COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
Fax: 804-698-4019 - TDD (804) 698-4021
www.deq.virginia.gov

Douglas W. Domenech
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4020
1-800-592-5482

To: The Honorable Robert F. McDonnell

Members of the General Assembly

From: David K. Paylor

Date: October 1, 2012

Subject: Status of Virginia's Water Resources: A Report on Virginia's Water Resources Management Activities (2012)

In accordance with § 62.1-44.40 of the *Code of Virginia*, the Department of Environmental Quality (DEQ), on behalf of the State Water Control Board, I am pleased to provide you with the 2012 report "Status of Virginia's Water Resources: A Report on Virginia's Water Resources Management Activities." The purpose of this report is to provide a summary of the status of the Commonwealth's water resource supply. The report also provides a summary of DEQ's water supply and resource planning accomplishments for the year.

This report is being made available on DEQ's website at http://www.deq.virginia.gov/LawsRegulations/ReportstotheGeneralAssembly.aspx.

If you have any questions concerning this report or if you would like a hard copy of this report, please contact Angie Jenkins, Policy Director, at (804) 698-4268.

STATUS OF VIRGINIA'S WATER RESOURCES
A Report on Virginia's Water Resources Management Activities

A report to the Honorable Robert F. McDonnell, Governor and the General Assembly of Virginia

Virginia Department of Environmental Quality

October 2012

TABLE OF CONTENTS

FIGURES

FIGURES (continued)

TABLES

ACRONYMS

DEQ: DEPARTMENT OF ENVIRONMENTAL QUALITY

EPA: ENVIRONMENTAL PROTECTION AGENCY

FERC: FEDERAL ENGERY REGULATORY COMMISSION

GWCP: GROUNDWATER CHARACTERIZATION PROGRAM

GWMA: GROUNDWATER MANAGEMENT AREA

MGD: MILLION GALLONS PER DAY

NOIRA: NOTICE OF INTENDED REGULATORY AMENDMENT

NURE: NATIONAL URANIUM RESOURCE EVALUATION

PDC: PLANNING DISTRICT COMMISION

SWCB: STATE WATER CONTROL BOARD

SWIP: SURFACE WATER INVESTIGATIONS PROGRAM

TMDL: TOTAL MAXIMUM DAILY LOAD

USGS: UNITED STATES GEOLOGICAL SURVEY

VDH: VIRGINIA DEPARTMENT OF HEALTH

VWPP: VIRGINIA WATER PROTECTION PROGRAM

VWUDS: VIRGINIA WATER USE DATA SYSTEM

I. EXECUTIVE SUMMARY

This annual report, submitted to the Governor and the Virginia General Assembly in accordance with § 62.1-44.40 of the *Code of Virginia*, describes the status of the Commonwealth's surface and groundwater resources, provides an overview of climatological conditions and impacts on water supplies in the Commonwealth, and provides an update on the Commonwealth's Water Resources Management Program for the calendar year 2011, as well as an update regarding current 2012 conditions. Water quantity is the focus of this report. Water quality issues are addressed in the State's Water Quality Assessment Report which can be found at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments/2012305b303dIntegratedReport.aspx.

Virginia's estimated 52,232 miles of streams and rivers are part of nine major watersheds. Annual state-wide rainfall averages almost 43 inches. The total combined flow of all freshwater streams in the state is estimated at about 25 billion gallons per day. The 248 publicly owned lakes in the Commonwealth have a combined surface area of 130,344 acres. Additionally, many hundreds of other small privately owned lakes and ponds are distributed throughout the state. Other significant water features of Virginia include approximately 236,900 acres of tidal and coastal wetlands, 808,000 acres of freshwater wetlands, 120 miles of Atlantic Ocean coastline, and more than 2,300 square miles of estuaries. A summary of Virginia's surface water resources is provided in Appendix 1.

Precipitation in Virginia during the 2011-2012 water year (October 1, 2011 through September 30, 2012) has been variable spatially and generally below normal in many locations within the eastern half of the Commonwealth. Consequently, stream flows within many of the basins located in this part of the state have been lower than normal. Abnormally dry conditions, with subsequent low stream flows, have persisted particularly in the middle part of the James River basin and in the Chowan River basin.

Ground water levels west of I-95 and in shallow aquifers east of I-95 generally align with surface water levels. However, water levels in confined aquifers within the Atlantic Coastal Plain continued to decline. In the Franklin area, this decline was temporarily reversed by the shutdown of the International Paper Franklin mill during 2011. This mill, however, reopened in June of 2012; consequently ground water levels in this area began to return to pre-2011 levels.

The Office of Water Supply is a part of the Water Division of the Virginia Department of Environmental Quality (DEQ). The Office currently consists of three programs, including Groundwater Characterization, Water Supply Planning, and Water Withdrawal Permitting (See Section III for summaries of programs). The Office of Water Supply collaborates with other

state and federal programs to support local water resources planning. Programmatic highlights of the Office of Water Supply during 2011 include:

- Monitoring of 74 surface water stations, 77 real-time ground water stations and 178 additional wells, and 30 Total Maximum Daily Load (TMDL) data sites (Section III.A.)
- Three new real-time ground-water monitoring well clusters were added to the monitoring network in Bedford County, New Kent County and in Northumberland County (Section III.B.)
- Two groundwater resource reports (Groundwater Resources of the Blue Ridge Geologic Province and Groundwater Use in the Virginia Portion of the Shenandoah Valley) are anticipated for publication in September of 2012 (Section III.B.)
- The Ground Water Completion Report database was expanded by adding nearly 21,000 digital water well records (Section III.B.)
- Teaching and speaking engagements at six ground water-related educational events (Section III.B.)
- Receipt of and commencement of the review for 38 regional water supply plans and 10 local water supply plans (Section III.C.)
- Development of a new web-based data management tool to facilitate compilation and review of data submitted with water supply plans (Section III.C.)
- Continued work with the State Water Plan Advisory Committee to assist DEQ in developing, revising, and implementing the state water resources plan (Section III.C.)
- Issuance of 39 ground water withdrawal permits (17 new or expanded, 20 renewals, 2 modifications (Section III.D.)
- Issuance of 13 Virginia Water Protection (VWP) Program permits (6 new, 7 modifications) (Section III.D.)
- Acknowledgement that public water supplies continue to account for the greatest percentage of the total water use in Virginia (Section IV)
- Observation of continued demands on surface and ground water resources (Section V)
- Development of a plan to incorporate new hydrogeologic information on the coastal plain aquifer system into the ground water withdrawal permitting regulatory process used to evaluate the impacts of existing and proposed ground water withdrawals within the Coastal Plain and Eastern Shore regions (Section VI)
- The proposed expansion of the Eastern Virginia Ground Water Management area to include the counties in the Northern Neck region of the Virginia Coastal Plain (Section VI)
- Development of new statistical tools to predict summer low flows in streams based upon rainfall and stream flow monitoring data collected during the previous winter (Section VI)

Virginia's public health, environment, and economic growth depend on the availability of quality water resources. To assure water resources are available for future generations and the continued growth of Virginia, effective water resource management must continue to be

premised on a process that improves the quality and quantity of water available to the Commonwealth.

II CLIMATOLOGICAL CONDITIONS

This section provides an overview of the climatological conditions that have affected Virginia's Water Resources during the current 2011-2012 water year (October 1, 2011 through September 30, 2012). Appendix 2 contains the most recent report from the Virginia Drought Management Task Force, which includes a current update of climatic conditions from the Climatology Office of the University of Virginia.

Precipitation during the 2011-2012 water year has been variable while temperatures have been generally higher than normal. Statewide precipitation totals for the current water year are within the normal range (93% of normal). Normal precipitation is defined as the mean precipitation for a thirty year period of record. Precipitation over the western portions of the state has generally been above normal. However, much of the central and southern regions received less than normal precipitation during much of the year. The spring period (March through May) set the record (of 118 years) for the warmest, averaged statewide. Because of this, the rates of moisture loss were substantially higher than normal. In addition, most of the state's Drought Regions accumulated less precipitation than normal for the spring. A current update on drought conditions in Virginia, as well as descriptions of the Drought Regions can be obtained from the DEQ Drought Management website (Virginia DEQ - Drought Current Status).

III PROGRAM SUMMARIES

The Office of Water Supply currently consists of three programs: Ground Water Characterization, Water Supply Planning and Water Withdrawal Permitting. The Surface Water Investigations Program, which was part of the Office of Water Supply during 2011, was transferred to the Office of Wetlands and Stream Protection during 2012. Summaries of each of these programs follow, including updated information on their respective accomplishments during 2011.

Surface Water Investigations Program

VDEQ and the United States Geological Survey (USGS) are the primary agencies responsible for collecting hydrologic data in Virginia. The two agencies work cooperatively to provide a comprehensive picture of real-time and historical hydrologic conditions in the Commonwealth. The mission of the Surface Water Investigations Program (SWI) is to collect systematic and reliable hydrologic data regarding the quantity of surface water and elevation of ground water in the Commonwealth. This is accomplished through a network of real-time satellite telemetry gauging stations and is essential for the successful planning and management of the Commonwealth's water resources.

In 2011, SWI field personnel monitored 74 surface water gauges (Figure 1) on an eight week schedule, servicing the real-time satellite equipment and measuring stream flow ("discharge"). Over 500 discharge measurements were made by SWI personnel for the gauging station network in 2011. Stream depth, width and velocity are measured in the waterway to determine discharge. From these measurements, a rating curve is developed by correlating discharge with water level in the stream ("gauge height"). The gauge height is recorded by a data logger located in a permanent gauge house every 15 minutes, saved and transmitted to the USGS database hourly by satellite telemetry, converted into discharge, then updated on the USGS website (http://waterdata.usgs.gov/va/nwis/rt).

Under the Clean Water Act the EPA requires that each state develop a list of impaired water bodies and TMDLs. A TMDL or "Total Maximum Daily Load" is the maximum amount of pollutant that a body of water can have and still meet water quality standards. A TMDL calculation must account for seasonal variation in water quality. The SWI program is a major component of the Commonwealth's TMDL program, because it houses the sole hydrologist in the state that supplies the flow data. In 2011, SWI measured 30 miscellaneous TMDL sites.

The SWI office also provides reliable information on the elevation of the ground water in the Commonwealth to determine the availability of the natural resource. Field personnel monitor 77 real-time ground water stations (Figure 1). They measure the ground water elevation, and service the satellite data collection platforms on a 6-8 week schedule. There are also 143 quarterly taped and 35 yearly taped ground water wells that are not real-time. Some of the sites were drilled by DEQ personnel while most were reclaimed from abandoned or discontinued public, private, or industry owned wells. The wells are maintained by SWI personnel. The USGS provided water level data for an additional 140 wells. These data are available online at http://groundwaterwatch.usgs.gov/StateMaps/VA.html.

The groundwater and streamflow data are published in an annual report. In the 2011 report, SWI and USGS analyzed a total of 187 streamflow data sites and 402 ground water sites. These data were reviewed, approved, and published with final stream discharge and ground water elevation available through the USGS Water Data website at http://wdr.water.usgs.gov/wy2011/search.jsp.

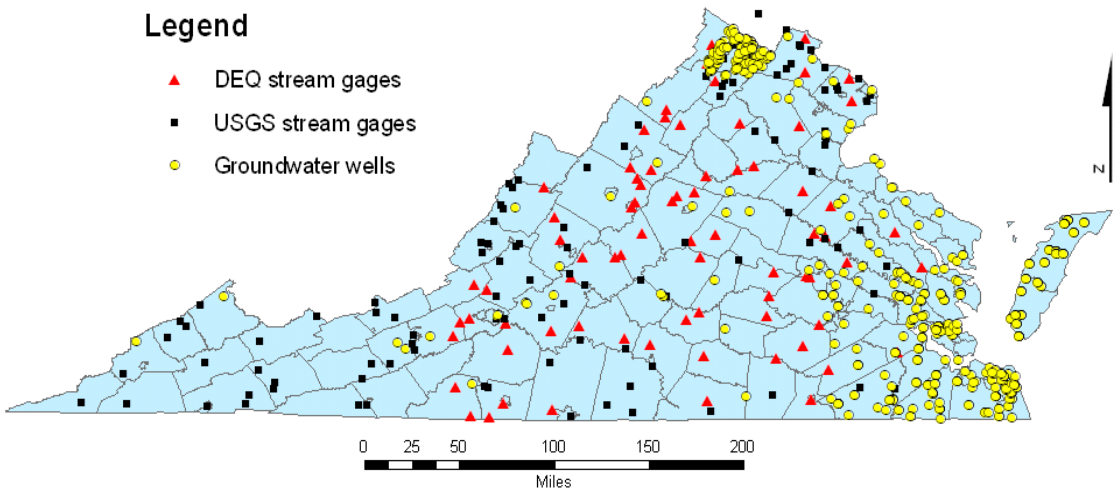


Figure 1: State-wide stream gages and observation wells.

Ground Water Characterization Program

DEQ established the Ground Water Characterization Program (GWCP) in response to negative impacts experienced by many localities, businesses, and domestic well users during the drought of 2002. The organizational objective of the GWCP is to protect Virginia's environment and promote the health and well being of its citizens by collecting, evaluating, and interpreting technical information necessary to manage ground water resources of the Commonwealth. The GWCP staff works to assure that necessary information is available to support resource management decisions and water supply planning activities, assess ground water availability, facilitate drought monitoring, and provide technical support for the expansion or creation of ground water management areas. The GWCP staff conducts technical assistance on a wide range of ground water related issues. Providing technical assistance to citizens and local governments within the Commonwealth is seen as one of the most important opportunities in gaining awareness of the wide range of viewpoints and issues affecting the region. Long term goals for the GWCP include expansion of the State Observation Well Network west of the fall line and in Virginia's Northern Neck peninsula and publication of regional ground water resources reports.

Expansion of the State Observation Well Network

During the 2011 calendar year, two new real time wells were installed for the purpose of monitoring groundwater levels in the Potomac Aquifer in the Virginia Coastal Plain at the Peace Road Groundwater Research Station in New Kent County. Three new wells were also added at the Surprise Hill Groundwater Research Station for monitoring groundwater levels in the Aquia, Piney Point, and Yorktown-Eastover Aquifer in the Northern Neck. In the Blue Ridge, an existing groundwater observation well (SOW 226 in Bedford County) was converted into a dual zone groundwater monitoring station that monitors groundwater levels associated with shallow and deep groundwater systems within the fractured bedrock at the site. This site was also equipped with tensiometers for measuring hydraulic heads in the unsaturated portion of the groundwater system, and a tipping bucket rain gauge that allows for the correlation of groundwater level response to rainfall events.

Information obtained from the observation well network is used to help guide groundwater management decisions, and aid in the study of local and regional aquifer system responses to a variety of natural and anthropogenic stresses. Network wells help to determine the magnitude and extent of the continuing long-term water-level declines in wells completed within the coastal plain's Potomac aquifer due primarily to ground water withdrawals (Figure 2). Water-level monitoring at observation wells completed to different depths at the same ground water research station can also demonstrate how ground water levels vary along with natural changes in precipitation and stream flows (Figure 3).

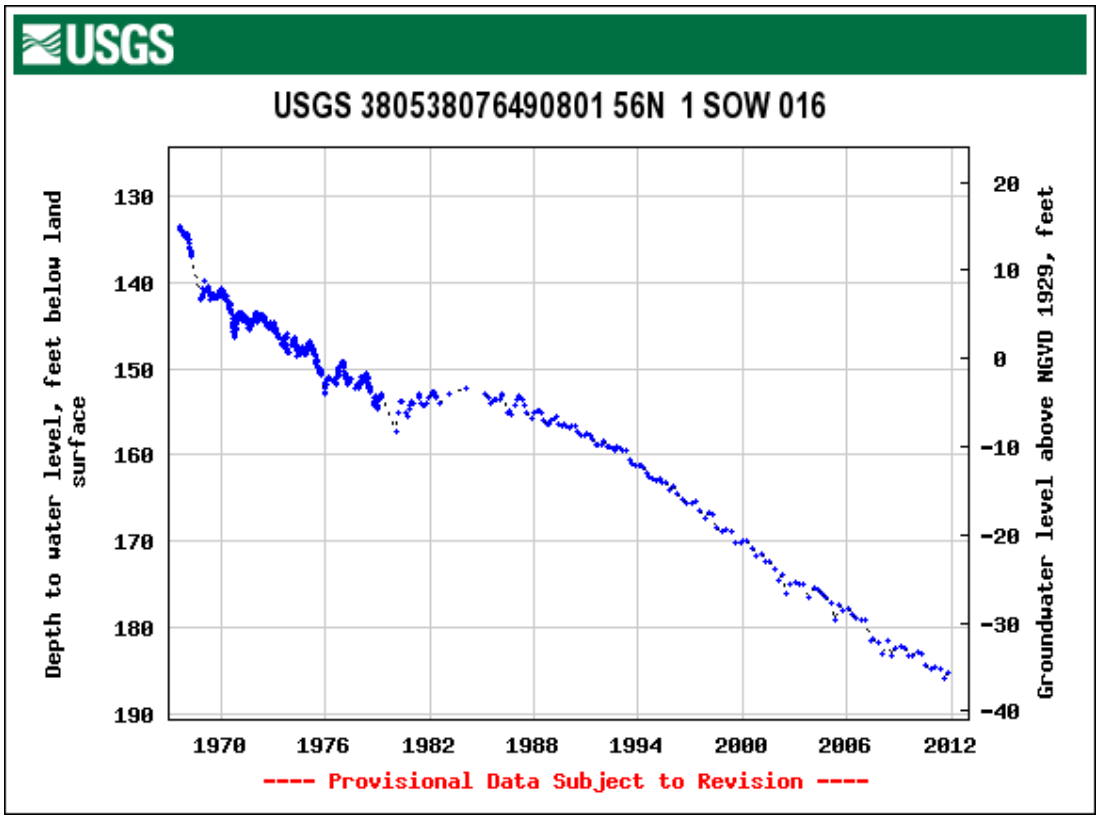


Figure 2: Groundwater level field measurements for State Observation Well 216 in Westmoreland County, Virginia - August 25, 1967 to December 31, 2011. This well is completed in the Potomac Aquifer.

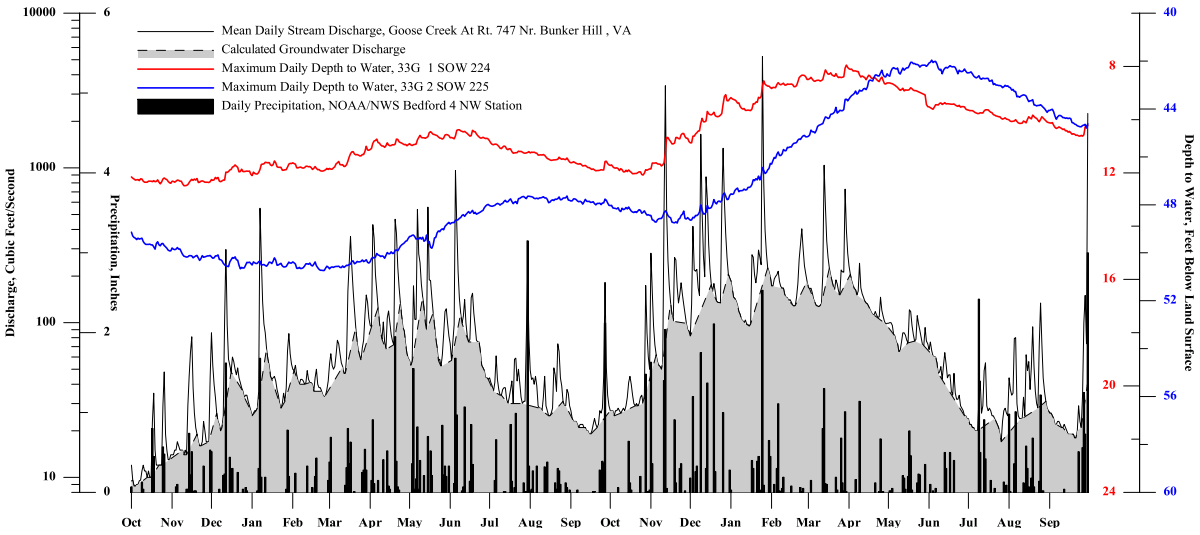


Figure 3: Maximum daily depth to water in State Observation Wells 224 and 225, daily precipitation, mean daily stream discharge, and calculated groundwater discharge in the upper Goose Creek Watershed for the 2009-2010 Water Years, Bedford County, Va.

Ground Water Resource Reports

Regional groundwater resource reports document and describe the geologic controls on the occurrence, movement, availability, and quality of ground water as it occurs within the geologically distinct provinces and sub-provinces of Virginia, and summarize current ground water withdrawal rates and trends. Two groundwater resource reports (Groundwater Resources of the Blue Ridge Geologic Province, and Groundwater Use in the Virginia Portion of the Shenandoah Valley) are anticipated for publication in September of 2012. Report revisions resulting from comments and ideas generated during the peer review of initial drafts are underway. When completed, the regional reports will be made available to the public via the GWCP web site (http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization.aspx). Twenty Ground Water Reports, completed in the late 1970's and early 1980's by the State Water Control Board, are currently available on the GWCP web page. These reports document the availability, utilization rates, and water quality of ground water resources within selected counties and political sub-regions of Virginia. To this day, these ground water resource reports are the only readily available published source of information pertaining to the occurrence, movement, and availability of ground water for a large number of the investigated areas.

Statewide Water Well Construction and Geochemical Databases

Water well construction information is vital for understanding and describing local and regional ground water systems. The GWCP has continued to compile and maintain a GIS database of well construction records. Each record describes in varying detail the location and physical properties of the well and the water-bearing properties of the geologic material in which the well is completed. These records include information from the State Water Control Board (SWCB), DEQ, USGS, The Virginia Department of Geology and Mineral Resources (VDGMR), and the Virginia Department of Health (VDH). Currently there are about 57,000 well records in the GWCP well construction database.

Considerable effort and time is being invested to cull duplicate records from the well database and to rectify a substantial number of non-domestic water supply wells with questionable coordinates and incomplete construction information. Incorporation of new electronic well construction data from cooperating drillers into the GWCP dataset as well as the incorporation of new public water supply well records forwarded to the DEQ by VDH is ongoing. In the 2011 calendar year, staff added nearly 21,000 digital water well records to the GWCP well construction database.

In 2008, a geochemical database of groundwater samples was compiled and geo-referenced by GWCP staff. This database contains information about the natural geochemical conditions of groundwater throughout the Commonwealth from approximately 23,000 groundwater samples originating from approximately 12,400 wells. Sample data originated from State Water Control Board, USGS, VDH, and National Uranium Resource Evaluation (NURE) data, and has been consolidated and normalized to standard concentrations and uniform reporting units. The

geochemical database is also used to manage new groundwater geochemical information made available to or acquired by GWCP staff.

Currently, the absence of accurate well-head location requirements (coordinates) for domestic water well completion reporting forms means that the thousands of residential wells drilled annually have no readily usable spatial representation. Consequently, there is no efficient way to analyze the residential demands on local groundwater systems or of effectively analyzing the local geologic controls on these systems. The GWCP works to educate private well drillers about the importance of voluntarily reporting well coordinate information, and encourages the electronic submittal of water well completion reports to VDH so that the data can be more easily converted into a database format. The GWCP has also initiated an effort to actively pursue and incorporate existing georeferenced well construction information that is currently stored and managed electronically by drillers within the Commonwealth.

Virginia Spring Database

The GWCP staff have initiated an effort to locate, characterize, and publish a database of springs throughout Virginia with an emphasis on the predominantly carbonate terrains of western Virginia. Springs are important water resources for municipalities, agriculture, and private landowners. Locations and discharge measurements of springs are important components of any hydrogeologic analysis and are increasingly sought after by resource managers. No comprehensive analysis of springs has been undertaken by the Commonwealth since 1930. A spring database structure was formalized in 2007 capable of meshing various historic datasets with more recent field measurements. The spring database contains site location information, field measurements such as spring discharge, pH, specific conductance, total dissolved solids, dissolved oxygen and temperature, laboratory water quality analyses, scanned images of historic documents, and site photos. Since its inception in 2006, the spring database has grown from a little over 200 springs to 932 spring locations associated with over 2800 field measurements, and analyses from 331 water quality sampling events. Data sharing agreements exist with sister agencies in the Virginia Department of Conservation and Recreation's Karst Program, Virginia Division of Mines Minerals and Energy, and the USGS in order to accelerate the acquisition of spring data and to prevent duplication of work. A quick and easy-to-use spring reporting form is available for field personnel of sister agencies to inventory springs encountered during field work.

Well Logging Activities

The GWCP operates, in cooperation with the USGS, a geophysical logging truck used for evaluating wells throughout the Commonwealth. The truck is equipped with borehole geophysical probes used for analyzing the structural, hydrogeologic, and geophysical properties of the host geologic formation(s) penetrated by a well. Borehole geophysical logging provides a means for acquiring important information pertaining to well construction and condition, and is an effective technique for acquiring the geologic and hydrogeologic data required to better understand local and regional groundwater systems. In the 2011 calendar year, 33 wells were evaluated with geophysical and/or camera logs in the Commonwealth. Data

from these logs were used to help bring non-permitted wells into compliance, by GWCP staff to help document and describe groundwater resource conditions within the Commonwealth, and by utility personnel and private businesses to better understand and manage local supply wells.

In the groundwater management areas, GWCP staff utilize geophysical logging techniques and analyze mud rotary cuttings to assist water withdrawal permit applicants complete permit applications. Geophysical and well cuttings logs help to identify and assign groundwater withdrawals to the proper aquifer and to further define the geologic and hydrogeologic conditions underlying the Virginia Coastal Plain physiographic province (Figure 4). In FY 2011, 5 wells were logged with either geophysical or mud rotary cuttings methods to assist with proper permit documentation.

The recent acquisition of a NeuraScanner has provided GWCP staff with the ability to scan and digitize archival geophysical logs previously available only as paper logs. The digitization of archival well log information effectively preserves old well log data and greatly improves the value of the data by making it more readily available to geologists and computer modelers for regional groundwater analysis efforts.

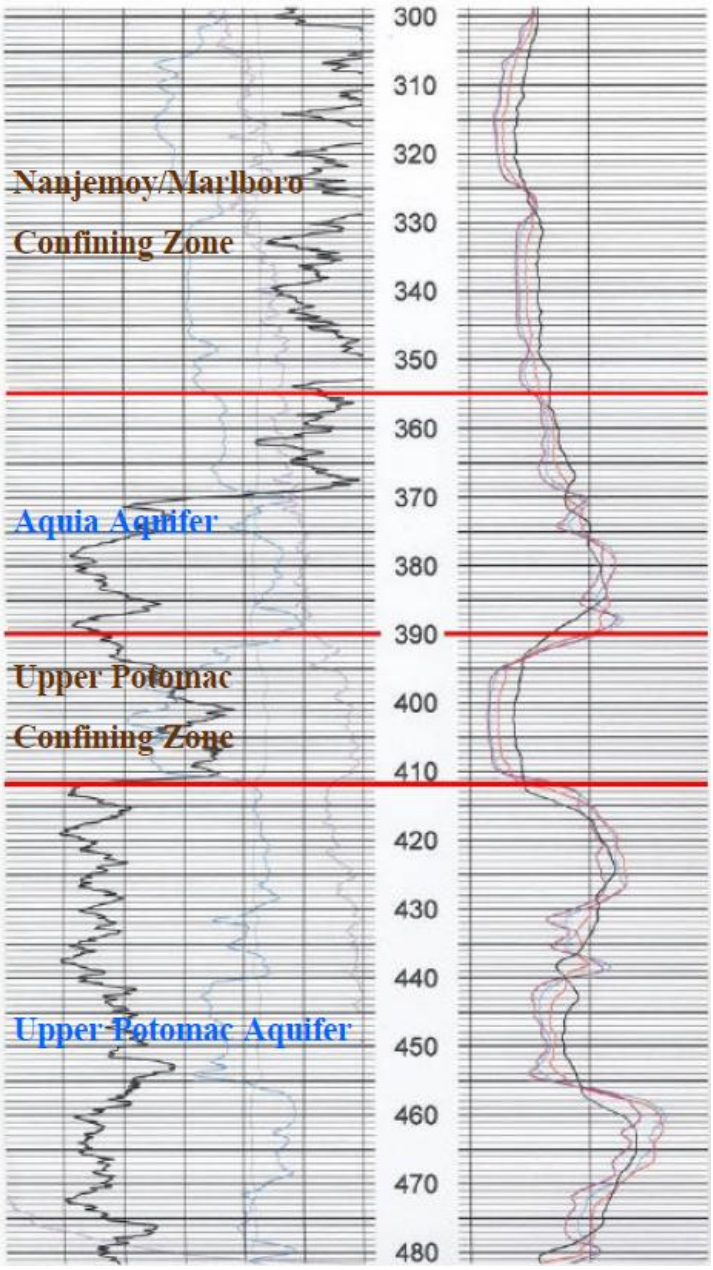


Figure 4: Aquifer Picks determined from a geophysical log run in the Coastal Plain. Geophysical logging methods are utilized by GWCP staff to assist withdrawal permit applicants with locating target aquifers and for further defining and describing hydrogeologic conditions throughout Virginia.

