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Soil Survey of the First Settlement Zone
1:100,000

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volume 3

Soil Survey of the First Settlement Zone
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List of Volumes

1. Introduction, Summary and Recommendations
2. Reconnaissance Soil Survey, 1:500,00 scale
3. Soil Survey of the First Settlement Zone, 1:100,00 scale
4. Detailed Soil Survey of the Tartous Area, 1:25,000 scale
5. Reconnaissance Land Use Survey of Syria, 1:500,000 scale and Land Use Survey of the First Settlement Zone, 1:100,000 scale
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FOREWORD

The 1:100,000 scale soil survey of the First Settlement Zone is a reconnaissance soil survey based on the soil profile and soil landscape information compiled during the course of the 1:500,000 scale soil survey. Alluvial areas can be detected and boundaries mapped on the larger scale, but cartographic detail beyond this cannot reliably be done until map scales of 1:40,000 or larger are used. Likewise, the taxonomic category of subgroup is adapted for reconnaissance survey of 1:100,000 scale. Establishing new soil subgroups in addition to those presently used in the 1:500,000 scale soil survey would be impractical and serve no purpose in terms of additional interpretations.

Detailed reference material and statistical data are presented for Syria in Volume10, the 1:500,000 scale reconnaissance soil survey. Since these data are presented in Volume10, they are not repeated here.

Soil classification or soil taxonomy is presented in a later part of this report. This is in conformance with recent trends in soil science which emphasize how soils are used rather than technical information of interest primarily only to other soil scientists. Although soil classification is essential, its principal use is as a tool for soil scientists to interpret soil information.

Land use information is necessary for base line data for the soil survey. When land use and soil data are entered into the geographic information system, which is the next step of this study, the land use information will be compared to the soils potential to aid decision makers in their use of these project volumes.

The present trend in soil survey reports is to emphasize soil limitations and potentials. Soil management information, such as crop rotations, fertilizer applications and the like changes as research results become known. The soil management information is generally found in research bulletins.

Inceptisols, Entisols and Aridisols are common soil orders in Syria with smaller areas of Mollisols. These orders are common where precipitation is somewhat limiting and soil parent materials have high percentages of calcium and magnesium carbonates. Although precipitation is heavy in some parts of the First Settlement Zone, slopes are steep and this, coupled with large areas of carbonate rock, has prevented much water from entering the soil and translocating clay to lower soil horizons. Thus Alfisols, which must have argillic horizons, are not common. Vertisols are present in Syria in the First Settlement Zone but they do not dominate large areas. Vertisols require the presence of aluminum silicate minerals along with an alternate wet/dry climate.

Usually the topography is basin-like or flat and weathering is not so intense that kaolinitic clay minerals have formed. These unique conditions do not dominate in most areas of Syria.

The purpose of science is to make predictions. The study of soils is a science because a certain set of environmental factors will produce a certain soil and when these environmental factors are repeated, one can predict that a similar soil will result. If this were not so and individual borings and pits were required for each delineation, the study of soils would not be a science. In this project it is thought that a sufficient number of profiles were described and analytical data obtained during the course of the 1:500,000 scale soil survey to support the soil boundaries drawn and the taxonomic units used in the 1:100,000 scale soil survey.

This soil survey contains much information useful in any land-planning program in the First Settlement Zone of Syria. Of prime importance are the predictions of soil behavior for selected land uses. Also important are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations and the effect that selected land uses will have on the environment.

The soil survey has been prepared for many different users. Farmers and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, and builders can use it to plan land use, select sites for construction, develop soil resources and identify special practices needed to insure the best performance. Conservationists, teachers, students and specialists in recreation, waste disposal and pollution control can use the soil survey to help them understand and protect the environment. Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be unstable to be used as a foundation for buildings or roads.

These and other soil properties that affect land use are described in the soil survey. Broad areas of soils are shown on the general soil map; the location of soils in more detail is shown on the 1:100,000 maps. Each kind of soil is described and much information is given for each soil for specific uses.

volume 3

Soil Survey of the First Settlement Zone 1:100,000

SOIL SURVEY OF THE FIRST SETTLEMENT ZONE, SYRIA *

(1:100,000 SCALE)

The First Settlement Zone includes the area in Syria receiving an annual precipitation of 350 mm or more. Figure 3-1 shows the area involved. The area lies roughly in an arc from the inner rim of hills and mountains running parallel to the Mediterranean Coast, and going east along the Turkish border. Another area lies south and west of Damascus. For convenience of preparing the Landsat base maps the zone has been divided into Sections A, B and C. The First Settlement Zone includes approximately 33,080 km2 or 3,308,066 hectares. It is the major crop and fruit producing area of Syria and includes most of the population and the larger towns and cities.

1 GENERAL NATURE OF THE FIRST SETTLEMENT ZONE (5 - See references)

This section gives general information concerning the Zone. It describes climate, physiography, relief, geology, natural vegetation and agriculture.

(*). Prepared by Frederick C. Westin, Haluk Yuksel, Inam El Daya, Ayman Jabri and Adib Safi. Frederick C. Westin is Professor of Soils, Remote Sensing Institute, S.D. State University, Brookings, S.D., USA; Haluk Yuksel is a Soil Scientist with Louis Berger International, Inc., East Orange, N.J., Inam Daya, Ayman Jabri and Adib Safi are staff members with the Directorate of Soils, Ministry of Agriculture and Agrarian Reform, Syria. Others who participated in the field work were Bruce K. Worcester of the Remote Sensing Institute, S.D. State University, Brookings, and Riad Rizik, Directorate of Soils, Damascus, Syria.

1.1 CLIMATE

Mediterranean climate prevails in the First Settlement Zone. It is characterized by a rainy winter and a hot rainless summer. The two transitional seasons are short. December and January are the coldest months and July and August the hottest. Annual precipitation is irregular. The precipitation pattern is controlled by the position and altitude of the mountain ranges on the western border. Most of the precipitation falls on the highlands which impede the flow of humid air east.

The coastal region is included in Area B (Figure 3-1). Included are the littoral plains and the lower slopes of the mountains. The climate is subhumid and annual precipitation ranges from 700-1100 mm. The summer temperature is warm, winters are temperate and there is no or rare frost. Table 3-1 gives climatic data for Tartous which is representative of the coastal region.

The western mountain region also is included in Area B, and also the high plateau of Golan in Area A. Precipitation in these mountains ranges from 800-1000 mm or more. Some of this precipitation is snow. Winters are cold and summers moderate. Precipitation decreases on the eastern slopes of the mountains with the fall in elevation. Area C in northeast Syria receives up to 500 mm of precipitation owing to its location south of the Taurus Mountains in Turkey. The Ain El Arab portion of Area B also receives adequate precipitation due to its position south of the mountains in Turkey.

On the low mountains and on the plateaus and plains east of the western Syrian mountains and south of the Taurus range the climate takes on more continental characteristics. Temperatures are cool in winter with frost possible and summers are hot. Climatic data are given in Table 3-1 for Hama and Homs which characterize this area. Data also are given for Quamishli in the northeast which characterizes Area C.

1.2 PHYSIOGRAPHY, RELIEF AND GEOLOGY (6)

The major physiographic areas of the First Settlement Zone include the western mountain ranges including the rift valleys, the inland plateaus, the basalt plateaus, mountains and plains and the littoral plains.

The generalized physiographic, relief and geologic features of the First Settlement Zone are shown in Figures 3-2, 3-3 and 3-4. The principal mountain range is Jabal Lattakia which occurs north of the Tripoli-Homs depression in Area B. Jurassic hard dolomites and limestones and Cretaceous hard limestone are the main rocks. Elevations reach 1550 m. A mountainous area of Mesozoic green rocks, including peridotites, diabases, amphibolites and pillow lava, occurs in the extreme northwest of this area. Just east of Jabal Lattakia is the Ghab plain, a graben floored with fluviatile deposits and lacustrine marl. East of Ghab and parallel to it, also in Area B, is Jabal Zawiyeh, a horst of Cretaceous and Eocene limestone. Elevations here are no higher than 877 m. Jabal el Kurd occurs in the northern part of Area B northwest of Aleppo. This is a low mountain of Cretaceous chalky limestone.

The Anti-Liban range comprises the western border of Area A. These are folded mountains bordered by flexures. Elevations range up to 2800 m. The rocks are Jurassic hard dolomites and limestones and Cretaceous hard limestone.

The Inland Plateau region includes the regions of Aleppo, Hama and the plateau of Homs in Area B and the upper Jezireh of Area C. Hard or chalky limestone with rolling relief characterizes the Aleppo area. Red soils have developed from these calcareous materials here and in the plains south. Near Hama the Orontes River flows in a deep gorge through flat topography underlain by Cretaceous chalky limestone. The plateau of Homs is formed on Neogene lacustrine marls, conglomerates, and limestone. The upper Jezireh is an area of Neogene age conglomerates, sandstones, limestones, clays, and marls. The Ain El Arab portion of Area B consists of rolling plains underlain by hard or chalky limestone.

Basalt occurs in all areas of the First Settlement Zone. In Area A the Huran and Golan plateaus and the highlands near Sweida are Quaternary basalts which have vertic soils. In Area B West of Homs is a Pliocene basalt flow of Neogene age. Several other basalt plateaus occur east and north of Hama and south of Aleppo. Neogene and Quaternary basalts occur in the northeast part of Area C.

Littoral plains occur along the coast. The largest is the plain of Akkar in the Tripoli-Homs depression. The materials mostly are colluvial-alluvial mixtures.

1.3 NATURAL VEGETATION (8)

The mountain zones of Areas A and B of the First Settlement Zone are characterized by upper and lower stages. In the lower stage the evergreen-oak type is dominant. (Quercus calliprinos and infectoria, Pyrus, Fraximus, Amygdalus, Ceratonia and Graminaceae). The upper stage is dominantly oak-juniper. (Quercus infectoria, Quercus pseudocerris, Juniperus oxycedus and excelsa and Pinus syriaca). Between 1400-2000 m cedar and fir are dominant (Cedrus libani and Abies cilicica); between 2000- 2500 m the vegetation is mostly Juniperus excelsa. Above 2500 m grass is domina (Perennial graminaceae) with Carex and dwarf shrubs.

East of the western mountains in Areas A, B and C the vegetation was grass (Andropogon, Dactylis) and shrubs. On the drier borders of the First Settlement Zone the natural vegetation was sparse dwarf shrubs (Artemisia herba-alba, Anabasis aphylla), short grasses (Poa sinaica, Stipa Tortillis) and lichens.

1.4 LAND USE

Cultivated areas are dominant in the First Settlement Zone. Field boundaries can be detected on the Landsat imagery which aids in identifying these areas. Where the bedrock is light colored the reflectance is light unless masked by permanent vegetation. In basaltic areas the fields appear dark. In the mountains cultivated areas are the result of slope management with the slope being broken into small nearly level fields by stone-bordered terraces. Cultivation is intense in the areas around Hama, Homs and Aleppo in Area B and in

Area C.

Grazing land in the First Settlement Zone is the principal land use where soils are stony and thin and where slopes are prohibitively steep. The grazing areas lack field patterns and appear a uniform faint pink on the May Landsat image. Orchards and forests generally appear in red hues on the Landsat imagery. Evergreen trees are a darker red than deciduous trees. Barren land which occurs in basaltic areas and in hard limestone appears lavender.

According to the Statistical Abstracts for 1977 (7) the following are the most important Syrian rainfed crops: wheat, barley, lentils, olives, sorghum, sesame, chick peas, water melons, grapes, figs, pistachio and almonds. Fallowing is a common practice in rainfed cultivated areas. Some of these crops are partly irrigated. Irrigation is both by water from wells and from river reservoirs. Cotton is the principal irrigated crop. Other irrigated crops include tomatoes, corn, tobacco, sugar beets, potatoes, peanuts, sunflowers, forage crops, apples, apricots and other tree fruits and nuts.

2 HOW THIS SURVEY WAS MADE

This soil survey was made on Landsat satellite color composite prints at a scale of 1:100,000. The prints were made from May 1978 imagery that was geometrically-corrected and contrast-enhanced. The contrast enhancement is a linear stretch that uniformly expands the range of brightness values in the image data to fill the tonal range of the output display.

Two data sources were available which reduced considerably the time required to complete this 1:100,000 scale soil survey. They were: the 1:500,000 scale soil map and report prepared by Haluk Yuksel (9) and the 1:100,000 land use map prepared by Dominique Durlin (3). Yuksel's map was prepared on August 1977 imagery while Durlin's map used the same date Landsat imagery as the 1:100,000 scale soil map. Yuksel's map and legend identified the dominant soils present in the First Settlement Zone. He also classified and interpreted the soils. Durlin's map, by identifying land use, provided clues as to the agricultural potential and limitations of the identified soils. Both Yuksel and Durlin spent considerable time in the field. Yuksel described and has laboratory data for 97 soil profiles which support and document the survey. The principal refinements of the 1:100,000 scale soil survey over the 1:500,000 scale survey is that more alluvial areas could be recognized and delineated and that major soil areas could be subdivided to reflect land use and potentials and limitations not possible to recognize on the 1:500,000 scale imagery.

The procedure followed in making the 1:100,000 scale soil survey is similar to that described by Klingebiel and Myers (5) for using Landsat for determining soil potential. In brief the steps of the procedure are as follows:

1. Prepare overlays on clear plastic of resource maps (soils, geology, topography, climate, vegetation, infrastructure) at the same scale as the imagery.

2. Prepare photo interpretation keys to interpret color and tonal differences observed on the imagery.

3. Synthesize all of the available data and maps and prepare a first draft soil map for field study.

4. Assemble yield and related data by kinds of soil.

5. Develop criteria and assumptions to use in making soil interpretations.

6. Reconnaissance ground check the preliminary map.

7. Alter the preliminary map as needed based on the ground check.

8. Describe the map units.

9. Record in tabular form the properties of the soils including factors limiting use.

10. Prepare a table of yield estimates for selected crops under defined levels of management.

11. Prepare interpretive maps.

Step 11 can best be accomplished by digitizing the maps and entering the data into an information system where the computer prepares the individual interpretive maps using the tabular data.

3 NOTES ON THE USE OF LANDSAT IMAGERY FOR SOIL SURVEYS

Landsat imagery has several advantages over conventional black and white air photos. First, a single scene covers 3.5 million hectares. This permits a synoptic view and comparisons can be made over a large area where sun angle and other light characteristics are the same. Second, the data are multispectral. Two of the channels reflect energy in visible light (band 4 = green light, band 5 = red light) and two are in the reflective infrared (bands 6 and 7). Each band has a characteristic capacity to be absorbed or reflected by soils and vegetation and other features. By superimposing the channels and assigning colors to them a color composite is prepared. Generally three channels are used for a color composite. Channel 4 is passed through a blue filter, channel 5 through a green filter and channel 7 through a red filter. The use of the color composite results in unique colors for soils and vegetation. This is called a "signature" since it identifies the feature. Generally, when ground truth establishes the identity of a feature by a certain color and pattern, this can be applied to the same features wherever they occur on that image.

A third advantage of Landsat is that the data are acquired every 18 days (nine days if two satellites are in orbit). Thus the earth's features can be observed throughout the growing season. This is called the temporal feature. Usually, the best time to observe soils is when cropped soils are bare at the beginning of the growing season.

A final advantage of Landsat is that the data are recorded digitally for small areas called picture elements (pixels) that are 56 m by 79 m in size. The digital format allows the data to be manipulated by computer. When it is realized that each Landsat scene is composed of about 30 million pixels, it can be appreciated why computer handling is necessary.

Some soil factors that influence reflectance are soil color, moisture content, texture, organic matter content and iron oxide content. Increasing moisture content causes a decreased reflectance or darker shades on the image. If soils are moist, sands have a higher reflectance than clays. If soils are dry, sands have a lower reflectance than clays. Surface soil roughness decreases reflectance. Reflectance decreases as organic matter and iron oxide content increase. Thus the basaltic soils appear dark on Landsat images as do the soils high in organic matter and the red soils high in iron oxide. The light colored limestone soils appear nearly white on the image.

Growing vegetation absorbs red light and reflects infrared light. Healthy vegetation appears bright red on a color composite while vegetation under stress from lack of water or insect and disease damage is a lighter shade of red. Coniferous trees have a lower infrared reflectance than deciduous trees and appear brown rather than red. Water has low reflectance in the visible wave lengths and high absorption at reflective infrared wavelengths.

4 GENERAL SOIL MAP FOR BROAD LAND USE PLANNING

General soil maps have been prepared for areas of the First Settlement Zone. Figure 3-5 is of Area A, Figure 3-6 of Area B and Figure 3-7 of Area C and the Ain El Arab portion of Area B. General soil maps provide a synoptic view of the distribution of major soils. The individual map units each have a distinctive pattern of soils, relief and drainage whose boundaries can be recognized on the Landsat satellite images. Typically each map unit consists of one or more major soils and some minor soils in a unique natural landscape. The map units have been identified in the nomenclature of soil taxonomy on each of the figures. In the text they also are described in general terms. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are suited for certain kinds of agriculture or to other land uses can be identified on the map. Likewise areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale the general soil maps do not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting the site of a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, stoniness, drainage or other characteristics that affect their management.

The units on the general soil map are described below. The same legend of 10 map units applies to Areas A, B and C but not all areas utilize each of the map units.

1. Lithic Xerorthents: Shallow to moderately shallow, hilly to mountainous, excessively drained, usually stony, moderately fine textured soils.

This map unit occurs in First Settlement Zone Areas A, B and C. It has formed on basalt, Neogene, Paleogene, Cretaceous, Jurassic and Mesozoic materials. Topography is rugged, but in many areas the mountain slopes are terraced so that narrow nearly level, rock-supported, fields follow the contour. The fields are planted as orchards, and often wheat and other crops are planted under the trees. Even though many areas are cultivated the dominant use is for grazing, bushland or forest. Workability is poor to very poor, the mechanization potential is very low, and the water erosion hazard is very high. The relative productivity is very poor.

On the May Landsat image these areas consist of a mottled pink-white mosiac. Even when cultivated the fields are too small to discriminate which results in the mosiac pattern. Since relief is pronounced, shadows occur so that the major drainages stand out in an apparent three-dimensional effect.

2. Typic Xerochrepts: Deep to moderately shallow, red, nearly level to undulating, well to imperfectly drained, medium to moderately fine textured soils generally on uplands.

This map unit occurs in First Settlement Zone Areas A and B. In Area A these soils have developed from Neogene age basalt. In Area B they have developed from Quaternary and Neogene materials.

These soils principally are cultivated although there is some stoniness. Where silty, these soils have fair workability. Where moderately fine the workability is poor. The mechanization potential is generally high to medium, the water erosion hazard is moderate to high and the relative productivity is good to fair.

On the May Landsat image these soils generally have distinguishable field patterns and appear dark brown, dark green, or black. Since the soil surface color is red, the bare soil image tone on Landsat is dark. Vegetated areas are red.

3. Calcixerollic Xerochrepts: Deep to moderately deep, red, undulating, well drained, moderately stony, moderately fine soils on uplands. These soils have a pronounced horizon of soft calcium carbonate in their substratum.

This map unit occurs in First Settlement Zones Areas B and C. In both areas soils have formed in Neogene materials. The majority of this unit is in Area C. The soils mainly are cultivated although stoniness in places is excessive and creates a problem. Workability is fair to poor due to the moderate fine texture. Mechanization potential is medium to high, the water erosion hazard is high and the relative productivity is fair to good.

On the May Landsat image in Area C the field boundaries are very apparent with fields of various shapes and sizes forming a complex network. The image tone is dark green or grayish green where the soils are bare or nearly bare and red where crops are growing.

4. Lithic Xerochrepts: Moderately shallow to moderately deep light brown, undulating to hilly, somewhat excessively drained, stone-free to moderately stony, fine to moderately fine-textured soils of uplands.

This map unit occurs in First Settlement Zone Areas A, B and C. In Area A it occurs both in Neogene materials and Quaternary basalt. In Area B it occurs in Neogene, Paleogene and Cretaceous materials, and in Area C it occurs in Neogene and Quaternary basalt materials.

This unit generally is not cultivated, but is used for potential rangeland or for orchard crops. If cultivated fields are small and terraced, workability and mechanization potential generally are very poor, the water erosion hazard is very high, and relative productivity is poor to very poor.

On the May Landsat image field boundaries are not apparent since cultivated fields, if present, are small and irregular. Colors are greenish brown mottled with white, lavender mottled with grayish yellow, or mottled light and dark gray.

5. Petrocalcic Xerochrepts: Moderately shallow to deep, red, gently undulating to rolling, well drained, stone-free or slightly stony, moderately fine textured soils on uplands. A hardened Calcite layer occurs in the substratum.

This map unit is confined to Area B of the First Settlement Zone. The soils are derived from Neogene materials. Most of these soils are under cultivation and some are irrigated. Workability is poor, mechanization potential is medium to very low, water erosion hazard is moderate to very high and relative productivity is very low.

On the May Landsat image field boundaries are apparent, and colors are medium or olive green with brown or dark brown mottles.

6. Vertic Xerochrepts: Deep, gently undulating to rolling, well to imperfectly drained, slightly stony, fine-textured soils of plains.

This unit occurs in First Settlement Zone Areas A, B and C. In Area A it occurs on basalt of Quaternary and Neogene age. In Area B it occurs on Neogene and Quaternary materials, and in Area C it occurs on Neogene materials and basalt of the Quaternary period.

The unit, generally, is cultivated. Workability is very poor, mechanization potential is medium, erosion hazard is very high, and relative productivity is fair to poor.

Field boundaries are apparent. Colors on the May Landsat image are medium grayish green to dark green with brown, white and red mottles.

7. Typic Haploxerolls: Deep to moderately shallow, red, nearly level to undulating, well drained moderately fine textured soils of uplands and basins.

The unit is confined to First Settlement Zone Area B where there are two characteristic occurrences. The Areas labeled 7 are from Quaternary deposits in basins or floors of valleys. The Ghab valley and the smaller valley on the Lebanese border are examples. The other area is labeled 7-stony. Here the soils are dark colored, but are very stony or bouldery and are derived from basalt.

The 7 unit is nearly all cultivated, but the 7-stony unit is mostly used for pasture; although a few fields have been created by removing the stones and boulders.

On the May Landsat image field boundaries are distinct in unit 7, but not in 7-stony. Colors in unit 7 are red, white and blue with brown, and green. In 7-stony colors are dark or olive green and of uniform tone.

8. Typic Chromoxerert: Deep, red, gently undulating, fine textured soils of uplands.

This unit occurs in the First Settlement Zone in Areas A, B and C. In Area A it is developed in Quaternary materials, in Area B from Neogene materials, and in Area C from basalt of Neogene age.

This unit generally is all cultivated. Due to fine textures workability is poor but mechanization potential is medium. The water erosion hazard is high and the relative productivity is fair to good.

On the May Landsat image field boundaries are distinct and colors are very dark gray and green, with patches of white. Some red and light blue mottles occur.

9. Typic Xerofluvents: Deep, nearly level, imperfectly drained, moderately fine-textured soils of bottomlands and low terraces.

This unit occurs in the Ain el Arab area of Area B and Area C of the First Settlement Zone. Although this soil map unit occurs throughout the study area the delineations are too narrow to show on the generalized map except in the areas indicated. The soil generally is associated with Quaternary materials.

This unit is cultivated where drainage and texture permit. Workability is poor, mechanization potential is medium, water erosion hazard is medium and relative productivity is good.

On the May Landsat image field boundaries are distinct and colors are red and blue with some white. Irrigation is a common practice on these soils.

10. Rock Outcrop: Rock outcrop occurs in First Settlement Zones A and B. In Area A it is associated with basalt of the Quaternary and Neogene periods. In Area B it occurs in Neogene and Cretaceous materials.

These areas essentially lack any soil and are barren of vegetation except where soil material occurs as a thin layer in basins in the rock. These areas provide limited grazing. For the most part, however the areas lack potential for any agriculture.

The general soil map areas with the best cropland potential are 2, 6, 7, 8 and 9. Area 7-Stony is very stony or bouldery, Area 1 has thin, rocky or stony soils on steep slopes or mountains. Areas 3, 4 and 5 have shallow profiles. Area 10 consists of rock outcrops.

