

DRAFT NORTHERN SHENANDOAH VALLEY REGIONAL WATER SUPPLY PLAN

1.0 INTRODUCTION

The Northern Shenandoah Valley regional water supply planning group is comprised of twenty local governments that formed a technical advisory committee (TAC). Participating jurisdictions assigned members to the TAC representing the City of Winchester, five counties of Clarke, Frederick, Page, Shenandoah, and Warren; and the fourteen towns of Berryville, Boyce, Edinburg, Front Royal, Luray, Middletown, Mount Jackson, New market, Shenandoah (town), Stanley, Stephens City, Strasburg, Toms Brook, and Woodstock. The Clarke County Sanitation Authority, Frederick County Sanitation Authority, Stoney Creek Sanitation District and Toms Brook – Maurertown Sanitation District. The twenty jurisdictions participating in the regional Plan signed a resolution before November 2008 for the Northern Shenandoah Valley Regional Commission to prepare the water supply plan on their behalf and submit it to the Virginia Department of Environmental Quality on or before November 2, 2011, per the regulation. The Northern Shenandoah Valley Regional Commission prepared this regional water supply plan with the involvement of all TAC members.

The purpose of the regional water supply plan is to comply with the State Water Control Board regulation 9 VAC 25-780, Local and Regional Water Supply Planning. This plan is designed to facilitate comprehensive assessment of existing water sources and uses, estimation of projected water demand in the northern Shenandoah Valley to 2040, and a determination of water surpluses and or deficits to meet the projected water demands. In addition, this Plan surveys the water conservation steps taken in each jurisdiction, documents drought response actions, and helped develop consideration of alternative water supplies. The goal is to achieve the following:

- ◆ Provide adequate, reliable, and safe water to citizens balancing the need for environmental protection and future growth.
- ◆ Establish a comprehensive and continuous planning process for the wise use of our water resources.
- ◆ Plan for water needs for 30-50 yrs
- ◆ Involve Public in Decision Process
- ◆ Identify Alternative Water Sources
- ◆ Encourage Regional Water Planning

Three years were used to characterize water use and sources: 2002, 2003, and 2008. The TAC determined that the wettest and driest years within the recent decade as well as the most recent year should all be included in this Plan.

The planning region relies on both groundwater from wells and springs and surface water from intakes on rivers.

2.0 EXISTING WATER SUPPLY

2.1 Existing Water Sources

Under the 1974 Safe Water Drinking Act, the Environmental Protection Agency is the Federal agency with responsibility for protecting public water systems. EPA's definition, of public water systems is one that provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year. EPA has defined three types of public water systems:

- **Community Water System (CWS):** A public water system that supplies water to the same population year-round.
- **Non-Transient Non-Community Water System (NTNCWS):** A public water system that regularly supplies water to at least 25 of the same people at least six months per year, but not year-round. Some examples are schools, factories, office buildings, and hospitals which have their own water systems.
- **Transient Non-Community Water System (TNCWS):** A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.

In Virginia, the Virginia Department of Health has primary responsibility for compliance with the Safe Water Drinking Act requirements. Below is a description of CWS for the twenty localities within the northern Shenandoah Valley planning region.

2.1.1 Clarke County

Existing water sources in Clarke County include a public community water system owned and operated by the Clarke County Sanitation Authority and several private community water systems.

Public CWS. The Clarke County Sanitation Authority has a public CWS with water with an intake on Prospect Hill Spring with a permitted capacity of 180,000 gallons per day (gpd). Prospect Hill Spring is under the influence of surface water. The Clarke County Sanitation Authority provides and sells water to citizens located within the Town of Boyce. The Authority maintains three finished water storage tanks with a combined capacity of 275,000 gallons. In addition, there are several private Community systems in the County that use groundwater as a source. The two towns within Clarke County are Berryville and Boyce. The water supply for them is discussed below. There are homes and businesses within Clarke County that are served by individual groundwater wells. A map of the CWS in Clarke County is included in [Map 2.1](#)

Private CWS. Private CWS include Grafton school, serving 123 persons with a groundwater well; the Retreat with six groundwater wells and a maximum permitted capacity of 59,200 gpd; and River Park with a groundwater well and a maximum capacity permitted at 13,600 gpd.

2.1.2 Town of Berryville

The Town of Berryville has a public CWS with an intake on the main stem of the Shenandoah River with a permitted capacity of 864,000 gpd. There are no private CWS within the town.

2.1.3 Town of Boyce

The Town of Boyce has water provided for by the Clarke County Sanitation Authority. Boyce does not own nor bill the distribution system.

2.1.4 Frederick County

Existing water sources in Frederick County include public community water systems owned and operated by the Frederick County Sanitation Authority, as well as privately owned community water systems. Frederick County has two towns: Middletown and Stephens City. In addition to public and private CWS, there are homes and businesses within Frederick County that are served by groundwater wells. These wells vary in quantity throughout the year. A map showing the public CWS in Frederick County is presented on [Map 2.1](#).

Public CWS. Frederick County Sanitation Authority has three groundwater wells (Anderson, Whetzel, and Bartonsville) with water storage in a series of interconnected quarries. Water quantity for the wells is as follows: Anderson well permitted maximum capacity is 547,000 gpd, the Whetzel well permitted max capacity is 936,000 gpd, and the Bartonsville well has a maximum permitted capacity of 509,760 gpd. The authority also purchases up to 2 million gallons a day (MGD) from the City of Winchester. The authority provides water to Stephens City as well as to the Town of Stephens City.

Private CWS. Private CWS in Frederick County on groundwater wells include the four systems of Hilltop Trailer Park (permitted 14 connections at 5,600 gpd), Shawnee Land with four wells serving 155 connections (with a combined permitted capacity of 172,800 gpd), Lake Holiday Estates with seven groundwater wells and a combined permitted capacity of 326,000 gpd, and Tavenner Trailer Court with four groundwater wells with a combined average capacity of 244,800 gpd serving 81 connections.

2.1.5 Town of Middletown

Middletown purchases water from the City of Winchester, but the town owns and operates the water distribution system. There are no private CWS in Middletown.

2.1.6 Town of Stephens City

The Town of Stephens City purchases water from the Frederick County Sanitation Authority. There are no private CWS in Stephens City limits.

2.1.7 Page County

Existing water sources in Page County include public community water systems owned using groundwater wells and springs, as well as privately owned community water systems. Page

County has three towns: Luray, Shenandoah Town, and Stanley. In addition to public and private CWS, there are homes and businesses within Page County that are served by groundwater wells. These wells vary in quantity throughout the year. A map showing the public CWS in Page County is presented on **Map 2.1.**

Public CWS. Some of the Page County residents are served by the Town of Stanley groundwater wells.

Private CWS. Private CWS in Page County on groundwater wells include the Egypt Bend Estates with two wells and a combined maximum permitted capacity of 38,100 gpd, Luray Homes with two wells and a combined permitted capacity of 12,000 gpd, Old Farms Subdivision with two wells and a combined permitted capacity of 3,200, Page Valley Estates on two groundwater wells with a combined permitted capacity of 20,106, and Shenandoah Utility Services on one groundwater well with a permitted capacity of 28,000 gpd.

2.1.8 Town of Luray

The Town of Luray has closed the two springs Hite and Hudson with a combined permitted capacity of 1.224 MGD (Hite at 1.0 + MGD and Hudson 0.224 MGD). Instead the Town of Luray uses two groundwater wells with a permitted combined capacity of ___ gpd. There are no private CWS in Luray.

2.1.9 Town of Shenandoah

The Town of Shenandoah has three groundwater wells that serve the town with a combined permitted design capacity limited by yield for Wells 2 and 3 and pump capacity for Well No. 5; therefore, the source capacity permitted is 0.601 MGD. There are no private CWS within the Town of Shenandoah.

2.1.10 Town of Stanley

The Town of Stanley has six groundwater wells with a combined permitted capacity for the first four of 805,650 gpd. There are no private CWS in Stanley. Part of the Stanley water distribution serves residents outside town limits in the County. Stanley is in the process of a wellhead protection program including fencing and an ordinance.

2.1.11 Shenandoah County

Existing water sources in Shenandoah County include public community water systems owned and operated by the Sanitary District, as well as privately owned community water systems. Shenandoah County has five towns: Edinburg, Mount Jackson, New Market, Strasburg, Toms Brook, and Woodstock. In addition to public and private CWS, there are homes and businesses within Frederick County that are served by groundwater wells. These wells vary in quantity throughout the year. A map showing the public CWS in Shenandoah County is presented on **Map 2.1.**

Public CWS. Shenandoah County has two Sanitary Districts serving the Orkney Springs area and the Town of Toms Brook. The Stoney Creek Sanitary District is comprised of seven groundwater wells with a combined permitted design capacity of 392,800 gpd.

Private CWS. Nine private CWS on groundwater wells exist in Shenandoah County and include Battleground Trailer Park, with a daily capacity limited by storage to 11,200 gpd, Edinburg Extended with two groundwater wells with a combined permitted capacity of 34,000 gpd (max capacity 42,000 gpd), George's Chicken has six wells with a combined permitted capacity of 14.98 MGD (plus purchases water from Woodstock Town), Hollar Subdivision has three wells with a combined permitted capacity of 26,000 gpd (maximum combined design capacity of 259,200 gpd), Lambert's Mobile Villa with two groundwater wells and a permitted capacity of 14,800 (maximum combined capacity design is 119,068), Massanutten View has three wells with an average daily use of 24,000 gpd (maximum combined design capacity is 158,400 gpd), Mountain Waterworks has one well permitted to serve 17 connections (max 6,800 gpd), Ryan's Subdivision has one well serving 17 connections (6,800 gpd max), and Valley View Subdivision has two wells serving 19 connections with an average daily capacity of 5,225 gpd (93.6 gpd maximum design combined capacity).

2.1.12 Town of Edinburg

The Town of Edinburg has two groundwater wells with a maximum design capacity of 432,000 gpd, though the current VDH permit is 240,000 gpd. Edinburg's water supply is limited by its filtration capacity. There are no private CWS in Edinburg. Edinburg Town has a wellhead protection ordinance.

2.1.13 Town of Mount Jackson

The Town of Mount Jackson has five groundwater wells serving the Town with a combined permitted capacity of 699,200. In addition, the Town has recently had two additional wells permitted by VDH that are capped and waiting to be brought into the system. There are no private CWS serving the Town. Mount Jackson has conducted an inventory of potential sources of point source pollution within their wellhead areas.

2.1.14 Town of New Market

New Market Town has six groundwater wells with a maximum designed capacity of 2,923,200 gpd (2.92 MGD). There are no private CWS within New Market. New Market has a wellhead protection overlay area.

2.1.15 Town of Strasburg

The Town of Strasburg has a public CWS based on an intake of surface water on the North Fork of the Shenandoah River. The town was permitted to withdraw 1MGD but their permit was increased to 3 MGD in 2010. There are no private CWS in Strasburg.

2.1.16 Town of Toms Brook

Toms Brook Town has two wells with a Sanitary District with a combined maximum design capacity of 298,080 gpd. There are no private CWS within Toms Brook.

2.1.17 Town of Woodstock

The Town of Woodstock has a public CWS based on an intake of surface water on the North Fork of the Shenandoah River. The town was permitted to withdraw 2.02 MGD. There are no private CWS in Woodstock.

2.1.18 Warren County

Existing water sources in Warren County include privately owned community water systems. Warren County has one town: Front Royal. The town has a public CWS. In addition to public and private CWS, there are homes and businesses within Warren County that are served by groundwater wells. These wells vary in quantity throughout the year. A map showing the public CWS in Warren County is presented on [Map 2.1](#).

Public CWS. Warren County has no public CWS.

Private CWS. Warren County has five private CWS on groundwater wells. These include: Dungadin Subdivision with three wells and a combined permitted capacity of 22,000 gpd (maximum design capacity is limited to 11,520 gpd), Freezeland Manor Subdivision with two wells with a combined permitted 33,600 gpd capacity (storage limited to 20,867 gallons), High Knob with six wells and a combined capacity permitted at 155,520 gpd, Jackson Meadow with two wells and a combined permitted 17,680 gpd capacity, three groundwater wells at Shenandoah River Estates permitted capacity combined of 22,000 gpd, and Shenandoah Shores with five wells and a permitted capacity of 159,600 gpd.

2.1.19 Town of Front Royal

The public CWS serving the Town of Front Royal and some of the surrounding Warren County is based on surface water river intakes. Three river intakes (on Sloan Creek, Happy Creek, and the South Fork of the Shenandoah River) have a combined permitted capacity of 3 MGD. No private CWS are located within Front Royal.

2.1.20 Winchester City

Existing water sources in the City of Winchester include public community water systems owned and operated by the City of Winchester, as well as privately owned community water systems. In addition to public and private CWS, there are businesses within City of Winchester that are served by groundwater wells. These wells vary in quantity throughout the year. A map showing the public CWS in City of Winchester is presented on Map 2.1.

Public CWS. Winchester City has an intake on the North Fork of the Shenandoah River with a design capacity limited by the sedimentation basin of 10 MGD (the pumping capacity is 17 MGD and the source yield is rated 29-35 MGD). In addition, Winchester has a permit to withdraw up to 1 MGD from Fay Spring. Fay Spring requires treatment and is not currently in use.

In addition to residential use averaging 1.55 MGD, the City of Winchester sells water to Middletown and Frederick County averaging a total of 2.11 MGD, other uses include Commercial light use 2.201 MGD, and unaccounted for losses in the City is 1.853 MGD,

Private CWS. Private CWS in Winchester City rely on groundwater wells.

2.2 Amount of Water Available to be Purchased from Outside each Jurisdiction from any Source with the Capacity to Withdraw more than 300,000 Gallons per Month of Surface and Groundwater

The Clarke County Sanitation Authority currently provides water to the Town of Boyce. There is no known contract between the Town of Boyce and CCSA and Boyce owns no water distribution infrastructure. The Frederick County Sanitation Authority currently purchases water from the City of Winchester. It has a contract allowing them to continue purchasing water with no end date with a cap of 2 MGD. The Frederick County Sanitation Authority currently provides water to the Town of Stephens City. There is no known end date for the contract between the Town of Stephens City and the FCSA. The City of Winchester sells water to the Town of Middletown with a cap of 238,000 gpd. The City of Winchester and the Town of Middletown are entering discussions in June 2011 regarding the limit of water to be purchased. There is no end date for the water purchase agreement between FCSA and Winchester. The Stoney Creek Sanitation District in Shenandoah County provides water to the Orkney Springs / Bayse village. The Toms Brook-Maurertown Sanitation District in Shenandoah County serves Toms Brook with water. Toms Brook does not own nor operate any water infrastructure. No sanitation districts contracts have expiration dates.

2.3 Estimate of Agricultural Users of More Than 300,000 Gallons per Month

The water usage records from Virginia Department of Environmental Quality were reviewed but detailed livestock or crop data was not available for agricultural users of groundwater or surface water. The U.S. Department of Agriculture 2002 and 2007 Census of Agriculture for each county in the planning region was reviewed. The Census of Agriculture data provides estimates of crop land in acres and cattle head size. Estimates of agriculture in Counties were based on the 2007 Census Ag data. In general, most agriculture in the counties of the region use surface water stream intakes for irrigation. The agricultural livestock and crop (type and quantity) for each county are presented in the table below. There are no known self-supplied users of more than 300,000 gallons per month of water in the Towns or City.

2.3.1 Clarke County

Self-Supplied agricultural users of water in Clarke County included Dorsey and Moore (0.0794 MGD in 2008), White Post (unreported quantity), and Ivy Hill Farm with 0.0353 MGD. The total agricultural large users of water in Clarke reported use about 0.1147 MGD. According to the Census of Agriculture, the farms in Clarke County cover 67,919 acres with an estimated monthly use of water of 5,365,800 or 0.179 MGD. Total cropland in Clarke County was 32,530 acres in the 2007 Ag census data. Total crop irrigation unreported has not been estimated for any counties since the irrigation of crops varies based on climatological conditions.

2.3.2 Frederick County

Self-Supplied agricultural users of water in Frederick County included Timber Ridge Fruit Farm (no information on water use in 2008), MacDonald Farm 0.003 MGD, and Springwood Farms using 0.04 MGD. The total agricultural large users of water in Frederick reported use about 0.043 MGD. According to the 2007 Census of Agriculture, Frederick County has 98,278 acres in farmland for livestock and approximately 37,900 acres in crops with an estimated monthly water use for livestock of 5,459,040 gallons or 0.182 MGD.

2.3.3 Page County

Self-Supplied agricultural users of water in Page County using over 300,000 gallons per month in 2008 included Noah Turner Landscaping of 0.031 MGD and Happy Valley Greenhouse using a reported 0.001 MGD. Totaling reported farm use of 0.032 MGD. In addition, according to the 2007 Census of Agriculture, Page County farmland covers 64,387 acres. There were about 27,702 acres in crops grown in Page County. Based on the number of farms and types of livestock, it was estimated that 8,264,880 gallons per month are used or 0.2755 MGD.

2.3.4 Shenandoah County

No Self-Supplied agricultural users of water in Shenandoah County using over 300,000 gallons per month in 2008 were reported. According to the 2007 Census of Agriculture, farms in Shenandoah County cover 141,286 acres and 60,247 acres are crops land. Based on the number and type of livestock, an estimated 14,630,760 gallons per month are used on the farm lands collectively, or 0.488 MGD.

2.3.5 Warren County

The Front Royal Fish Cultural Station was the lonely large Self-Supplied agricultural water user reported in 2008 to use over 300,000 gallons per month. According to the 2007 Census of Agriculture, Warren County has 47,635 acres in farmland and 13,354 acres in crops. Based on livestock type and head, an estimated 3,127,680 gallons of water are used monthly to support farms, or 0.104 MGD.

A summary of the 2007 Agricultural Census data is presented below.

AGRICULTURAL SUMMARY in NORTHERN SHENANDOAH VALLEY					
Agricultural Census Data	Clarke County	Frederick County	Page County	Shenandoah County	Warren County
Farms (acres) 2007	67,919	98,278	64,387	141,286	47,635
Farms (acres) 2002	74,279	112,675	64,045	133,032	48,940
Land in irrigated farms (ac) 2007	6,630	8,107	1,698	8,918	502
Farm harvested cropland (ac) 2007	4,241	2,791	916	3,046	96
Other nonpasture cropland (ac) 2007	42	2	(D)	65	-
Pastureland farms irrigated (ac) 2007	1,783	(D)	647	2,270	197
Irrigated Land (ac) 2007	515	299	295	756	58
Total Cropland (acres) 2007					
Total Cropland (acres) 2007	32,530	37,900	27,702	60,247	13,354
Total Cropland (acres) 2002					
Total Cropland (acres) 2002	47,926	59,312	33,178	70,324	23,536
Irrigated harvested cropland (ac) 2007	515	282	(D)	725	43
Irrigated pastureland / other (ac) 2007	-	17	(D)	31	15
Land enrolled in conservation / Reserve (acres) 2007					
Land enrolled in conservation / Reserve (acres) 2007	(D)	707	119	398	27
2002	858	1,187	466	804	167
Top Livestock Inventory (numbers)					
Cattle and Calves 2007 (number)	14,905	15,164	22,958	59,600	13,500
Horses and Ponies (number)	2,891	1,089			
Hog and Pigs (number)		(D)			
Goats (all)		717			
Poultry - Layers (number)	1,533	1,265	248,956		
Broilers Chicken			7,015,010		
Turkeys			902,211		
Pullets			139,000		
Sheep and Lambs (number)	791		600	3,800	
Top Crop (acres)					
Forage-Land used for all Hay, Haylage, Grass Silage, and Greenchop (Ac) 07	16,909	21,776	16,360		
Corn for Grain (ac) 2007	3,115	2,199	2,752		
Corn for Silage (ac) 2007	1,750	1,126	2,728		
Soybeans for beans (ac) 2007	2,030	831	776		
Apples(ac) 2007	590	5,600			
Barley for Grain (Ac)			1,050		

Based on the 2007 Ag Census data, the number of farms and types of livestock were reviewed and an estimated monthly use of water was calculated. The table below presents ag monthly

water use estimated in the region. As stated previously, estimated water use for crops was not calculated because crop irrigation is dependent upon the seasonal water conditions.

