

Natural Conditions
Assessment for Low DO
Sappony Creek
Dinwiddie County, Virginia

Submitted by

Virginia Department of Environmental Quality

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Executive Summary

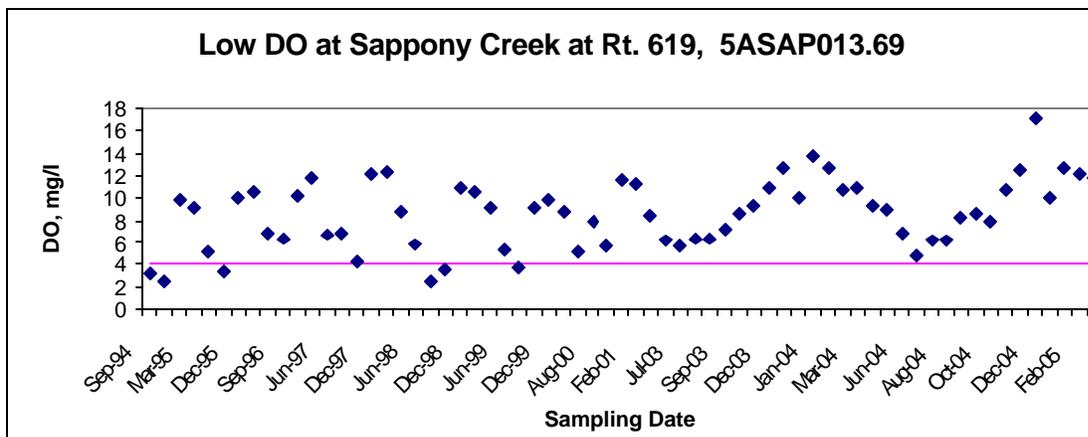
This report presents the assessment of whether low DO in the Sappony Creek watershed is due to natural conditions or whether a Total Maximum Daily Load (TMDL) must be performed because of anthropogenic impacts. Sappony Creek is located in Dinwiddie and western Sussex Counties in the Chowan River Basin (USGS Hydrologic Unit Code 03010201). The TMDL waterbody identification codes (WBID, Virginia Hydrologic Unit) for Sappony Creek is VAP-K22R-01.

There are 98.54 total stream miles in the Sappony watershed (National Hydrography Dataset (NHD)). The impaired segment for low DO is 20.19 miles of Sappony Creek in the Piedmont Physiographic Province of Virginia.

The watershed itself has an area of approximately 69.2 square miles. Horsepen Branch is a major tributary that enters Sappony Creek from the south in the central part of the watershed. The average annual rainfall recorded at Stony Creek, VA is 45.32 inches. The watershed is approximately 44,367.8 acres in size and is predominately forested (68.6 percent). Agriculture encompasses 21.2 percent of the watershed, with 15.1 percent cropland and 6.2 percent pasture/hayland. Residential and high use industrial areas compose approximately 0.6 percent of the land base. The remaining 9.1 percent of the watershed is comprised of 4.5 percent of transitional areas and grasses, and 4.6 percent wetlands and open water.

Sappony Creek was listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters and 2004 305(b) / 303(d) Integrated Report (VADEQ, 2003 & 2004) due to violations of the State's water quality standards for DO and fecal coliform bacteria. This report evaluates the DO impairment by determining if natural conditions are the cause of the impairment, thus obviating the need for a TMDL. The segment was de-listed for a fecal coliform bacteria TMDL because of acceptable fecal coliform levels in the 2004 305(b) / 303(d) Integrated Report. Out of 65 DO values collected between September 1994 and March 2005 at station 5ASAP013.69, 6 were below the lower water quality standard for DO of 4.0 mg/l (Figure E1) for a percent violation rate of 9.2 percent.

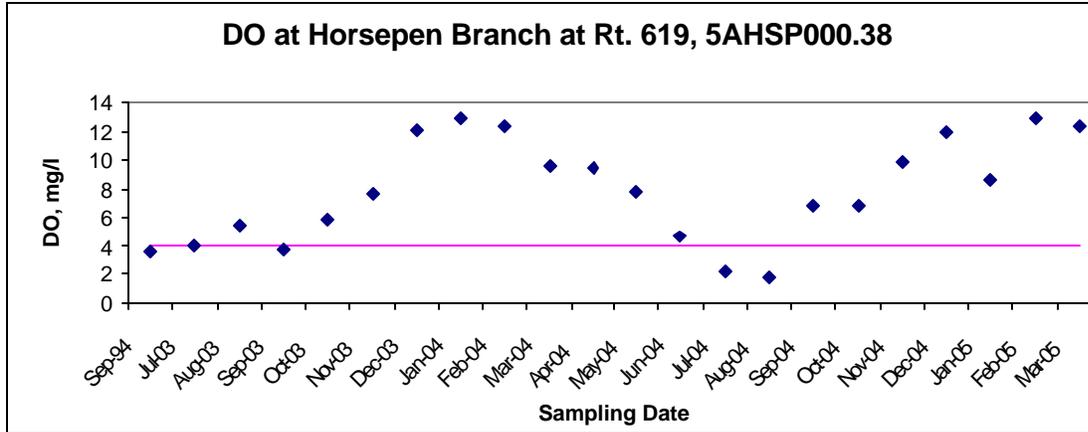
Figure E1. DO at Sappony Creek at Rt. 619, 5ASAP013.69, September 1994 to March 2005.



DEQ added several associated mainstem and tributary monitoring stations during data collection for the low DO assessment of natural conditions or development of a TMDL. Sappony Creek at Rt. 40 (5ASAP005.54), at Rt. 665 (5ASAP007.77), at Rt. 709 (5ASAP018.57), at Rt. 1 (5ASAP021.29), at Millrun Branch at Rt. 659 (5AMLB000.23), and at UT to Sappony Creek at Rt. 1 (5AXEZ000.23), all had violation rates of zero to 4.5 percent for DO.

Only Horsepen Branch at Rt. 619 (5AHSP000.38) exceeded the allowable 10.5 percent violation rate with 22.7 percent violations for DO (Figure E2).

