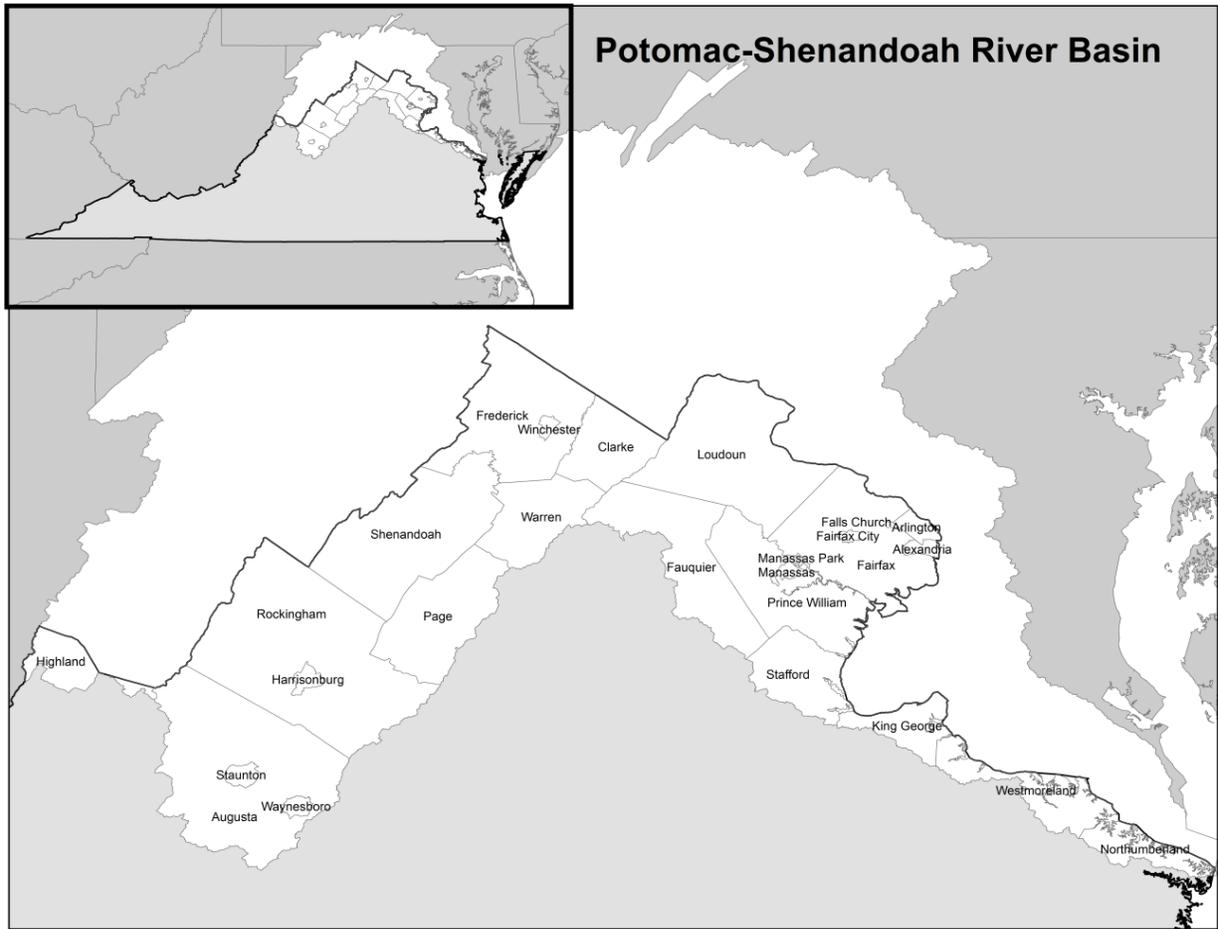


## Potomac-Shenandoah River Basin Summary

For a full description of localities included in the water supply plans, as well as explanations of various terms and concepts used throughout this summary, please review the Introduction to the State Plan Appendices.

