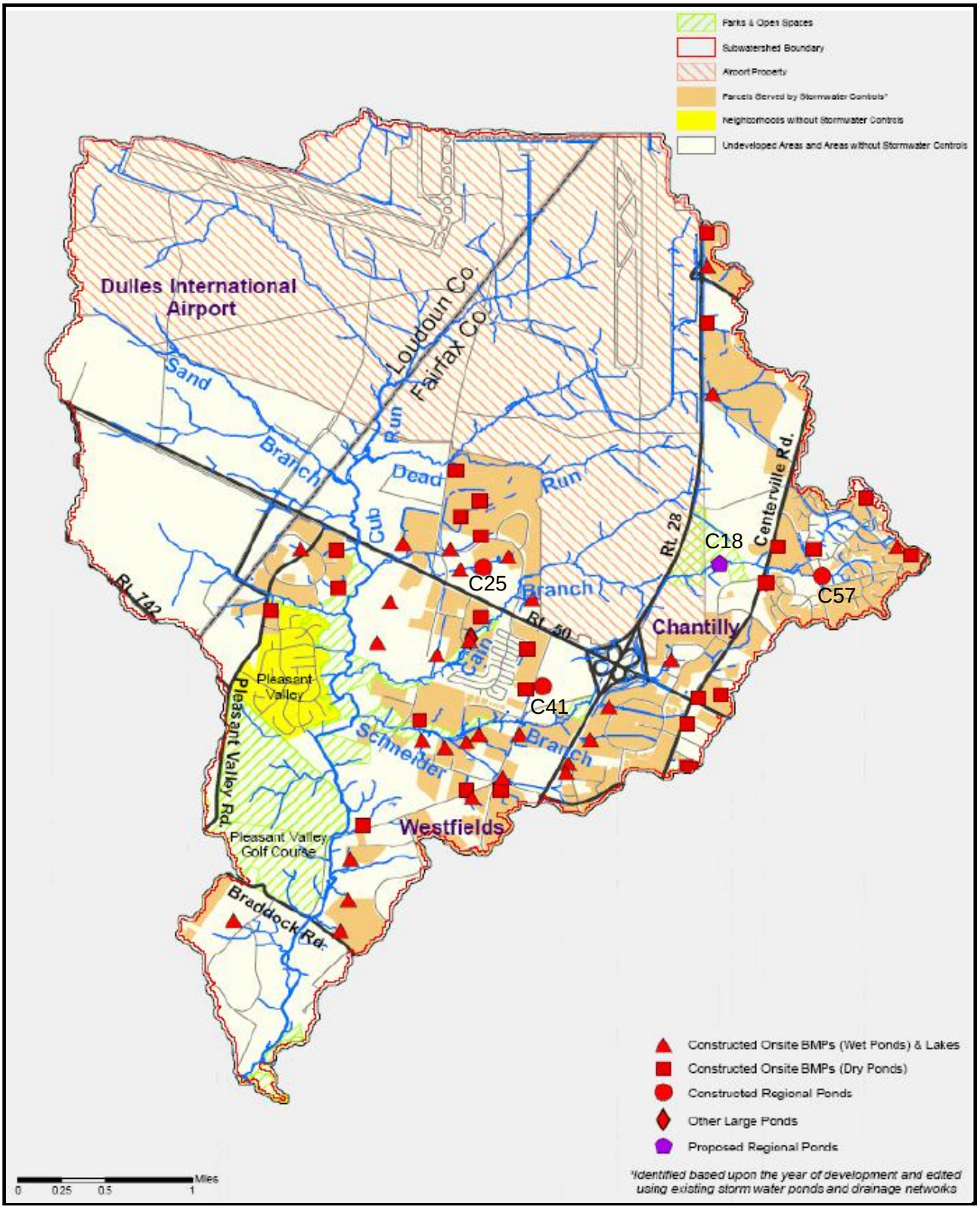


Figure 3-3
Stormwater Facilities in the
Upper Cub Run Subwatershed

Future changes in land use result primarily from converting undeveloped open space to the planned land use. Much of this area is planned for, or has options for, non-industrial uses, including office parks, conference centers, various retail, hotels, restaurants and some residential uses. This subwatershed also has significant areas with a planned land use designation of "Mixed Use," which includes a mix of related uses such as office, hotel, residential and/or retail development. These areas generally have high percentages of impervious area and, for the purposes of watershed planning, similar impacts on the county streams.

The high planned development density in this subwatershed partially results from changes to the county land use plan as part of the rezoning to protect the Occoquan Reservoir water supply. In conjunction with the rezoning of nearly 41,000 acres of land to the R-C District, the Zoning Ordinance was amended to allow higher development densities to promote employment in areas near Dulles International Airport and prevent incompatible residential uses from areas with high projected airport-related noise impacts.

The Upper Cub Run subwatershed has relatively little residential land use compared to other areas of the Cub and Bull Run watersheds (e.g., Flatlick Branch and Big Rocky Run). The County Plan was developed to minimize residential development within areas most affected by aircraft noise associated with Dulles International Airport. Existing and future residential development is primarily in the following areas within this subwatershed:

- Headwaters of Cain Branch located east of Centreville Road and including portions of Chantilly Highlands, Franklin Farm Foundation, Armfield Farms and Franklin Glen Governance
- Meadows of Chantilly Mobile Home Community
- Pleasant Valley subdivision

3.3.3 Existing and Future Impervious Area

Table 3-8 provides an overview of the existing and projected future impervious area estimates for the Upper Cub Run subwatersheds.

The subwatersheds have a relatively low density of development; however, they are rapidly developing. Based on the planned land use, these subwatersheds will have some of the highest development densities in the Cub Run and Bull Run watersheds.

Table 3-9 summarizes the existing and future impervious area in Fairfax County, Loudoun County and Dulles International Airport portions of the subwatershed. In this table, the Fairfax County and Loudoun County values exclude the airport, which spans the county line.

Table 3-8
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Upper Cub Run Subwatershed

Subwatershed	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Sand Branch	788	47	6	355	45
Dead Run	1,474	133	9	531	36
Cain Branch	1,407	183	13	450	32
Schneider Branch	1,134	295	26	476	42
Upper Cub Run Main Stem	5,841	526	9	1,811	31
TOTAL UPPER CUB RUN SUBWATERSHED	**10,644**	1,183	**11**	3,622	**34**

Table 3-9
Summary of Existing and Future Impervious Area for the Dulles Airport, Loudoun County and Fairfax County Portions of the Upper Cub Run Subwatershed

	Total Area in Upper Cub Run Subwatershed (Acres)	Existing Impervious Area		Future Impervious Area	
		(Acres)	(Percent)	(Acres)	(Percent)
Fairfax County *	4,882	703	14	1,421	29
Loudoun County *	1,255	102	8	551	44
Dulles Airport	4,506	399	9	1,642	36
Total Subwatershed	**10,643**	**1,230**	**11**	**3,614**	**34**

* *Values for Fairfax County and Loudoun County excluding Dulles Airport*

The impervious area will triple for future land use. Approximately 50 percent of the impervious area increase results from planned Dulles International Airport expansion. Development within Loudoun County and Fairfax County also contributes significantly to the impervious area increase.

3.3.4 Existing Stormwater Controls

Figure 3-3 shows the dry and wet stormwater ponds in the Upper Cub Run subwatershed and the developed area upstream from these ponds. This figure also shows the location of existing and planned Fairfax County regional ponds, and existing ponds that serve large areas but are not part of the county regional pond program.

Table 3-10 summarizes the number of existing dry ponds, wet ponds and regional ponds, and the total subwatershed area served by these ponds. The watershed may contain other stormwater controls, such as underground detention and treatment facilities, and rooftop detention.

Table 3-10
Summary of Number of Ponds and Cumulative Drainage Area
For the Upper Cub Run Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	25	663 acres
Wet Ponds	26	1,645 acres
Total in Subwatershed	51	2,308 acres

The existing dry and wet ponds cover 22 percent of the total area and most of the developed area in the subwatershed.

The Loudoun County portions of the subwatershed were undeveloped when this inventory was performed. Future development will include stormwater ponds to control peak flows and stormwater quality to comply with the Loudoun County Development Standards Manual.

Three constructed Fairfax County regional ponds exist in the Upper Cub Run subwatershed:

- C25 was constructed as a series of wet ponds located on an unnamed tributary within the Avion Business Park.

- C41 is a newly constructed pond located on an unnamed tributary to Cain Branch within the West Fairfax commerce center. This pond serves a portion of the Route 28–Route 50 interchange.

- C57 is a dry pond located towards the headwaters of Cain Branch east of Centreville Road within the Armfield Farms community.

The subwatershed includes one previously proposed but not constructed regional pond identified as C18, with a planned location on Cain Branch between Route 28 and Centreville Road.

A pond on Cain Branch south of Route 50 can be considered regional due to the large upstream drainage area. This pond is not part of the Fairfax County regional pond program.

3.3.5 Stream Habitat

Physical Habitat

The Fairfax County Stream Physical Assessment Study summarizes the stream physical habitat. Assessment data are not available for Loudoun County streams. Figure 3-4 shows the stream physical habitat ratings for the streams in the Upper Cub Run subwatershed, and Table 3-11 summarizes these ratings.

For the most part, the physical habitat conditions are rated as good and fair.

Table 3-11
Summary of Physical Stream Habitat Ratings
Upper Cub Run Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.4	2
Good	8.6	57
Fair	4	27
Poor	2.2	14
Very Poor	-	-

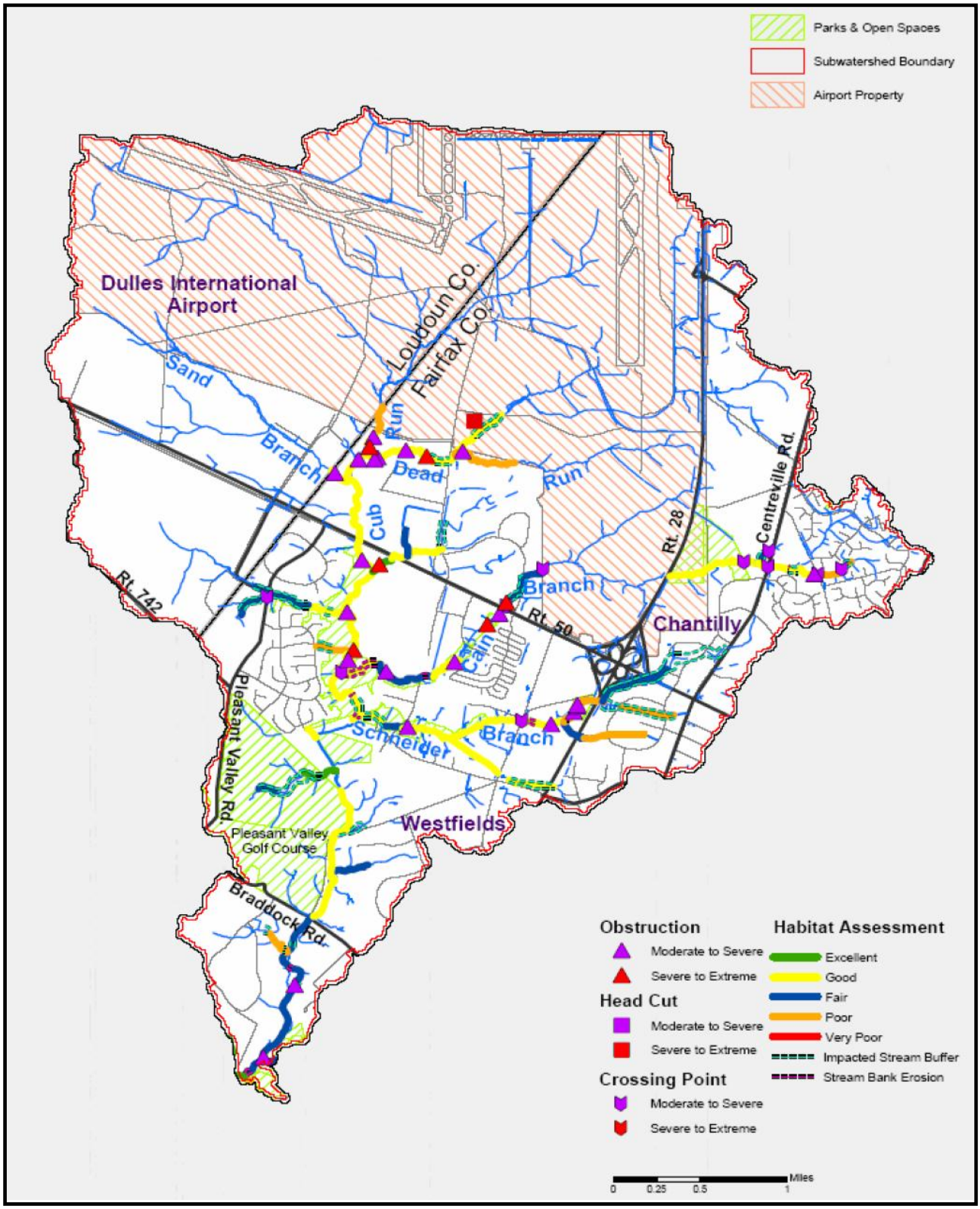


Figure 3-4
Existing Conditions in the
Upper Cub Run Subwatershed

Excellent habitat is found on two small tributaries to Cub Run. Good habitat occurs within many reaches of Cub Run and lower reaches of Schneider Branch. Poor habitat occurs on several small tributaries and upper reaches of Schneider Branch near the Route 28 interchange, and business parks southeast of this interchange that have a very high impervious area and impacted stream buffers.

Figure 3-4 also shows the following information from the Stream Physical Assessment Study:

- Locations where the stream buffer is impacted
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting.
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-4 includes these features where the impact scores indicate they significantly affect the streams.

The Upper Cub streams have few stream erosion lines and other inventory points. Streams with erosion inventory lines and impacted buffers are scattered throughout the subwatershed.

Fish and Benthic Macroinvertibrate Studies

The Stream Protection Strategy includes three sampling locations in the Upper Cub Run subwatershed where the fish and benthic macroinvertibrates were sampled and studied. The conditions found at these sites are summarized on Table 3-12.

These data suggest that the habitat quality in the subwatershed is fair to good and correlate well with the physical habitat assessments. Based on these evaluations, the Cub Run main stem above Cain Branch is a watershed protection area where the high quality stream environments are managed to protect the existing conditions. Cain Branch is in Restoration I watershed management area where causes of stream degradation are identified and remedied. The areas tributary to the upper Cub Run main stem are in the Restoration II category where the watershed is impaired and managed to prevent further degradation.

Table 3-12
Summary of Stream Protection Strategy Results for
Upper Cub Run Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Cain Branch immediately upstream from Cub Run	Fair	Poor	Moderate	Fair	Restoration I
Cub Run main stem at Schneider Branch	Good	Fair	Low	Good	Protection
Cub Run main stem below Braddock Road	Poor	Good	Moderate	Good	Restoration II

3.3.6 Stream Water Quality

Fairfax County samples for water quality at a single station (29-08) where Cub Run crosses Braddock Road near the bottom of the subwatershed. These data are summarized in Section 2 and indicate water quality in this subwatershed is typical for many county streams. Fecal coliform concentrations regularly exceed the state criteria for surface waters. Dissolved oxygen levels are high, indicating the stream is healthy. Other measured parameters are within acceptable levels and do not indicate abnormal conditions within this subwatershed.

3.3.7 Stream Geomorphology

Deep clay soils and shale characterize the stream banks within the Upper Cub Run subwatershed. The headwater areas north of Route 50 and west of Route 28 have little topographic relief and include many wetland areas. The streams in these areas have ill-defined stream valleys. Towards the bottom of the subwatershed, the stream valleys become more defined.

The Fairfax County Stream Physical Assessment Study includes the Channel Evolutionary Model (CEM) stage. Most of the streams are in stage III and IV, indicating that some stream segments are widening while adjacent segments are stabilizing. Sections in Schneider Branch, lower Dead Run and an unnamed tributary are in stage II, indicating the stream channel is down-cutting.

The stream channel substrate is largely silt though some reaches include cobbles and gravel.

3.3.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Upper Cub Run subwatershed:

- The presence of many illegal dumps along Route 50
- Dumping near the location of the old Upper Cub Run wastewater treatment plant. Dumping was also identified as a problem along Route 50.
- Concerns about runoff from Pleasant Valley Golf Course and its impact on water quality
- Concerns about Loudoun County development and policies, and their potential effects on Fairfax County streams
- Concerns about the impacts of future development at Dulles International Airport on stream conditions and flooding along the Cub Run mainstream
- Preservation of railroad abutments and other features associated with the Manassas Gap Railroad
- Stream erosion and obstruction along Cub Run main stem at Route 50
- Large office park development in the subwatershed and lack of implementation of state-of-the-art stormwater controls to limit impacts on streams
- Impact of large church development on Pleasant Valley Road near Route 50
- Flooding near Old Lee Road and Braddock Road
- Impact of development on stream flooding, and on the Federal Emergency Management Agency (FEMA) designated 100-year flood plain and associated requirements for flood insurance, especially near Pleasant Valley

3.3.9 Modeling Results

Figure 3-5 presents stormwater modeling results for the Upper Cub Run subwatershed for existing and future conditions. Section 2.8 presents additional details on the modeling and the modeled scenarios.

The modeling results indicate peak flows and velocities for the two-year design storm will decrease slightly between existing and future conditions with stormwater controls. The modeled scenario assumes that stormwater controls for Dulles International Airport improvements will control flows from existing runways that do not have such controls. This reduction also results from stormwater retention ponds that reduce peak flows and thus provide the greatest benefit in watershed headwaters.