Figure E2. DO at Horsepen Branch at Rt. 619, 5AHSP000.38.



Based on percent violations under 10.5 percent for the DO data collected at the original listing station, 5ASAP013.69, and all associated stations except Horsepen Branch, the Sappony Creek impaired segment is recommended for de-listing in the 2006 305(b) / 303(d) Integrated Report. The Horsepen Branch station had a 22.7 percent violation rate. Horsepen Branch was not originally monitored with the Sappony Creek listing station. Horsepen Branch will be listed impaired for low DO in the 2006 305(b) / 303(d) Integrated Report, based on the DO data collected in 2003 and 2004 for the Sappony Creek Natural Conditions Assessment for Low DO, with a TMDL due date of 2018.

DEQ performed the assessment of the Sappony Creek low DO natural condition in lieu of a TMDL. Therefore neither a TMDL Technical Advisory Committee (TAC) meeting nor a public meeting was involved. Public participation will occur during the next water quality standards triennial review process.

1. Introduction

Sappony Creek was listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters and 2004 305(b) / 303(d) Integrated Report (VADEQ, 2003 & 2004) due to violations of the State's water quality standards for DO and fecal coliform bacteria. This report evaluates the DO impairment by determining if natural conditions are the cause of the impairment, thus obviating the need for a TMDL. The segment was de-listed for a fecal coliform bacteria TMDL because of acceptable fecal coliform levels in the 2004 305(b) / 303(d) Integrated Report.

A glossary of terms used throughout this report is presented as Appendix A.

2. Physical Setting

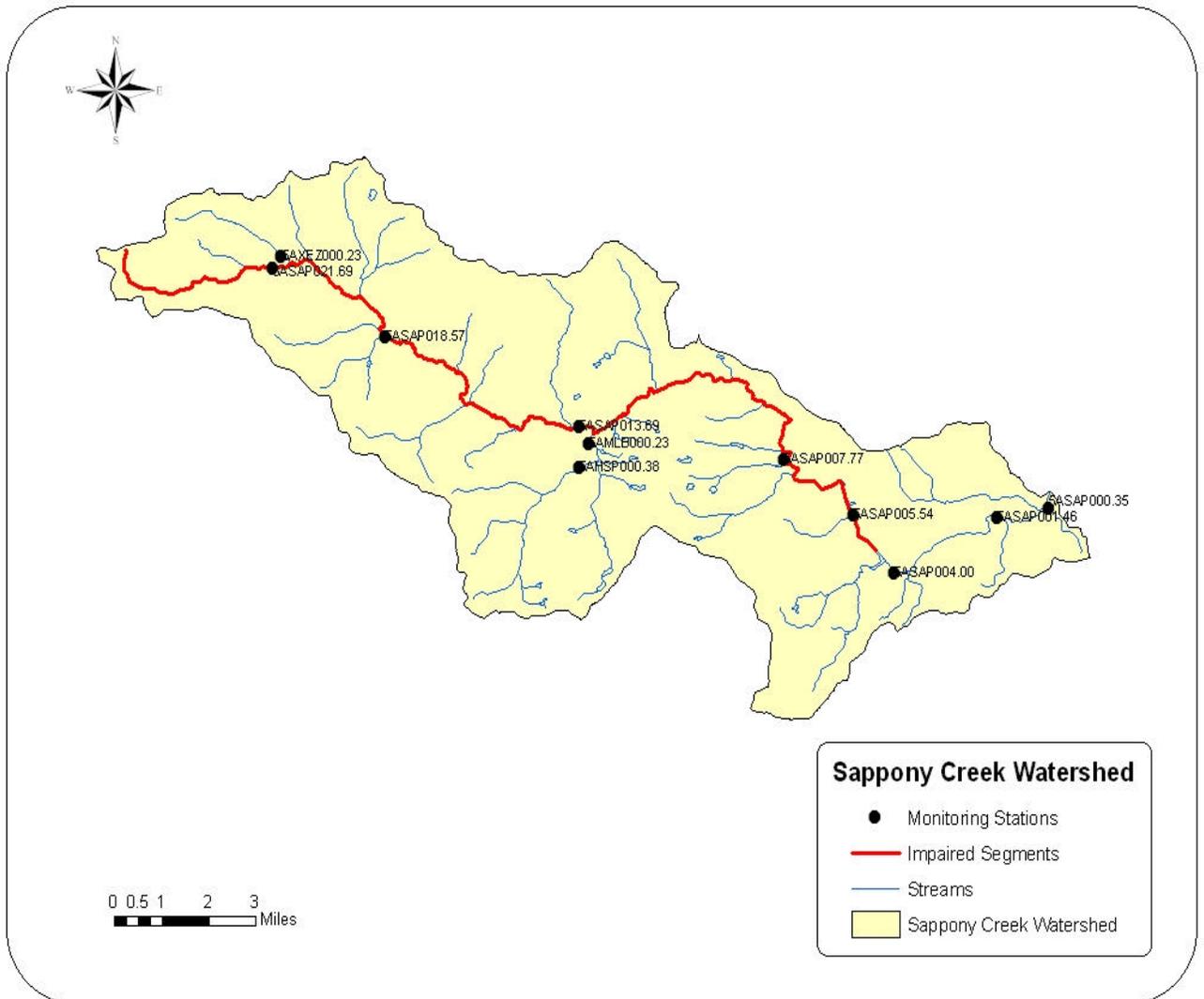
2.1. Listed Water Bodies

Sappony Creek is located in Dinwiddie and western Sussex Counties in the Chowan River Basin (USGS Hydrologic Unit Code 03010201). The TMDL waterbody identification codes (WBID, Virginia Hydrologic Unit) for Sappony Creek is VAP-K22R-01. There are 98.54 total stream miles in the Sappony watershed (National Hydrography Dataset (NHD)). The impaired segment for low DO is 20.19 miles of Sappony Creek, as described in Table 1.

