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ENVIRONMENTAL SCIENCES DIVISION

SOIL SURVEY OF SOLID WASTE STORAGE AREA 6

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NUCLEAR AND CHEMICAL WASTE PROGRAMS
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EXECUTIVE SUMMARY

The soil survey of SWSA-6 shows the location, extent, and distribution of soils and their relationships to both the geologic formations and the geomorphic processes that have produced the present landforms. There are three major parent material groups within the SWSA-6 boundary. Of largest extent and most significant is the in situ regolith from the uppermost Maryville Formation of the Conasauga Group. This regolith, also commonly called residuum or saprolite, is the result of chemical weathering by the downward percolation of water, which removes soluble constituents, including calcium carbonate. The initial rock volume does not decrease, but the bulk density decreases markedly with a consequent increase in porosity (isovolumetric weathering). Soil horizons form the uppermost part of the weathered acidic saprolite. The degree of weathering of in situ saprolite is based in the hydrology of the landforms. If water can enter the soil rather than run off, the soil will be more deeply weathered and more acid in the upper part. If the amount of rainfall that runs off is far greater than the amount that infiltrates the soil is always in the process of geologic erosion and, as a result, has weak expression of horizons, and the saprolite beneath is relatively unleached and still has a high pH. Additional study of the physical, chemical, and mineralogical properties of these particular soils down to bedrock will be necessary in order to model the properties of the soil system in which most low-level radioactive solid wastes are currently being buried.

The Maryville regolith is separated into three major groups, based on the degree of weathering of the uppermost 2 m and the development and expression of soil horizons. The processes that are active in the upper 2 m of soil also affect deeper parts of the saprolite. The soils in Map Unit No. 2 are the least developed, with a narrow pH gradient from the surface downward into the deeper and less weathered saprolite. The soils in Map Unit No. 3 are more weathered and more strongly developed, the pH is lower (more acid) in the upper soil horizons, and carbonates have been transported deeper into the saprolite; there has also been more alteration and weathering of clay minerals deeper into the saprolite. The soils of Map Unit No. 4 represent the highest degree of weathering; the pH gradient remains acid deeper into the saprolite before free calcium carbonate occurs. The soils of Map Unit No. 10 represent regolith and saprolite from the interbedded Maryville-Nolichucky formations; this particular saprolite is less weathered because of its low permeability.

The next major type of soil parent material (colluvium and alluvium) consists of transported sediments derived from the in situ soils and saprolite located on sloping hillside landforms. This parent material has been partially sorted as it was washed and rolled down slope. Thus, it nearly always has a lower clay content than the upland in situ soils. The location, distribution, and extent of colluvial and alluvial parent materials is represented by Map Units No. 5, 6, 7, 8, and 11. The soils from this kind of parent material have chemical properties that are different from those of the upland in situ soils, because they are in lower and wetter parts of the landscape and have been altered by other chemical processes associated with wetness. With these soils, much additional water passes over the surface as overland flow or through the soil as lateral flow. The physical and chemical properties of these particular soils are important, since water or leachate passing through them will be filtered and purified before it emerges onto the surface as a spring, seep, or flow. The third kind of parent material in SWSA-6 is ancient alluvium. Its location and extent is represented by Map Unit No. 9. Beneath the alluvium parent material, highly weathered in situ residuum occurs. It is the most highly weathered Maryville residuum within SWSA-6, and it represents the kind of weathering products that will eventually form in the less weathered Maryville saprolite where waste is now being placed. The presence of ancient alluvium has importance not only in determining past geomorphic events that shaped the present landforms, but also in future geomorphic events that will tend to destabilize not only the in situ upland soils but even more the highly disturbed soils of trench fill and cover.

The best location for placing waste is within Map Unit No. 9. More space could be made available if the boundary fence were relocated to include all of the upland summit landform on which the old alluvium is located. Disturbed soil removed from trenches in Map Unit No. 9 has much better properties for cover material than soil from any other place within SWSA-6. The next-best location for burial is the hill where trenches are now being excavated. This hill is mostly isolated from lateral movement of water within deeper in situ saprolite layers. However, the excavated soil is mostly fragmental and allows for very rapid infiltration of rainfall. It also lacks suitable physical and chemical properties for filtering and purifying trench leachate, because of its low surface area.

It is recommended that final on-site cover for a trench or a group of trenches be obtained from the colluvial soils. This cover material can be compacted and rendered less permeable. Also, additives can be mixed as it is pushed into place. Furthermore, raw fragmental cover material makes a poor medium for plant roots, while a final cover of colluvium along with lime and fertilizer amendments provides for the development of a thick grass sod that will greatly retard surface erosion. Based on the acid nature of both the residual soils and the disturbed high-fragment-content cover soil, soil fertility tests should be made once a year for determination of lime and fertilizer applications required to establish and maintain a thick grass cover that will reduce erosion rates as well as slowing down the establishment of trees.

The next phase of SWSA-6 soil characterization will be the characterization of the physical, chemical, and mineralogical properties of the soils of greatest extent, extending from the surface down to hard unleached, unoxidized bedrock. This soil survey and the subsequent characterization study, integrated with ongoing geologic, geochemical, geophysical, and hydrologic investigations will allow for better pathways analysis and performance assessment of SWSA-6.

ABSTRACT

An intensive soil survey was made of Solid Waste Storage Area (SWSA) 6 (Oak Ridge National Laboratory) at a scale of 1:1200. Ten mapping units were established to encompass the major soils and landforms, with each map unit distinguished from all other map units by either properties of geologic parent material, degree of chemical weathering within a particular parent material, landform character, or soil morphology. Upland soil parent materials consist of residuum from the uppermost part of the Maryville Limestone and the overlying Nolichucky Shale. Toe-slope parent materials consist of colluvium that washed or rolled downslope or soil materials transported as mudflows from upland soils, with alluvium in first- and second-order drainageways. Upland landforms are all doubly convex erosion surfaces.

The amount of chemical weathering, the thickness of upland soils, and the depth to unoxidized rock are dependent on slope gradient, water-flow pathways, degree of rock fracturing, and the extent of soil and rock erosion by late Pleistocene and Holocene geomorphic processes. Foot-slope landforms have generally concave slope shapes where sediment accumulates. Colluvium stratigraphy exhibits at least one lithologic discontinuity, but there may be two discontinuities preserved in some thicker colluvia.

One or more paleosols, either complete or partially truncated, are preserved in these concave landforms. Alluvial soils were not examined in detail but were separated from colluvial soils because of their wetness. A small area of ancient alluvium was located on a stable

upland summit that formed the highest elevation in SWSA-6. On the nearly level summit, a thin loess cap was preserved on the older alluvial soil. Upland and colluvial soils are all highly leached and strongly acid even though they are formed from a calcareous parent rock. The highly fractured rock, being relatively permeable, has been leached free of carbonates in the upper levels so that there is a wide pH gradient from the surface downward. Most of the soils were classified as Ultisols, with minimal areas of Alfisols, Inceptisols, and Entisols.

Based on the soil survey, representative landforms and soils will be selected to study physical, chemical, and mineralogical properties of the soil and weathered rock. Those properties will be used to predict both the amount and duration of leachate filtration and purification in downward migration to the water table or lateral migration through colluvial and alluvial soils to ground-water seeps.

ACKNOWLEDGMENTS

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INTRODUCTION

Solid Waste Storage Area 6 (SWSA-6) is the only currently operating shallow land burial (SLB) facility for low-level radioactive waste (LLW) at the Oak Ridge National Laboratory (ORNL). In order to ensure that it complies with the proposed governmental guidance on LLW disposal, existing site characterization data were compiled (Boegly 1984) and an additional characterization plan was established (Boegly et al. 1985). Part of this characterization effort involves mapping the soils in order to determine the location of each. From the map specific sites can be sampled and analyzed, the results of which can be related to the known occurrence of each particular soil.

The site includes 28 ha (68 acres) located in Melton Valley, northwest of White Oak Lake and southeast of Lagoon Road and Haw Ridge in Roane County (Fig. 1). Because of severe erosion and high-acid soils, SWSA-6 area vegetation maintained itself in sagegrass and red cedars, an early stage of old field succession, as revealed in a 1958 oblique aerial photograph of the area (Fig. 2). Major burials of LLW at SWSA-6 were not initiated until SWSA-5 was closed in 1973 (Webster 1976). The site is underlain by the upper part of the Maryville Limestone and possibly by Nolichucky Shale formations of the Conasauga Group. Most of the current and past waste disposal operations at ORNL have taken place within these same geologic formations.

The soils of Roane County were mapped in the 1930s, and the results were published in 1942 at a scale of 1:48000 (Soil Survey Staff 1942). Due to the limited depth of observation and great changes in

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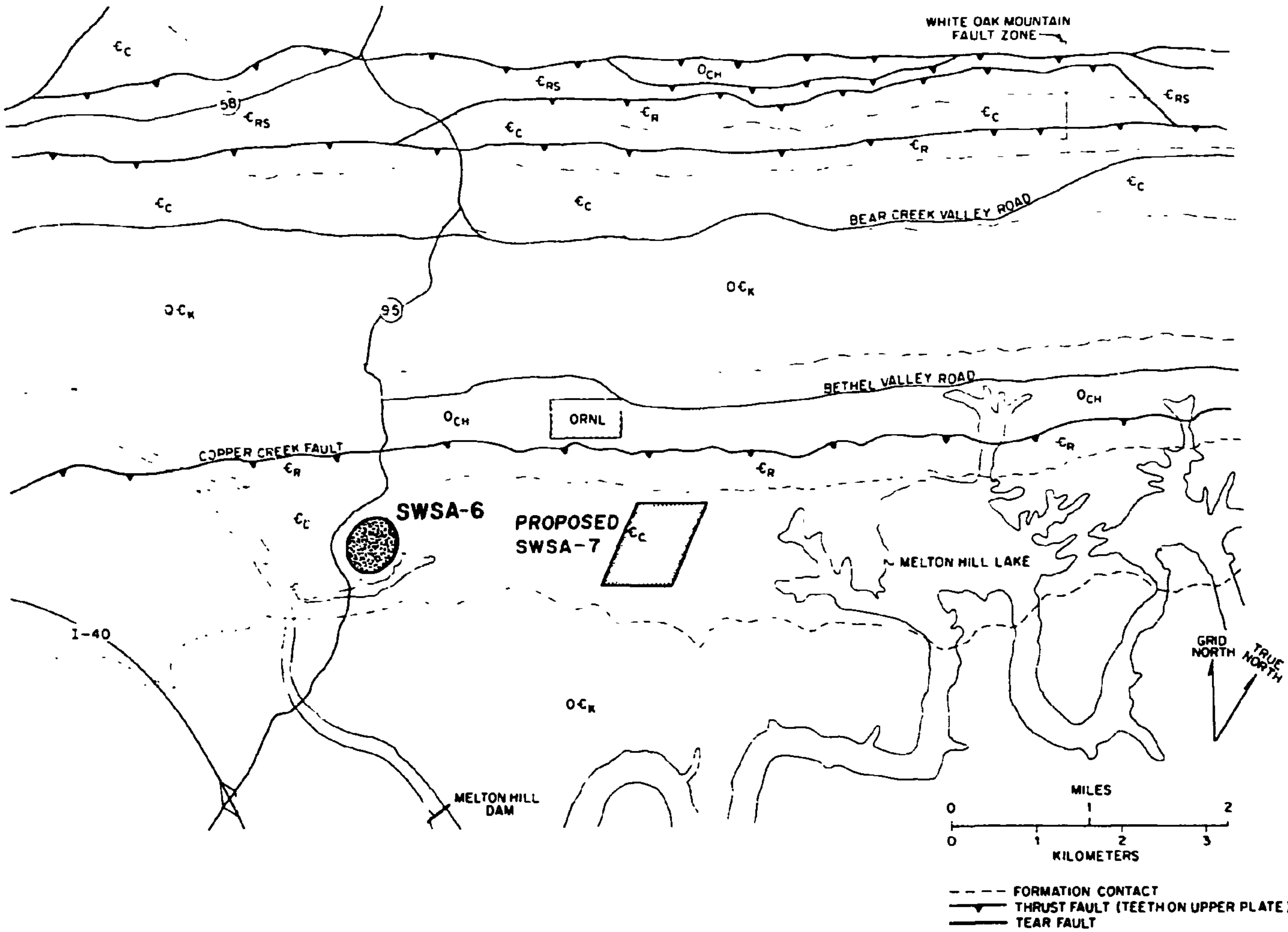

