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, 2013

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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 2012, as well as an update regarding current 2013 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/2010305b303dIntegratedReport.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 2012-2013 water year (October 1, 2012 through September 30, 2013) has been variable both spatially and temporally. After a very dry first quarter, especially November and December 2012, precipitation has gradually increased throughout 2013. Consequently, summertime groundwater levels and stream flows were well above normal throughout Virginia.

Groundwater 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 at a lower water withdrawal rate. Groundwater levels within confined-aquifer observation wells in the region surrounding the mill are slowly responding to these changes. Water levels have begun to decline in wells near the mill, while in other wells farther away levels have continued to rise. Due to the lag time in responses to potentiometric changes in the confined aquifer system, water levels in these wells will eventually resume a declining trend.

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 2012 include:

- Monitoring of 68 surface water stations, 78 real-time groundwater stations and 181 additional wells, and 37 Total Maximum Daily Load (TMDL) data sites. (Real-time data are collected at 15-60 minute intervals and transmitted to viewable databases every 1-4 hours)
- Four new real-time observation wells were installed in Northumberland and Accomack counties, and a 1343 ft deep exploratory core hole in Westmoreland County was reconstructed and converted into a groundwater level monitoring well
- Geophysical logging of two coreholes in Suffolk and Isle of Wight counties to assist in refining the hydrogeologic framework as it relates to the Chesapeake Bay impact structure and its influence on groundwater availability in the Coastal Plain
- Two groundwater resource reports (Groundwater Resources of the Blue Ridge Geologic Province and Groundwater Use in the Virginia Portion of the Shenandoah Valley) were published and are available on line at http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/ReportsPublications.aspx
- The Groundwater Completion Report database was expanded and now includes approximately 57,000 digital water well records
- The locations of 496 springs were verified using both Global Positioning System (GPS) and Geographic Information System (GIS) techniques and an additional 34 new spring locations were documented
- Teaching and speaking engagements were conducted at four groundwater-related educational events
- Continued compliance review for 38 regional water supply plans and 10 local water supply plans, including the development of a water supply plan database with nearly 100,000 data points
- Completion of work with the State Water Plan Advisory Committee to assist DEQ in developing, revising, and implementing the state water resources plan. The committee issued a final report in December 2012. The report can be found at: http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterSupplyPlanning/WSPAC_Final_Report.pdf
- Issuance of 24 groundwater withdrawal permits (15 new or expanded, 9 renewals)

- Issuance of 9 Virginia Water Protection (VWP) Program permits (3 new, 6 modifications)
- Continued management of the annual water-withdrawal reporting program. Withdrawals were reported for the 2012 calendar year by 993 user facilities from approximately 2938 withdrawal measuring points. The reported totals for 2012 exceeded 7 billion gallons per day (including withdrawals for power generation). (Sections IV, V and VI)
- Observation of continued demands on surface and groundwater resources (Section V)
- Further development of the plan to incorporate new hydrogeologic information on the coastal plain aquifer system into the groundwater withdrawal permitting regulatory process used to evaluate the impacts of existing and proposed groundwater withdrawals within the Coastal Plain and Eastern Shore regions (Section VI)
- The expansion of the Eastern Virginia Groundwater Management area to include the counties in the Northern Neck region of the Virginia Coastal Plain. The expansion was adopted by the State Water Control Board during its June 2013 meeting (Section VII)
- Continued 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 VII)

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 2012-2013 water year (October 1, 2012 through September 30, 2013). 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, a report by the U. S. Geological Survey (USGS) describing recent hydrologic conditions, and a report by DEQ on the current status of the 4 major drought indicator reservoirs.

Precipitation during the 2012-2013 water year was well below normal during November and December, 2012. Since then, however, precipitation increased steadily to normal to above-normal rates. Late spring – early summer precipitation was significantly above normal. As a result, stream flows across Virginia were above to well-above normal by July. Groundwater levels, which had been low in many areas during the spring, also

increased to normal levels as a result of the late spring and early summer rains. A current update on drought conditions in Virginia, as well as descriptions of the Drought Regions can be obtained from the DEQ Drought Monitoring website (Virginia DEQ - Drought Current Status).

III PROGRAM SUMMARIES

The Office of Water Supply currently consists of three programs: Groundwater 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 all four of these programs follow, including updated information on their respective accomplishments during 2012.

Surface Water Investigations Program

DEQ and the 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 groundwater 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 2012, SWI field personnel monitored 68 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 2012. 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 2012, SWI measured 37 miscellaneous TMDL sites with a total of 165 measurements.

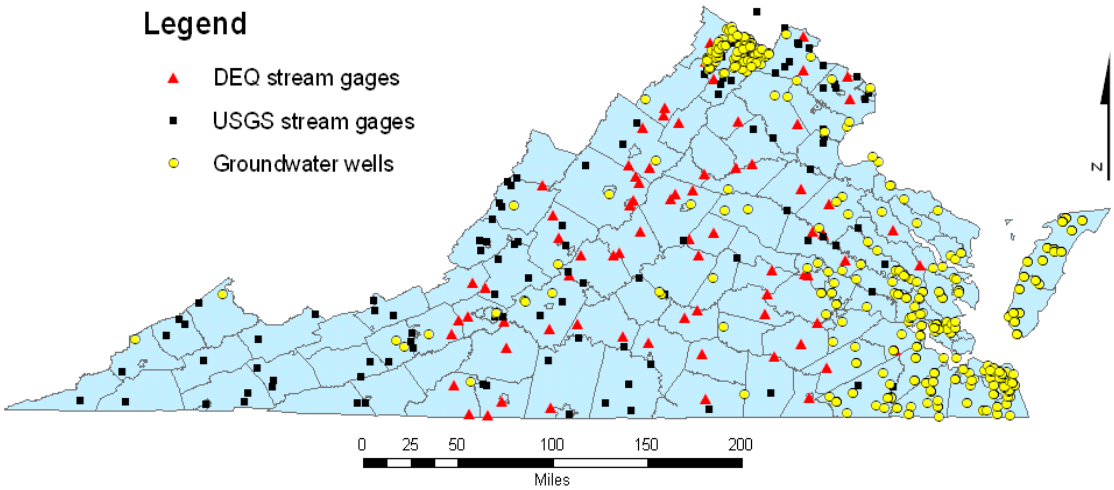


Figure 1: State-wide stream gauges and observation wells.

Groundwater Characterization Program

DEQ established the Groundwater 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 groundwater 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 groundwater availability, facilitate drought monitoring, and provide technical support for the expansion or creation of groundwater management areas. Providing educational outreach to members of the Commonwealth is seen as one of the most important opportunities in developing 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 groundwater resources reports.

The GWCP office also provides reliable information on the elevation of the groundwater in the Commonwealth to determine the availability of the natural resource. Field personnel monitor 78 real-time groundwater stations (Figure 1). They measure and record the groundwater elevation, and service the satellite data collection platforms on a 6-8 week schedule. There are also 146 quarterly taped and 35 yearly taped groundwater 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 GWCP personnel. The USGS provided water level data for an additional 163 wells. These data are available online at http://groundwaterwatch.usgs.gov/StateMaps/VA.html.

The groundwater data are published in an annual report. In the 2012 report, GWCP and USGS analyzed a total of 387 groundwater sites. These data were reviewed, approved, and published with final stream discharge and groundwater elevation available through the USGS Water Data website at http://wdr.water.usgs.gov/wy2007/search.jsp.

Expansion of the State Observation Well Network

During the 2012 calendar year, three real-time wells were installed at the Surprise Hill groundwater monitoring station in Northumberland County for monitoring groundwater levels in the uppermost portions of the coastal plain aquifer system (Calvert confining unit, Yorktown-Eastover aquifer, and Columbia aquifers). An additional real-time well was installed in Accomack County for monitoring groundwater levels near Chincoteague in the Yorktown-Eastover aquifer. In Westmoreland County, a decades-old 1,343 foot exploratory core hole (the Oak Grove Core) was reconstructed and converted into a real-time groundwater level observation well for monitoring groundwater levels in the Lower Potomac aquifer.

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 to groundwater withdrawals (Figure 2). Water-level monitoring at observation wells completed to different depths at the same groundwater monitoring station can also demonstrate how groundwater levels vary along with natural changes in precipitation (Figure 3).

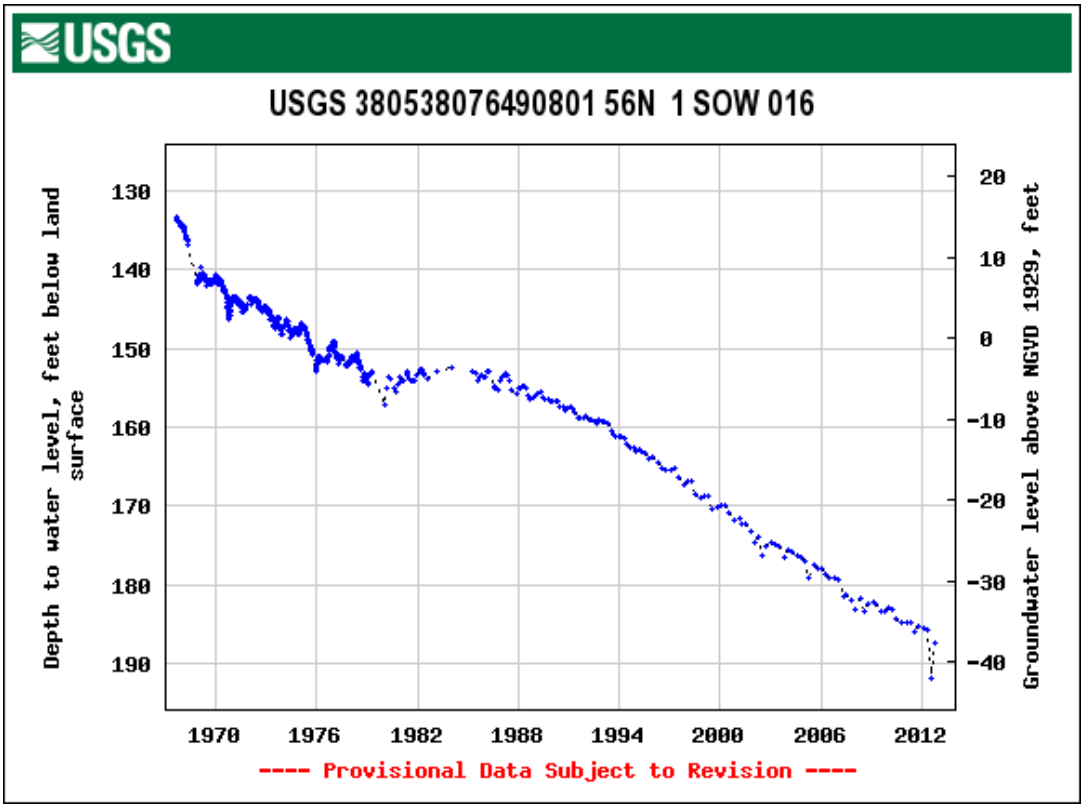


Figure 2: Groundwater level field measurements for State Observation Well 216 in Westmoreland County, Virginia - August 25, 1967 to December 31, 2012. This well is completed in the Potomac Aquifer.

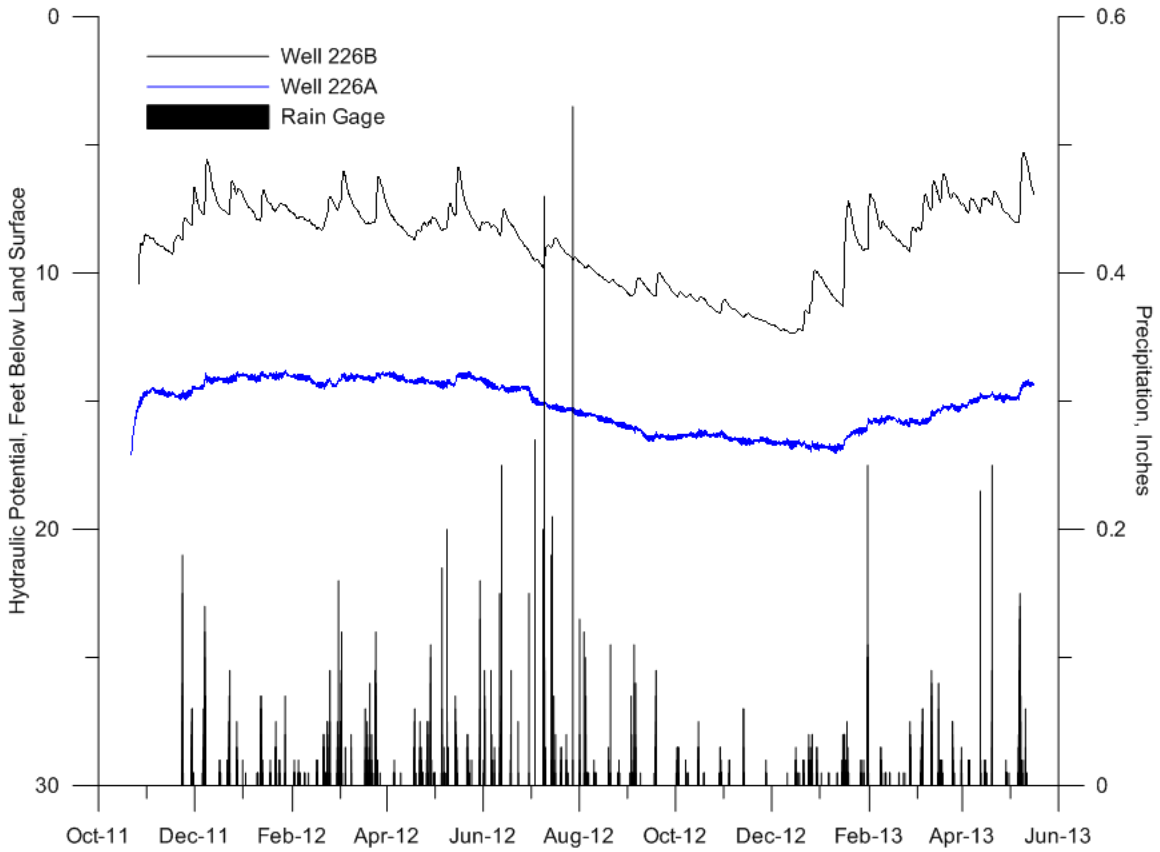


Figure 3: Maximum daily depth to water in State Observation Wells 226Aand 226B and daily precipitation at the National Weather Service Bedford 4 NW rain gauge from late 2011 through May 2013, Bedford County, Va.

Groundwater Resource Reports

Regional groundwater resource reports document and describe the geologic controls on the occurrence, movement, availability, and quality of groundwater as it occurs within the geologically distinct provinces and sub-provinces of Virginia, and summarize current groundwater withdrawal rates and trends. Two groundwater resource report publication drafts (Groundwater Resources of the Blue Ridge and Groundwater Use in the Virginia Portion of the Shenandoah Valley 1892-2007) were reviewed at a joint DEQ/USGS project review. Report revisions resulting from comments and ideas generated during the project review were completed in August 2012 and online publication of the reports was made available to the public via the GWCP web site (http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/ReportsPublications.aspx).

Eighteen Groundwater Resources 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 groundwater

resources within selected counties and political sub-regions of Virginia. To this day, these groundwater resource reports are the only readily available published source of information pertaining to the occurrence, movement, and availability of groundwater 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 groundwater systems. In 2007 and 2008, the GWCP compiled a GIS database of approximately 35,000 historic 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), Department of Environmental Quality (DEQ), The United States Geological Survey (USGS), The Virginia Department of Geology and Mineral Resources (VDGMR), and the Virginia Department of Health (VDH).

Considerable effort and time is being invested to cull duplicate records and to rectify a substantial number of non-domestic water supply wells with questionable coordinate 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. Currently, the well construction database houses well construction and location data for approximately 57,000 wells state wide.

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 continues to educate private well drillers about the importance of voluntarily reporting well coordinate information, and by encouraging 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 2885 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 Department 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.

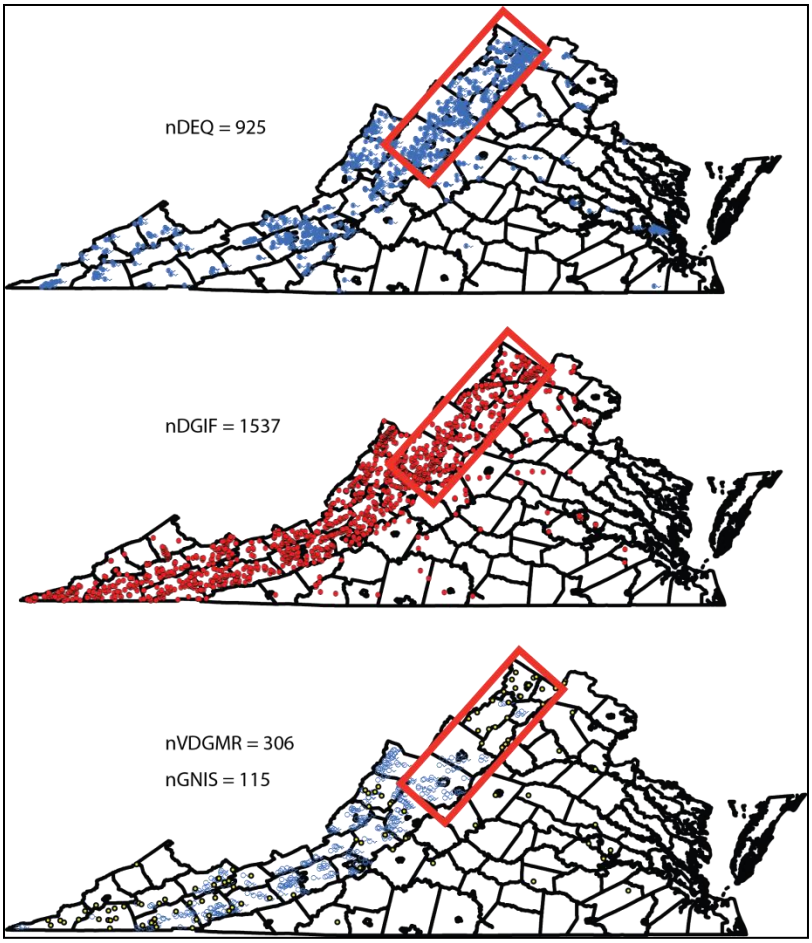


Figure 4: GIS comparison of the DEQ spring dataset (in red box) with legacy datasets evaluated during 2012.

In 2012, DEQ's spring dataset was evaluated against three legacy datasets using GIS techniques (Figure 4). High resolution satellite imagery and topographic datasets were used to verify and improve the locational accuracy of DEQ's current spring dataset, while at the same time evaluating the three legacy datasets for accuracy and to prevent duplication. In total, over 885 spring locations were analyzed in 77 quadrangles in the Shenandoah Valley. The project verified over 496 spring locations, provided GPS grade accuracy to 164 springs found to be off by several hundred meters of more, and linked over 242 duplicates between the datasets. An additional 34 new spring locations were discovered by chance while reviewing the satellite imagery. Qualitative hydrologic comparisons were made at 191 spring locations (comparison of near-drought imagery to imagery collected during wetter periods). The project demonstrated the utility of GIS-based review of spring datasets and will result in the production of a much higher-quality spring resource publication for the Shenandoah Valley.

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 2012 calendar year, 17 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 Ground Water Management Areas, GWCP staff utilize geophysical logging techniques and analyze mud rotary cuttings to assist water withdrawal permit applicants with completing 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 5). In the 2012 calendar year, 13 wells were logged with either geophysical or mud rotary cuttings methods to assist with proper permit documentation. Additionally, 2 coreholes were logged in Suffolk and Isle of Wight counties as part of a groundwater withdrawal permit condition. These cores helped to further refine the hydrogeologic framework as it relates to the Chesapeake Bay impact structure and its influence on groundwater availability in the Coastal Plain.

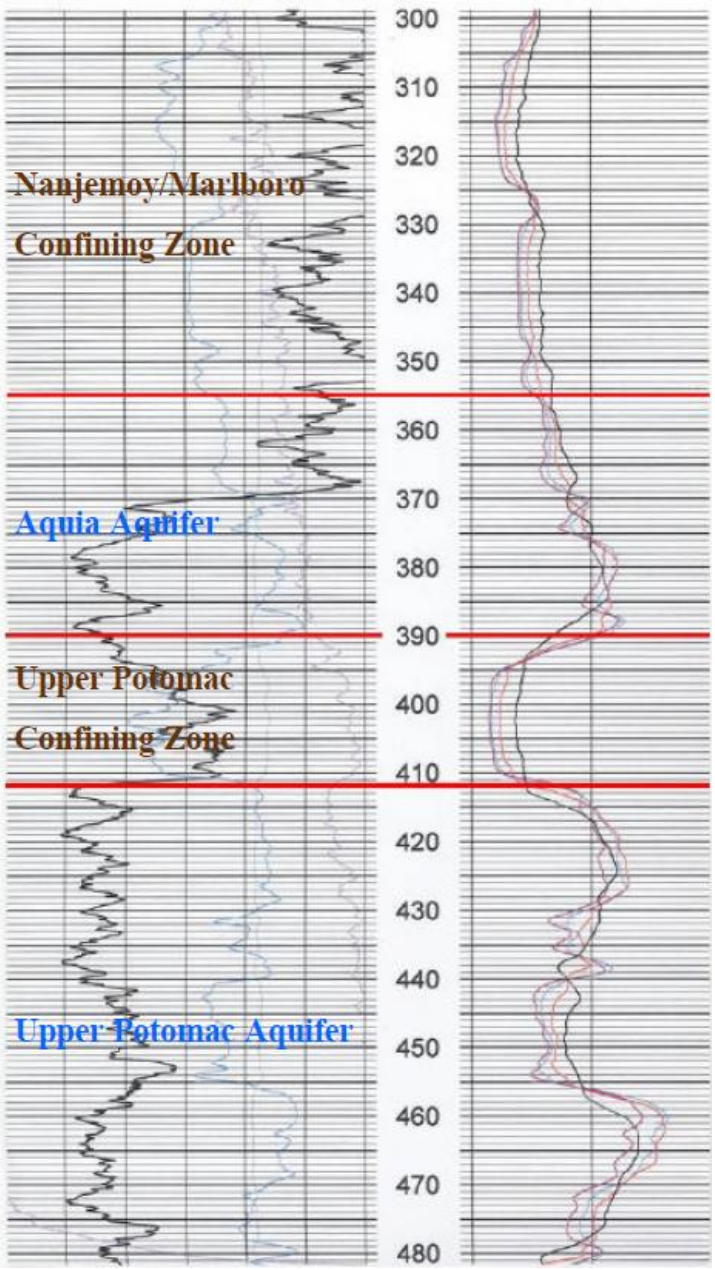


Figure 5: Aquifer Picks determined from a geophysical log run in the Coastal Plain. Geophysical logging methods are utilized by GWCP staff to assist withdrawal permit applicants with locating target aquifers and for further defining and describing hydrogeologic conditions throughout Virginia.