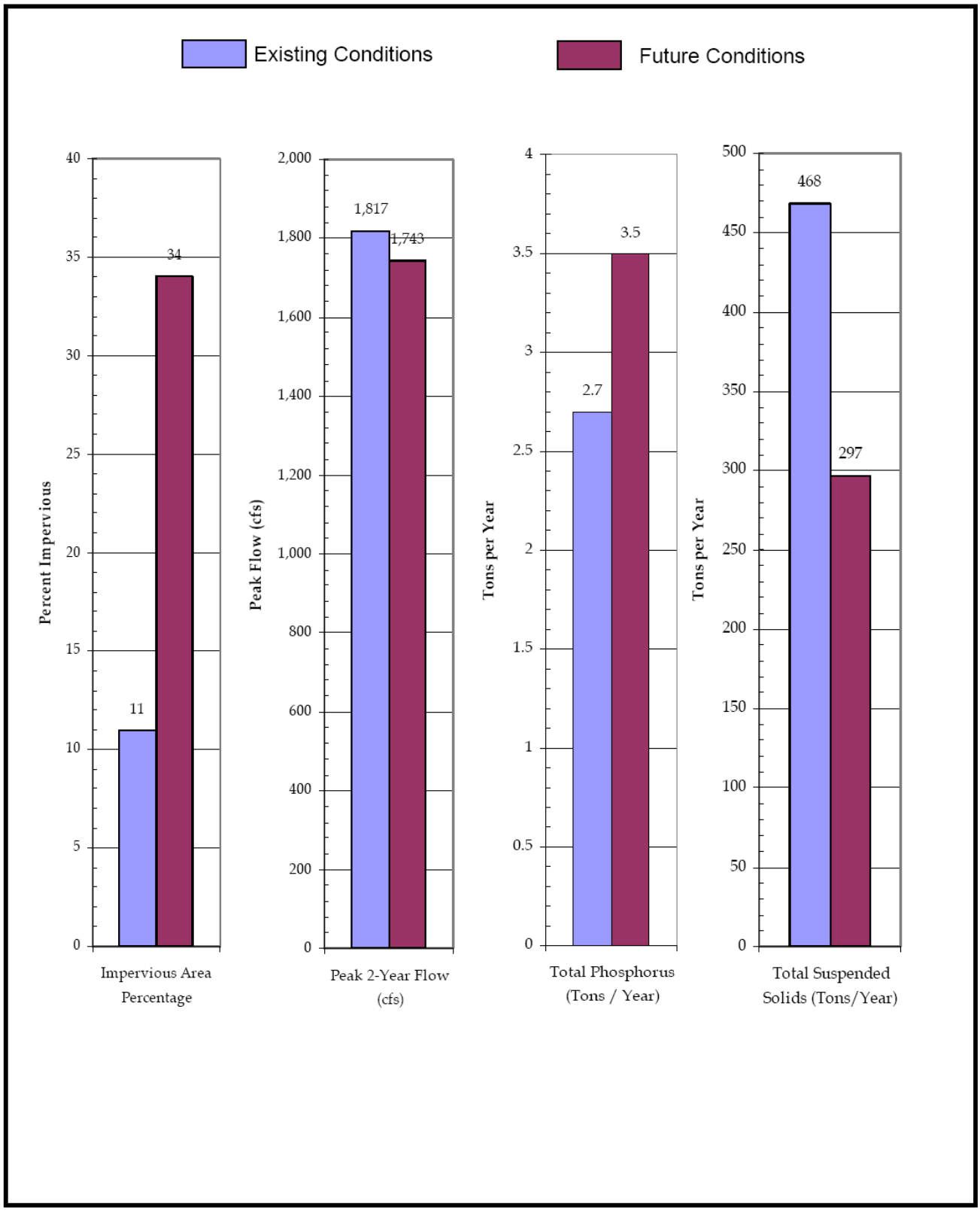


Figure 3-5
Overview of Existing and Future Conditions
in the Upper Cub Run Subwatershed

3.4 Elklick Run Subwatershed

Overview of Conditions in the Elklick Run Subwatershed

- **Drainage area = 7,406 acres (11.6 square miles)**
- **Seventy-five percent of the subwatershed is in Loudoun County**
- **Existing impervious area = 9 percent**
- **Future impervious area = 19 percent**
- **The Fairfax County portion of the Elklick Run subwatershed is in the R-C District. The planned land use is about 30 percent five-acre Estate Residential land use and the remaining area is Fairfax County Park Authority Sully Woodlands parkland. This area currently has and will continue to have a low development density. Existing and future impervious areas equal 1 and 9 percent, respectively.**
- **Seventy five percent of the Elklick Run subwatershed is within Loudoun County. Areas in Loudoun County portions of the subwatershed include low-, medium- and high-density residential development. Higher density development will mostly occur north of Braddock Road. The Loudoun County portion of the Elklick Run subwatershed includes the South Riding development as well as commercial areas along the Route 50 corridor. Existing and future impervious areas equal 11 and 22 percent, respectively.**
- **The Loudoun County portion of the subwatershed includes various wet stormwater ponds that control the runoff from the existing development. These include large ponds at the outlets of the major streams. Future development will also likely include ponds to control peak flows and reduce pollutant loads as required by the Loudoun County Development Standards Manual.**
- **The subwatershed includes four proposed but not constructed Fairfax County regional stormwater ponds.**
- **Based on the available data, the habitat in the Fairfax County streams is good to fair.**
- **The main stem of Elklick Run in Fairfax County is in CEM stage IV indicating that the stream is starting to stabilize.**
- **The primary concern for this subwatershed is the impact that Loudoun County development will have on the conditions of the Fairfax County streams.**

The following sections summarize the conditions in the Elklick Run subwatershed.

3.4.1 Overview of Drainage Characteristics

Figure 3-6 shows the Elklick Run subwatershed drainage boundaries and the major streams as well as the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds.

Elklick Run flows northwest to southeast with its headwaters in Loudoun County. There are no named tributaries; however, the subwatershed includes numerous unnamed tributaries.

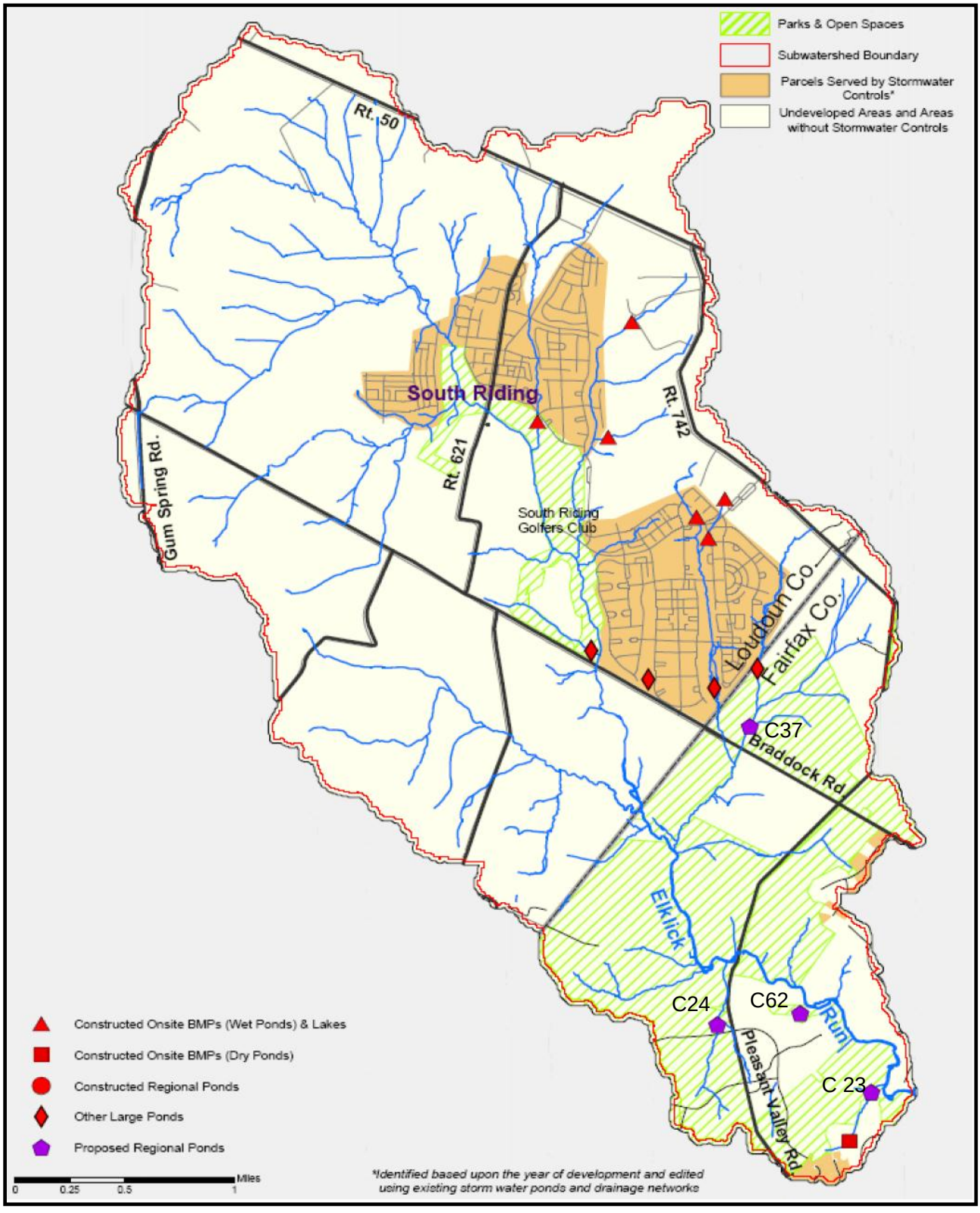


Figure 3-6
Stormwater Facilities
in the Elklick Run Subwatershed

The total subwatershed area is 7,406 acres (11.6 square miles). Seventy-five percent of the subwatershed area is in Loudoun County.

3.4.2 Existing and Future Land Use

Tables 3-13 and 3-14 summarize the existing and future land use in the Fairfax County and Loudoun County portions of the Elklick Run subwatershed.

The Fairfax County portion of the subwatershed lies entirely within the R-C District. Approximately 32 percent of the land is 5-acre Estate-Residential and the remainder is Fairfax County Park Authority parkland. The development density is low and will remain so.

Under existing conditions, the Loudoun County portion of the subwatershed is approximately 22 percent medium-density residential with the remaining land mostly vacant open space or areas with very low development density.

For future conditions, the Loudoun County portions of the subwatershed include low-, medium- and high-density residential development with commercial and office development along the Route 50 corridor. The predominant land use is medium-density residential. Areas south of Braddock road have lower-density planned residential land use with a planned density of up to one home per two acres corresponding to the Estate-Residential land use.

3.4.3 Existing and Future Impervious Area

Table 3-15 provides an overview of the existing and future impervious area estimates.

The Fairfax County portions of the subwatershed have low existing and future impervious area. Impervious area will increase from 1 to 9 percent as the vacant and undeveloped Estate-Residential areas are developed.

The impervious area in Loudoun County portions of the subwatershed will double, increasing from 11 to 22 percent as these areas develop as defined by the Loudoun County General Land Use Plan.

The total subwatershed impervious areas will increase from 9 to 19 percent with 80 percent of the additional impervious area in Loudoun County.

Table 3-13
Summary of Existing and Future Land Use in the Fairfax County Portion of the Elklick Run Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	1,540	84.8	1,233	67.9
Estate-Residential	272	15.0	579	31.9
Low-Density Residential	3	0.2	3	0.2
Medium-Density Residential	-	-	-	-
High-Density Residential	-	-	-	-
Low-Intensity Commercial	-	-	-	-
High-Intensity Commercial	-	-	-	-
Industrial	-	-	-	-
Residential Planned Community	-	-	-	-
Dulles Airport	-	-	-	-

Table 3-14
Summary of Existing and Future Land Use in the Loudoun County Portion of the Elklick Run Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	4,375	78.3	206	3.7
Estate-Residential	-	-	1,766	31.6
Low-Density Residential	-	-	844	15.1
Medium-Density Residential	1,192	21.3	2,388	42.7
High-Density Residential	-	-	39	0.7
Low-Intensity Commercial	-	-	144	2.6
High-Intensity Commercial	-	-	-	-
Industrial	-	-	177	3.2
Residential Planned Community	-	-	-	-
Dulles Airport	23	0.4	23	0.4

Table 3-15
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Elklick Run Subwatershed

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Fairfax County	1,816	18	1	163	9
Loudoun County	5,590	615	11	1,230	22
TOTAL	**7,406**	633	**9**	1,393	**19**

3.4.4 Existing Stormwater Controls

Figure 3-6 shows the stormwater ponds in the Elklick Run subwatershed and the developed area upstream from these ponds. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Fairfax County

A single dry pond exists in the Fairfax County portions of the subwatershed. This pond controls runoff from a low-density residential area. Ponds are not required to serve the Estate-Residential and parkland that composes the remainder of the subwatershed.

Four proposed but not constructed regional ponds sites are within this subwatershed:

- C23 is on an unnamed tributary south of Elklick Run.
- C24 is on an unnamed tributary to Elklick Run west of Pleasant Valley Road.
- C37 is on an unnamed tributary to Elklick Run near the Loudoun County border.
- C62 is on an unnamed tributary south of Elklick Run

Loudoun County

The Loudoun County portion of the subwatershed includes 10 wet ponds that control the runoff from all of the developed land. Development includes four large wet ponds downstream from the existing and future development that can be considered regional due to the large upstream drainage area.

3.4.5 Stream Habitat

Physical Habitat

The Fairfax County Stream Physical Assessment Study summarizes the stream physical habitat condition for the Fairfax County streams. Figure 3-7 shows the stream

physical habitat ratings for the Elklick Run streams, and Table 3-16 summarizes these ratings.

Table 3-16
Summary of Physical Stream Habitat Ratings for the Fairfax County Portions of the Elklick Run Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.8	12
Good	2.8	40
Fair	3.3	47
Poor	0.1	2
Very Poor	-	-

The physical habitat is mostly fair to good with some of it excellent. Poor habitat is limited to a small tributary north of Cub Run and west of Pleasant Valley Road. This stream is within the golf course, which affects the stream buffers.

The lower reach Elklick Run exhibits excellent habitat ratings.

Fair habitat is limited to tributaries, whereas most of the Elklick Run main stem has good physical habitat ratings.

Figure 3-7 also shows the following from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion

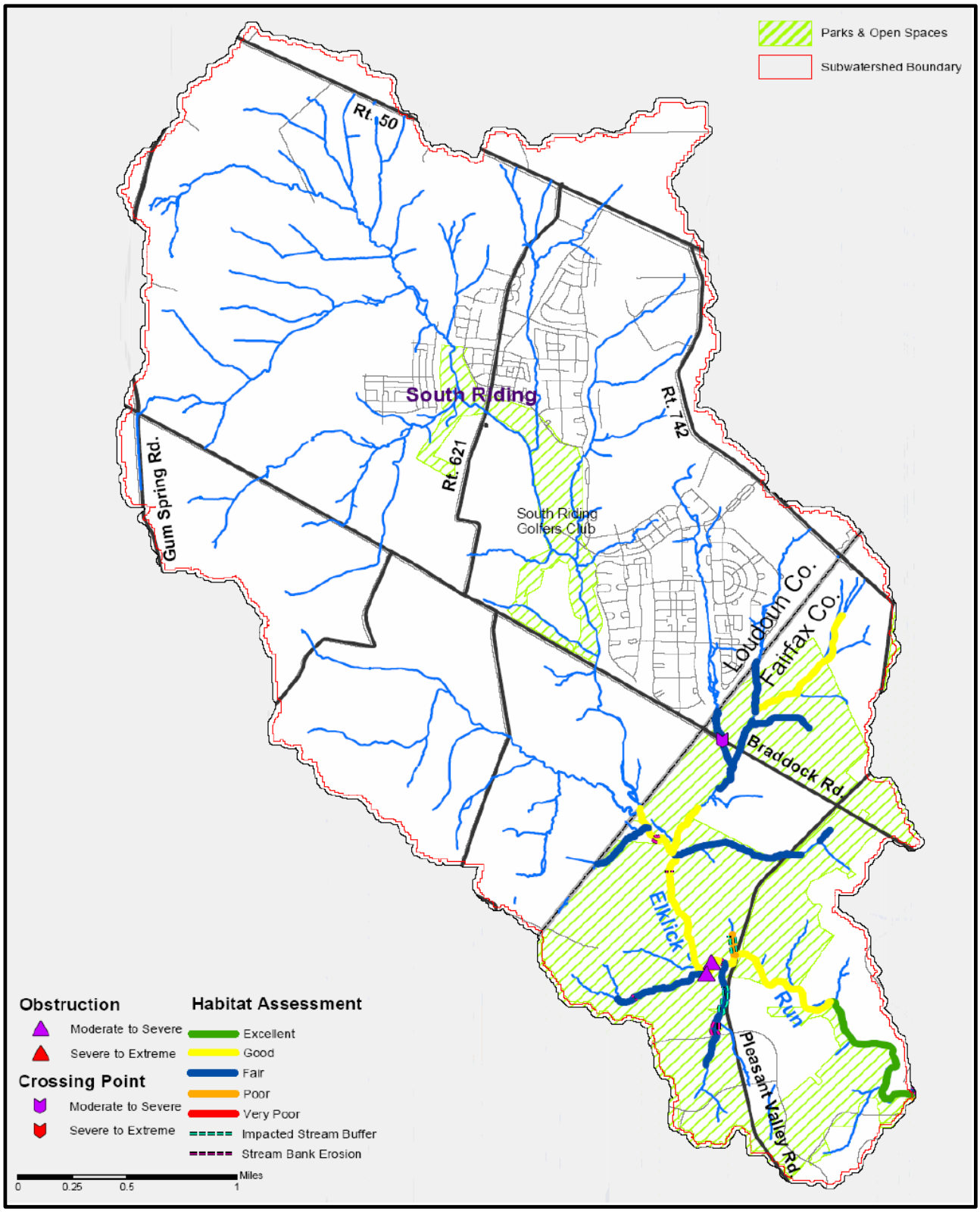


Figure 3-7
Existing Conditions
in the Elklick Run Subwatershed

- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting.
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-7 includes these features where the impact scores indicate they significantly affect the streams.

The Elklick Run streams have few of these features. Small portions of the streams have stream erosion inventory lines and compromised stream buffers.

Fish and Benthic Macroinvertibrate Studies

The Stream Protection Strategy includes one sampling location in the Elklick Run subwatershed. The conditions at this site are summarized in Table 3-17.

Table 3-17
Summary of Stream Protection Strategy Results for
Elklick Run Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Elklick Run downstream from Pleasant Valley Road	Fair	Fair	Very Low	Fair	Restoration I

The physical stream habitat is rated as good, whereas sampling of the organisms suggests a fair stream habitat.

The Fairfax County portions of this watershed are within the SPS restoration I watershed management category where the causes of the stream degradation are identified and remedied.

3.4.6 Stream Water Quality

Fairfax County does not regularly sample for water quality in the Elklick Run subwatershed.

3.4.7 Stream Geomorphology

Deep clay soils and shale characterize the stream banks within the Elklick Run subwatershed. The streams generally have ill-defined stream valleys near the

Loudoun County border. Towards the bottom of the subwatershed, the stream valleys become more incised and defined.

The underlying geology affects conditions in the stream. The stream passes through an igneous intrusion area between Pleasant Valley Road and Cub Run. Rock associated with this zone may help to produce the excellent habitat ratings in the lower reaches of Elklick Run.

The Fairfax County Stream Physical Assessment Study includes the stream Channel Evolution Model (CEM) stage. Most of the streams, including all segments of the Elklick Run main stem, are in stage IV, indicating the streams are stabilizing.

The stream bottom substrate varies over the subwatershed. Lower reaches include boulders in the riffles and silt in the pools. Other areas include a mix of sand, gravel, cobble and silt substrate.

3.4.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Elklick Run subwatershed:

- Impact of development in Loudoun County on the Fairfax County streams
- Local flooding and poor drainage near the intersection of Pleasant Valley Road and Braddock Road
- Septic systems in the Estate-Residential portions of the R-C District. The county should consider alternative disposal methods but should not extend the sewers to serve these areas.
- Stream erosion on Elklick Run at Pleasant Valley Road
- Water quality impacts of runoff from the South Riding Golf Course

3.4.9 Modeling Results

Figure 3-8 presents stormwater modeling results for the Elklick Run subwatershed. Section 2.8 presents additional details on the modeling and modeled scenarios.

