## CHAPTER 6. GROUNDWATER PROTECTION PROGRAMS/ASSESSMENT

Groundwater programs in Virginia strive to maintain existing high quality water through adopted statutes, regulations, and policies. Advancing groundwater protection efforts is the goal of many programs in numerous state agencies. The [2015 USGS Water Use Report](https://pubs.usgs.gov/circ/1441/circ1441.pdf) estimated that approximately 1.56 million Virginians depend on private groundwater wells for their domestic water supply. The 2020 State Water Resources Plan estimates that groundwater is the source of around 18 percent of Virginia’s public and private residential water supply. While Virginia's groundwater is generally of good quality, both the quality and quantity can vary across the five physiographic provinces found in the state. Reliance on groundwater is also highly variable across the state, depending on a variety of geographic, geologic, and socioeconomic factors.



Figure 6-1 Virginia Physiographic Providences

General groundwater quality information by physiographic province:

Appalachian Plateau

Geology: Sedimentary rock yielding groundwater of varying quality

Pollution Potential: Moderate

DEQ Management Efforts: Documentation and some monitoring of quantity and quality of springs, some limited ambient groundwater quality sampling

Valley & Ridge

Geology: Sedimentary rocks including limestone, dolomite, and shale

Pollution Potential: High in limestone areas where groundwater moves rapidly

DEQ Management Efforts: Documentation and some monitoring of quantity and quality of springs, some limited ambient groundwater quality sampling

Blue Ridge

Geology: Sedimentary, igneous, and metamorphic rock; well yields are low

Pollution Potential: High, because of rapid movement of water in fractures, joints, and bedding planes

DEQ Management Efforts: Documentation and some monitoring of quantity and quality of springs, some limited ambient groundwater quality sampling

Piedmont

Geology: Diverse geology with a wide range of groundwater quality and availability

Pollution Potential: Low to moderate

DEQ Management Efforts: Documentation and some monitoring of quantity and quality of springs, some limited ambient groundwater quality sampling

Coastal Plain

Geology: Unconsolidated sand, clay, marl, and shell strata; groundwater is abundant and use is high

Pollution Potential: High, due to geology and population density

DEQ Management Efforts: Review of water quality monitoring data collected by permittees, limited documentation and monitoring of quantity and quality of springs, some ambient groundwater quality sampling, chloride monitoring strategy

The organizational objective of DEQ’s Groundwater Characterization and Monitoring Program (GCMP) 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. GCMP operations are generally divided into three regions: Coastal Plain, Piedmont-Blue Ridge, and Valley-Plateau. Each region has at least one dedicated staff geologist, with additional staff assigned to the Coastal Plain. One geologist is primarily dedicated to ambient water quality monitoring. Staff ensure that the necessary information is available to support resource management decisions, water supply planning activities, drought monitoring, and the expansion or creation of groundwater management areas. Staff are also responsible for monitoring and maintaining the 297 DEQ-managed wells in the State Observation Well Network and for entering high-quality data into the U.S. Geological Survey (USGS) database system for publication. Staff actively participate in outreach and educational opportunities to increase public awareness of the wide range of issues affecting Virginia’s water resources.

The operational objectives of the GCMP focus on the collection of hydrogeologic and groundwater geochemical data for groundwater resource management needs. When possible, these data are collected and published collaboratively with other state and federal agencies to maximize efficiencies and enhance quality. Long-range goals of the GCMP include expansion of the State Observation Well Network, and publication of county and regional groundwater resources reports.

The following paragraphs briefly describe groundwater protection and assessment activities in the Commonwealth. Information provided in Tables 6-1, 6-2, 6-3, 6-4 and 6-5 is presented for the Commonwealth as a whole.

**Regional Groundwater Reports**

Between 1973 and 1984, before DEQ’s formation in 1993, geologists employed by the State Water Control Board (SWCB) compiled 18 groundwater resources reports to document the availability, utilization rates, and water quality of groundwater resources within selected counties and political sub-regions of Virginia. These reports continue to be the only readily available source of information pertaining to the occurrence, movement, and availability of groundwater for a large number of the areas initially investigated. Although the majority of these historical reports are out of print, the reports are available upon request.

Recent reporting efforts have focused on groundwater use and availability in the Valley and Ridge, the occurrence of groundwater in the Blue Ridge, further refinement of the Coastal Plain Hydrogeologic framework in the Eastern Shore and the Piney Point Aquifer, and development of a methodology for continuous chloride monitoring in the Coastal Plain. More recently published reports are available from the GCMP upon request. Select reports published in collaboration with the USGS are available for download from the USGS website:

<https://va.water.usgs.gov/cgi-bin/pubs?keyword=virginia>.

**Database Integration**

In 2015, DEQ’s Office of Water Supply initiated the development of VAHydro, a web-based platform for water resource management in Virginia. VAHydro is an integrated platform that links multiple modules pertaining to water resources, such as water withdrawal permitting, water supply planning, water withdrawal reporting, groundwater well registration, and drought monitoring/modeling of both surface water and groundwater. In 2021, DEQ began a process to migrate the functionality and data in VAHydro into DEQ’s enterprise CEDS database, which while a significant undertaking, will allow for better integration with other DEQ programs. This scoping process is expected to conclude in 2022. VAHydro also includes data migrated from a number of legacy DEQ databases, several of which are described below.