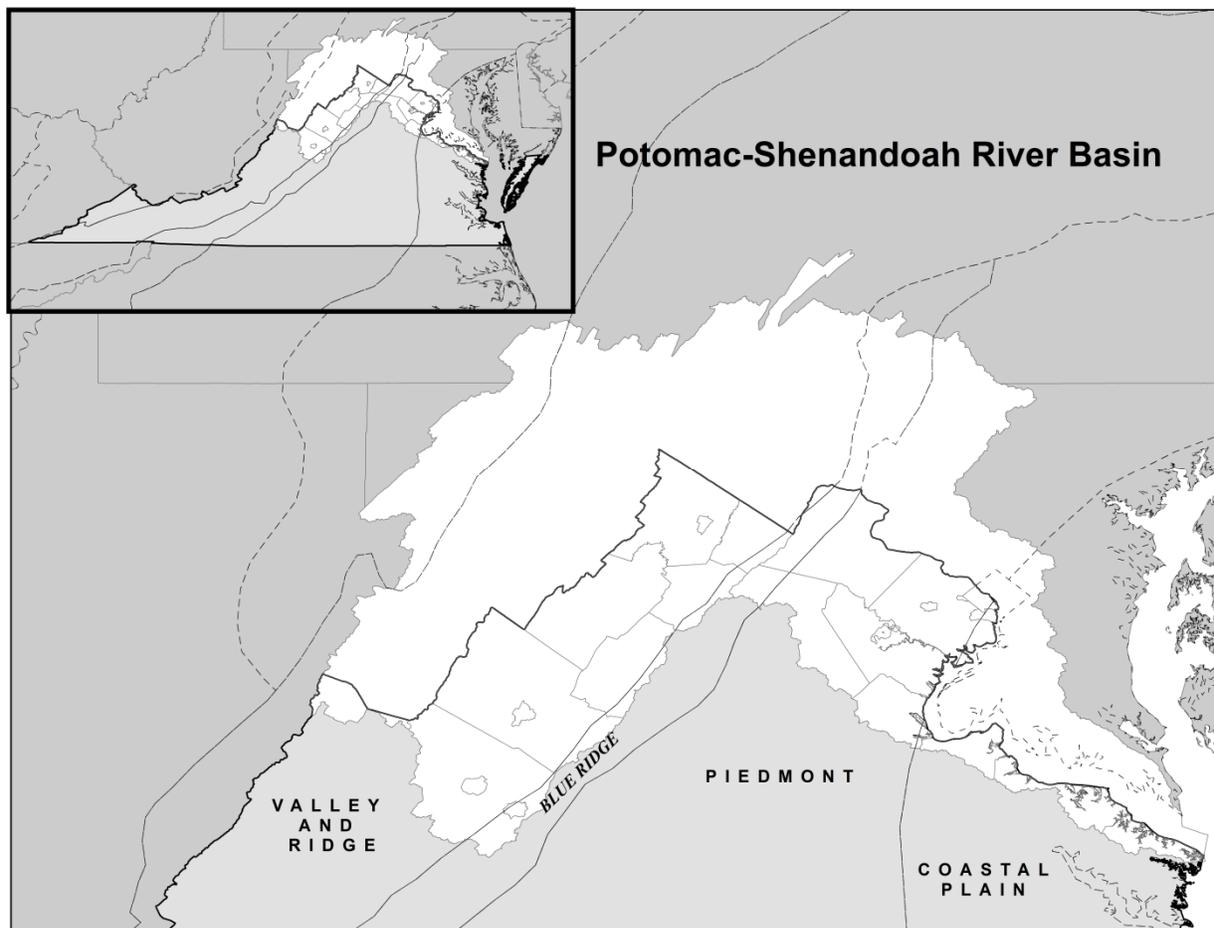
The Potomac-Shenandoah River Basin stretches across parts of four states (Maryland, Pennsylvania, Virginia, and West Virginia) as well as the District of Columbia. As its name implies, the Basin is made up of the Shenandoah River and the Potomac River sub-basins, occupying the northern portion of Virginia and covering 5,681 square miles, or approximately 13% of the Commonwealth's total area. In Virginia, the Potomac-Shenandoah River Basin is defined by both hydrologic and political boundaries. The James River and Rappahannock River Basins border the Basin to the south. The West Virginia and Maryland State lines and the District of Columbia border the northern and western perimeters of the Basin.

All or part of the following jurisdictions lie within the Basin: the Counties of Arlington, Augusta, Clarke, Fairfax, Fauquier, Frederick, Highland, King George, Loudoun, Northumberland, Page, Prince William, Rockingham, Shenandoah, Stafford, Warren, and Westmoreland; the Cities of Alexandria, Fairfax, Falls Church, Harrisonburg, Manassas, Manassas Park, Staunton, Waynesboro, and Winchester. These jurisdictions are represented within six regional water supply plans (Fauquier County and Towns, Northern Neck, Northern Shenandoah, Northern Virginia, Upper James, and Upper Shenandoah) and four local water supply plan (Town of Hillsboro, King George County, Stafford County, and the Town of Warrenton).



Potomac-Shenandoah River Basin Localities

The Basin lies in five geological provinces: the Appalachian Plateau, the Ridge and Valley, Blue Ridge, Piedmont Plateau, and the Coastal Plain.



Potomac-Shenandoah River Basin Physiographic Provinces

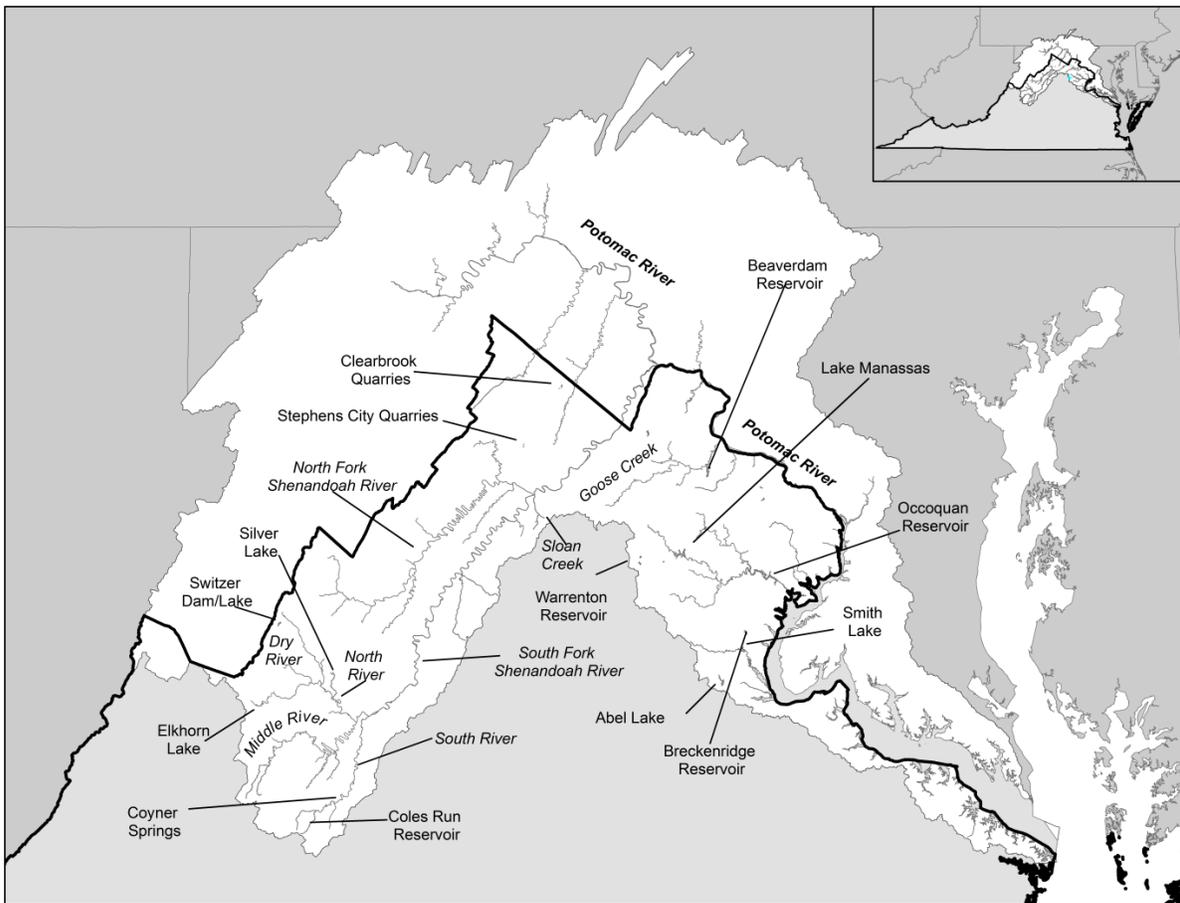
Approximately 2,298 of the 14,700 square miles of the Potomac River sub-basin drainage area lie in Virginia; the rest are found in three states (Maryland, Pennsylvania, and West Virginia) and the District of Columbia. About 40% of the Potomac River sub-basin's land area is forested, 33 percent is farmland and pasture, and an estimated 27% is urban. Similarly, approximately 45% of the land area in the Shenandoah River sub-basin is forested, due to a large amount of federally-owned land and the steep topography. Farmland and pasture account for 39% of the Shenandoah sub-basins land area, while 16% is urban. Major industries in the Basin include agriculture and forestry throughout the Basin; chemical production and agriculture in the Shenandoah Valley; high-tech service and light industry in northern Virginia; and fishing the lower Potomac estuary.