5 SOIL MAPS FOR MORE DETAILED PLANNING

The map units shown on the 1:100,000 scale maps prepared as a separate atlas represent the kinds of soil in the survey area. They are described in this section. The description together with the soil maps can be useful in determining the potential of the soil and in managing it for food and fiber production, in planning land use and developing soil resources, and in enhancing, protecting and preserving the environment.

Preceding the name of each soil map unit is the symbol that identifies the soil on the 1:100,000 scale soil map. Each soil description includes general facts about the soil and a brief description of a representative soil profile. In each description the principal hazards and limitations are indicated and the management concerns and practices needed are discussed.

The map units on the 1:100,000 scale soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most soil map units usually are made up of two to four dominant kinds of soil. Such map units are called soil associations. A soil association is made up of soils that are geographically associated and are shown as one unit on the map since it is not practical to separate them at the 1:100,000 scale. A soil association has considerable regularity in geographic pattern and in kinds of soil that are a part of it. However, the extent of the soils can differ appreciably from one delineation to another. See Table 3-2 for a brief description of mapping unit.

The acreage and proportional extent of each map unit is given in Table 3-14. Additional information on properties, limitations, capabilities and potentials for many soil uses is given for each kind of soil in other tables in this survey report. The tables are grouped in a rear section of this report.

A51a- Typic Salorthids-Aquollic Salorthids, level to depressional.

These deep, well to poorly drained clays occur in a shallow basin about 40 km south of Aleppo. The unit consists of about 70 % Typic Salorthids and 30 % Aquollic Salorthids. The Typic Salorthids occupy slightly higher and better drained positions. Both soils are developed in Quaternary lacustrine deposits. The delineation on Landsat imagery is medium blue with white patches.

Typically the Typic Salorthid soil has a surface layer of yellowish brown silt loam about 5 cm thick. Next is a layer of light yellowish brown silty clay loam 9 cm thick. The underlying material, to a depth of 32 cm,

is a pale brown silty clay loam. Below this, from 32-40 cm, is a white silty clay loam. The soil is saline from 14 cm.

The Aquollic Salorthid resembles the Typic except that it has a few faint olive and pale yellow mottles. Neither soil is eroded, the Typic Salorthid has no water table but there is a water table at 50-75 cm in the Aquollic Salorthid. Both soils are saline but are free of alkali. There are few coarse fragments on or in the soil and no stones or rock.

The soils support native plants and are used for grazing. The soils have a fair to good potential for grazing but a poor potential for cultivated crops because of high salinity and seasonal wetness. Because of wetness and salinity the soil is not suited for building site development. The Capability subclasses are VIs and VIw respectively.

E21a- Typic Xerofluvents-Typic Xerorthents, level.

The composition of the unit is 90 percent Typic Xerofluvents and 10 percent Typic Xerorthents.

These deep, imperfectly drained, moderately fine textured soils occur on stream and river bottom lands and terraces throughout the First Settlement Zone. The soil parent material is Quaternary alluvium.

Where irrigated the soils appear red on the Landsat imagery or alternately red and dark green. Field boundaries are apparent. Where not irrigated the soils appear white with red and green mottling. The shape of the delineations is snake-like, conforming to stream courses.

Typically the Typic Xerofluvents have an A1 surface layer 13 cm thick of a grayish brown clay. This is over a C-horizon 13-125 cm thick of dark grayish-brown clay alluvium.

The Typic Xerorthent soil normally has a very dark gray sandy clay loam or silty clay loam surface horizon about 16 cm thick. Below this is a very dark grayish brown clay loam subsoil about 20 cm thick. This in turn is underlain by a dark gray sandy clay loam subsurface.

Neither soil is eroded but in places there is a water table within 50-75 cm. Inundation can be expected. The soils are free of salt and alkali and may have a few coarse fragments on and in the soil.

Permeability is slow and water holding capacity is high. Mechanization potential is medium and relative productivity is fair.

The soils are suited for cultivation and generally they are cultivated using irrigation where available. These soils may be flooded too frequently for use as building sites. If roads are constructed across areas of these soils considerable grading and filling are needed to prevent flood damage. The soil is not suited for any kind of waste disposal system because of flooding. The capability subclass is IIw.

E41a- Typic Xeropsamments, level to undulating. Deep, excessively drained sands occurring along the beaches of the Mediterranean coast in Area B.

These soils have a severe wind erosion problem. They are used for recreational purposes and have limited use for agriculture. They are in capability class VIII.

E61a- Lithic Xerorthents - Lithic Xerochrepts, steep, and mountainous, moderately shallow to shallow, excessively to well drained soils.

Five to 60% of the surface and subsurface contains coarse fragments and 15-60% is stony. The soils are derived from Neogene and Quaternary basalts and basalt flows and occur in Areas A and C. The composition of the unit is: Lithic Xerorthents 40%, Lithic Xerochrepts 30%, Rock Outcrops 20% and Typic Xerochrepts 10%. The areas appear light blue mottled with pink and bluish white on the Landsat imagery.

Typically the Lithic Xerorthents have a very dark grayish brown sandy loam surface horizon 6 cm thick. This rests on a grayish brown loam subsurface 20 cm thick which rests on basalt.

Typically the Lithic Xerochrepts have a very dark grayish brown loam surface horizon about 7 cm thick over a 17 cm thick subsurface of dark grayish brown sandy clay loam substratum. Below this is basalt bedrock.

Typically the Rock Outcrop consists of basalt and lava flows.

The Typic Xerochrept member of the association consists of a dark brown loam surface horizon 6 cm thick. This is underlain by a dark brown loam subsurface 19 cm thick. Below this is a very dark gray loam horizon 13 cm thick. This is underlain by a yellowish brown clay loam substratum.

The composition of E61a is: Lithic Xerorthents 40%; Lithic Xerochrepts 30%; Rock Outcrop 5%; and Typic Xerochrepts 25%.

The E61a unit is best suited for pasture or orchards. The water erosion hazard is very severe when the unit is cultivated. The capability subclass is VIIe.

E61b- Lithic Xerorthents-Lithic Haploxeralfs, rolling to hilly, extremely stony, moderately shallow, excessively drained, fine-textured soils.

The unit is composed of Lithic Xerorthents 60%, Lithic Haploxerolls 20%, Lithic Xerochrepts 15% and Rock Outcrops 5%. The soils of the unit are derived from Neogene or Quaternary basalt and basalt flows.

Typically, the Lithic Xerorthents have very dark brown loam surface horizons 6 cm thick overlying a 20 cm thick grayish brown loam subsurface which grades into basalt.

The Lithic Haploxerolls consist of a black clay loam surface horizon about 13 cm thick. Below this is a very dark grayish brown clay loam subsurface about 19 cm thick. This overlays a dark reddish brown clay loam

substratum which grades into basalt.

Typically, the Lithic Xerochrepts have a dark brown clay surface horizon about 12 cm thick. Underlying this is a dark brown clay subsurface about 12 cm thick. This overlays a brown clay subsoil 20 cm thick which rests on basalt.

Typically, the rock outcrop consists of barren basalt knobs and lava flows. This unit is used for rangeland because of extreme stoniness and thin soil profiles. The soils are eroded and very susceptible to further erosion if overgrazed. Seeding establishment is very difficult, workability is very poor, mechanization potential and relative productivity are very low. The capability subclass is VIIe.

E61c- Lithic Xerorthents-Lithic Xerochrepts, rolling to hilly, extremely stony. Shallow to moderately shallow, well to excessively drained clays.

This association occurs in Areas A and B. The soil parent materials are Neogene and Paleogene limestone and marl. The composition of the unit is: Lithic Xerorthents 80%; Lithic Xerochrepts 10% and Rock Outcrop 10%.

This unit appears white with brown and green mottles on the May Landsat color composite imagery.

Typically, the Lithic Xerorthents consist of a dark grayish brown clay loam 7 cm thick over the limestone and/or marl substratum.

The Lithic Xerochrepts typically have a dark reddish brown clay surface 3 cm thick over a reddish brown clay 15 cm subsurface horizon. This overlies a yellowish red clay subsoil 7 cm thick over a reddish yellow C horizon. Bedrock limestone or marl occurs at about 50 cm.

Typically, the rock outcrop consists of white limestone or marl that has red veins of weathered material in the cracks.

The map unit has undergone severe water erosion. There are up to 60% of coarse fragments on and in the profiles and up to 50% stoniness. Workability and mechanization potential are very poor, water erosion hazard is very high and relative productivity is very poor.

The map unit presently is used for grazing purposes and to prevent further deterioration grazing should be controlled. The best use for the unit is some type of permanent vegetation.

The unit is in capability subclass VIIe.

E61e- Lithic Xerorthents, hilly to mountainous extremely eroded, moderately shallow, moderately fine, excessively drained soils of convex slopes in the Ain el Arab area of Area B.

Up to 35% coarse fragments occur in the surface horizon and up to 60% occur in the subsoils of this unit. The composition of the unit is: Lithic Xerorthents 45%; Lithic Xerochrepts 20%; Calcixerollic Xerochrepts 20%

rock outcrops 10%; and Petrocalcic Xerochrepts 5%. The parent material of the unit is Neogene and Paleogene limestone and marl.

The soils appear in mottled tones of white, green and pale brown on the Landsat imagery. Field patterns are apparent on areas where soils are cultivated. In these cultivated areas the percentage of Calcixerollic Xerochrepts increases to make up about 50% of the unit while the Lithic Xerorthents percentage drops to 15%.

Typically, the Lithic Xerorthents have dark reddish-brown clay surface horizons 13 cm thick. Below this is a dark reddish brown subsurface horizon about 20 cm thick. This is overlain by nearly white limestone bedrock.

Typically, the Lithic Xerochrepts have reddish-brown clay loam surface horizons 11 cm thick of weak medium blocky structure. This overlies a reddish-brown clay loam subsurface of moderate medium blocky structure 11 cm thick. Below this is a strong brown calcareous clay 15 cm thick. This overlies a yellowish red clay loam 11 cm thick which grades into limestone bedrock.

Typically, the Calcixerollic Xerochrepts have yellowish-red clay loam surface horizons of medium blocky structure 5 cm thick. This overlies a calcareous brown, blocky-structured clay 16 cm thick. Below this is a strong brown calcareous clay of subangular blocky structure 19 cm thick. This overlies brown calcareous clay colluvium.

Typically, the rock outcrops are white or light gray with red stains in the joints and cracks.

Typically, the Petrocalcic Xerochrepts have dark brown moderate, medium blocky-structured clay loam surface horizons 17 cm thick. Below this is a brown moderate medium blocky- structured clay loam subsurface horizon 34 cm thick. This is overlain by a brown calcareous clay loam hardened calcareous horizon.

With the exception of the Calcixerollic Xerochrepts the soils are poorly suited for mechanization, are extremely susceptable to water erosion and have very low relative productivity. They are in capability subclass VIIe. The Calcixerollic Xerochrepts have fair potential for mechanization, are highly susceptible to water erosion and have low relative productivity. They are in capability subclass IVc.

E61f- Lithic Xerorthents-Lithic Xerochrepts, rolling to hilly. Moderately shallow, moderately fine to fine, excessively to well drained soils of hilly slopes of Area B.

Up to 60% of the surface is covered with coarse fragments but less than 5% of the subsoil consists of coarse fragments. Three to 15% of the unit is stony. The composition of the unit is: Lithic xerorthents 70%; rock outcrops 20%; Lithic Xerochrepts 10%. The parent material of the unit is Neogene or Paleogene gypsum, limestone or marl.

The unit on Landsat appears mostly white with some green and purple. Cultivated field boundaries are not apparent. The soils mostly are in pasture but there are small areas in forest and some areas are barren.

For a general description of Lithic Xerorthents similar to this see map unit E61c.

Rock outcrops are nearly white to gray with a red weathered surface.

For a Lithic Xerochrepts general description see map unit E61e.

Water erosion on the soils is severe, up to 60% of the surface consists of coarse fragments although less than 5% of the subsoil consists of coarse fragments. Workability of the soils is very poor, mechanization potential is very low, the water erosion hazard is very high and the relative productivity is very poor. The unit is suitable for pasture, orchard and forestry use. The capability subclass is VIe.

E61g- Lithic Xerorthents-Lithic Xerochrepts-Calcixerollic Xerochrepts, hilly. Shallow to moderately shallow, moderately fine to fine, excessively drained soils of hilly areas in Area B.

Up to 60% of the surface is covered with coarse fragments and up to 15% of the subsoil is composed of coarse fragments. Rockiness is extensive. The composition of the unit is: Lithic Xerorthents 40%; rock outcrops 30%; Lithic Xerochrepts 20% and Typic Xerochrepts 10%. The parent material of the unit is Neogene or Paleogene gypsum, limestone and marl.

The appearance of the unit on Landsat varies with its use. The orchard areas are dark green, red and black. The forest areas appear dark brown and red mottled. The rangeland areas are light blue with some dark brown and white. The forest areas are dark brown and red mottled. The bush rangeland is mostly red with white and light blue. Cultivated field boundaries are not apparent.

For a general description of Lithic Xerorthents see soil map unit E61c.

Typically, the rock outcrops are dark gray with red showing on freshly exposed surfaces.

A general description of Lithic Xerochrepts can be found under map unit E61c.

For a general description of Typic Xerochrepts see soil map unit I11a.

Typically, Typic Xerochrepts have a very dark gray clay surface horizon of medium moderate subangular blocky structure 18 cm thick. Below this is a dark grayish brown clay of moderate medium subangular blocky structure 18 cm thick. Next is a grayish brown clay of moderate medium blocky structure 29 cm thick. This rests on grayish brown limestone.

Water erosion is very severe. Up to 60% of the surface consists of coarse fragments although only 5-15 % of the subsoil consists of coarse

fragments. The workability and mechanization potential of the unit is very poor, the water erosion hazard is very high and the relative productivity is very low. The unit is suitable for orchards, forests and grazing but care should be taken to control erosion. The capability subclass is VIe and VIIe.

E61h- Lithic Xerorthents-Lithic Xerochrepts, mountainous, rocky. Shallow, fine, excessively drained rocky soils of mountain areas of Areas A and B.

Up to 60% of the surface is covered with coarse fragments and up to 15 of the subsoil is composed of coarse fragments.

About 30% of the area is rock outcrop. The composition of the unit is: Lithic Xerorthents 40%; Lithic Xerochrepts 10%, rock outcrop 30%; Typic Xerochrepts 10%; Entic Haploxerolls 5% and Lithic Haploxerolls 5%. The parent material of the unit is Neogene or Paleogene gypsum, limestone or marl.

The appearance of the unit on Landsat is rust-colored with no apparent field boundaries.

For a general description of Lithic Xerorthents see map unit description E61c. For a general description of Lithic Xerochrepts see map unit description E61e. The rock outcrops typically are gray to dark gray with red freshly broken surfaces.

Typically, the Entic Haploxerolls have very dark brown clay loam surface soils of medium moderate subangular blocky structure 13 cm thick. This rests on a dark brown clay loam subsurface horizon 19 cm thick. This overlies a brown subsurface horizon 26 cm thick which grades into the parent material.

The Lithic Haploxerolls are similar to the Entic Haploxerolls but have a Lithic contact at 45 cm.

Water erosion is very severe. Up to 60 percent of the surface consists of coarse fragments and 10-15% of the subsoil consists of coarse fragments. The workability and mechanization potential of the unit is very poor, the water erosion hazard is very high, and the relative productivity is very low. The unit is suitable for orchards, forests and grazing

The capability subclass is VIIe or VIII.

E61i- Lithic Xerorthents, mountainous, extremely rocky. Shallow, fine, excessively drained, rocky soils of mountains.

The unit occurs in Area B. Although the soils are steep and rocky in places they are cultivated by use of terracing . Up to 60% of the surface is covered with coarse fragments while up to 15% of the subsoil consists of coarse fragments. About 30% of the area is rock outcrop. The composition

of the unit is: Lithic Xerorthents 40%; rock outcrop 30%, Typic Xerochrepts 10%; Lithic Xerochrepts 10% and Entic Haploxerolls 10%. The parent material of the unit is Cretaceous limestone.

The appearance of the cultivated areas on May Landsat imagery is mottled white , red orange and green with a suggestion of field boundaries . The forest areas are mostly red with mottled white. The brush areas are pink and the pasture areas are mostly white with a few green and red mottles. The barren areas are nearly solid white. The orchard areas are a nearly solid lighter shade of red than the forest.

For a general description of Lithic Xerorthents see map unit description E61c. For a general description of Typic Xerochrepts see map unit E61f. See map unit E61c for a general description of Lithic Xerochrepts.

Water erosion is very severe. The workability and mechanization potential of the unit is very poor and the relative productivity is very low except for the areas of Typic Xerochrepts and Entic Haploxerolls where relative productivity is fair. Most of the areas shown on the map are terraced. This essentially has created a new soil as the original soil was rearranged to form narrow fields following the contours of the mountain. The edges of the terraces are supported by rock walls. The soil in these narrow fields lies on nearly level slopes in spite of the fact that the general shape of the unit is hilly to mountainous. However, the soil in the terraces still is thin and stony.

The map unit is in capability VIIe but small patches of IIs occur.

E61j- Lithic Xerorthents-Lithic Xerochrepts, mountainous. Shallow, fine textured, excessively drained soils of the mountains north of Lattakia in Area B.

The soils have developed from an undifferentiated volcanic complex of the Mesozoic era consisting of radiolarites, diabases, spillites and pillow lava. Up to 60% of the surface is covered by coarse fragments and 5-15% of the subsoil consists of coarse fragments. Rocky areas are inclusions. Although steep and stony some areas are terraced and cultivated.. The composition of the unit is: Lithic Xerorthents 50%; Lithic Xerochrepts 30%; Typic Xerochrepts 10% and Typic Haploxeralfs 10%.

The appearance of the cultivated areas on May Landsat imagery is dark brown and blue mottled. It is mostly black with patches of red and light blue for the forested areas

Typically, the Lithic Xerorthents from metamorphic material consist of a very dark brown sandy loam 7 cm thick over the bedrock. The Lithic Xerochrepts from these metamorphic materials are similar to those described in unit E61a but the shallow bedrock is mixed metamorphic rather than basalt.

Water erosion is very severe on this unit where disturbed. Workability is very poor and the mechanization potential is very poor. The relative productivity is very poor for crops but orchards produce excellent fruit.

Much of the E61j area is terraced and used for wheat in the winter and tobacco in the summer. The map unit is mostly in VIe capability subclass but small areas are in IIs.

Illa- Typic Xerochrepts-Vertic Xerochrepts, level to gently undulating. Deep and moderately deep, medium to moderately fine textured, well drained soils of flats.

These soils occur on an irrigated flat along the coastal area north of Lattakia in Area B. The soils are used for citrus, olives, tomatoes, peanuts, squash and beans. There are less than 5% of coarse fragments on the surface, no stoniness and very little rockiness. Ease of seeding establishment is fair, workability is fair, mechanization potential is high to medium, the water erosion hazard is moderate and relative productivity ranges from good to poor. The composition of the unit is Typic Xerochrepts 70% and Vertic Xerochrepts 30%. The parent material of the unit is undifferentiated Quaternary materials.

The appearance of the unit on May Landsat imagery is dark brown and dark red with white and blue patches. Field boundaries are apparent.

A general description of the Typic Xerochrepts includes a dark brown sandy loam surface horizon 16 cm thick. This overlies a very dark grayish brown sandy loam subsurface 7 cm thick. Below this is a dark reddish brown sandy clay subsoil 27 cm thick and a reddish brown substratum 17 cm thick. This overlies mixed alluvial material.

Typically, the Vertic Xerochrepts have a dark brown clay surface horizon 4 cm thick. This overlies a brown clay subsurface 20 cm thick. Below this is a brown clay subsoil 46 cm thick resting on a very dark grayish brown substratum.

The Typic Xeochrept parts of the unit are in capability subclass IVs and the Vertic Xerochrepts in IIs.

Illc- Typic Xerochrepts -Vertic Xerochrepts, rolling to hilly, extremely stony.

These soils are developed from Neogene and Quaternary basalt in area A. Normally, mainly because of extreme stoniness, they are used for pasture. Where less stony or stones have been partially removed they are cultivated. Both components of this unit occur in Area A in the Al Souweyda area. On May Landsat images the unit appears yellowish brown and reddish brown to nearly black. The pasture land use generally appears in lighter tones.

The composition of the unit is: Typic Xerochrepts 40%; rubble lands 30%; Lithic Xerochrepts 10%; Vertic Xerochrepts 10% and Lithic Xerorthents 10%.

The soils of the unit are gently undulating to undulating, deep to moderately shallow and well drained. They are extremely stony and rocky. Seeding establishment and workability are very poor, potential for mechanization is very low and relative productivity is very poor.

Typically, the Typic Xerochrepts have a dark brown clay surface horizon 16 cm thick. Below this is a yellowish red clay subsurface 14 cm thick. This is underlain by a yellowish red clay subsoil 38 cm thick. This grades into yellowish red clay 16 cm thick which grades into calcareous reddish yellow substratum.

The Vertic Xerochrepts have a yellowish red clay surface horizon 14 cm thick over a yellowish red clay subsoil 36 cm thick which rests on light yellowish red clay basalt residuum.

Grapes, apples and olives are the principal uses along with pasture. The Typic, Vertic and Lithic Xerochrepts are in capability subclass IVs, the rubble lands in VIII and the Lithic Xerorthents in VIe.

I11d- Typic Xerochrepts-Lithic Xerochrepts, undulating to rolling.

These soils are developed from Neogene and/or Paleogene limestone and marl in two small areas northwest of Damascus in Area A. Their principal use is as pasture. On the May Landsat image the units appear light grayish green with white and red mottles.

The soils are gently undulating to undulating, deep to moderately shallow, fine textured, and well to imperfectly drained. The soil surface has up to 35% coarse fragments and there may be up to 60% coarse fragments in the profile. The workability of the unit is poor to very poor, the mechanization potential is medium to very low and the relative productivity is fair to very poor. The composition of the unit is: Typic Xerochrepts 40%; Lithic Xerochrepts 30%; Petrocalcic Xerochrepts 10%; Lithic Xerorthents 10% and rock outcrops 10%.

The Typic Xerochrepts are generally similar to those described in unit E61f. The Lithic Xerochrepts, the Petrocalcic Xerochrepts and the Lithic Xerorthents resemble those described in unit E61e. The rock outcrops are gray to light gray limestone.

The best use for the unit is for grazing and possibly limited irrigation on the flatter areas. The capability subclass ranges from VIIe to IIs.

I11e- Typic Xerochrepts-Calcixerollic Xerochrepts, gently undulating to rolling.

Deep to moderately deep, imperfectly drained to well drained, moderately fine textured soils of plains. They occur in Area B on the uplands east and northeast of Hama. The parent material generally is limestone.

The appearance of the unit on the May Landsat image is white with green and tan mottlings. Field boundaries are apparent.

The composition of the unit is: Typic Xerochrepts 60%, Calcixerollic Xerochrepts 30% and Lithic Xerochrepts 10%. The parent material is mostly Neogene and Paleogene limestones and marl.

Typically, the Typic Xerochrepts have dark reddish brown clay loam surface horizons 15 cm thick. This rests on a reddish brown clay subsurface horizon 37 cm thick. Below this is a light reddish brown clay subsoil 48 cm thick over white limestone .

The general description of the Calcixerollic Xerochrepts and the Lithic Xerochrepts resemble the descriptio . of these soils in mapping unit E61e. They occur here, however, on less rugged topography.

This unit is used for cropland. Workability is fair to poor, mechanization potential is fair, water erosion hazard is very high to medium and relative productivity is poor. The capability subclass is 60% IIs, 30% IVc and 10% VIIe.

I11f- Typic Xerochrepts-Lithic Xerochrepts, gently undulating. Steep to moderately shallow, moderately fine textured, red, imperfectly drained to well drained soils of plains.

They occur on the uplands in Area B in the Homs area, northeast of Hama, east of Idlib and south and south-west of Aleppo. The soil parent material is limestone or marl.

The appearance on the May Landsat imagery is dark brown and dark green and red with field boundaries.

