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Resource Data Inventory for the Oak Ridge Area

L. K. Mann
J. T. Kitchings

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1823

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RESOURCE DATA INVENTORY FOR THE OAK RIDGE AREA

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ABSTRACT

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This report describes a natural resources data base. This data base is useful in natural resource management on the Department of Energy Reservation at Oak Ridge, in research site selection on the National Environmental Research Park (NERP) within the Reservation, in summarizing and analyzing resource data in areas selected for industrial development in and near the Reservation, and in regional analyses both on the Reservation and on adjacent land. Soils, surface geology, slope classes, slope aspect, land use, and roads have been digitized on a 0.5-ha cell size for the Oak Ridge area. The region included in the data base is of lands historically administered by the Department of Energy and its predecessors and includes the NERP lands. A soils map of the area (Appendix to report) was prepared using the 1942 Roane County soil survey and draft maps of the 1978 Anderson County survey.

Two examples of using the data base with IMGRID, a data storage, retrieval, and modeling system developed by the Tennessee Valley Authority at Norris, Tennessee, are presented. The first example is a search for barren or glade type soils and the second is a summary of forest productivity classes. Both are generated from soils, slope classes, and slope aspect. Summary information concerning soil series distribution, most common soils, and taxonomy of soils is also included.

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INTRODUCTION

Five Department of Energy sites throughout the United States have been designated as National Environmental Research Parks (NERP) over the past nine years. These sites are to be used as protected areas for the experimental evaluation of effects of energy technologies on biological systems. Fundamental to utilizing these sites in this manner is the establishment of an effective resource inventory system. This system can provide a base for site related research as well as information applicable to energy technology development in the region surrounding the sites. Such a resource inventory system ideally consists of an accessible data compilation as well as theoretical system research related to both the particular site and to the surrounding region.

Natural resource inventories have been conducted for many years prior to the establishment of a NERP at Oak Ridge (Kitchings and Mann, 1976; Dahlmann et al., 1977; Bradburn, 1977). Data have been acquired primarily for research purposes, often with goals which have not required a resource inventory applicable regionally or even to sizeable parts of the reservation. However, much natural resource data for the Department of Energy (DOE) Reservation and adjacent lands does exist from prior sources often in the form of maps and also as digitized data bases.

In order to standardize and to provide a more readily retrievable form of the available natural resource data, a pixel base computerized data storage and analysis system was chosen as an appropriate medium.

The system selected is IMGRID version 3.5 (J. Watts, manuscript in preparation), a computer package prepared by D. D. Holmes and R. L. Jolly at TVA (Holmes and Jolly, 1980). The system allows overlaying numerous separate data sets, interpretation of spatial relationships, and the use of simple models of interactions among data sets. Although there are several disadvantages to this system, the largest and most significant being the labor intensiveness of data coding, we felt that there were enough advantages to this system to justify its use.

Data are coded on a 0.5-ha cell size since this is approximately the level of resolution of the Forest Management Program's forest stand inventory which has compiled more natural resource data than are currently available from other sources. The 0.5-ha cell, when used with several data sets and allowing for mapping inaccuracies and other errors, can be used for reasonably accurate modeling of 2.5-ha blocks of land. This seemed to us to be a practical unit of land use for research site searches, wildlife habitat prediction and mapping, forest typing, and other modeling. The entire DOE Reservation, along with adjacent lands controlled by TVA and the City of Oak Ridge, was included because extant data for these areas (from studies conducted when these areas were administered by DOE) were available which would constitute a positive step toward creation of a regional data base. The total acreage in the data base is approximately 15,728 ha. Areas originally in the DOE lands at Oak Ridge but which are no longer part of the property are also included. This includes the large tract of land for the Clinch River Breeder Reactor (CRBR) site, now administered by TVA.

Data for the Oak Ridge area are being stored in two forms: either as data available for the entire reservation, including soils, geology, forest plot inventories, surface drainage, and slope aspect, or as data collected at a particular site or sites. This report is the first documentation of data being included in the pixel data base and includes soils, geology, slope and slope aspect, land use, and roads. Although all of these data bases are available for use, emphasis in this report is on the soils data base with reference to the others only in conjunction with using the soils data.

SOILS

There are two primary sources of soils information for the Oak Ridge area. Soils of Roane County were mapped and published in a soil survey in 1942 (Swann et al.), while the soil survey for Anderson County was completed in 1978 and will be published in 1982. Aerial photos of Anderson County with soil mapping units drawn on them (in draft form) were made available to us by the soil conservation service office in Nashville (Fig. 1). In addition to these sources, portions of Roane County have been mapped by D. McKinney[1] and R. Moneymaker.[2] For both Roane and Anderson counties, soil mapping units were transferred to a single base map by enlarging or reducing the original Roane county soil map and the Anderson County aerial

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[1]Soil Conservation Service

[2]Retired, Soil Conservation Service

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Fig. 1. Example of Anderson County draft soil survey map.

photographs to the appropriate scale and tracing the units using a light table (Appendix). Each of the soil types has a unique code designation which allowed using that label as a code for digitizing. There are 62 soil codes (including slope and erosion classes) identified in the old Roane County survey and an additional 148 codes for Anderson county and the more recently mapped parts of Roane County. This includes 55 different soil series (Table 1). Of these only 14 occupy more than 1% of the reservation land (Table 2).

There are some difficulties in including soil units from such disparate sources as the Roane and Anderson soil maps in one data base. Soil classifications have changed considerably in the time interval from 1942 to the present. The original Roane County survey follows the classification of 1938 (Baldwin et al.) while more recent surveys follow the Seventh Approximation System (Soil Conservation Service, 1975). In the 1942 survey, soil types were considered a combination of series designation and textural classes while currently soil type, no longer a taxonomic category, designates a particular phase of a series and/or a way of designating mapping units. Soil series designations were used in both systems. Most series have been retained, but definitions have been modified so that soils mapped as belonging to one series in 1942 might now be mapped either as an entirely different series or as several series, often including the prior designation. However, the concept of soil series designations is approximately the same in both systems.

Table 1. Approximate proportion of area in each soil series at the Oak Ridge site.

Series	% of land area in data base	% of NERP
Allen	.43	.89
Apison	5.43	4.67
Armuchee	7.45	6.80
Armuchee/Muskingum	2.76	1.99
Atkins	.34	.23
Bodine	.83	.37
Calvin	.20	0
Capshaw	.13	.27
Carbo	.24	.43
Claiborne	.98	1.10
Clarkesville	10.90	16.02
Colbert	3.38	4.87
Colbert/Talbott	1.90	2.49
Collegedale	3.81	3.36
Decatur	.21	0
Dewey	2.49	2.63
Dunmore	.05	.02
Emory	.21	.34
Etowah	.27	.44
Fullerton	22.41	15.49
Gladeville Rock	.94	1.31
Greendale	.51	.76
Hamblen	.34	.23
Hector	.11	.18
Holston	.18	.11
Huntington	.15	.16
Jefferson	1.58	1.78
Leadvale	.80	.96
Lehew	9.26	8.97
Lindside	.43	.62
Litz	1.91	.57
Melvin	.41	.64
Minvale	.70	.94
Montevallo	.89	1.92
Muse	.03	.07
Muskingum	.93	2.50
Newark	.17	.21
Nolichucky	.45	0
Philo	.22	.07
Pope	2.62	3.93
Roane	1.43	2.31
Rockland	.16	.39
Sensabaugh	.05	0
Sequatchie	.34	.48
Sequoia	.65	.57
Shouns	.40	.16
Solway	.79	.57
Staser	.01	0
Talbott	2.53	3.34
Tasso	.27	.41
Tupelo	.01	.04
Tyler	.04	.09
Upshur	.40	.53
Waynesboro	.91	1.87
Wolftever	.75	.89
Not identified (Buildings,dumps, etc.)	4.22	.18

Table 2. Soils in the Oak Ridge area which occupy more than 1% of the land included in the data base.

Series	% of NERP	Taxonomic class
Fullerton	15.5	Clayey, kaolinitic, thermic Typic Paleudult
Clarksville	16.0	Loamy-skeletal, siliceous, mesic Typic Paleudult
Lehew	9.0	Loamy-skeletal, mixed, mesic Typic Dystrochrept
Armuchee	6.8	Clayey, mixed, thermic Ochreptic Hapludult
Apison	4.7	Fine-loamy, siliceous, thermic Typic Paleudult
Collegedale	3.4	Clayey, mixed, thermic Typic Paleudult
Colbert	4.9	Very-fine montmorillonitic, thermic Vertic Hapludalf
Armuchee/Muskingum	2.0	Clayey, mixed, thermic Ochreptic Hapludult/fine-loamy, mixed, mesic Typic Dystrochrept
Pope	3.9	Coarse loamy, mixed, mesic Fluventic Dystrochrept
Dewey	2.6	Clayey, kaolinitic, thermic Typic Paleudult
Talbott	3.3	Fine, mixed, thermic Typic Hapludalf
Litz	0.6	Loamy-skeletal, mixed, mesic Ruptic-Ultic Dystrochrept
Colbert/Talbott	2.5	
Jefferson	1.8	Fine-loamy, sileceous, mesic Typic Hapludult
Roane	2.3	Fine-loamy, siliceous, thermic Glossic Fragiudult
Total	79.3	

On the other hand, the great group designations have changed drastically. Roane County soils were classed in the red and yellow Podzolic great soil groups and are now classed in the Fragiudult, Hapludult, and Paleudult great groups with minor components of other groups (Table 3). In addition, the intensity of mapping or precision of classification is quite different in the 1942 survey as opposed to the 1978 survey (Appendix).

