PART VI
Soils of Virginia

James C. Baker, Extension Soils and Land Use Specialist

There are more than 600 soil series mapped in Virginia. These soils show great ranges in properties and thus in their suitability for different uses. Much of the difference in soils relates to the geologic parent materials from which they have formed as well as the local topography. The diverse nature of the parent materials is seen in the Physiographic and Soil Parent Material Map of Virginia (Figure 1).

Major soil divisions

A. Appalachian division.

The soils in this area have formed in materials deposited beneath ancient seas. These deposits became sedimentary rocks of which primary types are limestone, shale, sandstone, and conglomerate.

Soils formed from limestone are found primarily in valley areas. In the past, most limestone derived soil areas have been farmed and remain some of the most agriculturally important soils of the region. They are permeable and usually well drained although the major land use problem with these soils is the variation of depth of soil above bedrock. In addition, the subsoils commonly have high contents of clay and some sites have eroded.

Soils formed from shales usually occur on more sloping landscapes in the valleys and along the bases of mountains. These soils commonly range from shallow to moderately deep to bedrock and may contain many shale fragments throughout the soil profile.

Soils formed from sandstone and conglomerates occur along the major ridges and mountains. These soils are usually shallow, sandy, and often stony or gravelly.

In addition to major characteristics discussed above, soils formed in transported materials by gravity (colluvium) and water (alluvium) are common in lower landscape positions and are important agriculturally. Soils formed from colluvium commonly have compacted subsoil layers (called fragipans), high seasonal water tables, and may be stony. Soils formed in alluvium are generally the most productive soils of the region. Some are on floodplain positions and as such may be subject to stream overflow. Those on non-overflow positions, such as stream terraces, are usually well suited to many uses although some have seasonally high water tables.

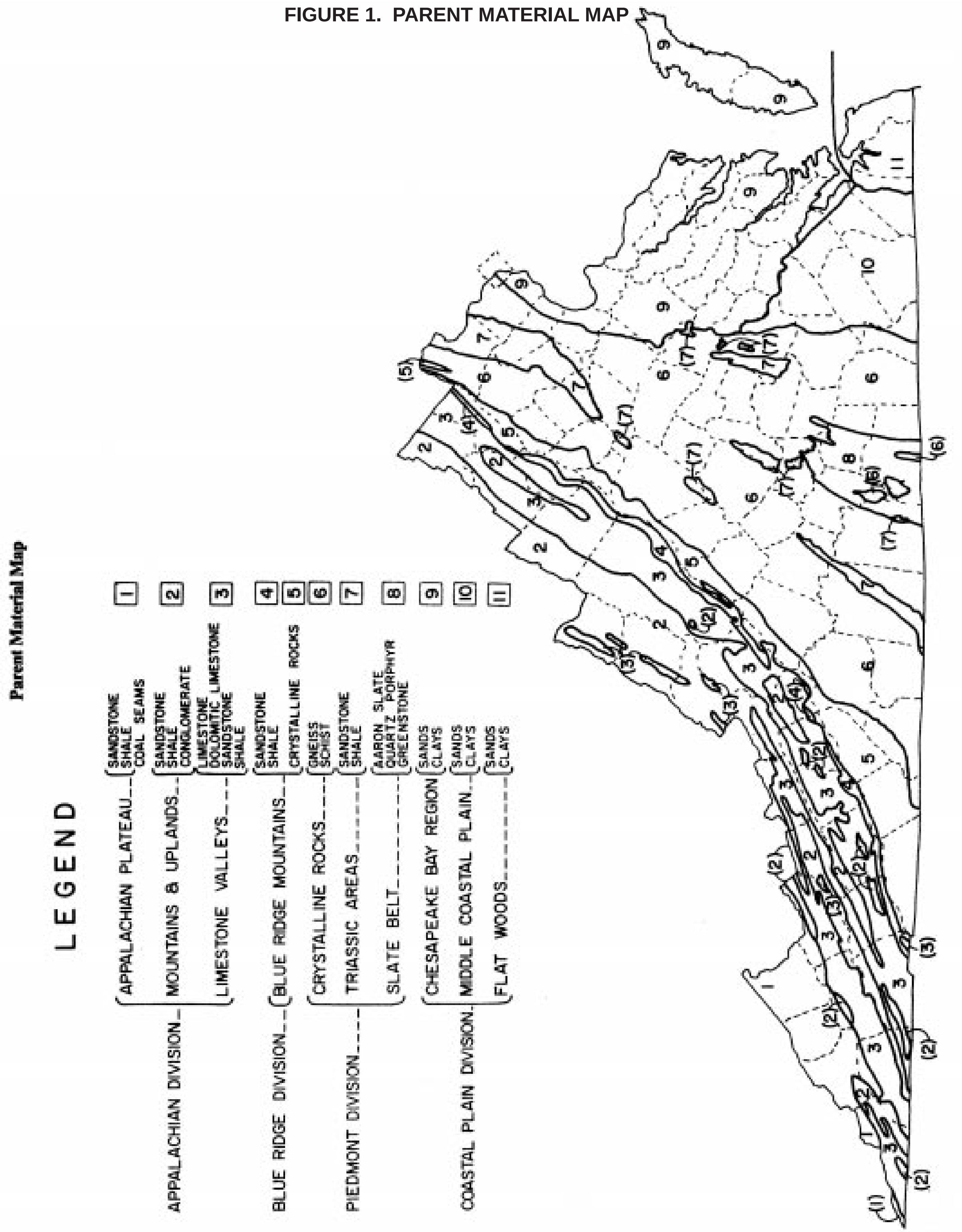
B. Blue Ridge division.