Technical Assistance

GWCP staff members frequently participate as speakers at groundwater related events. Educational and speaking opportunities for the 2012 calendar year included teaching classes at the Virginia Water Well Association Annual Winter Driller Conference and Fall Field Day, the South Atlantic Well Driller's Jubilee, and giving presentations at the

Page County Karst Workshop, the Virginia Division of Geology and Mineral Resources Annual Symposium, and numerous local groundwater related meetings and events. In addition to formal educational opportunities, GWCP staff provide data and technical assistance to citizens, private businesses, and municipalities with groundwater resource related questions and concerns.

Ambient Groundwater Quality Monitoring

At the end of 2012, GWCP staff began development of an ambient groundwater monitoring strategy appropriate in scope and scale to document the natural chemical conditions of aquifers throughout the Commonwealth. Tasks performed in the last month of 2012 included: analysis and summary of existing ambient groundwater quality monitoring strategies for all 15 eastern seaboard states from Florida to Maine, the identification and outreach to potential stakeholders including internal DEQ programs, state and national organizations, the purchase of water quality sampling equipment, coordination with the Division of Consolidated Laboratory Services for sampling procedures and schedules, and the first of several rounds of equipment blank testing on the program's existing stock of submersible pumps and tubing.

Development of the Ambient Groundwater Quality Strategy document continued in 2013 in parallel with active sample collection at multiple wells and spring sites throughout the Commonwealth. Drafts of the strategy and implementation documents will be made available for stakeholder comment and review in the fall of 2013.

Water Supply Planning Program

November 2, 2013 marks the 8th 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 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 6). 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 6). All 38 regional plans were submitted to the SWCB by the November 2, 2011 deadline established in the regulation.

All plans are under review for consistency and compliance with the regulation. Plans are submitted to other state agencies (Department of Health, Department of Conservation and Recreation, Department of Game and Inland Fisheries, Department of Historic Resources, and Marine Resources Commission) for evaluation and comments.

Plans also are posted to DEQ's website for a 30-day public comment period after tentative and final decisions are made to determine compliance. Compliance determination for all plans is expected by late 2013.

Information from the water supply plans will be used for development of the State Water Resources Plan. The first draft of the Plan is expected to be completed by early 2014.

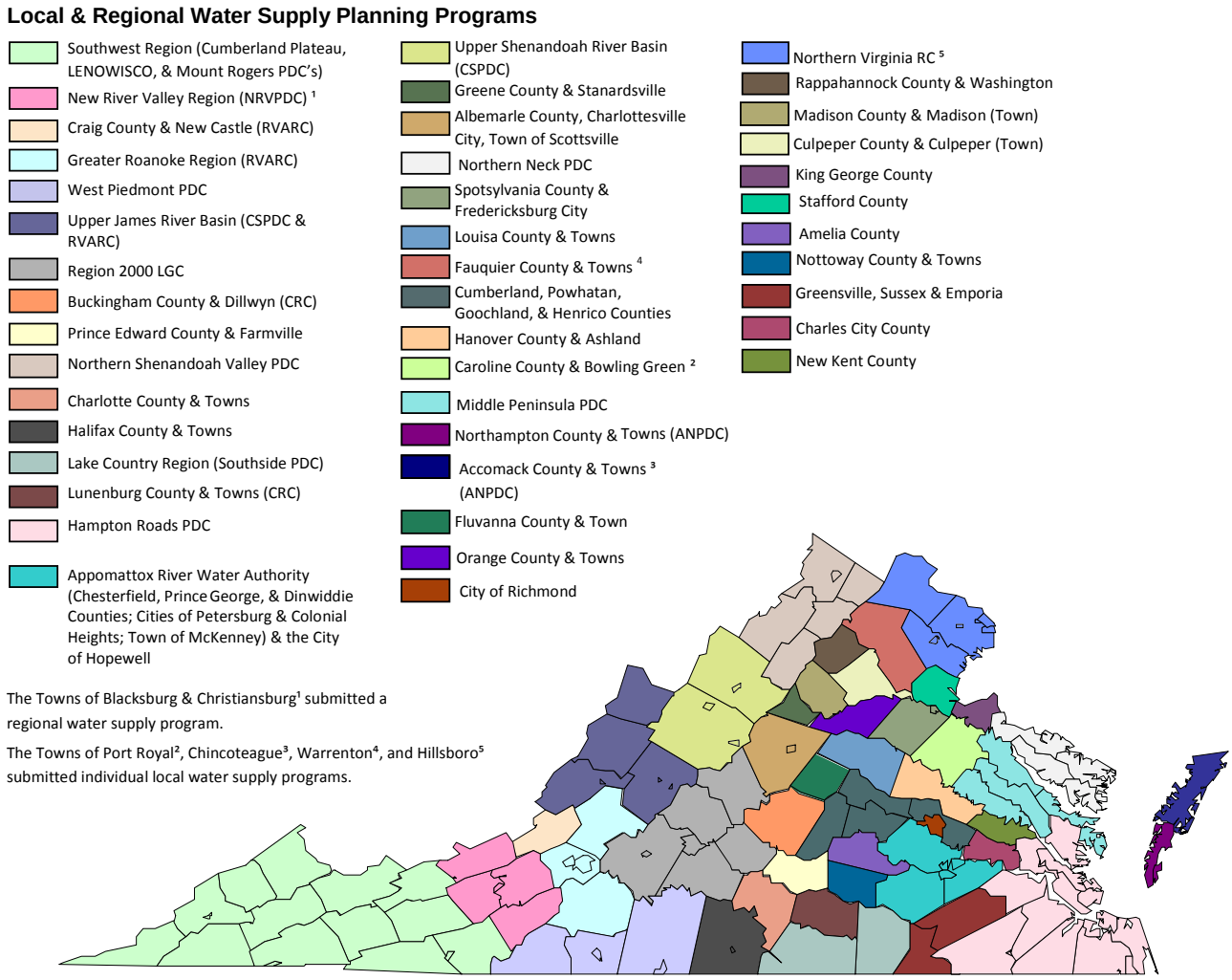


Figure 6: Local and regional water supply planning programs as of June 13, 2012. (38 Regional Programs & 10 Local Programs, Total = 48)

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 was 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 (iv) other policies and procedures that the Director of DEQ determines may enhance the effectiveness of water supply and water resources planning in Virginia. The committee expired December 31, 2012.

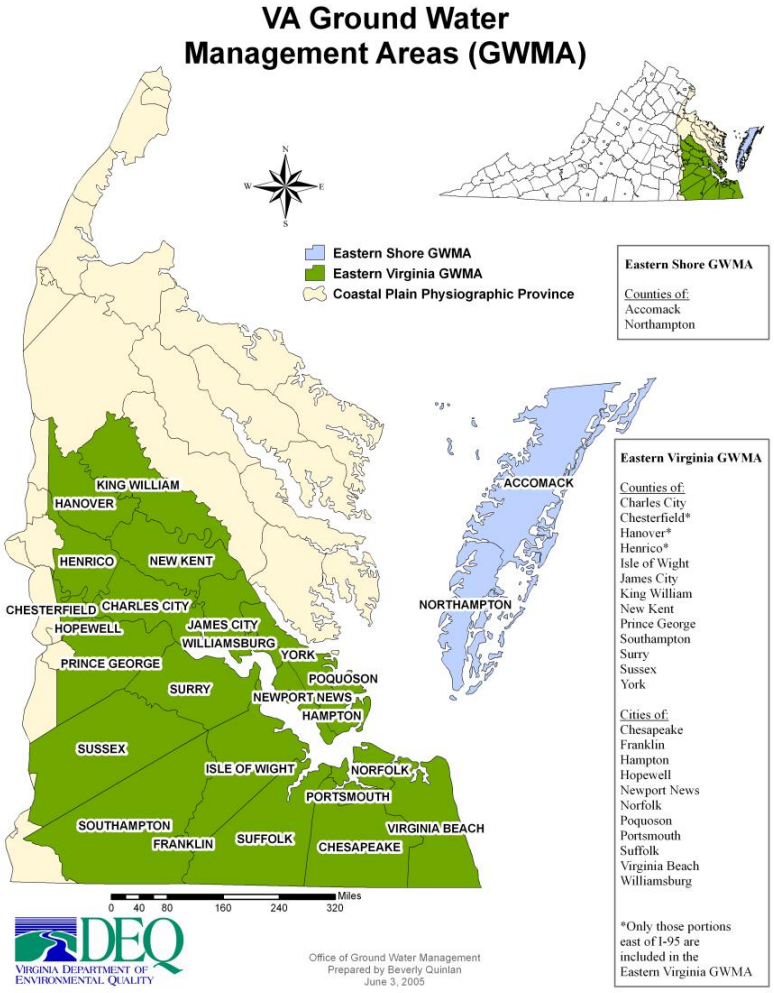
The committee issued a final report in December 2012. The report can be found at this link:
http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterSupplyPlanning/WSPAC_Final_Report.pdf.

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, the Town of Lovettsville, the Town of Stanley, Wythe County, Rye Valley Service Authority, the 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 Withdrawal Permitting Programs
The Water Withdrawal Permitting Programs include groundwater and surface water permitting. Under the Groundwater Management Act of 1992, Virginia manages groundwater through a program regulating groundwater withdrawals within Groundwater 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. Summaries of 2012 activities within each of these programs are set forth below.

Groundwater Withdrawal Permitting Program (GWPP)

The Virginia Groundwater Act of 1973 recognized the duty of the SWCB to manage groundwater resources and declare management areas. Subsequently, two Ground Water Management Areas (GWMAs) were declared; the Eastern Virginia GWMA and the Eastern Shore GWMA (see Figure 7). Groundwater Withdrawal Permits are required in the GWMA's for any withdrawal in excess of 300,000 gallons in any month. The permitting program operates under regulations developed pursuant to the Groundwater Management Act of 1992.



Figu

Figure 7: Groundwater Management Areas of Virginia

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 permits issued under historic use conditions and new or expanded use permits operating under their first or second 10 year permit term. Applications that involve human consumptive uses receive priority in the evaluation over all other uses.

The GWPP staff meets with all prospective permit applicants to discuss the permitting process, administrative requirements and technical requirements prior to application submission. Technical evaluations of impacts and resource sustainability are conducted by groundwater modeling contractors. Modeling contractors work closely with GWPP staff on proposed withdrawals to discuss technical requirements prior to application submission. Through an ongoing collaborative effort with modeling contractors, permit program staff provide technical support to applicants by reviewing and providing comments on all proposals for field data collection in support of permit development.

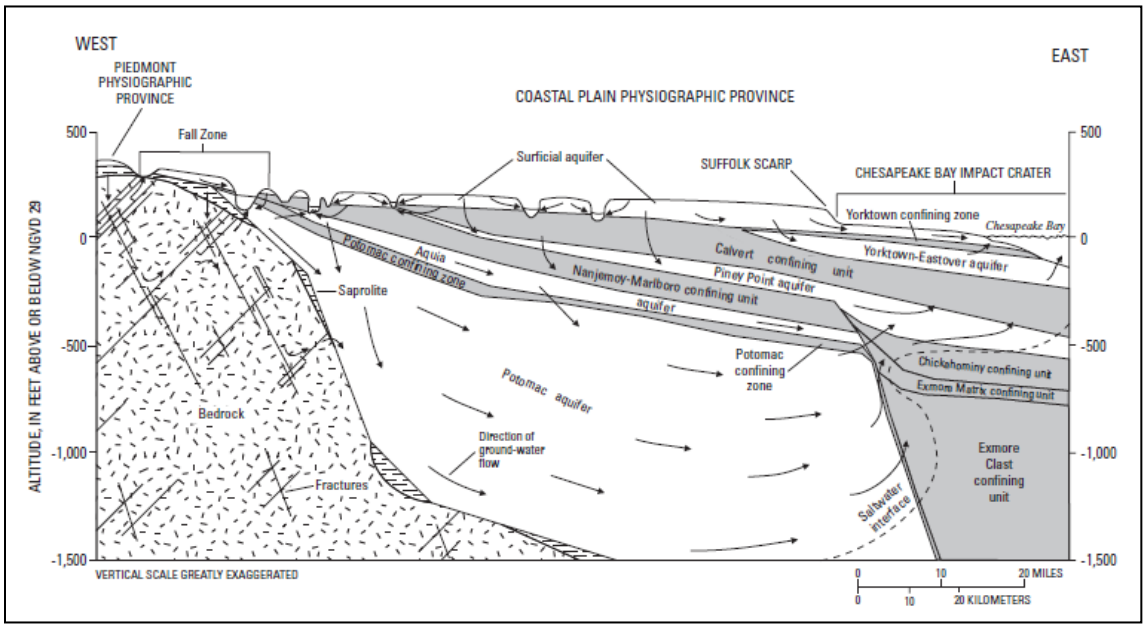


Figure 8. Generalized hydrogeologic section and directions of ground-water flow in the Virginia Coastal Plain (from Figure 2 of McFarland, E.R., and Bruce, T.S., 2006, The Virginia Coastal Plain Hydrogeologic Framework: U.S. Geological Survey Professional Paper 1731, 118 p., 25 pls.; altitudes relative to National Geodetic Vertical Datum of 1929)

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." (VA Code§ 62.1-254) 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 aquifers produce overlapping cones of depression and some have resulted in interference among wells. In addition, decades of water level observations in these aquifers indicate a declining trend in water levels of

about 2.4 feet per year within the coastal plain confined aquifer system. In order to manage the resource comprehensively, protect existing ground water users from new or expanding withdrawals, and to ensure continued resource viability in the future the SWCB, at its June 17, 2013 meeting, adopted revisions to the Groundwater Withdrawal Regulations (9VAC25-610) and expansion of the Eastern Virginia GWMA to the remainder of the Coastal Plain Physiographic Province (Figure 9). The 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. These actions will become effective in accordance with the Administrative Process Act and Executive Order No. 14(2010).

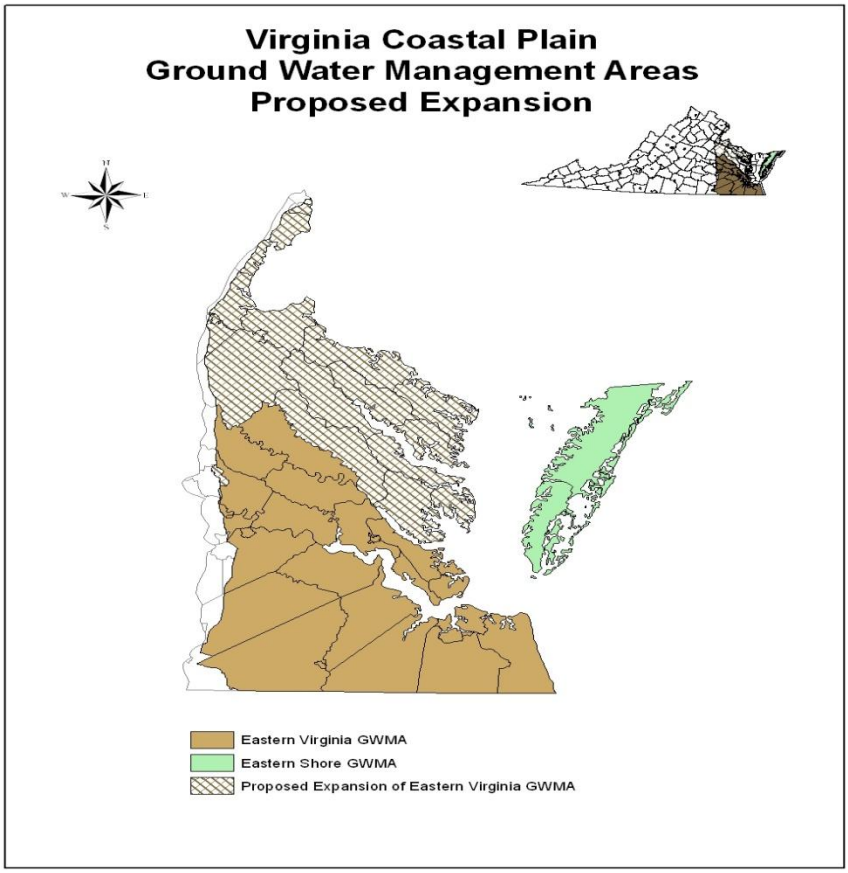


Figure 9: Proposed Expansion of the Eastern Virginia Groundwater Management Area

The areal extent of the two existing GWMAs results in 238 active permits. In 2012 a total of 24 permits were issued (15 new or expanded and 9 renewals). There were a total of 67 active applications in process at the end of 2012; 35 of these applications represent a renewal and 32 represent a new or expanded use request from a lawful existing user. DEQ received 9 renewal request applications and 6 new or expanded use applications.

2012 Ground Water Withdrawal Permitting efforts included the issuance of Groundwater Withdrawal Permits to the following facilities:

1. Hanover Courthouse, Potomac Aquifer, Hanover County
2. Avondale Water System, Potomac Aquifer, Hanover County
3. Town of Wakefield Water System, Potomac Aquifer, Sussex County
4. Scots Landing Subdivision, Potomac Aquifer, Hanover County
5. Oak Springs Water System, Potomac Aquifer, King William County
6. AES Waterworks, Potomac Aquifer, King William County
7. Rockahock Campground Water System, Chickahominy Piney Point Aquifer, New Kent County
8. Northeast Regional Water System, Potomac Aquifer, Sussex County
9. Drewryville Water System, Yorktown-Eastover and Columbia Aquifers, Southampton County
10. Dreamland Mobile Home Park Water System, Yorktown-Eastover and Columbia aquifer Accomack County
11. White Tail Park Water System, Potomac and Chickahominy-Piney Point Aquifer, Prince George County
12. Town of Holland, Potomac Aquifer, Suffolk County
13. Saint Brides Water System, Yorktown-Eastover Aquifer, Chesapeake
14. Scottswood Subdivision Water System, Potomac Aquifer, Southampton County
15. YMCA Camp Silver Beach Water System, Yorktown-Eastover Aquifer, Northampton County
16. Norfolk Deep Wells Water System, Potomac Aquifer, Suffolk County
17. Combined Skimino Banbury Water System, Chickahominy Piney Point Aquifer, York County
18. Sedley Water System, Potomac Aquifer, Southampton County
19. Triangle Mobile Home Park Water System, Yorktown-Eastover Aquifer, Northampton County
20. Perdue, Yorktown-Eastover Aquifer, Accomack
21. Bow Creek Golf Course, Yorktown-Eastover Aquifer, Virginia Beach
22. Princess Ann Athletic Complex, Yorktown-Eastover Aquifer, Virginia Beach
23. Gillespe Farm, Yorktown Eastover Aquifer, Accomack
24. Hogneck Farm, Yorktown-Eastover Aquifer, Accomack

Virginia Water Protection (VWP) Water Withdrawal Permitting Program
Water withdrawal projects involve planning, coordination, modeling, and engineering long before any permits are obtained. Projects involving instream flow impacts from surface water withdrawals, and surface water impacts related to 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 due to water withdrawals through use of the Joint Permit Application process. Examples of projects include, but are not limited to, reservoirs, power plants, public water supply and industrial intakes, and irrigation withdrawals. The issuance of VWP Permits for surface water withdrawal activities is authorized under Virginia 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 84 active VWP permits. Because existing facilities were originally excluded from the VWP permitting requirements, water use by facilities with VWP permits makes up a relatively small percentage of the total reported 2012 surface water withdrawals (excluding power generation uses). Of the 421 non-power generation facilities that reported surface water withdrawals during 2012 totaling approximately 1050 million gallons per day (mgd) (see Section IV), those with active VWP permits made up approximately 103.5 mgd (approximately 10%). Three existing permits have active applications in process for modification or reissuance. There are also six new applications for surface water withdrawals in-process state-wide (Figure 10). During 2012, surface water withdrawal planning and permitting efforts included:

DEQ issued VWP permits to the following facilities:

- Chatmoss Country Club, withdrawal from an unnamed tributary to Leatherwood Creek, Henry County
- Dominion North Anna Unit 3 Nuclear Power Plant, withdrawal from the North Anna River in Louisa County
- Loudoun County Potomac River Project, withdrawal from the Potomac River in Loudoun County

DEQ issued modified VWP permits to the following facilities:

- Appomattox Regional Water Authority, withdrawal from Lake Chesdin on the Appomattox River
- Flannagan Hydroelectric Project, withdrawal from Flannagan Reservoir on the Pound River in Dickenson County
- Gathright Hydroelectric Project, withdrawal from Lake Moomaw on the Jackson River in Alleghany County
- Henrico County, Cobbs Creek Reservoir and withdrawal from the James River in Cumberland County
- Henrico County, James River intake in Henrico County
- Stafford County, Rocky Pen Run Reservoir and withdrawal from the Rappahannock River, Stafford County

DEQ received a Joint Permit Application from the following facilities:

- Engel Family Farms, withdrawal from the James River, Henrico County
- Hammock Dairy Farm, withdrawal from Pie Creek, Pittsylvania County
- Henry County Public Service Authority, withdrawal from the Smith River, Henry County
- Louisa County Water Authority, withdrawal from Lake Anna on the North Anna River, Louisa County
- Viniterra Golf Course, withdrawal from Crumps Mill Pond on Southern Branch, New Kent County

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

- Appomattox Regional Water Authority, withdrawal from Lake Chesdin on the Appomattox River
- Stafford County, Rocky Pen Run Reservoir and withdrawal from the Rappahannock River, Stafford County

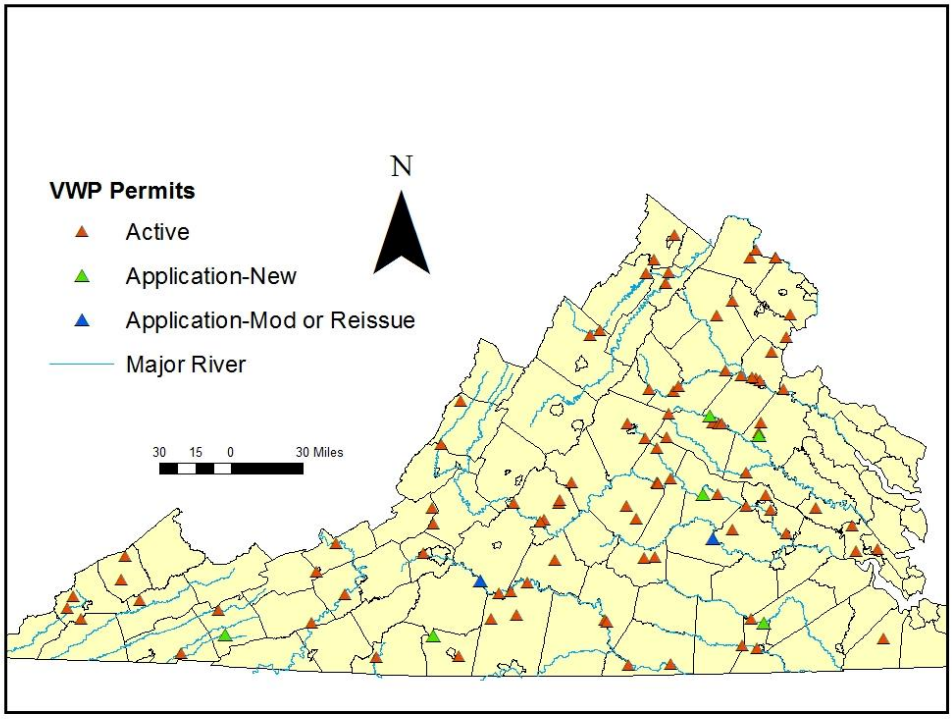


Figure 10: Current Virginia Water Protection (VWP) Active Permits and Applications for Surface Water Withdrawals across the Commonwealth.