The composition of the unit is : Typic Xerochrepts 60%; Lithic Xerochrepts 30% and Petrocalcic Xerochrepts 10%. The Typic Xerochrepts of this unit resemble those described in unit I11e. The associated Lithic Xerochrepts have similar profiles as the Typic Xerochrepts but bedrock occurs generally at less than a meter. The Petrocalcic Xerochrepts have substratums cemented with calcium carbonates.

This unit is used for cropland either irrigated or rainfed. Workability is hampered by the fine texture. Generally the mechanization potential is good and the relative productivity is fair to good. The capability subclass is 60% IIs; 30% IVe; and 10% VIs. The range site is silty.

I12b- Calcixerollic Xerochrepts-Typic Xerochrepts, undulating to strongly sloping. Deep to moderately deep, fine textured, well drained soils of plains.

These soils occur on the uplands in Area C. The soil parent material is undifferentiated Quaternary deposits including terraces.

The appearance of the I12b unit on May Landsat imagery consists of white, red and blue field patterns in triangles, squares and rectangles with no orientation.

The composition of the unit is : Calcixerollic Xerochrepts 40%; Typic Xerochrepts 30%; Vertic Xerochrepts 10%; Lithic Xerochrepts 10% and Lithic Xerorthents 10%.

Typically, the Calcixerollic Xerochrepts have yellowish red clay loam surface horizons 11 cm thick. This overlies a reddish-brown clay loam subsurface 11 cm thick. Below this is a strong brown calcareous clay 15 cm thick. This overlies a yellowish red clay loam 11 cm thick. The Typic and Lithic Xerochrepts are similar to those described in map unit I11e. The Vertic Xerochrepts are similar to those described in I11a. The Lithic Xerorthents resemble those described in unit E61e.

This unit is used for cropland. Workability is poor, mechanization potential is fair, and relative productivity is fair. The water erosion hazard is high. The capability subclass is 40% IIIe, 40% IVs, and 20% VIIe.

I12c- Calcixerollic Xerochrepts-Typic Camborthids, hilly, extremely stony.

This unit occurs in Area A north of Al Souweyda.

The soils are deep to moderately shallow, fine textured, and well drained. They are developed in basalt and basalt flows. Up to 40% of the surface consists of coarse fragments which along with steep slopes usually limits the use of the unit to grazing.

The appearance of the unit on May Landsat imagery is light gray with medium blue mottles.

The composition of the unit is: Calcixerollic Xerochrepts 40%; Typic Camborthids 20%; Typic Calciorthids 20%; Typic Xerochrepts 10% and Lithic Xerochrepts 10%.

The Calcixerollic Xerochrepts resemble those described for E61a. The Typic Camborthids and Typic Calciorthids are Aridisols with thin brown profiles. The Typic Xerochrepts and Lithic Xerochrepts resemble profiles described in unit E61a.

Workability of the soils in the unit is very poor to poor, mechanization potential is low, and relative productivity is low. The capability subclass, because of stoniness and hilly slopes, is VIs.

I12d- Calcixerollic Xerochrepts-Vertic Xerochrepts, level to gently undulating.

This unit occurs in area C where it occupies a broad basin southeast of El Quamishli.

The soils are deep, well to imperfectly drained, moderately fine to fine textured. There are some included areas that are saline. The parent material is alluvium and residuum from limestone and marl.

The appearance of the cultivated areas on May Landsat imagery is blue and red swatches corresponding to cultivated fields. The pasture areas are mottled light blue.

The composition of the unit is: Calcixerollic Xerochrepts 40%; Vertic Xerochrepts 30%; Typic Salorthids 10%; Typic Chromoxererts 10% and Entic Chromoxererts 10%.

Typically, the Calcixerollic Xerochrepts have a yellowish red sandy clay loam surface horizon 16 cm thick. This overlies a reddish brown calcareous clay subsurface 40 cm thick. Beneath this is a yellowish red calcareous clay subsoil 28 cm thick. The Vertic Xerochrepts resemble the Calcixerollic Xerochrepts but have finer textured surface horizons. A general description for Typic Salorthids is given in the description of unit A51a. Typic and Entic Chromoxererts are described in unit VIIa.

Workability of this unit is medium to very poor. The mechanization potential is medium to very low and the relative productivity is fair to very poor. The capability subclass of the Chromoxererts is IIIs, that of the Xerochrepts is IVc and of the Salorthid VIs.

I12e- Calcixerollic Xerochrepts-Typic Xerochrepts-Xerollic Calciorthids, rolling.

This unit occurs in Area B on uplands east of Hama and Homs. The parent material is Neogene and/or Paleogene limestone and marl.

The soils are deep to moderately deep, moderately fine textured, well drained and occur on uplands. There are coarse fragments on and in the soil profile and some stoniness.

The appearance of the cultivated areas on May Landsat is dark green mottled with white and light blue. Field patterns are apparent. The orchard areas are light olive brown with green and white mottles.

The composition of the unit is : Calcixerollic Xerochrepts 50%; Typic Xerochrepts 20%; Xerollic Calciorthids 20% and Lithic Xerochrepts 10%.

A general description of Calcixerollic Xerochrepts is given in I12d. Typic and Lithic Xerochrepts are described in unit I11e. Xerollic Calciorthids have lighter colored profiles than the other soils in the association.

Workability of the unit is poor and mechanization potential ranges from medium to very low. Relative productivity ranges from fair to poor. The capability subclass of the Calcixerollic Xerochrepts is IIIc, that of Typic Xeochrepts and Xerollic Calciorthids is IVs, while that of the Lithic Xerochrepts is VIIe.

I12f- Calcixerollic Xerochrepts-Typic Xerochrepts-Vertic Xerochrepts, undulating to rolling.

This unit occurs in Area C and is the most extensive unit in the area. Although some areas are used for pasture the dominant use is as cropland. The parent material is Neogene and/or Paleogene limestone and marl.

The soils are deep to moderately deep, moderately fine textured, and well drained.

The appearance of I12f on May Landsat imagery is red where crops are growing and green for fallow fields. Pasture areas generally are a mottled dark green and red.

The composition of the unit is: Calcixerollic Xerochrepts 50%; Typic Xerochrepts 15%; Petrocalcic Xerochrepts 10%; Vertic Xerochrepts 10%; Lithic Xerochrepts 5%; Lithic Xerorthents 5% and rock outcrop 5%.

General descriptions for these units are found as follows: Calcixerollic, Typic and Lithic Xerochrepts are described in unit I11e; Vertic Xerochrepts in unit I12d; Petrocalcic Xerochrepts and Lithic Xerorthents in unit E61e.

Workability is very poor and mechanization potential ranges from fair to very poor. Relative productivity ranges from fair to very poor. The capability subclass of the Calcixerolls is IIIc; the Typic and Vertic Xerochrepts is IVc; the Petrocalcic Xerochrepts is VIs and the Lithic Xerochrepts and Xerorthents is VIIe.

I13a- Lithic Xerochrepts - Lithic Xerorthents, strongly sloping, dissected.

This unit occurs in Area A southwest of Damascus. It is used for pasture but there are a few narrow irrigated stream bottomlands. The parent material consists of Quaternary materials.

The soils are moderately shallow, moderately fine textured and well to excessively drained. Erosion has been very severe. The soils are stony and there is some rockiness.

The appearance of the unit on May Landsat imagery is white with light brown to yellow marking the dissection.

The composition of the unit is: Lithic Xerochrepts 50%; Lithic Xerorthents 40%; and Petrocalcic Xerochrepts 10%. Lithic Xerochrepts are discribed generally in unit E61f, Lithic Xerorthents in E61c, and Petrocalcic Xerochrepts in E61e.

Workability is very poor to poor. Mechanization potential is fair on the Petrocalcic unit but very poor on the other components. The relative productivity is very poor. The Lithic Xerochrepts are in capability subclass IVs and the rest of the unit is in VIe.

I13c- Lithic Xerochrepts-Lithic Haploxerolls, rolling to strongly rolling.

This unit occurs in Area B in the Tripoli-Homs depression. There is some stoniness and rockiness. The parent material consists of Quaternary materials and basalt.

The soils are moderately shallow to moderately deep, moderately fine textured and well to excessively drained. Erosion has been moderate to severe.

The appearance of the unit on May Landsat imagery is as follows: where cultivated white, green and red patterns; where in pasture green and red mottled; where in orchards dark green dark red and white mottled.

The composition of the unit is: Lithic Xerochrepts 40%; Typic Xerochrepts 30%; Lithic Haploxerolls 10% and Lithic Xerorthents 10%.

General descriptions of the Lithic and Typic Xerochrepts and the Lithic Xerorthents is given in unit E61a. The Lithic Haploxeroll general description is given in unit E61h.

Workability is very poor and mechanization potential very low. Relative productivity is low. The Lithic Xerochrepts are in capability subclass IVs and the rest of the unit is in VIs.

I13d- Lithic Xerochrepts-Lithic Xerorthents-Petrocalcic Xerochrepts, rolling.

This unit occurs in Area A as a small delineation west of Damascus. The parent material is Neogene and/or Paleogene Limestone and marl.

The soils are moderately shallow to shallow, excessively drained and moderately fine textured. They are stony and rocky.

On May Landsat imagery the cultivated areas are dark brown mottled with white. The pasture areas are white with greenish brown mottles.

The composition of the unit is: Lithic Xerochrepts 40%; Lithic Xerorthents 20%; Petrocalcic Xerochrepts 20%; Typic Xerochrepts 10% and Calcixerollic Xerochrepts 10%.

The Lithic Xerochrepts are described generally in unit E61a; the Lithic Xerorthents in E61c; the Petrocalcic Xerochrepts and the Calcixerollic Xerochrepts in unit E61e and the Typic Xerochrepts in unit E61f.

Workability is poor to very poor. Mechanization potential is medium to very low and relative productivity is very poor. The capability subclass is VIIe for the Lithic Xerochrepts and Lithic Xerorthents; VIs for the Petrocalcic Xerochrepts; IIs for the Typic Xerochrepts and IIIc for the Calcixerollic Xerochrepts.

I13e- Lithic Xerochrepts-Typic Xerochrepts, gently undulating to rolling.

This unit occurs in Area B around Idlib. The parent material is Neogene and/or Paleogene limestone and marl.

The soils are moderately shallow, moderately fine textured and well drained. Coarse fragments are abundant on and in the soil and rockiness is common.

On May Landsat imagery the cultivated areas are white with blue green and brown mottling. The pasture areas are lavender with green, red and white mottling. The orchard areas are white with brown mottling.

The composition of the unit is: Lithic Xerochrepts 40%; Petrocalcic Xerochrepts 30%; Typic Xerochrepts 20% and rock outcrop 10%.

A general description of Lithic Xerochrepts is found in unit E61a. Petrocalcic Xerochrepts are described in E61e and Typic Xerochrepts are described in E61f. Rock outcrops consist of gray limestone with red weathering surfaces.

Workability is very poor and potential mechanization ranges from very low to medium. Relative productivity is poor. The Lithic Xerochrepts are in capability subclass IVe, The Petrocalcic Xerochrepts in VIs and the Typic Xerochrepts in IIs. The rock outcrop is in VIII.

I13f- Lithic Xerochrepts-Petrocalcic Xerochrepts, undulating to hilly.

This unit occurs in Area B around Aleppo. The parent material is Neogene and/or Paleogene limestone and marl.

The soils are moderately shallow and fine to moderately fine in texture. They are well to excessively drained. Coarse fragments are abundant on and in the soil and stoniness is common.

On May Landsat imagery the cultivated areas appear in field patterns that are white with dark green and brown mottling. The pasture areas appear dark brown mottled with white.

The composition of the unit is: Lithic Xerochrepts 40%; Petrocalcic Xerochrepts 30%; Typic Xerochrepts 10%; Calcixerothic Xerochrepts 10% and Vertic Xerochrepts 10%.

A general description of Lithic Xerochrepts is found in unit E61a. Petrocalcic and Calcixerollic Xerochrepts are described in E61e, and Typic Xerochrepts in E61f, Vertic Xerochrepts are described in unit I12d.

Workability is very poor and mechanization potential is very low to medium. Relative productivity is poor. The Lithic and Typic Xerochrepts are in capability subclass IVe, the Petrocalcic Xerochepts in VIs, the Calcixerollic Xerochrepts in IIIc and the Vertic Xerochrepts in IVc.

I13i- Lithic Xerochrepts-Typic Xerochrepts-Typic Xerorthents, hilly to mountainous.

This unit occurs in Area B in the mountains northeast of Lattakia. Where cultivated the unit is terraced. The parent material is variable ranging from limestone and marl to basalt.

The soils are moderately deep, moderately fine and excessively drained. Coarse fragments are abundant on and in the soil and stoniness and rockiness are common.

On May Landsat imagery the cultivated areas appear mostly white with some pink and blue. The pasture areas have a half red, half white mottled appearance. The bush areas appear mostly red with white mottling.

The composition of the unit is: Lithic Xerochrepts 40%; Typic Xerochrepts 20%; Typic Xerorthents 20%; Lithic Xerorthents 10% and Rock Outcrops 10%.

A general description of Lithic Xerochrepts is given in unit E61a. Typic Xerochrepts are described in E61f and Lithic Xerothents in E61c. Typic Xerorthents resemble the Lithic Xerothents but the bedrock contact is at 40 cm. The rock outcrop consists of limestone or basalt.

Workability and potential for mechanization both are very poor. Relative productivity is fair for the Typic Xerochrepts but very poor for the other units. The capability subclass is IIs for the Typic Xerochrepts and VIIe for the remainder of the unit.

I14b- Petrocalcic Xerochrepts-Lithic Xerochrepts, gently undulating to rolling.

This unit occurs in Area B on the plain south of Homs. The unit is under cultivation. The parent material is Neogene limestone.

The soils are moderately shallow, moderately fine textured and well drained. They have abundant coarse fragments on and in the soil and some rockiness.

On May Landsat imagery they appear olive green with field patterns.

The composition of the unit is: Petrocalcic Xerochrepts 60%; Lithic Xerochrepts 20%; Typic Xerochrepts 10% and Lithic Xerorthents 10%.

A general description of Petrocalcic and Lithic Xerochrepts and Lithic Xerorthents is found in unit E61e. Typic Xerochrepts are described in unit I11e.

Workability of the soils is poor to very poor and mechanization potential is medium to low. Relative productivity is poor. The capability subclass is VIs for the Petrocalcic Xerochrepts, IVe for the Lithic Xerochrepts and IVs for the remaining two components.

I15a- Vertic Xerochrepts-Typic Xerochrepts-Typic Chromoxererts, level

This unit occurs in Area B in the Tripoli-Homs depression. The unit is under cultivation. The parent material is undifferentiated Quaternary deposits including terraces, and basalt.

The soils are deep, fine textured and imperfectly to well drained.

On May Landsat imagery the unit appears dark brown to nearly black mottled with light green and red.

The composition of the unit is: Vertic Xerochrepts 50%, Typic Xerochrepts 20%; Typic Chromoxererts 20% and Typic Pelloxererts 10%.

A general description of Vertic and Typic Xerochrepts is given in unit I11a. Generally The Typic Chromoxererts have very dark grayish brown clay surface horizons 12 cm thick. Below this is a dark brown clay subsurface horizon 15 cm thick. This overlies a dark grayish brown substratum 73 cm thick. The Typic Pelloxererts resemble the Chromoxererts but have gray colors indicating restrictive drainage.

Workability of the soil is very poor but mechanization potential is fair. The relative productivity ranges from good for the Vertic Xerochrepts, (capability subclass IIs), through fair for the Typic Xerochrepts and Typic Chromoxererts (capability subclasses IIIc and IIIs respectively), to poor for the Typic Pelloxererts, (capability subclass VIs).

I15b- Vertic Xerochrepts-Typic Chromoxererts, gently undulating, stony.

This unit occurs in Area A along an alluvial area northwest of Deraa. The entire unit is irrigated. The source of the alluvium mostly is from the predominantly basalt uplands that surround the area.

The soils are deep, moderately fine to fine textured and well drained. Although stony, there are less than 5% of coarse fragments on the surface and in the profile.

On the May Landsat image the area appears dark grayish blue to nearly black with pink mottles. Field patterns are apparent.

The composition of the unit is: Vertic Xerochrepts 50%; Typic Chromoxererts 20%; Typic Xerochrepts 15%; Lithic Xerochrepts 10% and

basalt flows and hills 5%.

A general description of the Vertic and Typic Xerochrepts is given in unit 11a. The Typic Chromoxererts are described in unit I11a. The Lithic Xerochrepts are described in unit I11f. The basalt flows and hills are dark gray to black bedrock exposures.

Workability is very poor, mechanization potential is medium and relative productivity is low. The Vertic and Typic Xerochrepts are in capability subclass IVs and IVc respectively. The Typic Chromoxererts are in VIs and the Lithic Xerochrepts in IVs. The basalt flows and hills are in VIII.

I15c- Vertic Xerochrepts-Typic Xerochrepts, undulating , very stony.

This unit occurs in Area A along and near the Jordan border. The unit is used for irrigation, non irrigated cropland, pasture, and orchards. The units that are cropped are less stony and have less slope than other uses. The parent material of the unit is Neogene and/or Quaternary basalt and basalt flows.

The soils are deep, moderately fine to fine textured and well drained. They are very stony with 15-60% of the surface consisting of stone.

On May Landsat imagery the cultivated areas and orchards are very dark brown to black with blue and red mottling. The pasture areas are brown with lavender mottling.

The composition of the unit is: Vertic Xerochrepts 50%; Typic Xerochrepts 20%; Lithic Xerochrepts 10%; Typic Chromoxererts 10% and basalt flows and hills 10%.

A general description of Vertic and Typic Xerochrepts is given in the description of I11a. Lithic Xerochrepts are described in I11f and Typic Chromoxererts are described in I15a. The basalt flows are dark gray to black bedrock exposures.

Workability is very poor and mechanization potential is very low due to slope and stoniness characteristics. The relative productivity is poor. The capability subclass of the Vertic and Typic Xerochrepts and the Lithic Xerochrepts is IVs. The Typic Chromoxererts are in VIs and the basalt flows in VIII.

I15d- Vertic Xerochrepts-Calcixerollic Xerochrepts-Typic Chromoxererts, undulating. This unit occurs in Areas B and C.

The I15d unit is used for irrigation and nonirrigated cropland in Areas B and C. It is used for pasture in the Ain el Arab Area of B and for orchards in Area B. The parent material of this unit includes basalt, limestone and marl.

The soils are deep, fine textured and are well to imperfectly drained. There is some stoniness and rockiness.

On May Landsat imagery the irrigated areas are mostly red with gray, green and white mottling. The orchard areas are orange, light blue, dark brown and white. In Area C the cultivated areas are in more distinct field patterns and are blue, dark green and red. The pasture areas are gray, dark green and orange.

The composition of the unit is: Vertic Xerochrepts 50%; Calcixerollic Xerochrepts 20%; Typic Chromoxererts 20%; and Typic Xerochrepts 10%.

A general description of the Vertic Xerochrepts and Typic Xerochrepts is in unit I11a. The Calcixerollic Xerochrepts are described in unit I11d and the Typic Chromoxererts in unit I15a.

Workability is restricted because of fine textures. Mechanization potential is medium and relative productivity is fair. The Calcixerollic Xerochrepts are in capability subclass IIIs and the Vertic and Typic Xerochrepts are in capability subclass IVs.

M11a- Typic Haploxerolls-Pachic Haploxerolls-Typic Xerochrepts, level to depressional.

This unit is confined to Area B where it occurs in the Ghab valley. Some areas are irrigated and the rest is used for nonirrigated cultivated land. The parent material is undifferentiated Quaternary deposits including terraces.

The soils are deep, fine textured and well drained.

On May Landsat imagery the irrigated areas appear in red, blue and dark brown field patterns. The nonirrigated cultivated areas are dark brown with some red and blue.

The composition of the unit is: Typic Haploxerolls 40%; Typic Xerochrepts 30%, Pachic Haploxerolls 20% and Aquic Haploxerolls 10%.

The Typic Haploxerolls consist of black clay loam surface soils 15 cm thick. This overlies a grayish brown clay loam subsurface 30 cm thick. Under this is a grayish brown clay loam substratum of alluvium. The Typic Xerochrepts are described in unit I11a. Pachic Haploxerolls resemble Typic Haploxerolls but have thicker mollic epipedons. Aquic Haploxerolls resemble Typic Haploxerolls but have mottles indicating restrictive drainage.

Workability is restricted because of fine textures but mechanization potential and relative productivity both are fair to good. The capability subclass of the Typic Haploxerolls and Typic Xerochrepts is IIIe and IIIc respectively. The Pachic Haploxerolls and the Aquic Haploxerolls are in IVc.

M11b- Typic Haploxerolls-Aquic Xerochrepts-Typic Xerochrepts, level to gently undulating.

The soils in this unit occur in a small valley in the Tripoli-Homs depression in Area B and all are under cultivation. The parent material is

undifferentiated Quaternary deposits including terraces.

The soils are deep to moderately deep, fine textured and well drained. There are some coarse fragments on and in the soil profile and some stoniness. Some areas are poorly drained.

On May Landsat color composite imagery this unit appears very dark brown with bluish and pink mottles.

The composition of the unit is: Typic Haploxerolls 35%; Typic Xerochrepts 30%; Aquic Xerochrepts 20%; Typic Xerorthents 10% and Typic Chromoxererts 5%.

The Typic Haploxerolls are described in unit M11a. The Typic Xerochrepts are described in I11a. The Aquic Xerochrepts resemble Typic but have grayer colors and mottles. The Typic Xerorthents have thin light brown profiles over unconsolidated materials. The Typic Chromoxererts are described in unit I15a.

Workability of the soils is poor due to fine textures but mechanization potential is medium. Relative productivity is fair.

The Typic Haploxerolls and Typic Xerochrepts are in capability subclass IIIc. The Aquic Xerochrepts are in IVw, and the Typic Xerorthents are in VIIe. The Typic Chromoxererts are in capability subclass IIIs.

M11c- Typic Haploxerolls-Typic Xerochrepts-Vertic Xerochrepts, level to undulating.

This unit occurs in Area B in a tract just southeast of Lattakia. The parent material is undifferentiated Quaternary deposits.

The soils are deep to shallow, moderately fine textured and well drained. There are some coarse fragments on and in the soil and some stoniness.

On May Landsat color composite imagery the unit appears as a splotchy red, light blue and nearly black mosaic.

The composition of the unit is: Typic Haploxerolls 35%; Typic Xerochrepts 25%; Vertic Xerochrepts 10%; Lithic Xerochrepts 10%; Lithic Xerorthents 10%, Typic Xeropsamments 5% and rock outcrops 5%.

The Typic Haploxerolls are described in unit M11a, the Typic and Vertic Xerochrepts in I11a, the Lithic Xerochrepts in I11f and Lithic Xerorthents in E61e. The Xeropsamments are sandy beach deposits and the rock outcrops are hard Cretaceous limestone.

Workability of the unit is poor due to fine textures Mechanization potential mostly is medium and relative productivity is fair to good. The capability subclass of the Typic Haploxerolls is IIIc, that of the Typic Xerochrepts IIIe, the Vertic Xerochrepts IIs, the Lithic Xerochrepts IVe, the Lithic Xerorthents VIIs and the rock outcrops VIII.

M12a- Lithic Haploxerolls-Typic Xerochrepts, hilly to gently undulating, stony.

This unit occurs on the plain northwest of Homs in Area B. The principal use is pasture, but some areas have been partially cleared of stones and are cultivated. The parent material is Neogene and/or Quaternary basalt and basalt flows.

The soils are moderately shallow, moderately fine textured and well drained. Stones are abundant.

On May Landsat color composite imagery the pasture areas appear dark brown with light green mottling. The cultivated areas are dark brown with green pink and green mottling.

The composition of the unit is: Lithic Haploxerolls 50%; Typic Xerochrepts 20%, Lithic Xerochrepts 10%; Pachic Haploxerolls 10% and Lithic Haploxerolls 10%.

Typically, the Lithic Haploxerolls consist of a dark brown clay loam surface horizon, 6 cm thick, a dark brown sandy loam or clay loam subsurface 23 cm thick over basalt bedrock. Typic Xerochrepts are described in unit I11a, Lithic Xerochrepts in I11f and Pachic Haploxerolls in M11a. The Vertic Haploxerolls resemble Typic but are finer textured.