The modeling results suggest the peak flow controls that will be required in the Fairfax County and Loudoun County portions of the watershed effectively control the peak flows from future development. Nutrient loads will more than double in the future, though the loads per acre are less than those for most subwatersheds.

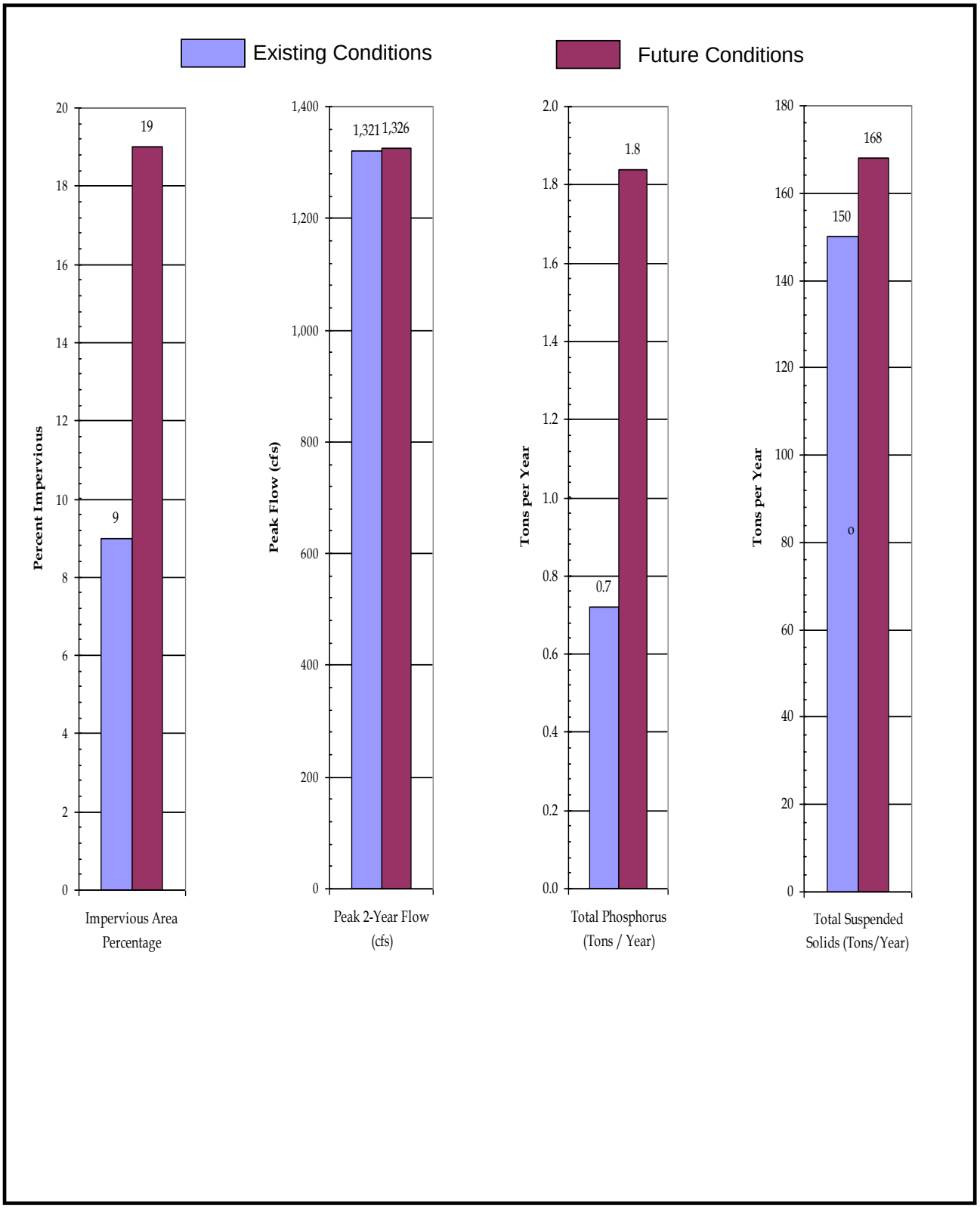


Figure 3-8
Overview of Existing and Future Conditions
in the Elklick Run Subwatershed

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3.5 Flatlick Branch Subwatershed

Overview of Conditions in the Flatlick Branch Subwatershed

- **Drainage area = 5,048 acres (8 square miles)**
- **Existing impervious area = 18 percent**
- **Future impervious area = 23 percent**
- **The subwatershed includes 53 dry ponds and 26 wet ponds. This includes seven constructed regional ponds. Nearly 50 percent of the subwatershed is upstream from these existing ponds.**
- **The subwatershed includes five proposed but not constructed regional ponds.**
- **Little developable open space is available for additional development within the Flatlick Branch subwatershed. Most of the development that will occur will be commercial and office development near Route 28 and within the Westfields area. The upper reaches of the subwatershed are approaching build out conditions.**
- **The watershed includes portions of the Greenbriar and Brookfield neighborhoods that were developed before stormwater controls were required. Stormwater drainage is provided by closed-pipe storm sewer systems that discharge runoff to the streams without stormwater control facilities to reduce peak flows and stormwater pollution.**
- **The stream habitat in the subwatershed is fair to poor.**
- **Some of the stream segments have conditions that suggest that the streams are actively eroding. The streams are in CEM stages III and IV indicating that the streams are widening and, in some locations, stabilizing.**

The following sections summarize the conditions in the Flatlick Branch subwatershed.

3.5.1 Overview of Drainage Characteristics

Figure 3-9 shows the Flatlick Branch subwatershed drainage boundaries and the major streams in the subwatershed. As discussed later in this section, Figure 3-9 also presents the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds.

Flatlick Branch flows northeast to southwest. The subwatershed includes the Frog Branch, Oxlick Branch and many unnamed tributaries.

The total subwatershed area is 5,048 acres (8 square miles).

3.5.2 Existing and Future Land Use

Table 3-18 provides an overview of the existing and future land use in the Flatlick Branch subwatershed.

The subwatershed includes a high percentage of residential development, mostly medium-density. Commercial, office and other non-residential uses exist along the Route 50 corridor.

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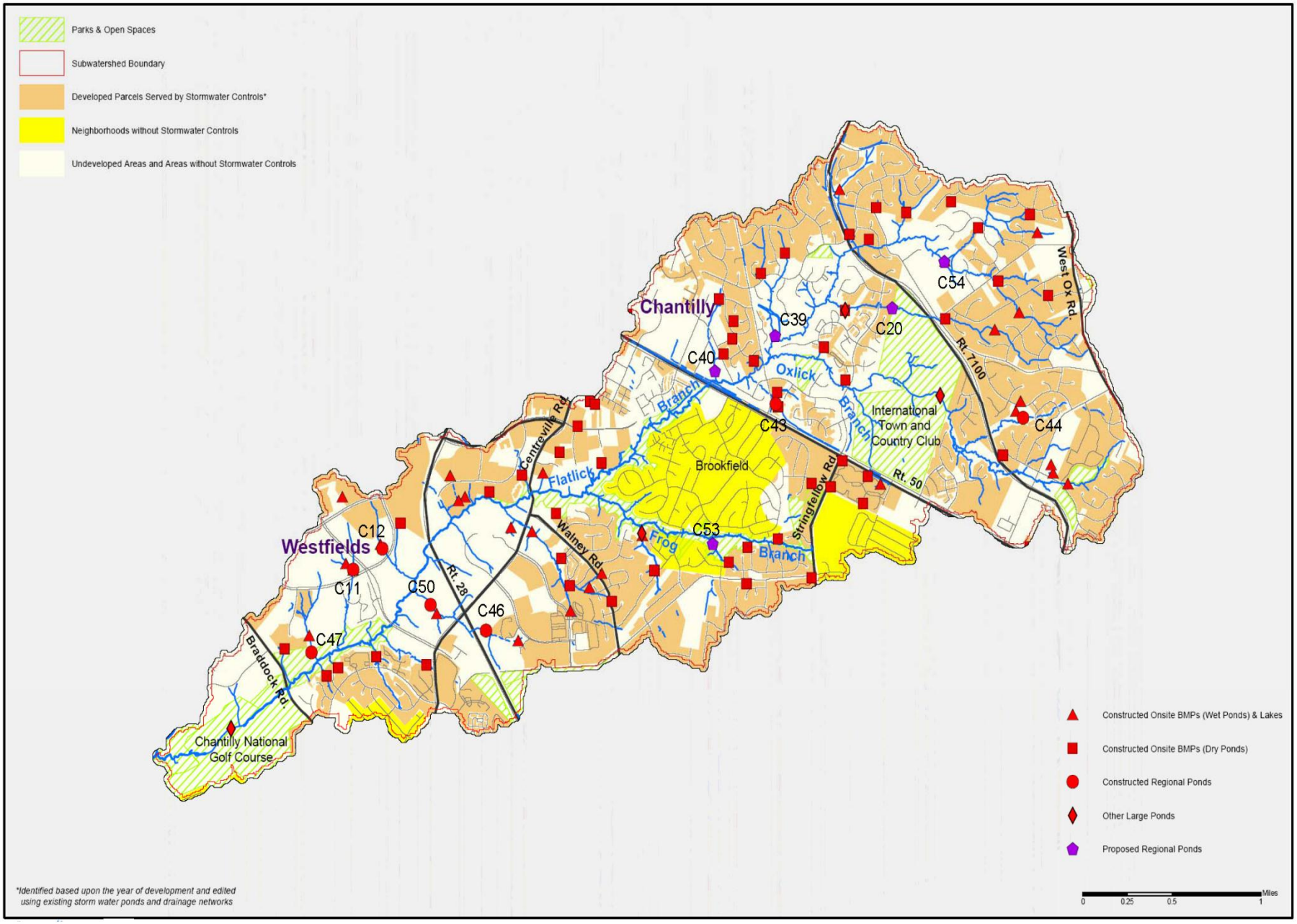

Figure 3-9
Stormwater Facilities in the Flatlick Branch Subwatershed

The subwatershed has relatively little open land available for new development. Future changes result from conversion of undeveloped open land to residential and industrial land use. The industrial areas are primarily within the Route 28 corridor and within Westfields, and will include commercial, office and industrial land uses. Much of this area is upstream from Fairfax County regional ponds that will control the runoff from this development.

Table 3-18
Summary of Existing and Future Land Use
in the Flatlick Branch Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	1,698	33.6	596	11.8
Estate-Residential	217	4.3	217	4.3
Low-Density Residential	313	6.2	646	12.8
Medium-Density Residential	1,500	29.7	1,686	33.4
High-Density Residential	456	9.0	475	9.4
Low-Intensity Commercial	523	10.4	525	10.4
High-Intensity Commercial	113	2.2	111	2.2
Industrial	227	4.5	793	15.7
Residential Planned Community	-	-	-	-

Future development will also occur on residential parcels where the existing density is less than the planned density. Much of this development is ongoing, for example in the watershed upstream of Route 7100.

3.5.3 Existing and Future Impervious Area

Table 3-19 provides an overview of the existing and future impervious area estimates.

The impervious area increases five percentage points from 18 to 23 percent. This small increase suggests the subwatershed is mostly built out, and additional impervious area will occur mainly in the lower reaches of the subwatershed, downstream from Centreville Road.

Table 3-19
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Flatlick Branch Subwatershed

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Oxlick Branch	935	159	17	178	19
Frog Branch	651	124	19	130	20
Remainder of Flatlick Branch	3,462	623	18	866	25
TOTAL FLATLICK BRANCH	**5,048**	906	**18**	1,173	**23**

3.5.4 Existing Stormwater Controls

Figure 3-9 shows the existing dry and wet stormwater ponds in the Flatlick Branch subwatershed and the developed area upstream from these existing ponds as well as the location of Fairfax County regional ponds and other ponds that serve large drainage areas. Planned but not constructed regional ponds are also shown. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Table 3-20 summarizes the number of existing dry and wet ponds as well as the total subwatershed area upstream from these ponds:

Table 3-20
Summary of Number of Ponds and Cumulative Drainage Area
for the Flatlick Branch Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	53	1,273 acres
Wet Ponds	26	1,093 acres
Total in Subwatershed	79	2,366 acres

Nearly 50 percent of the subwatershed drainage area is upstream from these 79 existing ponds. In addition, various lakes associated with golf courses exist that, while

not providing peak flow and nutrient reduction as provided by constructed stormwater ponds, do provide nutrient reduction and other water quality benefits.

The subwatershed contains seven constructed Fairfax County regional ponds and three additional ponds that serve large drainage areas:

- Regional Pond C11 – Two wet ponds located northwest of the intersection of Stonecroft Road and Conference Center Drive (eastern intersection) that serves a portion of Westfields
- Regional Pond C12 – Wet pond located north of the intersection of Stonecroft Road and Lee Road that serves a portion of Westfields
- Regional Pond C43 – Dry pond constructed north of the intersection of Route 50 and Lees Corner Road. This pond serves townhouse residential areas.
- Regional Pond C44 – Wet pond located west of the intersection of Misty Creek Lane and Broadrun Drive
- Regional Pond C46 – Wet pond located southeast of the intersection of Route 28 and Westfields Boulevard that serves commercial development within Westfields International Center at Dulles
- Regional Pond C47 – Wet pond located south of Conference Center Drive and west of Parkstone Drive within Westfields
- Regional Pond C50 – Wet pond located due west of the intersection of Route 28 and Westfields Boulevard. This pond is downstream from regional pond C46.
- CP52 – This is a regional pond that existing prior to the completion of the 1989 study that identified the locations of the regional ponds. This pond is located south of Frog Branch between Waverly Crossing Lane and Lowry Drive.
- Lake at Chantilly National Golf Course and Country Club. Flatlick Branch flows through this lake close to where Flatlick Branch enters Cub Run. This pond does not have peak flow-shaving benefits but provides water quality benefits. Sedimentation in this lake requires it to be dredged occasionally.
- Lake within the International Town and Country Club that is downstream from a large area of single-family residential. This lake is downstream from regional pond C44.
- Large dry pond located north of Brandy Station Road, south of Shady Ridge Lane and west of Stringfellow Road. This pond is downstream from the proposed site for region pond C20.

Five proposed but not constructed regional ponds sites are within the Flatlick Branch subwatershed:

- C20 is on an unnamed tributary to Flatlick Branch.
- C39 is on an unnamed tributary to Flatlick Branch.
- C40 is on an unnamed tributary to Flatlick Branch.
- C53 is on an unnamed tributary to Frog Branch
- C54 is at an existing lake in the headwaters of Flatlick Branch

The subwatershed includes Brookfield and portions of Greenbriar where development occurred before the county required stormwater controls. Stormwater drainage is provided by closed-pipe storm sewer systems that discharge runoff to the streams without stormwater control facilities to reduce peak flows and stormwater pollution.

3.5.5 Stream Habitat

Physical Habitat

The Fairfax County Stream Physical Assessment Study summarizes the stream physical habitat condition for the Fairfax County streams. Figure 3-10 shows the stream physical habitat ratings for the Flatlick Branch streams, and Table 3-21 summarizes these ratings.

Table 3-21
Summary of Physical Stream Habitat Ratings
for the Flatlick Branch Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.6	4
Good	4.5	29
Fair	6.0	39
Poor	3.3	21
Very Poor	1.2	7

The existing physical habitat is mostly fair to good with some excellent, poor and very poor habitat. Excellent habitat is found in minor tributaries to Frog Branch and the Flatlick Branch main stem just upstream from Braddock Road. Poor habitat is found

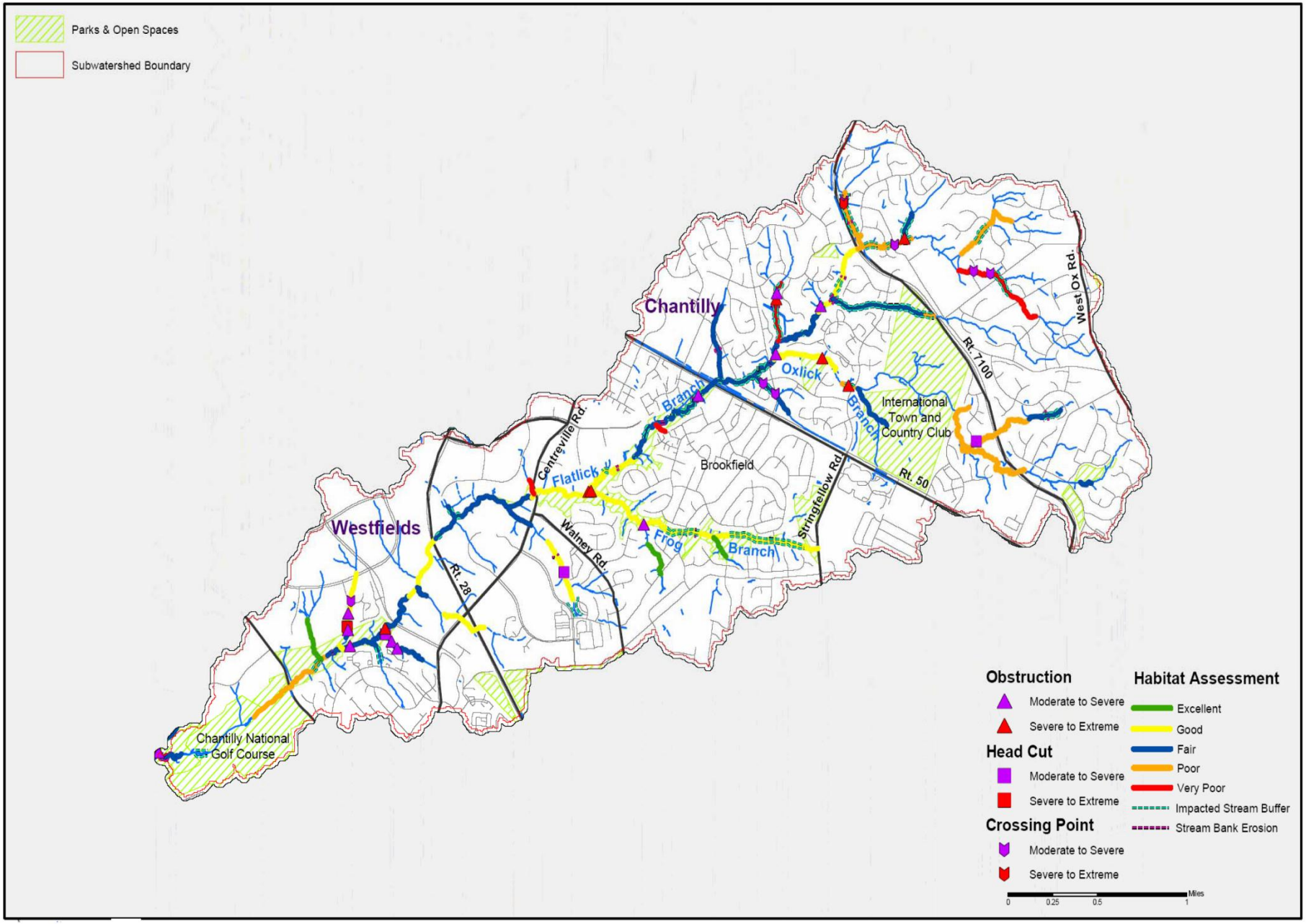

Figure 3-10
Existing Conditions in the Flatlick Branch Subwatershed

in the lower reaches of the Flatlick Branch main stem near Braddock Road and in the subwatershed's headwater areas. The very poor habitat is found in various tributaries. The physical habitat of the main stem of Flatlick Branch ranges from fair to good. Frog Branch has good to excellent habitat scores.