AG Water Use				
County	# of Farms	Avg. Size of Farms (Acres)	Livestock	Estimated Monthly Usage (Gallons)
Clarke	496	136	14905	5365800
Frederick	676	145	15164	5459040
Page	530	121	22958	8264880
Shenandoah	1043	135	40641	14630760
Warren	387	123	8688	3127680
Regional Total Monthly water Use				36848160

2.4 Residences and Businesses that are Self-Supplied and Individual Wells Withdrawing Less than 300,000 Gallons per Month

Estimation of the residences and businesses that are self-supplied and served by individual groundwater wells withdrawing less than 300,000 gpm (gallons per month), is calculated by subtracting the public and private community water systems from the locality population. Populations served by the public community water systems was provided by each jurisdiction based on 2008 data. Populations served by the private community water systems was estimated from the number of connections multiplied by estimated community household for that locality. The County population served by individual wells has town populations and private water systems subtracted.

Locality	2008 Total Population	Minus Town Population	Population Served by Public CWS	Estimated Population served by Private CWS (est 125 gpd)	Estimated Remaining Population Served by Individual Wells	Estimated Water Use on Wells (75 pg)
Clarke County	13,758	9,261		705	8,556	641,700
Town of Berryville	3,941	0	3,941			
Town of Boyce	556	0	556			
Frederick County	74,786	71,851		5993	65,858	4,939,350
Town of Middletown	1,199	0	1,199			
Town of Stephens City	1,736	0	1,736			
Page County	23,869	15,321		811	13,810	1,035,750
Town of Luray	4,953	0	4,953			
Town of Shenandoah	2,104	0	2,104			
Town of Stanley	1,491	0	2,500			
Est Page County Served by Stanley CWS			700			
Shenandoah County	40,609	21,656		1,357	20,299	1,522,425
Town of Edinburg	1,001	0	1,001			
Town of Mount Jackson	2,290	0	2,290			

Town of New Market	2,477	0	2,477			
Town of Strasburg	7,096	0	7,096			
Town of Toms Brook	251	0	251			
Town of Woodstock	5,838	0	5,838			
Warren County	36,377	22,107		3,097	19,010	1,425,750
Town of Front Royal	14,270	0	14,270	0		
City of Winchester	25,679	0		0		

George's Chicken uses 14,980,000 gpd

2.5 Wellhead Protection Ordinance / Sourcewater Protection Programs

The County of Clarke has a wellhead protection program in place. Frederick County has an ordinance to protect the quarries storing the groundwater from being accessed by the general public. In addition FCSA has a fence surrounding the quarries to limit accessibility. In Page County, the Town of Stanley is developing an ordinance to protect wellhead areas. In Shenandoah County, the Towns of New Market and Edinburg have wellhead protection programs in place.

3.0 EXISTING WATER USE INFORMATION

3.1 Community water Systems

The populations for each jurisdiction in the Northern Shenandoah Valley region was available by U.S. Census for 200 and 2010 and is presented on the table below. In addition, the estimated populations for the years reported in this water supply plan include 2002, 2003 and 2008. Estimates for the Town populations during 2002, 2003, and 208 were calculated by a straight line derivation from 200 and 2010 Census data.

Population

Population			Estimated Population*		
Locality	Census 2000	Census 2010	Est 02	Est 03	Est 08
Clarke County	12,652	14,034	12,928	13,067	13,758
Berryville Town	2,963	4,185	3,207	3,329	3,941
Boyce Town	426	589	442	459	556
Frederick County	59,209	78,305	63,028	64,938	74,486
Middletown Ton	953	1,261	1,015	1,045	1,199
Stephens City Town	1,380	1,825	1,469	1,514	1,736
Page County	23,177	24,042	23,350	23,437	23,869
Luray Town	4,871	4,974	4,891	4,902	4,953
Shenandoah Town	1,878	2,161	1,935	1,963	2,104
Stanley Town	1,326	1,532	1,367	1,388	1,491
Shenandoah County	35,075	41,993	36,459	37,150	40,609
Edinburg Town	807	1,050	856	880	1,001
Mount Jackson Town	1,978	2,368	2,056	2,095	2,290
New Market Town	2,105	2,570	2,198	2,245	2,477
Strasburg Town	4,840	7,660	5,404	5,686	7,096
Toms Brook Town	246	252	247	247	251
Woodstock Town	4,798	6,097	5,058	5,188	5,838
Warren County	31,584	37,575	32,782	33,381	36,377
Front Royal Town	13,589	14,440	13,759	13,844	14,270
Winchester City	23,585	26,203	24,109	24,370	25,679

Note* Estimated Population calculated from (Census 2010 - Census 2000)/10 = annual increase

The residential population of each jurisdiction is provided by community water systems or self supplied wells.

3.2 Community Water Systems Use

See the Spreadsheets Sections 70 and 80 for a summary of public and private water use. In addition, the spreadsheet contains an estimated monthly water demand disaggregated into categories for use including residential commercial, heavy industrial, military, production process water, unaccounted-for water losses, sales and other. These are presented for each jurisdiction on the spreadsheets.

3.3 Estimate of Water Used by Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Inside the Service Areas of the Community Water System

Surface Water Intake Water Users

In Clarke County there is Federal Emergency Management Agency (FEMA) with an average daily use in 2008 of 0.715 MGD. FEMA uses water from an intake on the Shenandoah River. In Frederick County there were three self supplied nonagricultural users of water including the Winchester Golf Club (Golf pond water of 0.0896 MGD); Carpers valley Golf Course and Gore plant had no water usage in 2008. Page County has one self supplied nonagricultural water user the Luray Caverns Country Club using an average daily 0.0405 MGD of stream water from the South Fork of the Shenandoah River. In Shenandoah County there are three self supplied nonagricultural water users: Bryce Resort (with surface water intake on Stoney Creek of 0.2222 MGD for creating snow and golf course), Shenvalee Lodge Inc with a Smith Creek intake of 0.045 MGD, and the Strasburg Plant (O-N Minerals Company) with groundwater in Shenandoah Quarry with an average daily use of 0.0009 MGD. The Riverton Plant has an intake on the Shenandoah River in Warren County, but did not report any water use in 2008. In the City of Winchester the WINCHESTER PLANT (Federal Mogul Friction Product) is a self supplied nonagricultural user but had no water use reported in 2008.

Groundwater Users

Berryville Graphics is the one nonagricultural self supplied groundwater user in Clarke County using 0.0028 MGD. In Frederick County the groundwater self supplied nonag users include Valley Protein (0.1434 MGD) and Gore Plant (0.015 MGD). In Shenandoah County the nonagricultural self supplied users of groundwater include George Chicken (33 MGD), Shrine Mont (0.26), Valley milk Products, Strasburg Plant, Bowman's Apple, and Howell Metal. The total MGD for these surface water self supplied nonagricultural users is 336249.96 MGD. In Warren County the groundwater include the Bowling Green Club (0.05 MGD) and Shenandoah

Valley Golf Club (0.0332 MGD). In the City of Winchester the Federal Mogul Plant using 0.39 MGD.

3.4 Estimate of Water Used by Self-Supplied Nonagricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Outside the Service Areas of the Community Water System

None reported.

3.5 Estimate of Water Used by Self-Supplied Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Inside the Service Areas of the Community Water System

The breakdowns are calculated by County only from the Ag Census data. Estimates of water use for cattle (beef) & calves 12 gpd, milk cows 35 gpd, pigs 5 gpd, sheep 2 gpd, poultry layers and broilers 0.06, horses consume 12 gpd, goats 0. For crops use the following estimates: soybean 25 in/acre, veggies 15 inches/acre, and unknown 20 in/acre.

3.6 Estimate of Water Used by Self-Supplied Agricultural Users of More than 300,000 Gallons per Month of Surface and Groundwater Outside the Service Areas of the Community Water System

None reported.

3.7 Estimate of Water Used by Self-Supplied Users of Less than 300,000 Gallons per Month of Surface and Groundwater Inside the Service Areas of the Community Water System

Estimates of those on wells per County was based on 2008 population minus those served by public and private CWS = estimated number on wells. Estimate the annual average water use per capita based on 75 GPD.

Estimation of the residences and businesses that are self-supplied and served by individual groundwater wells withdrawing less than 300,000 gpm (gallons per month), is calculated by subtracting the public and private community water systems from the locality population. Populations served by the public community water systems was provided by each jurisdiction based on 2008 data. Populations served by the private community water systems was estimated from the number of connections multiplied by estimated community household for that locality. The County population served by individual wells has town populations and private water systems subtracted.

Locality	2008 Total Population	Minus Town Population	Population Served by Public CWS	Estimated Population served by Private CWS (est 125 gpd)	Estimated Remaining Population Served by Individual Wells	Estimated Water Use on Wells (75 pg)
Clarke County	13,758	9,261		705	8,556	641,700
Town of Berryville	3,941	0	3,941			
Town of Boyce	556	0	556			
Frederick County	74,786	71,851		5993	65,858	4,939,350
Town of Middletown	1,199	0	1,199			
Town of Stephens City	1,736	0	1,736			
Page County	23,869	15,321		811	13,810	1,035,750
Town of Luray	4,953	0	4,953			
Town of Shenandoah	2,104	0	2,104			
Town of Stanley	1,491	0	2,500			
Est Page County Served by Stanley CWS			700			
Shenandoah County	40,609	21,656		1,357	20,299	1,522,425
Town of Edinburg	1,001	0	1,001			
Town of Mount Jackson	2,290	0	2,290			
Town of New Market	2,477	0	2,477			
Town of Strasburg	7,096	0	7,096			
Town of Toms Brook	251	0	251			
Town of Woodstock	5,838	0	5,838			
Warren County	36,377	22,107		3,097	19,010	1,425,750
Town of Front Royal	14,270	0	14,270	0		
City of Winchester	25,679	0		0		

George's Chicken uses 14,980,000 gpd

4.0 EXISTING RESOURCE INFORMATION

This a section of the Northern Shenandoah Valley Regional Water Supply Plan, is prepared in accordance with Title 9: Environment, of the State Water Control Board’s final regulation for Water Supply Planning 9 VAC 25-780-10 through 9 VAC 25-780-190, under Statutory Authority: Sections 62.1-44.15 and 62.1-44.38:1 of the Code of Virginia. A combination of ground water, springs, and surface water supply potable water to the planning area.

4.1 General Environmental Setting

Geology and Hydrology:

The Shenandoah Valley is a 160 mile-long valley located in the northwestern portion of Virginia. The Shenandoah Valley is part of the Great Valley within the Appalachian Mountain chain. The Appalachian Mountains stretch from Georgia to Maine, the Great Valley lies in Pennsylvania to Alabama. The headwaters for the Shenandoah River are in Augusta and Rockingham Counties. The Shenandoah Valley is about 160 miles long, lies in a north-south direction, and is bounded between the Blue Ridge Mountains on the east and the Allegheny Mountains on the west. Water runoff has carved the mountains' distinctive alternating pattern of ridges and valleys. The soils include karst and non-karst features.

The Shenandoah River, which runs through the valley, flows north and is a tributary to the Potomac River that drains into the Chesapeake Bay, and ultimately Atlantic Ocean. A soft limestone layer forms much of the base of the Shenandoah Valley. The Shenandoah River carved out the Shenandoah Valley, dissolving the limestone and carrying the sediments north to the Potomac.

Meteorology:

While most of the Commonwealth receives an annual precipitation of 40 inches a year, the Shenandoah Valley receives an average of about 33-36 inches a year. The Blue Ridge Mountains on the eastern side of the Valley averaged 46-58 inches ([Climatesource.com](http://climatesource.com)). Precipitation averaged more than 52 inches with a maximum area above 64 inches on the western sides and peaks of the Appalachian and Allegheny Mountains in West Virginia.

The weather in the Shenandoah Valley is influenced by the surrounding mountains. When air hits the mountains, moving in with a front, the air rises, cools, and precipitation falls on the mountain peak. For example, when a low front forms along the coast or piedmont, it hits the Blue Ridge Mountains, located east of the Valley. The Blue Ridge blocks the clouds from dropping precipitation in the Valley, and cause the precipitation to fall out east of the mountains, or along the peak. The same phenomenon occurs to the west of the Shenandoah

Valley. In the winter, cold-fronts and Alberta Clippers dump heavy snowfalls on the western slope of the Appalachian and Allegheny ranges in West Virginia, leaving the Valley dry. Even in the warmer weather, the mountains to the west of the Valley are more likely to receive precipitation from a storm front moving west to east. This is known as an orographic effect of the mountain ranges and is visible even in cloud formations.

The high relief of the Appalachian and Blue Ridge mountain systems also influences the rainfall pattern. As moist air flows from the east, it rises, condenses, and precipitates. As the air flows down over the western slopes, however, little rain falls and a rain shadow results. When the air flow is from the west, the Shenandoah River valley is in the rain shadow of the Appalachian Mountains; when the airflow is from the east, it is in the shadow of the Blue Ridge Mountains. As a result, the Shenandoah River valley (and New River Valley) is the driest portion of Virginia, and one of the driest east of the Mississippi.

Tall cumulus clouds typically appear across the mountain tops, while the sky in the Valley remains cloud-free. In addition, the 160 mile long Valley forms a funnel, moving air rapidly across the Valley. In general, the temperature on the mountains flanking the Valley is usually 10-15 degrees cooler than the Valley. Temperatures within the Valley vary little from year to year. Summer averaging 76 degrees in temperature, though rarely reaching 100 degrees. Winter has temperatures in the mid 30s. The average six month growing season is fed by 33-39 inches of precipitation each year.

Rainfall is drained out of the Valley through a series of tributaries and streams that flow into the Shenandoah River, flowing northward to the Potomac River. According to P. Jerry Stenger, UVA Climatologist, the following data was collected during 1971 to 2000 in Berryville, Woodstock, Luray, and Frederick County weather stations. The average annual precipitation in our area is 38.27 inches, the maximum average annual temperature is 65.48 degrees Fahrenheit (F) and minimum temperature average is 41.66 F. The season temperature variation ranges from annual averages for winter max/min is summarized in Table 1 below.

TABLE 4.1: Seasonal Regional Average Climatic Norms

Regional Average Climatic Normals (1971–2000) by Season

	Winter	Spring	Summer	Fall	Annual
Total Precipitation (Inches)	7.80	10.03	10.74	10.01	38.58
Average Daily Maximum Temperature (°F)	44.5	65.0	84.8	67.6	65.5
Average Daily Minimum Temperature (°F)	23.3	40.0	60.5	42.7	41.7

Average Daily Mean Temperature (°F) 33.9 52.5 72.7 55.2 53.6

Table 4.2 presents data locally for each weather station from 1971 to 2000.

4.2: Local Climate Facts

Station Climatic Normals (1971–2000) By Month			
Total Precipitation (Inches)			
Station Name	County	Elev. (Ft.)	Annual
BERRYVILLE	Clarke	600	38.27
LURAY 5 E	Page	1400	41.61
WINCHESTER 7 SE	Frederick	680	39.10
WINCHESTER WINC	Frederick	720	36.40
WOODSTOCK 2 NE	Shenandoah	680	37.52
			38.58
Average Daily Maximum Temperature (°F)			
Station Name	County	Elev. (Ft.)	Annual
BERRYVILLE	Clarke	600	64.5
LURAY 5 E	Page	1400	68.7
WINCHESTER 7 SE	Frederick	680	63.2
WINCHESTER WINC	Frederick	720	65.2
WOODSTOCK 2 NE	Shenandoah	680	65.8
			65.48
Average Daily Minimum Temperature (°F)			
Station Name	County	Elev. (Ft.)	Annual
BERRYVILLE	Clarke	600	42.2
LURAY 5 E	Page	1400	41.0
WINCHESTER 7 SE	Frederick	680	43.6
WINCHESTER WINC	Frederick	720	40.8
WOODSTOCK 2 NE	Shenandoah	680	40.7
			41.66

The climate of the Shenandoah Valley, particularly regarding precipitation, is strongly influenced by the surrounding mountains. When moist air flows toward Virginia from areas to the west

and northwest, it encounters the high relief of the Allegheny Mountain system to the west of the Shenandoah Valley. As that air is forced to rise over the mountains (known as orographic lifting), it cools, moisture condenses out and the bulk of the precipitation falls on the western slopes of the Alleghenies. This leaves comparatively drier air to descend into the Valley and produce less precipitation.

Likewise, when moist air from the nearby Atlantic Ocean flows across Virginia from the east, it encounters the Blue Ridge Mountains to the east of the Shenandoah Valley. The same orographic lifting usually results in lower precipitation amounts in the Valley. This double “rain shadow” effect puts the Shenandoah Valley in the driest portion of Virginia and makes it one of the driest locations in the eastern U.S.

Typical annual precipitation amounts for nearby stations on the east-facing slopes of the Blue Ridge Mountains run about ten inches higher than the Shenandoah Valley (around 48 inches as opposed to 38 inches). Statewide average annual precipitation is around 44 inches.

The general mechanisms for precipitation change throughout the course of the year. Larger-scale mid-latitude cyclones and associated frontal passages predominate the colder months and smaller-scale thunderstorm activity usually providing most of the rainfall in the warmer months. The Shenandoah Valley, along with the rest of Virginia, experiences no distinct “dry” or “wet” seasons with respect to precipitation. Nonetheless, the normally high rates of evapotranspiration in the summer months usually lead to an overall loss of moisture, while the colder months allow for the replenishment of deep soil and groundwater reserves.

In addition, the varied height and orientation of the flanking mountains can create large differences in precipitation amounts at smaller scales. This is especially true during the summer months, when the primary source of rainfall in Virginia is the thunderstorm.

The predominant flow of surface winds is generally in up and down the roughly 160-mile length of the Valley (northeasterly and southeasterly directional categories). Diurnal heating and cooling also gives rise to a “mountain and valley” breezes component, which circulates air from higher surrounding elevations to the Valley floor and up again. Summer average temperatures in the Valley are in the mid-70’s (°F) and rarely reach the 100° mark, while winter temperatures average in the mid-30’s. The freeze-free growing season averages about six months, from mid-April to Mid-October, though local microclimates and elevational differences can bring considerable variation.

4.1.1 Detailed Resource Characteristics

A description of existing environmental conditions is included that may possibly affect in-stream and ground water uses as well those conditions that may potentially impact the quality and or quantity of supply sources currently serving the planning area.

4.2 State or Federal Listed Threatened or Endangered Species or Habitats of Concern

Two state agencies are responsible for listing the threatened and endangered species: the Virginia Department of Conservation and Recreation (DCR) maintains the plants and insects in the region and Virginia Department of Game and Inland Fisheries (VDGIF) maintains the animals listed. The U.S. Department of Agriculture and U.S. Fish & Wildlife Service identify federally protected species which are also on the state lists. Appendix [redacted] has the entire list of aquatic species or those associated with riverine ecosystems found to inhabit identified from VDGIF to occur within the region.

The Tiers are defined as:

Tier	Degree of Conservation Need	Description
1	Critical Conservation Need	Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, facing immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed.
2	Very High Conservation Need	Has a high risk of extinction or extirpation. Populations of these species are at very low levels, facing real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.
3	High Conservation Need	Extinction or extirpation is possible. Populations of these species are in decline or have declined to low levels or are in a restricted range. Management action is needed to stabilize or increase populations.
4	Moderate Conservation Need	The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a significant declining trend or one is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

According to the code of Virginia...."Special concern" means any species, on a list maintained by the VDGIF director, which is restricted in distribution, uncommon, ecologically specialized or threatened by other imminent factors.