The soils of this area are formed from a combination of sedimentary rocks, igneous rocks formed from molten magma, and metamorphosed rocks formed by heat and/or pressure alteration of other rocks. The igneous and metamorphosed rocks are termed crystalline rocks on the soil parent material map.

In general, the sedimentary rocks are on western slopes of the Blue Ridge and the crystalline rocks are on the eastern slopes. The overriding soil use constraints in the Blue Ridge region are steep slopes, stoniness, and shallow soil over bedrock. 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. It is imperative to minimize erosion hazards.

The soils derived from sedimentary rocks occur predominantly on steep slopes and are shallow to bedrock. The soils formed from crystalline rock may be on steep slopes but also occur on more gently sloping highland areas along the Blue Ridge. To the north of Roanoke, these gently sloping ridges are narrow, thus limiting uses to forestry and recreation. To the south of Roanoke, the Blue Ridge Highland area is gently sloping and

FIGURE 1. PARENT MATERIAL MAP



several miles wide. This area is intensively used for agriculture and is dominated by deep, well drained soils suitable for many uses. As with all regions where steep slopes may occur, care must be taken to control erosion. Some regions also have locally important areas of soils formed from colluvium which in this region is quite variable in texture and drainage.

C. Piedmont division

This is the largest physiographic region in Virginia. It occurs between the Blue Ridge and a line running between Arlington and Emporia. The Piedmont region is dominated by igneous and metamorphic rocks with important areas of sedimentary rocks in some counties.

The predominant parent material rocks are gneiss, schist, and granite, of which quartz, feldspar, and mica are the dominant primary minerals. Soils developed from these rocks and minerals form acid, infertile soils, with sandy loam surfaces. Many of the clayey subsoils are red or yellowish red due to the oxidized iron weathered from the primary minerals. Natural fertility is low; however, these soils respond well to liming and fertilization. Depth to bedrock varies but in most places, these soils are deeply weathered for several feet. Some areas in this region have particularly high aluminum in the subsoil, which can be an agronomic problem for some crops. Liming is necessary on such soils. Historically, much of the Piedmont region was cleared and farmed intensively, 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. The best soils are still agriculturally productive through well managed soil fertility and erosion control plans.