IV SUMMARY OF WATER WITHDRAWALS IN 2012

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 purpose of withdrawal reporting is to enable appropriate planning for the Commonwealth's future water needs through the collection of accurate information.

The data reported are contained within the Virginia Water Use Data System (VWUDS) database, which stores withdrawal data collected since 1982. 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. For 2012, non-zero withdrawals were reported by 993 user facilities for approximately 2938 withdrawal measuring points. The reported totals

for 2012 exceeded 7 billion gallons per day for all use types, including nuclear and fossil fuel power generation.

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 non-consumptive use. These flows are also exempted from the reporting requirement and are generally not reported to the VWUDS database. A significant portion of water diverted for uses related to fossil fuel and nuclear power generation is also non-consumptive. For these reasons, the following summary of total statewide water withdrawals does not include water withdrawn for power generation. Details regarding 2012 fossil fuel and nuclear 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 2012 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 2012 for non-power generation uses were predominantly from surface water sources. Withdrawals from streams totaled approximately 665 mgd, while withdrawals from reservoirs totaled an additional 394 mgd. Thus, surface water sources made up approximately 87% of the total (Figure 11). Wells and springs provided the remainder of the water withdrawn. Total 2012 non-power generation withdrawal rates (1221 mgd) were about 2% less than the 2011 total of 1245 mgd. The ratio of surface water use to groundwater use also remained nearly the same as the previous year.

Figures 12 through 14 depict the spatial distribution of 2012 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 15 contains six pie charts that depict the magnitudes and proportions of 2012 withdrawals by use category (excluding power generation). Also depicted are the average water withdrawals over the 2008 – 2012 period for each category. Withdrawals for public water supply and for manufacturing were the largest for both 2012 and for the average of the previous five years. Pumping for agriculture and irrigation made up lesser, but still significant, portions of the groundwater withdrawal totals (Figure 15 c & d). Withdrawals for other uses from both groundwater and surface water sources were much smaller. 2012 withdrawals for all uses except agriculture were slightly less than the 2008-2012 average withdrawals.

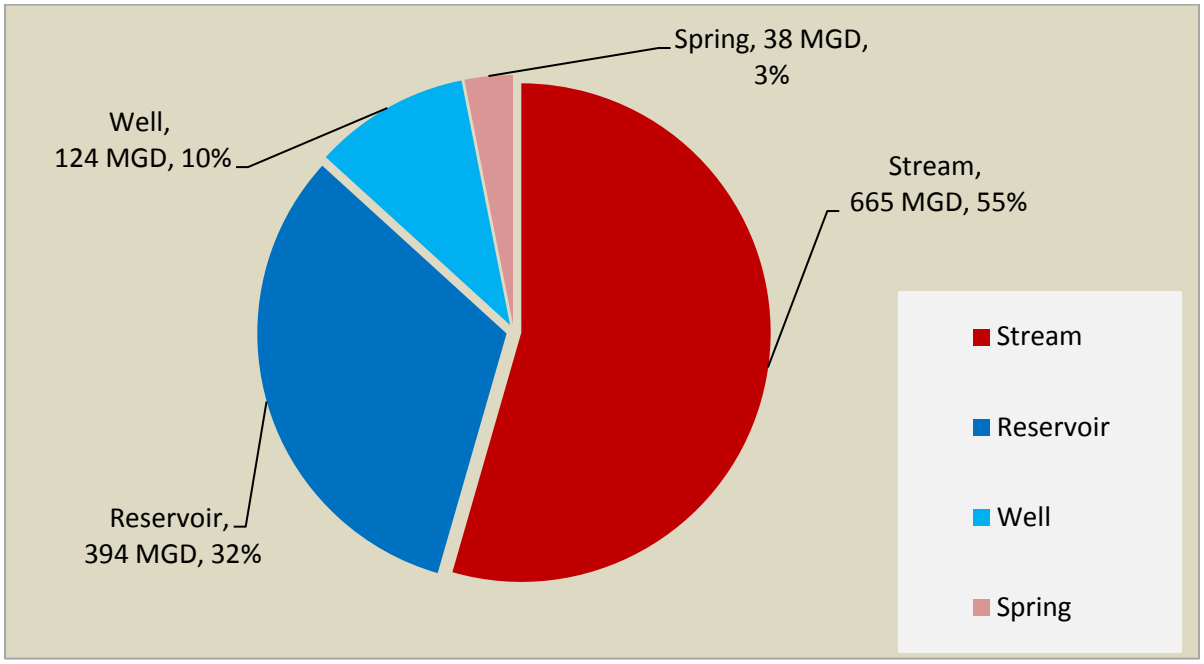


Figure 11: Total Water Withdrawals by Source in 2012 (excluding power generation).

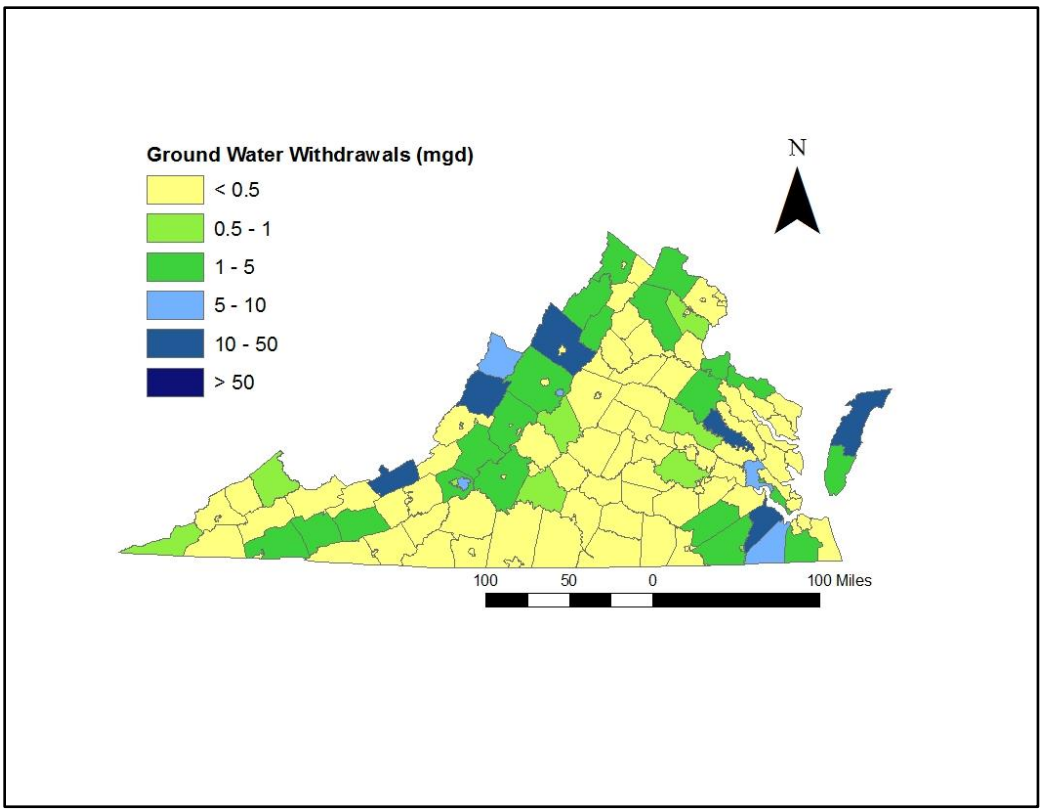


Figure 12: 2012 Total Groundwater Withdrawals by Locality (mgd).

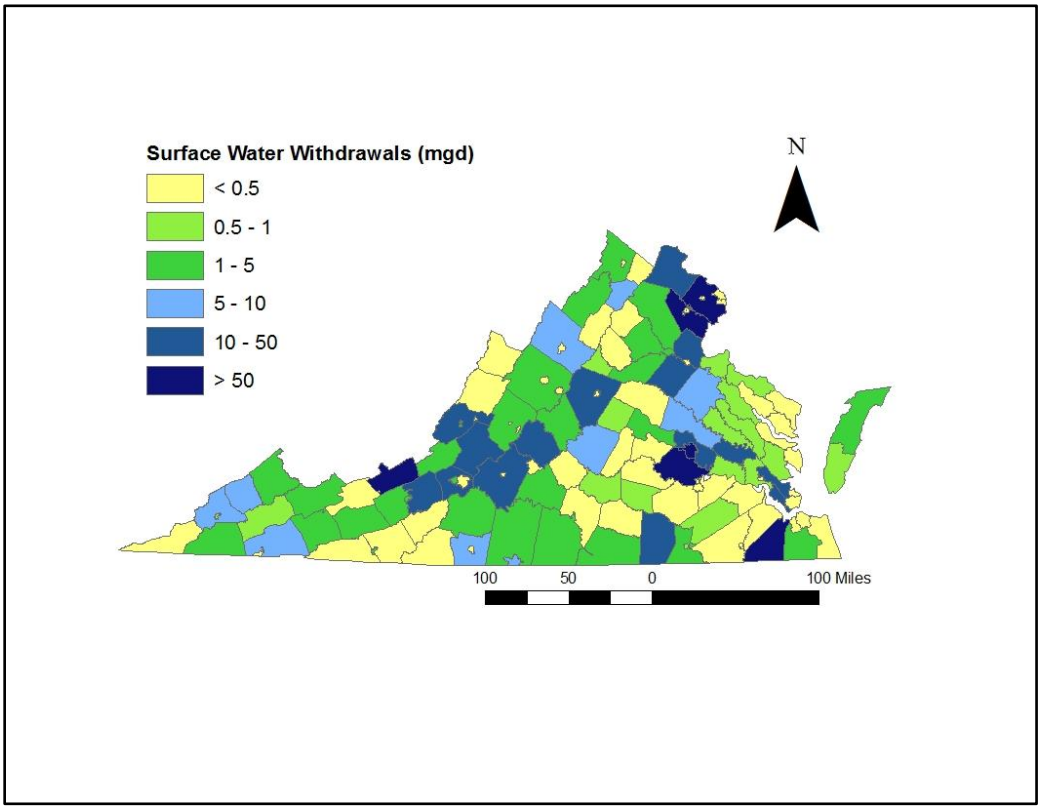


Figure 13: 2012 Total Surface Water Withdrawals by Locality (mgd).

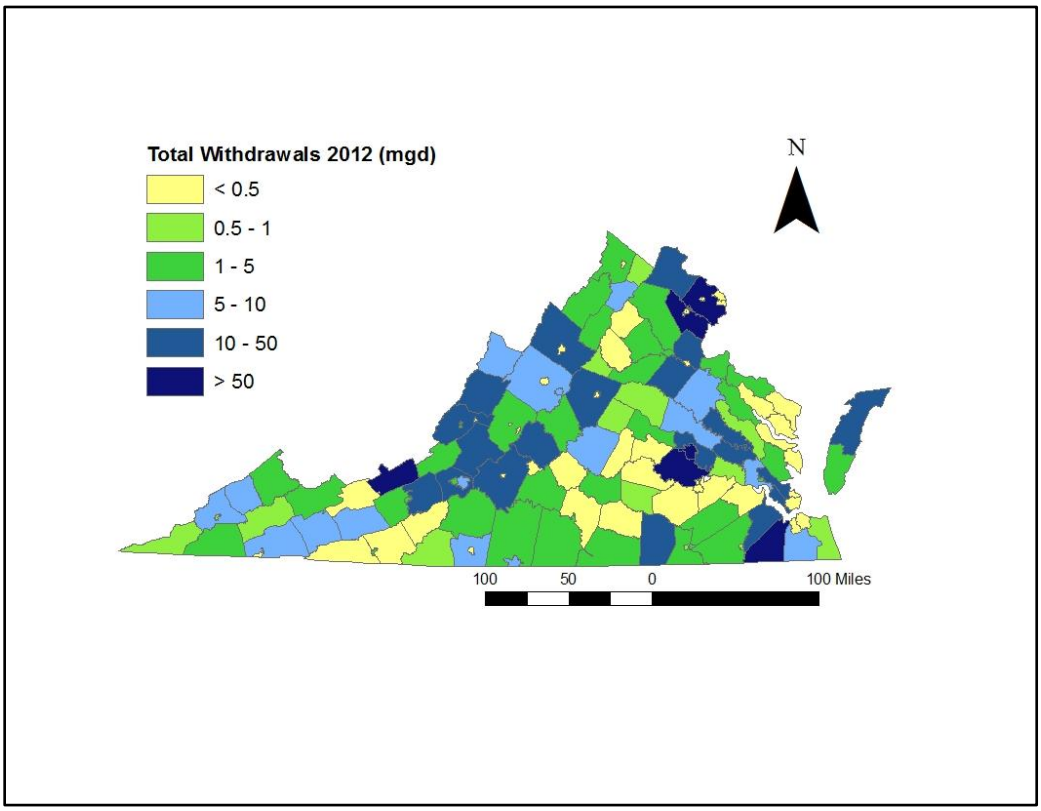
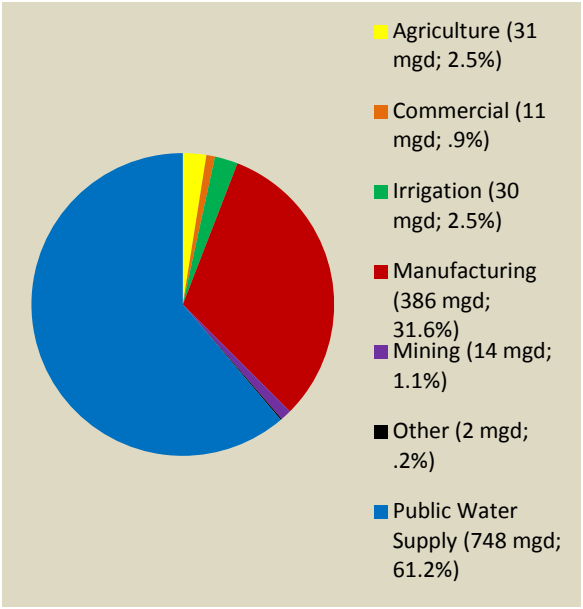
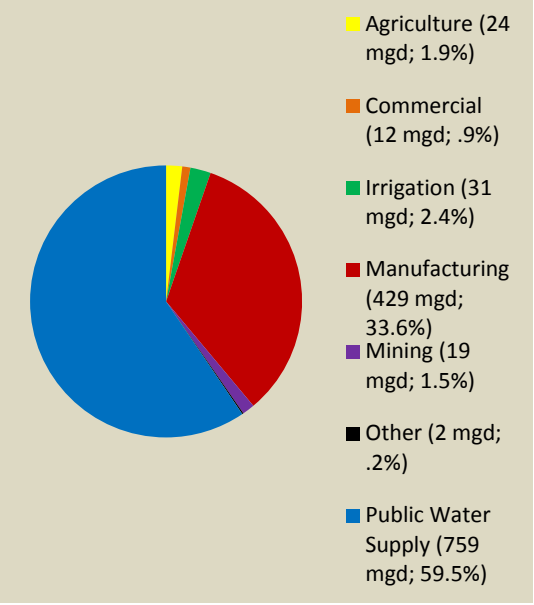


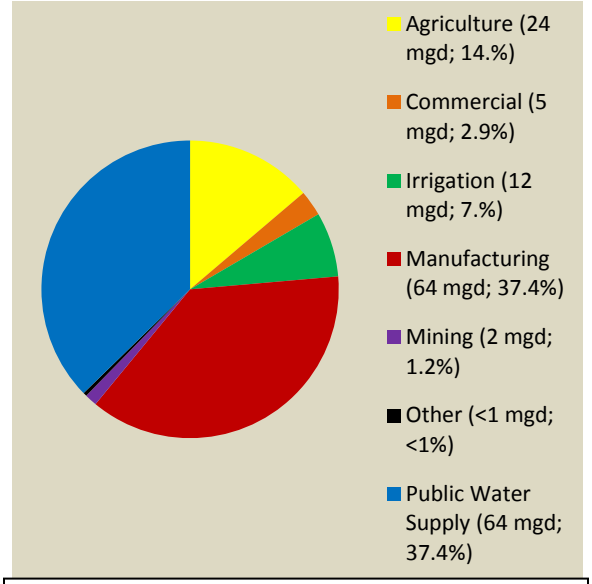
Figure 14: 2012 Total (Groundwater + Surface Water) Withdrawals by Locality (mgd).



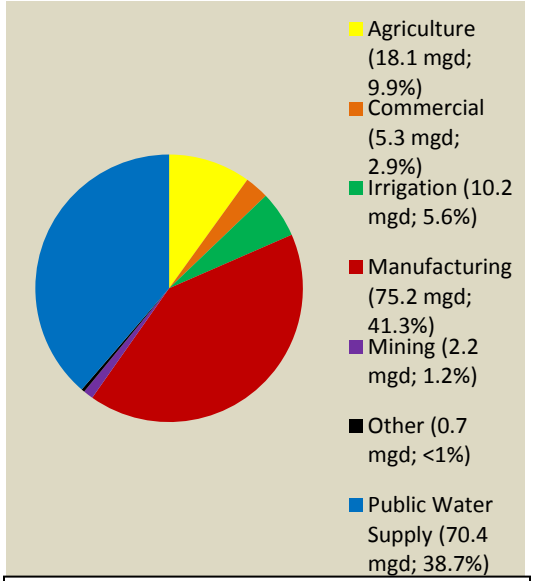
(a) 2012 Total Water Withdrawals by Category (total = 1221 mgd)



(b) Average Total Water Withdrawals by Category for 2008-2012 (total = 1276

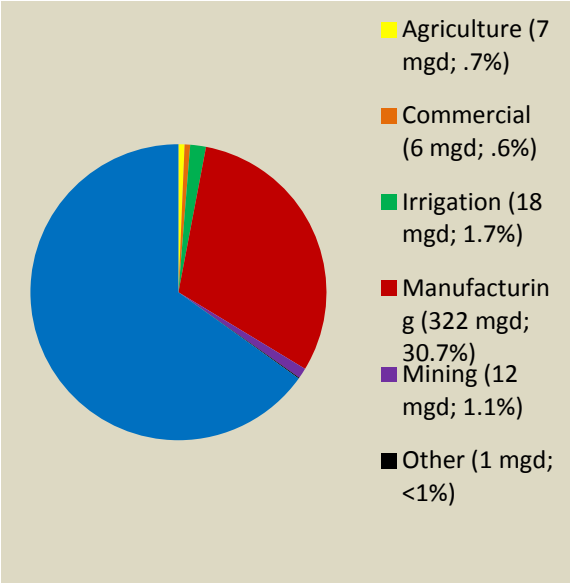


(c) 2012 Total Groundwater Withdrawals by Category (total = 171 mgd)

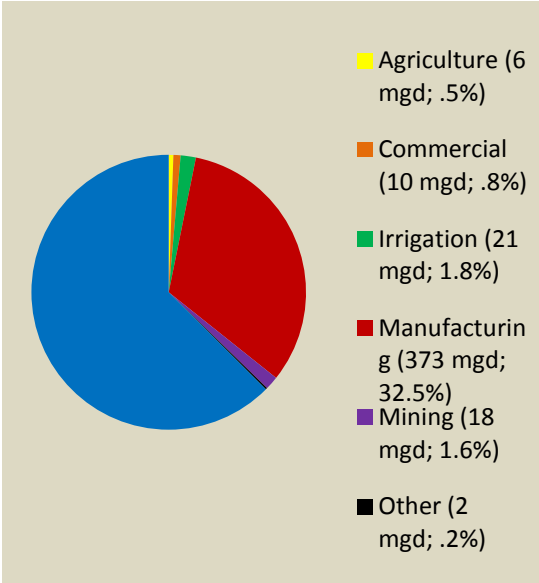


(d) Average Total Groundwater Withdrawals by Category for 2008-2012(total = 182 mgd)

Figure 15: Water Withdrawals in Virginia by Category and by Source, including average withdrawals for 2008-2012.