Technical Assistance

GWCP staff members participate as speakers at groundwater related events. Educational and speaking opportunities for the 2011 calendar year included teaching classes at the Virginia Water Well Association Annual Driller Conference, the Virginia Tech Advanced Operator Short School, the Virginia Department of Health, the Virginia Master Well Owner Network, and

speaking engagements at the Great Valley Water Resource Forum, The Virginia Division of Geology and Mineral Resources (VDMR) Annual Geologic Symposium, and several other local groundwater related events. In addition to these events, GWCP staff provide data and technical assistance to citizens, private businesses, and municipalities with groundwater resource related questions and concerns. In 2011 GWCP staff assisted with data collection efforts in cooperation with the Virginia Division of Geology and Mineral Resources, the USGS, the Virginia Museum of Natural History, and multiple localities and Public Service Authorities.

Water Supply Planning Program

November 2, 2011 marked the 6th anniversary of the implementation of the Local and Regional Water Supply Planning Regulation (9VAC 25-780). Ten local governments elected to develop local water supply planning programs that continuously develop comprehensive actions to manage water demands, sources of water supply, and the effects of drought: the Counties of Amelia, Charles City, King George, New Kent, and Stafford, the City of Richmond, and the Towns of Chincoteague, Hillsboro, Port Royal, and Warrenton (Figure 5). The remaining localities committed to regional water supply planning by submitting written plans detailing, among other things, the current and future water supply need, the current and anticipated sources of supply, current and future conservation measures, and future alternatives for meeting demands (Figure 5). All regional plans were submitted to the DEQ by the November 2, 2011 deadline established in the regulation. A new web-based data management tool was developed by Office of Water Supply staff to facilitate compilation and review of the large amounts of data submitted with the water management plans.

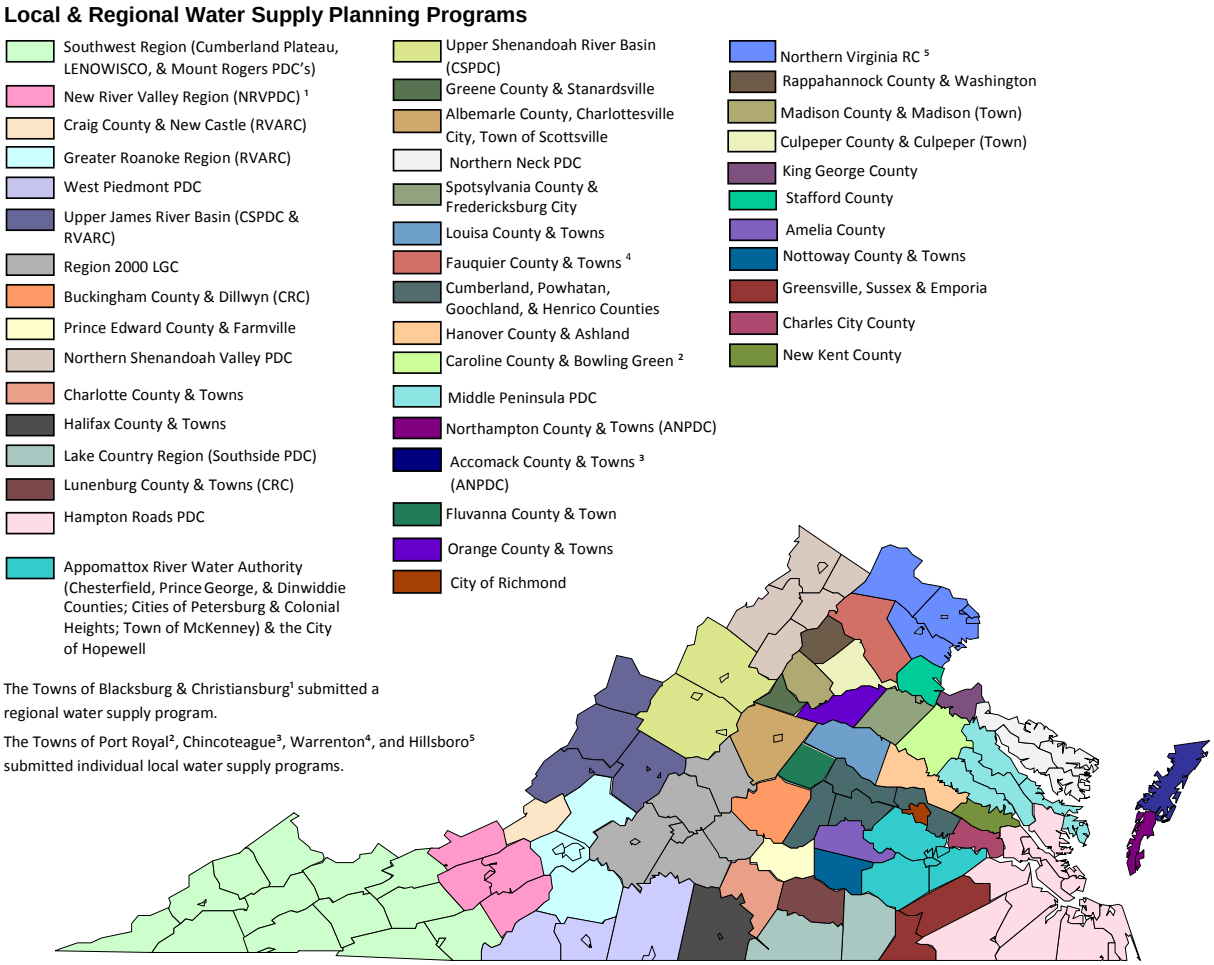


Figure 5: Local and regional water supply planning programs as of June 13, 2012. (38 Regional Programs & 10 Local Programs, Total = 48).

Wellhead Protection Implementation Grants

Since December 2005, DEQ and VDH have collaborated to provide grants totaling $805,977 to fund wellhead protection implementation projects at twelve municipalities with groundwater based community water supplies. Localities benefiting from this funding are Accomack-Northampton PDC, James City Service Authority, Town of Lovettsville, Town of Stanley, Wythe County, Rye Valley Service Authority, Town of Burkeville, Augusta County Service Authority, Rockingham County, the Town of New Market, Fauquier County, and the Town of Dayton. The funding source has been a combination of Federal Clean Water Act and Safe Drinking Water Act dollars. The latest round of projects was funded entirely with Safe Drinking Water Act dollars and the projects are managed by DEQ.

Water Supply Plan Advisory Committee

During the 2010 session, the Virginia General Assembly established the State Water Supply Plan Advisory Committee to assist DEQ in developing, revising, and implementing the state water resources plan. The Committee is charged with examining: (i) procedures for incorporating local and regional water supply plans into the state water resources plan and minimizing potential conflicts among various submitted plans; (ii) the development of methodologies for calculating actual and anticipated future water demand; (iii) the funding necessary to ensure that the needed technical data for development of a statewide planning process; (iv) the effectiveness of the planning process in encouraging the aggregation of users into common planning areas based on watershed or geographic boundaries; (v) the impact of consumptive use and reuse on water resources; (vi) opportunities for use of alternative water sources, including water reuse and rainwater harvesting; (vii) environmental flows necessary for the protection of instream beneficial use of water for fish and wildlife habitat; (viii) the role of the State Water Control Board in complying with the state water resources plan; and (ix) other policies and procedures that the Director of DEQ determines may enhance the effectiveness of water supply and water resources planning in Virginia. The Act establishing the committee sunsets December 31, 2012.

Pursuant to the enabling legislation, the Committee must meet at least twice each calendar year. The Committee met twice in 2010, twice in 2011, and in February, May, and June in 2012. Additionally, seven subcommittees were formed to focus on specific issues. The subcommittees held meetings in addition to the Advisory Committee meetings and reported to the full Advisory Committee. The Committee is expected to deliver a report to DEQ late Fall of 2012.

Water Withdrawal Permitting Program

The Water Withdrawal Permitting Program includes groundwater and surface water reporting and permitting. The Virginia water withdrawal reporting regulation provides for a statewide program that requires monthly measurements and annual reporting of surface and ground water withdrawals by applicable individuals or facilities that meet the threshold (average daily withdrawal during any single month exceeding 10,000 gallons per day). The purpose of withdrawal reporting is to enable appropriate planning for the Commonwealth's future water needs through the collection of accurate information. Summaries and detailed information regarding the reported 2011 withdrawals are included in Section IV.

Under the Ground Water Management Act of 1992, Virginia manages ground water through a program regulating ground water withdrawals within Ground Water Management Areas. The Virginia Water Protection Permit (VWP) Program regulates surface water withdrawals from state waters and related permanent structures, fill, excavation, or back-flooding. DEQ issues VWP permits for such impacts through use of the joint permit application process and collaboration between the Office of Water Supply and the Office of Wetlands and Stream Protection. Examples of projects include, but are not limited to, reservoirs, power plants, public

water supply and industrial intakes, and irrigation withdrawals. Summaries of 2011 activities within each of these programs follow below.

Ground Water Withdrawal Permitting Efforts

The Virginia Groundwater Act of 1973 recognized the duty of the SWCB to manage groundwater resources and declare management areas. Subsequently, two Groundwater Management Areas (GWMAs) were declared; the Eastern Virginia GWMA and the Eastern Shore GWMA (see Figure 6).

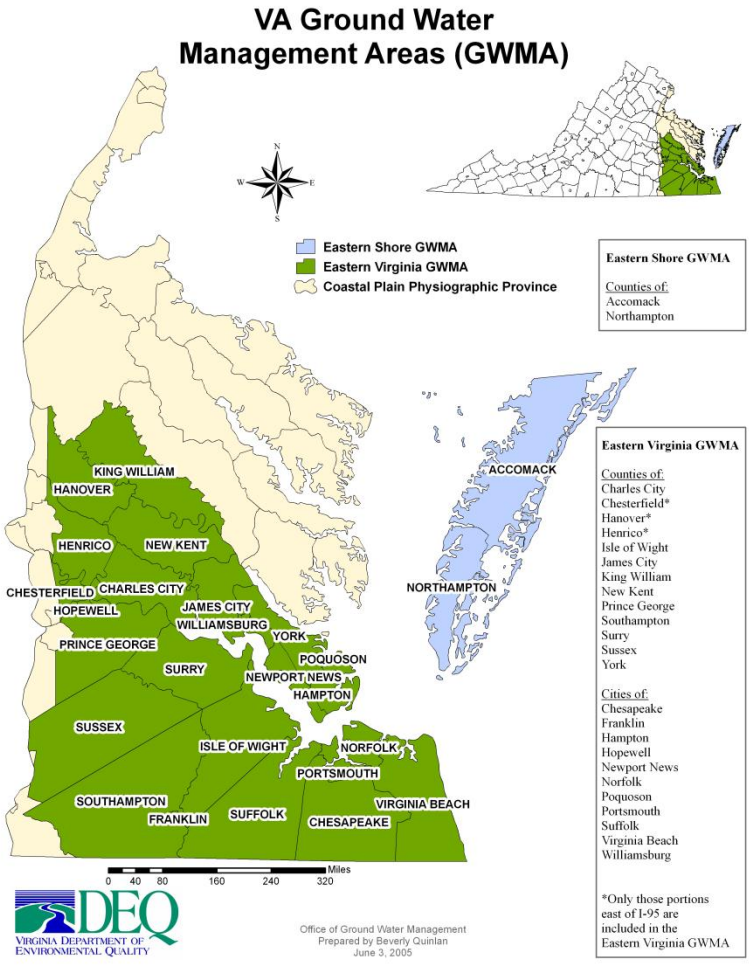


Figure 6: Groundwater Management Areas of Virginia.

The permitting program operates under regulations developed pursuant to the Groundwater Management Act of 1992. Groundwater Withdrawal Permits are required in the management areas for any withdrawal in excess of 300,000 gallons in any month. Permit applications for new withdrawals or for increases to existing withdrawals are evaluated for sustainability, considering the combined impacts from all existing lawful withdrawals. Existing lawful

withdrawals include those associated with permits issued under historic use conditions and with currently active new or expanded use permits.

Technical evaluations of impacts and resource sustainability are conducted by groundwater modeling contractors. Modeling contractors work closely with Groundwater Permitting Program staff on proposed withdrawals to discuss technical requirements prior to application submission. Permit Program staff meet with all prospective permit applicants to discuss the permitting process and technical requirements prior to application submission. Through an ongoing collaborative effort with modeling contractors, permit program staff provides technical support to applicants by reviewing and providing comments on all proposals for field data collection in support of permit development. There are 241 active permits (Figure 7). In 2011 a total of 39 permits were issued (17 new or expanded, 20 renewals, 2 modified). There were a total of 85 active applications in process at the end of 2011; 61 of these applications represent a renewal or expanded use request from a lawful existing user. DEQ received 3 renewal request applications and 10 new or expanded use applications in 2011.

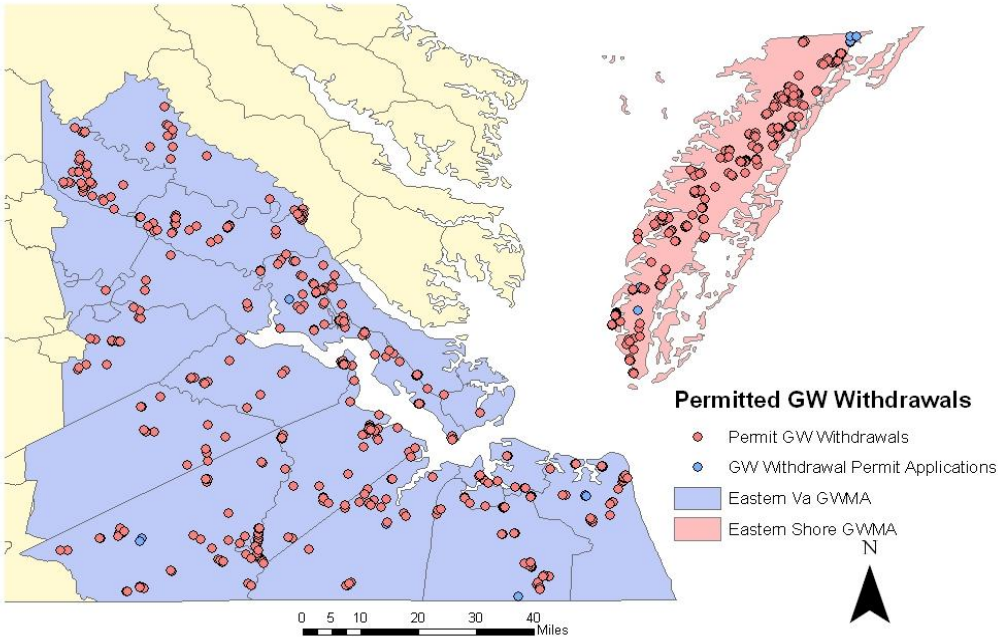


Figure 7: Permitted Ground Water Withdrawals within Virginia's Ground Water Management Areas.

Pursuant to § 62.1-254 of the Virginia Code, DEQ is required by the Groundwater Management Act of 1992 "to conserve, protect and beneficially utilize the groundwater of this Commonwealth and to ensure the public welfare, safety and health." The confined aquifers of

the Coastal Plain Aquifer System (see figure 8) have historically yielded high rates of groundwater satisfying much of the area's industrial, commercial, municipal, and agricultural demands. Large withdrawals from these sand aquifers produce overlapping cones of depression and some interference among wells has occurred. In addition, decades of water level observations in these aquifers indicate a declining trend in water levels: water levels are falling at a rate of about 2 feet per year in the Middle Potomac aquifer.

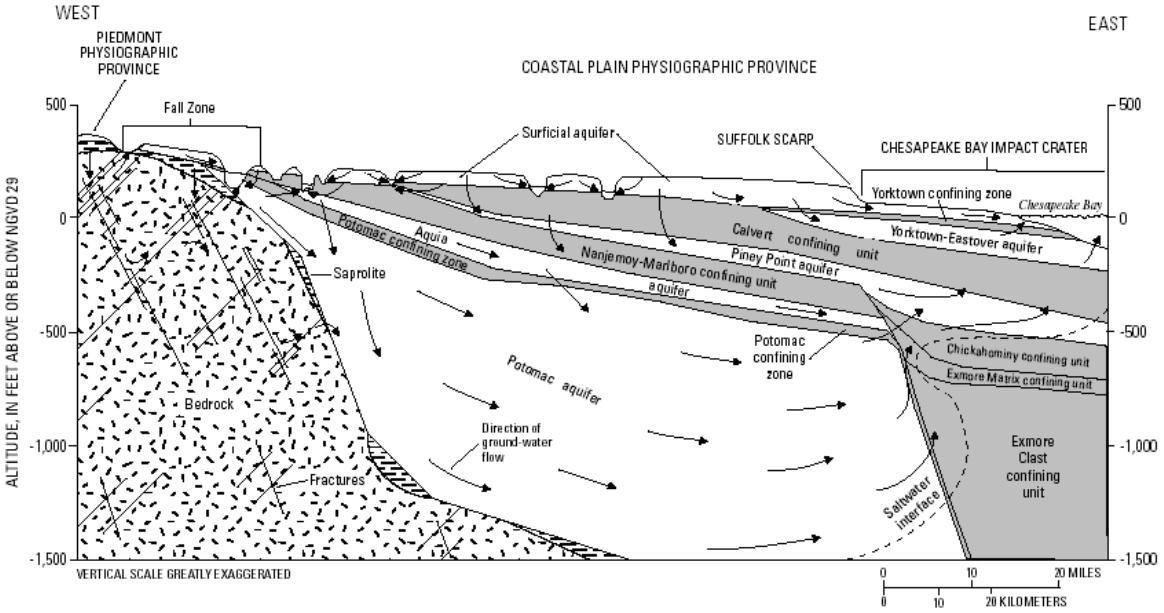


Figure 2. Generalized hydrogeologic section and directions of ground-water flow in the Virginia Coastal Plain (altitude relative to National Geodetic Vertical Datum of 1929).

Figure 8: The Virginia Coastal Plain Aquifer System (from McFarland, E. Randolph, and T. Scott Bruce, *The Virginia Coastal Plain Hydrogeologic Framework*: Professional Paper 1731: US Geological Survey, Reston VA, 2006).

2011 Ground Water Withdrawal Permitting efforts included:

DEQ issued Groundwater Withdrawal Permits to the following facilities:

- Route 33 Corridor Water System, Middle Potomac Aquifer, New Kent County
- Cedarwood Water System, Middle Potomac Aquifer, Prince George County
- Colonial Downs Water System, Middle Potomac Aquifer, New Kent County
- Walnut Grove, Middle Potomac Aquifer, Hanover County
- Cherrydale Water System, Middle Potomac Aquifer, Hanover County

- Hanover Farms Water System, Middle Potomac Aquifer, Hanover County
- Burnside Farms Mayfield Ellerson Water System, Middle Potomac Aquifer, Hanover County
- Colonial Forest Water System, Middle Potomac Aquifer, Hanover County
- High Point Farms Water System, Middle Potomac Aquifer, Hanover County
- Spring Meadows and Meadowgate Water System, Hanover County
- Wildwood Farms Water System, Middle Potomac Aquifer, Prince George County
- Chippokes Plantation State Park Water System, Brightseat-upper Potomac Aquifer, Surry County
- Whitehouse Farms Water System, Middle Potomac Aquifer, Charles City County
- JCSA-Ware Creek Manor Water System, Chickahominy-Piney Point and Lower & Middle Potomac Aquifers, New Kent County
- Naval Security Activity Northwest Water System, Yorktown-Eastover Aquifer, James City County
- Rushmere Water System, Brightseat-upper Potomac Aquifer, City of Chesapeake
- BASF Corporation, Middle Potomac and Brightseat-upper and middle Potomac Aquifers, Isle of Wight County
- Colonial Williamsburg Golden Horseshoe Golf Club Green Course, Lower & Middle Potomac Aquifers, James City County
- James River Country Club, Columbia Aquifer, City of Williamsburg
- RCS Smithfield Incorporated, Brightseat-upper Potomac Aquifer, City of Newport News
- Branchville Boykins Waterworks, Lower & Middle Potomac Aquifers, Isle of Wight County
- Edgehill Well System, Brightseat-upper Potomac Aquifer, Southampton County
- Sewells Point Golf Course, Columbia Aquifer, City of Norfolk
- Oceana Golf Club, Columbia Aquifer, City of Virginia Beach
- Indian River Water Company, Columbia Aquifer, City of Chesapeake
- Virginia Beach National Golf Club, Columbia Aquifer, City of Virginia Beach
- Town of Chincoteague, Columbia Aquifer, Accomack County
- Rip Rap Road Ready Mix Plant, Columbia Aquifer, City of Hampton
- Campostella Ready-Mix Plant, Brightseat-upper Potomac and Columbia Aquifers, City of Norfolk
- Oceana Ready-Mix Concrete Plant, Columbia Aquifer, City of Virginia Beach
- Elizabeth Manor Golf and Country Club, Columbia Aquifer, City of Portsmouth

- Kiptopeke State Park, Columbia Aquifer, Northampton County
- Fort Eustis, Brightseat-upper Potomac Aquifer, City of Newport News

Virginia Water Protection (VWP) Permitting Efforts

Water withdrawal projects involve planning, coordination, modeling, and engineering long before any permits are obtained. Projects involving surface water impacts from surface water withdrawals, related permanent structures, fill, excavation, or back-flooding are regulated under the VWP Permit Program. The VWP Permit Program issues VWP permits for surface water impacts through use of the Joint Permit Application process. The issuance of VWP Permits for surface water withdrawal activities is authorized under the VA Code §§62.1-44.15.20 and 62.1-44.15.22. VWP permits related to surface water withdrawals are regulated in accordance with 9 VAC 25-210 *et seq*.

The VWP Permit Program serves as Virginia's Section 401 certification program for federal Section 404 permits issued under the authority of the Clean Water Act. The VWP Permit Program is also a separate regulatory program under State Water Control Law; thus, a federal permit action is not a pre-requisite of a VWP permit action. Section 404 permits are often required for the construction of dams and intake structures and for impacts to wetlands and streams. Application is made through the Joint Permit Application process for concurrent federal and state project review; although federal and state agencies may issue permits independently. As of the date of this report, there are 86 active VWP permits. Six of these existing permits have active applications in process for modification. There are also six new applications for surface water withdrawals in-process state-wide (Figure 9).

During 2011, surface water withdrawal planning and permitting efforts included:

DEQ issued VWP permits to the following facilities:

- Cumberland River Coal Company, withdrawal from Roaring Fork in Wise County
- Dominion North Anna Nuclear Power Station, withdrawal from Lake Anna in Louisa County
- Glenmore Country Club, withdrawal from Rivanna River in Albermarle County
- Gretna Town, withdrawal from Whitethorn Creek in Pittsylvania County
- Kyanite Mining Corporation, Willis Mountain Plant, withdrawal from a tributary to Whispering Creek in Buckingham County
- Nelson County Service Authority, Black Creek Reservoir on Black Creek in Nelson County

DEQ issued modified VWP permits to the following facilities:

- Appalachian Power Company, Claytor Hydroelectric Plant, Claytor Lake, New River in Pulaski County
- Dominion Altavista Power Station, withdrawal from the Roanoke River in Campbell County
- Dominion Pittsylvania Power Station, withdrawal from the Roanoke River in Pittsylvania County
- Gathright Hydroelectric Project, Lake Moomaw, Jackson River in Alleghany County
- Portsmouth City, Lake Kilby Water Treatment Facility, Lakes Meade and Kilby in Suffolk City
- Rivanna Water and Sewer Authority, Ragged Mountain Reservoir in Rivanna River, Albemarle County
- Woodberry Forest School, withdrawal from the Rapidan River in Madison County

DEQ received a Joint Permit Application from the following facilities:

- Chatmoss County Club, withdrawal from a tributary to Leatherwood in the City of Martinsville
- Greene County, White Run Pumped Storage Reservoir, Rapidan River in Greene County
- Powhatan County, withdrawal from James River in Powhatan County
- Virginia Beef Corporation, withdrawal from Broad Run in Prince William County

DEQ received requests to modify existing VWP permits issued to the following facilities:

- Bedford County Public Service Authority, Smith Mountain Lake, Roanoke River in Bedford County
- Gathright Hydroelectric Project, Lake Moomaw, Jackson River in Alleghany County
- Henrico County, Cobbs Creek Reservoir, James River in Cumberland County
- Portsmouth City, Lake Kilby Water Treatment Facility, Lakes Meade and Kilby in Suffolk City
- Rivanna Water and Sewer Authority, Ragged Mountain Reservoir in Rivanna River, Albemarle County
- Stafford County Rocky Pen Run Reservoir, Rocky Pen Run in Stafford County

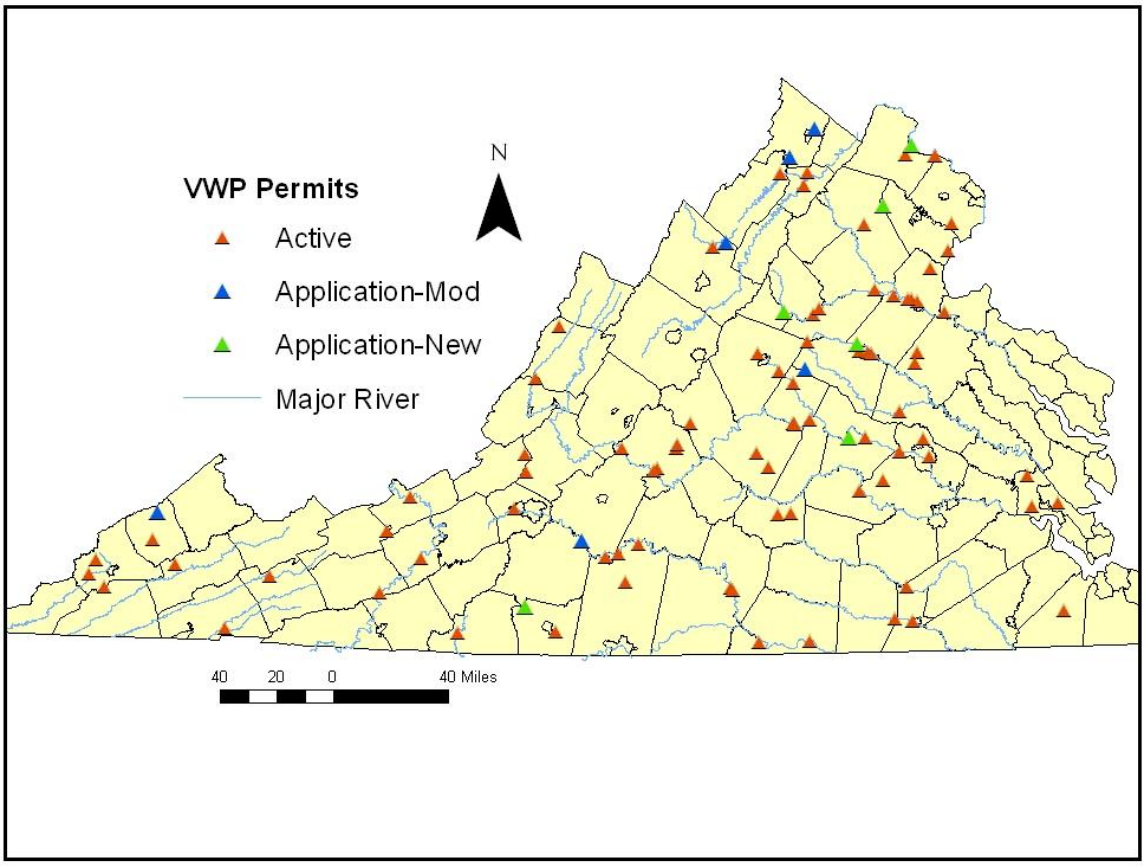


Figure 9: Current Virginia Water Protection (VWP) Active Permits and Applications for Surface Water Withdrawals across the Commonwealth.