Workability is poor, mechanization potential is low to medium and relative productivity is low. The Lithic Haploxerolls are in capability subclass VIIe, the Typic and Lithic Xerochrepts in IVs, the Pachic Haploxerolls in IVc and the Vertic Haploxerolls in VIe.

M12b- Lithic Haploxerolls - Lithic-Vertic Xerochrepts, gently undulating to hilly, bouldery.

This unit occurs in Area B northwest of Homs and at the northern end of the Ghab Valley. The general use of this unit is for pasture because of the boulders. In places that are less bouldery, the soils are under cultivation. The parent material of the unit is Neogene and Quaternary basalt and basalt flows.

The soils are moderately deep to moderately shallow, moderately fine textured and well drained. Coarse fragments are abundant on and in the soil.

On May Landsat color composite imagery the unit appears medium brown with orange and dark brown mottles when in pasture and dark brown when cultivated.

The composition of the unit is: Lithic Haploxerolls 30%; Lithic-Vertic Xerochrepts 20%; Lithic Xerochrepts 20%; Typic Xerochrepts 20% and Lithic Xerorthents 10%.

A general description of Lithic Haploxerolls is given in Unit M12a. The Lithic-Vertic Haploxerolls have finer textures than the Lithic soils.

Lithic Xerochrepts are described in unit I11f and Typic Xerochrepts in unit I11a. Lithic Xerothents are described in unit E61e.

Workability is hampered by boulders and fine textures. Potential mechanization is very low and relative productivity is poor to very poor. The Lithic Haploxerolls and Lithic and Typic Xerochrepts are in capability subclass IVs. The Lithic Vertic Xerochrepts are in VIe, and the Lithic Xerothents are in VIs.

V11a- Typic Chromoxererts-Entic Chromoxererts, gently undulating to rolling.

This unit occurs in Area C in the extreme northeast corner of Syria. The unit is all under cultivation. The parent material is basalt.

The soils are deep, fine textured and well drained.

On May Landsat imagery the unit is a mosaic of red and navy blue squares, rectangles and triangles corresponding to field boundaries. The red areas are in crops; the blue areas are in fallow.

The composition of the unit is: Typic Chromoxererts 70% and Entic Chromoxererts 30%.

The Typic Chromoxererts have a brown clay surface horizon 20 cm thick. Below this is a brown clay subsoil 30 cm thick. This is overlain by a reddish brown clay subsoil 36 cm thick. Below this is a light reddish brown clay 12 cm thick which grades into bedrock. Entic Chromoxererts resemble Typic Chromoxererts but are shallower.

Workability of the unit is restricted by fine textures. The mechanization potential is medium and the relative productivity is fair. The capability subclass of both units is IIIs.

V11b- Typic Chromoxererts-Vertic Xerochrepts, nearly level to gently undulating.

This unit occurs in Area B in the plains north of Aleppo. Some areas are irrigated, some are in cropland and some in orchards.

The soils are deep, fine textured and imperfectly drained. There are a few coarse fragments on and in the soil.

On May Landsat color composite imagery the irrigated areas are a mosaic of and very dark blue field patterns. The cultivated areas are dominated by very dark blue colors with a few red fields. The orchard areas are light rust hues with darker rust lines.

The composition of the unit is: Typic Chromoxererts 40%; Vertic Xerochrepts 30%; Typic Xerochrepts 20%; and Lithic Xerochrepts 10%.

A general description of Typic Chromoxererts is given in unit V11a. Vertic Xerochrepts are described in M11c, Typic Xerochrepts in I11a and Lithic Xerochrepts in I11f.

Workability is poor due to fine textures but mechanization potential is medium. Relative productivity is fair to good. The Typic Chromoxererts are in capability subgroup IIIs, the Vertic and Typic Xerochrepts in IIs and the Lithic Xerochrepts in VIe.

MISCELLANEOUS LAND TYPES:

X11a- Basalt flows and rock outcrops of lava plateaus and plains.

This unit occurs in Area A northwest of Souweyda and provides limited grazing. It appears on May Landsat imagery as purplish gray with brown mottles.

X11b- Rock outcrops and rubble lands of lava plateaus and plains.

This unit occurs in Area A east of Golan. It is used for limited grazing. The areas appear dark bluish brown with pink and lavender mottling on May color composite Landsat Imagery.

X11c- Basalt flows and rubble lands of plateaus and plains.

This unit occurs in Area A east of the Souweyda highlands and provides limited grazing. It appears on May Landsat color composite imagery as dark gray mottled faintly with blue and white.

X11d- Highly eroded side slopes and rubble lands of lava plateaus.

This unit occurs in Area A east of the Souweyda highlands and provides limited grazing. It appears as light gray mottled with blue on May color composite Landsat imagery.

X12a- Rock outcrop.

This unit is used mainly for limited grazing, or limited orchard use. Some areas are barren.

This unit occurs in Area B. Three main areas occur: west and south of Aleppo (mostly Neogene materials) south of Idlib (mostly Paleogene materials) and west of Hama (mostly Cretaceous materials). On May color composite Landsat imagery the unit is lavender with dark brown.

Table 3-3, found with the other tables in the back of this report, gives a brief description, the major use and the location of the soil mapping units.

6 USE AND MANAGEMENT OF THE SOILS

The soil survey is an inventory and evaluation of the most basic resource of Syria-the soil. Within the limits of the 1:100,000 map scale it is useful : adjusting land use to the limitations and potentials of natural resources and environment. Also, it can help avoid soil-related failures in uses of the land.

Both field experience and measured data on soil properties are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops, pasture and woodland, as sites for buildings and highways, sanitary facilities and parks and other recreational facilities. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified and failures caused by unfavorable soil properties can be avoided. A site where soil properties are favorable can be selected or practices that will overcome the soil limitations can be planned.

Planners and other users of the soil survey can evaluate the impact of specific land uses on the overall productivity of the First Settlement Zone. Productivity and environment are closely related to the nature of the soil. Plans should maintain or create a land use pattern in harmony with the natural soil.

6.1 CROPS AND PASTURE

The major management concerns in the use of soils for crops and pasture are described in this section. In addition, the system of land capability classification is explained and the general productivity of the soils for the main crops and pasture is given for each soil map unit.

As described earlier, the basic legend for this survey is the same as that used for the 1:500,000 scale survey.

An advantage of using Landsat is that the image tells a great deal about use of the land. Colors and patterns visible on the image combined with knowledge of crop calendars are the main indicators used. By combining the soil data with the land use data, the map units can be more precisely defined and the accuracy of the information about the soil potentials and limitations improved.

Soil erosion by water and to a lesser extent by wind are serious problems in the First Settlement Zone. This is especially true where mountain slopes are cultivated. Loss of soil by erosion reduces productivity and results in sedimentation in streams and lakes. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with thin surface horizons like the thin soils on the mountains and steeper slopes which are called Entisols in this report.

Controlling erosion minimizes pollution of streams and lakes by sediment and improves water quality for recreation and municipal use.

A cropping system that keeps vegetative cover on the soil for extended periods holds soil erosion losses to amounts that will not reduce the productive capacity of the soil. During periods when vegetation does not protect the soil, careful management of crop residues is essential.

Where slopes are short and irregular, such as the I13 map units, contouring or terracing is not practical. In these areas cropping systems that provide substantial vegetative cover are needed to control erosion.

Minimizing tillage and leaving crop residue on the surface increase the infiltration rate and reduce the risks of runoff and erosion. Together with grassed waterways these practices can be adapted to most soils of the First Settlement Zone.

Contour farming, contour strip cropping, terraces and diversions reduce the risk of runoff and erosion.

Soil blowing is less of a hazard in the First Settlement Zone than water erosion. Soil blowing is keyed somewhat to soil texture with sandy textures most susceptible. However, clays if aggregated also will blow. Most of the soils in the First Settlement Zone, have clay texture and may present wind erosion problems.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous. Clayey soils often have poor tilth. If cultivated when wet, they become cloddy and preparing good seed beds is difficult. Timely tillage, grasses and legumes in the cropping system, and crop residue management improve tilth. Tilth is the factor assessed in the "workability" factor in the tables.

A variety of crops are adapted to soils of the First Settlement Zone. In Area A in the Zabadani region some valley bottoms are wide enough to farm. On the spring imagery, the dark areas are cultivated and the red areas are orchards. In winter, local wheat and barley dominate but chickpeas are important. In summer, local wheat and broad beans are the main irrigated crops. Orchards dominate the area southwest of Damascus and often they are irrigated. Apples, peaches, apricots and plums dominate.

The Quneitra area was not available for ground checks but the imagery indicates that the leading winter crops are local wheat and chickpeas. Sesame and barley are minor crops and grapes, olives and figs are the major perennials.

In the Souweyda Salkhad area, grapes appear to dominate but apples and olives are important.

In Area B, in the Tartous area, the coastal plain is narrow and olive orchards dominate. South of Tartous to the Lebanese border local and Mexican wheat are the main winter crops. Tobacco, millet and tomatoes are the principal summer crops. Irrigated crops are peanuts, cucumbers and tomatoes. Olive trees are the main crop in the mountains. From Tartous to Banias, the coastal plain widens and these terraces are used for cultivated crops. In the Lattakia area, the main nonirrigated winter crops are local and Mexican wheat and barley. In the summer, tobacco is dominant particularly in the cultivated terraces in the mountains. On the coastal plain tomatoes and sesame are grown. The irrigated summer crops are tomatoes, peanuts and squash. Most of the perennials are olives and apples and some oranges.

In the Massiaf region of Area B, the winter crops are nonirrigated wheat, barley, lentils, chickpeas and beans. The nonirrigated summer crops are corn, beans and millet. The irrigated summer crops include tomatoes, potatoes and corn. Orchards include grapes, figs, olives and a few irrigated apricots and pomegranates.

In the al Ghab region of Area B, the leading winter nonirrigated crop is Mexican wheat. In the summer crops include local wheat, sugar beets and watermelon. Summer irrigated crops are cotton, corn and sunflowers. Most perennials are not irrigated and include grapes, figs, olives and pomegranates.

In the Idlib region of Area B, nonirrigated winter crops are local wheat, barley, lentils, Mexican wheat and chickpeas.

In the Afrin region of Area B, the west slope of the north-south oriented valley is in olive orchards with some cultivated crops. The east slope of the valley is cultivated and the bottomland is irrigated. Here and in the Azaz area and south to Aleppo, the leading crops are local and Mexican wheat and lentils. Summer crops include tomatoes, melons, sesame and cotton.

In the Homs-Hama region of Area B, local wheat and barley are the main nonirrigated winter crops. In the summer, watermelon is important. The winter irrigated crops include local and Mexican wheat. The summer irrigated crops include cotton, sugar beets, tomatoes, potatoes and some grapes.

In the Ain al Arab region of Area B, the main irrigated winter crop is Mexican wheat. The principal irrigated summer crop is cotton. Other summer crops are tomatoes, corn and sesame.

In Area C, which is mostly cultivated, all rotations include fallow. This is apparent from the Landsat imagery where bare soil reflects blue or green. The nonirrigated cropland includes local wheat and barley with smaller percentages of lentils and chickpeas. The winter irrigated crop is dominated by Mexican wheat with some local wheat and lentils. The main irrigated summer crop is cotton.

6.2 CROP PRODUCTIVITY

Productivity tables are given in the table section of this report for the soils of the First Settlement Zone. Actual yields per acre are not given. Rather the soils that are cultivated are placed into 5 classes which reflect their ability to produce crops. Before preparing the productivity tables, the soils were arrayed into the 5 classes in tables according to slope and soil depth.

The report that accompanies the 1:500,000 scale soil map of Syria, authored by Haluk Yuksel, includes detailed descriptions of the soil map units of Syria, including the ones used for this report (9). The percent composition of each map unit is given and each component separately is described according to its characteristics and qualities. The reader should refer to this report for a complete characterization and interpretation of the soils.

In the present report, use has been made of Yuksel's descriptions and data. In the tables that characterize the soil map units in this report, the components have been averaged to present a composite.

The productivity classes in Table 3-7 are based on soil characteristics as summarized in Table 3-3 and interpreted in Table 3-5. It is assumed that the soils are well managed. Such management provides drainage, erosion control and protection from flooding. It also includes proper planting and seeding rates, suitable high yielding varieties, appropriate tillage practices including time of tillage and seedbed preparation and tilling when soil moisture is favorable. It includes control of weeds, plant diseases and harmful insects, optimum levels of nitrogen, phosphorus, potassium and trace elements, the effective use of crop residues and timeliness of all fieldwork. The limitations and potentials of the soils are given in Table 3-5. The

class limits for soil properties are given in Table 3-4 and class limits for soil potentials are given in Table 3-6.

6.3 CAPABILITY CLASSES AND SUBCLASSES

Capability classes and subclasses show in a general way the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used and the way they respond to treatment. The grouping does not take into account major land forming that would change slope such as the terracing done in the mountain regions of Syria. Neither does it take into account major reclamation projects and it does not apply to horticultural crops or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, forest or engineering purposes.

In this report, all of the soil mapping units have been grouped at two levels: capability class and subclass. These levels are defined below.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable or cultivation.

Class VIII soils and land forms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, e, w, s or c to the class numeral, for example IIIe. The letter e shows that the main limitation is risk of erosion. The letter w shows that water in or on the soil interferes with plant growth. The letter s shows that the soil is limited mainly because it is shallow, droughty, saline or stony. The letter c is used to show the chief limitation is climate that is too dry or cold.

In class I there are no subclasses since the soils have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in class V are subject to little or no erosion.

Precipitation was used in placing the soils in the capability classification. Areas where the soil itself had no limitation to plant growth, the amount of precipitation affected the capability classification as follows:

Less than 150 mm - class VII
150 - 250 mm - class VI
250 - 350 mm - class IV
350 - 600 mm - class III
600 - 800 mm - class II
More than 800 mm - class I

Thus in the First Settlement Zone in the area receiving 350-600 mm, the best soil could not be rated better than class III.

The capability class and subclass of the mapping units is given in Table 3-3.

6.4 PASTURE

The native vegetation in many parts of the First Settlement Zone has been depleted by excessive use and the amount of forage produced is much less than that originally produced. Productivity of pastures can be increased by management that is effective on specific kinds of soils.

Where climate and topography are about the same differences in the kind and amount of vegetation that pastures can produce are closely related to the kind of soil.

Table 3-7 shows classes of pasture productivity for soil map units in pasture.

The productivity rating refers to the amount of vegetation that can be expected to grow annually on well managed but not improved pastures.

Productivity ratings of soils for orchards, for forest, and for brush rangeland are given for the soil map units in Table 3-7.

6.5 SOIL PROPERTIES AND SOIL POTENTIALS

Soil properties are characteristics of the soil mapping unit that can be measured. Included are the soil slope, depth, texture, drainage, stoniness, coarse fragments and present erosion. From these properties, the capability subclass is determined. Table 3-3 lists selected characteristics for the soils of the First Settlement Zone. The class limits for soil properties are explained in Table 3-4.

Soil potential is indicated by land suitability orders and classes and is based on soil properties including the climate. Economic evaluations are not considered in

determining the soil potential. The potentials for rainfed and irrigated agriculture of the soils of the First Settlement Zone are given in Table 3-5. Also given are the soil limitations that help explain the potentials classification. In addition ratings of the soil map units for workability, seeding establishment, potential mechanization and erosion hazard are presented in Table 3-5.

The data and interpretations given in Tables 3-3 and 3-5 are for an average of the components that make up the soil mapping units. For information on the composition of each mapping unit refer to the section where the mapping units are described.

Soil potential ratings are adapted from the land suitability classification of the Food and Agriculture Organization of the United Nations. Table 3-6 gives the class limits for soil potentials.

Soil potential is presented in two categories - order and class. There are two land suitability orders. The letter "S" signifies suitable land and "N" unsuitable land. Suitable land is land on which sustained use in the defined manner is expected to yield benefits that will justify the recurrent and minor capital inputs. Unsuitable land is land having characteristics which preclude its sustained use in the defined manner because of an unacceptable level of recurrent or development inputs required.

Land suitability classes are subdivisions of land suitability orders. Four classes are recognized in the suitability order and two classes in the unsuitability order. Soils with similar productive capacity are grouped in each class. The four suitability classes are: S1 Highly suitable, S2 Moderately suitable; S3 Marginally suitable; and Sc Conditionally suitable. The S1 class was divided into S1a (high productivity) and S1b (good productivity). The productivity of S2 soils is fair or medium, S3 soils is low and Sc soils is very low.

Class N1 land is defined as currently unsuitable and N2 land as permanently unsuitable.

Highly suitable land (S1) is defined as land that is expected to be highly productive for the defined use and yield high benefits amply justifying the required recurrent and minor capital inputs. There are no significant limitations not presently treated that will reduce crop yields or increase recurrent costs for production or conservation. The textures on all soils with S ratings are medium to fine. The S1a land includes soils that are deep, on nearly level slopes and that have a very high productivity rating. The S1b land includes soils that are deep to moderately deep and occur on gently undulating to undulating topography. The S2 rating is for soils that are moderately deep to moderately shallow and that occur on strongly undulating to rolling topography. The S3 rating includes soils that are moderately shallow, stony or bouldery and are on strongly rolling to hilly topography. The Sc rating is for shallow soils on mountainous topography. Ordinarily, the soils in this group would be placed in N1, the currently unsuitable group. However, these soils have been terraced which neutralizes the slope factor. Moreover, even though stony and thin they are being cultivated and/or are in orchards and apparently they have been for centuries. Although productivity is very low it is enough to sustain subsistence farming.

The only unsuitable land class used is N2 - permanently unsuitable land. The only map units in this category are rock outcrops, rubble lands, lava flows and beach sand.

The major limitations distinguish among the soil map units the nature of the management requirements. Lower case letters with mnemonic significance are used following the class symbol. Land may have more than one limitation in which case a sequence of letters is used, the most severe shown first. The following limitations are used: a - alkalinity, high sodium percentage; c - climate, climate too dry or cold; d - depth and stoniness, limitation due to shallow depth or stoniness or both, restricting root development; e - erosion, either past erosion damage or erosion hazard; f - fertility, low content of plant nutrients; g - surface gravel or stones, limitation is due to coarse fragments hampering tillage and seeding establishment i - inundation, flooding of land by river water; m - moisture deficiencies, droughtiness due to soil conditions; p - physical soil deficiencies, limitation due to adverse physical soil properties (other than mentioned under v); s - salinity, limitation caused by high salt content that restricts vegetative growth; t - unfavorable topography or relief, macro or micro; v - vertisolic, limitation due to a high content of swelling clay; and w - wetness, waterlogging caused by high water table, slow permeability, slow surface drainage or a combination of these.

6.6 RELATIVE PRODUCTIVITY

This rating was developed to give a measure of the ability of the soil to respond to good management such as improved cultural practices and fertilizer, and to provide sustained moderate yields of adapted cultivated crops. Five productivity ratings were developed: high, good, fair, poor and very poor.

The high rating is used for deep, medium to fine textured soils on nearly level slopes. The soils have physical and chemical properties favorable for high production of common cultivated crops under good management. Subhumid climate and fine texture and possibly restricted drainage and slight salinity are factors that may be slightly limiting. This class corresponds to the S1a land suitability class.

The good rating includes deep to moderately deep soils on gently undulating to undulating topography. Soil depth and soil slope along with subhumid climate and fine textures are slightly limiting. This class corresponds to S1b land suitability class.

The fair rating includes moderately deep to moderately shallow soils on strongly undulating to rolling topography. Soil depth and soil slope are moderately limiting and subhumid climate and fine texture may be slightly limiting. This class corresponds to the S2 land suitability class.

The poor rating is for moderately shallow soils on strongly rolling to hilly topography. Stones and boulders are common. Moderately shallow profiles and hilly topography along with stoniness are limiting factors. This class corresponds to the S3 land suitability class.

The very poor rating is for shallow soils on mountainous topography. Stoniness and rock outcrops are common. Shallow stony profiles and excessively steep topography are serious limitations. This class corresponds to the Sc land suitability class.

Table 3-7 lists the productivity ratings for the soil mapping units.

6.7 ENGINEERING

This section provides information about the use of soils for building sites, sanitary facilities, construction material and water management. Among those who can benefit from this information are engineers, landowners, land developers, builders and farmers.

The ratings in the engineering tables are based on estimated data in the Soil Properties Section. Among the soil properties used were grain size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, soil wetness, depth of seasonally high water table, slope, natural soil structure and geologic origin of the soil material.

On the basis of information about soil properties, ranges of values can be estimated for permeability, shrink-swell potential and available water capacity.

These factors of soil behavior affect construction and maintenance of roads, pipelines, airport runways, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems and other engineering works.

Data presented in this section are useful for land use planning. Limitations to the use of these data, however, should be well understood. First, the data generally are not presented for depths below about one meter. Also, because of the 1:100,000 scale areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by engineers having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 3-8 is a listing of engineering properties and classifications. The main sources of these data are the hundreds of borings made in the course of the survey and laboratory analysis of selected soil samples from typical soil profiles.

In making soil borings during field mapping, soil scientists identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture or amount of sand, silt and clay, and gravel and other coarse fragments; the structure or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place. They record the depth of plant roots, determine the pH or reaction of the soil and identify the free carbonates.

Samples of the soil material are analyzed in the laboratory to verify the field estimates of soil properties. Most engineering test classifications are estimates based on soil profile descriptions, chemical soil tests and particle size analysis.

In Table 3-8, texture is defined in the standard terms used by the US Department of Agriculture. These terms are defined according to the percentages of sand, silt and clay in soil material that is less than 2 mm in diameter.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (2) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (1).

In the Unified system soils are classified according to properties that affect their use as construction materials. Soils are classified according to grain size distribution of the fraction less than 7 mm in diameter, plasticity index, liquid limit and organic matter content. Soils are grouped into 15 classes - eight of coarse grained soils identified as GW, GP, GM, GC, SW, SP, SM and SC; six of fine grained soils identified as ML, CL, OL, MH, CH and OH, and one class of organic soils identified as Pt. Soils on the borderline have a dual classification, for example CL-ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A1 through A7 on the basis of grain-size distribution, liquid limit and plasticity index. Soils in group A1 are coarse grained and low in content of fines. At the other extreme, in group A7 are fine grained soils. Highly organic soils are classified in group A8.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil. These indices are used in both the Unified and AASHTO soil classification systems.

6.7.1 BUILDING SITE DEVELOPMENT

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings and local roads and streets are indicated in Table 3-9. A slight limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A moderate limitation indicates that the soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A severe limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design or intensive maintenance are required. Most dwellings built in the mountains are constructed by overcoming severe topography limitations.

Shallow excavations are made for pipelines, sewerlines, communication and power transmission lines, basements, open ditches and cemeteries. Such digging is influenced by soil wetness, texture and consistence of the soil, the tendancy to cave in and the presence of dense soil layers, bedrock or large stones. Ratings do not apply to materials below about one meter.

Dwellings and small commercial buildings generally are built on undisturbed soil. For these buildings the soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. The ratings were obtained from estimates of the compressibility and shrink-swell potential of the soil. Soil texture, plasticity, wetness and depth to a seasonally high water table were also considered. Depth to bedrock, slope and large stones also are important considerations.

Local roads and streets referred to in Table 3-10 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying material; a base of gravel, crushed rock or soil material stabilized with lime or cement and a flexible or rigid surface. The load supporting capacity and the stability of the soil are important in the design and construction of roads and streets. The classification of the soil and the texture, density and shrink-swell potential are important considerations. Soil wetness, flooding, slope, depth to hard rock and percent of stones affect stability and ease of excavation.

6.7.2 SANITARY FACILITIES

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Table 3-10 shows the degree and kind of limitations of each soil mapping unit and for use of the soil as daily cover for landfills.