Table 1. Impaired segment descriptions (Sappony Creek)

Segment (segment ID)	Impairment (source of impairment)	Upstream Limit Description	Downstream Limit Description	Miles Affected
Sappony Creek VAP-K22R-01	DO (Natural Conditions)	Sappony Creek headwaters	Spiers Pond	20.19

Figure 1. Map of the Sappony Creek study area.



2.2. Watershed

2.2.1. General Description

Sappony Creek, located within Dinwiddie and western Sussex Counties, Virginia, is a major tributary to the Nottoway River. It is about 25 miles long and flows southeast from its headwaters along Lew Jones Road west of DeWitt, VA, to its confluence with the Nottoway River three miles west of Stony Creek, VA. The watershed itself has an area of approximately 69.2 square miles. Horsepen Branch is a major tributary that enters Sappony Creek from the south in the central part of the watershed. There are several unnamed tributaries entering Sappony Creek from the north and south portions of the watershed. There is no continuous flow gaging station on Sappony Creek, however there is a gage on Stony Creek near Dinwiddie, VA, 02046000, located five miles northeast of Sappony Creek, with a drainage area of 112 mi².

2.2.2. Geology, Climate, Land Use

Geology and Soils

Sappony Creek is in the Piedmont physiographic region. The Piedmont of Virginia extends eastward from the Blue Ridge to the Fall Line, where Paleozoic-age and older igneous and metamorphic rocks are covered by unconsolidated sediments of the Atlantic Coastal Plain. The Virginia Piedmont is part of the greater southeastern Piedmont, which extends from northeastern Alabama through Georgia, South Carolina, North Carolina, Virginia, Maryland, and southeastern Pennsylvania. The Piedmont is characterized by deeply weathered, poorly exposed bedrock and a high degree of geological complexity, making it one of the last frontiers of North American regional geology. The Piedmont contains a collage of rock associations or terranes that are bounded by northeast-trending regional faults. (<http://www.geology.state.va.us/DOCS/Geol/pied.html>).

Soils for the Sappony Creek watershed were documented utilizing the VA State Soil Geographic Database (STATSGO). Two general soil types were identified using in this database. Descriptions of these soil series were derived from queries to the USDA Natural Resources Conservation Service (NRCS) Official Soil Series Description web site (<http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi>). Figure 2 shows the location of these general soil types in the watershed.

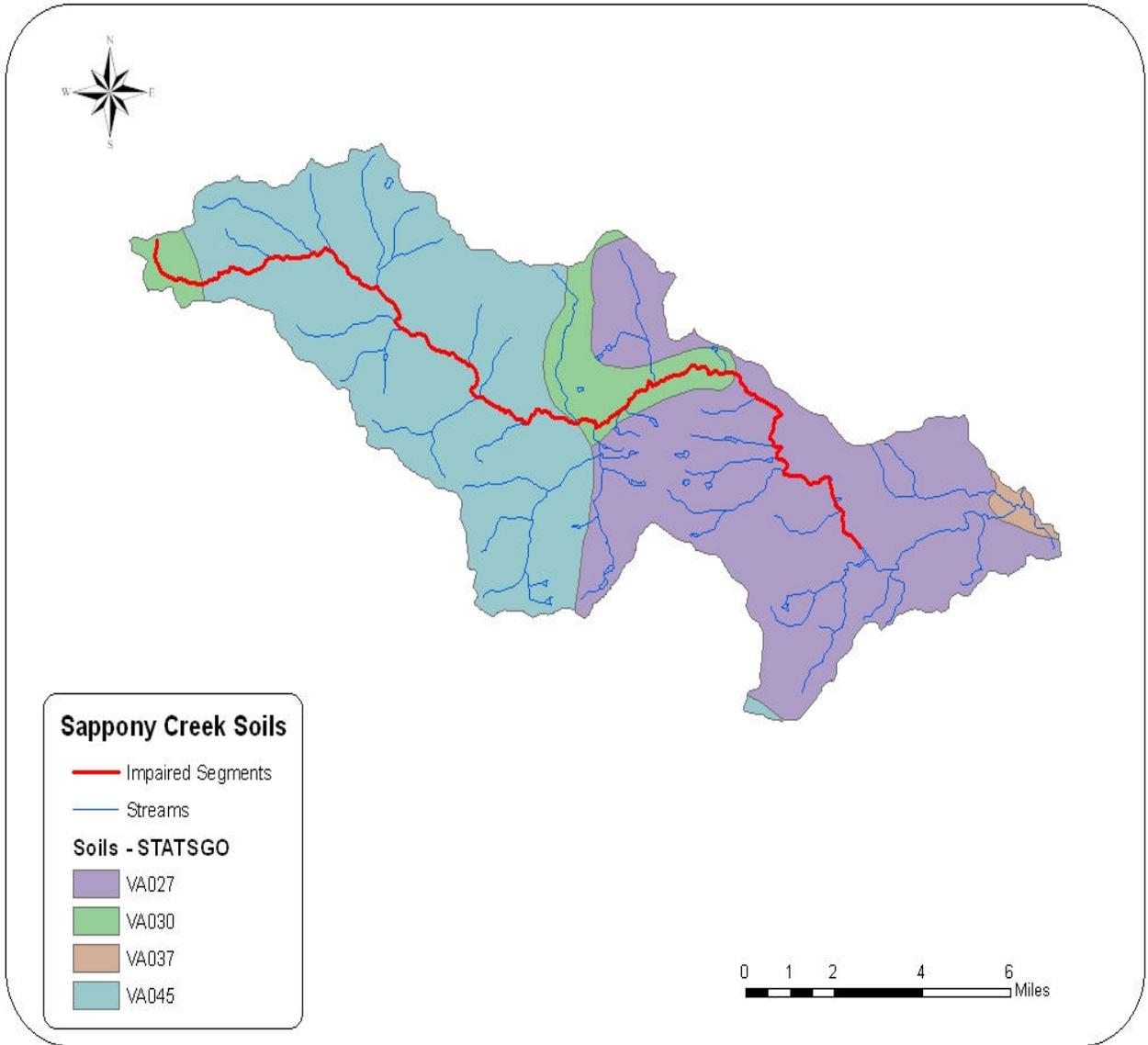
The soils of the Emporia-Johnston-Kenansville-Remlik-Rumford-Slagle-Suffolk-Tomotley series (VA027) are very deep, poorly to well drained soils. These soils are located on low stream or marine terraces and in the floodplains of the Atlantic Coastal Plain. These series are formed from fluvial and marine sediments, and are typically fine to coarse loamy soils. Permeability of these soils ranges from slow to moderately rapid, depending on soil composition.