IV SUMMARY OF WATER WITHDRAWALS IN 2011

The Virginia Water Withdrawal Reporting Regulation (9 VAC 25-200-10 *et seq*.) requires that individuals or facilities that withdraw water at volumes greater than 10,000 gallons per day (gpd)(one million gallons per month for crop irrigators) must measure and report annually to DEQ the monthly volume of water withdrawn. The data reported are contained within the Virginia Water Use Data System (VWUDS) database, which stores withdrawal data collected since 1982 under this regulation. In 2008, DEQ began offering an electronic reporting option through a website in addition to the existing hard copy mailing method. The website includes features to allow operators to input withdrawals as they occur throughout the year and to view withdrawal reporting information from previous years.

The categories of water withdrawals identified in the VWUDS database include agriculture, commercial, irrigation, manufacturing, mining, fossil fuel power, hydropower, nuclear power, and public water supply. Withdrawals of less than 10,000 gallons per day are exempt from the reporting requirements and are not included in the VWUDS database and are not available for this report.

Water diverted for hydropower use is essentially all non-consumptive use and these flows are generally not reported to the VWUDS database. Additionally, most of the water diverted for hydropower generation is used non-consumptively and is exempt from reporting. For these reasons, the following summary of total statewide water withdrawals does not include water withdrawn for power generation. Details regarding 2011 power generation water withdrawals (excluding hydropower) are included in Section VI of this report. Appendix 3 lists the top 20 individual non-power generating water withdrawals ranked by the amount of their 2011 reported withdrawals.

Water withdrawn in the Commonwealth may be used by a withdrawing entity or locality, or it may be transferred to another entity/locality. The water use data presented in this report were compiled from database records that record water withdrawn by a locality or entity (withdrawals), water transferred to another locality (releases), and water purchased from another locality (deliveries). Ideally, the total amount of water reported as released should equal the total reported as delivered. In reality however, the amounts of reported deliveries are generally significantly less than the amount reported as released. This discrepancy is most likely a result of low reporting rates from facilities that purchase water. In order to avoid double counting, this report will generally refer to "water use" as synonymous with "water withdrawn", and any reporting or illustration of water transfers will be clearly marked as "water transferred" or "water purchased". A summary of how water transfers are stored in the VWUDS database can be found in Appendix 4.

Water withdrawals in Virginia during 2011 for non-power generation uses were predominantly from surface water sources. Withdrawals from streams totaled approximately 685 mgd, while withdrawals from reservoirs totaled an additional 393 mgd. Thus, surface water sources made

up approximately 88% of the total (Figure 10). Wells and springs provided the remainder of the water withdrawn. Total 2011 non-power generation withdrawals (1245 million gallons (MG)) were approximately 183 MG less than the 2010 total of 1428 MG. The ratio of surface water use to ground water use remained approximately the same, however.

Figures 11 through 13 depict the spatial distribution of 2011 water withdrawals in Virginia. Ground water pumping from wells and springs occurred predominantly in the Coastal Plain (including the Eastern Shore) and in the Shenandoah Valley. Surface water withdrawals were distributed widely across the state and were greatest around cities and counties that serve as population centers. Figure 14 contains six pie charts that depict the magnitudes and proportions of 2011 withdrawals by use category (excluding power generation). Also depicted are the average water withdrawals over the 2007 – 2011 period for each category. Withdrawals for public water supply and for manufacturing were the largest for both 2011 and for the average of the previous five years. Pumping for agriculture and irrigation made up lesser, but still significant, portions of the ground water withdrawal totals (Figure 14 c & d). Withdrawals for other uses from both ground water and surface water sources were much smaller. 2011 withdrawals for all uses were slightly less than the 2007-2011 average withdrawals.

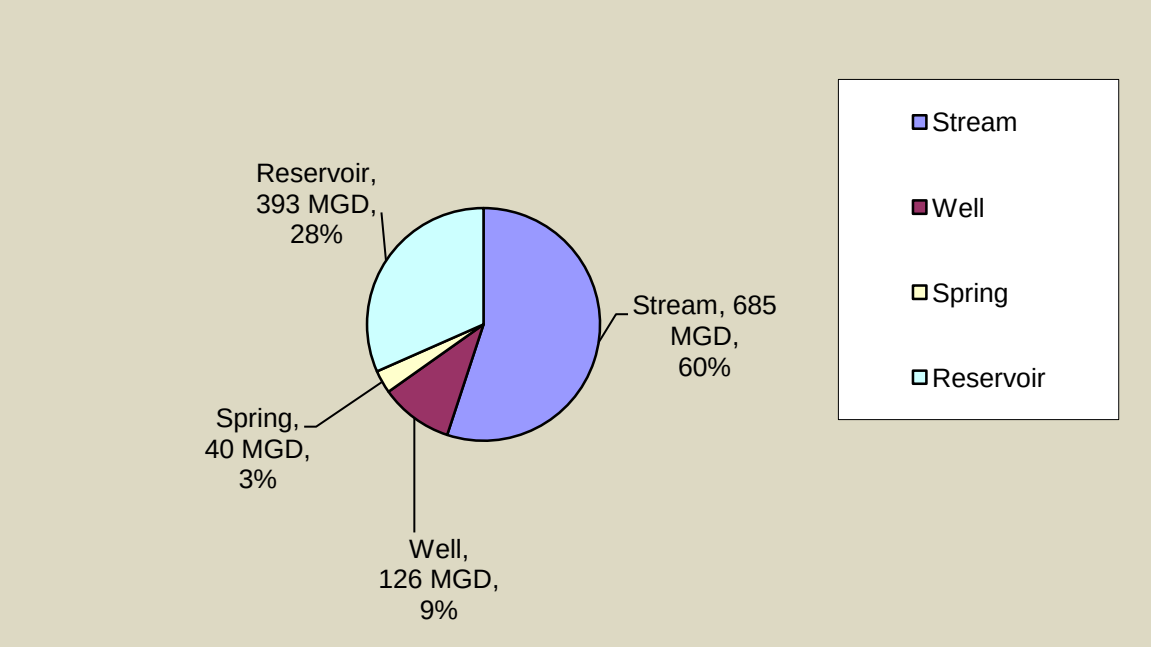


Figure 10: Total Water Withdrawals by Source in 2011 (excluding power generation).

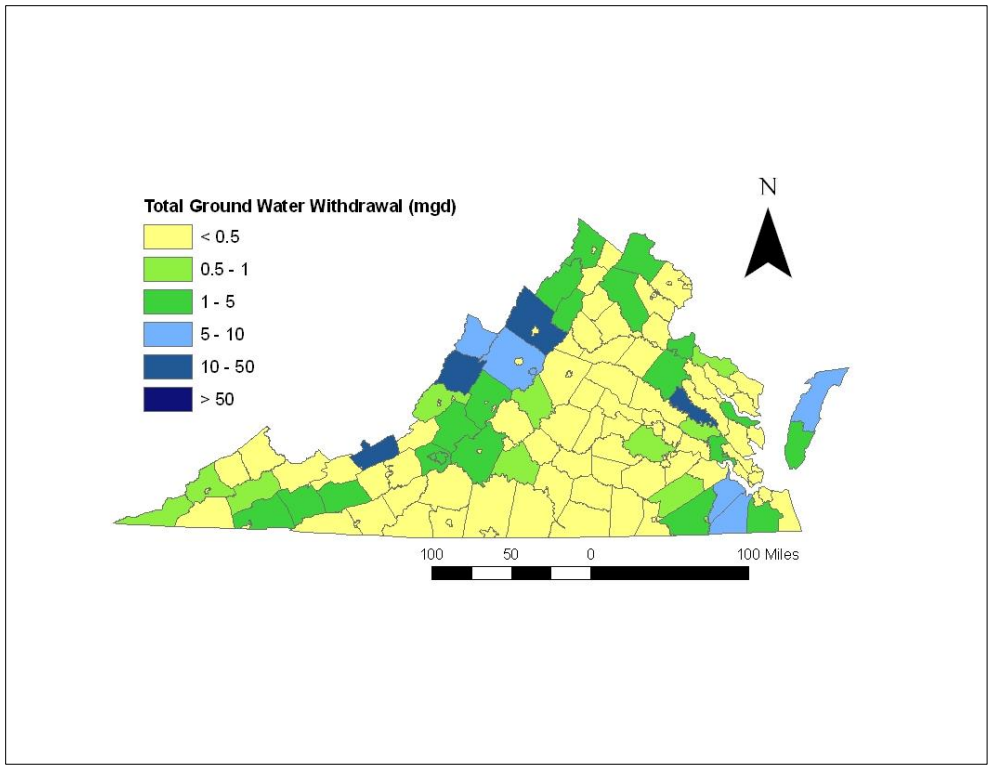


Figure 11: 2011 Total Ground Water Withdrawals by Locality (mgd).

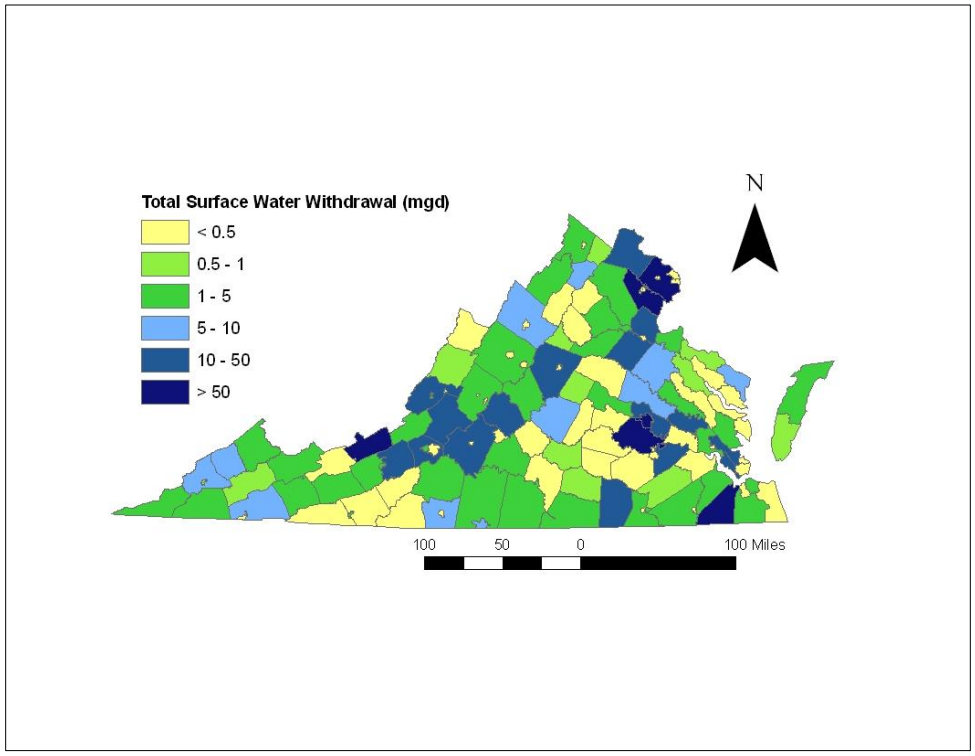


Figure 12: 2011 Total Surface Water Withdrawals by Locality (mgd).

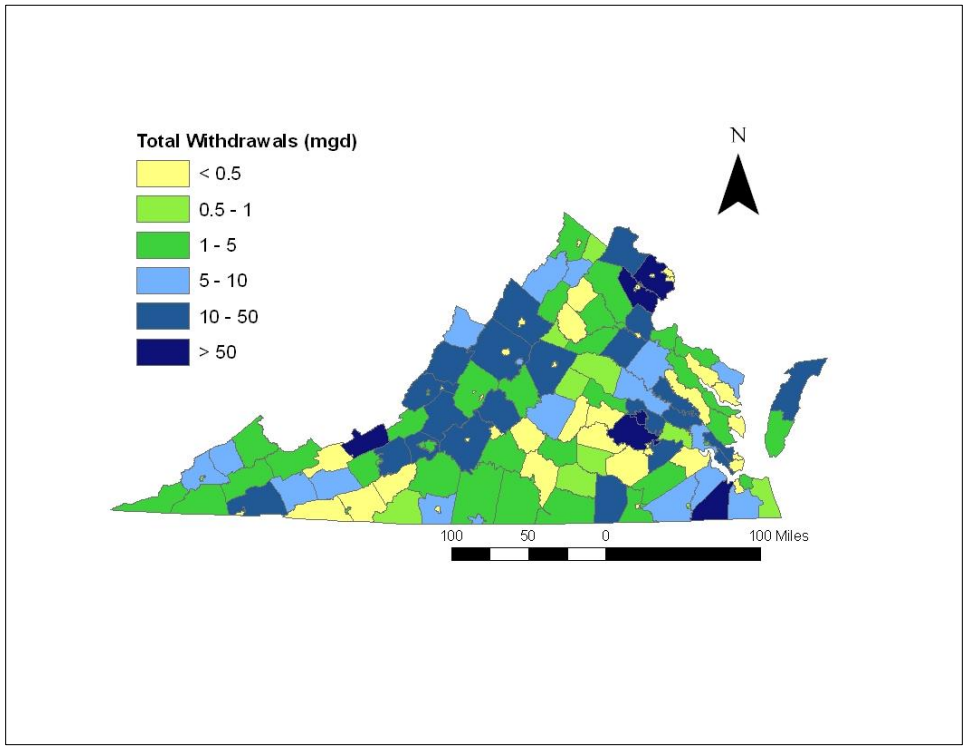
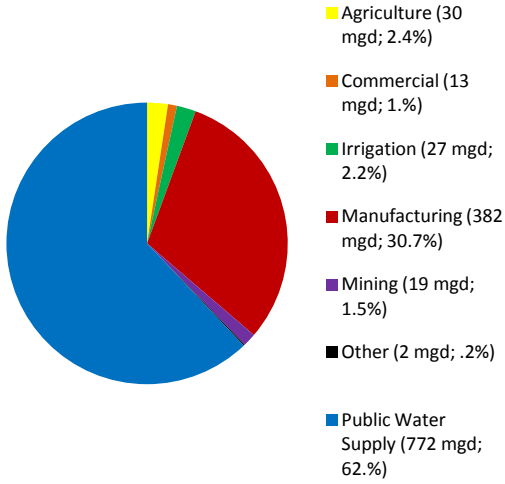
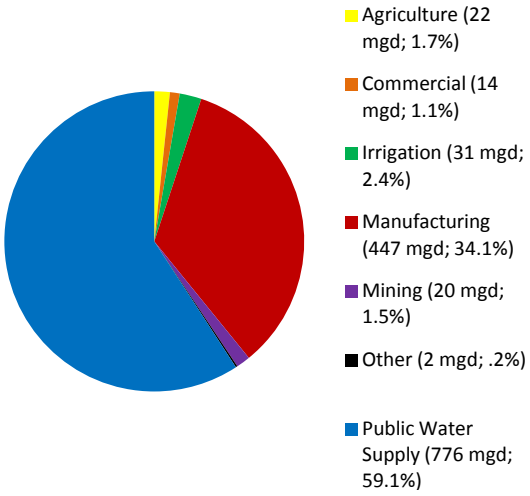


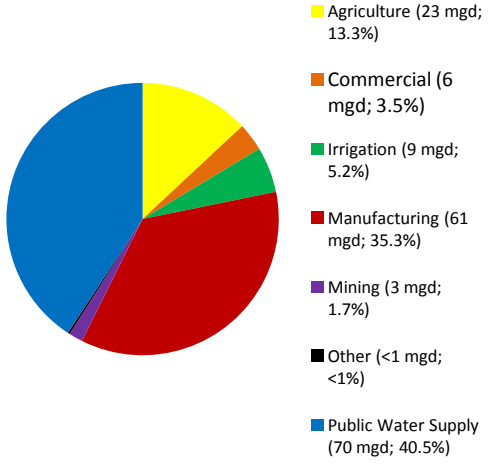
Figure 13: 2011 Total (Ground Water + Surface Water) Withdrawals by Locality (mgd).



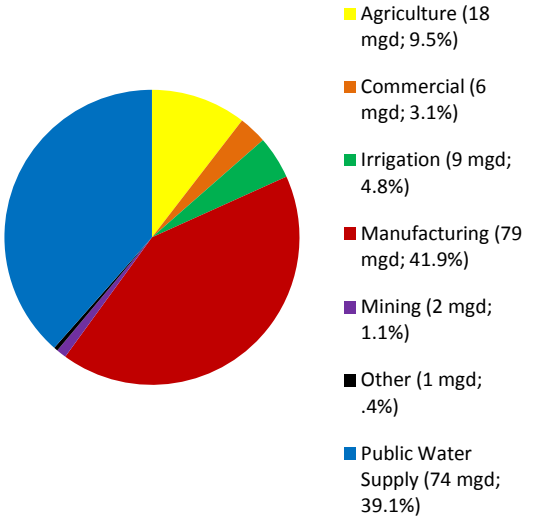
(a) 2011 Total Water Withdrawals by Category (total = 1245 mgd)



(b) Average Total Water Withdrawals by Category for 2007-2011 (total = 1312 mgd)

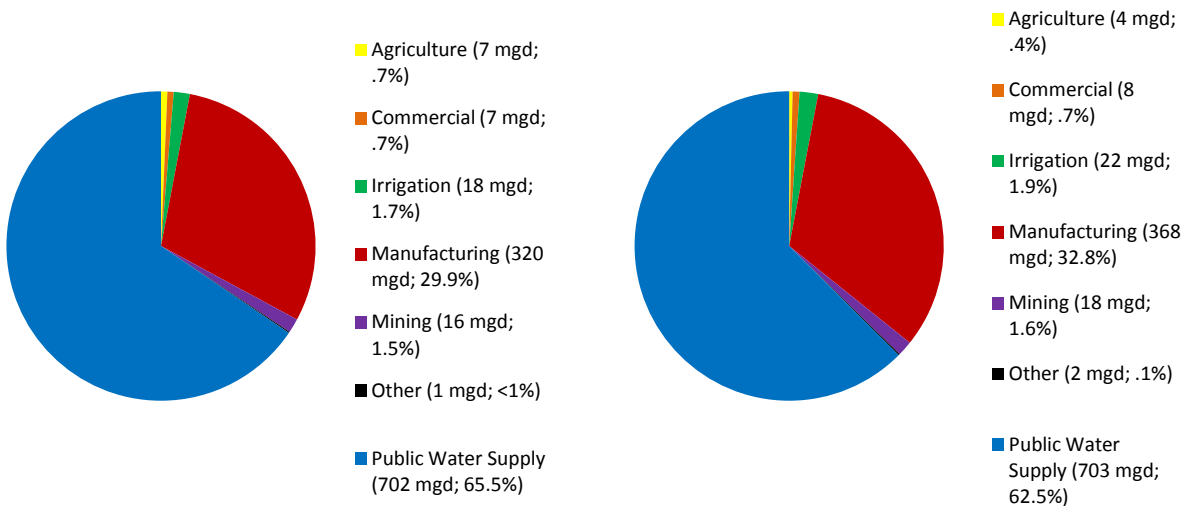


(c) 2011 Total Ground Water Withdrawals by Category (total = 173 mgd)



(d) Average Total Ground Water Withdrawals by Category for 2007-2011 (total = 189 mgd)

Figure 14: Water Withdrawals in Virginia by Category and by Source, including average withdrawals for 2007-2011.



(e) 2011 Total Surface Water Withdrawals by Category (total = 1072 mgd)	(f) Average Total Surface Water Withdrawals by Category for 2007-2011 (total = 1124 mgd)

Figure 14: Water Withdrawals in Virginia by Category and by Source, including average withdrawals for 2007-2011 (continued).

V RECENT TRENDS IN WATER WITHDRAWALS IN VIRGINIA

Table 1 contains a summary of water withdrawals in Virginia as reported in VWUDS for the 2007 through 2011 period. The table compares the average annual 2011 withdrawals by source type and use category with the corresponding average rates for the five-year period prior to and including 2011.

Ground water withdrawals were approximately 16 mgd (8%) less than the average rates for the five-year period. Agricultural ground water pumpage increased, however manufacturing pumpage decreased. The decrease in manufacturing withdrawals was primarily due to the shutdown of the International Paper mill at Franklin in the southeastern part of the state. Total surface water withdrawals were also less than the 2007-2011 average by about 5 percent. This difference was primarily due to a decrease in manufacturing withdrawals of approximately 40 mgd below 2010 levels and about 48 mgd below the five-year average. The main cause of this decrease was the shutdown of the Yorktown Refinery in Yorktown, which withdrew approximately 53 mgd in 2010. As a result of these and other changes, total manufacturing withdrawals in 2011 were about 65 mgd (15%) less than the 2007-2011 average. Total 2011 (ground water plus surface water) withdrawals were 68 mgd (5%) below the five-year average.

Table 1: Summary of Virginia Water Withdrawals: 2007 – 2011.

	Category	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Average MGD	2011 Diff. from Average (MGD)	2011 % change from average
Ground Water	Agriculture	22.6	15.1	11.0	18.1	22.6	17.9	4.7	26
	Commercial	6.2	6.0	5.1	5.8	5.8	5.8	0.0	0
	Irrigation	7.0	9.6	8.4	11.4	9.4	9.1	0.2	3
	Manufacturing	84.0	93.5	87.3	69.9	61.5	79.2	-17.7	-22
	Mining	2.1	1.6	2.4	1.9	2.9	2.2	0.7	32
	Other	2.7	0.3	0.4	0.4	0.4	0.8	-0.4	-48
	Public Water Supply	81.8	75.3	74.6	67.2	70.5	73.9	-3.4	-5
	Total (GW)	**206.2**	**201.4**	**189.1**	**174.7**	**172.9**	**188.9**	**-16.0**	**-8**
Surface Water	Agriculture	1.1	5.8	0.8	5.3	7.1	4.0	3.1	76
	Commercial	10.9	8.7	5.8	8.0	7.0	8.1	-1.1	-13
	Irrigation	23.8	23.4	20.0	23.4	18.0	21.7	-3.7	-17
	Manufacturing	395.1	393.0	369.6	361.9	320.4	368.0	-47.6	-13
	Mining	17.7	17.2	17.7	19.7	16.0	17.7	-1.7	-10
	Other	2.5	1.5	1.1	1.5	1.3	1.6	-0.3	-18
	Public Water Supply	756.6	654.7	683.4	716.7	702.0	702.7	-0.7	0
	Total (SW)	**1207.6**	**1104.3**	**1098.4**	**1136.4**	**1071.7**	**1123.7**	**-52.0**	**-5**
Total (GW + SW)	Agriculture	23.7	20.9	11.8	23.5	29.7	21.9	7.8	35
	Commercial	17.0	14.7	10.9	13.8	12.8	13.9	-1.1	-8
	Irrigation	30.7	33.0	28.3	34.8	27.4	30.8	-3.5	-11
	Manufacturing	479.0	486.5	456.9	431.8	381.9	447.2	-65.3	-15
	Mining	19.8	18.8	20.1	21.6	18.8	19.8	-1.0	-5
	Other	5.2	1.8	1.5	1.9	1.7	2.4	-0.7	-29
	Public Water Supply	838.4	729.9	757.9	783.6	772.3	776.4	-4.1	-1
	Total	**1413.8**	**1305.6**	**1287.4**	**1310.9**	**1244.5**	**1312.4**	**-68.0**	**-5**

VI CATEGORIES OF WATER WITHDRAWALS IN VIRGINIA

This section provides detailed information regarding water withdrawals for each of the major use categories for 2011 and for the last five years (2007 – 2011). Withdrawals by source types are described for this time period and the spatial distributions of 2011 withdrawals for each category are illustrated. The facilities that reported the largest withdrawals also are listed.

Agricultural Water Withdrawals in Virginia

Agriculture includes operations such as commodity farms, fish farms, and hatcheries. Figure 15 shows the state-wide total of groundwater and surface water use for agriculture from 2007-2011. Groundwater is the major source of water for agricultural uses. There are no major transfers of water for agricultural purposes, so the water withdrawals also represent water use. Reported use in 2011 increased compared to that reported for 2010. The total reported 2011 agricultural withdrawal was above the 2007-2011 average by approximately 35% (Table 2). The apparent rising trend in agricultural water use may be due mainly to a growing interest in aquaculture in the State. Table 3 lists the largest reported 2011 agricultural water withdrawals, all of which are aquacultural facilities. The withdrawals listed in this table account for 79% of all agricultural water use in the state. A substantial portion of reported withdrawals now include sub-category information in VWUDS. All sub-categories of agriculture are listed in Table 4. As with previous years, the largest 2011 agricultural withdrawals occurred in Bath and Highland Counties in the Valley region and Craig, Wythe, and Smyth Counties in the Southwest region (Figure 16).

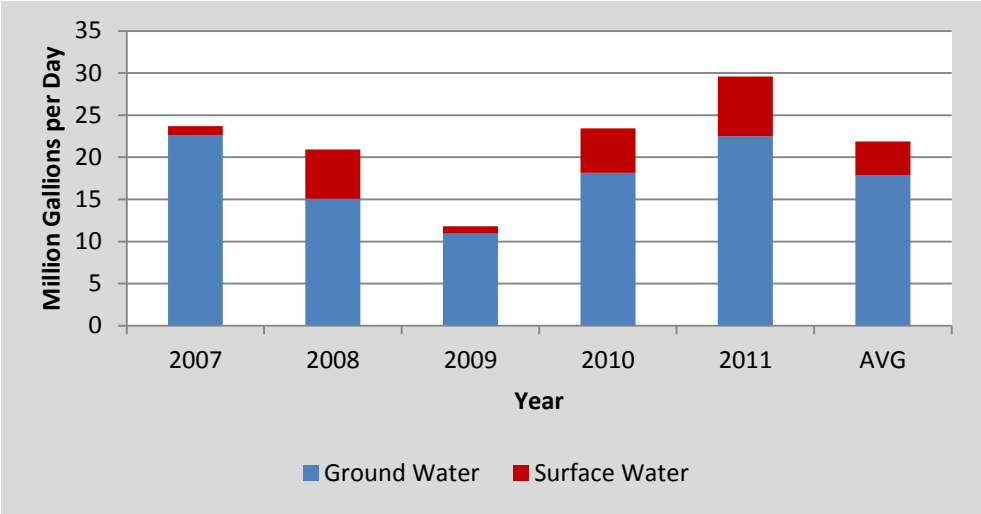


Figure 15: 2007-2011 Agricultural Water Withdrawals by Source Type.

Table 2: 2007-2011 Agricultural Water Withdrawals by Source Type, with 2011 Change from 5-year Average.