For most soil interpretations and uses, the old and new surveys can be used simultaneously with the differences in intensity of survey presenting the greatest difficulty. Most of the soils mapped in Roane County would still fall under the same series designations. A few (Table 4) would be included under one or more different series. At least one soil in the Anderson draft map, Solway series, may be more appropriately included in a series more commonly mapped previously in Roane County as Upshur (personal communication, D. McKinney).

Table 3. Classification of soils occurring in the Oak Ridge area

Ultisols		
Paleudults		
	Typic	Minvale
		Holston
		Etowah
		Allen
		Bodine
		Waynesboro
		Fullerton
		Dewey
		Collegedale
		Claiborne
		Clarksville
		Dunmore
		Nolichucky
	Fragic	Tasso
	Rhodic	Decatur
Hapludults		
	Typic	Apison
		Shouns
		Sequoia
		Muse
		Jefferson
	Aquic	Wolftever
	Humic	Sequatchie
	Ochreptic	Armuchee
Fragiudults		
	Typic	Leadvale
	Glossic	Roane
Fragiaquults		
	Aeric	Tyler
Inceptisols		
Dystrochrepts		
	Typic	Montevallo
		Calvin
		Lehew
		Muskingum
	Fluventic	Greendale
		Pope
	Fluvaquentic	Philo
	Lithic	Hector
	Fluventic-Umbric	Emory
	Ruptic-Ultic	Litz
Eutrochrept		
	Fluvaquentic	Hamblen
		Lindside
	Dystric Fluventic	Sensabaugh
Alfisols		
Hapludalfs		
	Typic	Talbott
		Upshur
		Solway
		Carbo
	Aquic	Tupelo
	Ultic	Capshaw
	Vertic	Colbert
Entisols		
Fluvaquents		
	Typic	Atkins
		Melvin
	Aeric	Newark
Mollisols		
Hapludolls		
	Fluventic	Huntington
	Cumulic	Staser
Rendolls		
	Lithic	Gladeville

Table 4. Soils of the 1942 survey (Swann et al.) which have possible alternate designations.

1942 designation	Possible alternate designations
Clarkesville	Includes some Bodine
Upshur	Mapped as Solway in Anderson County
Colbert	Includes Capshaw (deeper soils on lower slopes) and Carbo where very rocky
Wolftever	Whitwell
Lindside	Includes Tupelo (wetter narrow valleys) and some Capshaw
Pope	Ealy

It is apparent from the preceding discussion that a new survey of Roane County soils would be useful. However, as demonstrated in the examples of using this data, it is adequate for many purposes. A general description and discussion of soils of Tennessee, their formation, properties, and relationships to each other is available elsewhere (Springer and Elder, 1980).

With soil units geographically located by pixel coordinates, several kinds of information can be modeled and mapped. Considerable data are available at the series level for all of the soils occurring at Oak Ridge (National Cooperative Soil Survey, 1969-1980). These data include pedogenic information, range in chemical and physical characteristics, associated soils, flooding potential, engineering use and capabilities, and suitability for various vegetation. This data set can be combined with the map units and the resultant mosaics mapped for a visible display of whatever characteristics are desired.

SLOPE AND SLOPE ASPECT

When considering soils data, one of the first additional bits of information of interest in relation to vegetation distribution and community dynamics is the microclimatic differences found on that soil unit in response to slope and aspect. Although some soils are restricted in their distribution to uplands, bottomlands, terraces, etc., many soils occur on a wide range of aspects and slopes. Because of the variety of potential uses of slope and aspect data in forest management, research, and other land use, these data were included in the data base.

Aspect can be coded directly from topographic maps. Our aspect data consists of 8 directions (N, NE, E, SE, S, SW, W, and NW) plus a flat or not codable category, which normally were coded as the predominant aspect of the cell as taken from TVA quadrangle maps. Although slope steepness could theoretically be coded directly from the same topographic map, the difficulties in correctly coding some 40,000 cells influenced us to have a slope class map prepared by Photo Science, Inc.[1] This map indicates, by various shading intensities, 5 slope classes: flat to 3%, 4 to 8%, 9 to 16%, 17 to 31%, and greater than 31%. These slope classes were selected as those most likely to be of value in a variety of land use situations, especially forest management and other vegetation characterization.

---

[1]Montgomery County Airpark, Gaithersburg, Maryland.

LAND-USE

Classification of each data cell as to its present land-use category was accomplished by overlaying the grid system with an S-16A base map (prepared in 1974 by TVA for the Oak Ridge Operations office) of the Oak Ridge area. Categories of land use were described on the basis of present usage and included: (1) the "health and safety zones" surrounding ORGDP, Y-12, and ORNL, (2) lands within the Oak Ridge National Environmental Research Park (NERP), (3) the Comparative Animal Research Laboratory area, (4) the TVA industrial development area (including the Clinch River Breeder Reactor site), (5) NERP Natural areas, (6) NERP Research Control areas, (7) cultural features, i.e., cemeteries, archaeological sites, etc., (8) power substations, radio towers, etc., and (9) lands with no specific present designation. This information was obtained primarily from Kitchings and Mann (1976) and the Oak Ridge Reservation Land-Use Plan.

Information of this sort can be used in land use planning to minimize the potential overlap of use of particular land areas. As an example, the expansion of the present three plant physical facilities could be planned so as not to interfere with existing environmental or ecological research sites. These categories also can be coupled with other data algorithms for the distribution of wildlife species.

ROADS

Accessibility is often an important requirement in placement of new facilities and/or research sites. The Oak Ridge Reservation is crisscrossed with a variety of roads. Some are major state highways

while others are no more than infrequently used logging roads. Four categories of roads were used in the data system: (1) Paved state-maintained highways, (2) paved roads maintained by the Department of Energy (DOE), (3) DOE maintained gravel roads, and (4) logging or minimum maintenance roads. As was the case with the land-use designations, the base grid system was overlayed with an S-16A map which had been revised by the Environmental Sciences Division's Forestry Management group to show the placement of all roads on the Reservation. Each grid cell was then coded according to the previously described category.

GEOLOGY

Since surface geology and soils are closely related, the geologic data base for Oak Ridge is documented in this report, although it was not used in the examples presented here. McMaster (1963) prepared a geologic map of the Oak Ridge area which delineates 9 major geologic categories (Table 5). These categories were coded as they occur on that map. The original map units were based primarily on rock outcrops, road cuts, and other visible indications of changes in surface geology. Although this is adequate for very general uses, the soils data (at least in the more recently mapped areas) provide additional resolution to patterns of surface geology. In a few areas, core drilling has provided additional information (C. S. Haase,[1] personal communication) which shows some inaccuracies in the base map. However, such information is not extensive enough at this time to revise this data set.

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[1]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830.

Table 5. Surface geology of the Oak Ridge area

Category	%
Rockwood Formation	0.5
Sequatchie Formation	0.2
Reedsville Shale	0.2
Chickamauga Limestone	20.4
Knox Group	41.0
Conasauga Shale	23.0
Rome Formation	
Siltstone-shale-sandstone	9.2
Cherty pure to silty shale	5.3

DISCUSSION AND EXAMPLES OF USE

We have selected for demonstrational purposes two examples of the types of information and display available with our data. The first is a simple search for soils of a particular type while the second is a slightly more complex example of modeling forest potential productivity involving the manipulation of several data sets.