Soils of the Appling-Wedowee-Ashlar-Louisburg-Vance-Worsham series (VA030) are moderate to very deep that formed in residuum from weathered igneous, metamorphic, and crystalline rock of the Piedmont Plateau. Soils range from excessively to poorly drained, with moderately rapid to slow permeability.

The Portsmouth - Roanoke -Rains - Eunola - Levy - Kalmia Series (VA037) are very deep, very poorly to moderately well drained soils. These soils are located on low stream or marine terraces and in marshes of the Atlantic Coastal Plain. These series are formed from fluvial and marine sediments. Permeability of these soil types ranges from very slow to rapid, depending on soil composition.

Soils of the Georgeville-Nason-Iredell-Lignum-Orange-Goldston series (VA045): are deep range from poorly to moderately to well drained. These soils are slow to moderately permeable with slow to medium to high runoff. They were formed from upland materials of weathered fine-grained metamorphic rock

Figure 2. Soil Characteristics of the Sappony Creek Watershed.



Climate

The climate summary for Sappony Creek comes from a weather station located in Stony Creek, VA, with a period of record from 8/ 1/1948 to 3/31/2004. The average annual maximum and minimum temperature (°F) at the weather station is 70.3 and 45.6 and the annual rainfall (inches) is 45.32 (Table 2) (Southeast Regional Climate Center, http://www.sercc.com/climateinfo/historical/historical_va.html).

Table 2. Climate summary for Stony Creek, Virginia (448129)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	47.8	52.0	60.8	72.2	79.4	86.9	90.2	87.7	82.1	71.6	61.8	51.0	70.3
Average Min. Temperature (F)	26.4	29.2	35.4	44.0	52.9	61.9	66.1	64.3	57.4	44.7	36.1	28.6	45.6
Average Total Precipitation (in.)	3.68	3.25	4.29	3.10	4.33	4.08	4.84	4.82	4.03	2.90	2.82	3.17	45.32

Land Use

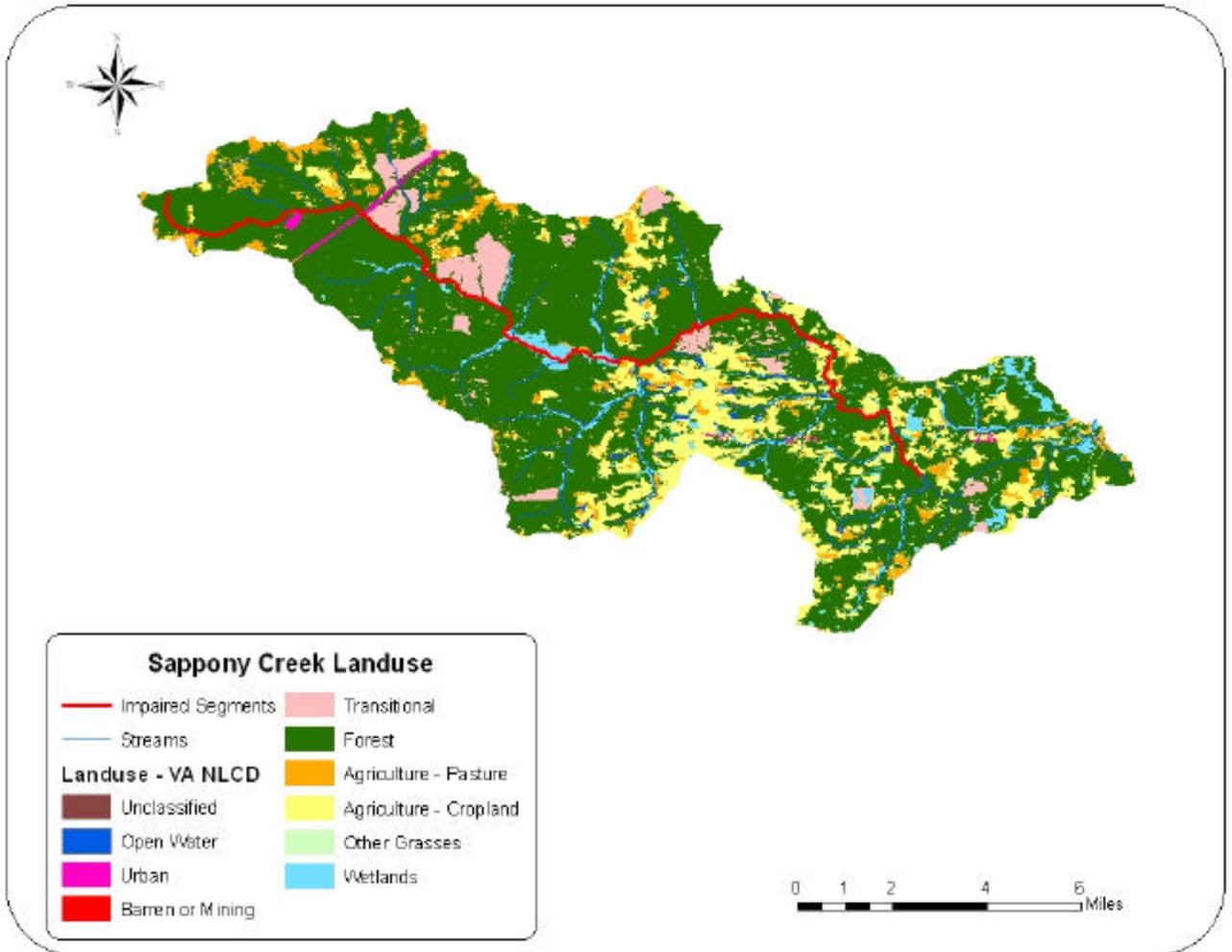
The Sappony Creek watershed extends approximately 17 miles from its headwaters west of DeWitt, VA to its confluence with the Nottoway River west of Stony Creek. The watershed is approximately 44,367.8 acres in size and is predominately forested (68.6 percent). Agriculture encompasses 21.2 percent of the watershed, with 15.1 percent cropland and 6.2 percent pasture/hayland. Residential and high use industrial areas compose approximately 0.6 percent of the land base. The remaining 9.1 percent of the watershed is comprised of 4.5 percent of transitional areas and grasses, and 4.6 percent wetlands and open water. Land use is described in Table 3.