(e) 2012 Total Surface Water Withdrawals by Category (total = 1050 mgd)



(f) Average Total Surface Water Withdrawals by Category for 2008-2011 (total = 1146 mgd)

Figure 15: Water Withdrawals in Virginia by Category and by Source, including average withdrawals for 2008-2012 (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 2008 through 2012 period (excluding withdrawals for power generation). The table compares the average annual 2012 withdrawals by source type and use category with the corresponding average rates for the five-year period prior to and including 2012.

Ground water withdrawals were approximately 11 mgd (6%) less than the average rates for the five-year period. Agricultural groundwater pumpage increased, however manufacturing pumpage decreased. Total surface water withdrawals were also less than the 2008-2012 average by about 4 percent. This difference was primarily due to a decrease in manufacturing withdrawals of approximately 40 mgd below 2010 levels and about 31mgd below the five-year average. The main cause of this decrease was the 2011shutdown of the Yorktown Refinery in Yorktown, which withdrew approximately 53 mgd in 2010. As a result of these and other changes, total (groundwater + surface water) manufacturing withdrawals in 2012 were about 61 mgd (14%) less than the 2008-2012 average. Total 2012 (groundwater plus surface water) withdrawals for all use types were about 54 mgd (4%) below the five-year average.

Table 1: Summary of Virginia Water Withdrawals: 2008 – 2012.

	Category	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Average MGD	2012 Diff. from Average (MGD)	2012 % change from average
Ground Water	Agriculture	15.1	11.0	18.1	22.6	23.5	18.0	5.5	30
	Commercial	5.8	4.8	5.5	5.5	4.8	5.3	-0.5	-9
	Irrigation	9.6	8.4	11.4	9.5	12.1	10.2	1.9	18
	Manufacturing	93.5	87.3	69.9	61.5	63.9	75.2	-11.3	-15
	Mining	1.6	2.4	1.9	2.9	2.3	2.2	0.1	4
	Other	0.6	0.6	0.7	0.7	0.7	0.7	0.0	0
	Public Water Supply	75.3	74.6	67.6	70.8	63.8	70.4	-6.6	-9
	Total (GW)	**201.4**	**189.1**	**175.1**	**173.4**	**171.1**	**182.0**	**-10.9**	**-6**
Surface Water	Agriculture	5.8	6.0	5.3	7.1	7.0	6.3	0.7	12
	Commercial	8.6	5.8	8.0	7.0	6.4	7.2	-0.8	-11
	Irrigation	23.4	19.8	24.0	19.2	18.1	20.9	-2.8	-14
	Manufacturing	393.0	369.6	361.9	320.4	322.1	353.4	-31.3	-9
	Mining	17.2	17.7	19.7	16.0	12.0	16.5	-4.5	-27
	Other	1.4	1.1	1.5	1.3	1.0	1.3	-0.2	-17
	Public Water Supply	654.5	683.3	716.5	702.7	683.7	688.1	-4.4	-1
	Total (SW)	**1103.9**	**1103.2**	**1136.9**	**1073.6**	**1050.3**	**1093.6**	**-43.3**	**-4**
Total (GW + SW)	Agriculture	20.9	17.0	23.4	29.7	30.6	24.3	6.2	26
	Commercial	14.4	10.6	13.5	12.5	11.2	13.9	-2.7	-19
	Irrigation	33.0	28.1	35.4	28.7	30.1	30.8	-0.7	-2
	Manufacturing	486.5	456.9	431.8	381.9	386.1	447.2	-61.2	-14
	Mining	18.8	20.1	21.6	18.8	14.3	19.8	-5.5	-28
	Other	2.0	1.7	2.2	2.0	1.7	2.4	-0.7	-29
	Public Water Supply	729.9	757.9	784.0	773.5	747.6	776.4	-28.8	-4
	Total	**1305.4**	**1292.3**	**1312.0**	**1247.0**	**1221.4**	**1275.6**	**-54.2**	**-4**

VI CATEGORIES OF WATER WITHDRAWALS IN VIRGINIA

This section provides detailed information regarding water withdrawals for each of the major use categories for 2012 and for the last five years (2008 – 2012). Withdrawals by source types are described for this time period and the spatial distributions of 2012 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 16 shows the state-wide total of groundwater and surface water use for agriculture from 2008-2012. 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 2012 increased slightly compared to that reported for 2011. However, the total reported 2012 agricultural withdrawal was above the 2008-2012 average by approximately 26% (Table 2). The 2009 ground water total was lower than normal due to the temporary closure of the Coursey Spring Fish Hatchery in Bath County for renovations. The apparent rising trend in agricultural water use may be due in part to a growing interest in aquaculture in Virginia. Reported withdrawals from both groundwater and surface water sources that supplied aquacultural facilites increased approximately 47% (19 mgd to 28 mgd) from 2008 to 2012, due in large part to an increase in use at Coursey Spring after 2009.

Table 3 lists the largest reported 2012 agricultural water withdrawals, all of which are aquacultural or fish hatchery facilities. The withdrawals listed in this table account for approximately 77% of all reported 2012 agricultural water use in the state. A portion of reported withdrawals now include sub-category information in VWUDS. All sub-categories of agriculture are listed in Table 4. Similar to previous years, the largest 2012 agricultural withdrawals occurred in Bath and Highland Counties in the Valley region and Wythe and Smyth Counties in the Southwest region (Figure 17).

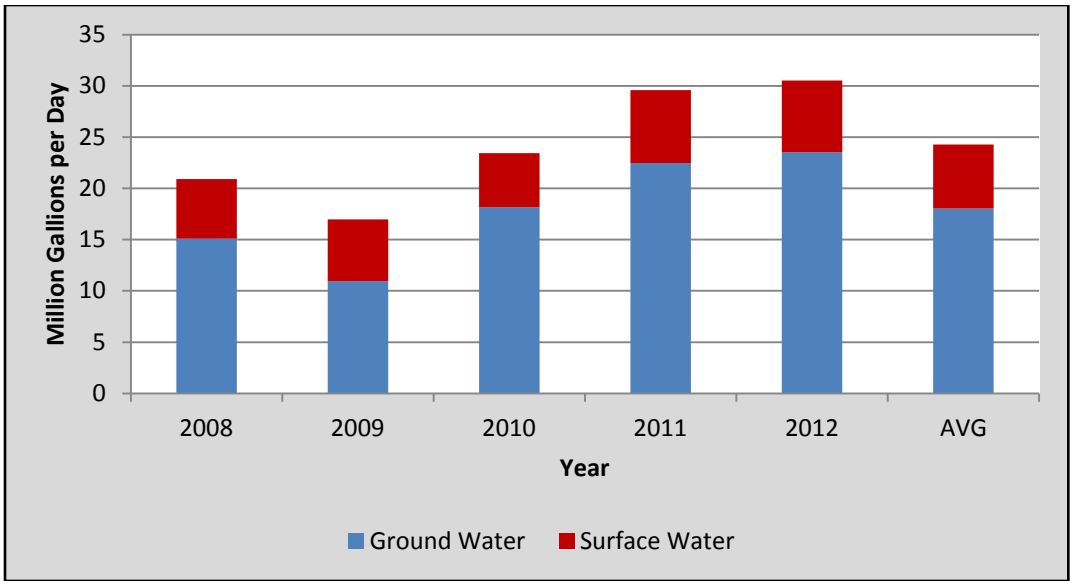


Figure 16: 2008-2012 Agricultural Water Withdrawals by Source Type.

Table 2: 2008-2012 Agricultural Water Withdrawals by Source Type, with 2012 Change from 5-year Average.

Source Type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	15.09	10.95	18.15	22.48	23.54	18.04	5.50	30
Wells	0.61	0.76	0.87	0.51	0.62	0.67	-0.05	-8
Springs	14.48	10.19	17.28	21.97	22.92	17.37	5.55	32
Total SW	5.83	0.84	5.30	7.10	6.99	6.25	0.74	12
Streams	5.83	6.00	5.30	7.10	6.99	6.24	0.75	12
Reservoirs	0	0.04	0	0	0	0.01	-0.01	-100
TOTAL GW+SW	20.92	16.99	23.45	29.58	30.53	24.29	6.24	26

[1]Abs change = difference between 2012 water withdrawals and average 2008-2012 water withdrawals (MGD)
[2]% change = percent change in 2012 water withdrawals from average 2008-2012 water withdrawals

Table 3: Top Water Withdrawals for Agriculture in 2012.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2012 MGD
Commonwealth of Virginia	Coursey Spring Fisheries	Bath	GW	Coursey Spring	6.19	10.22
Virginia Trout Company Inc	Terry Place Plant	Highland	GW	Blue Spring	4.25	4.18
Commonwealth of Virginia	Marion Fish Cultural Station	Smyth	SW	Staleys Creek	2.86	3.36
Commonwealth of Virginia	Wytheville Fish Hatchery	Wythe	GW	Boiling and West Springs	3.33	3.35
Virginia Trout Company Inc	Monterey Plant	Highland	GW	Vandevender Spring	2.46	2.77
Commonwealth of Virginia	Paint Bank Fish Cultural Station	Craig	SW	Paint Bank Branch	2.48	2.70

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

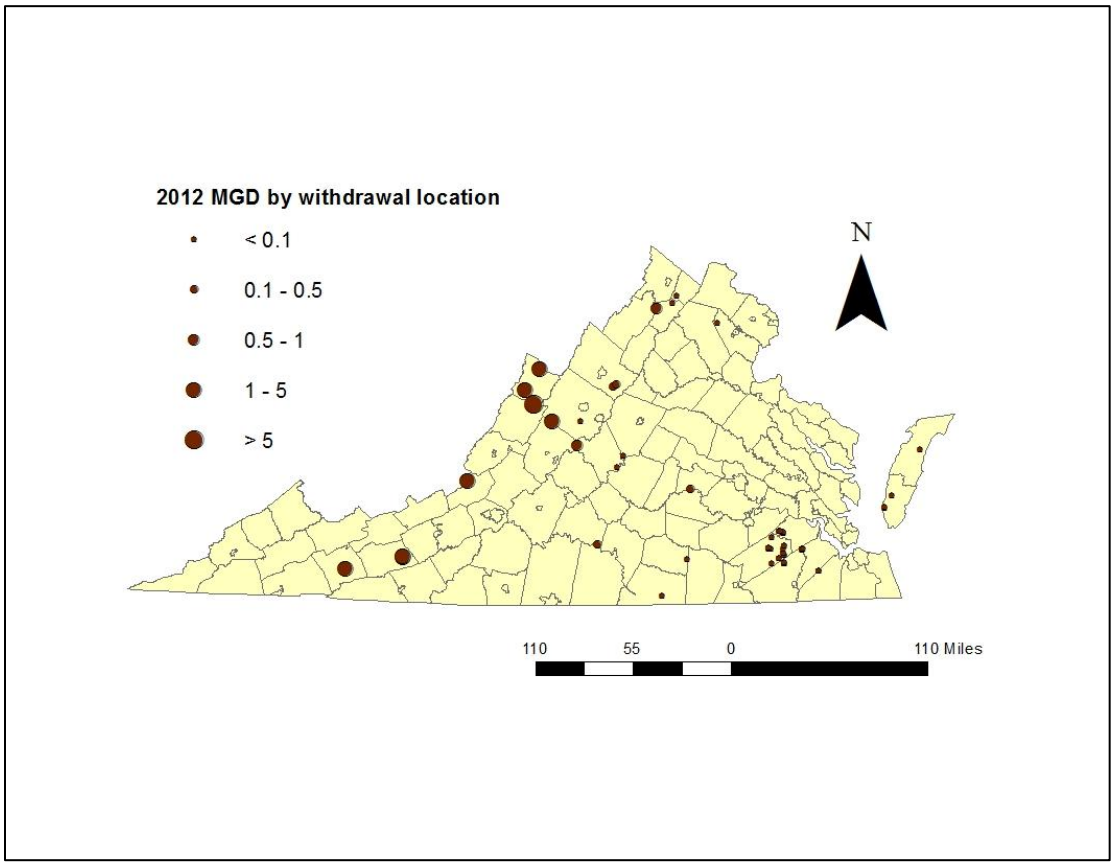


Figure 17: 2012 Agricultural Water Withdrawals by Withdrawal Point Location (mgd).

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 18 shows the state-wide total of irrigation-related groundwater and surface water withdrawals for 2008-2012. 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 2012 increased relative to those in 2011 and were 4% lower than the average withdrawals over the 2008-2012 period (Table 5). Table 6 lists the top 2012 reported irrigation water withdrawals by specific source. Many of the irrigation water withdrawals in 2012 occurred on the Eastern Shore where irrigation users in Accomack and Northampton Counties accounted for 41% of the reported 2012 state-wide water withdrawals for irrigation. A number of irrigation facilities are also located within the northern coastal plain in the Rappahannock and York River basins, as well as the Shenandoah Valley (Figure 19). Table 7 lists all sub-categories of irrigation.

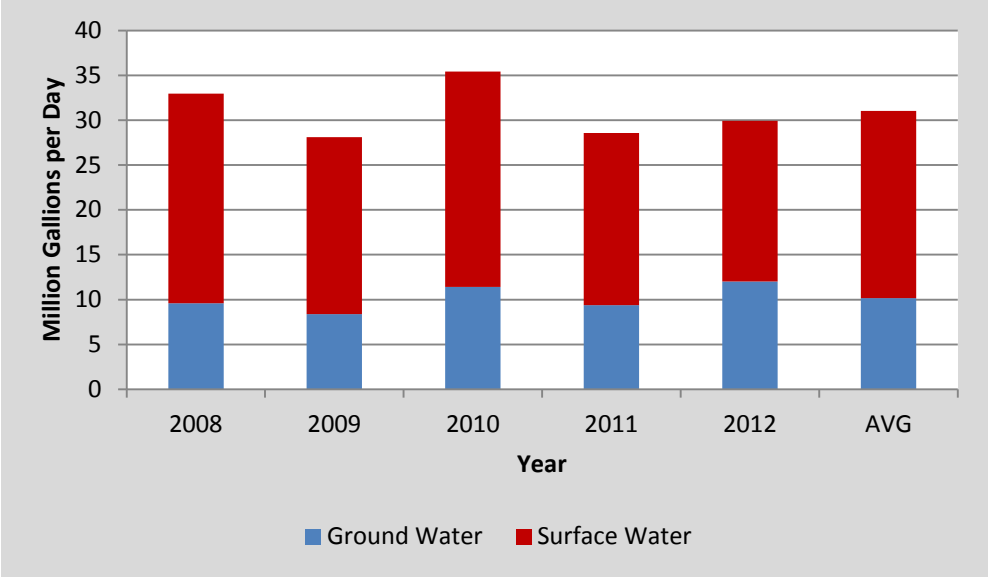


Figure 18: 2008-2012 Irrigation Water Withdrawals by Source Type.

Table 5: 2008-2012 Irrigation Water Withdrawals by Source Type, with 2012 Change from Five-year Average:

Source type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	9.58	8.37	11.4	9.39	12.01	10.15	1.86	18
Wells	2.6	2.48	2.87	2.63	2.77	2.67	0.10	4
Springs	0.04	0.11	0.18	0.27	0.34	0.19	0.15	81
Reservoirs[3]	6.94	5.87	8.46	6.67	9.1	7.41	1.69	23
Total SW	23.38	19.74	24.03	19.19	17.91	20.89	-2.98	-14
Streams	15.25	12.08	15.72	10.69	10.77	12.90	-2.13	-17
Reservoirs	8.13	7.57	8.18	8.26	6.88	7.80	-0.92	-12
TOTAL GW+SW	32.96	28.11	35.43	28.58	29.92	31.04	-1.12	-4

[1]Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2012 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by groundwater

Table 6: Top Water Withdrawals by Specific Source for Irrigation in 2012:

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2012 MGD
Robert C Darby and Sons	Arbuckle Farms	Accomack	GW	6 Dug Ponds	4.73	6.12
E Phillip and David L Hickman	Dublin Farms	Accomack	SW/GW	13 Farm Ponds, 1 Dug Pond	2.4	2.28
Saunders Brothers, Inc.		Nelson	SW/GW	6 surface water sources, 1 groundwater source	0.9	0.75
Black Marsh Farms, Inc	Black Marsh Farm	Caroline	SW	Rappahannock River	0.59	0.67
Cloverfield Enterprises	Cloverfield Farm	Essex	SW	Rappahannock River & Farm Ponds	0.49	0.67

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

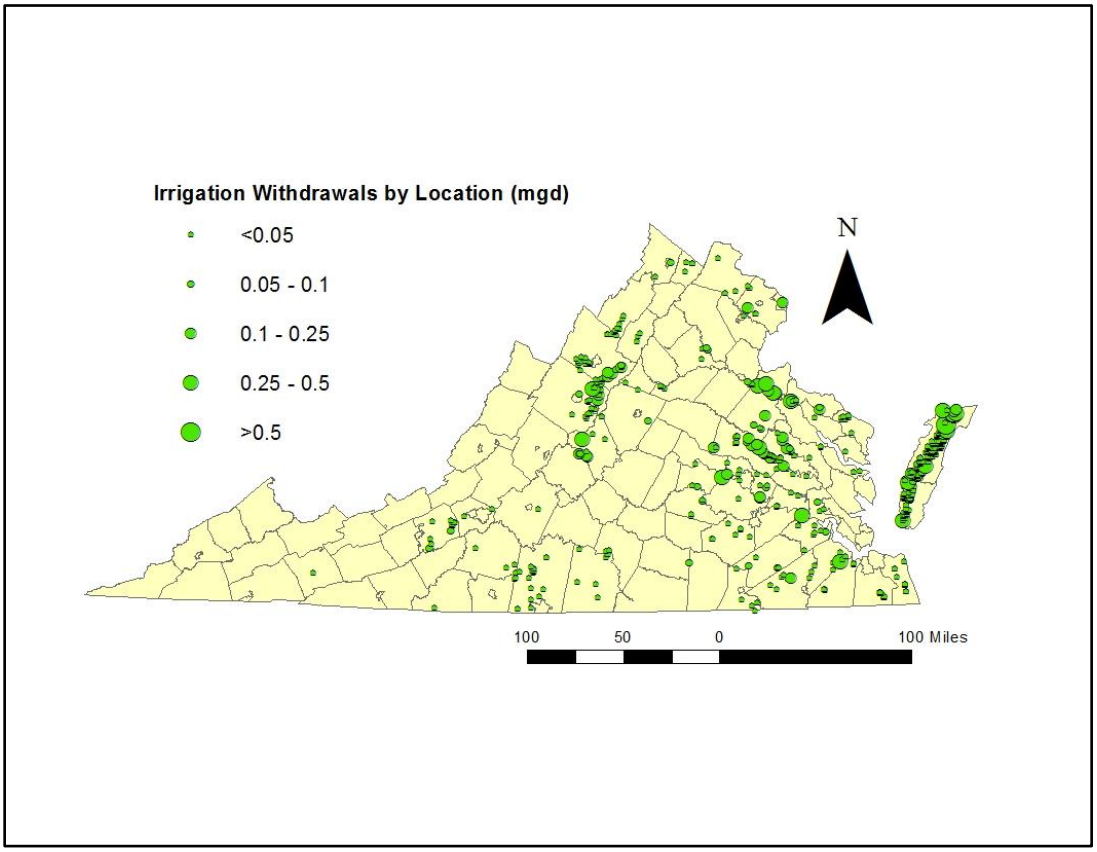


Figure 19: 2012 Irrigation Water Withdrawals by Withdrawal Point Location (mgd).

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 20 shows the state-wide total of groundwater and surface water withdrawals for commercial purposes from 2008-2012. Surface water withdrawal totals are typically greater than groundwater withdrawal totals for commercial operations. Total water withdrawals for commercial operations in 2012 were approximately 10% lower than the average withdrawals over the past five years (Table 8). The five facilities reporting the largest 2012 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 21). Sports and recreation clubs (*i.e.* private golf courses) and public golf courses were the commercial subcategories with the largest 2012 withdrawals and together accounted for about 41% of the total commercial withdrawals (Table 11, Figure 22). Areas where the largest commercial withdrawals occurred were spread across the state, with concentrations in the Tidewater region and in central and northern Virginia.

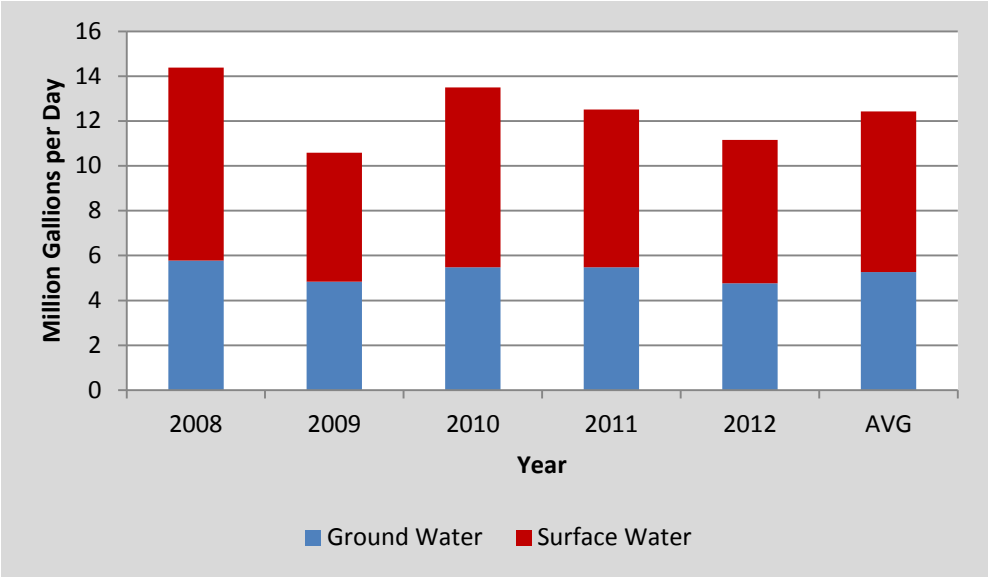


Figure 20: 2008-2012 Commercial Water Withdrawals by Source Type.