Fig. 1. Location of SWSA-6

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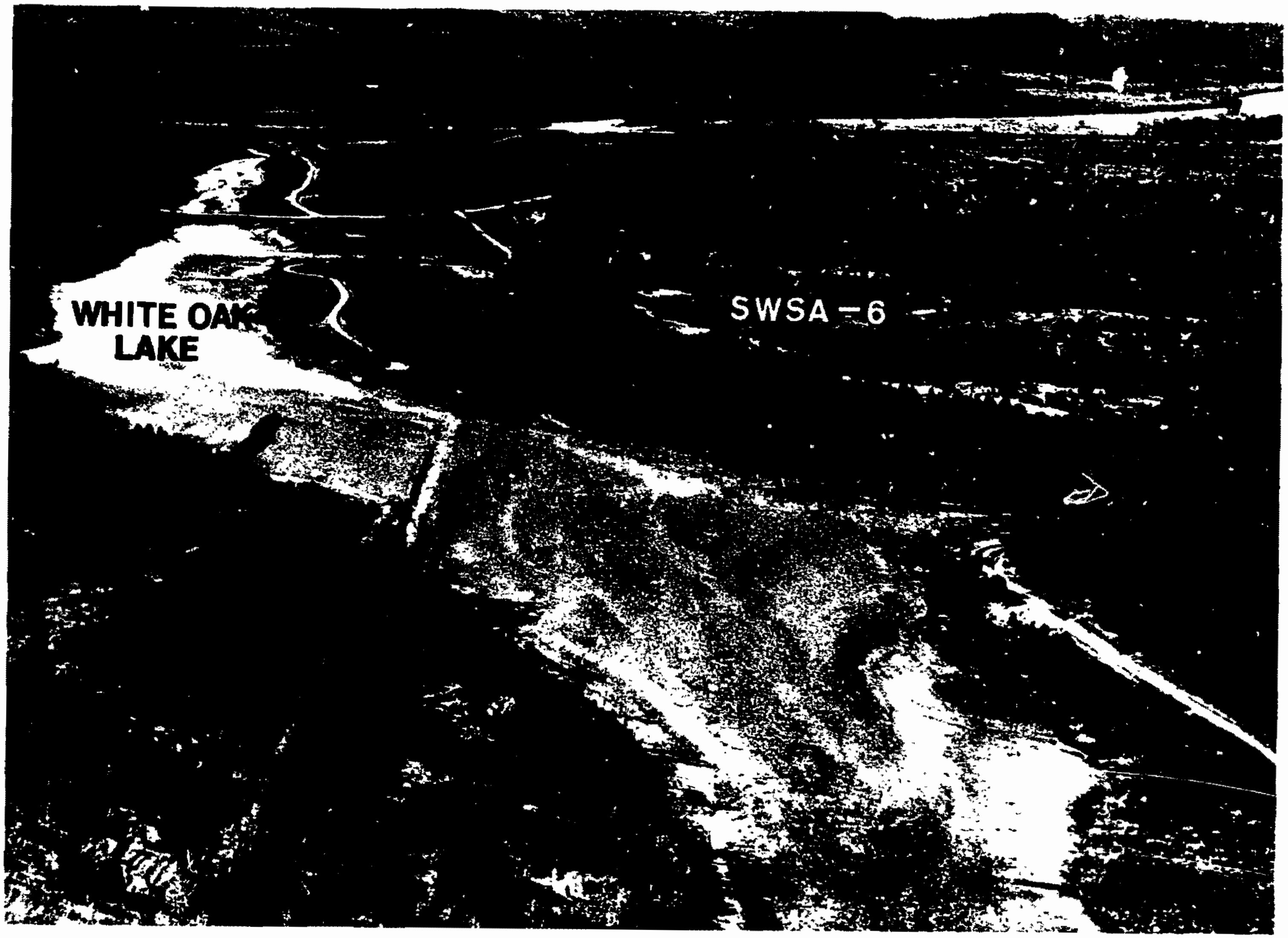

Fig. 2. Aerial Photograph of SWSA-6 Area

concept and classification of soils, the present Roane County Soil Survey is obsolete. It does not have sufficient detail; it was designed for screening use, and the depth of observation was limited to ~ 100-150 cm (40-60 in.).

The objective of this investigation was to provide a detailed soil survey report that utilizes pedologic, geologic, and hydrologic site characterization studies. Investigation of soil properties is the first step to take for site characterization, because soil and weathered rock strata provide the first and most important natural barrier to contaminant migration from SLB facilities.

PROCEDURE

Soil mapping was accomplished at a scale of 1:1200, by walking over the entire area while making periodic observations of landforms and soils. A map unit is defined by the landform and its configuration, the major soil or soils, and the geologic parent materials. Slope, erosion, and surface texture phases were not used in defining map units. A 6-cm barrel auger was used to make soil profile observations to a depth of 150 cm, or to auger refusal if less than 150-cm. After the map was constructed, representative sites were selected to encompass the major soils observed in SWSA-6. Backhoe pits were excavated at these sites to a depth of 2 m. A barrel auger was used to make observations to a total depth of 3 m, or to auger refusal, in the bottom of the pits (Lee et al. 1984).

The basic precepts of Soil Taxonomy (Soil Survey Staff 1975), which underlie the concept of a "soil series", were used in conceptually defining each of the different soils so that they could be classified at least through the "family" level. "Soil series" names were added to some of the described soil profiles, even though the concept of the named "soil series" did not completely apply. Departures from the series concept are noted by the use of footnotes. Where a series name is used along with the word "variant," this denotes significant departures from the concept of that series. However, the soil morphology and the physical properties of a soil may be similar enough to use some existing data from that series until data have been generated for the particular soil in question (Appendix A).

Soils are described according to the procedures contained in the Soil Survey Manual, revised (Soil Survey Staff 1984). Moist soil colors are from Munsell Soil Color Charts (1975 edition). Soil pH measurements were taken using a Hellige-Truog pH kit.

SOIL GENESIS

Soil genesis involves a considerable number of processes and their interactions, both of which are defined by the soil-forming factors of climate, biota, relief, parent materials, and time. These factors and their interactions drive the basic pedogenic processes of additions, losses, transformations, and translocations. A certain subset of the basic pedogenic processes defines and drives a particular soil-forming process.

Each of the factors except climate is defined as accurately as possible in the heading of each soil profile description. The assumption that the macroclimate is nearly the same for each of the soils is reasonable, but the interactions of climate with relief and perhaps the biota results in soils with differing morphology. The past climate is known with some certainty in the Recent epoch (0 to 200 y), with less certainty in the Holocene (200 to 12,000 y), and with much less certainty in the Pleistocene (12,000 to 2×10^6 y). It is fairly certain that the last major climatic perturbation of the Pleistocene, the Wisconsinan glacial, profoundly affected many soils and land forms in East Tennessee while hardly affecting others. Recent palynological data reported by Delcourt and Delcourt (1981) revealed that during the Late Wisconsinan (about 18,000 years ago), black spruce and other northern boreal forest tree species had their southern limit at the latitude of Atlanta, Georgia, and westward through northern Alabama. At elevations above 1350 m in the southern Appalachians, periglacial processes and sporadic permafrost destabilized landforms. Soils were stripped down to hard bedrock, and mass movement of saturated soil as mudflows down mountainsides was widespread. In East Tennessee, soils and their parent geologic formations at lower elevations were also affected by the Wisconsinan climate change. Most landforms and soils derived from impermeable shales were geomorphically sensitive and underwent one or more episodes of stripping or colluviation during climatic changes; whereas more permeable soils derived from solution-modified carbonate rocks were less sensitive to climate changes, remained stable without any mass movement downslope, and are considered geomorphically insensitive.

The major criterion for determining soil stability is the permeability of both the soil and the underlying geologic formation. If water flow in a soil and in the saprolite beneath is maintained in an unsaturated mode, the soil remains more stable than a saturated soil in which water flows under a hydraulic head. Geomorphic stability is also related to topography. Hence, the combination of relatively high relief, periods of soil saturation, and intense frost action during the Wisconsinan glacial period stripped many of the shale-derived soils to coherent rock. The highly fractured Maryville Limestone was slightly permeable, and as a result the soils were slightly more stable and not as truncated as other soils formed over the Athens and Sevier shales in East Tennessee. The presence of considerable colluvium in SWSA-6 is direct evidence for geomorphic instability during the Wisconsinan. In addition, about 3000 years ago a worldwide (or at least northern hemisphere) climate change, known as the "Neo-Glacial" was sufficient to destabilize some soils. Its effects are most evident in shale-derived soils at low elevations and also at elevations above 1500 m in the Southern Appalachians where its effects are more widespread. The SWSA-6 foot-slope landforms contain at least two ages of colluvium (Fig. 3 and Table 1). The foot-slope landform, Map Unit No. 5, has a soil with a fragipan that marks a time-stratigraphic boundary. In addition, the equivalent landform, Map Unit No. 10, nearby in proposed SWSA-7, also contains at least a double sequence of colluvium (Rothschild et al. 1984): the lower colluvium of Soil No. 10w in SWSA-7 is less weathered than the lower colluvium of Soil No. 5 in SWSA-6, and a fragipan has not developed.

The other major climatic effect is excess rainfall that infiltrates and leaches soluble components during downward percolation. This is a geochemical process of weathering. The biotic factor increases the rate of chemical weathering by its role in acidifying soil leachate, but the biotic factor (trees) retards the effects of leaching to some extent by cycling of calcium and other cations from deeper, less weathered rock layers. Soil Profile II shows this effect quite well by the high pH readings in the surface horizons and the lower pH's below (Appendix B). The biotic factor probably has been quite similar for all of the well-drained landforms in the area, although slope aspect and its influence on the soil microclimate could affect the soils.