4.3 Anadromous, Trout and Other Significant Fisheries

There are no anadromous fish present within the planning region; however, the migratory catadromous American eel is present. Game fish occur abundantly throughout the South Fork, North Fork, and Mainstem of the Shenandoah River and many of their tributaries. The following game fish are actively sought through sport fishing during the seasons spring through fall: Rock bass, Smallmouth bass, Largemouth bass, Green sunfish, Bluegill sunfish, Redbreast sunfish, and Pumpkinseed. In addition, trout are native and others are stocked in the Mainstem, North Fork, and South Fork of the Shenandoah River. Rainbow trout occurs in the Mainstem, North Fork,

and South Forks of the Shenandoah River. The South Fork and North also have Brook trout and Brown trout. The Fisheries Division of VDGIF has identified all of the reaches in this region as wild (Class I-IV) or stockable (Class V and VI) trout streams or as tributaries to wild trout streams. Local canoe and camping shops advertise periodic trout fishing events. Annual fly fishing tournaments hosted in Page, Shenandoah and Warren Counties on tributaries to the Shenandoah draw local and visiting sportsman.

The predominant fishes within the South Fork, North Fork, and Mainstem of the Shenandoah River identified by the Virginia Polytechnic and State University are listed below:

(<http://www.cnr.vt.edu/PLT/potomacshenandoah/aquaticinsects/fishoftheshenandoahriver.htm>)

Mainstem of the Shenandoah River:

American eel
Banded killifish
Margined madtom
Channel catfish
Yellow Bullhead
Brown Bullhead
Rainbow Trout
Common Carp
Central Stoneroller
Cutlips Minnow
Bluntnose minnow
Pearl dace
Longnose dace
Blacknose dace
Bluehead chub
Creekchub
River chub
Fallfish
Spotfin shiner
Common shiner
Rosyface shiner
Comely shiner
Spottail shiner
Swallowtail shiner
Northern hogsucker
Shorthead redhorse
Mottled sculpin
Fantail darter
Tessellated darter
Rock bass
Smallmouth bass
Largemouth bass

Green sunfish
Bluegill sunfish
Redbreast sunfish
Pumpkinseed

- **South Fork of the Shenandoah River:** All species present in the Mainstem of the Shenandoah River (listed above) plus Brook trout, Brown trout, Satinfish shiner, and White sucker.
- **North Fork of the Shenandoah River:** All species present in the Mainstem of the Shenandoah River (listed above) plus Brook trout, Brown trout, Satinfish shiner, White sucker, Fathead minnow, and Greenside darter.

4.4 State Scenic River segments and Significant Recreational Rivers

Throughout the Shenandoah watershed, opportunities are ubiquitous for canoeing, kayaking, and whitewater rafting through rentals, guided tours, and general recreation.

The Virginia Department of Conservation and Recreation (DCR) administers the Wild and Scenic River Program. In June 2009 the DCR issued a list of 24 scenic river designations in Virginia. One reach of the Shenandoah River in the planning area is legislatively designated as a Virginia Scenic River. The Shenandoah River 21.6 mile section from the Warren/Clarke County line to the state border between West Virginia and Virginia State is designated as scenic under legislation 21.6 §10.1-417. This section of the river was originally designated in 1979, and extended in 1992. The DCR has identified two river segments in our planning region as “Desirable components: evaluated and found worthy of designation” as a Scenic River in Virginia (http://www.dcr.virginia.gov/recreational_planning/documents/srmap.pdf). These two segments include the North Fork in Shenandoah County from Burnshire Bridge (Route 758) to the town of Strasburg and in Page /Warren Counties the segment of the South Fork of the Shenandoah River from Goodes Mill to Overall. Five segments of the Shenandoah River located in the planning region were determined by DCR to contain “Potential Components: Identified as being worthy of future study” for consideration as a scenic river. These potentially suitable scenic segments include: North Fork of the Shenandoah River from New Market to Burnshire Bridge; Cedar Creek headwaters to its confluence with the North Fork; North Fork Shenandoah River from its confluence with Cedar Creek to the town of Front Royal; South Fork of the Shenandoah River from Port Republic (upstream of the planning region) to Goodes Mill; and South Fork Shenandoah from Overall to the town of Front Royal.

In order for a river be declared a National Wild and Scenic River, it takes an act of Congress. There are no river segments in the planning area designated as Nationally Wild and Scenic.

Historic and Archaeological Resources

Huntsberry Farm Project (Shenandoah Valley Battlefields Foundation) is the largest historical site within the planning region. Smaller archeologically and historically significant areas and districts are within the Towns and the City of Winchester. A complete listing of archeologically and historically significant areas is appended.

Geologic Formations

The area of the Shenandoah Valley was once under the ocean over 450 million years ago. The bones of the fish and shells, rich in calcium, settled to the bottom of the ocean. Over time, these calcium-rich deposits formed rocks under the pressure of the water above creating dolomite and limestone sedimentary layers. Eventually the ocean receded and the mountains were thrust up, approximately 300 million years ago. The mountains eroded from water and weather and the streams drained into what is known as the Shenandoah River, carving the valley. The resultant soils and rock formations on the Valley floor and along mountain sides contain much of the limestone and dolomite. As water from runoff and precipitation contacts the limestone and dolomite, a chemical reaction occurs and the rock dissolves, creating a karst landscape. Karst is a landform feature created from the dissolved rocks that can take the form of caves, caverns, sinkholes, seeps, springs, and ponures. These karst features are ubiquitous throughout the planning area. Karst landscapes have a direct and rapid interconnection with the surface. Land use activities in karst areas have immediate impacts on water quality.

Another unique feature of the Valley is the fertile, well draining soils. The area is ranked high in the state for agriculture. The fertile Valley soils make Shenandoah Valley the “breadbasket” of Virginia.

It is important to note that a section of Clarke County has a sole source aquifer designation. The Environmental Protection Agency (EPA) defines a sole or principal source aquifer as one which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water. For convenience, all designated sole or principal source aquifers are usually referred to simply as “sole source aquifers.”

4.5 Wetlands

Palustrine forested, scrub-shrub, and emergent wetlands constitute the wetland types within the planning area. The U.S. Fish & Wildlife Service’s Wetland Inventory Map and areas was evaluated as a layer to characterize the wetlands in the region; however, it was determined to be an underestimate. Wetlands are vital for sustaining populations of fish and wildlife in the United States. They provide habitat for approximately one-third of federally-listed plants and animals, and nesting, migratory and wintering areas for more than 50 percent of the Nation's migratory bird species. Wetlands play an important role in water quality improvement by nutrient removal. Wetland plants filter and trap sediments, thereby improving water quality. Wetlands also have an important role in improving water quantity, such as flood control.

Groundwater fed streams in the area are replenished and a wall of floodwater can be soaked up by wetland ecosystems if present along riverbeds.

4.6 Riparian Buffers and Conservation Easements

Land protected either as a buffer or in an easement preserves habitats of ecosystems, provides connectivity of migratory ways, affords open space, provides alternative livestock management, improves water quality, and offers economic savings.

The Virginia Department of Forestry has some riparian buffers located within the planning area (see <http://www.dof.virginia.gov/regCentral/she-wq-rfb.shtml>). In addition, the Natural Resources Conservation Service (NRCS) Soil and Water Conservation District (SWCD), has worked with localities to plant vegetated buffers through the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program, and the state's cost-share program to increase riparian corridors.

A conservation easement is a legal agreement between a landowner and a government agency or non-profit conservation organization that places permanent limits on the future development of the property in order to protect the land. While often donated by landowners, the County then has the opportunity through state grant funding, to purchase one or more conservation easements from local landowners. Landowners who establish a conservation easement permanently protect their land while retaining ownership and enjoyment of the property. Landowners do not have to grant public access to conserved properties, and most conserved properties are actively used for farming or as forestland. The establishment of conservation easements through the DCR, state conservation board / agency, or a local land trust such as the Virginia Department of Forestry, Virginia Outdoor Foundation, Virginia Land Conservation Foundation Valley Conservation Council, Potomac Conservancy, or Chesapeake Bay Foundation assist in acquiring easements for localities and private landowners. Land owners can elect to place an easement on riparian areas without any incentive except for a federal income tax deduction and local tax incentives. The land trust agency holds the easement.

Land protected either as a buffer or in an easement preserves habitats of ecosystems, provides connectivity for migrations, affords open space, and improves water quality. Estimates of preserved land, by acres, for each county within the planning area are presented below.

- Clarke County - 3068 acres
- Frederick County - over 5,469 acres
- Page County - 1,230 acres
- Shenandoah County - 1,625 acres

- Warren County - over 5,034 acres

4.7 Land Use and Land cover

The Shenandoah River drains 1,957,690 acres of land. The watershed can be broken down into several land-uses. Forest and agricultural lands make-up roughly 1,800,000 acres of watershed. The maximum elevation within the watershed is 3,350 feet mean sea level. The minimum elevation is 300 feet mean sea level and occurs at the confluence with the Potomac River. The Shenandoah River basin is composed of three sub basins (8-digit United States Geologic Survey (USGS) Hydrologic Unit Codes (HUC)). The three sub basins are the South Fork of the Shenandoah River (HUC 02070005), North Fork of the Shenandoah River (HUC 02070006), and the Shenandoah River (HUC 02070007).

The data for this section is presented in the table below.

Locality	Sq. miles	Acres
Frederick County	414.6	265,360.7
Winchester City	9.3	5,974.0
Clarke County	176.6	113,034.5
Warren County	213.7	136,766.7
Shenandoah County	512.2	327,811.1
Page County	311.1	199,120.0
Total NSVRC:	1,637.6	1,048,067.2
Fed/State land	250	160,000
Clarke County Land use:		
Developed	12.95	8288
Crop	36.6	23424
Edge	10.1	6464
Managed Natural	3.66	2342.4
Pasture	51	32640
Wooded	61.6	39424
Frederick County Land use:		
Business	5.746828125	3677.97
Historic	2.871	1837.44
Industrial	10.53251563	6740.81
Institutional	0.437125	279.76
Mixed-Use	1.164828125	745.49
Mobile Home Community	0.145109375	92.87

Mixed-Use Agricultural	0.08215625	52.58
Mixed-Use Commercial/Office	0.167484375	107.19
Mixed-Use Industrial	0.2559375	163.8
Neighborhood	0.182625	116.88
Natural Resources & Recreation	2.063546875	1320.67
Open Space	0.030109375	19.27
Planned Unit Development	3.028828125	1938.45
Recreation	0.649078125	415.41
Residential	14.55532813	9315.41
Urban Center	0.758265625	485.29
Agricultural	371.9546875	238051
Winchester Land use:		
High Residential	0.584	373.76
Medium Residential	1.4	896
Low Residential	1.5	960
Heavy Industrial	0.12	76.8
Light Industrial	1.1	704
Major Commercial	1.14	729.6
Major Institutional	0.49	313.6
Park/Open	0.62	396.8
Public	0.33	211.2
Residential/Office	0.15	96
Special Mix-Use	0.114	72.96
Page Land use:		
Primary Community	3.2166875	2,058.68
Secondary Community	8.728421875	5,586.19
Towns	8.4725625	5,422.44
Agricultural	144.1859375	92,279
Environmental Protection	111.8625	71,592
Shenandoah Land use:		
Agriculture	149.76	95846.4
Commercial	1.3	832
High-Density Residential	0.438	280.32
Industrial	1.91	1222.4
Low-Density Residential	61.42	39308.8
Public	1.92	1228.8
Town	12.73	8147.2
Transportation	3.06	1958.4
Vacant	1.79	1145.6

Water	2.18	1395.2
Woodland	161.08	103091.2
Warren County Land use:		
Agriculture	193.49	123833.6
Commercial	0.569	364.16
Industrial	1.5	960
Residential	20.58	13171.2

4.8 Impaired Streams

Two legacy contaminants are in the Shenandoah River: mercury and PCBs. This background section summarizes the history of how mercury and PCBs were introduced into the river. A listing of all TMDL stream segments follows.

History:

PCB Contamination:

Polychlorinated biphenols (PCBs) are one of two legacy contaminants threatening the quality of the Shenandoah River. PCBs consist of 209 chemical compounds (congeners) that were sold under various trade names. PCBs accumulate in the fatty tissue and are considered highly toxic probable carcinogens. PCBs were outlawed in the 1970s in the U.S.

Avtex Fibers rayon plant (manufacturing site on 440-acres in Front Royal), was a source of leaking PCBs into the Shenandoah River. After manufacturing rayon, polyester, and polypropylene fibers for commercial, defense, and space industries for more than 45 years, Avtex Fibers (and previous owners) closed in 1989. In June 1986, Avtex was designated a Superfund site on U.S. EPA's National Priorities List. Per EPA's fact sheet:

The contamination discovered at the Avtex Fibers site was of such magnitude and complexity that the area has been the subject of a number of removal, enforcement, and long-term cleanup actions. Tons of rayon manufacturing wastes and by-products, zinc hydroxide sludge, and fly ash and boiler room solids were disposed of on site in 23 impoundments and fill areas encompassing 220 acres. Waste disposal practices at the plant contaminated the groundwater under the site and in residential wells across the river from the site. The principle contaminants found in the groundwater were carbon disulfide, ammonia, arsenic, antimony, phenol and high pH. Arsenic, lead, and PCBs have been found in soils. PCBs associated with the plant were detected in the Shenandoah River. When the plant closed in 1989, the community was left to contend with severely contaminated land and water.

Currently, the former Avtex site has undergone extensive remediation; however, the legacy of PCBs remains as a contaminant in the river. Avtex site was one of ten sites selected by EPA as a pilot Superfund Redevelopment Initiative with the goal of returning the site to productive use.

In 1989, Virginia issued a “do not eat” advisory for all species of fish in the Shenandoah River and portions of the North and South Forks of the Shenandoah. Because of this fish consumption advisory, the Shenandoah River was listed on both Virginia’s and West Virginia’s 1998 Section 303(d) lists of TMDL streams. The river is listed for other impairments as well. Two segments of the Shenandoah River measuring approximately 42 stream miles in length were listed on Virginia’s Section 303(d) list. The first segment, the North Fork of the Shenandoah River running from Passage Creek to its influence with the South Fork of the Shenandoah River, measures 5.33 miles in length. The second segment, composed of the South Fork of the Shenandoah River and the Main Stem of the Shenandoah River, measures 36.45 miles in length. A third segment of the Shenandoah River was listed on West Virginia’s 1998 Section 303 (d) list.

Mercury Contamination:

In addition to PCBs, the second legacy contaminant threatening water quality is mercury. From 1929 to 1950, a DuPont textile plant, located in the headwaters of the South Fork in Waynesboro, discharged mercury waste into the South River. Mercury subsequently contaminated the South Fork of the Shenandoah River, the Shenandoah River, and the floodplains along the three rivers. A 2009 USGS study of mercury contamination revealed that 96 percent of the mercury loads to the South River come from soil contaminated by this textile plant, are continuing to contaminate several Shenandoah Valley rivers at a rate of “about 416 pounds of mercury / year” into the South River (USGS, Eggleston, 2009).

TMDL Stream Segments:

South Fork Shenandoah River

Location: South Fork Shenandoah River from its confluence with North and South Rivers downstream to its confluence with Hawksbill Creek. (Start Mile: 100.97 End Mile: 41.98

Total Impaired Size: 58.99 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Impairment = Benthics on South Fork Shenandoah River from its confluence with North and South Rivers downstream to its confluence with Hawksbill Creek. (Start Mile: 100.97 End Mile: 41.98 Total Impaired Size: 58.99 Miles)

Naked Creek (In process of getting delisted due to natural causes of impairment, mountainside sloughing)

Location: Naked Creek including the East Branch from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 12.44 End Mile: 0.00 Total Impaired Size: 12.44 Miles)

City / County in Planning Area: Page Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Cub Run

Location: Cub Run originating on the east side of the Massanutten Mountain from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 9.62 End Mile: 0.00 Total Impaired Size: 9.62 Miles)

City / County in Planning Area: Page Co

Impairment = Escherichia coli

Line Run

Location: Line Run from the headwaters downstream to its confluence with Honey Run. (Start Mile: 3.9 End Mile: 0.00 Total Impaired Size: 3.9 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Honey Run

Location: Honey Run from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 4.53 End Mile: 0.00 Total Impaired Size: 4.53 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Mill Creek

Location: Mill Creek from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 6.74 End Mile: 0.00 Total Impaired Size: 6.74 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Big Run

Location: Big Run from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 5.4 End Mile: 0.00 Total Impaired Size: 5.4 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Lake Arrowhead (No TMDL – due to natural conditions of lake stratification)

Location: Lake Arrowhead (Total Impaired Size: 36.07 Acres)

City / County in Planning Area: Page Co.

Impairment = Oxygen, Dissolved

Pass Run

Location: Pass Run from the headwaters downstream to its confluence with Hawksbill Creek. (Start Mile: 9.07 End Mile: 0.00 Total Impaired Size: 9.07 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

Hawksbill Creek

Location: Hawksbill Creek from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 19.23 End Mile: 0.00 Total Impaired Size: 19.23 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli

12 miles – temperature impairment

East Hawksbill Creek

Location: East Hawksbill Creek from the headwaters downstream to its confluence with Hawksbill Creek. (Start Mile: 9.13 End Mile: 0.00 Total Impaired Size: 9.13 Miles)

City / County in Planning Area: Page Co.

Impairment = Escherichia coli, Benthic-Macroinvertebrate Bioassessments

Rocky Branch

Location: Rocky Branch from the headwaters downstream to its confluence with Pass Run. (Start Mile: 4.18 End Mile: 0.00 Total Impaired Size: 4.18 Miles)

City / County in Planning Area: Page Co.

Impairment = pH

Jeremys Run

Location: Jeremys Run from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 10.94 End Mile: 0.00 Total Impaired Size: 10.94 Miles)

City / County in Planning Area: Page Co.

Impairment = pH

South River/South Fork Shenandoah River/North Fork Shenandoah River/Shenandoah River

Location: South River from the INVISTA discharge downstream (inclusive of the entire South Fork Shenandoah River and North Fork Shenandoah River from its confluence with Passage Creek downstream to its confluence with the South Fork Shenandoah River) to the Shenandoah River's confluence with Craig Run. (Start Mile: 163.27 End Mile: 8.16 Total Impaired Size: 155.11Miles)
City / County in Planning Area: Page Co., Warren County
Impairment = Mercury

South Fork Shenandoah River

Location: South Fork Shenandoah River from its confluence with North and South Rivers downstream to its confluence with Hawksbill Creek. (Start Mile: 100.97 End Mile: 41.98 Total Impaired Size: 58.99 Miles)
City / County in Planning Area: Page Co.
Impairment = Escherichia coli

Location: South Fork Shenandoah River from its confluence with North and South Rivers downstream to its confluence with Hawksbill Creek. (Start Mile: 100.97 End Mile: 41.98 Total Impaired Size: 58.99 Miles)
For Impairment = Benthic-Macroinvertebrate Bioassessments

Cedar Creek

Location: Cedar Creek from its confluence with Fall Run downstream to its confluence with Stickley Run. (Start Mile: 17.87 End Mile: 3.68 Total Impaired Size: 14.19 Miles)
City / County in Planning Area: Frederick Co. Shenandoah Co.
Impairment = Escherichia coli

Crooked Run

Location: Crooked Run excluding the tributary feeding the east arm of Lake Frederick from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 8.87 End Mile: 0.00 Total Impaired Size: 8.87 Miles)
City / County in Planning Area: Frederick Co. Warren Co.
Impairment = Escherichia coli, Dissolved Oxygen

Stephens Run

Location: Stephens Run from an unnamed tributary .95 miles upstream of Crooked Run downstream to its confluence with Crooked Run. (Start Mile: .95 End Mile: 0.00 Total Impaired Size: .95 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Oxygen, Dissolved

Little Isaacs Creek

Location: Little Isaacs Creek from the Timber Ridge School STP downstream (including an unnamed tributary originating near Reynolds Store) to its confluence with Isaacs Creek. (Start Mile: 9.53 End Mile: 0.00 Total Impaired Size: 9.93 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Escherichia coli

Hogue Creek

Location: Hogue Creek from the headwaters downstream to its confluence with Back Creek. (Start Mile: 16.76 End Mile: 0.00 Total Impaired Size: 16.76 Miles)

City / County in Planning Area: Frederick Co.