Other soils formed in the region were formed from igneous and metamorphic rocks with a high base content of calcium and magnesium. Soils formed from such minerals tend to be more fertile but in some instances they form clayey subsoils with very high capacity to shrink and swell on wetting and drying. Where such soils are eroded this condition poses a particular set of managerial challenges to farmers and even more to developers. Where uneroded, most of these soils are moderately well suited to lawns and gardens if properly managed. The depth to bedrock is generally two to six feet.

Scattered throughout the Piedmont are other soil areas formed from sandstone and shale which were geologic sediments deposited in Triassic age basins. These ancient basins are oriented in a northeast to southwest direction, roughly paralleling the Blue Ridge. The region to the north and east of Charlottesville have shallow to deep soils which can be quite productive when depth to bedrock is not a problem. To the south and east of Charlottesville, such soils may have high clay content, with high water tables and very high aluminum levels. On such soils, it is difficult to establish high productivity for crops, lawns, or gardens. Some soils in this region have high shrink-swell clays which pose severe stability problems for urban uses and tillage and root pruning problems for agricultural uses. Depth to bedrock varies from two to ten feet.

D. Coastal Plains division

Soils of this region are formed from unconsolidated sediments deposited when the ocean level was much higher than at present. As sea levels lowered, many of these deposits were reworked by meandering rivers and streams that originated in the western part of the state and flowed to the east.

In general, the closer to the coast, the nearer the water table to the soil surface.

Soils in the coastal plain are acid, infertile, highly weathered, and vary from sandy textures to very clayey textures. Many of the soils have thick sandy surfaces which make them susceptible to summer droughts. Most landscapes are nearly level to gently sloping and because of this feature the soils are not as susceptible to erosion.

These soils and landscapes, commonly coupled with larger field sizes, accommodate more efficient farming practices. This region has the highest percentage of row crop agriculture. Modern soil fertility/liming managerial practices, high capacity farm implementation, and other production technologies make the more suitable soils of this region competitive with any other part of the state.

There are still significant acres of poorly drained soils with high water tables in the coastal plains region. Many of these areas are in woodland or exist as jurisdictional wetlands which are protected from drainage by current law. These wetland areas provide the essential mechanisms necessary to slow water movement from uplands to estuaries and bays of eastern Virginia, 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 may occur within the same landscape. Soils within similar landscapes are somewhat variable in properties, much of this being due to local variations of parent materials. Several soils may occur together within 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.

The Virginia Cooperative Soil Survey has produced detailed soil survey maps for nearly 90% of the state. 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 should be available at the local Virginia Tech Extension office or Natural Resources Conservation Service office.

Soils for homesites

The homeowner should be aware of the following soil/site features: 1) surface drainage and permeability, 2) erodibility, 3) presence of expansive clays, 4) relief and soil depth, and 5) if a septic tank and drainfield system is planned, the soil must “perc.”

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 seasonally high water tables is usually greater than 6 feet. Well drained soils are generally the most suitable for building sites and most types of plantings. Poorly drained soils may 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 and everything in between these extremes. In some areas of Virginia, over 90 percent 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 through the profile. This varies from rapid to very slow. 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 and compacted layers 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 are very costly to install later when a problem arises.

Erodibility

The susceptibility of a home site to soil erosion depends on the kinds of soil but also 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 contractors make an attempt 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.

Expansive clays

Soils with a high content of expansive clays will change volume on wetting and drying. These expansive soils may cause severe damage to foundations and footings of buildings, sidewalks, roads, and other structures. Where such clays are at or near the soil surface, severe root pruning of plant seedlings may occur. Where 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 instances it may be advisable to seek an alternative site. In any case, planning ahead of construction is far less costly than remediation of a site once expansive soils have caused building damage.

Relief and soil depth

Home sites 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.