The Potomac-Shenandoah River Basin is divided into eight USGS hydrologic unit codes (HUC) as follows: HUC 02070001- South Branch Potomac; HUC 02070004 - Conococheague-Opequon; HUC 02070005 - South Fork Shenandoah; HUC 02070006 - North Fork Shenandoah; HUC 02070007 - Shenandoah; HUC 02070008 - Middle Potomac-Catoctin; HUC 02070010 - Middle Potomac-Anacostia-

Occoquan; HUC 02070011 - Lower Potomac.ac-Catoctin; HUC 02070010 - Middle Potomac-Anacostia-Occoquan; HUC 02070011 - Lower Potomac. The eight hydrologic units are further divided into 92 waterbodies or watersheds and 181 6th order sub-watersheds.

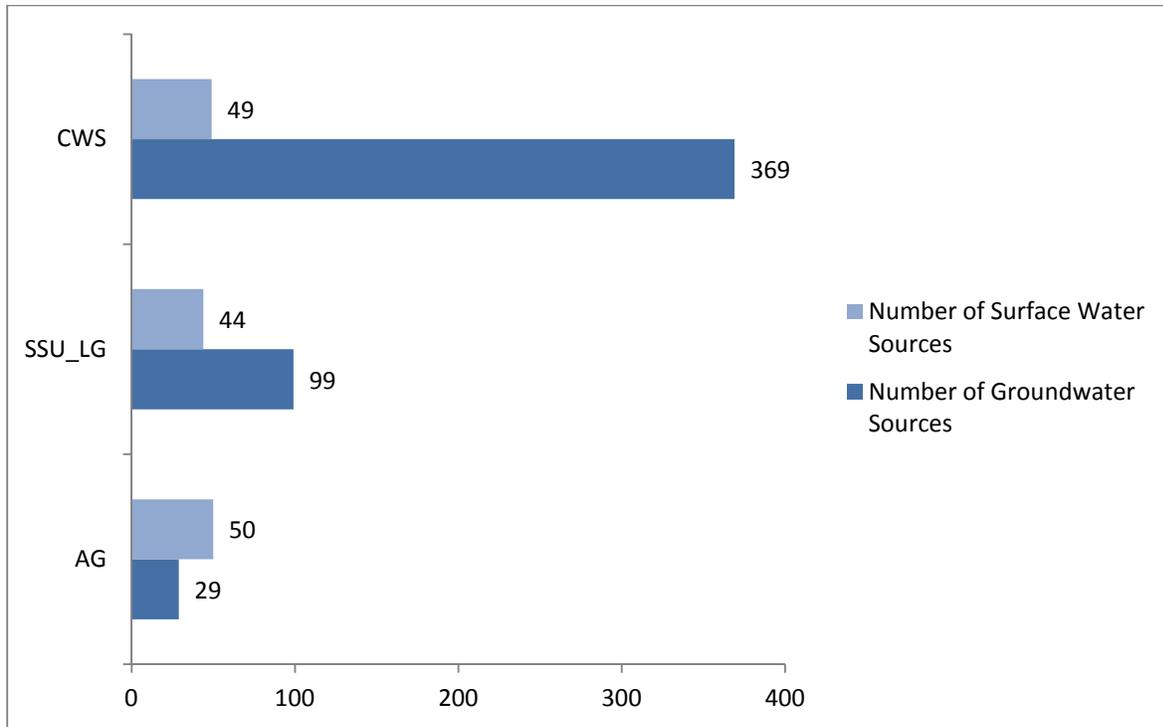
#### Existing Water Sources

Water sources in the Basin include stream intakes, reservoirs, springs, and groundwater. Surface water sources (reservoirs, streams, and springs) account for 143 withdrawals. Additionally, there are 497 groundwater withdrawals currently identified in the Potomac-Shenandoah River Basin. Source water reservoirs include Abel Lake, Airlie Reservoir, Beaverdam Creek Reservoir, Breckenridge-Lunga Reservoir, Clear Brook Quarry, Elkhorn Lake, Hirst Reservoir, Lake Manassas, Occoquan Reservoir, Rocky Pen Run Reservoir, Silver Lake, Smith Lake, Coles Run Reservoir, Stephens City Quarries, Switzer Lake, and Warrenton Reservoir. Stream intakes and spring sources used in the Basin include the Dry River, Middle River, North River, Potomac River, Shenandoah River, South River, Back Creek, Broad Run, Christian's Creek, Cook's Creek, Dam Creek, Daniel's Run, Goose Creek, Happy Creek, Hawksbill Creek, Jeb's Creek, Linville Creek, Lodge Creek, Meadow Run, Mill Creek, Mossy Creek, Pass Run, Passage Creek, Pogue Run, Potomac Creek, Sloan Creek, Smith Creek, Spring Creek, Stony Creek, Baker Spring, Coyner Spring, Elk Run Spring, Gardner Spring, Hite Spring, Quicks Spring, Rawley Spring, and Vandevender Spring.