If the degree of soil limitation given is slight, soils are generally favorable for the specified use and limitations are minor and easily overcome; if moderate, soil properties or site features are unfavorable for the specified use but limitations can be overcome by special planning and design; and if severe soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special design or intensive maintenance is required. Soil suitability is rated by the terms good, fair or poor, which, respectively, mean about the same as the terms slight, moderate and severe.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between the depths of 47-180 cm are evaluated for this use. The soil properties considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth of seasonal high water table, depth to bedrock and susceptibility to flooding. Stones and bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 62 to 160 cm. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that have a high content of organic matter and those with cobbles, stones or boulders are not suitable. Seasonal high water tables are a limitation. Slope, depth to bedrock and susceptibility to flooding also affect the suitability sites.

Sanitary landfill is a method of disposing of solid wastes by placing refuse in successive layers either in excavated trenches or on the surface. The waste is spread, compacted and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. The best soils for this purpose have

loamy or silty (medium) textures, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey or fine textured soils are likely to be sticky and difficult to spread. Sandy or gravelly soils (coarse textures) generally have rapid permeability which might allow harmful liquids to contaminate the ground water. Soil wetness can be a limiting factor because operating heavy equipment on a wet soil is difficult.

Ease of excavation affects the suitability of a soil for the trench type landfill. A suitable soil is deep to bedrock and free of large stones and boulders.

The limitations in Table 3-10 apply to soil material within a depth of 1 1/2 meters. Site investigations are needed before the final selection of a landfill site is made.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet or dry weather. Soils that are medium textured and free of stones are better than other soils. Clayey soils may be sticky and difficult to spread and sandy soils may be subject to soil blowing.

The soils used for final cover of landfills should be suitable for growing plants. The A horizon generally is best for this purpose.

6.7.3 WATER MANAGEMENT

Many soil properties and site features affect water management practices. In Table 3-11, the soil and site features that affect use are indicated for the soil map units. This information is significant in planning, installing and maintaining water control structures.

The suitability is indicated by ratings of favorable or unfavorable. Numbers are used to indicate the rating:1 = favorable and 2 = unfavorable.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Drainage of soil is affected by such soil properties as permeability, texture, depth to bedrock, or other layer that affects the rate of water movement. Other properties of importance include depth to the water table, slope, stability of ditchbanks, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility of flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface, available water capacity, need for drainage and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across the slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope, depth to bedrock, large stones, permeability, ease of establishing vegetation, and resistance to water erosion, soil

blowing and soil slipping.

Grassed waterways are constructed to channel runoff to outlets at nonerosive velocity . Features that affect the use of soils for waterways are slope, permeability, erodability, wetness and suitability for permanent vegetation.

6.8 PHYSICAL AND CHEMICAL PROPERTIES

Table 3-12 shows estimated values for several characteristics and features that affect soil behavior in engineering uses. The estimates are given for soil profiles except that the wind erodability group represents only the surface layer. The components of each mapping unit were averaged to give the estimates shown in the table. Table 3-13 gives the limits of the classes set up for each property.

Permeability is estimated on the basis of known relationships among soil characteristics observed in the field, particularly soil structure and porosity. The estimates are for vertical water movement when the soil is saturated. Permeability of the soil is an important factor to consider in planning and designing drainage systems, in evaluating the potential for septic tank systems and other waste disposal systems and other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed in pH values. Soil reaction is important in selecting the crops, ornamental plants or other crops to be grown, in evaluating the fertility level of soils and in evaluating the corrosivity of soils.

Erosion factors are used to predict the erodability of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodability factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodable. K values range from about 0.15 to about 0.40. To estimate the annual soil loss per acre, the K value is modified by factors representing plant cover, grade and length of slope, management practices and climate. The soil loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing the crop production or environmental quality. The rate is expressed in kilograms of soil loss per hectare per year.

Wind erodability groups are made up of soils that have similar properties that affect their resistance to blowing, if cultivated. The groups are used to predict the susceptibility of soils to blowing and the amount of soil loss as a result of blowing.

Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands and very fine sands. These soils are extremely erodable so vegetation is difficult to establish. They generally are not suited for crops.

2. Loamy sands, loamy fine sands and loamy very fine sands. These soils are very highly erodable but crops can be grown if intensive measures are taken to control soil blowing.

3. Sandy loams, coarse sandy loams, fine sandy loams and very fine sandy loams. These soils are highly erodable but crops can be grown if intensive measures are taken to control soil blowing.

4. Calcareous loamy soils that are less than 35% clay and more than 5% finely divided calcium carbonate. These soils are erodable but crops can be grown if intensive measures are taken to control soil blowing.

5. Clays, silty clays, clay loams and silty clay loams that are more than 35% clay. These soils are moderately erodable but crops can be grown if measures are taken to control soil blowing.

6. Loamy soils that are less than 18% clay and less than 5% finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5% finely divided calcium carbonate. These soils are erodable but crops can be grown if measures to control blowing are used.

7. Loamy soils that are 18 - 35% clay and less than 5% finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodable and crops can easily be grown.

8. Silty clay loams that are less than 35% clay and less than 5% finely divided calcium carbonate. These soils are very slightly erodable and crops can easily be grown.

9. Stony or gravelly soils and other soils not subject to soil blowing.

7 FORMATION OF SOILS

In this section five factors of soil formation are related to the soils of the First Settlement Zone. These factors determine the characteristics of the soil at any given point. They are 1) the physical and mineralogical composition of the parent material, 2) the climate under which the soil has accumulated and existed since accumulation, 3) the plant and animal life on and in the soil, 4) the topography or relief, and 5) the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of plant and animal life are conditioned by relief. Runoff of precipitation is high when slopes are steep so that less water enters the soil to cause weathering and support vegetation. The resulting soils are shallow. If topography is nearly level, runoff is less, more water enters the soil, weathering is more intense, vegetation is more vigorous and the resulting soil is deep.

The parent material also affects the kind of soil profile that forms and, in extreme cases, such as loose sand or very hard rock, determines it almost entirely. Finally, time is always required for the differentiation of soil horizons. Horizons can form fairly rapidly in alluvial material or volcanic ash. Usually, however, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

7.1 PARENT MATERIAL

Parent material is the mass of unconsolidated and consolidated material in which soils form. The two properties of soils that are tied most closely to parent material are texture and mineralogy. In the First Settlement Zone limestones and marl are important soil parent materials. Some limestones are extremely resistant and these areas essentially are rock outcrops. Such an area occurs west of Aleppo. Other limestones and marl weather more readily. These more easily weathered materials have inclusions of silicate minerals and iron. The resulting soils are deep to moderately shallow, fine textured, have expanding lattice clays and red colors. They are classified as Inceptisols and Vertisols, primarily. Basalt is an important parent material in all areas of the First Settlement Zone. Many basaltic areas are stony, others are essentially unweathered bedrock and some have weathered into deep, dark colored vertic soils. Basalt contains silicate minerals and a high content of iron so that resulting soils are dark colored and contain expanding lattice clays.

Alluvium is water-deposited material along streams that is variable in mineralogical composition and texture, depending upon the rock and soil materials in the watershed. In the First Settlement Zone, however most alluvium is fine to moderately fine textured, high in expanding clay materials and exchangeable cations.

7.2 CLIMATE

Climate is one of the most important factors of soil formation. It influences the rate of chemical and physical weathering. The First Settlement Zone has a Mediterranean climate. The taxonomic term used to describe the moisture regime of Mediterranean climates is Xeric. In this moisture regime winters are moist and cool and summers are warm and dry. The moisture, coming in winter when potential evapotranspiration is at a minimum, is particularly effective for leaching. Thus the soils formed in this environment are relatively highly weathered considering the total annual precipitation. The annual precipitation throughout the First Settlement Zone is 350 mm or more but along the Mediterranean coast and in the mountains precipitation is much heavier. The soils in these areas on gentle slopes, then, are more deeply developed than those east of the mountains.

7.3 PLANT AND ANIMAL LIFE

Living organisms play an important part in soil formation. These include plants, animals, insects, earthworms, bacteria and fungi. In the First Settlement Zone, the soils in the mountains have developed under trees and brush and some grass. In the

Ghab depression and on the uplands east of this area where the climate is subhumid grass was the dominant vegetation except on rock outcrops which are barren. The organic matter produced by grass accumulates at the surface which is evident in the dark surface layers of the Mollisols and some Inceptisols. Iron has remained in an oxidized state in most of the upland soils which tends to mask the dark colors of some soils with red hues. Microorganisms help decompose plant residues thus releasing nutrients for plant food. Earthworms, burrowing insects, moles and other animals that live in the soil mix the soil material.

7.4 RELIEF AND TOPOGRAPHY

Relief influences soil formation through its effect on drainage, runoff, erosion, plant cover and soil temperature. On the Entisols in the mountains, for example, much of the rainfall is lost through runoff. Where these soils are terraced the rainfall loss is reduced. As a result of runoff, less water is taken in the soil and more soil is lost through erosion These soils have very thin layers in which organic matter accumulates and if the parent material is calcareous, the soils are calcareous at the surface. Often these soils are stony and stoniness increases proportionally as finer clay, silt and sand particles erode.

More moisture enters the gently undulating Inceptisols and Mollisols so that horizons in which organic matter accumulates are thicker and calcium carbonate occurs deeper in the profile.

In swales and depressions, such as the Ghab depression, extra moisture is received by runoff from adjacent soils. The horizons where organic matter accumulates are thicker. If drainage is impeded soils may be wet during rainy periods. Sometimes salts accumulate under poor drainage and saline soils form. Irrigation without adequate drainage also will cause salinity which retards plant growth.

7.5 TIME

The length of time that soil material is exposed to the other four factors of soil formation is reflected in the First Settlement Zone. No highly weathered soils occur in Syria. Ultisols and Oxisols, both of which are highly weathered form under hot moist conditions where weathering is intense. Of the soils present, the Inceptisols and Mollisols have undergone some weathering while the Fluvents are young soils on active flood plains. The Orthents are kept youthful by erosion and the Aridisols by a dry environment. The Vertisols are fine textured so little water percolates through the profiles to cause leaching.

8 DISCUSSION OF TAXONOMIC UNITS

In a preceding part of this report, brief descriptions of the soil mapping units were provided. These descriptions are composed of combinations of taxonomic units. Taxonomic units are defined in a soil classification system. The system used here is called the Comprehensive system which is the standard system used in the United States. In this section of the report, the taxonomic units used in the Soil Survey of the First Settlement Zone are discussed.

The objective of a soil taxonomy is to have hierarchies of classes that permit the understanding of the relationships between soils and the factors responsible for their character.

There are six hierarchies or categories in the Comprehensive soil taxonomic system. In order of decreasing rank the categories are order, suborder, great group, subgroup, family and series. For detailed soil surveys the mapping units are series. For the 1:100,000 soil survey, the mapping units are subgroups.

The taxonomy has 10 soil orders. Six are represented in the 1:100,000 Scale Soil Survey of Syria: Alfisols, Aridisols, Entisols, Inceptisols, Mollisols and Vertisols. The unique properties of Alfisols are a combination of an ochric or umbric epepedon, an argillic horizon, a medium to high supply of bases and an adequate amount of available water. These are minor soils in the survey area, where they occur in the mountains.

Aridisols are soils that lack available water for mesophytic plants for extended periods. They are light-colored, generally shallow and lack the deep wide cracks associated with Vertisols. These are minor soils in the survey area, where they occur along the drier eastern and southern fringes.

Entisols are mineral soils that lack horizons developed by soil forming processes. Entisols occur extensively in the mountains.

Inceptisols are soils that have water available to plants, have one or more pedogenic horizons, some weatherable minerals and a moderate to high capacity of the clay fraction to retain cations. Inceptisols are the major soil order represented in the survey area.

Mollisols have thick, very dark brown to black surface soils, friable consistence, a dominance of calcium among the extractable cations and sufficient clay minerals to give a high cation exchange capacity. They occur in the survey area in Area B, particularly in the Ghab depression.

Vertisols are soils with a high clay content, pronounced changes in volume with changes in moisture, deep wide cracks and evidences of soil movement such as slickensides or gilgai microrelief. Vertisols occur in all 3 areas of the survey area.

Taxonomy is a sorting process. The order category sorts soils into a small number of classes. To reduce the heterogeniety in the order category sorting is done at the next lower category - the suborder. The differentia for the suborders vary with the order. It can be moisture regime as in the use of "Xer" for Xeric or Mediterranean climate. It also can indicate the major reason for presence or absence of horizons. The major suborders present in the First Settlement Zone include: for Alfisols, Xeralfs; for Aridisols, Orthids; for Entisols, Fluvents, Orthents and Psamments; for Inceptisols, Ochrepts; for Mollisols, Xerolls; for Vertisols, Xererts.

In the Great Group Category, all of the soil horizons are considered collectively, as well as moisture and temperature regime. In the Alfisol order the Great Group is Haploxeralf. In the Aridisol order, Camborthids and Salorthids are recognized. In the Entisol order Xerofluvents, Xerorthids and Xeropsamments are

recognized. Among the Inceptisols Xerochrepts are the only Great Group. In the Mollisols only the Haploxerolls were mapped while the Chromoxererts were the only Vertisols recognized.

Throughout the categories of order, suborder and great group emphasis is placed on causes of sets of properties that cause soil development. The subgroup level sorts out the central concept of the great group which is labeled "typic" for typical. The second subgroup sets out the soils that are transitional to other orders, suborders and great groups. These are called intergrades. A subgroup called extragrades is used for soils with properties not represented in the great group.

The typic subgroups used include Typic Salorthids, Camborthids, Xerofluvents, Xerorthents, Xeropsamments, Xerochrepts, Haploxerolls, and Chromoxererts.

The intergrade subgroups include Aquic Salorthids, Calcixerollic Xerochrepts, Vertic Xerochrepts, Aquic Xerochrepts and Entic Chromoxererts. The extragrade subgroups include Lithic Haploxeralfs, Lithic Xerorthents, Lithic Xerochrepts, Lithic-Vertic Xerochrepts, Lithic Haploxerolls and Pachic Haploxerolls.

Detailed profile descriptions to illustrate these taxonomic units can be found in the report accompanying the 1:500,000 scale soil map, and in Volume 10.

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Table 3-1. Climatic data for Tartous, Hama, Homs and Quamishli

	Month												
	J	F	M	A	M	J	J	A	S	O	N	D	Year
Average Monthly Precipitation in mm													
Tartous	185	130	106	50	20	5	0	5	18	50	100	200	869
Hama	76	60	44	32	12	1	0	0	3	13	34	60	335
Homs	105	88	64	45	17	1	0	0	4	15	45	95	479
Quamishli	105	60	75	65	55	2	2	0	2	20	35	75	496
Average mean daily air temperature in °C													
Tartous	12	13	15	18	21	24	26	27	26	23	18	14	19.8
Hama	7	9	12	16	21	26	28	28	25	20	14	9	17.9
Homs	7	9	11	16	20	24	26	26	24	19	13	8	16.9
Quamishli	7	8	11	16	23	28	33	33	28	21	14	9	18.7

Table 3-2
Brief Description, Area Where Found
and Geology of Mapping Units

MAP SYMBOL	BRIEF DESCRIPTION	AREA WHERE FOUND	GEOLOGY
A51a	Saline soils on flats	B	Quaternary
E21a	Alluvial soils on flats	A,B,C	Quaternary
E41a	Sandy beaches	B	Quaternary
E61a	Thin rocky soils on steep, low mountains	A,B,C	Basalt
E61b	Thin, rocky soils on steep low mountains	B	Limestone, Marl
E61c	Thin, extremely stony soils rolling to hilly	A,B	Limestone, Marl
E61e	Thin rocky soils, hilly extremely eroded	B	Limestone, Marl
E61f	Thin rocky soils, rolling to hilly	B	Gypsum, Limestone, Marl
E61g	Thin rocky soils, hilly	B	Gypsum, Limestone, Marl
E61h	Thin very rocky soils on mountains	A,B	Gypsum, Limestone, Marl
E61i	Thin very rocky soils on mountains	B	Cretaceous Limestone

Table 3-2 (cont'd)

MAP SYMBOL	BRIEF DESCRIPTION	AREA WHERE FOUND	GEOLOGY
E61j	Thin rocky soils on mountains	B	Undifferentiated Volc. complex
I11a	Deep to moderately deep silt loams on nearly level plains	B	Undifferentiated Quaternary
I11c	Deep to moderately shallow, clays, extremely stony, on rolling slopes	A	Basalt
I11d	Deep to moderately shallow, moderately fine soils on undulating plains	C	Limestone and Marl
I11e	Deep moderately fine soils on undulating plains	B	Undifferentiated
I11f	Deep to moderately shallow, moderately fine soils on undulating plains	B	Undifferentiated
I12b	Deep to moderately deep clays on strongly undulating plains	C	Limestone and Marl
I12c	Deep to moderately shallow clays, extremely stony on undulating plains	A	Basalt
I12d	Deep moderately fine soils on gently undulating plains	C	Limestone and Marl
I12e	Deep to moderately deep moderately fine soils on rolling plains	B	Limestone and Marl

Table 3-2 (cont'd)

MAP SYMBOL	BRIEF DESCRIPTION	AREA WHERE FOUND	GEOLOGY
I12f	Deep to moderately deep moderately fine soils on undulating to rolling plains	C	Limestone and Marl
I13a	Moderately shallow moderately fine soils on rolling to strongly rolling plains	A	Quaternary
I13c	Moderately shallow to moderately deep moderately fine soils on strongly rolling plains	B	Basalt
I13d	Moderately shallow to shallow moderately fine soils on strongly rolling to hilly uplands	A	Limestone and Marl
I13e	Moderately shallow, moderately fine soils on undulating plains	B	Limestone and Marl
I13f	Moderately shallow fine to moderately fine soils on rolling to gently undulating plains	B	Limestone and Marl
I13i	Moderately deep moderately fine soils on hilly topography	B	Basalt Limestone Marl
I14b	Moderately shallow moderately fine soils on gently undulating to rolling slopes	B	Basalt

Table 3-2 (cont'd)

MAP SYMBOL	BRIEF DESCRIPTION	AREA WHERE FOUND	GEOLOGY
I15a	Deep clays on nearly level slopes	B	Quaternary
I15b	Deep, moderately fine, stony soils on gently undulating to undulating plains	A	Basalt
I15c	Deep moderately fine, very stony soils on gently undulating to undulating plains	A	Basalt
I15d	Deep fine textured soils on rolling to gently undulating plains	B,C	Basalt Limestone Marl
M11a	Deep moderately fine soils on level slopes	B	Quaternary
M11b	Deep to moderately deep, moderately fine soils on nearly level to undulating slopes	B	Quaternary
M11c	Deep to shallow, moderately fine soils on gently undulating to undulating slopes	B	Quaternary
M12a	Moderately shallow moderately fine, stony soils on hilly slopes	B	Basalt
M12b	Moderately deep to moderately shallow, moderately fine, bouldary soils on hilly topography	B	Basalt
V11a	Moderately deep to moderately shallow, moderately fine soils on strongly rolling topography	C	Quaternary

Table 3-2 (cont'd)

MAP SYMBOL	BRIEF DESCRIPTION	AREA WHERE FOUND	GEOLOGY
V11b	Deep, fine textured soils on nearly level slopes	B	Quaternary
X11a	Basalt flows and rock outcrops of lava plateaus and plains	A	Basalt
X11b	Rock outcrops and rubble lands of lava plateaus and plains	A	Same
X11c	Basalt flows and rubble lands of plateaus and plains	A	Same
X11d	Highly eroded side slopes and rubble lands of lave plateaus	A	Same
X12a	Rock outcrops	B	Limestone

Table 3-3 SOIL PROPERTIES OF MAPPING UNITS
(an average of the components)
(see table 3-4 for class limits)

MAP UNIT SYMBOL	SOIL SLOPE	SOIL DEPTH	SOIL TEXTURE		SOIL DRAIN-AGE	STONINESS %	COARSE FRAGMENTS IN PROFILE %	PRESENT EROSION	CAPABILITY SUBCLASS
			A	B					
A51a	1	1	4	5	3	1	1	1	VIc VIw
E21a	1	1	5	5	5	1	1	1	IIs
E41a	1	1	2	2	1	1	1	1	VIII
E61a	7	3	4	5	1	4	1	3	VIIe
E61b	7	3	4	3	1	4	1	3	VIe
E61c	6	4	5	5	1	4	1	3	VIIe
E61e	4	3	4	4	2	5	1	3	VII3-IVc
E61f	6	3	4	4	1	1	3	3	VIe
E61g	7	4	4	5	1	1	1	4	VIIe
E61h	8	4	5	5	1	1	1	4	VIIe
E61i	8	4	5	5	1	1	1	2	VIIe
E61j	8	4	4	5	1	4	1	1	VIIe
I11a	1	2	3	4	3	1	6	1	IVs
I11c	2	1	5	5	3	4	1	1	IVs

Table 3-3 (cont'd)

MAP UNIT SYMBOL	SOIL SLOPE	SOIL DEPTH	SOIL TEXTURE		SOIL DRAIN-AGE	STONINESS %	COARSE FRAGMENTS IN PROFILE %	PRESENT EROSION	CAPABILITY SUBCLASS
			A	B					
I11d	2	3	4	5	5	1	2	3	IIIs
I11e	2	1	4	5	5	1	1	2	IIs
I11f	2	3	4	5	3	1	1	1	IIs
I12b	3	2	4	5	3	2	3	2	IIIc
I12c	3	1	3	5	3	2	3	1	IVs
I12d	2	1	5	5	3	1	1	1	IVc
I12e	3	1	4	5	3	2	4	2	IIIc
I12f	3	2	4	5	3	1	2	2	IIIs
I13a	4	3	4	5	3	5	5	3	IVs
I13c	4	3	4	4	3	2	2	3	IVs
I13d	5	3	4	5	3	4	4	3	VIIe
I13e	2	3	4	5	3	1	4	4	IVe
I13f	3	3	4	5	3	3	4	3	IVe
I13i	5	3	4	5	3	4	2	3	VIIe
I14b	3	3	4	5	3	2	4	2	IIs

Table 3-3 (cont'd)

MAP UNIT SYMBOL	SOIL SLOPE	SOIL DEPTH	SOIL TEXTURE A	SOIL TEXTURE B	SOIL DRAIN-AGE	STONINESS %	COARSE FRAGMENTS IN PROFILE %	PRESENT EROSION	CAPABILITY SUBCLASS
I15a	1	1	5	5	3	1	2	1	IIs
I15b	3	1	4	5	3	3	1	1	IVs
I15c	2	1	4	5	3	4	2	1	IVs
I15d	3	1	5	5	3	2	2	3	IVs
M11a	1	1	4	5	3	1	1	1	IIs
M11b	1	1	4	5	3	2	1	1	IIIc
M11c	2	1	4	5	3	2	1	2	IIIe
M12a	5	3	4	4	3	3	2	3	IIe
M12b	5	3	4	4	3	4	3	3	IVs
V11a	2	1	5	5	3	1	1	1	IIIs
V11b	2	1	5	4	4	1	2	1	IIIs
X11a	Rock outcrop								
X11b	Rock outcrops and rubble land								
X11c	Basalt flows								
X11d	Rubble lands, lava								
X12a	Rock outcrop, limestone								

Table 3-4
Class limits for soil properties

SOIL SLOPE								
Code	1	2	3	4	5	6	7	8
Slope %	0-2	2-5	5-9	9-15	15-30	30-50	50-75	>75

SOIL DEPTH				
Code	1	2	3	4
Depth (cm)	>100	50-100	20-50	<20

SOIL TEXTURE	
Code	Texture
1	Very coarse (cs, gravel)
2	Coarse (Sand, L. sand)
3	Medium (Silt loam, loam, sandy loam)
4	Mod. fine (clay loam, silty clay loam, sandy clay loam)
5	Fine (clay, silty clay, sandy loam
6	Very fine (clay over 60%)

SOIL DRAINAGE							
Code	1	2	3	4	5	6	7
Class	Excessive	Somewhat Excessive	Well	Moderate-ly well	Imperfect	Poor	Very Poor

SURFACE STONINESS					
Code	1	2	3	4	5
Coverage(%)	None	1-3	3-15	15-60	>60

Table 3-4 (cont'd)

COARSE FRAGMENTS IN PROFILE						
Code	1	2	3	4	5	6
Coverage %	<5	5-15	15-35	35-60	60-80	>80

PRESENT EROSION				
Code	1	2	3	4
Erosion Class	slight	moderate	severe	very severe

