GEORGIA DEPARTMENT OF PUBLIC HEALTH

Manual for On-Site Sewage Management Systems

SECTION C | SOIL INFORMATION

Environmental Health Section

SECTION C - SOIL INFORMATION

1) Preface

Soil information and its proper application can contribute to the solution of many waste disposal problems in Georgia. It can effectively be combined with geology, engineering and ecology to yield an integrated approach to environmental improvement. This Manual concentrates primarily on evaluating the suitability of soils for disposal of liquid waste from individual homes through septic tanks and subsurface soil absorption systems.

It is hoped that the following information will help to point out how to avoid the mistakes frequently made in choosing suitable development sites where the soil is to be used for treatment and disposal of liquid waste. Such mistakes can result in increased land use conflict, environmental degradation and a waste of time and money.

Although these sections of the Manual were developed to provide information to all people interested in solving relevant waste disposal problems where soil characteristics are contributing factors, the majority of the material will probably be most useful to environmental health specialists and other environmental health workers, surveyors, engineers, developers and other persons and groups frequently confronted with making significant land use decisions.

2) Introduction

A. *Soil and Environmental Health* - Soil is a term that means different things to different people. To some it is a material in which plants grow in a yard or a field. To some, the color of the soil is important and they speak of red soil, yellow soil or blue clay. To others, the soil texture is important and they speak of sandy soil, clay soil, light soil or heavy soil. To some the soil is everything above hard rock and to others it is the plow layer. Thus, a part of soil evaluation deals with communicating exactly what is meant by the terms “soil”, “soil types” and “soil characteristics.”

The soil scientist, who deals with the genesis and morphology of soils, thinks of soil as that part of the unconsolidated mantle (parent material), covering the surface of the earth, that has been acted on by the forces of climate and vegetation, on a given relief, over a period of time, to form a separate and distinct body (soil profile). Thus, the soil reflects the natural environment of a unit of landscape. By observing the soil characteristics of a given unit of landscape and knowing the environmental conditions that produce such characteristics, a prediction of the problems of the natural environment can be made.

The rapid expansion of the population and its migration into urban and suburban areas has created the need for environmental predictions for planning purposes. A house and lot constitute the environment within which a family makes their home. Such conditions as extremes of wetness or soil permeability on a home site exert a strong influence on the environmental health of the family living on that site. Dampness, ponded water, flooding around or under a house, use and failure of conventional septic tank systems, cracked foundations and the inconveniences that go with these problems, are a direct outgrowth of the soil-water relationship on a lot or within a subdivision.

Problems with environmental health associated with soils result from errors in man's attempt to modify his environment. These errors are generally made by failing to predict soil suitability and in making allowances for modifications or corrective measures. For example, the natural environment of a lot changes in terms of wetness throughout the year and from year to year with changes in the weather. Thus, an evaluation of the wetness of a lot based on the presence of free water in the soil can be expected to vary throughout the year.

Prevention of environmental health problems associated with soils and waste disposal requires prediction of the problems before development begins. Prediction of the problems allows for modifications to be considered prior to development. Corrective measures made after development are more costly, as well as inconvenient to the homeowner or developer. The use of modifications or corrective measures raises the cost of development of a site in terms of initial investment, in terms of maintenance required and in terms of the end result obtained.

Evaluation of land from an environmental health viewpoint requires an understanding of the problems associated with a given unit of landscape (soil study) and an understanding of the processes of conventional septic tank systems.

B. *On-Site Disposal of Liquid Wastes* - Wastewater (sewage) contains many substances that are undesirable and potentially harmful. Present are pathogenic bacteria, infectious viruses, putrescible organic matter, toxic chemicals and excesses of the nutrients nitrogen and phosphorus. Any of these could create public health hazards and nuisances if the wastes were discharged into the environment without proper treatment. To protect the public and the environment, wastes must be treated and disposed of in a safe and effective manner.

Characteristics of Household Wastes: Normal household sewage consists of all the liquid household waste, including waste from the toilet, bath, kitchen and laundry. This is composed of about 99.9 percent liquids and about 0.1 percent solids. The small percentage of solids is responsible for nuisances and, along with the microorganisms in sewage, is the cause of health hazards. Approximately two-thirds of the solids are of organic composition. The remainder is inorganic.

The organic compounds are the primary cause of odors and the nuisance problems attributed to sewage. These are the compounds that require large volumes of oxygen to make them stable, inoffensive, and non-hazardous. Organic compounds in sewage are divided into three groups: nitrogen compounds, carbohydrates, and fats. Nitrogen compounds include proteins, amino acids, amines, peptone, urea, etc. The carbohydrates include sugars, starches, cellulose, etc. The fats include fats, oils, grease, soaps, detergents, etc.

The total solids in sewage consist of dissolved (or soluble) solids, suspended (or colloidal) solids, and the heavier settleable solids. The dissolved and suspended solids remain in the sewage and do not settle out, while the settleable solids are removed from the sewage by gravity. In raw sewage, about 20 percent of the total organic solids are dissolved (soluble) solids. In aged sewage (after 24 hours in a septic tank), the dissolved solids increase to about one-half or slightly more of the total solids initially in the sewage. This is a result of the bacterial action on the suspended and settleable solids.

Treating the Wastes: A successful on-site sewage management system is one which will render the wastes harmless while not allowing harmful pollutants to accumulate to dangerous levels in the environment. It is important to point out that the environment is the part of the system providing the final treatment necessary before the water is of a suitable quality for reuse. It is a stream in the case of a municipal treatment plant and the soil in the case of a conventional septic tank system. If the pollutant load received by the environment is too great, pollutants will not be broken down and they will accumulate, leading to failure of the system.

The environment will perform three functions in the treatment of wastes. It will, (1) tie up inorganic compounds by chemical adsorption in the soil and sediments or by plant or animal uptake, (2) dilute the waste concentrations by the addition of purer surface water or groundwater and (3) break down the wastes and recycle the constituents. The ultimate goal of any wastewater treatment and disposal system is to perform the latter function.

To design a safe and effective wastewater treatment and disposal system, it is necessary to evaluate the physical characteristics of the local environment where discharge of the partially treated wastewater is to be made. Each site has its own characteristics that limit its potential as a treatment medium. This is particularly critical where on-site sewage management systems are necessary. On-site systems lack the advantage of public or community sewage systems, where wastes can be collected and conveyed to a treatment plant located at a site, which is selected for its suitability to receive the wastes. Thus, there are fewer restrictions for sites serviced by a public or community sewage system. On-site systems, on the other hand, must be located near the point of waste generation and local environmental conditions are often less than optimal. The result is that development must often be prohibited or other means of disposal found.

Conventional Septic Tank Systems: Traditionally, the septic tank-soil absorption system has been used to provide on-site treatment and disposal of liquid wastes. It is an ideal system for disposal of liquid wastes since it is simple, relatively maintenance free and inexpensive when compared to public systems. When properly designed, installed and maintained, it is a very satisfactory system.

In general, the septic tank is used to provide partial treatment of the raw wastewater. Its primary purpose is to protect the soil absorption system from becoming clogged by solids suspended in the raw wastewater. The wastewater is discharged from the home directly into the tank where it is retained for a day or more. During this time, the larger solids settle to the bottom, where a sludge blanket develops. The greases, oils and other floating particles rise to the top to form a scum layer.

In addition to acting as a settling chamber and providing storage for the sludge and scum, the septic tank also digests or breaks down the solids that have been removed. Anaerobic bacteria, organisms that live without oxygen, feed on the sludge and reduce its volume. In the process, soluble organic matter is released from the sludge into the effluent. Methane and carbon dioxide gases are also produced which are vented from the tank through the house plumbing vent. Only about 40 percent of the sludge volume can be reduced in this manner, however and about once every three to five years it is advisable to pump the tank to remove the accumulated solids. If this is not done, the tank will fill with sludge to the point where the settled solids will be suspended and washed out into absorption fields, where they can quickly clog the soil pores.

The clarified liquid flows from the septic tank to the soil absorption field for secondary treatment and final disposal. It is an odorous liquid, high in partially degraded waste constituents, suspended solids, organic matter, ammonia and nitrogen. Pathogenic (disease-causing) bacteria and viruses may also be present in high numbers, as indicated by the incidence of fecal coliforms.

However, the conventional septic tank system has no process designed specifically to destroy pathogenic organisms. Should any pathogenic organisms be present in the sewage, they may be removed by the sedimentation process or be killed by the septic conditions existing in the septic tank. However, a large number of any pathogenic organisms present initially in the sewage are carried out of the tank in the effluent. Since the system has no chlorination process, the destruction of these remaining pathogens, as well as the oxidation of the effluent, must be accomplished in the soil. These pathogenic organisms gradually die off or desiccate as the effluent filters through the soil, but during this time they are carried for varying distances. The smaller organisms, especially the viruses, may be carried for great (although unknown) distances. The movement of viruses seems to depend on soil moisture and with high water tables and saturated soil conditions; viruses may move a considerable distance. In one New York state study, it was found that viruses are able to travel more than 200 feet in sandy soils.

Primary and secondary treatment of sewage has the same goal, whether the treatment occurs in a sewage treatment plant, an oxidation pond or an on-site sewage management system. That goal is the destruction of all or most of the pathogenic organisms and the removal by oxidation of the organic matter and other detrimental chemical compounds in the sewage. The main difference is that in a sewage treatment plant, the treatment is controlled and regulated by man through the use of various pieces of equipment. In the on-site sewage management system, the treatment is dependent entirely upon natural processes. Once the system has been installed, man has virtually no control over the functioning of the system and can do little to regulate the treatment processes that are occurring naturally. A certain amount of preventive maintenance can be provided, but, except for removal of accumulated solids from the tank, this is only to avoid external interference.

For this reason, the conditions under which a system is installed must be the most favorable to the functioning of the system. This includes not only the construction of the system, which is controlled by man, but also the natural factors, such as soil conditions, slope of the land, drainage, water table, etc., that are not controlled by man but can be selected by man. The selection of these natural factors is as important to the proper functioning of the absorption field as is the selection of the proper equipment in a sewage treatment plant.

The conventional septic tank system uses sedimentation and anaerobic decomposition in the tank and oxidation in the absorption field to treat the sewage. The two types of treatment occurring in the tank take place at the same time and are counter to each other. The settleable solids in the sewage settle to the bottom of the tank, removing about 35 percent of the solids through putrefaction and fermentation. This decomposition produces large amounts of gases, which tend to stir up the contents of the tank as the gases rise to the top.

Because of the rising gases, many of the fine particles which would otherwise settle out, remain suspended in the liquid sewage and are carried out to the absorption field in the effluent.

To a large degree, the amount of solids being carried out to the absorption field in the effluent is determined by the accumulated solids in the tank. The tank will never clog completely as long as effluent is carried out to the absorption field. As the accumulated solids gradually build up in the tank, they increase in the effluent. To some extent, the amount of solids in the tank and in turn in the effluent being carried out to the absorption field can be reduced by increasing the retention time in the tank. This can be done by using a larger tank. When the tank has reached its capacity and can accumulate no more solids, the amount of solids in the effluent will equal the amount of solids in the raw sewage coming into the tank minus those solids that are lost by decomposition. The solids leaving the tank in the effluent are in direct proportion to the accumulated solids in the tank and to the solids in the raw sewage coming into the tank.

The solids being carried out in the effluent can be held to a minimum by having the tank frequently cleaned, i.e., by having the tank pumped to remove the accumulated solids. Except for cleaning the tank, other maintenance is not required. While several septic tank cleaners and other chemicals are on the market to assist the decomposition process occurring in the tank or in the absorption field, these serve no useful purpose. The decomposition process that occurs in the tank is a natural process carried out by anaerobic bacteria and requires no outside chemical assistance. The aerobic process occurring in the absorption field requires only oxygen, in addition to the bacteria present, for the decomposition process to take place. Chemicals currently on the market do not significantly aid the process and also may have some adverse effects on the system. In fact, some products break down or loosen the sludge layer in the septic tank, which is then flushed into the absorption field and causes premature clogging.

Chemicals such as magnesium and calcium tend to keep the soil open so that the effluent can be absorbed more readily by the soil. However, magnesium compounds are poorly soluble. When combined with the sewage or the effluent, these form compounds that are not readily soluble so that their ions are not readily liberated. This reduces their effectiveness in opening the soil. Sodium and potassium compounds are very soluble so that their ions are readily available. However, these have an opposite effect from magnesium and calcium ions, causing a breakdown in the soil, which increases the chances of clogging. In either case, a relatively large amount of the chemical is needed to cause an effect. If any benefits are derived by the use of the chemicals, it is only on a temporary basis and will not be a solution to any problem.

“Seeding the tank” with anaerobic bacteria is another aid that has been advocated in starting the bacterial process of a new tank. This is done by placing old sewage or sludge or manure in the new tank so that the anaerobic process will begin immediately. However, raw sewage coming into the tank from the building initially contains sufficient anaerobic and facultative bacteria so that the seeding is not necessary, although it has no adverse effects.

Raw sewage initially contains three to five parts per million (ppm) of free oxygen and is acted upon by aerobic and facultative bacteria. This oxygen in the sewage is derived from the liquid waste (wash water, kitchen sink waste, bath waste, etc.) rather than from the human waste. However, the oxygen is soon used up by the aerobic bacteria and the less efficient facultative and anaerobic bacteria become more active. At this point, the sewage becomes septic.

Sewage contains an abundance of nutrients and water, providing an excellent microbiological medium for the growth of bacteria. Raw sewage contains from 100,000 to 1,000,000 bacteria per milliliter. This increases to 10,000,000 to 10,000,000,000 per milliliter in aged sewage. The strictly aerobic bacteria cannot grow in stale or septic sewage and tend to die off. However, many of the strict aerobes are spore formers and exist in the stale or septic sewage in their dormant stage. The majority of the bacteria are facultative and grow in septic as well as raw sewage. These bacteria also grow in the sewage effluent that passes through the tank into the soil. Other microorganisms in sewage include protozoa, fungi, nematodes and viruses. The amoebae are the major intestinal protozoa and exist in the sewage in the cyst stage. Although the yeasts are facultative or anaerobic, most of the other fungi, including the molds and the non-intestinal protozoa, are aerobic. The aerobic organisms tend to die off in the septic sewage or occur in the cyst stage. In this stage they are largely unaffected by the septic conditions. Since the viruses grow only in living cells they do not increase in the septic tank or in the effluent in the soil. Instead, they tend to die off over a varying but usually long period of time.

Many genera of bacteria are present in septic sewage. Among the acid producers, Alcaligenes, Aerobacter, Escherichia, Flavobacterium and Pseudomonas are the most numerous. These are facultative and are also active when the effluent is oxidized. A few of the anaerobes are also acid producers. The methane formers are less numerous and are strict anaerobes. These include species of the genera Methanobacterium, Methanococcus and Methanoscorcina, although other species produce methane as one of their end products. The Desulfovibrio species are strict anaerobes and are important in the reduction of sulfur compounds. Their end product is hydrogen sulfide, which may react with existing metallic ions to form other sulfides, most of which are insoluble.

Since anaerobic bacteria must derive their oxygen from organic matter, they must utilize a larger amount of organic matter than do aerobic bacteria, but their decomposition processes are not as complete as those of aerobic bacteria. The anaerobic decomposition processes, because of the limited source of oxygen, are much slower than are the aerobic decomposition processes. Because of this and the short time that sewage remains in the septic tank, the decomposition of organic matter is incomplete and must be completed through the oxidation processes in the soil.

In the putrefactive and fermentative processes that occur in the tank, the solids are broken down into inorganic compounds, liquids and gases. In addition to these, many of the solids initially in the sewage remain in the effluent since these processes are not carried to completion due to the slow action of the anaerobic bacteria.

The solids that do remain tend to be converted to suspended and dissolved solids. While many settleable solids still remain in the effluent, they are of a smaller size than are the settleable solids in the raw sewage. These factors make the septic tank an inefficient means of sewage treatment.

The 40-50 percent of nitro-organic compounds (mainly proteins, amino acids and amines) is reduced primarily to simpler compounds (methane gas, ammonia and ammonium compounds) through the process of ammonification. Fermentation of the 40-50 percent carbohydrates (starches, sugars, cellulose, etc.) is partially carried out with the liberation of large quantities of methane, hydrogen sulfide and carbon dioxide gases. The sugars and starches are quickly acted upon by the bacteria. The cellulose, however, is fermented much more slowly and receives only minimal bacterial decomposition while in the tank.

The sulfur compounds are acted upon by sulfur bacteria (species of Clostridium, Proteus, Senatia, etc.), which produce hydrogen sulfide or other sulfides from organic sulfur compounds. These sulfides, including dissolved hydrogen sulfide gas, are carried out to the absorption field along with the compounds not acted upon. Detergents, soaps, fats, greases and small amounts of other chemicals that are present in the sewage are acted upon very little by the bacteria in the tank. Those that do not rise to the top of the tank as scum are carried to the absorption field in the effluent.

The nitrogen cycle, the carbon cycle, the phosphorus cycle and the sulfur cycle are all essential in nature for the decomposition and the reuse of essential materials. They are also essential in the treatment of sewage, whether this treatment is in a treatment plant or in an on-site sewage management system. In the conventional septic tank system, these cycles have their beginnings in the septic tank under anaerobic conditions. The cycles are completed only under aerobic conditions in the absorption field. Aerobic conditions must be found in the soil in the absorption field or these cycles are incomplete and the organic and inorganic matter remains in the unstable and offensive state.

In the nitrogen cycle, the nitrogen compounds (proteins, amino acids, amides, urea, etc.) are partially decomposed into ammonia, methane gases and into ammonium compounds in the septic tank under anaerobic conditions. This cycle is continued in the absorption field where the compounds are oxidized first into nitrites and then into nitrates. The cycle is completed when plants absorb the nitrates out of the soil and convert them into plant protein. A continuation of the cycle is the conversion of the plant protein into animal protein. However, in the area of the absorption field only part of the nitrates is taken up by the plants. The remainder stays in the soil. Nitrates are generally considered quite mobile in soils and can be leached out in the groundwater as well as taken up by plants. Private water supplies in the vicinity of absorption fields will sometimes contain nitrates. The concentration of the nitrates in well water is variable and is dependent upon the porosity of the soil, the concentration of the nitrogen compounds in the sewage, the amount of nitrates absorbed by the plants and the distance of the water supply from the absorption field. A high concentration of nitrates in drinking water should be avoided. A maximum contaminant level of 10 milligrams nitrates per liter of water has been set by the Environmental Protection Division, Georgia Department of Natural Resources.

The oxidation of ammonium compounds to nitrites and nitrates is the nitrification process. In the absence of oxygen, the reverse process is brought about by anaerobic bacteria and the nitrates and nitrites are reduced to ammonium compounds.

The sulfur cycle is also reversible. The sulfur compounds in the sewage are decomposed to hydrogen sulfide and to other sulfide compounds under anaerobic conditions in the tank. In the absorption field, in the presence of oxygen, the sulfur bacteria oxidize these compounds first to sulfites and then to sulfates. Under anaerobic conditions in the absorption field the sulfites and sulfates are reduced to sulfides. Hydrogen sulfide or other sulfides present in the effluent remain unchanged if anaerobic conditions exist in the absorption field. The black odorous substance associated with malfunctioning or poorly functioning absorption fields is ferrous sulfide. The presence of this product in an absorption field indicates the lack of sufficient oxygen and therefore anaerobic conditions. Ferrous sulfide is an insoluble compound and increases the clogging of the soil.