***Statewide Well Construction Database***

One of DEQ’s goals is to merge the various sources of historical and new well information into one statewide database that can be used for regional analysis of groundwater aquifer systems. Major challenges to this goal include managing data duplication and disparities among multiple data sets and quantifying location accuracy. Efforts to sort and merge this data were completed in 2010. Since 2010, the database has grown from about 35,000 wells to over 66,000 wells. Additional wells have originated from a number of data sources including digitized data from water well drillers, the Virginia Department of Health (VDH) VENIS and SDWIS databases, county-specific well databases, and project-specific data collected and entered into the database. Despite this database being the largest of its kind in Virginia, it is representative of a fraction of the millions of wells that have been drilled throughout the State. Most wells in Virginia have been and continue to be documented by a paper well completion report, and are unavailable electronically. Currently, the established system for documenting private well construction data outside of the Groundwater Management Areas does not facilitate incorporation into a georeferenced database that could be utilized to better understand local hydrogeologic conditions. For this reason, DEQ continues to encourage the development of a streamlined process for accurately reporting the location and construction details of newly completed wells in a digital format.

In 2015, the General Assembly amended the Ground Water Management Act of 1992 to require that all new private wells constructed in a Groundwater Management Area must be registered with DEQ. This requirement became effective on July 1, 2016. A number of improvements have occurred with this legislation. DEQ and VDH have worked together on a common set of well construction information to be collected from well drillers and have linked their database tools. This coordination continues in 2022 with DEQ’s participation in the VDH’s Private Well Regulations Workgroup.

DEQ also established an on-line well registration program that allows well drillers to enter the agreed upon information into the on-line database. In addition to these new wells in the Coastal Plain some well drillers are also entering their legacy well construction data and data for wells from outside the GWMA. This allows location and construction information to be collected and ultimately used to better understand the hydrogeology in the Commonwealth. As of November 2021, nearly 11,000 water well completion reports have been submitted online in VAHydro. The integration of VAHydro into CEDS, noted above, will preserve and enhance these capabilities.

***Statewide Legacy Geochemical Database***

Staff compiled a master database of legacy ambient water quality data of waters from wells and springs throughout the Commonwealth in 2010. In 2014 the database was revised to describe additional geochemical and field collected parameters and to accept recently acquired groundwater sampling data from ambient groundwater monitoring efforts. Ambient water quality data comprising this database includes major ion geochemistry, trace elements, nutrients, radiologicals, and field parameters. Nearly 16,000 samples taken from approximately 7,000 geo-referenced wells and springs are currently in the data set. When combined with location data, ambient water quality samples from wells and springs provide valuable information about the background concentrations of naturally occurring ionic constituents and field parameters of groundwater flow systems. In addition to their value in describing the geochemical conditions within natural groundwater flow systems it is anticipated that these data will be used by municipalities, consultants, and state and federal agencies for a wide variety of applications such as determining the extent and magnitude of elevated ionic concentrations (above background levels) due to groundwater contamination from anthropogenic sources, for predicting chemical and biological interactions due to the contamination of groundwater, and for optimizing well placement to insure high quality drinking water for private residences and municipalities.

**State Observation Well (SOW) Program**

DEQ collects groundwater levels data at 297 wells, and the USGS collects groundwater levels data at approximately 100 wells, in the DEQ/USGS Groundwater Level Monitoring Network. Of the wells in the shared network, approximately 189 are equipped with real-time monitoring instrumentation that measures, stores, and uploads water-level data to a USGS server using satellite telemetry. Data from the wells in the DEQ/USGS network are published in the [Annual Water Data Report](https://wdr.water.usgs.gov/). Currently, DEQ/USGS water level data are available on a USGS interactive map browser at <http://groundwaterwatch.usgs.gov/statemap.asp?sc=51&sa=VA>. These data are becoming an increasingly important metric for regional water supply planning efforts and drought monitoring forecasts. The information provided by these wells is important for monitoring statewide drought conditions, determining when groundwater recharge actually occurs, and monitoring the effects of groundwater withdrawal. A large subset of the data are required for continued calibration of several groundwater flow models developed for management of the resource including the VAHydro-GW (coastal plain aquifer system) and the VAHydro-GWES (Eastern Shore).

**Statewide Spring Database**

Since the 2020 IR, staff created a comprehensive statewide spring database that is continually maintained and updated. The database contains basic site information and spring morphology, field measurements and laboratory water quality results necessary to characterize watershed- and regional-scale groundwater flow systems in complex fractured bedrock terrains of western Virginia. As discrete points of groundwater aquifer discharge to surface streams, the data have value to the public, industry and other programs in DEQ that deal with subsurface contaminant transport such as Pollution Response, Petroleum Storage Tanks, and TMDL programs. Working agreements, standardized forms and definitions have been developed by staff that have been used by field personnel in sister agencies such as DCR and Virginia Department of Energy (formerly DMME) in order to increase the rate of compilation of new springs into this central database containing spring locations, morphology, discharge, and basic geochemistry. As of November 2021, there are 1,639 springs in the database connected to 5,900 spring visit entries (documenting spring flow rates and/or basic water quality measurements made in the field), and 2,917 laboratory water quality results.

**Geochemical Sampling Program Development**

In 2013, staff developed the Ambient Groundwater Quality Monitoring Strategy to serve as a plan for characterizing groundwater geochemical conditions throughout the Commonwealth. This led to the formation of the Ambient Groundwater Quality Monitoring Program in 2014, which is implemented by a staff member funded through EPA section 106 funding. The strategy document describes the extent of currently available groundwater chemistry data, provides a rationale and methodology for a scientifically defensible distribution of sampling resources, and provides a cost analysis for the full implementation of the sampling strategy. The Ambient Groundwater Quality Monitoring Strategy was finalized in November 2013 after review and input from a variety of federal, state and private organizations and institutions. Additionally, an annual implementation plan is developed detailing the portions of the sampling strategy in each geologic terrain that will be accomplished with respect to that fiscal year’s budgetary considerations. Information about GCMP documents, including the strategy and FY2020 implementation plan, is available upon request.