The only urban area (0.56 percent) is one industrial facility on 40 acres located in the headwaters southwest of DeWitt, VA, and the I-85 right-of-way also in the headwaters. The majority of the basin is in forest and transitional land use, especially above the original listing station. Horsepen Branch is also primarily in forest land use, with no urban presence, slight transitional land use in the headwaters and minor cropland along Rt. 619 on the eastern boundary of the watershed (Figure 3).

Table 3. Land Use in the Sappony Creek Watershed.

Land use	Count	Acres	Sq Miles	Percent of Total
Open Water	908	201.9345165	0.315017846	0.46
Low Intensity Residential	234	52.04039303	0.081183013	0.12
High Intensity Residential	0	0	0	0.00
High Intensity Commercial/Industrial/Transportation	883	196.3746455	0.306344447	0.44
Bare Rock/Sand/Clay	0	0	0	0.00
Quarries/Strip Mines/Gravel Pits	0	0	0	0.00
Transitional	9062	2015.342058	3.143933611	4.54
Deciduous Forest	62017	13792.26092	21.51592703	31.09
Evergreen Forest	33846	7527.175822	11.74239428	16.97
Mixed Forest	40955	9108.180754	14.20876198	20.53
Pasture/Hay	12309	2737.45811	4.270434652	6.17
Row Crops	30077	6688.969663	10.43479267	15.08
Other Grasses (Urban/recreational; e.g. parks)	0	0	0	0.00
Woody Wetlands	8862	1970.86309	3.07454642	4.44
Emergent Herbaceous Wetlands	347	77.17101017	0.120386776	0.17
Total:		44367.77098	69.21372273	100.00

Figure 3. Land Use in the Sappony Creek Watershed.



3. Description of Water Quality Problem/Impairment

Sappony Creek was listed as impaired on Virginia's 2002 303(d) Report on Impaired Waters and 2004 305(b) / 303(d) Integrated Report (VADEQ, 2003 & 2004) due to violations of the State's water quality standards for DO and fecal coliform bacteria. This report evaluates the DO impairment by determining if natural conditions are the cause of the impairment, thus obviating the need for a TMDL. The segment was de-listed for a fecal coliform bacteria TMDL because of acceptable fecal coliform levels in the 2004 305(b) / 303(d) Integrated Report. Out of 65 DO values collected between September 1994 and March 2005 at station 5ASAP013.69, (Table 4), 6 were below the lower water quality standard for DO of 4.0 mg/l (Figure 4) for a percent violation rate of 9.2 percent.

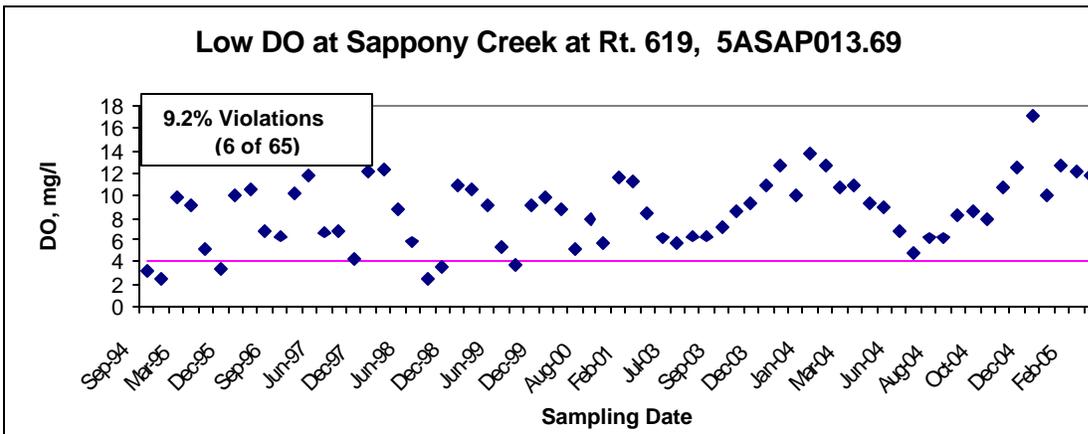
Table 4. DO data collected by DEQ on Sappony Creek at 5ASAP013.69

Station	Date of First Sample	Date of Last Sample	Number of Samples	(SU)			Number of Exceedances*
				Average	Minimum	Maximum	
5ASAP013.69	09/14/1994	03/07/2005	65	8.55	2.42	17.19	6

* Exceedances of the minimum pH water quality standard of pH 6.0 SU.

A time series graph of all data collected at station 5ASAP013.69 shows the DO values ranging from 2.42 mg/l to 17.19 mg/l (Figure 4). The horizontal line at the DO 4.0 mg/l represents the minimum instantaneous water quality standard. The data points below the 4.0 mg/l line illustrate violations of the water quality standard.

Figure 4. Time series of DO concentrations (station 5ASAP013.69).



3.1 Associated Mainstem and Tributary site DO

DEQ added several associated mainstem and tributary monitoring stations during data collection for the low DO assessment of natural conditions or development of a TMDL. Associated station DO data are presented in Figures 5 - 12 below.

Figure 5. DO at Sappony Creek at Rt. 40, 5ASAP005.54.