A properly designed and constructed absorption field is a very effective biological and physical filter, which is able to break down the organics and other chemical substances and remove pathogenic organisms, including viruses. This is true, however, only where the soils meet rather specific criteria. Quite often these criteria are not met and failing systems result, causing public health hazards and nuisances.

Unfortunately, many soils in the state do not meet the necessary criteria and thus are unsuitable for on-site liquid waste disposal, while many others are only marginally suitable and may require extensive modification to make them suitable. We are interested in identifying those with minimal or no restrictions and also those soils with marginal suitability that may be successfully modified and safely used for wastewater disposal.

C. *Problems and Causative Factors in Failure of Subsurface Waste Disposal Systems* - Regardless of the initial permeability of the soil, many absorption fields fail after a number of years of use due to soil clogging. This first type of failure discussed below might be characterized as creeping failure, or death by old age and/or lack of proper maintenance. Failure may be evidenced by the surfacing of untreated effluent causing nuisance odors and public health hazards. Alternatively, subsurface ponding of water in the absorption field may cause the tank to overfill, resulting in sluggishness or stoppage of the drains in the buildings being serviced by the conventional septic tank system. Water then backs up in toilets and other fixtures in the buildings.

The reason for creeping failure is the gradual formation underground of an impermeable clogged or crusted layer in the soil below and around the absorption field. Flow of water through this clogged or crusted zone is severely restricted or even eliminated, although the permeability of the surrounding soil remains essentially unchanged. Consequently, large volumes of septic tank effluent accumulate in the absorption field.

Several physical, chemical and biological phenomena occur, progressively or jointly, to produce zones of gradually decreasing permeability in soils inundated by septic tank effluent. These processes are largely independent of the composition, constitution or texture of the soil at the system site, the design or layout of the absorption field or the nature of the materials and techniques used in its construction. As a result, even the most carefully constructed systems installed in soils of optimum permeability are subject to failure through clogging or crusting. Some of the mechanisms involved in soil clogging by septic tank effluent are described in the following paragraphs.

Every soil is composed of myriads of particles of varying shapes and sizes. Since these particles cannot fit together perfectly to form a solid mass, each soil is replete with a labryinthic series of interjoining pores of capillaries, which are normally filled to varying proportions with air or water depending upon the moisture content of the soil. Because these capillaries or pores are interconnected, moisture such as that from rainfall can slowly pass from higher to lower layers (horizons) in the soil and eventually into the groundwater. Soils composed mainly of large particles (sands) have larger capillaries and conduct water faster (i.e., water soaks or percolates through sandy soils at higher rates). As soil particles size decreases, the size of the capillaries also decreases and although the number of capillaries increases, water soaks or percolates much slower through finer grained soils (Rates decrease in the series: coarse sand >fine sand>sandy loam>silt>silt clay>clay).

When large amounts of pure water are allowed to pass through soils composed of particles of different sizes, the rate of percolation is found to gradually decrease. The reason for this is that the flow of water causes smaller particles to become dislodged and to be swept into some of the larger capillaries where they become lodged in constricted areas, effectively blocking the capillaries.

This phenomenon causes deterioration of the physical structure of the soil and when referred to surface soil it is given the name "puddling." Compression of puddled soils can cause "smearing," i.e., more effective blockage of the soil capillaries under compression forces. Smearing can occur during construction of on-site sewage management systems if heavy machinery is run over or used to excavate wet soils. This compression effect can cause reduction in flow through the walls of absorption trenches as it effectively seals off soil capillaries.

Puddling and smearing are not the only phenomena that initiate blockage of the soil capillaries. Although most of the solids present in household waste waters (usually about 400 ppm) settle out as sludge at the bottom of the septic tank and the bulk of fats and grease separates as a floating scum at the top of the tank, the effluent discharged at an intermediate height from the tank into the distribution system leading to the absorption field is not completely free of suspended insoluble solids. Residues of vegetable matter and fibers from toilet tissue and similar items form swollen gel-like particles not very different in density from water. Such particles do not settle out rapidly and some are carried in the effluent into the absorption field. Normal septic tank effluent usually contains about 140-150 ppm of suspended solids. The capillaries in the soil of the absorption field filter out these suspended particles very effectively, but the pores of the soil filter become stopped up by them, reducing the rate of percolation.

Effluent from the tank also contains large numbers of bacteria. The bacterial cells also behave like small particles. They are filtered out of the percolating effluent by the soil capillaries, causing further blockage of the soil pores.

Both these bacteria and the natural soil bacteria present in the absorption field are provided with a constant supply of dissolved inorganic and organic nutrients that contained in the effluent flowing into the field. Consequently, all of these bacteria multiply very rapidly in the soil and the resulting microbial biomass creates further barriers to the seepage of water through the soil capillaries.

Although these phenomena cause a detrimental reduction in the rate of flow of water through the soil, they also produce a beneficial increase in the wastewater treatment capability of the soil. A tighter filter is more efficient at removing suspended solids while the larger bacterial biomass is more efficient at degrading organic wastes in the septic tank effluent.

Septic tank effluent enters the absorption field intermittently in direct relation to amount and frequency of water usage. Effluent entering the septic tank displaces a finite volume of clear liquid into the absorption field. To avoid surfacing of effluent or saturation of the absorption field, soil percolation rate must balance the volume of the effluent to be filtered through the soil layers. As a sequel, air enters the absorption field through soil pores to further dry the absorption field.

As long as air continues to be drawn into the absorption field as the water soaks away, a mixed population of aerobic microorganisms will remain in the absorption field to affect biodegradation of the soluble and insoluble organics transported into the absorption field with the septic tank effluent.

However, as more and more soil capillaries become plugged, the rate at which the water seeps away becomes slower and slower so that less and less air is drawn into the absorption field. Under these conditions, aerobic fermentation in the absorption field is gradually replaced by anaerobic fermentation.

During microbial fermentations, microorganisms digest organic materials using part of them for energy maintenance and part for forming their cellular mass. In order to break down and utilize organic compounds, microorganisms must have other compounds available to be used as electron acceptors. The oxygen present in the air is the normal terminal electron acceptor used by all aerobic organisms in this process. The oxygen is reduced to water and used to produce carbon dioxide (CO2) from some organic compounds. If no air is available, microorganisms that can live in the absence of air (anaerobic bacteria) will use other inorganic (e.g., nitrate or sulfate) or organic compounds as electron acceptors. Reduction products associated with organic matter conversion under anaerobic conditions include nitrogen (from nitrate), sulfide (from sulfate) and methane (from organic), each again being accompanied by carbon dioxide (CO2) produced from organic matter decomposition.

In absorption fields, when air is no longer drawn into the soil the range of electron acceptors available to microorganisms in the absorption field becomes very restricted. There is no dissolved oxygen in the septic tank effluent because any air in the water has already been used up in fermentations in the tank. Most of the simple, readily biodegradable organic compounds have also been converted in the tank, so that these, too, are no longer available as electron acceptors. Only minor amounts of methane are produced in ponded effluents. The only significant electron acceptor available in ponded fields is sulfate (4-10 ppm). This is rapidly reduced to sulfide. Even though septic tank effluent is alkaline (pH=7.5-8.0), owing to free ammonia in the water, free hydrogen sulfide (odor) becomes detectable in fields that have been constantly ponded for a few months.

Sulfides are toxic to most microorganisms. Only surface bacteria, which can reduce sulfides further to elemental sulfur, can survive in the presence of high sulfide concentrations. The presence of free sulfide in stagnant absorption fields may therefore kill off many of the bacteria, which would otherwise be degrading organics. Some of the free sulfide may be converted to insoluble sulfur, causing further blockage of soil pores. However, very little of the sulfide produced in the absorption field remains in the free state. The bulk of it combines with ions of heavy or transition metals (e.g., iron, manganese, nickel, copper, magnesium, zinc, etc.) present in the soil or in the wastewater (5 ppm total metal cations in septic tank effluent). This causes the deposit of black, insoluble, inorganic sulfides in the beds. Failed absorption fields invariably have intensely black impervious layers underneath and around the gravel. The gravel itself is generally coated with black slime. This is not surprising since incoming tank effluent already contains 2-5 ppm of sulfide.

The insoluble sulfides contribute to further blockage of the soil capillaries, but this may not be their most deleterious effect. Many elements tied up in insoluble form as sulfides are required by microorganisms for their redox enzymes, the organic catalysts needed for respiratory functions, including degradation of organic matter. Binding of trace elements by sulfides may therefore inhibit organisms otherwise capable of destroying organic materials in the absorption field.

One last contributor to clogging is the action of the anaerobic bacteria themselves. Many microorganisms, especially anaerobic bacteria, produce polysaccharide slimes or gums, which they secrete into their surroundings. These seem to function as a protective sheath around the bacterial cell wall. When formed in situ in the absorption field, such polysaccharides help to form an impermeable layer in the bacterial zone. Organic matter, obtained from clogged layers of ponded fields, contain about 5% polysaccharides, some of which may be from bacterial slimes or gums of this type.

Appearance of Clogged Zone: A combination of physical deterioration in soil structure, soil pore blockage by solids and bacteria from the effluent, proliferation of heterotrophic soil bacteria and deposition of insoluble sulfides and bacterial slimes, gums and metabolites (e.g. sulfur) produces a zone of clogging in the soil which will not allow water to seep away at a tolerable rate. Measurement of the distribution of organic matter through typical clogged layers reveals that the bulk of this material occurs in the soil immediately next to the gravel. The amount decreases abruptly with the distance outward or downward from the gravel. A similar distribution is found in the amount of sulfides in the soil.

Where this type of zone occurs in a coarse textured soil, air can begin to penetrate into the soil beneath the clogged areas restoring aerobic conditions when the flow of water diminishes. The minor amounts of organic matter present under the zone of maximum clogging are then apparently oxidized and degraded rapidly, so that the soil in this region reassumes an almost natural appearance. A relatively sharp boundary then results between this aerobic layer and the heavily blocked, black anaerobic layer. The dense anaerobic layer becomes very hard and brittle, assuming the character of a crust in the soil. Occasionally a narrow grey intermediate zone is observed underneath the black crust. This crust is very strong since it is capable of retaining thousands of gallons of stagnant water, which are ponded above it in the field under several feet of hydrostatic head. The soil above the crust is thus permanently saturated with moisture, but that below the crust is unsaturated, generally having about the same moisture content as similar soils at the same depth in areas quite far removed from the field.

D. *Other Causes of Failure* - Other possible causes of failures with on-site sewage management systems that use soil for final treatment include, but are not limited to:

1. Seasonal or permanent high ground water elevations;
2. Structural damage to soils with high clay content by construction equipment, especially if soil moisture is high;
3. System improperly installed;

4. Inadequate design capacity for the actual sewage loading;
5. User abuse in the form of overloading, failure to perform maintenance intervals, neglect of leaking or maladjusted plumbing fixtures, inordinate use of chemical additives or other deleterious material and physical damages to part of the sewage system caused by digging, grading, filling, heavy traffic or other damaging actions;
6. Flooding by storm water or other surface water sources; and
7. Adverse soil conditions such as shallow bedrock or very slowly permeable soil conditions.

3) Soil Evaluations

A. *Use of Soil Maps in Evaluating Site Suitability for Soil Absorption Systems* - Soil maps are an essential part of the environmental evaluation of an area. They represent parts of the earth surface. Soil evaluation for on-site sewage management systems involves a specific location in the landscape that is difficult to describe without a map.

The soil maps indicate different soil types by soil symbols and the solid lines containing the symbol show the boundary and extent of each area. For example, Troup (Tr) represents a deep, well-drained soil, located on upland ridge tops and hillsides of the Southern Coastal Plains; Chatuge (Ch) represents a deep, poorly drained, nearly level soil located on low stream terraces in mountain valleys. Interpretations of the soil maps will indicate whether or not soil at a particular site is subject to an intermittent high groundwater table or has rock formations near the surface. These will also help to avoid mistakes caused by variable percolation test rates that result from the test being conducted during different seasons of the year.

The preliminary investigation of an area with soil maps will permit the determination of site suitability regardless of the time of year the evaluation is made. The soil map is reliable for predicting general soil capabilities for an area of several acres. However, it generally does not contain enough detail to predict the limitations for a specific disposal site because different types of soil can exist within short distances. Maps are likely to be least reliable in the vicinity of a soil boundary.

The preliminary investigation of an area with the use of soil maps can be an important tool in reducing development costs. If the soil map indicates that a high percentage of an area is unsuitable for conventional septic tank/soil absorption systems, it may not be economically feasible to pursue development. This would require consideration of alternative on-site sewage management systems or a community or public sewage treatment system. If a community or public sewage treatment system is selected, then a lot by lot evaluation could be eliminated.

A subdivision map or plat showing lots and roads is of little value for evaluating an area for the development of conventional septic tank/soil absorption systems unless soil types have been used as a basis for the evaluation. In fact, without consideration of soil types during the preliminary investigation, this could create problems such as road and street relocation, resubdividing and other costly changes.

B. *Physiographic Provinces* - The physiographic provinces or major land resources areas

(MLRA's) provide a general idea of what can be expected in terms of soil conditions and parent materials. Georgia has eight provinces that vary greatly from the mountains to the sea. See Figure 2.C.

- *Sand Mountain (MLRA 129)* - This province consists of mountain plateaus with gently sloping ridge crests at elevations of approximately 1500 to 2000 feet above sea level. Side slopes of the plateaus are steep with escarpments of sandstone, shale and limestone. Mean annual rainfall is approximately 54 inches.
- *Southern Appalachian Ridges and Valleys (MLRA 128)* - This province consists of ridges of limestone, cherty limestone, sandstone and gently sloping valleys filled with material eroded from the ridges. Elevations range from approximately 600 to 1500 feet above sea level. Mean annual rainfall is between 52 and 56 inches.
- *Southern Blue Ridge (MLRA 130B)* - The Blue Ridge Province consists of mountain ridges with steep slopes, foothills and narrow intervening valleys, underlain by acid crystalline metamorphic rock. Depth to rock is shallow except over some of the colluvial materials occurring near the bottom of slopes. Elevations range from about 700 to 4,700 feet above sea level. Mean annual rainfall is between 52 and 90 inches.
- *Southern Piedmont (MLRA 136)* - This province is a broad plain that has been dissected by streams. It is an old land surface with rounded slopes that is underlain by acid crystalline and metamorphic rock. Elevations range from about 500 to 1500 feet above sea level. Mean annual rainfall is 44 to 56 inches. The degree of the slope has a strong influence on the soils developed over a given parent material. On steep relief, the soils are generally shallow and weakly developed, while on flat relief the soils are usually deeply weathered with deep clay subsoils. Clay or fragipans are frequently associated with flat areas and seasonal water tables are associated with these soils.
- *Sand Hills (MLRA 137)* - This province consists of gently sloping to steep sloping soils derived from marine sands, loams and clays that were deposited on acid crystalline and metamorphic rocks. Elevations range from 300 to 500 feet above sea level. Mean annual rainfall is between 40 and 52 inches.
- *Black Lands (MLRA 135A)* - This province consists of irregular out-croppings of marl and clays and shallow to moderately deep soils derived from marl and clay. Elevation is approximately 400 feet above sea level. Mean annual rainfall is about 46 inches.
- *Southern Coastal Plain (MLRA 133A)* - This province consists of soils occupying broad in stream areas having gentle to moderate slopes and underlain by marine sands, loams and/or clays. Elevations range from approximately 250 to 500 feet above sea level. Soils are generally deep and depth to rock is usually greater than six feet. Mean annual rainfall is between 40 and 52 inches.
- *Atlantic Coast Flatwoods (MLRA 153)* - This province consists of nearly level and shallow depression soils, which generally have seasonal high water tables and are underlain by marine sands, loams and/or clays. Deep sandy surface soils are usually found in this province, but loams and clays underlie most of the area and restrict downward movement of water. Seasonal water tables and drainage are a problem. Elevations range from sea level to about 300 feet above sea level. Mean annual rainfall ranges between 44 and 53 inches.

- *Tidewater Area (MLRA 153B)* – This province is on a nearly level coastal plain crossed by many broad, shallow valleys that have meandering stream channels. Most of these valleys terminate in estuaries along the coast. Mostly unconsolidated Coastal Plain sediments occur at the surface throughout this area. They are a mixture of river-laid sediments in old riverbeds and on terraces, flood plains and deltas. The soils in the area are characterized by restricted drainage; an aquic moisture regime; and mixed clay and siliceous mineralogy. The water table typically is close to the surface. Elevation ranges from sea level to less than 25 feet. Local relief is mainly about 3 feet or less. Average annual precipitation in this area is 40 to 58 inches.

C. *Soil Profile* - A soil profile consists of a vertical section of the soil extending through all its horizons and into the parent material. A number of similar soil borings indicate a soil series landscape. A soil profile will have a surface soil, a subsoil and parent material. Upland soils, other than in the coastal plains, usually have hard rock below the parent material.

Soil borings are made in a unit of landscape to confirm expectations. A record should be kept of the depth, color, and texture of each major horizon. The record should show the range in depth, color and texture within a unit of landscape. Several borings may be necessary where deviations are noted.

Soils on hilly or steep topography can frequently be expected to have thin or no subsoils. In some places, the original surface has eroded away and the present surface layer contains subsoil material.

Changes in the soil series may be due to changes in parent material, deposits or capping, and depth to restrictive layers such as clay, sand, fragipans or hard rock.

The soil borings will indicate depth to hard rock. The soil color, especially subsoil color, will indicate the presence of a seasonal water table in the soil, which causes problems during wet weather. The soil texture will indicate possible problems with the rate of absorption, as well as the best horizon to test for absorption rates and in which to install absorption lines.

D. *Soil Color* - Soil color is a reliable guide to the natural drainage of a landscape. It can provide clues as to whether the soil has difficulty absorbing the normal rainfall or can absorb the rainfall without ponding at some point in the soil profile.

Soil color is directly related to the oxidation or reduction of the iron present in most soils. The organic acids passing through the soil require the addition of oxygen from their decomposition to carbon dioxide and water. When soil pores remain filled with water for extended periods, the oxygen supply is restricted and the iron is reduced to help supply the needed oxygen. This produces gray, brown or red mottles or gray matrix color.

The significance of this to the proper function of an absorption field is that colloidal organic matter moves into the absorption field and, if not oxidized, tends to block the soil pores. In addition, unaerated sewage effluent then travels into the ground water for reuse in a very poor quality condition.

Uniform red, brown or yellow soil color does not insure the proper function of an absorption field. It does indicate that the soil is able to absorb the normal rainfall without ponding, but soils with bright colors (red, brown, yellow) may have slow rates of absorption and, consequently, not be capable of absorbing the additional burden of sewage effluent.

Red or Brown - Red or brown colors indicate good natural drainage in relation to rainfall. Soils with these colors occur on upland ridges or side slopes and allow good runoff of rainfall. Many soils that are red or brown in color may have slow rates of absorption.