Impairments = Escherichia coli, Temperature

Babbs Run

Location: Babbs Run from the headwaters downstream to its confluence with Back Creek. (Start Mile: 11.46 End Mile: 0.00 Total Impaired Size: 11.46 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Fecal Coliform

Opequon Creek

Location: Opequon Creek and its tributaries from the headwaters downstream to its confluence with Abrams Creek. (Start Mile: 57.47 End Mile: 32.66 Total Impaired Size: 24.81 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Escherichia coli

Abrams Creek

Location: Abrams Creek from the headwaters downstream to its confluence with Opequon Creek. (Start Mile: 10.8 End Mile: 0.00 Total Impaired Size: 10.8 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Escherichia coli, Benthos

Opequon Creek

Location: Opequon Creek from its confluence with Abrams Creek downstream to the VA/WV state line. (Start Mile: 32.66 End Mile: 23.56 Total Impaired Size: 9.1Miles)

City / County in Planning Area: Frederick Co.

Impairment = Escherichia coli, Benthic-Macroinvertebrate Bioassessments

Lick Run

Location: Lick Run (also known as Hiatt Run) from its headwaters downstream to its confluence with Opequon Creek. (Start Mile: 8.85 End Mile: 0.00 Total Impaired Size: 8.85 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Escherichia coli

Redbud Run

Location: Redbud Run and tributary from the headwaters downstream to its confluence with Opequon Creek. (Start Mile: 8.05 End Mile: 0.00 Total Impaired Size: 8.05 Miles)

City / County in Planning Area: Frederick Co.

Impairments = Escherichia coli, Benthic-Macroinvertebrate Bioassessments

South River/South Fork Shenandoah River/North Fork Shenandoah River/Shenandoah River

Location: South River from the INVISTA discharge downstream (inclusive of the entire South Fork Shenandoah River and North Fork Shenandoah River from its confluence with Passage Creek downstream to its confluence with the South Fork Shenandoah River) to the Shenandoah River's confluence with Craig Run. (Start Mile: 163.27 End Mile: 8.16 Total Impaired Size: 155.11 Miles)

City / County in Planning Area: Page Co., Clarke Co., Warren Co.

Impairment = Mercury

South Fork Shenandoah River/North Fork Shenandoah River/Shenandoah River

Location: South Fork Shenandoah River from the Rivermont Drive Bridge downstream to the VA/WV state line on the Shenandoah River (inclusive of the North Fork Shenandoah River from its confluence with Passage Creek downstream to its confluence with the South Fork Shenandoah River). (Start Mile: 51.10 End Mile: 0.00 Total Impaired Size: 51.10 Miles)

City / County in Planning Area: Clarke Co. Warren Co.

Impairment = PCB

Happy Creek

Location: Happy Creek from the headwaters downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 8.42 End Mile: 0.00 Total Impaired Size: 8.42 Miles)

City / County in Planning Area: Warren Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Holmans Creek

Location: Holmans Creek from the headwaters downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 10.42 End Mile: 0.00 Total Impaired Size: 10.42 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Escherichia coli, Benthic-Macroinvertebrate

North Fork Shenandoah River

Location: North Fork Shenandoah River from its confluence with Turley Creek downstream to its confluence with Stony Creek. (Start Mile: 92.61 End Mile: 60.75 Total Impaired Size: 31.86 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Escherichia coli, Benthic-Macroinvertebrate

Mountain Run/Smith Creek/War Branch

Location: Mountain Run from the headwaters downstream to its confluence with Smith Creek; Smith Creek from the headwaters downstream to its confluence with the North Fork Shenandoah River; War Branch from the headwaters downstream to its confluence with Smith Creek. (Start Mile: 5.98, 33.83, 6.81 End Mile: 0.00, 0.00, 0.00 Total Impaired Size: 5.98 Miles, 33.83 Miles, 6.81 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Escherichia coli

Smith Creek

Location: Smith Creek from the Shenandoah Fisheries outfall downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 25.19 End Mile: 0.00 Total Impaired Size: 25.19 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Mill Creek

Location: Mill Creek from the headwaters downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 15 End Mile: 0.00 Total Impaired Size: 15 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Fecal Coliform, Benthic-Macroinvertebrate Bioassessments

Crooked Run

Location: Crooked Run from the headwaters downstream to its confluence with Mill Creek. (Start Mile: 3.89 End Mile: 0.00 Total Impaired Size: 3.89 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Stoney Creek

Location: Stony Creek from its confluence with Foltz Creek downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 17.04 End Mile: 0.00 Total Impaired Size: 17.04 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Escherichia coli,

Impairment = Benthic-Macroinvertebrate Bioassessments - Stony Creek from the Georges Chicken discharge downstream to its confluence with the North Fork Shenandoah River.

(Start Mile: 5.76 End Mile: 0.00 Total Impaired Size: 5.76 Miles)

Laurel Run

Location: Laurel Run from its confluence with an unnamed tributary near USFS Road 252 downstream to its confluence with Stony Creek. (Start Mile: 3.72 End Mile: 0.00 Total Impaired Size: 3.72 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Little Stony Creek

Location: Little Stony Creek from the headwaters downstream to its confluence with an unnamed tributary near USFS Road 92. (Start Mile: 3.24 End Mile: 0.00 Total Impaired Size: 3.24 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Stony Creek

Location: Stony Creek from the headwaters downstream to its confluence with Foltz Creek.
(Start Mile: 26.49 End Mile: 17.04 Total Impaired Size: 9.45 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Temperature, water

Toms Brook

Location: Toms Brook from the headwaters downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 7.18 End Mile: 0.00 Total Impaired Size: 7.18 Miles)

City / County in Planning Area: Shenandoah Co.

Impairments = Benthic-Macroinvertebrate Bioassessments

Narrow Passage Creek

Location: Narrow Passage Creek from the headwaters downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 10.75 End Mile: 0.00 Total Impaired Size: 10.75 Miles)

City / County in Planning Area: Shenandoah Co.

Impairments = Escherichia coli

Pughs Run

Location: Pughs Run from the headwaters downstream to its confluence with the North Fork Shenandoah River. (Start Mile: 5.86 End Mile: 0.00 Total Impaired Size: 5.86 Miles)

City / County in Planning Area: Shenandoah Co.

Impairments = Escherichia coli

Tumbling Run

Location: Tumbling Run from the headwaters downstream to the 5 mile upper limit of the PWS designation for the Strasburg Public Water Intake. (Start Mile: 5.05 End Mile: .9 Total Impaired Size: 4.15 Miles)

City / County in Planning Area: Shenandoah Co.

Impairments = Escherichia coli

North Fork Shenandoah River

Location: North Fork Shenandoah River from its confluence with Passage Creek downstream to its confluence with the South Fork Shenandoah River. (Start Mile: 5.29 End Mile: 0.00 Total Impaired Size: 5.29 Miles)

City / County in Planning Area: Warren Co.

Impairment = Escherichia coli

Orndorff Spring Branch

Location: Orndorff Spring Branch from the spring downstream to its confluence with Cedar Creek. (Start Mile: .23 End Mile: 0.00 Total Impaired Size: .23 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Cedar Creek

Location: Cedar Creek from the headwaters downstream to a spring branch near Van Buren Furnace (Start Mile 21.07 End Mile 18.54 Total Impaired Area: 2.53 Miles)

City / County in Planning Area: Shenandoah Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Cedar Creek

Location: Cedar Creek from its confluence with Fall Run downstream to its confluence with Stickley Run. (Start Mile: 17.87 End Mile:3.68 Total Impaired Size: 14.19 Miles)

City / County in Planning Area: Frederick Co. Shenandoah Co.

Impairment = Escherichia coli

Passage Creek

Location: Passage Creek from its confluence with Peters Mill Run downstream to its confluence with the North Fork Shenandoah River. (Start Mile:18.47 End Mile: 0.00 Total Impaired Size: 18.47 Miles)

City / County in Planning Area: Shenandoah Co.

Shenandoah Co. Warren Co.

Impairment = Escherichia coli

Manassas Run

Location: Manassas Run from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 9.15 End Mile: 0.00 Total Impaired Size: 9.15 Miles)

City / County in Planning Area: Warren Co.

Impairment = Fecal Coliform

Borden Marsh Run

Location: Borden Marsh Run and tributaries from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 9.46 End Mile: 0.00 Total Impaired Size: 9.46 Miles)

City / County in Planning Area: Clarke Co. Warren Co.

Impairment = Escherichia coli

Willow Brook

Location: Willow Brook from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 3.95 End Mile: 0.00 Total Impaired Size: 3.95 Miles)

City / County in Planning Area: Warren Co.

Impairment = Escherichia coli

Crooked Run

Location: Crooked Run excluding the tributary feeding the east arm of Lake Frederick from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 8.87 End Mile: 0.00 Total Impaired Size: 8.87 Miles)

City / County in Planning Area: Frederick Co. Warren Co.

Impairment = Escherichia coli

Crooked Run

Location: Crooked Run excluding the tributary feeding the east arm of Lake Frederick from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 8.87 End Mile: 0.00 Total Impaired Size: 8.87 Miles)

City / County in Planning Area: Frederick Co. Warren Co.

Impairment = Oxygen, Dissolved

Stephens Run

Location: Stephens Run from an unnamed tributary .95 miles upstream of Crooked Run downstream to its confluence with Crooked Run. (Start Mile: .95 End Mile: 0.00 Total Impaired Size: .95 Miles)

City / County in Planning Area: Frederick Co.

Impairment = Oxygen, Dissolved

Crooked Run X-trib

Location: Crooked Run X-trib from the headwaters downstream to its confluence with Crooked Run. (Start Mile: .09 End Mile: 0.00 Total Impaired Size: .09 Miles)

City / County in Planning Area: Warren Co.

Impairment = Oxygen, Dissolved

Page Brook Run/Spout Run

Location: Page Brook Run from the headwaters downstream to its confluence with Roseville Run; Spout Run from its confluence with Page Brook Run downstream to its confluence with the Shenandoah River. (Start Mile: 8.78, 3.70 End Mile: 0.00, 0.00 Total Impaired Size: 8.78 Miles, 3.70 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Fecal Coliform

Spout Run

Location: Spout Run from its confluence with Page Brook Run downstream to its confluence with the Shenandoah River. (Start Mile: 3.70 End Mile: 0.00 Total Impaired Size: 3.70 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Long Branch

Location: Long Branch from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 3.63 End Mile: 0.00 Total Impaired Size: 3.63 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Escherichia coli

Chapel Run

Location: Chapel Run and tributaries from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 9.44 End Mile: 0.00 Total Impaired Size: 9.44 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Escherichia coli

Chapel Run

Location: Chapel Run and tributaries from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 9.44 End Mile: 0.00 Total Impaired Size: 9.44 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Benthic-Macroinvertebrate Bioassessments

Dog Run

Location: Dog Run from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 4.80 End Mile: 0.00 Total Impaired Size: 4.80 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Escherichia coli

Wheat Spring Branch

Location: Wheat Spring Branch from the headwaters downstream to its confluence with the Shenandoah River. (Start Mile: 4.31 End Mile: 0.00 Total Impaired Size: 4.31 Miles)

City / County in Planning Area: Clarke Co.

Impairment = Escherichia coli

Reference – State Water Control Board

http://townhall.virginia.gov/L/GetFile.cfm?File=E:\townhall\docroot\103\1593\2876\Text_DEQ_2876_v2.pdf

4.9 Point Source Discharges

Significant point sources of discharges into the Shenandoah River include permitted activities through the DEQ Virginia Pollutant Discharge Elimination System (VPDES) permit program and the three sanitary landfills located in planning area. The landfills are located in Page County (serving Page and Warren Counties), Frederick County (serving Frederick and Clarke Counties and the City of Winchester), and Shenandoah County.

DEQ administers the VPDES permit program, under the State Water Control Law [9 VAC 25-31](#) as mandated by Section 402 of the Clean Water Act. Other point source discharges are administered through the EPA's Phase 1 (11/16/90) and Phase 2 (12/8/99) storm water regulations, and pending Virginia stormwater regulations to be managed by both DCR and the DEQ.

DEQ maintains a list of all "major" dischargers, a distinction based on discharge quantity and content. This data has been requested and will be included when available.

4.10 Potential Threats to Water Quantity and Quality

The two legacy contaminants in the soils of the Shenandoah River include mercury and PCB contamination. In early December 2009, the U.S. Geological Survey released a report summarizing contaminated riverbank and floodplain soils as the main source of mercury found in fish in several Shenandoah Valley rivers. The study found that 96 percent of the mercury loads to the South River, a tributary of the Shenandoah River's South Fork, are from soil that was contaminated between 1929 and 1950 by a textile manufacturing plant in Waynesboro, Va.

The discharged mercury waste contaminated the South River and eventually the South Fork of the Shenandoah River, the Shenandoah River and the floodplains along all three rivers. In the report, USGS estimates that about 416 pounds of mercury get into the South River annually.

Non-point sources of pollution pose a threat to water quality including urban sprawl and associated runoff. In addition, agriculture, a predominant land use throughout the planning area poses threats to water quality with runoff, livestock in rivers, and use of fertilizers, pesticides, and herbicides. Deforestation is another land use in the area that threatens to adversely impact adjacent streams and their quality of water.

Another potential threat to ground water quality in the region is significant petro release sites. DEQ maintains a database from data gathered during monitoring of these significant petro release sites. Various remediation measures have been implemented including no action to pump-out abatement with extensive monitoring of plume and substitution of water supplies for potentially contaminated wells surrounding petro release sites. Per DEQ's database, the larger petro release sites in the planning region include:

Page County – Hope Mills Country Store

Clarke County – Whitepost, south of Boyce

Frederick County – Flying J truck stop

Warren County – Northern Virginia 4H Center

Shenandoah County – Shenandoah Caverns Shell; Sheetz 701 Truck Stop; Hamburg Store; Conicville; Borden's Auto Parts; Walker's Cash Grocery; Emmart Oil Bulk Plant; Loves Truck Stop; Wilcohen's Travel Plaza; Holsinger Brother's Exxon; and Holsinger Chevron.

Above ground, and underground storage tanks (ACTs and USTs) listed in DEQ database indicate numerous storage tanks within the planning area. If the integrity of the storage tank is compromised, threats to water quality may result. Proposed development in all counties can adversely impact future water quantity through increased demand. For example, the proposed Cloverbud projects in Page County that include industrial as well as secondary residential infrastructure expansions, may impact water quality and quantity. Efforts will be taken to adhere to state and local regulations during construction and maintenance to minimize impacts posed to the quality of receiving water bodies.

Another threat to water quality is the potential for hydrofracking for natural gas in the planning region. Although the Marcellus shale within the planning area is not as productive in natural gas as areas to the west and south, the proximity to the Tennessee Valley Transmission Main pipeline makes tapping into local gas wells attractive. The Marcellus areas in the Northern

Shenandoah Valley are primarily located within the western portion of Frederick and Shenandoah Counties. Permits for exploratory wells have been issued in these two counties but no exploratory drilling has occurred to date. In the event a permit is issued by the Virginia Department of Mines, Mineral and Energy for a natural gas well site, the planning commission will work closely with the locality to develop ordinances to help protect water quality and quantity.

5.0 Projected Water Demand

5.1 Population Data

NSRVC Water Supply Plan: Population & Projections

County/Town	Decennial Census Count					Projected Population*			% County Population		Avg. % of County Population 2000-2010
	1970	1980	1990	2000	2010	2020	2030	2040^	2000	2010	
Clarke County	8,102	9,965	12,101	12,652	14,034	18,320	21,230	26,027			
Berryville				2,963	4,185	4,877	5,651	6,928	23.4%	29.8%	26.6%
Boyce				426	589	693	803	984	3.4%	4.2%	3.8%

Frederick County	28,893	34,150	45,723	59,209	78,305	95,648	114,539	142,853			
Middletown				953	1,261	1,540	1,844	2,300	1.6%	1.6%	1.6%
Stephens City (Town)				1,380	1,825	2,229	2,669	3,328	2.3%	2.3%	2.3%

Page County^^	16,581	19,401	21,690	23,177	24,042	24,523	25,014	25,515			
Luray				4,871	4,895	4,944	4,994	5,044			
Shenandoah (Town)				1,326	1,422	1,472	1,517	1,563			
Stanley				1,878	2,373	2,504	2,605	2,683			

Shenandoah County	22,852	27,559	31,636	35,075	41,993	49,427	56,927	66,906			
Edinburg				807	1,050	1,186	1,366	1,606	2.3%	2.5%	2.4%
Mount Jackson				1,978	2,368	2,788	3,211	3,773	4.7%	4.7%	4.7%
New Market				2,105	2,570	2,995	3,450	4,055	5.0%	5.1%	5.1%
Strasburg				4,840	7,660	7,918	9,120	10,718	11.5%	15.2%	13.4%
Toms Brook				246	252	321	370	435	0.7%	0.6%	0.7%
Woodstock				4,798	6,097	6,969	8,027	9,434	11.4%	12.1%	11.8%

Warren County	15,301	21,200	26,142	31,584	37,575	45,722	53,092	65,143			
Front Royal (1)				13,589	14,440	16,069	17,543	19,954	20.0%		

Winchester (City)	14,643	20,210	21,947	23,585	26,203	29,339	32,485	36,571			
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Region (Total)	106,372	132,485	159,239	185,282	222,152	264,115	305,311	366,039			
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Notes:

*Projected using US Census 1970-2010 and Virginia Employment Commission (2020, 2030) for extrapolated straightline projection to 2040

^2040 population estimated using % change 2000 to 2030

Population estimates for Mt Jackson, New Market, Strasburg and Woodstock include 20% projected future growth rate increase

Front Royal (1) Assumes 20% of the County population resides within the town

^^Page County projections by Luray Planner, L.Webb

The future population was calculated using a scatter plot of Census data for each locality for 2000 and 2010, Virginia Employment Commission projection for 2020 and 2030 and a straight line projected out to 2040. The Northern Shenandoah Valley Regional Planning Commission staff met with each County and respective Town(S) and the City of Winchester to best determine projected growth corridors and future population projections to allocate County population growth into the Towns. The projected growth corridors and future service areas were also discussed.

5.2 Projected Water Demand

City of Winchester Projected Future Water Demands Date: 5/26/2011

DRAFT

Usage Category	Avg. Daily Demand (mgd from 2008)	Estimated % Demand Increase to 2040	Estimated Daily Demand in 2040 (mgd)	Year	Population	% Increase
Residential	1.55	42.4%	2.21	2008	25,680	
Commercial/Industrial	2.20	42.4%	3.13	2040	36,571	42.40%
Sale to Frederick Co.	1.90		0.0%		1.90	
Sale to Middletown	0.20		0.0%		0.20	
Unaccounted (losses)	1.85		-10.0%		1.67	
Total		7.70			9.11	
Supply Source			Maximum Source Capacity (mgd)			
NF Shenandoah River			14.00			
Faye Spring			1.00			
Total Available Capacity			15.00			
Estimated Daily Demand - 2040			9.11			
Estimated Available Capacity - 2040			5.90			

In Page County, using data provided by the Towns of Luray, Shenandoah and Stanley, over 45 percent of the County’s population is connected to some form of public utilities currently. In 2009, Page County’s “natural increase” (total number of births per year, less total number of deaths as calculated by the Virginia Department of Health) was a negative number, indicating more residents died that year in the County (11.2 deaths per every 1,000 residents) than those born that year (10.1 births per every 1,000 residents). Page County’s percentage of population

increase has declined over the past several Census cycles. From 1970 – 1980 the County experienced a 17 percent population increase, from 1980 – 1990 a 11.7 percent population increase, from 1990 – 2000 a 6.8 percent population increase, and 2000 – 2010 a 3.7 percent population increase. After looking at Page County’s 2010 census, I think it is safe to assume that the County’s most recent population increase (3.7 percent) is the result of a modest net in-migration to the County, with the “natural” population increase/decrease being a nonfactor.