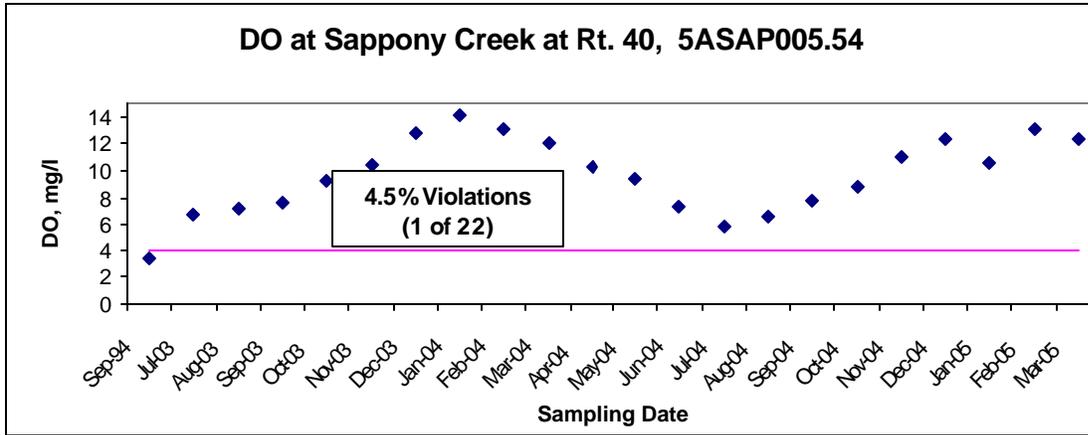


Figure 6. DO at Sappony Creek at Rt. 665, 5ASAP007.77

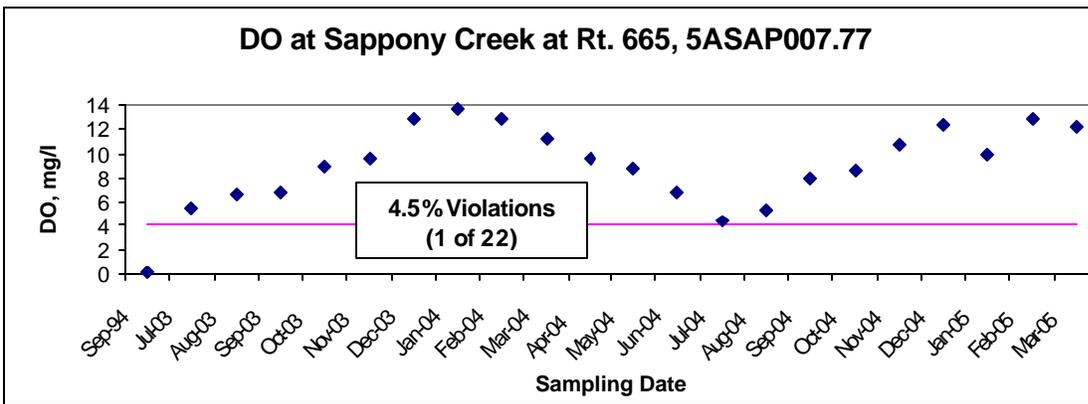


Figure 7. DO at Sappony Creek at Rt. 709, 5ASAP018.57.

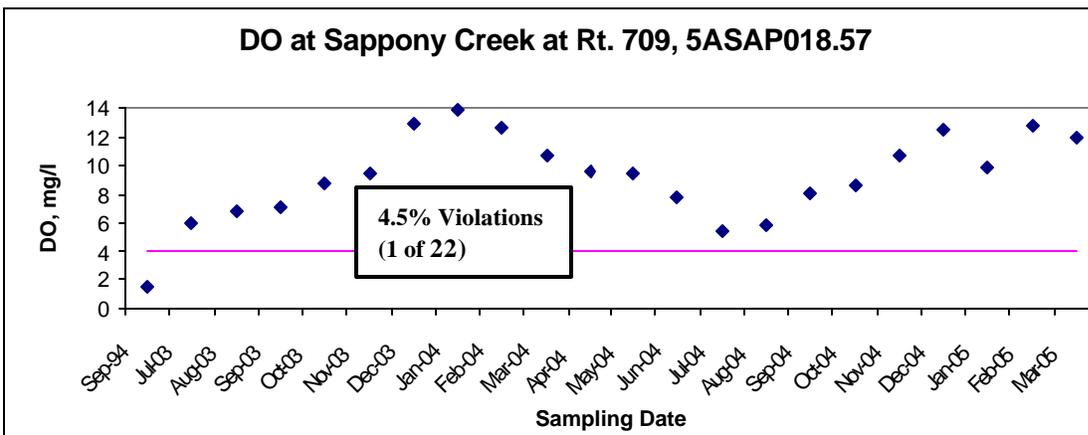


Figure 8. DO at Sappony Creek at Rt. 1, 5ASAP021.29.

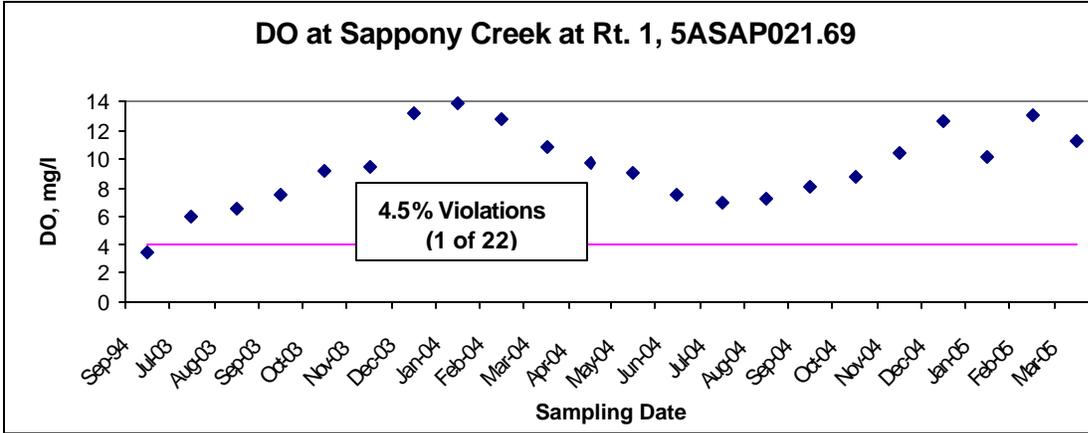


Figure 9. DO at Horsepen Branch at Rt. 619, 5AHSP000.38.

