Is Groundwater Important To Virginians?

Groundwater is the source of drinking water for about one-third of Virginia's almost 6.4 million citizens. Total withdrawals of water in Virginia in 1991 for domestic, public supply, industrial, and agricultural uses offstream amounted to about 8.0 billion gallons a day, of which about 200 million gallons a day was groundwater. ***About 80 percent of Virginians use groundwater for at least part of their everyday needs.***

What Is Groundwater?

Most of the rock and soil formations within a half-mile of the earth's surface consist of solid rocks and minerals and the empty spaces between and within them. These empty spaces or voids can hold gases or fluids, including the underground water that supplies wells and springs. Groundwater occurs in the voids between the soil and rock particles much as water fills the pores of a sponge. The formation in which the groundwater is located is called an aquifer.

Aquifers can be thought of as porous reservoirs filled with sand and other materials that transmit water from recharge to discharge areas. Any addition to the groundwater supply is recharge and any removal from this supply—whether it be to pumping wells, springs, seeps, streams, or marshes—is discharge. For example, about 30 percent of Virginia's annual stream flow is derived from groundwater.

Many people greatly overestimate the rate of groundwater's movement from regions of recharge to discharge because they mistakenly think groundwater flows at rates similar to those of streams and rivers. The average rate of movement through an aquifer composed of coarse sand is 0.3 meters per day (360 feet per year), whereas the average rate through a clay confining bed is 0.00002 meters per day (less than half an inch per year). Only in limestone caverns, open lava tubes, or large rock fractures can the rates of groundwater movement resemble those of streams and rivers on the surface. The movement of contaminants through such formations is likewise very rapid.

Because the movement of groundwater from recharge to discharge areas is generally so slow, groundwater at any one place may be very old. The U.S. Geological Survey estimates that groundwater within half a mile of the land surface has been underground for an average of 200 years; for deeper aquifers, the average is 10,000 years.

In the Coastal Plain of Virginia, large population centers have developed, such as the Norfolk-Virginia Beach-Newport News metropolitan area, which had a total population of about 1.4 million in 1992. In this region, groundwater is an important resource, since fresh surface water supplies are limited. Controls and regulations of pumpage and use are mandated under the Virginia Groundwater Act of 1973 to avoid overpumpage, migration of salty water into potable water aquifers, and to assure, as much as possible, a long-term equitable and adequate supply of groundwater for all beneficial uses.

Virginia's groundwater is a valuable but vulnerable resource. Once mined or overpumped, an aquifer may never, in a human time frame or at a reasonable cost, return to its former usefulness. For example, this may be due to chemical changes, caused by intruding saltwater; physical changes in the structure of the aquifer; or simply from inadequate rates of recharge and costs of pumpage.

Once contaminated, groundwater can be very expensive to clean up. Even with new, sophisticated techniques, pinpointing the source of contamination is difficult, as is removing contaminants from the aquifer materials. Preventing or minimizing the possibility of groundwater contamination is the best way to assure this valuable resource is available today and in the future.

The ***Virginia Water Resources Research Center*** *(VWRRC) has had an important continuing role in providing research results and other information to Virginians on groundwater. In 1990, the VWRRC received the Public Service Award from the Universities Council on Water Resources in recognition of its groundwater program.*

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Virginia's Groundwater

Virginia Water Resources Research Center

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Septic Systems: *As the leading contributor to the total volume of waste discharged directly into the ground, septic systems are a significant source of groundwater contamination. Of particular concern are human wastes carrying disease-causing organisms such as pathogenic bacteria and viruses. Septic systems rely on soil to filter and treat sanitary sewage; they are not designed to handle industrial wastes, petroleum by-products, or household hazardous wastes such as pesticides, varnishes, and cleaning products. In addition to contaminating groundwater directly, such wastes may clog drain fields, kill the bacteria that decompose wastes in septic tanks and soil, and prevent septic systems from functioning properly for the treatment of sanitary sewage.*