Gray - Gray colors indicate a ponding of water in any horizon in which they occur. Soils with gray colors occur on flat or slightly depressed low lands and most of the rainfall soaks into these soils. The ponding of water is generally seasonal in nature and usually will not be present in dry periods. It can occur in sands or clays and may not be directly related to percolation tests. Gray color may also occur in the lower subsoil or at the horizon of some soils on steep slopes and should not be interpreted as a sign of wetness in these instances.

Black - Black colors are due to organic matter that masks the true color of the soil. Organic matter accumulates because the soils remain wet most of the time, which prevents its breakdown. Soils with this color exist in shallow depressions or bays.

Gray and Yellow Mottling - Gray and yellow mottling indicates a seasonal ponding of water in the soil at the depth at which the mottling occurs. Absorption lines shall not be placed at depths where the mottling is observed because they can be expected to fill with ground water during wet periods. To be reliable, moist soil from the subsoil of the profile should be observed for color. In most cases, there is a direct relationship between soil color and landscape positions.

Water may pond in soils for very short periods above the levels indicated by gray mottles. The gray color indicates the water ponds for an extended period. Even a mottle-free soil may be saturated for short periods after a rain.

Gray Color in Soil - The gray color or gray mottles are usually associated with ponded water in the soil profile. It is related to the reduction of the iron in the soil from the ferric to the ferrous form. Reduction of iron occurs when organic acids are present in a saturated soil with limited oxygen. The organic acids are unable to secure enough oxygen from the water and revert to the next most readily available supply from the ferric iron. Gray mottles or colors indicate the supply of oxygen is limited during wetter portions of the year. A higher percentage of gray in a soil indicates longer duration and greater frequency of the ponding periods.

Soils with gray colors or mottles indicate potential problems with absorption systems. Periods of soil saturation will interfere with the disposal of water into the soil. Soils with a wetness problem have a low oxygen supply during saturated periods and the addition of effluent compounds the problem, causing more rapid clogging of soil pores with organic waste.

Gray colors or mottles indicate about four weeks of saturation on a repeating basis throughout the year. The cause of the saturation of the soil may be due to slow percolation in the gray mottled zone or to a restriction at some depth below the horizon which ponds water into the mottled horizon.

Absorption fields installed in mottled horizons of soil will have difficulty absorbing sewage effluent and organic waste during the periods of saturation. Saturation of the absorption field will eliminate the safety factor provided by the gravel trench storage area and overload the system. Repeated saturation of absorption fields with excess ground water causes blocking of the soil pores with colloidal organic matter due to low oxygen supply. Unsaturated conditions are necessary at both the absorption field depth as well as below the absorption field for a reasonable distance to insure adequate filtration and treatment of sewage effluent.

E. *Natural Soil Drainage* - The natural drainage of soil depends on how much of the water falling on the soil enters the soil and how well it passes through the soil. The position of the soil on the landscape and the degree of slope influence the former and affect the drainage class of the soil.

Flat land or depression areas have very little runoff and may receive additional runoff from higher ground, most of which must drain through the soil. Poorly drained soils generally occur in these positions. Undulating or rolling land has more runoff and less water must pass through the soil. Soils in these positions are generally well drained or moderately well drained. On steep slopes, most of the water runs off. The amount and types of vegetation also influence the amount of runoff.

The texture of the soil is another factor that influences the natural drainage. Sandy soils drain better than clay soils. A well-drained clay soil may still not be absorbent enough to pass a percolation test. Whether the subsoil is heavy (clay) or light-textured (sandy) may influence the natural soil drainage.

Fragipans and solid rock influence the natural drainage because they restrict the downward movement of water. If the internal drainage is limited, then the capacity of the soil to absorb water is limited and water will stand in the soil above the restriction.

The presence of water above the restriction is reflected in the color of the soil. The colors and where they occur in the soil are used in determining the drainage class of the soil. The drainage classes do not refer to specific depths at which the mottling occurs but rather to the horizons in which mottling occurs. The depth to gray mottles will affect classification of the soil.

The question might be raised as to how the soil could be excessively drained. The excessively drained class is a reflection of the availability of water to plants rather than of drainage as such. It reflects drainage in that these soils do not hold enough moisture for normal plant growth. However, soils that are excessively drained may be undesirable for the installation of on-site sewage management systems due to the fact that the effluent may pass through the soil too rapidly to be properly filtered and thus reaches the groundwater before it has been adequately treated.

The drainage classes are as follows:

1. *Poorly Drained Soils* - Poorly drained soils can generally be expected on broad flats or depression areas along drainage ways. Runoff water moves very slowly and the soil remains saturated for long periods. Frequently, these soils receive additional runoff water from higher surrounding areas. The seasonal water table is at or near the soil surface for long periods. The surface and subsoil colors are grays with a few yellow

and reddish mottles. Frequently the subsoils are clay, but poorly drained soils may also be sandy. Percolation tests are not needed on these soils because a seasonal water table will restrict their use. Some of these soils may pass a percolation test during dry periods.

2. *Somewhat Poorly Drained Soils* - Somewhat poorly drained soils occur on flat to gently sloping relief and most of these areas are subject to flooding. Water drains from the surface soil but not from the subsoil. They are commonly mottled with gray at depths of six (6) to twenty (20) inches from the soil surface. They have a seasonal water table in the lower surface or upper subsoil. The entire soil generally has a yellowish or leached appearance, indicative of internal drainage problems. The percolation tests, if done in such soils, must be conducted above the seasonal water table elevation and be properly saturated prior to running the tests.

3. *Moderately Well-Drained Soils* - Moderately well drained soils occur on nearly level to strongly sloping topography. These soils have gray mottling in the lower subsoil (below 20 inches), indicating a restriction to drainage below this depth. Soils with restrictive layers, such as fragipans, may have this drainage classification but it is not restricted to soils with fragipans. These soils generally have rather pale surface colors but may have red, brown or yellow colors in the upper subsoil. Percolation tests on these soils will mainly measure lateral movement of water because movement is restricted in the lower subsoil. Deeper percolation tests may be necessary to determine the degree of restriction to internal drainage.

4. *Well-Drained Soils* - Well-drained soils occur on nearly level to steep relief. They are free of internal restrictions in natural drainage. The soils may be red, brown or yellow in the subsoil. In some places, yellow and red mottling may occur in the lower subsoil. These soils may need to have percolation tests run because some well drained soils are too heavily textured (clayey) to absorb water at the necessary rates.

5. *Excessively Drained Soils* - Excessively drained soils generally have little or no subsoil development and do not retain much water. Most of these soils are sandy. Many of these soils are shallow to rock north of the fall line. Contamination of shallow ground water aquifers is a concern where these soils are being considered for the installation of on-site sewage management systems using soil absorption for disposal of effluent.

F. *Soil Texture* - Soil texture depends upon the relative proportions of sand, silt and clay particles in a soil. These proportions can be determined by special equipment in a laboratory. Relative differences in soil textures can be determined in the field by feeling the soil when moist. It is of value to determine if a soil is predominantly sand, clay or silt or is a mixture of various sizes. Within a geographic region, infiltration rate, permeability, aeration and drainage are closely related to soil texture. The evaluation of texture is needed to provide some indication of the rate of absorption and problems with absorption. Sandy horizons will have larger pores than clayey soils. Thus, a clay soil can be blocked by organic matter in the drainfield more readily and fail more rapidly. The essential part of texture evaluation is to determine if a soil is sandy or loamy or contains enough clay to produce a ribbon when moist.

G. *Seasonal Water Tables and Free Water in Soils* - Attempting to determine seasonal water tables by the free water present in a soil at any point in time can create problems with uniformity of evaluation. The problem is one of consistency of evaluation both in wet and dry periods. Therefore, the evidence of gray colors or gray mottling is the best indicator to determine if soils are saturated or have seasonal water tables. Free water may occur above the depth of gray colors or mottling in wet periods and be absent in dry periods. Thus, a reliable evaluation of seasonal water tables must include gray colors. Generally, the presence of Chroma 2 gray color in the soil horizon is an indication of the seasonal high water table.

Free water moves through the larger soil pores after a rain. The distance that the free water moves downward depends on the intensity and duration of rain, the surface absorption capacity of the soil, changes in pore size with soil texture, depth to restrictive layer and the amount of free water already in the soil. Free water will pond on top of a soil or near the surface causing seasonal water tables that usually can be observed during late winter or spring. Care must be exercised in using the presence of free water to indicate a seasonal water table. A well-drained sand may have free water moving through the profile for a day or two following a heavy rain. Therefore, free water present in the soil shall be associated with gray colors in the form of mottles or base color of the soil to provide consistency in indicating seasonal water tables. When free water is present in the absence of gray soil colors, this could indicate a slow rate of absorption.

Seasonal water tables are the result of restrictions in free water movement. The restrictions can be clay horizons, plinthite horizons, dense sandy horizons, parent material, fragipans and rock. Oxidation of organic waste is greatly reduced in the presence of free water. Since one of the objectives of an absorption field is the oxidation of organic matter, the accumulation of this waste creates problems. The soil pores are clogged with biomass from the growth of microorganisms. Health hazards may result if a seasonally high water table forces the sewage effluent in an absorption field to surface, causes effluent to back up into a dwelling or commercial establishment or allows the effluent to enter and contaminate ground water.

H. *Degree and Type of Slope* - Soil information and soil type have a definite relationship with relief and landscape features. Major changes in slope usually indicate changes in soil characteristics. Landscapes can be mentally divided into slope units for evaluation. Not only the degree of slope, but also the type of slope should be observed. A convex slope has a mounded shape and is shallow to parent material. A concave slope is bowl-shaped and because of the slow movement of runoff water, there is a corresponding increase in the amount of water moving through the soil, which weathers the parent material and forms a deeper soil. The type of slope commonly changes from one side of a drainage way to the other. Examples may include:

1. *Flat Topography* - Flat topography receives the maximum impact of climate in the form of rainfall. Slopes are less than 2 percent. Runoff, if it occurs, is very slow and ponding is common for long periods. The rain has time to enter the soil, resulting in more intense and deeper weathering, which causes downward movement of clay and thick sandy surfaces. Internal drainage problems and seasonal water tables are expected on flat landscapes.

2. *Gently Sloping Topography* - Gently sloping topography appears flat but actually has a slight convex curve to the surface. Slopes range from two to six percent. This allows for a portion of the rainfall to run off before entering the soil. The soils on this type of

topography are generally weathered and deeply developed but can be expected to be better drained than those on flat topography.

3. *Sloping Topography* - Sloping topography includes those with slopes in the range of six to fifteen percent. Runoff is increased and the soils are generally shallower to parent material. High clay content layers are common between 15 and 36 inches from the surface. Natural waterways are a problem in subdivisions, and lot adjustment may be necessary to avoid drainage ways. Erosion of surface soils can be a major problem in subdivisions due to increased slopes with this type of topography.

4. *Concave Relief* - Concave relief describes areas of depression. These areas receive large amounts of water and tend to be very wet. Generally, they are not acceptable for construction of absorption fields.

I. *Position in Landscape* - The position of an area of land in the landscape, like the physiographic province, gives some idea of what to expect in terms of soils. The position may be apparent from observation or it may become apparent as soil borings are made. Examples may include:

1. *Alluvial Position / Bottom Land / Floodplain* - Alluvial positions are the areas adjacent to streams or rivers where flooding may occur. They differ slightly from colluvial positions in that the soil material has been picked up by floodwaters, sorted by stream flow and deposited. Sandy materials are deposited adjacent to the stream channel and clays are deposited in the slack water adjacent to the valley walls. The alluvial soils are formed by deposition in layers rather than by weathering of parent material. The soil horizons are not distinct and may be nothing more than textural changes. The position in the landscape is characteristic in that it is a flat area adjacent to the stream, with the soil having poor definition in terms of surface soil and subsoil horizons. The soils may range from excessively drained to poorly drained. Rates of absorption are not a problem in dry weather in the better drained alluvial soils. The major hazards are periods of flooding and the complete saturation of the soil that occurs during these times.

2. *Colluvial Positions (Local Alluvial)* - Colluvial positions are the areas along drainage ways that periodically flood during and after a rain. Runoff water from the upland carries small rocks and soil material down the slopes and part of this is deposited at the base of the slope with little sorting. The result is a filling of the area with partially sorted soil material and the development of a deep surface horizon. The soil in such a position may range from excessively drained sand to poorly drained clay. The problem with colluvial areas is the periodic flooding of the soil during and after a rain, the seepage from adjacent uplands that keeps the soil moist and the natural accumulation of organic matter. Flooding does not always remain long enough in some places to reduce the soil and produce a gray color. The incidence of failure of absorption fields is related to the accumulation of organic matter. Over a period of time, the absorption field fails as the organic matter accumulates in the field and blocks lateral movement of water. Detailed topographic maps provide a good means of locating drainage ways in the landscape. Observing the landscape before making soil borings may indicate the site to be the lowest point and thus the channel of runoff water. The soil borings may indicate a deep uniform surface soil not expected in upland soils. Rates of absorption may be good in such positions in dry weather.

3. *Old Colluvial* - Old colluvial deposits are formed from materials that have moved down-slope by gravity and water. The material has not been sorted and may contain angular and partially rounded rocks of all sizes. These deposits are generally associated with mountainous areas but may occur at a considerable distance from their source. The distinguishing features are a uniform slope gradient at the base of the mountain and the loose rock throughout the profile. The depth of thickness of the deposit is variable. The natural drainage ranges from well drained to poorly drained. The area of contact with the old land surface frequently forms a tight layer, resistant to water movement, which may be reflected in the natural drainage of the soil. Local deposits of material occur on mountain slopes and throughout the Piedmont and Valley provinces. The soil problems are similar to those of upland soil except that a tight layer can be expected at the point of contact with the old land surface, which may limit absorption. Stability of the material may be a problem when it is cut for roads or house sites. Weathering of underlying rocks is generally deeper than that of adjacent areas without colluvial depositions.

4. *Terrace Positions* - The terrace positions are the old alluvial positions that have been left by the down cutting of streams. The result is that only the low terrace positions may flood under normal rainfall. The terrace positions are generally underlain by gravel depositions. The topography is characterized by the almost flat relief and the location adjacent to streams but at a higher elevation. The soils range from well drained to poorly drained, with the better drained soils adjacent to the stream and more poorly drained soils adjacent to the valley walls. The soils have developed surface and subsoil horizons similar to upland soils. They are frequently underlain by rounded gravel depositions. The problems of these soils are similar to those of the upland soils. The gravel deposits may be loose or compact and dense. Many soils in this position have fragipans. The lower terraces are subject to flooding.

5. *Upland Positions* - This term includes all areas not covered by other positions. The soils developed in these positions result from the soil-forming factors working on parent material. The natural drainage may range from excessively drained to very poorly drained and is not related to elevation. The upland soils are strongly influenced by and reflect the type of parent material from which they were formed and are also influenced by the degree of slope.

4) Soil Investigations

A. *Soil Investigation Requirements:*

1. Subdivisions:

   a. *Pre-Development Review* - It is recommended that developers considering subdivision or mobile home park development obtain at least a preliminary soil study from a Certified Soil Classifier, Registered Engineer or Registered Geologist prior to developmental improvements.

   b. *Final Review* - A soil map and soil descriptions based on a high intensity soil study are required for subdivisions and mobile home parks prior to approval of such development by the county health authority. The soil map shall be overlaid onto a copy of the final subdivision plat and the approved professional (Certified Soil Classifier, Registered Engineer or Registered Geologist) must affix their signature and seal on the final plat.

c. *Minimum Requirements for a High Intensity Soil Study (Level 3)* - A high intensity soil study shall be identified as a Level 3 soil survey and map. A Level 3 soil survey and/or soil map are based on a comprehensive soils investigation of a given landscape. The purpose of the soil survey is to identify, delineate and interpret the suitability of the soil series found on the site as it pertains to use for on-site sewage management systems. The soil survey must meet or exceed specified accuracy and quality standards for the data from which the County Board of Health permits on-site sewage management systems. All Level 3 soil surveys and related interpretive data shall be based on the Georgia Department of Public Health Manual for On-Site Sewage Management Systems, National Cooperative Soil Survey standards and the current Soil Survey Manual (Soil Survey Staff, 1993). Soil series used to name map units must be classified according to the most recent edition of Soil Taxonomy (Soil Survey Staff, 1999), with map unit boundaries and map features plotted on a map at a scale that may range from one inch equals ten feet (1"=10') to one inch equals one hundred feet (1"=100'). Smaller map scales (1"=200', 1"=500', etc.) are not acceptable. Level 3 soil surveys must be based on a two-foot contour interval topographic map. The topographic map and boundary survey must be provided before the beginning of any fieldwork. The soil survey must include a title block or caption that includes the project and/or client name, location of the project, date of the survey, narrative, bar scale and north arrow. The soil survey shall include any features that may affect the location or performance of on-site sewage management systems. Examples are: the location of springs, wells, existing structures, rock outcrops, ephemeral drains, gullies and visible trash pits. The soil survey must include a legend that defines any symbols used to illustrate these features on the soil map. The soil survey and soil map must bear the name, stamp, address and telephone number of the Certified Soil Classifier, Registered Engineer or Registered Geologist performing the survey. The "Official" Level 3 soil survey used for on-site sewage management system permitting is that which bears the original seal and signature of the individual performing the work. The Certified Soil Classifier, Registered Engineer or Registered Geologist shall affix their signature and seal only on soil surveys that are their work or work performed under their direct supervision. Any revision to a Level 3 soil survey must be clearly designated as such and dated. The Level 3 soil survey must include a table or narrative that describes site-specific properties of each map unit (named for soil series) mapped at the site. For each map unit, the table or narrative must include the following: soil series name (symbols are not allowed), the percent slope or slope range (symbols are not allowed), minimum depth (range is unnecessary) to seasonal saturation (seasonal high water table), minimum depth (range is unnecessary) to auger refusal or impervious layer (soft or hard bedrock or other horizons that restrict water movement), recommended installation depth (if applicable) and estimated percolation rate at the recommended installation depth (if applicable). The estimated percolation rate shall be based on the most limiting soil horizon that comes into contact with the absorption trench sidewall, bottom and for a distance one (1') foot below the recommended installation depth. The upper and lower depth limits of the horizon in which installation is recommended shall be provided for each map unit. The depth range over which installation is recommended must be at least 24 inches to encompass a 12-inch sidewall thickness and 12 inches of soil below the trench bottom. If the 24-inch thickness installation zone includes a horizon with lower percolation rate than the optimum, the maximum percolation rate in the depth interval must be used for on-site system design. Minimum depths to bedrock or seasonal saturation shall be provided for each map unit and specific depths identified for each boring on the soil map. Phases of soil series are an acceptable method to map depths more narrow than those used to define the series. Variants of series have different interpretations than the named series and these differences shall be reflected in the interpretive table. An interpretive statement describing the limitations for utilization of on-site sewage management systems shall be provided for each soil series map unit. This interpretive statement may contain notes, observations or other pertinent information reflecting the soil properties of the map unit that affect its ability to function for wastewater disposal. These map unit interpretation statements must be based on the soil properties and landscape positions observed on site by the approved professional. Map unit interpretive statements shall be expressed in a narrative format on the soil survey report or soil map. The number of soil observations required for the Level 3 soil survey will depend on the soil conditions encountered during the study and landscape complexity at the site. At least four (4) pedons shall be evaluated and classified for each one (1) acre mapped. For example, if an area is 1.5 acres, a minimum of 6 test borings must be evaluated and classified. If the site is less than one acre, a minimum of four (4) pedons shall be evaluated and classified. However, the Soil Classifier, Registered Engineer or Registered Geologist shall perform as many soil boring observations as necessary to ensure the named soil series or a soil series with similar or more favorable properties are verifiable onsite. All soil observations must be numbered and flagged on site and their location illustrated with a symbol and corresponding boring number on the finished soil map. All permanent and reproducible ground control points utilized to locate soil observations will be shown on the finished soil map so these observation points can be reestablished at a later date. All soil maps must contain a statement describing the method and/or instruments used to locate each soil observation from control points. Boundaries between map units are commonly gradual instead of abrupt as implied by a line drawn on a map. In addition, the boundary between map units may be difficult to locate exactly unless definitive landscape features are present or closely spaced soil observations are made to locate the boundary. To ensure that on-site sewage systems are not installed in soils unsuitable for their use, soil delineation lines between suitable soils, limited suitable soils and unsuitable soils shall be accurate to within 20 feet of the delineated soil boundary. If through additional closely spaced soil observations the site evaluator can document the area within 20 feet of the boundary has soils suitable for an on-site sewage system (conventional or alternative), the system may be installed closer than 20 feet from the suitable-limited suitable-unsuitable boundary. The location of all observations used to determine near boundary soil suitability must be shown on the final soil map and characteristics observed must be summarized in the site report. All soil observations shall be a minimum depth of 72 inches unless a refusal layer, including seasonal saturation horizon, is identified. If the lower limit of the recommended installation depth is greater than 48 inches, the soil observation must be extended to not less than 24 inches beneath this lower limit. Backhoe pits may be substituted for observations from auger borings. Mechanical augers, which disturb soil structure, shall not be used. The Soil Classifier, Registered Engineer or Registered Geologist must keep field notes for each soil observation that include: boring number, soil series name, percent slope, depth and type of restrictive horizons present and morphological properties of major subsoil horizons (upper and lower depth, texture, matrix and redoximorphic feature color [Munsell notation]). All surveys and related interpretive data shall meet National Conservation soil survey (NCSS) and United States Department of Agriculture (USDA) Soil Survey Manual standards for map purity. Map units will not have more than 15 percent inclusions of soils with different interpretation for on-site sewage management systems from the named series.