Table 8: 2008-2012 Commercial Water Withdrawals by Source Type, with 2012 Change from Five-year Average.

Source type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	5.78	4.84	5.48	5.47	4.77	5.27	-0.50	-9
Wells	4.72	3.87	4.64	4.58	4.73	4.51	0.22	5
Springs	1.06	0.97	0.84	0.89	0.04	0.76	-0.72	-95
Total SW	8.6	5.75	8.02	7.04	6.39	7.16	-0.77	-11
Streams	2.82	2.38	3.06	2.94	2.49	2.74	-0.25	-9
Reservoirs	5.78	3.37	4.96	4.1	3.9	4.42	-0.52	-12
TOTAL GW+SW	14.38	10.59	13.5	12.51	11.16	12.43	-1.27	-10

[1]Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2012 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by groundwater

Table 9: Top Water Withdrawals by Specific Source for Commercial Operations in 2012.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2012 MGD
Colonial Williamsburg, Inc.	Colonial Williamsburg Hotel	Williamsburg	GW	6 Wells	0.9	1.37
Wintergreen Partners, Inc.	Lake Monocan	Nelson	SW	Lake Monocan	0.87	0.81
Central Virginia Water Storage Corp.	Storage Reservoir (CVWSC)	Buckingham	SW	CVWSC Storage Reservoir	0.83	0.71
Commonwealth of Virginia	James River Correctional Center	Goochland	SW	James River, Beaverdam Creek	0.73	0.64
Commonwealth of Virginia	St. Brides Correctional Center	Chesapeake	GW	2 Wells	0.17	0.26

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

Table 10: Top Water Transfers for Commercial Operations in 2012.

Source	Purchaser	Purchaser Facility	Purchaser Location	Avg. MGD[1]	2012 MGD
Post Camp WTP	United States Government	Post Camp Service Area	Prince William County	0.52	0.92
Fairfax County WA-Southside	Metro Washington Airport Authority	Dulles International Airport	Fairfax County	0.28	0.73
Wintergreen Partners, Inc.-Lake Monocan	Nelson County Service Authority	Wintergreen Mt Service Area	Nelson County	0.23	0.20
Commonwealth of Virginia, James River Correctional Facility	County of Goochland	Goochland Courthouse Service Area	Goochland County	0.13	0.08

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

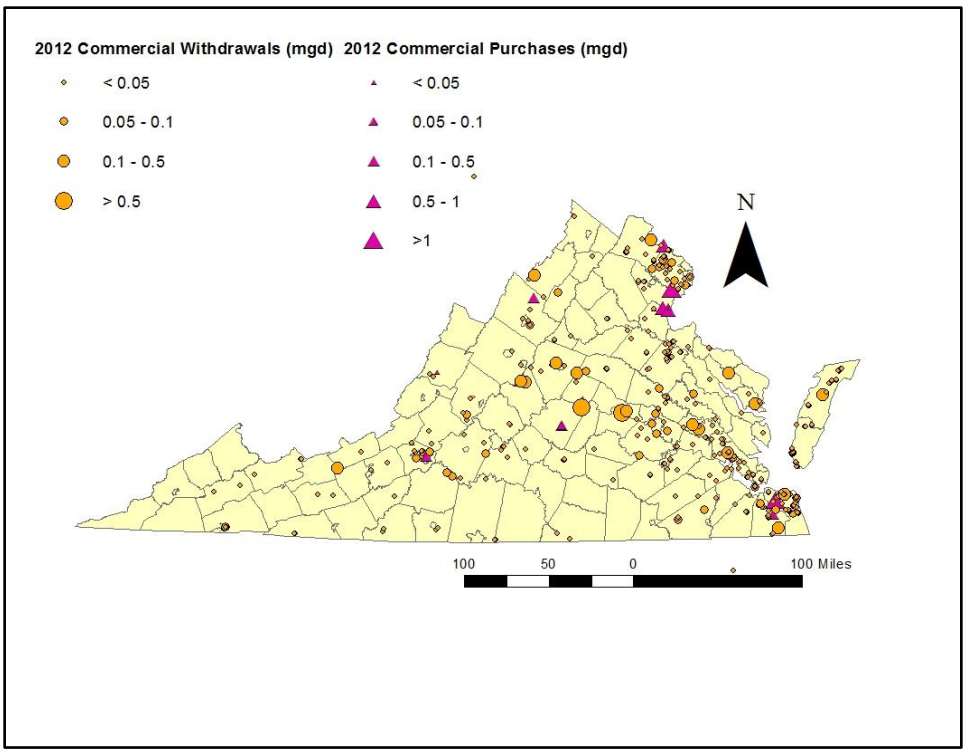


Figure 21: 2012 Commercial Water Withdrawals and Purchases (mgd).

Table 11: 2008-2012 Commercial Water Withdrawals by Subcategory.

General Sub-Category	Specific Sub-Category	2008 MGD	2008 MGD	2009 MGD	2010 MGD	2012 MGD	Avg MGD
Amusement and Recreation Services	Membership sports and recreation clubs	2.96	2.12	3.07	2.73	2.59	2.69
Amusement and Recreation Services	Public golf courses	2.49	1.65	2.68	2.07	1.65	2.11
Justice, Public Order, and Safety	Correctional institutions	1.43	1.23	1.25	0.9	1.28	1.22
Trucking and Warehousing	Special warehousing and storage	1.69	0.43	0.7	0.65	0.71	0.84
Hotels and Other Lodging Places	Hotels and motels	1.79	1.57	1.51	1.33	0.63	1.37
Administration of Economic Programs	Admin. of general economic programs	0.33	0.33	0.36	0.39	0.24	0.33
Educational Services	Elementary & Secondary Schools	0.13	0.1	0.1	0.09	0.13	0.11
Executive, Legislative, and General	General government	0.1	0.14	0.14	0.14	0.12	0.13

(This table includes only those sub-categories with >0.1 mgd of self-supplied withdrawals in 2012.)

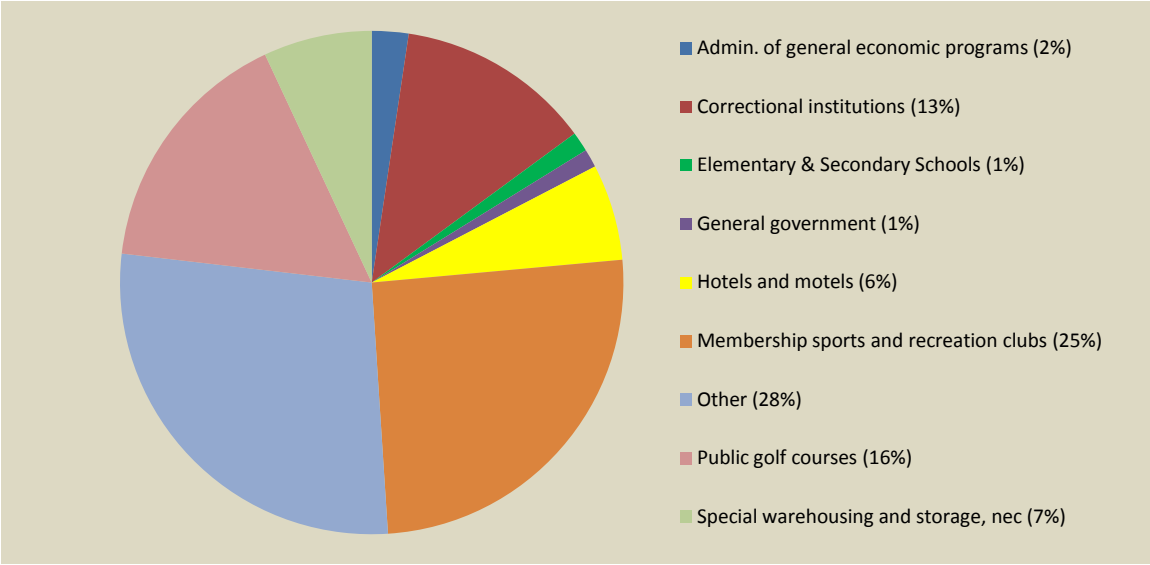


Figure 22: 2012 Commercial Water Withdrawals by Specific Sub-Category.

Mining Water Withdrawals in Virginia

Mining includes operations such as sand, rock, and coal mining. Total water withdrawals in 2012 for mining purposes decreased relative to previous years (Figure 23 and Table 12). Surface water remained the major source of water for mining purposes. Because there are no major transfers of water for mining purposes, the water withdrawals also represent water use. The five facilities reporting the largest 2012 mining withdrawals are listed in Table 13. The majority of stone and sand mining facilities located along the I-95 corridor; coal mining withdrawals are located in the southwestern Appalachian basin (Figure 24). Crushed and broken granite activities accounted for approximately 48% of the total 2012 water withdrawals for mining. Coal mining and processing activities made up 28% of mining withdrawals and quarrying for limestone, sand and gravel accounted for most of the remainder (Table 14 and Figure 25).

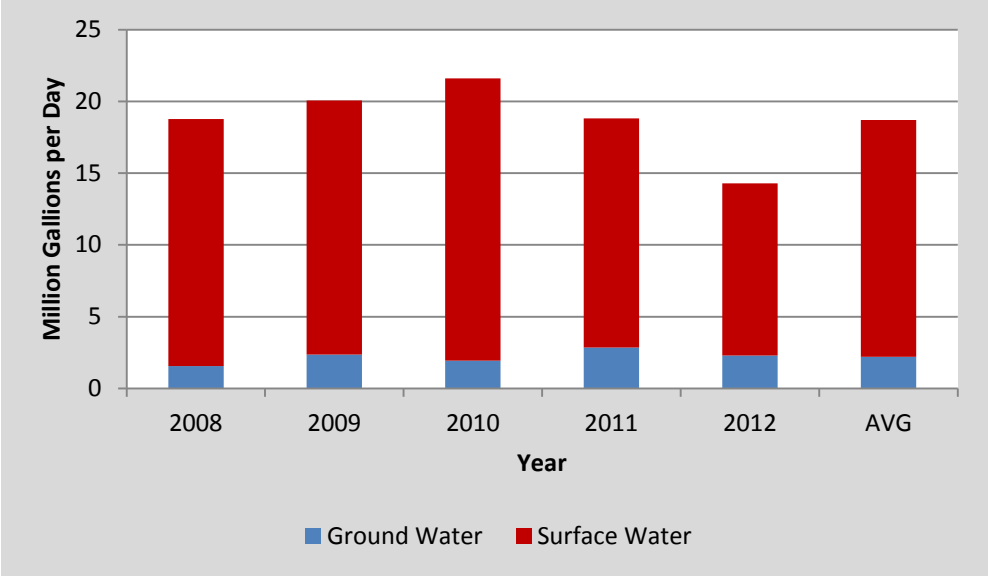


Figure 23: 2008-2012 Mining Water Withdrawals by Source Type.

Table 12: 2008-2012 Mining Water Withdrawals by Source Type, with 2012 Change from 5-year Average.

Source type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	1.55	2.35	1.93	2.86	2.29	2.20	0.09	4
Wells	1.51	2.31	1.89	2.82	2.25	2.16	0.09	4
Reservoirs[3]	0.04	0.04	0.04	0.04	0.04	0.04	0.00	0
Total SW	17.23	17.71	19.66	15.96	12.00	16.51	-4.51	-27
Streams	10.44	8.25	7.87	7.73	6.00	8.06	-2.06	-26
Reservoirs	6.79	9.46	11.79	8.23	6.00	8.45	-2.45	-29
TOTAL GW+SW	18.78	20.06	21.59	18.82	14.29	18.71	-4.42	-24

[1]Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2012 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by groundwater

Table 13: Top Water Withdrawals by Specific Source for Mining Operations in 2012.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2012 MGD
VULCAN CONSTRUCTION MATERIALS	MANASSAS PLANT	Prince William	SW	Pump Silting Basin #1	1.58	1.67
PARAMONT COAL CO VA LLC	TOMS CREEK PREPARATION PLANT	Wise	SW	Little Toms Creek & Upper Banner Mine Reservoir	0.98	1.67
VULCAN CONSTRUCTION MATERIALS	ROYAL STONE PLANT	Goochland	SW/GW	Little Tuckahoe Creek, Quarry Sump, & Well	1.13	1.08
DICKENSON-RUSSELL COAL CO LLC	MCCLURE #1 MINE & PREP PLANT	Dickenson	SW	Caney Creek	0.94	1.06
BOXLEY MATERIALS COMPANY	BLUE RIDGE PLANT	Bedford	SW	Quarry	1.09	1.01

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

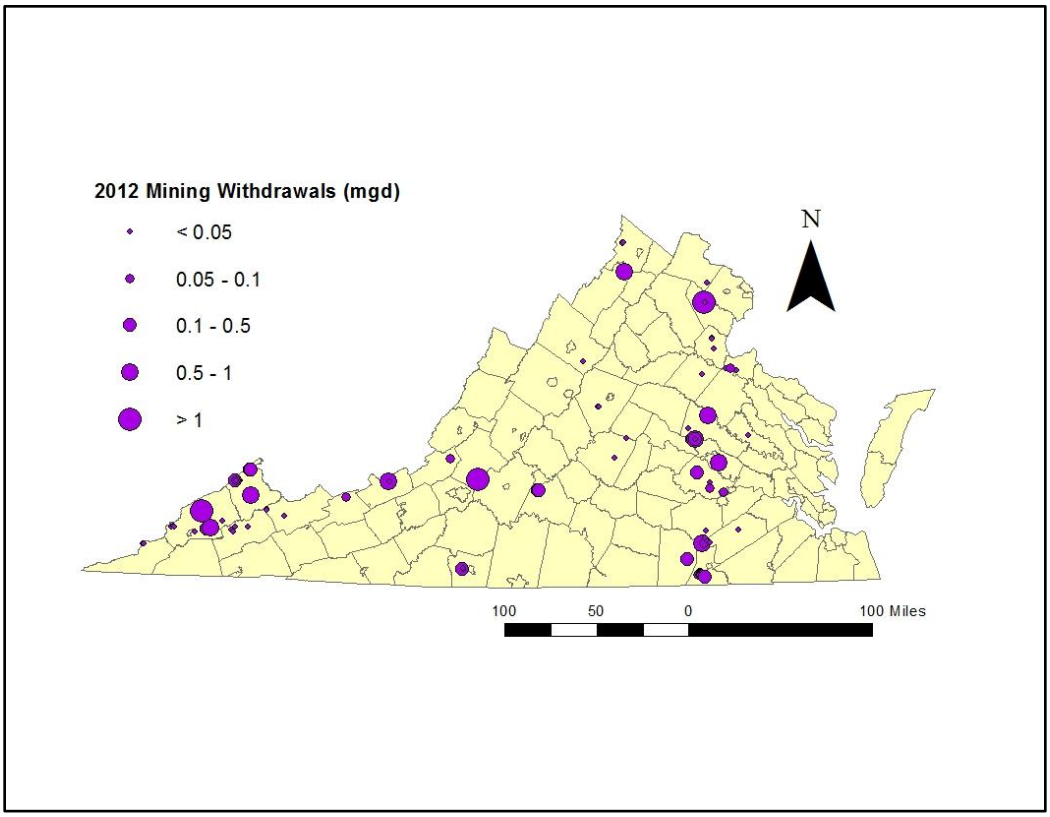


Figure 24: 2012 Mining Water Withdrawals by Withdrawal Point Location (mgd).

Table 14: 2008-2012 Mining Water Withdrawals by Sub-Category

General Sub-Category	Specific Sub-Category	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg MGD
Nonmetallic Minerals, Except Fuels	Crushed and broken granite	8.67	9.42	9.36	8.68	6.86	8.60
Coal Mining	Coal mining services	4.47	1.67	1.87	2.31	2.8	2.62
Nonmetallic Minerals, Except Fuels	Crushed and broken limestone	3.26	3.64	3.32	2.43	2.07	2.94
Coal Mining	Bituminous coal - underground	0.33	0.55	0.55	0.55	0.59	0.51
Coal Mining	Bituminous coal - surface	0.46	0.46	0.52	0.52	0.53	0.50
Nonmetallic Minerals, Except Fuels	Construction sand and gravel	1.13	3.54	2.71	2.63	0.21	2.04
Nonmetallic Minerals, Except Fuels	Clay and related minerals	0.03	0.04	0.06	0.06	0.06	0.05
Nonmetallic Minerals, Except Fuels	Crushed and broken stone	0.43	0.32	0.05	0.06	0.05	0.18
Nonmetallic Minerals, Except Fuels	Industrial sand	0.01	0.02	0.03	0.02	0.03	0.02

(This table includes only those sub-categories with >0.01 mgd of self-supplied withdrawals in 2012.)

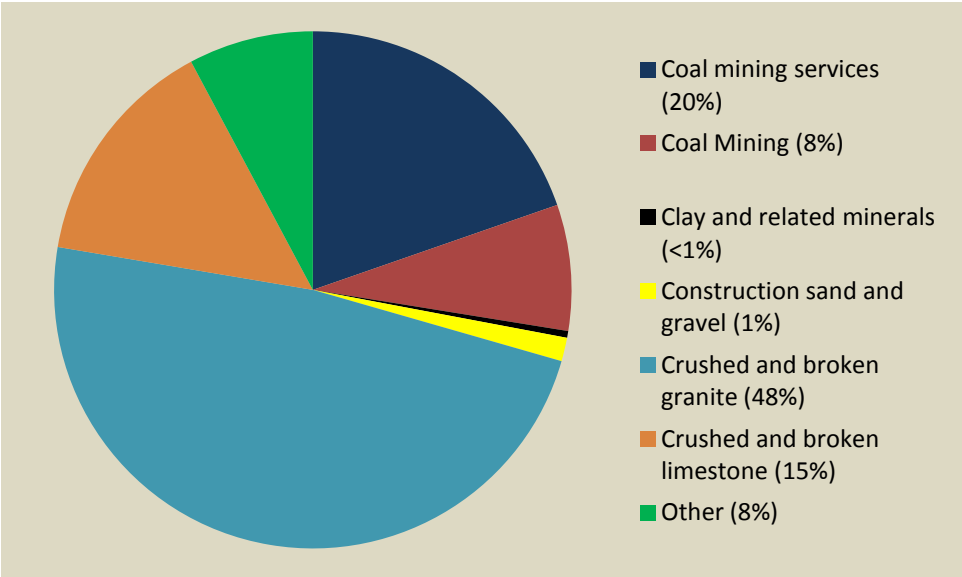


Figure 25: 2012 Mining Water Withdrawals by Sub-Category (mgd).

Manufacturing Water Withdrawals in Virginia

Manufacturing includes operations such as paper mills, food processors, drug companies, furniture, and concrete companies. Figure 26 illustrates the changes in state-wide totals of groundwater and surface water withdrawals for manufacturing from 2008-2012. Surface water is the predominant source of water for manufacturing, accounting for about 83% of the total withdrawals in 2012. There are no major transfers of water for manufacturing purposes, so the water withdrawals also represent water use. Total water withdrawals for manufacturing during 2012 were approximately 42 mgd (10%) lower than the average over the past five years (Table 15). Much of this reduction was due to the shutdown of the Yorktown Refinery in Yorktown, which withdrew approximately 53 mgd in 2010. In addition, the International Paper mill in Franklin ceased operation in 2011 and resumed during 2012, but at a lower water withdrawal rate. Table 16 lists the facilities with the largest manufacturing water withdrawals in 2012. Most of these facilities manufacture chemicals and allied products. Withdrawals for this subcategory remained essentially the same as in 2011, totaling about 252 mgd, which equals 65 percent of the 2012 total manufacturing withdrawals (Table 17 and Figure 27). Withdrawals for manufacturing paper and allied products made up most of the remainder (26%) of the 2012 manufacturing withdrawals.

Water withdrawals for manufacturing purposes are spread throughout much of Virginia (Figure 28). Clusters of large-scale withdrawals occur in the Tidewater, Richmond and Shenandoah Valley regions, as well as the New River and the Jackson/Upper James River basins.

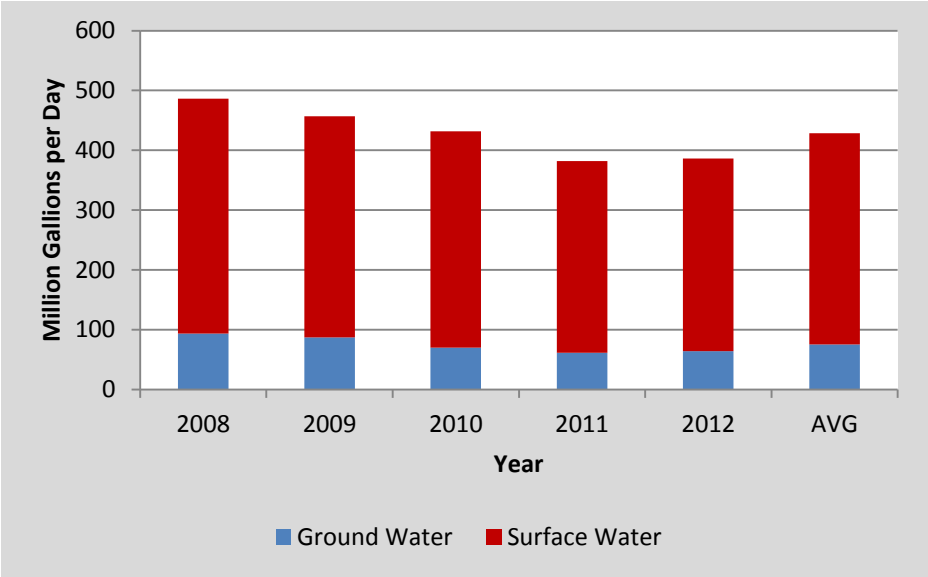


Figure 26: 2008-2012 Manufacturing Water Withdrawals by Source Type.