Source Type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	22.64	15.09	10.95	18.15	22.48	17.86	4.62	26
Wells	0.55	0.61	0.76	0.87	0.51	0.66	-0.15	-23
Springs	22.09	14.48	10.19	17.28	21.97	17.20	4.77	28
Total SW	1.07	5.83	0.84	5.3	7.1	4.03	3.07	76
Streams	1.02	5.83	0.8	5.3	7.1	4.01	3.09	77
Reservoirs	0.05	0	0.04	0	0	0.02	-0.02	-100
TOTAL GW+SW	23.71	20.92	11.79	23.45	29.58	21.89	7.69	35

[1]Abs change = difference between 2011 water withdrawals and average 2007-2011 water withdrawals (MGD)
[2]% change = percent change in 2011 water withdrawals from average 2007-2011 water withdrawals

Table 3: Top Water Withdrawals for Agriculture in 2011.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[3]	2011 MGD
Commonwealth of Virginia	Coursey Spring Fisheries	Bath	GW	Coursey Spring	6.53	9.55
Virginia Trout Company Inc	Terry Place Plant	Highland	GW	Blue Spring	4.02	4.58
Commonwealth of Virginia	Wytheville Fish Hatchery	Wythe	GW	Boiling and West Springs	3.57	3.36
Commonwealth of Virginia	Marion Fish Cultural Station	Smyth	SW	Staleys Creek	1.69	3.44
Commonwealth of Virginia	Paint Bank Fish Cultural Station	Craig	SW	Pain Bank Branch	1.48	2.56

[3]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

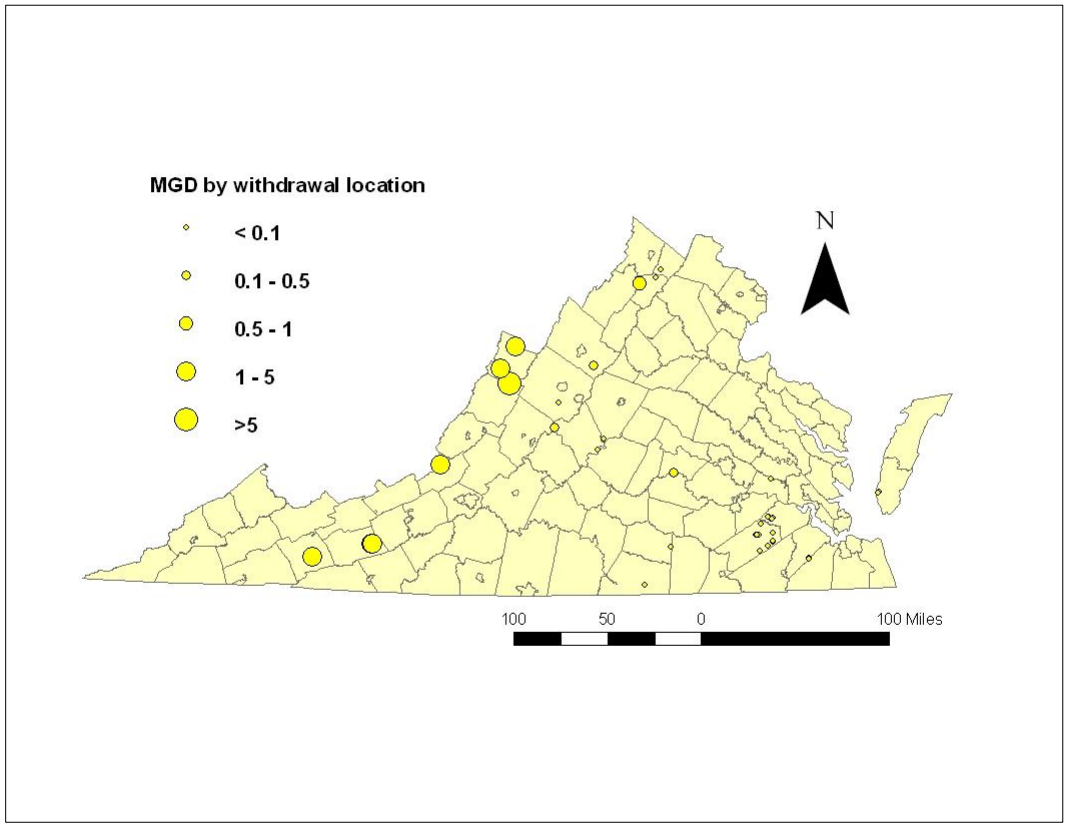


Figure 16: 2011 Agricultural Water Withdrawals by Withdrawal Point Location (mgd).

Table 4: Sub-categories of Agriculture in Virginia.

General Sub-Category	Sub-Category Group	Specific Sub-Category
Agricultural Production-Livestock	Animal Specialties	Animal aquaculture
		Animal specialties not elsewhere classified
		Fur-bearing animals and rabbits
		Horses and other equines
	Dairy Farms	Dairy farms
	General Farms, Primarily Animal	General farms, primarily animal
	Livestock, Except Dairy and Poultry	Beef cattle feedlots
		Beef cattle, except feedlots
		General livestock not classified
		Hogs
		Sheep and goats
	Poultry and Eggs	Broiler, fryer, and roaster chickens
		Chicken eggs
		Poultry and eggs not classified
		Poultry hatcheries
		Turkeys and turkey eggs
Agricultural Services	Animal Services, Except Veterinary	Animal specialty services
		Livestock services, except veterinary
	Crop Services	Cotton ginning
		Crop harvesting
		Crop planting and protecting
		Crop preparation services for market
	Farm Labor and Management Services	Farm labor contractors
		Farm management services
	Landscape and Horticultural Services	Landscaping counseling and planning
		Lawn and garden services
		Ornamental shrub and tree services
	Soil Preparation Services	Soil preparation services
	Veterinary Services	Veterinary services for livestock
		Veterinary services, specialties
Fishing, Hunting, and Trapping	Commercial Fishing	Finfish
		Miscellaneous marine products
		Shellfish
	Fish Hatcheries and Preserves	Fish hatcheries and preserves
	Hunting, Trapping, Game Propagation	Hunting, trapping, game propagation
Forestry	Forest Products	Forest products
	Forestry Services	Forestry services
	Timber Tracts	Timber tracts

Irrigation Water Withdrawals in Virginia

Irrigation withdrawals are used to promote growth in crops such as tobacco, corn, soybeans, turf grass, and ornamental nursery products. Figure 17 shows the state-wide total of irrigation-related groundwater and surface water withdrawals for 2007-2011. Surface water continues to be the major source of water for irrigation in terms of the total amount used. There are no major transfers of water for irrigation, so the water withdrawals also represent water use. Reported water withdrawals for irrigation in 2011 decreased relative to those in 2010 and were 12% lower than the average withdrawals over the 2007-2011 period (Table 5). Table 6 lists the top 2011 irrigation water withdrawals by specific source. The majority of irrigation water withdrawals

in 2011 occurred on the Eastern Shore where irrigation users in Accomack and Northampton Counties accounted for approximately 38% of the reported state-wide water withdrawals for irrigation. A large number of significant irrigation facilities are also located within the northern coastal plain in the Rappahannock and York River basins, as well as the Shenandoah Valley (Figure 18). Table 7 lists all sub-categories of irrigation.

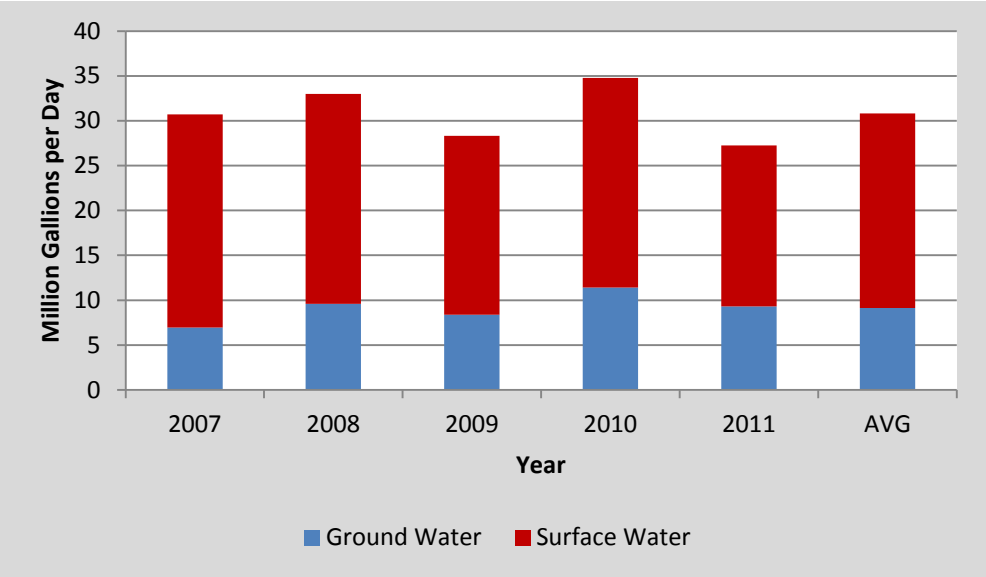


Figure 17: 2007-2011 Irrigation Water Withdrawals by Source Type.

Table 5: 2007-2011 Irrigation Water Withdrawals by Source Type, with 2011 Change from 5-year Average:

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	6.94	9.58	8.37	11.4	9.3	9.12	0.18	2
Wells	3.19	2.6	2.48	2.87	2.62	2.75	-0.13	-5
Springs	0	0	0.09	0.13	0.24	0.09	0.15	161
Reservoirs[3]	9.62	8.03	7.57	7.9	7.14	8.05	-0.91	-11
Total SW	23.77	23.42	19.95	23.39	17.96	21.70	-3.74	-17
Streams	14.15	15.39	12.29	15.36	10.58	13.55	-2.97	-22
Reservoirs	9.62	8.03	7.57	7.9	7.14	8.05	-0.91	-11
TOTAL GW+SW	30.71	33	28.32	34.79	27.26	30.82	-3.56	-12

[1]Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2011 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by ground water

Table 6: Top Water Withdrawals by Specific Source for Irrigation in 2011:

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2011 MGD
Robert C Darby and Sons	Arbuckle Farms	Accomack	GW	6 Dug Ponds	3.50	4.31
E Phillip and David L Hickman	Dublin Farms	Accomack	SW/GW	13 Farm Ponds, 1 Dug Pond	2.58	2.41
Cloverfield Enterprises	Black Marsh Farm	Caroline	SW	Rappahannock River	0.56	0.91
Saunders Brothers, Inc.		Nelson	SW/GW	6 surface water sources, 1 groundwater source	1.0	0.71
Woodward Turf Farms, Inc		Culpeper & Fauquier	SW	Rappahannock River	0.58	0.54

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

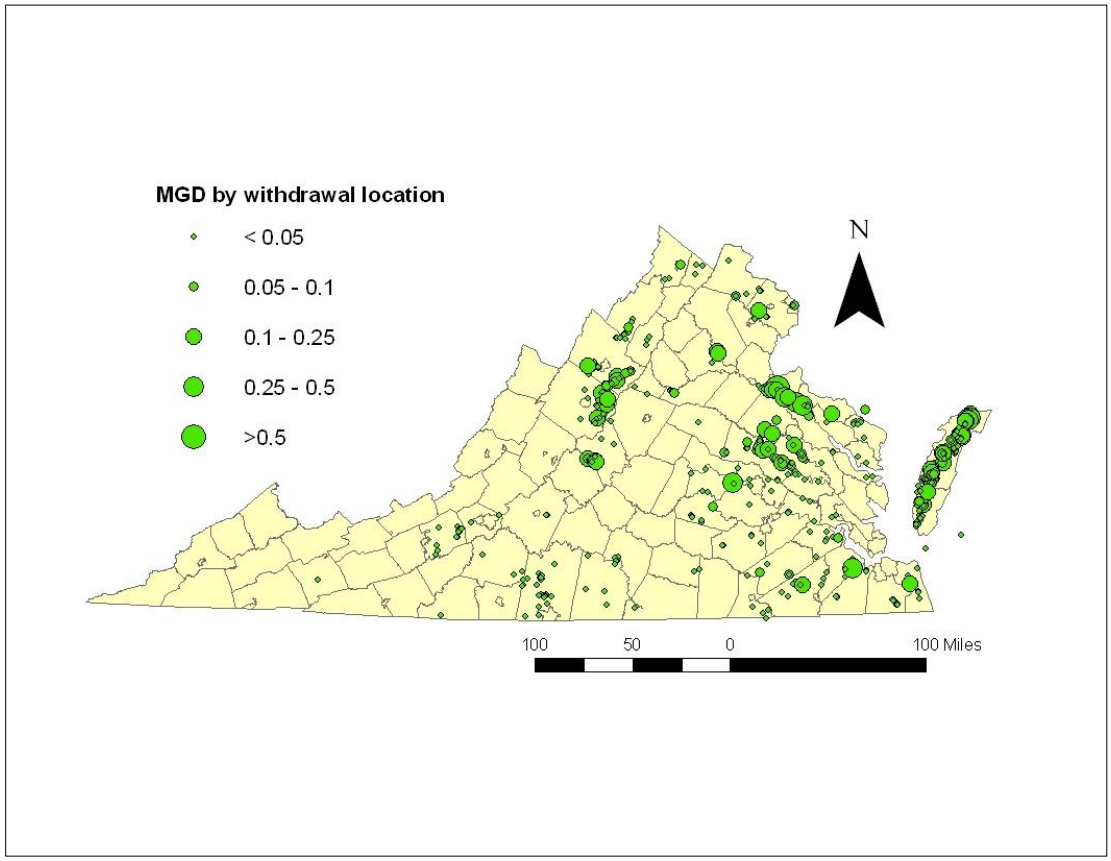


Figure 18: 2011 Irrigation Water Withdrawals by Withdrawal Point Location (mgd).

Table 7: Sub-categories of Irrigation:

General Sub-Category	Sub-Category Group	Specific Sub-Category
Agricultural Production-Crops	Cash Grains	Wheat
		Rice
		Corn
		Soybeans
		Cash grains not elsewhere classified
	Field Crops, Except Cash Grains	Cotton
		Tobacco
		Sugarcane and sugar beets
		Irish potatoes
		Field crops, except cash grains not elsewhere classified
	Vegetables and Melons	Vegetables and melons
	Fruits and Tree Nuts	Berry crops
		Grapes
		Tree nuts
		Citrus fruits
		Deciduous tree fruits
		Fruits and tree nuts not elsewhere classified
	Horticultural Specialties	Ornamental nursery products
		Food crops grown under cover
	General Farms, Primarily Crop	General farms, primarily crop

Commercial Water Withdrawals in Virginia

Commercial operations include golf courses, local and federal installations, hotels, and laundromats, among others. Figure 19 shows the state-wide total of groundwater and surface water withdrawals for commercial purposes from 2007-2011. Surface water withdrawal totals are typically greater than ground water withdrawal totals for commercial operations. Total water withdrawals for commercial operations in 2011 were slightly lower (8%) than the average withdrawals over the past five years (Table 8). Top water withdrawals for commercial operations are listed in Table 9. In addition to water withdrawals, the total commercial water use in some counties also includes water transferred from elsewhere (Table 10, Figure 20). Sports and recreation clubs (*i.e.* private golf courses) and public golf courses were the commercial subcategories with the largest 2011 withdrawals and together accounted for about 42% of the total commercial withdrawals (Table 11, Figure 21). Areas where the largest commercial withdrawals occurred were spread across the state, with concentrations in the Richmond, Hampton Roads and northern Virginia regions.

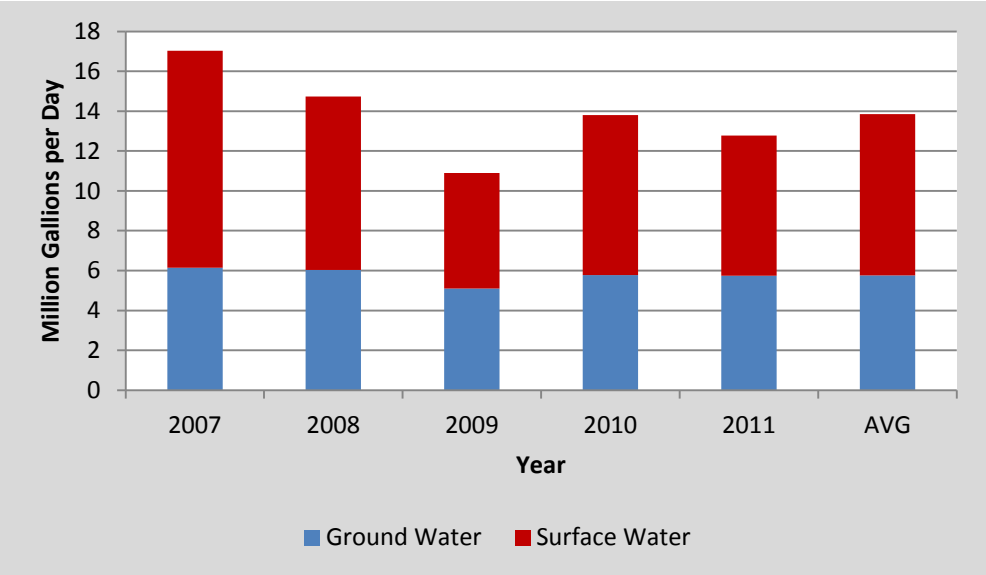


Figure 19: 2007-2011 Commercial Water Withdrawals by Source Type.

Table 8: 2007-2011 Commercial Water Withdrawals by Source Type, with 2011 Change from 5-year Average.

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	6.15	6.03	5.1	5.77	5.75	5.76	-0.01	0
Wells	5.92	4.97	4.13	4.93	4.88	4.97	-0.09	-2
Springs	0.23	1.06	0.97	0.84	0.87	0.79	0.08	10
Total SW	10.88	8.7	5.8	8.03	7.02	8.09	-1.07	-13
Streams	3.33	2.92	2.43	3.05	2.99	2.94	0.05	2
Reservoirs	7.55	5.78	3.37	4.98	4.03	5.14	-1.11	-22
TOTAL GW+SW	17.03	14.73	10.9	13.8	12.77	13.85	-1.08	-8

[1]Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2011 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by ground water

Table 9: Top Water Withdrawals by Specific Source for Commercial Operations in 2011.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2011 MGD
Colonial Williamsburg, Inc.	Colonial Williamsburg Hotel	Williamsburg	GW	6 Wells	0.72	1.17
The Homestead Water Co.	Virginia Hot Springs	Bath	GW	3 Springs	0.64	0.74
Commonwealth of Virginia	James River Correctional Facility	Goochland	SW	James River, Beaverdam Creek	0.79	0.68
Wintergreen Partners, Inc.	Lake Monocan	Nelson	SW	Lake Monocan	0.91	0.66
Central Virginia Water Storage Corp.	Storage Reservoir (CVWSC)	Buckingham	SW	CVWSC Storage Reservoir	0.86	0.65

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

Table 10: Top Water Transfers for Commercial Operations in 2011.

Source	Purchaser Owner Name	Purchaser Facility	Purchaser Location	Avg. MGD[1]	2011 MGD
Lunga Reservoir Intake	United States Government	Post Camp WTP	Prince William County	0.45	1.15
Post Camp WTP	United States Government	Post Camp Service Area	Prince William County	0.36	0.83
Commonwealth of Virginia, College of William and Mary	City of Williamsburg	Williamsburg Service Area	City of Williamsburg	0.28	0.33
Wintergreen Partners, Inc.-Lake Monocan	Nelson County Service Authority	Wintergreen Mt Service Area	Nelson County	0.24	0.24
Commonwealth of Virginia, James River Correctional Facility	County of Goochland	Goochland Courthouse Service Area	Goochland County	0.11	0.14

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

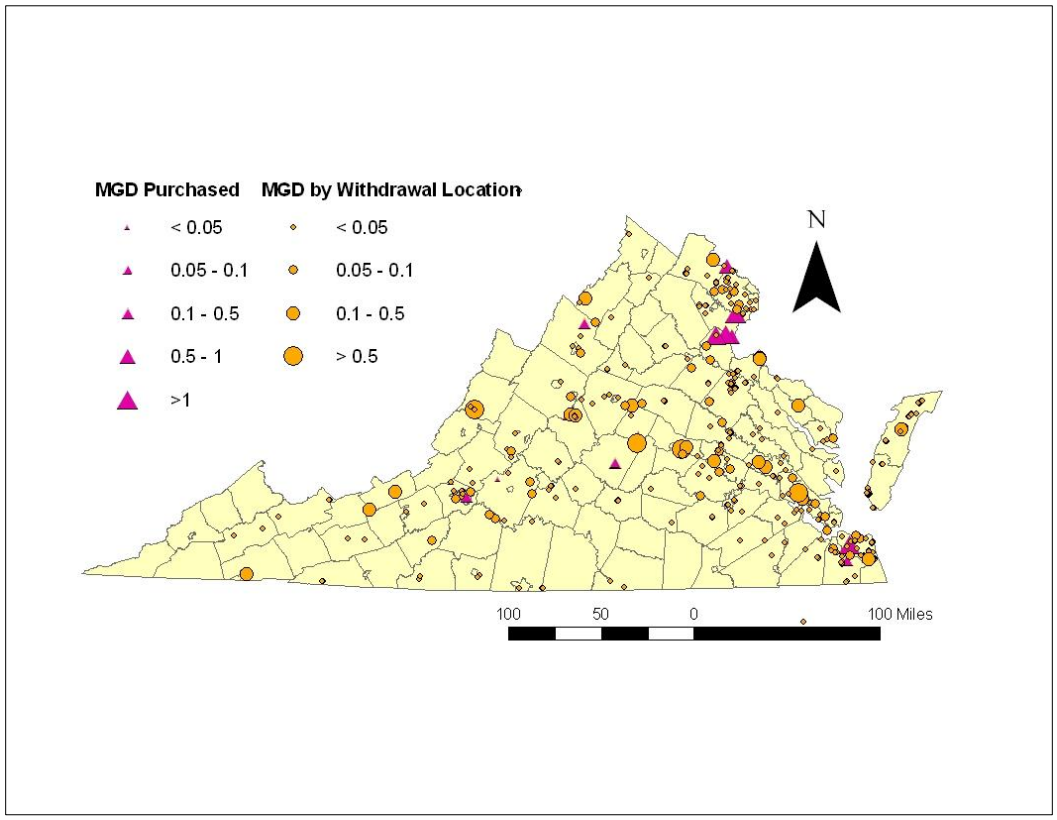


Figure 20: 2011 Commercial Water Withdrawals and Purchases (mgd).

Table 11: 2007-2011 Commercial Water Withdrawals by Subcategory.

General Sub-Category	Specific Sub-Category	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg MGD
Amusement and Recreation Services	Membership sports and recreation clubs	4.34	3.05	2.17	3.07	2.72	3.07
Amusement and Recreation Services	Public golf courses	2.88	2.49	1.65	2.68	2.05	2.35
Hotels and Other Lodging Places	Hotels and motels	.92	1.79	1.57	1.51	1.33	1.42
Justice, Public Order, and Safety	Correctional institutions	1.61	1.43	1.23	1.25	0.90	1.28
Trucking and Warehousing	Special warehousing and storage	.85	1.69	0.43	0.70	0.65	0.86
National Security and Intl. Affairs	National security	1.94	0.36	0.36	0.39	0.40	0.69
Administration of Economic Programs	Admin. of general economic programs	0.21	0.27	0.28	0.27	0.32	0.27
Administration of Economic Programs	Regulation, administration of utilities	0.00	0.00	0.00	0.25	0.24	0.10
Hotels and Other Lodging Places	Trailer parks and campsites	0.18	0.14	0.09	0.06	0.15	0.12
Executive, Legislative, and General	General government	0.10	0.10	0.14	0.14	0.14	0.12
Electric, Gas and Sanitary Services	Refuse systems	0.11	0.09	0.06	0.00	0.12	0.08

(This table includes only those sub-categories with >0.1 mgd of self-supplied withdrawals in 2011.)

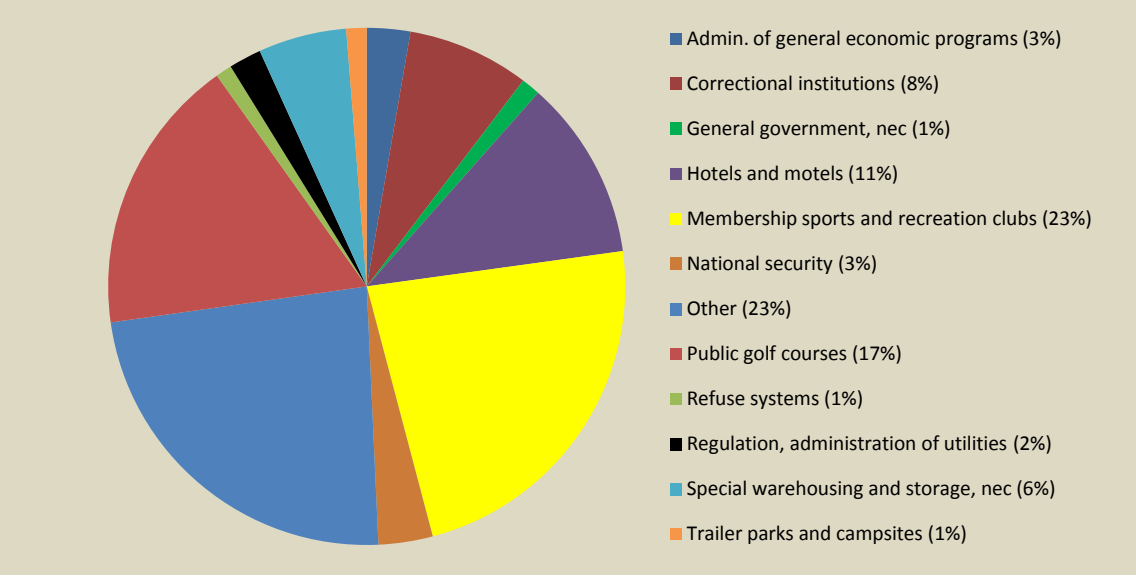


Figure 21: 2011 Commercial Water Withdrawals by Specific Sub-Category.

Mining Water Withdrawals in Virginia

Mining includes operations such as sand, rock, and coal mining. Total water withdrawals in 2011 for mining purposes were similar to those of previous years (Figure 22 and Table 12). The major source of water for mining is surface water. There are no major transfers of water for mining purposes, so the water withdrawals also represent water use. For 2011, mining water withdrawals were slightly less than the five-year (2007-2011) average. The top seven facilities in terms of 2011 mining withdrawals are listed in Table 13. Stone and sand mining facilities with the largest withdrawals are mainly located along the I-95 corridor; coal mining withdrawals are located in the southwestern Appalachian basin (Figure 23). Crushed and broken granite activities accounted for approximately 46% of the total 2011 water withdrawals for mining. Quarrying for limestone, sand and gravel accounted for an additional 27% while coal mining activities made up almost all of the remainder (Table 14 and Figure 24).

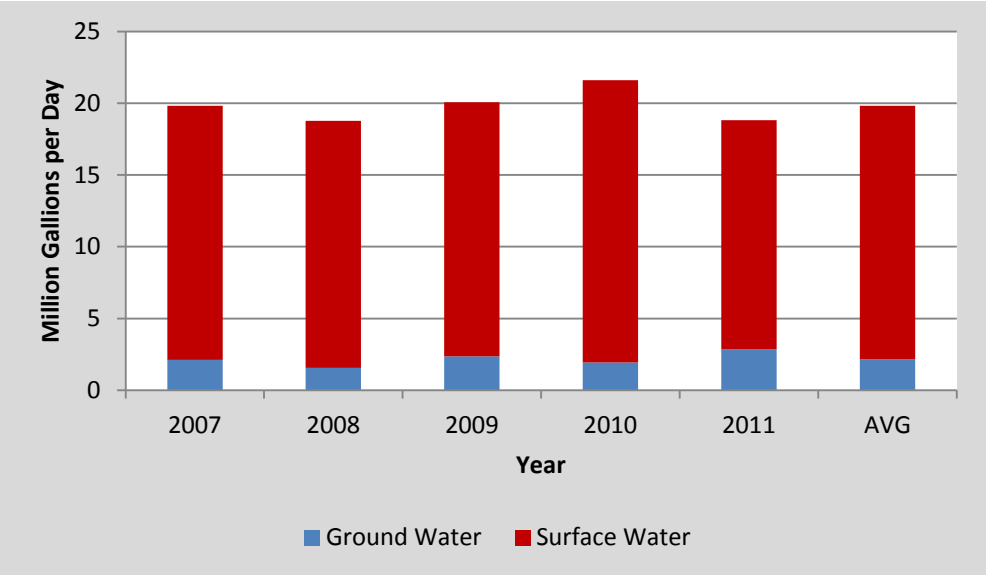


Figure 22: 2007-2011 Mining Water Withdrawals by Source Type.

Table 12: 2007-2011 Mining Water Withdrawals by Source Type, with 2011 Change from 5-year Average.

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	2.11	1.55	2.35	1.93	2.86	2.16	0.70	32
Wells	2.1	1.51	2.31	1.89	2.82	2.13	0.69	33
Springs	0.01	0.04	0.04	0.04	0.04	0.03	0.01	18
Total SW	17.7	17.23	17.71	19.66	15.96	17.65	-1.69	-10
Streams	9.31	10.44	8.25	7.87	7.73	8.72	-0.99	-11
Reservoirs	8.39	6.79	9.46	11.79	8.23	8.93	-0.70	-8
TOTAL GW+SW	19.81	18.78	20.06	21.59	18.82	19.81	-0.99	-5

[1]Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2011 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by ground water

Table 13: Top Water Withdrawals by Specific Source for Mining Operations in 2011.