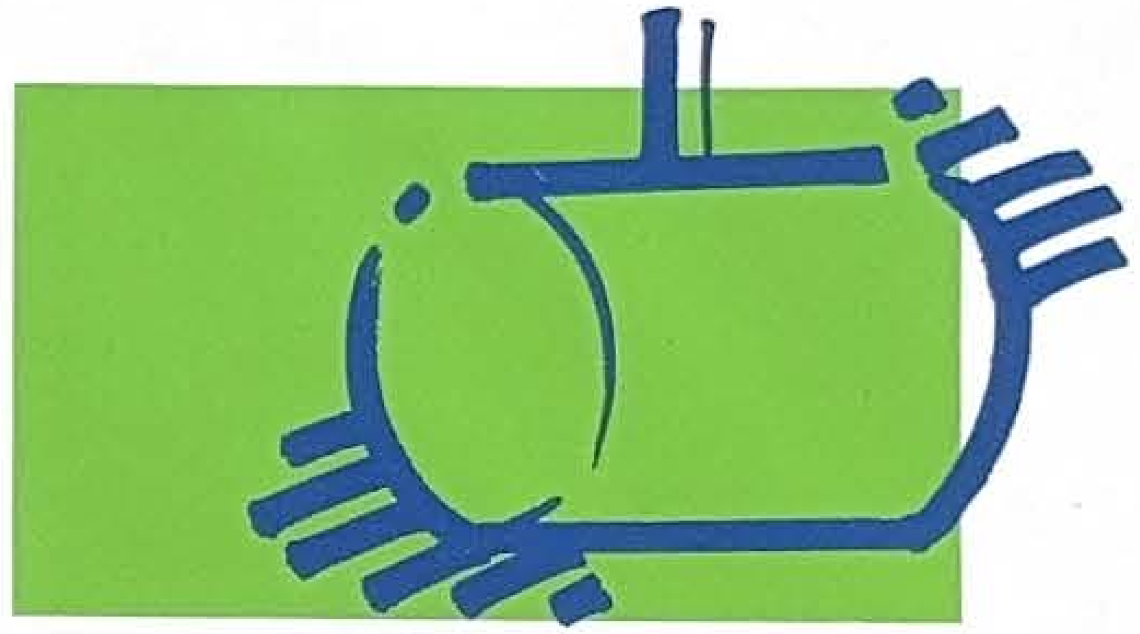
Individuals play an important role in protecting groundwater from septic system wastes. If you are building a new home, be sure your septic system is properly designed, sited, and installed. If you're moving to another residence, have the well water tested through a certified laboratory and the septic system examined by a certified contractor before you begin using it—or even before you agree to buy or rent. Having your septic tank pumped out every three to five years, or more often if needed, will help reduce the potential for groundwater contamination. Water conservation in your home can extend the life of your septic system. Where soil conditions prevent the use of septic systems and a community sewer system is prohibitively expensive, alternative methods of wastewater disposal may be employed.

Pesticides: *Across the nation, groundwater contamination by pesticides has occurred, not necessarily because the chemicals were misused, but, in some cases, because they have been used repeatedly over large tracts of land and may have concentrated in soils. Agricultural drainage wells, which drain runoff from fields, provide a direct conduit for pesticides to enter groundwater supplies. Abandoned wells, improperly sealed wells, stormwater drainage basins and wells, and natural sinkholes also allow pesticides in surface runoff from urban and rural areas to contaminate groundwater. The best way to reduce the threat of groundwater contamination by pesticides from agriculture, forestry, and lawn and garden care is to use less toxic, rapidly degradable pesticides with low leaching potentials, prevent pesticide spills, and control drift offsite.*

Integrated Pest Management, an alternative to relying solely on pesticides, includes the use of biological controls (natural pest predators), cultural practices (patterns of planting), genetic manipulation (developing pest-resistant crop varieties), and carefully planned use of chemicals to protect crops. Crop rotation, pest monitoring, and soil analysis and conditioning can help promote healthy crops.