Development of the strategy included testing and modification of sampling equipment and methodology in order to attain the highest sampling quality control possible in the range of geologic, hydrologic, and well construction conditions encountered throughout the state. Groundwater samples have been collected under this program at selected wells and springs in Virginia since the 2013 calendar year. In that time, over 160 samples have been collected from over 100 discrete locations in 32 different cities and counties across the Commonwealth. Sampling of observation wells scheduled for installation in the upcoming year will expand program sample coverage within Virginia’s Piedmont and Blue Ridge.

In 2020 and 2021, the Ambient Groundwater Quality Program continued to focus on the collection of groundwater samples from trend wells and newly installed State Observation Wells. Trend wells were selected for sampling on a quarterly basis to monitor for salt water “upconing,” the transient upwelling of salty groundwater that can occur in response to the local removal of non-saline groundwater by supply wells in the Coastal Plain aquifer system. Trend wells were also sampled to document chloride concentrations in portions of the Coastal Plain aquifer system that may be vulnerable to lateral migration of the fresh water/salt water interface, or the more regional phenomena known as salt water intrusion. Trend wells are typically sampled quarterly, or 4 times per year, but sampling was suspended during intervals due to the pandemic. Spot sampling focused on new State Observation Wells associated with the West Point paper mill. New SOWs were drilled at the mill and nearby sites, and other existing wells were brought into the SOW network.

**EPA/DEQ/USGS Cooperative Studies**

Since the 2020 IR, GCMP staff have been involved in cooperative efforts with the USGS to develop an updated groundwater flow model of Virginia’s Eastern Shore. An improved understanding of the hydrogeology of the Eastern Shore is currently required to refine groundwater management strategies associated with sustainable extraction rates as well as regional contaminant fate and transport predictions (including saltwater intrusion). The recently revised hydrogeologic framework of the Eastern Shore (a collaborative effort with the DEQ and the USGS: USGS Scientific Investigations Report 2019-5093) is currently being used to provide the model domain for the updated groundwater flow model. Water levels data acquired through the DEQ/USGS State Observation Well Network will provide much of the necessary information for model calibration. Results of the modeling effort will be documented and published by the USGS.

Recent cuttings descriptions and geophysical borehole logs collected and analyzed by DEQ geologists have identified inconsistencies in the mapped hydrostratigraphy of the Coastal Plain aquifer system to the southwest of the James River. Improved coverage provided by the recent stratigraphic data has resulted in significant refinement of aquifer geometries for several aquifers in this region of the Coastal Plain aquifer system, which may have implications for the management of permitted groundwater withdrawals. A detailed revision of the hydrostratigraphy has been conducted by the USGS and is summarized in a USGS Scientific Investigations Report that is anticipated for publication early in 2022.

DEQ Office of Water Supply staff have continued working in cooperation with the USGS and the Virginia Tech Department of Biological Systems Engineering on several cooperative science projects. The primary focus of the past two years has centered on developing an instream flow framework for widely available hydrologic and ecological monitoring data. DEQ has taken an approach that combines state planning and reporting databases, multiple river and habitat models, and biometric assessment of fish and benthic monitoring data to develop a more geo-spatially specific understanding of the relative risk to aquatic life resulting from surface water withdrawals in Virginia. Two professional papers outlining project methods, results and potential management implications were published in the Journal of the American Water Resources Association and the potential management implications won the Journal’s Outstanding Technology Paper of 2021.

### **Groundwater Withdrawal Permitting Program**

The Virginia General Assembly adopted the Ground Water Act of 1992 (Act) and repealed the Ground Water Act of 1973. The Act establishes criteria for the creation of groundwater management areas and requires entities that withdraw more than 300,000 gallons of groundwater in any month to obtain a permit. The Act also requires previously exempted agricultural groundwater withdrawals to obtain groundwater withdrawal permits. The DEQ adopted the Groundwater Withdrawal Regulations to implement the Act effective September 23, 1993 and amended those regulations January 1, 1999. This regulation added specific requirements for agricultural groundwater withdrawal permits and required DEQ to perform technical evaluations of those proposed withdrawals.

Between 2009-2013, growing concerns over increased water use by new and expanding withdrawals, overlapping cones of depression, and declining water levels in the Coastal Plain aquifers compelled the Board to expand the Eastern Virginia GWMA to include all of the Coastal Plain east of I-95 in order to ensure comprehensive management of the aquifer system. Accompanying modifications to the Groundwater Withdrawal Regulations, which became effective on January 1, 2014, codified the criteria for the declaration of GWMAs and for the issuance of groundwater withdrawal permits to withdrawers of groundwater in excess of 300,000 gallons per month in a declared GWMA.

Since 2015, DEQ issued 102 existing user permits. Two existing user applications remain pending. Three applicants were determined to need “new or expanded” permits since the current level of use for each exceeds the historic use amounts documented in the application. The total maximum annual groundwater withdrawal volume authorized for the 102 issued existing user permits is approximately 2.41 billion gallons per year (BGY), which equates to an annualized average daily withdrawal rate of 6.60 MGD. These facilities will begin applying for reissuance of their groundwater withdrawal permits as early as 2025 and their withdrawals will be evaluated to ensure compliance with the technical criteria for permit issuance. There is the potential for challenges in reissuing permits in these areas, particularly in localities along the fall-line where aquifer thickness and depth is limited, including King George and Caroline counties.

Groundwater Withdrawal Permit applications for new or expanded (increase to existing withdrawal) withdrawals in a GWMA are evaluated to determine impacts of the proposed permit on the groundwater resource. The evaluation determines the area of impact, the potential for a proposed withdrawal to cause saltwater intrusion, and weighs the combined impacts from all existing lawful withdrawals. VAHydro-GW is used as the modeling tool for technical evaluations. This model evolved over time originating from the Regional Aquifer-System Analysis (RASA) Groundwater Flow Model (1988) and the Virginia Coastal Plain Model (2009). Every proposed withdrawal is modeled to estimate its potential impact on the aquifer into the future, as well as to determine the area of impact (AOI), evaluate the 80 percent drawdown criteria (wherein a withdrawal is evaluated to determine if it will cause water levels to drop below the critical surface, or 80 percent of the distance from land surface to the top of the aquifer in use), and assess potential water quality changes associated with the withdrawal. This collaborative effort enables program staff to provide technical support to applicants and directly supports permit development. Each year DEQ works with many new groundwater users to evaluate and permit proposed withdrawals where the technical criteria are met.