Table 15: 2008-2012 Manufacturing Water Withdrawals by Source Type, with 2012 Change from 5-year Average.

Source type	2008 MGD	2008 MGD	2009 MGD	2010 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	93.46	87.31	69.86	61.49	63.94	75.21	-11.27	-15
Wells	93.13	87.28	69.7	61.26	63.39	74.95	-11.56	-15
Springs	0.33	0.03	0.16	0.23	0.55	0.26	0.29	112
Total SW	392.99	369.61	361.9	320.37	322.11	353.40	-31.29	-9
Streams	390.1	367.05	359.03	317.38	319.05	350.52	-31.47	-9
Reservoirs	2.89	2.56	2.87	2.99	3.06	2.87	0.19	6
TOTAL GW+SW	486.45	456.92	431.76	381.86	386.05	428.61	-42.56	-10

[1]Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2012 water withdrawals from average water withdrawals; [3]GW Reservoirs = irrigation ponds recharged by groundwater

Table 16: Top Water Withdrawals for Manufacturing Facilities in 2012.

Owner Name	Facility	City/County	Manufacturing Sub-Category	Type	Source	Avg. MGD[1]	2012 MGD
Honeywell International, Inc	Hopewell Plant	City of Hopewell	Chemicals and Allied Products	SW	James River	108.81	110.58
Celanese Acetate, LLC	Celco Plant	Giles County	Chemicals and Allied Products	SW	New River	56.81	56.51
Meadwestvaco Corporation	Covington Plant	Alleghany County	Paper & Allied Products	SW	Jackson River	38.43	38.27
Dupont E I De Nemours & Co.	Spruance Plant	Chesterfield County	Chemicals and Allied Products	SW	James River	28.67	30.75
United States Government.	Radford Ammunitio ns WTP	Montgomery County	Chemicals and Allied Products	SW	New River	21.91	22.16
Rock-Tenn Corp.	West Point Plant	King William County	Paper & Allied Products	GW	Potoma c Aquifer	19.39	20.09

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD

Table 17: 2008-2012 Manufacturing Water Withdrawals by Sub-Category

General Sub-Category	Specific Sub-Category	2008 MGD	2008 MGD	2009 MGD	2010 MGD	2012 MGD	Avg MGD
Chemicals and Allied Products	Chemical preparations	119.57	102.89	113.44	112.21	113.36	112.29
Paper and Allied Products	Paperboard Mills	83.66	86.26	87.1	86.24	83.82	85.42
Chemicals and Allied Products	Cellulosic manmade fibers	59.37	58.04	53.21	56.93	56.51	56.81
Chemicals and Allied Products	Organic fibers, noncellulosic	33.46	30.21	31.21	30.84	33.78	31.90
Chemicals and Allied Products	Industrial inorganic chemicals	18.2	24.34	27.87	33.54	28.19	26.43
Paper and Allied Products	Paper mills	37.11	32.71	15.25	7.58	12.95	21.12
Chemicals and Allied Products	Plastics materials and resins	15.88	12.98	11.41	10.86	12.67	12.76
Transportation Equipment	Ship building and repairing	11.76	5.19	3.19	2.41	7.8	6.07
Chemicals and Allied Products	Medicinals and Botanicals	8.69	8.56	8.51	7.87	7.79	8.28
Stone, Clay, and Glass Products	Lime	5.57	6.73	7.78	8.34	7.64	7.21
Paper and Allied Products	Sanitary food containers	5.51	5.17	3.68	4.85	5.14	4.87

(This table includes only those sub-categories with >2 mgd of self-supplied withdrawals in 2012.)

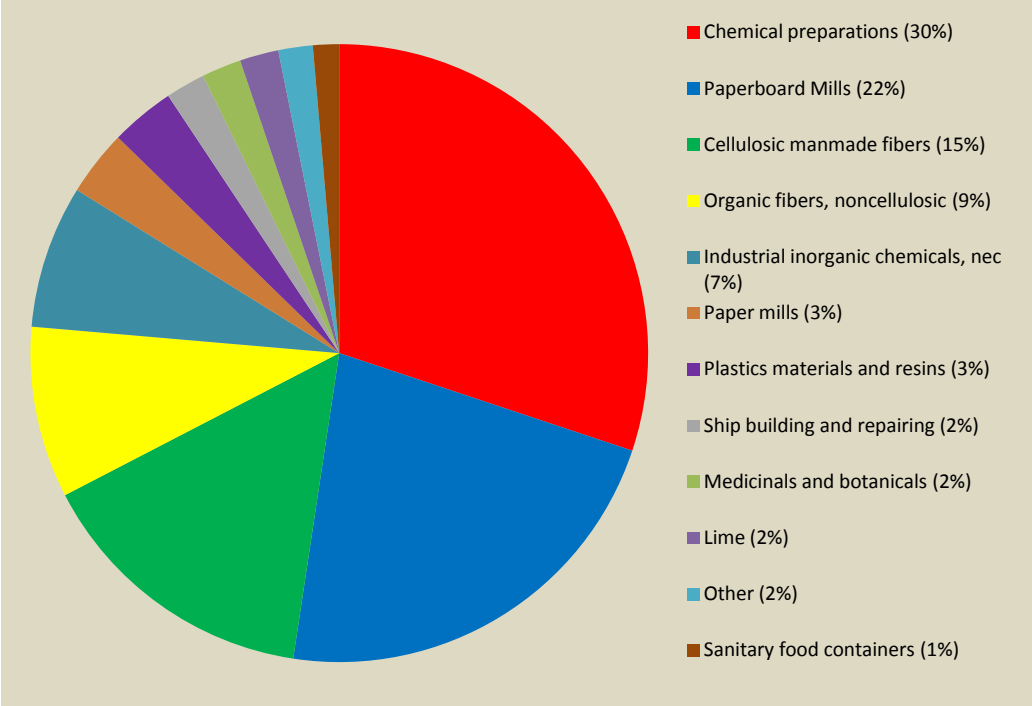


Figure 27: 2012 Manufacturing Water Withdrawals by Specific Sub-Category (mgd).

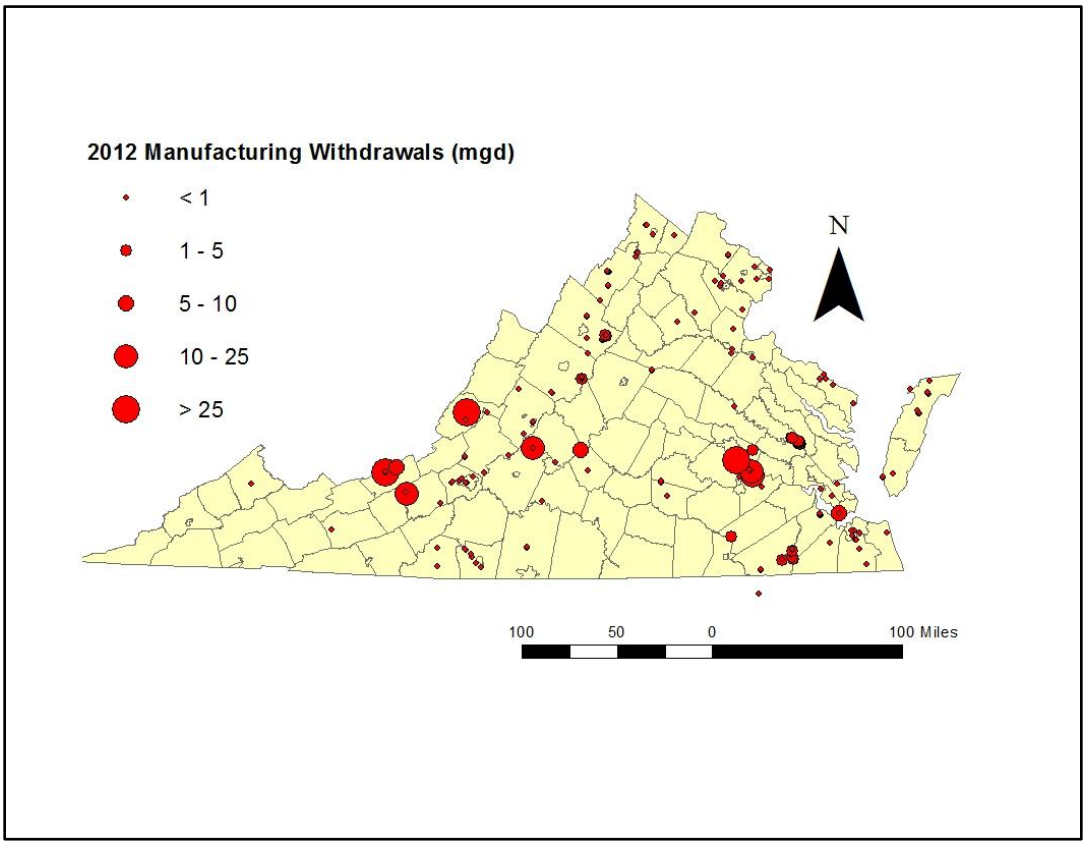


Figure 28: 2012 Manufacturing Water Withdrawals by Withdrawal Point Location (mgd).

Public Water Supply Water Withdrawals in Virginia

Public water supply includes municipal and private water purveyors. Figure 29 shows the state-wide totals of groundwater and surface water withdrawals for public water supply from 2008-2012. 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 2012 were nearly equal to the average for the 2008-2012 period (Table 18) and slightly less than 2011 withdrawals. Table 19 lists the 8 facilities that withdrew water for public water supply at the greatest rates during 2012. 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 larger 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 from the Environmental Protection Agency's most recent report tabulating the number of public water systems in Virginia as of Federal Fiscal Year 2011 (ending September 30, 2011) and the corresponding population served by these systems. While most of the systems use groundwater, the majority of the population is served by surface water systems.

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 30). The largest public water supply purchases (Figure 31) 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.

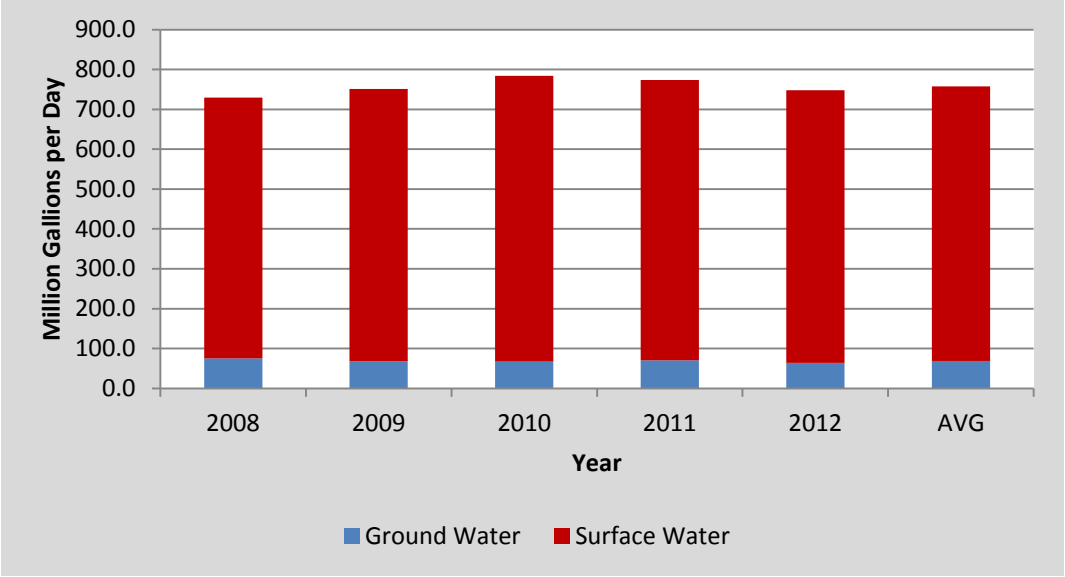


Figure 29: 2008-2012 Public Water Supply Water Withdrawals by Source Type.

Table 18: 2008-2012 Public Water Supply Water Withdrawals by Source Type, with 2012 Change from 5-year Average.

Source type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	75.3	67.9	67.6	70.8	63.8	69.1	-5.3	-8
Wells	60.1	54.3	49.7	54.0	49.2	53.4	-4.3	-8
Springs	12.8	13.2	17.5	16.5	14.3	14.9	-0.6	-4
Other GW[3]	2.5	0.3	0.4	0.4	0.4	0.8	-0.4	-50
Total SW	654.5	683.3	716.5	702.7	683.7	688.1	-4.4	-1
Streams	298.9	346.7	349.4	338.4	319.1	330.5	-11.4	-3
Reservoirs	355.7	336.6	367.1	364.3	364.7	357.7	7.0	2
TOTAL GW+SW	729.9	751.2	784.0	773.5	747.6	757.2	-9.7	-1

[1]: Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]: % change = percent change in 2012 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 2012.

Owner Name	Facility	City/County	Type	Source	Avg. MGD[1]	2012 MGD
Fairfax County Water Authority	Potomac River WTP	Fairfax County	SW	Potomac River	89.3	86.3
Fairfax County Water Authority	Occoquan Reservoir	Prince William County	SW	Occoquan Reservoir	60.9	63.9
City of Richmond	Richmond WTP	City of Richmond	SW	James River and Kanawha Canal	64.9	63.1
City of Norfolk	Western Branch Reservoir	Suffolk	SW	Western Branch Reservoir	60.7	62.8
Appomattox River Water Authority	Lake Chesdin WTP	Chesterfield County	SW	Lake Chesdin	30.7	31.1
Henrico County	Henrico County WTP	Henrico County	SW	James River	25.6	25.8
City of Newport News	Lee Hall WTP & ROF	City of Newport News	SW	Lee Hall Reservoir	24.5	23.4
Virginia American Water Co.	Hopewell District	City of Hopewell	SW	Appomattox River	16.5	21.0

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

Table 20: Top Water Transfers for Public Water Suppliers in 2012.

Source	Supplier	Purchaser Owner Name	Purchaser Facility	2012 MGD
City of Norfolk	Norfolk Service Area	City of Virginia Beach	Virginia Beach Service Area	32.4
US Government	Dalecarlia WTP	Arlington County	Arlington Service Area	22.8
Fairfax County Water Authority	Occoquan Reservoir	Prince William County Service Authority	OWDT Service Area	21.5
Appomattox River Water Authority	Lake Chesdin WTP	Chesterfield County	Chesterfield County Service Area	18.8
Fairfax County Water Authority	Potomac River WTP	Loudoun Water	Lower Broad Run Service Area	18.8
US Government	Dalecarlia WTP	City of Falls Church	Falls Church Service Area	15.6
Virginia American Water Company	Alexandria Service Area	City of Alexandria	Alexandria Service Area	15.6
Fairfax County Water Authority	Occoquan Reservoir	Virginia American Water Company	Alexandria Service Area	15.6
City of Richmond	City of Richmond Service Area	Henrico County	City-County Contract Service Area	13.6
City of Richmond	City of Richmond Service Area	Chesterfield County	Chesterfield County Service Area	10.6

[1]Avg. MGD = Average water withdrawals from 2008-2012 (MGD

Table 21: Number of Public Water Systems and Population Served by Public Water Systems in Virginia, Federal Fiscal Year ending September 30, 2011.

	Total	Groundwater	Surface Water
Number of Systems	2787	2395	392
Population Served	7,090,048	751,035	6,339,013

Sourcehttp://water.epa.gov/scitech/datait/databases/drink/sdwisfed/upload/epa816r13003.pdf (page 14, accessed 7/5/13).

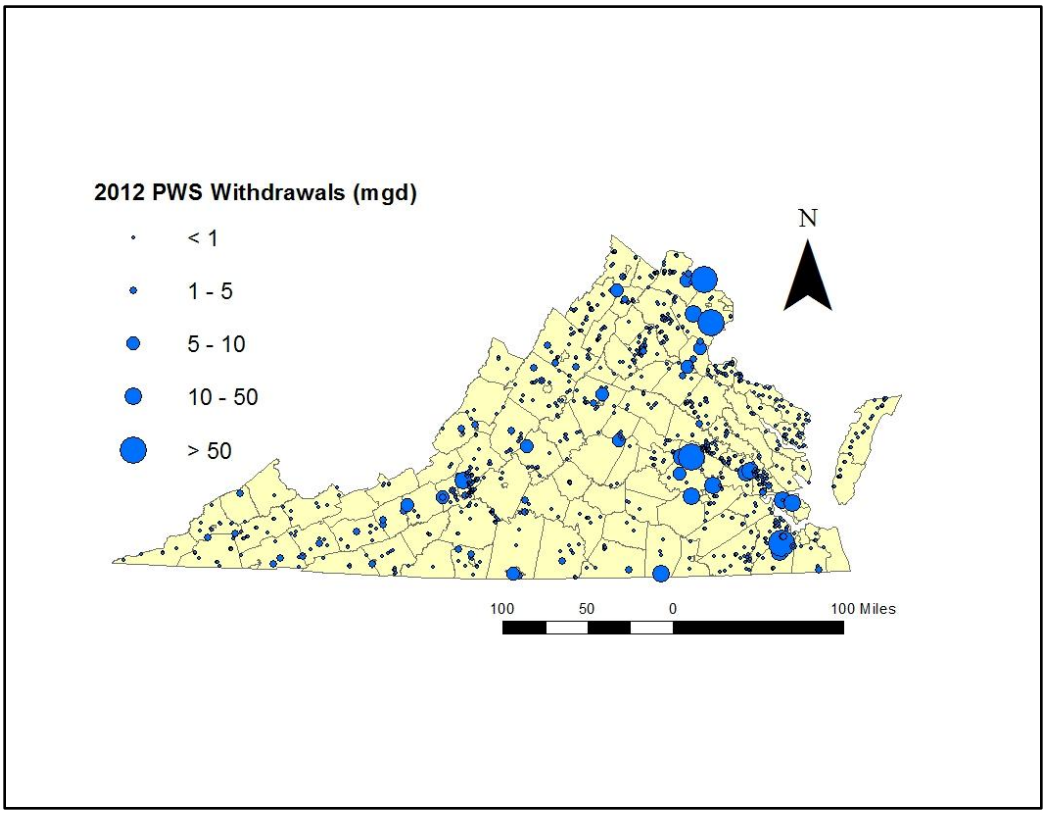


Figure 30: 2012 Public Supply Water Withdrawals by Location (mgd).

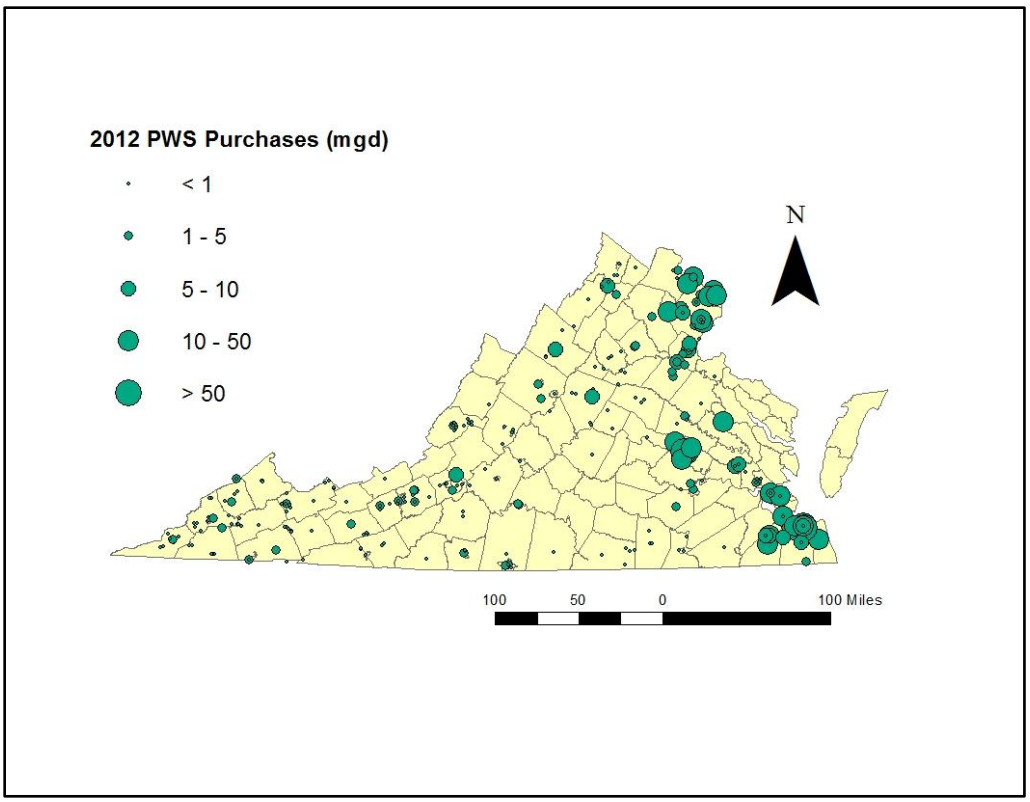


Figure 31: 2012 Public Supply Water Purchases by Location (mgd).

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 2012 by nuclear and fossil-fuel power generating plants are listed in this section. Ground water withdrawals for this category are insignificant compared to surface water withdrawals. Total power generation withdrawals were slightly less than those of 2011, continuing an annual trend over the past 5 years (Figure 32 and Table 22). The eleven power generation facilities with the greatest 2012 withdrawals are listed in Table 23. Most of the large fossil-fuel facilities are located in the eastern half of the state. Virginia has two nuclear-powered generating plants, located in Louisa and Suffolk counties (Figure 33).