Example I - Barren or Glade Soils

An assemblage of plants, many of them ordinarily found in the prairie states, occurs throughout the Ridge and Valley on shallow limestone derived soils. These plants occupy areas known as barrens (DeSelm et al., 1969) and are similar to those in the cedar glades of Middle Tennesee. Since several species which occur in the glades are under

review for protection by the Endangered Species Act (Fish and Wildlife Service, 1980) and others which occur in the barrens at Oak Ridge have been suggested for protection (Parr and Taylor, 1978), we were interested in locating those soil units which are representative of barrens as they have been mapped in the soil surveys. These soils are currently mapped as Gladeville soils. They occur on undulating to rolling bare or nearly bare rocky places with slopes of 2 to 20%. These soils are lithic Rendolls formed in residuum weathered from thin-bedded flaggy limestone and probably would have been previously classified in the Rendzina great soil group. Most older surveys would have classified these soils as "rockland" although some would have been designated Colbert, Fairmount, or Colbert/Talbott complex (National Cooperative Soil Survey, series descriptions). Although it would be possible to examine the soil maps of Anderson County directly to locate Gladeville soils for this example, it is certainly simpler and more accurate to print a map containing only those soils in which we are interested. In addition, by combining slope information with series designations we can print soil map units from the older survey in the Colbert, Colbert/Talbott complex that are possibly barren/glade soils. From the sites thus located (Fig. 2) we discovered one large barren area, now in pasture, on CARL lands not previously known to us and a smaller area west of the Clinch River near several barren areas previously surveyed.

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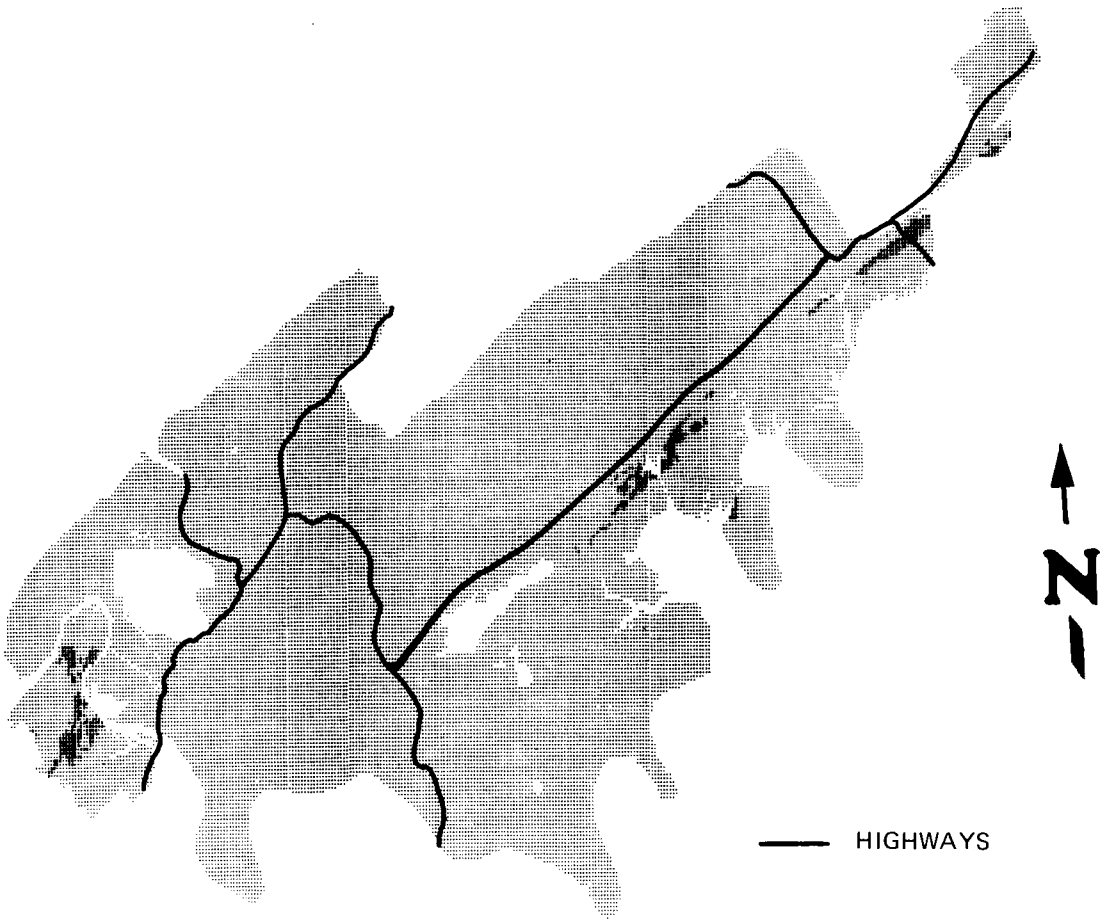


Fig. 2. Glade or barren soil types (dark areas) in the Oak Ridge area (grey). Dark lines indicate major highways.

Example II - Forest Productivity Classes

One of our future applications of this system will be in forest management planning taking into consideration projected and current land use, projected and current research needs, wildlife habitat, and forest production. Although the forest inventory data are not yet available for consideration, the data that we have can be combined to evaluate one aspect of forest land use -- potential forest productivity.

Soils have been categorized into woodland suitability classes (USDA, 1969) based on suitability for producing similar kinds of wood crops under similar management and with about the same potential productivities. Suitability groups also take into consideration site index (when available) for a number of tree species, erosion hazard, equipment restrictions, seedling mortality, suggested species to plant, stoniness or rockiness, excessive wetness, restricted rooting depth, excessively clayey or sandy soils, and steep and severely eroded soils. The USDA suggests 23 suitability classes for the southern Appalachian Ridges and Valley based on the above criteria. These can be further grouped into four forest potential productivity classes (Table 6). Site index values of loblolly pine, yellow poplar, upland oaks, and southern yellow pines (shortleaf and Virginia pines) are not available for all four soil productivity classes. Yellow poplar site index decreases by approximately 3.1 m (10 ft) in the first two classes [30.5 - 27.4 m (100 - 90 ft)] and loblolly pine decreases by the same amount in all four classes [27.4 - 18.3 m (90 - 60 ft) in 3.1-m increments)], giving a rough indication of the relative productivity of these sites to one another. Site index for yellow poplar has been reported as high as 42.7 m (140 ft) at a North Carolina site (Beck and Della-Bianca, 1975) and over 30.5 m (100 ft) for loblolly at a number of sites in Georgia, Virginia, and South Carolina (Nelson et al., 1963), demonstrating that soils at Oak Ridge rated as relatively high in potential productivity are, on a regional scale, closer to moderate in potential productivity. Site index curves for loblolly pine are not usually presented below a value of 15.2 m (50 ft), which is slightly

Table 6. Potential productivity groups of forest soils of the southern Appalachian ridges and valleys that occur in the Oak Ridge area.

Potential Productivity class	Soils	Site index	
		Yellow Poplar	Loblolly pine
High	Atkins, Emory, Etowah, Greendale, Hamblen, Huntington, Lindside, Melvin, Newark, Pope, Philo, Sequatchie, Staser	100	90
Moderately high	Allen, Apison, Bodine (5 - 20% slopes and 20 - 40% north and east slopes), Capshaw, Claiborne, Decatur, Dewey, Dunmore, Fullerton, Holston, Jefferson, Leadvale, Litz, Minvale, Muse, Nolichucky, Roane, Sensabaugh, Sequoia, Shouns, Tasso, Waynesboro	90	80
Moderate	Armuchee, Bodine (20 to 40% south and west slopes and ridge tops), Calvin, Carbo,Claiborne (5 - 30% severely eroded slopes), Clarkesville, Colbert, Collegedale, Decatur (5 - 30% severely eroded slopes), Dewey (5 - 30% severely eroded slopes), Dunsmore (5 - 30% severely eroded slopes), Fullerton (30 - 45% south and 12 - 45%, severely eroded slopes),Lehew, Litz (5 - 20% severely eroded slopes), Muse (5 - 20% severely eroded slopes), Muskingum (5 to 20% and 20% to 45% north and east slopes), Montevallo (2 - 20% and 20 - 45% north and east slopes), Sequoia (2 - 20% severely eroded slopes), Solway, Talbott, Tupelo, Tyler, Upshur, Waynesboro (5 - 30% severely eroded slopes), Wolftever	80-90	70
Low	Armuchee (5 - 20% severely eroded slopes), Colbert (rocky, clay, or silty clay), Dewey (greater than 30% severely eroded slopes), Gladeville, Hector, Lehew (20 - 45% south slopes), Litz (greater than 20% severely eroded slopes), Montevallo (20 - 45% south and west slopes), Muskingum (stony or 20% to 45% south and west slopes)	not available	60 or less

less than the lowest site index range available at Oak Ridge. Site index for loblolly pine is not available for some of the least productive soils here (e.g., Gladeville). Using site index as a scale for productivity classes results in a scale of one to nine, with nine representing the best sites and one the worst. The Oak Ridge soils would be ranked one to five in productivity with one and two combined in the lowest productivity class.