Beginning in 2014, the Virginia Coastal Plain Groundwater Initiative (VCPGWI) was developed to address a pre-existing over allocation of groundwater in the Coastal Plain confined aquifer system. The over allocation has resulted in long-term decline of groundwater levels and growing concerns about land subsidence and saltwater intrusion. In order to begin reversing these trends, DEQ worked with a cohort of the top permitted groundwater users in the Eastern Groundwater Management Area to negotiate reductions to their permitted limits. Under their original permitted limits, these users combined represented approximately 87 percent of all permitted groundwater withdrawals within the GWMA. DEQ issued new permits with reduced limits to the majority of these users in 2016. In 2017, DEQ completed the issuance of permits with reduced limits for the remaining facilities, resulting in a reduction in the total permitted withdrawals from the Coastal Plain of more than 76 million gallons per day (mgd), accomplished through a 52 percent reduction in permit limits among the largest groundwater users in the Coastal Plain. Subsequent modeling scenarios have indicated that the permit reductions associated with the VCPGWI will likely dramatically reduce the head loss within the major aquifers in the Coastal Plain and thereby reduce the extent of areas where water levels have dropped below the critical surface. DEQ is continuing to work with permitted facilities to decrease net withdrawals, to identify alternate sources of water, and to investigate other innovative ways to increase supplies in order to maintain groundwater productivity and availability over the next 50 years. Since taking these actions, and others, regional head declines appear to be leveling off and may represent a transition that will be the basis of increases in water levels in the future.

As of September 1, 2021, DEQ administers a total of 367 groundwater withdrawal permits, including those issued to existing users. These users are authorized to withdraw a combined total of approximately 41.5 bgy, which equates to an annual average withdrawal rate of 113.9 mgd.

In 2015, the Virginia General Assembly enacted a bill creating the Eastern Virginia Groundwater Management Advisory Committee (EVGMAC). This committee was charged with advising DEQ, the Governor, and the General Assembly on steps that could be taken to maintain the long term availability and productivity of the Coastal Plain aquifer system. The Committee’s report was submitted in November 2017. In 2020, the Virginia General Assembly reestablished the EVGMAC as an advisory committee to assist the State Water Commission and DEQ in the management of groundwater in the Eastern Virginia Groundwater Management Area. The committee meets four times each fiscal year and DEQ annually reports the results of the Committee’s examinations and related recommendations, and any responses from DEQ, to the State Water Commission, the Governor, and the General Assembly no later than November 1 of each year.

The passage of House Bill 358 (2018 Va. Acts Ch. 427) partially addressed one recommendation of the EVGMAC by requiring subdivisions with 30 or more plots with individual wells to apply for a technical evaluation and to either adhere to well construction and source recommendations made by DEQ or record a mitigation plan in the subdivision plat. In 2019, DEQ developed the application and guidance documents required to implement the requirements of the bill.

Legislation enacted following the 2019 General Assembly Session (2019 Va. Acts Ch. 755) directed the SWCB to adopt regulations providing incentives, such as an expedited general permit process, for the withdrawal of groundwater from the surficial aquifer, rather than the confined aquifer, in the Eastern Shore GWMA. In 2019, DEQ published a NOIRA to establish the framework for the issuance of a general permit for withdrawals from the surficial aquifer in the Eastern Shore GWMA. A comment period ran from November 11, 2019 through January 6, 2020. DEQ convened a RAP and developed regulations that were approved by the SWCB in December of 2021. The new general permit regulation includes the establishment of permit terms, withdrawal limitations, reporting requirements, and other elements necessary to permit withdrawals through this new general permit framework.

Legislation enacted following the 2020 General Assembly Session (2020 Va. Acts Ch. 670) prohibits construction of wells for non-agricultural irrigation in aquifers other than the surficial (water table) aquifer, unless DEQ determines this aquifer is inadequate to meet the proposed beneficial use, once the SWCB adopts a general permit for regulation of withdrawals from the surficial aquifer. DEQ published a NOIRA on November 23, 2020 and the public comment period closed on December 23, 2020. A Technical Advisory Committee (TAC) was formed to develop amendments to 9VAC25-610 (Groundwater Withdrawal Regulations). The final TAC meeting was held on June 22, 2021. The proposed regulation was presented to the SWCB, and approved in December 2021. An additional public comment period followed and wthe final regulation will be reviewed by the SWCB in 2022.

Legislation enacted following the 2021 General Assembly Special Session I (2021 Special Session I Va. Acts Ch. 100) will improve the efficiency and effectiveness of water use by requiring all applications for Virginia Water Protection (VWP) permits for surface water withdrawals and Ground Water Withdrawal permits to include: 1) a water auditing plan and 2) a leak detection and repair plan that satisfy the requirements in regulations to be adopted by the State Water Control Board. These plans would also, once approved, be incorporated by reference as conditions in the permit. DEQ is beginning the regulatory process to implement the provisions of this bill.

Legislation enacted following the 2021 General Assembly Special Session (2021 Special Session I Va. Acts Ch. 275) directs DEQ to convene a working group for the purpose of developing a schedule of annual maintenance fees for certain water withdrawal permits. A working group was convened for this purpose and a report will be submitted to the Governor and General Assembly that includes a summary of the working group’s discussions and recommendations for a schedule of annual maintenance fees that shall, at a minimum, be sufficient to reflect no less than 40% of the direct costs required for the development, administration, compliance, and enforcement of such permits. The workgroup developed and DEQ communicated the recommended fee schedule to the General Assembly. The 2020 General Assembly did not take up a bill to implement this proposal.

