Virginia Cooperative Extension
Virginia Tech • Virginia State University

Part VI.

Soils of Virginia

Authored by:

John M. Galbraith, Extension Soils Specialist, School of Plant and Environmental Sciences, Virginia Tech

James C. Baker, Extension Soils Specialist (retired), Virgina Tech

There are more than 880 soil series mapped in Virginia. These soils show great ranges in properties and behavior, and thus in their suitability for different uses. Much of the difference in soils relates to the materials from which they formed; the local topography, hydrology, and soil climate; how long they have been forming; and the degree of human alteration they have received. The diverse nature of the parent materials (the geologic material from which the soil formed) and geologic resources they formed in is seen in the Physiographic and Soil Parent Material Map of Virginia (**fig. 1. page 105**), which divides the soils of the commonwealth into four major divisions. Differences in soils, common topography, rock types, and geology also form the basis of the five physiographic regions that influence hydrology, climate, and patterns in vegetation and land use (**www.dcr.virginia.gov/natural-heritage/natural-communities/document/ncoverviewphys-veg.pdf**). In general, the soils in Virginia are highly weathered outside of the Appalachian Plateau and clayey in the subsoil outside of the Appalachian Plateau, where they are loamy with more rocks, and the Coastal Plain, where they are loamy with almost no rocks and more sand. Almost all soils are moderately permeable and have a pH less than 6.2, unless noted. Acid soils need lime and fertilizer on a regular basis, as predicted by a soil test.

Soil Properties

In the following sections, the reaction (pH), depth class, and natural drainage class are described. The reaction classes (pH values) mentioned are: extremely acid (3.5-4.4), very strongly acid (4.5-5.0), strongly acid (5.1-5.5), moderately acid (5.6-6.0), slightly acid (6.1-6.5), and neutral (6.6-7.0). Alkaline classes are pH 7.1 and higher.

Very shallow soils are less than 10 inches deep to bedrock; shallow soils are less than 20 inches deep; moderately deep soils are 20-40 inches to bedrock; deep soils are 40-60 inches deep; and very deep soils are at least 60 inches deep.

Redoximorphic (redox) features are color patterns associated with prolonged wetness. Redox depletions of iron are grayish in color, and redox concentrations of iron are yellow, orange, or red. Excessively and somewhat excessively drained soils are either sandy throughout, with no restrictions to drainage, or are very shallow to bedrock. Water drains very rapidly in excessively drained soils, while in somewhat excessively drained soils, the water is drained rapidly, producing no redox features. Water is removed readily but not rapidly from well-drained soils, and there are no redox features in the upper 40 inches. Water is drained from moderately well-drained soils somewhat slowly during some times of the year due to a restriction to drainage, or there is a temporary seasonal high water table during the growing season, and redox depletions occur between 20 and 40 inches as a result. Somewhat poorly drained soils have either a moderately deep restriction to drainage or a prolonged seasonal high water table during the growing season, producing redox depletions or a dominant gray color in the upper 20 inches. Poorly drained soils have either a shallow restriction to drainage or a prolonged and shallow seasonal high water table during the growing season, producing a dominant gray color right below the topsoil and often a much darker-than-average topsoil color. Very poorly drained soils have free water near the ground surface for long periods during the growing season and much thicker and darker-than-average topsoil, or they have textures that are organic due to inhibited decomposition of organic matter.

Legend

Appalachian Division

Appalachian Plateau	Sandstone, Shale, Coal Seams	1
Mountains & Uplands	Sandstone, Shale, Conglomerate	2
Limestone Valleys	Limestone, Dolomitic Limestone, Sandstone, Shale	3

