Water Resources Plan

Clarke County Comprehensive Plan
Implementing Component Plan

Adopted by the
Clarke County Board of Supervisors on
September 18, 2018

ACKNOWLEDGEMENTS

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COMPREHENSIVE PLAN SUBCOMMITTEE

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CLARKE COUNTY PLANNING DEPARTMENT

Brandon Stidham, Planning Director
Ryan Fincham, Senior Planner/Zoning Administrator
Alison Teetor, Natural Resource Planner
Debbie Bean, Administrative Assistant

Clarke County Planning Department
101 Chalmers Court, Suite B
Berryville, VA 22611
540-955-5132

DATE OF PLANNING COMMISSION PUBLIC HEARING AND ADOPTION:
July 6, 2018

DATE OF BOARD OF SUPERVISORS PUBLIC HEARING AND ADOPTION:
September 18, 2018

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ACRONYMS

BMP – Best Management Practice

BWWTP – Boyce Waste Water Treatment Plant

CCSA – Clarke County Sanitary Authority

CREP – Conservation Reserve Enhancement Program

CWA – Clean Water Act

DCR- Virginia Department of Conservation and Recreation

DEQ – Virginia Department of Environmental Quality

EPA – Environmental Protection Agency

FOSR – Friends of the Shenandoah River

FWSA – Frederick-Winchester Service Authority

GPS – Global Positioning System

LFSWCD – Lord Fairfax Soil and Water Conservation District

MGD – Million Gallons per Day

NGVD – National Geodetic Vertical Datum

NPS – Non-point Source Pollution

NSVRC – Northern Shenandoah Valley Regional Commission (formally - LFPDC – Lord Fairfax Planning District Commission)

ODW – Virginia Department of Health Office of Drinking Water

PCB – Poly Chlorinated Biphenyls, are industrial products or chemicals

RMP – Resource Management Plan

STP – Sewage Treatment Plant

SWCB – State Water Control Board

SWCD – Soil and Water Conservation District

TMDL – Total Maximum Daily Load

USDA – United States Department of Agriculture

USGS – United Stated Geological Survey

VDH – Virginia Department of Health

VPDES – Virginia Pollution Discharge Elimination System

VSMP – Virginia Stormwater Management Program

WIP – Watershed Implementation Plan

GENERAL INFORMATION

Description of Resources

Clarke County is located in the northern Shenandoah Valley and consists of approximately 114,021 acres. Clarke's location at the junction of two distinct geologic regions - the Valley & Ridge and the Blue Ridge Physiographic Provinces (Figure 1) - creates two different hydro-geologic areas, underlain by characteristic bedrock types. Differences in resistance to weathering are also shown by the extent of bedrock openings where groundwater occurs and moves.

In the Blue Ridge bedrock, water occurs in fractures in the rock, joints, faults, and bedding plane separations.

In the Valley area, the carbonate bedrock is more easily dissolved by water, and many fractures can become enlarged into solution channels. The Valley section of the county encompasses two major basins within the Potomac River Watershed: Opequon Creek to the west and the Shenandoah River on the east. The drainage divide between these two basins is present in an area of the county that is frequently referred to as the Limestone Ridge. Formal definition of this area is necessary because of its importance to the underlying groundwater flow systems.

In North America elevations are given using either Sea Level Datum of 1929, also called the National Geodetic Vertical Datum (NGVD) of 1929. The Limestone Ridge is delineated as the area higher than the contour for 630 ft above NGVD 1929 (Figure 2) (Nelms, et. al., 2010). Clarke County was divided into nine groundwater areas based on surface-water basin boundaries (Figure 3).

Figure 1


Physiographic Provinces
N
W
E
S
Valley Region
BERRYVILLE
BOYCE
Blue Ridge Region
THE COUNTY OF CLARKE VIRGINIA 1836
Clarke County GIS
May 2, 2018
2 1 0 2 Miles
Legend
Physiographic Provinces
Shenandoah River
Incorporated Town
Perennial Streams
Roads
County Boundary
Path: \\ccgov\gov\shared\GIS\arcgis_maps\Environmental\Water_Resource\Water_Resource_Plan_maps\fig_1_Phys_prov.mxd

Figure 2

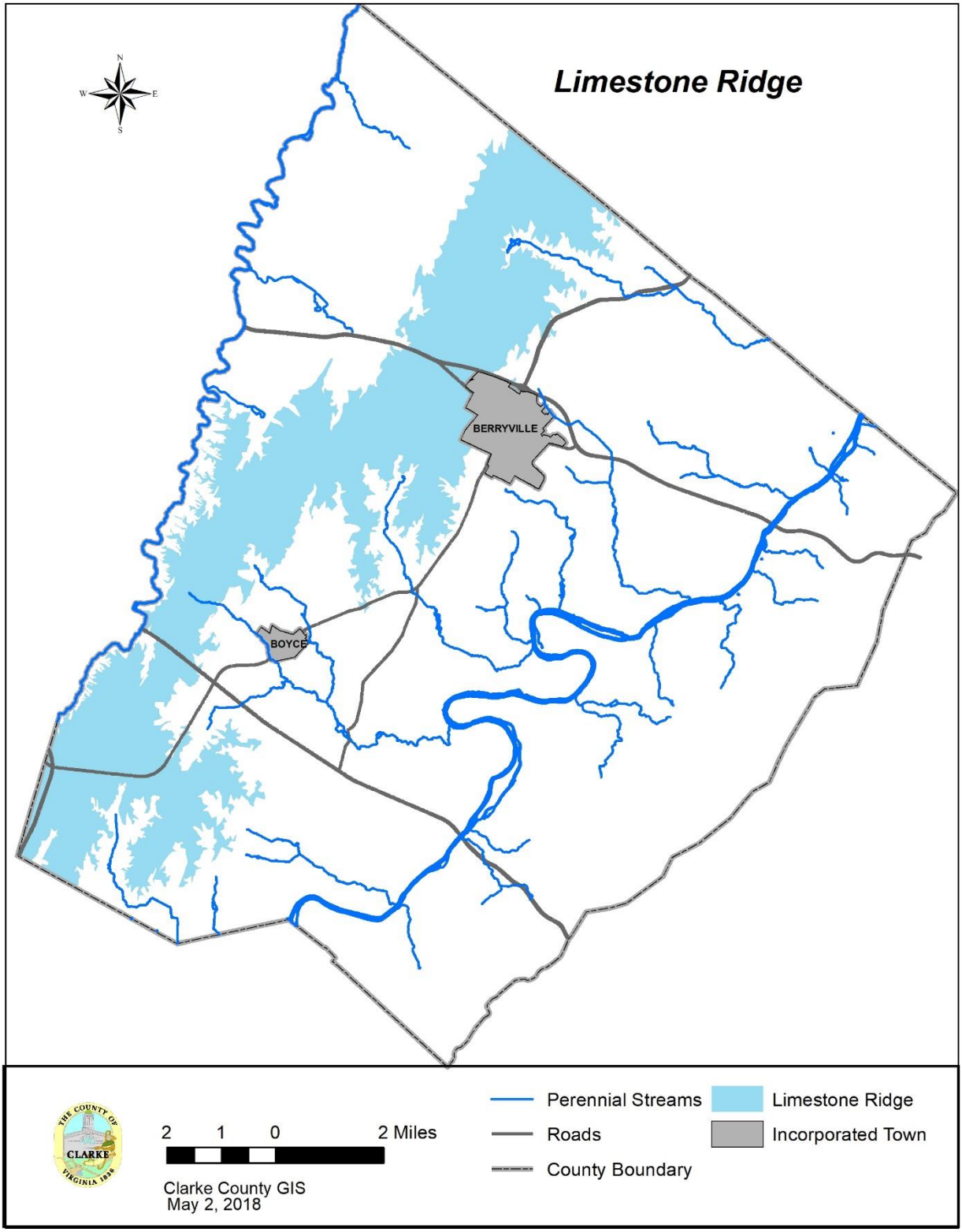
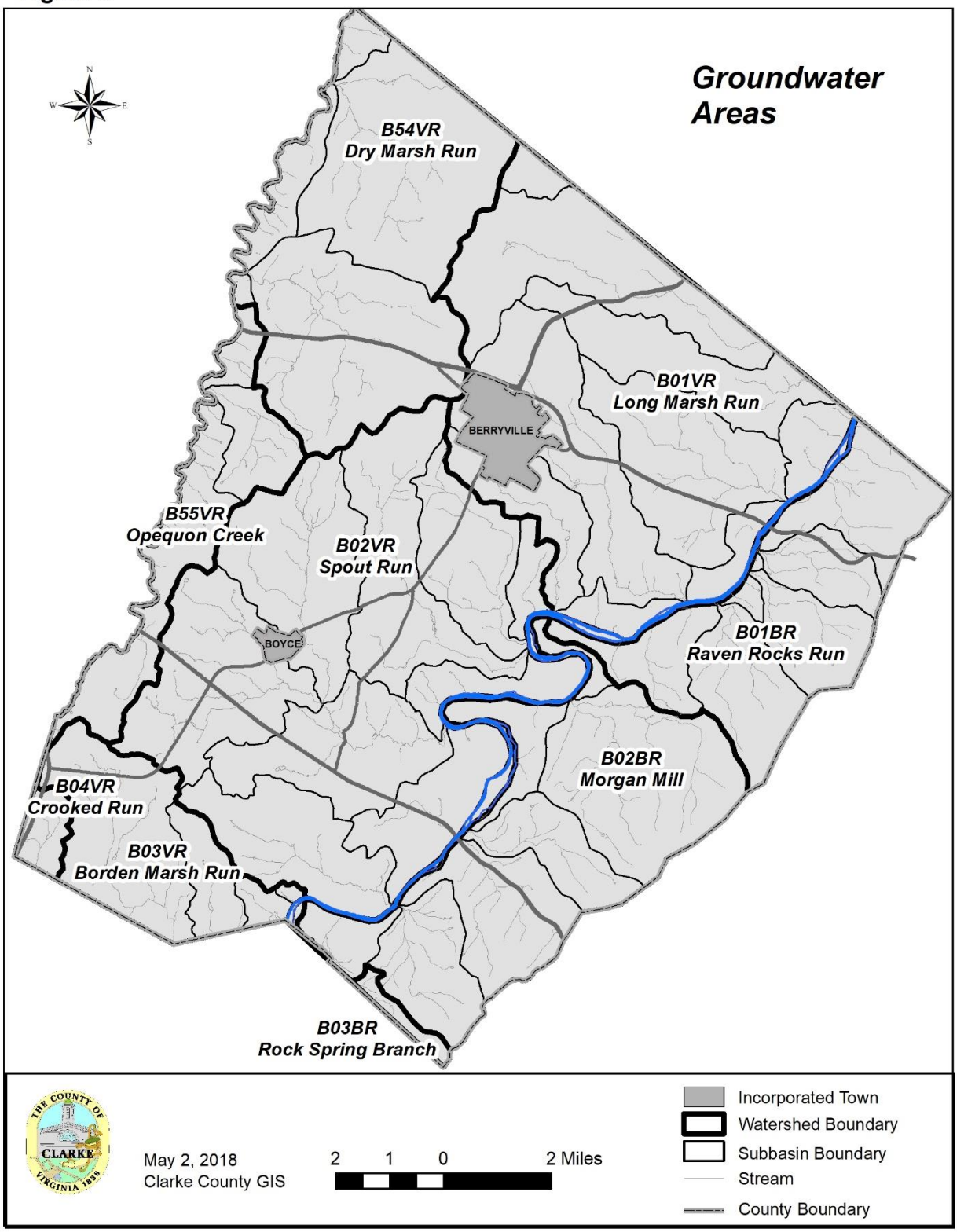

Limestone Ridge
BERRYVILLE
BOYCE
N
W
E
S
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
Perennial Streams
Roads
County Boundary
Limestone Ridge
Incorporated Town

Figure 3


Groundwater Areas
B54VR
Dry Marsh Run
B01VR
Long Marsh Run
BERRYVILLE
B55VR
Opequon Creek
B02VR
Spout Run
BOYCE
B01BR
Raven Rocks Run
B02BR
Morgan Mill
B04VR
Crooked Run
B03VR
Borden Marsh Run
B03BR
Rock Spring Branch
May 2, 2018
Clarke County GIS
2 1 0 2 Miles
Incorporated Town
Watershed Boundary
Subbasin Boundary
Stream
County Boundary

Delineation of these groundwater areas could assist future water- management activities because each area contains similar physical, geologic, and hydrologic characteristics (Nelms, et. al., 2010).

In the Blue Ridge Section of the county, the boundaries of the three groundwater areas may mimic the boundaries of the individual groundwater flow systems because the conceptual model for this part of the county assumes groundwater divides generally are closely related to the surface-water divides.

In the Great Valley Section of the county, the groundwater areas only represent areas with similar characteristics and not necessarily groundwater boundaries because flow beneath surface-water divides has been observed (Jones, 1987).

Details of these two sections are described in Chapter III below. Additional details can also be found in the 2010 USGS report (Nelms, et. al., 2010).

STATEMENT OF PURPOSE, SCOPE AND PLAN APPLICATION

Purpose and Scope

The Comprehensive Plan establishes basic land use policy for the County. The critical nature of water resources to public health as well as the overall environment warrants the Water Resources Plan to implement the Goals, Objectives, and Policies of the County Comprehensive Plan, specifically Objective 3 in the Comprehensive Plan, which states: "Protect natural resources, including soil, water, air, scenery, night sky, wildlife habitats, and fragile ecosystems through the following policies, the Water Resources Plan, and other adopted policies."

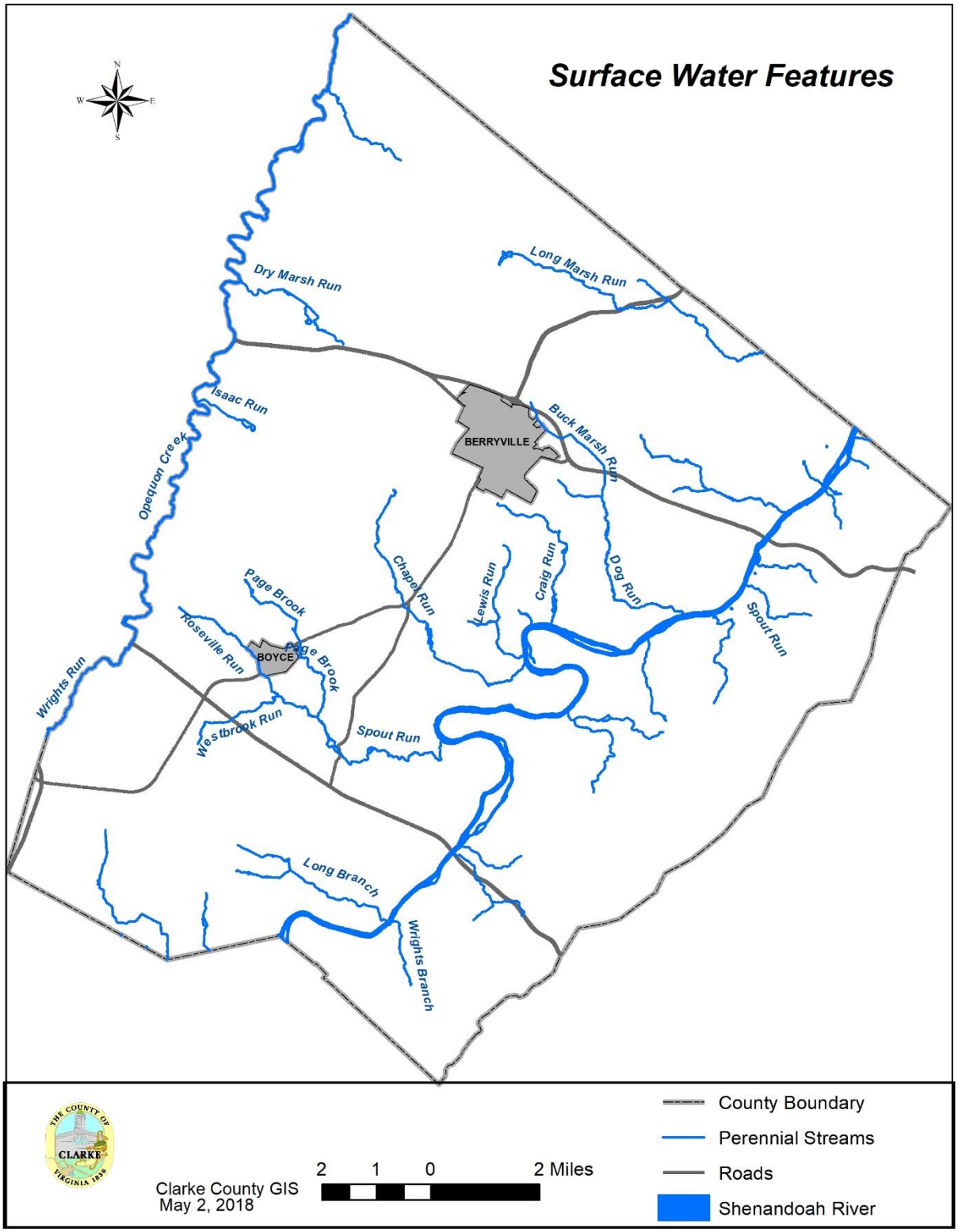
Water resources are significant for many reasons. Groundwater provides the primary source of potable water for more than 75% of the County residents and provides 80-90% of the base flow for surface water (Nelms, et.al. 2010). The Shenandoah River is a designated State Scenic River and is a major recreational attraction. The 21 perennial secondary streams provide water for livestock and a few are large enough for swimming and fishing (Figure 4).

A clean adequate water supply is a reflection of the overall health of the County's natural environment. Therefore, the ability to maintain the availability and enhance the quality of our water resources is integral to our quality of life.

Water resources include both ground and surface waters. These water features are integrally linked together by the hydrologic cycle, where water moves from the atmosphere to the surface as rain. Rain then percolates through the soil to groundwater and is discharged at springs to streams, becomes surface water, and evaporates back to the atmosphere.

Land use practices have an impact on the quality and quantity of these water features. The groundwater resources of Clarke County are particularly susceptible to contamination resulting from human activities because of the sensitive nature of the aquifers, found in carbonate rocks underling the Valley region of the County.

Figure 4


Surface Water Features
N
W
E
S
Dry Marsh Run
Long Marsh Run
Isaac Run
Opequon Creek
BERRYVILLE
Buck Marsh Run
Chapel Run
Lewis Run
Craig Run
Dog Run
Spout Run
Page Brook
Roseville Run
BOYCE
Page Brook
Wrights Run
Westbrook Run
Spout Run
Long Branch
Wrights Branch
THE COUNTY OF CLARKE VIRGINIA 1836
Clarke County GIS
May 2, 2018
2 1 0 2 Miles
County Boundary
Perennial Streams
Roads
Shenandoah River

Groundwater protection and management problems are generally greater in areas that are underlain by carbonate rocks, such as limestone and dolostone, than in areas underlain by most other rock types because of the presence of solution-enlarged sinkholes, conduits, and caves.

These geologic features characterize what is called karst terrane. The generally high permeability of these rocks facilitates the infiltration and transport of contaminants from the land surface to the groundwater reservoir. The primary threats to surface water quality within our County come from point source discharge of sewage treatment facilities, non-point agricultural and urban runoff, and failing septic systems.

Table 1. Contamination threats to water resources associated with principal land uses in Clarke County, Virginia.