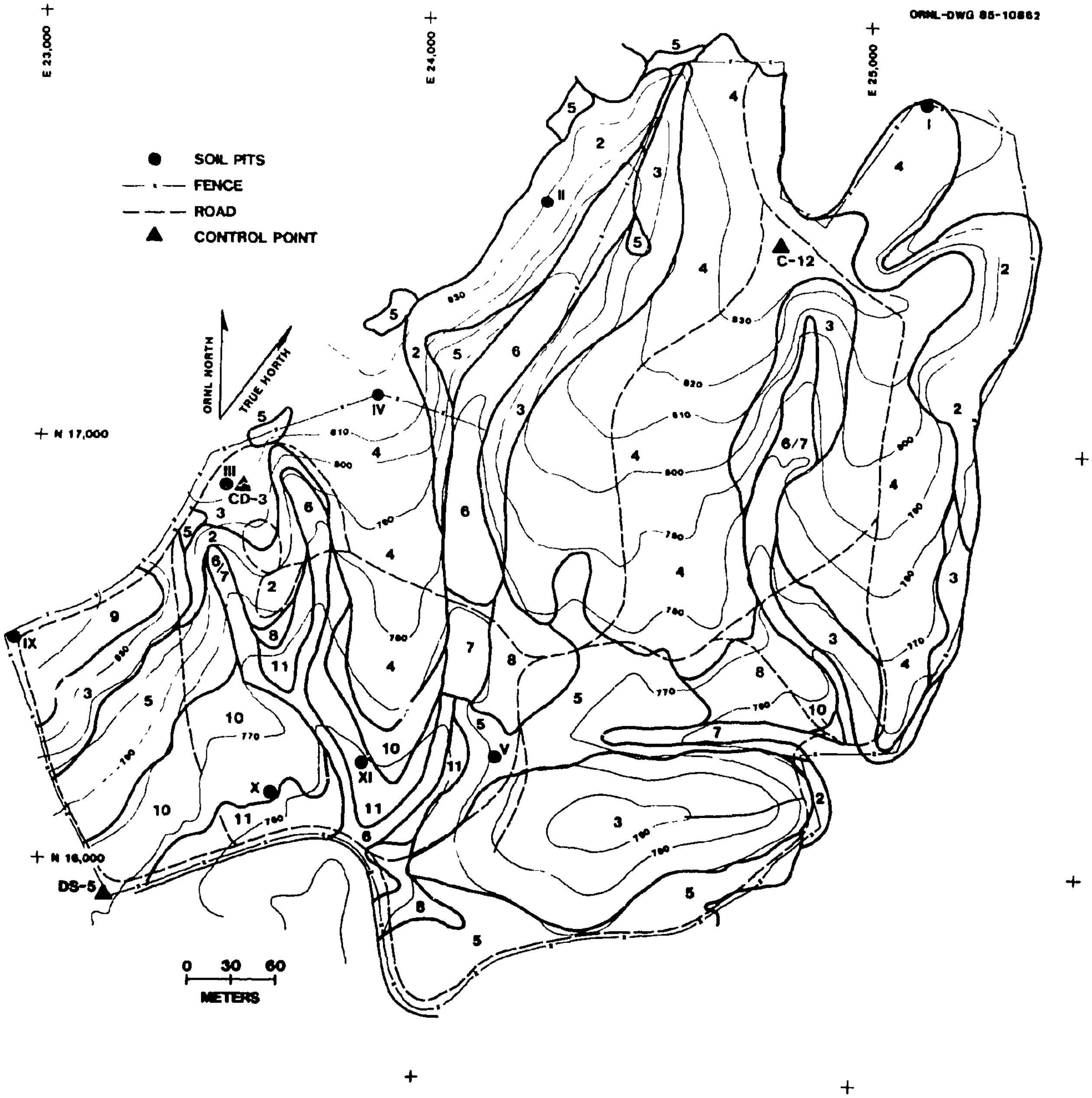

Fig. 3. Aerial Soil Survey Map of SWSA-6

Table 1. Legend for the SWSA-6 Soil Survey Map (Fig. 3)

Map unit	Description
2	Steep and very steep side-slopes with doubly convex slopes. Soils are mostly Typic Dystrochrepts; loamy-skeletal, mixed, thermic. (Berks-Variant Series).
3	Long narrow side-slopes with slope gradients more than 12%, and narrow doubly convex upland summits. Soils are mostly Ruptic-Ultic Dystrochrepts; loamy-skeletal, mixed, thermic (Litz series).
4	Broad upland summits and broad side-slopes with slope gradients between 6 and 12%, and doubly convex slope configuration. Soils are mostly Typic Hapludults; clayey, mixed, thermic (Muse series).
5	Foot-slopes with mostly doubly concave slope configuration. Slopes range from 6 to 20%. Soils are Typic Fragiudults; fine-silty, mixed, thermic (Leadvale series) and Typic Hapludults; fine-silty, mixed, thermic (Shelocta series).
6	Drainageways with mostly wet alluvial soils that classify as Typic or Aeric Fluvaquents; fine-silty, mixed, thermic (series not designated).
7	Drainageways that have been filled with debris from land clearing activities or with earth materials from trenching operations (Udorthents).
8	Foot-slope landforms that have been filled with debris from land clearing activities or with earth materials from trenching operations (Udorthents).
9	Broad nearly level upland summit, plus shoulder and side-slopes with gradients of 6 to 20%. The summit soils formed in loess/alluvium/shale residuum, whereas the side-slope soils formed in alluvium/shale. Soils are Typic Paleudults; fine-silty and clayey, siliceous and mixed, thermic (Turbeville series).
10	Low upland with slope gradients between 6 and 12% and mostly doubly convex slope configuration. Soils are mostly Ruptic-Aquultic Dystrochrepts; loamy-skeletal and clayey, mixed, thermic (series not designated).
11	Toe-slopes with slope gradients of 2 to 6% and doubly concave slope configuration. Soils are mostly Aquic Hapludalfs; clayey, mixed, thermic. (Tupulo series).

The parent material of SWSA-6 seems to be the uppermost part of the Maryville Limestone. The geologic materials beneath Map Units Nos. 10 and 11 appear to be the interbedded transitional zone between the Maryville Limestone with calcareous shale and siltstone, which has an oxidized color in the 2.5Y hue (olive brown), and the Nolichucky Shale, which is a claystone with an oxidized color in the 7.5YR hue (brown).

The interactions of climate, slight parent material differences, and past geologic faulting and fracturing seem to be the primary reasons for the differing degrees of geomorphic stability, the resultant times of soil formation, and the different soils in the area. The soil-forming process in freely drained oxidized landforms of SWSA-6 leaches carbonates, transforms primary minerals to secondary clay minerals or weathers the cements that bind clay particles in claystones, and translocates these clay particles downward in the soil, forming a clay-enriched subsoil horizon. This horizon is commonly labeled "Bt." If the clay increase is large enough, the Bt horizon can qualify as an argillic horizon, one of the key diagnostic horizons for classifying soils in Soil Taxonomy (Soil Survey Staff 1975). The presence of the ancient alluvial soil, Profile IX, in Map Unit No. 9 of SWSA-6 indicates that the long-term soil-forming processes have resulted in the argillic horizon becoming thicker and richer in clay. If the rate of soil formation exceeds the rate of sediment accumulation in a foot-slope landform, argillic horizons will form close to the surface and will later be buried, or truncated and then buried, by subsequent mass earth movements.

Foot-slope and toe-slope landforms have one or more soil-forming processes that are or were active. These landforms collect particles that erode from higher places, as well as receiving additional run-on water. Profiles can be characterized as cumulative where the "youngest" soil material is at the surface, although the "youngest" soil material may be the highly weathered and very acid A and B horizons of an upland soil. Sediment may accumulate at a fairly constant rate; however, most of the colluvium has accumulated as the result of one or more catastrophic events (the climate changes of the Pleistocene and Holocene) that produced upland instability. Locally intense events such as cloudbursts can also contribute sediment. This kind of sediment from local intense events, however, usually has a very localized and sporadic distribution, and its source is easily seen; whereas climatic changes result in regional patterns and distributions of colluvium.

Foot-slope and toe-slope landforms are commonly subject to fluctuating water tables and variable oxidation-reduction chemistry. In these zones, manganese, iron, and other ions are differentially mobilized and translocated. In soil zones that remain wet, the removal of manganese and iron compounds leaves the soil a pale brown to brownish-gray color. The rock under soil Profiles X and XI is quite impermeable and thus retains some mobile ferrous iron compounds that impart a bluish or greenish color to the lower subsoil. Further evidence that the rock under profile X is relatively impermeable is the presence of calcite fillings that have not yet been dissolved. Water evidently flows laterally through the soil and rock interface to the stream channel.

SOIL CLASSIFICATION

Ten orders are recognized in the soil classification system of Soil Taxonomy used in the United States (Soil Survey Staff 1975). SWSA-6 contains four of these: Entisols, Inceptisols, Alfisols, and Ultisols. Entisols are those soils without any diagnostic horizons that would place soils into one of the other orders. Most of the Entisols occupy the floodplains and highly disturbed areas of the tract. The soils in Map Unit No. 6 are very young, wet, and often stratified to the surface. They are geomorphically unstable and accumulate sediments from higher areas. They are classified as Typic and Aeric Fluvaquents. The soils of Map Units Nos. 7 and 8 classify into the suborder of Udorthents. These soils are very young and are forming from highly disturbed shaley parent materials. Udorthents have either a C horizon at the soil surface or a very thin A horizon with grass roots over a C horizon.

By definition, Inceptisols are those soils which are stable enough to have formed a cambic horizon. A cambic horizon is one in which more than 50% of the rock structure has been destroyed and in which soil structure, produced by a soil-forming process, occupies more than half of the volume of the horizon. Cambic horizons are labeled "Bw." Other requirements for a cambic horizon include a color change produced by oxidation-reduction processes and little or no translocation of clay particles.

The soils of Map Unit No. 2 classify as Inceptisols, because erosion has stripped off the pedogenic soil horizons about as fast as they form, keeping the soil in a youthful steady state condition. The cambic horizon in the soils of Map Unit No. 2 displays a colc change (more oxidized) relative to the C horizon beneath, a loss of rock structure, and the formation of a weak soil structure. The suborder that the soils of Map Unit No. 2 fall into are the Ochrepts. Ochrepts have an ochric epipedon that is light in color or, if dark, too thin to qualify for a mollic or umbric epipedon. Ochrepts are further divided at the great group level into those with high base status and those with low base status. All of the soils in SWSA-6 that classify as Inceptisols are acidic and leached, with no free carbonates and no horizon with a base saturation greater than 60%. Low base status places Ochrepts into the Dystrochrept great group. Within the Dystrochrept great group are several subgroups. The soils of Map Unit No. 2 have a typical Dystrochrept morphology and are labeled as Typic Dystrochrepts.

The soils of Map Unit No. 3 also classify as Dystrochrepts, but they are in a more advanced stage of development. Most of these soils have a Bw cambic horizon progressing towards qualifying as an argillic horizon, but have too much rock structure and insufficient clay translocation to qualify as an argillic horizon. The other and minor part of the subsoil has an argillic horizon, labeled Bt. This argillic horizon is interrupted by the cambic horizon. Identifying the soil in this map unit is the term "ruptic-ultic": ruptic indicating the cambic-argillic interruption, and ultic indicating that the soil has a base saturation less than 35% at a depth of 150 cm below the top of the argillic horizon.