An historic decline (in population increases) can be observed for the past 40 years and the future population projections reflect this decline; however, the projections still show a *slight net increase* in population for each ten year cycle until 2040. These slight net increases assume a few more folks will move into the County each year, than leave. Any unforeseen circumstance (e.g. a major industry moving into, or out of, the County, etc.) could change this, so a 2 percent overall projected population increase for Page County between 2010 – 2020, and continued until 2040. In addition, portions of the County’s growth were assigned to the County’s Towns based upon historic trends.

The goal of this section of the Plan is to forecast populations and water use to 2040 and identify water deficits or surpluses. Water deficits or surpluses identified herein are preliminary based on best available information to date. It should be noted that the mandated Virginia Code requires this Plan to be reviewed every five years; and updated and resubmitted to DEQ and SWCB every ten years. In this review and update process, deficits and surpluses will be revised based on most recent population projections, development patterns, and water conservation actions employed by localities.

Data collection included population projections and employment estimates from Weldon-Cooper, the Virginia Employment Commission, and Virginia Economic Development Partnership. In addition, data for growth and development was compiled from the annual Northern Shenandoah Valley Regional Housing Report, Comprehensive plans, and economic development projections. Where locality-specific information was detailed, it was substituted for the Weldon-Cooper statistical estimates of population. In this section of the Plan, water demand projections are forecasted for a 32 year time horizon to 2040. Population figures extending beyond 2020 is less confident than those forecasts from present to 2010; however, these will be revised during the periodic Plan updates.

Water demands are presented per County include three broad categories: community water systems, small self-supplied users, and large self-supplied (ag and nonag) water users. Community water systems (CWS) include water provided to localities as well as non-municipalities. A CWS **public water system** serves at least 15 residential connections or at least 25 individuals. Average daily water use calculations for the community water systems for Clarke and other localities in this report were based on 2008 data presented in 80 B1-B3.

Small self-supplied water demand projections are users of less than 300,000 gallons a month. This group of water users is assumed to be primarily groundwater wells and is anticipated to remain static with 2008 data unless further changed by locality comments. All self-supplied users and nonmunicipal community water systems were anticipated to remain static. Future water demand was calculated by increasing the residential municipal community water use, increasing a given percent from previous decade, per the Virginia Employment Commission. For example, if the population increased 11.66% between 2020 and 2030; then the 2020 demand was multiplied by 11.66% and added to the 2020 demand to calculate the 2030 demand. This demand estimation process was applied for calculating all localities.

Demand projections for large nonagricultural self-supplied water (for both surface water and groundwater sources) are incomplete due to data gaps from some of the large nonagricultural self-supplied users reported in Sections 70 and 80 of this Plan, previously submitted to the Northern Shenandoah Valley Regional Commission. The agricultural large self-supplied water projections expected to stay static with the 2008 numbers, until additional data is provided to quantify this use.

Employment Data and Analysis

Additional characterization of water use for each locality included evaluation of current and likely future commercial, industrial, and manufacturing large water consumers. According to the Virginia Employment Commission, the top employers in the Northern Shenandoah Valley are listed below. These top employers are anticipated to continue to grow and be top water users throughout the planning period to 2040 (per Virginia Employment Commission).

- Valley Health System
- Wal Mart
- Frederick County School Board
- Food Lion
- VDOT
- Page County School Board
- Marshall's
- Cracker Barrel Old Country Store
- Berryville Graphics
- The Home Depot
- City of Winchester
- U.S. Department of Homeland Defense
- County of Frederick
- Martin's Food Market
- Shenandoah County School Board
- Target Corporation
- Lowes' Home Centers, Inc.
- Warren County School Board
- Winchester City Public Schools
- Postal Service
- Rubbermaid Commercial Products LLC
- George's Chicken
- Shenandoah University

These listed employers provide the largest percentage of employment within the Shenandoah Valley as categorized by industry with many serving in manufacturing, construction, retail trade, educational services, health care and social assistance, and accommodation and food services sectors.

Assumptions:

Several assumptions are presented in this section including:

- Extrapolation of population to 2040 from 2000-2030
- Town water use - % of overall County water use
- Locality projections include recent Comp Plans and developments
- Small self supplied water use remains static 2008-2040 (golf course)
- Per capita quantity 75 gpd wells, 125 gpd public CWS

Population data available through Weldon-Cooper and the Virginia Employment Commission estimate to 2030; therefore, population projections beyond 2030 numbers provided by Weldon-Cooper and Virginia Employment Commission were calculated by extrapolating the slope of the linear population projections from 2000 to 2030 to the outyear of 2040. The second assumption, allocation of county water use to towns, the jurisdictional populations were proportionally allocated to each locality based on the percentage of county population per town known in 2008. For example, if 10.5% of the 2008 total population of Shenandoah County resided in the town of Woodstock, then the decadal projections of Woodstock's population were calculated to be 10.5% of the estimated Shenandoah County populations for 2020, 2030, and 2040. For individual jurisdictions, the population projections vary accordingly based on geographic size and its development with many of the jurisdictions defined as rural with more open spaces and less population density. The third assumption addresses locality projections readjusted to reflect the most recent County Comprehensive Plans addressing planned development and amenities.

An additional assumption was the demand usage of water. It was assumed that the small self-supplied users would remain fixed, such that a golf course in Warren County would not expand in size nor use additional water in the future than what it currently used in 2008. Water per capita quantity was the fifth assumption. Water use was calculated by multiplying a water consumption per capita for the population served by the small self-supplied water system that includes 75 gpd per person for groundwater (rural demands) and 110 gpd per person for surface water intakes. Another demand assumption was that town water residences would consume an average of 110 gallons a day, whereas county private well water use would consume 75 gallons a day per person. This consumption estimate corroborates with the U.S. Geological Survey's water consumptive calculations.

Clarke County, Towns of Berryville and Boyce:

In Clarke County the residential community water systems for municipalities include surface water stream intake on the Shenandoah River main stem for the Town of Berryville and the Clarke County Sanitation Authority withdrawal from Prospect Hill Spring for the Town of Boyce and some Clarke

County. The nonmunicipal residential community water use includes three groundwater well users: Grafton School, the Retreat, and River Park. It is assumed that the nonmunicipal CWS water use will be static for a total of 151,840 gpd (125,920 gpd for the Retreat and River average daily and maximum daily 25,920 gpd for Grafton - since an average daily withdrawal is not available).

Clarke's self-supplied users for nonagricultural demand in 2008 included the federal commercial source ,FEMA and Berryville Graphics. Three large self-supplied users demand water for agriculture include White Post, Ivy Hill, and Moore & Dorsey. Small self-supplied users using less than 300,000 gallons / month include residences and small businesses on individual wells. In 2008 this was estimated to be 24 residences in the Town of Berryville (multiplied by factor of 2.28 persons/ household times estimated 75 gpd per capita) and 46 residences in the County of Clarke time a factor of 2.5 using 75 gpd or 0.0086 MGD. The small businesses in Clarke County using private wells were estimated. All self supplied users and nonmunicipal community water systems were anticipated to remain static. Future water demand was calculated by increasing the residential municipal community water use, increasing a given percent from previous decade, per the Virginia Employment Commission.

Clarke County			
Community Water Users (CWS)		2008 MGD Avg	2008 MGD Max
Clarke County Sanitation Authority (SW)	Berryville Town	0.383	0.776
Prospect Hill Spring	Boyce Town	0.066	0.157
Nonmunicipal CWS			
Grafton School	(123 people)		0.03
Retreat		0.023	0.069
River Park		0.013	
Total Nonmunicipal CWS			
Small Self Supplied Users (GW)			
Berryville 24 Residences**	GW	0.004	
Clarke County 46 Residences**	GW	0.009	
Large Self Supplied Users - NonAg			
Federal Emergency Management Agency	SW	0.072	
Berryville Graphics	GW	0.003	
Large Self Supplied Users - Ag			
White Post	SW	0.018*	
Iv Hill	SW	0.035	
Moore & Dorsey	GW	0.0794	
Small businesses	GW	0.017	

Notes

* 2002 only reported water use

** Per Capita consumption = residences X DEQ No. persons/house X 75 gpd

An estimated 12,335 people were not serviced with municipal (County minus Town 2008 populations) community water supply. Multiplying that population times an average 75 gallons per day per capita yielded 0.92513 MGD not on municipal water. However, a portion of that population is serviced by nonmunicipal residential cws that consumed 0.0136 MGD. Therefore, 0.92513 MGD minus 0.0136 MGD yields 0.91153 MGD of water that is estimated to service the remaining 2008 County population. This amount is how much Clarke County is expected to change by the decade and is estimated to increase at the rates provided for the towns (12.19% by 2020, 11.66% by 2030, and 9.91% by 2040). The County estimates of water use for populations not serviced by CWS are reflected in the demand figures.

In summary, the existing and projected water demand for Clarke County is as follows:

2008	1.60183 MGD
2020	1.79364
2030	1.97158
2040	2.14044

Frederick County, Towns of Middletown and Stephens City:

In Frederick County there are two towns, both of which purchase their water from outside localities. The Town of Middletown purchases water from the City of Winchester and the Town of Stephens City purchases water from the Frederick County Sanitation Authority. The residential community water use is supplied by various sources (well, spring, surface, and purchase from the City) and treated by the Frederick County Sanitation Authority, stored in quarries, and served to residents of the Town of Stephens City and those in Frederick County on public water service. The nonmunicipal community water users in Frederick County combined used an average of 0.3332 MGD (based on 80% of the system design capacity, rather than actual water consumed). These served over 575 people.

The large self-supplied nonagricultural users combined water use was 0.1465 MGD. Large self-supplied agricultural users with a combined demand of 0.043 MGD, where data available; however, four of the six agricultural SSUs did not provide water use data in 2002, 2003, or 2008. Five small self-supplied businesses use private water supplies (less than 300,000 gallons / month) servicing 4158 persons and meeting a business demand 0.815 MGD. An estimated 337 residential structures (with an average of 2.64 persons/home) located within Frederick County obtain their water from private wells within the service area of CWS. These small self-supplied users represent 0.066726 MGD consumed in 2008.

An estimated 71,755 County residents were not serviced with municipal CWS in 2008. Multiplying the population times an average 75 gallons per day per capita yielded 5.381625 MGD not on municipal water. However, a portion of that population (575) is serviced by nonmunicipal residential cws. Therefore, the County residents not on residential CWS (except those served at Summit) is 71,755 minus 575 persons, or 71,180 persons which consume 5.3385. The water demand met by the Summit housing is calculated as 80% system capacity or 0.2608 MGD. The estimated County demand from those not on

residential CWS would be 5.3385 minus 0.206 or 5.1325 MGD. This figure forms the basis for 2008 population demand not serviced by residential CWS. This amount is estimated to increase at the rates provided for the towns (12.19% by 2020, 11.66% by 2030, and 9.91% by 2040). The County estimates of water use for populations not serviced by CWS are reflected in the demand figures.

Frederick County				
Community Water Users (CWS)		2008 MGD Avg	2008 MGD Max	Future Use
Frederick County Sanitation Authority	County	4.806		
Purchase	Stephens City			
	Middletown	1.933		
Nonmunicipal CWS				
HillTop Trailer Park				
Shawnee Land				
Summit				
TavenerTrailer Court				
Total Nonmunicipal CWS	575 people	0.333		
Small Self Supplied Users (GW)				
Indian Hollow Elementary				
Timber Ridge School				
Redland United Methodist Church				
Rosedale Baptist Church				
Valley Proteins				
SubTotal SSU	4158 people	0.815		
SubTotal additional County residences	337 homes**	0.067		
Large Self Supplied Users - NonAg				
Winchester Golf Club				
Carpers Valley Golf Course				
Gore Plant				
Winchester Valley Protein				
Subtotal NonAg Large SSU		0.147		
Large Self Supplied Users - Ag				
Combined	5 GW + Spring	0.043		
Iv Hill	SW	0.035		
Moore & Dorsey	GW	0.0794		
Small businesses	GW	0.017		

Notes

* 2002 only reported water use

** Per Capita consumption = residences X DEQ No. persons/house X 75 gpd

In summary, the existing and projected water demand for Frederick County is as follows:

2008	20.56177 MGD
2020	22.20031
2030	24.00612
2040	24.8073

Page County, and Towns of Luray, Shenandoah, and Stanley

In Page County the residential community water use is supplied by groundwater wells and springs servicing the three Towns. In 2008, the combined water use for nonmunicipal community sources were all groundwater wells withdrawing a total of 0.9512 MGD in 2008 (based on 80% total system design because actual water consumption use not available). These include Egypt Bend Estates, Luray Homes, Shenandoah Utilities, and undisclosed populations in nonmunicipal community water users subdivisions.

The large self-supplied nonagricultural user was the Luray Caverns Country Club. Eight large self-supplied agricultural users in Page County withdrew water from a combination of stream intakes, groundwater, and a spring totaling a 0.103 MGD withdrawal in 2000 for five agricultural users with three with no information. Small self-supplied users include schools, Shenandoah National Park, and Stanley Industrial Park with a combined withdrawal in 2008 of 0.547 MGD. This was assumed to be static throughout the planning time; however, it is noted that the Stanley Industrial Park is converting to community water systems and is anticipated to become a large water demand user. An estimated 96 houses on private wells in the service areas of the towns were multiplied by the County average of 2.42 persons per household using 75 gpd total 0.017424 MGD in 2008.

An estimated 15,781 people were not serviced with municipal CWS. Multiplying that population times an average 75 gallons per day per capita yielded 1.183575 MGD not on municipal water. However, a portion of that population is serviced by nonmunicipal CWS that consumed 0.095120 MGD. Therefore, 1.183575 MGD minus 0.095120 MGD yields 1.08846 MGD of water that is estimated to service the remaining 2008 County population. This amount is estimated to increase at the rates provided for the towns (12.19% by 2020, 11.66% by 2030, and 9.91% by 2040). The County estimates of water use for populations not serviced by CWS are reflected in the demand figures.

Page County				
Community Water Users (CWS)		2008 MGD Avg	2008 MGD Max	Future Use
Luray Town	GW	0.823		
Shenandoah Town	GW	0.328		
Stanley Town	GW	0.427		
Nonmunicipal CWS				
Egypt Bend Estates	267 people			
Luray Homes	65 people			
Shenandoah Utilities	55 people			

Old Farms Subdivision				
Valley View Estates				
Total Nonmunicipal CWS		0.951		
Small Self Supplied Users (GW)				
Schools				
Shenandoah National Park				
Stanley Industrial Park				
SubTotal SSU		0.547		
SubTotal additional County residences	96 houses**	0.017		
Large Self Supplied Users - NonAg				
Luray Caverns Country Club		0.041		
Subtotal NonAg Large SSU		0.041		
Large Self Supplied Users - Ag				
Combined (5 users)	SW, GW + Spg	0.103		
<u>Notes</u>				
** Per Capita consumption = residences X DEQ No. persons/house X 75 gpd				

In summary, the existing and projected water demand for Page County is as follows:

2008	3.46955 MGD
2020	3.984046
2030	4.35094
2040	4.6454

Shenandoah County, Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, and Woodstock:

In Shenandoah County the municipal residential community water use serves the Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, Woodstock, and Shenandoah County (Stoney Creek Sanitary District serving the village of Bryce). In 2008, the nonmunicipal community water users were all groundwater wells except Battleground Trailer Park on spring fed water and George’s Chicken which also uses surface water purchased from the Town of Woodstock in addition to groundwater wells.

The large self-supplied nonagricultural users include Bryce Resort, Shenvalee Lodge, and the Strasburg Plant. Thirteen documented large agricultural, self-supplied users withdraw water (data for water use is not available). Small self-supplied users (those using less than 300,000 gallons of water per month) include Valley Lunch Restaurant, Virginia Department of Transportation office complex, Bowman Apple Products Company Inc., Community Christian School, Columbia Gas Transmission Corporation, and Valley Baptist Christian School.

An estimated 24047 people were not serviced with municipal CWS. Multiplying the that population times an average 75 gallons per day per capita yielded 1.1803525 MGD not on municipal water. However, a portion of that population is serviced by nonmunicipal residential CWS that consumed 0.2208 MGD. Therefore, 1.1803525 MGD minus 0.2208 MGD yields 0.95955 MGD of water that is estimated to service the remaining 2008 County population. This amount is estimated to increase at the rates provided for the towns (12.19% by 2020, 11.66% by 2030, and 9.91% by 2040). The County estimates of water use for populations not serviced by CWS are reflected in the demand figures.

Shenandoah County				
Community Water Users (CWS)		2008 MGD Avg	2008 MGD Max	Future Use
Edinburg Town	GW			
Mt Jackson Town	GW			
New Market Town	GW			
Strasburg Town	SW			
Toms Brook Town	GW			
Woodstck Town	SW			
Stoney Creek Sanitary District	GW			
Nonmunicipal CWS				
Battleground Trailer Park	SW			
George's Chicken	SW+Purchase			
Total Nonmunicipal CWS	240047	0.959		
Small Self Supplied Users (GW)				
Valley Lunch Restaurant				
VA DOT				
Bowman Apple Products				
Community Christian School				
Colombia Gas Transmission Corp				
Valley Baptist Christian School				
SubTotal SSU				
SubTotal add'In County residences				
Large Self Supplied Users - NonAg				
Shenvalee Lodge				
Strasburg Plant				
Bryce Resort				
Subtotal NonAg Large SSU				
Large Self Supplied Users - Ag				
Combined (5 users)	SW, GW + Spg			

<u>Notes</u>				
** Per Capita consumption = residences X DEQ No. persons/house X 75 gpd				

In summary, the existing and projected water demand for Shenandoah County is as follows:

2008	20.14205 MGD
2020	20.61852
2030	21.12989
2040	21.6075

Warren County

In Warren County the residential community water use is supplied by stream intakes servicing the Town of Front Royal. In 2008, the Town of Front Royal consumed an average water withdrawal 4.317700 MGD. The two large self-supplied nonagricultural users were golf clubs withdrawing groundwater with a combined water demand of 0.0929 MGD during 2008. One large agricultural self-supplied user, Front Royal Fish Culture Station, in 2008 used 0.727 MGD from Passage Creek surface water. Seven businesses comprise the small self-supplied water use in 2008 including North Fork Resort #7, Shenandoah National Park – Dickey Ridge Center, Skyline Caverns, Inc., Front Royal River Campground, Christendom College, Hidden Springs Sr Living Facility, North American Housing Corporation, and Shenandoah Valley Golf Club offices. The combined small self-supplied users for nonag demand were estimated at 0.77 MGD.

An estimated 18,827 people were not serviced with residential community water supply (cws). Multiplying the that population times an average 75 gallons per day per capita yielded 1.41203 MGD not on municipal water. An additional portion of that population is serviced by one other residential nonmunicipal cws that consumed an estimated 0.0106 MGD. Therefore, 1.41203 MGD minus 0.0106 MGD yields 1.40143 MGD of water that is estimated to service the remaining 2008 County population. This amount is estimated to increase at the rates provided for the towns (12.19% by 2020, 11.66% by 2030, and 9.91% by 2040). The County estimates of water use for populations not serviced by CWS are reflected in the demand figures.