Blue Ridge Division

Blue Ridge Mountains	Sandstone, Shale	4
	Crystalline Rocks	5

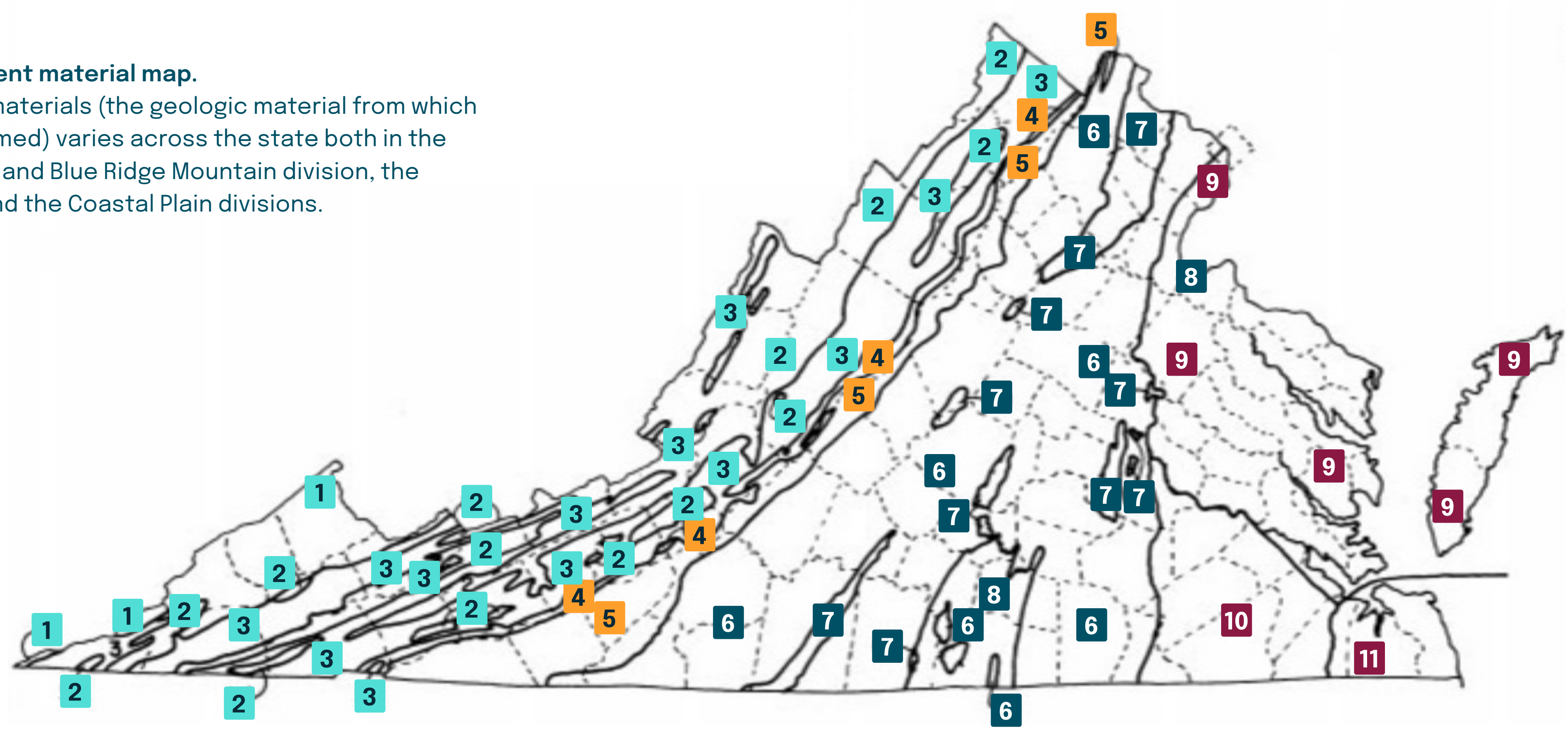
Piedmont Division

Crystalline Rocks	Gneiss, Schist	6
Triassic Areas	Sandstone, Shale	7
Slate Belt	Aaron Slate, Quartz Porphyr, Greenstone	8

Coastal Plain Division

Chesapeake Bay Region	Sands, Clays	9
Middle Coastal Plain	Sands, Clays	10
Flat Woods	Sands, Clays	11

Figure 1. Parent material map.
The parent materials (the geologic material from which the soils formed) varies across the state both in the Appalachian and Blue Ridge Mountain division, the Piedmont, and the Coastal Plain divisions.



Major Soil Divisions

The following sections associate soils with specific properties in each of the four divisions across the Commonwealth.

Appalachian Division

The soils in the southwestern part of Virginia have formed in parent materials deposited beneath ancient seas or on the ancient Coastal Plains bordering those seas. Those deposits became sedimentary rocks after their deep burial and cementation into acid shale, siltstone, sandstone, and conglomerate, or their consolidation (diagenesis) into limestone and dolomite (carbonate rocks). The division is made up of the Appalachian Plateau physiographic region that has flat-lying bedrock (**fig. 1, parent material 1, page 105**) and the Ridge and Valley physiographic region that has folded and faulted bedrock (**fig. 1, parent materials 2 and 3**).