Figure 3-10 also shows the following information from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-10 includes these features when the impact scores indicate they significantly affect the streams.

Two reaches of the Flatlick Branch main stem have high incidences of stream erosion inventory points and obstructions, indicating active erosion:

1. Between Braddock Road and Stonecroft Road
2. Between Frog Branch and Route 50

Various reaches have stream buffers affected.

Fish and Benthic Macroinvertibrate Studies

The Stream Protection Strategy includes two sampling locations in the Flatlick Branch subwatershed. The conditions found based on the fish and benthic sampling at these sites are summarized in Table 3-22.

These sampling data indicate that the habitat is poor in the Flatlick Branch subwatershed. The sampling data are mostly consistent with the physical habitat condition ratings. The entire Flatlick Branch subwatershed is within the SPS restoration II category where the watershed is managed to prevent further degradation.

Table 3-22
Summary of Stream Protection Strategy Results for
Flatlick Branch Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Flatlick Branch upstream from Frog Branch	Poor	Poor	High	Poor	Restoration II
Flatlick Branch upstream from Braddock Road	Fair	Fair	Low	Poor	Restoration II

3.5.6 Stream Water Quality

Fairfax County samples for water quality in the Flatlick Branch subwatershed at two locations:

- Route 50 (29-05)
- Braddock Road (29-06)

These data are summarized in Section 2 and indicate water quality in this subwatershed is typical for many county streams. Fecal coliform concentrations regularly exceed state criteria for surface waters. Dissolved oxygen levels are high, indicating healthy streams. The nitrate concentrations at Route 50 are 50% greater than those at other stations in the subwatershed. Other measured parameters are within acceptable levels and do not indicate abnormal conditions within this subwatershed.

3.5.7 Stream Geomorphology

The Flatlick Branch subwatershed has variable stream geomorphology, largely due to the underlying geology in this area of the Triassic basin. The streambed in Frog Branch is red sandstone that causes this stream to be less affected by erosion and have good habitat scores. Other areas of the subwatershed, including the lower reaches of Flatlick Branch, have deep clay soils and shale that make the streams susceptible to changes in stream flow and therefore to exhibit greater impacts from stream erosion.

The Fairfax County Stream Physical Assessment Study includes the Channel Evolution Model (CEM) stage and stream substrate.

- Frog Branch has bedrock and cobble as the dominant stream substrate. The streams are classified as being in stage III transitioning to stage IV, indicating the streams are stabilizing.

- Oxlick Branch is in CEM stage III with some segments in stage II. The streams are widening and down-cutting. The substrate in these reaches is sand.

- Upper Flatlick upstream from Route 50 is in stage III and IV, indicating the streams are widening and may be stabilizing. The substrate is primarily sand and cobble with some silt and gravel.

- Middle Flatlick downstream between Route 28 and Route 50 is predominantly in stage III, indicating the stream is widening. Some reaches are transitioning to stage IV, suggesting the streams are stabilizing in some areas. The stream substrate is a mix of sand, gravel, cobble and silt.

- Lower Flatlick downstream from Route 28 is between stage III and IV, indicating stream widening though some sections are stabilizing. The substrate is a mix of sand, gravel and silt.

3.5.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Flatlick Branch subwatershed:

- Trash and litter were identified as issues throughout this subwatershed.

- Erosion in small streams within homeowner association common property and other open space. In these areas small streams are actively down-cutting. This is occurring where stormwater outfalls from the nearby development concentrate the flow. Prior to development, the flow was distributed over the land surface. The concentrated flow produced by the stormwater outfalls creates drainage ditches where none existed before, resulting in stream erosion. In other areas, drainage ditches need to be cleaned and maintained. These concerns were identified for Franklin Glen Governance and Fair Oaks Estates but also occur in many residential areas north of Route 50.

- Flooding at Walney Road

- Maintenance of stormwater ponds, both private and public

- Invasive species (grape vines) taking over and killing trees near Lee's Corner Elementary School

3.5.9 Modeling Results

Figure 3-11 presents stormwater modeling results for the Flatlick Branch subwatershed. Section 2.8 presents addition details on the modeling and modeled scenarios.

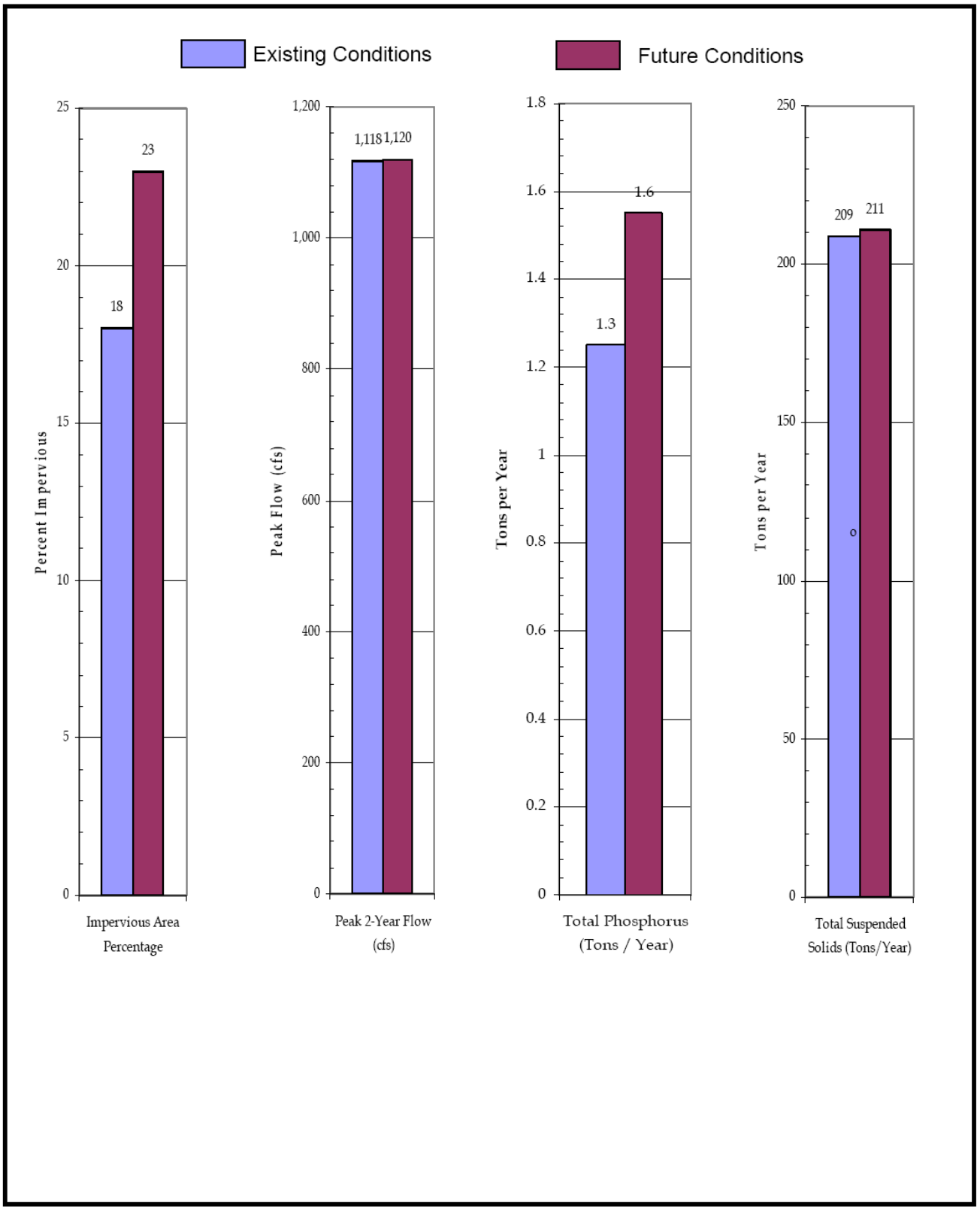

Figure 3-11
Overview of Existing and Future Conditions
in the Flatlick Branch Subwatershed

Future peak flows with stormwater controls for the two-year storm are essentially unchanged for future conditions. Total phosphorus loadings increase by 24 percent.

3.6 Big Rocky Run and Round Lick Branch Subwatersheds

Overview of Conditions in the Big Rocky Run and Round Lick Branch Subwatersheds

- **Drainage area**
  Big Rocky Run = 5,997 acres (9.4 square miles)
  Round Lick Branch = 1,047 acres (1.6 square miles)
- **Existing impervious area**
  Big Rocky Run = 23 percent
  Round Lick Branch = 17 percent
- **Future impervious area**
  Big Rocky Run = 27 percent
  Round Lick Branch = 18 percent
- **The watersheds have relatively little open space available for future development. As a result, the development in the watershed is approaching built out conditions.**
- **Existing stormwater ponds reduce peak flows and control stormwater runoff from most of the developed portions of the subwatershed.**
- **The subwatersheds include areas in Greenbriar, Birch Pond and Country Club Manor where the development occurred before stormwater controls were required. The stormwater systems in these areas are closed-pipe systems that discharge flows to the streams without controls to reduce peak flows and reduce pollutant runoff.**
- **The stream habitat in the Big Rocky Run subwatershed is among the best found in the Cub Run streams in spite of the high development density and lack of stormwater controls in portions of the subwatershed. This largely results from the underlying geology that causes the streams to have rocky substrate that is resistant to stream erosion and produces good habitat scores.**

The following sections summarize the conditions in the Big Rocky Run and Round Lick Branch subwatersheds.

3.6.1 Overview of Drainage Characteristics

Figure 3-12 shows the Big Rocky Run and Round Lick Branch subwatersheds' drainage boundaries and major streams. As discussed later in this section, Figure 3-12 also presents the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds.

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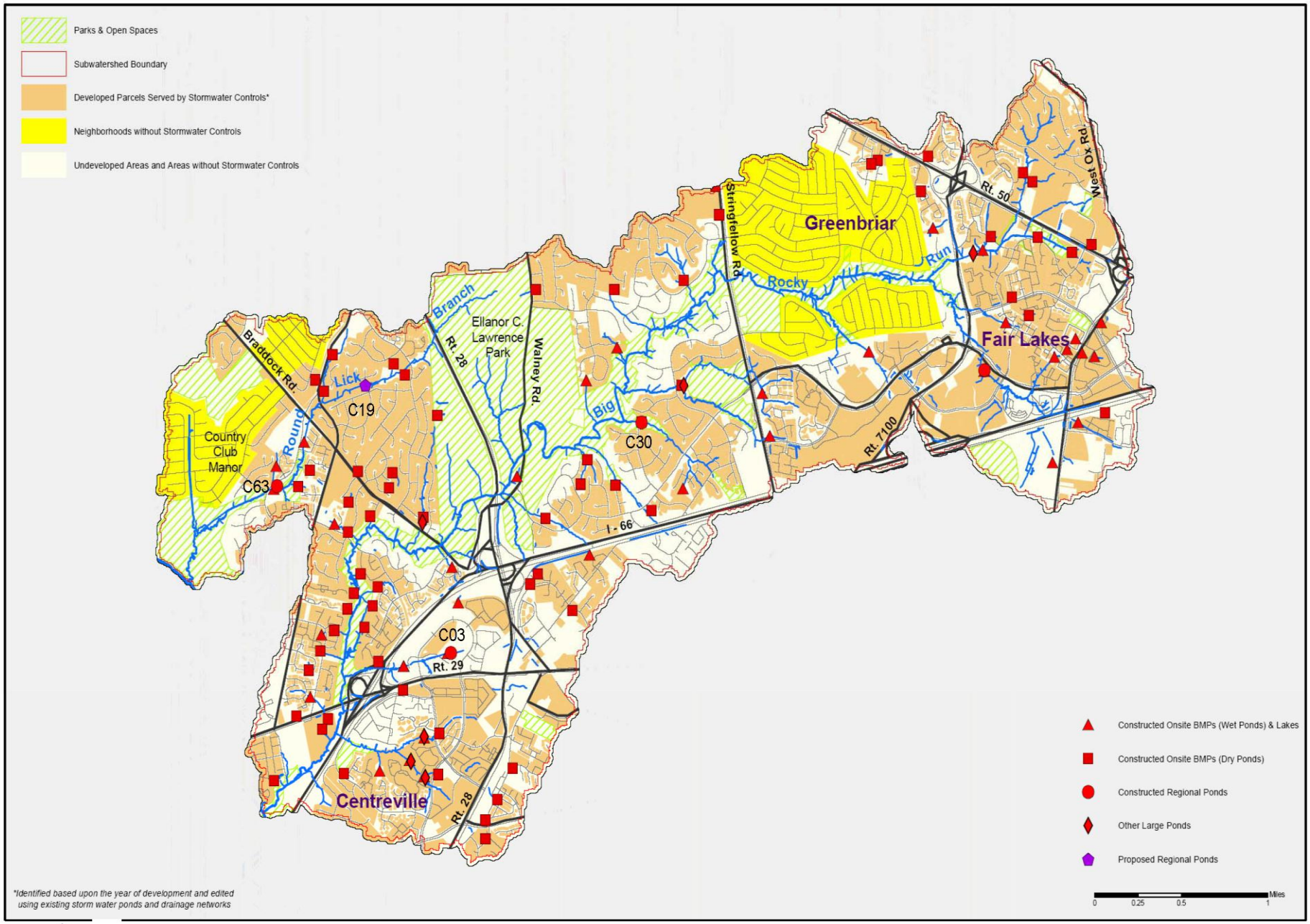

Figure 3-12
Stormwater Facilities in the Big Rocky Run and Round Lick Branch Subwatersheds

Big Rocky Run flows northeast to southwest. The headwaters are near Fair Oaks and Fair Lakes. None of the tributaries are named. The subwatershed area equals 5,997 acres (9.4 square miles).

Round Lick Branch also flows northeast to southwest with no named tributaries. The subwatershed area equals 1,047 acres (1.6 square miles).

3.6.2 Existing and Future Land Use

Tables 3-23 and 3-24 summarize the existing and future land use in the Big Rocky Run and Round Lick Branch subwatersheds.

The Big Rocky Run subwatershed includes a high percentage of residential development with an approximate equal split between medium- and high-density residential land uses. Commercial, office and other mixed uses exist in the Fair Lakes and Fair Oaks areas. Future development opportunities are small, mainly consisting of converting undeveloped areas and areas with low development density to the planned medium-density residential and commercial land use.

The Round Lick Branch is mostly medium-density residential with very little opportunity for additional development.

The Ellanor C. Lawrence Park composes a large portion of Big Rocky Run and Round Lick Branch subwatersheds, preserving a large percentage of open space.

In some cases, areas where the existing development density is Estate-Residential will be developed at the higher density allowed by the Comprehensive Land Use Plan.

Table 3-23
Summary of Existing and Future Land Use in the
Big Rocky Run Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	1,727	28.8	1,130	18.9
Estate-Residential	156	2.6	-	-
Low-Density Residential	120	2.0	234	3.9
Medium-Density Residential	1,685	28.1	1,998	33.3
High-Density Residential	1,319	22.0	1,319	22.0
Low-Intensity Commercial	618	10.3	858	14.3
High-Intensity Commercial	192	3.2	232	3.9
Industrial	180	3.0	180	3.0
Residential Planned Community	-	-	45	0.7

Table 3-24
Summary of Existing and Future Land Use in the
Round Lick Branch Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	343	32.8	334	31.9
Estate-Residential	4	0.4	-	-
Low-Density Residential	19	1.8	24	2.3
Medium-Density Residential	550	52.6	559	53.4
High-Density Residential	86	8.2	86	8.2
Low-Intensity Commercial	43	4.1	43	4.1
High-Intensity Commercial	1	0.1	1	0.1
Industrial	-	-	-	-
Residential Planned Community	-	-	-	-

3.6.3 Existing and Future Impervious Area

Table 3-25 provides an overview of the existing and future impervious area estimates.

Table 3-25
Summary of Drainage Areas and Existing and Projected Future Impervious Area for
the Big Rocky Run and Round Lick Branch Subwatersheds

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Areas	
		Acres	Percent	Acres	Percent
Big Rocky Run	5,997	1,397	23.3	1,601	26.7
Round Lick Branch	1,047	177	16.9	187	17.9
TOTAL	**7,044**	1,574	**22.3**	1,789	**25.4**

The Big Rocky Run impervious area increases four percentage points from 23 to 27 percent.

Round Lick Branch impervious area increases one percentage point from 17 to 18 percent.

The small impervious area increase suggests these two subwatersheds are mostly built out with little room for additional development.

3.6.4 Existing Stormwater Controls

Figure 3-12 shows the stormwater ponds in the Big Rocky Run and Round Lick Branch subwatersheds, and the developed area upstream from these ponds. This figure also shows the Fairfax County regional stormwater ponds and other ponds that control large areas of the subwatershed as well as the location of planned but not constructed Fairfax County regional stormwater ponds. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Big Rocky Run

Table 3-26 summarizes the number of dry and wet ponds, and the total subwatershed area upstream from these ponds in the Big Rocky Run subwatershed.

Table 3-26
Summary of Number of Ponds and Cumulative Drainage Area
for the Big Rocky Run Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	56	1,516 acres
Wet Ponds	32	1,667 acres
Total in Subwatershed	88	3,183 acres

Approximately 53 percent of the subwatershed drainage area is upstream from these 88 ponds.

The watershed contains two constructed Fairfax County regional ponds and six additional ponds that serve large drainage areas but may not be part of the county regional pond program:

- Regional Pond C03 – Two wet ponds in Centreville within Trinity Centre between Trinity Parkway and Route 29
- Regional Pond C30 – Dry pond between Doyle Lane and Bare Island Drive in a mostly single-family residential watershed
- Wet pond on Big Rocky Run immediately upstream from the Fairfax County Parkway and includes a large area of the headwaters of Big Rocky Run

- CP1 – Two wet regional ponds constructed before the 1989 regional pond study within Centreville west of the intersection of Centrewood Drive and Machen Road
- CP2 – Wet pond constructed before the 1989 regional pond study within Centreville west of Machen Road between Rosebud Lane and Morning Dove Lane
- CP34 – Dry pond constructed before the 1989 regional pond study north of Braddock Road between Cedar Break Drive and Sequoia Farms Drive
- CP64 – Dry pond constructed before the 1989 regional pond study located north of the Melville Lane and Bare Island Drive intersection. The watershed includes Poplar Tree Park.
- Wet pond and dry pond in series within Fair Lakes south of Fair Lakes Parkway near Fair Lakes Circle

No proposed regional ponds are within Big Rocky Run.