WarrenCounty				
Community Water Users (CWS)		2008 MGD Avg	2008 MGD Max	Future Use
Front Royal Town	SW	4.318		
Nonmunicipal CWS				
	SW			
	SW+Purchase			

Total Nonmunicipal CWS	18,827 people**	1.4		
Small Self Supplied Users (GW)				
North Fork Resort #7				
SNP - Dickey Ridge Center				
Skyline Caverns, Inc.				
Front Royal River Campground				
Christendom College				
Hidden Springs Sr Living Facility				
N. Am Housing Corporation				
Shenandoah Valley Golf Club Office				
SubTotal SSU		0.77		
SubTotal add'l In County residences				
Large Self Supplied Users - NonAg				
Golf Course	GW			
Golf Course	GW			
Large Self Supplied Users - Ag		0.929		
Front Royal Fish Culture Station	SW	0.727		
Combined (5 users)	SW, GW + Spg			
<u>Notes</u>				
** Per Capita consumption = residences X DEQ No. persons/house X 75 gpd				

In summary, the existing and projected water demand for Warren County is as follows:

2008	7.99963 MGD
2020	8.68610
2030	9.43422
2040	10.1442

City of Winchester

In summary, the existing and projected water demand for the City of Winchester is as follows:

2008	17.6398 MGD
2020	19.74270
2030	21.9993
2040	24.1409

Overall, the estimated regional water use in MGD is presented below for the northern Shenandoah Valley:

	2008	2020	2030	2040
Clarke County	1.60183	1.79364	1.97158	2.14044
Frederick County	20.56177	22.20031	24.00612	24.8073
Page County	3.46955	3.984046	4.35094	4.6454
Shenandoah County	20.14205	20.61852	21.12989	21.6075
Warren County	7.99963	8.68610	9.43422	10.1442
Winchester City	17.6398	19.7427	21.9993	24.1409
Total	71.41463	77.02531	82.89205	87.48574

Based upon these estimates reported herein, Frederick County is the biggest water user in the planning region, followed by Winchester City, then Shenandoah County. Although Shenandoah County’s current water demand exceeds Winchester City’s use, within the planning horizon, Winchester City water use will outpace Shenandoah County by 2030 represent the locality with the second greatest water demand. Warren County then Page County use less water than Shenandoah County. Clarke County has the lowest water consumption rate in the region. Again, this report presents a minimum of growth anticipated especially for the Town of Strasburg in Shenandoah County and Stanley in Page County. Based upon new permit for water withdrawal for the Town of Strasburg, attendant increases in population are anticipated to follow. The economic development authority application for developing the industrial park and associated infrastructure will also likely result in increased socioeconomic status with a parallel increased population that may likely exceed figures projected in this draft water demand report.

The Virginia Department of Environmental Quality will prepare a statewide water resources plan that will be initiated once all the regional and local plans have been received. The statewide water resources plan will include narrative addressing cumulative demand, use conflict, or in-stream flow information pursuant to 9 Virginia Code VAC 25-780-140 G.

6.0 WATER DEMAND MANAGEMENT

This section of the report documents a survey, titled Form 110, of the localities, as stipulated in Section 9 VAC 25-780-110, a detailed compilation of the survey is presented in Table 2: NSVRC Combined Results of Survey Form 110, appended to this report. Section 110, entitled Water Demand Management Information, include a survey of water efficiency practices, water conservation (raising awareness and financial incentives), and water loss reduction efforts in use by the localities. Subsection B addresses future planning efforts of water use demands, pursuant to section 100 D of the code. Future water planning analyses of population estimates and demand uses will address and incorporate water conservation practices, techniques, and technologies available. Below is a summary of the Form 110 surveys in our region which is presented in Table 1, listing the yes or no response to questions within the categories. Detailed answers to the individual survey questions are presented in Table 2.

Table 1: Summary of Form 110 Answers for Localities in the Northern Shenandoah Valley Regional Commission			
Locality	Water Use Efficiency	Water Conservation	Water Loss Reduction
Clarke County	1 - Y, 8 - N	5 - Y, 9 - N	6 - Y, 3 - N
Frederick County	0 - Y, 9 - N	2 - Y, 12 - N	3 - Y, 5 - N, 1 - I
Page County (Old Farms)	1 - Y, 7 - N, 1-NA	0 - Y, 14 - N	1 - Y, 8 - N
Page County (Egypt Bend)	1 - Y, 6 - N, 2-NA	1 - Y, 12 - N, 1 - NA	4 - Y, 5 - N
Page Public Water Systems	0 - Y, 8 - N, 1-NA	0 - Y, 10 - N, 4- NA	0 - Y, 6 - N, 3-NA
Shenandoah County	0 - Y, 9 - N	0 - Y, 14 - N	4 - Y, 5 - N
Stoney Creek	0 - Y, 9 - N	1 - Y, 13 - N	6 - Y, 3 - N
Warren County	1 - Y, 8 - N	4 - Y, 10 - N	0 - Y, 9 - N
Winchester City	3 - Y, 5 - N, 1-NA	7 - Y, 7 - N	6 - Y, 3 - N
Town of Berryville	1 - Y, 8 - N	4 - Y, 10 - N	6 - Y, 3 - N
Town of Boyce	0 - Y, 9 - N	4 - Y, 10 - N	4 - Y, 3 - N, 1-NA, 1-NV
Town of Edinburg	0 - Y, 9 - N	3 - Y, 11 - N	5 - Y, 4 - N
Town of Front Royal	0 - Y, 8 - N, 1- NA	6 - Y, 8 - N	7 - Y, 2 - N
Town of Luray	1 - Y, 6 - N, 2- NA	3 - Y, 8 - N, 3- NA	1 - Y, 7 - N, 1- NA

Town of Middletown	1 - Y, 8 - N	7 - Y, 7 - N	6 - Y, 3 - N
Town of Mount Jackson	1 - Y, 7 - N, 1- NA	2 - Y, 9 - N, 3- NA	4 - Y, 4 - N, 1- NA
Town of New Market	0 - Y, 8 - N, 1- NA	0 - Y, 14 - N	4 - Y, 5 - N
Town of Shenandoah	0 - Y, 9 - N	1 - Y, 13 - N	4 - Y, 5 - N
Town of Stanley	1 - Y, 6 - N, 2- NA	3 - Y, 8 - N, 3 - NA	1 - Y, 7 - N, 1- NA
Town of Stephens City*	1 - Y, 0 - N, 8 - NA	2 - Y, 0 - N, 12 -NA	1 - Y, 2 - N
Town of Strasburg	0- Y, 9 - N	3 - Y, 11 - N	6 - Y, 3 - N
Town of Toms Brook	0 - Y, 9 - N	1 - Y, 13 - N	6 - Y, 3 - N
Town of Woodstock	0 - Y, 8 - N, 1 - NA	1 - Y, 13 - N	4 - Y, 5 - N
Y - Yes answers, N - No answers, NA – Not Applicable, I – Incomplete, *- Needs Verification			

6.1 Water Use Efficiency:

In general, the localities had the least measures in place addressing water use efficiency practices listed by DEQ in the survey form; although several localities are considering adopting practices to improve water efficiency. Most of the localities have adopted the Virginia Uniform Statewide Building Code, but it is enforced through the county (example, the six towns of Shenandoah County do not have town codes to that effect because it is enforced through the county.) Clarke County and towns had water-efficient landscaping ordinances or site plans encouraging xeriscaping. No localities had homeowner associations with low water use known, and several rural areas had no homeowner associations. Two localities adopted ordinances declaring wasteful water use unlawful. In response to whether the localities implemented practices for irrigation efficiency, only one had irrigation measured but at least three others were considering metering irrigation. Only one locality had a water supplier listed on U.S. EPA’s Water Sense partners list. In addition to the water efficiency practices listed by DEQ, alternative practices were implemented throughout several localities.

6.2 Water Conservation:

Fourteen questions address water conservation measures within the planning area, conserving water through a reduction in water use. These questions include financial incentives and educational awareness, among other water reduction measures. Five localities have an ordinance to address water conservation through reduced water use and at least three are considering adopting such an ordinance. Three locality water suppliers developed and implemented water conservation plans and two are considering conservation plans. Over half the localities adjusted their standard operating procedures to improve water conservation and have low flow fixtures. Two localities used State Clean Water revolving funds to upgrade their wastewater treatment and one uses the return water system on wastewater

treatment to irrigate landscaping at the town facilities. No revolving funds were used to promote water conservation, and most were unaware that option was available. Only one locality offers yard taps to customers to reduce outdoor water use, although another locality is considering outdoor faucets. Thirteen localities have implemented public education programs to raise awareness about water usage. No localities offer funding incentive programs (rebates, tax breaks, vouchers, etc.) to encourage customers to reduce water use although seven water suppliers implements a rate structure that discourages excessive water use.

6.3 Water Loss Reduction:

Form 110 includes nine questions that address water loss through leak detection maintenance and repair programs. Seventeen localities have source and service water connection meters. Thirteen localities implement operating strategies for leak detection and regularly schedule periodic water audits. No localities have an ordinance in place to repair leaking water fixtures, appliances, or plumbing, although one jurisdiction removes sewer charges if proof of leak repair is provided. No localities have used Clean Water State revolving funds or Drinking Water State revolving funds to install water meters in the distribution system. The majority of localities have the following measures: policies to prohibit unauthorized water hydrant connections, strategies to repair main leaks, include dedicated funds on capital improvement plans or master plans to upgrade existing facility infrastructure to reduce water loss. Nine localities have developed and implemented public education programs to reduce customer water loss. Four jurisdictions implement water loss reduction practices in addition to others listed by DEQ on the survey form.

6.4 Summary:

In conclusion, the process of gathering data for the surveys resulted in raising locality awareness of water efficiency practices and ordinances they could consider. Overall, it was noted during individual meetings with jurisdictions the survey increased concepts of water conservation practices available. The region's jurisdictions show varying levels of water demand management. In general, the results indicate that the localities had the greatest number of measures in place addressing water loss reduction, primarily through their leak detection maintenance programs. It was noted that repairs are necessary and since the survey, several localities have since contacted the NSVRC Executive Director, to assist in investigating use of economic stimulus funds for water distribution repairs. Of the three categories, water use efficiency was the area with the least measures in place. The NSVRC hosted a Water Conservation workshop for locality land use managers, planners, and public works to present expertise in drought management, water efficiency best practices, and drought ordinances. It is anticipated that the increased awareness in water conservation will continue throughout the water supply planning process and result in increased water efficiency.

Table 6.2: Combined Form 110 Survey Results, attached in Appendix.

6.5 Practices to Address Water Loss

Unaccounted for water losses is water lost throughout the distribution system, in leaks, unnecessary system use, theft, or wasted water. Control measures to monitor and ultimately minimize water loss can be implemented by localities to reduce water loss. The best step is to conduct a detailed water efficiency audit to determine what constitutes the water lost for each locality. Then a comprehensive leak detection and repair program would be promoted to improve water efficiency. Capital projects and Community Development Block Grant opportunities for funding such leak improvements could be sought after. Meter upgrades and routine performance detections would be useful. Offering leak detection for all residents is a service each locality should offer to assist each homeowner / renter in identifying water leak issues and encourage remediation. For example, a locality could offer a 5% water bill savings for a month if the resident included a receipt for a water leak repair. In addition, water conservation practices could be implemented by citizens by raising awareness of water loss and conservation practices. The low water energy efficient appliances could be encouraged to retrofit older homes. The Virginia Uniform Statewide Building Code sections that limit the maximum flow of urinals, water closets, and appliances in 1994 will be adopted in all new building and houses.

7.0 DROUGHT RESPONSE and CONTINGENCY PLANS

The mandated Water Supply Plan, set forth in 9 VAC 25-780-120, requires a locality to specify how a drought or low water condition is declared, what actions they will implement to conserve water under such a condition, and how they will enforce water conservation actions. This Drought Response Plan is a section of the Northern Shenandoah Valley Regional Water Supply Plan and also is a stand-alone document that establishes a coordinated response to drought for the City of Winchester and the five Counties of Clarke, Frederick, Page, Shenandoah, and Warren. The Plan identifies duties and responsibilities of localities to manage water resources during drought and low water events (such as equipment failure or contamination) to minimize adverse impacts on public health and safety, economic activity, and environmental resources; and help preserve the water supply throughout the planning area.

This Regional Drought Response Plan is divided into the following sections:

- A. Drought Stages
- B. Locality Declaration
- C. Actions in Response to Drought Stage

A. Drought Stages

State regulations stipulate a minimum of three drought stages be included in the water supply drought response sections. The Northern Shenandoah Valley Regional Water Supply Plan's Drought Response section includes these three graduated stages of a drought:

Drought Stage	Description	Action
Watch	Drought potential if conditions persist	Increase water conservation awareness; voluntary actions by citizens
Warning	Onset of drought is imminent	Water conservation awareness; precautionary measures voluntary but encouraged by localities
Emergency	Significant drought or low water event	Mandatory responses for water conservation by localities and public

Jurisdictions will have varied declarations of a drought in part due to water sources, water demands, upstream water withdrawals, groundwater's delayed response to reflect low precipitation, equipment failure, and local variations in meteorology and soil moisture.

Local ordinances adopted by the localities within this planning region are appended to the Drought Response Section of the Water Supply Plan. The ordinances document jurisdictional commitment to water conservation implementation and enforcement of the Drought Response Section.

B. Locality Declaration of a Drought Stage

A drought is a period of time characterized by deficits in precipitation, low soil moisture, and surface and subsurface water levels below normal. The physical water shortages adversely affect people, crops, and animals.

A drought phase will be declared when conditions exist that less water is present than under normal streams flows under specific meteorological situations. Public declaration of the drought stage will be determined by the local water purveyor, Chief Administrative Officer (CAO), or designee as determined by the locality. A water purveyor is a public utility, municipal water company, county water district, or municipality that delivers drinking water to customers. Any localities purchasing water from another locality shall follow all drought stage declarations made by the local water purveyor and CAO/designee of the jurisdiction where water is purchased.

The Northern Shenandoah Valley Regional Commission (NSVRC) will act as a clearinghouse to assemble local drought stage designations and broadcast results to the general public and all jurisdictions within the planning region through electronic communication and website postings. The NSVRC staff will communicate with the upper headwaters area in the Central Shenandoah Planning District Commission area and will convey upstream drought conditions to the Northern Shenandoah Valley region jurisdictions. Results of upstream water supply conditions will also be posted on the NSVRC website to provide a comprehensive watershed-wide assessment of drought declarations within the Shenandoah Valley to facilitate localities' awareness of their water declarations.

When one or more of the following conditions are present, the local water purveyor, CAO, or designee may consider a Drought Stage declaration:

Drought Watch Stage

- A local trigger indicates watch level (at a predetermined level) or
- DEQ drought website indicates 2/4 boxes **yellow** for the area
<http://www.deq.virginia.gov/watersupplyplanning/drought/shenandoah/current.html>,
or
- A nearby subwatershed trigger indicates watch levels

Drought Warning Stage

- A local trigger indicates warning level (at a predetermined level), or
- DEQ drought website indicates 2/4 boxes **orange** for the area
<http://www.deq.virginia.gov/watersupplyplanning/drought/shenandoah/current.html>,
 or
- A nearby subwatershed trigger indicates warning levels

Drought Emergency Stage

- A local trigger indicates emergency level (predetermined level), or
- DEQ drought website indicates 2/4 boxes **red** for the area
<http://www.deq.virginia.gov/watersupplyplanning/drought/shenandoah/current.html>,
 or
- A nearby subwatershed trigger indicates emergency levels

Local Water Sources

Twenty localities in the planning region draw their water supply from three subwatersheds in the Shenandoah River basin: the North Fork of the Shenandoah River watershed, the South Fork of the Shenandoah River watershed, and the watershed of the main stem of the Shenandoah River. Water sources within the region’s subwatersheds vary and include groundwater, stream intakes, quarries, and water purchased from another jurisdiction. The water sources and subwatersheds for each locality within the region are shown in Table 1, below (Note: stream surface water = SW, groundwater = GW, quarry = Q). Table 1 lists the watershed where the source intake is located, not necessarily the watershed of the jurisdiction using the water. For example, the City of Winchester is located in the subwatershed of the main stem of the Shenandoah River; however, the City’s source intake is located in the subwatershed of the North Fork of the Shenandoah River in Strasburg.

Locality Served	North Fork of the Shenandoah River Watershed	South Fork Shenandoah River Watershed	Main Stem Shenandoah River Watershed
Shenandoah County	GW		
New Market	GW		
Mt Jackson	GW		
Edinburg	GW		
Woodstock	SW		

Toms Brook	GW		
Strasburg	SW		
Page County		GW	
Shenandoah Town		GW	
Stanley		GW	
Luray		GW	
Warren County	GW	GW	
Front Royal		SW	
Frederick County	Quarry & Purchase from Winc SW / GW)		
Middletown	Purchase (SW) From Winc		
Stephens City	Purchase (SW/GW) From FCSA		
City of Winchester	SW		
Clarke County			GW
Boyce			Purchase From CCSA
Berryville			SW

Additional water source data for each locality is presented in Appendix A.

Local Triggers:

Each locality has selected local triggers to monitor and use to declare a drought or low water condition. Typically triggers include a stream level measured at a gage or a groundwater level measured at a specified level in a well. A locality may assume a trigger is activated when either their local trigger has reached a predetermined level and / or a trigger from a neighboring jurisdiction within the same subwatershed has been reached. Table 2 summarizes local triggers and subwatershed triggers to be used when considering a drought stage declaration.