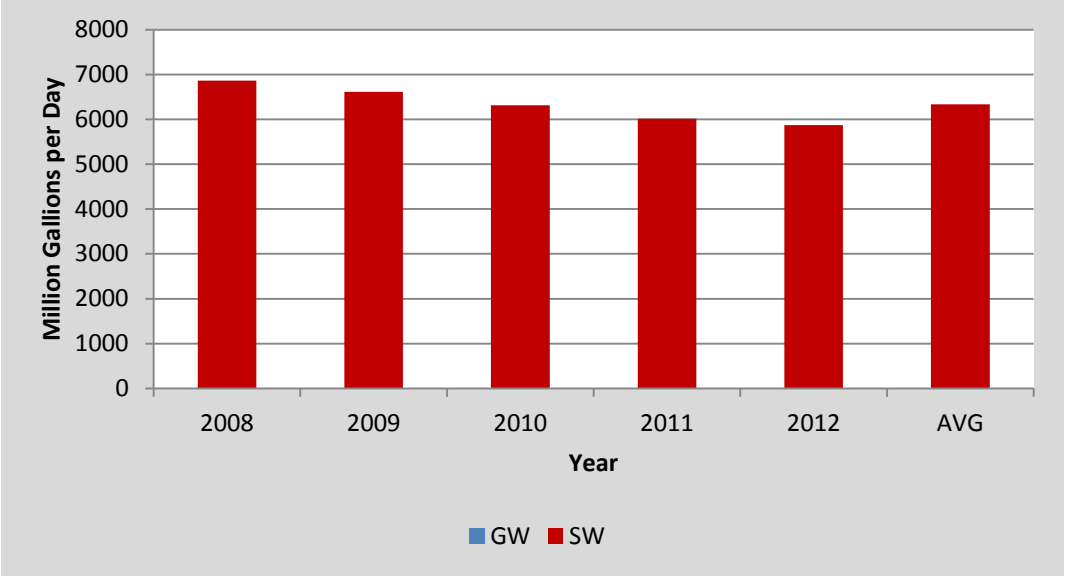


Figure 32: 2008-2012 Power Generation Withdrawals by Source Type.

Table 22: 2008-2012 Power Generation Withdrawals by Source Type, with 2012 Change from 5-year Average (excluding Hydropower).

Source type	2008 MGD	2009 MGD	2010 MGD	2011 MGD	2012 MGD	Avg. MGD	Abs. change[1] (MGD)	% change[2]
Total GW	2.4	1.0	1.6	0.4	0.6	1.2	-0.6	-51
Wells-Fossil	2.0	0.6	1.2	0.0	0.2	0.8	-0.6	-72
Wells-Nuclear	0.4	0.4	0.4	0.3	0.3	0.4	0.0	-2
Total SW	6860	6611	6309	6015	5871	6333	-463	-7
Streams-Fossil	2997	2763	2580	2335	2023.5	2539.6	-516	-20
Streams-Nuclear	1977	1961	1907	1948	1937.8	1946.2	-8	0
Reservoirs-Fossil	2	1	1	1	0.5	1.1	-1	-53
Reservoirs-Nuclear	1885	1886	1820	1732	1908.8	1846.4	62	3
TOTAL GW+SW (both Types)	6863	6612	6311	6015	5871	6334	-463	-7

[1]Abs change = difference between 2012 water withdrawals and average water withdrawals (MGD); [2]% change = percent change in 2012 water withdrawals from average water withdrawals

Table 23: Top Water Withdrawals by Power Generation Facilities in 2012.

Owner Name	Facility	City/County	Type[1]	Major Source	Avg. MGD[2]	2012 MGD
Dominion Generation	Surry Nuclear Plant	Surry	N	James River	1946.5	1938.2
Dominion Generation	North Anna Nuclear Power Plant	Louisa	N	Lake Anna	1846.4	1908.8
Dominion Generation	Chesterfield Power Station	Chesterfield	F	James River	830.3	681.9
Dominion Generation	Yorktown Fossil Power Plant	York	F	York River	690.8	531.0
Dominion Generation	Chesapeake Energy Center	Chesapeake	F	South Branch, Elizabeth River	490.3	376.5
Dominion Generation	Possum Point Power Station	Prince William	F	Potomac River	150.4	160.7
Appalachian Power Company	Glen Lyn Power Plant	Giles	F	New River	124.2	92.7
GenOn Potomac River LLC	Potomac River Generation Station	Alexandria	F	Potomac River	123.1	86.2
Dominion Generation	Bremo Bluff Power Plant	Fluvanna	F	James River	110.0	76.1
Dominion Generation	Clover Power Station	Halifax	F	Roanoke River	10.0	8.7
Appalachian Power Company	Clinch River Plant	Russell	F	Clinch River	9.0	8.7

[1]N = Nuclear; F = Fossil

[2]Avg. MGD = Average water withdrawals from 2008-2012 (MGD)

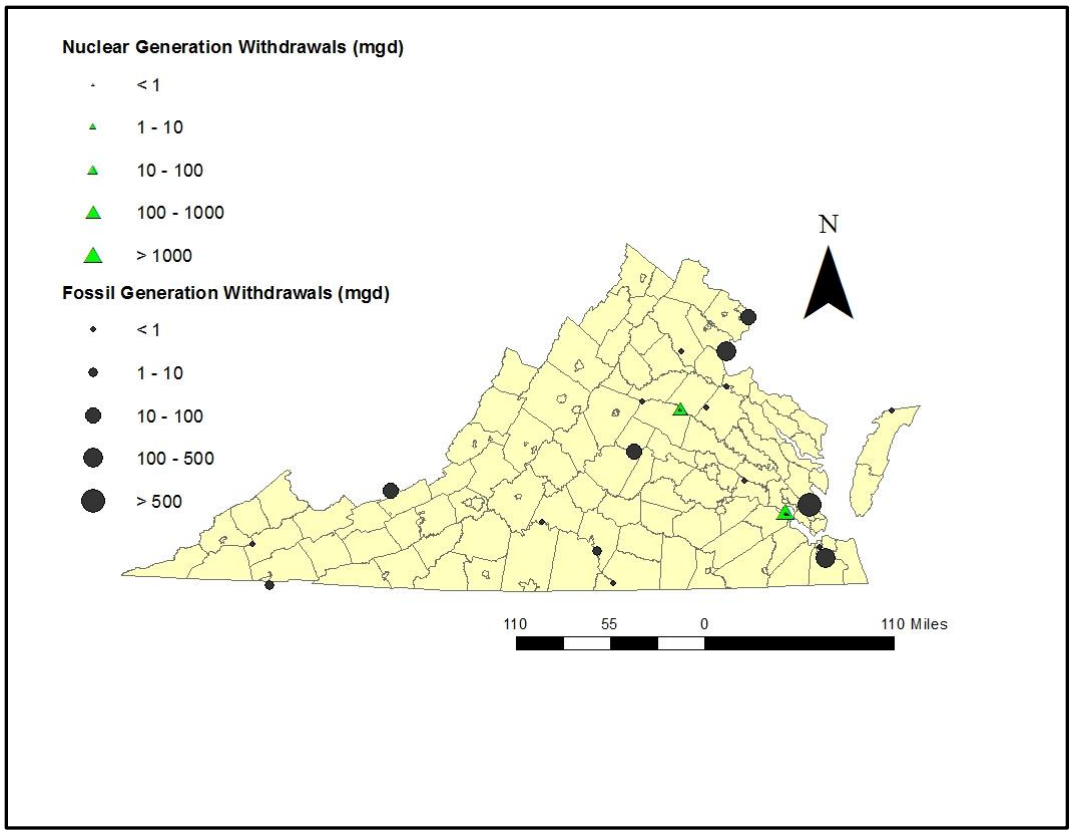


Figure 33: 2012 Power Generation Withdrawals by Withdrawal Point Location (mgd).

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 state water withdrawal reporting and local water supply planning activities. Water withdrawals for 2012, however, were about 4% lower than the average of the 2008-2012 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. As part of the preparation of the initial State Water Resources Plan required by § 62.1-44.38, DEQ has been analyzing historic and projected surface water withdrawal information along with other pertinent data from local and regional water supply plans. An initial state-wide cumulative impact analysis of the future demands projected by the planning localities is scheduled for completion during 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 has undertaken 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. Updated ground-water models have been constructed and will be available for regulatory purposes by the end of 2013. Preliminary simulations using these models indicate that the impacts due to current and projected future withdrawals may be more severe than those predicted by previous modeling. Consequently, there may be less ground water available for future uses than previously indicated.

- During 2013, amendments to the Eastern Virginia Groundwater Management Area Regulation (9VAC25-600) and the Groundwater Withdrawal Regulation (9VAC25-610) were approved by the State Water Control Board. These amendments include an expansion of the Eastern Virginia Groundwater Management Area to include the northern portion of the coastal plain aquifer system in order to address the continuing declines in groundwater levels in this area. The proposed Expansion Area includes the following additional counties and city: Caroline, King and Queen, Gloucester, Mathews, Middlesex, Essex, King George, Westmoreland, Richmond, Lancaster, Northumberland, parts of Arlington, Fairfax, Prince William, Spotsylvania, Stafford, and the City of Alexandria (Figure 9).

- Significant data gaps continue to 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 resumed operations during 2012 after a shutdown over the previous year, with subsequent potentiometric level decreases. Plans have been made with International Paper for additional monitoring of the Potomac Aquifer and overlying aquifer levels at additional wells in the Franklin vicinity. This monitoring will assist in determining the extent of the potentiometric drawdown due to the Franklin mill.

- Major watersheds have historically lacked established science-based in-stream flow targets to protect fish and wildlife habitat, recreational uses, and navigation uses specific to individual watersheds. DEQ staff collaborated with EPA, The Nature Conservancy, Virginia Department of Game and Inland Fisheries, and USGS staff as part of the EPA Healthy Waters Initiative (HWI) to perform a state-wide assessment of flow alteration information, generating over 7000 correlations between measures of flow alteration and ecological health. An evaluation of these results is now underway to determine the most critical flow components necessary for biological health in streams.

- 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. Preliminary results indicate that these tools may prove to be extremely useful in preparing for drought conditions.

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. Federal funding cuts are expected to eliminate 3 to 4 additional data stations, including an important long-term surface-water gauging station at Farmville. 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 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 (2012 estimate from U.S. Census Bureau) – 8.186 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
August, 2013

Normal to near-normal hydrologic conditions continued throughout most of the Commonwealth of Virginia during July and early August 2013. Stream flows and ground water levels remained normal or above the normal range and estimated precipitation totals were normal to above normal.

Radar-based estimates of 30-day, 60-day and 90-day precipitation totals illustrate that rainfall totals across most of Virginia continued to be normal to above normal throughout most of July, before lessening over the past couple of weeks in many areas. Rainfall totals over the past 60 – 90 days were well above normal amounts over most of the state. Consequently, rainfall totals for the current water year (since October 1, 2012) are greater than normal throughout most of Virginia (Appendix A).

The most recent U.S. Drought Monitor web pages indicate that, for the fourth consecutive month, no abnormally dry (D0) conditions are currently mapped within Virginia (Appendix B). Likewise, no areas of Virginia are currently mapped as containing Moderate Drought (D1) conditions.

Reports from the United States Geological Survey (USGS) and the Environmental Quality (VDEQ) follow below. The VDEQ report is a listing of recent conditions at the 4 major drought indicator reservoirs.

Statewide information on the current drought status is available on the VDEQ website at
http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/Drought.aspx

U.S. Geological Survey Report, August 8, 2013:

Streamflow conditions continue to be in the normal to above normal percentiles for most river basins in Virginia (fig. 1). Short- and long-term drought conditions for streamflow are not present across the Commonwealth (fig 2). The only exception to this is in the Middle Roanoke Basin where a single gage (02064000 Falling River near Naruna, VA) shows below normal drought conditions for only the 7-day average streamflows.

Groundwater conditions are in the normal to much above normal percentile classes across the Commonwealth (fig. 3). Water levels continue to rise in well 41H 3, which is located in the central Piedmont, and are now classified as within the normal percentile classes (fig. 4).

Normal to above normal percentile classes occur in all of the wells (table 1) and 67% of the wells classified as normal have water levels between the 50th and 75th percentile classes in the Virginia Climate Response Network (http://groundwaterwatch.usgs.gov/crn/StateMaps/VA.html).

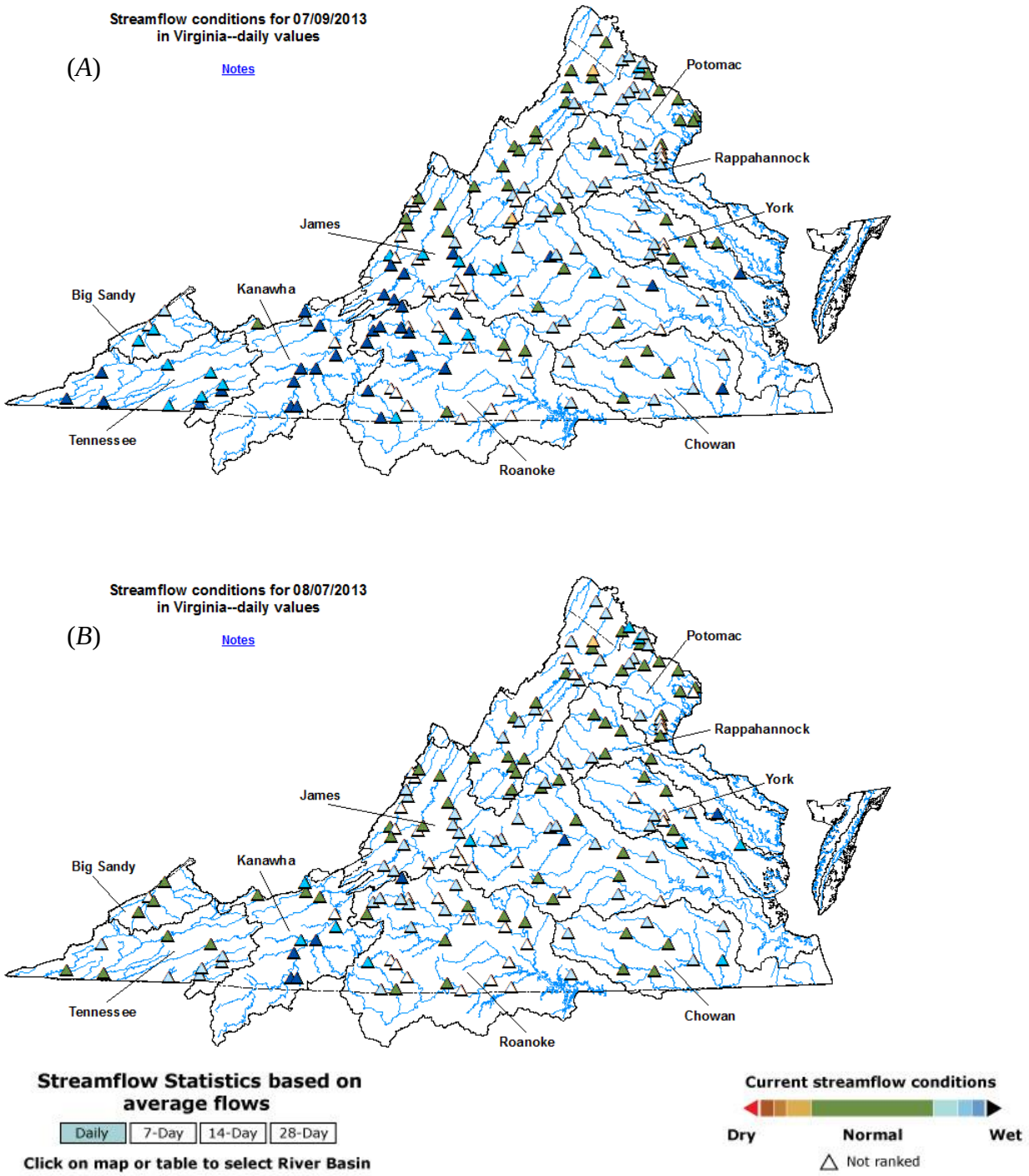


Figure 1. Streamflow conditions for (A) July 9, 2013 and (B) August 7, 2013 in Virginia.

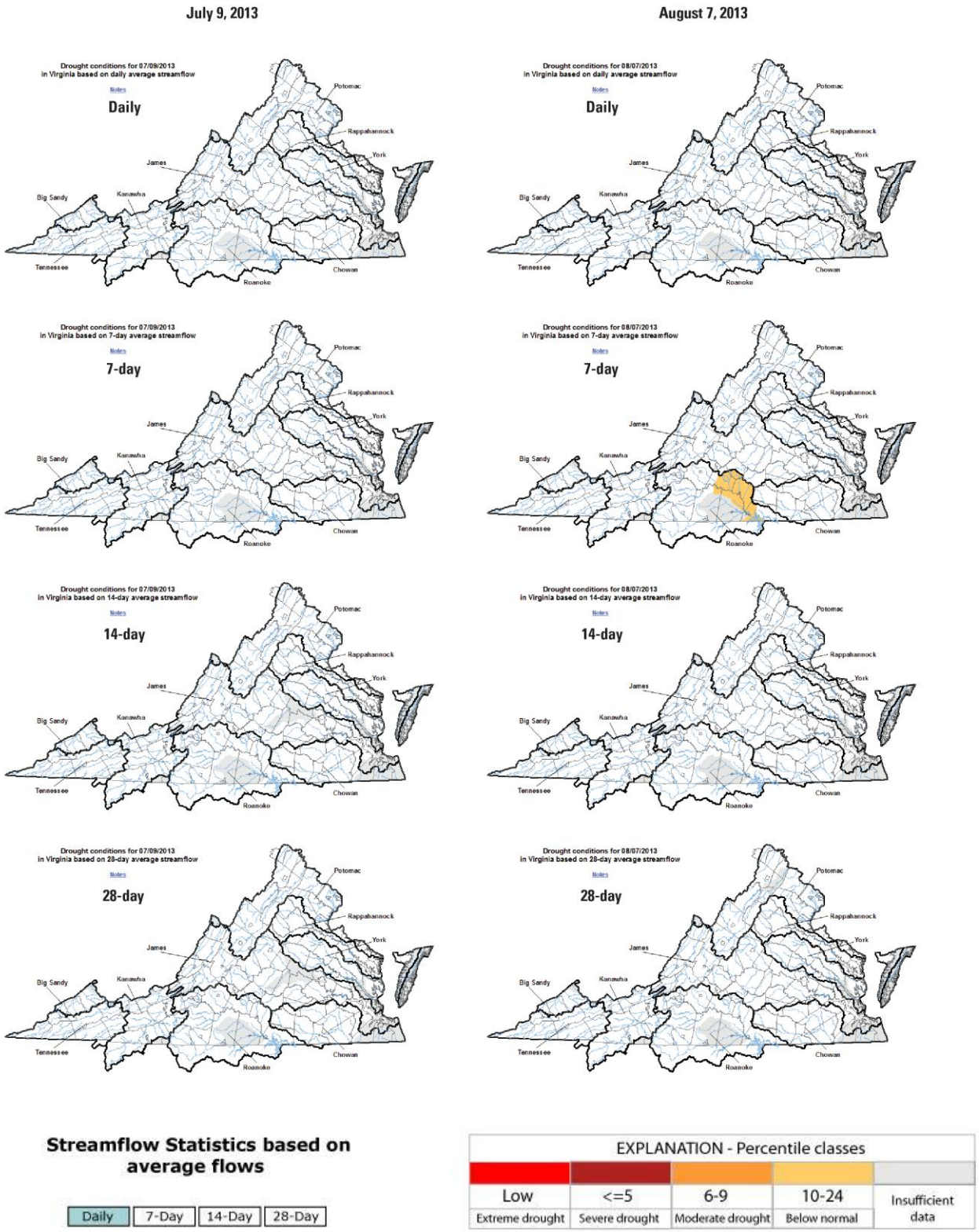


Figure 2. Comparison of drought conditions in Virginia based on daily, 7-, 14-, and 28-day average streamflows referenced to July 9, 2013 and August 7, 2013.

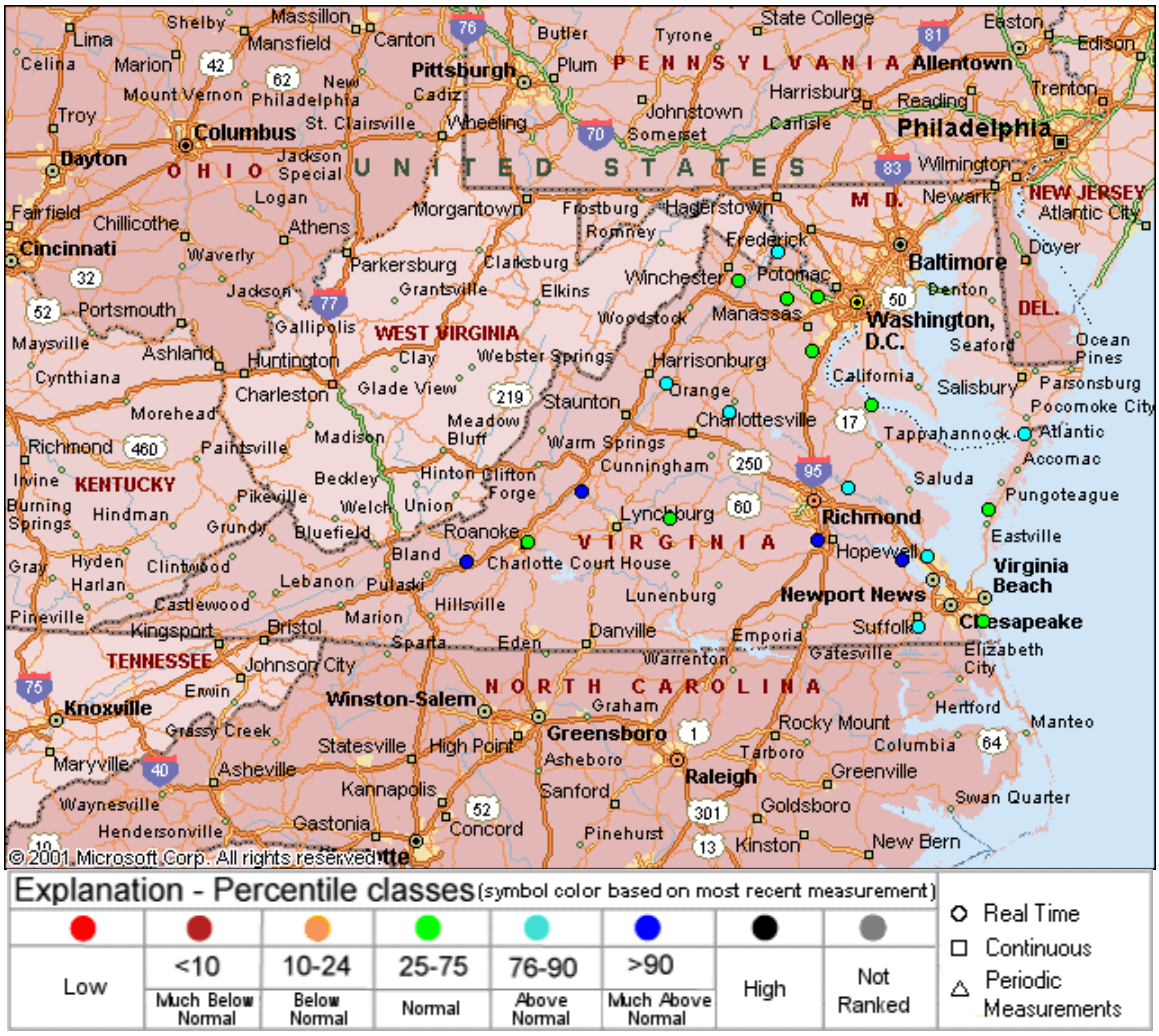


Figure 3. Groundwater-level conditions from the Virginia Climate Response Network for August 7, 2013 in Virginia.