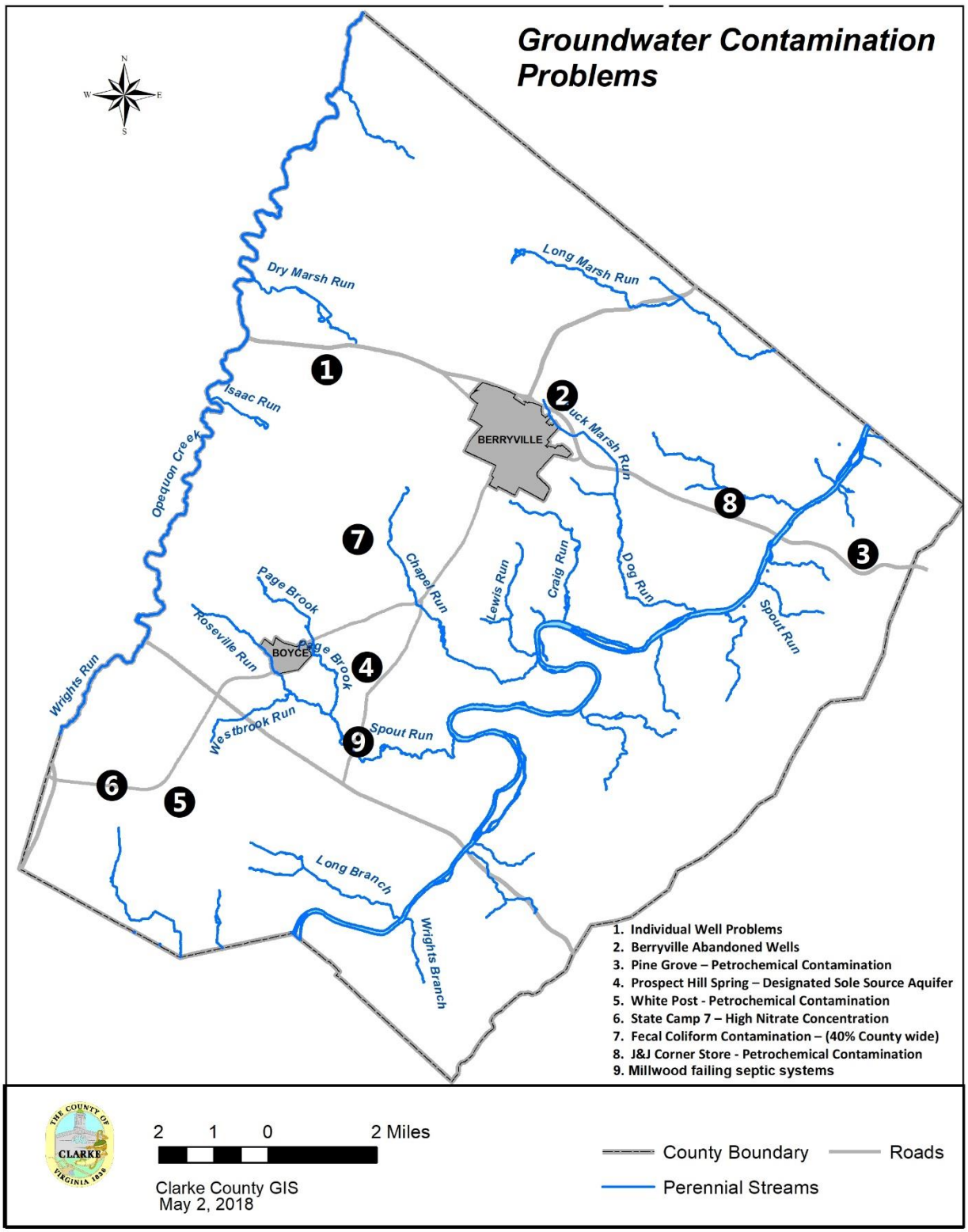
LAND USE	LAND USE ACTIVITY	TYPE OF CONTAMINATION
Agriculture	Animal Feed Lots Manure spreading & pits Chemical Application Chemical Storage Areas	Coliform bacteria, pesticides, fungicides, fertilizers - nitrates
Residential	Septic systems Hazardous household products (paints, cleaning products) Lawn chemicals, fertilizers Underground storage tanks	Coliform bacteria, chemicals, nitrates, petroleum
Commercial and Industrial	Auto repair Construction areas Car washes Gas stations Paint shops Road deicing operations Storage tanks Storm Water Runoff	Petroleum, chemicals, detergents, salts
Other uses	Transportation - railroad - trucking	Petroleum, chemicals, variety of contaminants

From: Wellhead Protection Programs: Tools for Local Government, 1989

Problems with water contamination have occurred throughout the County, and are well documented in the previous Plan. Examples include:

- Groundwater Contamination (Figure 5)
    - In the 1960's, well contamination in the Boyce-Millwood area led to the creation of the Clarke County Sanitary Authority in 1968 (LFPDC 1987). By the mid-1970s, the authority began supplying water to more than 200 residences and businesses from the high-yielding Prospect Hill Spring.
    - Water samples collected by the Clarke County office of the State Health Department from 1980 to1998 indicated approximately 40% of wells sampled were contaminated by fecal coliform.
    - In 1981, the Berryville public water supply wells became contaminated by a combination of nitrates, phenols, and herbicides, requiring construction of a $1.3 million water treatment plant using the Shenandoah River as the water source.
    - In 1986, 10 wells in the village of Pine Grove were contaminated by petroleum believed to have leaked from underground storage tanks.
    - In 1987 a survey conducted by the Lord Fairfax Health District identified 46% of the sewage disposal systems in Millwood did not meet the standards of the Health Department causing eventual construction of public sewer to the Village of Millwood in 2002.
    - A groundwater study completed in 1990 by the USGS identified 40% well contamination rates countywide.
    - A 1991 a water testing program conducted by the Agricultural Extension Office showed that 40% of sampled wells were contaminated by fecal coliform.
    - In 1992, the groundwater supply for the community of White Post was contaminated by petroleum products necessitating the expenditure of more than $2 million by the State Water Control Board to bring potable water from Prospect Hill Spring to White Post.

Figure 5

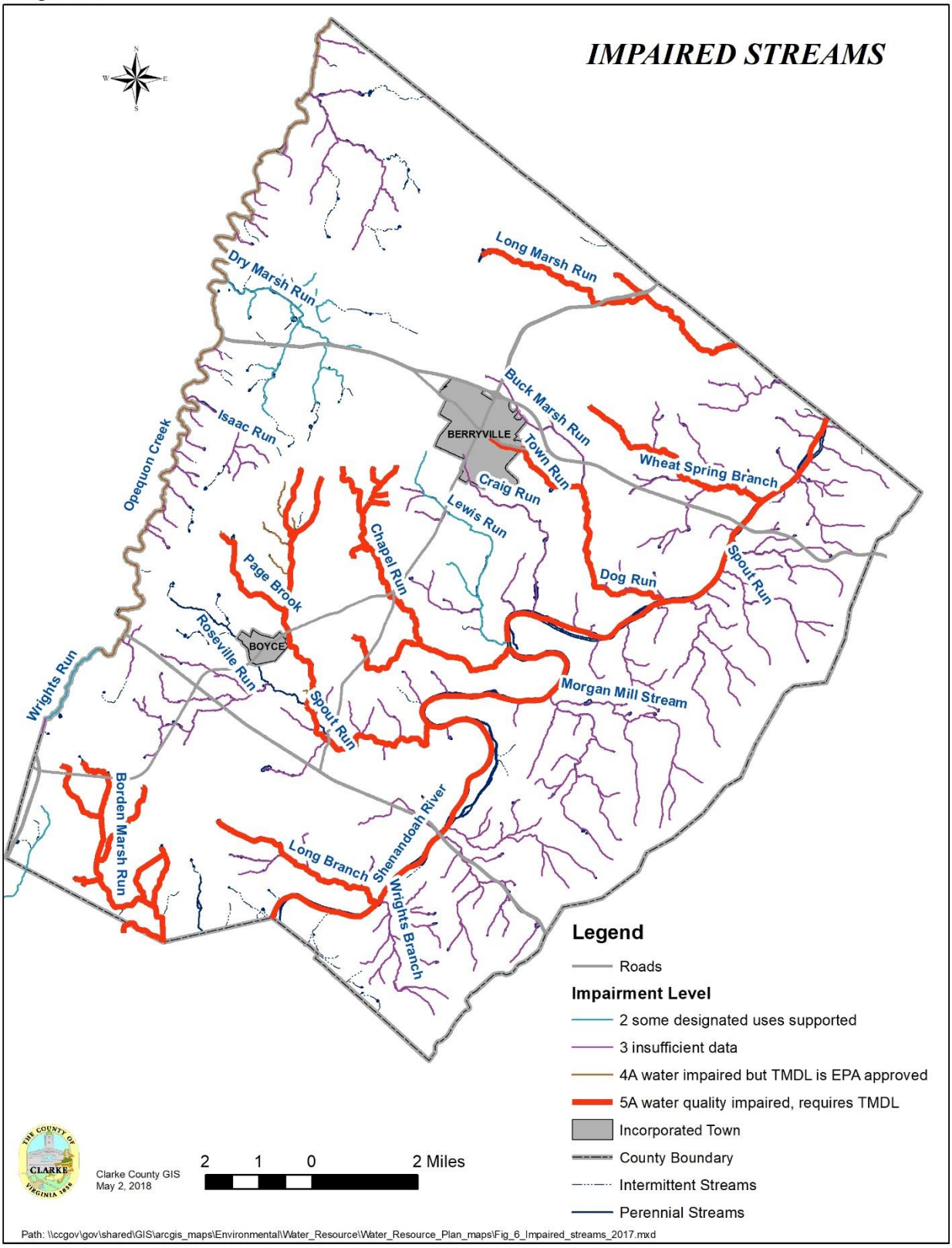

Groundwater Contamination Problems
N
W
E
S
Dry Marsh Run
Long Marsh Run
Isaac Run
Opequon Creek
Buck Marsh Run
BERRYVILLE
Chapel Run
Lewis Run
Craig Run
Dog Run
Spout Run
Page Brook
Roseville Run
BOYCE
Page Brook
Wrights Run
Westbrook Run
Spout Run
Long Branch
Wrights Branch
1
2
3
4
5
6
7
8
9
1. Individual Well Problems
2. Berryville Abandoned Wells
3. Pine Grove – Petrochemical Contamination
4. Prospect Hill Spring – Designated Sole Source Aquifer
5. White Post - Petrochemical Contamination
6. State Camp 7 – High Nitrate Concentration
7. Fecal Coliform Contamination – (40% County wide)
8. J&J Corner Store - Petrochemical Contamination
9. Millwood failing septic systems
THE COUNTY OF CLARKE VIRGINIA 1836
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
County Boundary
Roads
Perennial Streams

- In 1995 the Town of Boyce constructed a sewage treatment plant due to the high number of failing septic systems. Approximately 185 homes and business were connected initially. Currently 278 homes/businesses are connected to sewer in Boyce.
- In 2010, petroleum leaked from an underground storage tank at J&J Corner Store at the intersection of Harry Byrd Highway (Route 7) and Shepherds Mill Road (Route 612) causing well contamination issues for approximately 20 households.

- Surface Water Contamination (Figure 6)
  - Of the 21 perennial secondary streams, 11 are designated as impaired waterways not meeting water quality standards primarily e. coli and sediment.
  - The Shenandoah River is contaminated by mercury and PCB's from industrial sources. Mercury was used by Du Pont Co. in Waynesboro as a catalyst in fiber production between 1929 and 1950. During that time, strict storage and disposal regulations did not exist, and mercury made its way to the South River. A serious contamination problem was discovered in the 1970s. The Health Department advisory extends from Waynesboro to Front Royal. The Clarke County section is contaminated with PCB's from the Avtex Fibers plant in Front Royal.

In summary, these issues prompted the goals, objectives and strategies outlined in this plan. This Plan will describe the resource, the work that was done prior to 1999 to understand and protect the resource, the work that has been completed since the previous plan, and provide strategies to correct current problems and protect and maintain these resources for the future.

Figure 6


IMPAIRED STREAMS
Long Marsh Run
Dry Marsh Run
Buck Marsh Run
Isaac Run
Opequon Creek
BERRYVILLE
Town Run
Wheat Spring Branch
Craig Run
Lewis Run
Chapel Run
Page Brook
Dog Run
Spout Run
Roseville Run
BOYCE
Wrights Run
Morgan Mill Stream
Spout Run
Borden Marsh Run
Long Branch
Shenandoah River
Wrights Branch
Legend
Roads
Impairment Level
2 some designated uses supported
3 insufficient data
4A water impaired but TMDL is EPA approved
5A water quality impaired, requires TMDL
Incorporated Town
County Boundary
Intermittent Streams
Perennial Streams
CLARKE
Clarke County GIS
May 2, 2018
2 1 0 2 Miles
Path: \\ccgov\gov\shared\GIS\arcgis_maps\Environmental\Water_Resource\Water_Resource_Plan_maps\Fig_6_Impaired_streams_2017.mxd

Summary of Prior Plan

The previous Water Resource Plan (1999) laid the groundwork for efforts to protect County water quality. These efforts included:

- Adoption of the Septic Ordinance (County Code Section 143)
- Adoption of the Well Ordinance (County Code Section 180)
- Adoption of the Sinkhole Ordinance (County Code Section 180)
- Completion of a 1990 USGS Report "Ground-Water Hydrology and Quality in the Valley & Ridge and Blue Ridge Physiographic Provinces of Clarke County, Virginia."
- Completion of 3 grant-funded water quality improvement projects for the Spout Run watershed
- Establishment of the EPA sole source aquifer for Prospect Hill Spring
- Adoption of the Spring Conservation Overlay District (Zoning Ordinance Section 3-E-2)
- Adoption of the Stream Overlay Protection District (Zoning Ordinance Section 3-E-5)
- Investigation into Surface Water Management Area designation
- Participation in Tributary Strategy's effort

Summary of Recent Activities

- Continued update and strengthening of Septic Ordinance, well ordinance, and stream overlay protection district regulations
- Completion of a 6-year USGS Report entitled "Hydrogeology and groundwater availability in Clarke County, Virginia"
- Establishment of a real-time monitoring network consisting of 3 wells and 2 stream gages
- Completion of four Minimum Instream Flow Studies for the North Fork, South Fork, and Main Stem of the Shenandoah River
- Completion and adoption of a Drought Response Plan
- Participation in the update of the State Water Supply Plan
- Completion of 2 grant funded water quality improvement projects for the Spout Run watershed
- Participation in Chesapeake Bay TMDL cleanup effort

Details of the above summaries for the 1999 Water Resource Plan and Implementation Status can be found in Appendix I attached.

Plan Application

The Plan should be used by property owners, elected and appointed officials, and other interested stakeholders to understand the County's approach to protecting water resources. The Plan should also be applied in tandem with the recommendations found in the County's Comprehensive Plan, Agricultural Land Plan, Mountain Land Plan, and other relevant component plans. Examples of some of the ways that this Plan can be used include:

- Determining how the County should protect water resources both quality and quantity to insure adequate clean supply's for County residents.
- Balancing water quality and availability with the desire to accommodate current and future growth and economic development.
- Evaluating land development applications and proposed changes to the Zoning and Subdivision Ordinances.
- Reviewing and updating the County's Comprehensive Plan and component plans.

Chapter I contains the Plan's revised list of Goals, Objectives, and Strategies – collectively these items describe the County's program for protecting water resources.

Chapter II details the short term implementation goals.

Chapter III describes the Valley and Blue Ridge regions that are geologically different. Also described are the groundwater areas that could assist future water- management activities because such areas contain similar physical, geologic, and hydrologic characteristics.

Chapter IV Provides background information on water quality and quantity protection efforts.

Chapter V describes the process for reviewing and updating the Plan on a regular basis.

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CHAPTER I

PLAN GOALS, OBJECTIVES, AND STRATEGIES

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CHAPTER I -- PLAN GOALS, OBJECTIVES, AND STRATEGIES

This Chapter contains the Water Resources Plan's Goals, Objectives, and Strategies. The Goals Statement depicts the purpose and long-term expectations of the Plan in general terms. The Objectives describe the specific topics to be addressed in furtherance of the Goals Statement. Strategies are detailed action items to be followed to implement the Plan's Goals and Objectives.

A. Goals Statement

The Goals of the 2018 Water Resources Plan are as follows:

1. **Protect and enhance water quality.**
2. **Protect and maintain water availability.**
3. **Engage and educate individuals, communities and governments in watershed stewardship.**

Section B below lists the Objectives associated with each of the three Goals and the recommended implementation Strategies for each Objective.

B. Plan Objectives and Strategies

GOAL 1: Protect and enhance water quality

Objective 1. Protect groundwater resources from contamination and reduce contamination where present

Strategy (a). Continue to review and update the County ordinances related to groundwater protection.

I) Evaluate the Spring Conservation Overlay District (regulations in the County Zoning Ordinance) protecting Prospect Hill Spring to update septic system requirements and consider expansion to include EPA sole source aquifer boundaries.

II) Septic Ordinance (County Code Chapter 143):

a. Implement regular maintenance, monitoring, and reporting of all septic system components including drain lines, distribution boxes, and septic tanks. Included in the maintenance is a regular pump-out schedule as recommended by the Virginia Department of Health (VDH). A mandatory pump-out has been adopted in the County Code but never implemented due to lack of administrative capabilities.

b. Utilize VDH staffing resources to ensure annual operation and maintenance inspections of alternative septic systems and identification of substandard systems. Provide County funding if necessary to ensure VDH resources remain available and capable to manage this program.

c. Identify grant opportunities and other funding sources to replace inadequate systems with those meeting current standards.

d. Continue to require resistivity testing to ensure drainfields are located away from karst features.

III) Sinkhole Ordinance (County Code Chapter 180, Article II): Develop educational information to increase awareness of sinkholes and the potential threat to groundwater. Other approaches include direct mailing to affected landowners, adding information to County website, brochures, and press releases.

IV) Karst Plans (Zoning Ordinance Section 6-H-15): Continue to require karst plans for all site plans in karst soils to insure protection of karst features from potential contamination threats.

Strategy (b). Continue to work with state agencies and the legislature to insure the County has sufficient authority to protect water resources through local ordinances and land use controls.

Strategy (c). Continue to work with The Virginia Department of Health (VDH) Office of Drinking Water (ODW) and the Department of Environmental Quality to obtain grants for the development of Wellhead Protection Plans for public wells throughout the County, including those serving Shenandoah Retreat, Pine Grove and River Park.

Strategy (d). Groundwater database development

I) Develop a database of all existing well and septic permits on file in cooperation with the Health Department. Homes with systems not on file should be surveyed to determine the type and location of water source and sewage disposal. Consider permanent funding for a part-time employee to GPS well and septic locations.

II) Work with VDH to share data collected by state employees regarding well and septic systems throughout the County.

III) Compile a clearinghouse of past, present, and future water resource studies to insure that data remains available to future planners for continued protection of water resources.

Strategy (e). Work with Lord Fairfax Soil and Water Conservation District (LFSWCD) to minimize levels of nitrate leading to groundwater from cultivated crops by encouraging use of Best Management Practices (BMPs).

Strategy (f). Establish a well water test program with FOSR, or others, to measure groundwater levels of nitrate and other contaminants and track such contaminant levels.

Objective 2. Protect surface water resources from contamination

Strategy (a). Cooperate with and encourage use of the programs administered by the Lord Fairfax Soil and Water Conservation District and other agencies involved in developing Best Management Practices (BMPs) to reduce non-point source pollution.

Strategy (b). Encourage development of comprehensive Resource Management Plans, which are designed to create a comprehensive approach for installing all available BMPs for a particular property to maximize water resource protection for agricultural and urban land uses. These plans could be a requirement to qualify for land use taxation.

Strategy (c). Continue to work cooperatively with DEQ and all partners to generate TMDLs and Implementation plans for impaired waters. Secure regular updates on status of implementation of such plans.