Displaying the distribution and extent of these four soil classes required first associating soils with productivity classes. This could not be done by using the series level data or even the soil survey mapping units because of the limitations on growth on some soils with south facing aspect and the beneficial effects on others with north facing aspect. Functions (known as keywords) in the IMGRID package allow overlaying and comparing data sets so that soils with different aspects can be assigned different productivity values. The same is true for soils with different slopes, although slope information is often available on the soil mapping units and was adequate for this example. In addition, we did not want to include large areas which are currently under buildings, landfills, or in other uses which totally exclude forest growth. These areas were excluded in the soil mapping surveys and were given a zero productivity rating (for display purposes) along with areas outside the reservation and areas normally under water. Results of this analysis (Table 7) indicate that nearly 85% of the reservation land area falls in categories 3 and 4 (moderately high and moderate for the southern Appalachians), and less than 10% are either low or high in potential productivity. Most of the sites of

Table 7. Approximate land surface of the Oak Ridge area in potential forest productivity classes.

Potential forest productivity class	%
2 (worst)	8.3
3	45.7
4	38.7
5 (best)	7.3

highest productivity lie along major stream drainages and narrow, sheltered bottomlands and coves. Sites of lowest productivity are in a variety of locations including severely eroded areas, excessively drained steep slopes, and shallow rocky soils.

The results of these examples are shown (Figs. 2 and 3) using overprinting of line printer symbols which results in maximum contrast among levels. Roads were designated on a separate display to provide an overlay for orientation on the other maps.

ORNL - DWG 81 - 13690 ESD

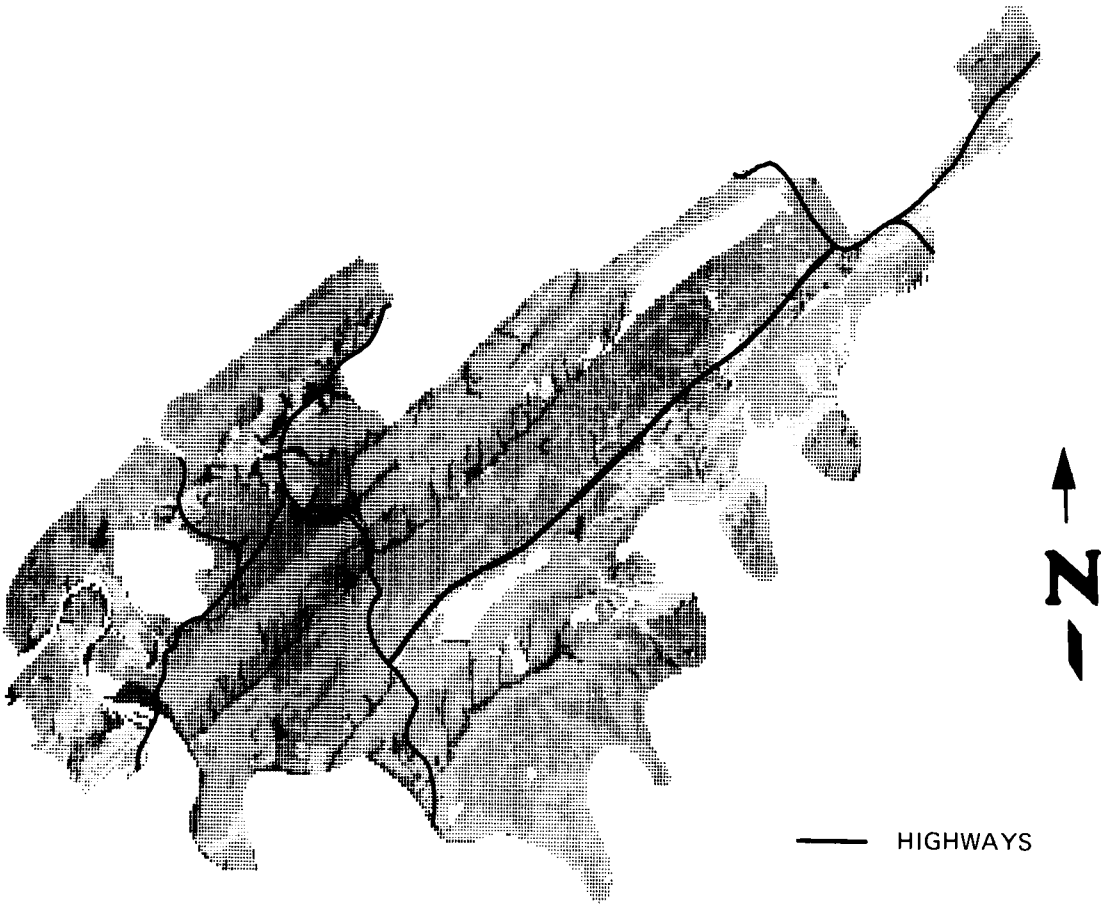


Fig. 3. Forest potential productivity classes in the Oak Ridge area as identified by soils. Darkest zones are those with highest productivity. Highways are shown in black.

REFERENCES

Baldwin, M., C. E. Kellogg, and J. Thorp. 1938. Soils classification. pp. 979-1001. IN Soils and Men. Yearbook of Agriculture, USDA. U.S. Government Printing Office, Washington, D.C.

Beck, D. E. and L. Della-Bianca. 1975. Board-foot and diameter growth of yellow poplar after thinning. USDA Forest Service Research Paper SE-123. Southeastern Forest Experiment Station, Asheville, N.C. 20 pp.

Bradburn, D. M. 1977. Forest Management Plan, ERDA Oak Ridge Reservation: 1976-1980. ORNL/TM-5833. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Dahlman, R. C., J. T. Kitchings, and J. W. Elwood. 1977. Land and Water Resources for Environmental Research on the Oak Ridge Reservation. ORNL/TM-5352. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

DeSelm, H. R., P. B. Whitford, and J. S. Olson. 1969. The Barrens of the Oak Ridge Area, Tennessee. Am. Midl. Nat. 81(2):315-330.

Fish and Wildlife Service. 1980. Endangered and threatened wildlife and plants. Review of plant taxa for listing as endangered or threatened species. Fed. Regist. 45 No. 242. Washington D.C.

Holmes, D. D., and R. L. Jolly. 1980. IMGRID version 3.5 manual. Tennessee Valley Authority. Norris, Tennessee. 508 pp.

Kitchings, J. T. and L. K. Mann. 1976. A description of the Terrestrial Ecology of the Oak Ridge Environmental Research Park. ORNL/TM-5073. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 58 pp.

McMaster, W. M. 1963. Geologic Map of the Oak Ridge Reservation, Tennessee. ORNL/TM-713. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 23 pp.

National Cooperative Soil Survey. 1969-1980. Revisions of established series description and soil interpretations records. National Cooperative Soil Survey, USA.

Nelson, T. C., K. B. Trousdell, E. V. Brender, and T. Lotti. 1963. Board-Foot growth of loblolly pine as related to age, site, and stand density. J. For. 61(2):120-123.

Oak Ridge Operations. 1980. Oak Ridge Reservation Land-use plan. ORO-748 (Rev. 1). Technical Information Center. Oak Ridge, Tennessee. 62 pp.

Parr, P. D., and F. G. Taylor, Jr. 1978. Plant Species on the Department of Energy - Oak Ridge Reservation that are rare, threatened or of special concern. ORNL/TM-6101. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Soil Conservation Service. 1975. Soil Taxonomy. Agriculture Handbook No. 436, USDA. 754 pp.

Springer, M. E., and J. A. Elder. 1980. Soils of Tennessee. The University of Tennessee Agricultural Experiment Station and USDA Soil Conservation Service. Bulletin 596, 66 pp.

Swann, M. E., W. Roberts, E. H. Hubbard, and H. C. Porter. 1942. Roane County, Tennessee, Soil Survey. USDA Bureau of Plant Industry. Series 1936 #15. 125 pp. Washington, D.C.