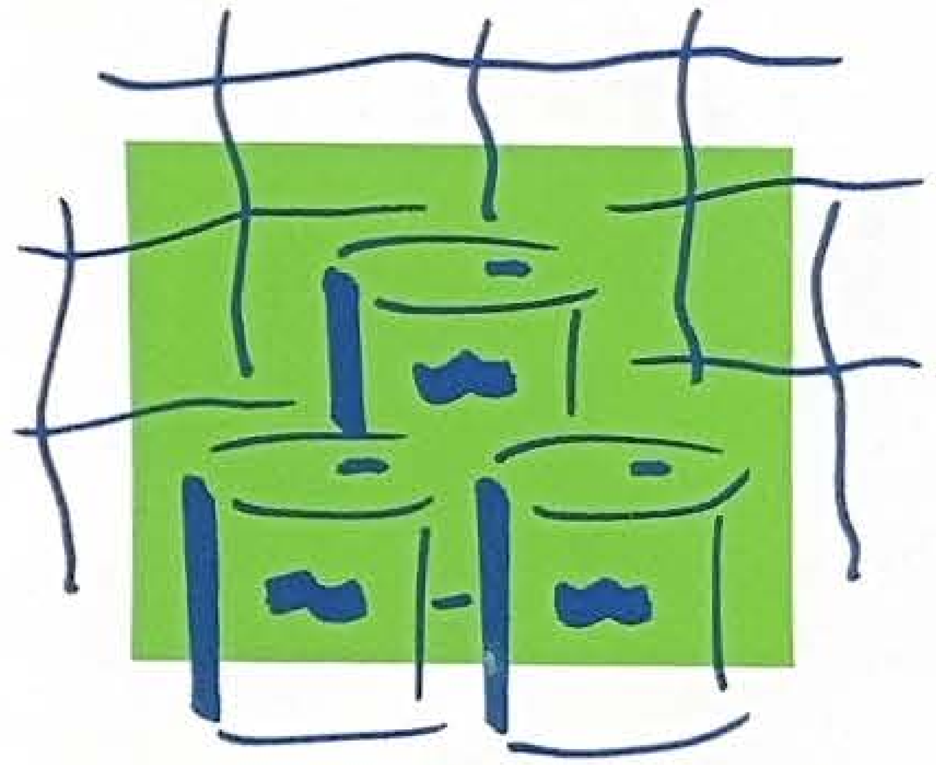
If you use pesticides, always follow label directions when applying, storing, handling, and discarding them. Overapplication or improper disposal can contaminate groundwater. Triple rinse empty containers and dispose of pesticide in the rinse water by following disposal instructions on the label. Be sure to check local ordinances before you dispose of pesticide containers in a landfill or trash receptacle.

Underground Storage Tanks: *Buried steel tanks used to store gasoline, diesel fuel, heating oil, and other petroleum products have a lifespan of about 15 years. Rusted and corroded tanks and lines can leak petroleum into groundwater and contaminate large amounts of drinking water. If you can smell or taste a petroleum product in your water, the water should not be used for drinking or cooking until it has been tested.*



Most often, residents who report contamination of well water by oil or gasoline discover that their own leaking fuel tanks are responsible. If you're building a house, locate the new tank above ground in a basement or garage or use a new double lined or fiberglass tank. If your oil storage tank is old and underground, check for the unexplained loss of oil. For example, if your oil tank is used only for heating your home, check the gauge in late spring and in fall before you begin to use your furnace again. The presence of water in your tank also indicates a leak. A leaking tank should be pumped dry and removed from the ground. Buried steel tanks will rust out eventually and could collapse, causing a cave-in above.