Soils in the Appalachian Plateau are typically shallow to moderately deep on very steep slopes and moderately deep to very deep (5-8 feet) on more gentle slopes. Farming and grazing are limited to gently sloping areas in valleys or on broad summits. The soils are mostly very strongly acid and well drained, but they are not highly developed or weathered due to forming in resistant bedrock types on steep slopes. Most soils are loamy with many rock fragments ranging up to boulder size. These soils are yellowish brown to brown in the subsoil, but many at higher elevations have very dark topsoil. Common series are deep and very deep Cloverlick, Shelocta, and Highsplint formed in colluvium (gravity-transported material) and moderately deep Marrowbone, Mattewan, and Dekalb that formed over siltstone and sandstone and contain many rock fragments.

Soils in valley areas of the Ridge and Valley formed from limestone and dolomite (**fig. 1, parent material 3**). The bedrock is generally deeper than 80 inches on farmed soils, but ranges from shallow to moderately deep in pastures and forest, with some rock outcrops. In the past, most limestone- and dolomite-derived soil areas have been farmed, and they remain some of the most agriculturally important soils of the region due to their moderate natural fertility. They are moderately to strongly acid and well drained. The major land-use problem with these soils is the variable depth to bedrock and the presence of numerous sinkholes that provide pathways for excess nutrients into the groundwater. The surface textures are typically silt loam or loam, with yellowish red to red subsoils that have high clay contents. Common soil series are Groseclose and Frederick. Soils like Carbo and Endcav have yellowish brown to strong brown clayey subsoils that shrink and swell dramatically when they wet and dry, limiting their land use and productivity because of droughtiness and damage to infrastructure.

Deep and very deep soils formed from strongly acid shales on ridges within the valleys (**fig. 1, parent material 3**) have low natural fertility. Most of these well-drained and moderately slowly permeable Lowell and Rayne soils have been cleared and planted to crops or pastures. They have strong brown clayey and silty subsoils. Shallow to moderately deep soils formed from strongly acid siltstones and shales along the mid- to lower flanks of the mountainsides (**fig. 1, parent material 2**). They are typically permeable and well drained. Weikert (shallow) and Berks (moderately deep) are silt loam or loam throughout and contain many shale fragments throughout the soil profile, limiting their water-holding capacity. Gilpin (moderately deep) soils have a silt loam and loam textures and fewer rock fragments.

Soils formed from very acid, strongly cemented sandstones and conglomerates occur along the major ridgelines and upper portion of the mountains. These soils are usually shallow, sandy, and often gravelly or cobbly with many stones and boulders covering the surface. Rock outcrops are common. They remain in native forest as part of the National Forest System because of their inherently low fertility and very low water-holding capacity, numerous large rock fragments, and very steep slopes. Soils that are shallow to bedrock have limited rooting zones for crop and pasture plants. Commonly occurring, very strongly acid soil series on more gentle slopes are the moderately deep, yellowish brown Dekalb soils and the deep Shelocta soils that have silty clay loam subsoils. Moderately deep, strong brown to reddish brown Lily and Calvin soils form at high elevations under native forests and over maroon-red sandstones and shales.

Soils formed in materials transported by gravity (colluvium) and water (alluvium) are common on gentle slopes in lower landscape positions and are important agriculturally. Laidig soils were formed from colluvium and have dense, very slowly permeable subsoil layers called "fragipans" that restrict roots and water, and have moderately deep, seasonal, high water tables. Strongly to moderately acid, loamy Jefferson colluvial soils are well drained and permeable and are used for pasture or forest, or for cropland on more gentle slopes. They have few limitations for use if they are on gentle slopes. Soils formed in alluvium are generally the most productive soils of the region because of high water-holding capacity and moderate natural fertility. Slightly acid to neutral Ross, Weaver, and Timberville are silty and loamy soils on floodplain positions and are subject to stream overflow. Poorly drained, silty soils like Purdy have restricted use because of poor drainage. Very deep, strongly to very strongly acid, clayey, red, well-drained, and highly weathered Shottower soils occur on nearby higher positions such as stream terraces and are well suited to many land uses. They have very low natural fertility.

Blue Ridge Division

The Blue Ridge Mountain division and region ranges from 5 to 25 miles wide. The soils of this division are formed from a combination of crystalline igneous rocks, formed from molten magma that cooled underground, and metamorphosed rocks, formed by heat and/or pressure alteration of other rocks. The bedrock on the western slopes of the division are highly consolidated acid shale, sandstones, conglomerates, and quartzite.