TABLE 2: LOCAL TRIGGERS FOR WATER LEVELS

Locality		Groundwater / Spring	Surface Water/ Reservoir	Other*		Local Triggers/Gages
Clarke County	Watch	GW levels fall between the 10 th & 25 th percentile	Stream flows fall between the 10 th and 25 th percentile			County monitoring well network; Spout Run USGS gage; Main Stem Millville USGS gage
	Warning	GW levels fall between the 5 ^h & 10 th percentile	Stream flows fall between the 5 ^h & 10 th percentile			
	Emergency	GW levels fall below the 5 th percentile	Stream flows fall below the 5 th percentile			
Frederick County	Watch		Stream flows fall between the 10 th and 25 th percentile	Quarry elevation measures >		Quarry Elevation; USGS Gage North Fork Shenandoah at Strasburg; will consider Winchester drought declaration
	Warning		Stream flows fall between the 5 ^h & 10 th percentile	Quarry elevation measures <		
	Emergency		Stream flows fall below the 5 th percentile	Quarry elevation measures <		
Page County	Watch	GW levels fall between the 10 th & 25 th percentile	Stream flows fall between the 10 th and 25 th percentile			Static water level in well; USGS Gage South Fork Shenandoah in Luray; Rockingham County USGS GW Well 41Q 1
	Warning	GW levels fall between the 5 ^h & 10 th percentile	Stream flows fall between the 5 ^h & 10 th			
	Emergency	GW levels fall below the 5 th percentile	Stream flows fall below the 5 th			
Shenandoah County	Watch		Stream flows fall between the 10 th and 25 th percentile			Local well monitoring; USGS Gage North Fork Shenandoah at Mt Jackson and Strasburg North Fork
	Warning		Stream flows fall between the 5 ^h & 10 th percentile			
	Emergency		Stream flows fall below the 5 th percentile			
Warren County	Watch		Stream flows fall between the 10 th and 25 th percentile			USGS Gage South Fork in Front Royal, USGS Gage North Fork Shenandoah at Strasburg, USGS Gage Passage Creek
	Warning		Stream flows fall between the 5 ^h & 10 th percentile			
	Emergency		Stream flows fall below the 5 th percentile			
City of Winchester	Watch		Stream flows fall between the 10 th and 20 th percentile (or below 80 cfs)			USGS Gage North Fork Shenandoah North Fork near

			for a period of 5 consecutive days.		Strasburg
	Warning		Stream flows fall between the 5 th and 10 th percentile (or below 72 cfs) for a period of 5 consecutive days.		
	Emergency		Stream flows fall below the 5 th percentile (or below 63 cfs) for a period of 5 consecutive days.		
Town of Berryville	Watch		Stream flows fall between the 10 th and 25 th percentile		USGS Gage at
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		
Town of Boyce	Watch	GW levels fall between the 10 th & 25 th percentile			Follow drought declaration by Clarke County based on Clarke County Monitoring Well Network
	Warning	GW levels fall between the 5 ^h & 10 th percentile			
	Emergency	GW levels fall below the 5 th percentile			
Town of Edinburg	Watch		Stream flows fall between the 10 th and 25 th percentile		USGS Gage North Fork in Mt Jackson
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		
Town of Front Royal	Watch		Stream flows fall between the 10 th and 25 th percentile		USGS Gage South Fork in Front Royal
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		
Town of Luray	Watch		Stream flows fall between the 10 th and 25 th percentile/		USGS Gage South Fork in Luray; Rockingham County USGS GW Well 41Q1
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		

Town of Middletown	Watch		Stream flows fall between the 10 th and 25 th percentile		Follow drought declaration from Winchester; Passage Creek, Buckton USGS gage
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		
Town of Mt Jackson	Watch	Well info	Stream flows fall between the 10 th and 25 th percentile		Historic records of town well;; USGS Gage North Fork in Mt Jackson
	Warning	Well info	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	Well info	Stream flows fall below the 5 th percentile		
Town of New Market	Watch	Static water level in well is ___ feet	Stream flows fall between the 10 th and 25 th percentile		Static wellhead in Town wells, USGS gaging station at Cootes Store, Broadway and/or Smith Creek
	Warning	Static water level in well is ___ feet	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	Static water level in well is ___ feet	Stream flows fall below the 5 th percentile		
Town of Shenandoah	Watch	GW levels fall between the 10 th & 25 th percentile	Stream flows fall between the 10 th and 25 th percentile		USGS Gage South Fork Shenandoah in Luray, & Rockingham County USGS GW Well 41Q1
	Warning	GW levels fall between the 5 ^h & 10 th percentile	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	GW levels fall below the 5 th percentile	Stream flows fall below the 5 th percentile		
Town of Stanley	Watch	GW levels fall between the 10 th & 25 th percentile	Stream flows fall between the 10 th and 25 th percentile		USGS Gage South Fork Shenandoah in Luray, and Rockingham County USGS GW Well 41Q1
	Warning	GW levels fall between the 5 ^h & 10 th percentile	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	GW levels fall below the 5 th percentile	Stream flows fall below the 5 th percentile		
Town of Strasburg	Watch		Stream flows fall between the 10 th and 25 th percentile		USGS Gage North Fork Shenandoah at Strasburg
	Warning		Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency		Stream flows fall below the 5 th percentile		
Town of Stephens City	Watch		Stream flows fall between the 10 th		Follow drought declaration from

		and 25 th percentile		Frederick County (quarry level); USGS Gage Spout Run near Millwood
	Warning	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	Stream flows fall below the 5 th percentile		
Town of Toms Brooks	Watch	Stream flows fall between the 10 th and 25 th percentile		
	Warning	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	Stream flows fall below the 5 th percentile		
Town of Woodstock	Watch	Stream flows fall between the 10 th and 25 th percentile/		USGS Gage North Fork Shenandoah at Strasburg
	Warning	Stream flows fall between the 5 ^h & 10 th percentile		
	Emergency	Stream flows fall below the 5 th percentile		

DEQ Drought Indicator Analysis Website

The DEQ drought indicator analysis website uses a four-square icon that is color-coded to indicate drought stage in the Shenandoah River Basin:

(<http://www.deq.virginia.gov/watersupplyplanning/drought/shenandoah/current.html>). The icon addresses groundwater, surface stream flow, precipitation, and Palmer Drought Severity Index. The icon color yellow indicates drought watch stage, orange denotes a drought warning stage, and red represents drought emergency stage. Localities may reference this website when making drought stage determinations. When two or more squares are colored yellow, orange, or red, a drought stage declaration may be considered by a locality.

Governor Declaration:

A drought stage may also be triggered by a declaration by the Commonwealth's Governor. Droughts declared by the Governor are based on the Virginia Drought Assessment and Response Plan and the professional judgment of the Virginia Drought Monitoring Task Force (Task Force). The Task Force includes representatives from several state, federal and local agencies, as well as universities and non-government organizations. The Task Force monitors stream flows, lake levels, precipitation, groundwater levels and other climatic indicators. In the event the Governor declares an emergency drought, there will be an automatic emergency drought designation. Likewise, gubernatorial declaration can rescind a drought stage.

C. Drought Response Actions

While some drought response actions are applicable to all jurisdictions in the planning region (see list below), other drought response actions are individually determined by each locality based upon the environmental setting and their position within the watershed, water source, and political circumstances. Local water managers and staff will be apprised of Drought Stage declarations through the use of automated crew messaging / emergency notification. **Note:** In the event of a prolonged, multi-seasonal drought emergency, the locality reserves the right to institute a program of water rationing.

The NSVRC will act as a clearinghouse and provide public notification of any drought stage declaration within the region. The public notices will serve to build and raise awareness of the drought status and educate the public of early water conservation steps individuals and localities can implement. Public notification will occur through the newspaper, public service announcements, notices with water bills, and the NSVRC website. The locality websites will also list drought stage and water conservation actions. The NSVRC website will define the drought stage with a notice that the public will be informed as to appropriate actions, as listed above. Violators of water use may have names printed in the newspaper listing the amount of water used during a drought stage.

Drought stage downgrading will be conducted by the local water purveyor, jurisdictional CAO, or designee as determined by each locality. Decisions to downgrade a stage will be based on the local trigger, DEQ, and other designated triggers as precipitation increases and soil moisture content and water levels rise in streams and wells.

Proposed Drought Response Actions

1. Drought Watch Actions:

The following are the regional actions to be taken by the respective localities when a Drought Watch stage is declared by the local water purveyor, CAO, and/or designee of a locality in the Northern Shenandoah Valley water supply planning region. Water conservation actions listed below will be encouraged when a Drought Watch is declared. It is possible that the increased public awareness of water conservation activities during a drought watch may reduce water use up to 5%.

- A Drought Watch notification will be publicized through the general news media or any other appropriate method for making such notification public. These include newspapers of general circulation such as Northern Virginia Daily, Winchester Star, Daily News Record, radio 92.5 WINC FM, television 3, etc.
- Localities will include water conservation information on their website on a northern Shenandoah Valley webpage [nsvenvironment](#) hyperlinked to the NSVRC.Com website.
- Localities will contact the Northern Shenandoah Valley Regional Commission (NSVRC) office when a drought stage is implemented. The NSVRC will update the locality's drought status on the regional drought website and [nsvenvironment](#) webpage.

- All citizens, including private well users, will be encouraged to begin voluntary water conservation actions (see below).
- Locality staff will continue to monitor drought trigger indicators on a monthly basis and report significant changes to local officials.
- Localities will increase water use efficiency and/or promote use reclaimed water for public facility landscaping.
- Leak detection consults by localities will be conducted upon request, as staff can support.
- Public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day are asked to review and voluntarily implement existing drought water conservation methods as outlined in this plan.
- The public will continue conservation until water storage (source and distribution) is replenished.

Voluntary Water Conservation Actions:

- Mow lawns to 2 inches or more and leave clippings (higher cut encourages grass roots to grow deeper to hold soil moisture better than closely clipped lawn.).
- Use mulch around plants to reduce evaporation.
- Aerate lawn to reduce evaporation.
- Avoid over fertilizing your lawn. Fertilizer applications increase the need for water. Apply fertilizers that contain slow-release, water-insoluble forms of nitrogen.
- Place rain barrels under gutter downspouts to collect water for plants, car washing, or general cleaning projects.
- Plant native or dry-loving (xeric) plants in landscaping.
- Do not use the garbage disposal.
- Use automatic dishwasher only when load is full.
- Limit showers to 5 to 10 mins / day / person.
- Avoid running water to get cold temp, keep a pitcher of cold water in fridge.
- Wrap hot water heater and pipes with insulating material.
- Install faucet aerators.

2. Drought Warning Actions:

When a Drought Warning stage is declared by the local water purveyor, CAO, and/or designee of a locality in the Northern Shenandoah Valley water supply planning region, the following are the regional actions to be taken by the respective localities. Water conservation actions and the reduction or elimination of non-essential water uses will be encouraged when a Drought Watch is declared. It is intended that water conservation measures listed will generally result in reductions of water use of 5 to 10%.

- A Drought Warning notification shall be publicized through the general news media or any other appropriate method for making such notification public in newspapers of general circulation and radio and television.
- Localities will include water conservation information on their website.
- Localities will contact the Northern Shenandoah Valley Regional Commission (NSVRC) office when the Drought Warning stage is implemented. The NSVRC will update the locality's drought status on the regional drought website and nsvenvironment webpage.
- Public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day will initiate voluntary water conservation measures.
- All local government offices and institutions should consider the reduction or elimination of non-essential water uses with the goal of reducing water usage by 5 to 10%.
- Locality staff will continue to monitor drought triggers monthly to indicate levels and report significant changes to local officials.
- Leak detection consults by localities will be conducted upon request, as staff can support.
- Continue conservation until water storage (source & distribution) is replenished.
- All citizens, including private well users, will be encouraged to voluntarily reduce or eliminate non-essential water uses (see under Drought Emergency Actions) and follow the water conservation actions.

Voluntary Water Conservation Actions:

In addition to those actions listed under the Drought Watch section:

- Use a broom instead of a hose to clean driveways, walks and patios.
- Do not wash hard surfaces or buildings.
- Turn off ornamental fountains or other such structures, unless the water is recycled.
- Reduce lawn watering to no more than 2 times a week, between the hours of 9:00 p.m. and 10:00 a.m.
- Reduce vegetable garden watering by watering only when needed, between the hours of 9:00 p.m. and 10:00 a.m.
- Apply water directly to plants by using soil-soakers or drip irrigation. Avoid use of sprinklers.
- Do not plant new landscaping or grass.

3. Drought Emergency Actions:

The following mandated actions will be implemented when a Drought Emergency is declared by the local water purveyor, CAO and/or designee of a locality in the Northern Shenandoah Valley water supply planning region. The non-essential uses listed below are prohibited during the drought emergency stage.

- A Drought Emergency notification shall be publicized through the general news media or any other appropriate method for making such notification public.
- Localities will include water conservation information on their website.
- Localities will contact the Northern Shenandoah Valley Regional Commission (NSVRC) office when the Drought Warning stage is implemented. The NSVRC will update the locality's drought status on the regional drought website.
- All citizens, including private well users, will initiate the mandatory non-essential water use restrictions listed below and follow the water conservation actions listed under the Drought Watch and Warning sections above.
- Public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day will initiate the mandatory non-essential water use restrictions listed below and follow the water conservation actions listed under the Drought Watch and warning sections above.
- All local government offices and institutions will initiate the mandatory non-essential water use restrictions listed below with the goal of reducing water usage by 10 to 15%.
- Localities will be authorized to adopt local ordinances to enforce the mandatory non-essential water use restrictions listed below and to establish, collect, and retain fees for violations of these restrictions.
- Locality staff will continue to monitor drought indicators on a monthly basis and report significant changes to local officials.
- Localities may consider developing increased conservation rate charges or surcharges to respond to drought conditions.
- All users continue conservation until water storage (source & distribution) is replenished.
- Commercial customers are to follow the mandatory non-essential water use restrictions listed below, where appropriate.
- All other residential, business and industrial water users; whether supplied by public water supplies, self-supplied sources, or private water wells; who do not normally utilize water for any of the non-essential uses listed below are requested to voluntarily reduce water consumption by at least 10%. This reduction may be the result of elimination of other non-essential water uses, application of water conservation practices, or reduction in essential water uses.

Non-Essential Water Uses

The following non-essential water uses will be prohibited during periods of declared drought emergencies. Below each non-essential use is a list of exceptions. These prohibitions and exceptions will apply to uses from all sources of water and will only be effective on an individual locality basis when a locality in the Northern Shenandoah Valley water supply planning region declares a Drought Emergency. The conservation actions listed in the Drought Watch and Warning section of the Northern Shenandoah Valley Drought Plan become mandatory during the Drought Emergency stage.

Local governments and public waterworks may impose water use restrictions more or less stringent than the mandatory non-essential water use restrictions listed below consistent with local water supply conditions at any time. Nothing contained in this drought response plan should be construed to limit the powers of the local governments to adopt and enforce local emergency ordinances as necessary to protect the public welfare, safety, and health.

Water use restrictions shall not apply to the agricultural production of food or fiber, the maintenance of livestock including poultry, nor the commercial production of plant materials so long as best management practices are applied to assure the minimum amount of water is utilized.

1. Unrestricted non-commercial watering (public or private)

Lawn Irrigation Exceptions-

- Newly sodded and seeded areas may be irrigated to establish cover on bare ground at the minimum rate necessary for no more than a period of 60 days. Irrigation rates may not exceed one inch of applied water in any 7 day period. Consider delaying seeding or sodding of new lawns.
- Gardens, bedding plants, trees, shrubs and other landscape materials may be watered with hand held containers not exceeding three (3) gallons in capacity. Watering may be done between the hours of 9:00 p.m. and 10:00 a.m. to avoid the heat of the day. Do not use sprinklers.

Golf Course Irrigation Exceptions-

- Tees and greens may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.
- Fairways may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary not to exceed one inch of applied water in any ten-day period.
- All allowed golf course irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.

Athletic Field Irrigation Exceptions-

- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at a rate not to exceed one inch per application or more than a total of one inch in multiple applications during any ten-day period. All irrigation water must fall on playing surfaces with no outlying areas receiving irrigation water directly from irrigation heads.
- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. during necessary overseeding, sprigging or resodding operations at the minimum rate necessary for a period that does not exceed 60 days. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period.
- All allowed athletic field irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
- Irrigation is prohibited on athletic fields that are not scheduled for use within the next 120-day period.

2. Use of Fire Hydrants

Exceptions-

- Except for necessary governmental operations such as firefighting, health protection purposes, or certain testing and drills by the fire department as approved by the local government or waterworks operator

3. Washing of paved surfaces such as streets, roads, sidewalks, driveways, garages, parking areas, tennis courts, and patios; flushing of sewers and hydrants

Exceptions-

- Surfaces may be washed with hand held containers not exceeding three (3) gallons in capacity.

Washing should not occur during the heat of the day.

- As needed to ensure public health and safety, and approved by the local government or waterworks operator

4. Washing or cleaning of mobile equipment including automobiles, trucks, trailers and boats

Exceptions-

- Mobile equipment may be washed at car washes that utilize reclaimed water as part of the wash process or reduce water consumption by at least 10% when compared to a similar period when water use restrictions were not in effect. Any facility operating a reclaimed water system must prominently display, in public view, a sign stating that such a recycling system is in operation.

- Mobile equipment may be washed using hand held containers not exceeding three (3) gallons in capacity or hand held hoses equipped with automatic shutoff devices provided that no mobile equipment is washed more than once per calendar month and the minimum amount of water is utilized.

- Automobile dealers and rental agencies may wash cars that are in inventory no more than once per week utilizing hand held containers not exceeding three (3) gallons in capacity, hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.

5. Use of water for the operation of ornamental fountains, artificial waterfalls, misting machines, and reflecting pools

Exceptions-

- Fountains and other means of aeration necessary to support aquatic life are permitted.

6. Filling and topping off outdoor swimming pools

Exceptions-

- Newly built or repaired pools may be filled to protect their structural integrity.

- Outdoor pools operated by commercial ventures, community associations, recreation associations, and similar institutions open to the public may be refilled as long as:

- Levels are maintained at mid-skimmer depth or lower,

- Any visible leaks are immediately repaired,

- Backwashing occurs only when necessary to assure proper filter operation,
- Deck areas are washed no more than once per calendar month (except where chemical spills or other health hazards occur),
- All water features (other than slides) that increase losses due to evaporation are eliminated, and
- Slides are turned off when the pool is not in operation.
- Swimming pools operated by health care facilities used in relation to patient care and rehabilitation may be filled or topped off.

7. Serving of water in restaurants, clubs, or eating-places

Exceptions-

- May only be allowed at the specific request of the customer

The NSVRC staff will continue to receive monthly reports from system operators maintain database; share information for local jurisdictions; monitor the DEQ and USGS websites; serve as a regional liaison assisting localities to publish notices of alert levels and water restrictions. In addition, staff will maintain a list of mandatory water conservation actions on the NSVRC website and news media.

Local governments and water utilities may impose more stringent watering schedules. Citizens are encouraged to contact their local water providers for more specific guidance. The water use restrictions during an emergency stage will be enforced by the locality and a violation of the ordinance will be a misdemeanor with a penalty fine determined by the locality where the violation occurred.

This Drought Response Plan is designed to present the best available practices to date; however, the plan remains flexible to incorporate best technologies as available and actual practices that were determined to be most suitable in response to real droughts. The contents of this Drought Response Plan are subject to revision a minimum of every five years, in accordance with state regulations. In addition, in the event of a drought, practices and actions that best support drought remediation will be substituted in future plans.

The Counties of Clarke and Warren currently have a drought response plan in place. These are appended to this Water Supply Plan.