While more work remains to ensure long-term sustainability of our groundwater, the ongoing initiatives discussed above are a major step in ensuring conservation of one of Virginia’s most important natural resources. In the years to come, DEQ will continue building upon this success incrementally through continued outreach and permitting efforts.

## Storage Tank Compliance Program

The Registration Program tracks ownership and technical information for some 80,000 active and closed Underground Storage Tanks (USTs) and some 16,000 active and closed Aboveground Storage Tanks (ASTs) in the Commonwealth. As of 2018 there are some 5,900 active UST facilities and some 3,900 active AST facilities in the state. Each year the program receives over 600 registrations that report new tanks, tank closures, and amendments to existing tank information, such as changes of ownership. DEQ and the public use the registration information to determine the identity of persons responsible for pollution prevention measures and cleanup of releases.

The AST Compliance Program regulates ASTs greater than 660 gallons that store oil. AST facilities of 25,000 gallons or greater that store oil are required to have an Oil Discharge Contingency Plan (ODCP) and are subject to pollution prevention requirements. Nearly 1.4 billion gallons of oil are stored in the active regulated AST facilities across the Commonwealth. Through facility inspections, the program seeks to ensure that Virginia’s AST facilities have measures in place to prevent releases and to respond quickly and effectively if releases occur.

The UST Compliance Program regulates USTs larger than 110 gallons that contain regulated substances, which include most petroleum products. Over 169 million gallons of regulated substances are stored in the 18,000 active USTs across the Commonwealth. Through tank inspections, the program seeks to ensure that USTs in the Commonwealth have measures in place to prevent releases and to have immediate notice of actual releases.

On August 8, 2005, President Bush signed H.R. 6, the Domenici-Barton Energy Policy Act of 2005. In Title 15 of the Act are amendments to Subtitle I of the Solid Waste Disposal Act addressing the regulation of underground storage tanks (primarily petroleum). Based upon EPA guidelines, DEQ revised its regulations on September 15, 2010 to incorporate UST secondary containment, delivery prohibition and operator training requirements. In 2015 EPA updated the federal UST regulation and Virginia’s UST regulation including the federal amendments became effective on January 1, 2018 with some requirements effective immediately and other requirements effective by January 1, 2021.

The existing State Water Control Law (§62.1-44.34:9(2) & (8)) requires DEQ to carry out its powers and duties with regard to underground storage tanks in accordance with applicable federal laws and regulations.

### **Storage Tank Remediation Program**

The Remediation Program directs the investigation and cleanup of petroleum-contaminated sites managed by responsible parties. The DEQ ensures that appropriate emergency response, initial abatement measures, site investigation and site remediation are performed by the responsible party. The DEQ also authorizes activities eligible for reimbursement from the Virginia Petroleum Storage Tank Fund.

The DEQ will conduct investigation and cleanup of high-priority petroleum contaminated sites in instances where the responsible party is unknown or financially unable to undertake the required work. Through a number of contractors, the DEQ conducts emergency response, initial abatement measures, site investigation and site remediation.

The DEQ also provides immediate, interim, and permanent relief to individuals whose drinking water wells have been rendered unusable by petroleum contamination. Through a DEQ contractor, carbon filtration units (CFUs) are installed and maintained on contaminated wells until a permanent solution is implemented. Permanent solutions typically include extension of an existing public water supply or installation of a new well free from petroleum contamination.

More than 9,200 site cleanups were completed from January 2013 through December 2018. Average cleanup time and average cleanup costs per site are among the lowest in the nation. From the inception of the program through December 2018 DEQ has overseen over 43,000 cleanups.

### **Office of Financial Responsibility and Waste Programs**

The DEQ’s Office of Financial Responsibility and Waste Programs implements the requirements for groundwater monitoring and corrective action as originally defined under Subtitle D of the Resource Conservation and Recovery Act (RCRA). Funding for the program comes from the Commonwealth’s General Revenue augmented by permit fees. All groundwater data are collected by the solid waste facilities and their consultants and reviewed by DEQ staff for adherence to regulatory requirements under 9 VSWMR 20-81-250 and 260.

Information provided in Table 6-4 Solid Waste Landfill Corrective Action category was derived for the sites in Virginia’s Solid Waste Corrective Action universe, as reported through December 2021. Just over 80 landfill sites have been identified as having the potential for impacts on human health and the environment by exceeding one or more of their groundwater protection standards. In cases where groundwater monitoring detects exceedances above groundwater protection standards (such as EPA’s Maximum Contaminant Levels for drinking water), facilities are required to implement clean-up measures under a process called groundwater Corrective Action. As shown in Table 6-4, the number of sites which are implementing groundwater Corrective Action across the Commonwealth is 61.

### **Office of Remediation Programs**

Included in Table 6-4 are groundwater contamination statistics from the DEQ's Office of Remediation Programs (ORP). ORP consists of the Federal Facilities Restoration Program, Superfund Program, Voluntary Remediation Program, Site Assessment Program, and the Brownfields Program. The Federal Facilities Restoration (FFR) Program includes 44 Army, Navy, Marine Corps, Air Force, Defense Logistics Agency, Federal Aviation Administration, and NASA installations and 12 Formerly Used Defense Sites (FUDs). Currently 12 Federal Facilities and 1 FUDs site are listed on the National Priority List (NPL). The mission is to clean up contaminated sites at military installations through a partnering team process. The Department of Defense, NASA, and the EPA support the program. To date, three Federal Facilities have achieved the base-wide construction completion milestone – all remedies are in place and functioning as intended. The Superfund Program, funded with both Federal and State dollars, oversees and at times implements investigation and cleanup activities required by law or legal agreements at 23 NPL sites. Five of these sites have completed response actions and have been delisted. The Voluntary Remediation Program (VRP) provides a mechanism for eligible participants to voluntarily clean up properties not mandated for remediation under existing environmental laws. This program serves as a mechanism for cleanup of brownfields sites. There are over 146 sites undergoing active remediation and over 332 sites which have completed cleanup and reached closure. A combination of program enrollment fees (user fees) and EPA grant funding supports the Voluntary Remediation Program. The Site Assessment Program (SAP), supported by EPA, is designed to assess potential CERCLA sites for inclusion on the NPL. The DEQ's Brownfields Program, also supported by a combination of state funds and EPA grant funding, provides incentives to owners and/or developers of potential brownfield sites to promote the redevelopment and reuse of these underutilized properties. The Brownfields program has assisted with the redevelopment and reuse of over 120 sites in Virginia in the last three years. None of these five programs currently collect groundwater quality data; however, they do receive and review data collected by outside sources.