CAPABILITY CLASS	
Degree of Limitation	Restrictions limiting use as cropland
I	Very few restrictions
II	Moderate restrictions
III	Severe restrictions
IV	Very Severe restrictions
V,VI,VII	Extremely severe restrictions, generally not cultivated
VIII	Generally not agricultural land
	CAPABILITY SUBCLASS
	Kind of Limitation
e	erosion-steep slopes
w	wetness-wet soils
s	soil-coarse, stony thin soils
c	climate-dry, cold

Table 3-5 Soil potentials of mapping units
(an average of the components)
(see table 3-6 for class limits and explanation of headings)

MAP UNIT SYMBOL	WORK-ABILITY	SEEDING ESTABLISH-MENT	POTENTIAL MECHAN-IZATION	EROSION HAZARD	POTENTIAL SUITABILITY FOR USE			
					RAINFED AGRICULTURE	MAJOR SOIL LIMITATIONS	IRRIGATED AGRICULTURE	MAJOR SOIL LIMITATIONS
A51a	4	3	2	3	Sc	s	-	-
E21a	3	4	2	3	S1a	w	S1a	s2
E41a	1	1	1	1	N2	mep	-	-
E61a	4	4	4	4	Sc	tde	-	-
E61b	4	4	4	4	Sc	tde	-	-
E61c	4	4	4	5	Sc	tde	-	-
E61e	4	3	3	4	S3	dte	-	-
E61f	3	3	4	5	S3	tde	-	-
E61g	4	4	4	5	S3	tde	-	-
E61h	4	4	4	5	Sc	td	-	-
E61i	4	4	4	5	Sc	td	-	-
E61j	4	4	4	5	Sc	td	-	-
I11a	3	3	1	3	S2	g	S2	sw
I11c	4	4	4	4	S2	gt	-	-
I11d	4	4	3	5	S2	d	-	-

Table 3-5 (cont'd)

MAP UNIT SYMBOL	WORK-ABILITY	SEEDING ESTABLISH MENT	POTENTIAL MECHAN-IZATION	EROSION HAZARD	POTENTIAL SUITABILITY FOR USE			
					RAINFED AGRICULTURE	MAJOR SOIL LIMITATIONS	IRRIGATED AGRICULTURE	MAJOR SOIL LIMITATIONS
I11e	3	3	2	5	S1a	c	-	-
I11f	3	4	2	5	S1b	d	S1b	Sw
I12c	4	3	3	4	S2	tdc	-	-
I12d	3	3	2	4	S1a	-	-	-
I12e	4	4	4	5	S2	tdc	-	-
I12f	4	3	3	5	S2	t	-	-
I13a	4	4	4	5	Sc	tdg	-	-
I13c	4	3	4	5	S2	t	-	-
I13d	4	4	3	5	Sc	tdg	-	-
I13e	4	4	3	5	S2	g	-	-
I13f	4	3	2	5	S3	gt	-	-
I13i	4	4	4	5	Sc	td	-	-
I14b	4	4	4	5	S3	gt	-	-
I15a	4	4	2	3	S1a	-	-	-
I15b	4	3	3	4	S2	d	S2	S

Table 3-5 (cont'd)

MAP UNIT SYMBOL	WORK-ABILITY	SEEDING ESTABLISH MENT	POTENTIAL MECHAN-IZATION	EROSION HAZARD	POTENTIAL SUITABILITY FOR USE			
					RAINFED AGRICULTURE	MAJOR SOIL LIMITATIONS	IRRIGATED AGRICULTURE	MAJOR SOIL LIMITATIONS
I15c	4	4	4	4	S2	g	S2	s
I15d	4	3	2	5	S2	tg	S2	s
M11a	3	2	2	4	S1a	-	S1a	saw
M11b	4	2	2	4	S1a	-	-	-
M11c	3	4	2	4	S1b	t	-	-
M12a	4	4	3	4	S3	t	-	-
M12b	4	4	4	5	Sc	td	-	-
V11a	4	2	2	4	S1a	v	-	-
V11b	4	4	2	4	S1b	vd	S1b	swb
X12a	Basalt Flows							
X11b	Rock Outcrops and Rubble Lands							
X11c	Basalt Flows and Rubble Lands							
X11d	Rubble Lands Highly Eroded							
X12a	Rock Outcrop							

Table 3-6
Class limits for soil potentials

Workability. The workability of soils relates to the use of hand or animal drawn implements. It depends on soil texture, organic matter content, soil structure and consistence and the stone and gravel content of the surface soil.

Rating	Description
1	good (few stones or gravel, coarse textures)
2	fair (slight stoniness, few loamy textures)
3	poor (moderate stoniness, clayey textures)
4	very poor (abundant stones and gravel)

Seeding Establishment. This rating evaluates the soil for seed germination, seedling emergence and initial root development. The rating is based on soil consistence, kind and stability of structure and susceptibility of surface sealing.

Rating	Description
1	good (friable soils, little gravel, no sealing)
2	fair (moderately friable soils, some gravel, slight sealing)
3	poor (firm consistence, moderate gravel, moderate sealing)
4	very poor (hard consistence, abundant gravel, strong sealing)

Mechanization Potential. The following characteristics are used to evaluate the use of tractors and other implements landform and slope steepness; amount of microrelief; stones and rocks on and in the soil; physical condition of soil.

Rating	Description
1	high (flat to undulating, stone-free, coarse textures)
2	medium (rolling, slightly stony, medium textures)
3	low (hilly, stony or dense clays)
4	very low (steep, rocky or swampy)

Table 3-6 (cont'd)

Water Erosion Hazard. This interpretation is based on bare unprotected soil surface. The evaluation is based on slope, soil texture, and soil structure.

Rating	Description
1	low - nearly level, coarse texture, good structure
2	slight - undulating, moderately coarse, good structure
3	moderate - rolling, medium texture, weak structure
4	high - hilly and fine texture, or cloddy
5	very high - steep and very fine texture, or cloddy

Major Soil Limitations

a	alkali	i	inundation
c	climate	m	moisture deficiency - soil related
d	depth, stoniness	p	poor soil physical condition
e	erosion	s	salinity
f	fertility	t	topography
g	gravel	v	vertisolic (cracking clays)
		w	wetness

Table 3-7
Principal use and productivity ratings for soil mapping units
Use Codes: I = irrigated, C = Cultivated, P = pasture, O = orchards, F = forest, B = barren, Br = brush
Productivity Codes: H = high, G = good, F = fair, P = poor, VP = very poor and B = barren

SOIL	PRINCIPAL USE	PRODUCTIVITY RATING	SOIL	PRINCIPAL USE	PRODUCTIVITY RATING
A51a	P	F	I13c	P,O	F
E21a	I,C	H	I13d	C,P	VP
E41a	B	-	I13e	C,P	F
E61a	C,P,O,Br	VP	I13f	C,P	P
E61b	P	VP	I13i	C,P	VP
E61c	P	VP	I14a	I,C	F
E61e	C,P	P	I14b	C	P
E61f	P,F	P	I15a	C	H
E61g	P,O,F,Br	P	I15b	I,C	F
E61h	Br	VP	I15c	I,C,P,O	F
E61i	C,P,O,F,Br	VP	I15d	I,C,P,O	F
E61j	C	VP	M11a	I,C	H
I11a	I,C	F	M11b	C	H
I11c	C,P	F	M11c	C	G
I11d	C,P	F	M12a	C,P	P
I11e	C	H	M12b	C,P	VP
I11f	I,C	G	V11a	C	H
I12b	C	F	V11b	I,C,O	G
I12c	P	F	X11a	P	VP
I12d	C,P	H	X11b	P	VP
I12e	C,P	F	X11c	P	VP
I12f	C,P	F	X11d	P	VP
I13a	P	VP	X12a	P,O	VP

Table 3-8
Engineering properties and classification
(Ratings represent an average of the components of the soil map unit)
(See text for explanation of column headings)

SOIL MAP UNIT	DEPTH (cm)	TEXTURE	CLASSIFICATION		FRAGMENTS >7 cm.	LIQUID LIMIT (%)	PLASTICITY INDEX
			UNIFIED	AASTO			
A51a	>100	fine	ML-CL	A7	<5	60-85	30-50
E21a	>100	fine	CH	A7	<5	60-85	30-50
E41a	>100	coarse	SP-SM	A3	<5	<25	<5
E61a	20-50	mod. fine	ML-CL	A6	<5	30-50	15-35
E61b	20-50	mod. fine	ML-CL	A6	<5	30-50	15-35
E61c	<20	fine	CL	A7	<5	60-85	30-50
E61e	20-50	mod. fine	ML-CL	A6	5-15	30-50	15-35
E61f	0-50	mod. fine	ML-CL	A6	15-35	30-50	15-35
E61g	<20	mod. fine	CL	A6-A7	5-15	30-50	15-35
E61h	<20	mod. fine	CL	A6-A7	<5	30-50	15-35
E61i	<20	fine	CL	A6-A7	5-15	60-85	30-50
E61j	<20	mod. fine	CL	A6-A7	5-15	30-50	15-35
I11a	50-100	medium	ML	A4	>80	40-55	15-25
I11c	50-100	fine	CL	A7	<5	60-85	30-50
I11d	50-100	mod. fine	ML-CL	A6-A7	5-15	30-50	15-35
I11f	20-50	mod. fine	ML-CL	A6	60-80	30-50	15-35
I12b	50-100	mod. fine	CL-CH	A7	15-35	30-50	15-35
I12c	>100	mod. fine	CL-ML	A6-A7	15-35	30-50	15-35
I12d	>100	fine	ML-CL	A6-A7	<5	60-85	30-50
I12e	50-100	mod. fine	CL-ML	A7-A6	35-60	30-50	15-35
I12f	50-100	mod. fine	CL-ML	A7	15-35	30-50	15-35

Table 3-8 (cont'd)

SOIL MAP UNIT	DEPTH (cm)	TEXTURE	CLASSIFICATION		FRAGMENTS >7 cm.	LIQUID LIMIT (%)	PLASTICITY INDEX
			UNIFIED	AASTO			
I13a	20-50	mod. fine	ML-CL	A6	60-80	30-50	15-35
I13c	20-50	mod. fine	SC-CL	A6	35-60	30-50	15-35
I13d	20-50	mod. fine	ML-CL	A6-A7	35-60	30-50	15-35
I13e	20-50	mod. fine	ML-CL	A6-A7	15-35	30-50	15-35
I13f	20-50	mod. fine	ML-CL	A6-A7	35-60	30-50	15-35
I13i	20-50	mod. fine	ML-CL	A6-A7	35-60	30-50	15-35
I14b	20-50	mod. fine	ML-CL	A6	60-80	30-50	15-35
I15a	>100	fine	CH	A7	<5	60-85	30-50
I15b	>100	mod. fine	CL	A7	<5	30-50	15-35
I15c	>100	mod. fine	CL	A7	<5	30-50	15-35
I15d	>100	fine	CH-CL	A7	5-15	60-85	30-50
M11a	>100	mod. fine	CL-CH	A7	<5	30-50	15-35
M11b	>100	mod. fine	CL-CH	A4-A7	<5	30-50	15-35
M11c	>100	mod. fine	CL-CH	A7	<5	30-50	15-35
M12a	20-50	mod. fine	SM-SC,CL	A2-4,A7	<5	30-50	15-35
M12b	20-50	mod. fine	ML-CL	A6	15-35	30-50	15-35
V11a	>100	fine	CL	A7	<5	60-85	30-50
V11b	>100	fine	CL-CH	A7	15-35	60-85	30-50
X11a	Rubble Lands						
X11b	Rubble Lands-surface presently over 60% stones						
X11c	Basalt Flows-surface presently over 60% stones						
X11d	Rubble Lands, basalt						
X12a	Rock Outcrops, essentially no soil						

Table 3-9 Building site development
(Ratings represent an average of the components of the soil map unit)
1 = slight, 2 = moderate, 3 = severe. See text for definitions of slight, moderate and severe.

SOIL MAP UNIT	SHALLOW EXCAVATIONS	DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS
A51a	3-wetness	3-wetness	3-wetness	3-wetness	3-salts, wetness
E21a	3-floods, wetness	3-floods	3-floods	3-floods, wetness	3-floods, wetness
E41a	3-cut banks erode	3-too loose	3-too loose	3-too loose	1
E61a	3-slope	3-slope	3-slope	3-slope	3-slope
E61b	3-slope	3-slope	3-slope	3-slope	3-slope
E61c	3-slope	3-slope	3-slope	3-slope, rock	3-slope, rock
E61e	3-slope	3-slope	3-slope	3-slope	3-slope
E61f	3-slope, stones	3-slope, stones	3-slope, stones	3-slope	3-slope
E61g	3-slope	3-slope	3-slope	3-slope, rock	3-slope, rock
E61h	3-slope	3-slope	3-slope	3-slope, rock	3-slope, rock
E61i	3-slope, rocks	3-slope, rock	3-slope, rock	3-slope, rock	3-slope, rock
E61j	3-slope	3-slope	3-slope	3-slope, rock	3-slope, rock
I11a	1	1	1	1	1
I11c	2-stones	2-stones, shrink swell	2-stones, shrink-swell	2-stones, slope	2-stones, slope
I11d	2-stones	2-stones, rock	2-stones, rock	2-rock	2-rock

Table 3-9 (cont'd)

SOIL MAP UNIT	SHALLOW EXCAVATIONS	DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS
I11e	1	1	1	1	1
I11f	3-stones, slope	3-slope, stones	3-slope, stones	3-slope, stones	3-slope, stones
I12b	2-slope, stones	2-stones, slope	2-stones, slope	2-slope, rock	2-slope, rock
I12c	2-stones, slope	2-stones	2-stones	2-rock	2-rock
I12d	2-stones	3-shrink-swell	3-shrink-swell	3-shrink-swell	3-shrink-swell
I12e	3-stones	3-stones, slope	3-stones, slope	3-slope, stones	3-slope, stones
I12f	2-slope	2-slope, stones	2-slope, stones	2-rock	2-rock
I13a	3-stones, slope	3-slope, stones	3-slope, stones	3-slope	3-slope
I13c	3-slope, rock	3-slope	3-slope	3-slope	3-slope
I13d	3-rock, slope	3-slope, rock	3-rock, stones	3-slope	3-slope
I13e	2-rock	2-rock	2-rock	2-rock	2-rock
I13f	3-rock, slope	3-rock, slope	3-rock, slope	3-rock, slope	3-rock, slope
I14b	2-stone,slope	2-stone, slope	2-stone, slope	2-stone,slope	2-stone, slope
I15a	1	1	1	1	1
I15b	2-slope	2-slope	2-slope	2-slope	2-slope

Table 3-9 (cont'd)

SOIL MAP UNIT	SHALLOW EXCAVATIONS	DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	SMALL COMMERCIAL BUILDINGS	LOCAL ROADS AND STREETS
M11a	1	1	1	1	1
M11b	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope	2-rock,slope
M11c	2-slope, rock	2-slope, rock	2-slope, rock	2-slope, rock	2-slope, rock
M12a	3-stone, rock	3-slope	3-slope	3-slope	3-slope
M12b	3-slope	3-slope	3-slope	3-slope	3-slope
V11a	2-shrink-swell	2-shrink-swell	2-shrink-swell	2-shrink-swell	2-shrink-swell
V11b	2-shrink-swell	2-shrink-swell	2-shrink-swell	2-shrink-swell	2-shrink-swell
X11a	Rubble lands				
X11b	Rubble Lands-surface presently over 60% stones				
X11c	Basalt flows-surface presently over 60% stones				
X11d	Rubble lands, basalt				
X12a	Rock outcrops, essentially no soil				

Table 3-10 Limitations for sanitary facilities
(Ratings represent an average of the components of the soil map units)
1 = slight, 2 = moderate and 3 = severe. See text for definitions of slight, moderate and severe.

SOIL MAP UNIT	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOON AREAS	TRENCH SANITARY LANDFILL	AREA SANITARY LANDFILL	DAILY COVER FOR LANDFILL
A51a	3-percs slowly	1	2-too clayey	2-too clayey	2-too clayey
E21a	3-wetness percs slowly	2-floods	3-wetness	2-wetness	3-wetness
E41a	1	3-seepage	3-too sandy	3-too sandy	3-too sandy
E61a	3-steep	3-steep	3-steep	3-steep	3-steep
E61b	3-steep	3-steep	3-steep	3-steep	3-steep
E61c	3-steep	3-steep	3-steep	3-steep	3-steep
E61e	3-steep	3-steep	3-steep	3-steep	3-steep
E61f	3-steep	3-steep	3-steep	3-steep	3-steep
E61g	3-steep	3-steep	3-steep	3-steep	3-steep
E61h	3-steep	3-steep	3-steep	3-steep	3-steep
E61i	3-steep	3-steep	3-steep	3-steep	3-steep
E61j	3-steep	3-steep	3-steep	3-steep	3-steep
I11a	3-percs slowly, rock	2-rock	3-rock	2-rock	3-rock
I11c	3-rock, percs slowly	2-rock	3-rock	2-rock	3-rock

Table 3-10 (cont'd)

SOIL MAP UNIT	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOON AREAS	TRENCH SANITARY LANDFILL	AREA SANITARY LANDFILL	DAILY COVER FOR LANDFILL
I11d	3-rock, slope	2-rock	3-rock	2-rock	3-rock
I113	3-percs slowly	1	2-rock	1	1
I11f	3-slope, rock	3-slope, rock	3-rock	3-rock	3-too clayey, rock
I12b	3-slope, rock	3-slope, rock	3-rock	3-rock	3-too clayey, rock
I12c	3-rock, slope	3-rock, slope	3-rock	3-rock	3-too clayey, rock
I12d	2-rock	2-rock	2-rock	2-rock	2-too clayey
I12e	3-slope, rock, stone	3-slope, rock	3-rock	3-rock	3-too clayey, rock
I12f	3-rock, stone	3-rock, slope	3-rock	3-rock	3-too clayey, rock
I13a	3-slope, rock	3-slope, rock	3-rock	3-rock	3-rock, too clayey
I13c	3-slope, rock, stone	3-slope, rock	3-rock	3-rock	3-too clayey
I13d	3-slope, rock	3-slope	3-rock	3-rock	3-rock, too clayey
I13e	3-rock	3-rock	3-rock	3-rock	3-rock, too clayey
I13f	3-rock, slope	3-slope, rock	3-rock	3-rock	3-rock, too clayey
I13i	3-slope	3-slope	3-rock	3-rock	3-rock, too clayey
I14b	3-rock	3-rock, slope	3-rock	3-rock	3-rock, too clayey

Table 3-10 (cont'd)

SOIL MAP UNIT	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOON AREAS	TRENCH SANITARY LANDFILL	AREA SANITARY LANDFILL	DAILY COVER FOR LANDFILL
I15a	2-rock	2-rock	2-rock	2-rock, too clayey	2-too clayey
I15b	2-slope	2-slope	2-rock	2-rock	2-too clayey
I15c	2-rock, slope	2-stones, rock	2-rock	2-rock	2-rock
I15d	3-slope	3-slope	2-too clayey	2-too clayey	2-too clayey
M11a	2-percs slowly	1	2-too clayey	2-too clayey	2-too clayey
M11b	2-percs slowly	1	2-too clayey	2-too clayey	2-too clayey, stones
M11c	slope, percs slowly	2-slope	2-too clayey, stones	2-too clayey	2-too clayey, rock
M12a	3-slope, rock	3-rock, slope	3-stones	3-stones	3-stones
M12b	3-rock, slope	3-rock, slope	3-stones	3-stones	3-stones
V11a	3-percs slowly	1	3-too clayey	3-too clayey	3-too clayey
V11b	3-percs slowly	1	3-too clayey	3-too clayey	3-too clayey
X11a	Basalt flows				
X11b	Rock outcrops and rubble lands				
X11c	Basalt flows and rubble lands				
X11d	Rubble lands highly eroded				
X12a	Rock outcrop				

Table 3-11 Water Management
Ratings represent an average of the components of the mapping unit.
1 = favorable, 2 = unfavorable
(Principal limitation is shown after the rating)

SOIL MAP UNIT	POND RESERVOIR AREAS	DRAINAGE	IRRIGATION	TERRACES AND DIVERSIONS	GRASSED WATERWAYS
A51a	2-salts	2-salts	2-salts	not needed	not needed
E21a	2-seepage	2-wetness	1	1	1
E41a	2-too sandy	2	2-too sandy	2-too sandy	2-too sandy
E61a	2-slope		2-slope	2-slope	2-slope
E61b	2-slope		2-slope	2-slope	2-slope
E61c	2-slope, stones	2-stones	2-slope, stones	2-slope, stones	2-slope,stones
E61e	2-slope, erosion	2-slope, erosion	2-slope, erosion	2-slope, erosion	2-slope, erosion
E61f	2-slope	2-slope	2-slope	2-slope	2-slope
E61g	2-slope	2-slope	2-slope	2-slope	2-slope
E61h	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope
E61i	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope
E61j	2-slope	2-slope	2-slope	2-slope	2-slope
I11a	1	1	1	1	1
I11c	2-stones	2-stones	2-stones	2-stones	2-stones
I11d	2-slope	2-slope	2-slope	2-slope	2-slope

Table 3-11 (cont'd)

SOIL MAP UNIT	POND RESERVOIR AREAS	DRAINAGE	IRRIGATION	TERRACES AND DIVERSIONS	GRASSED WATERWAYS
I11e	1	1	1	1	1
I11f	2-slope	2-slope	1	1	1
I12b	2-slope	2-slope	2-slope	1	1
I12c	2-stones, slope	2-stones, slope	2-stones, slope	2-stones, slope	2-stones
I12d	1	2-percs slowly	2-percs slowly	1	1
I12e	2-slope	2-slope	2-slope	2-slope	1
I12f	2-slope	2-slope	2-slope	2-slope	1
I13a	2-slope, stones	2-slope, stones	2-slope, stones	2-slope, stones	2-slope, erosion
I13c	2-slope	2-slope	2-slope	2-slope	2-slope
I13d	2-rock, slope	2-rock, slope	2-rock, slope	2-rock, slope	2-rock
I13e	2-rock	2-rock	2-rock	2-rock	1
I13f	2-stones, slope	2-stones, slope	2-stones, slope	2-stones	1
I13i	2-slope	2-slope	2-slope	2-slope	1
I14b	2-rock	2-rock	2-rock	2-rock	1
I15a	1	1	1	1	1

Table 3-11 (cont'd)

SOIL MAP UNIT	POND RESERVOIR AREAS	DRAINAGE	IRRIGATION	TERRACES AND DIVERSIONS	GRASSED WATERWAYS
I15b	2-stones	2-stones	2-stones	2-stones	2-stones
I15c	2-stones	2-stones	2-stones	2-stones	2-stones
I15d	1	2-percs slowly	1	1	1
M11a	1	1	1	1	1
M11b	1	1	1	1	1
M11c	2-stones	2-stones	2-stones	2-stones	1
M12a	2-stones	2-stones	2-stones	2-stones	2-stones
M12b	2-stones	2-stones	2-stones	2-stones	2-stones
V11a	1	2-percs slowly	1	1	1
V11b	1	2-percs slowly	1	1	1
X11a	2-rock	2-rock	2-rock	2-rock	2-rock
X11b	2-rock	2-rock	2-rock	2-rock	2-rock
X11c	2-rock	2-rock	2-rock	2-rock	2-rock
X11d	2-rock	2-rock	2-rock	2-rock	2-rock
X12a	2-rock	2-rock	2-rock	2-rock	2-rock

Table 3-12
Physical and chemical properties of soils
Ratings represent an average of the components of the mapping units.
(See table 14 for class limits for these ratings)

SOIL MAP UNIT	PERMEABILITY	WATER HOLDING CAPACITY	SOIL REACTION	EROSION FACTORS		WIND ERODABILITY
				K	T Kg/hectare	
A51a	4	1	4	2	11,250	5
E21a	4	1	1	2	11,250	5
E41a	7	4	-	1	4,500	1
E61a	1	3	2	4	4,500	9
E61b	1	3	2	4	4,500	9
E61c	1	3	2	4	4,500	9
E61e	1	3	2	4	4,500	9
E61f	2	3	1	4	4,500	9
E61g	5	3	1	4	4,500	9
E61h	5	3	1	4	4,500	9
E61i	5	3	1	4	4,500	9
E61j	5	3	1	4	4,500	9
I11a	4	2	1	2	6,750	6
I11c	2	1	4	3	6,750	9
I11d	4	1	1	3	6,750	7
I11e	4	1	1	3	11,250	7
I11f	4	1	1	3	6,750	7
I12b	1	1	2	3	6,750	5
I12c	1	1	2	3	6,750	9
I12d	2	2	4	2	11,250	7