Owner Name	Facility	City/County	Type	Source	Avg. MGD [1]	2011 MGD
VULCAN CONSTRUCTION MATERIALS	MANASSAS PLANT	Prince William	SW	Pump Silting Basin #1	1.45	1.94
MID-ATLANTIC MATERIALS Inc - dba Aggregate Industries	KING GEORGE PLANT - Aggregate Industries	King George	SW	Rappahannock River	1.46	1.84
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	Goochland	SW/GW	Little Tuckahoe Creek, Quarry Sump, & Well	1.16	1.42
BOXLEY MATERIALS COMPANY	BLUE RIDGE PLANT	Bedford	SW	Quarry	1.13	1.29
MARTIN MARIETTA MATERIALS	DOSWELL QUARRY	Hanover	SW	Quarry	1.76	1.13
PARAMONT COAL CO VA LLC	TOMS CREEK PREPARATION PLANT				0.92	1.13
VULCAN CONSTRUCTION MATERIALS	LAWRENCEVILLE QUARRY	Brunswick	GW	Well	1.08	1.05

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

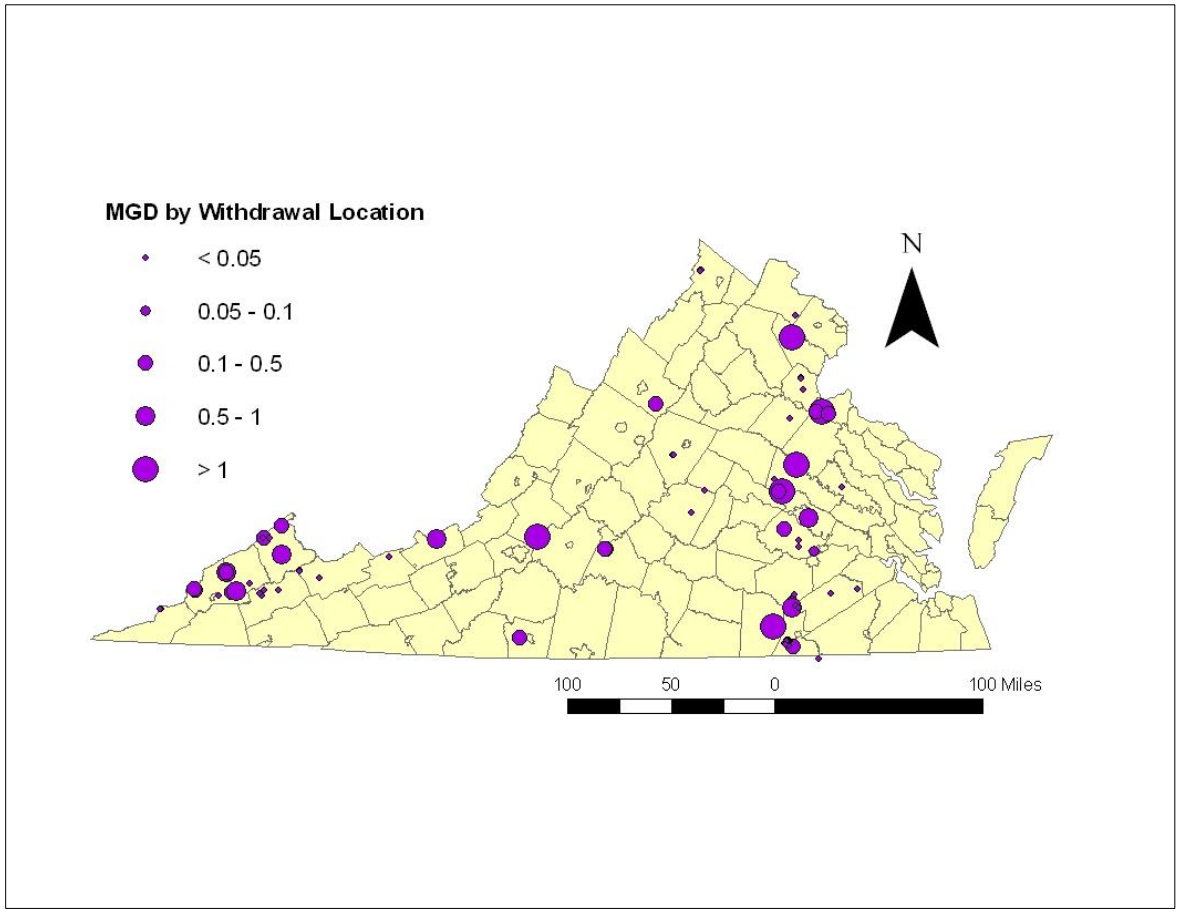


Figure 23: 2011 Mining Water Withdrawals by Withdrawal Point Location (mgd).

Table 14: 2007-2011 Mining Water Withdrawals by Sub-Category

General Sub-Category	Specific Sub-Category	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg MGD
Nonmetallic Minerals, Except Fuels	Crushed and broken granite	9.55	8.67	9.42	9.36	8.68	9.14
Nonmetallic Minerals, Except Fuels	Construction sand and gravel	4.28	1.13	3.54	2.71	2.63	2.86
Nonmetallic Minerals, Except Fuels	Crushed and broken limestone	2.16	3.26	3.64	3.32	2.43	2.96
Coal Mining	Coal mining services	2.22	4.47	1.67	1.87	2.31	2.51
Coal Mining	Bituminous coal - surface	0.76	0.59	0.9	0.92	0.89	0.81
Coal Mining	Bituminous coal - underground	0.25	0.2	0.11	0.15	0.17	0.18
Nonmetallic Minerals, Except Fuels	Clay, stone, and industrial sand	0.54	0.47	0.38	0.14	0.14	0.33

(This table includes only those sub-categories with >0.1 mgd of self-supplied withdrawals in 2011.)

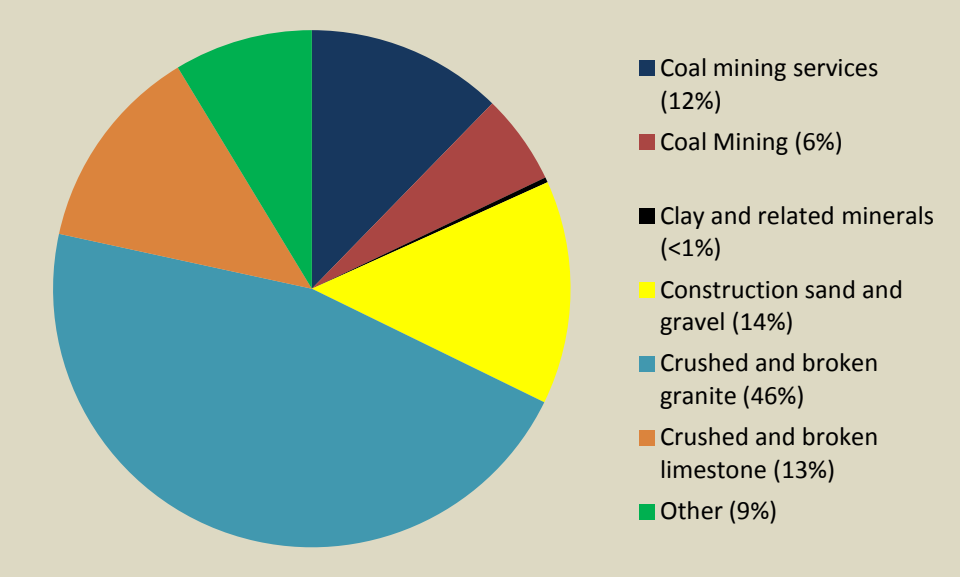


Figure 24: 2011 Mining Water Withdrawals by Sub-Category (mgd).

Manufacturing Water Withdrawals in Virginia

Manufacturing includes operations such as paper mills, food processors, drug companies, furniture, and concrete companies. Figure 25 illustrates the changes in state-wide totals of groundwater and surface water withdrawals for manufacturing from 2007-2011. Surface water is the predominant source of water for manufacturing, accounting for about 84% of the total withdrawals. There are no major transfers of water for manufacturing purposes, so the water withdrawals also represent water use. Water withdrawals for manufacturing during 2011 were approximately 65 mgd (15%) lower than the average over the past five years (Table 15). Most of this reduction was due to the shutdown of two facilities: the International Paper mill at Franklin in the southeastern part of the state, and the Yorktown Refinery in Yorktown, which withdrew approximately 53 mgd in 2010. Table 16 lists the facilities with the largest manufacturing water withdrawals in 2011. Most of these facilities manufacture chemicals and allied products. Withdrawals for this subcategory totaled about 252 mgd, which equals 66 percent of the 2011 total manufacturing withdrawals (Table 17 and Figure 26). Withdrawals for manufacturing paper and allied products made up most of the remainder (26%) of the 2011 manufacturing withdrawals.

Water withdrawals for manufacturing purposes are spread throughout much of Virginia (Figure 27). Clusters of large-scale withdrawals occur in the Hampton Roads, Richmond and Shenandoah Valley regions, as well as the New River and the Jackson/Upper James River basins.

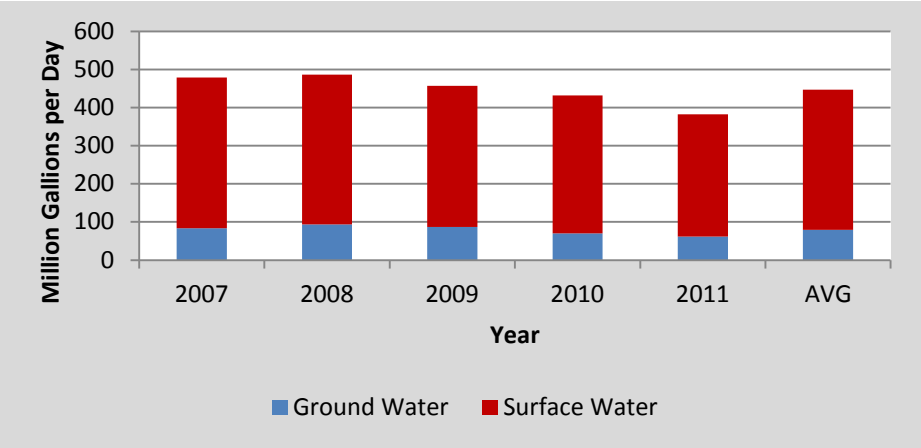


Figure 25: 2007-2011 Manufacturing Water Withdrawals by Source Type.

Table 15: 2007-2011 Manufacturing Water Withdrawals by Source Type, with 2011 Change from 5-year Average.

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	83.95	93.46	87.31	69.86	61.49	79.21	-17.72	-22
Wells	82.86	93.13	87.28	69.7	61.26	78.85	-17.59	-22
Springs	1.09	0.33	0.03	0.16	0.23	0.37	-0.14	-38
Total SW	395.04	392.99	369.61	361.9	320.37	367.98	-47.61	-13
Streams	392.26	390.1	367.05	359.03	317.38	365.16	-47.78	-13
Reservoirs	2.78	2.89	2.56	2.87	2.99	2.82	0.17	6
TOTAL GW+SW	478.99	486.45	456.92	431.76	381.86	447.20	-65.34	-15

[1]Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2011 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by ground water

Table 16: Top Water Withdrawals for Manufacturing Facilities in 2011.

Owner Name	Facility	City/County	Manufacturing Sub-Category	Type	Source	Avg. MGD[1]	2011 MGD
Honeywell International, Inc	Hopewell Plant	City of Hopewell	Chemicals and Allied Products	SW	James River	109.7	109.13
Celanese Acetate, LLC	Celco Plant	Giles County	Chemicals and Allied Products	SW	New River	57.43	56.92
Meadwestvaco Corporation	Covington Plant	Alleghany County	Paper & Allied Products	SW	Jackson River	38.54	38.93
United States Government.	Radford Ammunitions WTP	Montgomery County	Chemicals and Allied Products	SW	New River	20.56	28.24
Dupont E I De Nemours & Co.	Spruance Plant	Chesterfield County	Chemicals and Allied Products	SW	James River	28.2	27.49

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD

Table 17: 2007-2011 Manufacturing Water Withdrawals by Sub-Category

General Sub-Category	Specific Sub-Category	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg MGD
Chemicals and Allied Products	Chemical preparations	120.05	119.57	102.89	113.44	112.21	Chemicals and Allied Products
Paper and Allied Products	Paperboard Mills	81.57	83.66	86.26	87.1	86.24	Paper and Allied Products
Chemicals and Allied Products	Cellulosic manmade fibers	59.62	59.37	58.04	53.21	56.93	Chemicals and Allied Products
Chemicals and Allied Products	Industrial inorganic chemicals	20.26	18.2	24.34	27.87	33.54	Chemicals and Allied Products
Chemicals and Allied Products	Organic fibers, noncellulosic	32.16	33.46	30.21	31.21	30.84	Chemicals and Allied Products
Chemicals and Allied Products	Plastics materials and resins	20.44	15.88	12.98	11.41	10.86	Chemicals and Allied Products
Stone, Clay, and Glass Products	Lime	0.04	5.57	6.73	7.78	8.34	Stone, Clay, and Glass Products
Chemicals and Allied Products	Medicinals and botanicals	8.08	8.69	8.56	8.51	7.87	Chemicals and Allied Products
Paper and Allied Products	Paper mills	40.07	40.85	35.4	15.25	7.58	Paper and Allied Products
Food and Kindred Products	Animal and marine fats and oils	2.44	2.56	2.19	2.68	6.57	Food and Kindred Products
Paper and Allied Products	Sanitary food containers	5.71	5.51	5.17	3.68	4.85	Paper and Allied Products
Food and Kindred Products	Poultry slaughtering and processing	2.85	2.84	1.9	1.79	2.81	Food and Kindred Products
Transportation Equipment	Ship building and repairing	8.27	11.76	5.19	3.19	2.41	Transportation Equipment

(This table includes only those sub-categories with >2 mgd of self-supplied withdrawals in 2011.)

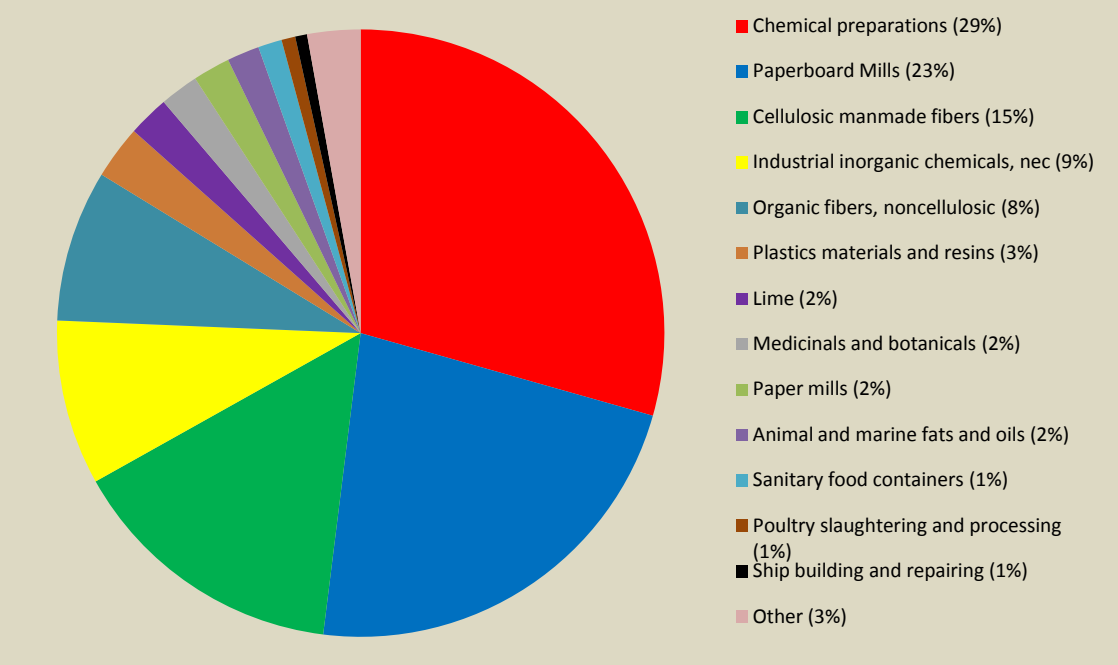


Figure 26: 2011 Manufacturing Water Withdrawals by Specific Sub-Category (mgd).

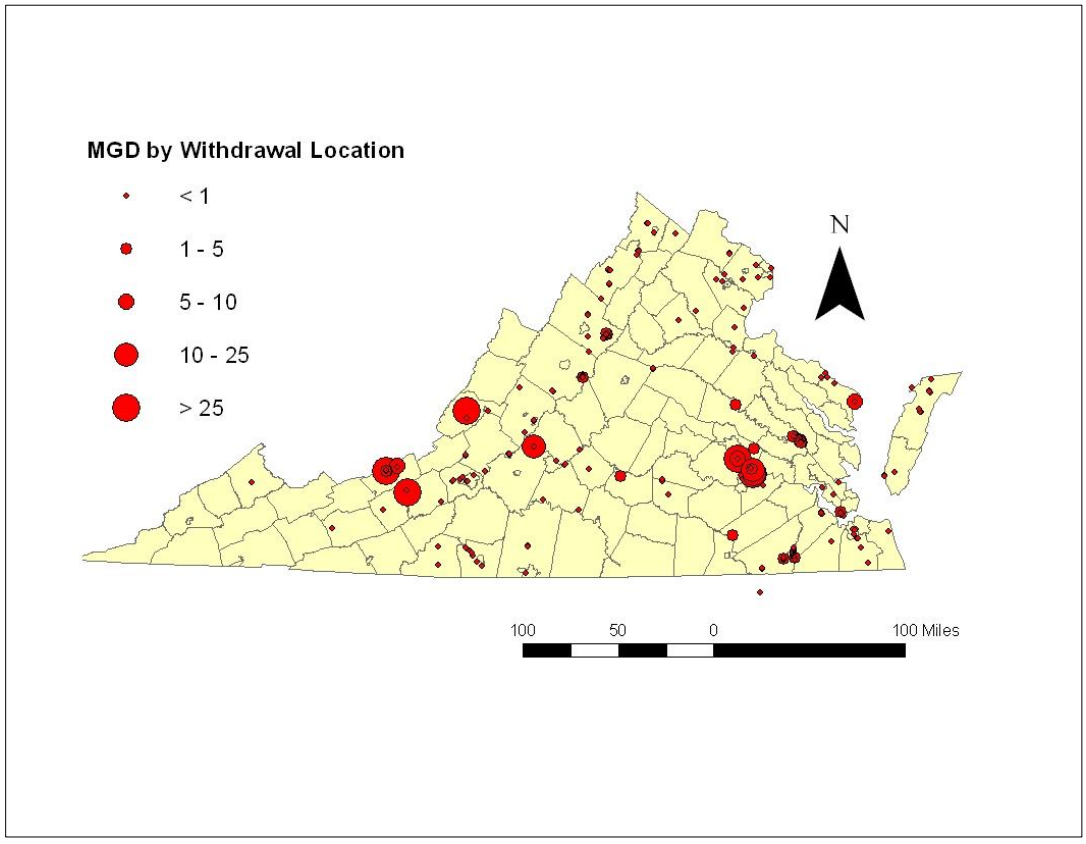


Figure 27: 2011 Manufacturing Water Withdrawals by Withdrawal Point Location (mgd).

Public Water Supply Water Withdrawals in Virginia

Public water supply includes municipal and private water purveyors. Figure 28 shows the state-wide totals of groundwater and surface water withdrawals for public water supply from 2007-2011. As with manufacturing, surface water is the major source of water for public water supply in terms of the overall quantities used. Water withdrawals for public water supply during 2011 were nearly equal to the average for the 2007-2011 period (Table 18) and slightly less than 2010 withdrawals. Table 19 lists the 10 facilities that withdrew water for public water supply at the greatest rates during 2011. Note that the facilities in this list are not identical to those listed in Appendix 3 because the latter reports the total system withdrawals. That is, some public water supply systems contain multiple facilities that, while not large enough individually to be reported by Table 19, are quite large when considered cumulatively.

There are several major transfers of water that occur for public water supply. Therefore, the total water used for public water supply in each locality includes the water withdrawals in that locality, as well as water transferred into that locality from elsewhere, minus any water sold to other localities. The VWUDS database does not keep track of domestic water withdrawals by private households; therefore, all of the water withdrawals for public water supply were reported from public water systems. The ten largest water transfers for public water supply are listed in Table 20. Table 21 displays information concerning the number of water systems in the state in 2011 and the corresponding population served by these systems.

As one would expect, the largest public supply water withdrawals are located within or near population centers such as the Washington DC metropolitan region, Richmond, Hampton Roads and Roanoke (Figure 29). The largest public water supply purchases (Figure 30) are located in the same areas, where suppliers with large reservoirs or river withdrawals sell water to their neighbors. Smaller public supplies are scattered throughout the rest of the state.

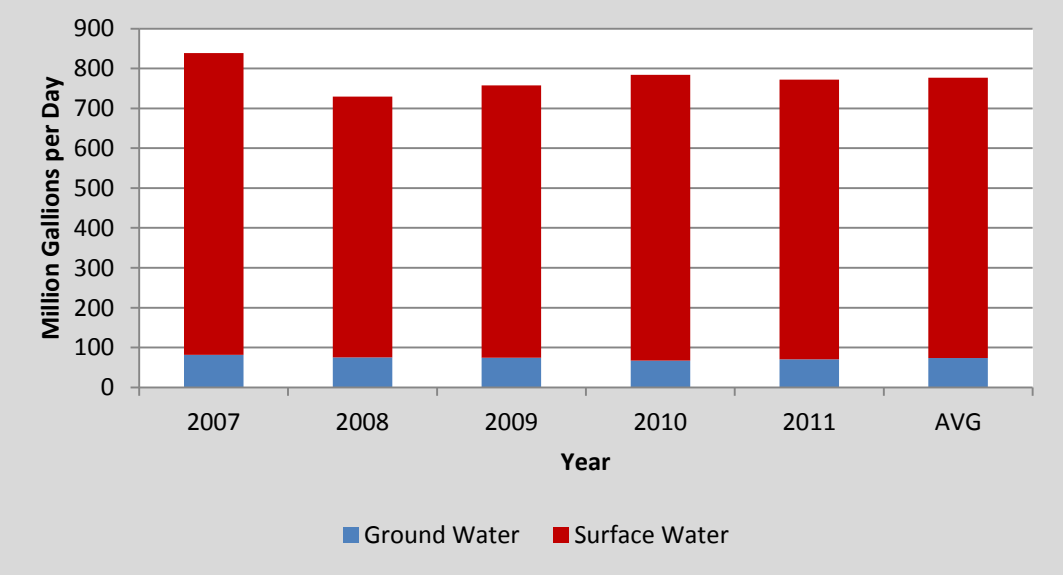


Figure 28: 2007-2011 Public Water Supply Water Withdrawals by Source Type.

Table 18: 2007-2011 Public Water Supply Water Withdrawals by Source Type, with 2011 Change from 5-year Average.

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	81.76	75.32	74.63	67.16	70.45	73.86	-3.41	-5
Wells	66.28	60.06	61.06	49.26	53.58	58.05	-4.47	-8
Springs	15.48	12.78	13.24	17.51	16.49	15.10	1.39	9
Other GW[3]	0	2.48	0.33	0.39	0.38	0.72	-0.34	-47
Total SW	756.64	654.53	683.28	716.48	701.82	702.55	-0.73	0
Streams	364.35	298.87	346.66	349.35	338.4	339.53	-1.13	0
Reservoirs	392.29	355.66	336.62	367.13	363.42	363.02	0.40	0
TOTAL GW+SW	838.4	729.85	757.91	783.64	772.27	776.41	-4.14	-1

[1]: Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]: % change = percent change in 2011 water withdrawals from average water withdrawals; [3]: other GW = source identified as a quarry

Table 19: Top Water Withdrawals by Public Water Supply Facilities in 2011.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2011 MGD
Fairfax County Water Authority	Potomac River WTP	Fairfax County	SW	Potomac River Intake	90.35	90.53
City of Richmond	Richmond WTP	City of Richmond	SW	James River and Kanawha Canal	66.27	63.01
Fairfax County Water Authority	Occoquan Reservoir	Prince William County	SW	Occoquan Reservoir	63.12	61.72
City of Norfolk	Western Branch Reservoir	Suffolk	SW	Western Branch Reservoir	60.8	53.62
Appomattox River Water Authority	Lake Chesdin WTP	Chesterfield County	SW	Lake Chesdin	30.11	31.31
City of Virginia Beach	Virginia Beach Service Area	Brunswick County	SW	Lake Gaston	31.34	30.61
Henrico County	Henrico County WTP	Henrico County	SW	Chickahominy River	26.16	24.9
City of Newport News	Lee Hall WTP & ROF	City of Newport News	SW	Lee Hall Reservoir	25.49	22.25
Virginia American Water Co.	Hopewell District	City of Hopewell	SW	Appomattox River	17.15	21.82
City of Newport News	Harwoods Mill WTP	City of Newport News	SW	Harwoods Mill Reservoir	22.01	20.96

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

Table 20: Top Water Transfers for Public Water Suppliers in 2011.

Source	Supplier	Purchaser Owner Name	Purchaser Facility	2011 MGD
City of Norfolk	Norfolk Service Area	City of Virginia Beach	Virginia Beach Service Area	31.98
US Government	Dalecarlia WTP	Arlington County	Arlington Service Area	22.46
Fairfax County Water Authority	Occoquan Reservoir	Prince William County Service Authority	OWDT Service Area	20.55
Fairfax County Water Authority	Potomac River WTP	Loudoun County Sanitation Authority	Lower Broad Run Service Area	19.33
Appomattox River Water Authority	Lake Chesdin WTP	Chesterfield County	Chesterfield County Service Area	19.22
US Government	Dalecarlia WTP	City of Falls Church	Falls Church Service Area	15.64
Virginia American Water Company	Alexandria Service Area	City of Alexandria	Alexandria Service Area	15.47
Fairfax County Water Authority	Occoquan Reservoir	Virginia American Water Company	Alexandria Service Area	15.47
City of Richmond	City of Richmond Service Area	Henrico County	City-County Contract Service Area	13.22
City of Richmond	City of Richmond Service Area	Chesterfield County	Chesterfield County Service Area	8.96

[1]Avg. MGD = Average water withdrawals from 2007-2011 (MGD

Table 21: Number of Public Water Systems and Population Served by Public Water Systems in Virginia, 2011.

	Total	**Ground Water**	**Surface Water**
Number of Systems	2838	2447	391
Population Served	7,048,127	766,928	6,281,199

Source: http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/upload/new_Fiscal-Year-2010-Drinking-Water-and-Ground-Water-Statistics-Report-Feb-2012.pdf, page 13 (accessed 7/12/12)

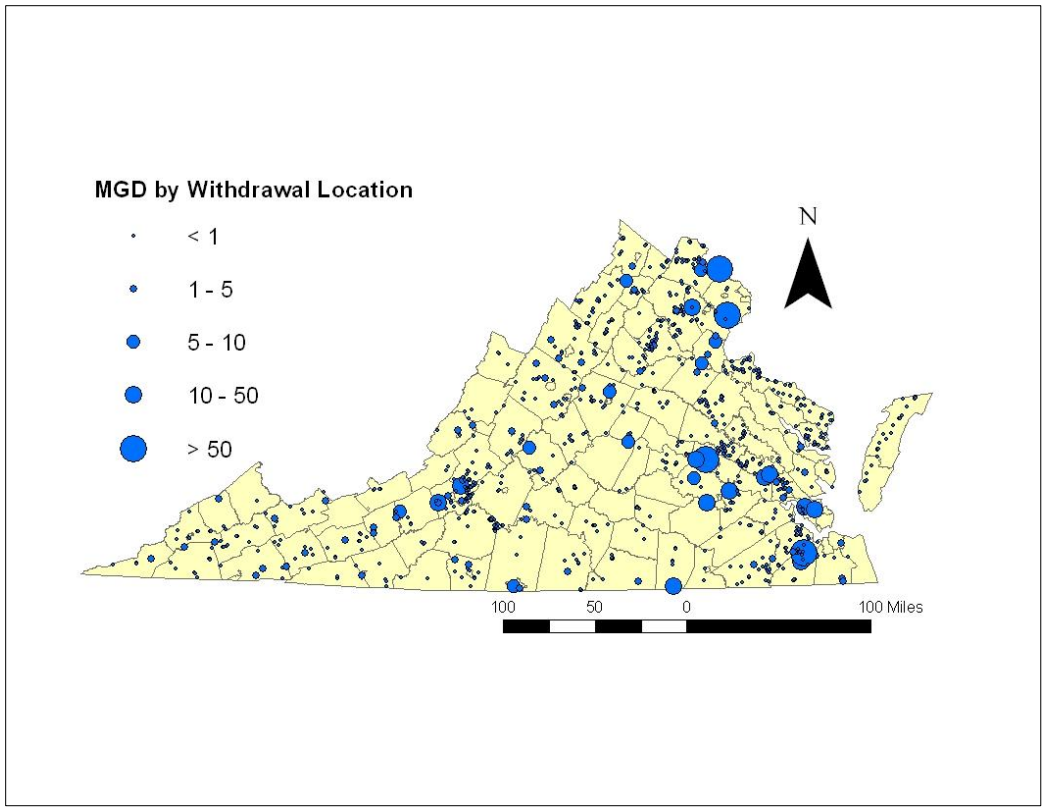


Figure 29: 2011 Public Supply Water Withdrawals by Withdrawal Point Location (mgd).