The Big Rocky Run subwatershed includes the Greenbriar and Birch Pond neighborhoods constructed before the county required stormwater controls. These areas have closed-conduit stormwater drainage systems that discharge to the streams without any controls to limit the peak flows or reduce the pollutants in the stormwater runoff.

Round Lick Branch

Table 3-27 summarizes the number of dry and wet ponds in the Round Lick Branch subwatershed and the total drainage area upstream from these ponds.

Table 3-27
Summary of Number of Ponds and Cumulative Drainage Area
for the Round Lick Branch Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	10	247 acres
Wet Ponds	3	400 acres
Total in Subwatershed	13	647 acres

The 13 ponds control the flow from 62 percent of the subwatershed.

The subwatershed includes one Fairfax County regional pond:

- Regional Pond C63 – Two wet ponds on Round Lick Branch adjacent to Sully Park Drive south of Braddock Road. These ponds include much of the Round Lick subwatershed.

The planned site for one proposed but not constructed regional pond, C19, is on the Round Lick Branch main stem upstream from regional pond C63.

The subwatershed includes the Country Club Manor neighborhood where the development occurred before the county required stormwater ponds to control peak flows and water quality. These neighborhoods have closed-pipe storm drainage systems and paved concrete channels that outfall to the existing streams with no stormwater controls to limit the peak flow rates and reduce the runoff's pollutant concentrations.

3.6.5 Stream Habitat

Physical Stream Habitat

The Fairfax County Stream Physical Assessment Study summarizes the physical habitat condition for the Fairfax County streams. Figure 3-13 shows the physical habitat ratings for the Big Rocky Run and Round Lick Branch streams. Tables 3-28 and 3-29 summarize the stream habitat for Big Rocky Run and Round Lick Branch subwatersheds, respectively.

Table 3-28
Summary of Physical Stream Habitat Ratings
for the Big Rocky Run Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	3.9	22
Good	6.3	36
Fair	5.9	33
Poor	1.6	9
Very Poor	0	0

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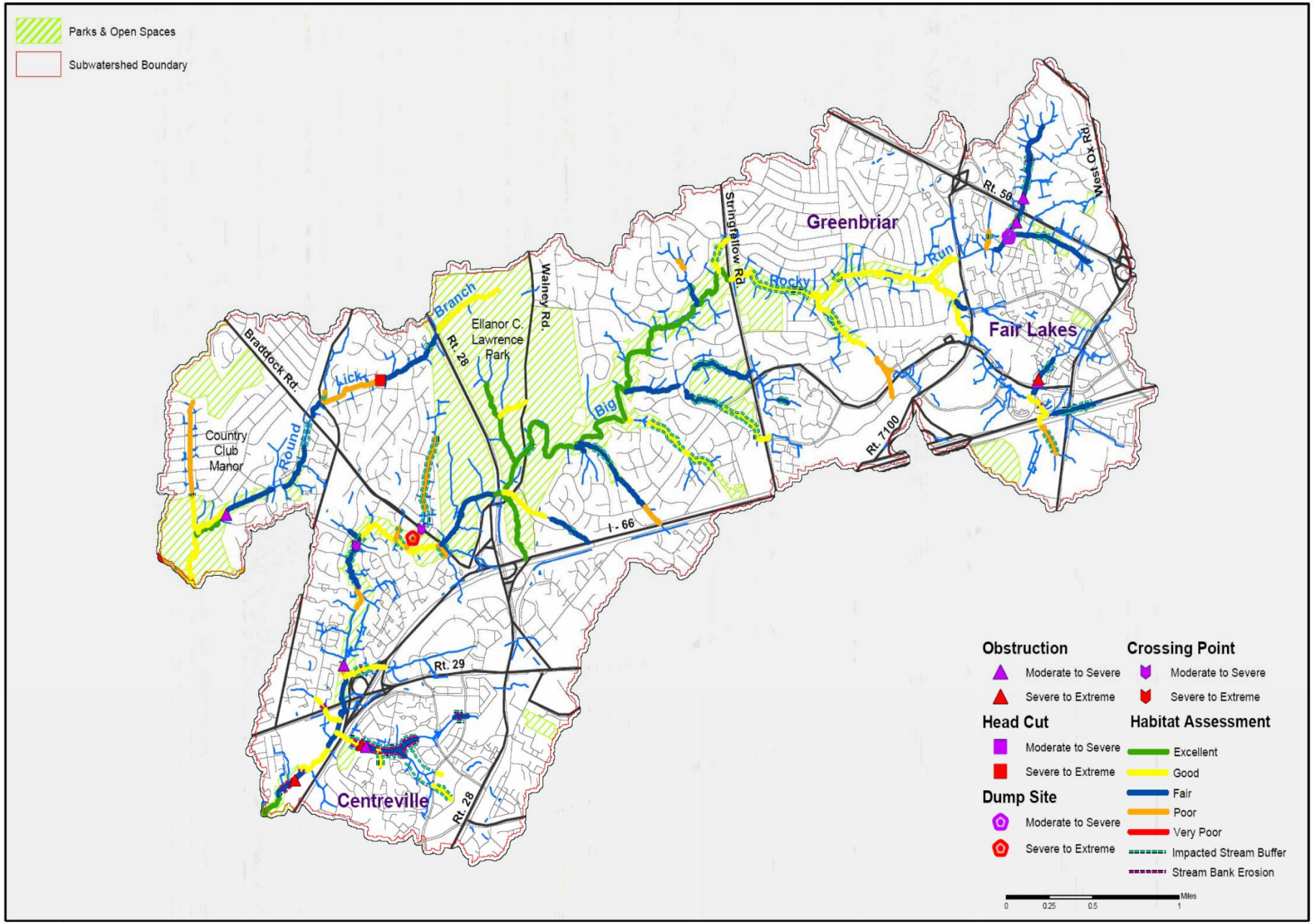

Figure 3-13
Existing Conditions in the Big Rocky Run and Round Lick Branch Subwatersheds

Table 3-29
Summary of Physical Stream Habitat Ratings
for the Round Lick Branch Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.3	8
Good	1.3	36
Fair	1.2	31
Poor	0.9	24
Very Poor	0.0	0

Big Rocky Run has a high percentage of streams rated as having excellent and good physical habitat. Excellent physical habitat scores exist in the main stem from Stringfellow Road to Route 28. Good physical habitat scores dominate most of the stream reaches upstream from Stringfellow Road. The rock and gravel substrate in these reaches contributes to the high habitat scores. Smaller tributaries have fair and poor habitat scores.

The main stem of Round Lick Branch has mostly poor and fair physical habitat ratings, with good habitat scores within Ellanor C. Lawrence Park in the upstream reaches and within the Cub Run Stream Valley Park in the downstream reaches.

Figure 3-13 also shows the following from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-13 includes these features when the scores indicate a significant stream impact.

Compared to other streams in the subwatershed, the upper reaches of Big Rocky Run upstream from Route 28 have few stream-erosion inventory lines and good scores for bank stability. Lower reaches of Big Rocky Run south of Route 28 have stream-erosion

inventory lines, blockages and poor stream bank stability scores, suggesting active stream erosion.

Round Lick Branch has no stream-erosion inventory lines. However, head cuts and stream bank stability scores suggest active erosion between Braddock Road and Sully Park Drive.

Fish and Benthic Macroinvertibrate Studies

The Stream Protection Strategy includes two sampling locations in the Big Rocky Run and none in the Round Lick Branch. The conditions found in Big Rocky Run based on the fish and benthic sampling at these sites are summarized in Table 3-30.

Table 3-30
Summary of Stream Protection Strategy Results for
Big Rocky Run and Round Lick Branch Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Big Rocky Run in Ellanor C. Lawrence Park upstream from Walney Road	Fair	Excellent	High	Good	Protection Area
Big Rocky Run near Confluence with Cub Run	Fair	Fair	Moderate	Fair	Restoration II

The stream organism sampling data indicate good to fair habitat in the Big Rocky Run subwatershed. The rock and gravel stream strata, and protection from the Big Rocky Run Stream Valley Park and Ellanor C. Lawrence Park contribute to habitat scores greater than would be expected for an urban stream with this subwatershed's development density and lack of stormwater controls over large areas.

The upper Big Rocky Run watershed above Ellanor C. Lawrence Park is within the watershed protection category in which the main management strategy is to identify and protect the conditions responsible for producing these high-quality stream environments.

The lower portions of the Big Rocky Run watershed are within Restoration II category in which the management strategy is to prevent further watershed degradation. Round Lick Branch was sampled subsequent to the SPS study and is within the SPS Restoration II category.

3.6.6 Stream Water Quality

Fairfax County regularly samples for water quality in the Big Rocky Run at a single location:

- Braddock Road (29-06)

Water quality sampling is not performed regularly within Round Lick Branch.

These data are summarized in Section 2 and indicate water quality in this subwatershed is typical for many county streams. Fecal coliform concentrations regularly exceed the state criteria for surface waters. Dissolved oxygen levels are high, indicating the stream is healthy and able to support life. Other measured parameters are within acceptable levels and do not indicate abnormal conditions within this subwatershed.

3.6.7 Stream Geomorphology

Big Rocky Run

The Big Rocky Run subwatershed has variable stream geomorphology, largely due to the underlying geology in this area of the Triassic basin. The streambed in Big Rocky Run upstream from Route 28 comprises rock, sand and gravel, causing these streams to be less affected by erosion and have good habitat scores. Other areas of the Cub and Bull Run watersheds have deep clay soils and shale that are more erodable and provide lower habitat scores.

The Fairfax County Stream Physical Assessment Study includes the Channel Evolution Model (CEM) stage and stream substrate.

The streams in Big Rocky Run subwatershed are in CEM stage III and IV, indicating the streams are widening but stabilizing. The substrate is predominantly sand and gravel with some silt, cobble, clay and boulders.

Round Lick Branch

The streams in Round Lick Branch are in CEM stage III and IV, indicating the streams are widening but stabilizing. The substrate is predominantly gravel.

3.6.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Big Rocky Run and Round Lick Branch subwatersheds:

- Trash and litter identified as issues in these subwatersheds

- Erosion in small streams within homeowner association common property or open space within the Fair Oaks Estates neighborhood north of Route 50. Local small streams are actively down-cutting. In many areas this is occurring where stormwater outfalls concentrate the flow, whereas before development occurred

runoff was distributed over the land surface. This flow concentration is creating ditches and stream erosion.

- Maintenance of stormwater ponds, both private and public
- Erosion and fallen trees near the location where Big Rocky Run crosses under Route 29
- Flooding where Stringfellow Road crosses Big Rocky Run
- Flooding on Poplar Tree Drive near Stringfellow Road
- Sediment control issues produced by water line construction along Stringfellow Road
- Dump site behind William Carr Lane
- Deteriorated trails along Big Rocky Run near Newton Patent Court
- Dumping of yard and landscaping debris in parkland near Awbrey Patent Drive
- Active beaver population and impact on stream and stream valley between Braddock Road and Awbrey Patent Drive
- Flooding of Awbrey Patent Drive. The frequency of flooding seems to be increasing over the past few years.
- Exotic plants taking over the stream valleys at some locations

3.6.9 Modeling Results

Figure 3-14 presents stormwater modeling results for the Big Rocky Run and Round Lick Branch subwatersheds. Section 2.8 presents additional details on the modeling and modeled scenarios.

Peak flows for the two-year design storm do not increase significantly from existing to future land use conditions. Total phosphorus loads increase 10 percent.

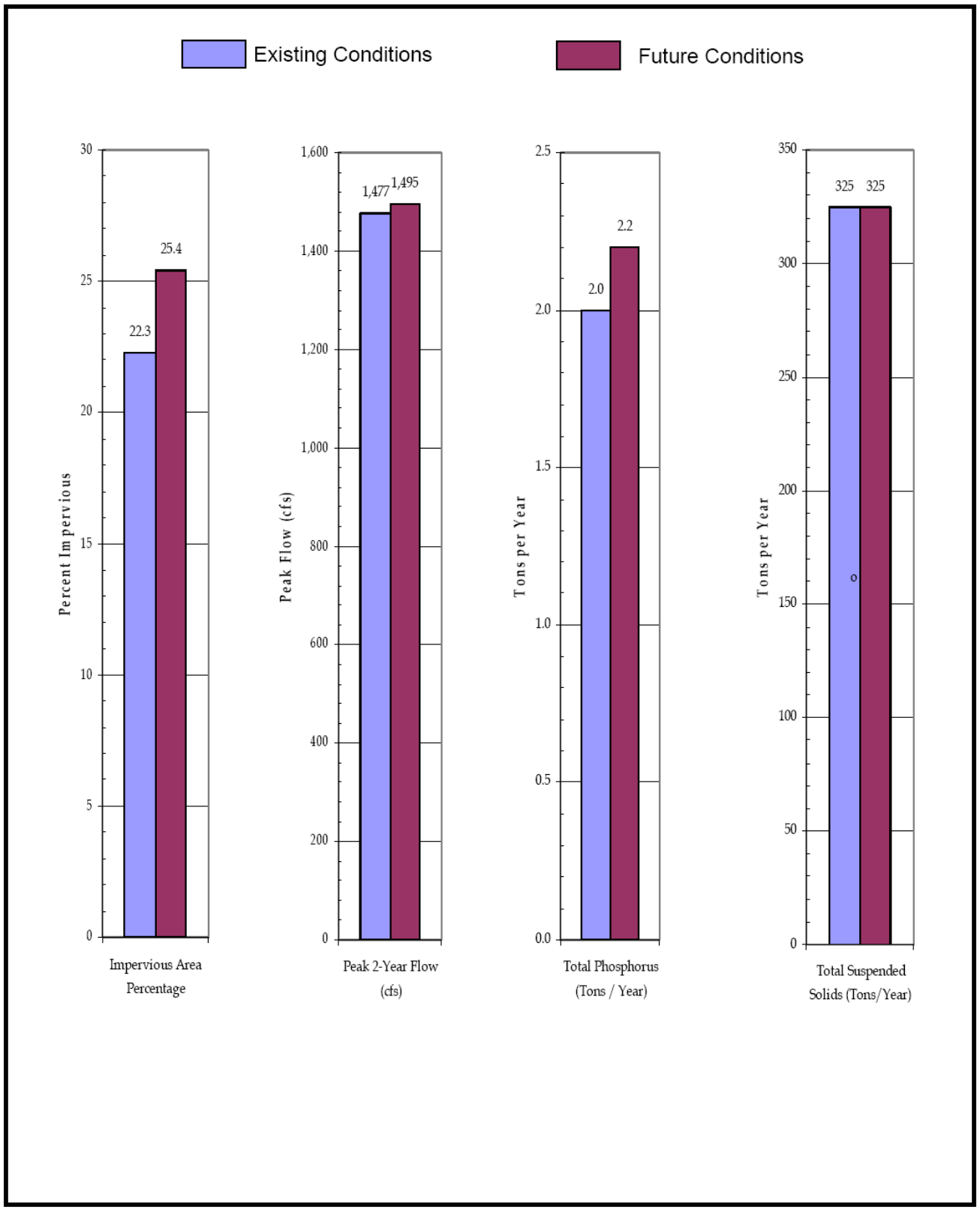

Figure 3-14
Overview of Existing and Future Conditions
in the Big Rocky Run and Roundlick Branch Subwatersheds

3.7 Lower Cub Run Subwatershed

Overview of Conditions in the Lower Cub Run Subwatershed

- **Drainage area = 3,939 acres (6.2 square miles)**
- **Existing impervious area = 9 percent**
- **Future impervious area = 12 percent**
- **Much of the subwatershed is in the Estate-Residential R-C District resulting in low existing development densities and little potential for future development.**
- **Stream conditions in the Lower Cub Run Subwatershed are affected by conditions in the upstream subwatersheds (Upper Cub Run, Elklick Run, Flatlick Branch, Big Rocky Run and Round Lick Branch). The total drainage area of these upstream subwatersheds equals 48 square miles and the average impervious area is projected to increase significantly from 14 to 26 percent.**
- **Stream habitat and erosion conditions vary, primarily due to the underlying geology and stream gradients.**
- **Small streams that enter Lower Cub Run downstream from Compton Road show poor habitat and stream erosion even though there is little development.**
- **Streams within the Virginia Run neighborhoods are affected by loss of habitat due to impacted stream buffers.**
- **The subwatershed includes three proposed but not constructed Fairfax County regional ponds.**

The following sections summarize the conditions in the Lower Cub Run subwatershed.

3.7.1 Overview of Drainage Characteristics

Figure 3-15 shows the Lower Cub Run subwatershed drainage boundaries and the major streams. As discussed later in this section, Figure 3-15 also presents the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds. The Lower Cub Run subwatershed is almost entirely in the rezoned R-C District. However, significant portions of the subwatershed near Virginia Run and Gate Post Estates were developed at a higher density than the one home per 5-acre Estate-Residential land use. Development in these areas was planned when rezoning occurred and, therefore, was allowed to proceed at the planned higher densities. These higher-density developments include stormwater ponds to control the peak flows and water quality. The Gate Post Estates neighborhood also includes low-impact development techniques such as drainage swales in place of traditional curb and gutter, reduced pavement width and sidewalks on only one side of the road. These designs reduce the amount of pavement within the development and the impact this development has on the local streams.