Potomac-Shenandoah River Basin Reservoirs and Stream Sources

Reported groundwater sources outnumber surface water sources in all use types except for agriculture. The number of groundwater sources for the SSU\_SM use type is unknown and, therefore, is not included in the figure below. As estimated for the year 2010, approximately 500,630 people in the Basin use private groundwater wells for residential water supply.



Potomac-Shenandoah River Basin Source Type by User Type

Nontraditional water sources, such as water reclamation and reuse, desalination, and interconnection are not commonly utilized by localities in the Commonwealth. Four facilities located in the Potomac-Shenandoah River Basin are permitted to generate and distribute reclaimed water: Loudoun Water (Broad Run Water Reclamation Facility) is permitted to generate and distribute up to 11 MGD of reclaimed water to a data center for cooling and to the National Rural Water Utilities Cooperative Finance Corporation for indoor toilet/urinal flushing, commercial air conditioning, non-bulk irrigation use, and non-residential fire suppression. Loudoun Water (Courtland Farms WTP) is permitted to generate and distribute up to 0.08 MGD of reclaimed water to a golf course for irrigation. Fairfax County (Noman M. Cole Jr. Pollution Control Plant) is permitted to generate and distribute up to 6.6 MGD to a waste to energy facility for cooling and to a golf course and recreational ball fields owned by the county for irrigation. Fauquier County Water and Sanitation Authority (Remington WWTF) is permitted to discharge up to 2.5 MGD to the Rappahannock River. The treatment plant provides up to 0.5 MGD of effluent to a natural gas, power generation facility for cooling, stack scrubbing, turbine washing, and fire suppression. Upper Occoquan Service Authority is permitted to discharge up to 64 MGD of treated effluent into a tributary of the Occoquan Reservoir.

## Transfers

Water withdrawn in the Basin may be used by the withdrawing user, or it may be transferred to another user. The transfer of water within and between river basins is a demand management practice that can address water supply and/or water quality needs by moving water from a basin or sub-basin with surplus supply to a basin or sub-basin with a supply deficit. Most often this practice of transferring water across sub-basin boundaries within a river basin - intrabasin transfers - occurs within a single county, but they can occur across county lines. Water movement that occurs when water is withdrawn from one major basin and transferred to a user in another major basin is called an interbasin transfer. Interbasin transfers of water are less common in Virginia. There are no reported interbasin transfers in the Potomac-Shenandoah River Basin.

The following table lists the Potomac-Shenandoah intrabasin transfers between water providers and the entities to which they sell water (water purchasers).

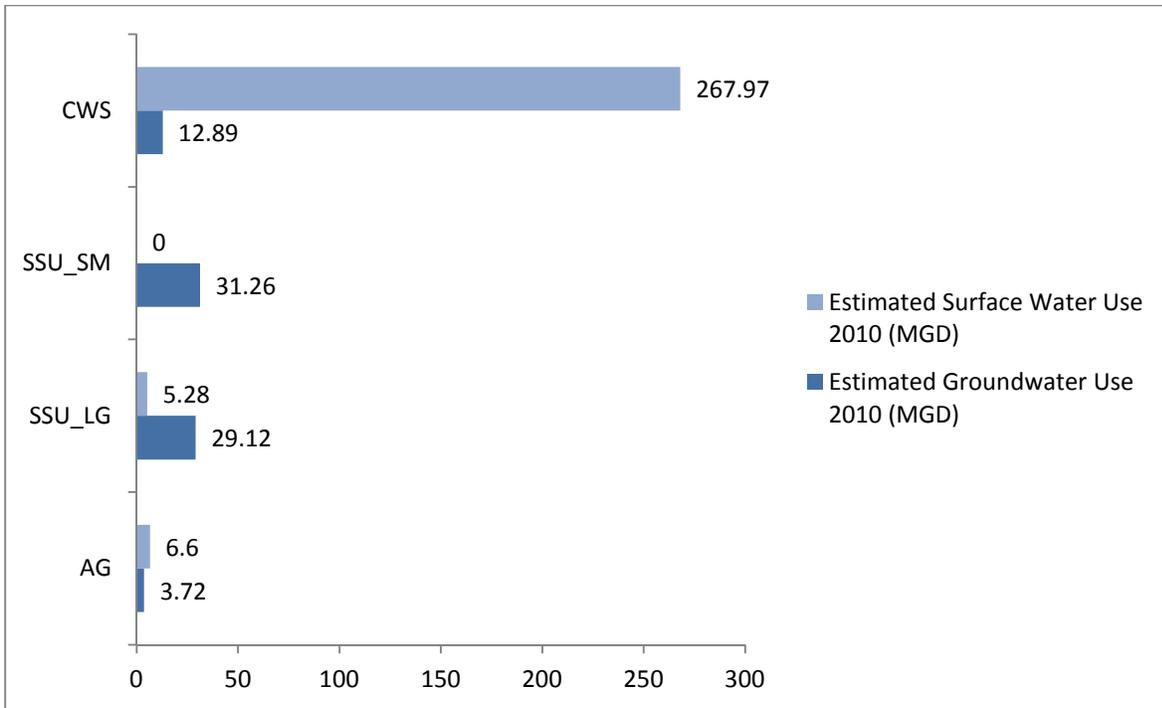
User Type	Water Purchaser and System(s)	Water Provider
CWS	Augusta County Service Authority (SA) – Blackburn, South River, Verona, Rt. 250 West	City of Staunton
CWS	Augusta County SA - Estaline Valley	Town of Craigsville
CWS	Fort Belvoir	Fairfax Water
CWS	City of Fairfax	Fairfax Water
CWS	Loudoun Water - Central System	Fairfax Water
CWS	Prince William County SA - Oak Ridge, OWDT	Fairfax Water
CWS	VA American Water Company - Dale City	Fairfax Water
CWS	Prince William County SA - Greater Manassas, Manassas Southside	Fairfax Water, City of Manassas
CWS	Fairfax Water	City of Fairfax
CWS	Loudoun Water - Central System	City of Fairfax
CWS	Fairfax Water	City of Falls Church
CWS	Town of Vienna	City of Falls Church
CWS	City of Manassas Park	City of Manassas
CWS	City of Manassas	Prince William County SA
CWS	City of Manassas Park	Prince William County SA