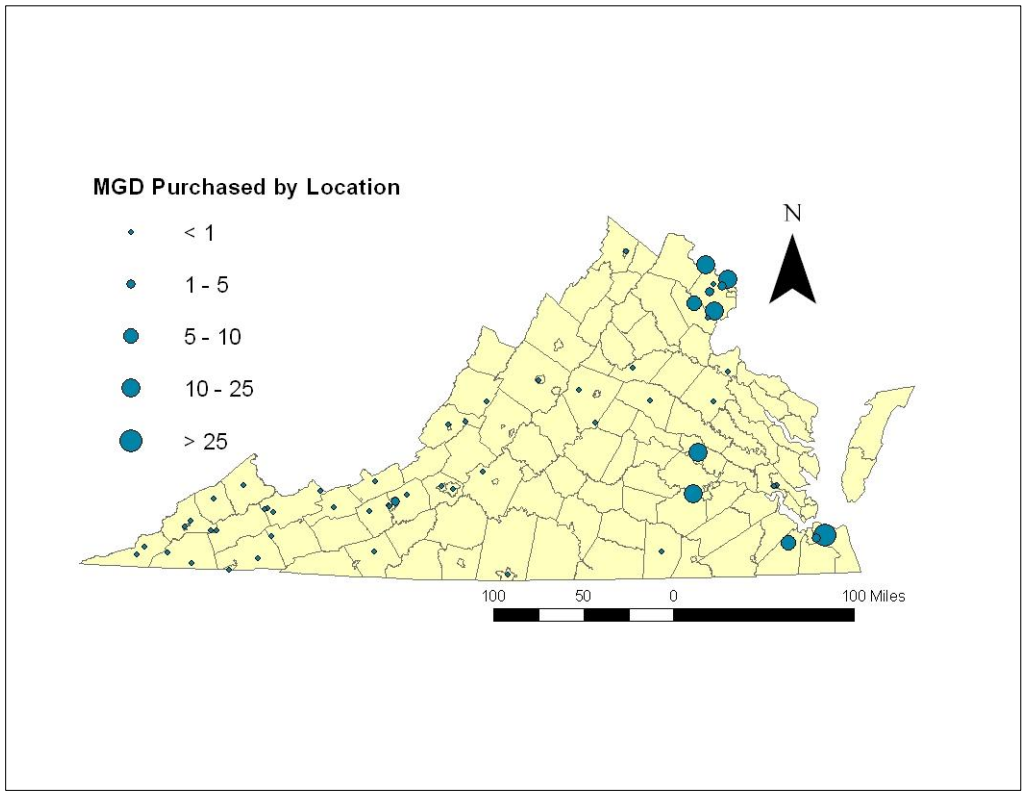


Figure 30: 2011 Public Supply Water Purchases by Location (mgd).

Power Generation Water Withdrawals in Virginia

Withdrawals for power generation are treated separately because most of the water diverted for these purposes is used non-consumptively. Water diverted for hydropower use is exempted from reporting and is nearly all non-consumptive use and these flows are generally not reported to the VWUDS database. Therefore, withdrawals during 2011 by nuclear and fossil-fuel power generating plants are discussed in this section. The largest water transfers for public water supply are listed in Table 23.

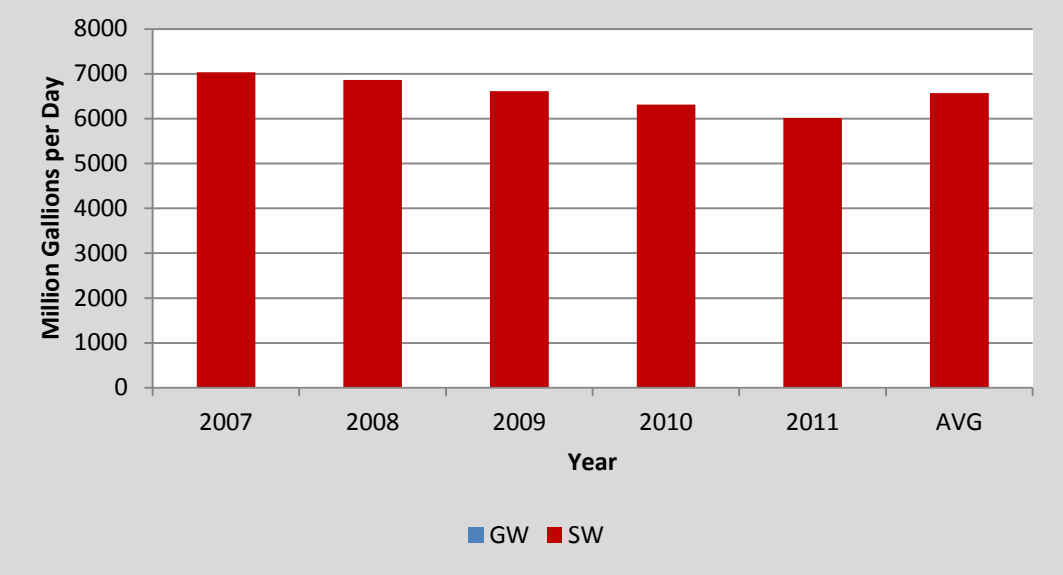


Figure 31: 2007-2011 Power Generation Withdrawals by Source Type.

Table 22: 2007-2011 Power Generation Withdrawals by Source Type, with 2011 Change from 5-year Average (excluding Hydropower).

Source type	2007 MGD	2008 MGD	2009 MGD	2010 MGD	2011 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	2.0	2.4	1.0	1.6	0.4	1.5	-1.1	-75
Wells-Fossil	1.7	2.0	0.6	1.2	0.0	1.1	-1.1	-96
Wells-Nuclear	0.3	0.4	0.4	0.4	0.3	0.3	0.0	-4
Total SW	7033	6860	6611	6309	6015	6566	-551	-8
Streams-Fossil	3061	2997	2763	2580	2335	2747	-412	-15
Streams-Nuclear	1939	1977	1961	1907	1948	1946	1	0
Reservoirs-Fossil	2	2	1	1	1	1	-1	-54
Reservoirs-Nuclear	2031	1885	1886	1820	1732	1871	-139	-7
TOTAL GW+SW (both Types)	7035	6863	6612	6311	6015	6567	-552	-8

[1]Abs change = difference between 2011 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2011 water withdrawals from average water withdrawals

Table 23: Top Water Withdrawals by Power Generation Facilities in 2011.

Owner Name	Facility	City/County	Type[1]	Major Source	Avg. MGD[2]	2011 MGD
Dominion Generation	Surry Nuclear Plant	Surry	N	James River	1946.7	1947.9
Dominion Generation	North Anna Nuclear Power Plant	Louisa	N	Lake Anna	1870.8	1731.6
Dominion Generation	Chesterfield Power Station	Chesterfield	F	James River	878.4	816.0
Dominion Generation	Yorktown Fossil Power Plant	York	F	York River	748.0	585.7
Dominion Generation	Chesapeake Energy Center	Chesapeake	F	South Branch, Elizabeth River	519.1	514.9
Dominion Generation	Possum Point Power Station	Prince William	F	Potomac River	146.4	150.4
Dominion Generation	Bremo Bluff Power Plant	Fluvanna	F	James River	120.7	102.3
Appalachian Power Company	Glen Lyn Power Plant	Giles	F	New River	155.4	74.7
GenOn Potomac River LLC	Potomac River Generation Station	Alexandria	F	Potomac River	157.1	71.3
Dominion Generation	Clover Power Station	Halifax	F	Roanoke River	10.6	9.8
Appalachian Power Company	Clinch River Plant	Russell	F	Clinch River	9.8	9.3

[1]N = Nuclear; F = Fossil

[2]Avg. MGD = Average water withdrawals from 2007-2011 (MGD)

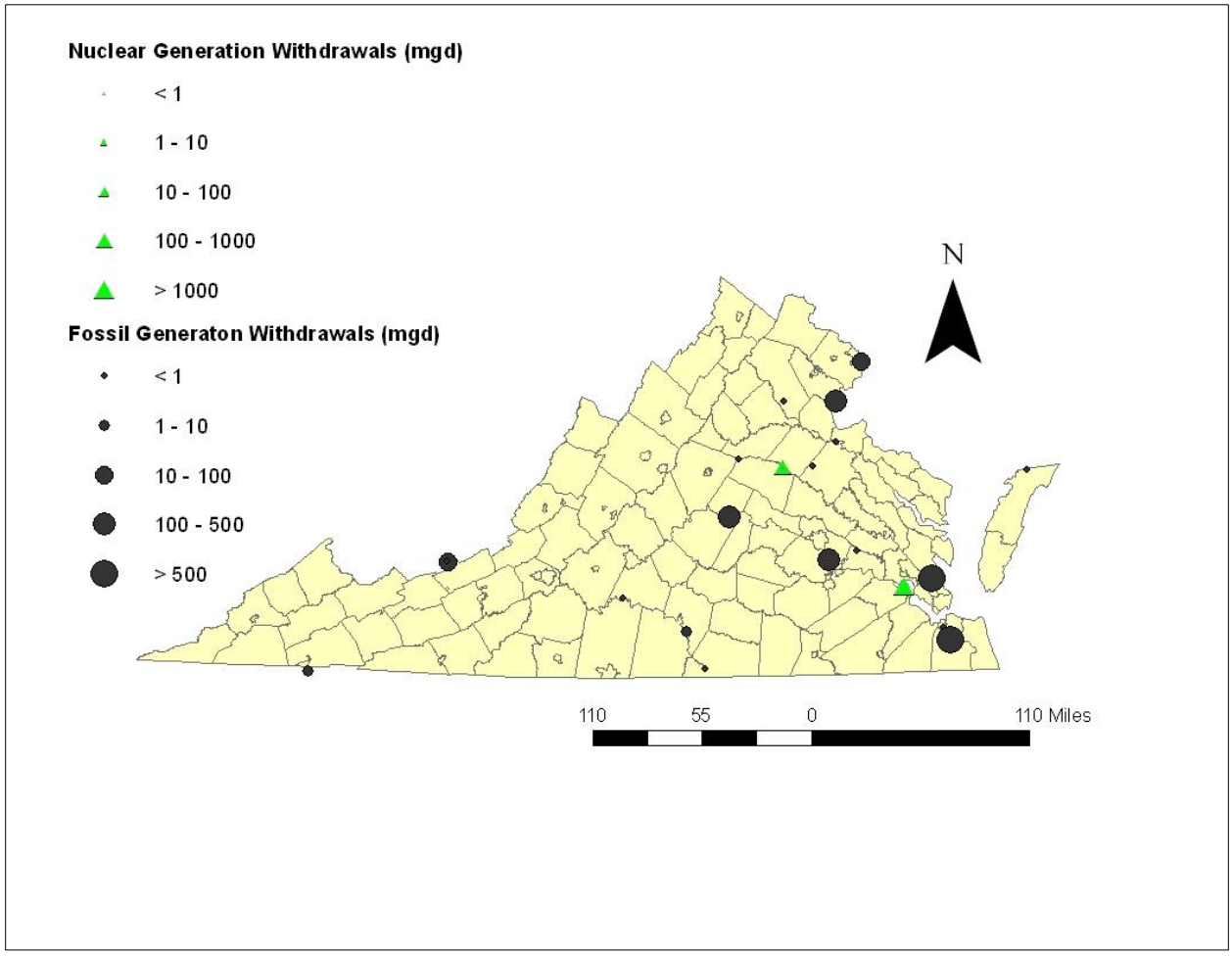


Figure 32: 2011 Power Generation Withdrawals by Withdrawal Point Location (mgd).

VII. WATER RESOURCES - WHAT'S ON THE HORIZON

Although Virginia historically has enjoyed plentiful water resources relative to demand, the growth of the Commonwealth's economy and population presents challenges for maintaining both the quality and quantity of these resources. This challenge is compounded by traditional behaviors and perceptions oriented toward the promotion of water resource consumption. Our water resources are used for a variety of important and sometimes competing in-stream and off-stream uses. Over the past decade, increased demand and competition for water coupled with reduced rainfall have established a greater sense of urgency in Virginia's approach to resource management. As Virginia nears the margins of the state's ability to satisfy water demand, resource management priorities must incorporate a focus on influencing consumer perceptions and behavior. This task requires promoting a shift in consumer behavior from consumption to conservation and re-use. Continued efforts to conserve Commonwealth water resources will ensure the sustainability of all beneficial water demands for the state's economy, welfare, and environment.

KEY WATER RESOURCE SIGNALS - The following are important water resource signals observed across the Commonwealth:

- A general trend of increased demands on the surface and groundwater resources of the Commonwealth has been observed over the past decade through the state water withdrawal reporting process and local water supply planning activities. Water withdrawals for 2011, however, were roughly equal to the average of the 2007-2011 period.

- Groundwater levels along the fall line have, in some locations, fallen below the elevation of the top of the confined aquifers. Groundwater levels in portions of southeastern Virginia continue to fall below critical surface elevations as designated by the "80%" criterion in the groundwater withdrawal permitting regulation. The fall line is described as the boundary between the Piedmont and Coastal Plain physiographic provinces. It loosely mirrors interstate 95 in the Commonwealth.

- In several locations, current local demands for groundwater to support desired growth in established Groundwater Management Areas can no longer be sustained by the coastal plain aquifer system. This statement is based on groundwater model scenarios showing violations of the regulatory criteria for proposed withdrawals and field observations that show water levels are lower than predicted by the model, including some approaching aquifer tops.

- DEQ estimates that approximately 90% of all existing surface water withdrawals in Virginia are excluded by statute from Virginia Water Protection permit requirements. Amendments to the VWP regulation in 2007 required these excluded or grandfathered users provide DEQ with

total annual withdrawal, maximum daily withdrawal, and month of maximum daily withdrawal information. DEQ is in the process of collecting and analyzing this information and anticipates these data will provide a more comprehensive view of current resource allocation in Virginia's watersheds. A hydrologic model has been completed for the entire Commonwealth of Virginia as of summer 2012. This model is capable of running at a 1 hour time step, and includes simulations of all existing permitted point sources, and all known withdrawals (both permitted, grandfathered and exempt). The model has already been used to analyze all new VWP surface water withdrawal applications received in 2011 and 2012, and has also been used as part of a detailed statewide assessment of the effects of water withdrawals and discharges on in-stream biology. This integrated modeling and analysis system has also been expanded to contain a repository of all water supply plan data, which will be fully imported by the end of 2012, and with the first round of a state-wide cumulative impact analysis of the future demands projected by the planning localities completed in 2013. These analyses may indicate that less water is available in certain watersheds for new and expanded uses than previously assumed. DEQ anticipates the need for increased storage and the expanded use of conjunctive systems to meet future water demands in some areas of the Commonwealth. Limitations in the accuracy of current un-metered water use reporting may require future programmatic changes to adequately account for water use and availability.

WATER RESOURCE MANAGEMENT OPPORTUNITIES - Based on the observed water resource management signals mentioned in the previous section, DEQ is exploring the following initiatives for sustainable water resource management. Several of these initiatives involve opportunities for collaboration with local, state, federal, and non-profit organizations as well as trade industry groups to increase understanding of the Commonwealth's water resources so that water can be supplied sustainably for all beneficial uses.

The hydrogeologic framework of Virginia's Coastal Plain and Eastern Shore regions was updated recently in cooperation with the USGS to incorporate data collected over approximately the past decade. The regulatory model currently used to evaluate the potential impacts of ground water withdrawals within the coastal plain uses an older hydrogeologic framework. An effort is underway to incorporate the new framework using updated modeling tools into the ground water withdrawal permitting process.

- Groundwater levels in the undesignated portion of Virginia's coastal plain are continuing to decline. Impacts from groundwater withdrawals are propagating along the fall line into the undesignated portion of Virginia's coastal plain and have the potential to interfere with wells in these areas without assigned mitigation responsibilities. Given current groundwater declines, the entire coastal plain aquifer system must be managed to maintain a sustainable future supply of groundwater. This will require applicable amendments to the Eastern Virginia Groundwater Management Area Regulation (9VAC25-600) and the Groundwater Withdrawal Regulation (9VAC25-610) to address the increasing demand on limited groundwater resources, changes to the administrative review process, and regulatory changes necessitated by new information on the coastal plain aquifer system currently underway. The Proposed Expansion Area includes the following additional counties and city: Caroline, King and Queen, Gloucester, Mathews, Middlesex, Essex, Spotsylvania (part), Stafford (part), Prince William (part), King George, Westmoreland, Richmond, Lancaster, Northumberland, Fairfax (part), Arlington (part); and Alexandria City (Figure 31).

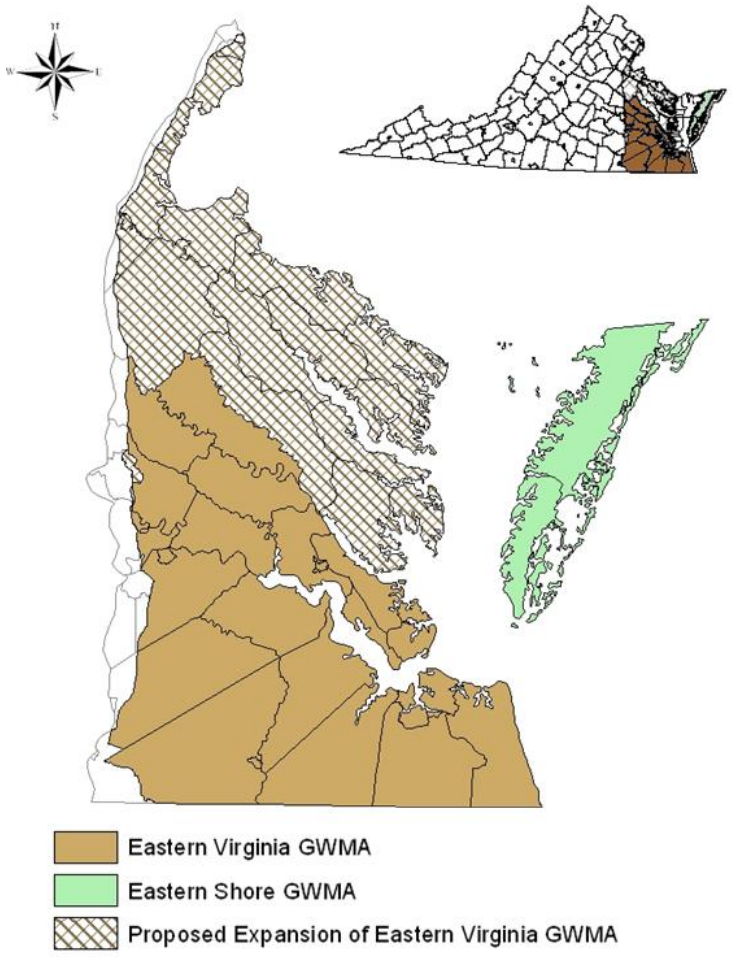


Figure 21: Proposed Expansion of the Eastern Virginia Groundwater Management Area.

- Significant data gaps exist in the State Observation Well Network west of the fall line and in Virginia's Northern Neck. DEQ collaboratively works with local governments to identify existing wells that meet established criteria for inclusion in the network. DEQ anticipates these opportunities for collaboration will increase as the recently submitted water supply plans are reviewed and local resource managers look for reliable data to support resource management decisions.

- The conversion of existing observation well sites in representative areas of the Blue Ridge and Valley & Ridge physiographic provinces provides an economically feasible way to obtain depth integrated hydraulic head values in complex fractured rock and karst groundwater systems. By recording the vertical and temporal distribution of isolated hydraulic head values in representative crystalline rock and karst environments, a unique opportunity is created for studying the response of these stratified system

components to groundwater inputs and outputs (i.e. precipitation, evapotranspiration, pumping, and stream base flow).

- The International Paper Franklin Paper Mill did not operate during 2011. International Paper had been the largest permitted groundwater user with average daily withdrawals of over 30 MG. During the mill shutdown, water level observations in aquifers indicated a slow and irregular recovery of potentiometric levels in the Potomac Aquifer. The mill resumed operations during 2012, with subsequent potentiometric level decreases. Monitoring of the Potomac Aquifer and overlying aquifer levels at additional wells in the Franklin vicinity will assist in determining the extent of the potentiometric drawdown due to the Franklin mill.
- Major watersheds lack established science-based in-stream flow targets to protect fish and wildlife habitat, recreational uses, and navigation uses specific to individual watersheds. Essential to determining water availability is defining the unique set of beneficial water uses within each watershed and assigning the requisite in-stream flow necessary to sustain those uses in each watershed. DEQ staff is collaborating with EPA, The Nature Conservancy, Virginia Department of Game and Inland Fisheries, and USGS staff to initiate a peer review process that synthesizes the best available in-stream flow science to support sustained management of Virginia's diverse water resources and uses.

- Comprehensive data regarding the location and construction of wells throughout the Commonwealth, especially residential, commercial, industrial, and irrigation wells that do not currently fall under the regulatory authority of DEQ are needed to address the increasing complexity of groundwater management issues. Timely, accurate, and easily accessible information supports resource characterization efforts that enable managers to understand how the resource responds to stresses from both demand and climatic events. Such information will also facilitate development of the state water supply plan as well as local government implementation and maintenance of their local and regional water supply plans. - Drought conditions occur periodically across Virginia during the summer and fall when rainfall is less frequent than other times of the year. With continued growth bringing the need for cooperation between water users and managers during dry times, the need for a "warning system" to recognize drought onset before it happens was recognized. Based upon the correlation between winter rainfall and summer stream base flows derived from winter ground-water recharge, the DEQ and USGS are cooperating in the development of new statistical tools to predict summer low flows in major streams with long-term gauging stations. It is hoped that the tools can eventually be used to extrapolate predictions to non-gauged streams.

WATER RESOURCE MANAGEMENT INVESTMENT CHALLENGES - To effectively manage water resources for current and future generations, continued financial investment is necessary for responsible management, policy development and implementation, and improved local government and public participation:

- The number of long term monitoring data stations for surface water flow, groundwater levels, and water resource use has consistently declined over the last twenty years. Sustained funding to support surface water flow and groundwater level data collection and analysis is essential to accurately account for the Commonwealth's water resources. Such surface and groundwater data are an integral part of many DEQ programs including numerous permitting programs, establishment of TMDLs, water supply planning, and overall resource characterization.

- Investment in regional water supply program development and implementation is necessary to build long-term local government stewardship of local and regional water resources. A secure source of funding for planning grants to local governments should be identified and implemented as a fundamental element to the success of initial water supply plan implementation and long-term plan maintenance.

- An estimated 20,000 wells are drilled in Virginia each year by approximately 400 water well drillers. Resources required to obtain well location (latitude/longitude to sub meter accuracy) and enter well construction information into a geo-referenced database have historically not been available. Members of the Virginia Water Well Association have expressed interest in implementing a grass roots program to obtain sub-meter coordinates at the time the well is drilled, as well as entering construction information into a data base that can be made available to resource managers. Funding is required to obtain commercially available hardware, software, and Global Positioning System units for distribution to water well contractors cooperating with the Commonwealth to obtain well locations and other information used by groundwater resource managers.

VII APPENDICES

Appendix 1: Virginia's Water Resources Data

State Population (2011 estimate from U.S. Census Bureau) – 8.096 million

State Surface Area – 42,774 square miles

Major River Basins (with Current Estimates of Flow):

Potomac/Shenandoah (5,681 square miles) – 1,842 MGD
Rappahannock (2,712 square miles) – 1,131 MGD
York (2,674 square miles) – 1,099 MGD
James (10,265 square miles) – 5,558 MGD
Chesapeake Bay/Small Coastal (3,592 square miles) – 97 MGD
Chowan River/Albemarle Sound (4,220 square miles) – 1,777 MGD
Roanoke (6,393 square miles) – 2,277 MGD
New (3,068 square miles) - 3,296 MGD
Tennessee/Big Sandy (4,132 square miles) – 2,618 MGD

Perennial River Miles (freshwater) - 52,232 miles

Publicly Owned Lakes and Reservoirs

Larger than 5,000 acres	5	109,838 acres
Smaller than 5,000 acres	243	52,392 acres
Total	248	162,230 acres

Freshwater Wetlands - 808,000 acres

Tidal and Coastal Wetlands - 236,900 acres

Estuary - 2,308 Square Miles

Atlantic Ocean Coastline - 120 Miles

State-wide Average Annual Rainfall - 42.8 inches

Average Freshwater Discharge of All Rivers - Approximately 25 billion gallons per day

Average Freshwater Discharge into the Chesapeake Bay – Approximately 9.73 billion gallons per day

Appendix 2: Drought Monitoring Task Force Report

VIRGINIA DROUGHT MONITORING TASK FORCE

Drought Status Report

September 7, 2012

During August, rainfall totals increased and temperatures moderated somewhat relative to the previous month. However, relatively dry conditions persisted in parts of the northern and central portions of the Commonwealth. The National Weather Service's Advanced Hydrologic Prediction Services (AHPS) web pages showing departures from normal rainfall over the past 30, 60 and 90 days (Appendix A) indicate that rainfall deficits still exist in parts of northern, central and southwestern Virginia. Stream flow conditions improved due to higher rainfall amounts in many areas of Virginia, except for parts of the Roanoke and Lower Shenandoah River Basins. Ground water levels continued to decline, however, in many areas.

The September 4, 2012 U.S. Drought Monitor web pages indicate that abnormally dry (D0) conditions exist across approximately 53% of the state (Appendices B & C). Moderate drought (D1) conditions extend across approximately 13% of Virginia, including the areas mentioned above plus the Eastern Shore. The northern half of Accomack County remains part of a severe drought (D2) region that extends throughout much of Delaware and eastern Maryland.

On August 14th, the DEQ issued a Drought Warning Advisory for the Appomattox River Basin. Water levels in Lake Chesdin, the main public water supply source in this basin, dropped to greater than 4 ft below its full pool level during August. The water level reported for September 7, 2012 was 36 inches (3 ft) below full pool level. The DEQ also declared Drought Watch Advisories on August 14th for the Northern Piedmont and Roanoke Drought Evaluation Regions due to continuing low ground water levels and stream flows (below the 25th percentile of historic levels and flows). During its regular monthly meeting on September 6th, the Drought Management Task Force recommended continuing these advisories and closely monitoring conditions during September.

Reports from the Climatology Office at the University of Virginia, the United States Geological Survey (USGS) the Virginia Departments of Health (VDH), Agriculture and Consumer Services (VDACS), and Environmental Quality (DEQ) follow below. The DEQ report is a listing of current conditions at the 4 major drought indicator reservoirs.

Report from the Climatology Office at the University of Virginia, September 6, 2012

Despite a number of frontal passages during the month of August, rainfall across most of the Commonwealth remained well below normal. Only the more southeastern two regions and the Eastern Shore received 90% or more of the August normal, averaged across each region; and seven regions averaged about 75% or less (Appendix D).

Appendix 2: continued

Due to the generally spotty nature of thunderstorm activity, rainfall received at any one location can vary considerably from the averages for its region. This has produced a mix of small wetter and drier spots across the state.

Over the course of the summer (June–August) regional averages only show serious deficits in Northern Virginia and the Northern Coastal Plain. Again, this does not take into account the wide localized variations throughout Virginia.

The heat of summer brings very high levels of evapotranspiration (the combined effect of direct evaporation and water uptake by plants). With normal temperatures, this moisture loss greatly exceeds normal rainfall during this period. Summer temperatures this year have averaged significantly above normal and evapotranspiration has generally exceeded rainfall in all but the wettest locations. The resultant drying of topsoil layers leaves little water available to penetrate into the groundwater system.

Thus far, the hurricane season has not been a quiet one, but tropical systems have brought very little moisture to Virginia. Forecasts still indicate expectations of a near normal season overall. Nonetheless, we are in the most active period of hurricane season and even weak and decaying remnants of these storms can be sufficient to bring heavy rains over large areas.

Climatologically, temperatures are expected to drop significantly over the next two months and evapotranspiration rates will be further reduced as the growing season draws to a close. This should help alleviate pressures on water supplies; but a very warm, dry September could enhance any risk of developing water supply problems—especially in well-fed systems.