### **Hazardous Waste Groundwater Activities**

Throughout the reporting period from Jan 1, 2011 – Dec 31, 2021 the DEQ implemented the requirements for groundwater monitoring and corrective action as specified by the Resource Conservation and Recovery Act (RCRA). Funding for the program activities comes from an EPA grant covering hazardous waste management activities such as permitting, closure and corrective action, as well as compliance and enforcement. The grant does not cover data collection, with the exception of quality control samples when allocated. All groundwater data are collected by the hazardous waste facilities and their consultants, and are reviewed by DEQ staff for adherence to regulatory requirements.

Under RCRA, groundwater quality is evaluated at both permitted and un-permitted facilities that have regulated units for the treatment, storage and disposal of hazardous waste. Permitted sites have to meet strict operational requirements to eliminate or minimize the risk of impacts on human health and the environment. Permits include contingency requirements mandating clean-up in case of a release of hazardous waste from a regulated unit or as identified during the site-wide RCRA Corrective Action process. Un-permitted sites are sites where operation has ceased and the facility is in the process of removing and/or decontaminating contaminated media (closure), sites where a permit is about to be issued, or sites where RCRA Corrective Action is being undertaken under an Order or agreement with EPA or DEQ. The information in the RCRA Corrective Action category in Table 6-4 has been combined into one reporting metric including both permitted and un-permitted sites.

Information provided in the Table 6-4 RCRA Corrective Action category was derived for all the sites in Virginia’s 2030 Corrective Action site portfolio, as identified by EPA. These sites, currently numbering 122, have been previously identified as exhibiting or having the potential for impacts on human health and the environment. The number of future additions to the Corrective Action universe is expected to be small.

Most facilities have more than one waste management unit, and all units need to be evaluated for potential impacts and conduct risk mitigation and/or remediation if necessary. All sites are currently in various stages of evaluation, site clean-up, or have met performance standards. To date, groundwater impacts continue to be identified at 52 sites. For an additional 70 sites, it was determined that groundwater has not been impacted or performance standards have been met through the cleanup process.

At the 52 sites where groundwater monitoring has detected exceedances above applicable groundwater protection standards (such as EPA’s Maximum Contaminant Levels for drinking water), facilities are required to implement appropriate mitigation and clean-up measures. More detailed information can be found on EPA’s Corrective Action page at

<https://www.epa.gov/hwcorrectiveactionsites/corrective-action-programs-around-nation>.

**Source Water and Wellhead Protection Efforts**

The Commonwealth and its localities work together to manage and protect water resources to meet long-term human and environmental needs. Protecting the quality of drinking water sources by preventing and reducing contamination is one of the best approaches to ensuring drinking water supply sustainability. The Virginia Department of Environmental Quality (DEQ) and the Virginia Department of Health-Office of Drinking Water (VDH-ODW) have a long history of cooperating on programs to develop and implement source water protection in the Commonwealth. In 2013, VDH-ODW worked with a firm to create a customized reporting tool into ArcGIS which organizes and manages source water data, which allows effective collaboration with waterworks to improve Source Water Assessment data. To further the agencies’ goal of source water protection, a number of programs are available to assist in these efforts.

The Source Water Protection Plan Development and Implementation Assistance is available for community waterworks that serve less than 50,000 people and process water directly from a drinking water supply source. DEQ is a partner with VDH-ODW in procuring contractors to develop these plans. VDH-ODW offers direct technical assistance to waterworks not already working with one of the source water protection contractors in the form of GIS maps and reports, source water protection plan templates, and other resources. Since 2005, VDH-ODW has been collaborating with DEQ to offer Wellhead Protection Implementation Project Grants for local wellhead protection implementation projects. This funding is available to localities or service authorities who own or operate a community waterworks, process drinking water directly from a groundwater supply source, have a protection strategy in place, and have an active source water protection committee. Additional information can be found at: <https://www.vdh.virginia.gov/drinking-water/source-water-programs/>.

|  |  |
| --- | --- |
| Total Number of Public Water Supply (PWS) systems | 2,808 |
| Total Number of GW-Dependent PWS Systems | 2,467 |
| Total Number of Community Water Supply Systems | 1,080 |
| Total Number of GW-Dependent Community Water Supply Systems | 768 |
| Total Population Relying on Community Water Supply Systems | 7,170,097 |
| Total Population Relying on GW-Dependent Community Water Supply Systems | 507,970 |
| Total Number of GW-Dependent Non-Transient Non-Community PWS Systems | 1,699 |
| Total Number of GW-Dependent Transient Non-Community PWS Systems | 1,208 |

Table 6-1 Public Water Supply Systems and Population Served from Virginia’s Source Water Assessment and Protection Reporting (December 9, 2021)

**Pesticide Collection Program**

The Virginia Department of Agriculture and Consumer Services (VDACS) have conducted a highly popular and successful Pesticide Disposal Program since 1990. Since the Program’s inception, more than 1.5 million pounds of unwanted pesticides have been collected from agricultural producers, licensed pesticide dealers and commercial pest control firms, homeowners and golf courses. There is no cost to participants.