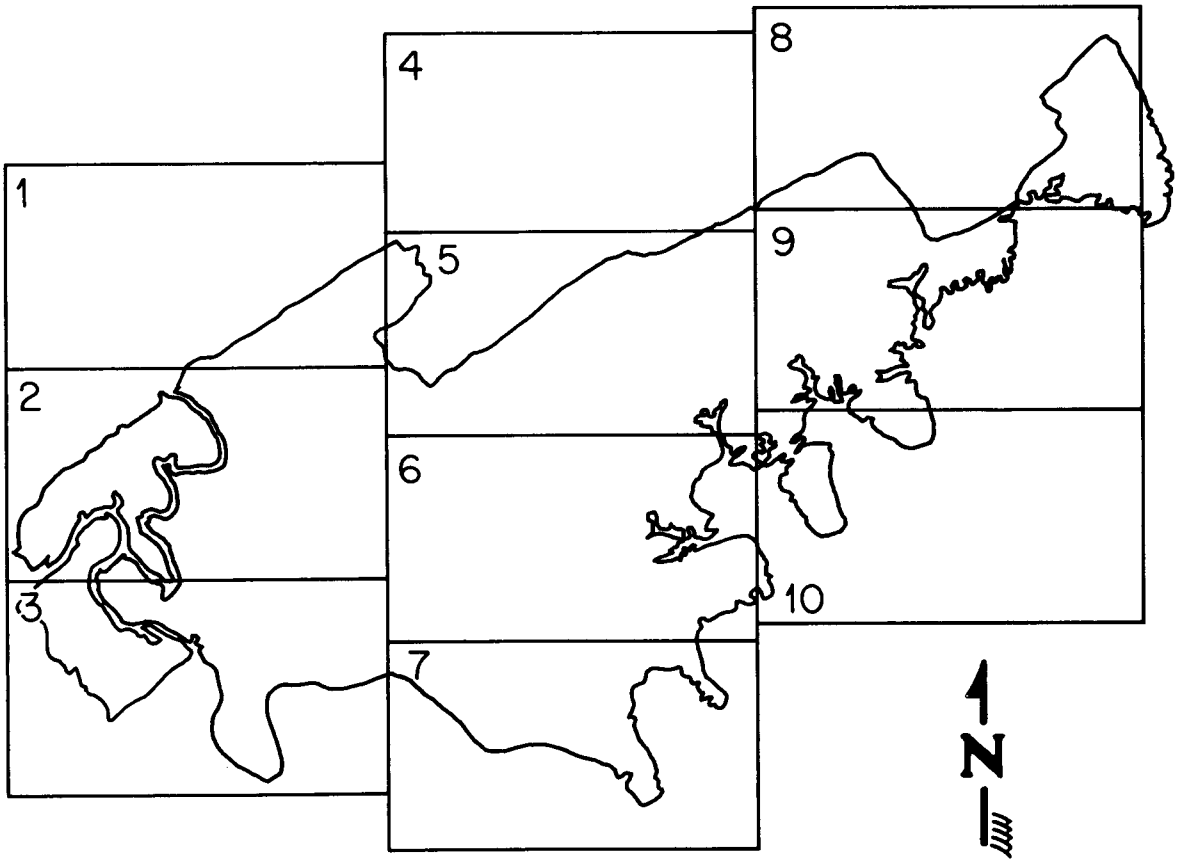
USDA. 1969. Soil Survey Interpretations for Woodlands in the Cumberland Plateau and Mountains and the Southern Appalachian Ridges and Valley of Alabama, Georgia, and Tennessee. Progress Report W-11. USDA Soil Conservation Service, Fort Worth, Texas. 30 pp.

APPENDIX

MAP OF THE SOILS OF THE OAK RIDGE AREA WITH KEY

KEY TO MAP

ORNL–DWG 82–13503



SOIL TYPES AS CODED ON MAP

CODE	SERIES	TEXTURE	PHASE	SLOPE
AF	ALLEN	VF SANDY LOAM		
AFX	ALLEN	VF SANDY LOAM		SLOPE
AL	ATKINS	VF SANDY LOAM		
AS	ARMUCHEE	SILT LOAM		
AV	APISON	VF SANDY LOAM		
AVK	APISON	VF SANDY LOAM	EROD	SLOPE
AVR	APISON	VF SANDY LOAM	EROD	
CC	CLARKSVILLE	CHERTY SILT LOAM		
CCH	CLARKSVILLE	CHERTY SILT LOAM		SMOOTH
CCL	CLARKSVILLE	CHERTY SILT LOAM		HILLY
CCT	CLARKSVILLE	CHERTY SILT LOAM	EROD	HILLY
CCZ	CLARKSVILLE	CHERTY SILT LOAM		STEEP
CL	COLBERT	SILT LOAM		
CLX	COLBERT	SILT LOAM		SLOPE
CS	COLBERT	SILTY CLAY LOAM		
DM	DEWEY	SILT LOAM		
DS	DEWEY	SILTY CLAY LOAM		
DSL	DEWEY	SILTY CLAY LOAM		HILLY
DSZ	DEWEY	SILTY CLAY LOAM		STEEP
FC	FULLERTON	CHERTY SILT LOAM		
FCH	FULLERTON	CHERTY SILT LOAM		SMOOTH
FCL	FULLERTON	CHERTY SILT LOAM		HILLY
FCR	FULLERTON	CHERTY SILT LOAM	EROD	
FCT	FULLERTON	CHERTY SILT LOAM	EROD	HILLY
FCZ	FULLERTON	CHERTY SILT LOAM		STEEP
GS	GREENDALE	SILT LOAM		
HL	HUNTINGTON	SILT LOAM		
HS	HECTOR	STONY FINE SANDY LOAM		
HV	HARTSELLS	VF SANDY LOAM		
HVX	HARTSELLS	VF SANDY LOAM		
JG	JEFFERSON	GRAVELLY FINE SANDY LOA		
JGX	JEFFERSON	GRAVELLY FINE SANDY LOA		SLOPE
LL	LINDSIDE	SILT LOAM		
LS	LEHEW	STONY FINE SANDY LOAM		
LV	LEADVALE	VF SANDY LOAM		
ML	MELVIN	SILT LOAM		
MS	MUSKINGUM	STONY FINE SANDY LOAM		
NV	NOLICHUCKY	VF SANDY LOAM		
NVR	NOLICHUCKY	VF SANDY LOAM	EROD	
NVX	NOLICHUCKY	VF SANDY LOAM		SLOPE
PG	POPE	GRAVELLY FINE SANDY LOA		
PL	POPE	LOAMY FINE SAND		
PS	PHILO	VF SANDY LOAM		
PV	POPE	VF SANDY LOAM		
RA	ROANE	GRAVELLY LOAM		
RG	ROANE	GRAVELLY LOAM		
RGA	APISON		GULLIED	
RGF	FULLERTON		GULLIED	
RSC	COLBERT-TALBOTT STONY LAND			
RSM	MUSKINGUM STONY LAND			
RST	TALBOTT STONY LAND			
SV	SEQUATCHIE	VF SANDY LOAM		
SVX	SEQUATCHIE	VF SANDY LOAM		SLOPE
TS	TALBOTT	SILTY CLAY LOAM		
TSH	TALBOTT	SILTY CLAY LOAM		SMOOTH
TSL	TALBOTT	SILTY CLAY LOAM		HILLY
US	UPSHUR	SILTY CLAY LOAM		VALLEY
WS	WOLFTEVER	SILT LOAM		
WSX	WOLFTEVER	SILT LOAM		SLOPE
WV	WAYNESBORO	VF SANDY LOAM		
WVB	WAYNESBORO	VF SANDY LOAM	EROD	HILLY
WVX	WAYNESBORO	VF SANDY LOAM		SLOPE
123	ROCKLAND			12 TO 25
123D	ROCKLAND			25 TO 45
123E	ROCKLAND			5 TO 12
135C	SHOUNS	SILT LOAM		12 TO 25
135D	SHOUNS	SILT LOAM		5 TO 20
168C	GLADEVILLE-ROCK OUTCROP			40 TO 60
168E	GLADEVILLE-ROCK OUTCROP			5 TO 12
173C	MONTEVALLO	SHALY SILT LOAM		12 TO 20
173D	MONTEVALLO	SHALY SILT LOAM		12 TO 20
173D3	MONTEVALLO	SHALY SILT LOAM	SEV EROD	20 TO 40
173E	MONTEVALLO	SHALY SILT LOAM		20 TO 40
173E3	MONTEVALLO	SHALY SILT LOAM	SEV EROD	12 TO 40
173X	MONTEVALLO	SHALY SILT LOAM	SEV EROD	2 TO 5
18B	CAPSHAW	SILT LOAM		3 TO 10
190	HARTSELLS	LOAM		20 TO 50
193	JEFFERSON-GRIMSLEY COMPLEX			15 TO 60
196	MUSKINGUM-GILPIN PETROS COMPLEX			0 TO 3
198	SEWANEE-EALY COMPLEX			

SOIL TYPES (continued)