Table 3-12 (cont'd)

SOIL MAP UNIT	PERMEABILITY	WATER HOLDING CAPACITY	SOIL REACTION	EROSION FACTORS K	EROSION FACTORS T Kg/hectare	WIND ERODABILITY GROUP
I12e	1	1	2	3	6,750	7
I12f	1	1	2	3	6,750	7
I13a	1	3	2	3	4,500	7
I13c	1	3	1	3	4,500	6
I13d	1	3	2	3	4,500	6
I13e	1	3	2	3	4,500	7
I13i	1	3	1	3	4,500	6
I14b	2	1	2	3	11,250	6
I15a	4	1	1	3	11,250	6
I15b	4	1	4	3	11,250	9
I15c	4	1	4	3	11,250	9
I15d	1	1	4	3	11,250	6
M11a	2	1	1	3	11,250	6
M11b	4	1	1	3	6,750	6
M11c	2	2	1	3	6,750	6
M12a	2	2	1	3	4,500	9
M12b	2	3	1	3	4,500	9
V11a	1	1	4	3	11,250	6
V11b	4	1	1	3	11,250	6
X11a	rock	-	-	-	-	-
X11b	2	1	4	3	4,500	9

Table 3-12 (cont'd)

SOIL MAP UNIT	PERMEABILITY	WATER HOLDING CAPACITY	SOIL REACTION	EROSION FACTORS		WIND ERODABILITY GROUP
				K	T Kg/hectare	
X11c	1	3	4	3	4,500	9
X11d	rock	-	-	-	-	-
X12a	rock	-	-	-	-	-

Table 3-13
Class limits for physical and chemical properties of soils

PERMEABILITY							
Class	1 Moderate	2 Moderately slow	3 Moderately Rapid	4 Slow	5 Rapid	6 Very Slow	7 Very Rapid
Limit (cm./h)	2.-6.25	.5-2.0	6.25-12.5	.125-.5	12.5-25	Less than 25	more than 25

WATER HOLDING CAPACITY				
Class	1 High	2 Medium	3 Low	4 Very low
Limit (cm/cm)	>23/150	15-23/150	8-15/150	0-8/150

SOIL REACTION									
Class	1	2	3	4	5	6	7	8	9
Limit (pH)	6.1-7.3	7.4-7.8	5.6-6.0	7.9-8.4	5.1-5.5	8.5-9.0	4.5-5.0	<4.5	>9.0

WATER ERODABILITY FACTOR "K" Factor				
Class	1 Low	2 Moderate	3 High	4 Very High
K Factor	<.17	.18-.28	.29-.37	>.37

Table 3-13 (cont'd)

WATER ERODABILITY GROUP

Class	Group
1	extremely erodible
2	very highly erodible
3	highly erodible
4	erodible
5	moderately erodible
6	slightly erodible
7	very slightly erodible
8	not subject to blowing

Table 3-14
Hectares and Proportionate Extent of
Soil Map Units
First Settlement Zone

SOIL MAP UNIT	AREA A	AREA B	AREA C	COMBINED AREAS	
	HECTARES	HECTARES	HECTARES	HECTARES	PERCENT
A51a	0	2,179	0	2,179	0.07
E21a	2,200	32,034	1,889	36,123	1.09
E41a	687	1,407	0	2,094	0.06
E61a	39,647	23,761	18,668	82,076	2.48
E61b	0	63,705	0	63,705	1.93
E61c	1,653	5,966	0	7,619	0.23
E61e	0	45,832	0	45,832	1.39
E61f	0	9,376	0	9,376	0.28
E61g	0	261,768	0	261,768	7.1
E61h	91,779	0	0	91,779	2.71
E61i	0	316,901	0	316,901	9.62
E61j	0	39,749	0	39,749	1.20
I11a	0	3,145	0	3,145	0.09
I11c	46,435	0	0	46,435	1.40
I11d	8,722	309	0	9,031	0.27
I11e	0	41,455	0	41,455	1.25
I11f	0	292,584	0	292,584	8.88
I12b	0	0	4,731	4,731	0.14
I12c	13,866	0	0	13,866	0.42
I12d	0	0	5,958	5,958	0.18
I12e	0	6,744	0	6,744	0.20
I12f	0	20,227	263,059	283,286	8.56
I13a	40,223	0	0	40,223	1.21
I13c	0	44,807	0	44,807	1.35
I13d	13,171	0	0	13,171	0.40

Table 3-14. (cont'd)

SOIL MAP UNIT	AREA A	AREA B	AREA C	COMBINED AREAS	
	HECTARES	HECTARES	HECTARES	HECTARES	PERCENT
I13e	0	83,434	0	83,434	2.52
I13f	0	97,391	0	97,391	2.94
I13i	0	47,101	0	47,101	1.42
I14b	0	10,758	0	10,758	0.32
I15a	0	27,003	0	27,003	0.81
I15b	9,233	0	0	9,233	0.28
I15c	189,786	0	0	189,786	5.74
I15d	0	156,831	153,313	310,144	9.38
M11a	0	82,883	0	82,883	2.51
M11b	0	5,063	0	5,063	0.15
M11c	0	13,323	0	13,323	0.40
M12a	0	18,092	0	18,092	0.55
M12b	0	68,928	0	68,928	2.08
V11a	0	0	53,406	53,406	1.61
V11b	0	129,775	0	129,775	3.92
X11a	38,818	0	0	38,818	1.17
X11b	90,961	0	0	90,961	2.75
X11c	40,291	0	0	40,291	1.22
X11d	10,319	0	0	10,319	0.31
X12a	0	177,458	0	177,458	5.36
URBAN	7,660	15,016	5,858	28,534	0.86
WATER	319	9,830	579	10,728	0.32
TOTAL	645,770	2,154,835	507,460	3,308,066	100.00

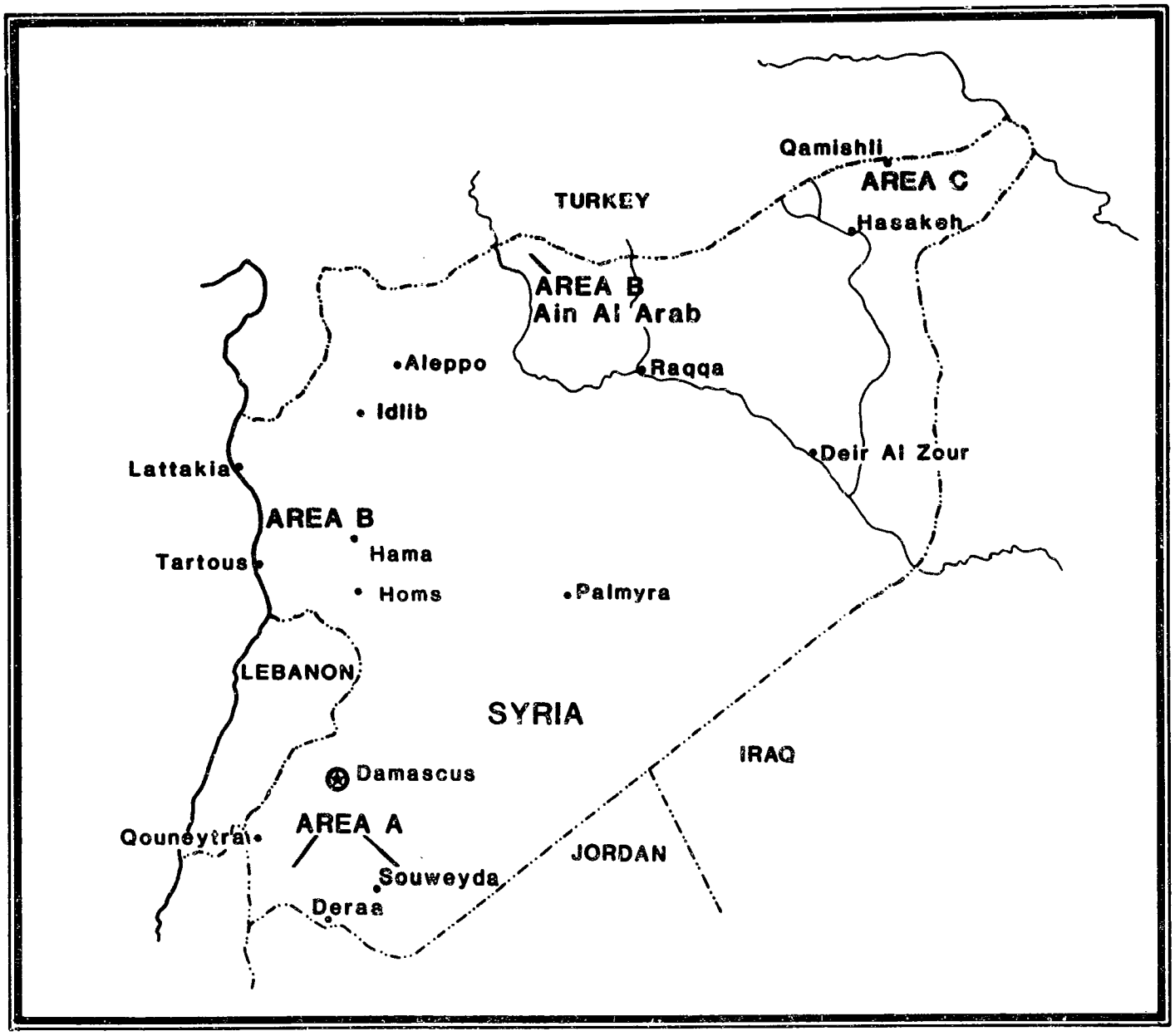

Figure 3-1.
Location of First Settlement Zone.

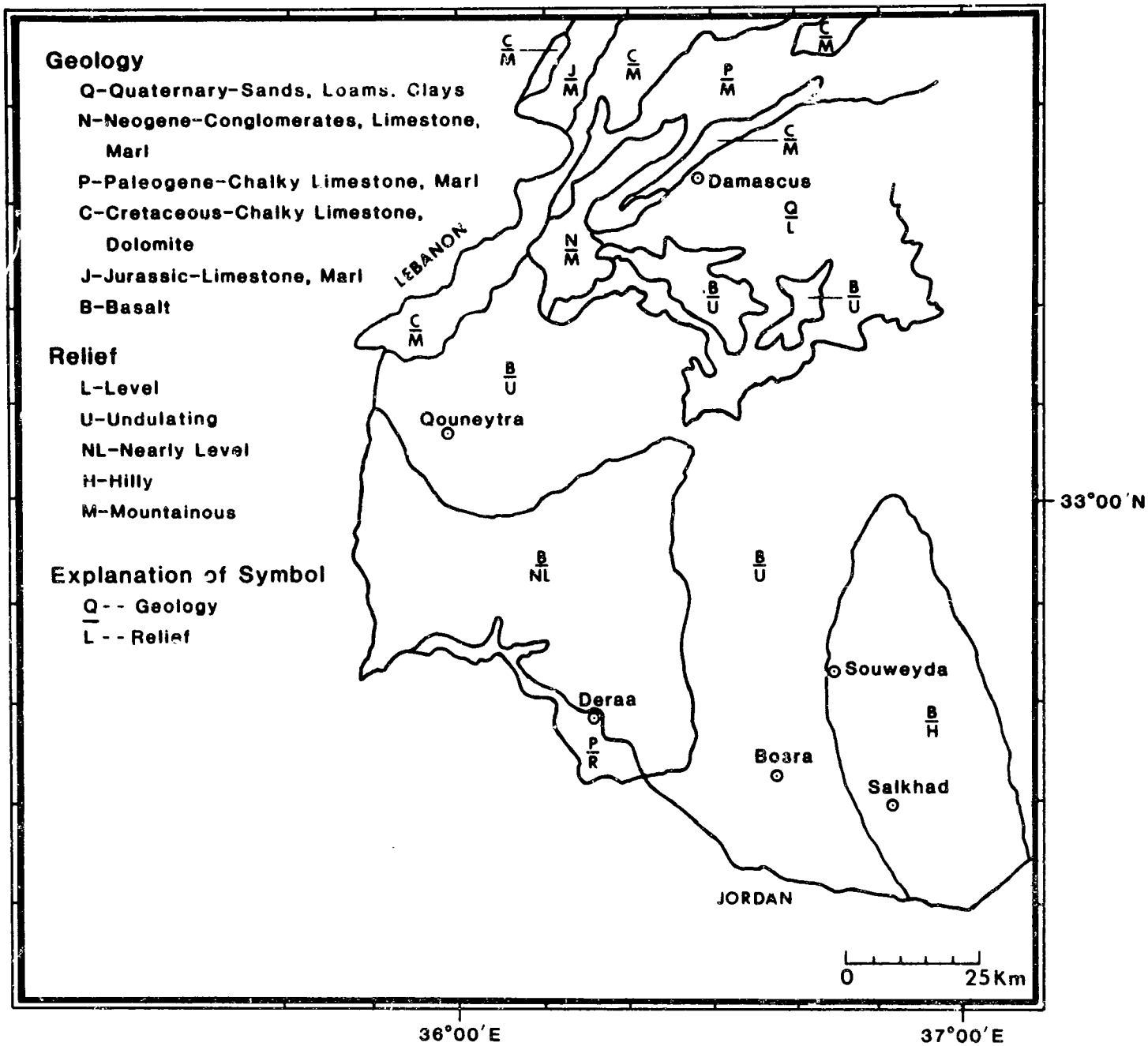

Figure 3-2.

Generalized geology and relief for Area A, First Settlement Zone.

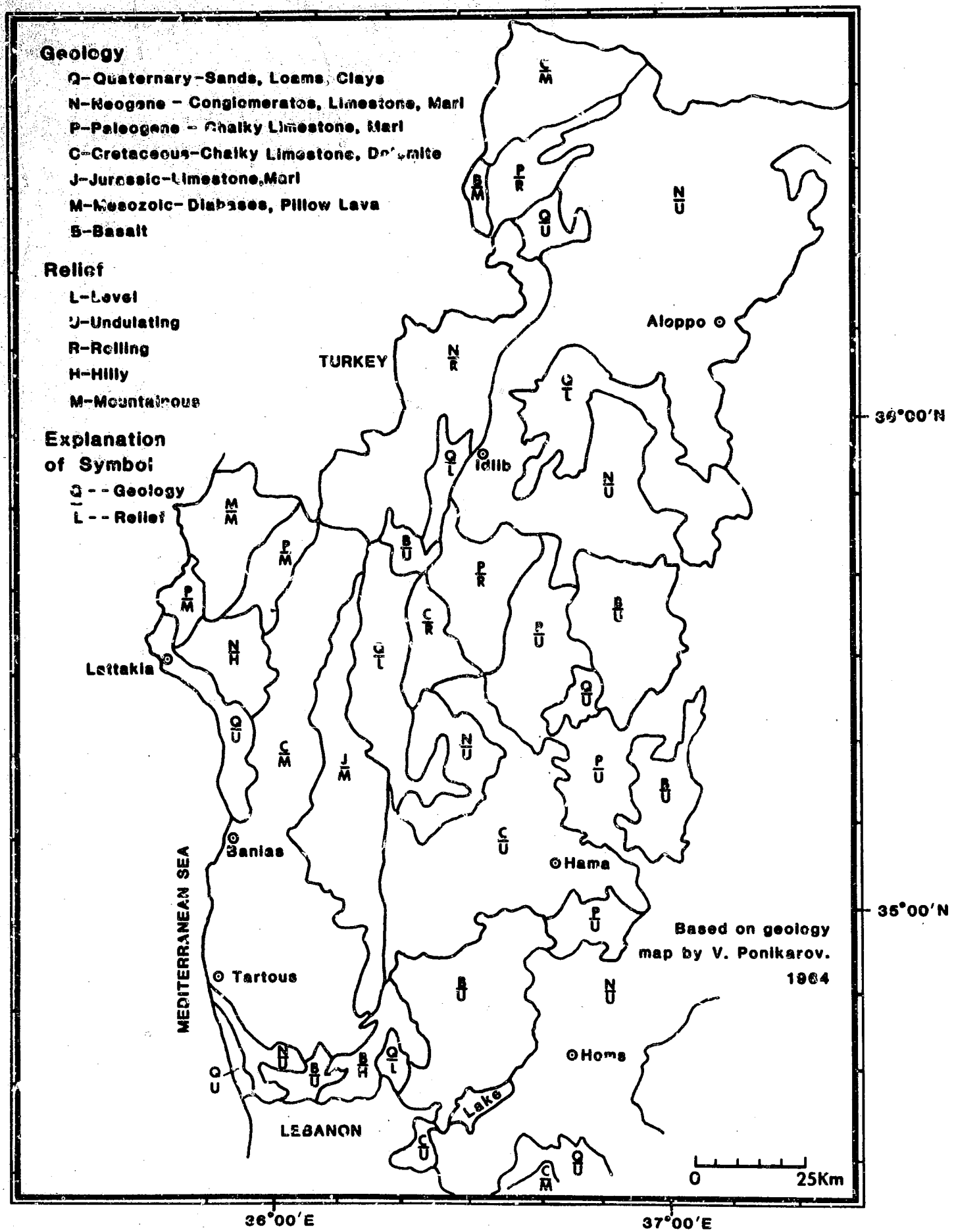

Figure 3-3.

Generalized geology and relief for Area B, First Settlement Zone.

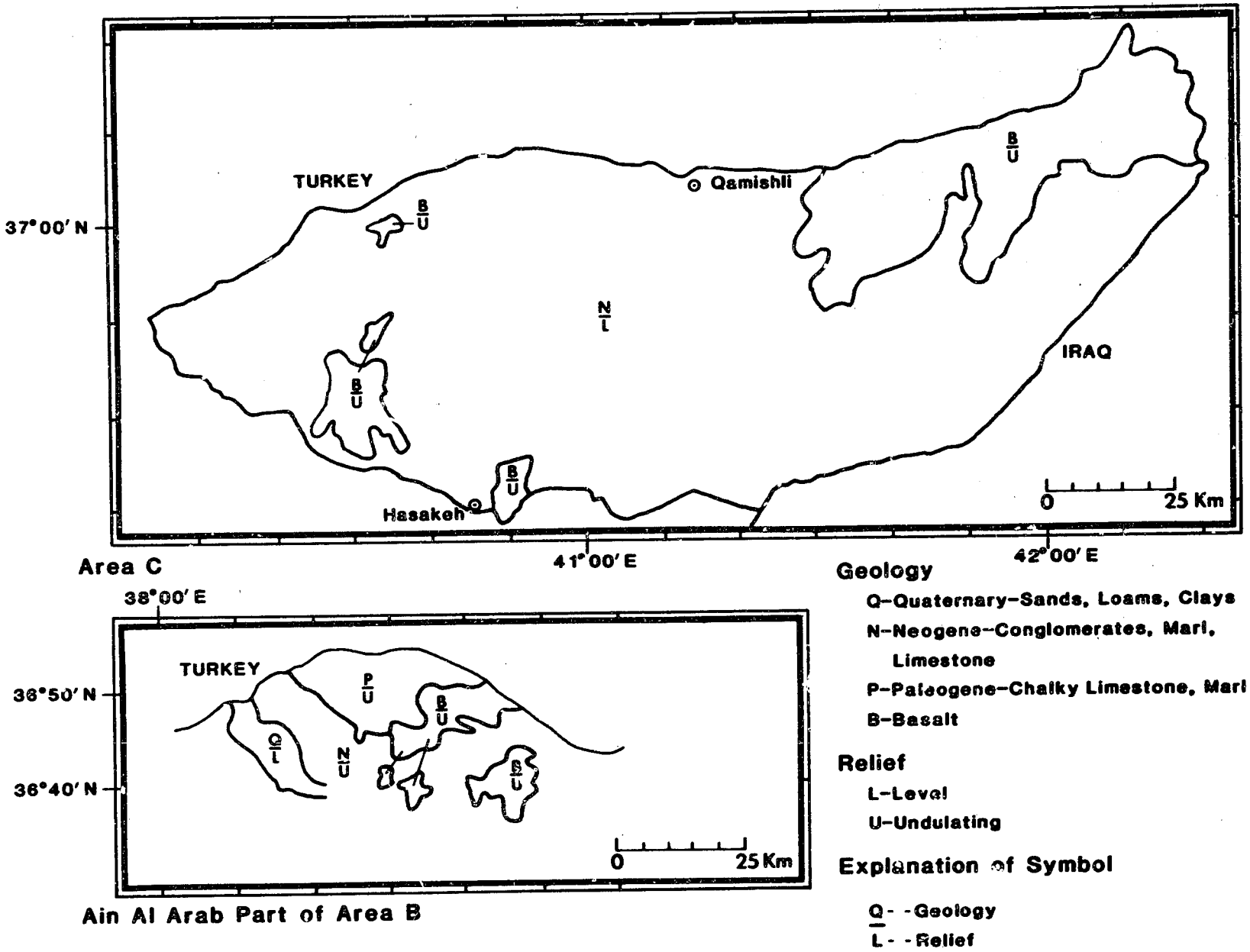

Figure 3-4.

Generalized geology and relief for Area C and the Ain Al Arab part of Area B, First Settlement Zone.

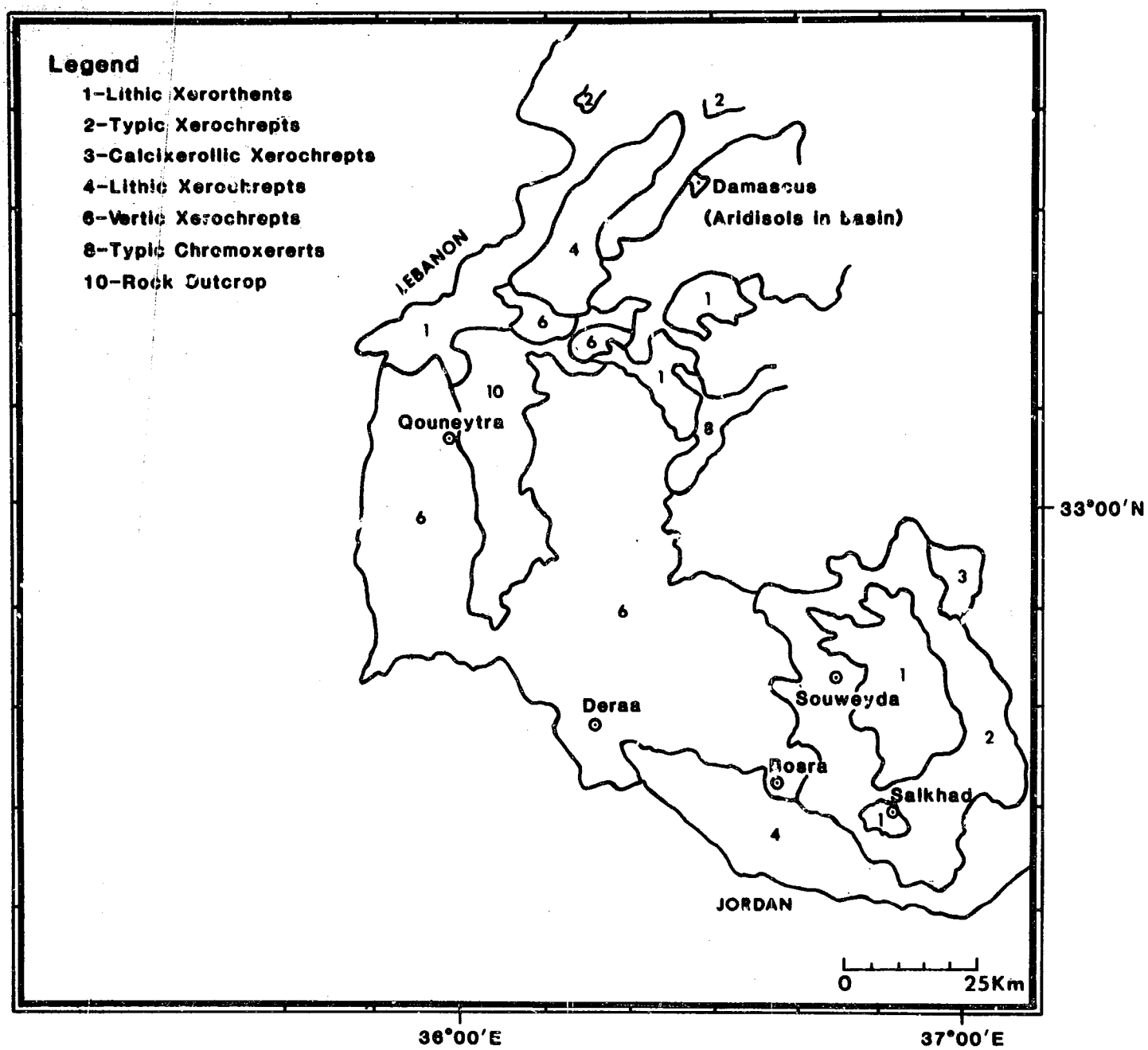

Figure 3-5.