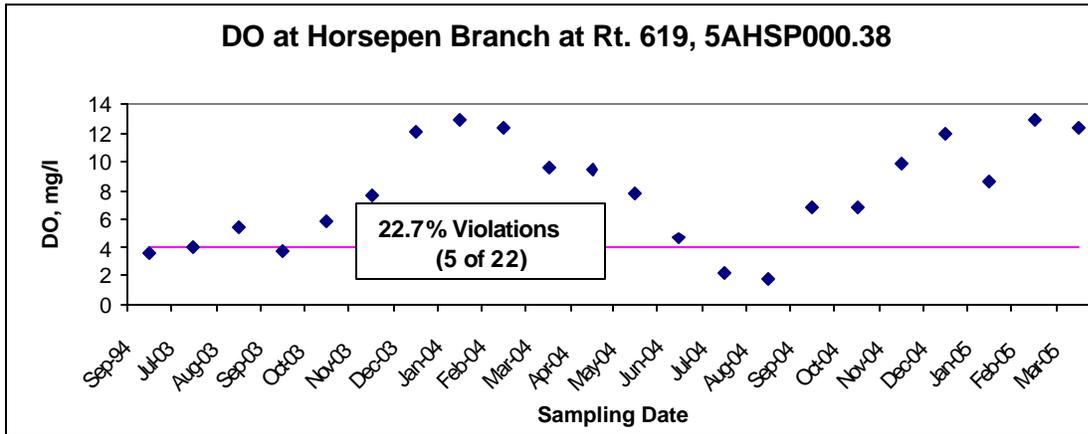


Figure 10. DO at Millrun Branch at Rt. 659, 5AMLB000.23.

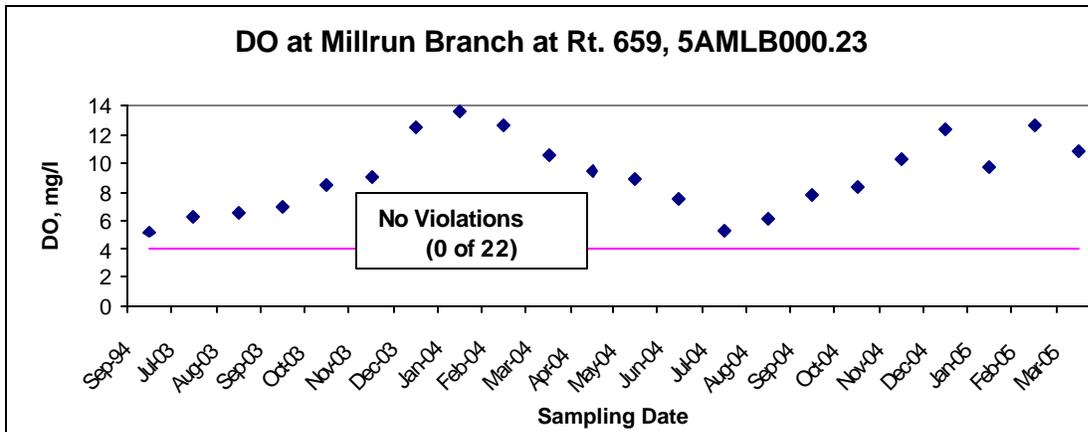
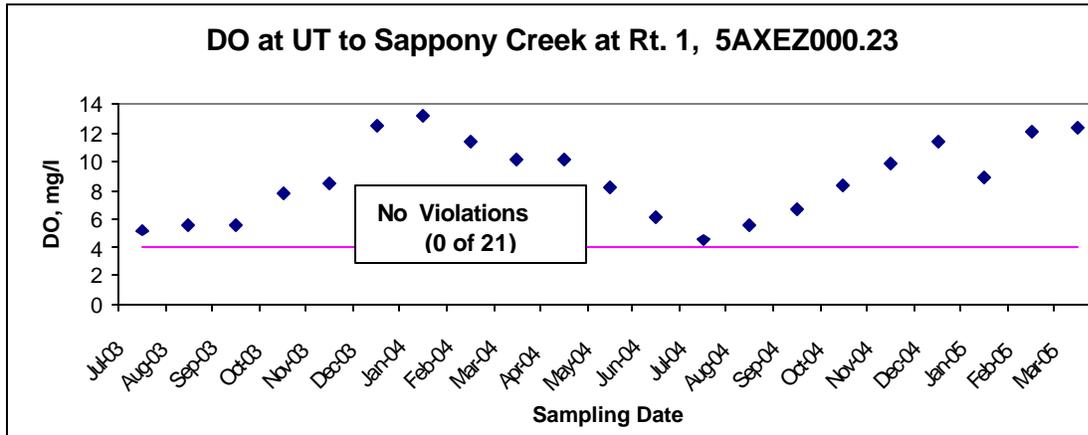


Figure 11. DO at UT to Sappony Creek at Rt. 1, 5AXEZ000.23.



4. Recommendation to De-list Sappony Creek for Low DO

Based on percent violations under 10.5 percent for the DO data collected at the original listing station, 5ASAP013.69 and all associated stations except Horsepen Branch, the Sappony Creek impaired segment is recommended for de-listing in the 2006 305(b) / 303(d) Integrated Report. The Horsepen Branch station had a 22.7 percent violation rate. Horsepen Branch was not originally monitored with the Sappony Creek listing station. Horsepen Branch will be listed impaired for low DO in the 2006 305(b) / 303(d) Integrated Report, based on the DO data collected in 2003 and 2004 for the Sappony Creek Natural Conditions Assessment for Low DO, with a TMDL due date of 2018.

5. Public Participation

DEQ performed the assessment of the Sappony Creek low DO natural condition in lieu of a TMDL. Therefore neither a TMDL Technical Advisory Committee (TAC) meeting nor a public meeting was involved. Public participation will occur during the next water quality standards triennial review process.