CODE	SERIES	TEXTURE	PHASE	SLOPE
2	EMORY	SILT LOAM		0 TO 4
2B1	EMORY	SILT LOAM		2 TO 5
21B	TASSO	SILT LOAM		2 TO 7
23B1	MINVALE	SILT LOAM		2 TO 5
23C	MINVALE	SILT LOAM		3 TO 15
23C	MINVALE	SILT LOAM		5 TO 12
23C1	MINVALE	SILT LOAM		5 TO 12
23C2	MINVALE	SILT LOAM	EROD	5 TO 12
24C	MINVALE	CHERTY SILT LOAM		3 TO 15
24C2	MINVALE	CHERTY SILT LOAM	EROD	5 TO 12
27	TUPELO			
29C	ALLEN	LOAM		5 TO 12
29C	ALLEN	LOAM		5 TO 12
29C1	ALLEN	LOAM		5 TO 12
29D	ALLEN	LOAM		12 TO 25
293	RAMSEY-ROCK OUTCROP			25 TO 65
296	MUSKINGUM-PETROS COMPLEX			15 TO 60
33C	JEFFERSON	LOAM		5 TO 12
33D	JEFFERSON	LOAM		12 TO 25
34C	JEFFERSON	GRAVELLY LOAM		5 TO 12
34D	JEFFERSON	GRAVELLY LOAM		12 TO 25
34E	JEFFERSON	GRAVELLY LOAM		25 TO 45
35C	MUSE	SILT LOAM		5 TO 12
35C1	MUSE	SILT LOAM		5 TO 12
35C2	MUSE	SILT LOAM	EROD	5 TO 12
350	BUILDINGS OR DUMPS			
360	BUILDINGS OR DUMPS			
37A1	LEADVALE	SILT LOAM		
37B	LEADVALE	SILT LOAM		2 TO 7
37E	LEADVALE	SILT LOAM		2 TO 5
37B1	LEADVALE	SILT LOAM		2 TO 5
42C2	DECATUR	SILT LOAM	EROD	5 TO 12
42E2	DECATUR	SILT LOAM	EROD	12 TO 25
44B	ETOWAH	SILT LOAM		2 TO 5
44B2	ETOWAH	SILT LOAM	EROD	2 TO 5
44C	ETOWAH	SILT LOAM		5 TO 12
44C2	ETOWAH	SILT LOAM	EROD	5 TO 12
44D	ETOWAH	SILT LOAM		12 TO 25
46B2	WAYNESBORO	LOAM	EROD	2 TO 5
46C	WAYNESBORO	LOAM		5 TO 12
46C2	WAYNESBORO	LOAM	EROD	5 TO 12
46C3	WAYNESBORO	LOAM	SEV EROD	5 TO 12
46D	WAYNESBORO	LOAM		12 TO 25
46D	WAYNESBORO	LOAM		12 TO 25
46D1	WAYNESBORO	LOAM		12 TO 25
46D3	WAYNESBORO	CLAY	SEV EROD	12 TO 25
46E2	WAYNESBORO	LOAM	EROD	25 TO 60
49B	HOLSTON	LOAM		2 TO 5
49B2	HOLSTON	LOAM	EROD	2 TO 5
49C	HOLSTON	LOAM		5 TO 12
49C2	HOLSTON	LOAM	EROD	5 TO 12
49D2	HOLSTON	LOAM	EROD	12 TO 25
5	GREENDALE	SILT LOAM		1 TO 6
5B1	GREENDALE	SILT LOAM		2 TO 6
50	SEQUATCHIE	LOAM		0 TO 5
50B1	SEQUATCHIE	LOAM		2 TO 5
57A1	TYLER	LOAM		
60C	CLAIBORNE	SILT LOAM		5 TO 12
60D	CLAIBORNE	SILT LOAM		12 TO 25
60E	CLAIBORNE	SILT LOAM		25 TO 45
60E4	CLAIBORNE	SILT LOAM	GULLIED	25 TO 45
63B2	DEWEY	SILT LOAM	EROD	
63C	DEWEY	SILT LOAM		5 TO 12
63C2	DEWEY	SILTY CLAY LOAM	EROD	5 TO 12
63C3	DEWEY	SILT LOAM	SEV EROD	5 TO 12
63D	DEWEY	SILT LOAM		12 TO 25
63D1	DEWEY	SILT LOAM		12 TO 25
63D2	DEWEY	SILT LOAM	EROD	12 TO 25
63D3	DEWEY	SILTY CLAY LOAM	SEV EROD	12 TO 25
63D3	DEWEY	SILTY CLAY	SEV EROD	12 TO 25
64C	DUNMORE	SILT LOAM		5 TO 12
64C2	FULLERTON	SILT LOAM		5 TO 12
64D	DUNMORE	SILT LOAM		12 TO 25
64D3	DUNMORE	SILTY CLAY LOAM	SEV EROD	12 TO 25
65C	FULLERTON	CHERTY SILT LOAM		5 TO 12
65C	FULLERTON	CHERTY SILT LOAM		5 TO 12
65C1	FULLERTON	CHERTY SILT LOAM		5 TO 12
65C2	FULLERTON	CHERTY SILT LOAM	EROD	5 TO 12
65D	FULLERTON	CHERTY SILT LOAM		12 TO 25

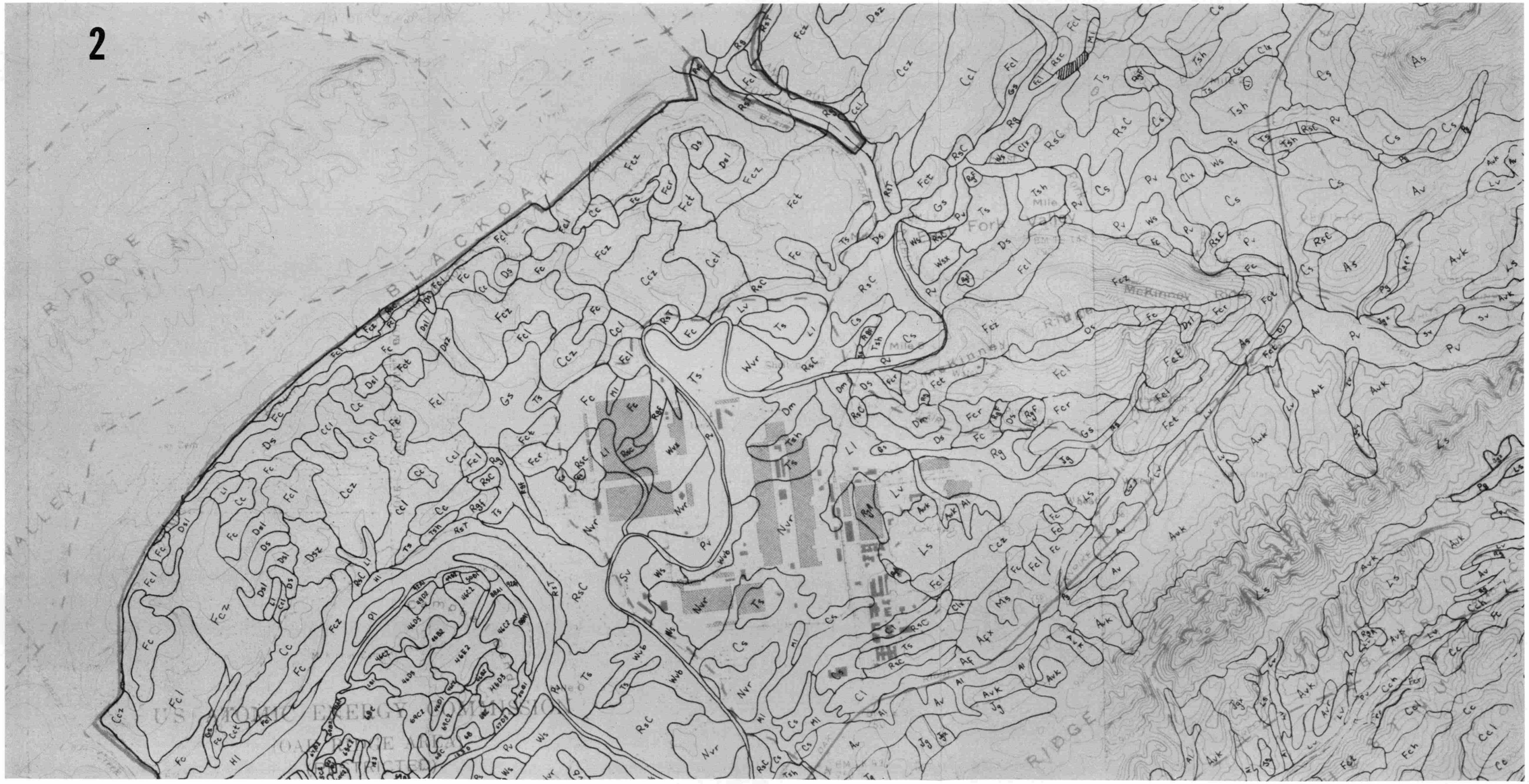
SOIL TYPES (continued)