The overriding soil use constraints in the Blue Ridge are steep slopes, stoniness, and shallow depth over bedrock. The soils formed over acid crystalline rocks (**fig. 1, parent material 5, page 105**) are very strongly to moderately acid and well drained. Common, very deep soils that have strong brown to yellowish brown loamy subsoils are Glenelg, Edneyville, Edneytown, and Hayesville, and those with clayey subsoils are Elioak. Loamy Myersville soils formed over more alkaline bedrock but have highly weathered into very strongly acid subsoils. The steep slopes associated with much of the area demand that careful attention be given to any activity, either cultivation or construction, that leaves the soil bare to minimize erosion hazards. Very deep, strongly to very strongly acid, clayey, red, well-drained, and highly weathered Braddock and Unison soils occur on footslopes and stream terraces on the east side of the region, and are well suited to many land uses. They have very low natural fertility.

Many slopes are very steep, but more gently sloping highland areas occur along the Blue Ridge Parkway. To the north of Roanoke, these gently sloping ridges are narrow, thus limiting uses to forestry and recreation within the national forests. To the south of Roanoke, the Blue Ridge Highland area is gently sloping and several miles wide. This area is intensively used for agriculture and is dominated by very deep, well-drained soils suitable for many uses, although high elevation areas have short growing seasons and cold climates. They require careful management for crop or Christmas tree production.

The western flanks of the division (**fig. 1, parent material 5, page 105**) north of Roanoke are covered by soils, such as shallow, strongly acid, yellowish brown Ramsey over sandstone, and deep, excessively drained Drall that formed over sandstone or quartzite rock. Many colluvial soils on broad footslopes that flank the Shenandoah Valley have fragipans (Buchanon, Laidig) and are high in rock fragments, severely limiting their water-holding capacity and rooting depth. Other colluvial soils with loamy subsoils (Jefferson) are suited to a wide variety of land uses.

Piedmont Division

The Piedmont is the largest physiographic division and region in Virginia. It occurs between the Blue Ridge Mountains and the fall line that runs between Arlington, Fredericksburg, Richmond, and Emporia. The fall line is the easternmost place where waterfalls and rock outcrops occur in stream and river bottoms, such as near Belle Isle in Richmond. The Piedmont region is dominated by crystalline igneous and metamorphic rocks (**fig. 1, parent material 6**) surrounding important areas of sedimentary rocks (**fig. 1, parent material 7**). The soils are warmer to the east of a line that runs between Martinsville, Appomattox, and Fredericksburg, and that affects some crop and timber production choices.

The predominant, acidic, crystalline bedrocks are gneiss, schist, and granite, of which quartz, feldspar, and mica are the dominant, primary minerals. Natural fertility is very low in these highly weathered soils. Highly available aluminum and very low phosphorus content limit native plants and crops. Liming is necessary to prevent particularly high aluminum in the subsoil from being an agronomic problem. Historically, much of the Piedmont region was cleared and farmed intensively to cotton and tobacco, causing extreme erosion over much of the region. Before modern soil fertility and managerial practices were adapted to these soils, agricultural production diminished and most farms reverted back to forests. Over two-thirds of this region is wooded today, with many plantation forests in the eastern half. The best soils on gentle slopes are still agriculturally productive through well-managed soil fertility and erosion control plans, while other former croplands are now in pasture.

Soils such as Cecil (Clifford) and Pacolet (Fairview) developed very deep, well-drained, very strongly acid, with sandy loam or loam surfaces and red clayey subsoils. Appling (Nathalie) and Wedowee (Toast) soils are similar except for having yellowish brown to strong brown subsoils. Madison (Poplar Forest) soils are similar to Pacolet but have abundant flakes of mica in the subsoil. The Fe-oxide content is higher in the red soils, controlling their subsoil color. Yellowish brown to strong brown Nason (Buffstat) and red Tatum (Littlejoe) are deep clayey soils formed from moderately weathered, fine-grained schist bedrock. The soil names in parentheses above are equivalent soils that formed on the cooler west side of the Piedmont.

Some soils were formed from igneous and metamorphic rocks with a high base content of calcium and magnesium. Soils formed from such minerals tend to be less acid and more naturally fertile, with less free aluminum in the subsoil. Davidson (dark red), Cullen (red), and Mecklenburg (yellowish red) form very deep, clayey soils that are well drained with low activity (low volume change and chemical activity) clays. However, in some instances the bedrock weathers into expansive clay subsoils with moderate chemical activity and very high capacity to shrink and swell on wetting and drying. These deep to very deep "shrink-swell" soils such as Iredell are slowly to very slowly permeable and moderately well to somewhat poorly drained. They are moderately suited to lawns and gardens if properly managed, but they pose a managerial challenge to farmers and developers.