To administer the Program, Virginia is subdivided into five regions. A pesticide disposal program is conducted annually in localities within one of the regions. Once all five regions have been served, the program starts another cycle. The Pesticide Disposal Program requires participants to transport their unwanted agricultural and commercial pesticides to a central collection site where the hazardous waste disposal contractor packages the pesticides for eventual disposal. If a participant cannot safely containerize the unwanted pesticides for transport, the disposal contractor will make such arrangements.

The pesticide disposal program has benefited from a high level of interagency cooperation among the VDACS, DEQ, DCR, DCLS, and Virginia Cooperative Extension. Initial funding to support this program was pooled from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Clean Water Act (Sections 319 Nonpoint Source and 106 Groundwater Protection) grants as well as the Office of Pesticide Services (OPS) program fees. Currently, the program is supported entirely by OPS program fees. Additional information may be found at: <https://www.vdacs.virginia.gov/pesticide-collection.shtml>.

**Plastic Pesticide Container Recycling Program**

The Virginia Department of Agriculture and Consumer Services (VDACS) and Virginia Cooperative Extension (VCE) conduct an annual plastic pesticide container recycling program. Since its inception, the program has collected and granulated over 1.9 million plastic pesticide containers. This equates to nearly two million pounds of plastic collected for refabrication.

The Plastic Pesticide Container Recycling Program addresses a challenge for agricultural producers and custom applicators. Typically, pesticide applicators dispose of their empty, clean plastic pesticide containers by hauling them to the local sanitary landfill. Recycling is an environmentally responsible alternative for the disposal of properly rinsed plastic pesticide containers. Granulated chips are transported to recycling facilities and fabricated into items such as pallets, fence posts, field drain tiles and parking stops thus keeping them out of landfills and reducing the potential for contamination from improperly rinsed containers which have either been landfilled or disposed of improperly.

To participate in the Program, a locality must make application to VDACS and agree to collect, inspect and store the properly rinsed containers until granulation. VDACS provides up to $1,875 per locality annually in reimbursement costs to participating localities to offset the cost of the program. This program is funded through OPS program fees. Additional information may be found at: <http://www.vdacs.virginia.gov/pesticide-container-recycling.shtml>.

**Groundwater Protection Programs - Conclusion**

Groundwater programs in Virginia strive to maintain the existing high water quality. Groundwater protection activities in the Commonwealth are as varied as the funding sources that support them. The following tables provide additional information.

| Contaminant Source | Ten Highest-PrioritySources() | Factors Considered in Selecting a Contaminant Source  | Contaminants  |
| --- | --- | --- | --- |
| **Agricultural Activities** |  |  |  |
| Agricultural chemical facilities |  |  |  |
| Animal feedlots |  |  |  |
| Drainage wells |  |  |  |
| Fertilizer applications | √ | State GW Protection Strategy | (E) |
| Irrigation practices |  |  |  |
| Pesticide applications | √ | State GW Protection Strategy | (A,B) |
| **Storage and Treatment Activities** |  |  |  |
| Land application | √ | State GW Protection Strategy | (E) |
| Material stockpiles |  |  |  |
| Storage tank (above ground) |  |  |  |
| Storage tank (underground) | √ | State GW Protection Strategy | (D) |
| Surface impoundments | √ | State GW Protection Strategy | (E) |
| Waste piles |  |  |  |
| **Disposal Activities** |  |  |  |
| Landfills | √ | State GW Protection Strategy | (M) 40 CFR-App IX  |
| Septic systems | √ | State GW Protection Strategy | (J) |
| Hazardous waste generators |  |  |  |
| Hazardous waste sites |  |  |  |
| Industrial facilities |  |  |  |
| Material transfer operations |  |  |  |
| **Other Activities** |  |  |  |
| Mining and mine drainage | √ | State GW Protection Strategy | (M) Acid Leachate |
| Pipeline and sewer lines |  |  |  |
| Salt water intrusion | √ | State GW Protection Strategy | (G) |
| Urban runoff | √ | State GW Protection Strategy | (M) NPS pollutants such as fertilizers & heavy metals |

Table 6- 2 Primary Sources of Groundwater Contamination

A-Inorganic Pesticides H-Metals

B-Organic Pesticides I-Radionuclides

C-Halogenated Solvents J-Bacteria

D-Petroleum Compounds K-Protozoa

E-Nitrite L-Viruses

F-Fluoride M-Other

G-Salinity/Brine

| Programs or Activities | Check(√)) | ImplementationStatus  | ResponsibleState Agency |
| --- | --- | --- | --- |
| Active SARA Title III Program | √ | fully-estab. | DEQ |
|  Ambient groundwater monitoring system | √ | Initiated program | DEQ |
| Aquifer vulnerability assessment |  |  |  |
| Aquifer mapping |  |  |  |
| Aquifer characterization | √ | cont. efforts | DEQ |
| Comprehensive data management system | √ | cont. efforts | DEQ |
| EPA-endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP) |  |  |  |
| Groundwater discharge permits (VPA) | √ | fully-estab. | DEQ |
| Groundwater Best Management Practices |  |  |  |
| Groundwater legislation (Quantity) | √ | fully-estab. | DEQ |
| Groundwater classification |  |  |  |
| Groundwater quality standards[[1]](#footnote-1) | √ | fully-estab. | DEQ |
| Interagency coordination for groundwater protection initiatives | √ | fully-estab. | DEQ/VDH/ VDACS |
| Nonpoint source controls | √ | cont. efforts | DCR/DEQ |
| Pesticide State Management Plan (Generic) | √ | fully estab. | VDACS |
| Pollution Prevention Program |  |  |  |
| Resource Conservation and Recovery Act (RCRA) Primacy | √ | fully-estab. | DEQ |
| Source Water Assessment Program | √ | fully-estab. | VDH |
| State Superfund |  |  | EPA primacy |
| State RCRA Program incorporating more stringent requirements than RCRA Primacy |  |  |  |
| State septic system regulations | √ | fully-estab. | VDH |
| Underground storage tank installation requirements | √ | fully-estab. | DEQ |
| Underground Storage Tank Remediation Fund | √ | fully-estab. | DEQ |
| Underground Storage Tank Permit Program | √ | fully-estab. | DEQ |
| Underground Injection Control Program |  |  | EPA primacy |
| Well abandonment regulations | √ | fully-estab. | VDH |
| Well installation regulations | √ | fully estab. | VDH/DEQ |