Appendix to Chapter 7: Water supply systems

(Surface Water = SW, Groundwater = GW)

North Fork Shenandoah Watershed by Locality from South to North on the North Fork of the Shenandoah River

- Town of New Market – Groundwater wells (6 wells)
- Town of Mount Jackson – GW wells (5 wells)
- Town of Edinburg – GW wells (2 wells)
- Town of Woodstock – SW intake on North Fork Shenandoah River
- Shenandoah County – Stoney Creek Sanitary District GW wells (7 wells)
- Town of Toms Brook – GW wells (2 wells)
- Town of Strasburg – SW intake on North Fork Shenandoah River
- City of Winchester – SW intake on the North Fork Shenandoah

South Fork Shenandoah Watershed by Locality from South to North on the South Fork of the Shenandoah River

- Town of Shenandoah – GW wells (3 wells)
- Town of Stanley – GW wells (6 wells)
- Town of Luray – 2 Springs and 1 GW well
- Page County - provided by town of Stanley & GW well system
- Warren County
- Town of Front Royal – SW intakes on Sloan Creek, Happy Creek, South Fork of the Shenandoah River

Main Stem of the Shenandoah Watershed by Locality from South to North on the Main Stem Shenandoah River

- Town of Middletown – purchase water from City of Winchester
- Town of Stephens City – purchase water from Frederick County Sanitation Authority (FCSA)
- Frederick County – FCSA Quarries, 3 GW wells, purchase from Winchester
- City of Winchester – SW intake on the North Fork of the Shenandoah River
- Clarke County – Spring water
- Town of Boyce – from Clarke County Service Authority (CCSA)

Town of Berryville – SW stream intake Shenandoah River (main stem)

8.0 STATEMENT OF NEED

8.0 ALTERNATIVES ANALYSIS

Appendices

T&E Species

VaFWIS Search Report Compiled on 1/6/2010, 2:45:00 PM

Database Search in (840) Winchester City [County], VA

73 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 29) (29 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
030062	ST	I	Turtle, wood	Glyptemys insculpta		BOVA,HU6
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	CBC
040129	ST	I	Sandpiper, upland	Bartramia longicauda		BOVA
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,CBC
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		BOVA,HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,CBC
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia		BOVA,HU6
100256	FS	II	Crescent, tawny	Phyciodes batesii batesii		BOVA,HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera		BOVA,HU6
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,CBC
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,CBC
040270	SS	III	Wren, sedge	Cistothorus platensis		HU6
030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6

040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,BBA,CBC
040364	SS		Dickcissel	Spiza americana		BOVA
040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,CBC
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,CBC
040210	SS		Owl, long-eared	Asio otus	Yes	CBC
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC
040319		I	Warbler, black-throated green	Dendroica virens		BOVA

VaFWIS Search Report Compiled on 1/6/2010, 2:51:11 PM

Database Search in (069) Frederick [County], VA

91 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 38) (38 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
050023	FESE	I	Bat, Indiana	Myotis sodalis		HU6
070001	FTST	II	Isopod, Madison Cave	Antrolana lira		HU6
040267	SE	I	Wren, Bewick's	Thryomanes bewickii	Yes	BOVA,BBS
060006	SE	II	Floater, brook	Alasmidonta varicosa		HU6
060201	FSSE	II	Springsnail, Appalachian	Fontigens bottimeri	Yes	HU6,TEWater

030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes	BOVA,HU6,Collections,TEWater
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	BOVA,BBA,CBC
040129	ST	I	Sandpiper, upland	Bartramia longicauda	Yes	BOVA,HU6,BBA,BBS
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,BBA,BBS,CBC,Collections
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		BOVA,HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,CBC
060081	ST	II	Floater, green	Lasmigona subviridis	Yes	HU6,Collections
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia		BOVA,HU6
100343	FS	II	Beetle, thin-neck cave	Pseudanophthalmus parvicollis		HU6
100256	FS	II	Crescent, tawny	Phyciodes batesii batesii		BOVA,HU6
060029	FSSS	III	Lance, yellow	Elliptio lanceolata		HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera		BOVA,HU6
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,CBC
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC,Collections
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,BBA,CBC,Collections
040270	SS	III	Wren, sedge	Cistothorus platensis		HU6
060071	SS	III	Lampmussel, yellow	Lampsilis cariosa		HU6

030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6
040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,BBA,CBC,Collections
040364	SS		Dickcissel	Spiza americana	Yes	BOVA,BBA
040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,CBC
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,CBC
040210	SS		Owl, long-eared	Asio otus	Yes	CBC
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC
040319		I	Warbler, black-throated green	Dendroica virens		BOVA

To view **All 91 species** [View 91](#)

* FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; FS=Federal Species of Concern; SC=State Candidate; CC=Collection Concern; SS=State Special Concern

** I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need; IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need

[View Map of All Query Results from All Observation Tables](#)

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

(22 records - displaying first 20)

[View Map of All Fish Impediments](#)

ID	Name	River	View Map
1086	BUTLER DAM	BABBS RUN	Yes
1089	CHEROKEE DAM	KECKLEY RUN	Yes
1096	COVE DAM #2	TR-LAUREL RUN	Yes
1090	COVE LAKE DAM #1	TR-LAUREL RUN	Yes
1143	FRESHWATER POND	MINES SPRING RUN	Yes
1095	HIGH VIEW MANOR DAM	HOGUE RUN	Yes
1099	IZAAK WALTON PARK POND	TR-OPEQUON CREEK	Yes
1097	LAKE FREDRICK DAM	CROOKED RUN	Yes
1104	LAKE ISAACS DAM	ISAAC CREEK	Yes
1103	LAKESIDE LAKE	TR-OPEQUON CREEK	Yes
1091	LEHMANS DAM	GOUGH RUN	Yes
1094	MEADOWLAKE DAM	HUGUE CREEK	Yes
1093	PLEASANT VALLEY LAKE DAM	TR-FURNACE BRANCH	Yes
1100	SEVEN VISTAS DAM	TR-CEDAR CREEK	Yes
1092	SHEPPARD LAKE DAM	TR-OPEQUON CREEK	Yes
1087	SILVER LAKE DAM	PARRISH RUN	Yes
1088	ST. CLAIR DAM	BABBS RUN	Yes
1145	STEPHENS PARK DAM	TR-CROOKED RUN	Yes
1098	SUMMIT DAM	ISAACS CREEK	Yes

1144	TAILINGS POND	MINES SPRING RUN	Yes
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To view **All 22 Fish Impediment records** [View 22](#)

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(35 Reaches - displaying first 20)

[View Map of All Threatened and Endangered Waters](#)

Stream Name	T&E Waters Species						View Map
	Highest TE*	BOVA Code, Status*, Tier**, Common & Scientific Name					
Buffalo Marsh Run (02070006)	FSSE	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
		060201	FSSE	II	Springsnail, Appalachian	Fontigens bottimeri	
Buffalo Marsh Run (02070006)	FSSE	060201	FSSE	II	Springsnail, Appalachian	Fontigens bottimeri	Yes
Unnamed trib. of Hogue Creek (02070004)	FSSE	060201	FSSE	II	Springsnail, Appalachian	Fontigens bottimeri	Yes
Albin Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Babbs Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Back Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Bear Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Brush Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes

Cedar Creek (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Crockett Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Dry Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Duck Run (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Fall Run (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Froman Run (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Furnace Run (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Gap Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Gravel Springs Run (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Green Spring Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Hogue Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Isaacs Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Laurel Run (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Little Brush Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes

To view **All 35 Threatened and Endangered Waters records** [View 35](#)

VaFWIS Search Report Compiled on 1/6/2010, 2:53:56 PM

Database Search in (043) Clarke [County], VA

86 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 33) (33 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
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070001	FTST	II	Isopod, Madison Cave	Antrolana lira	Yes	HU6,Collections
060006	SE	II	Floater, brook	Alasmidonta varicosa		HU6
030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes	BOVA,HU6,TEWater
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	CBC
040129	ST	I	Sandpiper, upland	Bartramia longicauda	Yes	BOVA,HU6,BBA,Collections
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,BBA,CBC,Collections
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,BBA,CBC,Collections
060081	ST	II	Floater, green	Lasmigona subviridis		HU6
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia		BOVA,HU6
100256	FS	II	Crescent, tawny	Phyciodes batesii batesii		HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera	Yes	BOVA,HU6,BBA
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC,Collections
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,CBC
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,CBC
040270	SS	III	Wren, sedge	Cistothorus platensis		BOVA,HU6
030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6
040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,CBC,Collections
040364	SS		Dickcissel	Spiza americana	Yes	BOVA,BBA

040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC,Collections
040238	SS		Flycatcher, yellow-bellied	Empidonax flaviventris	Yes	Collections
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,CBC,Collections
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,CBC,Collections
040210	SS		Owl, long-eared	Asio otus	Yes	BOVA,CBC
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC,Collections
040314	SS		Warbler, magnolia	Dendroica magnolia	Yes	BOVA,Collections
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC,Collections
040319		I	Warbler, black-throated green	Dendroica virens	Yes	BOVA,Collections

To view **All 86 species** [View 86](#)

* FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; FS=Federal Species of Concern; SC=State Candidate; CC=Collection Concern; SS=State Special Concern

** I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need; IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need

[View Map of All Query Results from All Observation Tables](#)

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

(1 records)

[View Map of All Fish Impediments](#)

ID	Name	River	View Map
1085	SHORT HILL FARM DAM	CRAIG RUN	Yes

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(1 Reaches)

[View Map of All Threatened and Endangered Waters](#)

Stream Name	T&E Waters Species						View Map
	Highest TE *	BOVA Code, Status *, Tier **, Common & Scientific Name					
Opequon Creek (02070004)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes

Cold Water Stream Survey (Trout Streams)

Managed Trout Species

VaFWIS Search Report Compiled on 1/6/2010, 2:57:50 PM

Database Search in (139) Page [County], VA

103 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 39) (39 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
020045	FESE	I	Salamander, Shenandoah	Plethodon shenandoah	Yes	BOVA,HU6,Collections
050023	FESE	I	Bat, Indiana	Myotis sodalis		HU6
050035	FESE	II	Bat, Virginia big-eared	Corynorhinus townsendii virginianus		HU6
200010	FEST		Rock-cress, shale barren	Arabis serotina	Yes	Collections
060006	SE	II	Floater, brook	Alasmidonta varicosa		HU6

030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes	BOVA,HU6,Collections,TEWater
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	BOVA,HU6,Collections
040129	ST	I	Sandpiper, upland	Bartramia longicauda		BOVA
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,BBA,BBS,CBC,Collections
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,Collections
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia	Yes	BOVA,HU6,Collections
070011	FS	II	Amphipod, Luray Caverns	Stygobromus pseudospinosus		HU6
100329	FS	II	Beetle, Avernus cave	Pseudanophthalmus avernus		HU6
100337	FS	II	Beetle, Hubbard's cave	Pseudanophthalmus hubbardi		HU6
100344	FS	II	Beetle, Petrunkevitch's cave	Pseudanophthalmus petrunkevitchi		HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	BBA,CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera	Yes	BOVA,HU6,BBA
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,HU6,BBA,CBC,Collections
030063	CC	III	Turtle, spotted	Clemmys guttata		HU6
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,BBA,CBC,Collections

060071	SS	III	Lampmussel, yellow	Lampsilis cariosa		HU6
030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6
040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,CBC,Collections
040364	SS		Dickcissel	Spiza americana		BOVA
040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,BBA,CBC
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,BBA,CBC
040210	SS		Owl, long-eared	Asio otus	Yes	CBC
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC,Collections
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
030040		I	Pinesnake, northern	Pituophis melanoleucus melanoleucus		HU6
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC
040319		I	Warbler, black-throated green	Dendroica virens	Yes	BOVA,BBA,Collections

To view **All 103 species** [View 103](#)

* FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; FS=Federal Species of Concern; SC=State Candidate; CC=Collection Concern; SS=State Special Concern

** I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need; IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need

[View Map of All Query Results from All Observation Tables](#)

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

(5 records)

[View Map of All Fish Impediments](#)

ID	Name	River	View Map
1107	DRY RUN DAM #101	DRY RUN	Yes
1106	DRY RUN DAM #102	NORTH DRY RUN	Yes
1109	LURAY	S FK SHENANDOAH R	Yes
1108	NEWPORT	S FK SHENANDOAH R	Yes
1148	SHENANDOAH DAM	SOUTH FORK SHENANDOAH RIVER	Yes

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(1 Reaches)

[View Map of All Threatened and Endangered Waters](#)

Stream Name	T&E Waters Species						View Map
	Highest TE*	BOVA Code, Status*, Tier**, Common & Scientific Name					
Passage Creek (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes

Cold Water Stream Survey (Trout Streams)

Managed Trout Species

VaFWIS Search Report Compiled on 1/6/2010, 3:01:07 PM

Database Search in (171) Shenandoah [County], VA

104 Known or Likely Species ordered by Status Concern for Conservation (displaying first 44) (44 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
050023	FESE	I	Bat, Indiana	Myotis sodalis	Yes	BOVA,HU6,Collections
050035	FESE	II	Bat, Virginia big-eared	Corynorhinus townsendii virginianus		HU6
200010	FEST		Rock-cress, shale barren	Arabis serotina	Yes	Collections
060006	SE	II	Floater, brook	Alasmidonta varicosa	Yes	BOVA,HU6,Collections,TEWater
060201	FSSE	II	Springsnail, Appalachian	Fontigens bottimeri	Yes	HU6,TEWater
030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes	BOVA,HU6,Collections,ObsBook,TEWater
040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	BOVA,HU6,BBA,CBC,Collections
040129	ST	I	Sandpiper, upland	Bartramia longicauda	Yes	BOVA,HU6,Collections
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,BBA,BBS,CBC,Collections
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,CBC,Collections,ObsBook
060081	ST	II	Floater, green	Lasmigona subviridis	Yes	BOVA,HU6,Collections,TEWater
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia		BOVA,HU6
060050	FSSS	II	Pigtoe, Tennessee	Fusconaia barnesiana		BOVA
100329	FS	II	Beetle, Avernus cave	Pseudanopthalmus avernus		HU6
100340	FS	II	Beetle, mud-dwelling cave	Pseudanopthalmus limicola		HU6
100343	FS	II	Beetle, thin-neck	Pseudanopthalmus		HU6

			cave	parvicollis		
110278	FS	II	PSEUDOSCORPION, CAVE	Mundochthonius holsingeri		HU6
110281	FS	II	PSEUDOSCORPION, CAVE	Chitrella superba		HU6
060029	FSSS	III	Lance, yellow	Elliptio lanceolata		HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	BBA,CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera	Yes	BOVA,HU6,BBA,BBS,Collections
020027	SS	II	Salamander, Cow Knob	Plethodon punctatus		BOVA,HU6
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC,Collections
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,CBC
030063	CC	III	Turtle, spotted	Clemmys guttata		HU6
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC,ObsBook
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,CBC
060071	SS	III	Lampmussel, yellow	Lampsilis cariosa	Yes	HU6,Collections
030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6
040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,BBA,CBC,Collections
040364	SS		Dickcissel	Spiza americana	Yes	BOVA,Collections
040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC
040241	SS		Flycatcher, alder	Empidonax alnorum		BOVA
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,CBC
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA

040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,CBC
040210	SS		Owl, long-eared	Asio otus	Yes	CBC,Collections
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC
040319		I	Warbler, black-throated green	Dendroica virens	Yes	BOVA,BBA

To view **All 104 species** [View 104](#)

* FE=Federal Endangered; FT=Federal Threatened; SE=State Endangered; ST=State Threatened; FP=Federal Proposed; FC=Federal Candidate; FS=Federal Species of Concern; SC=State Candidate; CC=Collection Concern; SS=State Special Concern

** I=VA Wildlife Action Plan - Tier I - Critical Conservation Need; II=VA Wildlife Action Plan - Tier II - Very High Conservation Need; III=VA Wildlife Action Plan - Tier III - High Conservation Need; IV=VA Wildlife Action Plan - Tier IV - Moderate Conservation Need

[View Map of All Query Results from All Observation Tables](#)

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

(10 records)

[View Map of All Fish Impediments](#)

ID	Name	River	View Map
1153	BURNSHIRE DAM	NORTH FORK SHENANDOAH RIVER	Yes
1123	CARROLL DAM	ALUM RUN	Yes

1127	CHAPMAN	N FK SHENANDOAH	Yes
1128	EDINBURG DAM	NORTH FORK SHENANDOAH RIVER	Yes
1141	MCCAFFREY DAM	NORTH FORK SHENANDOAH RIVER	Yes
1124	SEVEN FOUNTAINS DAM	TR-PASSAGE CREEK	Yes
1122	STONY CREEK DAM #9	STONY CREEK	Yes
1126	STRASBURG DAM	LITTLE PASSAGE CREEK	Yes
1125	WOODSTOCK DAM	LITTLE STONY CREEK	Yes
1129	WUNDER POND DAM	HOLMANS CREEK	Yes

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(23 Reaches - displaying first 20)

[View Map of All Threatened and Endangered Waters](#)

VaFWIS Search Report Compiled on 1/6/2010, 3:16:37 PM

Database Search in (187) Warren [County], VA

89 Known or Likely Species ordered by Status Concern for Conservation
(displaying first 36) (36 species with Status* or Tier I**)

BOVA Code	Status*	Tier**	Common Name	Scientific Name	Confirmed	Database(s)
050023	FESE	I	Bat, Indiana	Myotis sodalis		HU6
070001	FTST	II	Isopod, Madison Cave	Antrolana lira	Yes	HU6,Collections
040267	SE	I	Wren, Bewick's	Thryomanes bewickii		BOVA
060006	SE	II	Floater, brook	Alasmidonta varicosa	Yes	BOVA,HU6,Collections,TEWater
030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes	BOVA,HU6,Collections,TEWater

040096	ST	I	Falcon, peregrine	Falco peregrinus	Yes	BOVA,HU6,CBC
040129	ST	I	Sandpiper, upland	Bartramia longicauda	Yes	BOVA,HU6,Collections
040293	ST	I	Shrike, loggerhead	Lanius ludovicianus	Yes	BOVA,HU6,BBA,CBC,Collections
100155	FSST	I	Skipper, Appalachian grizzled	Pyrgus wyandot		HU6
040093	FSST	II	Eagle, bald	Haliaeetus leucocephalus	Yes	BOVA,HU6,CBC
060081	ST	II	Floater, green	Lasmigona subviridis	Yes	HU6,Collections,TEWater
040292	ST		Shrike, migrant loggerhead	Lanius ludovicianus migrans		BOVA
100248	FS	I	Fritillary, regal	Speyeria idalia idalia		BOVA,HU6
100344	FS	II	Beetle, Petrunkevitch's cave	Pseudanophthalmus petrunkevitchi		HU6
040372	SS	I	Crossbill, red	Loxia curvirostra	Yes	CBC
040306	SS	I	Warbler, golden-winged	Vermivora chrysoptera	Yes	BOVA,HU6,BBA
040213	SS	II	Owl, northern saw-whet	Aegolius acadicus	Yes	HU6,CBC
040266	SS	II	Wren, winter	Troglodytes troglodytes	Yes	BOVA,HU6,CBC
030063	CC	III	Turtle, spotted	Clemmys guttata		HU6
040094	SS	III	Harrier, northern	Circus cyaneus	Yes	BOVA,HU6,CBC
040204	SS	III	Owl, barn	Tyto alba pratincola	Yes	BOVA,HU6,CBC
040270	SS	III	Wren, sedge	Cistothorus platensis		HU6
060071	SS	III	Lampmussel, yellow	Lampsilis cariosa	Yes	HU6,Collections
030012	CC	IV	Rattlesnake, timber	Crotalus horridus		HU6
040264	SS	IV	Creeper, brown	Certhia americana	Yes	BOVA,HU6,BBA,CBC,Collections

040364	SS		Dickcissel	Spiza americana		BOVA
040366	SS		Finch, purple	Carpodacus purpureus	Yes	BOVA,CBC
040285	SS		Kinglet, golden-crowned	Regulus satrapa	Yes	BOVA,CBC
040112	SS		Moorhen, common	Gallinula chloropus cachinnans		BOVA
040262	SS		Nuthatch, red-breasted	Sitta canadensis	Yes	BOVA,CBC
040210	SS		Owl, long-eared	Asio otus	Yes	CBC
040278	SS		Thrush, hermit	Catharus guttatus	Yes	BOVA,CBC,Collections
040314	SS		Warbler, magnolia	Dendroica magnolia		BOVA
050045	SS		Otter, northern river	Lontra canadensis lataxina		BOVA
040225		I	Sapsucker, yellow-bellied	Sphyrapicus varius	Yes	BOVA,CBC
040319		I	Warbler, black-throated green	Dendroica virens	Yes	BOVA,BBA

To view **All 89 species** [View 89](#)

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[View Map of All Query Results from All Observation Tables](#)

Anadromous Fish Use Streams

N/A

Impediments to Fish Passage

(13 records)

[View Map of All Fish Impediments](#)

ID	Name	River	View Map
1138	APPLE MOUNTAIN LAKE DAM	OREGON HOLLOW	Yes
1139	APPLE MOUNTAIN UPPER LAKE DAM	OREGON HOLLOW	Yes
1135	COOLEY DAM	MOLLY CAMEL RUN	Yes
1133	DEER DAM	TR-HOWARDSVILLE BRANCH	Yes
1134	FRONT ROYAL DAM	SLOAN CREEK(OFF STREAM)	Yes
1131	LAKE JOHN DAM	MOLLY BOOTH RUN	Yes
1130	LAKE OF THE CLOUDS DAM	VENUS BRANCH	Yes
1140	LOCH LINDEN DAM	TR-OREGON HOLLOW	Yes
1141	MCCAFFREY DAM	NORTH FORK SHENANDOAH RIVER	Yes
1132	SPRING LAKE DAM	TR-VENUS BRANCH	Yes
1136	SULLIVAN DAM	DRY RUN	Yes
1137	WARREN	SHENANDOAH R	Yes
1147	WINCHESTER WATER SUPPLY DAM	NORTH FORK SHENANDOAH RIVER	Yes

Colonial Water Bird Survey

N/A

Threatened and Endangered Waters

(3 Reaches)

[View Map of All Threatened and Endangered Waters](#)

Stream Name	T&E Waters Species						View Map
	Highest TE*	BOVA Code, Status*, Tier**, Common & Scientific Name					
North Fork Shenandoah River (02070006)	SE	060006	SE	II	Floater, brook	Alasmidonta varicosa	Yes

		060081	ST	II	Floater, green	Lasmigona subviridis	
Cedar Creek (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes
Passage Creek (02070006)	ST	030062	ST	I	Turtle, wood	Glyptemys insculpta	Yes

Cold Water Stream Survey (Trout Streams)

Managed Trout Species