The other Dystrochrepts of SWSA-6 are those of Map Unit No. 10. These soils fall into the subgroup of Ruptic-Aquultic Dystrochrepts (implied subgroup). The clayey-argillic part of the soil is characterized by high moisture content and has gray mottles produced by a low permeability in the horizon, by perched water at the Cr-paralithic contact, and by fluctuating water at the lower part of the argillic horizon. The cambic part of the soil, being more permeable, does not show evidence of wetness even though the Cr-paralithic horizon beneath does perch water.

Alfisols are soils with a light-colored ochric epipedon, often underlain by an E horizon (unless there has been recent agriculturally accelerated erosion) and an argillic-Bt horizon beneath. Alfisols must have an argillic horizon and, at a depth of 125 cm below the surface must have more than 35% base saturation. The higher base saturation that separates Alfisols from Ultisols is often related to less intense weathering and leaching. Thus, the clay minerals usually have greater activities and higher cation exchange capacities in the argillic and lower horizons in Alfisols than in Ultisols.

The soils of Map Unit No. 11 classify as Alfisols. Based on their morphology, reaction, and moisture content, the Alfisols are further classified as Aquic Hapludalfs. The upper 25 cm of the argillic horizon in these soils is typically a mottled gray and yellow brown color.

The soils of Map Units Nos. 4 and 9 classify into the Ultisol order, because they have a light-colored ochric epipedon, an argillic horizon, and base saturation of less than 35% at a depth of 125 cm below the top of the argillic horizon. Ultisols usually have clay minerals that have lower activity and lower cation exchange capacity. Units Nos. 4 and 9 both fall into the same suborder of Udults, those soils with an udic moisture regime. The soils of Map Unit No. 4, because they have a thinner solum and a thinner argillic horizon, have a significant decrease in clay content of more than 20% within a depth of 150 cm below the soil surface. Udults with this clay distribution fall into the great group of Hapludults. The Udults of Map Unit No. 9 have a thick solum and a thick argillic horizon. The clay content of the soil does not decrease by more than 20% at a depth of 150 cm below the top of the soil. Udults with this clay distribution fall into the great group of Paleudults. The Hapludults of Map Unit No. 4 have a typical morphologic expression and fit into the Typic Hapludult subgroup. The Paleudults of Map Unit No. 9 also have a typical expression of morphology and fit into the Typic Paleudult subgroup.

The family classification incorporates the subgroup class and adds factual information based on a particular section of the soil profile, namely the family control section. The family control section in Entisols and Inceptisols begins at a depth of 25 cm and terminates at a depth of 100 cm. In the Alfisols and Ultisols the family control section begins at the top of the argillic horizon and ends at a depth 50 cm into the argillic horizon or at its base if the argillic horizon is less than 50 cm thick.

Within this section the particle size class is determined, such as loamy-skeletal, fine-silty, or clayey. The mineralogy is also determined. The particle size fraction used to determine mineralogy depends on the family particle class. For soils with a clayey particle size class (more than 35% clay), the mineralogy is based on the clay fraction, whereas in soils with a non-clay particle size class, the mineralogy is based on the fine and very fine sand fractions. Some mineral classes are based on the properties of the whole soil, but these particular mineral classes do not apply to the soils of SWSA-6.

The family classification also includes the soil temperature regime, which in SWSA-6 is thermic: soils with a mean annual soil temperature of 15 to 25° C measured at a depth of 50 cm. Therefore, a family classification might read as follows: Typic Hapludult; clayey, mixed, thermic.

The soil series is the lowest category of Soil Taxonomy. Each family class is represented by one to several soil series. The concept of the soil series brings the family class plus the kinds and sequences of horizons, solum thickness, parent materials, and landform together. Each soil series is represented by a typical pedon plus a defined range of characteristics represented by similar pedons that fit the series concept. Each soil series within a family class has one or more significant differences, often parent materials and landform, or horizonation that separates it from all pedons of other series within that family or in other related families. Classifications of SWSA-6 soils are summarized in Table 2.

COMPARISON OF SOILS IN SWSA-6 AND PROPOSED SWSA-7

SWSA-6 lies about 3 km west of proposed SWSA-7 within Melton Valley (Fig. 1). A soil survey of the SWSA-7 area was conducted in

Table 2. Classification of Soils at SWSA-6

Map unit[a]	Family classification	Soil series
2	Typic Dystrochrepts; loamy-skeletal, mixed, thermic	Petros variant[b]
3	Ruptic-Ultic Dystrochrepts; loamy-skeletal, mixed, thermic	Litz series[c]
4	Typic Hapludults; clayey, mixed, thermic	Muse series[c]
5	Typic Fragiudults; fine-silty, mixed, thermic	Leadvale series[d]
5	Typic Hapludults; fine-silty, mixed, thermic	Shelocta series[e]
6	Typic and Aeric Fluvaquents; fine-silty, mixed, thermic	SPND[e]
7, 8	Typic Udorthents; loamy-skeletal, mixed, thermic	SPND[e]
9	Typic Paleudults; fine-silty, siliceous, thermic	Turbeville series[f]
10	Ruptic-Aquultic Dystrochrepts; loamy-skeletal and clayey, mixed, thermic	SND[g]
11	Aquic Hapludalfs; clayey, mixed, thermic	Tupulo series

[a]Map Unit 5 has two soil families and series.
[b]Cr horizon too deep for Petros. Morphology is similar to Petros but the geologic formation is not.
[c]Soil temperature regime is thermic rather than mesic.
[d]Mixed rather than siliceous mineralogy.
[e]Soil profile not described.
[f]This series does not have a silt capping.
[g]Series not designated.

1983 as part of a soil characterization plan (Rothschild et al. 1984). The soil survey results for both areas are compared in order to determine whether the areas show enough differences in soil characteristics to justify additional analyses in SWSA-6.

Though both areas are underlain by the Maryville Limestone Formation of the Conasauga Group, they display significant differences in landform configuration, degree of geochemical weathering, and soils. A comparison of the particle size data for the near-surface saprolite reveals that SWSA-6 has a mean sand content of 36%, silt content of 22% and clay content of 42% (Table 3 in Boegly 1984). In contrast, the Cr horizon saprolite of SWSA-7 has a mean sand content of 58%, mean silt content of 32% and clay content of 10% (Table 8 in Rothschild et al. 1984). However, Appendix D of this same study indicates that there are higher clay contents deeper in the saprolite. Most of the sand-sized particles consist of shale and siltstone fragments, and the actual sand content is easily varied by the pretreatment given the sample.

The silt and clay contents of the soils in both areas are related to the physical properties of the saprolite. The clay content in Bt horizons of SWSA-6 soils is much higher than that in Bt horizons of SWSA-7. Only Profile No. 7 of SWSA-7 contains a significant clay content in the Bt horizon, but the reason for this is that the saprolite beneath is a claystone rather than the wide spread siltstone saprolite that underlies most of the rest of SWSA-7. In fact, both exposures of Map Unit No. 7 of SWSA-7 may underlie a different part (claystone) of the Maryville formation of the Conasauga Group. The saprolite under the soils of SWSA-6 has a higher claystone content, which gives rise to soils with higher clay content in the subsoil.

The bedrock under both areas has the same strike and the same general dip to the southeast. However, the Rogersville Shale of the Conasauga Group, which has a red, 2.5YR hue, occurs on an obsequent slope on the north side of SWSA-7 (Map Unit No. 9), and is not observed in SWSA-6. In the south part of SWSA-6 near White Oak Lake, a different claystone is exposed, which may represent the base of the Nolichucky Shale interbedded with the top of the Maryville Limestone. Thus, it appears that SWSA-7 is underlain by basal Maryville Limestone and has a high silt content and a low clay content, whereas SWSA-6 is underlain by upper Maryville Limestone and has a higher clay content and lower sand and silt contents. Figure 3 in Rothschild et al. (1984) indicates that the Maryville Limestone has a higher shale content in the upper portion.

In SWSA-7 there is a very striking difference between east- and west-aspect slope gradients. East-facing slopes are much steeper than west-facing slopes, giving rise to very asymmetrical valley cross-sections, as noted by Rothschild et al. (1984). The same general relationship holds for SWSA-6, but the asymmetry is not as pronounced. Drainageways are closer together in SWSA-7 than in SWSA-6. Thus, SWSA-7 is more dissected and has more local relief between the valley floor and the upland summits. The apparent rate of erosion has also been greater in SWSA-7 than in SWSA-6. The area of soils with depth to a Cr horizon of less than 50 cm is about 19% in SWSA-7 and less than 1% in SWSA-6. Two rather interesting features occur in SWSA-6. One of these is the large first-order drainageways that parallel each other and that are at right angles to the strike; and the other is the rounded hill in the southeast part of the area, which seems to be oriented at right angles to the rest of the broader landforms but parallel to the strike (Fig. 1). Other apparent differences are summarized in Tables 3, 4, and 5.

The above differences seem to be significant in a view of pedogenesis and geomorphology and are related to other significant hydrologic site characteristics that are related to low-level radioactive waste disposal practices. Differences between SWSA-6 and SWSA-7 seem to be too significant and the existing (SWSA) data base is not large enough to warrant the whole sale application of SWSA-7 data to pathway analysis and performance assessments of SWSA-6. These landforms compare only in their general configuration. The soils and geologic parent materials of the soils are somewhat similar. The soils for the most part are not very similar in terms of classifying to the soil series level but have more similarities at higher levels of classification. The only soils that are directly comparable between SWSA-6 and SWSA-7 are the soils in Map Unit No. 4 of SWSA-6 and the soils in Map Unit No. 7 of SWSA-7.

Table 3. Parent Materials of Map Units at SWSA-6

Map unit	Parent materials
2	Maryville:shale and siltstone rich saprolite
3, 4	Maryville:shale with less siltstone
5, 8	Colluvium from Maryville and ancient alluvium
6, 7	Alluvium from upland soils underlain by Maryville
9	Ancient alluvium from local and distant sources
10, 11	Basal Nolichucky and uppermost Maryville, interbedded

Table 4. Parent Materials of Map Units at Proposed SWSA-7

Map unit	Geologic materials
1, 2, 4, 4S	Maryville:siltstone rich
5	Craig member of uppermost Rogersville
6	Alluvium from Maryville
7	Maryville:shale and siltstone rich
8	Alluvium and colluvium from Maryville
9	Rogersville Shale
10, 10W	Colluvium from Maryville

Table 5. Landforms Comparison of Map Units at SWSA-6 and SWSA-7

SWSA-6 map unit(s)	Landform description	SWSA-7 map unit(s)
2	Narrow ridge tops	5, 9
3, 4	Side-slopes	4, 4S, 7
5, 8	Foot-slopes	10, 10W
6, 7	Floodplains	6
10	Low uplands	1, 2
11	Toe-slopes	8

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APPENDIX A

DETAILED MAP UNIT DESCRIPTIONS

Map Unit No. 2

Landform: Steep and very steep side-slopes. Slopes range from 20 to 45%.

Slope shape: Most are doubly convex, but some straight inclined segments occur between the break in the summit shoulder and the lower beginning of the foot-slope.

Vegetation: Second growth of red maple, Virginia pine, white pine, sourwood, scattered white oak, black gum .