Spills: *An estimated 18 percent of the trucks on Virginia's highways carry hazardous materials that, if spilled, could threaten groundwater or surface waters. Accidents also happen at manufacturing and storage facilities across the state. Government agencies will respond immediately to contain and lessen the effects of a chemical spill on land, in the air, or in water.*



Stockpiles and Bulk Storage: *Storing large quantities of materials at convenient locations allows the materials to be efficiently transported and used. Unfortunately, the improper storage of some materials can contaminate aquifers. If you know of the improper bulk storage of materials that could pose a threat to groundwater in your community, contact the Virginia Department of Environmental Quality.*

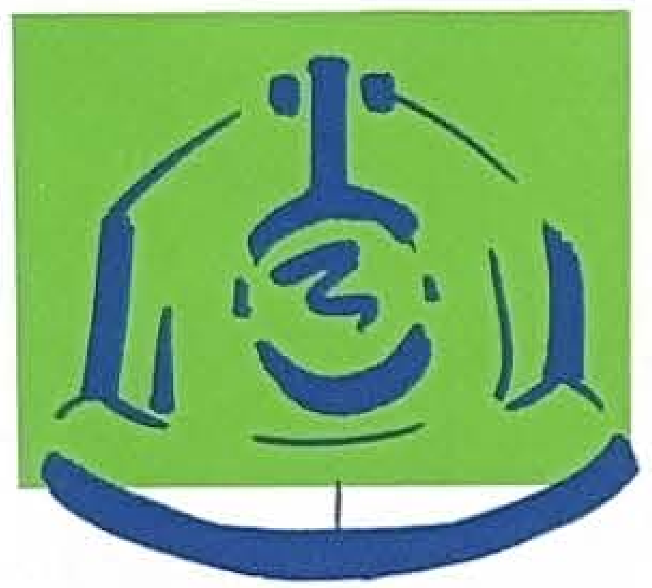
Waste Disposal: Unlined landfills and waste lagoons, illegel dumps, and hazardous waste sites all can contribute to groundwater contamination. Liquid wastes can infiltrate soil and rock layers, and precipitation percolating through solid wastes can leach out metals and other contaminants and carry them to groundwater. The disposal of wastes through underground injection also can endanger groundwater; in Virginia, the use of hazardous waste injection wells currently is banned.

Individual efforts to protect groundwater from problems caused by waste disposal are important. Recycling instead of discarding reduces the volume of trash taken to landfills. Another way to help protect groundwater is to avoid using illegal dumps and to help clean up such dumps in your community. Roadside littering is illegal, and waste management depends largely on citizen reports of open dumps to identify these sites and begin the cleanup process.

If you own or work at a business that is a "small quantity" generator of hazardous waste—dry cleaners, printers, auto repair shops, laboratories, and many others—be sure that non-domestic wastes are not entering your septic system or being sent illegally to dumps or municipal landfills.

Abandoned Wells: Improperly constructed or abandoned wells are a significant source of groundwater contamination in Virginia. If wells are not properly capped and sealed, they provide direct conduits for surface contaminants to enter groundwater.

If you use well water, be sure your own well is properly located, built, and sealed. If you move or change to a different water system, be sure that you cap and seal your well properly. Do not use abandoned wells for the disposal of any waste materials. If you know of any abandoned wells, report them to your local health official or the Virginia Department of Environmental Quality.