d. *Minimum Requirements for Special Soil Investigations (Level 4)* - A special soil study shall be identified as a Level 4 soil survey. The County Board of Health may require special soil studies when alternative on-site sewage management systems are proposed and additional soil data are needed to adequately address site suitability and/or system design. The County Environmental Health Specialist should be consulted prior to the initiation of the special investigation. The special investigation will typically be made for a specific location within an individual lot or parcel in the area proposed for the installation of an on-site sewage management system. Special investigations may include measurement of percolation rate for specific horizons, excavations to determine bedrock hardness and continuity, monitoring seasonal groundwater tables or other similar data that may be needed to aid in the interpretation of soil suitability and the protection of ground and surface water. Finished soil reports will have clear and obvious designations as to information that is Level 3 and/or Level 4. A Level 4 soil survey expands on the existing Level 3 soil survey in thoroughness and/or detail. Results of the Level 4 soil investigation should be presented in a format similar to that of the Level 3 soil investigation, including a map with more detailed soil delineations and/or location of measurements, an interpretive table and, if needed, narrative statements describing methods and results that impact suitability for an on-site sewage management system. The Level 4 soil survey shall meet all minimum requirements of the Level 3 soil survey, with the exception that test boring sites from the previous Level 3 investigation may be used for the Level 4 investigation. There is no minimum number of pedon observations required for a Level 4. At a Level 4 intensity, individual soil series are expected to be mapped and delineated with such a degree of accuracy that, at any location chosen to investigate within a given map unit, the named soil series or one with similar or more favorable properties for the installation of an on-site wastewater management system must be verifiable. The name, official seal and signature of the Certified Soil Classifier, Registered Engineer or Registered Geologist performing the investigation must be on the report.

2. Soil Data Acceptability for Individual Lots:

   a. Soil evaluations on individual lots shall be performed by the following individuals:

      (1) A Certified Soil Classifier, Registered Engineer or Registered Geologist if a Level 3 soil survey is required.

      (2) With the approval of the County Board of Health, an Environmental Health Specialist I or higher, District Environmental Health Director, DPH Environmental Health Program Director, meeting the following requirements, may conduct soil investigations for individual lots for single family residences:

         i. A Level II Inspector Certification; *and*

         ii. Successfully passes a field examination demonstrating the ability to identify soil texture and expected percolation rate, identify redoximorphic features and identify restricted or impervious soil horizons.

   b. Individuals who are approved by the County Board of Health that perform soil evaluations on individual lots for single family residences shall follow the following protocols:

      (1) A minimum of three soil borings shall be dug in the proposed location of the on-site sewage management system absorption field and duplicate absorption field area;

      (2) All borings shall be dug to a minimum depth of 72 inches unless a refusal layer is identified or to not less than 24 inches beneath the planned absorption trench bottom installation depth.

      (3) A soil report shall be made containing:

         i. A sketch identifying boring locations; and

         ii. A table identifying boring number, expected percolation rate and depth at which it occurs, the depth of seasonal high water table and depth of any refusal layer; and

         iii. Sites with poor percolation, redoximorphic features or impervious soil horizons within 24 inches of the planned absorption trench bottom, a seasonal high water table within 30 inches of the original ground surface or any other questionable soil features will be referred to a Certified Soil Classifier, Registered Engineer or Registered Geologist for evaluation.

3. Evaluation of soil for use as fill material

   a. Evaluation of soil for use as fill material on individual lots may be performed by the following individuals:

      (1) A Certified Soil Classifier, Registered Engineer or Registered Geologist

      (2) With approval of the County Board of Health, a Level II Certified Environmental Health Specialist I or higher, who has successfully completed

training and demonstrated proficiency in soil fill evaluation may approve soil for fill material.

b. Individuals approved by the County Board of Health to perform soil evaluations of fill material shall follow the following protocols:

(1) A minimum of four (4) borings shall be dug within the in-place fill material.

(2) All borings shall be dug to a minimum depth twelve (12) inches below the original soil surface.

(3) A fill site evaluation form shall be completed:

i. Evidence that the vegetative topsoil has been removed and fill area properly tilled.

ii. The soil fill is examined for texture and fines; percolation rate estimated.

iii. The size of the filled area identified and filled area properly sloped.

5) Glossary of Soil Terms

Aeration (soil). The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate (soil). Many fine particles held in a single mass or cluster. Natural soils aggregate, such as granules, blocks or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt or clay, deposited on land by streams.

Bottom land. The normal flood plain of a stream, subject to flooding.

Clay. As a soil separate, mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand and less than 40 percent silt.

Colluvium. Soil material, rock fragments or both moved by creep, slide or local wash and deposited at the base of steep slopes.

Depth to rock. Bedrock is to near the surface for the specified use.

Dissimilar Soil. Soil that is different from the named soil series in both properties and major interpretations.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained. Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky or shallows. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained. Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well-drained. Water is removed from the soil readily but not rapidly. It is available to plants throughout most of the growing season and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well-drained. Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall or both.

Somewhat poorly drained. Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall or a combination of these.

Poorly drained. Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall or a combination of these.

Very poorly drained. Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Flood plain. A generally flat plain or depression susceptible to being flooded from any source, including small and intermittent watercourses and coastal areas subject to intermittent tidal action.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Hardpan. A hardened or cemented soil horizon or layer. The soil material is sandy, loamy or clayey and is cemented by iron oxide, silica, calcium carbonate or another substance.

Horizon (soil). A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An exploration of the subdivisions is given in the Soil Survey Manual. The major horizons of mineral soil are as follows:

O horizon. An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon. The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon. The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum or some combination of these.

B horizon. The mineral horizon below an O, A or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as: (1) accumulation of clay, sesquioxides, humus or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon. The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock commonly underlies a C horizon but can be directly below an A or a B horizon.

Impervious soil. A soil through which water, air or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2 very low

0.2 to 0.4 low

0.7 to 0.75 moderately low

0.75 to 1.25 moderate

1.25 to 1.75 moderately high

1.75 to 2.5 high

More than 2.5 very high

Loam. Soil material that is seven to 27 percent clay particles, 28 to 50 percent silt particles and less than 52 percent sand particles.

Loamy. Soils ranging from moderately coarse textured to moderately fine textured soils.

Medium textured soil. Very fine sandy loam, loam, silt loam or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition or structure by heat, pressure and movement. Nearly all such rocks are crystalline.

Moderately coarse textured soil. Sandy loam and clay loam and silty clay loam.

Moderately fine textured soil. Clay loam, sandy clay loam and silty clay loam.

Morphology, soil. The physical make up the soil, including the texture, structure, porosity, consistence, color and other physical, mineral and biological properties of the various horizons and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance, few, common and many; size, fine, medium and coarse; and contrast, faint, distinct and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than five millimeters (about 0.2 inch); medium, from five to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, hardpan, fragipan, claypan, plowpan, and land traffic pan.

Parent material. The unconsolidated organic and mineral material from which soil forms.

Ped. An individual natural soil aggregate, such as granule, a prism or a block.

Pedon. The smallest volume that can be called a soil. A pedon is three-dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters) depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow - less than 0.06 inch/hr.

Slow - 0.06 to 0.2 inch/hr.

Moderately slow - 0.2 to 0.6 inch/hr.

Moderate - 0.6 to 2.0 inches/hr.

Moderately rapid - 2.0 to 6.0 inches/hr.

Rapid - 6.0 to 20 inches/hr.

Very rapid - more than 20 inches/hr.

Similar Soil. Soil that is different from the named soil but has the same interpretations as the named soil series.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter. Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from groundwater.

Sand. As a soil separate, this is individual rock or mineral fragments from 0.5 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing predominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay, and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance and then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet or horizontal distance.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 or E horizon. Generally, refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage or its equivalent in uncultivated soil, ranging in depth from four to 10 inches (10 to 25 per centimeters). Frequently designated as the plow layer or the Ap horizon.

Taxajunct. A soil that is different in some minor property but has the same interpretations as the named soil series.

Terrace. An embankment or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Texture, soil. The relative proportions of sand, silt and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sand clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. The sand, loamy sand and sandy loam classes may be further divided by specifying coarse, fine or very fine.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to top dress road banks, lawns and land affected by mining.

Variant. A soil that has a major difference in properties and interpretations than the named soil series.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

6) Saturated Hydraulic Conductivity Guidance

Guidelines for Measurement of Saturated Hydraulic Conductivity by the Constant Head Permeameter Method for On-Site Sewage Management Systems in Georgia

A. *Purpose* - The purpose of this section is to assist certified or registered professionals in the collection, interpretation, and submission of saturated hydraulic conductivity (Ks) data to the local environmental health specialists for permitting on-site sewage management systems (OSSMS). This guidance section is specific to the constant-head well permeameter method (also known as "borehole permeameter method" or "constant-head borehole infiltration test"). These recommendations were developed by private and public industry professionals as well as Department of Public Health (DPH) staff. Ks data may only be collected and reported by certified soil scientists, registered professional geologists, or registered professional engineers currently approved by the department to conduct soil evaluations. With appropriate documentation, certified and registered professionals may submit alternative methods of Ks data collection that are not covered in this section. The following guidance is not intended to replace education or experience and should be used in conjunction with professional judgement.

B. *Equipment* - A commercially available permeameter or similar device for maintaining a constant depth of water in a cylindrical auger hole at a desired depth and measuring the flow rate of water into the soil. An auger set (including a cutting head, planer or hole cleaner, brush, and extensions) for boring a cylindrical hole typically 2 to 4 inches in diameter. Any additional equipment specified/recommended in the respective procedure or by the manufacturer of the permeameter.

C. *Evaluation Procedure*

1. *Measurement location and replication* - Field assessment of the variability of soil type, landscape position and proposed system capacity by the approved professional determines the appropriate location of measurements and number of replicates necessary to characterize the hydraulic conductivity of the primary absorption field and repair area. Guidance from the *NRCS Field Book for Describing and Sampling Soils, Version 3.0,* suggests five (5) or more Ks measurements are required to capture natural variation. Justification should be provided for the number and locations of the measurements performed. At a minimum, measure Ks at the depths as described below.

   a. Daily design peak flow ≤ 750 gpd – DPH recommends measurements of Ks at five (5) locations that best characterize the soil and site conditions within the area to be used for the primary and repair OSSMS installation at the site. If the area to be used for the proposed primary and secondary systems is not contiguous, DPH advises taking measurements at an additional five (5) locations in the secondary area. Describe and justify deviations from the procedures suggested here.

   b. *Daily design peak flow > 750 gpd* – DPH recommends measurements of Ks at five (5) locations that best characterize the soil and site conditions within the area to be used for the primary OSSMS installation at the site. Additionally, measure Ks at five (5) locations within the area to be used for the secondary OSSMS installation, regardless of whether the secondary system area is contiguous with the primary area. Please describe and justify deviations from the procedures suggested here.

2. *Measurement depths* - Conduct measurements in the most restrictive soil horizon that encounters the proposed absorption trench sidewall and for one foot below the proposed absorption trench bottom elevation. Because of potential water flow to the surface, only Ks measurements at depths greater than six (6) inches from the ground surface are generally considered valid. Where appropriate, conduct measurements within a single horizon. Avoid inclusion of more than one (1) horizon (i.e., straddling two [2] or more horizons) if the thickness of the master (O, A, E, B, or C) horizon under consideration is greater than the required depth of the water in the hole. Thin horizons with similar soil properties may be bridged if necessary. Select the depth of water in the hole as described in the recommendations outlined in the respective procedures and maintain it constantly throughout the test. For commercial devices, consult the manufacturer's manual for selection of an appropriate water depth. Provide a description of any deviation from respective recommendations.

3. *Steady state* - Achieve steady state equilibrium at each test. Provide an explanation if steady state equilibrium is not achieved. Where the measurement is conducted under a constant depth of water, steady state condition for Ks can be defined as the time during which the rate of water flow from the hole reaches a constant value (i.e., no longer changes with time). Steady state is achieved when three (3) consecutive flow rate

measurements are the same. Alternately, after allowing saturation of the soil around the hole, flow rate should reach a quasi-steady state condition during which it varies around an average value. To determine this average, it is best to plot the rate of water flow (or the calculated Ks values) versus time and pass a smooth curve through them using a manually (referred to as fitting a curve by eye) or a mathematically (e.g., statistically) best fitted curve. The steady state flow rate is reached if the tail end of this fitted curve is nearly horizontal without showing an upward or downward trend. Use the arithmetic mean flow rate for the last three (3) to five (5) measurements after reaching steady state to calculate Ks. Longer saturation times should be considered for soils with mixed clay mineralogy and moderate to high shrink-swell potential (Amoozegar 1997) or for droughty conditions.

4. *Measurement recording frequency* - Measure Ks at time intervals outlined in the respective procedures or manufacturer's instrument-specific manual. In general, for Group II and III soil textures, measure and record at intervals of 15 minutes (or at least 100 cm^3 of water flow into the soil) for a minimum run time of one (1) hour or until steady state is achieved. For Group IV soil textures, measure and record at intervals of 30 minutes (or at least 100 cm^3 of water flow into the soil) for a minimum run time of four (4) hours and until steady state is achieved.

5. *Data analysis* – If multiple readings vary by an order of magnitude or more, additional measurements should be considered to achieve an acceptable level of confidence as determined by the professional. Because the soil property Ks is logarithmically distributed, the geometric mean of flow measurements must be used for calculations. For example, the geometric mean of the number set {1,2,3,4,5} would be as follows:

$$\sqrt[5]{1 \times 2 \times 3 \times 4 \times 5} = 2.6$$

D. *Record Keeping*

1. *Data log* - At a minimum, a report should include, but is not limited to: date, time, and weather conditions when data were collected, description of methodology, equipment type used, soil profile descriptions for all borings including measurement borings, locator map showing location of all Ks measurements and borings, adequate description of constants and equations used.
2. *Report the following for each measurement* - Auger hole diameter, depths of measurements, depth of water in the hole under the constant head, saturation start time and steady state time, clock time, reservoir readings, change in time, change in the water level in the permeameter, flow volume, flow rate (flow volume/time), graph of rate of water flow (or calculated Ks values) vs. time.

E. *Results and Interpretations*

1. *Recommended equation for calculation of Ks:*

Reynolds and Elrick (2002) Equation:

$$K_s = \frac{Q_s}{\left(\pi r^2 + \frac{H\lambda_C}{G} + \frac{H^2}{G}\right)}$$

Where $\boldsymbol{Q_s}$ is the steady volumetric flow rate in volume of water per unit time, $\boldsymbol{H}$ is the height of water ponded in the borehole, $\boldsymbol{r}$ is the radius of the hole in centimeters, $\boldsymbol{\lambda_c}$ is the soil macroscopic capillary length, and $\boldsymbol{G}$ is the unitless geometric factor. Bosch and West (1997) developed an equation to determine the value of *G*:

$$G = \frac{1}{2\pi}\left[A_1 + A_2\left(\frac{H}{r}\right) + A_3\left(\frac{H}{r}\right)^2 + A_4\left(\frac{H}{r}\right)^3\right]$$

The values of the coefficients A_1, A_2, A_3, and A_4 in this polynomial depend on texture and structure and are shown in the table below, along with values for λ_c.

Soil Texture/Structure	λ_c (cm)	A_1	A_2	A_3	A_4
I. Coarse and gravelly sands; may also include some highly structured soils with large cracks and/or macropores	2.8	0.079	0.516	-0.048	0.002
II. Most structured soils from clays through loams; also includes unstructured medium and fine sands	8.3	0.083	0.514	-0.053	0.002
III. Soils which are both fine textured (clayey) and unstructured	25	0.094	0.489	-0.053	0.002

2. *Comparison of Ks and Percolation Rate* – A mathematically modeled relationship between percolation rate and Ks was developed using the equations of Reynolds (2016) and can be referenced in the Table under paragraph E.4. If measured values are slower than anticipated based on observed soil morphology, DPH recommends using the measured values with appropriate adjustments for soil conditions and site limitations. If, however, measured values are higher than anticipated, DPH recommends the professional consider using those predicted from assessing soil morphology in the field along with appropriate site-specific adjustments. The reported percolation rate may not exceed the maximum values for each soil texture group as listed in the Georgia Manual for On-Site Sewage Management Systems or approved product sizing tables.

3. *Reporting of Results* – If required, the Ks report used to support soil interpretations must be submitted with the Level 4 (special study) used for site permitting. Complete reports include the date of completion and signature and seal of the Certified Soil Classifier, Professional Geologist, or Professional Engineer providing the service. The Soil Classifier, Engineer, or Geologist who performed the submitted Level 4 soil report is responsible for measured data interpretations and the determination of percolation rate or loading rate (reported in gallons/ft²/day). The Level 4 soil report must meet or

exceed all requirements listed in Section C of the Manual for On-Site Sewage Management Systems.