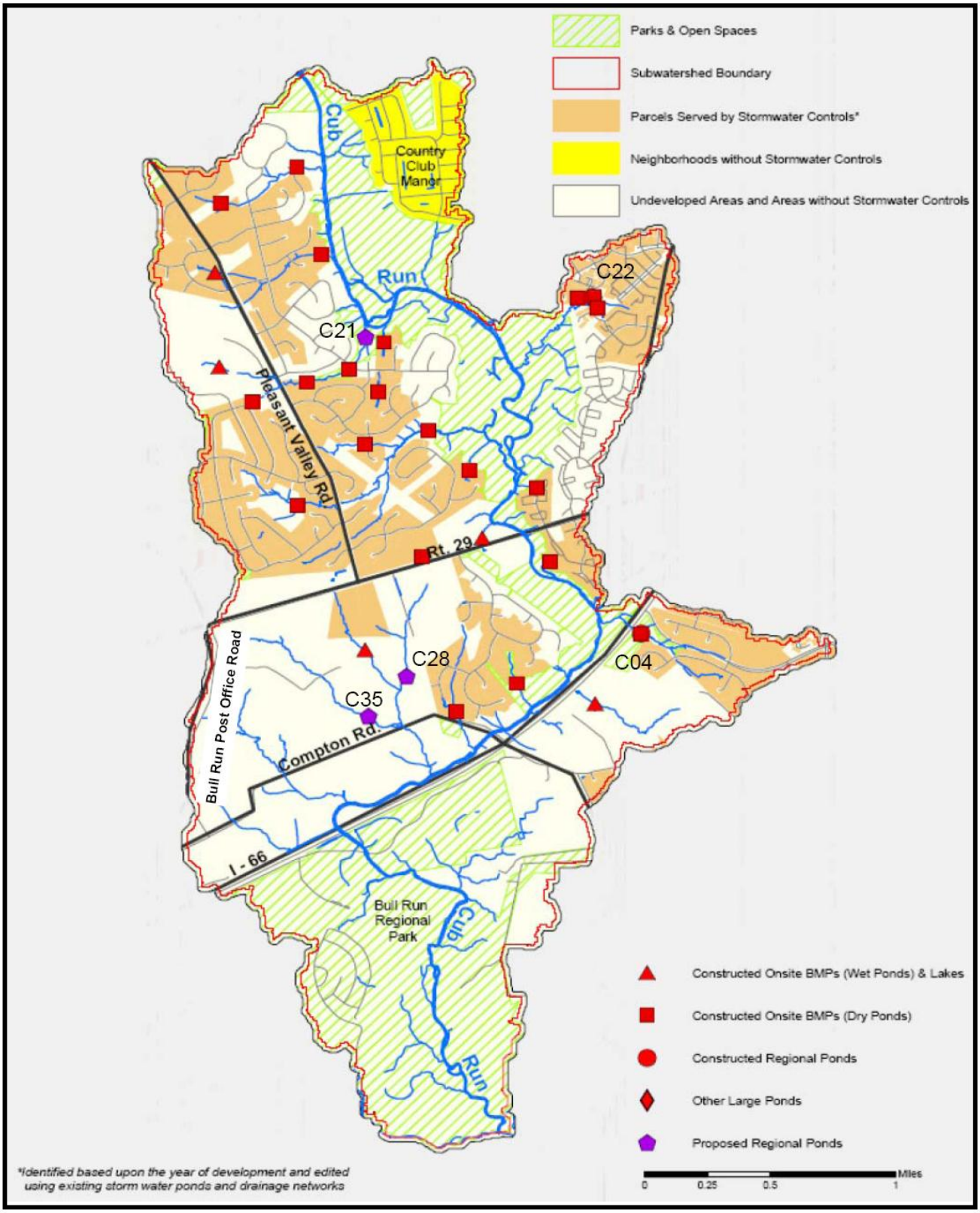

Figure 3-15
Stormwater Facilities in the
Lower Cub Run Subwatershed

The subwatershed begins near the confluence of Elklick Run, Flatlick Branch and Cub Run. Lower Cub Run flows generally from north to south but makes several turns along the way. Round Lick Branch and Big Rocky Run enter the Lower Cub Run subwatershed from the east.

3.7.2 Existing and Future Land Use

Table 3-31 provides an overview of the existing and future land use in the Lower Cub Run subwatershed.

The existing land use is predominantly Estate-Residential and Open Space. Low- and medium-density residential land use occurs in the Virginia Run and Gate Post Estates areas of the R-C District. These developments were planned at the time of the rezoning. Higher densities also exist outside of the R-C District to the east of the Cub Run main stem (London Towne and Lee Overlook). Some commercial development exists in the subwatershed along Route 29 east of Cub Run.

Future development will mainly result from development of vacant and underutilized parcels in compliance with the R-C district minimum lot sizes of 5 acres. This results in only small increases in impervious area.

The Northern Virginia Park Authority Bull Run Regional Park and Fairfax County Park Authority Cub Run Stream Valley Park compose a large portion of the Lower Cub Run subwatershed, preserving a large percentage of open space.

The UOSA advanced wastewater treatment plant is located within this subwatershed.

3.7.3 Existing and Future Impervious Area

Table 3-32 provides an overview of the existing and future impervious area estimates.

The impervious area for Lower Cub Run will increase three percentage points from 9 to 12 percent. These values also suggest the subwatershed is mostly built out with little room for additional development, and development that will occur will be low-density, 5-acre Estate-Residential.

The Lower Cub Run subwatershed area is 6.2 square miles, whereas the combined area of the upstream subwatersheds is 47 square miles. Therefore, conditions in the Lower Cub Run main stem are mostly affected by the existing and future development in upstream subwatersheds, including Upper Cub, Elklick Run, Flatlick Branch, Big Rocky Run and Round Lick Branch. The impervious area for these combined upstream subwatersheds is projected to increase from 14 percent for existing conditions to 26 percent for future conditions.

Table 3-31
Summary of Existing and Future Land Use in the Lower Cub Run Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	2,072	52.6	1,457	37.0
Estate-Residential	398	10.1	985	25.0
Low-Density Residential	248	6.3	248	6.3
Medium-Density Residential	670	17.0	697	17.7
High-Density Residential	213	5.4	213	5.4
Low-Intensity Commercial	98	2.5	98	2.5
High-Intensity Commercial	-	-	-	-
Industrial	12	0.3	12	0.3
Residential Planned Community	-	-	-	-
Upper Occoquan Sewerage Authority Advanced Wastewater Treatment Plant	228	5.8	228	5.8

Table 3-32
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Lower Cub Run Subwatershed

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Lower Cub Run	3,939	370	9.4	477	12.1

3.7.4 Existing Stormwater Controls

Figure 3-15 shows the existing stormwater ponds in the Lower Cub Run subwatershed and the developed areas upstream from these existing ponds. This figure also shows the location of existing Fairfax County regional ponds and other ponds that serve large drainage areas though they are not included in the county regional pond program. Finally, Figure 3-15 shows the location of planned regional ponds that have not been constructed. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Table 3-33 summarizes the number of existing dry and wet ponds and the total subwatershed area upstream from these ponds in the Lower Cub Run subwatershed.

Table 3-33
Summary of Number of Ponds and Cumulative Drainage Area
for the Lower Cub Run Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	20	1,080 acres
Wet Ponds	5	181 acres
Total in Subwatershed	25	1,261 acres

Approximately 32 percent of the subwatershed drainage area is upstream from these 25 existing ponds. These ponds control most of the areas currently developed at densities greater than Estate-Residential.

The Lower Cub Run subwatershed contains two constructed Fairfax County regional ponds:

- Regional Pond C04 – Dry pond located east of Route 66 between Store House Road and Picket Oaks Road
- Regional Pond C22 – Two dry ponds located north of Basingstoke Loop and south of Summer Lake Way

The following three proposed but not constructed regional ponds are within this subwatershed: C21, C28 and C35. These ponds are all on small, unnamed tributaries within the R-C District.

The Lower Cub Run subwatershed includes portions of the Country Club Manor neighborhood that was developed before stormwater controls were required. This development has closed-conduit stormwater drainage systems that discharge to the streams without any controls to limit the peak flows and reduce the pollutants in the stormwater runoff.

3.7.5 Stream Habitat

Physical Habitat

The Fairfax County Stream Physical Assessment Study summarizes the stream physical habitat condition for the Fairfax County streams. Figure 3-16 shows the stream physical habitat ratings for the Lower Cub Run streams, and Table 3-34 summarizes these ratings.

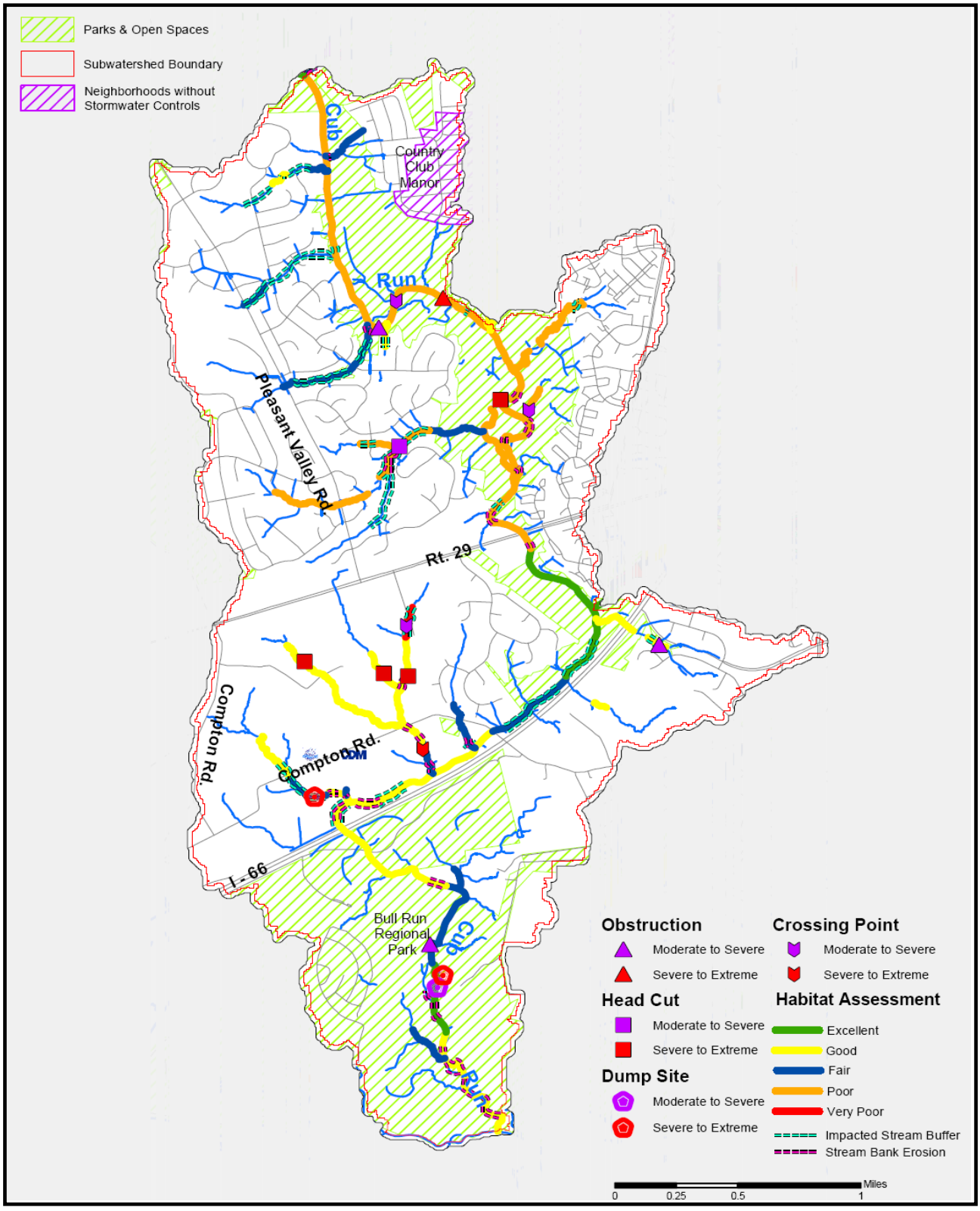

Figure 3-16
Existing Conditions in the
Lower Cub Run Subwatershed

Table 3-34
Summary of Physical Stream Habitat Ratings
for the Lower Cub Run Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	1.1	8
Good	4.3	32
Fair	2.9	22
Poor	5.1	38
Very Poor	0.1	1

The Lower Cub Run main stem can be broken into four reaches, primarily based on the underlying geology and stream habitat conditions:

- The main stem reach upstream from Route 29 generally has clay soils and shale. Poor bank stability and sediment deposition results in poor physical habitat conditions within the main stem of Cub Run upstream from Route 29. This section is within the Cub Run Stream Valley Park and generally has good stream buffers except at locations where utilities (power lines, water lines, etc.) cross the stream. The stream is adjacent to Virginia Run.

- The small streams that enter Cub Run from the Virginia Run neighborhoods generally have poor habit ratings primarily resulting from poor stream buffers. As with the first reach, these reaches lie in areas with clay soils and shale.

- The middle reach of Cub Run from Route 29 to below Big Rocky Run but upstream from Compton Road is in an area underlain by rock associated with an igneous intrusion. This stream has a high gradient and the substrate consists of rock, boulders and cobbles. The high gradient generally reduces sediment deposition in this reach. This stream lies within the Cub Run Stream valley park, and the stream buffers are generally good except where a power line crosses the stream. These factors produce excellent physical habitat scores for this middle reach.

- The lower reach downstream from Compton Road again is in clay soils with shale. The gradient decreases within Bull Run Regional Park, resulting in significant sediment deposition and braided streams. The habitat in this reach ranges from excellent to fair.

Figure 3-16 also shows the following information from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-16 includes these features where the impact scores indicate they have a significant stream impact.

Upper reaches of the Cub Run main stem, upstream from Route 29, generally have unstable vertical banks that result in many stream erosion inventory lines - especially at the outside of bends - and poor stream bank stability scores. Similar conditions exist downstream from Compton Road, through Bull Run Regional Park, to Bull Run. Stream segments within Bull Run Regional Park have high incidences of stream bank erosion, mostly occurring on the outside of bends.

Streams entering Cub Run from the north between Compton Road and Route 66 generally have good habitat. However, these streams show head cuts, stream-erosion inventory lines and poor stream bank stability scores that indicate active erosion. These streams have low development densities that should not produce this erosion. The erosion may result from past lands uses or down-cutting of Cub Run.

Fish and Benthic Macroinvertibrate Studies

The Stream Protection Strategy includes two sampling locations in Lower Cub Run. The conditions found at these sites based on the sampling of fish and benthic macroinvertibrates are summarized in Table 3-35.

The sampling data indicate that the habitat is poor to good in the Lower Cub Run subwatershed, correlating well with the physical habitat condition ratings. This entire subwatershed is within the restoration II category in which the main management strategy is to prevent further degradation.

Table 3-35
Summary of Stream Protection Strategy Results for
Lower Cub Run Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Lower Cub Run at Compton Road	Fair	Very Poor	Moderate	Poor	Restoration II
Lower Cub Run within Bull Run Regional Park	Fair	Fair	Moderate	Good	Restoration II

3.7.6 Stream Water Quality

Fairfax County samples for water quality in the Lower Cub Run at a single location:

- Cub Run at Compton Road (29-04)

These data are summarized in Section 2 and indicate water quality in this subwatershed is typical for many county streams. Fecal coliform concentrations regularly exceed the state criteria for surface waters. Dissolved oxygen levels are high, indicating a healthy stream capable of supporting life. Other measured parameters are within acceptable levels and do not indicate abnormal conditions within this subwatershed.

3.7.7 Stream Geomorphology

The Lower Cub Run subwatershed has variable stream geomorphology, largely due to the underlying geology in this area of the Triassic basin.

The Fairfax County Stream Physical Assessment Study includes the channel evolution model (CEM) stage and stream substrate.

The streambed in reaches upstream from Route 29 consists of clay soils and shale. The CEM stage is III, indicating the streams are widening. The substrate is largely silt. Many reaches exhibit large pools with very short segments of riffles between the pools.

Between Route 29 and Compton Road the stream is underlain by an igneous intrusion that results in a rocky substrate that is less affected by high stream flows and thus has higher physical habitat scores. The stream gradient is high. The CEM stages are IV and V, indicating the stream is stabilizing or has stabilized. The substrate is gravel, boulders and sand that result in excellent habitat ratings for this reach.

Farther downstream, clay soils and shale predominate. The stream bottom slope decreases, resulting in sediment deposition. In some areas within Bull Run Regional Park, sediment deposition is reducing the stream capacity, producing additional stream erosion and braded channels. The CEM stage is mostly III with some IV, indicating the streams are widening and stabilizing in some reaches. Upstream from Route 66, the dominant substrate is gravel. The substrate changes to sand, silt and clay in downstream reaches within Bull Run Regional Park.

3.7.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Lower Cub Run subwatershed:

- The county should allow alternatives to septic systems within the R-C District but should not extend sanitary sewer systems to serve these areas.
- Concerns about the potential impacts of the proposed Tri-County Parkway and Battlefield Bypass alternatives on the local streams. One proposed route for the Tri-County Parkway goes through this subwatershed and places the road very close to Cub Run within Bull Run Regional Park. As discussed in Section 2.4.4, the Commonwealth Transportation Board selected an alternative that lies entirely outside the Cub Run and Bull Run watersheds.
- Trash and dumping upstream from Compton Road and near London Towne
- Townhouses constructed close to the stream on the east bank between Route 29 and Big Rocky Run
- Impacts of trail fords on the stream stability within Cub Run Stream Valley Park
- Stream bank erosion in segments immediately upstream from Route 29
- Frequent roadway flooding where small streams cross Compton Road
- Protection and preservation of historic features, including Lane Mill and Manassas Gap Railroad features
- Stream bank erosion within Bull Run Regional Park
- Fallen trees producing snags between Route 29 and Compton Road
- Impact of utility crossings on stream erosion and buffers within Cub Run Stream Valley Park

3.7.9 Modeling Results

Figure 3-17 presents stormwater modeling results for the Lower Cub Run subwatershed. Section 2.8 presents additional details on the modeling and modeled scenarios.

Peak flows at the bottom of the Cub Run subwatershed increase by 9 percent between existing and future conditions (with stormwater controls). Nutrient loads from within the Lower Cub Run subwatershed increase by 32 percent. Much of this increase results from the development of open space as Estate-Residential land use within the R-C district. The loading per acre in this watershed is the lowest of the Cub Run subwatersheds.

3.8 Bull Run Subwatersheds

Overview of Conditions in the Bull Run East and West Subwatersheds

- **Drainage area**
  - **Bull Run East Subwatershed = 1,215 acres (1.9 square miles)**
  - **Bull Run West Subwatershed = 5,002 acres (7.8 square miles)**
    - **827 acres in Loudoun County (1.3 square miles)**
    - **4,175 acres in Fairfax County (6.5 square miles)**
  - **Existing impervious area**
    - **Bull Run East Subwatershed = 11 percent**
    - **Bull Run West Subwatershed = 3 percent**
- **Future impervious area**
  - **Bull Run East Subwatershed = 16 percent**
  - **Bull Run West Subwatershed = 10 percent**
- **The Bull Run East subwatershed has high-quality stream habitat and few erosion problems. The streams' substrate is boulders and rock that reduce the impact of increased stream flows and result in high habitat scores.**
- **There is little potential for future development in the Bull Run East subwatershed. This watershed includes 12 stormwater ponds that control the peak flows and water quality for much of the existing development.**
- **The Fairfax County portions of the Bull Run West subwatershed are entirely within the R-C District and the Loudoun County portions have similar planned development densities. The development densities are low and will remain low.**
- **The Bull Run West subwatershed has good to fair stream habitat quality. In many locations the stream buffers are affected by farm fields and pastures.**

The following sections summarize the conditions in the Bull Run subwatersheds.