Managing septic tank drainfield systems

Houses constructed where there are no public sewer systems will have an individual subsurface sewage disposal system. The system is most commonly a septic tank drainfield system. The drainfield will usually be within an area less than 50’ by 100’ in size. The purpose of the system is to carry all the waste water from the house and allow its absorption into the subsoil. Soil areas used for this purpose in Virginia must pass strict evaluations and testing procedures, commonly described in real estate ads as “perced...”. In order to pass this test, soils must be well drained, have good permeability, and be higher in elevation than adjacent drainage ways. 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

Plantings **-** A cover of grass should be maintained over the system. It is important to eliminate any erosion since the drainfield lines are often within two 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 since roots may 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 3 to 6 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 (Figure 2) 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 (ET). 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 in soil water for that month. For months where the average precipitation (P) was less than usage (ET) the number on the left vertical scale is negative. This indicates the soil must have the capacity to supply stored water in order for plants to continue to grow at the maximum rate.

Thus for summer months (mid point 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 seven inches of water in the upper three 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).

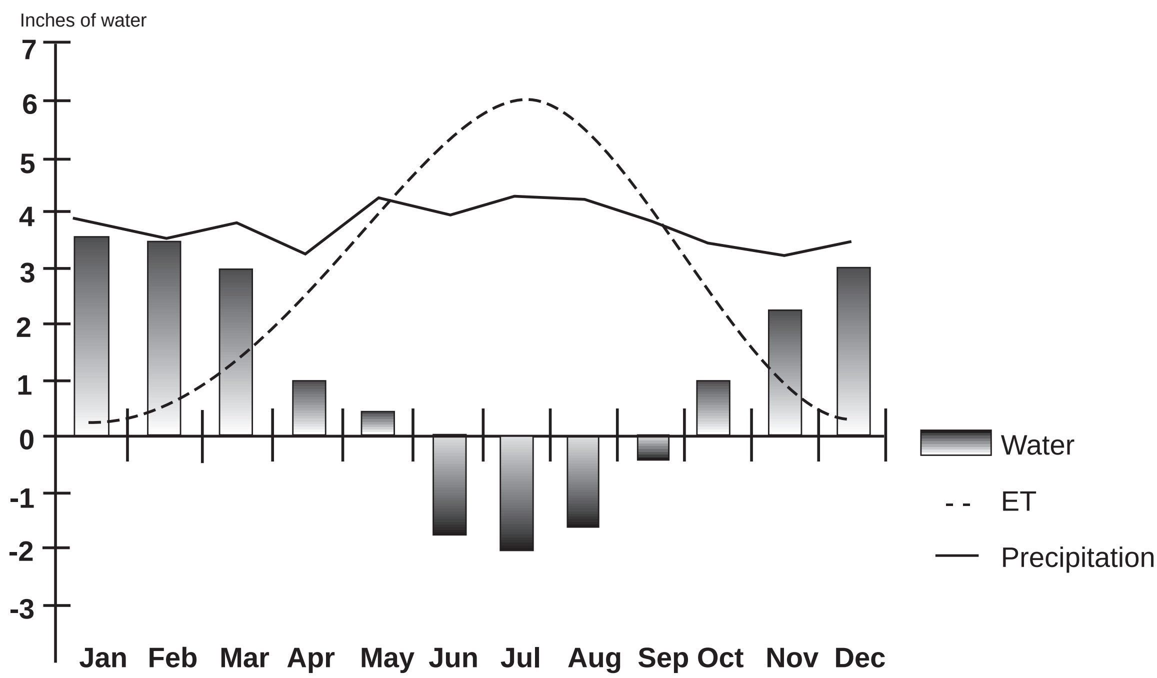
Soil water recharge

In Virginia, the normal climatic pattern has periods of water excess (where ET is less than P) and this is during the period of October to May. 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. Now the soil is fully recharged.

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 time most likely for nitrogen and other chemicals to enter ground waters. This 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, where once again, the soil will give up stored water to maintain maximum growth potential for the crop. Thus to minimize leaching, 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.

Figure 2



Note: Evapotranspiration (ET) is the total of water loss from the soil (evaporation) and the water used or lost from plants (transpiration).