4. *Percolation Rate compared with Ks Table User Notes* – This correlation was derived from calculating the volume of water per unit time passing through a borehole with radius of 5.1 cm (2 inches) and a constant pressure head of 15.2 cm (6 inches). It was also assumed the soil had been prewetted. These conditions match those prescribed in the Modified Taft Engineering Center Method, which is the currently approved method for determining soil percolation rate in the Georgia Manual for On-Site Sewage Management Systems. The Reynolds and Elrick (2016) equation was used to determine Ks. This table should not be used as a reference for Ks values calculated with other equations.

Most Structured and Medium Textured Soils

Soil Group	K_{fs} (cm/day)	K_{fs} (in/day)	Percolation Rate (min/in)
Group I - Sands Sand and Loamy Sand	83.81	33.00	5
	41.91	16.50	10
	28.85	11.36	15
	21.63	8.52	20
	17.31	6.81	25
Group II - Coarse Loams Sandy Loam and Loam	14.42	5.68	30
	12.36	4.87	35
	10.82	4.26	40
	9.62	3.79	45
	8.65	3.41	50
	7.87	3.10	55
Group III - Fine Loams Clay Loam, Silt Loam, Sandy Clay Loam, Silty Clay Loam, Silt	7.21	2.84	60
	6.66	2.62	65
	6.18	2.43	70
	5.77	2.27	75
	5.41	2.13	80
	5.34	2.10	85
	5.04	1.98	90
	4.78	1.88	95
Group IV - Clays Sandy Clay, Clay, Silty Clay with 1:1 minerals	4.54	1.79	100
	4.32	1.70	105
	4.12	1.62	110
	3.94	1.55	115
	3.78	1.49	120

Table developed by Thomas Martin, 1/30/2026.

K_{fs} - Field-Saturated Soil Hydraulic Conductivity

The K_{fs} to PT correlation assumes a static water head of 6.0 inches and a borehole radius of 4.0 inches with an antecedent pore water pressure head of -10 cm.

K_{fs} and PT were correlated using W. D. Reynolds' equations 1, 2, and 16 and Table 2, A Unified Test-Well Permeameter Methodology for Absorption Field Investigations, Geoderma 264 (2016) 160-170 and equations 5 and 6 and Tables 4 and 5, Drainfield Flow Characteristics Inferred from Percolation Test and Hydraulic Conductivity Data, Journal of Hydrology 661 (2025) 133675.

K_{fs} and PT values assume structured and medium textured soils, including structured clayey and loamy soils, as well as medium single-grain sands, with a dry-soil representative sorptive number (α*) of 0.12 cm^{-1}.

K_{fs} values assume the background pore water pressure head is sufficiently negative to produce near-maximum soil capillarity at the time of testing.

Soil Groups are based on Table 8.F in the Georgia Manual for On-Site Sewage Management Systems (2019).

This correlation table may not be appropriate for massive, fine textured soils.

7) Tables, Figures and Forms

Table 1.C Soil Series Suitability Codes

These codes are general statements of soil suitability and limitations for their use for on-site systems. As such, they are based on the range of conditions given for the soils as they occur state-wide. Suitability codes and installation recommendations submitted to County Boards of Health by qualified individuals should be based on data from their site-specific evaluation and may commonly differ from the general statements below.

Suitability Codes	
A	These soils are suitable for installation of on-site systems with proper system design, installation, and maintenance. Position of the site or other soil and landscape considerations may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation.
C	Because of flooding, shallow seasonal water tables, soil horizons with very slow percolation rate, perched water tables, or imperfect drainage, these soils are not suitable for installation of a conventional on-site system without site modifications, special designs or installation. Properties of the soil and site may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Non-conventional systems and installation must be approved by the local Environmental Health Specialist.
F	Because of soil limitations, these soils are unsuitable for installation of an on-site system.
H	These soils have bedrock limitations and are not suitable for installation of a conventional on-site system without special design or installation. Properties of the soil and site may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Non-conventional system design and installation must be approved by the local Environmental Health Specialist.
G	Because of severe slope conditions, on-site installation is not recommended.
J	These soils commonly have percolation rates that are too slow for installation of a conventional on-site system without special design or installation. Some areas may have favorable rates, which can be identified through intensive investigation. Properties of the soil and site may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Non-conventional system design and installation must be approved by the local Environmental Health Specialist.
K	These soils are suitable for installation of an on-site system. Shallow bedrock is common in this area; however, small areas of soils with shallow bedrock may occur as inclusions in these map units. It is recommended that intensive investigations be made or that the on-site system is installed prior to home construction to ensure bedrock limitations are not present on the site.

N	Because of soft bedrock at a shallow depth, these soils typically are not suitable for installation of a conventional on-site system. Hydraulic properties of the rock vary, however, and in some areas, the soft rock has a percolation rate suitable for on-site system installation. Intensive investigations are required to evaluate hydraulic properties of the rock and site suitability. On-site system installation before home construction may be required to ensure the system can be properly installed. Properties of the soil and site may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Non-conventional system design and installation must be approved by the local Environmental Health Specialist.
P	These soils have deep seasonal water tables that require shallow installation of on-site system drainfields. Intensive investigations and data collection may be needed to ensure percolation rates in shallow horizons have suitable percolation rates. Properties of the soil and site may require the drainfield area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Design and installation of an alternative system in these soils must be approved by the local Environmental Health Specialist.
R	These soils are suitable for installation of an on-site system. However, they are very rocky or stony which may require design modifications including increased drainfield area and special measures for excavations and system installation.
S	These soils have seasonal water tables and are commonly poorly suited for conventional on-site system installation. Very shallow, above ground, and other system designs may allow the site to be used. Design and installation of an alternative system in these soils must be approved by the local Environmental Health Specialist.
U	These soils are generally suitable for installation of on-site systems. However, slowly permeable subsoil horizons may result in short periods of saturated soils that impede on-site system function. Shallow installation of the drainfield trenches along with site water management will minimize this problem.

Table 2.C Soil Series Suitability

The suitability code information in this table should be used as a guide. They are based on the range of conditions for the soils as they occur state wide. A qualified Soil Classifier may assign properties or installation recommendations to the soils encountered onsite in a way not shown in this table. The Soil Classifier may report soils not listed in this table. The Soil Classifier's report will be based on specific findings from the particular site being mapped. Suitability information or "codes" will be developed and reported based on the Classifier's on-site investigation. As a minimum, suitability codes and statements will describe the soil's limitations and its capability of functioning with a particular type of on-site wastewater management system. If a site is not *suitable for use, the suitability code will state the nature of the soil limitation. Recommendations, specific details and concerns surrounding any particular site which deal with system performance and longevity are explained within the suitability code for the soil series.*

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardne ss	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
HAMBLEN	Sand Mountain	0-3%	>60"		24-36"	**C**
HARTSELLS	Sand Mountain	2-45%	20-40"	HARD	>72"	**H**
HECTOR	Sand Mountain	1-60%	10-20"	HARD	>72"	**H**
HECTOR (STONY)	Sand Mountain	2 - 60%	10-20"	HARD	>72"	**H**
LINKER	Sand Mountain	1-40%	20-40"	HARD	>72"	**H**
NAUVOO	Sand Mountain	2-35%	40-60"	SOFT	>72"	**A**
ALBERTVILLE	Ridges and Valleys	2-25%	40-60"	SOFT	>72"	**N**
ALLEN	Ridges and Valleys	2-40%	>60"		>72"	**A**
APISON	Ridges and Valleys	2-25%	20-40"	SOFT	>72"	**H**
ARAGON	Ridges and Valleys	2-25%	>60"		>72"	**J**
ARKABUTLA	Ridges and Valleys	0-2%	>60"		12-18"	**C**
ARMUCHEE	Ridges and Valleys	5-60%	20-36"	SOFT	>72"	**H**
BARFIELD	Ridges and Valleys	1-50%	8 - 20"	HARD	> 72"	**H**
BELLAMY	Ridges and Valleys	0 - 6%	> 60"		18 - 36"	**C**
BIGFORK	Ridges and Valleys		40 - 60"	HARD	> 72"	**A**
BODINE	Ridges and Valleys	5-70%	>60"		>72"	**A**
CAPSHAW	Ridges and Valleys	0-12%	40-80"	HARD	24-42"	*unsuitable*
CARTECAY	Ridges and Valleys	0-5%	>60"		6-18"	**C**
CEDARBLUFF	Ridges and Valleys	0-2%	>60"		6-12"	**C**
CHENNEBY	Ridges and Valleys	0-2%	>60"		12-30"	**C**
CHEWACLA	Ridges and Valleys	0-2%	>60"		6-24"	**C**
CONASAUGA	Ridges and Valleys	0-45%	20-40"	SOFT	>72"	*unsuitable*
CRAIGSVILLE	Ridges and Valleys	0 - 5%	> 60"		> 72"	**C**
CRAIGSVILLE (GRAVELLY)	Ridges and Valleys	0-5%	>60"		>72"	**C**
CUNNINGHAM	Ridges and Valleys	2-25%	40-60"	SOFT	>72"	**J**
DECATUR	Ridges and Valleys	1-25%	>60"		>72"	**A**
DEKALB	Ridges and Valleys	0-80%	20-40"	HARD	>72"	**H**
DEWEY	Ridges and Valleys	2-40%	>60"		>72"	**A**
DOCENA	Ridges and Valleys	0-6%	>60"		18-36"	**C**
DOWELLTON	Ridges and Valleys	0-8%	40-60"	HARD	6-12"	*unsuitable*
EMORY	Ridges and Valleys	0-5%	>60"		60-72"	**C**
ENDERS	Ridges and Valleys	1-65%	40 - >60"	SOFT	>72"	**J**
ENNIS	Ridges and Valleys	0-5%	>60"		>72"	**C**
ETOWAH	Ridges and Valleys	0-35%	>60"		>72"	**A**
EUHARLEE	Ridges and Valleys	2-10%	>60"		>72"	**A**