Strategy (d). Continue to support Friends of the Shenandoah River (FOSR) monitoring in the Shenandoah River and area streams in order to identify changes in water quality. Secure annual reports from FOSR indicating level and trends in collected data.

Strategy (e). Work with DEQ to reevaluate TMDLs to take into consideration natural sediment levels in marl streams, as identified by FOSR, when establishing impairment levels.

Strategy (f). Support and encourage use of all available grant funding sources to implement water quality improvement efforts and provide in-kind or monetary match to insure viability of grant applications.

Strategy (g). Protect wetlands for their hydrologic and ecological functions, and pursue opportunities to mitigate, restore or create wetlands.

Strategy (h). Continue to participate in and support the Chesapeake Bay TMDL water quality improvement efforts through the Regional Commission and LFSWCD.

Strategy (i). Consider development of a real-time water quality monitoring network to provide timely water-quality information in order to assess total maximum daily loads (TMDLs) and the effects of urbanization and agriculture on the water supply. Incorporate related FOSR data and well water testing conducted by County Extension in an annual report.

GOAL 2. Protect and maintain water availability

Objective 1. Protect water availability through regulatory action

Strategy (a). Continue to work with the Northern Shenandoah Valley Regional Commission and state agencies to update the Water Supply Plan to insure that adequate water resources are available for Clarke County residents. Specifically, encourage off-stream storage of river water during high flows to avoid supplementing water supplies with groundwater or interbasin transfer.

Strategy (b) Encourage Conservation Easements, appropriate LFSWCD BMPs installations, limit contamination sources, impervious surfaces, and high water users within

the limestone ridge area identified in the 2010 USGS report as the designated recharge area for the County, to protect groundwater availability.

Strategy (c) Evaluate and consider establishing regulation requiring hydrogeologic studies (such as drawdown tests) for water users greater than 10,000 gallons per day, to insure adequate water availability and to minimize impact to existing wells.

Strategy (d). Establish minimum well construction depth to protect water availability during drought based on the base-level altitude values as developed in the 2010 USGS study.

Strategy (e). Protect aquifers and stream base flows from unnecessary withdrawals by municipalities, industry, agriculture, or residents during periods of low flow and drought events by reducing water use, particularly in the Shenandoah River watershed by incorporating data collected from the Minimum Instream flow studies.

Strategy (f). Protect and enhance ground water recharge and quality by evaluating the petitioning the State Water Control Board to designate the County as a groundwater management area in accordance with State law.

Strategy (g). Work with State agencies and legislature to recognize the interrelationship between ground and surface water in the Shenandoah Valley when considering permitting of municipal water supplies and how groundwater withdrawals may impact surface water flow.

Strategy (h). Work with the Town of Berryville to consider utilizing Berryville Waste Water Treatment Facility effluent for crop irrigation and other non-potable usage.

Strategy (i). Consider impoundments in streams where appropriate for groundwater recharge, crop irrigation, and public water supply.

Objective 2. Protect water availability through programmatic action

Strategy (a). Begin to look at developing sustainable yields for groundwater withdrawals as discussed in the 2010 USGS report.

Strategy (b). Protect and maintain natural stream flows during low flow and drought periods though water conservation and reuse.

Strategy (c). Continue to fund USGS real-time network to provide timely water-quantity information to resource managers and others to make informed decisions about floods and water availability.

Strategy (d). Consider reinstating the real-time well at the Chet Hobert Park which was discontinued in 2013. This well represents the Dry Marsh groundwater area that experienced the most impact during the 1999-2000 drought.

Strategy (e). Add a streamflow gage on the Blue Ridge as no streamflow data is measured on the mountain.

Strategy (f). Continue to support USGS research efforts to enhance the County's understanding of water resources.

Strategy (g). Establish permanent funding for water resources studies including but not limited to the real-time monitoring network and groundwater quality network.

GOAL 3. Engage and educate individuals, communities and governments in watershed stewardship

Strategy (a). Engage the public at all levels to implement watershed stewardship and "good housekeeping" practices within the County.

Strategy (b). Expand and sustain public education at all levels to achieve widespread public understanding of the inter-relationship of human activities and natural resources, and the economic, public health, environmental, and community benefits of preserving the integrity of the natural watershed ecosystems.

Strategy (c). Engage governments at all levels to implement all appropriate goals and strategies in their regulations, programs and activities.

Strategy (d). Utilize the internet, websites, and social media to promote water quality and quantity awareness and the importance of stewardship.

CHAPTER II

RECOMMENDATIONS

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CHAPTER II—RECOMMENDATIONS

Project Priorities

Based on the Objectives and Strategies outlined in the previous section, the following strategies are recommended for short-term implementation (< 5 years).

1. Implement regular maintenance, monitoring, and reporting of all septic system components including drain lines, distribution boxes, and septic tanks. Included in the maintenance is a regular pump-out schedule as recommended by the Virginia Department of Health (VDH).
2. Develop a database of all existing well and septic permits on file in cooperation with the Health Department. Homes with systems not on file should be surveyed to determine the type and location of water source and sewage disposal. Consider permanent funding for a part-time employee to GPS well and septic locations.
3. Work with VDH to share data collected by state employees regarding well and septic systems throughout the County.
4. Consider development of a real-time water quality monitoring network to provide timely water-quality information in order to assess total maximum daily loads (TMDLs) and the effects of urbanization and agriculture on water supply.
5. Protect and enhance ground water recharge and quality by evaluating the petitioning of the State Water Control Board to designate the County as a groundwater management area in accordance with State law. At a minimum a groundwater management area should be established for the limestone ridge area identified in the 2010 USGS report as the designated recharge area for the County.
6. Encourage Conservation Easements, appropriate LFSWCD BMPs installations, limit contamination sources, impervious surfaces, and high water users within this area to protect groundwater availability.
7. Establish minimum well construction depths, to protect water availability during drought, based on the base-level altitude values, as developed in the 2010 USGS study.

8. Consider reinstating the real-time well at the Park that was discontinued in 2013. This well represents the Dry Marsh groundwater area that experienced the most impact during the 1999-2000 drought.
9. Add a streamflow gage on the Blue Ridge as no streamflow data is measured on the mountain.
10. Engage the public at all levels to implement watershed stewardship and "good housekeeping" practices on private, commercial, industrial, institutional, and public lands and roads.

CHAPTER III

DESCRIPTION OF BLUE RIDGE AND GREAT VALLEY REGIONS

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CHAPTER III – DESCRIPTION OF THE BLUE RIDGE AND GREAT VALLEY REGIONS

The eastern third of the County consists of the western slope of the Blue Ridge Mountains. This region is primarily forested. The Shenandoah River divides the mountain from the valley portion of the County. Approximately twenty-two miles of the main stem of the Shenandoah River run through the County. The western two-thirds of the County are in the northern Shenandoah Valley and are primarily open land in agricultural use.

The Blue Ridge area is characterized by elevations greater than 1,400 ft., steep slopes, low sinkhole density, high stream density, mean annual precipitation 40 in/yr.

In contrast, the Valley region has low elevation, generally less than 350 ft., gentle slopes, high sinkhole density, low stream density, mean annual precipitation 39 in/yr. Rainfall is the primary source of recharge with approximately 1 inch of rain covering 1 sq. mile equates to 17.4 million gallons of water. Groundwater is the dominant source of streamflow, especially in droughts. Differences in resistance to weathering are also shown by the extent of bedrock openings where groundwater occurs and moves.

In the Blue Ridge bedrock, water occurs in fractures in the rock, joints, faults, and bedding plane separations.

In the Valley area, the carbonate bedrock is more easily dissolved by water, and many fractures can become enlarged into solution channels.

Clarke County was divided into nine groundwater areas based on surface-water basin boundaries as part of the 2010 USGS study (Figure 3). As stated in the USGS report, these areas are based on surface water basin boundaries that contain similar physical, geologic, and hydrologic characteristics. The first numbers in parentheses represent the USGS groundwater area number (BR = Blue Ridge, VR = Valley/Ridge). Each area has been characterized based on total area and percentage of the County land base, land cover, urban areas, livestock exclusion, details on perennial streams, current active sampling sites, and contamination issues. Livestock exclusion data was derived from the Department of Conservation and Recreation BMP database query form. BMP records are organized based on the Virginia National Watershed Boundary Dataset (VaNWBD) 6th Level Units (VAHU6) that is described on the DCR website. These are shown as the 2nd code in parenthesis (Figure 7).

Long Marsh Run (B01VR) (PS-85, PS-86, PS-87)

- Land area: 23% (25,922 acres)
- Land cover is 66% agriculture, 20% forested and 13% urban.
- Urban areas: Berryville

- 14 miles of livestock inclusion installed since 2000
- Perennial tributaries:
    - Long Marsh Run – 7 miles long, 15% forested
    - Wheat Spring Branch – 4.7 miles long, 9% forested
    - Craig Run – 3 miles long, 7% forested
    - Buckmarsh Run – 2 ½ miles long, 0% forested
    - Dog Run – 4.8 miles long, 21% forested
    - Unnamed tributary (originates at Cool Spring) - .6 mile long, 43% forested
- Sampling points:
    - DEQ – 4 sites
    - FOSR – 5 sites
- Contamination Issues: This area includes 3 impaired waterways, Wheat Spring Branch, Dog Run, and Long Marsh Run. Craigs Run is listed as Category 3A meaning that no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Raven Rocks Run (B01BR) (PS-85)

- Land area: 10% (10,986 acres)
- Land cover is 87% forested, 7% agriculture and 6% urban.
- Urban areas: Shenandoah Retreat, Pine Grove
- No livestock exclusion installed
- Perennial tributaries (from north to south):
    - Unnamed tributary (Shenandoah University River Campus) - 860’ south of WV line, drainage extends into West Virginia, 1,640’ long, 100% forested
    - Unnamed tributary (Shenandoah University River Campus) - 2,900’ south of WV line, 2,190’ long, 90% forested, drains though Shenandoah Retreat
    - Unnamed tributary (Shenandoah University River Campus) - just north of Clubhouse, 1,181 long, 45% forested, drains though Shenandoah Retreat
    - Unnamed tributary (Shenandoah University River Campus) - just south of Clubhouse, 4,524’ long, 73% forested, drains though Shenandoah Retreat
    - Unnamed tributary - 1000’ south of Route 7 bridge, 1 ½ miles long, 100% forested
    - Spout Run: 1.6 miles long, 100% forested
    - Unnamed tributary - junction of Rt. 606 (River Rd) and Rt. 607 (Saw Mill Hill Rd.), 2.5 miles long, 100% forested
    - Unnamed tributary - 3,880’ north of junction of Rt. 606 (River Rd.) and Leeds Manor Lane, 1.7 miles long, 100% forested

- Sampling points:
    - DEQ – 0 sites
    - FOSR – 0 sites
- Contamination Issues: All streams in the area are classified as Category 3A meaning that no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired. In the early 1986, 10 wells in the village of Pine Grove were contaminated by petroleum believed to have leaked from underground storage tanks.

Shenandoah River/Spout Run (B02VR) (PS-82, PS-83, PS-84)

- Land area: 27% (31,367 acres)
- Land cover is 64% agriculture, 27% forested and 7% urban.
- Urban areas: Boyce, Millwood, and Waterloo
- 12 miles of livestock exclusion installed since 1999
- Perennial tributaries:
    - Long Branch - 4.6 miles long, 13% forested
    - Lewis Run – 3.3 miles long, 69% forested
    - Chapel Run – 5.9 miles long, 43% forested
    - Page Brook – 3.8 miles long, <1% forested
    - Roseville Run – 3.8 miles long, 29% forested
    - West Brook – 2.1 miles long, 25% forested
    - Spout Run (in the valley) – 6.1 miles long, 71% forested
- Sampling points:
    - DEQ – 5 sites
    - FOSR – 8 sites
- Contamination Issues: Spout Run and Long Branch are impaired based on high fecal coliform counts and sediment. A TMDL was developed in 2012 for Spout Run and 2015 for Long Branch. The TMDL for Long Branch also includes other tributaries including Borden Marsh Run and Crooked Run, along with several in Warren County.

Morgan Mill (B02BR) (PS-82, PS-84)

- Land area: 14% (15,955 acres)
- Land cover is 91% forested, 5% agriculture and 4% urban.
- Urban areas: Calmes Neck and Carefree Acres
- No livestock exclusion installed
- Perennial tributaries:

  - Morgan Mill Stream - 2.3 miles long, 99% forested
  - South Branch of Morgan Mill - 2.3 miles long, 100% forested
  - Unnamed tributary - 1000' north of Route 50, 1.4 miles long, 100% forested
  - Unnamed tributary - at junction with Route 50, 2.7 miles long, 100% forested
  - Wrights Mill - 1.4 miles long, 100% forested
- Sampling points:
  - DEQ – 0 sites
  - FOSR – 0 sites
- Contamination Issues: All streams in the area are classified as Category 3A meaning that no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Rock Spring Branch (B03BR) (PS-81)

- Land area: 0% (448 acres)
- Land cover is 98% forested and 2% urban.
- Urban areas: Shenandoah Farms
- Perennial tributaries include the headwaters for Rock Spring Branch
- Sampling points:
  - DEQ – 0 sites
  - FOSR – 0 sites
- Contamination Issues: This is a very small section of the County with the majority of the basin in Warren County. No known contamination issues.

Borden Marsh Run (B03VR) (PS-81)

- Land area: 6% (6,413 acres), extends into Warren County
- Land cover is 76% agricultural, 17% forested, and 6% urban.
- Urban areas: White Post and Double Toll Gate
- 3.8 miles of livestock inclusion installed since 2000
- Perennial tributaries:
  - Borden Marsh Run - 3.8 miles long, <1% forested
  - Wolfe Marsh Run - 1.2 miles long, <1% forested
- Sampling points:
  - DEQ – 0 sites

  - FOSR – 0 sites

- Contamination Issues: Borden Marsh Run is classified as impaired due to high e.coli levels, a TMDL was developed and approved in 2015. In 1992 the groundwater supply for the community of White Post was contaminated by petroleum products that necessitated the expenditure of more than 2 million dollars by the State Water Control Board to bring potable water from Prospect Hill Spring to White Post residents.

Crooked Run (B04VR) (PS-79)

- Land area: 1% (787 acres)
- Land cover is 81% agricultural, 7% forested, and 12% urban.
- Urban areas: southern Double Toll Gate
- No livestock exclusion installed
- Perennial tributaries include the headwaters of Crooked Run but it is intermittent in Clarke County
- Sampling points:
  - DEQ – 0 sites
  - FOSR – 1 sites
- Contamination Issues: Crooked Run is classified as impaired due to high e.coli levels, a TMDL was developed and approved in 2015.

Dry Marsh Run (B054VR) (PU-18, PU-19)

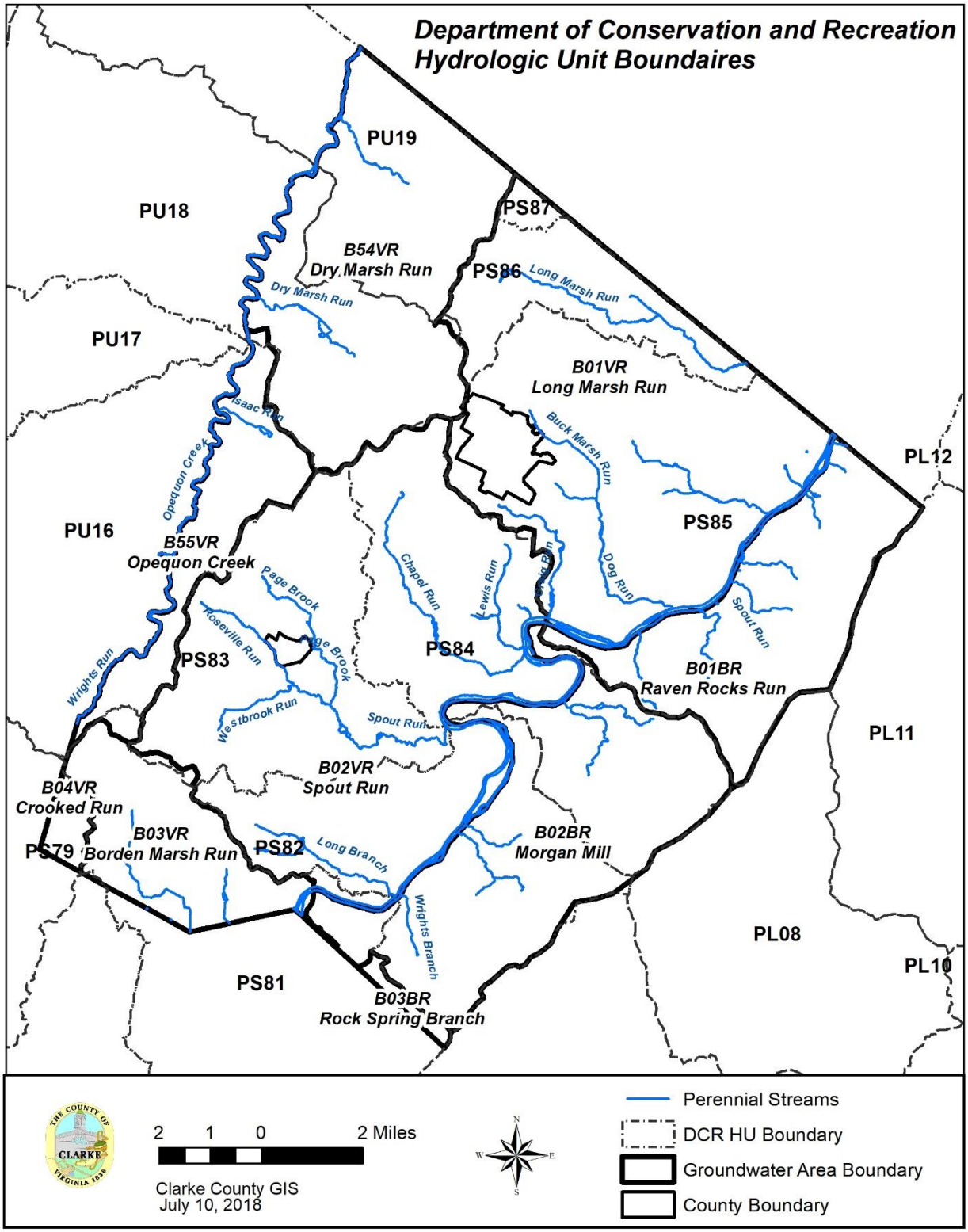
- Land area: 14% (16,488 acres)
- Land cover is 62% agriculture, 30% forested and 8% urban.
- Urban areas: scattered development
- 2.5 miles of livestock exclusion installed since 2001
- Perennial tributaries:
  - Dry Marsh Run – 3 miles long, 33% forested
  - Unnamed tributary – located at the junction of Wadesville Rd. and Swimley Rd., 2.5 miles long, 27% forested
  - Opequon Creek - 10 miles long, 60% forested
- Sampling points:
  - DEQ – 0 sites
  - FOSR – 0 sites

- Contamination Issues: Dry Marsh Run is considered fully supporting and not contaminated. Unnamed tributaries of Opequon Creek are classified as Category 3A meaning that no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Opequon Creek (B055VR) (PU-16)

- Land area: 5% (5,578 acres)
- Land cover is 64% agriculture, 30% forested and 5% urban.
- Urban areas: scattered development
- 4/10 mile of livestock exclusion installed in 2014
- Perennial tributaries:
    - Opequon Creek – 17.5 miles long, 40% forested
    - Isaac Run - 1 mile long, 67% forested
    - Wrights Run – 2.1 miles long, 8% forested
- Sampling points:
    - DEQ – 0 sites
    - FOSR – 0 sites
- Contamination Issues: The Opequon Creek was classified as an impaired water and a TMDL was developed in 2003, the implementation plan was developed in 2006. The cause of impairment was e. coli, and sediment. Isaac Run, Wrights Run are classified as Category 3A meaning that no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Figure 7


Department of Conservation and Recreation
Hydrologic Unit Boundaires
PU19
PU18
PU17
PU16
PS87
PS86
PS85
PS84
PS83
PS82
PS81
PS79
PL12
PL11
PL10
PL08
B54VR
Dry Marsh Run
B01VR
Long Marsh Run
B55VR
Opequon Creek
B01BR
Raven Rocks Run
B02VR
Spout Run
B04VR
Crooked Run
B03VR
Borden Marsh Run
B02BR
Morgan Mill
B03BR
Rock Spring Branch
Dry Marsh Run
Long Marsh Run
Isaac Run
Opequon Creek
Buck Marsh Run
Page Brook
Roseville Run
Chapel Run
Lewis Run
Dog Run
Spout Run
Wrights Run
Westbrook Run
Long Branch
Wrights Branch
2 1 0 2 Miles
Clarke County GIS
July 10, 2018
Perennial Streams
DCR HU Boundary
Groundwater Area Boundary
County Boundary

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CHAPTER IV

BACKGROUND INFORMATION

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CHAPTER IV – BACKGROUND INFORMATION

A. Interrelationship between Ground and Surface Waters

The 2010 USGS study evaluated ground-water availability in Dry Marsh Run and Spout Run. These drainages were selected as representative of distinct geologic regions in the County and the watershed boundary is completely within the County. These real-time stream gages were placed in the lower reaches of these waterways and the data collected were used in the water budget equation.