Table 6-3 Summary of State Groundwater Protection Program

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Source Type | Present in reportingarea  | Number of sites in area | Number of sites that are listed and/or have confirmed releases  | Number with confirmed groundwater contamination | Contaminants | Number of site investigations (optional)  | Number of sites that have been stabilized or have had the source removed (optional) | Number of sites with corrective action plans (optional)  | Number of Sites with active remediation (optional) | Number of sites with cleanup completed (optional) |
| NPL |  | 23 | 23 | 16 | (A), (B), others | 23 | 17 | 20 | 20 | 4 |
| CERCLIS(non-NPL) |  | 200+ | < 150 | < 80 | PAHs, VOCs SVOCs, metals |  |  |  |  |  |
| Voluntary Remediation |  | 734 | 734 | 650+ | (A) & (B), others |  | 350+ |  |  | 332 |
| Federal Facilities Restoration (NPL)  |  | 13 | 13 | 13 | (A), (B), others | 13 | 13 | 13 |  |  |
| Federal Facilities Restoration (nonNPL) |  | 31 | 18 | 18 | (A), (B), others | 18 | 18 | 18 |  |  |
| Leaking UST & AST as of Dec 2014 |  | 43,141 | 43,141 |  | petroleum hydrocarbons |  |  |  | 1,345 | 41,796 |
| RCRACorrectiveAction | PERMITTED (includes state and federal permits) and UNPERMITTED (closing, permit to be issued, or remediating under alternate mechanism | 121 | 121 | 51 | (A), (B), others  | 121 | 116 | 47 |  | 70 |
| Solid Waste Landfills | Permitted and unpermitted (monitoring under enforcement action) | 204 (total)196 permitted8 unpermitted | Not Applicable | 84 | VOCs, SOCs,metals | 84 | Not Applicable | 61 | Not Applicable | 20 |
| State Sites |  |  |  |  |  |  |  |  |  |  |
| Nonpoint Sources |  |  |  |  |  |  |  |  |  |  |
| Other (specify) |  |  |  |  |  |  |  |  |  |  |

Table 6-4 Groundwater Contamination Summary

Aquifer Description Commonwealth of Virginia

Data Reporting Period January 1, 2013 - December 31, 2021

**Source Type Abbreviations**

NPL - National Priority List (DEQ staff: B. Fisher)

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, & Liability Information System (DEQ staff: D.Harris)

Voluntary Remediation (DEQ staff: M. Anderson)

Federal Facilities (DEQ staff: B. Fisher)

UST & AST- Underground Storage Tanks & Above ground Storage Tanks (DEQ staff: B.Lamp)

RCRA - Resource Conservation & Recovery Act (DEQ staff: T. Mason)

Solid Waste Landfills (DEQ staff: L. Beckwith)

**Contaminant Type**

(A) listed and characteristic hazardous waste

(B) metals, halogenated organics, POL, PCB, Pesticides

Hydrogeologic Setting (1) Commonwealth of Virginia

Spatial Description (optional) (2)  NA

Map Available (optional) (3) NA

Data Reporting Period (4) January 1, 2013 - December 31, 2018

VOC

669

8,742

3,754

7,178527

Other (16)

NO3

SOC (15)

3,097

ND (6)

Number of Wells

No detections of parameters above MDLs or background levels

Background parameters exceed MCLs(14)

Number of wells requiring special treatment (13)

Number of wells removed from service (12)

Parameters are detected at concentrations exceeding the MCLs (11)

Nitrate ranges from greater than 5 to less than or equal to 10 mg/l

Other parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs (10)

Number of wells in sensitive or vulnerable areas (optional) (9)

Nitrate ≤5mg/l

VOC, SOC, and other parameters not detected (8)

Number of wells in sensitive or vulnerable areas (optional) (7)

Nitrate concentrations range from background levels to less than or equal to 5 mg/l

No detection of parameters other than nitrate above MDLs or background levels and/or located in areas that are sensitive or vulnerable

Parameter Groups

Total No. of Wells Used in the Assessment (5)

Monitoring Data Type

No detection of parameters above MDLs or background levels

Finished Water Quality Data from Public Water Supply Wells

Table 6-5 Aquifer Monitoring Data

These numbers are provided by the Virginia Department of Health, Office of Drinking Water (J.Vivas). Data is given for wells associated with mixed systems (surface and groundwater) and groundwater based systems. SOC data is limited due to waiver programs and no detections in systems that were monitored. VOC and SOC data may be incomplete due to optional data entry requirements in VDH field offices. MCL exceedence information required additional work that VDH staff limitations prevented. Software modernization efforts underway at EPA may make providing this information in future reports an easier task.

Column 5: Total number of wells (3,097) is a subset of sample results for VOC, SOC, and NO. There may be multiple sample results for a single well*.*

Column 6: No detections for NO3 analysis (8,797) is a combined total of sample results for contaminants 1038 and 1040.

1. <https://law.lis.virginia.gov/admincode/title9/agency25/chapter280/section70/> [↑](#footnote-ref-1)