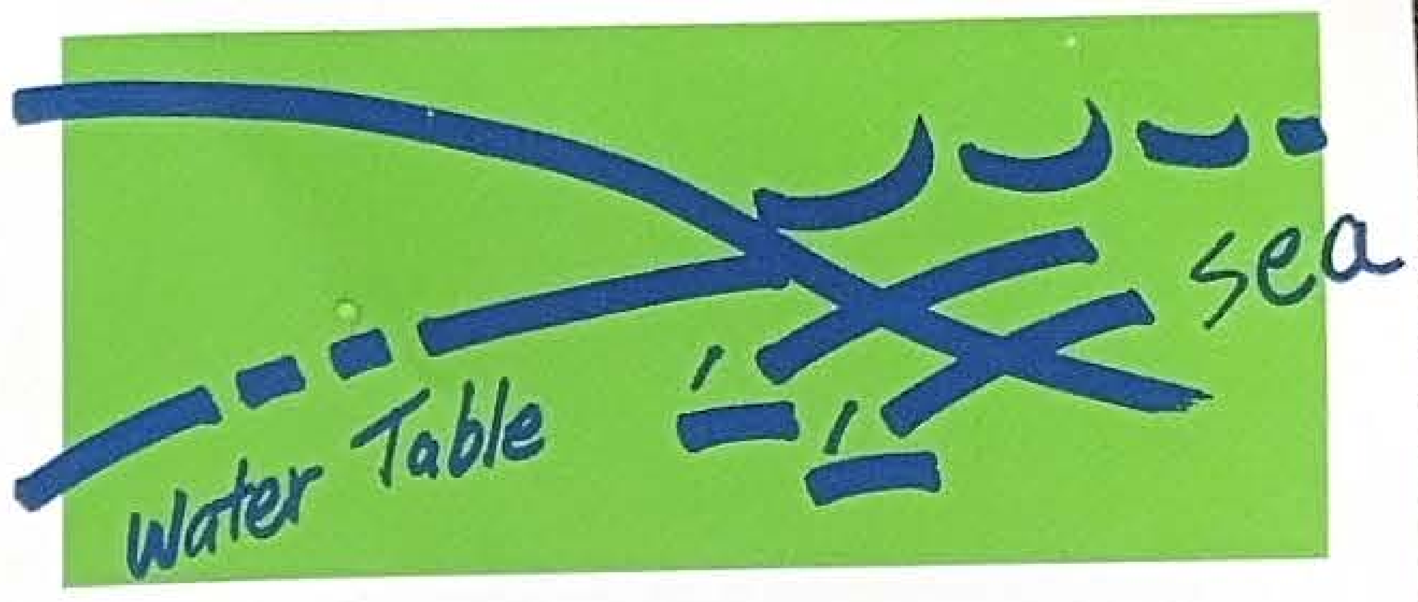
Mining: Precipitation can carry heavy metals, acidity, and radioactive materials from uncovered tailings and spoil piles into groundwater, and some methods of mining disrupt aquifers and can result in nearby wells going dry. The disposal of mining wastes and coal wash waters in abandoned mine pits or wells of any sort may contaminate groundwater resources.

Groundwater damage from mining can be minimized by employing the best management techniques and the best technology. In many cases, federal and state permits are required for mining activities, well drilling, and disposal of mine wastes. Threats to groundwater quality can be reduced by neutralizing acid mine drainage and sealing aquifers affected by mining activities. Tailings lagoons should be lined and reclaimed by covering with topsoil and planting vegetation. In some cases it may be necessary to cap tailings lagoons or piles with impermeable materials.

Nitrates: Nitrates from septic tanks, feedlots, fertilizers applied to farms, gardens, and lawns, and other sources can leach from soil into groundwater. Agricultural drainage wells, used to dispose of excess water from croplands during wet seasons, provide a direct route for fertilizers to contaminate groundwater, as do improperly constructed or abandoned domestic wells. If your well water exceeds the federal standard for nitrate—10 parts per million (ppm)—doctors recommend the use of bottled water, particularly for pregnant women and infants. In certain circumstances, high concentrations of nitrate in drinking water can cause methemoglobinemia ("blue baby syndrome") in infants and very high concentrations may poison livestock, especially cattle.

Reduction in the amount of nitrogen fertilizer used is the most effective way to reduce fertilizer-derived nitrate in groundwater. Some of the approved practices for reducing excess nitrate in the soil are using slow release fertilizers, applying nitrogen fertilizer in small amounts during the growing season as it is needed, and rotating crops with legumes, which are plants that add nitrogen to soil. The proper siting of wells, septic systems, livestock feedlots, and manure storage areas also can help reduce the potential for nitrate contamination.