Dry Marsh Run effective recharge ranged from 6.4 to 22.5 with an average of 11.6 in/yr. Baseflow of streams is 81-93% groundwater.

Spout Run Basin effective recharge ranged from 6.7-23.0 in/yr with an average of 11.9 in/yr. The baseflow 80-97% mean streamflow.

This high baseflow index indicates that groundwater is the dominant source of stream flow.

Another finding was that on average, annual effective recharge is about 30% of the annual precipitation. The timing and type of precipitation, however, is critical in determining the amount of water that will actually recharge the groundwater system. The majority of groundwater recharge occurs between January and April of each year when plants are dormant and evapotranspiration is at a minimum.

Below average recharge causes water level declines, effective recharge increases as precipitation increases but lack on snow during critical recharge periods (Nov-Apr) dramatically impacts amount of recharge. Water availability can be based on the amount of effective recharge.

Of principle concern is the fact that groundwater is the dominant source of streamflow. Too much water withdrawn without enough recharge can adversely affect aquatic systems.

B. Public Water and Sewer

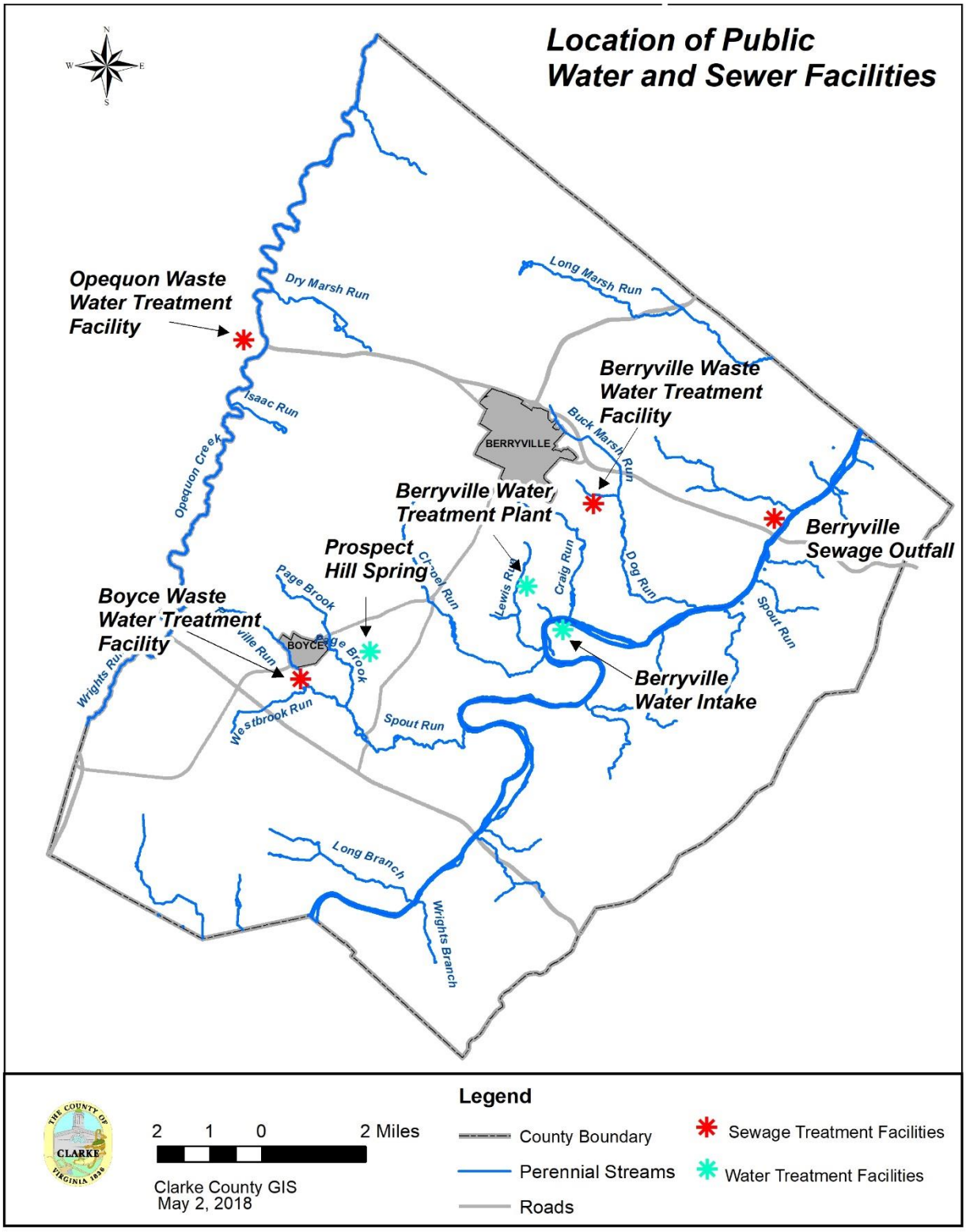
In Clarke County public water and sewer is administered by the Clarke County Sanitary Authority (CCSA). The sewer system consists of the Boyce Wastewater Treatment Plant (BWWTP) that serves the residents and businesses in designated exclusive sewer service areas for the Town of Boyce, the Waterloo Business Area, and the Village of Millwood (County Code Section 180 Article V, VI, and VII). Public water comes from Prospect Hill Spring that serves Millwood, Boyce, Waterloo and White Post.

The Town of Berryville provides separate water and sewer for the residents of Berryville. The waste water treatment facility is located on Parshall Road; the treatment capacity is 0.7 MGD. Public water comes from the Shenandoah River; the treatment plant is on Springsbury Road and is permitted to withdraw up to 0.864 MGD (Figure 8). The remaining areas of the County utilize private wells and septic systems. The County does not have a septage disposal facility so it has entered into a long term contract with the Frederick-Winchester Service Authority (FWSA) to utilize the Opequon Water Reclamation Facility, located in Frederick County, for septage disposal and treatment. This facility is permitted to treat up to 12 MGD and is located on the south side of Route 7 on the Frederick/Clarke County line (Figure 8). Other regional facilities utilizing water from the Shenandoah include Winchester, Frederick County, and Front Royal.

The current State Water Resources Plan (2015) states that, through careful planning and conservation efforts, there will be sufficient water to support the majority of needs through the year 2040. However, based on current supply, a deficit of 0.81 MGD is anticipated to occur in Frederick County by 2030. The Frederick County Sanitation Authority alternatives include quarry expansion and groundwater well improvements, and adding a water withdraw from the Opequon Creek at the northern section of the stream on the Clarke/Fredrick County border.

Concerns regarding water supply for Clarke residents based on excessive use in Frederick County and the City of Winchester stem from interbasin transfer from the North Fork of the Shenandoah that is treated and released into the Opequon Creek, bypassing the main stem of the Shenandoah River.

Figure 8


Location of Public
Water and Sewer Facilities
Opequon Waste
Water Treatment
Facility
Dry Marsh Run
Long Marsh Run
Berryville Waste
Water Treatment
Facility
Isaac Run
Opequon Creek
BERRYVILLE
Buck Marsh Run
Berryville Water
Treatment Plant
Berryville
Sewage Outfall
Prospect
Hill Spring
Page Brook
Crooel Run
Lewis Run
Craig Run
Dog Run
Spout Run
Boyce Waste
Water Treatment
Facility
BOYCE
Wrights Run
Page Brook
Berryville
Water Intake
Westbrook Run
Spout Run
Long Branch
Wrights Branch
THE COUNTY OF CLARKE VIRGINIA 1836
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
Legend
County Boundary
Perennial Streams
Roads
Sewage Treatment Facilities
Water Treatment Facilities

C. Water Quality

Water quality refers to the chemical and biological constituents of water.

Natural groundwater quality depends primarily on bedrock composition. Groundwater in the Valley area has generally higher concentrations of total dissolved minerals, because the rocks of the Valley are more soluble than those of the Blue Ridge.

Water from Valley wells and springs has relatively high calcium, low magnesium, and very low sodium and potassium. Except where onsite sewage disposal systems add water softener sodium, a growing problem.

Water in the Blue Ridge has variable amounts of calcium, low magnesium, and variable (but often high) sodium and potassium. Total hardness ranges from 89-422 milligrams per liter as calcium carbonate (mg/l) in the Valley, compared to 4-242 mg/1 in the Blue Ridge. Valley area groundwater is classified as very hard (Wright, 1990).

Unnatural groundwater quality or contaminated groundwater is caused primarily by human land uses.

D. Water Quality Impacts – Point and Non-point sources

Due to the environmental concerns caused by excessive nutrient discharges, state and federal regulatory agencies are implementing stringent limitations on both point source and non-point source nutrient discharges. “Point source” is defined by the U.S. Environmental Protection Agency as “a source of pollution that can be attributed to a specific physical location – usually an identifiable, "end-of-pipe point."

Specifically, sewage treatment facilities, stormwater discharge, and large animal feeding operations all are regulated and require permits from DEQ.

The positive outcome of these regulatory requirements is that water quality is improved where voluntary measures are not as effective.

E. Point Source – Regulated discharge

Sewage Treatment Facility upgrades.

Wastewater discharged from sewage treatment plants is the second largest source of surface water nitrogen pollution to the Chesapeake Bay.

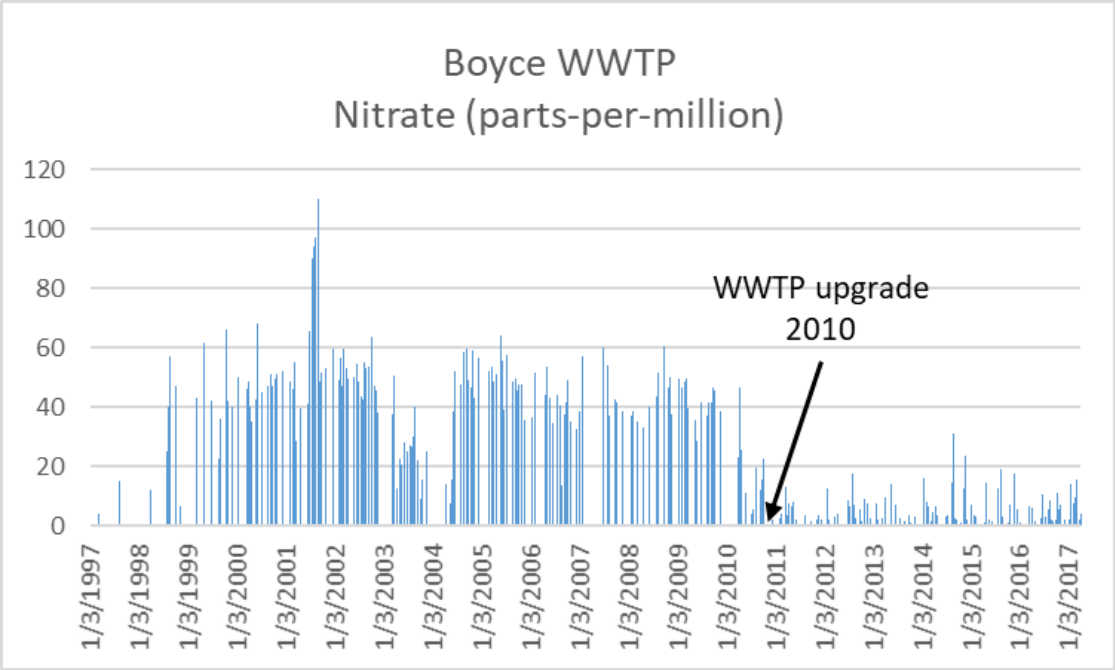
Agriculture contributes 42% of the nitrogen loading and is the largest source of nitrogen pollution to the Bay.

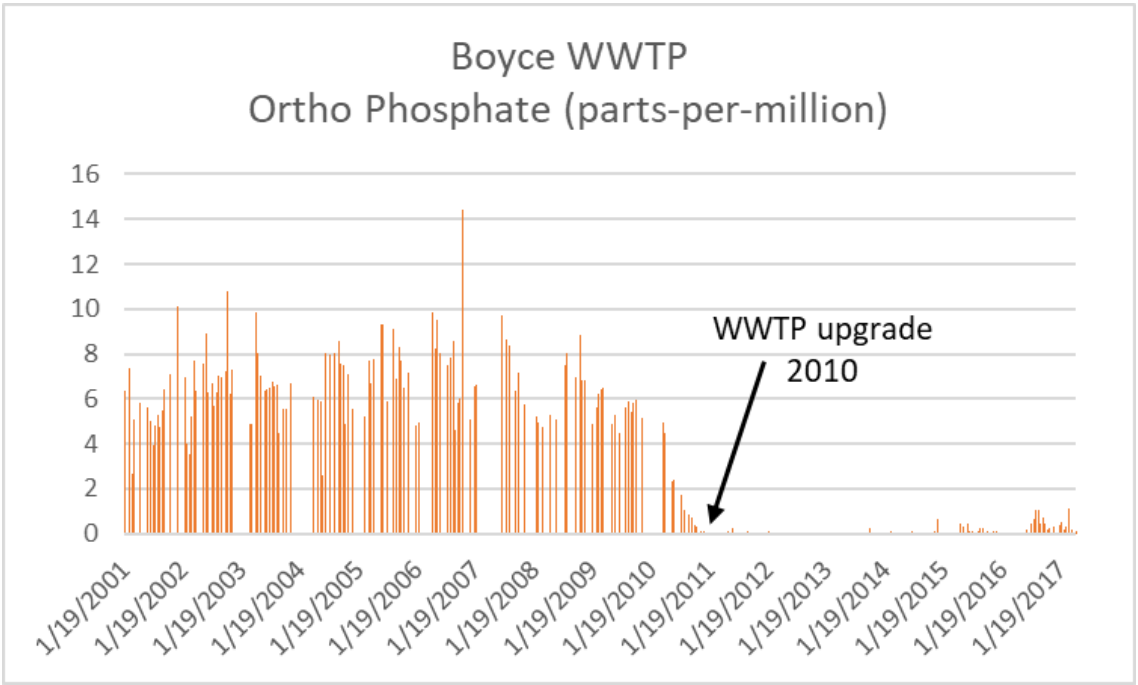
When approximately 12 million of the 16 million residents of the watershed flush their toilets, the wastewater goes to Sewage Treatment Plants (STP), which discharge into the Chesapeake Bay and its tributaries.

There are 304 “significant” STPs in the watershed, which discharge 1.5 billion gallons of wastewater each day. These plants contribute about 52 million pounds of nitrogen pollution annually to the Bay and its tributaries (Chesapeake Bay Foundation, 2003).

For wastewater treatment plants in Virginia nutrient discharge limitations require upgrading existing treatment systems to provide some form of biological nutrient removal (BNR). These systems provide the biological steps necessary to remove nutrients (nitrogen and phosphorus) from the wastewater.

The Berryville, Boyce and Opequon Waste Water Treatment facilities have all completed the required upgrades (DEQ, 2018 Wastewater Assistance & Training Nutrient Removal website).





FOSR data (2017)

According to DEQ, point source pollutant loads have been significantly reduced due to waste water treatment plant upgrades, but these reductions will level off as growth occurs in the service areas of these plants.

Agricultural and urban source sectors have benefitted from overachievement of nutrient reductions from waste water treatment plants. Although sediment loads from agricultural activities have decreased, these loads remain a primary source of sediment and further reductions are needed.

In addition, there is an additional need to address nutrient and sediment loads from urban sources.

F. Urban

Stormwater runoff from streets, lawns, parking lots, construction sites, industrial facilities and other impervious surfaces occurs as a result of precipitation events (for example, rain water or melted snow). The stormwater runoff may enter surface waters directly or through natural and constructed channel systems.

Activities occurring in developed and urban areas contaminate stormwater runoff with pollutants such as automobile oil, grease, metals, sediment, bacteria from animal waste, nutrients and pesticides from lawns, as well as deposits from airborne pollutants.

Unmanaged stormwater can cause erosion and flooding. It also can carry excess nutrients, sediment and other contaminants into rivers and streams.

Properly managed stormwater can recharge groundwater and protect land and streams from erosion, flooding and pollutants.

DEQ is currently the lead agency for developing and implementing statewide stormwater management and nonpoint source pollution control programs to protect the Common-wealth's water quality and quantity.

In 2010 the County updated its own stormwater regulations in an attempt to reduce the discharge limits for phosphorous from state levels of 0.45 lbs/ac/yr depended on site size and location to 0.28 most sites. In addition, the pollutant load was computed based on impervious surface and “managed turf” areas, like residential lawns, and additional BMPs and site design techniques were permitted. Beginning in 2014 phosphorous is excluded from lawn fertilizer in Virginia.

The County also developed a Stormwater Design Manual that contains technical plan requirements; methods, design tools and details for engineers; easements, inspections and maintenance enforcement.

In June 2016, the Virginia Department of Environmental Quality (DEQ) notified County Planning Department Staff that the County is not authorized to enforce its more stringent local stormwater regulations and that the County's stormwater ordinance is "null and void."

State law only authorizes localities to have more stringent regulations if they are a Virginia Stormwater Management Program (VSMP) Authority responsible for issuing the State permits – also referred to as an "opt in" locality. Localities such as Clarke County that have "opted out" of accepting responsibility of managing the VSMP process are prohibited under State law from applying more stringent regulations. Those counties that have "opted in" and are VSMP Authorities can only have more stringent regulations if they are approved by the State to have such regulations.

The County Attorney reviewed DEQ's position and concurred, ultimately resulting in action by the Board of Supervisors to repeal the County's stormwater ordinance.

As authorized under the State Water Control Law and the federal Clean Water Act, the Virginia Pollutant Discharge Elimination System (VPDES) permitting program, administered by DEQ, regulates point source pollution. This includes stormwater discharges from construction. The total phosphorus load of new development projects shall not exceed 0.41 pounds per acre per year, as calculated pursuant to 9VAC25-870-65 (DEQ, 2018, Stormwater management website).

G. Agriculture

The DEQ animal waste program is regulated under both the Virginia Pollution Abatement (VPA) Permit Regulation (9VAC25-32) and the Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulation (9VAC25-31).

In Clarke County there are 3 facilities, all dairy farms, operating with a VPA General Permit, Mercer Vu Farms (former White Post Dairy), Harvue Farms, and Riggs and Stiles Inc.