6. References

Maptech, Methodology for Assessing Natural Dissolved Oxygen and pH Impairments: Application to the Appomattox River Watershed, Virginia. 2003.

SRCC (Southeast Regional Climate Center)

http://www.dnr.state.sc.us/climate/sercc/products/historical/historical_va.html (Accessed 12/18/02)

USGS (United States Geological Survey), National Background Nutrient Concentrations in Streams from Undeveloped Areas. 1999.

VADEQ (Virginia Department of Environmental Quality), Virginia Water Quality Assessment 1998. Virginia. 1998.

VADEQ (Virginia Department of Environmental Quality), Virginia Water Quality Assessment 2002. Virginia. 2002.

Appendix A

Glossary

GLOSSARY

Note: All entries in italics are taken from USEPA (1998). All non-italicized entries are taken from MapTech (2002).

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

Ambient water quality. Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

Anthropogenic. Pertains to the [environmental] influence of human activities.

Background levels. Levels representing the chemical, physical, and Bacterial conditions that would result from natural geomorphological processes such as weathering or dissolution.

Best management practices (BMPs). Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Clean Water Act (CWA). The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

Concentration. Amount of a substance or material in a given unit volume of solution; usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Confluence. The point at which a river and its tributary flow together.

Contamination. The act of polluting or making impure; any indication of chemical, sediment, or Bacterial impurities.

Designated uses. Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

Dilution. *The addition of some quantity of less-concentrated liquid (water) that results in a decrease in the original concentration.*

Direct runoff. *Water that flows over the ground surface or through the ground directly into streams, rivers, and lakes.*

Discharge. *Flow of surface water in a stream or canal, or the outflow of groundwater from a flowing artesian well, ditch, or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.*

Discharge permits (under VPDES). *A permit issued by the U.S. EPA or a state regulatory agency that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water; it also includes a compliance schedule for achieving those limits. The permit process was established under the National Pollutant Discharge Elimination System, under provisions of the Federal Clean Water Act.*

Domestic wastewater. *Also called sanitary wastewater, consists of wastewater discharged from residences and from commercial, institutional, and similar facilities.*

Drainage basin. *A part of a land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. Also referred to as a watershed, river basin, or hydrologic unit.*

Effluent. *Municipal sewage or industrial liquid waste (untreated, partially treated, or completely treated) that flows out of a treatment plant, septic system, pipe, etc.*

Effluent limitation. *Restrictions established by a state or EPA on quantities, rates, and concentrations in pollutant discharges.*

Existing use. *Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).*

GIS. *Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989)*

Hydrologic cycle. *The circuit of water movement from the atmosphere to the earth and its return to the atmosphere through various stages or processes, such as precipitation, interception, runoff, infiltration, storage, evaporation, and transpiration.*

Hydrology. *The study of the distribution, properties, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.*

In situ. *In place; in situ measurements consist of measurements of components or processes in a full-scale system or a field, rather than in a laboratory.*

Margin of safety (MOS). *A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by EPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).*

Mean. *The sum of the values in a data set divided by the number of values in the data set.*

MGD. *Million gallons per day. A unit of water flow, whether discharge or withdraw.*

Monitoring. *Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.*

Narrative criteria. *Nonquantitative guidelines that describe the desired water quality goals.*

National Pollutant Discharge Elimination System (NPDES). *The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.*

Natural waters. *Flowing water within a physical system that has developed without human intervention, in which natural processes continue to take place.*

Non-point source. *Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.*

Numeric targets. *A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.*

Organic matter. *The organic fraction that includes plant and animal residue at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized*

by the soil population. Commonly determined as the amount of organic material contained in a soil or water sample.

Peak runoff. The highest value of the stage or discharge attained by a flood or storm event; also referred to as flood peak or peak discharge.

Permit. An authorization, license, or equivalent control document issued by EPA or an approved federal, state, or local agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Point source. Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Pollutant. Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, Bacterial materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).

Pollution. Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, Bacterial, chemical, and radiological integrity of water.

Public comment period. The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Raw sewage. Untreated municipal sewage.

Receiving waters. Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Restoration. Return of an ecosystem to a close approximation of its presumed condition prior to disturbance.

Riparian areas. Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.

Riparian zone. *The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.*

Runoff. *That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.*

Slope. *The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04), degrees (2 degrees 18 minutes), or percent (4 percent).*

Stakeholder. Any person with a vested interest in assessment of natural condition or TMDL development.

Standard. In reference to water quality (e.g. pH 6 – 9 SU limit).

Storm runoff. *Storm water runoff, snowmelt runoff, and surface runoff and drainage; rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate lower than rainfall intensity, but instead flows onto adjacent land or into waterbodies or is routed into a drain or sewer system.*

Streamflow. *Discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" since streamflow may be applied to discharge whether or not it is affected by diversion or regulation.*

Stream restoration. *Various techniques used to replicate the hydrological, morphological, and ecological features that have been lost in a stream because of urbanization, farming, or other disturbance.*

Surface area. *The area of the surface of a waterbody; best measured by planimetry or the use of a geographic information system.*

Surface runoff. *Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.*

Surface water. *All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.*

Topography. *The physical features of a geographic surface area including relative elevations and the positions of natural and man-made features.*

Total Maximum Daily Load (TMDL). *The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.*

Tributary. *A lower order-stream compared to a receiving waterbody. "Tributary to" indicates the largest stream into which the reported stream or tributary flows.*

Variance. *A measure of the variability of a data set. The sum of the squared deviations (observation – mean) divided by (number of observations) – 1.*

DCR. Department of Conservation and Recreation.

DEQ. Virginia Department of Environmental Quality.

VDH. Virginia Department of Health.

Wastewater. *Usually refers to effluent from a sewage treatment plant. See also **Domestic wastewater**.*

Wastewater treatment. *Chemical, Bacterial, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.*

Water quality. *The Bacterial, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.*

Water quality criteria. *Elements of the board's water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use.*

Water quality standard. *Provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§ 62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC § 1251 et seq.).*

Watershed. A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.