CODE	SERIES	TEXTURE	PHASE	SLOPE
65D1	FULLERTON	CHERTY SILT LOAM		12 TO 25
65D2	FULLERTON	CHERTY SILT LOAM	EROD	12 TO 25
65D3	FULLERTON	CHERTY SILT LOAM	SEV EROD	12 TO 25
65E	FULLERTON	CHERTY SILT LOAM		25 TO 45
65E1	FULLERTON	CHERTY SILT LOAM		25 TO 45
65E3	FULLERTON	CHERTY SILTY CLAY LOAM	SEV EROD	20 TO 45
66C	BODINE	CHERTY SILT LOAM		5 TO 12
66D	BODINE	CHERTY SILT LOAM		12 TO 25
66D	CLARKSVILLE	CHERTY		
66D1	CLARKSVILLE	CHERTY		
66E	BODINE	CHERTY SILT LOAM		25 TO 50
66E	CLARKSVILLE	CHERTY SILT LOAM		25 TO 45
66E1	CLARKSVILLE	CHERTY SILT LOAM		25 TO 45
67B	COLLEGEDALE	SILT LOAM		2 TO 5
67B	TALBOTT	SILTY CLAY LOAM	EROD	2 TO 5
67C2	COLLEGEDALE	SILT LOAM	EROD	5 TO 12
67C3	COLLEGEDALE	CLAY	SEV EROD	5 TO 12
67D2	COLLEGEDALE	SILT LOAM	EROD	12 TO 25
67D3	COLLEGEDALE	CLAY	SEV EROD	12 TO 25
68C	COLBERT-TALBOTT COMPLEX			
68C	COLLEGEDALE-ROCK OUTCROP			5 TO 20
68D	COLLEGEDALE-ROCK OUTCROP			
68E	COLLEGEDALE-ROCK OUTCROP			20 TO 45
69B2	COLBERT	SILTY CLAY LOAM	EROD	2 TO 5
69C	CARBO	SILTY CLAY LOAM		3 TO 12
69C2	COLBERT	SILTY CLAY LOAM	EROD	5 TO 12
69C3	COLBERT	CLAY	SEV EROD	5 TO 12
70D	SOLWAY	SILT LOAM		10 TO 25
70D3	SOLWAY	SILTY CLAY LOAM	SEV EROD	12 TO 25
71D	BLAND-ROCK OUTCROP COMPLEX			10 TO 20
71E	BLAND-ROCK OUTCROP COMPLEX			20 TO 50
73C	ARMUCHEE	SILT LOAM		5 TO 12
73C	LITZ	SILT LOAM		5 TO 12
73C1	LITZ	SILT LOAM		5 TO 12
73C2	LITZ	SILT LOAM	EROD	5 TO 12
73C3	LITZ	SHALY SILT LOAM	SEV EROD	5 TO 12
73D	ARMUCHEE	SILT LOAM		12 TO 20
73D3	ARMUCHEE	SHALY SILTY CLAY LOAM	SEV EROD	12 TO 20
73E	ARMUCHEE	SILT LOAM		20 TO 45
73E	LITZ	SHALY SILT LOAM		20 TO 40
73E1	LITZ	SHALY SILT LOAM		20 TO 40
73E3	ARMUCHEE	SHALY SILTY CLAY LOAM	SEV EROD	20 TO 45
73E3	LITZ	SHALY SILT LOAM	SEV EROD	20 TO 40
73E4	ARMUCHEE	SHALY SILTY CLAY LOAM	GULLIED	15 TO 40
74B2	SEQUOIA	SILTY CLAY LOAM	EROD	2 TO 5
74C	SEQUOIA	SILT LOAM		5 TO 12
74C	SEQUOIA	SILT LOAM		5 TO 12
74C1	SEQUOIA	SILT LOAM		5 TO 12
74C2	SEQUOIA	SILT LOAM	EROD	5 TO 12
74D	SEQUOIA	SILT LOAM		12 TO 25
74D3	SEQUOIA	SILTY CLAY LOAM	SEV EROD	8 TO 35
79D	CALVIN	SILT LOAM		8 TO 25
79D3	CALVIN	SHALY SILT LOAM	SEV EROD	12 TO 35
79E	CALVIN	SILT LOAM		25 TO 45
81D1	MONTEVALLO	SHALY SILT LOAM		12 TO 20
81E1	MONTEVALLO	SHALY SILT LOAM		20 TO 40
81F1	MONTEVALLO	SHALY SILT LOAM		40 TO 60
83C1	LEHEW	LOAM		5 TO 12
83E	LEHEW	LOAM		25 TO 60
83E	LEHEW	LOAM		25 TO 60
83E1	LEHEW	LOAM		25 TO 60
84C1	MUSKINGUM	LOAM		5 TO 12
84E	ARMUCHEE-MUSKINGUM COMPLEX			25 TO 60
86	STASER	LOAM		
88	HAMBLEN	SILT LOAM		
88A1	LINDSIDE	SILT LOAM		
9	SENSABAUGH	GRAVELLY LOAM		1 TO 5
90	NEWARK	SILT LOAM		
92A1	HUNTINGTON	FINE SILT LOAM		
94A1	LINDSIDE	FINE SILT LOAM		
99	ARENTS-PITS-DUMPS			

MAP OF THE SOILS OF THE OAK RIDGE AREA

ORNL-DWG 82-13477

ORNL-DWG 82-13476



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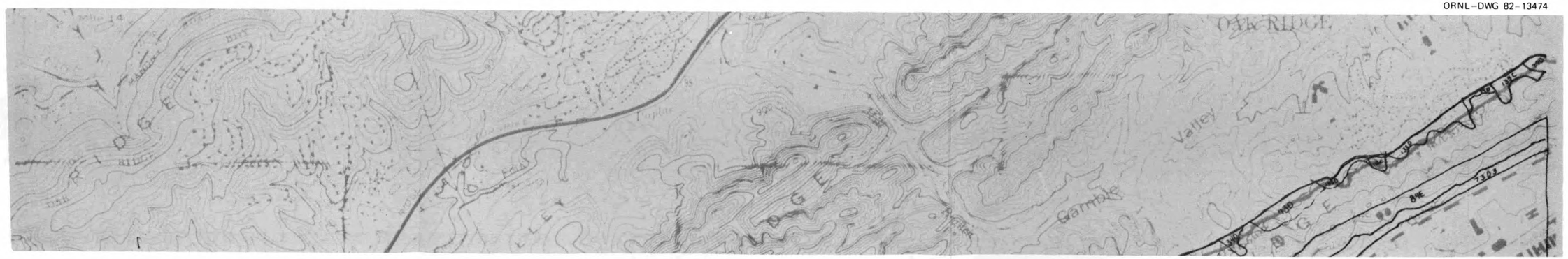

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5
Pinhook Gap
EAST FORK
Ts
Fc
Cs
Ls
As
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Ms
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Fct
Fcz
Cc
Cel
Rg
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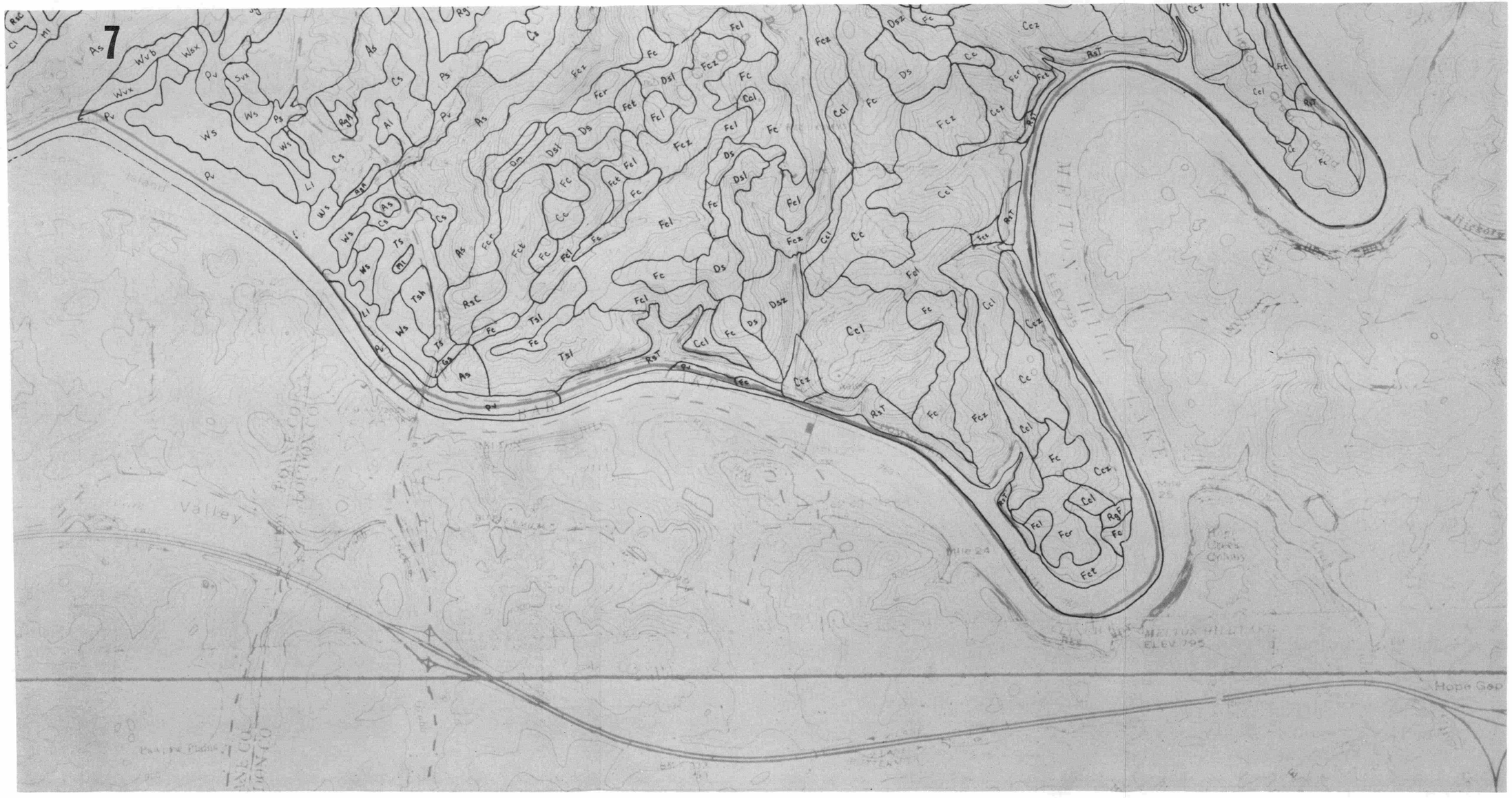