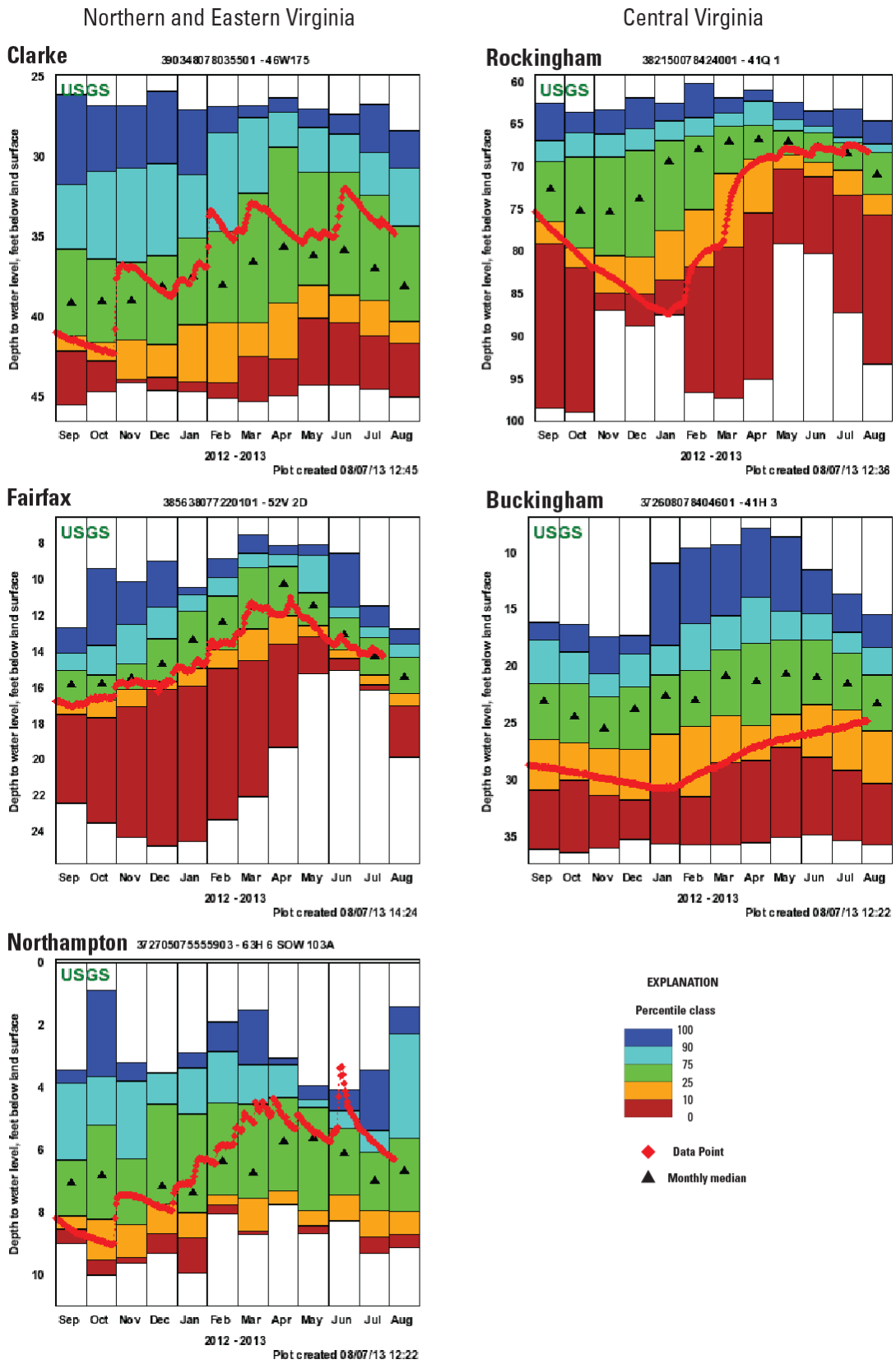


Figure 4. Hydrographs from selected wells showing groundwater levels in in Virginia from September 1, 2012 to present.

Table 1. Current percentile classes for groundwater levels in the Virginia Climate Response Network (VA-CRN), August 7, 2013.

[Groundwater levels are classified as normal between the 25th and 75th percentiles. Site names in red are shown on figure 4.]

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

Virginia Department of Environmental Quality
Conditions of Major Drought Indicator Reservoirs
August, 2013

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. Below is a summary of reported conditions on August 12, 2013:

- **Smith Mountain Lake** was at an adjusted elevation of 795.04 ft, 0.04 ft above full pool level. The adjusted elevation is the level the lake would be if the water currently held in the lower Leesville Lake for reuse were pumped back into Smith Mountain Lake. Levels at Smith Mountain Lake continued to be at or slightly above full pool level, with inflows generally above average.
- **Lake Moomaw** on the Jackson River was at 1580.74 feet, which is 1.26 ft below the top of the conservation pool (1582.0 feet MSL). Levels at Lake Moomaw continued to be near the conservation pool level over the past month.
- **Lake Anna** was at elevation 249.9 ft (1.9 ft above drought watch). The Drought Watch stage for Lake Anna Lake is elevation 248 feet and below.
- **Kerr Reservoir** was at 299.27 feet, which is 0.23 ft below the guide curve level for this time period and therefore 3.23 ft above Drought Watch status. Inflow to Lake Kerr has been normal to above normal for this time of year.

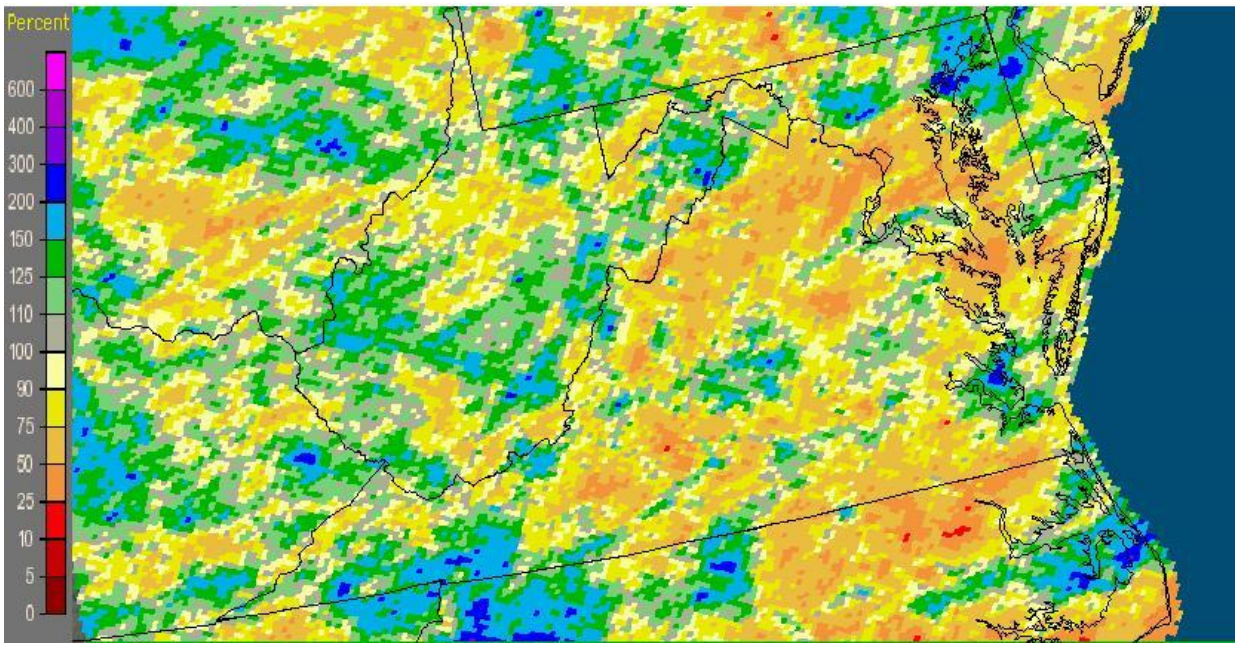
Current water levels at Drought Indicator Reservoirs:

Reservoir Name	Date / Time	Reported Elevation (ft msl)	Drought Watch Range (ft msl)	Drought Warning Range (ft msl)	Current Guide Curve Elevation) ft msl)	Drought Evaluation Region(s) represented
Smith Mt Lake	August 12th /11:05	795.04	793 – 791.5	791.5 – 790.0		Roanoke River
Lake Moomaw	August 12th / 10:30	1580.74	1565 – 1562.5	1562.5 – 1560.0		Upper & Middle James River
Lake Anna	August 11th /	249.9	248 - 246	246 – 244		Northern Piedmont
Kerr Reservoir	August 10th / 0800	299.27	3 – 6 ft below guide curve	> 6 ft below guide curve	299.50	Roanoke River, Southeast Virginia

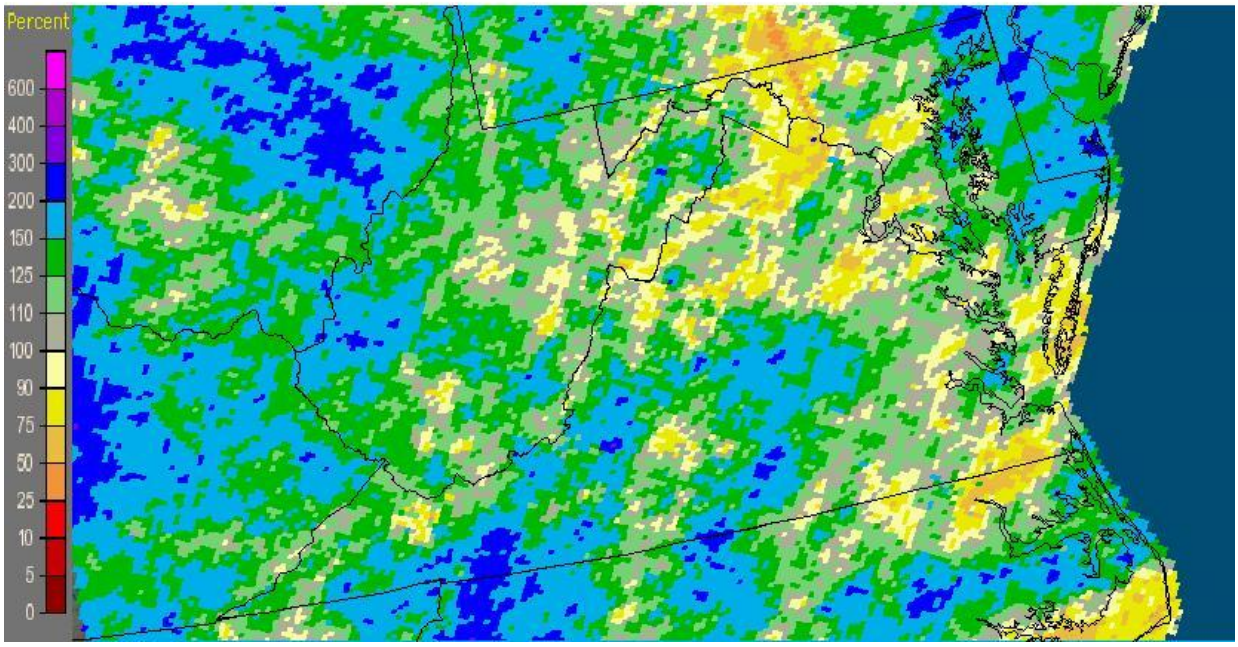
APPENDIX A

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

Virginia: Current 30-Day Percent of Normal Precipitation
Valid at 8/12/2013 1200 UTC- Created 8/12/13 14:17 UTC



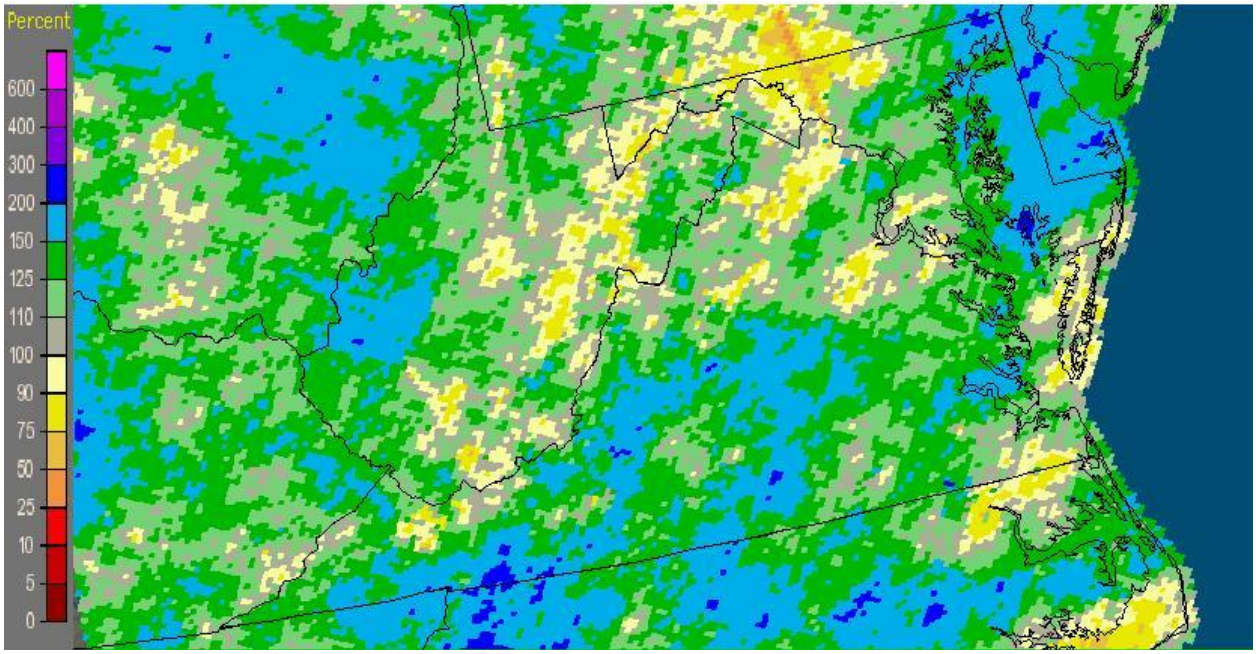
Virginia: Current 60-Day Percent of Normal Precipitation
Valid at 8/12/2013 1200 UTC- Created 8/12/13 14:22 UTC



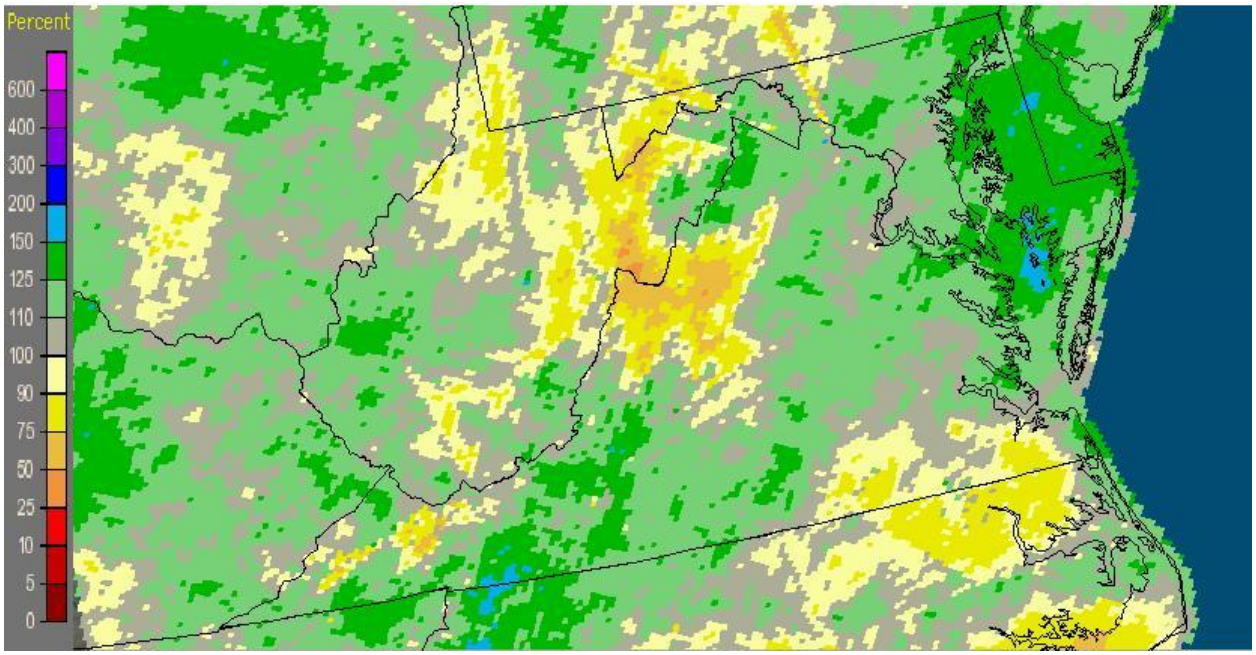
APPENDIX A (continued)

90-Day & Current Water Year Percent of Normal Precipitation (accessed from http://water.weather.gov/precip/)

Virginia: Current 90-Day Percent of Normal Precipitation
Valid at 8/12/2013 1200 UTC- Created 8/12/13 14:28 UTC



Virginia: Current Water-Year (Oct 1) Percent of Normal Precipitation
Valid at 8/12/2013 1200 UTC- Created 8/12/13 14:00 UTC



APPENDIX B

U.S. Drought Monitor

August 6, 2013
Valid 7 a.m. EST

Virginia

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	100.00	0.00	0.00	0.00	0.00	0.00
Last Week (07/30/2013 map)	100.00	0.00	0.00	0.00	0.00	0.00
3 Months Ago (05/07/2013 map)	100.00	0.00	0.00	0.00	0.00	0.00
Start of Calendar Year (01/01/2013 map)	36.45	63.55	43.94	0.00	0.00	0.00
Start of Water Year (09/25/2012 map)	54.31	45.69	12.24	0.00	0.00	0.00
One Year Ago (07/31/2012 map)	24.54	75.46	17.64	0.59	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, August 8, 2013
National Drought Mitigation Center,

Appendix 3: Top 20 Water Withdrawal Systems in 2012 (Non-Power Generation)

Owner	System	Category*	Total (MGD)
HONEYWELL INTERNATIONAL INC	HOPEWELL PLANT	MAN	110.58
FAIRFAX COUNTY WATER AUTHORITY	POTOMAC RIVER WTP	PWS	86.34
NEWPORT NEWS, CITY OF	NEWPORT NEWS	PWS	66.03
FAIRFAX COUNTY WATER AUTHORITY	OCCOQUAN RESERVOIR	PWS	63.93
RICHMOND, CITY OF	RICHMOND (CITY) WTP	PWS	63.08
NORFOLK, CITY OF	NORFOLK	PWS	62.95
CELANESE ACETATE LLC	CELCO PLANT	MAN	56.51
MEADWESTVACO CORPORATION	COVINGTON PLANT	MAN	38.27
APPOMATTOX RIVER WATER AUTHORITY	LAKE CHESDIN WTP	PWS	31.12
DUPONT E I DE NEMOURS & CO	SPRUANCE PLANT	MAN	30.75
CITY OF PORTSMOUTH	PORTSMOUTH	PWS	27.13
HENRICO COUNTY	HENRICO COUNTY WTP	PWS	25.83
UNITED STATES GOVERNMENT	RADFORD AMMUNITIONS WTP 1	MAN	22.16
VIRGINIA AMERICAN WATER CO	HOPEWELL DISTRICT	PWS	21.04
ROCK-TENN CP, LLC	WEST POINT PLANT	MAN	20.09
VIRGINIA BEACH, CITY OF	VIRGINIA BEACH SERVICE AREA	PWS	19.37
ROCK-TENN CP, LLC	WEST POINT PLANT	MAN	16.65
WESTERN VIRGINIA WATER AUTHORITY	ROANOKE CITY	PWS	15.19
GP BIG ISLAND, LLC	BIG ISLAND PLANT	MAN	14.69
CITY OF MANASSAS	MANASSAS	PWS	12.80
		TOTAL	804.49

*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. For the purposes of this report, transfers are defined as releases (RL) and deliveries (DL) between different owners or water systems. 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 (sales) 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).