Soil Series See Suitability Codes and Installation Information	**MLRA Major Land Resource Area**	**Slope % Ranges of the soil type**	**Depth to Bedrock (ranges)**	**Bedrock Hardness**	**Depth to Seasonal High H2O Table (inches)**	**Suitability Code and Installation Information**
FARRAGUT	Ridges and Valleys	2-20%	48 - > 60	SOFT	>72"	**A**
FULLERTON	Ridges and Valleys	2-45%	>60"		>72"	**A**
GORGAS	Ridges and Valleys	2-70%	10-20"	HARD	>72"	**H**
GORGAS (STONY-COBBLY)	Ridges and Valleys	2-70%	10-20"	HARD	>72"	**H**
GUTHRIE	Ridges and Valleys	0-2%	>60"		6-12"	**C**
HAMBLEN	Ridges and Valleys	0-3%	>60"		24-36"	**C**
HANCEVILLE	Ridges and Valleys	0-40%	> 60"	SOFT	>72"	**A**
HARTSELLS	Ridges and Valleys	2-45%	20-40"	HARD	>72"	**H**
HECTOR	Ridges and Valleys	1-60%	10-20"	HARD	>72"	**H**
HOLSTON	Ridges and Valleys	0-25%	>60"		>72"	**A**
KETONA	Ridges and Valleys	0-2%	40-72"	HARD	6-12"	*unsuitable*
KETONA (PONDED)	Ridges and Valleys	0-4%	40-72"	HARD	0 - 12"	*unsuitable*
LEADVALE	Ridges and Valleys	0-15%	48 - >60"	SOFT	0 - 12"	**C**
LEESBURG	Ridges and Valleys	2-45%	>60"		>72"	**A**
LILY	Blue Ridge	0 - 65%	20-40"	HARD	>72"	**H**
LINKER	Ridges and Valleys	1-40%	20-40"	HARD	>72"	**H**
LOCUST	Ridges and Valleys	0-10%	>60"		18-24"	**C**
LYERLY	Ridges and Valleys	1-10%	20-40"	HARD	>72"	**H**
MINVALE	Ridges and Valleys	2-45%	>60"		>72"	**A**
MONTEVALLO	Ridges and Valleys	2-80%	10-20"	SOFT	>72"	**H**
MOUNTAINBURG	Ridges and Valleys	1 - 65%	12-20"	HARD	> 72"	**H**
MOUNTAINBURG (STONY)	Ridges and Valleys	1-65%	12-20"	HARD	>72"	**H**
NAUVOO	Ridges and Valleys	2-35%	40-60"	SOFT	>72"	**A**
NELLA	Ridges and Valleys	2-60%	>60"		>72"	**A**
NELLA (STONY)	Ridges and Valleys	2-60%	>60"		>72"	**A**
PANAMA	Ridges and Valleys	12 -70%	> 60"		42 - 60"	**A**
PANAMA (GRAVELLY)	Ridges and Valleys	12-70%	> 60"		42-60"	**A**
RIVERVIEW	Ridges and Valleys	0-5%	>60"		36-60"	
ROANOKE	Ridges and Valleys	0-2%	>60"		0-12"	*unsuitable*
ROANOKE (PONDED)	Ridges and Valleys	0-2%	>60"		< 10"	*unsuitable*
ROME	Ridges and Valleys	0-6%	>60"		>72"	**A**
SEQUATCHIE	Ridges and Valleys	0-12%	>60"		>72"	**A**
SHACK	Ridges and Valleys	2-25%	>60"		24-48"	**C**
SHELLBLUFF	Ridges and Valleys	0-3%	>60"		36-60"	**C**
SIPSEY	Ridges and Valleys	4-30%	20-40"	SOFT	>72"	**H**
STASER	Ridges and Valleys	0-3%	>60"		36-48"	**C**
STEEKEE	Ridges and Valleys	10 -50%	20 - 40"	HARD	> 72"	**H**
SUBLIGNA	Ridges and Valleys	1-6%	>60"		>72"	**C**
SULLIVAN	Ridges and Valleys	0-2%	>60"		48-72"	**C**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
SUNLIGHT	Ridges and Valleys	8 - 60%	10 - 20"	SOFT	> 72"	**H**
TAFT	Ridges and Valleys	0 - 2%	> 60"		12 - 24"	**C**
TALBOTT	Ridges and Valleys	0-70%	20-40"	HARD	>72"	*unsuitable*
TANYARD	Ridges and Valleys	0 - 2%	> 60"		18 - 30"	**C**
TIDINGS	Ridges and Valleys	2-70%	40-60"	HARD	>72"	**A**
TOCCOA	Ridges and Valleys	0-4%	>60"		30-60"	**C**
TOWNLEY	Ridges and Valleys	2-60%	20-40"	SOFT	>72"	*unsuitable*
TOWNLEY (GRAVELLY)	Ridges and Valleys	2-60%	20-40"	SOFT	>72"	*unsuitable*
TUPELO	Ridges and Valleys	0-6%	>60"		12-24"	*unsuitable*
WAX	Ridges and Valleys	0-6%	>60"		18-36"	**C**
WAYNESBORO	Ridges and Valleys	2-30%	>60"		>72"	**A**
WEHADKEE	Ridges and Valleys	0-2%	>60"		0-12"	*unsuitable*
WHITWELL	Ridges and Valleys	0-6%	>60"		24-36"	**C**
WOLFTEVER	Ridges and Valleys	0-12%	>60"		30-42"	**C**
ARKAQUA	Blue Ridge	0-5%	>60"		18-24"	**C**
ASHE	Blue Ridge	2-95%	20-40"	HARD	>72"	**H**
ASHE (VERY STONY)	Blue Ridge	2-95%	20-40"	HARD	>72"	**H**
BANDANA	Blue Ridge	0-5%	>60"		18-24"	**C**
BILTMORE	Blue Ridge	0-5%	>60"		>42"	**C**
BRADDOCK	Blue Ridge	0-35%	>60"		>60"	**J**
BRADSON	Blue Ridge	0-35%	>60"		>60"	**J**
BRASSTOWN	Blue Ridge	2 - 95%	40-60"	SOFT	> 72	**K**
BREVARD	Blue Ridge	0-35%	>60"		>60"	**A**
BULADEAN	Blue Ridge	2 - 95%	40-60"	SOFT	> 72	**K**
BURTON	Blue Ridge	5-95%	20-40"	HARD	>72"	**H**
CASHIERS	Blue Ridge	2 - 95%	> 60"		> 72"	**A**
CATASKA	Blue Ridge	2 -95%	10-20"	SOFT	>72"	**H**
CHANDLER	Blue Ridge	2-95%	>60"		>72"	**A**
CHATUGE	Blue Ridge	0-15%	>60"		12-24"	**C**
CHEOAH	Blue Ridge	8-95%	40-60"	SOFT	>72"	**K**
CHESTNUT	Blue Ridge	2-95%	20-40"	SOFT	>72"	**H**
CLEVELAND	Blue Ridge	2-95%	10 - 20"	HARD	>72"	**H**
CLIFFIELD	Blue Ridge	2-95%	20 - 40"	HARD	>72"	**H**
CLIFTON	Blue Ridge	2 - 60%	>60"		>72"	**A**
CODORUS	Blue Ridge	*0-5%*	>60"		12-24"	**C**
COLVARD	Blue Ridge	0-5%	>60"		>48"	**C**
COWEE	Blue Ridge	2-95%	20-40"	SOFT	>72"	**H**
CULLASAJA	Blue Ridge	0-35%	>60"		>60"	**R**
CULLOWHEE	Blue Ridge	0-5%	>60"		18-24"	**C**
DELANCO	Blue Ridge	0-15%	>60"		12-30"	**C**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
DELLWOOD	Blue Ridge	0-5%	>60"		24-48"	**C**
DILLARD	Blue Ridge	0-15%	>60"		24-36"	**C**
DILLSBORO	Blue Ridge	0-35%	>60"		>60"	**A**
DYKE	Blue Ridge	0-35%	>60"		>60"	**A**
DYKE (STONY)	Blue Ridge	0-35%	>60"		>72"	**A**
EDNEYTOWN	Blue Ridge	2 - 95%	>60"		>72"	**A**
EDNEYTOWN (VERY STONY)	Blue Ridge	2-80%	>60"		>72"	**A**
EDNEYVILLE	Blue Ridge	2-95%	>60"		>72"	**A**
EDNEYVILLE (STONY)	Blue Ridge	2-95%	>60"		>72"	**A**
ELLIJAY	Blue Ridge	2-95%	>60"		>72"	**J**
ELSINBORO	Blue Ridge	0-35%	>60"		>60"	**A**
EVARD	Blue Ridge	2-95%	>60"		>72"	**A**
FANNIN	Blue Ridge	2-95%	>60"		>72"	**A**
FRENCH	Blue Ridge	0-5%	>60"		12-30"	**C**
GREENLEE	Blue Ridge	0-35%	>60"		>60"	**R**
HANMILLER	Blue Ridge	2 - 95%	20 - 40"	SOFT	>72"	**H**
HATBORO	Blue Ridge	0-5%	>60"		0-6"	**C**
HAYESVILLE	Blue Ridge	2-60%	>60"		>72"	**A**
HAYWOOD	Blue Ridge	0-35%	> 60"		>60"	**A**
HAYWOOD (STONY)	Blue Ridge	2-45%	>60"		>72"	**A**
HEMPHILL	Blue Ridge	0-15%	>60"		0-12"	*unsuitable*
HIWASSEE	Blue Ridge	0-35%	>60"		>60"	**J**
HUNTDALE	Blue Ridge	2 - 95%	>60"		>72"	**A**
IOTLA	Blue Ridge	0-5%	>60"		18-24"	**C**
JEFFERSON	Blue Ridge	2-75%	>60"		>72"	**A**
JEFFERY	Blue Ridge	2 - 95%	20 - 40"	HARD	>72"	**H**
JUNALUSKA	Blue Ridge	2 - 95%	20-40"	SOFT	>72"	**H**
KEENER	Blue Ridge	0-35%	>60"		>60"	**A**
KIWKORA	Blue Ridge	0-15%	>60"		0-12	*unsuitable*
LILY	Blue Ridge	0-65%	20-40"	HARD	>72"	**H**
LONON	Blue Ridge	0-35%	>60"		>60"	**A**
LOSTCOVE	Blue Ridge	0-35%	>60"		>60"	**R**
MAYMEAD	Blue Ridge	0-35%	>60"		>60"	**A**
MICAVILLE	Blue Ridge	2 - 95%	40 - 60	SOFT	> 72"	**K**
NANTAHALA	Blue Ridge	2 - 60%	40 - 60"	SOFT	> 72"	**J, K**
NIKWASI	Blue Ridge	0-5%	>60"		0 - 12"	**C**
NORTHCOVE	Blue Ridge	0-35%	>60"		>60"	**R**
OSTIN	Blue Ridge	0-5%	>60"		>42"	**C**
PIGEONROOST	Blue Ridge	2 - 95%	20-40"	SOFT	>72"	**H**
PLOTT	Blue Ridge	2 - 95%	> 60"		>72"	**A**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardne ss	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
PORTERS	Blue Ridge	2 - 95%	40-60"	HARD	>72"	**K**
PORTERS (STONY)	Blue Ridge	6-95%	40-60"	HARD	>72"	**K**
RABUN	Blue Ridge	2-50%	>60"		>72"	**A**
RABUN (STONY)	Blue Ridge	7-70%	>60"		>72"	**A**
RAMSEY	Blue Ridge	3 - 70%	10 - 20"	HARD	> 72"	**H**
RAMSEY (STONY)	Blue Ridge	3-70%	10-20"	HARD	>72"	**H**
REDDIES	Blue Ridge	0-5%	>60"		24-42"	**C**
ROSMAN	Blue Ridge	0-5%	>60"		30-60"	**C**
SALUDA	Blue Ridge	2 - 95%	10-20"	SOFT	>72"	**H**
SAWTEETLAH	Blue Ridge	0-35%	>60"		>60"	**A**
SAVNOOK	Blue Ridge	0-35%	>60"		>60"	**A**
SHELOCTA	Blue Ridge	0-35%	>60"		>60"	**A**
SHINBONE	Blue Ridge	2 - 95%	40 - 60"	SOFT	> 72"	**K**
SHOUNS	Blue Ridge	0-35%	>60"		>60"	**A**
SOCO	Blue Ridge	2 - 95%	20 - 40"	SOFT	> 72"	**H**
SPIVEY	Blue Ridge	0-35%	>60"		>60"	**R**
STATLER	Blue Ridge	0-35%	>60"		>60"	**A**
STELCOAH	Blue Ridge	2-95%	40-60"	SOFT	>72"	**K**
SUCHES	Blue Ridge	0-5%	>60"		30-48"	**C**
SYLCO	Blue Ridge	2-95%	20-40"	HARD	>72"	**H**
SYLVA	Blue Ridge	0-10%	>60"		0-12"	**C**
TALLADEGA	Blue Ridge	6-80%	20-40"	SOFT	>72"	**H**
TATE	Blue Ridge	0-35%	>60"		>60"	**A**
THUNDER	Blue Ridge	0-35%	>60"		>60"	**R**
THURMONT	Blue Ridge	0-35%	>60"		>60"	**A**
TOECANE	Blue Ridge	0-35%	>60"		>60"	**R**
TOCCOA	Blue Ridge	0-4%	>60"		30-60"	**C**
TOXAWAY	Blue Ridge	0-5%	>60"		0-6"	**C**
TRANSYLVANIA	Blue Ridge	0-5%	>60"		24-36"	**C**
TRIMONT	Blue Ridge	2-95%	>60"		>72"	**A**
TSALI	Blue Ridge	2-95%	10-20"	SOFT	>72"	**H**
TUCKASEGEE	Blue Ridge	0-35%	>60"		>60"	**A**
TUSQUITEE	Blue Ridge	0-35%	>60"		>60"	**A**
TUSQUITEE (STONY)	Blue Ridge	2-95%	>60"		>72"	**A**
UNAKA	Blue Ridge	2-95%	20-40"	HARD	>72"	**H**
UNISON	Blue Ridge	0-35%	>60"		>60"	**A**
WATAUGA	Blue Ridge	2-95%	>60"		>72"	**A**
WHITEOAK	Blue Ridge	0-35%	>60"		>60"	**A**
WHITESIDE	Blue Ridge	0-10%	>60"		18-36"	**C**
ALAMANCE	Southern Piedmont	0 - 15%	> 60		> 72"	**A**
ALCOVY	Southern Piedmont	2-10%	>60"		24 - 36"	**C**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
ALLEN	Southern Piedmont	2-40%	>60"		>72"	
ALTAVISTA	Southern Piedmont	0-10%	>60"		18-30"	**C**
APPLING	Southern Piedmont	0-25%	>60"		>72"	**A**
ASHLAR	Southern Piedmont	0-70%	20-40"	HARD	>72"	**H**
AUGUSTA	Southern Piedmont	0-2%	>60"		12-24"	**C**
BADIN	Southern Piedmont	2-55%	40 - 60"	HARD	>72"	*unsuitable*
BETHLEHEM	Southern Piedmont	2 - 45%	20 - 40"	SOFT	>72"	**N**
BUCKHEAD	Southern Piedmont	6-45%	> 60"		> 72"	**A**
BUNCOMBE	Piedmont & Coastal Plain	0 - 6%	> 60"		> 72"	**C**
CARTECAY	Southern Piedmont	0-5%	>60"		6-18"	*unsuitable*
CATAULA	Southern Piedmont	2-25%	> 60"		24 - 48	***C***
CECIL	Southern Piedmont	0-25%	>60"		>72"	**A**
CHENNEBY	Southern Piedmont	0-2%	>60"		12-30"	*unsuitable*
CHESTATEE	Southern Piedmont	10 -50%	>60"		>72"	**A**
CHEWACLA	Southern Piedmont	0-2%	>60"		+ 12" - 24"	*unsuitable*
COLFAX	Southern Piedmont	0-15%	>60"		6 - 18"	**C**
CONGAREE	Southern Piedmont	0-4%	>60"		30 - 48"	**C**
DAVIDSON	Southern Piedmont	2-25%	>60"		>72"	
DURHAM	Southern Piedmont	0-10%	>60"		>72"	**A**
DURHAM (PERCHED)	Southern Piedmont	0 - 10%	> 60"		48 - 72	**C**
ENON	Southern Piedmont	2-45%	>60"		>72"	**J**
FORK	Southern Piedmont	0-7%	>60"		12-24"	**C**
GEORGEVILLE	Southern Piedmont	2 - 50%	>60"		>72"	**A**
GOLDSTON	Southern Piedmont	2-60%	20 - 40"	HARD	>72"	*unsuitable*
GROVER	Southern Piedmont	2-45%	>60"		>72"	**A**
GUNDY	Southern Piedmont	6 - 40%	40 - 72"	SOFT	> 72"	
GWINNETT	Southern Piedmont	2-60%	40-60"	SOFT	>72"	**A or N**
HARD LABOR phase one	Southern Piedmont	0 - 15%	> 72"	NA	30 - 48"	**C**
HARD LABOR phase two	Southern Piedmont	0 - 15%	> 72"	NA	48- 60"	**P**
HELENA	Southern Piedmont	0-15%	>60"		18-30"	*unsuitable*
HERNDON	Southern Piedmont	2-25%	>60"		>72"	**A**
HIWASSEE	Southern Piedmont	2-50%	>60"		>72"	**A**
HULETT	Southern Piedmont	2-15%	>60"		>72"	**A**
IREDELL	Southern Piedmont	0-15%	40 - 60"	SOFT	12 - 24"	*unsuitable*
KIRKSEY	Southern Piedmont	0 - 10%	40 - 60"	HARD	18 - 36"	**J**
LLOYD	Southern Piedmont	2-50%	> 60"		> 72"	**A**
LOUISA	Southern Piedmont	6-80%	10-20"	SOFT	>72"	**N**
LOUISBURG	Southern Piedmont	26 - 45%	> 60"		>72"	
MADISON	Southern Piedmont	2-60%	>60"		>72"	**A**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
MASADA	Southern Piedmont	0-25%	>60"		>72"	**C**
MECKLENBURG	Southern Piedmont	2-25%	>60"		>72"	**J**
MOLENA	Southern Piedmont	0-35%	>60"		>72"	**A**
MUSELLA	Southern Piedmont	2-80%	14 - 20"	SOFT	>72"	**H**
NASON	Southern Piedmont	0-50%	40-60"	SOFT	>72"	**N**
ORANGE	Southern Piedmont	0 - 15%	40 - 60	HARD	12 - 36"	*unsuitable*
PACOLET	Southern Piedmont	2-80%	>60"		>72"	**A**
PAGELAND	Southern Piedmont	0-15%	20-40"	SOFT	18-36"	*unsuitable*
POINDEXTER	Southern Piedmont	2 - 60"	40 - 60"	HARD	> 72"	**H**
RAWLINGS	Southern Piedmont	6-45%	20-40"	HARD	> 72"	**H**
RION	Southern Piedmont	2-60%	>60"		>72"	**A**
RIVERVIEW	Southern Piedmont	0-5%	>60"		36-60"	**C**
ROANOKE	Southern Piedmont	0-2%	>60"		0-12"	*unsuitable*
SAW	Southern Piedmont	2 - 45%	20 - 40	HARD	> 72"	**H**
SEDGEFIELD	Southern Piedmont	0-10%	>60"		12-18"	*unsuitable*
SHELLBLUFF	Southern Piedmont	0-3%	>60"		36-60"	**C**
STARR	Southern Piedmont	0-8%	>60"		>72"	**C**
STATE	Southern Piedmont	0-10%	>60"		42 - 72"	**C**
SWEETAPPLE	Southern Piedmont	6-60%	24-50"	SOFT	>72"	**N**
TALLAPOOSA	Southern Piedmont	5-80%	10-20"	SOFT	>72"	**N**
TATUM	Southern Piedmont	0-50%	40-60"	SOFT	>72"	**N**
TOCCOA	Southern Piedmont	0-4%	>60"		30-60"	**C**
VANCE	Southern Piedmont	2-25%	>60"		>72"	**J**
WAKE	Southern Piedmont	2-45%	11 - 20"	HARD	>72"	*unsuitable*
WATEREE	Southern Piedmont	2-95%	20-40"	SOFT	>72"	**N**
WEDOWEE	Southern Piedmont	0-60%	>60"		>72"	**A**
WEHADKEE	Southern Piedmont	0-2%	>60"		0-12"	*unsuitable*
WICKHAM	Southern Piedmont	0-25%	>60"		>72"	**A**
WILKES	Southern Piedmont	2-60%	40 - 60	HARD	>72"	**N**
WINNSBORO	Southern Piedmont	2 - 25%	40 - 60"	SOFT	> 72"	**J**
WORSHAM	Southern Piedmont	0-8%	>60"		0-12"	*unsuitable*
WYNOTT	Southern Piedmont	2-45%	20-40"	SOFT	>72"	*unsuitable*
ZION	Southern Piedmont	2-45%	20-40"	HARD	>72"	*unsuitable*
AILEY	Sand Hills	0-25%	>60"		48 - 72"	**A**
BIBB	Sand Hills	0-2%	>60"		0 - 8"	*unsuitable*
BIGBEE	Sand Hills	0-5%	>60"		20 - 40"	**C**
CHASTAIN	Sand Hills	0-2%	>60"		0-12"	*unsuitable*
CHEWACLA	Sand Hills	0-2%	>60"		+ 12" - 24"	*unsuitable*
CONGAREE	Sand Hills	0-4%	>60"		30 - 48"	**C**
COWARTS	Sand Hills	1 - 25%			40 - 60"	
DOGUE	Southern Coastal Plain	0-15%	>60"		18-36"	*unsuitable*

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
DOTHAN	Sand Hills	0 - 12%			36 - 60"	**U**
ESTO	Sand Hills	2-25%	>60"		>72	**J**
EUNOLA	Sand Hills	0-6%	>60"		18-30"	**C**
EUSTIS	Sand Hills	0 - 30%	>60"		> 72"	**A**
FACEVILLE	Sand Hills	0-15%	>60"		>72"	**A**
FUQUAY	Sand Hills	0-10%	>60"		48 - 72"	**A**
GRADY	Sand Hills	0-2%	>60"		0-12"	*unsuitable*
GREENVILLE	Sand Hills	0 - 18%	>60"		>72"	**A**
IUKA	Sand Hills	0 - 2%	> 60"		12 - 36"	**C**
KINSTON	Sand Hills	0-2%	>60"		0-12"	*unsuitable*
LAKELAND	Sand Hills	0 - 85%	>60"		>72"	**A**
LEVY	Sand Hills	0-2%	>60"		+ 24" - 0"	**C or F**
LUCY	Sand Hills	0 - 45%	>60"		>72"	**A**
MASADA	Sand Hills	0-25%	>60"		>72"	**A**
NANKIN	Sand Hills	0-60%	>60"		40 - 60"	**J**
NORFOLK	Sand Hills	0-10%	>60"		48-72"	**A**
OCHLOCKONEE	Sand Hills	0 - 3%	>60"		36 - 60"	**C**
OCILLA	Sand Hills	0-10%	>60"		12-30"	**C**
ORANGEBURG	Sand Hills	0 - 25%	> 60"		> 72"	**A**
OSIER	Sand Hills	0 - 2%	> 60"		< 12"	*unsuitable*
PELHAM	Sand Hills	0-2%	>60"		0-12"	**C, or F**
PELION	Sand Hills	0-15%	>60"		12-30"	**C**
RED BAY	Sand Hills	0-15%	>60"		>72"	**A**
RIVERVIEW	Sand Hills	0-5%	>60"		36-60"	**C**
STILSON	Sand Hills	0-8%	>60"		30-36"	**C or S**
SUSQUEHANNA	Sand Hills	1-17%	>60"		>72"	*unsuitable*
TROUP	Sand Hills	0-40%	>60"		>72"	**A**
VAUCLUSE	Sand Hills	2 - 25%	>60"		> 72"	
WAGRAM	Sand Hills	0 -15%	>60		> 72"	**A**
WAHEE	Sand Hills	0 - 4%	72"		12 - 18"	**C or J**
AILEY	Southern Coastal Plain	0-25%	>60"		48 - 72"	**A**
ALAPAHA	Southern Coastal Plain	0-3%	>60"		0-12"	**C**
ALBANY	Southern Coastal Plain	0-6%	>60"		18 - 30"	**C**
AMERICUS	Southern Coastal Plain	0-25%	>60"		>72"	**A**
ARDILLA	Southern Coastal Plain	0-5%	>60"		12-24"	**C**
ARUNDEL	Southern Coastal Plain	2-35%	20-40"	HARD	>72"	*unsuitable*
BAYBORO	Southern Coastal Plain	0-2%	>60"		0-12"	*unsuitable*
BETHERA	Southern Coastal Plain	0-2%	>60"		0-18"	*unsuitable*
BIBB	Southern Coastal Plain	0-2%	>60"		0 - 8"	*unsuitable*
BIGBEE	Southern Coastal Plain	0-5%	>60"		20 - 40"	**C**
BINNSVILLE	Southern Coastal Plain	1 - 17%	7 - 20"	SOFT	20"	*unsuitable*

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
BLADEN	Southern Coastal Plain	0-2%	>60"		0-12"	**C**
BLANEY	Southern Coastal Plain	0-25%	>60"		>72"	
BLANTON	Southern Coastal Plain	0-20%	>60"		48 - 72"	**A**
BLANTON (*Moderately Wet)*	Southern Coastal Plain	0-20%	>60"		30 - 48"	**C, or S**
BONIFAY	Southern Coastal Plain	0-12%	>60"		48-60"	**A**
BONNEAU	Southern Coastal Plain	0-12%	> 60"		42 - 60"	**A**
BOSWELL	Southern Coastal Plain	1 - 17 %	> 60"		>72	*unsuitable*
BUNCOMBE	Southern Coastal Plain	0 - 6%			> 72"	**C**
CAHABA	Southern Coastal Plain	0-8%	>60"		>72	**A**
CARNEGIE	Southern Coastal Plain	2-12%	>60"		40 - 60"	**U**
CENTENARY	Southern Coastal Plain	0-5%	>60"		42 - 60"	**A**
CHASTAIN	Southern Coastal Plain	0-2%	>60"		0-12"	*unsuitable*
CHEWACLA	Southern Coastal Plain	0-2%	>60"		+ 12" - 24"	*unsuitable*
CHIPLEY	Southern Coastal Plain	0-8%	>60"		18 - 36"	**C**
CHISOLM	Southern Coastal Plain	0 - 10%	>60"		36 - 60"	
CLARENDON	Southern Coastal Plain	0-6%	>60"		24-36"	**C**
COWARTS	Southern Coastal Plain	1 - 25%			40 - 60"	**N**
COXVILLE	Southern Coastal Plain	0 - 2%	>60"		0 - 12"	*unsuitable*
DASHER	Southern Coastal Plain	0-1%	>60"		+ 12 to 12"	*unsuitable*
DOGUE	Southern Coastal Plain	0-15%	>60"		18-36"	**C**
DOTHAN	Southern Coastal Plain	0 - 12%			36 - 60"	**U**
DUNBAR	Southern Coastal Plain	0 - 2%			12 - 30"	**C, J**
DUPLIN	Southern Coastal Plain	0 - 7%	>60"		24 - 36"	**C, J**
ECHAW	Southern Coastal Plain	0-2%	>60"		30 - 60"	**C**
ELLABELLE	Southern Coastal Plain	0-2%	>60"		<6"	*unsuitable*
ESTO	Southern Coastal Plain	2-25%	>60"		>72	**J**
EULONIA	Southern Coastal Plain	0-6%	>60"		18 - 42"	**C, J**
EUSTIS	Southern Coastal Plain	0 - 30%	>60"		> 72"	**A**
EUTAW	Southern Coastal Plain	0 - 2%	>60"		6 - 18"	*unsuitable*
FACEVILLE	Southern Coastal Plain	0-15%	>60"		>72"	**A**
FLOMATON	Southern Coastal Plain	2 - 40%	> 60"		>72"	**A**
FOXWORTH	Southern Coastal Plain	0 - 25%	> 60"		40 - 72"	**A**
FREEMANVILLE	Southern Coastal Plain	0 - 12%	> 60"		40 - 60"	**U**
FUQUAY	Southern Coastal Plain	0-10%	>60"		48 - 72"	**A or U**
GOLDSBORO	Southern Coastal Plain	0 - 10%	> 60"		18 - 30"	**C**
GRADY	Southern Coastal Plain	0-2%	>60"		0-12"	*unsuitable*
GREENVILLE	Southern Coastal Plain	0 - 18%	>60"		>72"	**A**
GRITNEY	Southern Coastal Plain	0 - 15%	> 60"		18 - 36"	**C, or J**
HENDERSON	Southern Coastal Plain	2 - 20%	> 60"		> 72"	*unsuitable*
HEROD	Southern Coastal Plain	0-2%	>60		0-12"	*unsuitable*