Soils: The dominant soils classify as Typic Dystrochrepts; loamy-skeletal, mixed, thermic (Profile II). Soils of lesser extent classify as Typic Dystrochrepts; loamy-skeletal, mixed, thermic, shallow (Profile I) and Ruptic-Ultic Dystrochrepts; fine-loamy or loamy-skeletal, mixed, thermic (Profile III).

According to the 1941 USGS topographic map, all areas of Map Unit No. 2 were cleared. The present evidence indicates that the soils in this map unit, although never farmed, were probably pastured and periodically burned. The present A horizon is only a few centimeters thick. The present trees invaded via old-field succession after the AEC acquired the land in the early 1940s. The present trees indicate that the soils are very acid and highly leached to considerable depth.

The depth to the Cr horizon ranges from less than 50 to about 200 cm. The midrange is between 70 and 100 cm. The Cr horizon is not clay plugged, nor does it perch much water. Above the Cr horizon shale fragments are silt- or occasionally clay-coated. Below the Cr, the paralithic fragmented shale material is coated with either iron oxide (red) or manganese oxyhydroxides (black).

Included in mapping are the shoulder slopes between the summits and side-slopes and some small doubly convex upland summits that are less than 90 m wide. These particular soils (see Profile I) have been subjected to more intense geologic and man-accelerated erosion. Depth to the Cr horizon is less than 50 cm, and the paralithic materials are less weathered and harder. Also included are narrow foot-slopes where layers of colluvium have accumulated, unless the stream has been undercutting the slope. Nearly all areas of Map Unit No. 2 are on obsequent slopes where rock strata dip steeply into the slope.

Map Unit No. 3

Landform: Long narrow side-slopes with slope gradients greater than 12%. Slopes range from about 12% to 20%. Narrow upland summits with similar slope gradients are also included.

Slope shape: Most slope shapes are convex along the contour and either convex or straight across the contour. The entire area constitutes an erosion surface.

Vegetation: The 1941 USGS topographic map indicates that all areas were cleared. Revegetation occurred to a sage grass prairie with scattered red cedar until burial operations started. Nearly all areas of this unit have since been cleared. The present vegetation is Kentucky 31 tall fescue, except where active trenching is occurring.

Soils: The dominant soils are severely and very severely eroded and now classify as Ruptic-Ultic Dystrochrepts, loamy-skeletal and clayey, mixed, thermic. The uneroded soil from this map unit was described under a very large white oak (see Profile III). Erosion during the period of farming before the area was revegetated in the early 1940s removed from 40 to 70 cm of the upper soil, including most of the argillic horizon. More recent land clearing activities stripped off more of the soil.

In the disposal areas where the upper part of the soil has been truncated, there is still evidence that a reddish clayey argillic horizon was once present. Areas of soils that have been less disturbed, most of which are located beneath the TVA power line, verify the presence of argillic horizon remnants. Many shale fragments in the C horizon are coated with reddish clay. The shale fragments are more weathered in the soils of this map unit than in the soils of Map Unit No. 2.

The depth to the Cr horizon is commonly more than 100 and mostly more than 150 cm. The visual appearances of trench sidewalls 15 ft (~4.6 m) deep or deeper indicate very little change in chemical weathering to that depth.

The Cr horizon does not perch much water, but it does preclude downward particulate movement and excludes roots. However, tree roots have been observed well below the top of the Cr horizon. Roots are able, even in these particular paralithic materials, to move down dip. Another reason that water can penetrate to considerable depth is the presence of thin sandstone strata that are highly weathered. The other avenue of root and water access deep into the soil is provided by thin limestone strata. These strata have weathered out and have been largely replaced by translocated clay. Tree roots seem to prefer these areas over the soft sandstone strata.

Included in mapping, because of the heterogeneous nature of the Maryville Limestone, the complex folding and faulting, and landform configuration, are small areas of Typic Dystrochrepts (see Profile II), areas of eroded Typic Hapludults similar in appearance to Profile IV, and, in concave areas in foot-slopes at the base of slopes, areas of colluvium similar to Profile V.

Map Unit No 4

Landform: Broad upland summits and side-slopes with gradients less than 12%. Most gradients on upland summits are less than 6%, while side-slope gradients are generally between 6 and 12%.

Slope shape: Slopes are mostly slightly convex both with and across the contour. This unit is the most geomorphically stable of the upland shale units.

Vegetation: The 1941 USGS topographic map indicates that all areas of Map Unit No. 4 were cleared. Most areas inside the fence have been subsequently cleared of any forest regrowth. The present vegetation is Kentucky 31 tall fescue.

Soils: The dominant soils classify as Typic Hapludults; clayey, mixed, thermic (see Profile IV). Agricultural erosion was significant and, with the additional disturbance from land clearing, would be classified as SEVERE. The Ap horizon rests directly in the clayey Bt horizon. Only on small, nearly level areas are there any transitional horizons between the A horizon and the Bt horizon.

The soils are permeable with good subsoil structure; however, the permeability decreases in the clay-plugged BC and CB horizons. Depth to the Cr horizon is more than 2 m. The Cr horizon stops roots and the downward movement of particles but not ions, which continue onward and coat fragments with either red or black oxides. The paralithic materials beneath the Cr/C boundary are well oxidized and chemically weathered to considerable depth. No trenches were open in any delineations of this map unit, so no visual comparisons could be made between the saprolite under these soils and that under the soils of Map Unit No. 3.

Included in mapping because of the heterogeneous nature of the geologic formation and because of the landforms, are substantial areas of soils similar to Profile III. These parti[illegible]ils are located on steeper-gradient slopes or on shoulders that [illegible]ly convex. Also included at the base of slopes are soils similar to Profile V. Most of these included foot-slope areas have been filled either from recent land clearing activities or covered by backfill removed from trenches.

Map Unit No. 5

Landform: Foot-slope segments of the landform with gradients ranging from about 6% to more than 20%. Most areas have slope gradients in the range of 6 to 12%. This landform accumulates sediments derived from the attached uplands.

Slope Shape: Slopes are mostly doubly concave.

Vegetation: Most areas of these soils that were on slopes of less than 12% were intensively farmed and were all cleared in 1941. These areas revegetated to a mixed pine-hardwood forest and were some of the last areas to be cleared in the current operations. One major delineation of Map Unit No. 5 in the western part of the area is still wooded.

Soils: The dominant soils classify as Typic Fragiudults; fine-silty, mixed, thermic (Leadvale series) or as Typic Hapludults; fine-silty, mixed, thermic (Shelocta series); the described Profile V classifies as a Typic Fragiudult. The fragipan is degraded, but it still perches water. The Typic Hapludult pedons are either underlain by weathered shale at depths between 50 and 100 cm, or the lithologic discontinuity is too deep to allow for fragipan development in the top of the paleosol beneath.

The soils in Map Unit No. 5 formed in material that washed and moved down off the convex uplands. Many areas have one or more colluvial layers of different ages. In some areas there is a residual soil beneath the colluvium. The uppermost part of the soil is forming in modern colluvium from 30 to more than 50 cm thick, the result of past agricultural erosion. This material is quite high in clay content and has a reddish color, the source being the reddish clayey Bt horizons of the upland Litz and Muse soils. Water flows laterally through these soils at lithologic discontinuities. Flow zones can be identified by a sequence of colors. The center of the flow zone is pale brown (10YR 6/3) or grayish brown (10YR 5/2). Adjacent is a dark brown iron hydroxide zone. Next is a zone in which dark colored manganese compounds are concentrated. Flow zones are especially evident in the fragipan. Further, these soils become wetter with depth and with lower position on the foot-slope.

Included in mapping are small areas of soils at the foot-slope--upland border similar to Profiles II, III and IV. At the foot-slope--toe-slope border, the soils of this map unit merge with the soils of Map Unit No. 11 or with the soils of Map Unit No. 6 or No. 10. Also included are small areas that have been covered with soil and debris from land clearing activities or by weathered shale from trenching activities.

Some delineations of Map Unit No. 5 that are covered with weathered shale fill are identified as a separate Map Unit No. 8. These soils provide a natural repository for the collection of sediment derived from upland areas. They also provide a filtration medium for water that moves through them.

One fairly large delineation of Map Unit No. 5 occurs below the old alluvial soils of Map Unit No. 9. The colluvium in which the soils of this particular delineation formed consists of a mixture of shale and alluvium. The presence of old alluvium was evidenced by chert fragments and rounded gravels in the lowermost layer of colluvium in Profile V.

Map Unit No. 6

Landform: Drainageways with nearly level, fairly wide bottoms for first-order streams.

Slope Shape: Concave parallel and perpendicular to the channel.

Vegetation: These soils were probably cleared and used for agricultural activities prior to the AEC aquisition in 1942. The present vegetation, where it has not been cleared, consists of red maple, black gum, sweet gum plus other shrubs, reeds, and sedges.

Soils: The soils in this unit were not investigated in any detail. Most will classify into the Entisol Order, more specifically as Typic or Aeric Fluvaquents; fine-silty, mixed, thermic.

The wide bottoms are probably the result of past upland geomorphic instability and erosion, which generated more sediment than the streams could transport out of the watershed. As a result, the floodplain aggraded and spread out. Today, with loss of the trees, more water is available, and the channel is entrenching itself into the floodplain. Seeps and springs keep the soils wet most of the year, although the upper 50 to 75 cm will dry out during most summers. These soils merge into the soils of Map Unit No. 11 or No. 10 on the toe-slopes or into the foot-slope soils of Map Unit No. 5. Some map unit delineations are shown with a No. 6/7 symbol. These particular delineations have been partially filled with soil and debris from the most recent land clearing operations or filled in with shale backfill from the trenches. Larger delineations of Map Unit No. 6 that have been covered by shale backfill are identified as Map Unit No. 7.

Map Unit No. 7

This map unit consists of drainageways that have been filled with mostly weathered shale materials that were removed from trenches. The soils beneath are those in Map Unit No. 6. Some map unit delineations are identified by a No. 6/7 symbol. These delineations have been partly filled in except for the stream channel.

Map Unit No. 8

This map unit consists of areas on foot-slopes and toe-slopes that have been so disturbed or covered with fill that the original soils cannot be recognized. However, it is a reasonable assumption that the underlying soils are like those of Map Unit No. 5.

Map Unit No. 9

Landform: Upland summit that is nearly level (0 to 2% slope); plus the shoulder and upper side-slopes with slopes of 6 to 20%.

Slope shape: The summit is nearly level and 45 to 60 m wide. The shoulders around the summit are mostly doubly convex, while the side-slopes are mostly inclined-linear.

Vegetation: There is strong evidence both from the 1941 USGS topographic map and the presence of barbed wire fences that parts of this map unit were intensively farmed, but evidently very little lime or fertilizer was used. The area revegetated to a mixed pine-hardwood forest typical of acid and highly leached soils.

Soils: The soils classify as Typic Paleudults; fine-silty, siliceous, thermic on the nearly level ridge top, as Typic Paleudults; clayey, mixed, thermic on the easterly aspects, and as Typic Paleudults; fine-loamy (more sandy) on the westerly aspects. The flat upland summit has a silty capping, while the side-slope soils classify as clayey or fine-loamy. The southern side-slopes are mostly clayey, while the westerly and northerly aspects have a higher sand content in the upper part of the soil and have a fine-loamy particle size class. All of the soils are only slightly to moderately eroded, because of the relatively good permeability of the loess and alluvium and the fair permeability of the underlying shale.