These farms are required to have a nutrient management plan, a manure storage facility, and may require water quality monitoring (Figure 9) (9VAC25-192-70).

All other agricultural operations in the County are considered non-point sources and installation of Best Management Practices (BMPs) is strictly voluntary with cost-share for some practices available from LFSWCD.

H. Non-point Source

Best Management Practice Installation.

Reductions in nonpoint source (NPS) pollution can be attained by reducing activities that produce NPS pollutants, reducing the amount of pollutants generated by an existing activity and reducing the negative effects these pollutants can have by controlling their dispersal.

To that end, NPS (BMPs) are important tools in controlling NPS pollution and its impact on the environment.

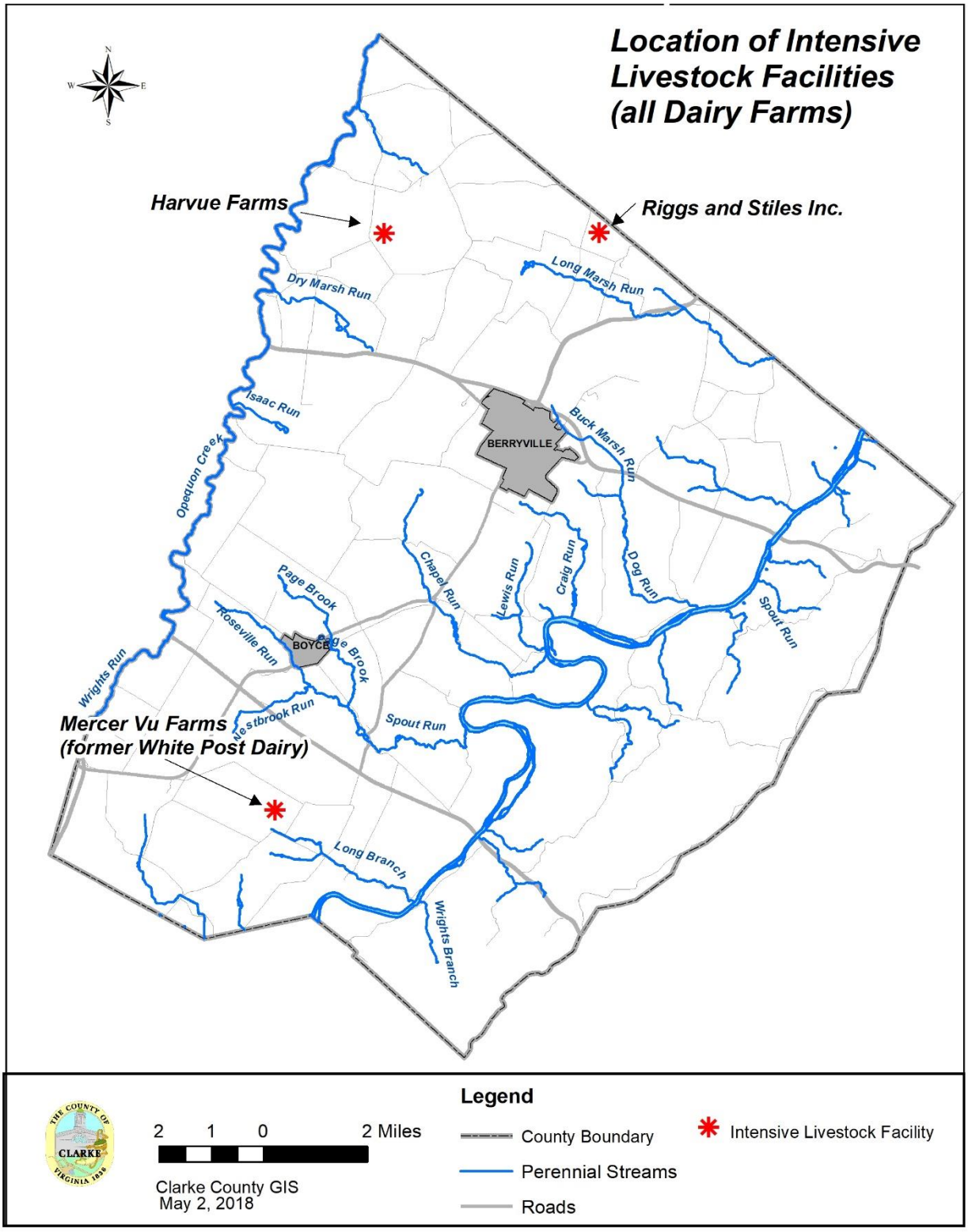
While there are many sources of NPS pollution, agriculture is among the most significant in Clarke County because the majority of land use is devoted to farming.

For example, one EPA study estimates that 27 percent of the phosphorus and 60 percent of the nitrogen entering the Chesapeake Bay originate from cropland. These pollutants need to be controlled to protect the environment.

The Department of Conservation and Recreation (DCR) administers programs through local soil and water conservation districts (SWCDs) to improve or maintain water quality in the state's streams, lakes and bays through the installation or implementation of agricultural BMPs (DCR. 2018. BMP cost-share program).

Through these programs, financial and technical assistance are offered as incentives to carry out construction or implementation of selected BMPs.

Figure 9


Location of Intensive Livestock Facilities (all Dairy Farms)
Harvue Farms
Riggs and Stiles Inc.
Mercer Vu Farms (former White Post Dairy)
Dry Marsh Run
Long Marsh Run
Isaac Run
Opequon Creek
Buck Marsh Run
BERRYVILLE
Page Brook
Chapel Run
Lewis Run
Craig Run
Dog Run
Spout Run
Roseville Run
BOYCE
Wrights Run
Westbrook Run
Long Branch
Wrights Branch
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
Legend
County Boundary
Perennial Streams
Roads
Intensive Livestock Facility

The state provides funds to SWCDs for targeted priority hydrologic units. Areas with the greatest pollution potential receive the greatest funding.

Clarke County is within the Lord Fairfax Soil and Water Conservation District (LFSWCD).

The cost-share program supports the use of various practices in conservation planning to treat cropland, pastureland, hay land and forested land. Some are paid for at a flat rate or straight per-acre rate. Others are cost-shared on a percentage basis up to 80 percent.

In some cases, the United States Department of Agriculture (USDA) also pays a percentage. The cost-share program's practices can often be funded by a combination of state and federal funds, reducing the landowner‘s expense to less than 30 percent of the total cost.

A 100% cost-share was provided by the LFSWCD in 2015 and 2016 for livestock exclusion from streams (SL-6). Current cost share for that practice is 80%. Landowners are responsible for the maintenance of BMPs.

Data is available at the DCR website which details the extent of BMP’s installed in watershed across the Commonwealth since 1998.

In Clarke County, the farming community has installed 486 practices over this time period. A variety of BMPs have been installed including CREP Riparian Forest Buffer Planting (CRFR-3, N=23), Harvestable Cover Crop (SL-8H, N=49), Manure Application to Corn Using Pre-app. Nitrate Test (NM-3B, N=37), Nutrient Management Plan Writing and Revision (NM-1, N=22), Riparian Buffer Rent (CP-22, N=22), Small Grain and Mixed Cover Crop for Nutrient Management and Residue Management (SL-8B, N=87), Stream Exclusion With Grazing Land Management (SL-6, N=86), Streambank protection (fencing) (WP-2, N=19).

These practices have resulted in 216,171 linear feet of stream fencing, creating over 49,000 acres of riparian buffer in the County. This shows a deliberate effort on the part of farmers to maintain and improve water quality (DCR. 2018. Website Virginia Agricultural BMP and CREP Database Query Form).

Stream Fencing

Stream Crossing

Waterer

Another state program is the Virginia Resource Management Planning program that provides a voluntary way to promote the use of conservation practices that improve farming operations and water quality. Resource management plans can help farm owners and operators take advantage of all the conservation measures at their disposal.

The plans are designed to encourage farmers, either the farm owner or operator, to use a high level of best management practices (BMPs) that reduce runoff pollution to local waters and, in many cases, improve the farmer's financial bottom line.

In return for full implementation, the plan holder can be assured that he or she is in compliance with any new state nutrient, sediment and water quality standards; in particular, regulations related to the Chesapeake Bay and all local stream segment TMDLs.

The certificate of safe harbor is valid for nine years provided the farmer continues to implement the RMP. Participation in the program is completely voluntary.

This could be tied to qualifying for use value taxation in Clarke County as an incentive.

I. Biosolids

The Virginia Department of Environmental Quality (DEQ) regulates oversight of all land application of treated sewage sludge, commonly referred to as biosolids.

A total of 11,125 acres are permitted for biosolids application in the County -- proportionately more than many other counties in the area -- and averaging 18,000 wet tons per year.

Biosolids contain about 5-8 pounds of nitrogen per ton. There is interest and concern about the effect of biosolids application on the quality of ground water in Clarke County.

In order to address this concern, the County applied for and received two grants in 2013, totaling $16,000, to monitor 10 springs in northern Shenandoah Valley for discharge, TN, TP, ammonia, ortho phosphate, nitrate-nitrite, E. coli, flow, and general water chemistry. Springs are located in Karst areas.

The purpose is to identify contribution of contamination from springs to surface waters to assist in:

1) Determining appropriate BMP's on agricultural lands, and

2) Determining the impact of biosolids applications on water quality as compared to other fertilizer sources (Webb W., et. al. 2014).

J. Improvement Programs- Federal, State, Regional, Local

Total Maximum Daily Load (TMDL) Watershed Restoration

Since 1998, DEQ has developed plans, with public input, to restore and maintain the water quality for impaired waters. These plans establish "total maximum daily loads" or TMDLs. TMDL is a term that represents the total pollutant a water body can assimilate and still meet standards.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Efforts to improve surface water quality throughout the region have been driven by the need to improve water quality in the Chesapeake Bay. Water quality degradation caused by nutrient over-enrichment has played a key role in the decline of the living resources of the Chesapeake Bay and its tributaries.

The need to reduce the nutrient flow from tributaries into the Chesapeake Bay prompted states, including Virginia, to enter into the Chesapeake Bay Agreement in 1987.

This agreement included a commitment to reduce and maintain the controllable loads of phosphorus and nitrogen entering the Bay by 40% by the year 2000 by developing tributary-specific strategies for each of the Bay's major tributaries.

Virginia's strategy for the Shenandoah and Potomac River Basin was completed in 1996 (Tributary Strategy Plan, 1996).

Despite extensive restoration efforts, including implementation of the Tributary Strategy Plans during the prior 25 years, the U.S. Environmental Protection Agency established a new Chesapeake Bay Total Maximum Daily Load (TMDL), a historic and comprehensive “pollution diet”, in 2010.

This TMDL includes accountability features to guide sweeping actions to restore clean water in the Chesapeake Bay and the region’s streams, creeks and rivers. The TMDL is designed to ensure that all pollution control measures needed to fully restore the Bay and its tidal rivers are in place that are expected to achieve 60 percent of the nutrient and sediment

pollution load reductions necessary to achieve applicable water quality standards as compared to 2009 levels by 2017.

By 2025, the goal is to have all practices and controls installed to achieve the Bay's dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll a standard as articulated in the Chesapeake Bay TMDL document. Scientific evidence shows that many of the pollution-reducing practices we are placing on the ground now may take years to show visible improvements in water quality. This is sometimes referred to as "lag" time.

French and Canadian researchers tracked the movement of fertilizer through a plot of land over the course of three decades. While more than half of the fertilizer applied to the land in 1982 was absorbed by agricultural crops like wheat and sugar beets, 12 to 15 percent remained in the soil. The researchers predicted it would take an additional 50 years before the fertilizer fully disappeared from the environment (DiPasquale, 2013).

Watershed Implementation Plans (WIPs) are the roadmap indicating how Bay jurisdictions, in partnership with federal and local governments, will achieve the Chesapeake Bay TMDL allocations by 2025.

Bay jurisdictions include Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia.

There are three phases of WIPs developed by the Bay jurisdictions. Phase I and Phase II WIPs were developed and submitted to EPA in 2010 and 2012, respectively. Both Phase I and Phase II WIPs describe actions and controls to be implemented by 2017 and 2025 to achieve applicable water quality standards.

The Phase II WIPs build on the initial Phase I WIPs by providing more specific local actions. Phase III WIPs will be developed by jurisdictions based on a midpoint assessment of progress and scientific analyses was through 2017.

Phase III WIPs will provide information on actions the Bay jurisdictions intend to implement between 2018 and 2025 to meet the Bay restoration goals.

The County participates in development of the WIP's through the Northern Shenandoah Valley Regional Commission (EPA Chesapeake Bay TMDL, website).

Beyond the requirements for the Chesapeake Bay TMDL, specific sections of the 1972 Federal Clean Water Act relevant to water quality improvement efforts include Section 303(d) and 305(b).

Section 303(d) requires States to submit a list of impaired and threatened waters, those not meeting water quality standards, for EPA approval every two years. For each water on the list, the state identifies the pollutant causing the impairment, when known. In addition, the state assigns a priority for development of Total Maximum Daily Loads (TMDL) based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors (40 C.F.R. §130.7(b)(4)).

In addition to section 303(d), lists of impaired waters, states are required to submit section 305(b) water quality reports to EPA. Section 305(b) reports provide information on the water quality status of all waters in the state, not just impaired or threatened waters.

In Virginia the agency responsible for monitoring and developing the 303(d) list is the Department of Environmental Quality (DEQ. 2016. Impaired Waters Fact Sheet).

Determining the amount of contamination a stream can assimilate without degrading water quality below the state water quality standards is the purpose of establishing TMDLs.

Water quality standards consist of statements that describe water quality requirements. They also contain numeric limits for specific physical, chemical, biological or radiological characteristics of water. These statements and numeric limits describe water quality necessary to meet and maintain uses such as swimming, fishing, and other water-based recreation, public water supply, and the propagation and growth of aquatic life (DEQ, 1998).

Those streams whose water quality currently does not meet minimum standards are declared “impaired” waterways. This designation or “priority ranking” is important to localities for targeting limited resources for stream pollution reduction improvements.

K. Impaired Waters

DEQ extensively tests Virginia's rivers, lakes and tidal waters for pollutants. More than 130 pollutants are monitored annually to determine whether the waters can be used for swimming, fishing and drinking. Waters that do not meet standards are reported to the citizens of Virginia and the U.S. Environmental Protection Agency in the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report.

DEQ has developed lists of impaired waters in every even year since 1992. This impaired waters list individually describes segments of streams, lakes and estuaries that exhibit violations of water quality standards. The report details the pollutant responsible for the violations, and the suspected cause and source of the pollutant.

DEQ currently has 7 active TDML monitoring sites in Clarke County. In addition, the Friends of the Shenandoah River (FOSR) has semi-monthly monitoring on 12 sites since 1997 (Figure 10). FOSR has been monitoring water quality in the Shenandoah and its tributaries since 1989. The Lab was certified by EPA in 1997 certified lab at Shenandoah University has analyzed over 40,000 surface water samples, resulting in over 249,000 individual measurements for a range of physio-chemical and biological parameters.

The FOSR citizen monitoring data is included in the Integrated Report on Water quality that is put together and submitted to EPA.

DEQ regularly coordinates with citizen monitoring groups to plan for monitoring of priority implementation areas (BMP installation) or before TMDL development begins or at other times, too.

Figure 10

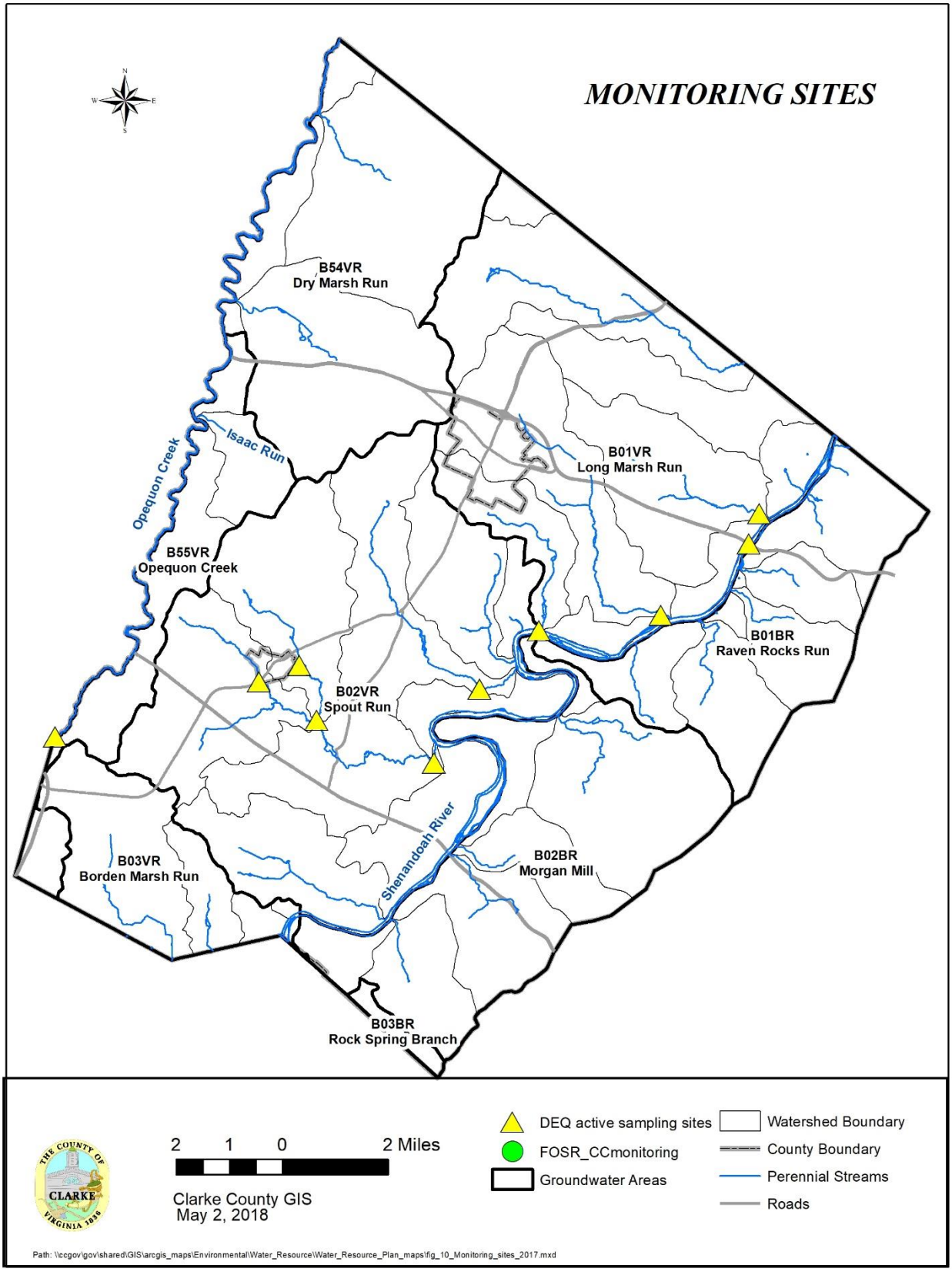

MONITORING SITES
B54VR
Dry Marsh Run
Isaac Run
Opequon Creek
B55VR
Opequon Creek
B01VR
Long Marsh Run
B01BR
Raven Rocks Run
B02VR
Spout Run
Shenandoah River
B02BR
Morgan Mill
B03VR
Borden Marsh Run
B03BR
Rock Spring Branch
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
DEQ active sampling sites
FOSR_CCmonitoring
Groundwater Areas
Watershed Boundary
County Boundary
Perennial Streams
Roads
Path: \\ccgov\gov\shared\GIS\arcgis_maps\Environmental\Water_Resource\Water_Resource_Plan_maps\fig_10_Monitoring_sites_2017.mxd

Table 2. EPA ASSESSMENT CATEGORIES and VIRGINIA SUBCATEGORIES

FULLY SUPPORTING	Waters are supporting one or more designated uses
EPA Category 1	Attaining all associated designated uses and no designated use is threatened
EPA Category 2	Available data and/or other information indicate that some, but not all of the designated uses are supported.
INDETERMINATE	Waters needing additional information
EPA Category 3	Insufficient data and/or information to determine whether any designated uses are met
IMPAIRED	Waters are impaired or threatened but a TMDL is not required.
EPA Category 4A	Water is impaired or threatened for one or more designated uses but does not require a TMDL because the TMDL for specific pollutant(s) is complete and US EPA approved.
IMPAIRED	Waters are impaired or threatened and require a TMDL
EPA Category 5	Waters are impaired or threatened and a TMDL is needed
Va. Category 5A	A water quality standard is not attained. The water is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

Currently, 636 waters are impaired statewide, 11 are in Clarke County. Most impaired waters require TMDLs. Then a TMDL Implementation Plan will be developed to bring the impaired water body up to standards. Implementation Plans include a schedule of actions, costs, and monitoring. Implementation Plan development typically starts within a year of EPA approval of the TMDL Study. Virginia state law requires the development of an Implementation Plan. The following watersheds are listed as impaired and scheduled for TMDL development and implementation planning. Several watersheds in the County must also complete the TMDL process.