Scattered throughout the Piedmont are other soil areas formed from sandstone and shale that were once sediments deposited in Triassic-age basins. These ancient (252-201 million years ago) basins (**fig. 1, parent material 7, page 105**) are oriented in a northeast to southwest direction, roughly paralleling the Blue Ridge. The soils north and east of Charlottesville developed over red siltstone and shale bedrock and are moderately deep to very deep. The very strongly acid, reddish brown, silty and clayey soils such as moderately deep Penn and deep Bucks can be quite productive. To the south and east of Charlottesville, many Triassic Basin soils have high clay content and very high aluminum levels. On soils such as the very deep, yellowish red Mayodan, it is difficult to establish high productivity for crops, lawns, or gardens without careful liming and fertilization. The very deep, red, silty, and clayey Georgeville soils formed over slate. Some soils in this region (**fig. 1, parent material 8**), such as moderately well-drained White Store and somewhat poorly drained Creedmore, have expansive clays in the subsoil that cause slow permeability and pose severe problems for farming and urban uses.

Coastal Plain Division

The Coastal Plain begins at the fall line to the west and extends to the bays and ocean on the east. Soils of this region are formed from stream and ocean water deposits that have never been consolidated into bedrock. All soils are very deep because consolidated bedrock is deeply buried by the unconsolidated sediments in all parts of the Coastal Plain. Some of the sediments were deposited when the ocean level was much higher than at present and still occur far west of the fall line in thin and discontinuous deposits. They form a wedge of sandy-textured parent material that is at the surface at the fall line and up to 15,000 feet thick at Virginia Beach. There are 11 marine terraces that are remnants of higher ocean levels. Between periods when the ocean was higher, gravel, sand, silt, and clay sediments were deposited by meandering rivers and streams that originated in the western part of the state. All Coastal Plain soils used for cropland require liming and fertilization, although aluminum toxicity is less of an issue than in the Piedmont. Excess fertilization is a concern on sandy Coastal Plain cropland soils, many of which are in close proximity to water bodies and streams.

Soils closer to the fall line have been exposed and forming and weathering longer than soil at lower elevations and closer to the Chesapeake Bay and Atlantic Ocean. Soils in the Coastal Plain are strongly to very strongly acid and are much more acid on the west side toward the fall line and becoming extremely acid with depth. Most are naturally infertile, with some moderately fertile soils at low elevations and along rivers that drain the western regions of Virginia. Many of the soils have thick sand or loamy sand surface textures, which make them susceptible to wind erosion and summer droughts. Major soils such as Norfolk and Suffolk are well drained with yellowish brown to strong brown loamy subsoils. Bojac soils are similar but have more sand and less clay in the subsoil, which makes them droughty in dry summers. Emporia and Slagle have moderately slow to slow permeability because of platy structure in the subsoil that restricts downward water movement, causing temporary seasonal high water tables in the upper subsoil. The soils on terraces of many rivers that drain the Piedmont and farther west are the well-drained Pamunkey soils, which have slightly to moderately acid subsoils, yellowish red colors, loamy textures, moderate natural fertility, and good structure throughout. Pamunkey is the unofficial state soil of Virginia and often sets records for crop production. Because most landscapes are nearly level to gently sloping, the soils are not as susceptible to erosion as in the other regions. In general, the closer to the coast, the nearer the water table is to the soil surface, the lower the elevation, and the higher the sand content. Many of the streams form sluggish swamps with very poorly drained soils that are high in organic matter.

Soils in the Northern Neck areas (**fig. 1, parent material 9, page 105**) are moderately acid, yellowish brown, very deep, and well-drained loamy soils with large amounts of sand. Eastern Shore and low-elevation soils such as Dragston and Lumbee are somewhat poorly and poorly drained, with grayish brown to light gray loamy-textured subsoils. Many cropland fields have drainage ditches and tile drains to remove excess water. Many streams and rivers dissect the landscape.

The soils and fields of Southside Virginia (**fig. 1, parent material 10**) are broader and more level than in the Northern Neck. These soils and landscapes, commonly coupled with larger field sizes, accommodate more efficient and large-scale farming practices. This region has the highest percentage of row crop agriculture in Virginia as well as a thriving plantation forestry industry. Modern soil liming and nutrient management practices, high-capacity farm implementation, and other advanced electronic tools and production technologies make the soils highly productive for row crops. Some soils have thick, sandy surface textures suitable for growing peanuts.

The growing season in the Tidewater area (**fig. 1, parent material 11**) is long and warm, which makes it well suited for both peanuts, and for cotton, which cannot grow in shorter growing season areas of Virginia. Many soils have water tables near the surface and must be drained for farming. The soils have sandy surfaces and loamy subsoils, with very sandy lower subsoils.

There are significant acres of slightly acid, poorly drained soils with high water tables in low-lying or flat landscapes in the Coastal Plain region. About 22% of the area is wetlands, and almost 75% of the wetland soils in Virginia occur in this region. The high amounts of sulfur in many marsh and swamp soils along bays and estuaries create extremely acid soil conditions if drained. Pungo is a very poorly drained swamp soil made up of highly decomposed organic material. Seasonally saturated mineral flats with poorly drained Roanoke, Rains, Tomotely, Nimmo, and Acredale soils are in plantation woodland or drained cropland, or they exist as jurisdictional wetlands, which are protected from drainage by law. These strongly to very strongly acid, loamy-textured soils are typically gray or brownish gray with dark topsoil and white sand below the subsoil. Unplowed freshwater wetland areas provide the essential mechanisms necessary to slow water movement from uplands to estuaries and bays of Eastern Virginia and to buffer nutrient losses from farm fields, thus serving to maintain high water quality and a sustainable biodiversity for the region.

Soils in Natural Landscapes and Soil Surveys

The discussion above is intended only as a general guide to major land resource areas in Virginia. It must be remembered that drastically different soils can occur within the same landscape. Soils within similar landscapes are somewhat variable in properties; much of this is due to local variations of parent materials. Several soils can occur together in a field of a few acres. Usually, soil bodies are related to landscape positions. The shape of the landscape configuration has a direct effect on soil drainage and soil type. Concave-shaped positions are collectors of water, while convex positions divert water and thus are usually better drained.

Virginia has detailed soil survey maps typically produced at the county level by Virginia Polytechnic Institute and State University in cooperation with the USDA-Natural Resources Conservation Service. These soil survey maps show the geographic locations of different soil bodies on the landscape. The use of the maps with soil descriptions and interpretative guides provides a means of estimating the suitability of an area for a particular land use. Soil surveys are available online, and paper copies may be available in libraries, at the local Virginia Cooperative Extension office, or at USDA-Natural Resources Conservation Service offices. Free online versions of county and statewide maps are available, as well as a digital file for use with geographic information system software.

Soils for Homesites

If a conventional on-site septic tank and drainfield system (conventional system) is planned, the soil must not have restrictions to drainage in the upper 36 inches. The homeowner should be aware of the following soil/site features if a conventional system is to be installed:

1. Surface drainage and permeability.
2. Erodibility.
3. Presence of shrink-swell clays.
4. Relief and soil depth, nutrient status, and pH.

Drainage and Permeability

Surface drainage and internal soil drainage relate to the shedding of water from a site by surface overflow and the removal of excess soil water to give the soil aeration. Well-drained soils are not saturated for significant periods of time, and the depth of a seasonally high water table is usually greater than 40 inches. Well-drained soils are generally the most suitable for building sites and most types of plantings. Poorly drained soils can have water at or near the ground surface during wet periods of the year.

All regions of Virginia have both well-drained and poorly drained soils, as well as soils between these extremes. In some areas of Virginia, such as in the Tidewater region, over 90% of the soils have potential wetness problems. These wet areas present special problems for landscaping, yard drainage, and maintenance of a dry basement.

Permeability is the rate that a soil will transmit water. This rate varies from rapid to very slow within any soil horizon. Often the most limiting rate is reported. Water movement is aided by a network of interconnected pores that extend throughout the soil. Where soil pores are small and total pore space is limited – such as in poorly aggregated subsoils with high clay content or where compacted layers exist – permeability will be slow to very slow. Layers of expansive clays, abrupt changes in texture, compacted layers, and platy structure restrict downward movement or percolation during wet periods and may result in temporarily perched water tables.

In many cases, wetness problems in basements or around footings can be overcome with proper surface drainage by diverting excess water away from problem areas. For new construction, the use of footing drains along with proper grading and surface water control is recommended to reduce the potential for wetness problems. Footing drains installed at construction time are relatively inexpensive, but they are very costly to install later when a problem arises.

Erodibility

The susceptibility of a homesite to soil erosion depends on the kinds of soil as well as on the grading and land forming done by the contractor during development. In many cases, especially on small lots, the natural soils have been completely removed, or at least disturbed, by cutting and filling. The original surface soil on the lot is likely to have been removed from the site or lost during construction, although some recent regulations now require contractors to reapply the topsoil to the finished grade. The erodibility therefore depends on characteristics of the slope and soil material. Vegetation should be established as soon as possible on any bare soil areas. Any kind of plant debris (straw, grass, mulch) or commercial cloth mesh that covers the ground will help reduce soil erosion until permanent vegetation or sod is in place.

Shrink-Swell Clays

Soils with a high content of shrink-swell (expansive) clays will change volume on wetting and drying. These expansive soils can cause severe damage to foundations and footings of buildings and to sidewalks, roads, and other structures. Where such clays are at or near the soil surface, severe root pruning of plant seedlings can occur. When such soils are encountered or expected, an on-site evaluation by a qualified soil scientist is recommended. If construction is planned on such soils, it may be advisable to remove the expansive material from the site. In some instances, special designs – such as rebar reinforcement – may be necessary. In other cases, it may be advisable to seek an alternative site or install an alternative on-site sewage treatment system. Proper planning ahead of construction is far less costly than remediation of a site once expansive soils have caused building, driveway, and other infrastructure damage.

Relief and Soil Depth

Homesites with excessive relief (steep slopes) may impose restrictions on basic construction and force other compromises relative to access and maintenance of public utilities. Locating lawns, gardens, play areas, and septic drainfields is difficult on steep slopes. There must be adequate soil depth for growing the kinds of plants desired. Steep slopes or shallow to bedrock conditions are severe limitations.

Nutrient Status and pH

Lawn, garden, and yard management testing of the soil is recommended every few years by a certified soil analysis laboratory. Acid rainfall causes a continuous acidification of the soil. The soils with low clay content or high amounts of low-activity clays are less buffered against acidification, which could cause aluminum toxicity problems. Plant nutrients and aluminum are most available at neutral pH. Homeowners should apply lime to raise the pH and fertilizer at the rates prescribed by the testing lab by carefully following the rates and instructions on the product. Lowering the pH to aid acid-loving plants and fruits should be done very carefully and cautiously.

Managing On-Site Septic Tank Drainfield Systems

Houses constructed where there are no public sewer systems will have an individual subsurface sewage disposal system. A conventional septic tank drainfield system will usually be within an area of about 50 feet by 100 feet in size, and will possibly have an adjacent reserve area half that size. The purpose of the system is to carry all the wastewater from the house and allow its slow absorption into and percolation through the subsoil. Soil areas used for this purpose in Virginia must pass strict evaluations and testing procedures. In order to pass this test for a conventional system, soils must be well drained, have moderate permeability, be higher in elevation than adjacent drainageways, and not be installed on excessively steep slopes or in drainageways. Alternative systems can be designed and built for less than ideal soil and site conditions. The septic tank drainfield system absorbs hundreds of thousands of gallons of sewage effluent and will last many years if the soil is suitable and the system is correctly installed and properly maintained.

Drainfield Maintenance

A cover of grass should be maintained over the system. It is important to prevent and eliminate any erosion because the drainfield lines are often within 2 feet of the land surface. The species of grass is not as important as the maintenance of a healthy cover. Do not locate trees or shrubs on or near the drainfield because roots could eventually damage and block the distribution lines. Heavy traffic over the drainfield should be avoided.

Cleaning

It is advisable to have the septic tank pumped and cleaned every three to six years. Contact your local health department for recommendations concerning maintenance, cleaning, or any alterations on any part of the septic drainfield system.

Soil Water Use

A yearly water budget diagram offers a way to show where soil water is being utilized (depleted) and where soil water is being recharged. The diagram **(fig. 2, page 114)** shows an average water budget for three climatic recording stations in Eastern Virginia. The left vertical scale is in inches of water. The bars show the difference between precipitation (P) and water usage. Evapotranspiration (ET) is the total of water loss from the soil (evaporation) and the water used or lost from plants (transpiration). A positive number indicates there was an excess of soil water for that month. For months where the average precipitation was less than usage, the number on the left vertical scale is negative. This indicates that the soil must have the capacity to supply stored water in order for plants to continue to grow at the maximum rate.

For summer months (the midpoint of the growing season), there was a deficit for each of the months of June, July, August, and September. The soil has to hold this total amount of water for continued plant growth. The best soils will store about 7 inches of water in the upper 3 feet of soil. This would be enough to make up for the expected water deficit in a climatic setting described by the water budget diagram in **figure 2**.

Soil Water Recharge

In Virginia, the normal climatic pattern from October to May has periods of water excess (where ET is less than P). This excess precipitation over ET will recharge the soil with water, month by month, until the soil is fully recharged. The data indicate this recharge would be complete sometime in January of the following year.

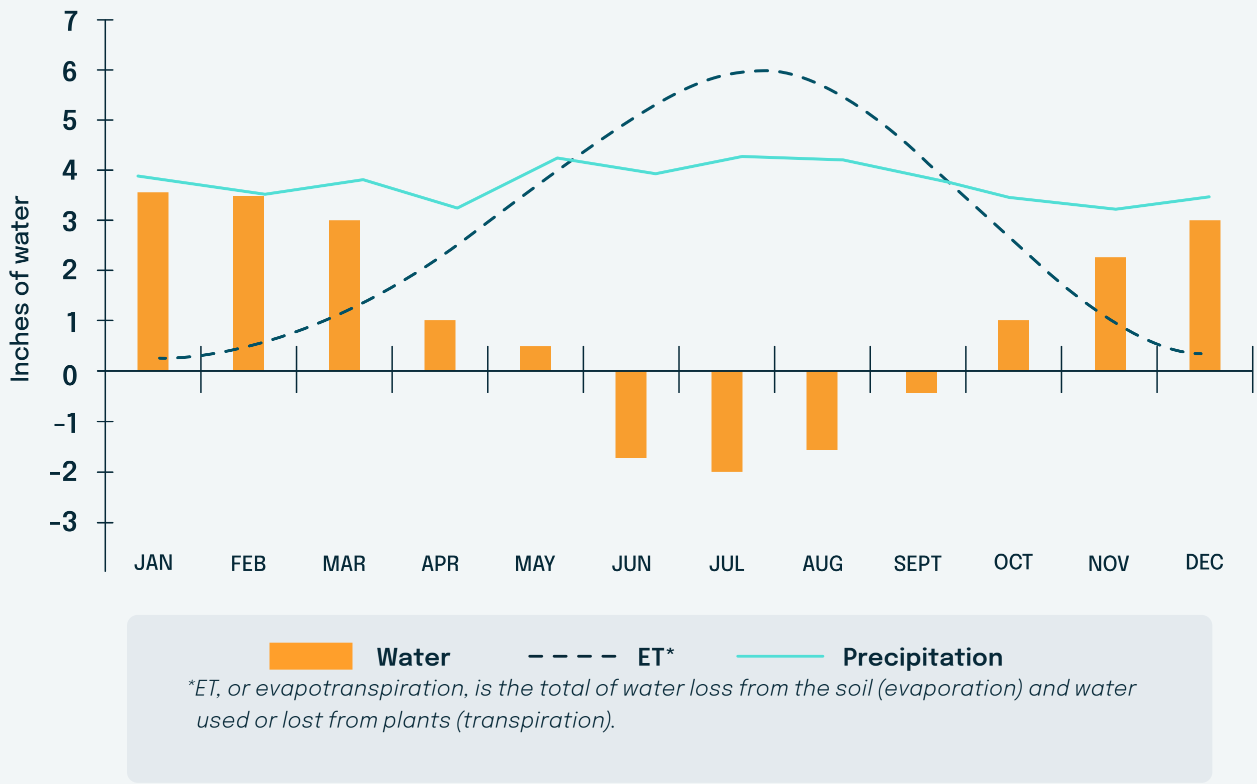


Figure 2. Example annual soil water budget. Evapotranspiration (ET) is the total of water loss from the soil (evaporation) and the water used or lost from plants (transpiration).

Leaching

After recharge is complete, before the growing season starts, the soil will have excess water. At this point, when precipitation events occur, excess water will (1) run off the soil surface, promoting erosion; or (2) push existing soil water through the soil, causing leaching and percolation losses. This is the most likely time for nitrogen and other chemicals to enter groundwater. It will continue until the growing season begins and plant use of water increases. Maximum leaching and maximum runoff will occur on average during this period when the soil is recharged and before plants begin to use it in the early growing season. This leaching potential will continue until about June, when once again, the soil will give up stored water to maintain maximum growth potential for the crop. In order to minimize leaching losses, applications of nitrogen or other soluble fertilizers should be applied as near to planting time as practical and/or added in split applications over the growing season.