It is most unusual to find old high-level alluvium lying on shale. Two factors appear to be responsible for its preservation: (1) the rather permeable nature of the underlying shale and (2) the basal gravel zone in the alluvium, which stabilizes the side-slopes by armoring the base of the alluvium which prevents slope retreat. The old alluvium occurs on one of the highest and broadest parts of SWSA-6, although small doubly convex shale summits to the north are higher.

The basal gravels contain chert from the Knox Group dolostones, rounded sandstone gravels, and very hard and smooth rounded quartzites from the metamorphic formations of the Great Smokies and Unakas. The border between the alluvium and underlying shale is marked by a change in slope, the shale having a steeper slope gradient.

Map Unit No. 10

Landform: Gently sloping and undulating low upland that in the context of the larger area of SWSA-6 has the appearance of a foot-slope and toe-slope. Slope gradient is mostly 6 to 12%.

Slope shape: Undulating with mostly doubly convex slope shapes. The landform is presently mostly an erosion surface.

Vegetation: Relatively sparse regrowth of Virginia pine, red maple, and some red cedar. The ground cover under the Virginia pine is quite different, in that it consists of mosses and cladonia lichens.

Soils: The dominant soils classify as Ruptic-Aquultic Dystrochrepts; clayey and loamy-skeletal, mixed, thermic. The soils formed mostly in the Nolichucky Shale and interbedded Nolichucky-Maryville Transition Zone rather than the other upland and side-slope Maryville Limestone-derived soils of Map Units Nos. 2, 3, and 4.

Depth to the Cr horizon varies from less than 50 to about 100 cm. The Cr horizon also has very irregular boundary and follows the dip of the shale. The shale is sufficiently impermeable to perch water, and is much less chemically weathered than the saprolitic shale under the soils of Map Units Nos. 2, 3, and 4. The argillic part of the soil becomes gray in the lower part. The cambic part of the soil is skeletal and porous in the upper part, but the permeability decreases down dip. Flow zones are very evident and mostly coincide with thin weathered out limestone strata.

It is not certain whether the soils of Map Unit No. 10 were once covered with the Maryville Limestone, or with colluvium derived from higher areas underlain by Maryville Limestone. Because of the impermeable nature of the shale, most of this map unit is severely eroded; gullies are still visible, but are not active. Not all of the soils of Map Unit No. 10 are immediately underlain by the Nolichucky Shale or interbedded Maryville-Nolichucky materials.

Included in this map unit are areas of soils similar to Profile V. Also, there are wetter areas downslope near White Oak Lake that are similar to the soils of Map Unit No. 11.

Map Unit No. 11

Landform: Toe-slope with slope gradient of about 2 to 6%.

Slope shape: Doubly concave.

Vegetation: Regrowth of sweet gum, red maple, shrubs, plus reeds and sedges.

Soils: The soils classify as Aquic Hapludalfs; clayey, mixed, thermic, and Aeric and Typic Ochraqualfs; clayey, mixed, thermic. The shale underlying the soils is quite unweathered, with calcite still present in vugs and joints. Some areas are underlain by Maryville Limestone, while other areas are underlain by Nolichucky Shale.

The upper part of the soils in this map unit is composed of modern alluvium, mostly washed from the upper horizons of soils higher in the landscape. The middle part of the soil is composed of older alluvium, while the lowest part consists of weathered residuum. It is clear that in the past the soils of Map Unit No. 11 were stripped of soil down to hard rock and then covered with sediments. Only 10 to 15 cm of shale has weathered above the Cr horizon since the emplacement of the lower alluvial unit. The clayey alluvial unit where Profile XI was described also contained exotic rock fragments derived from the high old alluvial unit. In some borings the alluvial gravels were at the lithologic discontinuity between alluvium and residuum.

Included in the map unit are soils similar to those in Map Units Nos. 6, 5, and 10.

APPENDIX B

SOIL PROFILE DESCRIPTIONS FOR SWSA-6

PROFILE I

Location:	Narrow ridge-top shoulder within 0.6 m of the fence approximately 145 m north of horizontal control point C-12.
Vegetation:	Kentucky 31 tall fescue inside the fence. Very scrubby Virginia pine and red cedar outside the fence.
Parent materials:	Slightly weathered siltstone facies of Maryville Limestone (Conasauga Group).
Landform:	Doubly convex upland shoulder slope just below the summit.
Slope:	12%.
Elevation:	254 m.
Aspect:	North.
Erosion:	Very severe prior to reforestation. The thin A horizon of 2 to about 5 cm thick has reformed in the last 40 years.
Classification:	Typic Dystrochrept; loamy-skeletal, mixed, thermic, shallow. Petros - variant series (variant due to high pH at the Cr-paralithic contact).

Horizon	Depth	Description
A	0 to 2 cm	Brown (10YR 4/3) very shaley silt loam; weak fine granular structure; friable; common fine grass roots; 50 to 60% shale fragments; abrupt wavy boundary.
Bw	2 to 8 cm	Olive yellow (2.5Y 6/6) very shaley silt loam; very weak fine subangular blocky structure; firm; 70 to 80% shale fragments; fragments coated with olive-yellow material; few fine roots; abrupt irregular boundary.
C	8 to 18 cm	Light olive brown (2.5Y 5/4) extremely shaley silt loam; steeply dipping rock structure; firm; fragments coated with olive brown silty material; very few fine roots on dip planes; abrupt irregular boundary.
Cr	18 to 40 cm	Olive (5Y 5/3) shale fragments with thin black coatings; very firm; no roots; mildly alkaline; no effervescense.

PROFILE II

Location:	Approximately 167 m west-southwest of horizontal control point C-12, and about 297 m north of horizontal control point CD-3.
Vegetation:	Regrowth of red maple, sweet gum, Virginia pine, red cedar, white pine, and abundant poison ivy.
Parent materials:	Slightly weathered shale and siltstone facies of the Maryville Limestone (Conasauga Group).
Landform:	Doubly convex middle side-slope about halfway between the upland shoulder and the foot-slope.
Slope:	About 40%.
Elevation:	253 m.
Aspect:	East.
Erosion:	Slightly eroded. This side-slope was too steep to farm, but it had been logged one or more times. The 1941 USGS topographic map showed this area in trees.
Classification:	Typic Dystrochrept; loamy-skeletal, mixed, thermic. Berks-variant[1] series.

Horizon	Depth	Description
O	4 to 0 cm	Hardwood leaf litter (including Oi, Oe, and Oa horizons).
A	0 to 10 cm	Dark yellowish brown (10YR 4/4) shaley silt loam; weak fine granular structure; very friable; many fine roots, 15 to 20% shale fragments; pH 6.5; clear wavy boundary.
Bw	10 to 26 cm	Yellowish brown (10YR 5/4) shaley silt loam; weak fine subangular blocky structure; very friable; common fine and few medium roots; 30 to 35% light olive brown (2.5Y 5/4) weathered shale fragments coated with yellowish brown soil material; pH 6.0; clear wavy boundary.

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[1]Variant due to lack of a lithic contact within 100 cm, and different geologic formation. Most of the Berks Soil Series is mapped on the Martinsburg Shale.

BC	26 to 47 cm	Brownish yellow (10YR 6/6) very shaley silt loam; about 30 to 40% weak fine subangular blocky structure, rest is rock structure; very friable; few medium roots; 40 to 50% shale fragments coated with brownish yellow soil material, but some coated with black manganese plasma; pH 5.8; clear irregular boundary.
CB	47 to 70 cm	Light olive brown (2.5Y 5/4) soft weathered shale fragments coated with yellowish brown (10YR 5/6) soil material that crushes to very shaley silt loam; 100% steeply dipping rock structure; friable; few medium roots; 50 to 80% shale fragments; clear irregular boundary.
C1	70 to 92 cm	Light olive brown (2.5Y 5/4) soft shale, siltstone, and sandstone coated with strong brown (7.5YR 5/6) soil material that crushes to very shaley silt loam; 100% steeply dipping rock structure; friable; few medium roots; 90% shale fragments; pH 5.0; clear irregular boundary.
C2	92 to 120 cm	Light olive brown (2.5Y 5/4) soft weathered shale and siltstone that crushes to very shaley silt loam; Steeply dipping rock structure; friable; shale fragments coated with strong brown soil material except in flow zones of grayish brown (10YR 5/2) plasma on fragments and in root channels; some fragments thinly coated with black manganese plasma; also present are thin yellowish brown (10YR 5/8) clay seams that weathered from a thin limestone stratum; common medium roots; pH 5.0; gradual irregular boundary.
Cr	120 to 150 cm	Brownish yellow (10YR 6/6) weathered shale and siltstone; steeply dipping rock structure; description incomplete; (pit was dug on March 20th and partly described; rain during the 21st to the 25th resulted in water filling the pit to a depth of 23 to 25 cm).

PROFILE III

Location:	3 m south of horizontal control point CD-3 and about 3 m from the base of a very large white oak tree.
Vegetation:	Present vegetation is Kentucky 31 tall fescue. The forest regrowth prior to clearing was mixed pine-hardwood.
Parent materials:	Soft moderately weathered shale facies of Maryville Limestone (Conasauga Group).
Landform:	Narrow upland summits, shoulders, and side-slopes with mostly doubly convex slope configuration, but with slope angles intermediate between those of the #2 soils and the #4 soils.
Slope:	Slopes fall mostly in the range of 6 to 18%. Slope at the pit was 6%.
Elevation:	248 m.
Aspect:	Mostly southerly.
Erosion:	Erosion from past agricultural activities was severe, with 20 to 30 cm removed. Recent land clearing activities stripped more of the soil profile, including most of the remaining argillic (Bt) horizon.
Classification:	Ruptic-Ultic Dystrochrept; clayey (Bt) part and loamy-skeletal (Bw) part; mixed, thermic (Litz series). Before the soils were very severely eroded, some would have classified as Typic Hapludults; clayey, mixed, thermic (Muse or Armuchee series).

Bt Part of PROFILE III

Horizon	Depth	Description
A	0 to 10 cm	Dark brown (10YR 3/3) silt loam; moderate fine granular structure; very friable; many fine roots; 5 to 10% shale fragments; clear wavy boundary.

E	10 to 18 cm	Light yellowish brown (10YR 6/4) silt loam; weak fine granular structure; very friable; common fine roots; 5 to 10% shale fragments; clear wavy boundary.
BE	18 to 25 cm	Yellowish brown (10YR 5/6) silty clay loam; moderate fine subangular blocky structure; friable; common fine roots; 10 to 15% shale fragments; clear wavy boundary.
Bt1	25 to 38 cm	Yellowish red (5YR 5/6) shaley clay; moderate medium subangular blocky structure parting to strong fine angular blocky structure; firm; few fine roots and few medium and coarse roots; 15 to 20% soft shale fragments are light yellowish brown (10YR 5/6) and are disoriented; peds and fragments coated with yellowish red (5YR 4/6) plasma; clear wavy boundary.
Bt2	38 to 56 cm	Yellowish red (5YR 5/6) shaley clay; moderate medium subangular blocky structure parting to strong fine angular blocky structure; firm; few medium roots; 20 to 30% soft light olive brown (2.5Y 5/6) shale fragments (that show rock structure); peds and shale fragments are coated with yellowish red (5YR 4/6) clay plasma; gradual irregular boundary.
Bt3	56 to 68 cm	Yellowish red (5YR 4/6) shaley clay; weak coarse subangular blocky structure; firm; few medium roots; 40 to 60% soft olive yellow (2.5Y 6/6) shale fragments; entire horizon plugged with yellowish red clay plasma; some shale fragments coated with red and dark red iron plasma; abrupt irregular boundary.