3.8.1 Overview of Drainage Characteristics

The Bull Run subwatersheds include small, unnamed streams that flow directly into Bull Run. Bull Run forms the southern Fairfax County and Prince William County boundary. For this study, this area is broken into two subwatersheds:

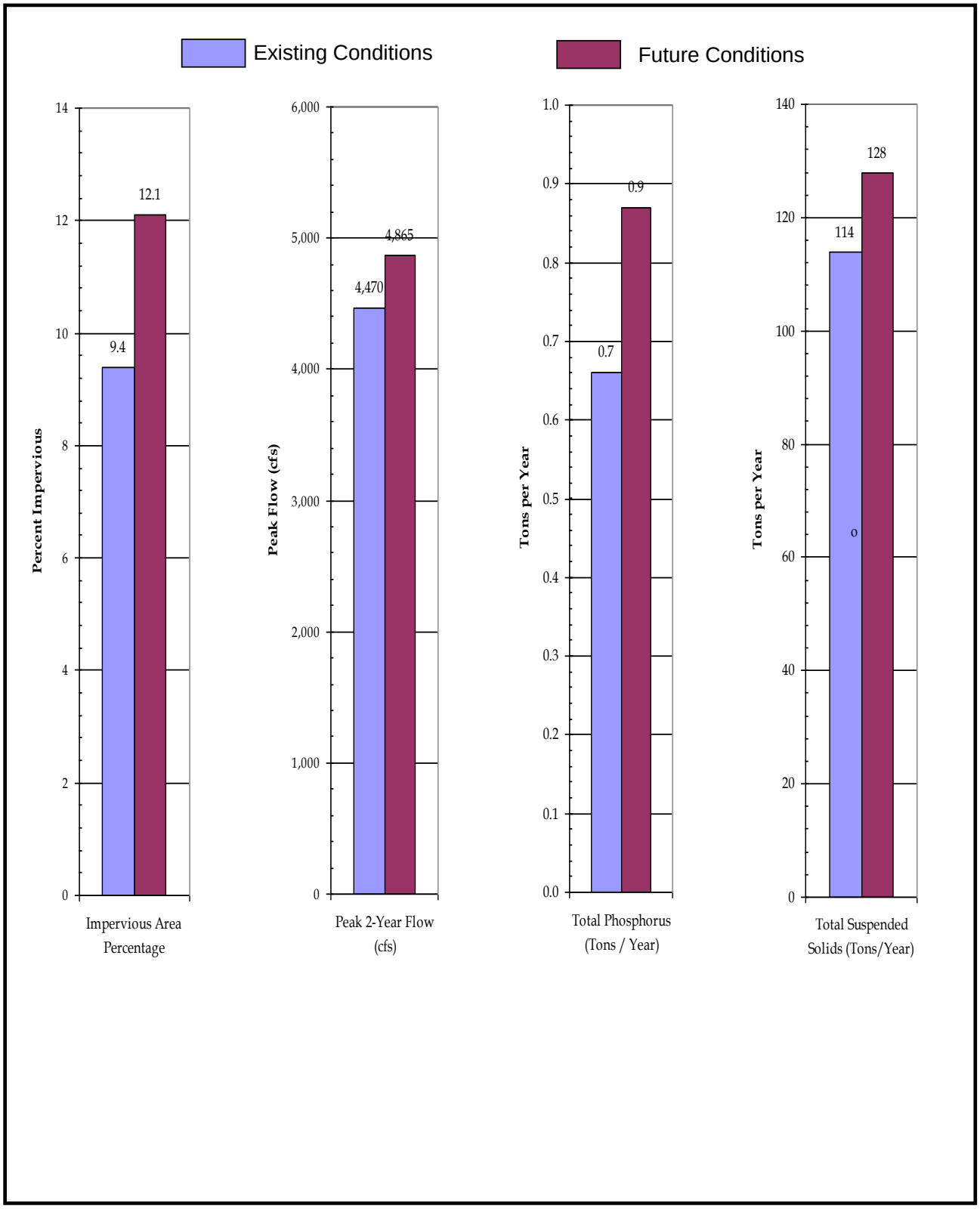

Figure 3-17
Overview of Existing and Future Conditions
in the Lower Cub Run Subwatershed

1. The Bull Run East subwatershed includes the areas that flow into Bull Run east of Cub Run but west of Little Rocky Run, as shown on Figure 3-18. As discussed later in this section, Figure 3-18 also presents the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds. This subwatershed includes the UOSA advanced wastewater treatment plant. Areas south of Compton Road are in the R-C District. Most of this area is in the Bull Run Regional Park, leaving very little Estate-Residential development. North of Compton Road the subwatershed includes primarily medium-density residential development in the Centreville area.

2. The Bull Run West subwatershed includes the streams that flow into Bull Run west of Cub Run and east of the Fairfax County/Loudoun County border, as shown on Figure 3-19. As discussed later in this section, Figure 3-19 also presents the location of existing dry ponds, wet ponds, regional ponds and previously proposed regional ponds. The Fairfax County portions of this subwatershed are entirely within the R-C District.

3.8.2 Existing and Future Land Use

Bull Run East Subwatershed

Table 3-36 provides an overview of the existing and future land use in the Bull Run East subwatershed.

The southern portion of the subwatershed, south of Compton Road, is in the R-C District. Most of this area is within either the UOSA advanced wastewater treatment plant or the Bull Run Regional Park. North of Compton Road the land use is mostly medium-density, single-family residential.

Future land use changes consist of developing the few areas of open land to the planned land use, resulting primarily in additional medium-density residential development. Much of this development is occurring as this study is being completed.

Bull Run West Subwatershed

The Bull Run West subwatershed lies entirely within the R-C District in Fairfax County. Areas in Loudoun County have similar planned land use. Table 3-37 presents the existing and planned future land use for this subwatershed. Under current conditions the subwatershed includes large areas of open space that have a planned land use of Estate-Residential. Future changes in land use will result from the development of this land as 5-acre residential. The subwatershed includes a quarry that has an industrial land use. The subwatershed includes preserved open space in the Bull Run Regional Park and Fairfax National Golf Course.

3.8.3 Existing and Future Impervious Area

Table 3-38 provides an overview of the existing and future impervious area estimates for the Bull Run East and Bull Run West subwatersheds.

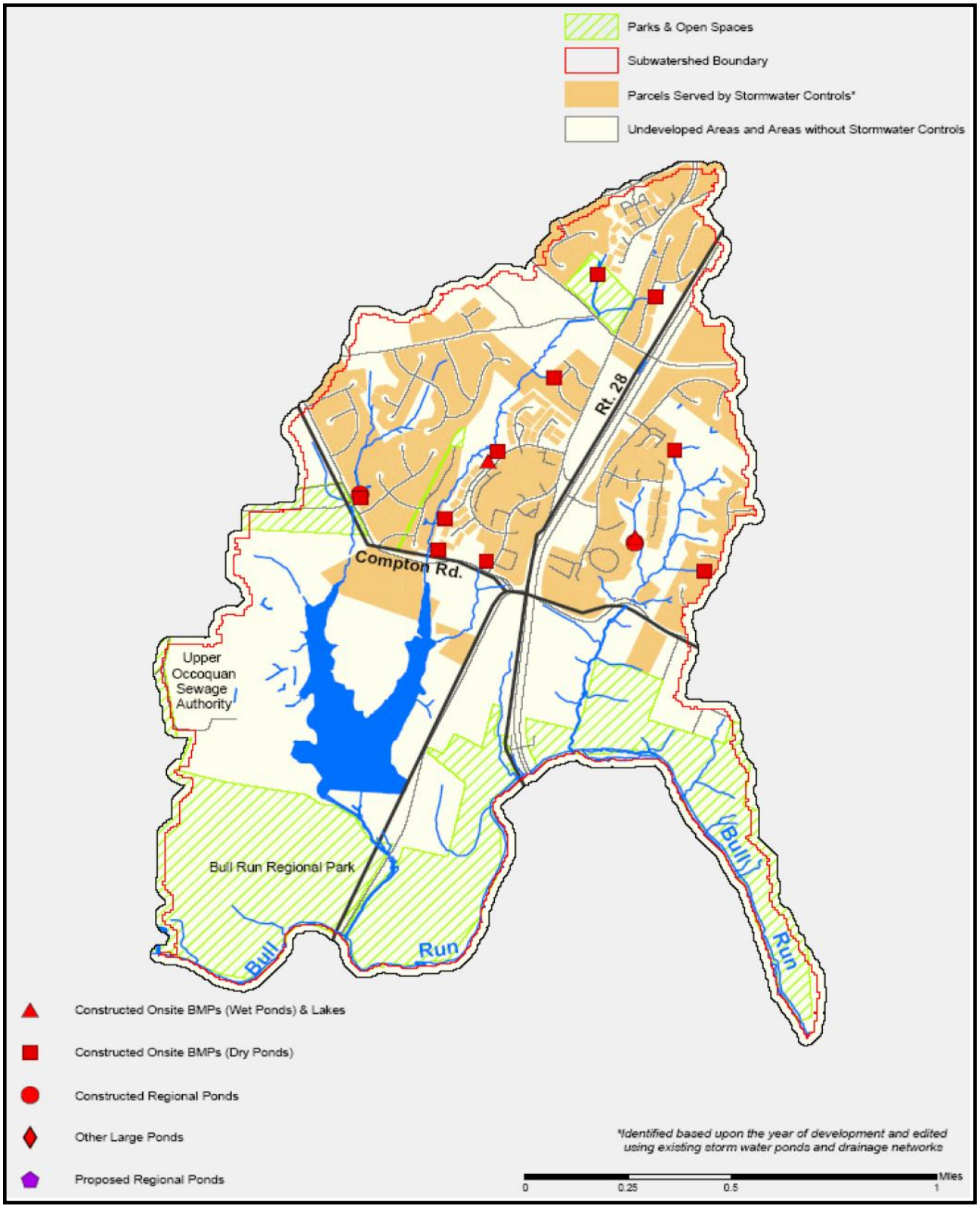

Figure 3-18
Stormwater Facilities in the
Bull Run East Subwatershed

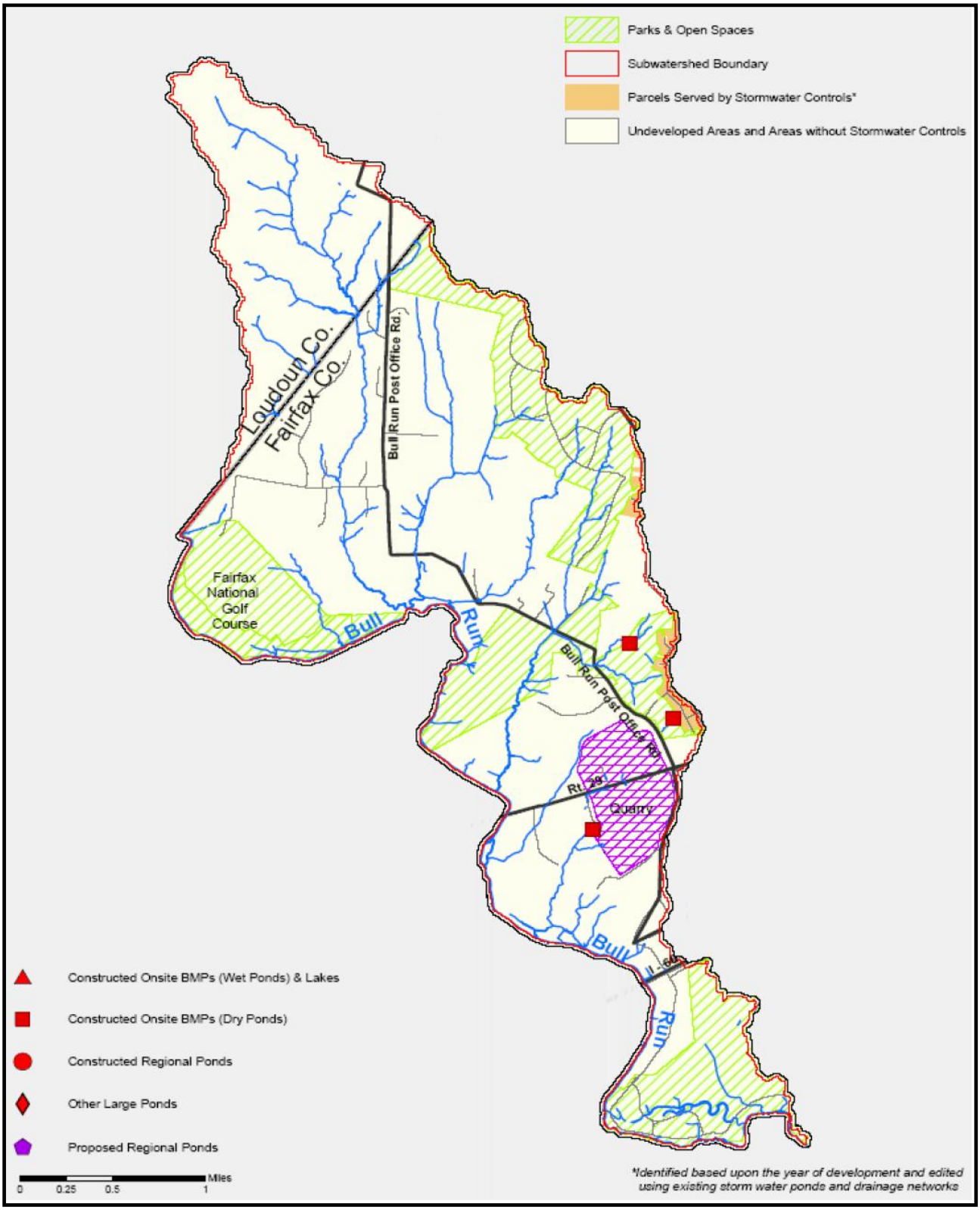

Figure 3-19
Stormwater Facilities in the
Bull Run West Subwatershed

The impervious area for the Bull Run East subwatershed increases five percentage points from 11 to 16 percent. These values suggest this subwatershed is mostly built out with little room for additional development.

The impervious area for the Bull Run West subwatershed increases seven percentage points from 3 to 10 percent. This low development density will have little impact on the local streams.

3.8.4 Existing Stormwater Controls

Figures 3-18 and 3-19 show the stormwater ponds in the Bull Run subwatersheds and the developed area upstream from these ponds. The watershed may contain other stormwater controls such as underground detention and treatment facilities, and rooftop detention.

Bull Run East Subwatershed

No ponds exist within the R-C district portion of the Bull Run East subwatershed. The existing ponds are mostly located within the upstream portions of the subwatershed, outside the R-C district. This subwatershed contains a large lake that receives treated effluent from the UOSA advanced wastewater treatment plant and drainage from the upstream watershed.

Table 3-36
Summary of Existing and Future Land Use in the Bull Run East Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	459	37.8	356	29.3
Estate-Residential	75	6.2	109	9.0
Low-Density Residential	29	2.4	32	2.6
Medium-Density Residential	185	15.3	253	20.8
High-Density Residential	143	11.8	143	11.8
Low-Intensity Commercial	15	1.2	24	1.9
High-Intensity Commercial	-	-	-	-
Industrial	9.8	0.8	-	-
Residential Planned Community	-	-	-	-
Upper Occoquan Sewerage Authority Advanced Wastewater Treatment Plant	298	24.5	298	24.5

Table 3-37
Summary of Existing and Future Land Use in the Bull Run West Subwatershed

Land Use	Existing Conditions		Future Conditions	
	Acres	Percent	Acres	Percent
Open Space	3,422	68.4	1,066	21.3
Estate-Residential	1,267	25.3	3,617	72.3
Low-Density Residential	39	0.8	40	0.8
Medium-Density Residential	4	0.1	5	0.1
High-Density Residential	-	0.0	-	0.0
Low-Intensity Commercial	26	0.5	25	0.5
High-Intensity Commercial	6	0.1	5	0.1
Industrial	240	4.8	245	4.9
Residential Planned Community	-	0.0	-	0.0

Table 3-38
Summary of Drainage Areas and Existing and Projected
Future Impervious Area for the Bull Run Subwatershed

County	Watershed Area (Acres)	Existing Impervious Area		Future Impervious Area	
		Acres	Percent	Acres	Percent
Bull Run East Subwatershed	1,215	134	11.0	191	15.7
Bull Run West Subwatershed	5,002	130	2.6	485	9.7
Total Bull Run Subwatershed	6,217	264	4.2	676	10.9

Table 3-39 summarizes the number of existing dry and wet ponds and the total subwatershed area upstream from these ponds in the Bull Run East subwatersheds.

Table 3-39
Summary of Number of Ponds and Cumulative Drainage Area
for the Bull Run East Subwatershed

Type of Pond	Approximate Number of Ponds *	Total Drainage Area Upstream from Ponds
Dry Ponds	10	293 acres
Wet Ponds	2	46 acres
Total in Subwatershed	12	339 acres

The watershed contains two Fairfax County regional ponds:

- Regional Pond C49 – Dry pond north of the Compton Road and Confederate Ridge Lane intersection. The watershed is single-family residential.
- Regional Pond C50 – Wet pond southeast of Ridgewater Court

No planned regional ponds are in this subwatershed.

Approximately 28 percent of the Bull Run East subwatershed drainage area is upstream from these existing ponds. These ponds control most of the areas developed at densities greater than Estate-Residential north of Compton Road. The UOSA lake also provides additional water quality protection for these areas.

Bull Run West Subwatershed

The Bull Run West subwatershed includes a few farm ponds and ponds associated with quarry operations. The low-density development in this subwatershed does not require additional stormwater controls.

3.8.5 Stream Habitat

The Fairfax County Stream Physical Assessment Study summarizes the stream physical habitat condition for the Fairfax County streams.

Bull Run East Subwatershed

Physical Habitat

Figure 3-20 shows the stream physical habitat ratings for the Bull Run East streams, and Table 3-40 summarizes the physical stream habitat.

Table 3-40
Summary of Physical Stream Habitat for the
Bull Run East Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.9	50
Good	0.5	30
Fair	0.4	20
Poor	0.0	0
Very Poor	0.0	0

The eastern-most stream has excellent physical habitat. The remaining streams have good to fair habitat.

Figure 3-20 also shows the following information from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion
- Head cuts indicate where the streambed is down-cutting
- Dump sites
- Locations where stream crossings affect the streams

Figure 3-20 includes these features when the impact scores indicate a significant stream impact.

The four inventory points within the Bull Run East subwatershed is a small number compared to the other subwatersheds

Fish and Benthic Macroinvertibrate Studies
The Stream Protection Strategy does not include sampling locations in the Bull Run East subwatershed. This area is within the watershed protection level II area where the primary management activity is to prevent further watershed degradation.