General Soil Map of Area A, First Settlement Zone.

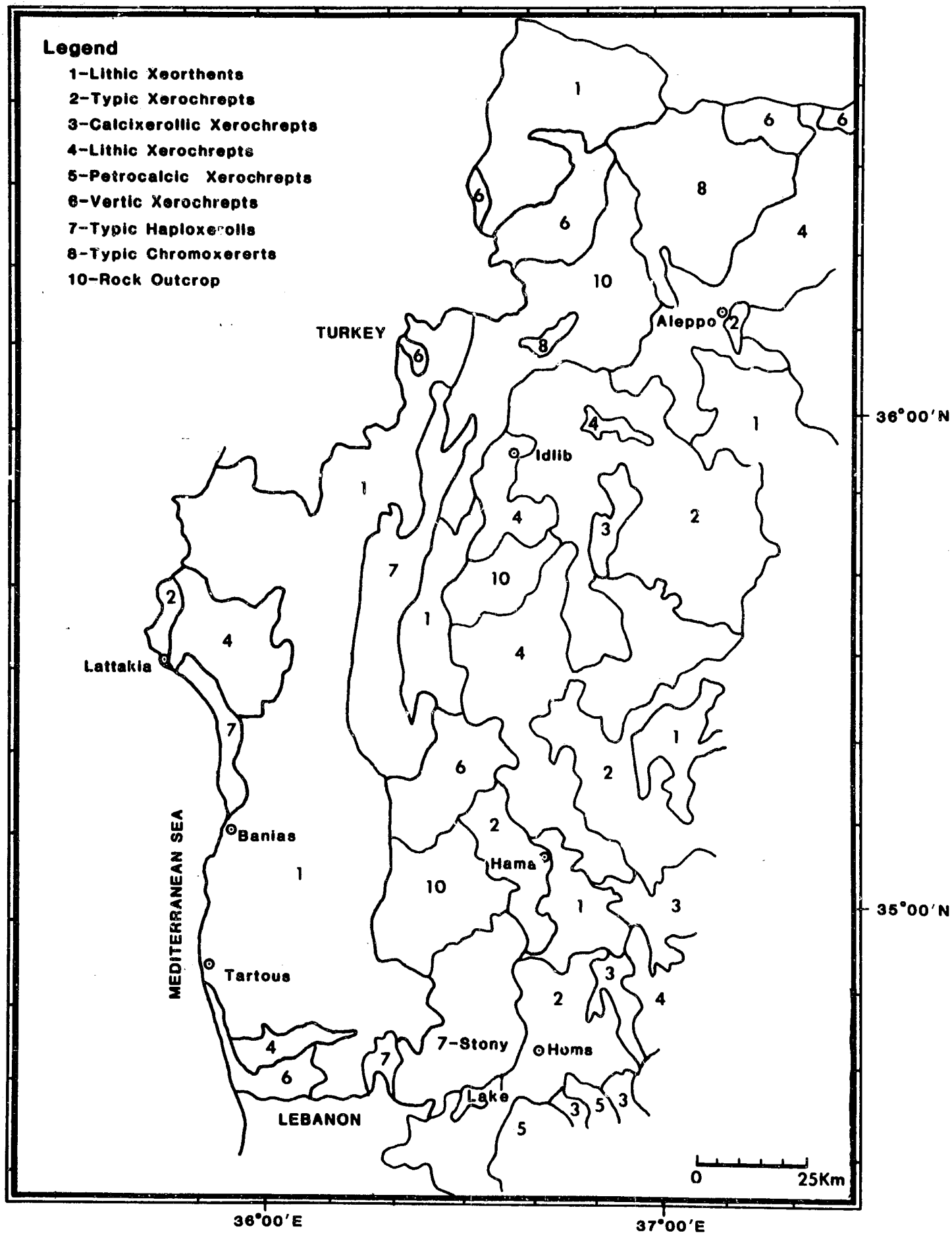

Figure 3-6.

General Soil Map of Area B, First Settlement Zone.

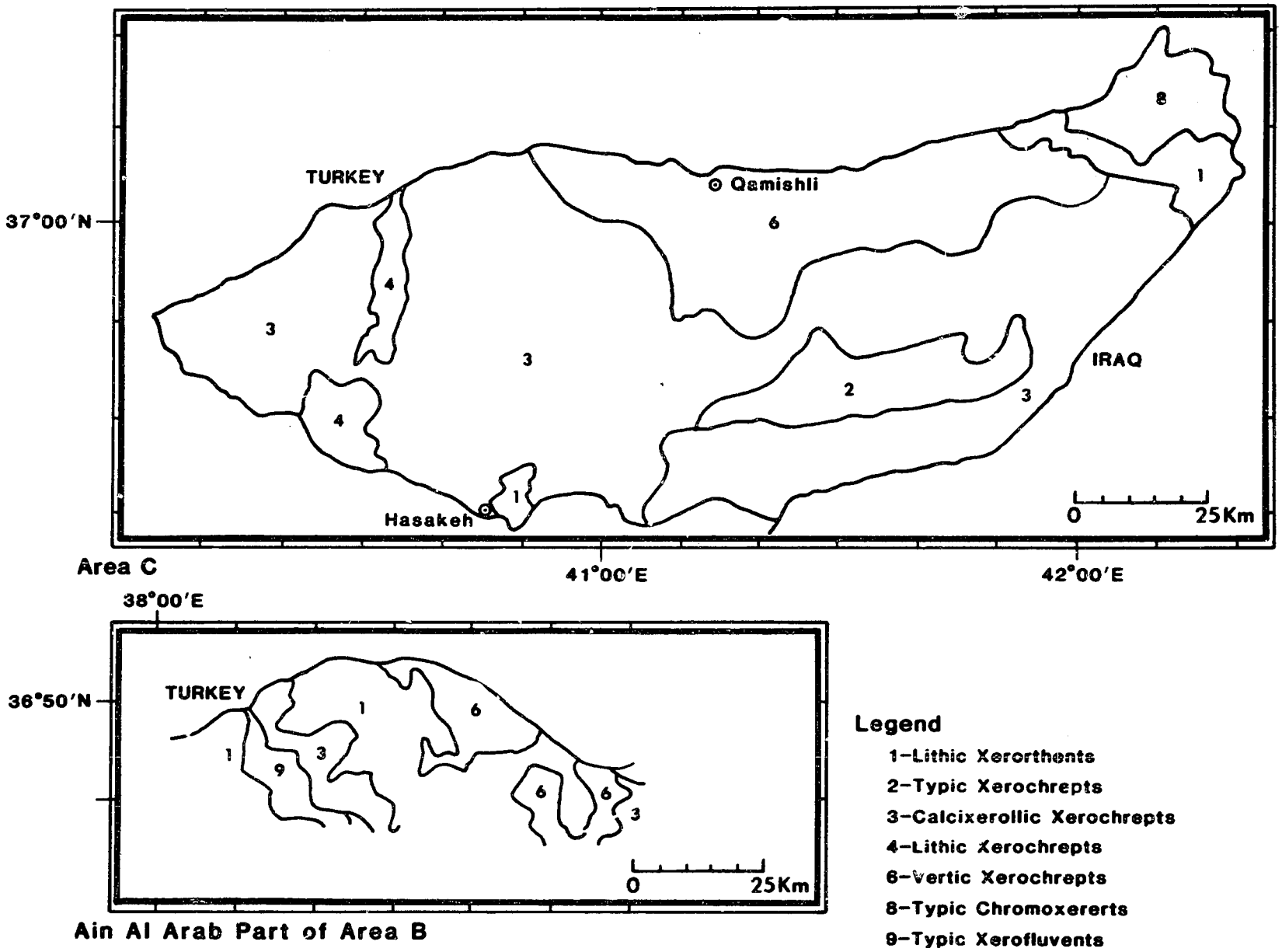

Figure 3-7.

General Soil Map of Area C and the Ain Al Arab part of Area B, First Settlement Zone.

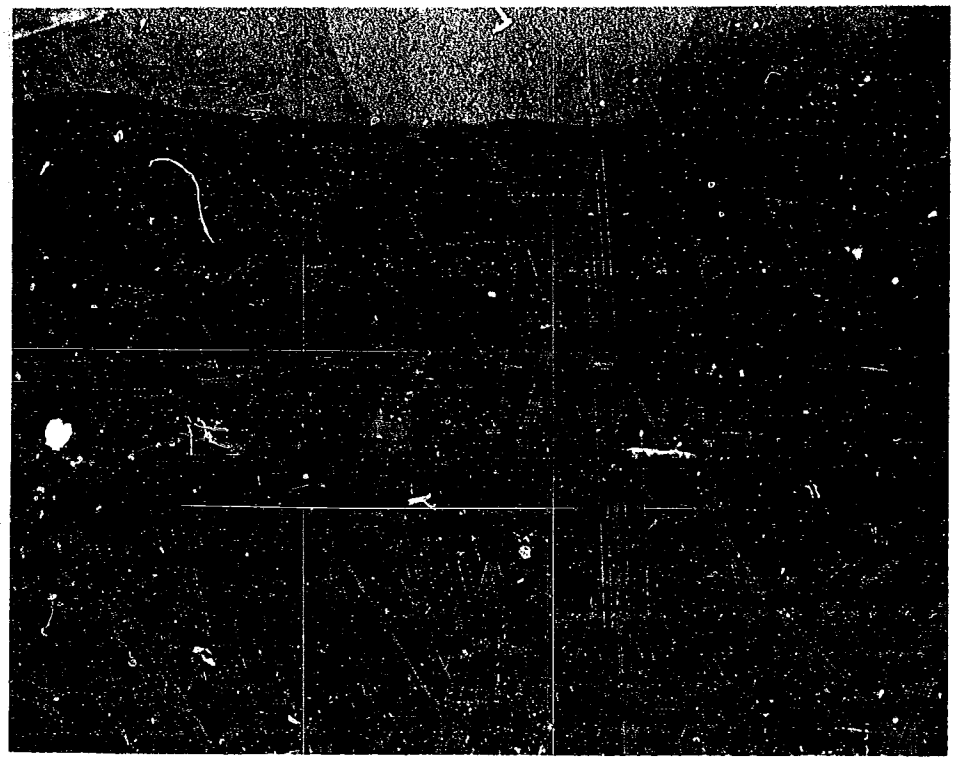

Figure 3-8.

Photograph: stony soils from basalt Area A, near Deraa (Vertic Xerochrepts)

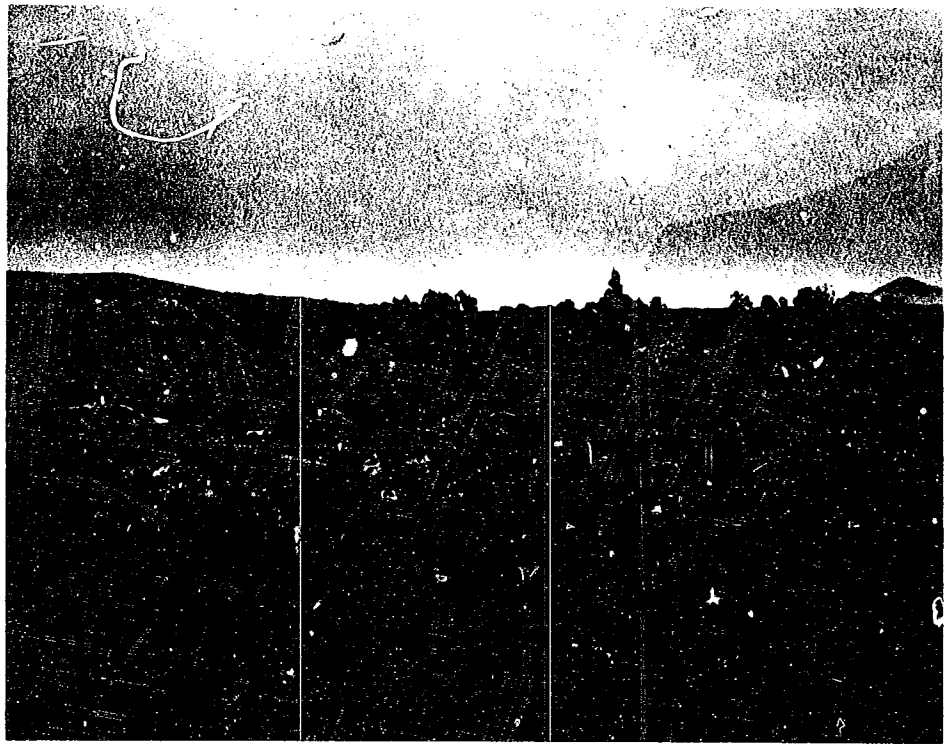

Figure 3-9.

Photograph: orchard in area of very stony soils. Area A, near Souweyda (Lithic Xerorthents)

Figure 3-10.

Photograph: terraces on steep low mountains (Lithic Xerorthents) permits limited cropping. Area B, east of Safita.

Figure 3-11.

Photograph: thin stony soil profile from Area B, east of Safita (Lithic Xerochrepts).

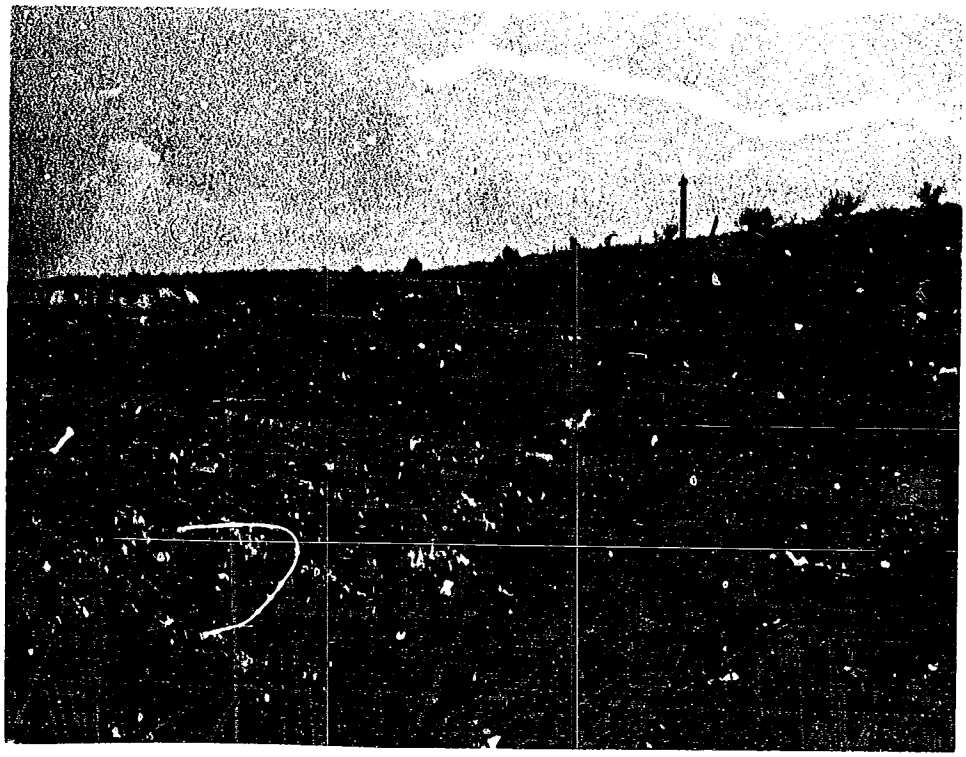

Figure 3-12.

Photograph: rolling stony soils under cultivation, Area B, northeast of Lattakia (Lithic Xerochrepts).

Figure 3-13.

Photograph: deep, nearly level soils in bay area with thin mountain soils in background. Area B, Ras al-Basit (Typic Xerochrepts and Lithic Xerorthents).

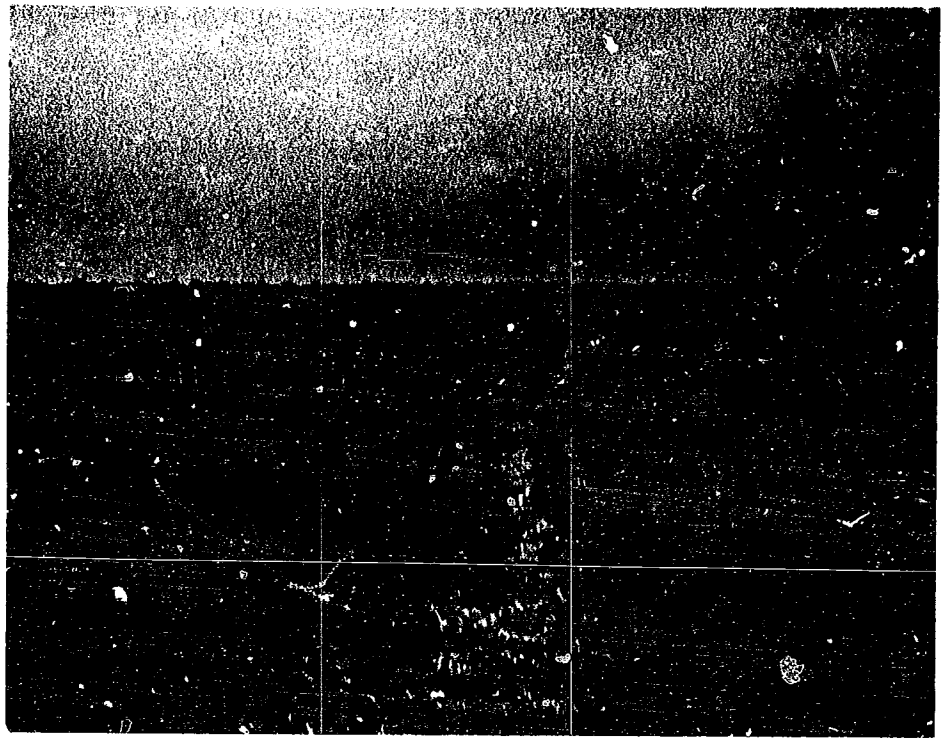

Figure 3-14. Photograph: deep, nearly level soils between Idlib and Aleppo, Area B (Typic Xerochrepts).

Figure 3-15. Photograph: rock outcrop south of Ariha, Area B.

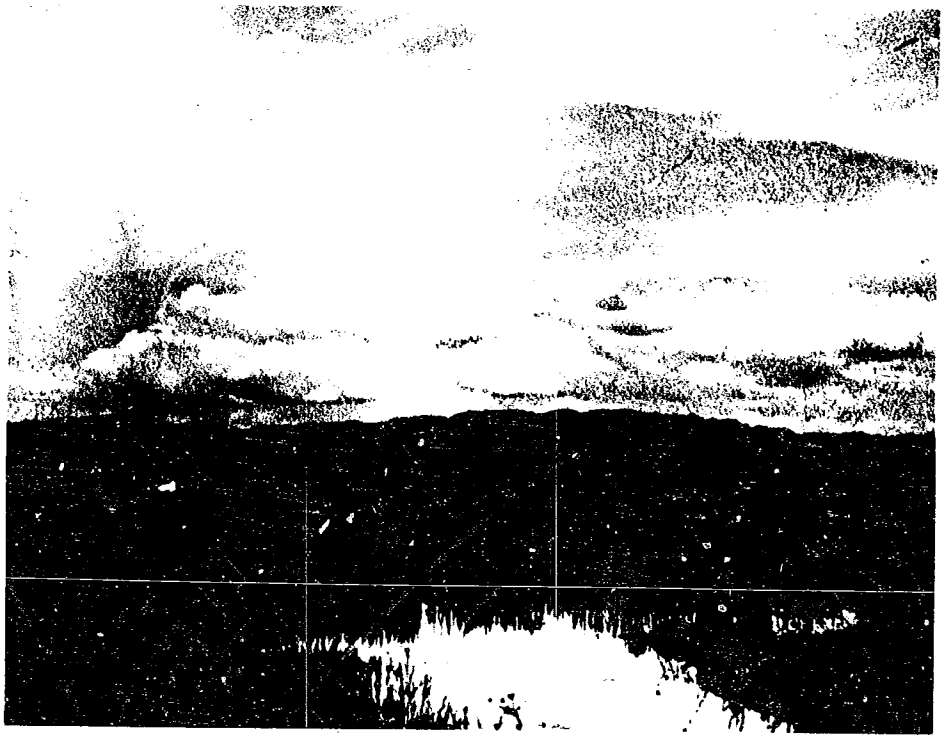

Figure 3-16.

Photograph: deep, nearly level, slowly permeable fine textured soils. Area C, Dyrik area (Typic chromoxererts).

Figure 3-17.

Photograph: soil ped from Vertisol soil. (Typic Chromoxererts)

Figure 3-18.

Photograph: cracks in the surface of vertisol soil. These soils churn during alternate wetting and drying cycles often tearing root systems of vegetation. Area C. Dyrik area (Typic Chromoxerert).

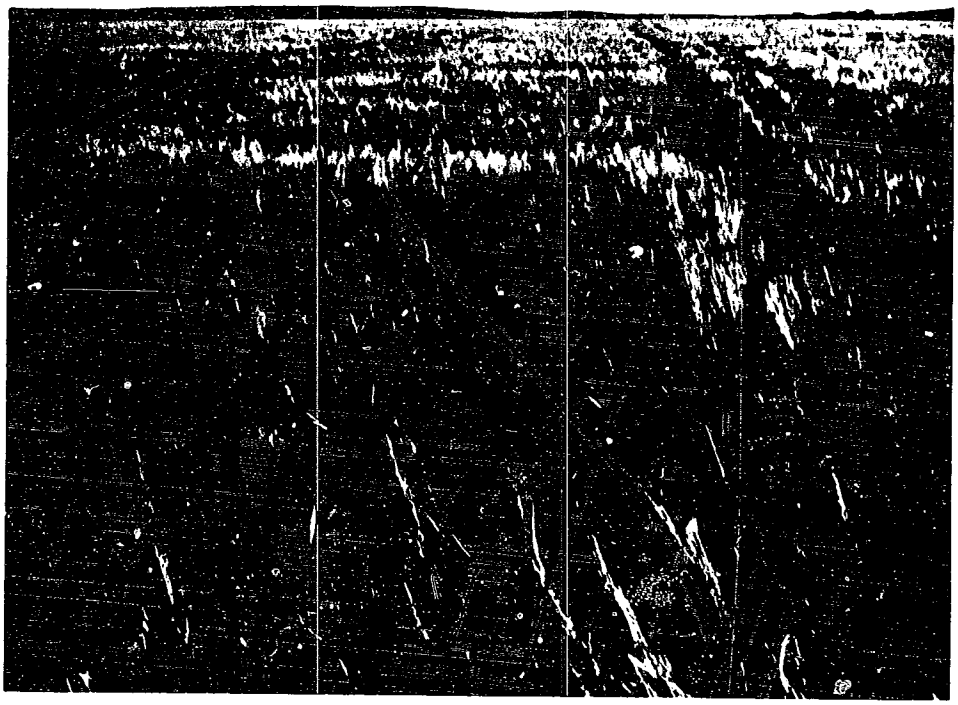

Figure 3-19.

Photograph: wheat on nearly level, deep productive soils. Area C, south of Quamishli: (Calcixerollic Xerochrepts).