BCt	68 to 84 cm	Light olive brown (2.5Y 5/6) harder shale fragments plugged with yellowish red (5YR 4/6) clay plasma that crushes to a very shaley clay; rock structure; friable; no roots; some shale fragments that are larger than 2 to 3 cm have black manganese plasma coatings (this horizon restricts water flow somewhat); 70 to 80% shale fragments; abrupt irregular boundary.
CBt	84 to 105 cm	Light olive brown (2.5Y 5/6) weathered shale fragments plugged with yellowish red (5YR 4/6) clay plasma that crushes to very shaley silty clay loam; rock structure; 40 to 60% shale fragments, mostly coated with dark red (2.5YR 3/6) iron plasma; thin sandstone lenses contain fine to medium muscovite flakes; abrupt irregular boundary.
C	105 to 175 cm	Light yellowish brown (2.5Y 5/4) and olive yellow (2.5Y 6/6) weathered shale-siltstone and dark reddish brown (5YR 3/4) very soft fine grained sandstone that crushes to silt loam or very fine sandy loam; rock structure; friable; few fine roots along thin clay laminae that weathered from limestone; dark red (2.5YR 3/6) clay plasma coats fragments in water flow zones, while other fragments are coated with thin black manganese plasma; abrupt irregular boundary.
Cr	175 to 260 cm	Olive brown oxidized shale and siltstone mostly coated with thin black manganese plasma; very soft sandstone stratum is dark yellowish brown (10YR 4/4); dark red (2.5YR 3/6) clay plasma moves down dip in water flow zones along with fine roots.

Bw part of Profile III
(described 1 meter away from Profile III Bt on the other pit wall)

Horizon	Depth	Description
A	0 to 18 cm	Very dark grayish brown (10YR 3/2) silt loam; strong fine granular structure; very friable; many fine and medium roots; less than 10% shale fragments; clear wavy boundary.
E	18 to 27 cm	Brownish yellow (10YR 6/6) silt loam; moderate fine granular structure; very friable; many fine and medium roots; 10 to 15% shale fragments; clear irregular boundary.
Bw1	27 to 46 cm	Yellowish red (5YR 5/6) shaley or very shaley clay; more than 80% rock structure; soil structure is weak coarse subangular blocky; firm; common medium roots; 40 to 70% light olive brown shale and siltstone fragments that are coated with yellowish red (5YR 5/6) clay plasma; abrupt irregular boundary. (This stratum was encountered at a depth of 68 to 84 cm in the Bt part of Profile III.)
Bw2	46 to 80 cm	Yellowish red (5YR 5/6) silty clay loam or silty clay; 50 to 60% rock structure; soil structure is moderate medium subangular blocky; friable; common medium roots; 20 to 35% light olive brown (2.5Y 5/6) very soft sandstone and siltstone fragments that are coated with red (2.5YR 4/8) iron plasma; abrupt irregular boundary.
C1	80 to 98 cm	Light olive brown (2.5Y 5/6) siltstone that crushes to a very shaley silty clay loam; rock structure throughout; friable; common medium roots; 80 to 90% fragments that are coated with red and dark red (2.5YR 4/6 and 3/6) iron plasma and some yellowish red (5YR 4/6) clay plasma, while some inner fragment fracture faces are coated with black manganese plasma; abrupt irregular boundary.

C2	98 to 124 cm	Light olive brown (2.5Y 5/6) siltstone, shale, and sandstone fragments that crush to silt loam or very fine sandy loam; rock structure; friable; common medium roots; 80 to 90% fragments that are coated with red and dark red (2.5YR 4/6 and 3/6) iron plasma; flow zones have yellowish red (5YR 5/6) clay plasma; abrupt irregular boundary.
Cr	124 to 150 cm	Light olive brown (2.5Y 5/4 and 5/6) harder siltstone and shale fragments, and yellowish red (5YR 5/8) soft sandstone fragments; steeply dipping rock structure; firm; few roots on fragment faces; more than 90% fragments; fragments are coated with red and dark red iron plasma on large faces and black manganese plasma on tighter and inner fracture faces.

PROFILE IV

Location:	About 116 m north of horizontal control point CD-3 and about 299 m south-southwest of horizontal control point C-12, and 1.2 m away from the fence corner post.
Vegetation:	Kentucky 31 tall fescue. The forest regrowth outside the fence is mixed pine-hardwoods.
Parent materials:	Highly weathered Maryville Limestone (Conasauga Group).
Landform:	Broad upland summits and side-slopes that are mostly doubly convex.
Slope:	6% at the pit.
Elevation:	251 m.
Aspect:	Southerly.
Erosion:	Most areas are severely eroded from past agricultural activities. More recent land clearing activities have stripped off more of the upper part of the soil. In most areas the Ap rests in the Bt horizon. The erosion at the pit is slight.
Classification:	Typic Hapludult; clayey, mixed, thermic. Muse series.

Horizon	Depth	Description
A	0 to 6 cm	Dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; very friable; many fine roots; less than 5% shale fragments; abrupt wavy boundary.
E1	6 to 15 cm	Yellowish brown (10YR 5/4) silt loam; weak medium granular structure; very friable; few fine roots; less than 5% shale fragments; common 1- to 2-mm hard manganese nodules coated with E material; clear wavy boundary.
E2	15 to 27 cm	Brown (10YR 5/3) silt loam; weak medium granular structure; very friable; few fine roots; less than 5% shale fragments; common 1- to 2-mm diam hard manganese nodules coated with brown soil plasma; clear wavy boundary.

Bt1	27 to 46 cm	Strong brown (7.5YR 5/6) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; thin strong brown (7.5YR 4/4) clay plasma on ped faces; less than 5% shale fragments; common 1- to 2-mm iron-manganese nodules; gradual wavy boundary.
Bt2	46 to 70 cm	Yellowish red (5YR 5/6) clay or silty clay; moderate fine subangular blocky structure; firm; few fine roots; thin yellowish red (5YR 4/6) clay plasma on ped faces, few black iron-manganese nodules; few highly weathered shale fragments; gradual wavy boundary.
Bt3	70 to 84 cm	Mottled yellowish red (5YR 5/8) and yellowish brown (10YR 5/6) clay; weak coarse subangular blocky structure parting to weak fine subangular blocky structure; firm; few fine roots; 15 to 20% soft light olive brown (2.5Y 5/4) shale and siltstone fragments that are mostly disoriented; peds are coated with red (2.5YR 4/6) clay plasma (this horizon is highly clay plugged); clear wavy boundary.
CBt	84 to 100 cm	Light olive brown (2.5Y 5/6) very soft and clay-plugged shale and siltstone that crushes to shaley silty clay loam; 90% rock structure; firm; few fine roots; 20 to 40% shale fragments; the clay plasma is strong brown (7.5YR 5/6) on primary fragment faces, while secondary faces are coated with red (10R 4/6) iron plasma; water flow zones are grayish brown to brown (2.5Y 5/2-5/3); clear irregular boundary.
C	100 to 120 cm	Light olive brown (2.5Y 5/6) shale and siltstone that crushes to shaley silty clay loam; 100% rock structure; firm; few root mats in the lower boundary; 40 to 60% fragments, some which are coated with strong brown (7.5YR 5/6) clay plasma, while many are coated with red and dark red (10R 4/6 and 3/6) iron plasma; clear irregular boundary.

Cr1	120 to 208 cm	Light olive brown (2.5Y 5/6) shale and siltstone that crushes to very shaly silt loam or silty clay loam; steeply dipping rock structure; very firm; more than 95% fragments that are coated with red (10R 4/8 and 2.5YR 4/8) iron plasma, while tight fracture faces have thin black manganese plasma coatings; clear irregular boundary.
Cr2	208 to 300 cm	Yellowish brown (10YR 5/4-5/6) shale and siltstone that crushes to very shaly silty clay loam; most fragments are coated with black manganese plasma, but water flow zones have yellowish red (5YR 5/8) plasma. (This horizon was described from auger cuttings. A remarkable feature was the change from the red plasma to the black manganese plasma and zones of soft manganese concentrations).

PROFILE V

Location:	SWSA-6; about 267 m east of horizontal control point CD-3 and about 420 m south of horizontal control point C-12.
Vegetation:	Second growth mixed pine-hardwoods.
Parent Materials:	From the surface downward there is: (1) modern slope wash,(2) Holocene(?) colluvium, (3) Wisconsinan(?) colluvium which contains chert fragments from the old alluvium in Map Unit No. 9 and (4) residuum from the Maryville Limestone (Conasauga Group).
Landform:	Lower foot-slope, with doubly concave slope configuration.
Slope:	12%.
Elevation:	235 m.
Aspect:	South.
Erosion:	Overwashed by modern sediments.
Classification:	Typic Fragiudult; fine-silty, mixed or siliceous, thermic. Leadvale series.

Horizon	Depth	Description
Ap	0 to 10 cm	Brown (10YR 4/3) silt loam; moderate fine granular structure; very friable; common fine roots; less than 5% shale fragments; pH-5.0; abrupt smooth boundary.
Bt1	10 to 25 cm	Strong brown (7.5YR 5/6) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; less than 5% shale fragments; most peds coated with brown (10YR 4/3) organo-clay plasma; pH 4.8; clear wavy boundary.

Bt2	25 to 39 cm	Strong brown (7.5YR 5/6) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; less than 5% shale fragments; peds coated with thin manganese plasma in the lower part; few fine faint pale brown (10YR 6/3) mottles mostly in ped interiors; pH 4.8; clear wavy boundary.
2Bt3	39 to 70 cm	Yellowish red (5YR 5/6) silty clay loam; moderate medium prismatic parting to moderate fine subangular blocky structure; firm; few fine roots; less than 5% shale fragments; some peds coated with manganese plasma in the upper part, some manganese nodules 1 to 2 mm in size in the lower part; primary prism faces coated with pale brown (10YR 6/3) glossic material; pH <4.8; gradual wavy boundary. (This horizon is the mixed zone.)
3Btx1	70 to 89 cm	Mottled brownish yellow (10YR 6/6) and strong brown (7.5YR 5/4) silty clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky structure; firm; few fine roots; less than 5% shale fragments; prism faces coated with light brownish gray (2.5Y 6/2) plasma; also present are red (2.5YR 4/6) concentrates that are about 1 cm in diameter; gradual irregular boundary.
3Btx2	89 to 130 cm	Prism interiors are pale brown (10YR 6/3) with black manganese blebs throughout; outward from the interior is an iron-enriched zone strong brown in color (7.5YR 5/6-5/8), while the prism face has a light gray (5Y 7/1) rind that is about 1 cm thick. Texture is light silty clay loam; moderate coarse prismatic structure to moderate medium subangular blocky structure; darker black prism interiors are very firm and brittle, while other parts are very firm; no roots; less than 5% shale fragments; brown (10YR 5/4) clay plasma covers some of the gray rind surrounding prisms; gradual irregular boundary.