Using soil tests to determine the need for fertilizers in different soil types and for various crops can save farmers and homeowners money, in addition to reducing the risk of groundwater contamination. Testing your domestic well water for nitrates is an important step for alerting yourself and your family to possible contamination.

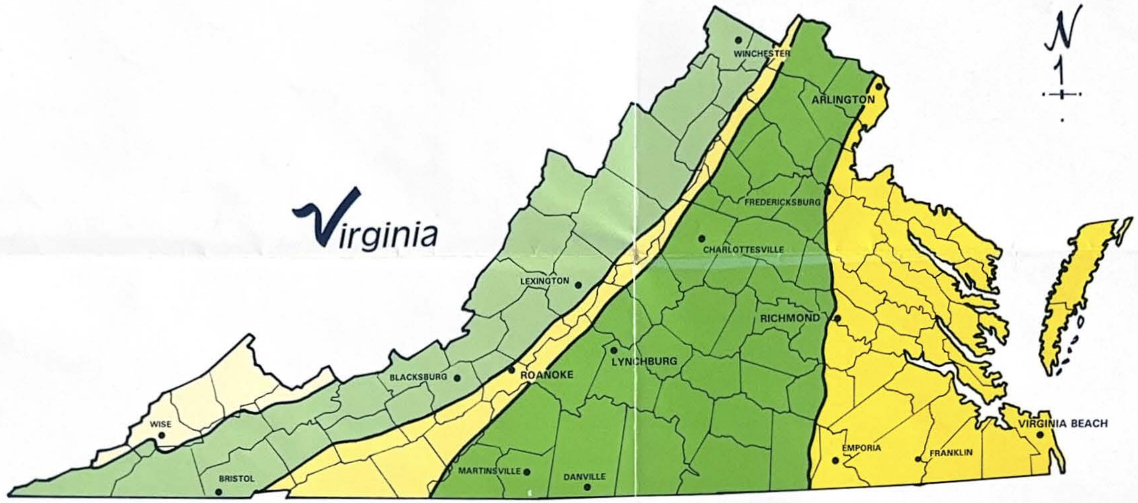


Saltwater Intrusion: Overpumping groundwater in areas where naturally occurring salty aquifers or marine waters are adjacent to freshwater aquifers can result in the movement of salty water into fresh waters. If you live where saltwater intrusion is a potential or an already existing problem, water conservation is probably the best contribution you can make to solving the problem. Limiting "luxury" water use and adopting conservation devices and measures such as turning off faucets while brushing teeth, shaving, shampooing, or washing can help. In areas of low annual rainfall, landscaping with drought-tolerant plants can reduce the amount of yard watering needed. If lawns and gardens must be watered, use drip irrigation, a method which delivers small amounts of water throughout the day to meet the plant's water requirements and minimizes evaporative water loss. Charging higher fees for water use and educating the residential and industrial community about water conservation are easily implemented methods to reduce potential groundwater mining—removing more groundwater than is replaced by recharge—and saltwater intrusion. Once an area has lost its groundwater to saltwater intrusion, developing new water supplies can be extremely expensive.

Where Do You Live?

How Does This Influence Your Groundwater?

Five distinct physiographic provinces, each unique in geology, topography, soil types, climate, and aquatic resources, comprise the Virginia landscape. The similar geologic structure of each physiographic province affects both the quantity and quality of groundwater in that area. The pollution potential of the groundwater depends on the thickness of the soils and the permeability of soils, rocks, and underlying materials in the province.



Cumberland Plateau

The Cumberland Plateau is underlain principally by sandstone, shale, and coal. Groundwater is generally of poor quality, tending to be sulfurous and iron-rich. Naturally saline water is a problem at depths greater than 300 feet. In coal mining areas, some groundwater has become acidic. Water contaminated by mine drainage and water from coal seams is unsuitable for most uses. Wells generally yield from 10 to 50 gallons a minute. Overall, the potential for groundwater pollution is moderate.

Valley and Ridge

The common rock types in the Valley and Ridge province are limestone, dolomite, shale, and sandstone. The groundwater tends to be hard, calcium-rich in limestone areas, sulfurous and iron-bearing in shale areas, and of good quality in sandstone areas.

The chief sources of groundwater in the Valley and Ridge province are fractured sandstones and cavernous limestones, which are quickly recharged from precipitation and surface streams. In limestone areas, well yields of up to 3,000 gallons a minute are possible. In the ridges and upland areas underlain by shale and sandstone, yields range from 5 to 100 gallons a minute, but usually only enough for rural or domestic use.

The relationship between groundwater and surface water is easily recognized here. In limestone areas, sizeable surface streams disappear into underground channels and conversely, some large springs emerge to become headwaters for rivers. The pollution potential is very high. Streams and surface runoff entering sinkholes contribute to the recharge of Valley and Ridge aquifers, providing direct conduits for contaminants.

Blue Ridge

The Blue Ridge province is a relatively narrow zone of mountains with the highest elevations in the state. The rocks that underlie the area are granite, gneiss, and marble. Because of the steep terrain and a thin covering of soil, surface runoff is rapid and groundwater recharge is low. Groundwater use is limited primarily to domestic wells, which usually yield less than 20 gallons a minute. Water from the province is generally of good quality, but the iron content is high in some locations. The groundwater pollution potential is low.

Piedmont

The Central province of Virginia is bordered by the Blue Ridge Mountains to the west and to the east by the fall line, an imaginary line that passes through Fairfax, Fredericksburg, Richmond, Petersburg, and Emporia and crosses Virginia's rivers where they descend from the uplands to the coastal lowlands. The province includes parts of 40 countries and is Virginia's largest province, encompassing 40 percent of the state's land area.

The subsurface geology in the Piedmont is diverse with some areas underlain by granite, gneiss, schist, slate and marble, and a few scattered areas of sandstone and shale. There are wide variations in groundwater quality and well yields. In areas dominated by hard crystalline rocks, most groundwater is found in faults and fractures within 300 feet of the land surface. Well yields commonly range from 3 to 20 gallons a minute. The groundwater is generally of good quality except in some areas with high iron concentrations and acidity. The pollution potential in this province is moderate to low.

Coastal Plain

This is the only Virginia province composed primarily of sand, gravel, clay, shell rock, and other unconsolidated deposits. With the Atlantic Ocean on the east and the fall line on the west, the Coastal Plain's aquifers store more water than those in any other province in the state. Almost half the groundwater use occurs here.

In many areas, the shallow water-table aquifer is the source of water for hundreds of domestic wells with yields of 10 to 50 gallons a minute. The deeper system of artesian aquifers is the primary source of groundwater for large municipal and industrial use. A large production well often yields 2,000 to 3,000 gallons a minute.

The water quality is good except for some areas of high concentrations of iron and hydrogen sulfide. The groundwater may be saline along the ocean or estuary shorelines. The high population densities combined with the highly permeable soils result in greater pollution potential, especially for the shallow water-table aquifers.

What Do You Know About Groundwater Use In Virginia? Did You Know That . . .

- More than an estimated 124 billion gallons of groundwater are withdrawn in Virginia each year.
- About 27.8 billion gallons of groundwater are used annually by public water supplies—residents, schools, business, industry, and other organizations.
- According to the 1990 Census of Population and Housing, the majority of households in 73 of Virginia's 95 counties depend on individual private wells drawing groundwater. More than 539,000 private household wells were in use in Virginia in 1990.
- The public water supply of 38 counties in Virginia is drawn exclusively from groundwater.
- 50 counties draw more than half of their public supplies from groundwater.
- Between 1980 and 1990, 84,000 new domestic wells were constructed statewide. In 52 of Virginia's 95 counties, new private wells exceeded new public system hookups.