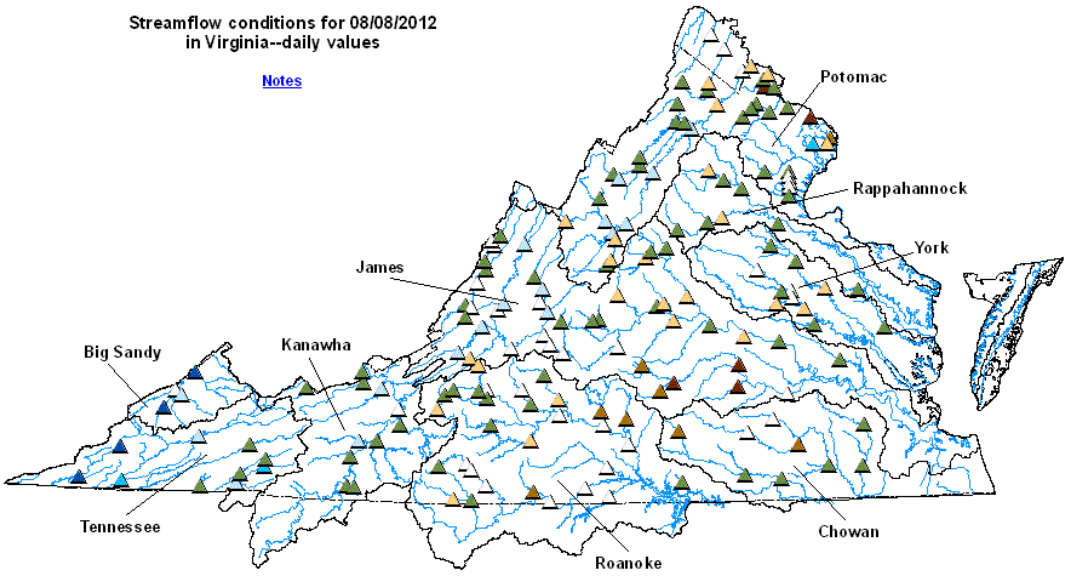
Appendix 2: continued

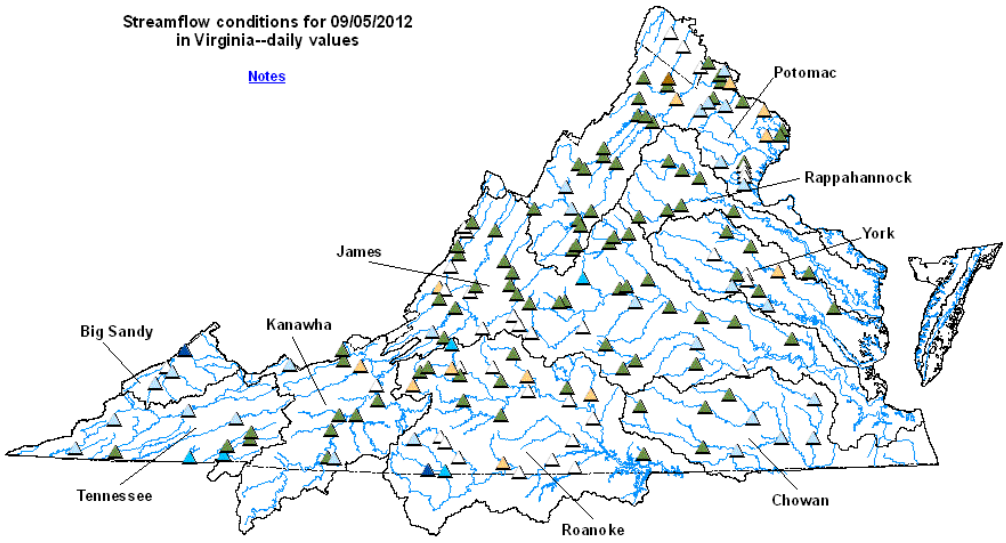
U.S. Geological Survey Report, September 6, 2012:

Stream flows have improved into the normal to wet range across a majority of the Commonwealth in response to the recent precipitation events. (figure. 1). Drought conditions for stream flow improved across the Commonwealth, except below normal conditions persist in parts of the Roanoke and Lower Shenandoah River Basins (fig. 2).
Groundwater levels (fig. 3) from the Virginia Climate Response Network (http://groundwaterwatch.usgs.gov/crn/StateMaps/VA.html) generally continue to follow the spring/summer recession with a couple slight increases during this reporting period. Below normal percentile classes exist in 30 percent of the wells and 50 percent of the wells have water levels in the normal percentile classes (table 1). The recent precipitation events that contributed to the improvement in stream flow and drought conditions across the Commonwealth had minor to no effect on current groundwater levels as illustrated by the hydrograph for well USGS 372608078404601 41H 3 (fig. 4).

Appendix 2: continued

(A)



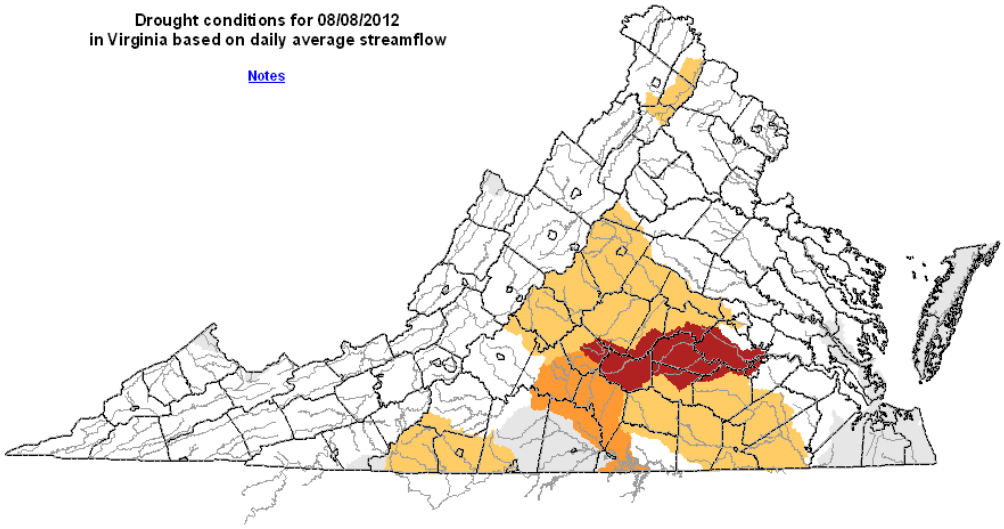


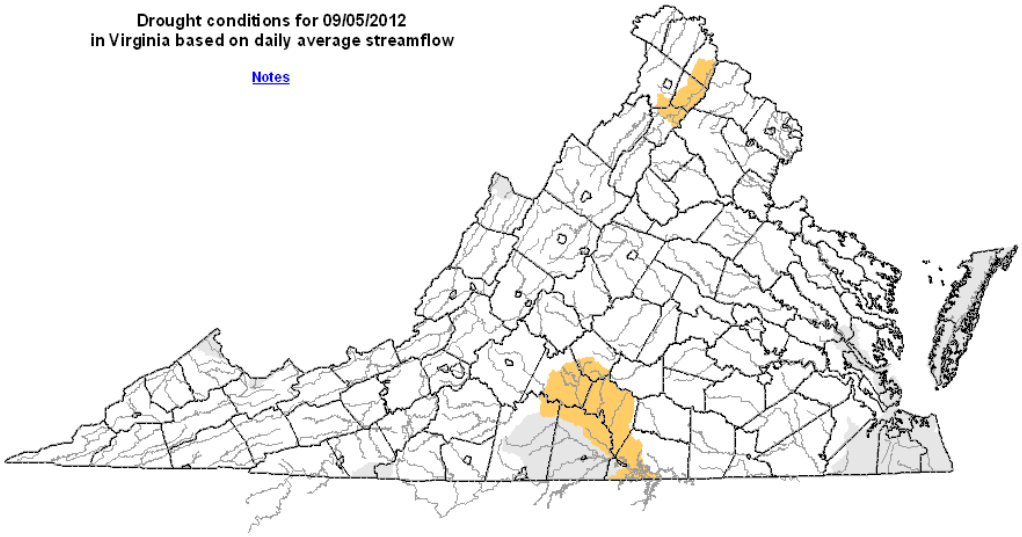
(B)

Figure 1. Streamflow conditions for (*A*) August 8, 2012 and (*B*) September 5, 2012 in Virginia.

Appendix 2: continued

(A)





(B)

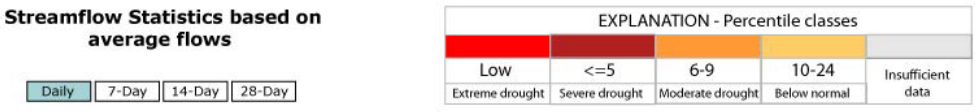


Figure 2. Drought conditions for (*A*) August 8, 2012 and (B) September 5, 2012 in Virginia.

Appendix 2: continued

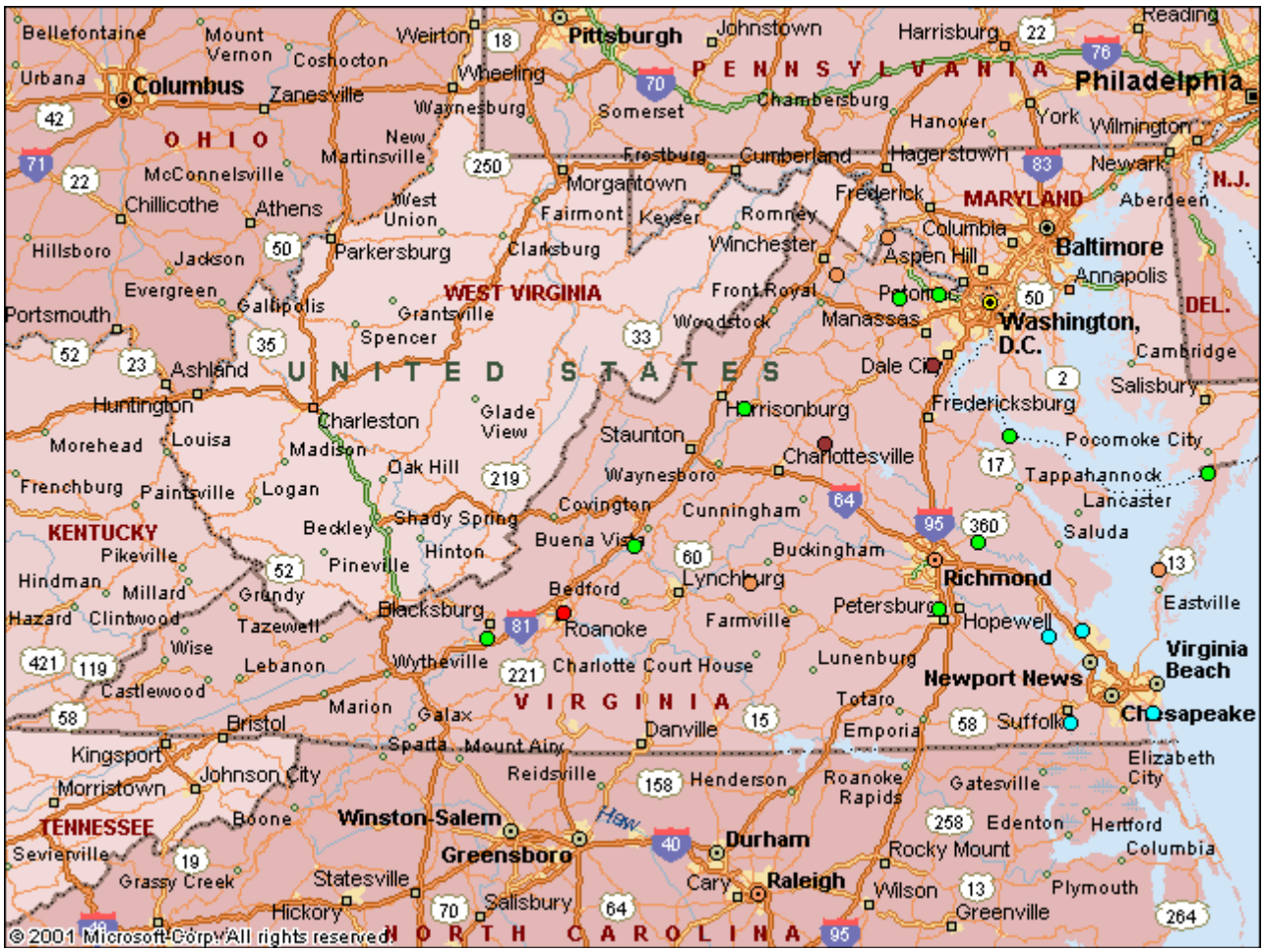


Figure 3. Groundwater-level conditions from the Virginia Climate Response Network for September 5, 2012 in Virginia.

Appendix 2: continued

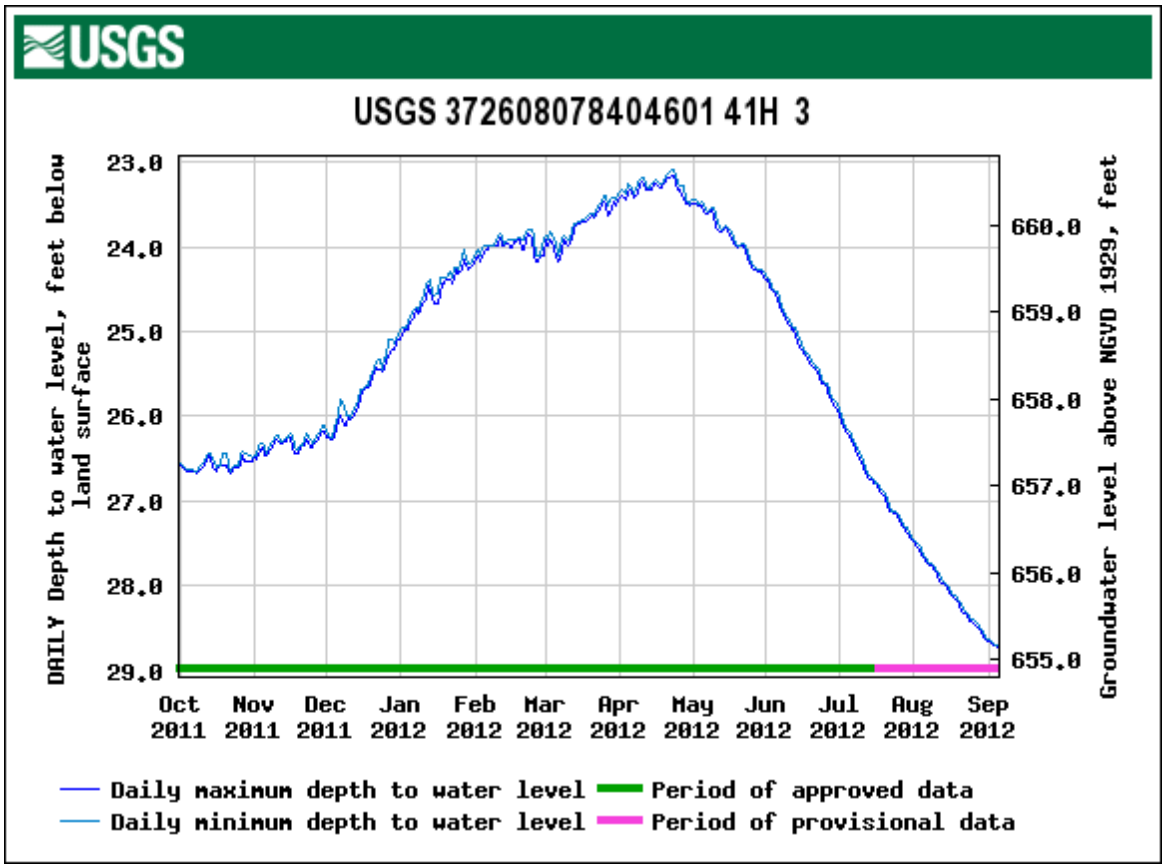


Figure 4. Hydrograph for well USGS 372608078404601 41H 3 located in Buckingham County, Virginia for the period October 2011 to present.

Appendix 2: continued

Table 1. Current percentile classes for groundwater levels in the Virginia Climate Response Network (VCRN), September 5, 2012.

[Groundwater levels are classified as normal between the 25th and 75th percentiles.]

Map index	Site ID	Site name	6-Jun-12	17-Jul-12	8-Aug-12	5-Sep-12	Trend[1]
1	363928076332901	58B 13	25-50	75-90	75-90	75-90	Down
2	364126076003501	62B 1 SOW 098A	100	75-90	75-90	75-90	Down
3	370712076413203	57E 13 SOW 094C	10-25	10-25	75-90	75-90	Up
4	370812080261901	27F 2 SOW 019	25-50	10-25	50-75	25-50	Down
5	370841076275204	59F 74 SOW 184C	50-75	50-75	50-75	50-75	Down
6	371644077244601	51G 1	25-50	10-25	50-75	50-75	Down
7	371653079552101	31G 1 SOW 008	10-25	0-10	10-25	Low	Down
8	372608078404601	41H 3	10-25	10-25	10-25	10-25	Down
9	372705075555903	63H 6 SOW 103A	10-25	10-25	10-25	10-25	Down
10	373737077083201	53K 19 SOW 080	50-75	50-75	50-75	50-75	Down
11	373758079271601	35K 1 SOW 063	50-75	25-50	50-75	25-50	Down
12	375723075344404	66M 19 SOW 110S	50-75	25-50	25-50	50-75	Up
13	381002078094201	45P 1 SOW 030	0-10	0-10	0-10	0-10	Down
14	381132076551001	55P 9	50-75	25-50	25-50	25-50	Down
15	382150078424001	41Q 1	25-50	25-50	25-50	25-50	Down
16	383423077245901	51S 7	50-75	10-25	10-25	0-10	Down
17	385607077381101	49V 1	90-100	25-50	25-50	25-50	Down
18	385638077220101	52V 2D	25-50	25-50	25-50	25-50	Down
19	390348078035501	46W175	10-25	10-25	25-50	10-25	Down
20	391542077423801	49Y 1 SOW 022	50-75	10-25	25-50	10-25	Down

[1] *Trend based on period from June 2012 to present*

Appendix 2: continued

VDH Office of Drinking Water, Situation Report, September 2012:

As of September 6, 2012, seven waterworks facilities in the Appomattox River basin have mandatory restrictions and one waterworks in the same basin (Farmville) is under voluntary restrictions. One additional waterworks in Loudoun County (Town of Round Hill) that uses ground water is also under voluntary restrictions.

ODW Drought Situation Report

Date: **9/6/12**

	Restriction totals	Population Totals
Mandatory	**7**	407,606
Voluntary	2	11,791
Total	**9**	419,397

N-None B-Better

M-Mandatory S-Stable/Same

V-Voluntary W-Worse

PWSID	Waterworks	Source Name	Restrictions	Situation	Population Served
3570150	Colonial Heights	Appomattox River Water Authority (Lake Chesdin)	**M**	W- Mandatory restrictions called for by ARWA on August 23, 2012	17,286
3730750	City Of Petersburg	Appomattox River Water Authority (Lake Chesdin)	**M**	W- Mandatory restrictions called for by ARWA on August 23, 2012	33,740
3053280	DCWA Central	Appomattox River Water Authority (Lake Chesdin)	**M**	W- Mandatory restrictions called for by ARWA on August 23, 2012	7,431
3149700	Puddledock Road	Appomattox River Water Authority (Lake Chesdin)	**M**	W- Mandatory restrictions called for by ARWA on August 23, 2012	9,723
4041035	Appomattox River Water Authority	Lake Chesdin	**M**	W- Water levels at Chesdin 49" below spillway on 8/6/12	45,463
4041845	Chesterfield County Central Water	Lake Chesdin / Swift Creek Reservoir	**M**	W- Water levels at Swift Creek Reservoir 26" below spillway on 8/6/12	290,463
5147170	Town of Farmville	Appomattox River	V	B	8,212
5135160	Town of Crewe	Crystal Lake	**M**	B	3,500
6107650	Town of Round Hill	Wells	V	S - Voluntary Restrictions as a precaution (9/4/2012)	3,579

Appendix 2: continued

STATUS OF AGRICULTURAL DROUGHT

Virginia Department of Agriculture and Consumer Services

September 2012

According to the USDA Crop Weather Report released on September 2, 2012, 75%% of topsoil moisture ranged from adequate to surplus. Virginia continues to experience diverse weather conditions. The majority of the state received precipitation over the past week. However, some parts of the Commonwealth received significant rainfall causing flooding in some areas while other parts of the state still suffer from drought like conditions. As of September 5, 2012, thirty-three Virginia counties have formally requested assistance in obtaining a Secretarial disaster designation due to drought and/or excessive heat: Amelia, Appomattox, Bedford, Buckingham, Caroline, Charlotte, Chesterfield, Culpeper, Cumberland, Dinwiddie, Essex, Gloucester, Greene, Hanover, King and Queen, King George, King William, Lancaster, Lunenburg, Madison, Matthews, Middlesex, Nottoway, Orange, Page, Pittsylvania, Powhatan, Prince Edward, Richmond, Shenandoah, Spotsylvania, Stafford, and Westmoreland. USDA/Farm Service Agency is in the process of preparing official loss assessment reports for these localities.

Central Virginia producers report that the recent pattern of warm weather and scattered showers has helped. As harvest reports come in, the corn crop was not as much of a total loss as originally thought. Producers in the Hanover region report that while some corn crops were a total loss, some producers have reported yields as high as 85 bushels per acre. Both cool season grasses and warm season grasses are growing well with adequate moisture.

Southeastern Virginia producers report that recent rains were welcomed, but tobacco farmers in Brunswick County reported incidents of minor flooding. Surry County producers reported that recent rains have slowed corn harvest and late season sprays. Corn that was harvested showed good yields (120-180 bushels per acre). Growers are cautiously optimistic about cotton, peanuts, and soybeans. Chesapeake and Virginia Beach producers report good growing conditions with frequent rainfall. Strawberries, corn and soybeans have done well.

Southwest Virginia and the Shenandoah Valley areas are reporting adequate moisture at this time. Southwest Virginia and the Shenandoah Valley areas are on track for an above average year. Dairymen in the Shenandoah Valley area are having difficulty making hay due to the frequent rain storms. Although many Southwestern Virginia producers report that recent rains are helping the late crops, several growers are reporting crop loss due to the earlier dry conditions. Scott and Lee Counties report they are receiving ample rainfall at this time. The apple industry reported smaller crops, but the markets are very active in buying apples, whether it is for processing, juice or retail.

Appendix 2: continued

In Virginia's Southside, scattered thunderstorms provided soil moisture relief over the past month. Although there are some areas that missed receiving significant rainfall, most areas report receiving fair amounts. Some areas in Mecklenburg and Brunswick Counties received heavy rains. As of late August, 30% of the Flue Cured tobacco crop had been harvested, ahead of the 25% at this point in 2011 and close to the five year average of 34%. Soybeans are doing well and responding to late season rains.

Eastern Virginia and Northern Virginia have pockets of areas that are dryer than normal. Rainfall has been hit or miss. Areas in Fauquier County near Midland and Catlett are dry. Likewise, Bedford County and the Nokesville area of Prince William County are dryer than the rest of the state. On a positive note, even in these areas, dairymen are not concerned about a shortage of feed. The quality will be lower than normal, but the quantity is expected to be adequate. The corn crop in Eastern Virginia was affected by the earlier drought, but more rain in recent days has eliminated any threat of drought for the remainder of the crop year. Northern Virginia areas are reporting spotty rainfall, which has replenished ground moisture and rejuvenated pastures and crops that are yet to be harvested. Some corn silage has already been harvested and did not benefit from recent rains; however, standing corn has been rejuvenated allowing the corn ears to continue maturing. Soybeans are thriving. Hay fields are growing.

The major harvest of fruits and vegetables in the northeast is complete for the year. The heavy rains that producers have experienced over the last month have led to fairly heavy disease pressure. There will be some light harvest of watermelons, tomatoes, peppers, cantaloupes, squash and cucumbers until frost. The broccoli crop is planted and growing nicely with harvest coming in late September. The corn crop in the region is currently being harvested with wet conditions slowing the tempo of the harvest. Fields in the northern part of the region are running from 0 bushels to 100 bushels per acre with fields in the southern part of the region running in excess of 200 bushels per acre. The region's soybean crop is in excellent condition. Growers received rainfall during the month of July, which has led to good growing conditions for both full season and double crop soybeans. If growers continue to receive consistent rainfall throughout the month of September as the pods fill out, the soybean crop in the northeast region should come in well above average. Growers are experiencing some insect pressure and are applying insecticides as well as fungicides.

The horticulture industry reports that most growers have experienced adequate rainfall throughout much of the Commonwealth. However, some areas of the state are experiencing rainfall shortages, which have necessitated the need for increased irrigation.

Appendix 2: continued

Virginia Department of Environmental Quality: Conditions of Major Drought Indicator Reservoirs:

September 7, 2012:

Four large multi-purpose reservoirs are identified as drought indicators in the Virginia Drought Assessment and Response Plan: Smith Mountain Lake, Lake Moomaw, Lake Anna and Kerr Reservoir. Levels at two of these reservoirs, both representing the Roanoke River Drought Evaluation Region, are currently below their Drought Watch level. Below is a summary of large reservoir conditions on September 7th, 2012:

- Smith Mountain Lake was at an adjusted elevation 792.29 ft, approximately 0.71 feet below Drought Watch level. The Drought Watch stage for Smith Mountain Lake is elevation 793 feet and below
- Lake Moomaw on the Jackson River was at 1568.5 feet on September 5th, 3.5 ft above its Drought Watch level (1565 feet MSL)
- Lake Anna was at elevation 249.6 ft (1.6 ft above drought watch) on September 7th. The Drought Watch stage for Lake Anna Lake is elevation 248 feet and below
- Kerr Reservoir was at 295.95 feet, approximately 3.55 ft below the Guide Curve for this time period. Drought Watch status is reached at greater than 3 ft below the Guide Curve. The current seven day forecast is for the reservoir level to drop to 295.50 ft.