Table 3. Impaired waters Clarke County, VA (Figure 3)

Waterbody Name	Cause of Impairment	Category	TMDL Schedule
Shenandoah River	PCB/Mercury e. coli	4A 5A	2002 2024
Borden Marsh Run	e. coli	4A	2018
Page Brook/Spout Run	e. coli/benthic	4A	2016
Long Branch	e. coli	4A	2016
Chapel Run	e. coli/benthic	5A	2020
Roseville	e. coli	4A	2022
Dog Run	e.coli	5A	2020
Wheat Spring Branch	e. coli	5A	2020
Long Marsh Run	e. coli	5A	2024

The majority of work to improve water quality has occurred in the Spout Run watershed.

When a watershed is identified as impaired and has a TMDL developed multiple grant opportunities are available to assist landowners financially with BMP installation.

All of the grants, to date, related to water quality improvement projects in Clarke County have been in the Spout Run Watershed (Figure 11), contained in the EPA Sole Source Aquifer (Figure 12)

A complete list of past and current watershed Programs and Grant Projects for Clarke County is detailed in Appendix II.

Figure 11

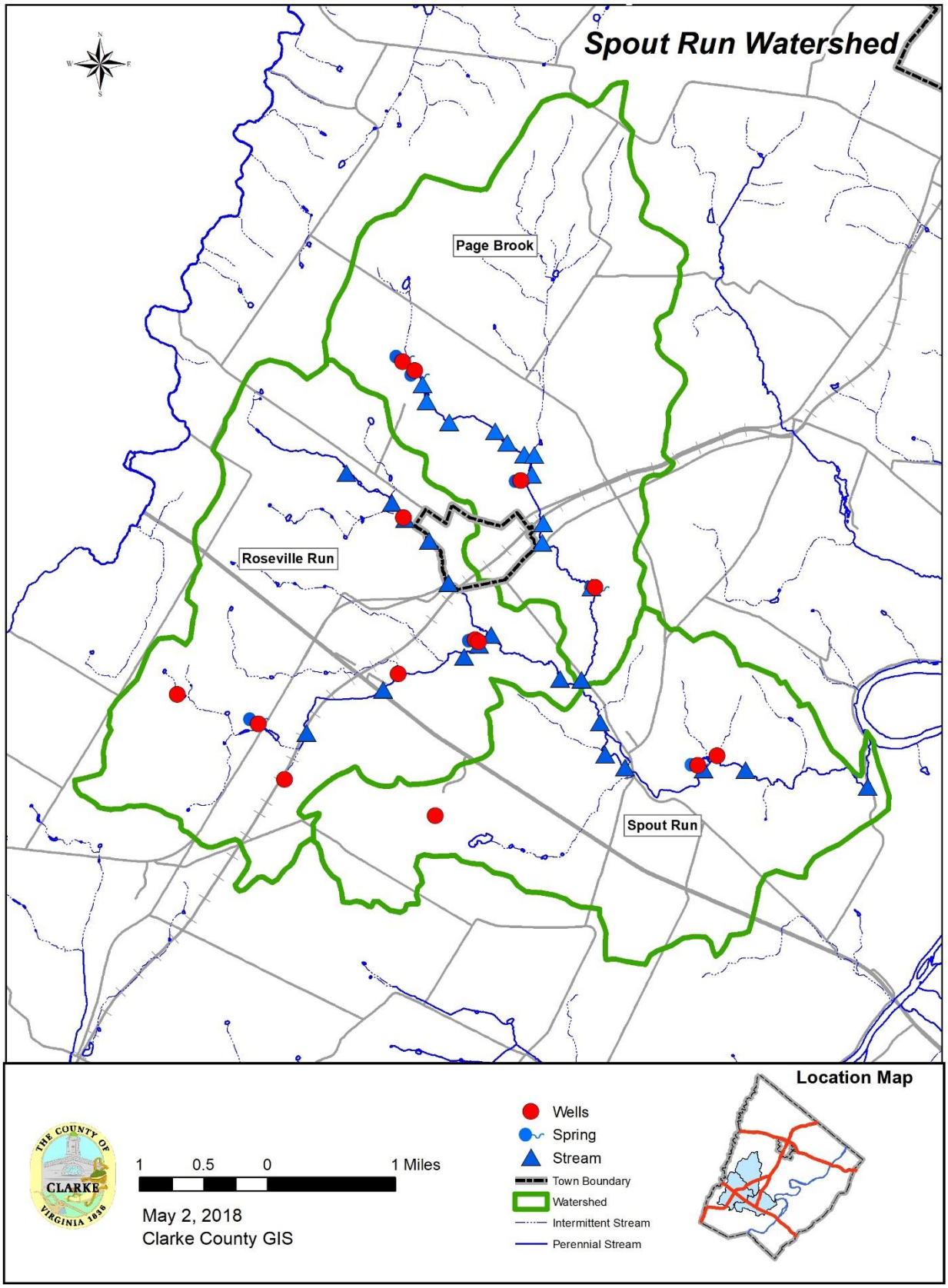
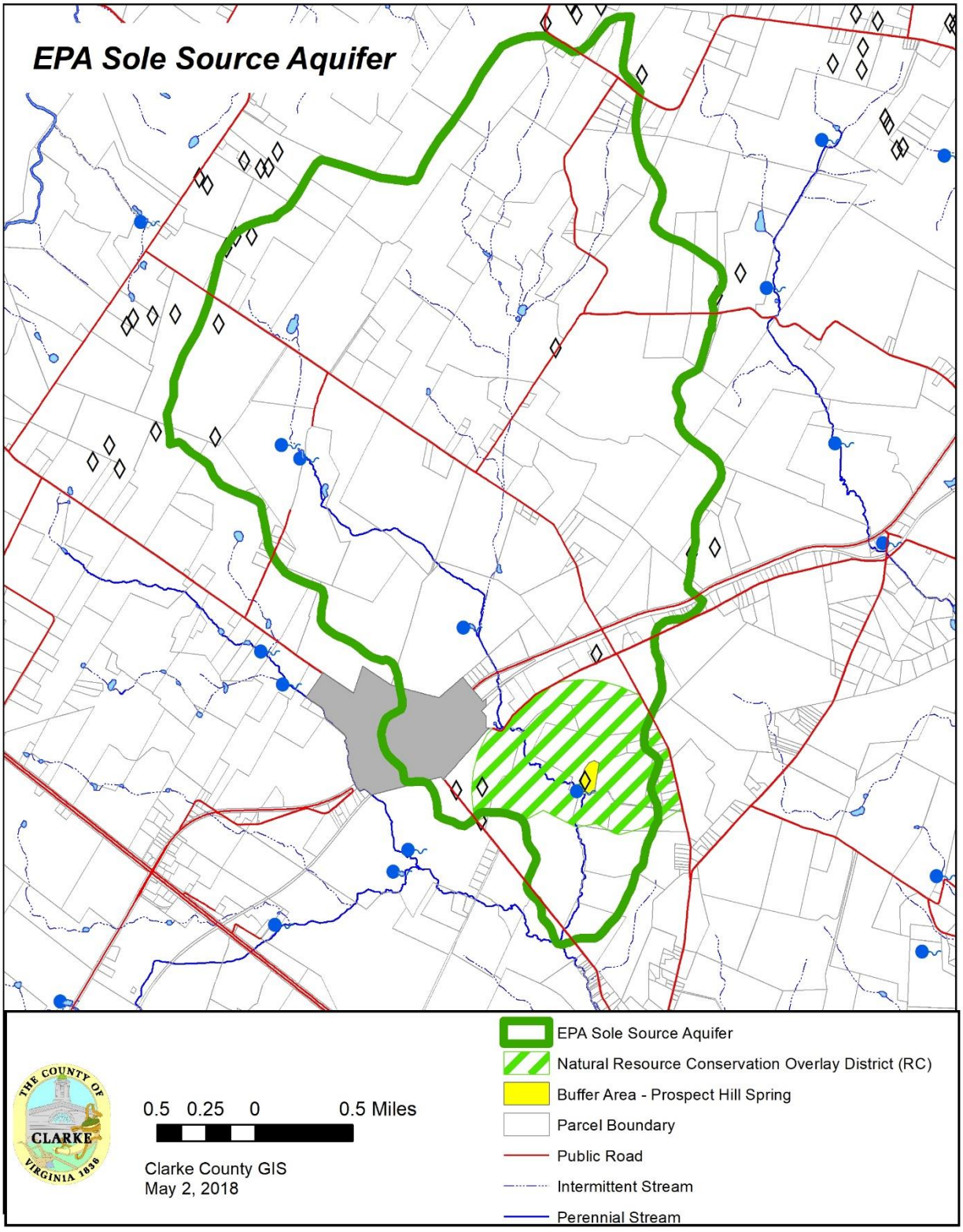

Spout Run Watershed
Page Brook
Roseville Run
Spout Run
Location Map
Wells
Spring
Stream
Town Boundary
Watershed
Intermittent Stream
Perennial Stream
1 0.5 0 1 Miles
May 2, 2018
Clarke County GIS

Figure 12


EPA Sole Source Aquifer
THE COUNTY OF CLARKE VIRGINIA 1836
0.5 0.25 0 0.5 Miles
Clarke County GIS
May 2, 2018
EPA Sole Source Aquifer
Natural Resource Conservation Overlay District (RC)
Buffer Area - Prospect Hill Spring
Parcel Boundary
Public Road
Intermittent Stream
Perennial Stream

L. Water Supply Planning

The Department of Environmental Quality oversees the Commonwealth's water supply planning efforts. This includes development of a state plan, assisting with local and regional plans, and implementing the Virginia Water Withdrawal Permitting Program. The regulation affecting the development of water supply plans in the Commonwealth is the Local and Regional Water Supply Planning Regulation (9VAC25-780), which became effective on November 2, 2005.

The purpose of this regulation is to establish a comprehensive water supply planning process for the development of local, regional, and state water supply plans. This process shall be designed to (i) ensure that adequate and safe drinking water is available to all citizens of the Commonwealth; (ii) encourage, promote, and protect all other beneficial uses of the Commonwealth's water resources; and (iii) encourage, promote, and develop incentives for alternative water sources, including but not limited to desalinization.

In addition, the regulation requires that all counties, cities, and towns in the Commonwealth of Virginia submit a local water supply plan or participate in a regional planning unit in the submittal of a regional water supply plan to the State Water Control Board. The most recent State Water Resources Plan was published in 2015 (DEQ, 2015). The State Plan was developed based on information provided by Virginia's counties, cities, and towns in response to the Water Supply Planning Regulation (9 VAC 25-780). The local and regional water supply plans include information about existing water use and sources of supply, future projections of population and water demand, anticipated water supply deficits, potential sources of future water supply, and current efforts to use water efficiently.

In addition to information from the local plans, the State Plan includes an analysis of how meeting future water needs may affect key water uses such as pollution assimilation, fish and wildlife habitat, and other existing downstream users. The Plan takes an extensive look at surface water and groundwater sources and includes an assessment of the capacity of these sources to meet the projected water demand in 2040. The Plan will be subject to incremental revision at five-year intervals as DEQ, localities, and other stakeholders provide input through ongoing water supply planning efforts.

Clarke County and the Towns of Berryville and Boyce worked with other localities in the Valley including Frederick County and the Towns of Middletown and Stephens City; Page County and the Towns of Luray, Shenandoah, and Stanley; Shenandoah County and the Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, and Woodstock; Warren County and the Town of Front Royal; City of Winchester, to develop a regional plan coordinated by the Northern Shenandoah Valley Regional Commission. The plan states that, through careful planning and conservation efforts, there will be sufficient water to support the majority of needs through the year 2040.

Based on current supply, a deficit of 0.81 MGD is anticipated to occur in Frederick County by 2030. Frederick County Sanitation Authority alternatives include quarry expansion and groundwater well improvements, and adding a water withdraw from the Opequon Creek at the northern section of the stream on the Clarke/Frederick County border. They have established the Opequon Water Supply Plan (OWSP) initiative, designed to ensure a safe and reliable, and sustainable supply of water to help meet the community's projected water needs.

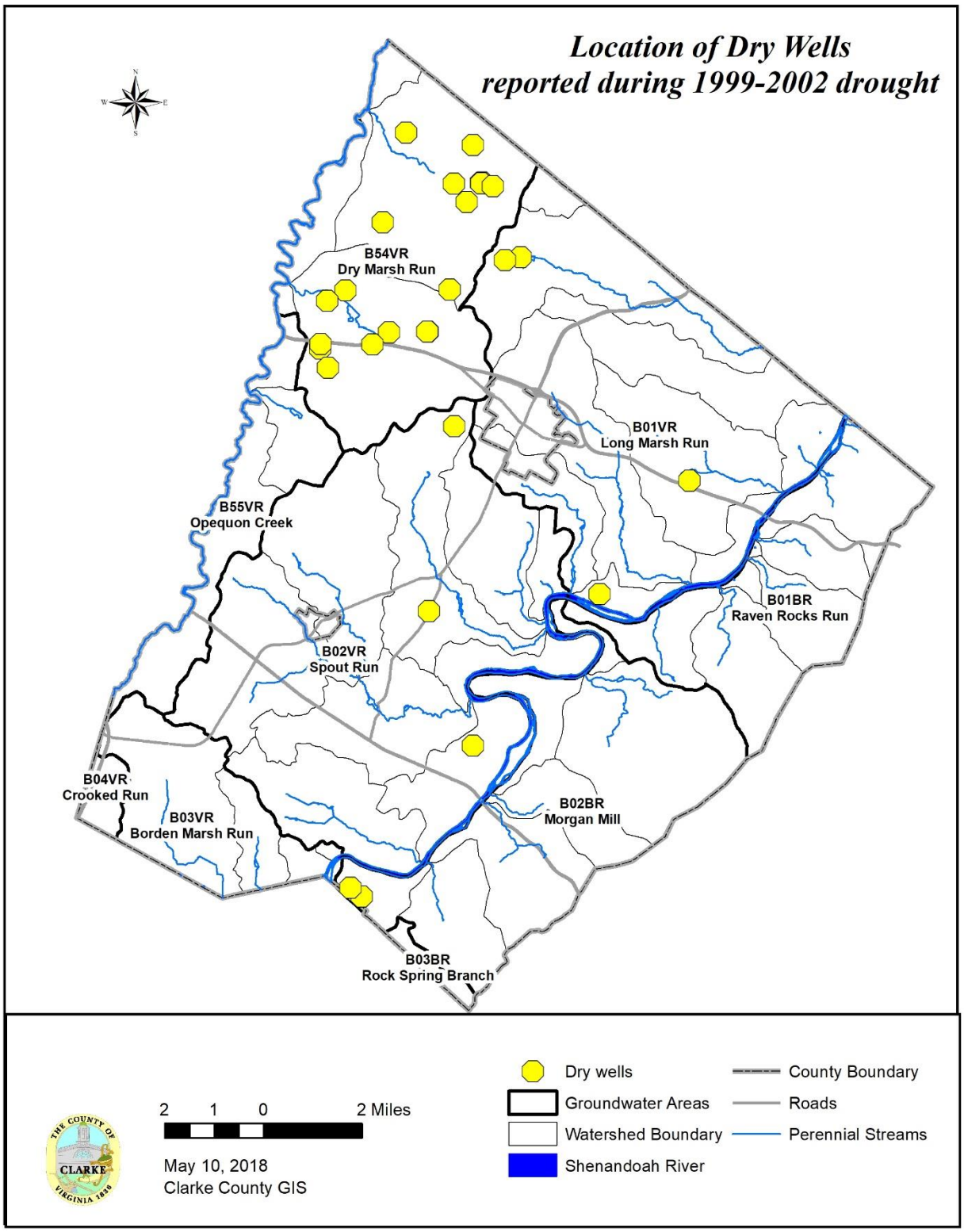
By 2035, Frederick Water's water customers may require up to twelve million gallons of water every day, more than doubling from today's average of 5.6 million gallons per day. A detailed report is available on their website.

M. Drought Response Plan

During the summer of 2002 Virginia experienced significant drought impacts due to precipitation deficits that dated to 1999 in most areas of the Commonwealth. While this drought did not reach the level of severity of the drought of record (1930-1932), increases in water demands when compared to the 1930's resulted in significant impacts to all sectors of Virginia's economy and society. This prompted the Department of Environmental Quality to require localities to develop drought response plans. In addition to providing alternate water sources, the water supply regulations require localities to develop drought response plans.

Clarke was proactive and adopted a Plan and Ordinance in 2008, ahead of the the Regional Drought Plan (2011), as there were 26 reported dry wells in the County due to the 1999-2002 drought (Figure 13). The purpose of the plan is to describe a low flow/drought

Figure 13


Location of Dry Wells
reported during 1999-2002 drought
B54VR
Dry Marsh Run
B01VR
Long Marsh Run
B55VR
Opequon Creek
B01BR
Raven Rocks Run
B02VR
Spout Run
B04VR
Crooked Run
B03VR
Borden Marsh Run
B02BR
Morgan Mill
B03BR
Rock Spring Branch
2 1 0 2 Miles
May 10, 2018
Clarke County GIS
Dry wells
Groundwater Areas
Watershed Boundary
Shenandoah River
County Boundary
Roads
Perennial Streams

response plan for the Shenandoah river basin. This plan utilizes the Virginia Drought Assessment and Response Plan developed by the Commonwealths Drought Response Technical Advisory Committee as a framework and incorporates the data collected and recommendations made in the final MIF report.

Clarke County receives an average of 36 inches of rainfall annually, spread fairly evenly throughout the year. In most years, rainfall is adequate to maintain and replenish our ground and surface water supplies.

However, the occurrence of droughts is a normal part of the weather cycle and should be expected. In the Shenandoah Valley drought is a cyclical phenomenon with a historical pattern of extreme drought occurring every thirty years with less severe droughts occurring roughly every decade.

During droughts, water available from our streams, rivers, and wells can be severely diminished. In addition, water use can increase drastically. The statewide Drought Assessment and Response Plan was used as a framework for this Drought Response Plan. Important differences between the State Drought Assessment and Response Plan and this local plan include:

1) Drought onset and stage declarations shall be made by the County staff under advisement from, but responsive to, USGS and the State Drought Monitoring Task Force.
2) Local data available from the USGS Groundwater Study, regional stream gages, and precipitation data will be utilized in drought stage declarations.

In order to monitor potential drought, the County will use the three drought indicators; precipitation, stream flows, and ground water levels; as the initial indicators to be considered when advising the Board of Supervisors regarding the declaration of a particular drought stage.

The drought stages are watch, warning, and emergency. When two indicators exceed the threshold for stage determination, this advisement may be to declare a specific drought stage or may include an explanation of why the particular drought stage should not be declared at that time. In Drought Watch responses are generally intended to increase awareness, in the

public and private sector, to climatic conditions that are likely to precede the occurrence of a significant drought event. During this drought stage, the primary activities that are suggested are to prepare for the onset of a drought event.

The response phase in this stage is voluntary conservation. Voluntary conservation involves the reduction of non-essential uses, fixing leaks, installing water saving devices, and a general increase in awareness to conserve water. It is unlikely that significant water use reductions will occur at this stage although it is possible that the increased public awareness of water conservation activities may reduce water use up to 5%.

During a Drought Warning responses are generally responses that are required when the onset of a significant drought event is imminent. Water conservation and contingency plans that have been prepared during a drought watch stage would begin to be implemented.

From the perspective of the Commonwealth, water conservation activities at this stage would generally be voluntary. Voluntary water conservation activities generally result in reductions in water use of 5-10%. In this stage all water users would be encouraged to spread out water use. For example, rather than filling large livestock water troughs once a day, consider installing automatic waterers that respond to demand by livestock throughout the day.

For a Drought Emergency responses are generally responses that are required during the height of a significant drought event. During these times, it is likely that some water supplies will not provide the quantity of water needed by all users. Non-essential uses of water should be eliminated. Mandatory water conservation requirements contained in water conservation and contingency plans should be initiated at this stage. Mandatory water conservation activities generally result in water use reductions of 10-15%.

The Town of Berryville has adopted its own Drought Response Plan (Code of Ordinances Chapter 17 - Water, Sewers and Sewage Disposal Article II. - Water Generally Sec. 17-25. - Drought response ordinance).

The Town of Boyce water supply is administered by the Clarke County Sanitary Authority (CCSA). The CCSA has opted to follow the County's Plan.

N. Groundwater Availability

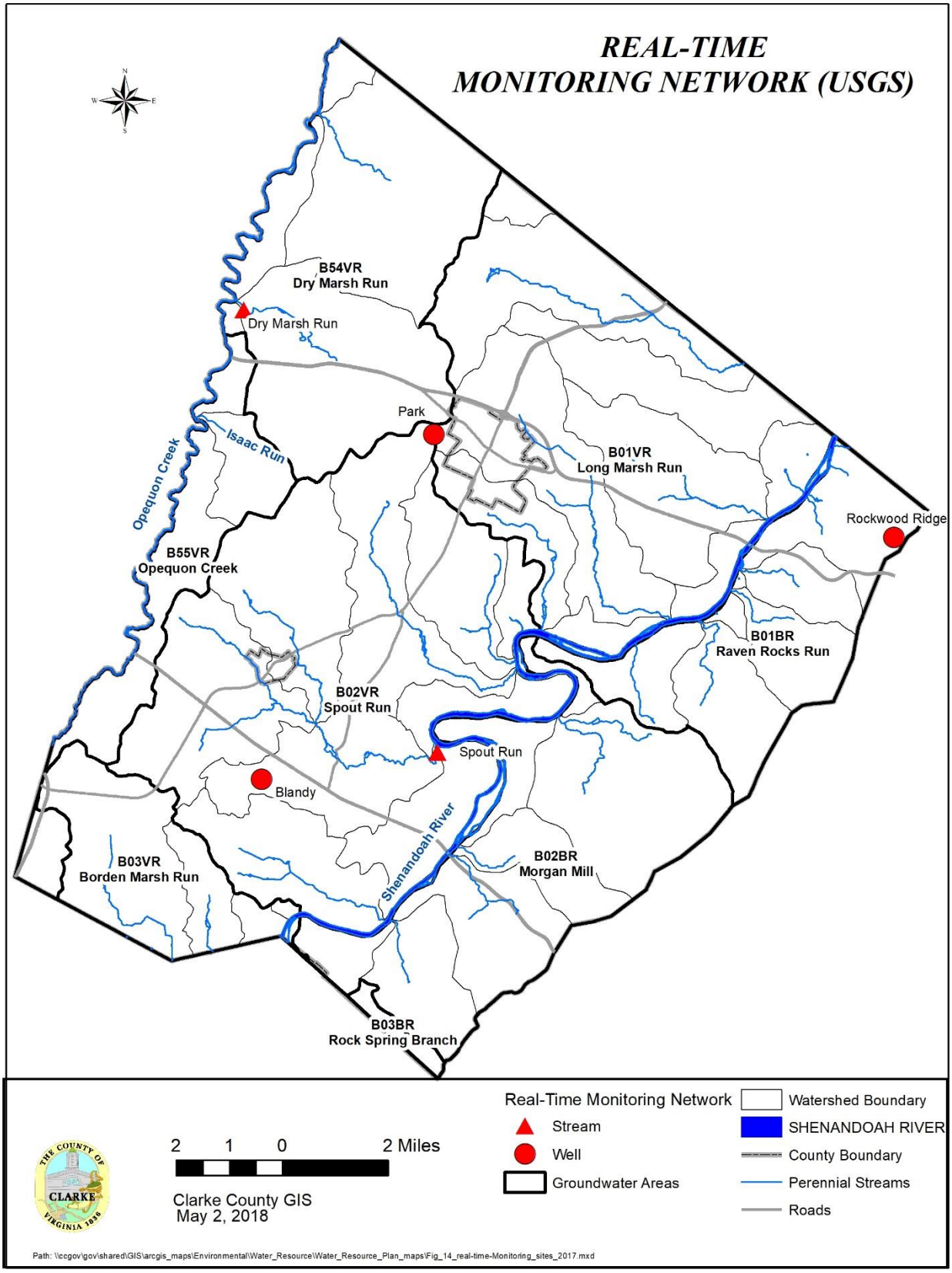
In 2002, as a result of a prolonged and serious drought, the County initiated a second USGS study of groundwater. The first was conducted in the late 1980's and published in 1990 (Wright, 1990). This study focused primarily on groundwater quality. The second USGS study was a 6-year ground-water study with the United States Geological Survey (USGS). The primary objective of this study was to enhance the County's understanding of the quantity and sustainability of our ground-water resources. A report entitled "Hydrogeology and Ground-Water Availability in Clarke County, Virginia" details the results of the 6-year study. The report describes the methodology used to describe the groundwater flow patterns that ultimately determine how groundwater is recharged.

Understanding how water gets into the system explains water availability and the potential for contamination. A summary of the report and description of how the data will be used to protect ground-water resources and reduce future impacts of drought follows. A PowerPoint presentation with graphics is available on the County website.

As a result of this study the County now has some data in which begin to evaluate its groundwater resources. Including numbers that detail when low groundwater recharge levels will begin to impact streams and aquatic systems; how changes in zoning and land use may impact groundwater resources; how groundwater volume is distributed in the County; where contamination is more likely to occur; and where recharge occurs.

Continued minimum monitoring of established real-time gage stations and wells (Figure 14) will add to this body of knowledge and allow for refinement of management strategies.

Figure 14


REAL-TIME
MONITORING NETWORK (USGS)
B54VR
Dry Marsh Run
Dry Marsh Run
Park
Isaac Run
Opequon Creek
B01VR
Long Marsh Run
Rockwood Ridge
B55VR
Opequon Creek
B01BR
Raven Rocks Run
B02VR
Spout Run
Spout Run
Blandy
Shenandoah River
B03VR
Borden Marsh Run
B02BR
Morgan Mill
B03BR
Rock Spring Branch
2 1 0 2 Miles
Clarke County GIS
May 2, 2018
Real-Time Monitoring Network
Stream
Well
Groundwater Areas
Watershed Boundary
SHENANDOAH RIVER
County Boundary
Perennial Streams
Roads
Path: \\ccgov\gov\shared\GIS\arcgis_maps\Environmental\Water_Resource\Water_Resource_Plan_maps\Fig_14_real-time-Monitoring_sites_2017.mxd

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CHAPTER V

CONCLUSION

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CHAPTER V -- CONCLUSION

A land use plan is only as good as the degree in which it is implemented so it is critical to work towards researching, evaluating, and pursuing the recommendations set forth in this Plan. Likewise, a land use plan is only effective if it is kept up to date and reflects the community's current conditions, needs, and impacts.

It is recommended that the Plan be reviewed on a five-year review schedule according to the following process:

1. On a five-year schedule from the adoption date of the current Water Resources Plan, the Planning Commission shall adopt a resolution addressing the status of the Plan, whether it should be updated, and to what degree it should be updated. This resolution may come in one of the following forms:

- A finding that the current Plan recommendations are sufficient and that no amendment is necessary.

- A finding that changes in the community warrants a comprehensive review and update of the Plan. An example would be the release of decennial Census data and growth projections.

- A finding that the Plan does not address, or inadequately addresses, a specific topic area or areas warranting a focused update of the Plan. While the update may have a specific purpose, the review should remain comprehensive to ensure that all impacts are carefully evaluated.

2. It is recommended that at the beginning of year four in the five-year schedule, the Commission should begin work evaluating the Plan status. This can be accomplished as a committee of the whole or by designating a special subcommittee. If the Board of Supervisors has established an agricultural advisory committee, the Planning Commission should include this committee's input on the Plan evaluation either by joint meetings with the committee or including representatives from its membership on a special subcommittee with Commission members.

Plan status should be evaluated by considering factors including, but not limited to:

- Recent release of updated data concerning TMDL implementation or water supply planning.

- Recent updates to the County Comprehensive Plan or related component plans.

- Changes to State law impacting water resources.

- Any other subject not addressed or inadequately addressed by the current Plan.

While not recommended, a proposal may be considered to amend the Plan outside of the scope of the Plan's five-year review cycle. Frequent, piecemeal changes to the Plan can result in the document becoming fragmented and inconsistent. It can also devalue the importance of the document as a long-range planning guideline. For these reasons, interim amendments are strongly discouraged.

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APPENDICES

APPENDIX I
Status of Implementation 1999 Water Resources Plan

APPENDIX II
Programs and Grant Projects

APPENDIX III
Guidance from Comprehensive Plan

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Appendix I – Status of Implementation 1999 Water Resources Plan

Policy	Description	Objective	Implementation Status	Comments	Impediments
Policy 1. Review and Update of County Ordinances related to groundwater protection	**A. Septic Ordinance:**				
	i. Phase out of non-standard waste disposal systems such as pit privies	eliminate significant threat to public health and groundwater quality	partially implemented	ongoing effot with HD	Problems in implementation are lack of funding sources for replacement of non-standard systems.
	ii. Implement regular maintenance, cleaning, and reporting of septic systems	Septic systems fail if they are not properly maintained by pumping approximately every five years.	not implemented		Need to develop administrative component
	iii. Identify acceptable alternatives to septic systems, when failed or inadequate systems are identified.	In 2010, the Virginia General Assembly passed regulations stating that a locality shall not prohibit the use of alternative onsite sewage systems	fully implemented	Installation and use of alternative systems should be accompanied by a maintenance schedule that is regulated by the Clarke County Sanitation Authority.	
	B. Sinkhole Ordinance: Amend the ordinance to require vegetative buffering of all Class 1 sinkholes which are subject to contamination.	sinkholes are direct pathways for surface contaminants to enter the groundwater	partially implemented	No specific action has been taken to send educational material, however setbacks to the discernable edge of sinkholes has been added to the Zoning Ordinance for structures and wells.	as with stream fencing there has not been the poitical will to require buffering
	C. Underground Storage Tank Ordinance: Create a database of the locations of all UST's in the County, and develop a County ordinance that will serve to regulate UST with less than 1,000 capacity that are used for petroleum or chemical storage.	The potential for groundwater contamination of leaking tanks exists for all UST.	not implemented	Underground Storage Tanks (UST) with greater than 1,000 gallon's capacity for petroleum products are regulated by DEQ.	No database has been developed for tanks < 1000
	D. Stormwater Resources Ordinance: Revise the ordinance to better address both runoff quantity and quality so as to protect surface and groundwater from contamination.	Stormwater Resources addresses the runoff from new development. In 2010 a Stormwater Ordinance was passed by the Board of Supervisors to require increased standards for water quality discharge.	void	Due to changes in State law in 2016, DEQ administers stormwater management for Clarke County.	
	E. Natural Resources Overlay District: Consider enlarging to incorporate all available data that delineates the groundwater recharge area for the spring	Enlarge the overlay district to match the boundaries of the EPA designated Sole Source Aquifer to add additional protection to Prospect Hill Spring	not implemented	Attempts to expand area were thwarted by residents stating not enough data exists to justify expansion of the Overlay District.	

Appendix I (cont.)

Policy	Description	Objective	Implementation Status	Comments	Impediments
Policy 2. Public awareness and education: Designate the Clarke County Natural Resource Planner as the County official responsible for Public education concerning protection and conservation of groundwater resources.		Public education is an essential component of any attempt to protect and conserve groundwater resources.	partially implemented	ongoing	
Policy 3. Non-point pollution: Cooperate with and encourage use of the programs administered by the Agricultural Extension Office and other agencies involved in developing Best Resources Practices (BMPs).		Non-point pollution is the single largest contributor to groundwater pollution in Clarke County.	partially implemented	ongoing	
Policy 4. Well Testing: Establish a County-wide well monitoring network to effectively monitor changes in water quality over time. This would include routine testing of specific wells for coliform and water chemistry.		Well monitoring is a fundamental way to track groundwater quality.	partially implemented	Establishing a long term groundwater quality monitoring network is still needed.	
Policy 5. Groundwater database development	**A. Develop a database of all existing well and septic permits on file in cooperation with the Health Department. Homes with systems not on file should be surveyed to determine the type and location of water source and sewage disposal.**	Identifying the types and locations of well and septic systems is important for documenting groundwater contamination. Septic systems are a known contamination source.	partially implemented	The County Planning Department compiled permit data from the 70's thru 2001, approximately 3,675 records, but this database does not have GPS location information. GPS data was collected from 2011 to 2015 but changes in Health Department personnel have caused this data collection to be discontinued.	Staffing shortages have delayed full implementation
	B. Compile existing data from all previously conducted groundwater studies	Analyzing this data in total can provide the County with valuable insight into trends relating to groundwater contamination.	partially implemented	ongoing	
	C. Use the GIS to identify and map areas sensitive to groundwater contamination. Utilize this information to prioritize areas in need of increased protection measures.	The GIS is a tool that can best serve County officials by identifying and mapping areas sensitive to groundwater contamination.	partially implemented	Due to lapses in GPS data collection and the lack of a long term groundwater quality monitoring network, mapping trends in groundwater contamination is not possible at this time.	
Policy 6. Establish a Stream Protection Overlay District and adopt regulations to protect those designated areas.		The intent of this district is to provide stream buffers for the purposes of filtering nonpoint source pollution from runoff, preventing erosion, moderating stream temperature, and providing for the ecological integrity of stream corridors and networks.	fully implemented	The Stream Overlay Protection District was adopted in 1999, Zoning Ordinance Section 3-E-5.	

Appendix I (cont.)

Policy	Description	Objective	Implementation Status	Comments	Impediments
Policy 7. Amend the Zoning Ordinance to require 100' building setbacks from perennial streams and 50' building setbacks from intermittent streams, as identified on the 7.5' USGS topographical maps, in the Agricultural-Open Space (AOC) District.		Preserving stream and river riparian corridor zones is essential for protecting water quality. Building setbacks from streams have been in place in the FOC zoning district since 1994. Requiring these same setbacks in AOC will serve to protect stream corridors in the Valley portion of the County.	fully implemented	Adopted in 2003, Zoning Ordinance Section 3-A-1-c. All other zoning districts have setback requirements as well.	
Policy 8. Establish a Countywide surface water monitoring network to effectively monitor changes in water quality overtime. This would include routine testing of and reporting for all perennial streams for coliform and water chemistry.		Several streams in the County are currently monitored but most are not. Identifying which streams are contaminated is necessary in order to allocate limited resources effectively.	partially implemented	DEQ currently has 7 active monitoring sites in Clarke County in addition the Friends of the Shenandoah River (FOSR) have been conducting bimonthly monitoring on 14 sites since 1997. The County provides annual funding to FOSR to support their sampling efforts.	Determine if monitored streams are adequately representating water quality in all streams
Policy 9. Encourage upgrading of sewage treatment plants to reduce nutrients discharging into surface waters.		wastewater treatment plants contribute a significant amount of nutrients to State waters	fully implemented	The Chesapeake Bay TMDL was established in 2010 requiring waste water treatment plant upgrades. The Berryville, Boyce and Opequon Waste Water Treatment facilities have all completed the required upgrades.	Regulatory
Policy 10. Encourage installation of Best Management Practices (BMPs) to reduce access of livestock to riparian buffer zones.		installation of BMP's protects riparian buffers	partially implemented	Extensive cooperative projects funded through grants in the Spout Run watershed have been completed in an effort to have the waterway removed from the EPA impaired waters list	Voluntary
Policy 11. Identify locations of individual onsite sewage disposal systems discharging into State waterways and replace with conventional septic systems where possible.		Straight pipes are not permitted, but some may exist that were installed before the adoption of the Septic Ordinance. Identifying the type and location of all sewage disposal systems in the County is a priority outlined in the Groundwater Resources Plan. These systems can be upgraded to eliminate sources of contamination.	partially implemented	Ongoing The County continues to work with the Health Department to identify and eliminate these substandard systems.	
Policy 12. Consider adopting a Shenandoah River Recreation Plan.		Efforts are underway to develop a recreational use plan for the Shenandoah River. These could include sections relating to the scenic river designation, protection of aesthetic values, and establishment of vegetated riparian buffers.	fully implemented	In 2006, a plan entitled "Shenandoah Valley River Use - Floating and Fishing: An Action Plan for Recreational Access to and Stewardship of Water Resources" was developed through the Regional Commission. In 2015 an implementing component of the Comprehensive Plan Recreation Plan, was adopted that details protection efforts for the River.	

Appendix I (cont.)

Policy	Description	Objective	Implementation Status	Comments	Impediments
Policy 13. Increase funding to multijurisdictional Minimum Instream Flow study in order that the data necessary to declare a Surface Water Management Area is available as soon as possible.		As currently funded, a complete MIF study will take 10 years. Requests for increased funding are necessary in order to complete this work in a timelier manner. This information is essential to designating the Shenandoah River a SWMA, for which Clarke County petitioned the State in 1990.	fully implemented	Minimum Instream Flow studies have been completed for the North Fork, South Fork, and Main Stem of the Shenandoah River.	
Policy 14. Conduct a comprehensive study in cooperation with the USGS to fully characterize tributary stream flow patterns, discharge rates, and floodplains.		Determining surface water flow patterns and discharge rates provides invaluable data as to the amount of water available for instream and offstream uses. Healthy stream habitats depend on adequate flow to assimilate pollutants from sources impacting surface waters. Baseline data can be incorporated into determining TMDL rankings for all County tributaries, not just those selected by the State. Once ranked, resources can be allocated to those streams with the highest potential for degradation.	fully implemented	A USGS study entitled Nelms, D.L., and Moberg, R.M., Jr., 2010, Hydrogeology and groundwater availability in Clarke County, Virginia: U.S. Geological Survey Scientific Investigations Report 2010–5112, 119 p. was completed in 2010.	
Policy 15. Update the 1988 Water Supply Plan to insure adequate water resources are available for Clarke County residents.		The 1988 Water Supply Plan outlined water supply needs and projected shortfalls through 2030. To date, no update has been completed or is planned. Periodic update of the section pertaining to Clarke County may be needed to prevent water deficits in the future.	fully implemented	The most recent Plan was completed in 2015 with updates proposed every five years. The County participates in these efforts through the Regional Commission.	
Policy 16. Conduct additional dye tracing studies to increase understanding of the interrelationship between ground and surface waters in the County.		The groundwater/surface water interrelationship is a complicated matter, requiring more technical information than is currently available.	fully implemented	Dye tracing studies were conducted in 1987, 1992, and 1998. The tests indicated that groundwater in this area can move two miles or more from recharge points, in as little as five months. No additional tracer studies have been conducted or are planned at this time. The 2010 USGS study did study ground and surface water flows and has provided detailed information on the contribution of groundwater to the base flow of surface waters.	

Appendix II – Programs and Grant Projects

CLARKE COUNTY - WATER RESOURCES PLAN					
PROGRAMS and GRANT PROJECTS - PAST AND CURRENT					
NAME	PROGRAM/GRANT ENTITY	DATE	Grant Amount	OBJECTIVE	COMMENTS
Prospect Hill Spring - Public Water Supply Permit	State Health Department	1977		Supply Boyce, Millwood, White Post and the Waterloo commercial district	
Prospect Hill - Honkala Report - Schnabel Report	Clarke County	1980 & 1983		Determine land use policies to protect the water quality of Prospect Hill	Resulted in the 400 acre Natural Resource Overlay District (RC) being established in 1983
Page Brook 4,900 acre drainage basin declared a sole-source aquifer (includes Prospect Hill)	EPA	1987		Protection of the Prospect Hill Spring from contamination creating a public health hazard	No Federal assistance allowed for any project that might contaminate that aquifer.
Groundwater Protection Plan	PDC	1987			
USGS Study - Wright	USGS	1990	$60,000	Characterize the ground water flow systems using hydrologic and water chemistry data and map the potentiometric surface; establish a monitoring network of wells and springs; assess the overall groundwater quality of the County.	
Prospect Hill Spring found with high bacterial levels	State Health Department	1994		County required to provide disinfection and filtration of the water	Cattle grazing around a sinkhole 500' above the spring were contributing to the contamination.
Millwood	Virginia Dept. of Health	1994		Sewage disposal systems (septic tanks) were found deficient, and constituted a public health hazard	Studies determine that up to 24% of the fecal bacteria found in the water was human in origin.
Statewide NonPoint Source Pollution / Impaired Waters Listing / Natural Heritage Priority Ranking		1996		Spout Run Watershed. Verification of Impaired Waters and TMDL Status	Source of impairment listed as NPS-Agriculture
Page Brook Watershed Restoration Project	EPA Section 319	1996	$75,000	Page Brook watershed. Study BMP installation possibilities.	2.5 miles of fencing were installed on four farms in the watershed. Water samples analysed monthly.
County condemnation of 7 acres around contaminated sinkhole close to Prospect Hill	Clarke County	1997	$60,000	Area fenced off and planted with vegetated buffers to decrease contamination	Substantial decrease in coliform bacteria present in Prospect Hill Spring
Roseville Run (tributary of Spout Run)	EPA	1998	$65,250	Installation of BMPs to protect the run.	

Appendix 2 (cont.)

NAME	PROGRAM/GRANT ENTITY	DATE	Grant Amount	OBJECTIVE	COMMENTS
Spout Run Main Stem	WQIF	1998	$45,150	BMP installation and verification of impact of sewage treatment plants and failing septic systems on water quality	
Wellhead Protection Program	VDH Office of Drinking Water	1999		Assess quality of drinking water sources	By 2003, all existing drinking water sources were assessed.
Millwood Sewer Construction Project	Clarke County	2002 - 2004	$1,101,850	Eliminate high levels of human fecal bacteria contaminating the Spout Run watershed	Public water and sewer lines were extended from Boyce to Millwood, replacing failing septic systems. 40 homes hooked to public
Wellhead Protection Plan Grant	VDH-ODW / DEQ	2006		Local wellhead protection implementation projects to prevent contamination and maintain good quality drinking water supplies.	Mostly implemented with the Spring Overlay District Ordinance. A few other public wells in small communities still in need.
Drought Response Plan	Clarke County	2008		Guides drought monitoring, evaluation and response in the County	
2010 Hydrology Report	USGS	2002-2008	$1,005,500	Enhance the County's understanding of the quantity and sustainability of our ground-water resources	
Spout Run TMDL	DEQ	2010		When state waters are assessed to be impaired, Total Maximum Daily Loads (TMDLs) are developed by DEQ to determine the total amount of a pollutant that a waterbody can handle without resulting in the impaired status of that waterbody.	
Spout Run Implementation Plan	DCR	2012		The goal of TMDL implementation is to restore water quality in impaired watersheds. To gage progress toward this goal, DEQ tracks Best Management Practice (BMP) installations and continues to monitor water quality in the impaired watersheds.	
Spout Run Implementation Grant	DEQ	2012-2014	$292,666 with $216,718 match	Significant number of streambanks were fenced, and streambank restoration was completed, reducing erosion.	Major participation and fund matching by various private groups. Disappointing participation with many landowners uninterested in participating. $85,250 returned due to lack of landowner participation.
National Fish & Wildlife Foundation Grant	NFWF	2013-2015	$141,600 with $87,822 match.		
Minimum Instream Flow Studies					
Main Stem Shenandoah River	Virginia Environmental Endowment, DEQ, USGS, and local government	1995-1998	$280,000	Provide the counties and communities in the Shenandoah Basin a better knowledge of: 1) the water resources in the basin; 2) the regional hydraulic system; 3) the effect of withdrawals and conservation measures on the ecology, agriculture, industry, and water supply.	
North Fork Shenandoah River		1998-2004	$400,000		
South Fork Shenandoah River		2004-2011	$700,000		
Main Stem Shenandoah River (model update)		2011-2013	$54,000		
Drought Response Plan	DEQ	2003		Guides drought monitoring, evaluation and response in the Commonwealth of Virginia	

Appendix III – Guidance from Comprehensive Plan

Guidance from the 2013 Comprehensive Plan and Related Component Plans

This section is a compilation of language and recommendations from the Comprehensive Plan and related component plans that support the revised Goals, Objectives, and Strategies of the Water Resources Plan. This section organizes the relevant language and recommendations into four categories: General Guidance from the Comprehensive Plan, Protect and Enhance water quality, Protect and Maintain Water Availability, and Engage and educate individuals, communities and governments in watershed stewardship. The latter three categories correspond to the three recommended Goals that are discussed in Chapter I.

While this is not intended to be a complete listing of all plan references pertinent to the Water Resources Plan, it is a compilation of references that bear direct relationship to the Plan's revised Goals, Objectives, and Strategies in the most concise manner. Quoted text is noted in italics.

General Guidelines from the Comprehensive Plan

- COMPREHENSIVE PLAN, Summary Statement of Purpose (p. ii):
  The County shall strive to support concepts, programs, projects, and regulations that ensure environmental sustainability. Clarke County's fundamental goal is to protect our natural resources so that we may pass them on to future generations. We seek to accomplish this through efforts that manage surface water and groundwater, protect and restore stream and river corridors, and preserve the integrity of our natural environment.

- COMPREHENSIVE PLAN, Chapter III Water Resources Plan (pp. III-12-15)
  The Water Resources Plan is comprised of two sections, one addressing groundwater resources and the other addressing surface water resources. The Board of Supervisors adopted the groundwater section on October 20, 1998, and the surface water section on December 21, 1999. The following is an overview of these two sections.

2018 WATER RESOURCES PLAN

1. Summary

A. Groundwater Resources

The groundwater resources section of the Water Resources Plan covers issues relating to groundwater, including groundwater contamination from non-point sources, protection of the Prospect Hill Spring water supply, and enhanced public education of the sensitive nature of limestone geology. This section is designed to accomplish Comprehensive Plan's Natural Resources Objective that states: "Protect natural resources, including soil, water, air, scenery, night sky, wildlife resources, and fragile ecosystems."

The groundwater resources of Clarke County are particularly susceptible to contamination resulting from human activities because of the sensitive nature of the aquifers found in carbonate rocks underling the Valley region of the County. Groundwater protection and resource problems are generally greater in areas that are underlain by carbonate rocks, such as limestone and dolostone, than in areas underlain by most other rock types, because of the presence of solution-enlarged sinkholes, conduits, and caves. These geologic features characterize what is called karst terrane. The generally high permeability of these rocks facilitates the infiltration and transport of contaminants from the land surface to the groundwater reservoir.

Three-fourths of the people in Clarke County depend on groundwater as the source of their drinking water. Protecting groundwater from pollution, therefore, has been of primary importance in the County for many years. The urgency and economic necessity for doing so was highlighted in 1981, when the Town of Berryville had to abandon the wells that provided its public water supply. The wells had been contaminated by a combination of nitrates, phenols, and herbicides, none of which could be traced to a single point source. Because new wells might later become contaminated, the Town decided to draw its water from the Shenandoah River and to construct a $1.3 million plant to treat the river water.

Pollution of private wells was recognized as a problem in the 1960s. Pollution sources included improperly installed and maintained septic systems, underground storage tanks, and materials placed on the soil surface, including pesticides, herbicides, and human and

animal wastes. Improper well installation was also a factor in these incidences of groundwater contamination.

The need for potable water in the Boyce-Millwood area led to the creation of the Clarke County Sanitary Authority in 1968. By the mid-1970s, the Authority began supplying water to more than 200 residences and businesses from the high-yielding Prospect Hill Spring. The recharge area of the Spring is now protected by a natural resource conservation overlay district, in which no development may occur that would adversely affect the quantity or quality of the Spring water. In addition, the County has applied for federal designation of the Prospect Hill Spring as a sole-source aquifer.

To minimize the effects of future growth and development, the Planning Commission established a Water Study Committee in 1985. This Committee directs plans and studies aimed at protecting the water resources of the County. Accomplishments of this Committee include the creation of the Clarke County Groundwater Protection Plan (1987), which, in addition to describing the sensitivity of Clarke groundwater, proposed a) an ordinance that limits land use around sinkholes, b) septic system installation guidelines, and c) water-well construction regulations. The Groundwater Protection Plan is a precursor to the groundwater resources section of the Water Resources Plan. The Committee also contracted with the U.S. Geological Survey (USGS) to conduct an in-depth study on the hydrology and quality of groundwater to assist in land use and planning decisions made in the County. This study produced the Water Resources Investigation Report 90-4134 entitled "Ground-Water Hydrology and Quality in the Valley & Ridge and Blue Ridge Physiographic Provinces of Clarke County, Virginia" (Wright, 1990).

B. Surface Water Resources

Surface waters include secondary streams or tributaries, such as the Shenandoah River, the Opequon Creek, and Spout Run (a state-designated trout stream). The surface water resources section of the Water Resources Plan addresses related issues including surface water contamination from point and non-point sources, off-stream water use, such as domestic supply and irrigation, and recreational uses. Point-source pollution comes from

specific, identifiable sources. Non-point source pollution is caused by diffuse sources such as erosion, runoff, precipitation, percolation, and direct deposition from livestock and wildlife.

The 2000 Bay agreement establishes a cap on the total amount of nitrogen and phosphorus that may be discharged from wastewater treatment facilities in Virginia. The cap is set at the level of those pollutants that the Bay can tolerate in order to correct its degradation. Most larger wastewater treatment facilities must upgrade their treatment facilities to achieve much lower discharges of such pollutants under individual caps placed on those facilities by the Commonwealth. In any expansion of smaller facilities (Boyce, for example) substantial reductions in the discharge of nitrogen and phosphorus are required.

Under the coordination of the Department of Conservation and Recreation there is substantial new focus on old programs and the initiation of new programs to achieve the overall non-point source reductions goals which are being carried out by the County and the Lord Fairfax Soil and Water Conservation District. These efforts are focused in the County on (1) Acceleration of Agricultural Best Management Practices; (2) Expansion of Nutrient Management Planning and Implementation Efforts; (3) Consolidation and Strengthening of the Local Stormwater Management Program; (4) Enhancing Implementation of the Local Erosion and Sediment Control Program; (5) Enhancing Outreach, Media and Education Efforts to Reduce Pollution Producing Behaviors. Nitrogen, phosphorus and sediment non-point source reduction goals have also been set for the entire Shenandoah River watershed and tributaries including Spout Run.

The Federal Total Maximum Daily Load (TMDL) Program is currently being carried out by the Lord Fairfax Soil and Water Conservation District in the Abrams/Opequon watershed where an Implementation Plan has been developed to correct the fecal and sediment impairments in the watershed. Further TMDL Program-related efforts are anticipated shortly in the Wheat Spring Branch, Dog Run and other watersheds in the County. It has not been possible to develop a plan to correct the PCB impairment of the main stem of the Shenandoah River in the County where PCBs are concentrated in river sediments. The River continues under a Health Department Advisory against consuming fish caught in the River

because of PCBs. The TMDL-related fecal impairment of Spout Run has been dealt with, at least in part, by the installation of sewer lines in Millwood.

Major fish kills have taken place in the Shenandoah River watershed in 2004-2006 with a dramatic reduction evident in the numbers of small-mouth bass and red-breasted sunfish. The State has established a fish-kill task force and a major effort is underway to determine the cause and find a solution to this serious environmental problem.

2. Priorities for the Next Few Years

A complete review and update of the Water Resources Plan should begin shortly after the adoption of the revised Comprehensive Plan. The update should focus on adding information and policies for the following items:

1. Impact of recent changes to the State's water quality regulations and stormwater management requirements.
2. Maintaining and expanding the County's water quality and quantity programs and infrastructure.
3. Additions or changes to policies that may be impacted through the update of or development of new implementing component plans.

Protect and Enhance water quality

- COMPREHENSIVE PLAN, Objective 3 – Natural Resources (pp. II-6-8)

Policy 6. Apply best management practices to protect local and regional water resources and environmentally sensitive areas such as the Shenandoah River, Opequon Creek, perennial streams, floodplains, wetlands, steep slopes, slippage soils, and highly erodible soils. Establish specific water quality performance guidelines to include Chesapeake Bay Resource Protection and Resource Management Areas when considering land use and development related activities.

Policy 11. Encourage and expand support for the Conservation Easement Purchase Program, both philosophically and financially, to protect natural resources

important to preserving soils, watersheds, water quality, scenery, natural habitats, and air quality.

Policy 15. Take all appropriate steps to protect public water sources, such as the Shenandoah River serving the Town of Berryville, and the Prospect Hill Spring serving the Town of Boyce and the communities of Millwood, Waterloo, and White Post.

Policy 16. Support Shenandoah Basin regional water planning efforts including creation of surface water management areas, and programs to study and address low flow issues. Oppose efforts to establish new interbasin transfers within the Shenandoah River watershed.

Policy 17. Utilize USGS Groundwater Study findings when evaluating proposed changes in land use and continue to support ongoing water resource monitoring efforts.

Policy 18. Establish and maintain a long term water quality monitoring network and real-time water quantity monitoring network, in cooperation with the USGS, to track changes and better assess impacts to our water resources.

Policy 19. Revise and implement the adopted County ordinance requiring pump out of septic systems per State requirements.

Policy 20. Recognize that karst terrane underlies the majority of the Shenandoah Valley, making groundwater in these areas is highly susceptible to contamination. Steps should be taken to protect groundwater and prevent contamination whenever possible.

Policy 21. Strengthen and develop site design features that protect the environment by minimizing new stormwater runoff and that provide the most effective measure of protection for onsite disposal of sewage. Factor in cost-effectiveness and ongoing maintenance requirements for current and future property owners.

Policy 22. Adopt the most stringent regulations for alternative onsite sewage treatment systems permitted by State law to protect the County's vulnerable surface and groundwater resources. Implement an onsite treatment system monitoring program including enforcement of mandatory pump-out requirements for septic

systems. For new development and re-development projects that require a land use change, ensure use of the onsite sewage treatment method that provides the maximum protection to surface/groundwater resources and Karst terrane.

- COMPREHENSIVE PLAN, Objective 1 – Agriculture (pp. II-2-4)

  Policy 5. Encourage the use of best management practices as outlined in the Chesapeake Bay Regulations and as determined by the Federal Total Maximum Daily Load (TMDL) program to improve water quality by the following methods.

  a. Making technical assistance available.

  b. Promoting public awareness on the benefits of, and necessity for, best management practices, erosion and sedimentation controls, storm water management and Chesapeake Bay Preservation Regulations.

  c. Assisting in the establishment of conservation plans for all farms adjacent to perennial streams.

  d. Encouraging the participation of all landowners engaged in agricultural activities to use the assistance of the Virginia Cooperative Extension Service, the Natural Resource Conservation Service, the Lord Fairfax Soil and Water Conservation District, and other public agencies.

- COMPREHENSIVE PLAN, Objective 2 – Mountain Resources (pp. II-4-5)

  Policy 1. Promote multiple uses of forested land that are non-intensive and compatible, such as outdoor recreation, wildlife habitats, watershed protection, and forest management.

  Policy 2. Ensure that timber harvesting is conducted in accordance with Virginia Department of Forestry and Chesapeake Bay protection standards and an approved forest management plan for each site so that sedimentation of streams and other environmental impacts are minimized.

Policy 3. Encourage the use of best management practices as outlined in the Chesapeake Bay Regulations and as determined by the Federal Total Maximum Daily Load (TMDL) program to improve water quality through the following methods.

a) Making technical assistance available.

b) Promoting public awareness on the benefits of, and necessity for, best management practices, erosion and sedimentation controls, stormwater management and Chesapeake Bay Preservation Regulations.

c) Assisting in the establishment of conservation plans for all farms adjacent to perennial streams.

d) Encouraging the participation of all landowners engaged in forestal activities to use the assistance of the Virginia Department of Forestry, the Natural Resources Conservation Service, the Lord Fairfax Soil and Water Conservation District, and other public agencies.

e) Supporting these and other innovative efforts to ensure continued water quality improvements in the future.

- COMPREHENSIVE PLAN, Objective 5 – Conservation Easements (pp. II-10-11)

Policy 3. Encourage and support the goals of the Conservation Easement Program to protect and preserve:

b. Forested areas for their value as natural habitat and recreation, ability to enhance air and water quality, prevent soil erosion, and as a source of renewable wood products.

d. All water resources with particular emphasis on land adjacent to the Shenandoah River and other perennial streams and the limestone ridge/groundwater recharge area to protect water quantity and quality (Figure 5, Groundwater Recharge Area).

f. Land with environmentally sensitive areas important to air and water quality, plant life, and wildlife.

- COMPREHENSIVE PLAN, Objective 7 – Energy Conservation and Sustainability (pp. II-12-13).

Policy 8. Encourage use of Low Impact Development (LID) techniques that help manage stormwater in an environmentally sensitive manner.

Policy 9. Establish water quality performance standards that include retention of vegetation, minimal site disturbance, and reduction of nutrients and sediment in post-development stormwater.

Policy 10. Coordinate with the Town of Berryville, the Town of Boyce, and the Clarke County School District on joint sustainable community practices such as energy efficiency and alternative transportation.

Policy 11. Encourage the use of cisterns and other water reuse applications in new residential and commercial developments.

- COMPREHENSIVE PLAN, Objective 8 – Village Plans (Millwood, Pine Grove, White Post) (pp. II-13).

Policy 2. Enhance the identity and appearance of established villages, such as Millwood, Pine Grove, and White Post.

- COMPREHENSIVE PLAN, Objective 9 – Designated Growth Areas for Development (pp. II-13-15).

Policy 7. Encourage the use of best management practices as outlined in the Chesapeake Bay Regulations and as determined by federal TMDL program to improve water quality and minimize runoff impacts that could be caused by development of the Berryville Growth Area and at primary highway intersections.