3Btx3	130 to 170	This horizon has the same color pattern as the horizon above except that the prisms are very coarse without parting to secondary structure and the prism interiors are larger and more brittle. Texture is silty clay loam. The remarkable observation in this horizon is the presence of large and hard manganese nodules 2 to 3 cm in cross section; pH 5.5 (this horizon was observed by spading into the pit bottom, so a lower boundary could not be determined).

The horizons below are described from barrel auger disturbed material.

3Btx4	170 to 190 cm	Mottled yellowish brown (10YR 5/8), light olive brown (2.5Y 5/6) and light brownish gray (2.5Y 6/2) silty clay loam; pH 8.0 noneffervescent.
4Btg	190 to 230 cm	Light olive gray (5Y 6/2) clay or silty clay with light olive brown (2.5Y 5/6) mottles and black manganese plasma in pores; encountered chert fragment about 1.5 cm in diameter at a depth of 200 cm; pH 8.0.
5Cr	230 to 235 cm	Light olive brown (2.5/Y 5/6) and light brownish gray (2.5Y 6/2) oxidized shale and siltstone; black manganese plasma coatings on shale fragments; pH 8.2.

Note: After fall and winter rains this pit filled with water to within 60-70 cm of the surface by lateral flows across the top of the fragipan.

PROFILE IX

Location:	SWSA-6; about 198 m south of horizontal control point CD-3, and about 198 m west of horizontal control point DS-5.
Vegetation:	Kentucky 31 tall fescue. The forest regrowth on the other side of the fence is mixed pine-hardwood with a few red cedar.
Parent materials:	Loess over alluvium over residuum.
Landform:	Remnant of old terrace-floodplain that has undergone topographic inversion. The nearly level summit has collected loess and dust over many thousands of years, which has been washed off the shoulder and side-slopes.
Slope:	0 to 2%.
Elevation:	260 m.
Aspect:	South.
Erosion:	Slight.
Classification:	Typic Paleudult; fine-silty, siliceous, thermic. (Very similar to the Turbeville series except for the loess capping).

Horizon	Depth	Description
Ap	0 to 10 cm	Dark brown (10YR 3/3) silt loam; moderate fine granular structure; very friable; many fine roots; no fragments; clear wavy boundary.
E	10 to 21 cm	Yellowish brown (10YR 5/4) silt loam or very fine sandy loam; moderate fine granular structure; very friable; few fine and medium roots; no fragments; clear wavy boundary.
Bt1	21 to 37 cm	Strong brown (7.5YR 5/4) silty clay loam: moderate fine subangular blocky structure; very friable; common medium roots; no fragments; clear wavy boundary.

Bt2	37 to 53 cm	Brown (7.5YR 4/4) silty clay loam; moderate fine subangular blocky structure; very friable; common medium roots; no fragments except in the boundary where a few pea-sized chert pebbles were found; yellowish red (5YR 5/6) clay plasma on ped surfaces; abrupt wavy boundary.
2Bt3	53 to 80 cm	Red (2.5YR 4/6) clay; strong fine and medium subangular blocky structure; firm; very sticky; few medium roots; 5 to 10% pebbles of chert and sandstone; yellowish red (5YR 5/6) clay plasma covering dark red (2.5YR 3/6) clay plasma; gradual wavy boundary.
2Bt4	80 to 119 cm	Red (2.5YR 4/8) clay; strong fine and medium subangular blocky structure; very firm and sticky; no roots; no fragments; water flow zones are strong brown (7.5YR 5/8) and pale brown (10YR 6/3); red (2.5YR 4/6) clay plasma coats ped surfaces; diffuse wavy boundary.
2Bt5	119 to 190 cm	Variegated red (2.5YR 4/8) and yellowish red (5YR 5/6) clay; weak fine and medium subangular blocky structure; very firm and sticky; no roots or fragments; water flow zones have a sequence of colors from the outside to the inside as follows: the outer color is strong brown (7.5YR 5/8); the next color in is pale brown (10YR 6/3); in the upper part of the horizon the inner flow zone color is light yellowish brown (2.5Y 6/4), while in the lower part of the horizon the inner flow zone color changes gradually to light brownish gray (2.5Y 6/2).

This horizon has perched water in the past, and perched water occurred after a rain while the pit was open. Whether perched water occurs in situ cannot be determined without additional testing by neutron probe or other techniques for monitoring in situ soil water content.

(The description to this depth is in a pit. The rest of the description is from a barrel auger, so only colors and textures are given.)

BC	190 to 230 cm	Variegated yellowish red (5YR 5/6), strong brown (7.5YR 5/8), and water flow zones of light brownish gray (2.5Y 6/2); silty clay loam; brown (7.5YR 4/4) clay plasma covers some inner parts of flow zones.
CB	230 to 300 cm	Yellowish brown (10YR 5/6) silty clay loam; light gray (10YR 7/2) material coats flow zones, and the inner part of flow zones has red (10R 4/8) iron plasma.

Based on data in ORNL/TM 9442, thickness of the alluvium is about 5 m on the upland summit.

PROFILE X

Location:	About 137 m north of horizontal control point DS-5 and about 223 m southeast of horizontal control point CD-3 in SWSA-6.
Vegetation:	Mostly Virginia pine. The ground cover in places consists of mosses and Cladonia sp lichens.
Parent materials:	A thin veneer of slope wash in most places over residuum from the Nolichucky Shale (Conasauga Group) or interbedded Maryville-Nolichucky.
Landform:	Low upland with mostly convex slope configuration.
Slope:	4%.
Elevation:	232 m.
Aspect:	South.
Erosion:	Moderate to severe.
Classification:	Ruptic-Aquultic Dystrochrept; argillic part is clayey, while cambic part is loamy-skeletal; mixed, thermic. No known series.

Horizon	Depth	Description
Ap	0 to 14 cm	Brown (10YR 5/3) silt loam; weak fine granular structure; friable; few fine and medium roots; 10 to 15% shale fragments; abrupt smooth boundary.
Bt	14 to 23 cm	Brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; few medium roots; 10 to 15% shale fragments; peds coated with yellowish brown (10YR 5/4) clay plasma; few fine prominent red (2.5YR 4/8) mottles in ped interiors in the lower part of the horizon; clear wavy boundary.
Btg	23 to 50 cm	Variegated red (2.5YR 4/8) and gray (10YR 6/1) clay; moderate coarse subangular blocky structure; firm; few fine roots; 10 to 15% shale fragments; light brownish gray (10YR 6/2) and pale brown (10YR 6/3) clay plasma coating ped surfaces; abrupt wavy boundary.

Cr	50 to 74 cm	Brown (7.5YR 4/2) shale thickly coated with greenish gray (5GY 6/1) clay plasma that crushes to extremely shaley clay; steeply dipping rock structure; very firm; 75 to 80% shale fragments; abrupt irregular boundary.
C	74 to 84 cm	Mottled brown, red, and gray clay strata; massive; firm; abrupt irregular boundary.

This material serves as a conduit for water flow to deeper areas in the shale. Roots also follow these soft clay strata.

C'r	84 to 120 cm	Brown (7.5YR 4/2) shale with larger faces coated with black manganese plasma while interior faces are coated with red iron plasma; glauconite pellets occur in this stratum.
C''	120 to 123 cm	Mottled brown, red, and gray clay that transmits water down dip between quite hard Cr materials.
C''r	123 to 150 cm	Same description as the C'r horizon.

The Bw horizon occupies more than 50% of the pedon. It has a high percentage of steeply dipping rock structure and forms in what is Cr material under the Bt part of the pedon, but when closer to the surface it is more open and the rock structure is somewhat disrupted. The Bw material is yellowish brown (10YR 5/6) shaley or very shaley silty clay loam. All shale fragments in the Bw horizon are coated with yellowish brown clay.

PROFILE XI

Location:	About 200 m north of horizontal control point DS-5 and about 220 m east of horizontal control point CD-3.
Vegetation:	Grasses and sedges.
Parent materials:	Modern slopewash over Wisconsinan aged alluvium over residuum from shale (Maryville Limestone, and interbedded Nolichucky-Maryville in some areas).
Landform:	Low toe-slope.
Slope:	2%.
Elevation:	230 m.
Aspect:	Southeast.
Erosion:	Overwashed by modern alluvium.
Classification:	Aquic Hapludalf: fine, mixed, thermic. Tupulo series.

Horizon	Depth	Description
Ap	0 to 18 cm	Dark yellowish brown (10YR 4/4) silt loam; moderate fine subangular blocky structure; very friable; few fine roots; less than 5% shale fragments; pH 5.0; abrupt smooth boundary.
Bw1	18 to 36 cm	Yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; very friable; few fine roots; 5 to 10% shale fragments; very thin dark yellowish brown (10YR 4/3) plasma on ped faces; clear wavy boundary.
Bw2	36 to 51 cm	Brownish yellow (10YR 6/6) silty clay loam; moderate fine subangular blocky structure; friable; few fine roots; 5 to 10% shale fragments; light yellowish brown (2.5Y 6/4) plasma on ped faces, and common medium distinct strong brown (7.5YR 5/6) iron mottles in ped interiors; pH 5.0; abrupt wavy boundary.

2E/B	51 to 64 cm	Pale brown (2.5Y 6/3) silt loam (E part), and light olive brown (2.5Y 5/4) silty clay loam (B part); weak fine subangular blocky structure; firm; very few fine roots; 10 to 15% shale fragments; many 1 to 3 mm iron/manganese nodules; pH 6.5; clear wavy boundary.
2Bt1	64 to 84 cm	Yellowish brown (10YR 5/4) clay or silty clay; massive; very firm; no roots; 5 to 10% shale fragments plus an occasional chert or quartzite gravel; very few 1 to 2mm iron/manganese nodules; light olive gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) plasma in root channels and coating cracks; pH 6.2; clear wavy boundary.
2Btg	84 to 96 cm	Gray (5Y 6/1) and light olive gray (5Y 6/2) clay; massive; very firm; no roots; less than 5% fragments; many medium and large yellowish brown (10YR 5/6) iron concentration zones; pH 6.5 to 7.0; clear wavy boundary.
2BC	96 to 105 cm	Variegated yellowish brown (10YR 5/6 and 10YR 5/8), and light olive gray (5Y6/2) clay; massive; firm; 10 to 15% fragments; pH 7.2; abrupt wavy boundary.
3Cg	105 to 112 cm	Greenish gray (5GY 6/1) and minor amounts of yellowish brown (10YR 5/6 and 5/8) soft shale that crushes to shaley silty clay loam; rock structure; firm; 70 to 80% soft shale and siltstone fragments that reduce to about 35% after crushing; pH 7.5; clear wavy boundary.
3Crg	112 to 150 cm	Olive gray (5Y 4/2) extremely firm shale coated with olive gray (5Y 5/2) plasma on upper faces and reddish iron plasma on other faces; pH 8.0.
3R	150 to 160 cm	Steeply dipping hard limestone shale and siltstone strata about 1 to 1.5 cm thick; pH 8.0 with calcite present; no coatings on fragments.

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