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
HORNSVILLE	Southern Coastal Plain	0 - 8%	> 60"		30 - 42"	**C, or J**
IRVINGTON	Southern Coastal Plain	0 - 5%	> 60"		18 - 36"	**C**
IUKA	Southern Coastal Plain	0 - 2%	> 60"		12 - 36"	**C**
IZAGORA	Southern Coastal Plain	0 - 8%	>60"		24-36"	**C**
JOHNS	Southern Coastal Plain	0 - 2%	> 60"		12 - 36"	**C**
JOHNSTON	Southern Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
KERSHAW	Southern Coastal Plain	0 - 15%	> 60"		> 72"	
KINSTON	Southern Coastal Plain	0-2%	>60"		0-12"	*unsuitable*
KOLOMOKI	Southern Coastal Plain	0 - 5%	>60"		60 - 72"	**A**
KUREB	Southern Coastal Plain	0-20"	>60"		>72"	
LAKELAND	Southern Coastal Plain	0 - 85%	>60"		>72"	
LEAF	Southern Coastal Plain	0 - 2%	>60"		6 - 18"	*unsuitable*
LEEFIELD	Southern Coastal Plain	0 - 12%	>60"		18 - 30"	**C**
LEON	Southern Coastal Plain	0-5%	>60"		12 - 24"	**C**
LEON (HYDRIC)	Southern Coastal Plain	0 - 2%	>60"		0 - 6"	*unsuitable*
LOWNDES	Southern Coastal Plain	0 - 17%	> 60"		> 72"	**A**
LUCY	Southern Coastal Plain	0 - 45%	>60"		>72"	**A**
LYNCHBURG	Southern Coastal Plain	0-2%	>60"		6 - 18"	**C**
MARLBORO	Southern Coastal Plain	0 - 10%	>60"		48 - 72"	**A**
MASCOTTE	Southern Coastal Plain	0-2%	>60		6 - 18"	**C**
MAXTON	Southern Coastal Plain	0 - 6%	>60"		60 - 72"	**A**
MEGGETT	Southern Coastal Plain	0-3%	>60"		0-12"	**C, or J**
MUCKALEE	Southern Coastal Plain	0 - 2%	>60"		0-12"	*unsuitable*
MYATT	Southern Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
NANKIN	Southern Coastal Plain	0-60%	>60"		40 - 60"	**J**
NOBOCO	Southern Coastal Plain	0 - 6%	> 60"		30 - 40"	**C or S**
NORFOLK	Southern Coastal Plain	0-10%	>60"		48-72"	**A**
OCHLOCKONEE	Southern Coastal Plain	0 - 3%	>60"		36 - 60"	*unsuitable*
OCILLA	Southern Coastal Plain	0 - 10%	>60"		12 - 30"	**C**
OGEECHEE	Southern Coastal Plain	0-2%	>60"		+ 12" - 12"	*unsuitable*
OKTIBBEHA	Southern Coastal Plain	1 - 30%	>60"		> 72"	*unsuitable*
OLUSTEE	Southern Coastal Plain	0 - 2%	> 60"		6 - 18"	**C**
ORANGEBURG	Southern Coastal Plain	0 - 25%	> 60"		> 72"	**A**
OSIER	Southern Coastal Plain	0 - 2%	> 60"		< 12"	*unsuitable*
OUSLEY	Southern Coastal Plain	0-5%	>60"		18 - 36"	**C**
PELHAM	Southern Coastal Plain	0-2%	>60"		+ 12" - 18"	*unsuitable*
PERSANTI	Southern Coastal Plain	0 - 6%	> 60"		18 - 36"	*unsuitable*
PICKNEY	Southern Coastal Plain	0-2%	> 60"		< 10" to 20"	*unsuitable*
PLUMMER	Southern Coastal Plain	0-5%	>60"		0-12"	**C**
RAINS	Southern Coastal Plain	0-2%	>60"		0-12"	**C**
RED BAY	Southern Coastal Plain	0-15%	>60"		>72"	**A**

Soil Series See Suitability Codes and Installation Information	MLRA Major Land Resource Area	Slope % Ranges of the soil type	Depth to Bedrock (ranges)	Bedrock Hardness	Depth to Seasonal High H2O Table (inches)	Suitability Code and Installation Information
REMBERT	Southern Coastal Plain	0-2%			0 - 12"	*unsuitable*
RIDGELAND	Southern Coastal Plain	0-2%	>60"		18-30"	**C**
RIGDON	Southern Coastal Plain	0 - 2%			18 - 30"	**C**
RUTLEGE	Southern Coastal Plain	0 - 2%	> 60"		0 - 6"	*unsuitable*
SHELLBLUFF	Southern Coastal Plain	0-3%	>72"		36 - 60"	**C**
STILSON	Southern Coastal Plain	0-8%	>60"		30-36"	**C or S**
SUFFOLK	Southern Coastal Plain	0 - 50%	>60"		> 72"	**A**
SUMTER	Southern Coastal Plain	1 - 40%				
SUNSWEET	Southern Coastal Plain	2-25%			40 - 60"	**J**
SURRENCY	Southern Coastal Plain	0 - 1%			0 - 6"	*unsuitable*
SUSQUEHANNA	Southern Coastal Plain	1-17%	>60"		>72"	*unsuitable*
TAWCAW	Southern Coastal Plain	0 - 2%	>72"		18 - 30"	*unsuitable*
TELFAIR	Southern Coastal Plain	2-15%	20-40"	HARD	12 - 36"	*unsuitable*
TIFTON	Southern Coastal Plain	0 - 8%	>72"		40 - 60"	**A or U**
TORHUNTA	Southern Coastal Plain	0 - 2%	>60"		6 - 18"	**C**
TROUP	Southern Coastal Plain	0-40%	>60"		>72"	**A**
VALDOSTA	Southern Coastal Plain	0 - 5 %	>60"		>72"	**A**
VARINA	Southern Coastal Plain	0-10%	>60"		48 - 60"	**A or U**
VAUCLUSE	Southern Coastal Plain	2 - 25%	>60"		> 72"	
WAGRAM	Southern Coastal Plain	0 -15%	>60		> 72"	**A**
WAHEE	Southern Coastal Plain	0 - 4%	72"		12 - 18"	**C, or J**
WEHADKEE	Southern Coastal Plain	0 - 2%	> 60		0 - 12"	*unsuitable*
WICKSBURG	Southern Coastal Plain	0-12%	>60		40 - 60"	**A or U**
AILEY	Atlantic Coastal Plain	0 - 25%	> 60"		48 - 72"	**A**
ALBANY	Atlantic Coastal Plain	0 - 6%	>72"		18 - 30"	**C**
ALLANTON	Atlantic Coastal Plain		>60		0 - 6"	*unsuitable*
ARDILLA	Atlantic Coastal Plain	0 - 5%			12 - 24"	**C**
BAYBORO	Atlantic Coastal Plain	0 - 2%	>60"		0 - 12"	*unsuitable*
BETHERA	Atlantic Coastal Plain	0 - 2%	>60"		0 - 18"	*unsuitable*
BIBB	Atlantic Coastal Plain	0 - 1%	>72"		.5 - 1"	*unsuitable*
BLADEN	Atlantic Coastal Plain	0 - 2%	>72"		0 - 12"	*unsuitable*
BLANTON	Atlantic Coastal Plain	0 - 45%	>72"		30 - 72"	**A**
BOHICKET	Atlantic Coastal Plain	0 - 2%	> 60"			*unsuitable*
BONIFAY	Atlantic Coastal Plain	0 - 12%	>72"		40 - 60"	**A**
BROOKMAN	Atlantic Coastal Plain	0 - 2%	> 60"	>72"	0 - 12"	*unsuitable*
CAINHOY	Atlantic Coastal Plain	0 - 10%	> 60"		40 - 60"	**A**
CAPE FEAR	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
CAPERS	Atlantic Coastal Plain	0 - 2%	> 60"		+ 12" - 12"	*unsuitable*
CARNEGIE	Atlantic Coastal Plain	2 - 12%			40 - 60"	**U**
CENTENARY	Atlantic Coastal Plain	0-5%			42 - 60"	**A**
CHASTAIN	Atlantic Coastal Plain	0 - 2%			0 - 12"	*unsuitable*

Soil Series See Suitability Codes and Installation Information	**MLRA Major Land Resource Area**	**Slope % Ranges of the soil type**	**Depth to Bedrock (ranges)**	**Bedrock Hardness**	**Depth to Seasonal High H2O Table (inches)**	**Suitability Code and Installation Information**
CHIPLEY	Atlantic Coastal Plain	0 - 8%			18 - 36"	**C**
CLARENDON	Atlantic Coastal Plain	0 - 6%			24 - 36"	**C**
COWARTS	Atlantic Coastal Plain	1 - 25%			40 - 60"	**N**
COXVILLE	Atlantic Coastal Plain	0 - 2%	>72"		0 - 12"	*unsuitable*
CRAVEN	Atlantic Coastal Plain	0 - 12%	> 60"		24 - 36"	**C**
CROATAN	Atlantic Coastal Plain				0 - 12"	*unsuitable*
DASHER	Atlantic Coastal Plain	0 - 1%			+ 12" - 12"	*unsuitable*
DOTHAN	Atlantic Coastal Plain	0 - 12%			36 - 60"	**U**
DUCKSTON	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 6"	*unsuitable*
DUNBAR	Atlantic Coastal Plain	0 - 2%	> 60"		12 - 24"	**C**
ECHAW	Atlantic Coastal Plain	0 - 2%			30 - 60"	**C**
ELLABELLE	Atlantic Coastal Plain	0 - 2%			+ 12" - 6"	*unsuitable*
EULONIA	Atlantic Coastal Plain	0 - 6%			18 - 42"	**C**
FOXWORTH	Atlantic Coastal Plain	0 - 25%			40 - 60"	**A**
FRIPP	Atlantic Coastal Plain	2 - 30%	> 60"		> 72"	*unsuitable*
FUQUAY	Atlantic Coastal Plain	0 - 10%	> 60"		48- 72"	**A or U**
GRADY	Atlantic Coastal Plain	0 - 2%			+ 24" - 12"	*unsuitable*
HAZLEHURST	Atlantic Coastal Plain	0 - 3%	> 60"		6 - 24"	**C**
HURRICANE	Atlantic Coastal Plain	0 - 5%	> 60"		24 - 42"	**C**
JOHNSTON	Atlantic Coastal Plain	0 - 2%			0 - 12"	*unsuitable*
KERSHAW	Atlantic Coastal Plain	2 - 15%			>72"	
KINGSFERRY	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 6"	*unsuitable*
KINGSLAND	Atlantic Coastal Plain	0 - 1%	> 60"		+ 2' - 6"	*unsuitable*
KINSTON	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
KUREB	Atlantic Coastal Plain	0 -20%			>72"	
LAKELAND	Atlantic Coastal Plain	0 -85%			>72"	
LEEFIELD	Atlantic Coastal Plain	0 - 12"			18 - 30"	**C**
LEON	Atlantic Coastal Plain	0 - 5%			0 - 6" or deeper	**C**
LEVY	Atlantic Coastal Plain	0 - 2%	> 60"		+ 2' to 0"	*unsuitable*
LOWNDES	Atlantic Coastal Plain	0 - 17%			> 48"	**A**
LUCY	Atlantic Coastal Plain	0 - 45%			40 - 60"	**A**
LUMBEE	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
LYNN HAVEN	Atlantic Coastal Plain	0 - 5%	> 60"		0 - 6"	*unsuitable*
MANDARIN	Atlantic Coastal Plain	0 - 3%	> 60"		18 - 36"	**C**
MASCOTTE	Atlantic Coastal Plain	0 - 2%			6 - 18"	**C**
MEGGETT	Atlantic Coastal Plain	0 - 3%	>60"		0 - 12"	*unsuitable*
NANKIN	Atlantic Coastal Plain	0 - 60%	>72"		40 - 60"	**J**
NOBOCO	Atlantic Coastal Plain	0 - 6%	> 60"		30 - 40"	**C or S**
OCILLA	Atlantic Coastal Plain	0 - 10%			12 - 30"	**C**
OGEECHEE	Atlantic Coastal Plain	0 - 2%			+ 1' to 12"	*unsuitable*

Soil Series See Suitability Codes and Installation Information	**MLRA Major Land Resource Area**	**Slope % Ranges of the soil type**	**Depth to Bedrock (ranges)**	**Bedrock Hardness**	**Depth to Seasonal High H2O Table (inches)**	**Suitability Code and Installation Information**
OLUSTEE	Atlantic Coastal Plain	0 - 2%	> 80"		6 - 18"	**C**
OSIER	Atlantic Coastal Plain	0 - 2%	> 60"		< 12"	*unsuitable*
OUSLEY	Atlantic Coastal Plain	0 - 5%	> 60"		18 - 36"	*unsuitable*
PELHAM	Atlantic Coastal Plain	0 - 5%			+ 1' to 18"	*unsuitable*
PICKNEY	Atlantic Coastal Plain	0 - 2%			< 10" to 20"	*unsuitable*
PLUMMER	Atlantic Coastal Plain	0 - 5%			0 - 12"	*unsuitable*
PONZER	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	*unsuitable*
POOLER	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	**C, or J**
POTTSBURG	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 24"	**C**
RAINS	Atlantic Coastal Plain	0 - 2%			0 - 12"	*unsuitable*
RICEBORO	Atlantic Coastal Plain	0 - 2%	> 60"		0 - 12"	**C, or J**
RIDGELAND	Atlantic Coastal Plain	0 - 2%	> 60"		18 - 30"	**C**
RIGDON	Atlantic Coastal Plain	0 - 2%	> 60"		18 - 30"	**C**
RIMINI	Atlantic Coastal Plain	0 - 10%	> 60"		> 72"	
RUTLEGE	Atlantic Coastal Plain	0 - 2%			0 - 6"	*unsuitable*
SAPELO	Atlantic Coastal Plain	0 - 2%			0 - 18"	**C**
SATILLA	Atlantic Coastal Plain	0 - 1%			0 - 18"	*unsuitable*
SCRANTON	Atlantic Coastal Plain	0 - 2%			6 - 18"	**C**
STILSON	Atlantic Coastal Plain	0 - 5%	>72"		30 - 40"	**C or S**
SUNSWEET	Atlantic Coastal Plain	2 - 25%	> 72"		40 - 60"	**J**
SURRENCY	Atlantic Coastal Plain	0 - 1%	>72"		0 to 0.5"	*unsuitable*
TAWCAW	Atlantic Coastal Plain	0 - 2%	>72"		18 - 30"	*unsuitable*
TELFAIR	Atlantic Coastal Plain	2 - 15%	20 - 40"		12 - 36"	*unsuitable*
TIFTON	Atlantic Coastal Plain	0 - 8%	>72"		40 - 60"	**U**
TROUP	Atlantic Coastal Plain	0 - 40%	>72"			**A**
VALDOSTA	Atlantic Coastal Plain	0 - 5%	>72"		>60"	**A**
WAHEE	Atlantic Coastal Plain	0 - 4%	72"		12 - 18"	**C, or J**
WICKSBURG	Atlantic Coastal Plain	0 - 12%	72"		40 - 60"	**A**

Table 3.C Soil Texture

Soil Class	Dry Soil	Moist Soil
Sand	Loose single grains, which feel gritty and can be seen with the naked eye. Squeezed in the hand the soil mass falls apart when pressure is released.	Squeezed in the hand it forms a cast, which crumbles when touched. Does not form a ribbon. Very gritty.
Sandy Loam	Aggregates are easily crushed; very faint velvety feeling initially but as rubbing is continued the gritty feeling of sand soon dominates.	Feels gritty, forms a cast, which bears careful handling without breaking. Doesn’t form a ribbon, will compact when squeezed between thumb and forefinger.
Loam	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized loam has a velvety feel that becomes gritty with continued rubbing. Casts bear careful handling.	Cast can be freely handled without breaking. Slight tendency to ribbon. Rubbed surface is rough, slightly gritty.
Silt Loam	Aggregates are firm but may be crushed under moderate pressure. Clods are firm to hard. Smooth, flour like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon with rubbed surface having a broken or rippled appearance.
Clay Loam	Very firm aggregates and hard clods that strongly resist crushing by hand. When pulverized the soil takes a somewhat gritty feeling due to the harshness of the very small aggregates which persist.	Cast can bear much handling without breaking. Pinched between thumb and forefinger it forms a ribbon whose surface tends to feel gritty when dampened and rubbed. Ribbon will break easily; barely sustaining its own weight. Will slick (shine) when rubbed. Soil is plastic, sticky and puddles easily.
Clay	Aggregates are hard and clods are extremely hard which strongly resists crushing by hand. When pulverized it has a gritty texture due to harshness of numerous very small aggregates, which persist.	Casts can bear considerable handling without breaking. Forms a long flexible ribbon and retains its plasticity when elongated. Rubbed surface has a very smooth, satin feeling, sticky when wet and easily puddle.