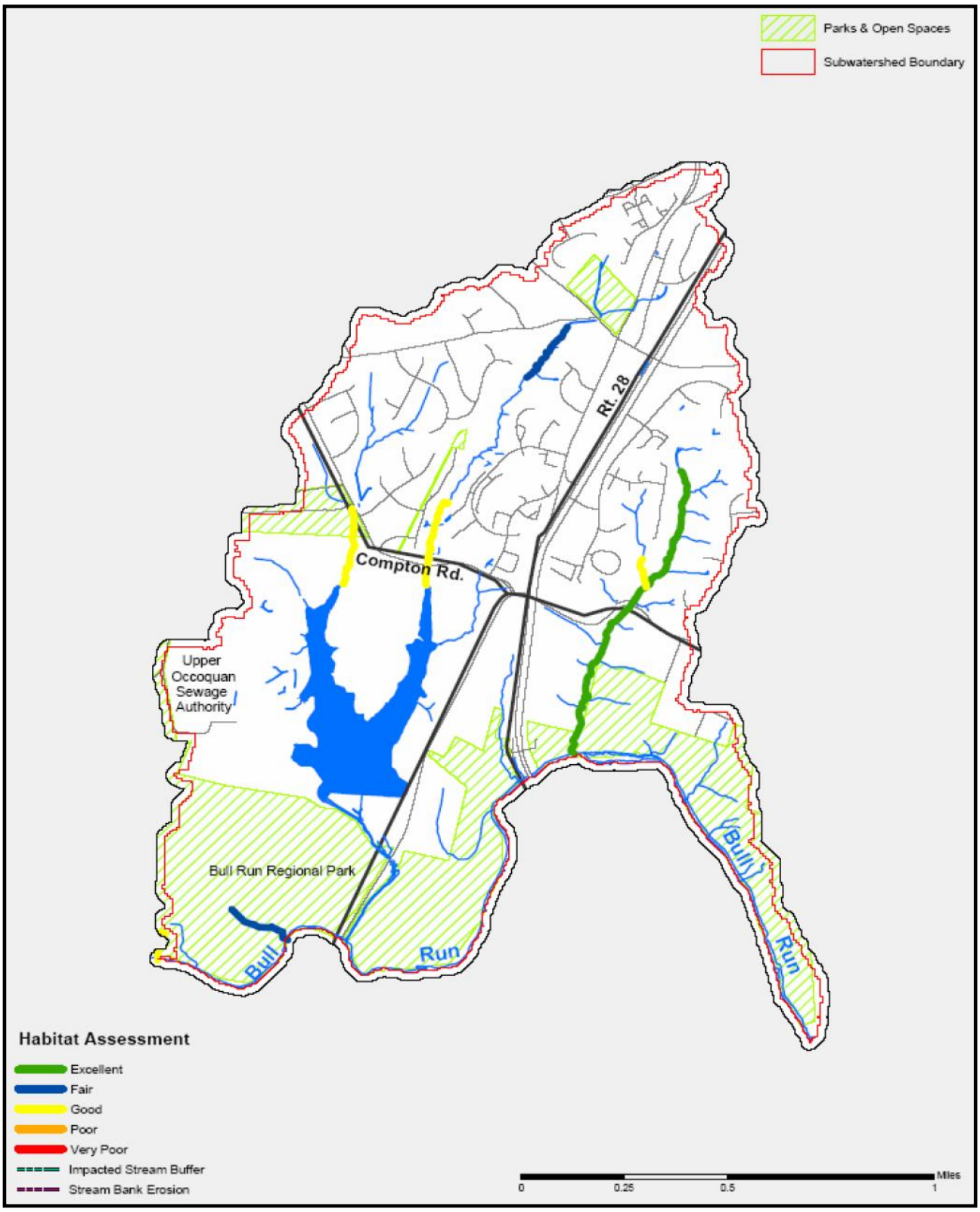

Figure 3-20
Existing Conditions in the
Bull Run East Subwatershed

Bull Run West Subwatershed

Physical Habitat

Figure 3-21 shows the stream physical habitat ratings for the Bull Run West streams, and Table 3-41 summarizes these ratings.

Table 3-41
Summary of Physical Stream Habitat Ratings
for the Bull Run West Subwatershed

Physical Stream Habitat Rating	Length of Stream (Miles)	Percent of Total Stream Length Analyzed
Excellent	0.0	0
Good	4.2	31
Fair	7.7	58
Poor	1.4	11
Very Poor	0.0	0

The stream physical habitat ranges from good to poor. The stream habitat is primarily affected by the loss of buffer within existing fields and pastures, suggesting these streams will benefit from buffer restoration projects on this private property.

The stream with poor stream habitat is downstream from the quarry, suggesting discharges from the quarry may be affecting the habitat.

Figure 3-21 also shows the following information from the Stream Physical Assessment Study:

- Locations where the stream buffer is affected
- Erosion inventory lines, indicating areas of active stream erosion
- Obstructions. Most obstructions indicate where trees have fallen into the stream from active erosion.
- Head cuts indicate where the streambed is down-cutting
- Dump sites
- Locations where stream crossings affect the streams

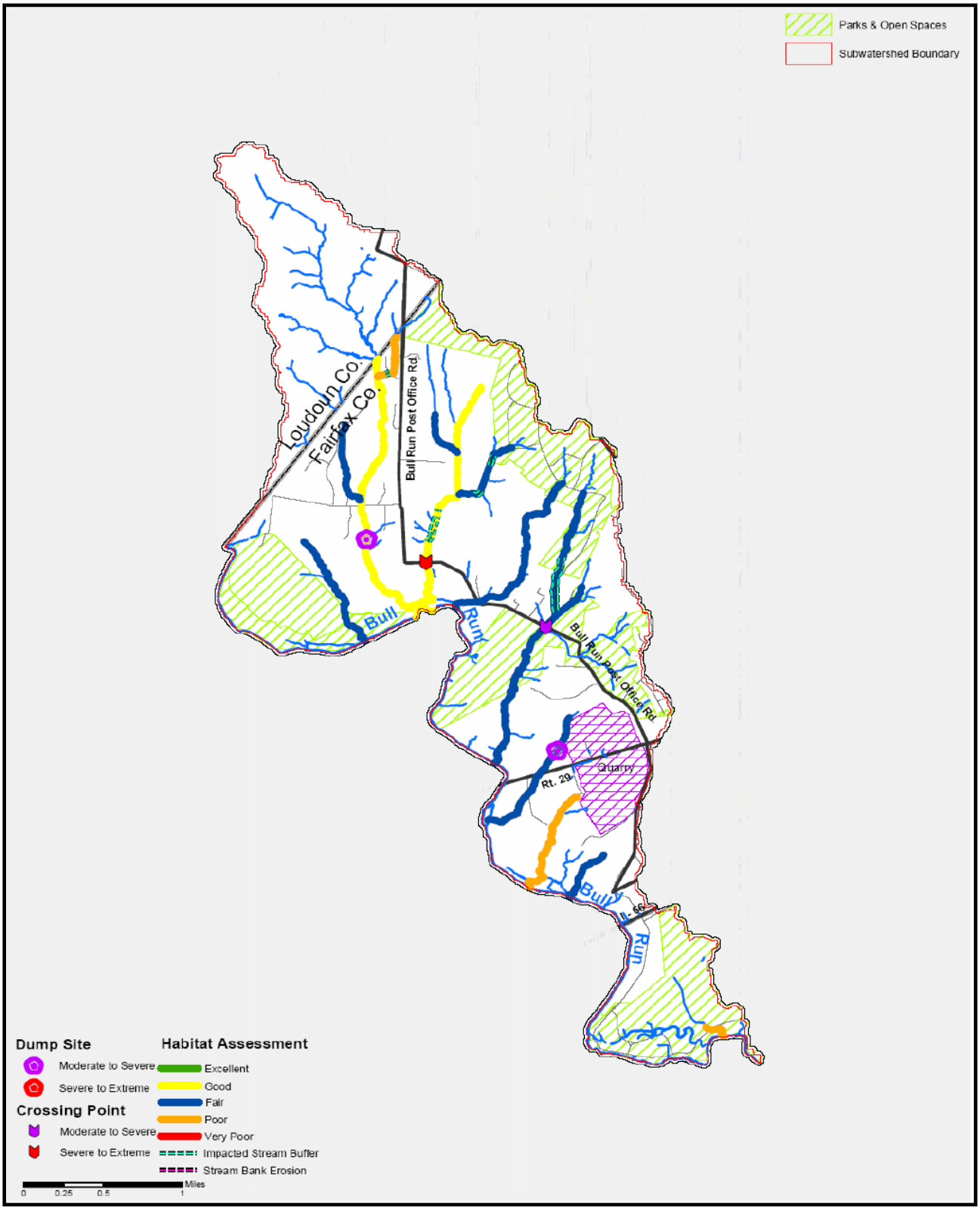

Figure 3-21
Existing Conditions in the
Bull Run West Subwatershed

Figure 3-21 includes only the features when the impact scores indicate a significant stream impact.

The Bull Run West subwatershed includes several locations where the stream buffer is affected and isolated areas of stream bank erosion. Bull Run Post Office Road stream crossings affect the streams at several locations.

Fish and Benthic Macroinvertibrate Studies
The Stream Protection Strategy includes one sampling location in the Bull Run West subwatershed on an unnamed tributary near Bull Run. The conditions at this site based on the fish and benthic macroinvertibrate sampling are summarized in Table 3-42.

Table 3-42
Summary of Stream Protection Strategy Results for
Bull Run West Subwatershed

Location	Index of Biotic Integrity	Habitat Score	Fish Taxa Richness	Overall Site Condition Rating	Watershed Management Category
Bull Run West Tributary near Bull Run	Excellent	Fair	High	Excellent	Protection

These sampling data indicate the habitat is excellent at this location. In fact, this location has some of the best habitat in Fairfax County. This area is within the SPS protection watershed category in which the main management strategy is to identify and protect the conditions responsible for producing these high-quality stream environments.

3.8.6 Stream Water Quality

Fairfax County samples for water quality in the Bull Run subwatersheds at a single location:

- Bull Run at Route 29 (30-01). The site samples the water within Bull Run and therefore includes the effects of the upstream Bull Run watershed but not the quality of the runoff from the Bull Run West subwatershed.

These data are summarized in Section 2 and indicate water quality in this subwatershed is typical for many county streams. Fecal coliform concentrations regularly exceed the state criteria for surface waters. Dissolved oxygen levels are high, indicating a healthy stream capable of supporting life. Other measured parameters are within acceptable levels and do not indicate abnormal conditions within this subwatershed.

3.8.7 Stream Geomorphology

The Bull Run subwatershed has variable stream geomorphology, largely due to the underlying geology in this area of the Triassic basin.

Bull Run East

The Bull Run East subwatershed has a variety of stream substrate conditions. The most eastern tributary has bedrock as the stream substrate. This results in the excellent physical habitat scores for this reach. This stream has CEM stages III and IV, indicating the streams are widening but stabilizing.

To the west in this subwatershed the substrate turns to sand and gravel, and finally to clay and silt. Sections of these streams are CEM stage II, indicating down-cutting. The remaining stream segments are classified as stage III and IV.

Bull Run West

The streams in this subwatershed are in CEM stage III and IV, indicating that portions of the streams are widening while others are stabilizing. The substrate is gravel and clay.

3.8.8 Concerns Identified by the Public

The CAC and attendees of the public forums identified the following concerns in the Bull Run subwatersheds:

- Alternatives to septic systems within the R-C District that do not involve extending the sanitary sewer system
- Impact of development in Loudoun County on Fairfax County streams
- Potential impacts of the planned Tri-County Parkway and Battlefield Bypass alternatives on the local streams
- Flooding at locations where Compton Road crosses the small streams especially near the UOSA advanced wastewater treatment plant
- Flooding at locations where Bull Run Post Office Road crosses the small streams
- Potential impact of Fairfax National Golf Course on stream water quality
- Impacts of UOSA discharges on the streams and water quality in the Occoquan Reservoir
- Trash and dumping at the Bull Run Post Office Road and Compton Road intersection

3.8.9 Modeling Results

Figures 3-22 and 3-23 present stormwater modeling results for the Bull Run East and Bull Run West subwatersheds. Section 2.8 provided addition details on the modeling and modeled scenarios.

In the Bull Run East subwatershed, the peak flows increase by 8 percent and the total phosphorus loads increase by 26 percent.

In the Bull Run West subwatershed, the peak flows increase 30 percent and the total phosphorus loads increase 125 percent. The increase largely results from development within the R-C district and lack of stormwater controls for it. The unit loading rates (pounds per acre per year) remain the lowest compared to the other subwatersheds in the Cub Run and Bull Run watersheds.

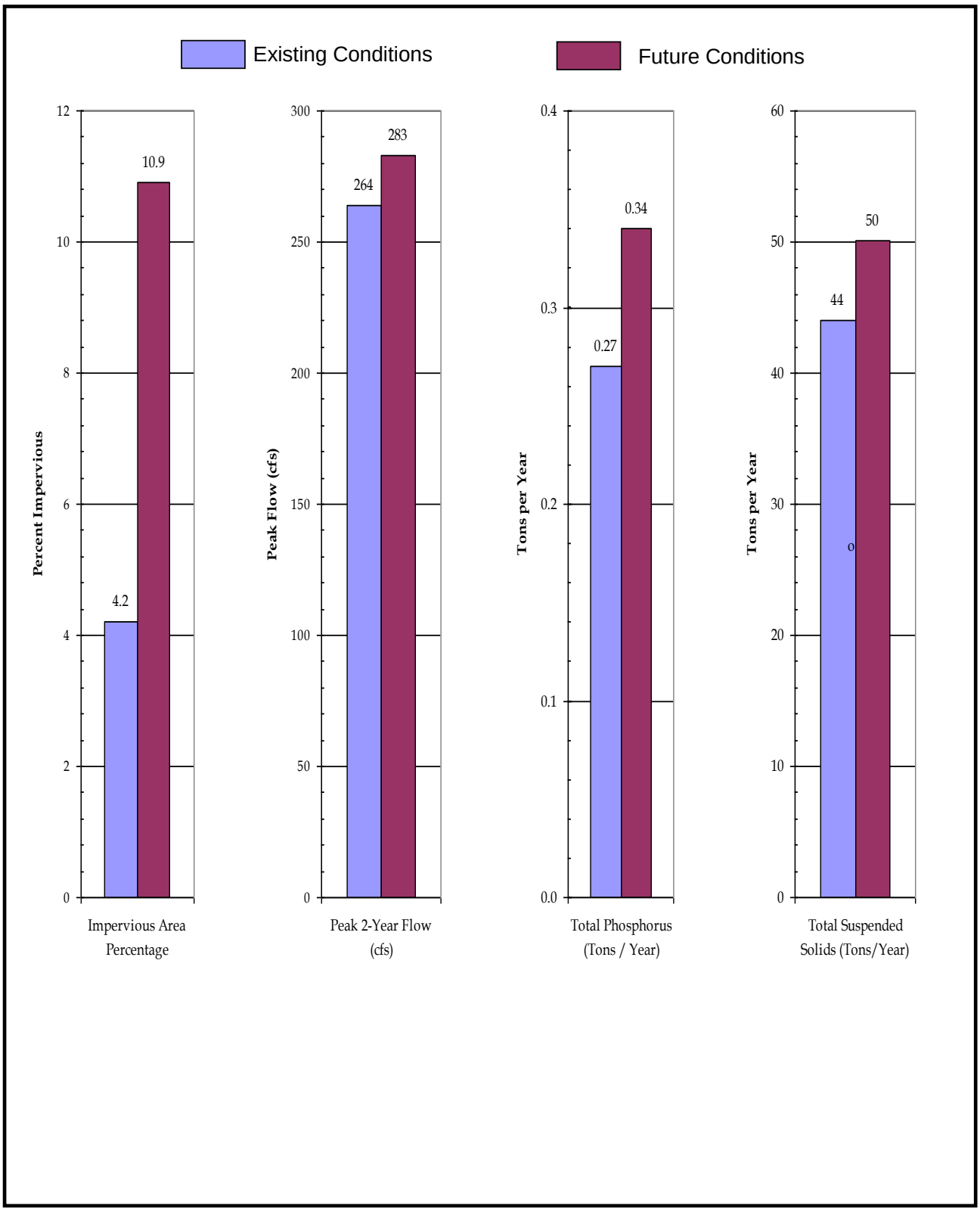

Figure 3-22
Overview of Existing and Future Conditions
in the Bull Run East Subwatershed

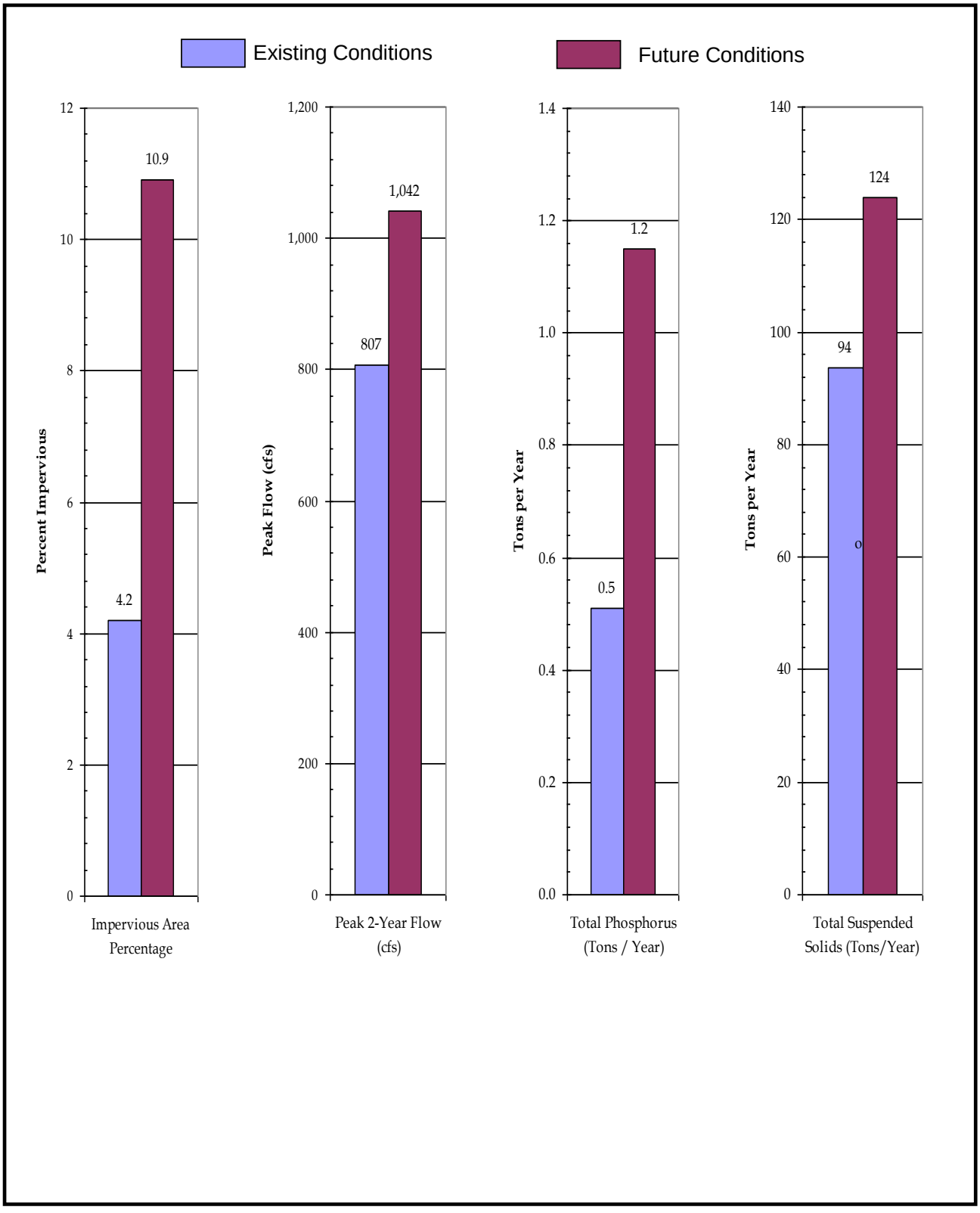

Figure 3-23
Overview of Existing and Future Conditions
in the Bull Run West Subwatershed