CWS	Town of Quantico	Quantico Marine Corps Base
CWS	Rockingham Co. - Countryside Sanitary District	Town of Bridgewater
CWS	Rockingham Co. - Harmony Hills, Rosedale Subdivision, RR Donnelly/Smith Creek	City of Harrisonburg
CWS	Fairfax Water	Town of Vienna
CWS	Arlington County	Washington Aqueduct
CWS	Town of Falls Church	Washington Aqueduct
SSU_LG	Reagan National Airport	Arlington County or Washington Aqueduct
SSU_LG	Federal Mogul Friction Product - Winchester Plant	City of Winchester
SSU_LG	Dulles International Airport	Fairfax Water or other

Potomac-Shenandoah River Basin Intrabasin Transfers

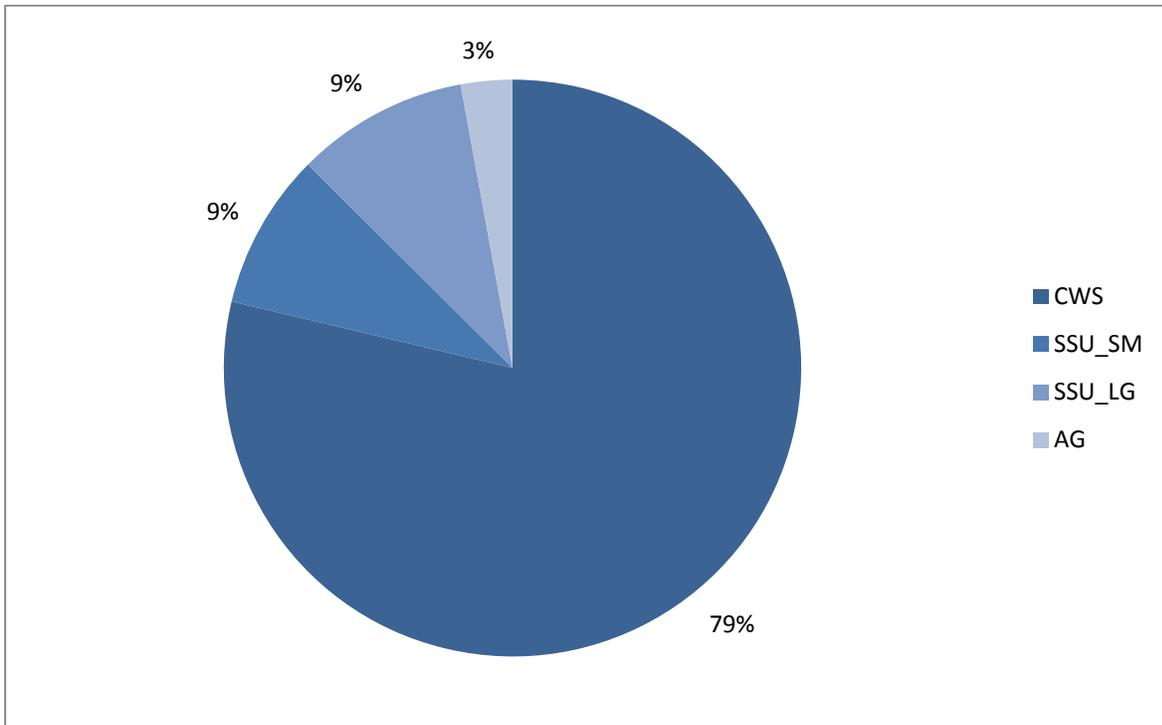
Existing Water Use

The total estimated water use by source and user type provided in the local and regional water supply plans is summarized in the following figure. The total estimated water use is approximately 357 MGD, with 280 MGD withdrawn from surface water sources and 77 MGD from groundwater sources. Although the number of groundwater withdrawals far exceeds surface water withdrawals in the Potomac-Shenandoah River Basin, the estimated existing use from surface water sources exceeds that of groundwater by a significant margin.



Potomac-Shenandoah River Basin Estimated Use by Source and Type

CWS used an estimated 79% of the total water in the Basin followed by SSU\_LG and SSU\_SM (both 9%), and AG (3%).

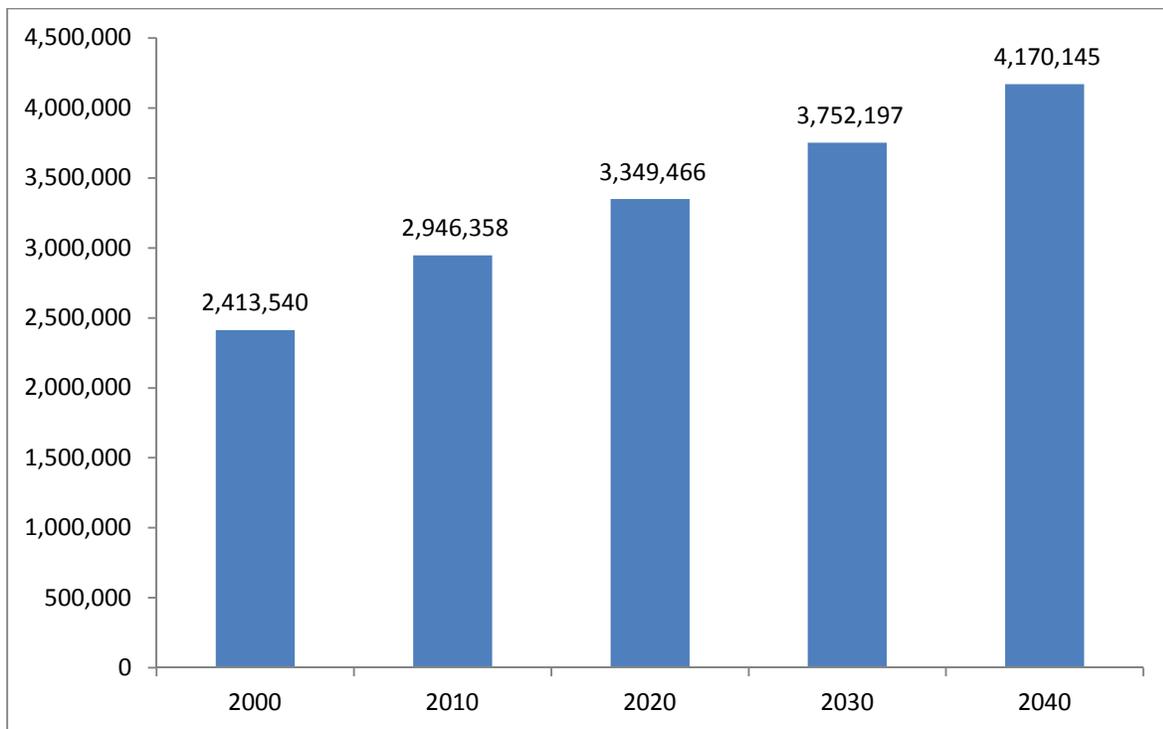


Potomac-Shenandoah River Basin 2010 Estimated Use by User Type

CWS reported their water use disaggregated into categories of use appropriate for the system. Categories commonly used included Residential, Commercial/Institutional/Light Industrial (CIL), Heavy Industrial, Military, Unaccounted for Water Losses, Production Processes, and Sales to other CWS. In addition, some CWS chose to include a category for “Other” use. Many smaller CWS did not report disaggregated use as required. No assumption on disaggregated use was made for these systems; they are not included in this chart. The majority of water used by CWS is for residential supply.

### Projected Water Demand

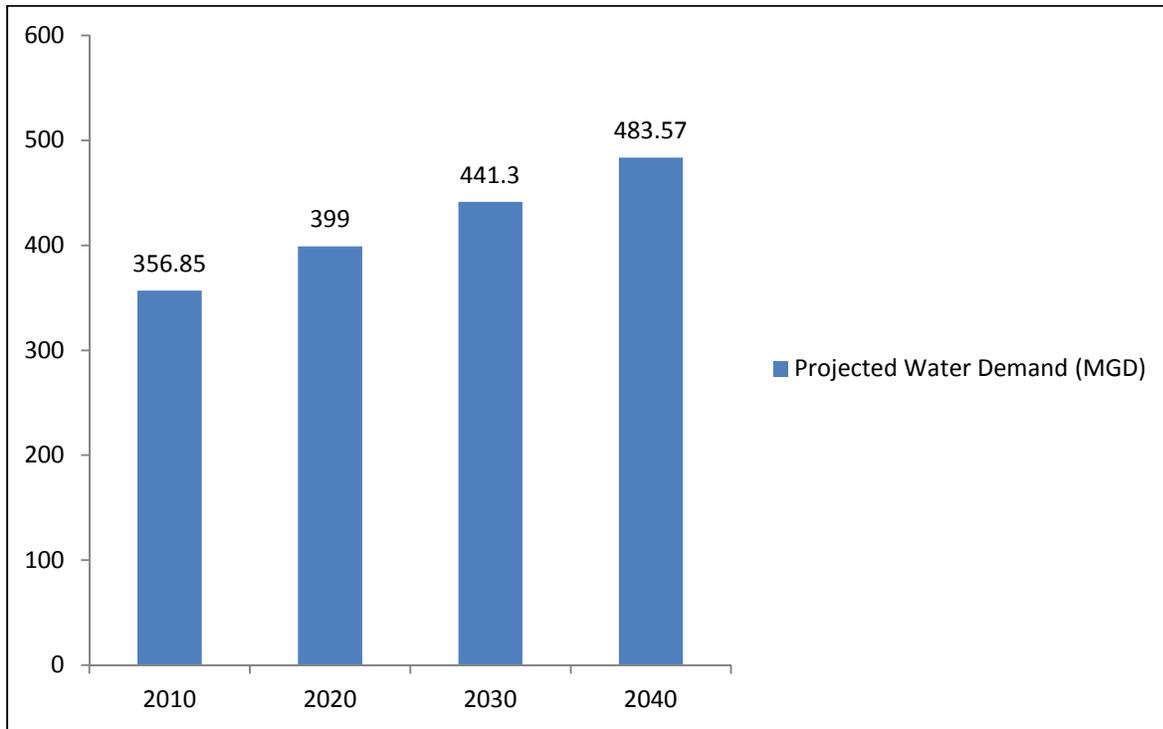
The projected population of the localities with at least a portion of their area in the Potomac-Shenandoah River Basin is displayed in the following figure. Population data was obtained from the Virginia Employment Commission’s population estimates, which rely on data produced by the United States Census Bureau. The overall population of the localities is projected to increase through the year 2040. By the year 2040 the estimated basin-wide population is projected at 4,170,145. The percent increase in population from the years 2000 through 2040 is estimated at 41.5%.



Potomac-Shenandoah River Basin Projected Population by Decade

A 30- to 50-year projection of future water demand is required by the WSP Regulation. Thirty years is the period of time common to all plans, so data is analyzed here for the timeframe of 2010 through 2040. The total projected water demand in the Potomac-Shenandoah River Basin, as reported in the regional

water supply plans, is estimated to increase from approximately 357 MGD to 484 MGD in 2040. The percentage change in water use during the 30-year timeframe is estimated at 32.6%.



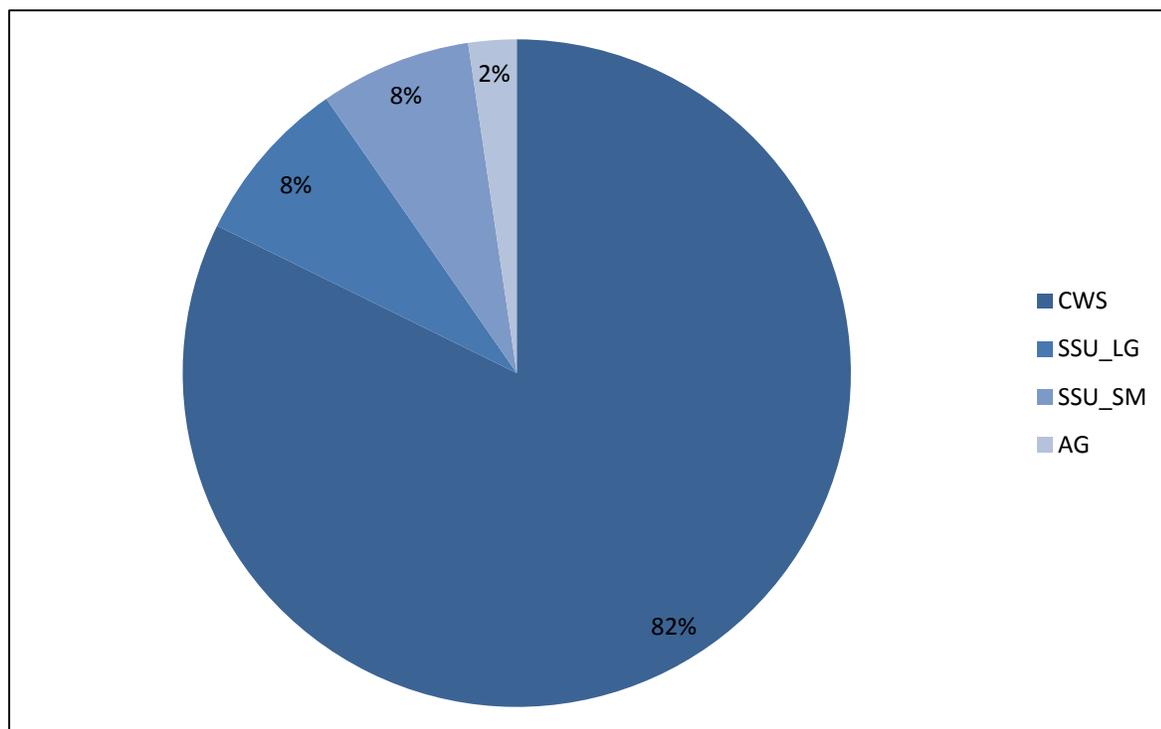
Potomac-Shenandoah River Basin Projected Water Demand

As depicted in the following table, the majority of the Basin's growth is expected to occur within CWS service areas, with a projected 35.7% increase in water demand over the 30-year period. Projected water demand for SSU\_LG has the next highest percentage growth (13.6%), followed by SSU\_SM (13.5%), and AG with 9%. The anticipated growth in AG water demand is a best guess on the part of the planning partners, as withdrawal data is limited and water use on an annual basis (in particular for crop irrigation) may change depending upon precipitation.

User Type	Reported Use 2010 MGD	Projected Demand 2020 MGD	Projected Demand 2030 MGD	Projected Demand 2040 MGD	Percent Change (2010-2040)
CWS	280.87	319.87	358.9	397.87	35.7%
SSU_LG	34.4	35.93	37.4	38.97	13.6%
SSU_SM	31.26	32.67	34.1	35.47	13.5%
AG	10.32	10.63	10.9	11.25	9.0%

Potomac-Shenandoah River Basin Projected Water Demand by User Type (2010-2040)

In the year 2040, CWS demand is estimated at 82% of the total demand for the Basin, followed by SSU\_LG and SSU\_SM (both at 8%), and AG accounting for 2%.



Potomac-Shenandoah River Basin Percentage of Projected 2040 Demand by User Type

#### Statement of Need and Alternative Water Sources

The following review of future water needs is obtained from the six regional and four local water supply plans represented in the Potomac-Shenandoah River Basin. The information is presented for all those localities with at least a portion of land area located within the Potomac/Shenandoah River Basin. The following lists the projected deficits in the Basin.

#### **Fauquier County Regional Water Supply Plan**

Fauquier County and the Towns of Remington and The Plains

Regional water supplies appear to be adequate to meet current and future demands through the planning period

#### **Town of Hillsboro Water Supply Plan**

The well and spring used by the town are inadequate, both from a quality and quantity standpoint. The Town has been under a VDH-imposed consent order and boil water notice since 2005, as the spring is under the influence of surface water. In March of 2012, Hillsboro submitted to the VDH-ODW a Grant Application for the Financial and Construction Assistance Programs to construct a new well, connect it

to the existing system, and provide additional storage and infrastructure improvements to the system. In November 2012, VDH approved a total funding package of \$1,200,000 for the project. It consists of a \$720,000 DWSRF loan at 2.5% interest for a term of 30 years and \$480,000 in grant funding from the Water Supply Assistance Grant Fund. Construction was projected to begin by late fall 2013.

### **King George County Water Supply Plan**

A water supply deficit of 1.5 to 2.0 MGD is estimated in the year 2030 for the King George County community water systems. A water supply deficit of 1.0 to 1.5 MGD is estimated in the year 2030 for self-supplied residential users in King George County. Alternative water sources identified include wastewater reuse, interconnection with a neighboring locality, reservoir development, and an intake on the Rappahannock River.

### **Northern Neck Regional Water Supply Plan**

Northumberland County; Westmoreland County and the Towns of Colonial Beach and Montross Regional water supply appears to be adequate to meet demand through the planning period.

### **Northern Shenandoah Regional Water Supply Plan**

Clarke County and the Towns of Berryville and Boyce; Frederick County and the Towns of Middletown and Stephens City; Page County and the Towns of Luray, Shenandoah, and Stanley; Shenandoah County and the Towns of Edinburg, Mt. Jackson, New Market, Strasburg, Toms Brook, and Woodstock; Warren County and the Town of Front Royal; City of Winchester

The plan states that, through careful planning and conservation efforts, there will be sufficient water to support the majority of needs through the year 2040. Based on current supply, a deficit of 0.81 MGD is anticipated to occur in Frederick County by 2030. Frederick County Sanitation Authority alternatives include quarry expansion and groundwater well improvements.

### **Northern Virginia Regional Water Supply Plan**

Arlington County; Fairfax County and the Towns of Clifton, Herndon, and Vienna; Loudoun County and the Towns of Hamilton, Leesburg, Lovettsville, Middleburg, Purcellville, and Round Hill; Prince William County and the Towns of Dumfries, Haymarket, Occoquan, and Quantico; Cities of Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park

The City of Fairfax is expected to experience a water deficit around 2038, with a total deficit of almost 0.20 MGD by 2040. The Town of Purcellville had a water supply deficit in 2007 until additional well sources were placed online later that year. The Town will maintain a water supply surplus until 2038 and, without additional water, a deficit of approximately 0.07 MGD may occur in 2040. The region's plan to address the projected shortfall of municipal supply includes constructing a stream intake/pumping station on the Potomac estuary below Little Falls (recently permitted by DEQ); utilizing a reverse osmosis

membrane treatment plant on the Occoquan estuary, using quarries located in Fairfax County to augment Fairfax Water storage, and using Loudoun County quarries to augment system storage (recently permitted by DEQ).

### **Stafford County Regional Water Supply Plan**

Stafford County is projected to experience a water supply deficit sometime between 2010 and 2015. Based on this analysis, new water supplies capable of providing at least 14.7 MGD of additional treated water safe yield are needed to meet the County's projected 2050 demand of 27.7 MGD (with additional conservation). Accounting for estimated raw water transmission and treatment losses of 6%, at least 15.6 MGD of additional raw water safe yield is needed to meet projected 2050 demand. The region plans to address a projected shortfall of municipal supply by completing the construction of the Rocky Pen Run Reservoir project and pursuing other surface and groundwater alternatives as needed. Additional alternatives listed in the plan include expansion of existing Abel Lake; increase dam height at Rocky Pen Run facility, development of Potomac River and Rappahannock River tributaries for surface water reservoirs (Austin Run, Aquia Creek, Potomac Run, Long Branch Creek, Alcott Run), development of off-stream pumped storage reservoirs adjacent to the Rappahannock River (Alcott Run, Horsepen Run, Richland Run, increase to Rocky Pen Run facility), development of Vulcan Quarry offline storage reservoir adjacent to Aquia Creek, desalination of Potomac River water, and groundwater development.

### **Upper James River Basin Water Supply Plan**

Highland County and the Town of Monterey

Population and demand will remain constant through 2040; therefore, existing water sources are anticipated to be adequate.

### **Upper Shenandoah Regional Water Supply Plan**

Augusta County and the Town of Craigsville; Rockingham County and the Towns of Bridgewater, Broadway, Dayton, Elkton, Grottoes, Mount Crawford, and Timberville; Cities of Harrisonburg, Staunton, and Waynesboro

Water demand is anticipated to increase during the planning period, as is population, which is projected to increase by 3% in Rockingham and Augusta counties. Population is anticipated to increase far more significantly in the cities and towns: 175% in Harrisonburg, 37% in Waynesboro, and 20% in Staunton; and ranging from 49% to over 300% in the towns. The Plan concludes that although water sources overall within the region will be adequate to meet projected demand, when examined individually, the counties of Augusta and Rockingham and the towns of Bridgewater, Broadway, Grottoes, Mt. Crawford, and Timberville show potential deficits by the year 2040 compared to existing permitted sources.

Augusta County (August County Service Authority) deficit of 0.83 MGD by 2027

Rockingham County (includes the Town of Mount Crawford) deficit of 1.272 MGD by 2020

Town of Bridgewater deficit of 0.05 MGD by 2030

Town of Broadway deficit of 0.23 MGD by 2040

Town of Grottoes deficit of 0.01 MGD by 2040

Town of Timberville deficit of 0.04 MGD by 2040

Development of new wells and treatment facilities; plant upgrades to provide additional supply and treatment capacity; development of new stream intakes, pump stations, and pipelines to provide additional source water; and development of purchase water agreements from neighboring jurisdictions and inter-jurisdictional collaboration on new infrastructure projects.

### **Town of Warrenton Water Supply Plan**

Existing service area build-out demand projections are in line with water supply resources, and a deficit is not anticipated during the planning period.

Locality	Estimated Year of Deficit	Estimated Deficit Amount (MGD)
Augusta County	2027	0.83
Rockingham County	2020	1.27
Town of Bridgewater	2030	0.05
Town of Broadway	2040	0.23
Town of Grottoes	2040	0.01
Town of Timberville	2040	0.04
King George County	2030	1.0 – 1.5
City of Fairfax	2040	0.20
Town of Purcellville	2040	0.07
Stafford County	2015 (Rocky Pen Run Reservoir completion date)	14.7
Frederick County	2030	0.81

Potomac-Shenandoah River Basin Projected Water Deficits