Current water levels at Drought Indicator Reservoirs:

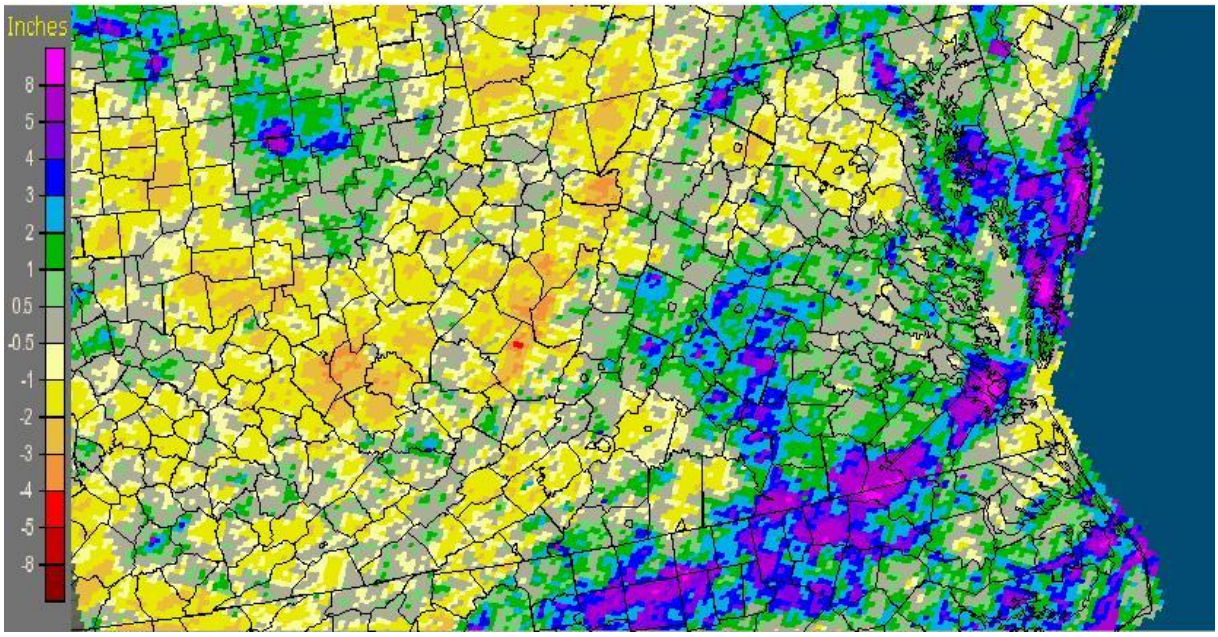
Reservoir Name	Date / Time	Reported Elevation (ft msl)	Drought Watch Range (ft msl)	Current Guide Curve Elevation) ft msl)	Drought Evaluation Region(s) represented
Smith Mt Lake	Sept / 1005	792.29	793 – 791.5		Roanoke River
Lake Moomaw	Sept 5 / 0730	1568.5	1565 – 1562.5		Upper & Middle James River
Lake Anna	Sept 7th /	249.6	248 - 246		Northern Piedmont
Kerr Reservoir	Sept 7th / 0800	295.95	3 – 6 ft below guide curve	299.50	Roanoke River, Southeast Virginia

Appendix 2: continued

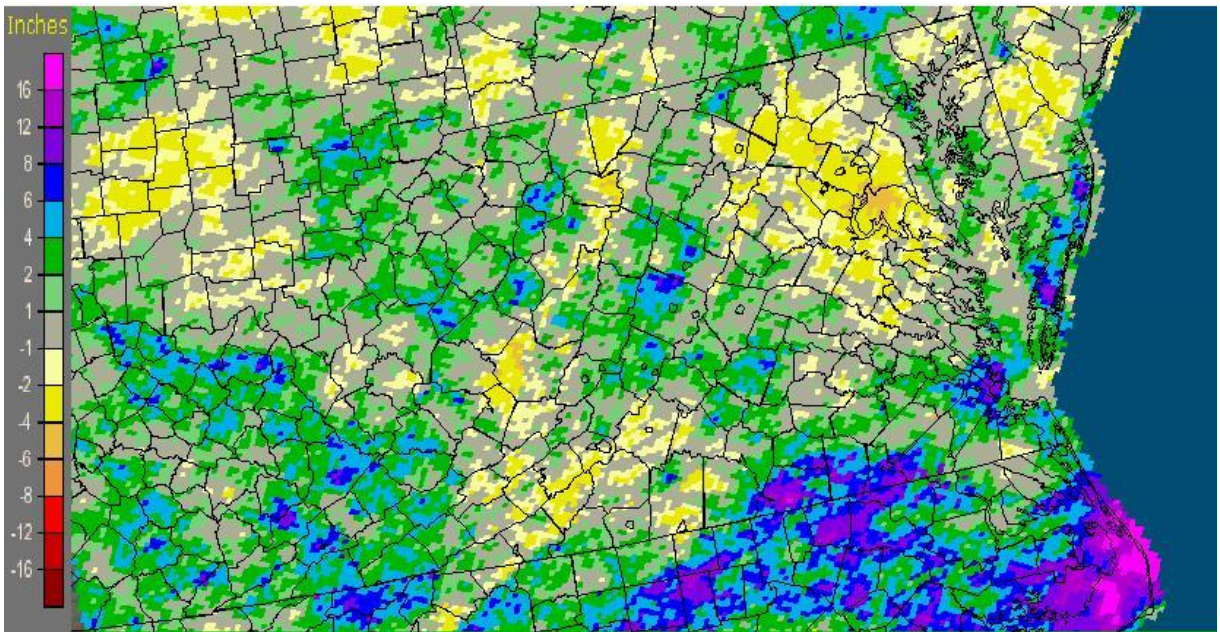
DMTF APPENDIX A

30 & 60-Day Departures from Normal Precipitation (accessed from http://water.weather.gov/precip/)

Virginia: Current 30-Day Departure from Normal Precipitation
Valid at 9/7/2012 1200 UTC- Created 9/7/12 14:07 UTC



Virginia: Current 60-Day Departure from Normal Precipitation
Valid at 9/7/2012 1200 UTC- Created 9/7/12 14:12 UTC

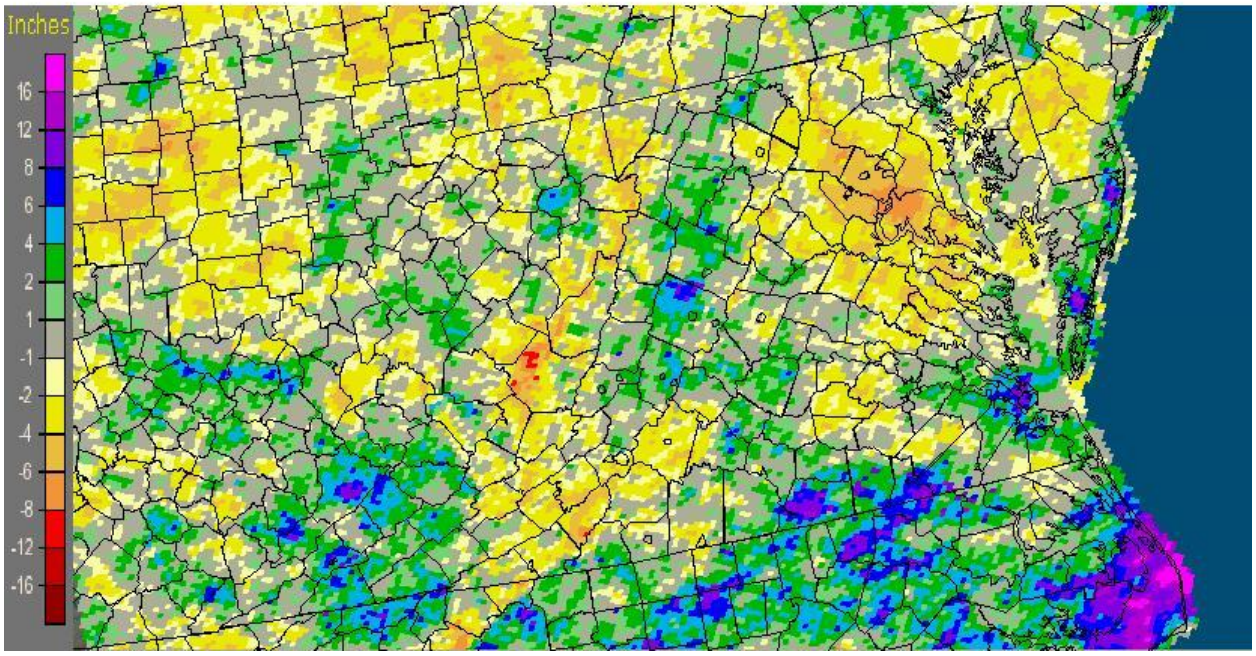


Appendix 2: continued

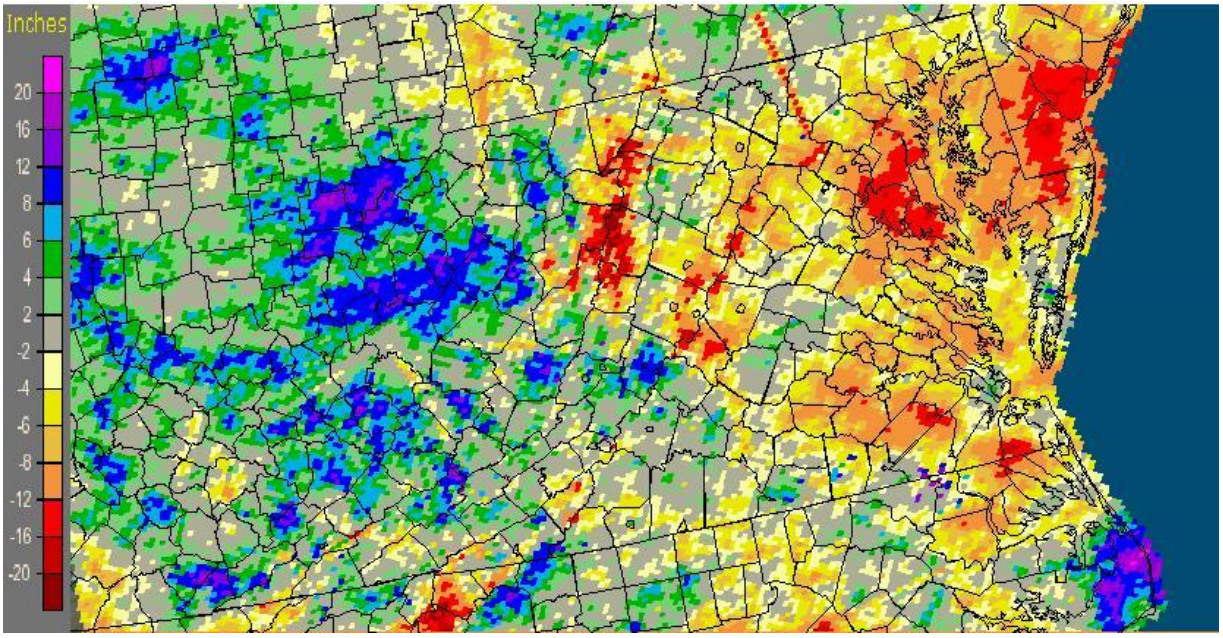
DMTF APPENDIX A (continued)

90-Day and Water-Year Departures from Normal Precipitation (accessed from http://water.weather.gov/precip/)

Virginia: Current 90-Day Departure from Normal Precipitation
Valid at 9/7/2012 1200 UTC- Created 9/7/12 14:17 UTC

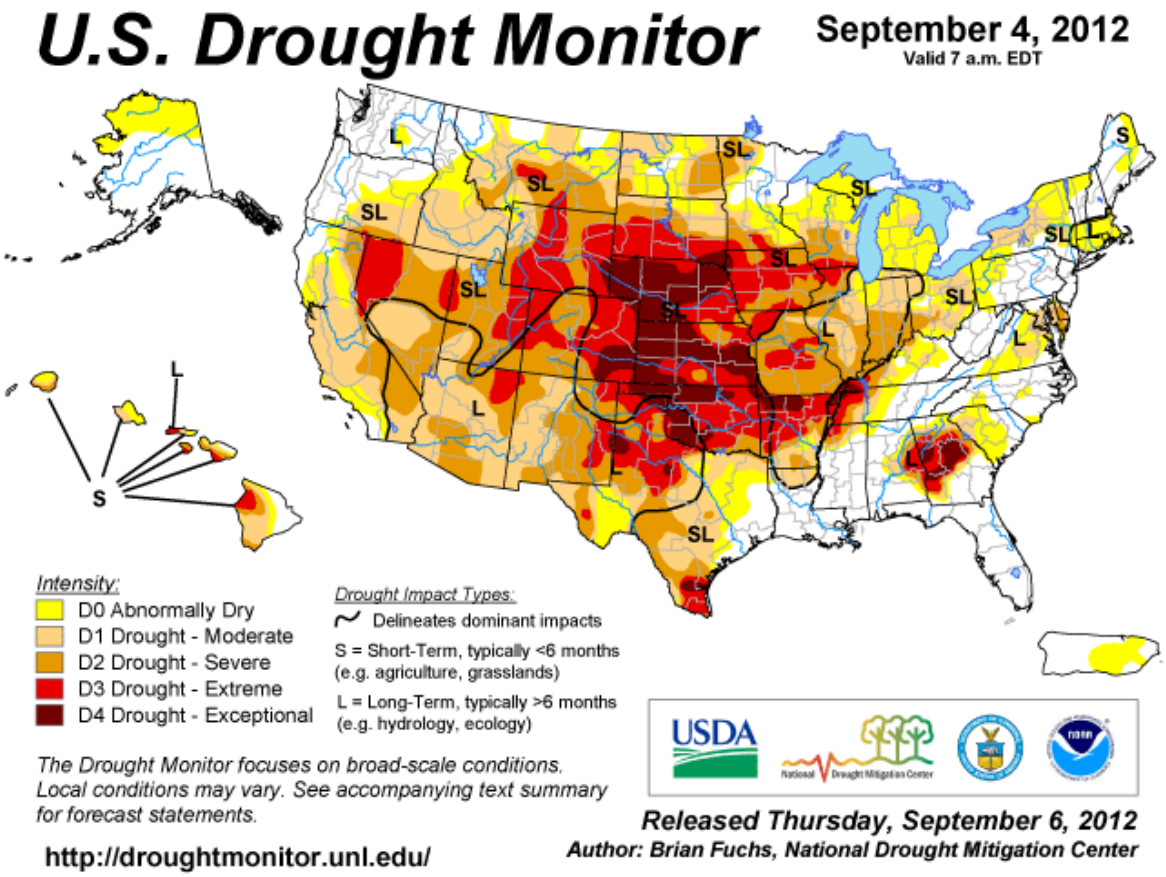


Virginia: Current Water-Year (Oct 1) Departure from Normal Precipitation
Valid at 9/7/2012 1200 UTC- Created 9/7/12 13:53 UTC



Appendix 2: continued

DMTF APPENDIX B



Appendix 2: continued

DMTF APPENDIX C

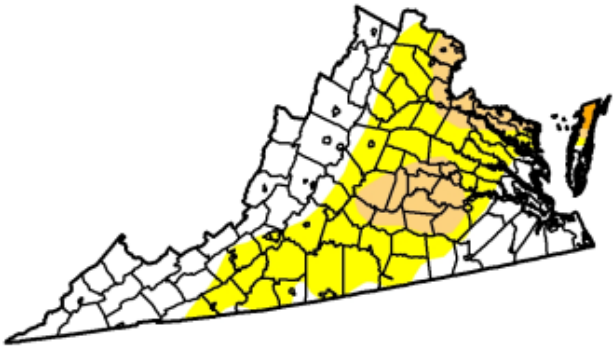
U.S. Drought Monitor

September 4, 2012
Valid 7 a.m. EST

Virginia

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	47.09	52.91	13.55	0.52	0.00	0.00
Last Week (08/28/2012 map)	41.25	58.75	19.59	0.52	0.00	0.00
3 Months Ago (06/05/2012 map)	91.48	8.52	0.00	0.00	0.00	0.00
Start of Calendar Year (12/27/2011 map)	98.44	1.56	0.00	0.00	0.00	0.00
Start of Water Year (09/27/2011 map)	95.83	4.17	0.00	0.00	0.00	0.00
One Year Ago (08/30/2011 map)	63.08	36.92	16.53	0.00	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

Released Thursday, September 6, 2012
Brian Fuchs, National Drought Mitigation Center

Appendix 2: continued

DMTF APPENDIX D

PRELIMINARY PRECIPITATION SUMMARY
(UVA Climatology Office) Prepared: 9/6/12

DROUGHT Aug 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	2.46	3.83	-1.37	64%
New River	2.51	3.31	-0.80	76%
Roanoke	2.79	3.72	-0.93	75%
Upper James	2.68	3.33	-0.65	81%
Middle James	2.60	3.82	-1.22	68%
Shenandoah	2.89	3.33	-0.44	87%
Northern Virginia	2.96	3.85	-0.89	77%
Northern Piedmont	3.20	3.82	-0.62	84%
Chowan	2.66	4.31	-1.65	62%
Northern Coastal Plain	1.78	3.86	-2.08	46%
York-James	5.52	4.87	0.65	113%
Southeast Virginia	4.63	5.12	-0.49	90%
Eastern Shore	3.80	3.87	-0.07	98%
Statewide	2.79	3.83	-1.04	73%

DROUGHT Jul 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	9.74	8.31	1.43	117%
New River	6.51	7.10	-0.59	92%
Roanoke	7.21	8.11	-0.90	89%
Upper James	7.48	7.37	0.11	101%
Middle James	6.29	8.23	-1.94	76%
Shenandoah	7.24	7.09	0.15	102%
Northern Virginia	5.55	7.62	-2.07	73%
Northern Piedmont	6.22	8.22	-2.00	76%
Chowan	8.96	8.82	0.14	102%
Northern Coastal Plain	4.00	8.31	-4.31	48%
York-James	9.95	9.97	-0.02	100%
Southeast Virginia	9.49	10.19	-0.70	93%
Eastern Shore	7.76	7.87	-0.11	99%

Statewide	7.23	8.17	-0.94	89%

DROUGHT Jun 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	12.73	12.45	0.28	102%
New River	9.39	10.95	-1.57	86%
Roanoke	10.65	12.00	-1.35	89%
Upper James	11.86	11.08	0.78	107%
Middle James	10.65	11.74	-1.09	91%
Shenandoah	11.97	10.80	1.17	111%
Northern Virginia	8.68	11.48	-2.80	76%
Northern Piedmont	10.85	12.23	-1.38	89%
Chowan	15.40	12.47	2.93	124%
Northern Coastal Plain	9.30	11.87	-2.57	78%
York-James	18.60	13.38	5.22	139%
Southeast Virginia	16.77	13.80	2.97	121%
Eastern Shore	14.40	10.85	3.55	133%
Statewide	11.67	11.96	-0.29	98%

DROUGHT May 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	16.27	17.27	-1.00	94%
New River	13.69	15.16	-1.48	90%
Roanoke	14.64	16.33	-1.69	90%
Upper James	16.70	15.36	1.34	109%
Middle James	14.44	15.98	-1.54	90%
Shenandoah	15.93	14.64	1.29	109%
Northern Virginia	13.78	15.82	-2.04	87%
Northern Piedmont	15.66	16.45	-0.79	95%
Chowan	18.30	16.56	1.74	111%
Northern Coastal Plain	12.38	16.03	-3.65	77%
York-James	23.10	17.65	5.45	131%
Southeast Virginia	22.37	17.66	4.71	127%
Eastern Shore	17.09	14.37	2.72	119%
Statewide	15.66	16.22	-0.56	97%

DROUGHT Apr 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.

Big Sandy	20.82	21.03	-0.21	99%
New River	18.34	18.71	-0.38	98%
Roanoke	17.62	20.13	-2.51	88%
Upper James	19.88	18.76	1.12	106%
Middle James	16.84	19.32	-2.48	87%
Shenandoah	18.42	17.56	0.86	105%
Northern Virginia	15.77	19.12	-3.35	82%
Northern Piedmont	17.59	19.74	-2.15	89%
Chowan	21.04	19.99	1.05	105%
Northern Coastal Plain	15.05	19.12	-4.07	79%
York-James	26.71	20.95	5.76	127%
Southeast Virginia	25.64	20.91	4.73	123%
Eastern Shore	20.30	17.29	3.01	117%
Statewide	18.67	19.64	-0.97	95%

DROUGHT Mar 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	25.52	25.28	0.24	101%
New River	22.18	22.38	-0.21	99%
Roanoke	22.15	24.40	-2.25	91%
Upper James	25.07	22.55	2.52	111%
Middle James	20.88	23.38	-2.50	89%
Shenandoah	21.95	20.76	1.19	106%
Northern Virginia	17.55	22.78	-5.23	77%
Northern Piedmont	20.41	23.55	-3.14	87%
Chowan	23.54	24.36	-0.82	97%
Northern Coastal Plain	17.12	23.40	-6.28	73%
York-James	29.21	25.64	3.57	114%
Southeast Virginia	28.90	25.11	3.79	115%
Eastern Shore	22.68	21.60	1.08	105%
Statewide	22.31	23.68	-1.37	94%

DROUGHT Feb 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	29.26	28.86	0.40	101%
New River	24.64	25.31	-0.68	97%

Roanoke	24.29	27.71	-3.42	88%
Upper James	27.01	25.40	1.61	106%
Middle James	23.48	26.50	-3.02	89%
Shenandoah	23.29	23.17	0.12	101%
Northern Virginia	19.14	25.45	-6.31	75%
Northern Piedmont	22.33	26.52	-4.19	84%
Chowan	25.97	27.53	-1.56	94%
Northern Coastal Plain	19.34	26.54	-7.20	73%
York-James	32.11	29.17	2.94	110%
Southeast Virginia	31.39	28.61	2.78	110%
Eastern Shore	26.34	24.79	1.55	106%
Statewide	24.67	26.81	-2.14	92%

DROUGHT Jan 1, 2012 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	32.39	32.59	-0.20	99%
New River	27.05	28.52	-1.48	95%
Roanoke	26.46	31.63	-5.17	84%
Upper James	29.73	28.68	1.05	104%
Middle James	25.58	30.16	-4.58	85%
Shenandoah	24.90	26.02	-1.12	96%
Northern Virginia	20.91	28.73	-7.82	73%
Northern Piedmont	23.85	30.04	-6.19	79%
Chowan	27.48	31.64	-4.16	87%
Northern Coastal Plain	20.78	30.29	-9.51	69%
York-James	33.92	33.31	0.61	102%
Southeast Virginia	33.30	32.77	0.53	102%
Eastern Shore	28.63	28.35	0.28	101%
Statewide	26.75	30.45	-3.70	88%

DROUGHT Dec 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	36.83	36.23	0.60	102%
New River	31.10	31.23	-0.14	100%
Roanoke	30.80	34.88	-4.08	88%
Upper James	34.43	31.63	2.80	109%
Middle James	29.53	33.33	-3.80	89%
Shenandoah	28.31	28.61	-0.30	99%
Northern Virginia	24.52	31.83	-7.31	77%
Northern Piedmont	27.53	33.32	-5.79	83%

Chowan	29.39	34.66	-5.27	85%
Northern Coastal Plain	23.22	33.57	-10.35	69%
York-James	35.26	36.70	-1.44	96%
Southeast Virginia	34.87	35.95	-1.08	97%
Eastern Shore	29.49	31.59	-2.10	93%
Statewide	30.31	33.57	-3.26	90%

DROUGHT Nov 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	41.68	39.51	2.17	105%
New River	35.34	34.26	1.08	103%
Roanoke	35.66	38.24	-2.58	93%
Upper James	38.19	34.99	3.20	109%
Middle James	33.48	36.84	-3.36	91%
Shenandoah	31.41	31.66	-0.25	99%
Northern Virginia	26.83	35.24	-8.41	76%
Northern Piedmont	29.77	37.12	-7.35	80%
Chowan	33.69	37.77	-4.08	89%
Northern Coastal Plain	26.93	36.71	-9.78	73%
York-James	37.51	40.07	-2.56	94%
Southeast Virginia	37.38	39.02	-1.64	96%
Eastern Shore	32.04	34.53	-2.49	93%
Statewide	34.13	36.80	-2.67	93%

DROUGHT Oct 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	45.09	42.39	2.70	106%
New River	38.32	37.43	0.88	102%
Roanoke	39.49	41.95	-2.46	94%
Upper James	41.64	38.24	3.40	109%
Middle James	37.70	40.68	-2.98	93%
Shenandoah	34.85	34.85	0.00	100%
Northern Virginia	32.10	38.72	-6.62	83%
Northern Piedmont	35.05	41.11	-6.06	85%
Chowan	37.48	41.35	-3.87	91%
Northern Coastal Plain	30.46	40.22	-9.76	76%

York-James	40.47	43.60	-3.13	93%
Southeast Virginia	39.79	42.68	-2.89	93%
Eastern Shore	35.01	37.74	-2.73	93%
Statewide	37.91	40.30	-2.39	94%

DROUGHT Sep 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	51.60	45.85	5.75	113%
New River	44.84	40.84	3.99	110%
Roanoke	46.28	46.18	0.10	100%
Upper James	47.07	41.74	5.33	113%
Middle James	45.21	44.81	0.40	101%
Shenandoah	40.85	38.52	2.33	106%
Northern Virginia	39.95	42.79	-2.84	93%
Northern Piedmont	40.75	45.39	-4.64	90%
Chowan	42.75	45.78	-3.03	93%
Northern Coastal Plain	40.00	44.31	-4.31	90%
York-James	47.87	48.50	-0.63	99%
Southeast Virginia	47.96	47.11	0.85	102%
Eastern Shore	38.87	41.35	-2.48	94%
Statewide	44.64	44.30	0.34	101%

DROUGHT Aug 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	54.46	49.68	4.78	110%
New River	47.20	44.15	3.04	107%
Roanoke	49.09	49.90	-0.81	98%
Upper James	50.04	45.07	4.97	111%
Middle James	50.74	48.63	2.11	104%
Shenandoah	44.40	41.85	2.55	106%
Northern Virginia	44.64	46.64	-2.00	96%
Northern Piedmont	45.07	49.21	-4.14	92%
Chowan	52.16	50.09	2.07	104%
Northern Coastal Plain	51.88	48.17	3.71	108%
York-James	58.67	53.37	5.30	110%
Southeast Virginia	60.35	52.23	8.12	116%
Eastern Shore	46.93	45.22	1.71	104%
Statewide	49.94	48.13	1.81	104%

DROUGHT Jul 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	59.74	54.16	5.58	110%
New River	50.83	47.94	2.88	106%
Roanoke	52.67	54.29	-1.62	97%
Upper James	52.65	49.11	3.54	107%
Middle James	55.38	53.04	2.34	104%
Shenandoah	47.08	45.61	1.47	103%
Northern Virginia	47.23	50.41	-3.18	94%
Northern Piedmont	47.20	53.61	-6.41	88%
Chowan	58.72	54.60	4.12	108%
Northern Coastal Plain	56.05	52.62	3.43	107%
York-James	68.32	58.47	9.85	117%
Southeast Virginia	68.11	57.30	10.81	119%
Eastern Shore	50.63	49.22	1.41	103%
Statewide	54.16	52.47	1.69	103%

DROUGHT Jun 1, 2011 - Aug 31, 2012

REGION	OBSERVED	NORMAL	DEPARTURE	% OF NORM.
Big Sandy	62.87	58.30	4.57	108%
New River	53.03	51.79	1.23	102%
Roanoke	55.34	58.18	-2.84	95%
Upper James	55.05	52.82	2.23	104%
Middle James	58.81	56.55	2.26	104%
Shenandoah	50.37	49.32	1.05	102%
Northern Virginia	49.20	54.27	-5.07	91%
Northern Piedmont	49.93	57.62	-7.69	87%
Chowan	61.89	58.25	3.64	106%
Northern Coastal Plain	59.99	56.18	3.81	107%
York-James	74.02	61.88	12.14	120%
Southeast Virginia	72.02	60.91	11.11	118%
Eastern Shore	56.90	52.20	4.70	109%
Statewide	57.26	56.26	1.00	102%

Appendix 3: Top 20 Water Withdrawal Systems in 2011 (Non-Power Generation)

Owner	System	Category*	Total (MGD)
HONEYWELL INTERNATIONAL INC	HOPEWELL PLANT	MAN	109.13
FAIRFAX COUNTY WATER AUTHORITY	POTOMAC RIVER WTP	PWS	90.53
NEWPORT NEWS, CITY OF	NEWPORT NEWS	PWS	71.73
RICHMOND, CITY OF	RICHMOND (CITY) WTP	PWS	63.01
FAIRFAX COUNTY WATER AUTHORITY	OCCOQUAN RESERVOIR	PWS	61.72
NORFOLK, CITY OF	NORFOLK	PWS	61.61
CELANESE ACETATE LLC	CELCO PLANT	MAN	56.92
MEADWESTVACO CORPORATION	COVINGTON PLANT	MAN	38.95
APPOMATTOX RIVER WATER AUTHORITY	LAKE CHESDIN WTP	PWS	31.31
VIRGINIA BEACH, CITY OF	VIRGINIA BEACH SERVICE AREA	PWS	30.61
UNITED STATES GOVERNMENT	RADFORD AMMUNITIONS WTP 1	MAN	28.26
DUPONT E I DE NEMOURS & CO	SPRUANCE PLANT	MAN	27.49
HENRICO COUNTY	HENRICO COUNTY WTP	PWS	24.90
VIRGINIA AMERICAN WATER CO	HOPEWELL DISTRICT	PWS	21.82
ROCK-TENN CP, LLC	WEST POINT PLANT	MAN	19.18
CITY OF PORTSMOUTH	PORTSMOUTH	PWS	18.85
ROCK-TENN CP, LLC	HOPEWELL PLANT	MAN	15.81
WESTERN VIRGINIA WATER AUTHORITY	ROANOKE CITY	PWS	15.30
CITY OF MANASSAS	MANASSAS	PWS	12.60
GP BIG ISLAND, LLC	BIG ISLAND PLANT	MAN	12.32
		TOTAL	812.05

*Category: MAN= Manufacturing, PWS= Public Water Supply

Appendix 4: Water Transfers in the VWUDS Database

Water use is tracked in the VWUDS database by recording different actions: WL = withdrawal, RL = release, DL = delivery, SR = System Release, and SD = System Delivery. Withdrawals from a water source (groundwater or surface water), in general, account for the largest portion of a locality's actual water use. Some users, however, buy water from another entity and record the amounts in the database as deliveries (DL). Other users sell water to another entity and record the water sold as releases (RL). Some users record both deliveries and releases along with their withdrawals. System release (SR) records contain data regarding the amounts of water released from a water treatment facility to a service area within a particular water system. System delivery (SD) records contain data about water received within a particular service area from, for example, a water treatment facility. Some entities report withdrawals, releases to outside customers, deliveries (purchases) of water from another outside customer, as well as system releases and deliveries within their own water treatment and distribution system.

Currently, not all water transfers are consistently reported to the VWUDS database. For example, in several instances, there are localities who have reported water releases (RL), but there are no corresponding data indicating the water has been received and used by another locality (DL). Or, some entities reportedly sell water (RL), but have no reported means of receiving water (WL or DL or SR).