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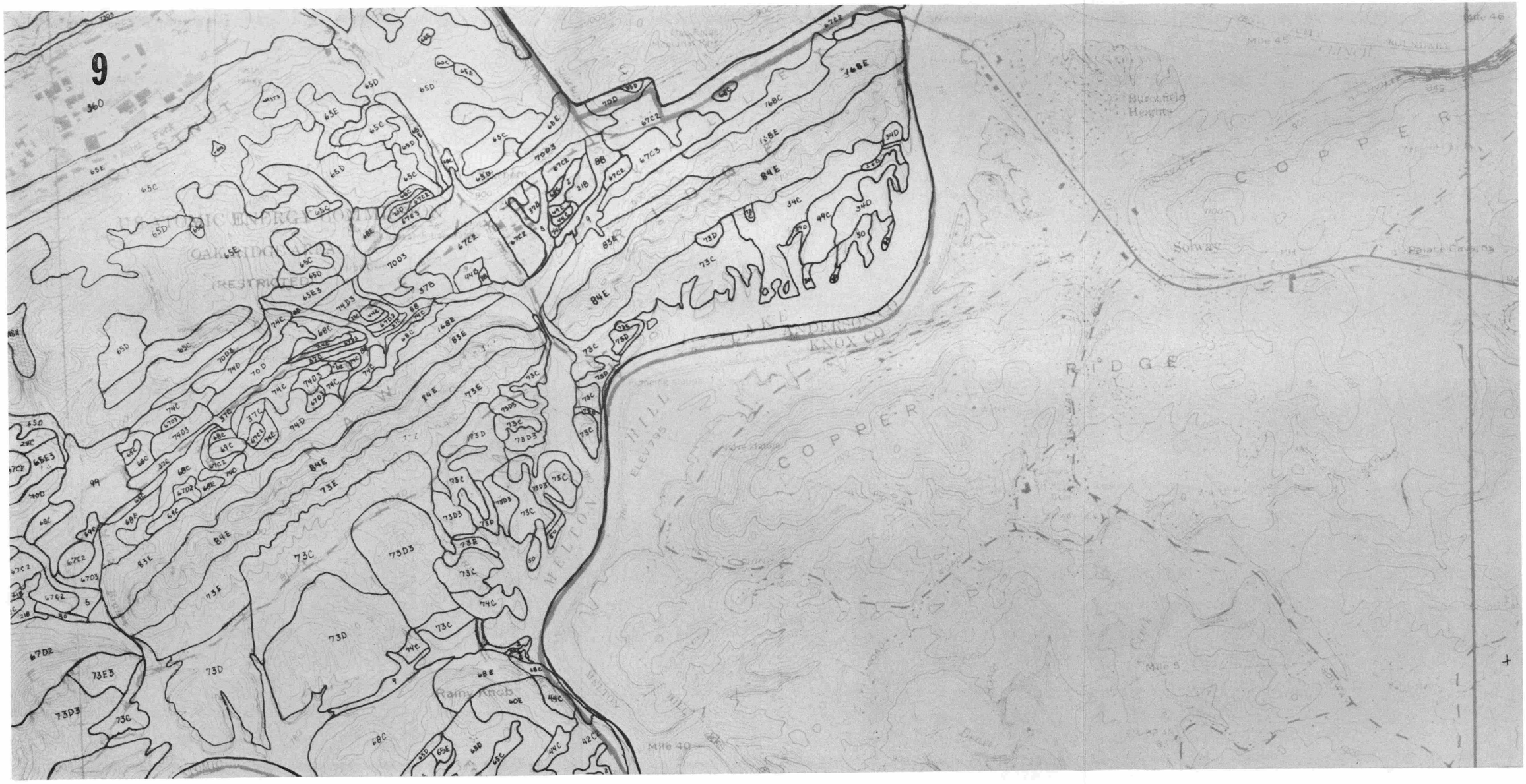

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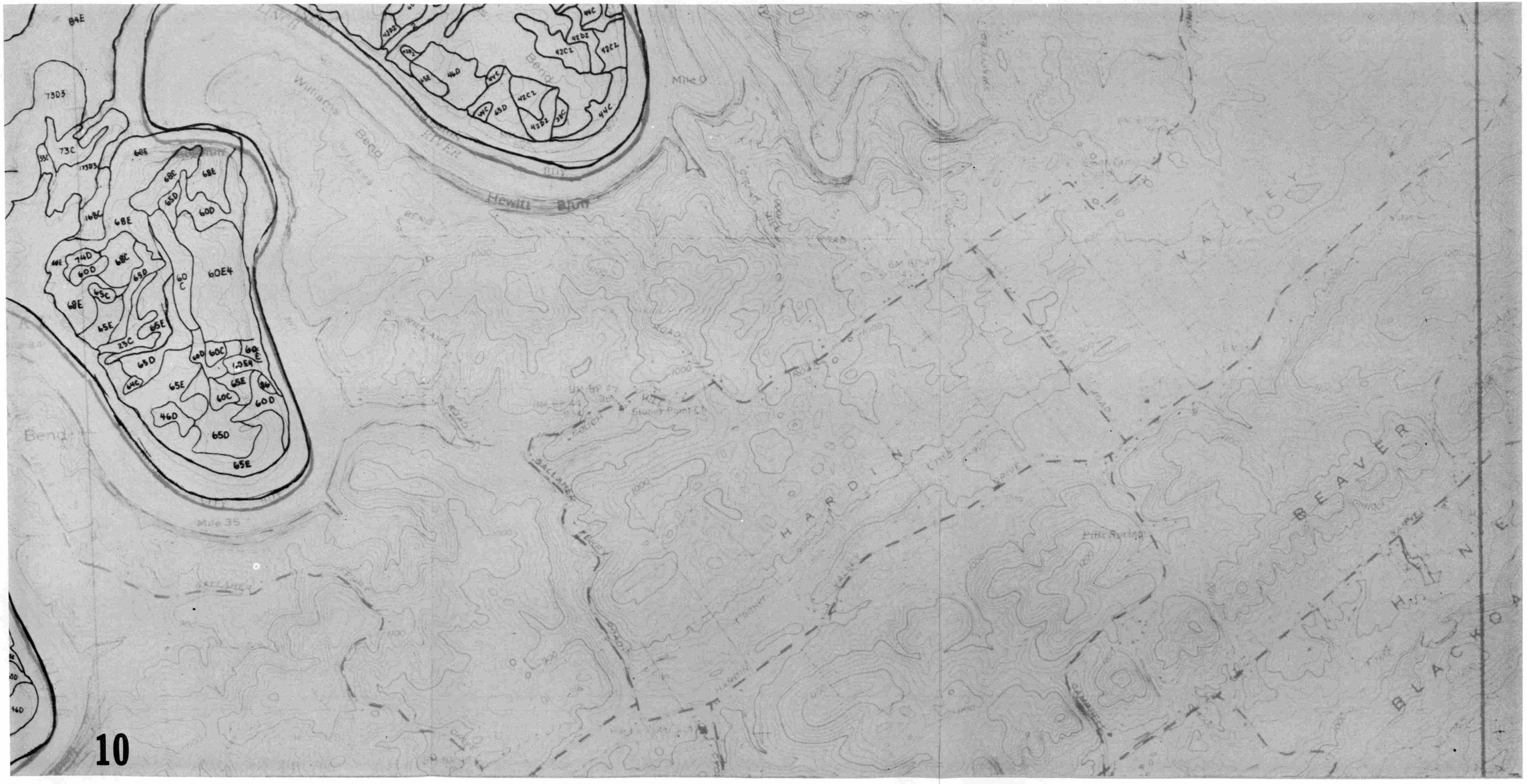

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