Figure 2.C Georgia Major Land Resource Areas (MLRA's)

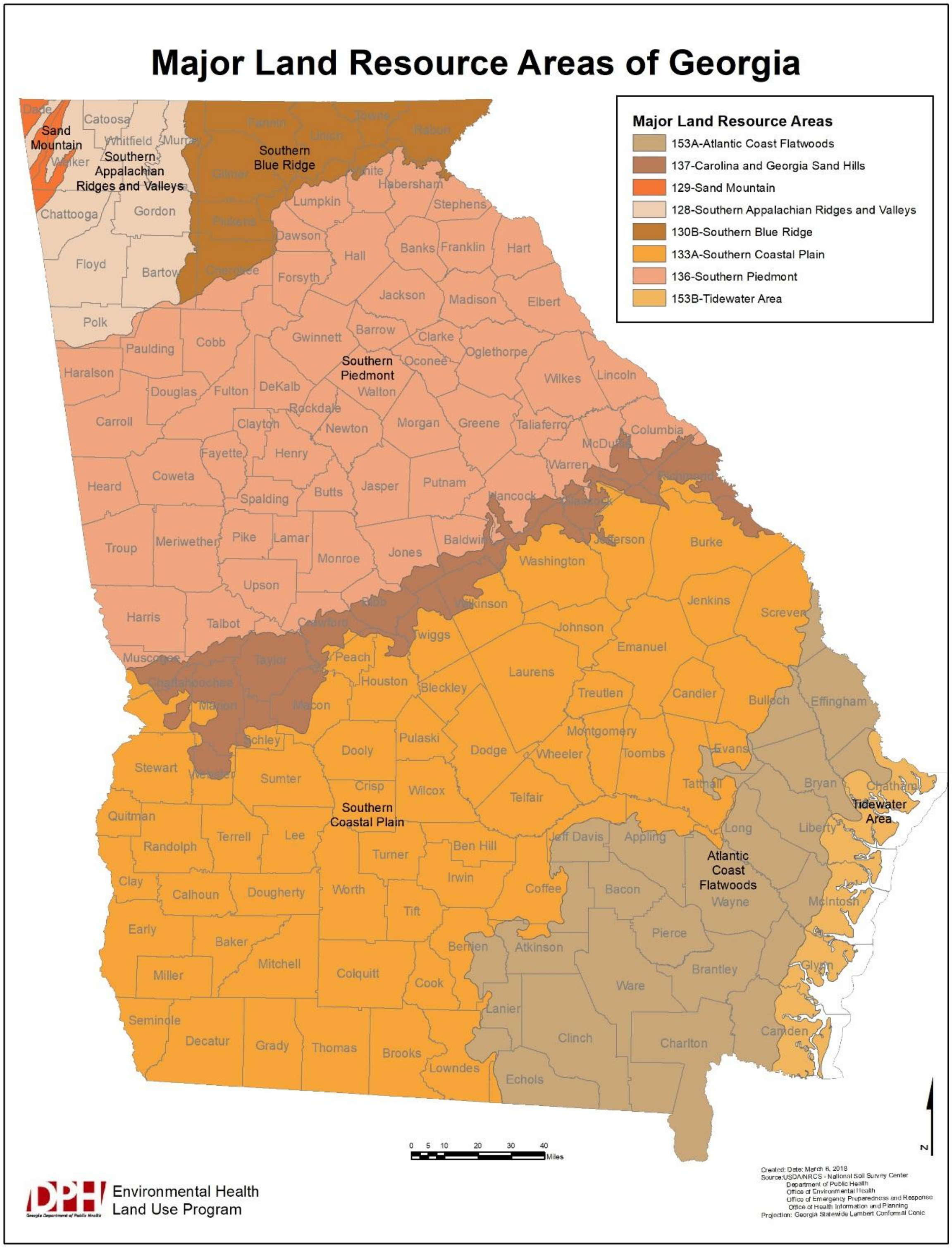

Figure 3.C Example Soil Report: Page 1 of 2

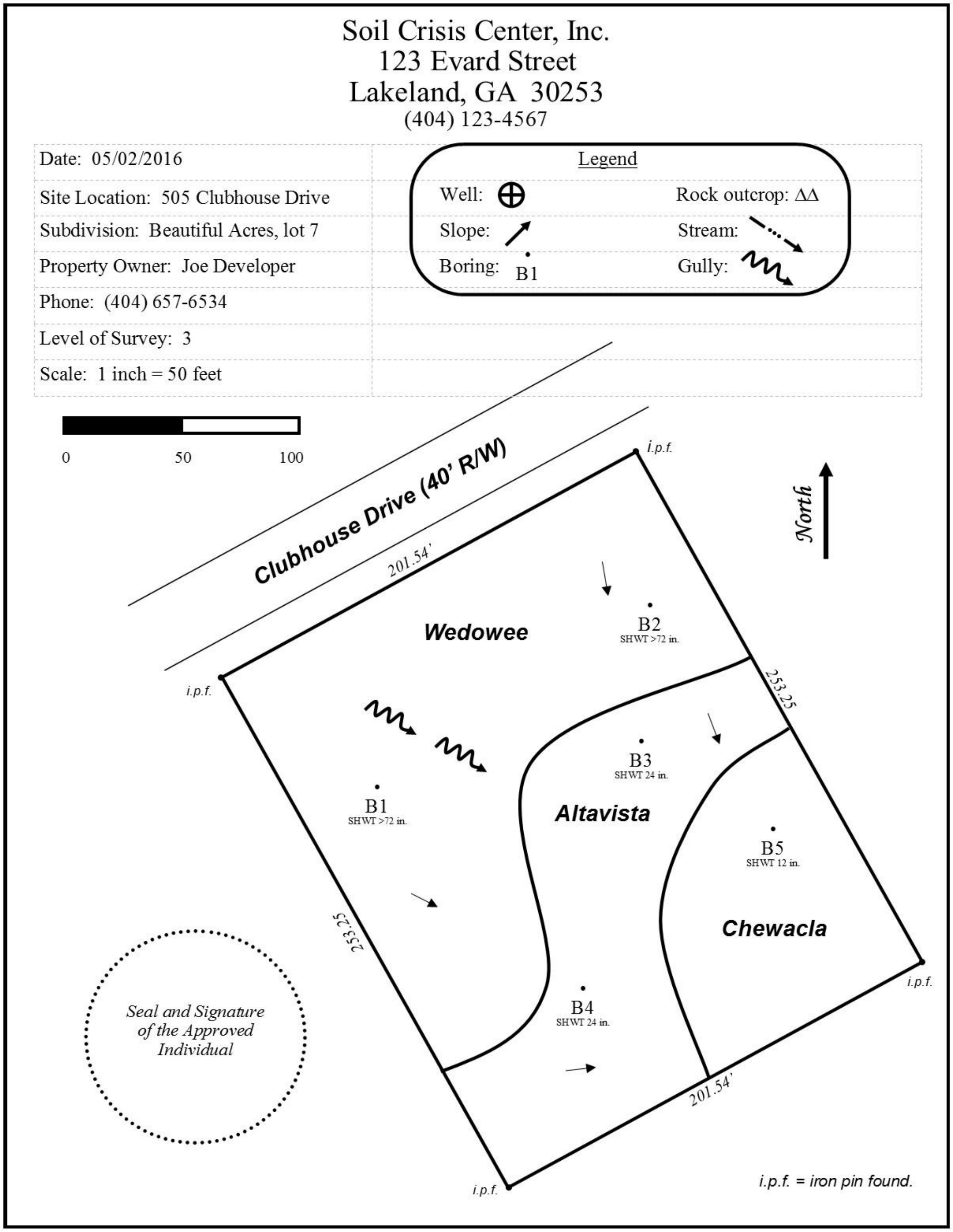
Soil Crisis Center, Inc.
123 Evard Street
Lakeland, GA 30253
(404) 123-4567
Date: 05/02/2016
Site Location: 505 Clubhouse Drive
Subdivision: Beautiful Acres, lot 7
Property Owner: Joe Developer
Phone: (404) 657-6534
Level of Survey: 3
Scale: 1 inch = 50 feet
Legend
Well:
Rock outcrop: ΔΔ
Slope:
Stream:
Boring:
B1
Gully:
0
50
100
Clubhouse Drive (40' R/W)
201.54'
i.p.f.
North
Wedowee
B2
SHWT >72 in.
253.25
B3
SHWT 24 in.
B1
SHWT >72 in.
Altavista
B5
SHWT 12 in.
Chewacla
253.25
B4
SHWT 24 in.
201.54'
Seal and Signature of the Approved Individual
i.p.f. = iron pin found.

Figure 4.C Example Soil Report: Page 2 of 2

Soil Crisis Center, Inc.
123 Evard Street
Lakeland, GA 30253
(404) 123-4567

Property Information	
Date: 05/02/2016	Level of Survey: 3
Site Location: 505 Clubhouse Drive	Property Owner: Joe Developer
Subdivision: Beautiful Acres, lot 7	Phone: (404) 657-6534
County: Susquehanna	Scale: 1 inch = 50 feet

Map Unit Properties						
Soil Series	Slope %	Depth to Bedrock	Depth to Seasonal High Water Table	Absorption Rate at Recommended Trench Depth	Recommended Trench Depth	Map Unit Suitability Code
Wedowee	5-15 %	>72 in.	>72 in.	45 min. / in.	24-36 in.	A
Altavista	5-10 %	>72 in.	24 in.	See codes	See codes	C
Chewacla	0-2 %	>72 in.	12 in.	Not Recommended	Not Recommended	F

Map Unit Suitability Codes	
A	These soils are suitable for installation of on-site systems with proper system design, installation, and maintenance. Position of the site or other soil and landscape considerations may require the drain field area to be greater than the minimum and/or the drain field design to require equal distribution or level field installation.
C	Because of flooding, shallow seasonal water tables, soil horizons with very slow percolation rate, perched water tables, or imperfect drainage, these soils are not suitable for installation of a conventional on-site system without site modifications, special designs or installation. Properties of the soil and site may require the drain field area to be greater than the minimum and/or the drainfield design to require equal distribution or level field installation. Non-conventional systems and installation must be approved by the local Environmental Health Specialist.
F	Because of soil limitations, these soils are unsuitable for installation of an on-site system.

General Notes
Boring locations illustrated on the soil map were located from the existing corner pins using a hip chain and compass. Base map is from final property plat surveyed by Generic Surveyors, Inc. dated 04/02/16. Survey was provided by owner.

Form 1.C Soil Data Record - Percolation, Water Table, and Soil Data

GEORGIA DEPARTMENT OF PUBLIC HEALTH Soil Data Record - Percolation, Water Table, and Soil Data					
Name of Proposed Development:					
Location of Proposed Development:					
County: Land Lot: Land District:					
Owner or Sponsor: Phone Number:					
Owner or Sponsor Address:					
Percolation Data					
Test Hole Number Hole Depth and Percolation Rate (minutes/inch) Types of Subsoil Encountered Test Hole Number Hole Depth and Percolation Rate (minutes/inch) Types of Subsoil Encountered					
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		
10			20		

- If it appears that the ground water table may adversely affect the operation of on-site sewage management systems at any time of the year, specify by lot numbers and indicate on a topographic map the areas so affected:
- If rock, shale, hardpan or similar formations occur as outcroppings or within a six-foot depth on any of the lots in this physical development, specify by lot numbers and indicate on a topographic map the areas so affected:

Boring Number	Soil Descriptions*
1	
2	
3	
4	
5	
6	

7	
8	
9	
10	
*Note: Soil descriptions must include color, texture, structure, consistence, and redoximorphic features. All borings must be located on a topographic map. Attach additional sheets as necessary.	

Form 2.C Soil Survey Report Check List

GEORGIA DEPARTMENT OF PUBLIC HEALTH **Level 3 Soil Survey Report Check List**			
✓ = Complete x = Incomplete			
Soil Survey Report:			
	Soil survey boundaries mapped at a scale within a range of one-inch equals ten feet to one-inch equals one hundred feet; a bar scale must be included.		
	Clear identification of mapping: intensity, scale, and symbols (plus a North arrow).		
	Caption identifying the project or client name, location of the project and county, contact number, and date of survey.		
	Name, address, phone number, and stamp or seal of the Certified Soil Classifier.		
	Level 3 subdivision reports on a site-specific two-foot contour interval topo map.		
Soil Properties Table, Interpretations, and Suitability Code (s):			
	Name of map unit (soil series, no symbols)		Verified seasonal high water table within 72 inches of the surface
	Suitability code (custom or Table 1.C)		Absorption rate and depth of occurrence (upper and lower limits of horizon).
	Percent slope		Depth to refusal/restrictive layer
Field Evaluations:			
	A minimum of at least one hole bored and classified per 0.25 acres. For any site less than one acre in size, four borings are the minimum requirement.		
	All borings numbered, flagged, and illustrated with their corresponding number on the finished soil map within 15 feet of the true boring location.		
	All borings to a minimum of 72 inches, unless a refusal layer is identified or to not less than 24 inches beneath the planned absorption trench bottom.		
	All reference points numbered and identified on-site.		
*Reports not including the required information should be returned to the Classifier. Notification of deficient reports shall be provided in writing by mail within 3 business days			

Comments:
DPH Representative: Date:

Form 3.C OSSMS Construction Permit (page 1)

GEORGIA DEPARTMENT OF PUBLIC HEALTH
CONSTRUCTION PERMIT AND SITE APPROVAL
For On-Site Sewage Management System

COUNTY	SUBDIVISION	LOT NUMBER	BLOCK

PROPERTY LOCATION (ADDRESS/DIRECTIONS)

I hereby apply for a construction permit to install an On-Site Sewage Management System and agree that the system will be installed to conform to the requirements of the rules of the Georgia Department of Public Health. Chapter 511-3-1. By my signature, I understand that final inspection is required and will notify the County Health Department upon completion of construction and before applying final cover material to the system.

PROPERTY OWNER'S/AUTHORIZED AGENT'S SIGNATURE	DATE

PROPERTY OWNER'S NAME	PHONE NUMBER	ALTERNATE PHONE NUMBER

PROPERTY OWNER'S ADDRESS

AUTHORIZED AGENT'S NAME (if other than owner)	PHONE NUMBER	RELATIONSHIP TO OWNER

Section A — General Information

1. REQUIRED SETBACK FROM RECEIVING BODIES EVALUATED (wells, lakes, sinkholes, streams, etc.) (1) YES (2) NO	5. TYPE OF STRUCTURE (single/multi-family residence, commercial, restaurant, etc.)	9. SOIL SERIES (e.g. Pacolet, Orangeburg, etc.)
2. WATER SUPPLY (1) PUBLIC (2) PRIVATE (3) COMMUNITY	6. WATER USAGE BY	10. PERCOLATION RATE / HYDRAULIC LOADING RATE
3. SEWAGE SYSTEM TO BE PERMITTED (1) NEW (2) REPAIR 3) ADDITION	7. NO. OF BEDROOMS / GPD	11. RESTRICTIVE SOIL HORIZON DEPTH (inches)
4. LOT SIZE (SQUARE FEET / ACRES)	8. LEVEL OF PLUMBING OUTLET (1) GROUND LEVEL (2) BASEMENT (3) ABOVE GROUND LEVEL	12. SOIL TEST PERFORMED BY

Section B — Primary / Pretreatment

1. DISPOSAL METHOD	2. GARBAGE DISPOSAL	3. SEPTIC TANK CAPACITY (gallons)	4. ATU CAPACITY	5. DOSING TANK CAPACITY (gallons)	6. GREASE TRAP CAPACITY (gallons)
	(1) YES (2) NO				

Section C — Secondary Treatment

1. ABSORPTION FIELD DESIGN (1) Level Field (2) Serial (3) Drip (4) Bed (5) Distribution Box (6) Mound/Area Fill (7) Other	4. TOTAL ABSORPTION FIELD SQUARE FEET REQUIRED	7. NUMBER OF ABSORPTION TRENCHES
2. ABSORPTION FIELD PRODUCT	5. TOTAL ABSORPTION FIELD LINEAR FEET REQUIRED	8. SPECIFIED LENGTH OF ABSORPTION TRENCHES
3. AGGREGATE DEPTH (inches)	6. DEPTH OF ABSORPTION TRENCHES (range in inches)	9. DISTANCE BETWEEN ABSORPTION TRENCHES

PERMIT

A permit is hereby granted to install the on-site sewage management system described above. This permit is not valid unless properly signed below. This permit expires twelve (12) months from date of issuance.

Any grading, filling, or other landscaping subsequent to issuance of a permit may render permit void, failure to follow site plan may render permit void. Any grading, filling, or other landscaping subsequent to final inspection by county health department, which adversely affects the function of the on-site sewage management system, may render approval void. Installation contractor is responsible for locating proper distances from buildings, wells, property lines, etc.

Issuance of a construction permit for an on-site sewage management system, and subsequent approval of same by representative of the Georgia Department of Public Health or county board of health shall not be construed as a guarantee that such systems will function satisfactorily for a given period of time; furthermore, said representative(s) do not, by any action taken in effecting compliance with these rules, assume any liability for damages which are caused, or which may be caused, by the malfunction of such system.

APPROVING ENVIRONMENTALIST / TITLE	DATE	CONSTRUCTION PERMIT NUMBER	SITE APPROVED AS SPECIFIED ABOVE
			(1) YES (2) NO

Form 4.C OSSMS Construction Permit (page 2)

GEORGIA DEPARTMENT OF PUBLIC HEALTH
CONSTRUCTION PERMIT AND SITE APPROVAL For On-Site Sewage Management System

County
County Phone
Permit Number
Property Address

PRESCRIBED TANK LOCATION / REMARKS

PRESCRIBED ABSORPTION FIELD LOCATION

PROPOSED SYSTEM LAYOUT/DESIGN

Form 5.C OSSMS Site Evaluation Request Form

ON-SITE SEWAGE MANAGEMENT SYSTEM SITE EVALUATION REQUEST

Division of Health Protection / Environmental Health / Land Use Program

Instructions: The applicant or authorized agent should provide as much information as possible on this form. The local board of health will issue OSSMS construction permits based on minimum standards after an assessment of site conditions, soil characteristics, and proposed daily wastewater flow. As a minimum, a site plan sketch; proposed daily flow (or number of bedrooms); and permission to visit the site must be provided. *Note: Where system components are not indicated by the applicant, the local board of health will permit minimum conventional system standards based on wastewater flow, soil characteristics, and site conditions.*

GENERAL INFORMATION

County:	**Subdivision:**	**Lot:**
Street Address/City/Zip:		

Request Type:	**Stub Out Location:**	**Water Supply:**	**Type of Facility:**	
1. New	1. Slab	1. Public	1. Residential	**Number of Bedrooms or gpd:**
2. Repair	2. Crawl-Space	2. Private Well	2. Non-Residential	**Garbage Disposal:** Yes / No
3. Addition	3. Basement	3. Community Well		**Lot Size:**
4. Relocation	4. Other			**Drainfield Type:**

PROPOSED SITE PLAN SKETCH

The following information must be provided in the space below: 1) lot sketch showing lot dimensions, proposed building location/dimensions, proposed building line and side line distances; 2) street or road name; 3) well location if applicable and well locations on adjacent property; 4) driveway, patio or other paved surfaces; 5) underground utilities; 6) plumbing stub out and proposed drainfield location; 7) location of easements and flood plain; 8) replacement area, if necessary. *Note: Complex lots, commercial systems, or alternative systems may require accurately scaled site plans and/or engineered design plans.*

The above information as furnished is true and correct to the best of my knowledge. I hereby apply for an on-site sewage management system construction permit and inspection of that system based upon this information. I do hereby give permission to the health department to enter onto the property, at reasonable hours, for the purpose of processing this application. The applicant and/or owner is responsible for adverse soil conditions, such as rock or water tables, encountered.

Signature of Applicant: **Date of Application:**

Applicant Name (print):	**Applicant Address:**	**Phone:**
Owner Name (print):	**Owner Address:**	**Phone:**

DEPARTMENT USE ONLY

Fee Amount Paid:	**Received By:**	**Date:**
Date of Evaluation:	**EHS:**	**Approved:**

*Note: The local board of health will approve the construction of any equivalent system components that have been approved for use in the state of Georgia by the Department of Public Health under the condition the installation is performed in accordance with the Rules of the Department of Public Health, Chapter 511-3-1; the Georgia Manual for On-Site Sewage Systems; and current TRC product approvals. The grant of a permit by the county board of health for the installation of any on-site sewage management system does not constitute a warranty or endorsement.

Form 6.C Lot Evaluation Record

LOT EVALUATION RECORD

Division of Health Protection / Environmental Health / Land Use Program

General Information

County:	Subdivision:	Lot:
Street Address:		

Boring Number	Estimated Percolation Rate	Depth to Estimated Percolation Rate	Depth to Seasonal High-Water Table	Depth to Refusal or Restrictive Layer

*Note: Sites with poor percolation, redoximorphic features or restrictive layers within 24 inches of the planned absorption trench bottom, a seasonal high-water table within 30 inches of the original ground surface or other questionable soil features will require evaluation from an approved professional.

Sketch Identifying Boring Locations

Comments and Recommendations

Evaluated By:	Date of Evaluation: