

Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture, is that land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high crop yields if acceptable farming methods are used. Prime farmland produces the highest yields with minimal inputs of energy and money, and farming it results in the least damage to the environment. Prime farmland is of major importance in satisfying the nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and it should be used with wisdom and foresight.

Prime farmland is either currently used for producing food or fiber or is available for this use. Urban or built-up land or water areas are not considered prime farmland.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It has favorable temperature and growing season and acceptable reaction. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods or frequently flooded during the growing season. The slope ranges mainly from 0 to 4 percent.

About 30,000 acres, or about 3 percent of Washoe County, South Part, meets the soil requirements for prime farmland provided adequate irrigation water is available. Areas are scattered throughout the survey area, but most are in the central part. About 6,500 acres are presently irrigated.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to transportation, industrial, and urban uses. The loss of prime farmland to other uses results in more intensive use of marginal lands, which generally are more erodible, more droughty, more difficult to cultivate, and less productive.

The map units that make up prime farmland in

Washoe County, Nevada, South Part are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The use and management of the soils are described in the section "Detailed Soil Map Units."

The map units that meet the soil requirements for prime farmland are:

- 130 Greenbrae sandy loam, clayey substratum, 0 to 2 percent slopes
- 131 Greenbrae sandy loam, 0 to 2 percent slopes
- 132 Greenbrae sandy loam, 2 to 4 percent slopes
- 200 Northmore sandy loam, 0 to 2 percent slopes
- 201 Northmore sandy loam, 2 to 4 percent slopes
- 445 Jubilee sandy loam, drained
- 460 Surprise loamy sand, 2 to 4 percent slopes
- 570 Turria loam
- 595 Springmeyer sandy clay loam, 0 to 2 percent slopes
- 600 Idlewild clay loam, drained
- 601 Idlewild sandy loam, drained
- 623 Orr sandy loam, 0 to 2 percent slopes
- 624 Orr gravelly sandy loam, 0 to 2 percent slopes
- 800 Truckee silt loam
- 810 Rose Creek fine sandy loam, drained
- 812 Rose Creek loamy fine sand, drained
- 813 Rose Creek gravelly fine sandy loam, drained
- 971 Aladshi sandy loam, 2 to 4 percent slopes
- 1040 Orr Variant gravelly sandy loam
- 1041 Orr Variant coarse sandy loam, thin surface
- 1130 Dithod sandy loam
- 1141 Bedell loamy sand, 2 to 4 percent slopes
- 1170 Wedertz sandy loam, 2 to 4 percent slopes
- 1300 Rose Creek Variant sandy loam
- 1301 Rose Creek Variant loamy fine sand

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Richard MacDougall, district conservationist, Soil Conservation Service, helped write this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated

yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The goal of good cropland management is to produce the greatest amount of the most needed crops, while protecting and improving the soil. To achieve this goal, the land must be protected according to its needs and used within its capabilities. This can be done by using plants that are well suited to the soil, applying soil management practices that protect the soil, and keeping the soil in good condition.

In the following paragraphs, the principal soil management practices needed in the survey area are described generally. Although the soils in the area differ in management needs, certain practices apply to all the cultivated soils.

Conservation cropping systems involve growing crops in accordance with needed cultural and management practices. In a good conservation cropping system, the benefits gained from soil-improving crops and proper management practices more than offset the effects of soil-depleting crops.

Some soil-improving practices are using rotations that include grasses and legumes, returning crop residue to the soil, proper tillage, adequate fertilization, and weed and pest control. Several cropping systems are used in the survey area. A typical one is alfalfa for 8 to 10 years, small grain for 2 years, and then alfalfa with a protective nurse crop of oats. The crop residue from the small grain is returned to the soil. Minimum tillage is used.

Crop residue management is the use of plant residue left in cultivated fields to add organic matter and control erosion. Residue is incorporated into the soil or is left on the surface during the part of the year when erosion is likely to occur. The organic matter benefits the soil by improving soil tilth and structure. Organic matter functions mainly as it decomposes. Applying nitrogen fertilizer to the soil aids decomposition.

It is particularly important that organic matter be continuously returned to the soil. The easiest and most common way to add organic matter to the soil is to return residue from crops. Unless sufficient crop residue

is returned to the soil, the physical condition of the soil declines, the soil becomes compacted, and slower water infiltration and poorer aeration result.

Erosion control prevents the excessive wearing away of the land surface by wind and running water. Protecting the surface layer is important because the surface layer contains most of the organic matter and generally is more fertile than the subsoil. Wind erosion can be controlled by maintaining a cover of crop residue or living plants during the winter windy period, October 15 to April 15. Leveling the soil to the proper grade and applying water at the proper rate help to control water erosion on irrigated land.

Addition of plant nutrients. Most of the irrigated soils used for crops in this survey area respond well to liquid or solid fertilizer. The specific fertilizer needed depends on the crop grown and the nutrient content of the soil. Applying fertilizer that contains nitrogen and phosphorus increases yields for small grain and aids in establishing alfalfa. Sufficient phosphate for the life of the alfalfa stand should be added except where the soil contains enough available phosphorus. Manure adds some nitrogen, phosphate, and potassium to the soil and promotes good tilth. If barnyard manure is available, it can be used with good results before planting corn or small grain.

Irrigation water management is the application of irrigation water at rates and in amounts that insure high crop production and minimize soil and water losses. It is needed in all irrigated areas. Good irrigation is the application of water according to crop needs and soil characteristics.

Efficient delivery of water to farms is the first step in supplying the moisture needed for growing crops. A good distribution system has enough capacity to meet the needs of the crops to be irrigated, is located and controlled so that seepage losses are minimal, and carries the required flow safely.

An efficient system for transporting water to the individual fields on a farm or ranch is designed and constructed to carry the required flow without excessive seepage and erosion. Control structures are needed to facilitate the handling of water.

The design of an irrigation system is governed by the method of irrigation to be used, the amount of land leveling needed, and the desired efficiency in applying water.

To apply water efficiently, a farmer needs to know the available water capacity of the soil, the rate that water enters and moves through the soil, and the amount of water required by the crop. Most crops should be irrigated when 40 to 50 percent of the available moisture in the top half of the root zone has been used. A soil check can be made 2 days after irrigation to determine whether the desired amount of moisture was added. Except when reclaiming saline-alkali soils, applications of irrigation water should be adjusted to the available water

capacity, the water intake rate, and the crop needs to avoid over-irrigating, leaching of plant nutrients, and aggravating any existing high water table condition.

Managing saline soils. Like most soils in arid and subarid regions, the soils in this survey area contain at least small quantities of soluble salts and alkali. Because rainfall is low and the rate of evaporation is high, percolating rainfall is insufficient to leach salts out of the root zone. In some soils, high concentrations of salts and alkali limit or prevent the growth of crops. In addition, many low-lying areas receive salty water from runoff or seepage. Surface evaporation of this water generally results in an increase of soluble salts on or in the soils. In some areas that have a high water table, water rises in the soil by capillary action and carries dissolved salts with it. The soluble salts are readily dissolved in water and can be moved to any part of the soil profile.

A soil that contains excessive amounts of soluble salts is called a saline soil. One that contains excessive amounts of adsorbed sodium is called an alkali soil. A soil that contains excessive amounts of both soluble salts and alkali is a saline-alkali soil.

Saline phases of several of the soils in the survey area have been mapped. The map unit name does not give the degree to which these soils are affected nor does it indicate whether the soils contain both salt and alkali. This information is given in the map unit description. In this survey area, three saline and alkali classes are used as soil phases.

Class 1 soils are free of excess salts and alkali. These soils contain less than 0.15 percent salts, and the conductivity of the saturation extract is less than 4 millimhos per centimeter at 25 degrees C. The content of exchangeable sodium is less than 15 percent.

Class 2 soils are slightly saline-alkali soils. These soils contain 0.15 to 0.35 percent salts, and the conductivity of the saturation extract is 4 to 8 millimhos per centimeter at 25 degrees C. The content of exchangeable sodium is 15 to 20 percent for soils of moderately coarse, medium, moderately fine, and fine texture.

Class 3 soils are strongly saline-alkali. These soils contain more than 0.65 percent salts, and the conductivity of the saturation extract is more than 16 millimhos per centimeter at 25 degrees C. The content of exchangeable sodium is more than 25 percent for soils of moderately coarse, medium, moderately fine, and fine texture.

Although there is a distinct gap between the second and third classes, an intermediate class is not needed in this survey area because only a very small percentage of the samples analyzed was moderately saline-alkali.

Some soils mapped as slightly saline-alkali are free of excess salts and alkali in the upper 4 or 5 inches, but they contain slight or moderate concentrations just below

the plow layer. Several soils mapped as strongly saline-alkali are only slightly affected in the plow layer.

Soils differ in the kinds of salt they contain and in the practices needed for improvement. For this reason, each soil requires individual treatment; however, some general guidelines can be given.

A good supply of irrigation water and adequate drainage must be provided to reclaim any soil in this survey area. The most common method of applying water for reclamation is to level the areas to a uniform grade and then to flood them between border dikes. If drainage is adequate and large amounts of water are used, this method is effective in leaching the soluble salts out of the root zone.

Proper pasture management is grazing pasture at a rate that maintains high-quality grasses and legumes. This can be accomplished by adjusting the stocking rates or season of use to allow maximum growth and survival of plants.

A common method of pasture management is to use several pastures in a rotation system that allows adequate regrowth in each. Livestock should be kept off the pastures when the soil is wet. Grazing when the pastures are wet results in compaction of the soil, a decrease in the rate of water intake, and destruction of soil structure. Pastures should be properly irrigated, and drainage should be provided. Increased yields can be obtained by applying commercial fertilizers and barnyard manure if it is available. Weeds generally can be controlled by mowing. Droppings of manure should be spread with a drag each spring.

Proper hayland management is the treatment and use of hayland to prolong the life of desirable forage plants, to maintain or improve the quality and quantity of the forage, to protect the soil, and to reduce water loss. Management includes the establishment and renovation of hayfields with long-term stands of adapted plants.

An important way to increase yields is to use adapted plants. To renovate and establish hayland, the plants selected should withstand climatic extremes and produce high yields during a relatively short growing season. High-quality, certified seed should be planted. Legume seeds should be inoculated. Land leveling and planing should be completed prior to preparing the seedbed. To control weeds, provide final smoothing, and control erosion, an annual crop should be grown for a year before reestablishing a forage crop. Seed can be drilled directly into the stubble of the annual crop.

Disease can be controlled by the use of resistant plants, crop rotation, and proper irrigation management.

Fertilization is essential to insure that growth is not limited. The amount needed depends on the properties of the soil and the plants grown.

The frequency and amount of irrigation water applied depends on the available water capacity of the soil and the rate of evapotranspiration.

Drainage is a major concern in some parts of this survey area. In some places where the water table has been lowered, the production of alfalfa hay, meadow hay, and pasture has been greatly increased.

The soils on some of the lower flood plains in the area have a fluctuating water table. Excessive irrigation has helped to raise the water table in some of the lower lying soils.

In soils that are inadequately drained, soluble salts and alkali accumulate, retarding or preventing the growth of crops. The inadequately drained soils are also poorly aerated, which reduces the growth of plants and increases their susceptibility to diseases.

Even in saline or alkali soils that are moderately well drained to well drained, a drainage system must be installed if the soils are to be reclaimed. For reclamation, large amounts of water must be used to leach the salts from the root zone and drains must be built to dispose of surface and subsurface water.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the map unit descriptions. In any given year, yields may be higher or lower than those indicated because of variations in weather, length of growing season, and other climatic factors or damage from insects.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue and barnyard manure; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the map unit descriptions are grown in the survey area, but estimated yields are not listed because the acreage of such crops

is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

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 slight 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 for cultivation.

Class VIII soils and miscellaneous areas 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, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is

limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class 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. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Soils adjacent to the Reno-Sparks metropolitan area and the soils in outlying valleys that are rapidly urbanizing are not included in table 5 although these soils have small areas that still support native plants. Because of urbanization, range management decisions are site specific in this area. Onsite assistance can be obtained by contacting the local office of the Soil Conservation Service.

Table 5 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to use as rangeland are listed. Explanation of the column headings in table 5 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important. Detailed descriptions of the range sites are in the Technical Guide available at the local office of the Soil Conservation Service.

Total production is the amount of vegetation that can be expected to grow annually on well managed

rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to manage grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland Management and Productivity

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *x*, *w*, *t*, *d*, *c*, *s*, *f*, and *r*.

In table 6, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Minimizing the risk of erosion is essential when harvesting timber. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and sloughing. Excavation for roads increases the hazard of erosion. Access roads should be designed to provide adequate cut-slope grade. Drains are needed to control surface runoff and keep soil losses to a minimum.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is

expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants. After harvesting, reforestation should be managed to reduce competition from undesirable understory plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production. Selecting tree species that are adapted to the soil is important in reforestation, whether reforestation is done primarily to grow commercial forests or to reduce soil erosion.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing by livestock or wildlife, or by both, without damage to the trees. Careful management, however, is important when grazing by livestock is a planned use of woodland. Animals can trample and compact soil, injure shallow roots, and bruise tree seedlings and sprouts.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on

measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet,

are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Fish and Wildlife Habitat

Norman Ritter, state resource conservationist, Soil Conservation Service, helped prepare this section.

Wildlife is a valuable resource in Washoe County. The rapid rate of urban development in the area increases the importance of improving and maintaining wildlife habitat.

Fish Habitat

Sport fishing is of considerable importance in the survey area. The Truckee River is the principal stream in the area and is heavily fished throughout the year. Smaller streams that rise on the flanks of the Sierras and a few small lakes also provide sport fishing.

These streams and small lakes support some natural reproduction. Fishing in Washoe County, however, depends mainly on annual stocking from state and federally-supported hatcheries. The rapid urbanization results in increases in both the number of people fishing the waters of the area and the amount of sediment and chemical pollutants entering the waters. Under these conditions, natural propagation is decreasing and hatchery stocking is becoming more important. As the physical habitat deteriorates, other fish of perhaps less desirable species may become dominant in the degraded waters.

The Nevada Department of Wildlife's Verdi Fish Hatchery on the Truckee River produces the Lahontan strain of cutthroat trout, a fish native to the survey area. The Pyramid Lake Indian tribe also operates a hatchery near Sutcliffe on the shores of Pyramid Lake. They specialize in propagating cutthroat trout and Cui-ui (lakesuckers), both of which have declined in numbers in recent years.

Several introduced game fish, such as brook and brown trout, have become established in the upper reaches of streams. Rainbow trout and whitefish also

inhabit the cooler stream areas. The introduced Sacramento perch is becoming an important part of the Pyramid Lake fishery, especially during spring. The introduced carp have become established in the lower, warmer reaches of streams. Other warm-water fishes, such as largemouth bass, sunfish, and crappie, have been introduced into privately-owned ponds and storage reservoirs. These areas generally are not open to public fishing.

Terrestrial Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

Several kinds of soils and a combination of land uses are generally needed to provide all the habitat elements needed by a specific type of wildlife. For this reason, interpreting the Washoe County soils for specific wildlife uses can best be done by referring to the section "General Soil Map Units."

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are Sandberg bluegrass, Indian ricegrass, and globe mallow.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of

the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, fir, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include quail, pheasant, meadowlark, field sparrow, and cottontail.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

In the following paragraphs, the general soil map units of the survey area are described as wildlife areas that differ in species potentially supported and in environmental factors.

Wildlife Area 1 is in general soil map unit 1. The soils in this area are nearly level and are on flood plains of the Truckee River and smaller streams. These soils provide suitable habitat for a wide variety of wildlife because of the amount of water available, the meadow vegetation and scattered patches of willows on the

poorly drained soils, and the big sagebrush and basin wildrye on the better drained soils of minor extent.

Wildlife species in this area include mink, cottontail, shore birds, ducks, geese, valley quail, and muskrat. Most of the wildlife is dependent on the meadows and the shallow water areas, and management should be directed toward improving or maintaining these areas. In the cultivated areas, fence rows and ditchbanks can be planted with desirable plants to make a more attractive habitat for quail and other openland wildlife.

Wildlife Area 2 is in general soil map units 2 and 6. This area is in the valleys on low-lying alluvial fans and low terraces. The native vegetation is mostly big sagebrush and Indian ricegrass on the alluvial fans and black greasewood and basin wildrye on the salt- and alkali-affected terraces.

Wildlife species in this area include jackrabbit, cottontail, coyote, badger, weasel, magpie, crow, and valley quail. The habitat in this area can be enhanced by properly locating watering facilities. In cultivated areas, planting desirable plants along fence rows and ditchbanks provides a more attractive habitat for openland wildlife.

Wildlife Area 3 is in general soil map units 3, 4, 5, and 9. The soils in this area are dry. They are on alluvial fans, terraces, and foothills. The native vegetation is mostly shadscale, bud sagebrush, and Indian ricegrass.

Wildlife species in this area include a few jackrabbits, ravens, kangaroo rats, and rattlesnakes. Dryness limits the management of this area. The habitat can be improved by properly locating watering facilities.

Wildlife Area 4 is in general soil map units 7, 8, 10, 11, and 12. This area is on the higher lying alluvial fans and terraces, foothills, and low mountain areas. The native vegetation includes big sagebrush, bitterbrush, low sagebrush, and grasses. Some areas support pinyon and Utah juniper.

Wildlife species in this area include sage grouse, chukar, dove, vultures, Stellar jays, mule deer, antelope, and a few mountain lions. Proper grazing use is a good management practice in this area. The habitat in this area can be improved by properly locating watering facilities.

Wildlife Area 5 is in general soil map units 13 and 14. This area is on mountain slopes. The native vegetation is mostly big sagebrush, bitterbrush, low sagebrush, mountainmahogany, and grasses. Some areas support Jeffrey pine.

Wildlife species in this area include mule deer, marmot, ground squirrel, spruce grouse, mountain quail, and golden eagle. Small seeps and wet areas provide water for most of this area. Proper grazing use is a good management practice in this area.

Wildlife Area 6 is in general soil map units 15, 16, 17, and 18. This area is on higher mountains in the Carson Range. The native vegetation is mostly conifer trees. Some included soils support sagebrush-grass, wet

meadows, and areas of quaking aspen in snow pockets. These soils contribute significantly to the overall potential of the habitat, and good management is needed.

Wildlife species in this area include mule deer, black bear, mountain beaver, snowshoe hare, bandtailed pigeon, sparrow hawk, and the introduced Merriam turkey. The habitat in this area can be improved by proper watershed and timber management.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes

for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic

layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent,

surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the

ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined

by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5

feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system

adopted by the American Association of State Highway and Transportation Officials (7).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of

soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and Water Features

Tables 15 and 16 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups, shown in table 15, are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or

soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An

artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. Only saturated zones within a depth of about 6 feet are indicated.

Depth to bedrock is given in table 16 if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the

freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (4, 17). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Aridisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Orthid (*Orth*, meaning truer, plus *id*, from Aridisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Camborthids (*Camb*, meaning change, plus *orthid*, the suborder of the Aridisols).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Camborthids.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties

and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy-skeletal, mixed, mesic Typic Camborthids.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (16). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (17). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Acrelane Series

The Acreland series consists of shallow, well drained soils on uplands. These soils formed in residuum derived from granodiorite. Slopes are 8 to 50 percent.

Typical pedon of Acrelane very stony sandy loam, in an area of Acrelane-Rock outcrop complex, 1,300 feet east and 600 feet south of the northwest corner of sec. 10, T. 20 N., R. 19 E.

A11—0 to 1 inch; brown (10YR 4/3) very stony sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine

- interstitial pores; 50 percent fine pebbles, 5 percent cobbles, 5 percent stones; slightly acid; abrupt wavy boundary.
- A12—1 to 3 inches; brown (10YR 5/3) gravelly loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine and fine vesicular pores; 15 percent pebbles; slightly acid; clear wavy boundary.
- B1—3 to 6 inches; brown (10YR 5/3) gravelly coarse sandy loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine interstitial pores; common thin clay coatings and bridges; 15 percent pebbles; neutral; clear wavy boundary.
- B2t—6 to 10 inches; reddish brown (5YR 4/4) very gravelly sandy clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable, sticky and plastic; common very fine roots; common very fine interstitial pores; many thin clay films in pores; 50 percent pebbles; neutral; abrupt wavy boundary.
- C1r—10 to 60 inches; decomposed granodiorite that has fractures and cracks plugged with clay; can be dug with hand tools, but contains some hard masses of rock that are the size of boulders.
- The thickness of the solum and the depth to weathered bedrock range from 10 to 20 inches. Reaction in the A1 horizon is medium acid to slightly acid. The Bt horizon is very gravelly sandy clay loam or very gravelly coarse sandy loam. Reaction in the B horizon is neutral or mildly alkaline. The B2t horizon is 18 to 30 percent clay and 35 to 60 percent gravel.
- Aladshi Series**
- The Aladshi series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 8 percent.
- Typical pedon of Aladshi sandy loam, 2 to 4 percent slopes, 400 feet east and 1,700 feet north of the southwest corner of sec. 3, T. 22 N., R. 21 E.
- A11—0 to 1 inch; brown (10YR 5/3) gravelly sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; few very fine roots; common very fine vesicular and interstitial pores; 15 percent pebbles; slightly acid; abrupt smooth boundary.
- A12—1 to 5 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular pores and few very fine tubular pores; slightly acid; abrupt wavy boundary.
- A13—5 to 7 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; slightly acid; abrupt wavy boundary.
- B21t—7 to 12 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak medium prismatic and angular blocky structure; hard, friable, sticky and plastic; common very fine, fine, and medium roots; common very fine tubular pores; many thin clay films coating ped faces; 10 percent pebbles; neutral; clear wavy boundary.
- B22t—12 to 23 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; moderate fine prismatic and subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; common thin clay films on faces of peds and in pores, few moderately thick clay films on faces of peds; 15 percent pebbles; moderately alkaline; clear wavy boundary.
- B3tca—23 to 34 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; few thin clay films bridging sand grains; common fine lime filaments or threads; 20 percent pebbles; moderately alkaline; clear wavy boundary.
- IIc1si—34 to 44 inches; brown (7.5YR 5/4) weakly silica-cemented very gravelly loam, dark brown (7.5YR 4/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine tubular pores and common very fine interstitial pores; few thin clay films bridging sand grains; common fine lime filaments or threads; 55 percent pebbles; moderately alkaline; gradual wavy boundary.
- IIc2—44 to 60 inches; pinkish gray (7.5YR 6/2) extremely gravelly sandy loam, dark brown (7.5YR 4/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores and common very fine interstitial pores; few fine lime filaments or threads; 65 percent pebbles; moderately alkaline.
- The solum ranges from 20 to 34 inches in thickness. Reaction in the A1 horizon is slightly acid or neutral. The Bt horizon is sandy clay loam, loam, or gravelly loam that is 18 to 27 percent clay. It is 5 to 20 percent rock fragments. Reaction in the Bt horizon is neutral to moderately alkaline.
- Apmat Series**
- The Apmat series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 8 percent.

Typical pedon of Apmat very stony coarse sand, 2 to 8 percent slopes, 2,600 feet east and 2,400 feet north of the southwest corner of sec. 10, T. 17 N., R. 19 E.

O—1 inch to 0; pine needle duff.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) very stony coarse sand, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine and few medium roots; many very fine to medium tubular pores; 5 percent pebbles, 10 percent cobbles, 5 percent stones; slightly acid; gradual smooth boundary.

A12—5 to 10 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine and few medium roots; many very fine to medium tubular pores; 15 percent pebbles; slightly acid; clear smooth boundary.

A2—10 to 21 inches; light brownish gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine to medium tubular pores; 30 percent pebbles, 5 percent cobbles; slightly acid; clear wavy boundary.

A&B—21 to 33 inches; pale brown (10YR 6/3) and light gray (2.5Y 7/2) very cobbly loamy coarse sand, dark brown (10YR 4/3) and grayish brown (2.5Y 5/2) moist; weak medium angular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few very fine to coarse roots; few very fine and fine tubular pores; few moderately thick clay films on ped faces and in pores and bridging sand grains; 5 percent pebbles, 30 percent cobbles, 5 percent stones, all highly weathered; neutral; clear irregular boundary.

B2t—33 to 42 inches; yellowish brown (10YR 5/4) extremely stony coarse sandy loam, dark yellowish brown (10YR 4/4) moist, with a few seams that are grayish brown (2.5Y 5/2); massive; slightly hard, firm, sticky and slightly plastic; very few roots; very few pores; common moderately thick clay films in pores and bridging sand grains; 20 percent pebbles, 10 percent cobbles, 40 percent stones, all highly weathered; neutral; clear irregular boundary.

B3t—42 to 55 inches; yellowish brown (10YR 5/4) extremely stony coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive, slightly hard, firm, slightly sticky and slightly plastic; very few roots; very few pores; few thin clay films bridging sand grains; 5 percent pebbles, 10 percent cobbles, 50 percent stones, all highly weathered; neutral; clear irregular boundary.

C1—55 to 63 inches; pale brown (10YR 6/3) extremely bouldery loamy coarse sand, dark brown (10YR 4/3)

moist; massive; soft, friable, nonsticky and nonplastic; 15 percent pebbles, 20 percent cobbles, 60 percent stones and boulders, all highly weathered; medium acid.

The solum ranges from 30 to 60 inches in thickness. Reaction in the profile is neutral to medium acid. The Bt horizon is loam or sandy loam that is 10 to 18 percent clay. It is 35 to 70 percent rock fragments.

Aquinas Series

The Aquinas series consists of moderately deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived mainly from granitic rocks. Slopes are 4 to 15 percent.

Typical pedon of Aquinas sandy loam, 4 to 8 percent slopes, 200 feet east and 500 feet south of the northwest corner of sec. 24, T. 21 N., R. 18 E.

A11—0 to 1 inch; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; many fine interstitial pores; medium acid; abrupt smooth boundary.

A12—1 to 7 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine interstitial pores; slightly acid; abrupt wavy boundary.

B21t—7 to 17 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate, fine to medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common fine tubular pores; many thin clay coatings and bridges on sand grains, and common thin and few moderately thick clay films on ped faces; slightly acid; clear wavy boundary.

B22t—17 to 29 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; massive; hard; friable, sticky and plastic; few very fine and fine roots; common fine tubular pores; many thin clay coatings and bridges on sand grains; slightly acid; clear wavy boundary.

B31t—29 to 34 inches; light brown (7.5YR 6/4) loamy coarse sand, brown (7.5YR 5/4) moist; massive; hard, friable, nonsticky and nonplastic; few micro and very fine roots; many very fine interstitial pores; common thin clay coatings and bridges; slightly acid; abrupt wavy boundary.

IIB32t—34 to 37 inches; light brown (7.5YR 6/4) clay, dark brown (7.5YR 4/4) moist; strong very fine to fine subangular blocky structure; very hard, friable, very sticky and very plastic; few micro and very fine roots; few micro and very fine tubular pores; many thin and few moderately thick clay films on ped faces; mildly alkaline; abrupt wavy boundary.

IIC1sim—37 to 40 inches; pinkish gray (7.5YR 6/2) strongly cemented duripan with reddish yellow (7.5YR 6/6) coatings in cracks, dark brown (7.5YR 4/4) moist; extremely hard, extremely firm; few micro and very fine roots in cracks; moderately alkaline; abrupt wavy boundary.

IIC2sicam—40 to 46 inches; light brownish gray (10YR 6/2) strongly silica-cemented duripan; extremely hard, extremely firm; strongly effervescent; moderately alkaline; clear wavy boundary.

IIC3—46 to 62 inches; pale brown (10YR 6/3) stratified old loamy valley-fill deposits with lenses and blotches of very pale brown (10YR 8/3), brown (10YR 5/3) moist; strong thin platy structure; very hard, firm, nonsticky and nonplastic; strongly effervescent; moderately alkaline.

The solum thickness and the depth to the strongly cemented duripan range from 30 to 40 inches. Reaction in the A1 horizon is medium acid to slightly acid. The B2t horizon is sandy clay loam or clay loam that is 20 to 35 percent clay. The B2t is commonly medium acid to slightly acid but may range to mildly alkaline in the lower part. The IIC3 material is mildly alkaline to moderately alkaline.

Arzo Series

The Arzo series consists of moderately deep, well drained soils that formed in alluvium and colluvium derived from basalt. These soils are on lower slopes. Slopes are 8 to 30 percent.

Typical pedon of Arzo very stony loam, in an area of Arzo-Indiano-Barnard association, 2,000 feet east and 700 feet south of the northwest corner of sec. 3, T. 24 N., R. 19 E.

A1—0 to 2 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, sticky and plastic; common coarse, medium, fine, and very fine roots; many fine and very fine tubular pores; 15 percent pebbles, 10 percent cobbles, 10 percent stones; neutral; clear smooth boundary.

B21t—2 to 7 inches; brown (7.5YR 4/2) gravelly clay, dark brown (7.5YR 3/2) moist; strong fine and medium prismatic structure parting to strong fine and medium angular blocky; very hard, friable, very sticky and very plastic; common very fine through medium roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; 15 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B22t—7 to 18 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, friable, very sticky and

very plastic; common very fine through coarse roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; common slickensides; mildly alkaline; clear smooth boundary.

B3tca—18 to 27 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong coarse and medium angular blocky structure; very hard, very friable, sticky and plastic; common fine roots and few medium roots; few very fine tubular pores, common thin clay films on ped faces and in pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C1ca—27 to 35 inches; yellowish brown (10YR 5/4) gravelly loam, dark brown (10YR 4/3) moist; massive; hard, firm, sticky and plastic; common fine roots and few medium roots; few very fine tubular pores; strongly effervescent, lime in seams and as soft masses; moderately alkaline; clear wavy boundary.

R—35 inches; weathered rock with lime and silica along cracks.

The depth to bedrock ranges from 20 to 40 inches. Reaction throughout the solum is neutral to moderately alkaline. The Bt horizon is clay or clay loam that is 35 to 45 percent clay.

Bango Series

The Bango series consists of very deep, well drained soils on low lake terraces. These soils formed in eolian and alluvium-modified lacustrine sediment derived from mixed rock. Slopes are 0 to 8 percent.

Typical pedon of Bango gravelly sandy loam, 0 to 8 percent slopes, 600 feet south and 1,000 feet east of the northwest corner of sec. 2, T. 22 N., R. 24 E.

A1—0 to 2 inches; light gray (10YR 7/2) gravelly sandy loam, brown (10YR 5/3) moist; moderate medium and thick platy structure; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine and fine vesicular pores; 30 percent pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B2t—2 to 10 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak thin platy; slightly hard, very friable, sticky and plastic; few very fine and fine tubular pores; 5 percent pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

C1ca—10 to 15 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, sticky and plastic; few fine roots; many very fine and fine interstitial and few very fine and

fine tubular pores; strongly effervescent; strongly alkaline; clear smooth boundary.

IIC2ca—15 to 21 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many very fine and fine interstitial pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.

IIC3ca—21 to 30 inches; white (10YR 8/2) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine tubular pores; violently effervescent; strongly alkaline; abrupt smooth boundary.

IIC4ca—30 to 39 inches; white (10YR 8/2) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; violently effervescent; strongly alkaline; abrupt smooth boundary.

IVC5—39 to 54 inches; very pale brown (10YR 7/4) very fine sand, yellowish brown (10YR 5/4) moist; single grained; loose, nonsticky and nonplastic; few fine roots; many very fine interstitial pores; moderately alkaline; abrupt smooth boundary.

VC6—54 to 66 inches; very pale brown (10YR 7/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; many very fine interstitial pores; moderately alkaline.

The depth of the solum ranges from 6 to 10 inches. Reaction is moderately alkaline or strongly alkaline throughout the profile. The B2t horizon is loam or clay loam that is 20 to 30 percent clay.

Barnard Series

The Barnard series consists of moderately deep, well drained soils on pediment remnants and terraces. These soils formed in alluvium and pedisodiment derived from mixed rock. Slopes are 2 to 4 percent.

Typical pedon of Barnard stony sandy loam, in an area of Barnard-Trosi association, 178 feet west and 178 feet south of the northeast corner of sec. 19, T. 19 N., R. 19 E.

A11—0 to 6 inches; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many micro to medium roots; 5 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

A12—6 to 15 inches; grayish brown (10YR 5/2) stony sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium angular blocky structure; slightly hard, friable, sticky and plastic; many fine to

medium roots; 5 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; abrupt smooth boundary.

B2t—15 to 26 inches; light yellowish brown (10YR 6/4) clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; very hard, firm, sticky and plastic; common very fine roots; many moderately thick clay films on ped faces; neutral; abrupt smooth boundary.

C1sim—26 to 29 inches; indurated silica-cemented hardpan; abrupt smooth boundary.

C2si—29 to 40 inches; interbedded ash and silts that are weakly cemented and highly compacted.

The thickness of the solum and the depth to the indurated pan range from 20 to 30 inches. The mollic epipedon is 7 to 17 inches thick. The B2t horizon is clay or silty clay loam that is 35 to 50 percent clay.

Barshaad Series

The Barshaad series consists of moderately deep, well-drained soils. These soils formed in residuum and colluvium derived from basalt. Barshaad soils are on plateau remnants, pediments, and ridgetops. Slopes are 2 to 15 percent.

Typical pedon of Barshaad very stony loam, in an area of Barshaad-Fugawee-Duckhill Variant association, 2,300 feet west and 2,300 feet south of the northeast corner of sec. 29, T. 20 N., R. 18 E.

A1—0 to 1 inch; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak thin and medium platy structure parting to weak fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; 10 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; abrupt smooth boundary.

B21t—1 to 9 inches; brown (10YR 4/3) gravelly clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to strong medium angular blocky; hard, firm, sticky and very plastic; many very fine and medium roots; common very fine and medium tubular pores; 15 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B22t—9 to 24 inches; yellowish brown (10YR 5/4) gravelly clay, dark yellowish brown (10YR 3/4) moist; moderate medium prismatic structure parting to strong medium angular blocky; hard, firm, sticky and very plastic; many very fine and medium roots; common very fine and medium tubular pores; 20 percent pebbles, 10 percent cobbles; neutral; abrupt wavy boundary.

R—24 inches; fractured and weathered basaltic rock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. Reaction throughout the profile is neutral to moderately alkaline.

The B2t horizon is clay that is 40 to 60 percent clay. It is 15 to 35 percent rock fragments.

Bedell Series

The Bedell series consists of very deep, somewhat excessively drained soils on alluvial fans and terraces. These soils formed in alluvium derived from mainly granitic rocks. Slopes are 2 to 15 percent.

Typical pedon of Bedell loamy sand, 4 to 8 percent slopes, 2,200 feet north and 100 feet east of the southwest corner of sec. 6, T. 22 N., R. 19 E.

A11—0 to 1 inch; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 10 percent fine pebbles; neutral; clear smooth boundary.

A12—1 to 15 inches; grayish brown (10YR 5/2) heavy loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine, fine, and medium roots; many very fine and fine tubular pores; 10 percent fine pebbles; neutral; clear smooth boundary.

B21t—15 to 24 inches; yellowish brown (10YR 5/4) heavy sandy loam, dark yellowish brown (10YR 3/4) moist; massive; very hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine and fine tubular pores; common thin clay films in pores and coating coarse fragments and sand grains; 10 percent fine pebbles; neutral; gradual smooth boundary.

B22t—24 to 54 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 3/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine and fine tubular pores; common thin clay films on coarse fragments and sand grains; 10 percent fine pebbles; neutral; gradual smooth boundary.

C1—54 to 65 inches; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine, fine, and medium roots; many very fine and fine interstitial pores; 10 percent fine pebbles; neutral.

The solum ranges from 30 to 55 inches in thickness. The B2t horizon is light sandy loam to heavy sandy loam that is 12 to 18 percent clay in the upper 20 inches. Reaction is slightly acid or neutral throughout the profile.

Biddleman Series

The Biddleman series consists of very deep, well drained soils on lakeshore terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 15 percent.

Typical pedon of Biddleman gravelly sandy loam, in an area of Bluewing-Biddleman-Bundorf association, 2,600 feet east and 50 feet south of the northwest corner of sec. 6, T. 21 N., R. 24 E.

A11—0 to 2 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; many very fine vesicular pores; 20 percent pebbles, 3 percent cobbles; moderately alkaline; clear smooth boundary.

A12—2 to 3 inches; brown (10YR 5/3) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure parting to moderate fine subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine through medium vesicular pores; 15 percent pebbles, 5 percent cobbles; moderately alkaline; abrupt wavy boundary.

B21t—3 to 6 inches; brown (10YR 5/3) gravelly loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky and slightly plastic; many very fine through medium roots; many very fine through medium pores; 20 percent pebbles; strongly alkaline; clear wavy boundary.

B22t—6 to 8 inches; brown (10YR 5/3) gravelly clay loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to thin through thick platy; hard, firm, sticky and plastic; many very fine and common fine roots; many very fine and common fine tubular pores; 25 percent pebbles; moderately alkaline; clear smooth boundary.

C1ca—8 to 16 inches; brown (10YR 5/3) cobbly loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine roots; common fine and medium tubular pores, many fine interstitial pores; 15 percent pebbles, 15 percent cobbles; strongly effervescent; strongly alkaline; clear smooth boundary.

11C2ca—16 to 30 inches; brown (10YR 4/3) extremely cobbly loamy sand, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores, few fine tubular pores; 30 percent pebbles, 45 percent cobbles; strongly effervescent; strongly alkaline; gradual wavy boundary.

11C3ca—30 to 60 inches; light gray (10YR 7/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and

nonplastic; few very fine and fine interstitial pores; 30 percent pebbles, 10 percent cobbles; strongly effervescent; strongly alkaline.

The thickness of the solum ranges from 8 to 18 inches. Reaction throughout the profile is moderately to strongly alkaline. The argillic horizon is loam, sandy clay loam, or clay loam that is 20 to 30 percent clay. It is 20 to 35 percent rock fragments.

Bieber Series

The Bieber series consists of shallow, well drained soils on terraces and pediments. These soils formed in alluvium and pediments derived from mixed rock sources. Slopes are 0 to 15 percent.

Typical pedon of Bieber stony sandy loam, 0 to 4 percent slopes, 570 feet east and 570 feet south of the northwest corner of sec. 20, T. 19 N., R. 19 E.

- A11—0 to 2 inches; dark grayish brown (10YR 4/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 5 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; clear smooth boundary.
- A12—2 to 8 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) stony sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine prismatic structure; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; 5 percent pebbles, 5 percent cobbles, 5 percent stones; few thin clay films on ped faces; neutral; abrupt smooth boundary.
- B2t—8 to 19 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse prismatic structure; very hard, very firm, very sticky and very plastic; few fine roots; few fine tubular pores; neutral; abrupt smooth boundary.
- IIC1sim—19 to 25 inches; very pale brown (10YR 7/3) indurated silica-cemented duripan; abrupt smooth boundary.
- IIC2—25 to 60 inches; highly weathered tuff conglomerate with few thin plates of strongly cemented duripan.

The thickness of the solum and depth to the indurated duripan are 10 to 20 inches. The mollic epipedon is 7 to 20 inches thick and in some pedons includes part or all of the argillic horizon. Reaction throughout the profile is slightly acid to moderately alkaline. The Bt horizon is clay or heavy clay loam that is 35 to 45 percent clay.

Blackwell Series

The Blackwell series consists of very deep, poorly drained soils on flood plains and along stream bottoms.

These soils formed in alluvium derived from mixed rock. Slopes are 0 to 4 percent.

Typical pedon of Blackwell sandy loam, in an area of Macareno-Blackwell-Carioca association, 400 feet west and 1,300 feet south of the northeast corner of sec. 19, T. 16 N., R. 19 E.

- A11—0 to 4 inches; dark grayish brown (10YR 4/2) loamy sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; slightly acid; abrupt smooth boundary.
- A12—4 to 11 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine to medium roots; many very fine to medium interstitial pores; slightly acid; abrupt smooth boundary.
- A13—11 to 19 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; common medium prominent strong brown (7.5YR 5/6) mottles; fine moderate prismatic structure; slightly hard, friable, slightly sticky and nonplastic; many very fine to medium roots; many very fine to medium tubular pores; 3 percent fine pebbles; neutral; clear smooth boundary.
- IIC1g—19 to 30 inches; light gray (10YR 6/1) gravelly sandy clay loam, dark gray (10YR 4/1) moist; many medium prominent strong brown mottles (7.5YR 5/6); massive; soft, very friable, nonsticky and nonplastic; common fine and medium roots; many fine interstitial pores; 15 percent fine pebbles; neutral; abrupt smooth boundary.
- IIC2—30 to 35 inches; very pale brown (10YR 7/3) coarse sandy loam, brown (10YR 5/3) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and nonplastic; many fine and medium dead roots; many fine and medium tubular pores; neutral; abrupt smooth boundary.
- IVC3—35 to 60 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; common medium yellowish red (5YR 5/8) mottles; strong fine subangular blocky structure; hard, firm, sticky and plastic; many fine and medium dead roots; many fine and medium tubular pores; neutral; clear smooth boundary.

The profile is more than 60 inches deep. These soils are wet during the winter under snow cover and remain water-logged until midsummer. Reaction ranges from slightly acid to neutral throughout the profile. The control section is sandy clay loam stratified with silt loam, loam, clay loam, coarse sandy loam, fine sandy loam, and

some thin strata of coarse sand. Clay content averages from 18 to 35 percent.

Bluewing Series

The Bluewing series consists of very deep, excessively drained soils on alluvial fans and terraces. These soils formed in sandy alluvium derived from mixed rock. Slopes are 4 to 15 percent.

Typical pedon of Bluewing very stony loamy sand, in an area of Hawsley-Ruhe-Bluewing association, 100 feet east and 100 feet south of the northwest corner of sec. 15, T. 24 N., R. 24 E.

A1—0 to 1 inch; light brownish gray (10YR 6/2) very stony loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; very few roots; many very fine and fine interstitial pores; 25 percent pebbles, 15 percent stones; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—1 to 9 inches; pale brown (10YR 6/3) very gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and few medium roots; common fine and medium tubular and many very fine and fine interstitial pores; 30 percent pebbles, 10 percent cobbles; moderately effervescent; strongly alkaline; clear wavy boundary.

IIC2ca—9 to 60 inches; pale brown (10YR 6/3) very gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and medium roots; many very fine and fine interstitial pores; 45 percent pebbles, 5 percent cobbles, 5 percent stones; strongly effervescent; strongly alkaline.

The profile is more than 60 inches deep. Reaction is mildly alkaline to strongly alkaline throughout. The control section from a depth of 10 inches to a depth of 40 inches is loamy coarse sand or coarse sand that is 3 to 10 percent clay. It is 50 to 80 percent rock fragments.

Bombadil Series

The Bombadil series consists of very shallow, well drained soils on mountain slopes. These soils formed in residuum derived mainly from basalt. Slopes are 15 to 50 percent.

Typical pedon of Bombadil very stony sandy loam, in an area of Bombadil-Hefed-Rubbleland association, 100 feet south and 2,600 feet west of the northeast corner of sec. 18, T. 20 N., R. 23 E.

A1—0 to 4 inches; pale brown (10YR 6/3) very stony sandy loam, dark brown (10YR 3/3) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine

and fine roots; many fine to medium tubular and vesicular pores; 10 percent pebbles, 15 percent cobbles, 15 percent stones; neutral; abrupt smooth boundary.

B21t—4 to 8 inches; brown (10YR 5/3) gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine tubular pores; many thin clay films on ped faces and lining pores and rock fragments; 15 percent pebbles, 5 percent cobbles; neutral; gradual smooth boundary.

B22t—8 to 13 inches; yellowish brown (10YR 5/4) gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; hard, very friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; many thin clay films on ped faces and rock fragments and lining pores; 20 percent pebbles; neutral; abrupt smooth boundary

R—13 inches; fractured and weathered basaltic bedrock.

Depth to bedrock ranges from 7 to 14 inches. Reaction throughout the profile is neutral to mildly alkaline. The control section is loam and is 18 to 25 percent clay. The B horizon is 10 to 20 percent rock fragments.

Booford Series

The Booford series consists of moderately deep, well drained soils on mountain slopes. These soils formed in residuum derived mainly from andesitic tuff. Slopes are 8 to 50 percent.

Typical pedon of Booford very stony loam, 30 to 50 percent slopes, 1,100 feet west and 1,800 feet south of the northeast corner of sec. 28., T. 19 N., R. 18 E.

A11—0 to 3 inches; grayish brown (10YR 5/2) very stony loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores and many very fine and fine interstitial pores; 5 percent pebbles, 10 percent cobbles, 10 percent stones; slightly acid; clear smooth boundary.

A12—3 to 8 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many medium, common very fine and fine, and few coarse roots; many very fine and fine tubular pores; 15 percent pebbles; slightly acid; clear smooth boundary.

B1t—8 to 12 inches; dark brown (7.5YR 4/2) clay, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; common very fine to medium roots; common very

fine and fine tubular pores; common thin clay films on ped faces and in pores; 10 percent pebbles; slightly acid; clear smooth boundary.

B2t—12 to 20 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 3/4) moist; strong coarse prismatic structure; very hard, very firm, very sticky and very plastic; few very fine through coarse roots; common very fine and fine tubular pores; continuous moderately thick clay films coating ped faces and pores; slightly acid; smooth boundary.

B3t—20 to 25 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 3/4) moist; massive; very hard, very firm, very sticky and very plastic; few fine and medium roots; very few pores; continuous moderately thick clay films coating coarse fragments; 10 percent pebbles; slightly acid; clear wavy boundary.

C1r—25 to 45 inches; weathered andesitic tuff with some thick clay films and roots in fractures.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The mollic epipedon is 7 to 15 inches thick and includes the upper part of the argillic horizon. Reaction throughout the profile is slightly acid to neutral. The Bt horizon is clay or gravelly clay and has a thin layer of clay loam in the upper part. It averages 45 to 60 percent clay and is 5 to 20 percent gravel.

Boomtown Series

The Boomtown series consists of very deep, well drained soils that formed in mixed colluvium derived mainly from andesite and basalt and in residuum of andesite. These soils are on plateaus and mountain slopes. Slopes are 30 to 50 percent.

Typical pedon of Boomtown very stony sandy loam, in an area of Jorge-Boomtown-Fugawee association, 850 feet east and 1,180 feet north of the southwest corner of sec. 3, T. 18 N., R. 18 E.

O1—4 to 3 inches; partially decomposed pine and fir needles; abrupt smooth boundary.

O2—3 inches to 0; strongly decomposed fir and pine needle duff; abrupt smooth boundary.

A11—0 to 11 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots and many medium and coarse roots; many very fine and fine tubular pores; 10 percent pebbles, 10 percent cobbles, 15 percent stones; slightly acid; clear wavy boundary.

A12—11 to 17 inches; brown (10YR 4/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine through coarse roots;

many very fine and fine tubular pores; 15 percent pebbles, 5 percent cobbles; slightly acid; abrupt wavy boundary.

A2—17 to 22 inches; light yellowish brown (10YR 6/4) gravelly loam, yellowish brown (10YR 5/4) moist; weak and moderate fine and medium subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine and fine roots and common medium and coarse roots; many very fine and fine tubular pores and common medium tubular pores; common thin clay films on peds and in pores; 20 percent pebbles; slightly acid; clear wavy boundary.

IIB2t—22 to 41 inches; very pale brown (10YR 7/4) clay, brownish yellow (10YR 6/8) moist; moderate coarse prismatic structure; hard, firm, sticky and plastic; few fine and medium inped roots; few fine and medium tubular pores; continuous thin and moderately thick clay films on peds and in pores; 5 percent saprolitic gravel; medium acid; clear wavy boundary.

IIB3t—41 to 53 inches; yellow (10YR 7/6) clay, brownish yellow (10YR 6/8) moist; many medium and large prominent very pale brown (10YR 8/3) mottles; moderate fine angular blocky structure; hard, firm, sticky and plastic; very few fine roots; common fine and medium tubular pores; many thin clay films on ped faces and in pores; 5 percent saprolitic gravel; slightly acid; clear wavy boundary.

IIC—53 to 61 inches; yellow (10YR 7/6) clay loam, brownish yellow (10YR 6/8) moist; many medium and large prominent very pale brown (10YR 8/3) mottles; massive; hard, firm, sticky and plastic; very few fine roots; very few fine tubular pores; many thin clay films on peds and in pores.

The solum thickness ranges from 40 to 60 inches. Reaction throughout the profile is medium acid to slightly acid. The control section is clay loam or clay that is 35 to 50 percent clay. It is 5 to 35 percent rock fragments.

Bundorf Series

The Bundorf series consists of shallow, well drained soils that formed in alluvium derived from mixed rock. These soils are on alluvial fans. Slopes are 4 to 15 percent.

Typical pedon of Bundorf very stony loam, in an area of Sutcliff-Bundorf-Kleinbush association, 1,200 feet north and 100 feet east of the southwest corner of sec. 14, T. 22 N., R. 24 E.

A1—0 to 2 inches; light gray (10YR 7/2) very stony loam, brown (10YR 5/3) moist; moderate thick platy and weak thin platy structure; soft, very friable, sticky and plastic; few very fine roots; many very fine and fine vesicular pores; moderately alkaline; strongly effervescent; clear smooth boundary.

B1t—2 to 6 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate fine and medium angular blocky structure; slightly hard, friable, sticky and plastic; common very fine, fine, and medium roots; common very fine and fine tubular pores; common thin clay films lining pores; moderately alkaline; effervescent; clear smooth boundary.

B2t—6 to 10 inches; pale brown (10YR 6/3) clay, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure; very hard, firm, sticky and plastic; common very fine, fine, and medium roots; common very fine and fine tubular pores; common moderately thick clay films on faces of peds and lining pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.

B3tca—10 to 14 inches; light brown (7.5YR 6/4) very cobbly clay loam, brown (7.5YR 5/4) moist; massive; hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; few thin clay films lining pores; 20 percent pebbles, 20 percent cobbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

C1sica—14 to 19 inches; light yellowish brown (10YR 6/4) very cobbly sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, and brittle, slightly sticky and slightly plastic; common very fine roots; many very fine and fine interstitial pores; 20 percent pebbles, 25 percent cobbles, 10 percent stones; violently effervescent; continuous weak silica cementation; very strongly alkaline; abrupt wavy boundary.

C2sicam—19 to 27 inches; indurated duripan.

The thickness of the solum ranges from 10 to 20 inches. The depth to the duripan ranges from 14 to 20 inches. Reaction in the solum ranges from mildly alkaline to strongly alkaline. The Bt horizon is clay or heavy clay loam that is 35 to 50 percent clay.

Burnborough Series

The Burnborough series consists of very deep, well drained soils on hillsides. These soils formed in residuum and colluvium derived from mixed rocks, predominantly andesite and rhyolite. Slopes are 15 to 50 percent.

Typical pedon of Burnborough very gravelly loam, in an area of Burnborough-Ticino-Gabica association, 600 feet east and 2,400 feet south of the northwest corner of sec. 23, T. 20 N., R. 18 E.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; 50 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

A12—5 to 11 inches; brown (10YR 4/3) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 40 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B1t—11 to 17 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; moderately thin clay films lining pores; 30 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B2t—17 to 29 inches; yellowish brown (10YR 5/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, sticky and plastic; few very fine through medium roots; many very fine and fine tubular pores; common thin and moderately thick clay films lining pores and coating rock fragments; 40 percent pebbles, 15 percent cobbles; neutral; clear smooth boundary.

B3t—29 to 60 inches; light yellowish brown (10YR 6/4) very gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; few thin clay films lining pores and coating rock fragments; 45 percent pebbles, 10 percent cobbles, 5 percent stones; slightly acid.

The solum thickness ranges from 40 to more than 60 inches. Reaction throughout the profile is slightly acid to neutral.

The Bt horizon is loam or light clay loam that is 18 to 35 percent clay. It is 35 to 60 percent rock fragments.

Cagle Series

The Cagle series consists of moderately deep, well drained soils on mountain slopes. These soils formed in colluvium and residuum derived from andesite. Slopes are 15 to 30 percent.

Typical pedon of Cagle very stony clay loam, in an area of Indiano-Duco-Cagle association, 150 feet east and 800 feet south of the northwest corner of sec. 35, T. 17 N., R. 20 E.

A11—0 to 7 inches; grayish brown (10YR 5/2) very stony clay loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular and interstitial pores; 25 percent pebbles, 15 percent stones; neutral; clear smooth boundary.

B21t—7 to 11 inches; grayish brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2)

moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; common fine and medium roots; common fine tubular pores; common thin clay films in pores on ped faces and coating rock fragments; 25 percent pebbles; neutral; clear smooth boundary.

B22t—11 to 20 inches; pale brown (10YR 6/3) gravelly clay, dark grayish brown (10YR 4/2) moist; strong medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; common fine through coarse roots; common fine tubular pores; many moderately thick clay films in pores, on peds, and coating rock fragments; 20 percent pebbles; neutral; clear smooth boundary.

B23t—20 to 23 inches; pale brown (10YR 6/3) very gravelly clay, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine tubular pores; 30 percent pebbles, 15 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

Cr—23 inches; highly weathered andesitic bedrock with few medium roots in the clay in cracks.

The depth of the solum to the paralithic contact ranges from 20 to 40 inches. The mollic epipedon is 7 to 18 inches thick and includes the upper part of the B2t horizon. Reaction throughout the profile is slightly acid to neutral. The argillic horizon is clay or clay loam that is 35 to 50 percent clay. It is 20 to 30 percent rock fragments in the upper part and 50 to 80 percent rock fragments in the lower part.

Calpine Series

The Calpine series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived mainly from granitic rocks. Slopes are 4 to 8 percent.

Typical pedon of Calpine coarse sandy loam, 4 to 8 percent slopes, 1,200 feet west and 200 feet north of the southeast corner of sec. 19, T. 22 N., R. 18 E.

A11—0 to 2 inches; brown (10YR 5/3) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; very few roots; many fine interstitial pores; 5 percent gravel; medium acid; clear smooth boundary.

A12—2 to 19 inches; dark grayish brown (10YR 4/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and few medium roots; many very fine interstitial and common fine tubular pores; 10 percent gravel; medium acid; clear smooth boundary.

B21—19 to 30 inches; brown (10YR 5/3) sandy loam, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; many very fine and medium roots; many very fine and fine tubular and common fine interstitial pores; 10 percent gravel; few thin clay films bridging sand grains; medium acid; clear smooth boundary.

B22—30 to 45 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine to coarse roots; common very fine to medium tubular pores; few thin clay films bridging sand grains; slightly acid; clear smooth boundary.

C1—45 to 65 inches; light yellowish brown (10YR 6/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few roots; many very fine interstitial pores; slightly acid.

The profile is more than 60 inches deep. The mollic epipedon is 10 to 20 inches thick. Reaction ranges from medium acid to neutral; the more acid horizons are in the upper part of the profile. The control section is sandy loam or coarse sandy loam that is 5 to 15 percent clay.

Carioca Series

The Carioca series consists of very deep, moderately well drained soils on uplands. These soils formed in residuum and colluvium derived from andesite. Slopes are 4 to 30 percent.

Typical pedon of Carioca stony sandy loam, in an area of Carioca-Sibelia Variant-Fugawee association, 300 feet east and 2,500 feet south of the northwest corner of sec. 22, T. 18 N., R. 18 E.

O1—1 inch to 0; lodgepole pine needle duff.

A1—0 to 7 inches; brown (10YR 5/3) stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; soft, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many fine vesicular and few fine tubular pores; 45 percent pebbles, 2 percent stones; medium acid; clear smooth boundary.

A2—7 to 18 inches; pale brown (10YR 6/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, medium, and coarse roots; many fine vesicular and few fine tubular pores; 50 percent pebbles, 5 percent cobbles, 5 percent stones; medium acid; abrupt wavy boundary.

A3—18 to 30 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist, dark brown (10YR 3/3) moist ped faces; moderate fine

- angular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and medium roots; common very fine tubular pores; common thin clay films in pores; 45 percent pebbles, 5 percent cobbles, 5 percent stones; medium acid; clear wavy boundary.
- B2t—30 to 40 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; moderate fine angular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine through medium roots; common fine tubular pores; many thin clay films on ped faces; 40 percent pebbles, 5 percent cobbles, 5 percent stones; medium acid; clear wavy boundary.
- B3t—40 to 56 inches; pale brown (10YR 6/3) extremely gravelly loam, dark brown (10YR 3/3) moist; few faint dark yellowish brown mottles; massive; very hard, firm, slightly sticky and slightly plastic; few very fine, fine, and medium roots; common very fine tubular pores; common thin clay films bridging sand grains and coating coarse fragments; 50 percent pebbles, 25 percent cobbles, 5 percent stones; slightly acid; clear wavy boundary.
- C1—56 to 65 inches; pale brown (10YR 6/3) gravelly loam, dark grayish brown (10YR 4/2) moist; common faint dark yellowish brown (10YR 4/4) mottles; massive; very hard, firm, sticky and plastic; very few very fine and fine roots; few fine tubular pores; many pressure faces; 30 percent gravel; slightly acid; gradual irregular boundary.
- Cr—65 to 75 inches; highly weathered andesite that wets to clay loam with hard andesite stones and boulders.
- The solum thickness ranges from 40 to 60 inches. Depth to a paralithic contact is more than 60 inches. Reaction is medium acid to slightly acid throughout the profile.
- The B2t horizon is loam or clay loam that is 15 to 30 percent clay. It is 35 to 75 percent rock fragments.
- A13—5 to 10 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, nonsticky and nonplastic; common very fine, fine, medium, and coarse roots; many very fine interstitial pores; 30 percent pebbles; medium acid; clear wavy boundary.
- A1—10 to 15 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, friable, nonsticky and slightly plastic; common very fine, fine, medium, and coarse roots; few very fine tubular pores; few thin clay films bridging and coating sand grains and in pores; 15 percent gravel; medium acid; abrupt wavy boundary.
- B21t—15 to 26 inches; brown (7.5YR 5/4) gravelly sandy clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine, fine, medium, and coarse roots; few very fine and fine tubular pores; common thin and few moderately thick clay films on ped faces and in pores; 40 percent pebbles; medium acid; clear wavy boundary.
- B22t—26 to 45 inches; brown (7.5YR 5/4) very gravelly sandy clay, dark reddish brown (5YR 3/4) moist; massive; very hard, firm, sticky, plastic; few very fine roots; few very fine and fine tubular pores; many thin clay films coating and bridging sand grains and in pores; 40 percent pebbles, 10 percent cobbles; medium acid; abrupt wavy boundary.
- IIC1—45 to 65 inches; stratified compact tuff, silts, and ash.

The solum ranges from 40 to 60 inches in thickness. Reaction in the solum ranges from medium acid to slightly acid.

The Bt horizon is very gravelly sandy clay loam, very gravelly clay loam, and very gravelly sandy clay. The clay content is 35 to 45 percent. The content of rock fragments in the argillic horizon ranges from 35 to 55 percent.

Celeton Variant

The Celeton Variant consists of shallow and very shallow, somewhat excessively drained soils on terraces. These soils formed in residuum derived mainly from lacustrine sedimentary rock. Slopes are 2 to 8 percent.

Typical pedon of Celeton Variant very gravelly loam in an area of Chalco-Celeton Variant complex, 2 to 8 percent slopes, 900 feet west and 2,000 feet north of the southeast corner of sec. 5, T. 21 N., R. 20 E.

Cassiro Series

The Cassiro series consists of deep and very deep, well drained soils on smooth to slightly convex alluvial fans and terraces. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 15 percent.

Typical pedon of Cassiro gravelly sandy loam, 2 to 4 percent slopes, 1,320 feet east and 150 feet south of the northwest corner of sec. 8., T. 20 N., R. 19 E.

A11—0 to 1 inch; dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine interstitial pores; 40 percent pebbles; slightly acid; clear wavy boundary.

A12—1 to 5 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (7.5YR 3/2) moist; massive;

A1—0 to 2 inches; light gray (10YR 7/2) gravelly loam, grayish brown (2.5Y 5/2) moist; moderate thick platy structure; soft, very friable, slightly sticky and slightly plastic; very few roots; common fine vesicular pores; 15 percent pebbles; effervescent; moderately alkaline; clear smooth boundary.

C1—2 to 6 inches; light gray (10YR 7/2) very gravelly loam, grayish brown (2.5Y 5/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine and common fine to coarse roots; 40 percent pebbles, 5 percent cobbles; slightly effervescent; moderately alkaline; gradual irregular boundary.

C2r—6 to 60 inches; highly fractured lacustrine sedimentary rock with some soil and roots in cracks to a depth of 16 inches; effervescent in spots.

The depth to weathered lacustrine sedimentary rock is 5 to 15 inches. Reaction in the profile is moderately alkaline. Texture of the control section is loam that is 15 to 24 percent clay. Rock fragments on the soil surface are hard, but rock fragments within the profile are soft. They make up from 35 to 90 percent of the profile.

Chalco Series

The Chalco series consists of shallow, well drained soils on pediment remnants. These soils formed in pediments derived from mixed rock. Slopes are 4 to 50 percent.

Typical pedon of Chalco stony loam, 4 to 8 percent slopes, 2,000 feet west and 1,300 feet north of the southeast corner of sec. 5, T. 19 N., R. 19 E.

The weak erosion pavement consists of gravel on 35 percent of the surface, cobbles on 5 percent, and stones on 1 percent.

A1—0 to 3 inches; light brownish gray (10YR 6/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine vesicular pores; neutral; abrupt smooth boundary.

B2t—3 to 12 inches; dark yellowish brown (10YR 4/4) clay, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure; extremely hard, very firm, very sticky and very plastic; few very fine to medium roots; few very fine to medium tubular pores; continuous thick clay films on ped faces; neutral; gradual smooth boundary.

IIB3t—12 to 15 inches; yellowish brown (10YR 5/4) gravelly clay, dark yellowish brown (10YR 4/4) moist; massive; hard, very firm, sticky and plastic; very few roots; very few pores; common moderately thick clay films in pores; 15 percent weathered sedimentary rock fragments; neutral; abrupt wavy boundary.

IICr—15 to 30 inches; weathered sedimentary rock.

The thickness of the solum and the depth to weathered sedimentary rock are 10 to 20 inches. Reaction is commonly slightly acid or neutral but ranges to mildly alkaline in the A horizon in some pedons. Reaction in the B2t horizon is commonly slightly acid or neutral but ranges to moderately alkaline just above bedrock. The Bt horizon is clay that is 40 to 60 percent clay.

Corbett Series

The Corbett series consists of moderately deep, somewhat excessively drained soils on uplands. These soils formed in weathered material derived mainly from granitic rocks. Slopes are 15 to 50 percent.

Typical pedon of Corbett bouldery sand, in an area of Toiyabe-Corbett-Rock outcrop association, steep, 600 feet east and 1,320 feet north of the southwest corner of sec. 16, T. 16 N., R. 19 E.

O—1 inch to 0; pine needle duff.

A11—0 to 3 inches; dark grayish brown (10YR 4/2) bouldery sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many very fine and fine interstitial pores; 20 percent pebbles, 10 percent boulders; medium acid; clear smooth boundary.

A12—3 to 8 inches; grayish brown (10YR 5/2) bouldery coarse sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine and fine interstitial pores; 20 percent pebbles, 10 percent boulders; slightly acid; clear wavy boundary.

C1—8 to 17 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine and fine interstitial pores; 25 percent fine pebbles; slightly acid; gradual wavy boundary.

C2—17 to 32 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine and fine interstitial pores; 25 percent fine pebbles; slightly acid; abrupt irregular boundary.

C3r—32 to 40 inches; weathered granodiorite.

The depth to weathered bedrock is 24 to 40 inches. Reaction throughout the profile is medium acid to slightly acid. The control section is loamy coarse sand or loamy sand that is 0 to 5 percent clay. It is 10 to 35 percent rock fragments.

Cradlebaugh Series

The Cradlebaugh series consists of very deep, poorly drained soils on slightly concave alluvial fans. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Cradlebaugh loam, 2,500 feet east and 1,000 feet north of the southwest corner of sec. 36, T. 21 N., R. 18 E.

- A1—0 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine to medium subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.
- C1—10 to 24 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; strongly effervescent; strongly alkaline; clear wavy boundary.
- C2si—24 to 29 inches; light gray (N 7/0) weakly silica-cemented loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, and brittle; few very fine roots; few very fine tubular pores; few fine segregated lime concretions; strongly effervescent; strongly alkaline; abrupt wavy boundary.
- C3gsi—29 to 35 inches; white (N 8/0) fine sandy loam, grayish brown (2.5Y 5/2) moist; common medium distinct dark reddish brown (5YR 3/3) mottles; hard, firm and brittle; few very fine roots; few very fine tubular pores; discontinuous weak silica cementation; strongly alkaline; clear smooth boundary.
- C4—35 to 60 inches; pale brown (10YR 6/3) sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; moderately alkaline.

The depth to the discontinuous weak silica cementation or to the horizon that contains durinodes ranges from 18 to 30 inches. These soils are calcareous to a depth of 20 to 30 inches. The mollic epipedon is 10 to 14 inches thick. Reaction throughout the profile ranges from moderately alkaline to strongly alkaline. The control section (between a depth of 10 inches and a depth of 40 inches) averages 20 to 30 percent clay.

Dalzell Series

The Dalzell series consists of moderately deep, somewhat poorly drained soils on terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Dalzell loamy fine sand, 850 feet east and 850 feet north of the southwest corner of sec. 8, T. 16 N., R. 20 E.

- A11—0 to 9 inches; light brownish gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine to medium pores; strongly alkaline; abrupt smooth boundary.
- A12—9 to 14 inches; light brownish gray (2.5Y 6/2) heavy loamy fine sand, dark grayish brown (2.5Y 4/2) moist; moderate fine platy structure; hard, friable, slightly sticky and nonplastic; common fine and very fine roots; slightly effervescent; very strongly alkaline; clear smooth boundary.
- B1t—14 to 18 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak thin platy structure; very hard, firm, slightly sticky and slightly plastic; few fine and very fine roots; few thin clay films on ped faces and in pores; effervescent; very strongly alkaline; clear smooth boundary.
- B2t—18 to 24 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure; very hard, firm, sticky and plastic; few fine and very fine roots; common thin clay films on ped faces; common moderately thick clay films in pores; effervescent; very strongly alkaline; clear smooth boundary.
- B3t—24 to 32 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; very hard, firm, sticky and plastic; very few roots; few thin clay films in pores; 15 percent strongly cemented durinodes and some weak silica-cemented lamellae in the lower portions; strongly effervescent; very strongly alkaline; clear smooth boundary.
- C1casim—32 to 36 inches; light gray (10YR 7/2) strongly cemented duripan, yellowish brown (10YR 5/4) moist; few medium prominent strong brown (7.5YR 5/6) mottles, brittle moist; strongly effervescent; strongly alkaline; clear smooth boundary.
- C2casi—36 to 39 inches; very pale brown (10YR 7/3) loamy sand, light olive brown (2.5Y 5/4) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; nonsticky and nonplastic; thin silica-cemented lamellae that are brittle when moist; strongly effervescent; strongly alkaline; abrupt wavy boundary.
- C3—39 to 61 inches; very pale brown (10YR 7/2) stratified sand, coarse sand, gravelly sand, and loamy fine sand, yellowish brown (10YR 5/4) moist; many large prominent mottles that are yellowish red (5YR 4/6) moist; massive; nonsticky and nonplastic; strongly alkaline.

The thickness of the solum and the depth to the strongly cemented duripan range from 20 to 40 inches. Reaction throughout the profile is strongly alkaline to very strongly alkaline. The Bt horizon is fine sandy loam, sandy loam, loam, and sandy clay loam and averages 18 to 35 percent clay.

Dithod Series

The Dithod series consists of very deep, somewhat poorly drained soils on flood plains and low terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Dithod sandy loam, 1,500 feet east and 650 feet north of the southwest corner of sec. 8, T. 19 N., R. 20 E.

- A11—0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; neutral; clear smooth boundary.
- A12—7 to 15 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 10 percent pebbles; neutral; clear smooth boundary.
- C1—15 to 60 inches; light brownish gray (10YR 6/2) stratified loamy fine sand, sandy loam, sandy clay loam, and clay loam, dark grayish brown (10YR 4/2) moist; common medium prominent brown (7.5YR 4/4) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine and very fine and common medium roots; common fine and very fine pores; 10 percent pebbles; neutral.

The profile is more than 60 inches thick. The mollic epipedon is 10 to 18 inches thick. Reaction throughout the profile ranges from neutral to moderately alkaline. The control section is stratified, and its texture ranges from loamy fine sand to clay loam. Clay content averages 18 to 25 percent.

Doten Series

The Doten series consists of very deep, moderately well drained soils on lake terraces, clay dunes, and basin plains. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 15 percent.

Typical pedon of Doten silty clay, 0 to 2 percent slopes, 1,300 feet east and 800 feet north of the southwest corner of sec. 25, T. 21 N., R. 18 E.

- Ap1—0 to 1 inch; dark grayish brown (2.5Y 4/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; soft, friable, sticky and very plastic; many very fine interstitial pores; mildly alkaline; abrupt wavy boundary.
- Ap2—1 to 7 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium to coarse subangular blocky structure; hard, friable, very sticky and very plastic; many very fine and fine and few coarse roots; few fine tubular pores; mildly alkaline; abrupt wavy boundary.
- A1—7 to 21 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (10YR 4/2) moist; strong coarse columnar structure; very hard, firm, very sticky and very plastic; common very fine to medium and few coarse roots; few very fine tubular pores; common pressure faces on peds and few intersecting slickensides; slightly effervescent; strongly alkaline; clear wavy boundary.
- C1—21 to 28 inches; grayish brown (10YR 5/2) clay, brown (10YR 4/3) moist; massive; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular pores; common pressure faces and few intersecting slickensides; strongly effervescent; strongly alkaline; clear wavy boundary.
- C2ca—28 to 50 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; few fine distinct brown (7.5YR 4/2), many medium distinct very pale brown (10YR 8/3), and common fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, sticky and very plastic; few micro and very fine roots; few very fine tubular pores; violently effervescent; strongly alkaline; gradual wavy boundary.
- C3ca—50 to 62 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; many medium distinct very pale brown (10YR 8/3), common fine prominent strong brown (7.5YR 5/6), and few fine faint brown (7.5YR 4/2) mottles; massive; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. Reaction in the profile ranges from mildly alkaline to very strongly alkaline. The control section is clay or silty clay that is 40 to 60 percent clay.

These soils have cracks that are open at the surface in summer and fall and are closed in winter and spring. Depth to mottles ranges from 22 to 36 inches. These soils have slight to strong salt concentrations in most horizons.

Doten Variant

The Doten Variant consists of very deep, moderately well drained soils on slightly concave lacustrine terraces

and basin-fill plains. These soils formed in fine lacustrine deposits derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Doten Variant silty clay, strongly saline, 2,000 feet west and 1,600 feet north of the southeast corner of sec. 22, T. 21 N., R. 19 E.

- A11—0 to 2 inches; light gray (10YR 7/2) silty clay, brown (10YR 5/3) moist; strong medium platy structure; soft, friable, sticky and very plastic; common fine to medium interstitial pores and common fine tubular pores; violently effervescent; strongly alkaline; abrupt wavy boundary.
- A12—2 to 5 inches; light gray (10YR 7/2) silty clay, brown (10YR 5/3) moist; weak medium platy structure; hard, friable, very sticky and very plastic; common very fine roots; common fine to medium interstitial pores, and common fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.
- C1—5 to 21 inches; light gray (10YR 7/2) silty clay, brown (10YR 5/3) moist; weak medium platy structure; hard, friable, very sticky and very plastic; few very fine to coarse roots; few fine tubular pores; few slickensides; violently effervescent; strongly alkaline; clear wavy boundary.
- C2—21 to 31 inches; light gray (10YR 7/2) silty clay, brown (10YR 5/3) moist; moderate very fine subangular blocky structure; hard, friable, very sticky and very plastic; few very fine to coarse roots; few fine tubular pores; few slickensides; violently effervescent; strongly alkaline; clear wavy boundary.
- C3—31 to 41 inches; light gray (10YR 7/2) silty clay, brown (10YR 5/3) moist; massive; hard, friable, very sticky and very plastic; few very fine to medium roots; few very fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.
- C4—41 to 51 inches; light gray (10YR 7/2) clay, brown (10YR 4/3) moist; common medium distinct dark brown (7.5YR 3/2) mottles; common fine distinct white (10YR 8/1) gypsum flecks; weak fine subangular blocky structure; hard, friable, very sticky and very plastic; few very fine to medium roots; few very fine tubular pores; violently effervescent; strongly alkaline; clear wavy boundary.
- C5—51 to 72 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; common medium distinct dark brown (7.5YR 3/2) mottles; strong fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; violently effervescent; strongly alkaline.

The soil profile is more than 60 inches deep. The control section (between depths of 10 inches and 40 inches) is silty clay or clay. The average content of clay is 40 to 60 percent. Surface cracks are 1 to 2 inches wide and 2 to 3 feet deep. They are open in summer

and fall and closed in winter and spring. Mottles are below a depth of 40 to 50 inches.

Dressler Series

The Dressler series consists of very deep, somewhat poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 4 percent.

Typical pedon of Dressler loamy sand, 2 to 4 percent slopes, 800 feet west and 2,200 feet south of the northeast corner of sec. 7., T. 17 N., R. 20 E.

- Ap—0 to 8 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 to 15 percent pebbles; slightly acid; clear smooth boundary.
- A1—8 to 19 inches; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and nonplastic; 20 percent pebbles; slightly acid; clear smooth boundary.
- C1—19 to 25 inches; light yellowish brown (10YR 6/4) gravelly loamy sand and gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; 20 percent pebbles, 5 percent cobbles; slightly acid; clear smooth boundary.
- C2—25 to 60 inches; pale brown (10YR 6/3) stratified gravelly loamy sand and gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; large prominent strong brown (7.5YR 5/6) mottles; massive; soft, very friable, nonsticky and nonplastic; 20 percent pebbles, 5 percent cobbles; slightly acid.

The soil profile is more than 60 inches thick. The mollic epipedon is 12 to 20 inches thick. Reaction throughout the profile is slightly acid to neutral. The average texture in the control section is gravelly sandy loam or sandy loam that is 2 to 10 percent clay. The control section is 5 to 35 percent rock fragments. Prominent or distinct mottles are between depths of 22 and 30 inches and extend to 60 inches.

Duckhill Series

The Duckhill series consists of very shallow, well drained soils on uplands. These soils formed in residuum derived mainly from altered andesite or rhyolite. Slopes are 30 to 50 percent.

Typical pedon of Duckhill stony loam, 30 to 50 percent slopes, 1,800 feet east and 750 feet south of the northwest corner of sec. 4, T. 18 N., R. 19 E.

- O—0.5 inch to 0; pine needle duff.
- A1—0 to 3 inches; dark grayish brown (10YR 4/2) stony loam, dark brown (7.5YR 3/2) moist; moderate

medium subangular blocky structure; soft, very friable, nonsticky and slightly plastic; very few roots; many fine and very fine interstitial pores; 35 percent pebbles, 1 percent stones, 5 percent cobbles; medium acid; clear smooth boundary.

B1t—3 to 6 inches; yellowish brown (10YR 5/4) very gravelly heavy loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine and medium roots; common fine tubular pores; many very fine interstitial pores; common thin clay films coating sand grains; 30 percent pebbles, 10 percent cobbles; medium acid; clear wavy boundary.

B2t—6 to 9 inches; yellowish brown (10YR 5/4) very gravelly light clay loam, dark brown (7.5YR 4/4) moist; massive; soft, friable, sticky and slightly plastic; common fine and few medium roots; common fine tubular pores; common moderately thick clay films in pores and coating coarse fragments; 50 percent pebbles; medium acid; abrupt irregular boundary.

C1r—9 to 12 inches; highly weathered altered andesite with a few medium roots and moderate thick clay films in the fractures; some soil in the larger cracks.

R—12 to 14 inches; hard altered andesite bedrock that is fractured.

The depth to weathered bedrock ranges from 6 to 10 inches, and the depth to hard bedrock ranges from 10 to 14 inches. Reaction in the solum is medium acid or slightly acid. The control section from surface to bedrock averages very gravelly loam that is 10 to 30 percent clay. The content of rock fragments through the whole profile averages 35 to 60 percent.

Duckhill Variant

The Duckhill Variant consists of very shallow, well drained soils on ridges. These soils formed in residuum from volcanic rocks. Slopes are 30 to 70 percent.

Typical pedon of Duckhill Variant very stony sandy loam, in an area of Fraval-Hirschdale-Duckhill Variant association, 2,000 feet west and 1,700 feet north of the southeast corner of sec. 5, T. 18 N., R. 18 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 10 percent pebbles; 10 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

A12—4 to 8 inches; brown (10YR 5/3) very stony sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine through medium roots; common very fine and fine

interstitial and tubular pores; 25 percent pebbles, 25 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

B2t—8 to 13 inches; yellowish brown (10YR 5/4) very cobbly clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few medium roots; common very fine and fine tubular pores; moderately thick clay films on ped faces, pores, and rock fragments; 10 percent pebbles, 40 percent cobbles, 10 percent stones; neutral; abrupt irregular boundary.

R—13 inches; hard andesite, some roots and clay films in fractures.

The solum thickness and the depth to hard bedrock are less than 14 inches. Reaction in the solum is slightly acid or neutral. The B2t horizon is clay loam, loam, or sandy clay loam that is 18 to 30 percent clay. It is 50 to 65 percent rock fragments.

Duco Series

The Duco series consists of shallow, well drained soils on mountain ridges and slopes. These soils formed in residuum mainly of rhyolite. Slopes are 15 to 50 percent.

Typical pedon of Duco very stony sandy loam, in an area of Indiano-Zephan-Duco association, 2,400 feet west and 2,400 feet south of northeast corner, sec. 27, T. 24 N., R. 18 E.

A11—0 to 3 inches; brown (10YR 5/3) very stony sandy loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 20 percent pebbles, 15 percent cobbles, 15 percent stones; neutral; clear smooth boundary.

A12—3 to 7 inches; brown (10YR 5/3) very gravelly fine sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine, fine, and medium tubular pores; 35 percent pebbles, 5 percent cobbles; slightly acid; gradual wavy boundary.

B2t—7 to 15 inches; brown (10YR 5/3) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate fine and medium angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; many very fine, fine, and medium tubular pores; common thin and moderately thick clay films on ped faces and coating coarse fragments; 25 percent pebbles, 25 percent cobbles; slightly acid; abrupt irregular boundary.

R—15 inches; hard fractured rhyolitic bedrock.

The depth of the solum to bedrock ranges from 10 to 20 inches. The mollic epipedon is 7 to 20 inches thick and includes part or all of the argillic horizon. Reaction throughout the profile is slightly acid to mildly alkaline. The control section is clay loam that is 27 to 35 percent clay. It is 35 to 75 percent rock fragments.

Fettic Series

The Fettic series consists of very deep, poorly drained soils on low terraces. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Fettic loam, 600 feet west and 1,000 feet south of the northeast corner of sec. 20, T. 21 N., R. 18 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to medium roots; many very fine and fine interstitial pores; slightly effervescent; moderately alkaline; clear smooth boundary.

B2t—4 to 12 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; strong fine and medium prismatic structure parting to strong fine angular blocky; hard, firm, sticky and plastic; many very fine to medium roots; many very fine and fine interstitial pores; common thin clay films in pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.

B3ca—12 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and slightly plastic; common fine and very fine and many medium roots; many fine and very fine tubular pores; few thin clay films in pores; violently effervescent; very strongly alkaline; clear smooth boundary.

C1ca—20 to 45 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine to medium roots in pockets; few fine tubular pores; violently effervescent; strongly alkaline; abrupt smooth boundary.

IIC2—45 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, light yellowish brown (2.5Y 6/4) moist; massive; hard, friable, slightly sticky and slightly plastic; very few roots; very few tubular pores; slightly effervescent; moderately alkaline.

The solum is 16 to 32 inches thick. The mollic epipedon is 7 to 14 inches thick and includes part or all of the argillic horizon. Reaction throughout the profile ranges from moderately alkaline to very strongly alkaline. The argillic horizon is clay loam that is 27 to 35 percent

clay. It is less than 15 percent fine sand and coarser sand. The exchangeable bases are 30 to 60 percent sodium.

Fireball Series

The Fireball series consists of deep, well drained soils that formed in residuum of basalt. These soils are on uplands. Slopes are 30 to 50 percent.

Typical pedon of Fireball extremely stony fine sandy loam in an area of Osobb-Rezave-Fireball association, 600 feet south and 800 feet west of the northeast corner of sec. 30, T. 23 N., R. 25 E.

A1—0 to 3 inches; light brownish gray (10YR 6/2) extremely stony fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine tubular pores; 20 percent stones, 10 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

B1—3 to 10 inches; light yellowish brown (2.5Y 6/4) very cobbly fine sandy loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine through medium roots; many very fine and fine tubular pores; 15 percent pebbles, 20 percent cobbles, 5 percent stones; few thin clay films coating rock fragments; slightly effervescent; moderately alkaline; gradual wavy boundary.

B2tca—10 to 24 inches; light yellowish brown (2.5Y 6/4) very gravelly loam, olive brown (2.5Y 4/4) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine through medium roots; many very fine and fine tubular pores; 30 percent pebbles, 10 percent cobbles; few thin clay films on faces of peds, in pores, and coating rock fragments; strongly effervescent; very strongly alkaline; clear wavy boundary.

C1ca—24 to 47 inches; white (10YR 8/2) extremely cobbly loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; few fine tubular pores; 25 percent pebbles, 25 percent cobbles, 10 percent stones; violently effervescent; very strongly alkaline; abrupt wavy boundary.

R—47 inches; hard, unweathered basalt.

The depth to the lithic contact is 40 to 60 inches. The solum thickness ranges from 16 to 30 inches. The A horizon is moderately alkaline or strongly alkaline. The B2t horizon is strongly alkaline or very strongly alkaline. It is loam, clay loam, or sandy clay loam that is 18 to 35 percent clay. It is 35 to 60 percent rock fragments. The C horizon is strongly alkaline or very strongly alkaline.

Fleischmann Series

The Fleischmann series consists of moderately deep, well drained soils on terraces. These soils formed in alluvium derived mainly from mixed rock. Slopes are 2 to 15 percent.

Typical pedon of Fleischmann gravelly clay loam, 2 to 4 percent slopes, 300 feet east and 2,500 feet south of the northwest corner of sec. 32, T. 20 N., R. 20 E.

- A1—0 to 4 inches; grayish brown (10YR 5/2) gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, firm, sticky and slightly plastic; many very fine to medium roots; many very fine to medium pores; about 15 percent gravel; slightly acid; clear smooth boundary.
- B1—4 to 10 inches; brown (10YR 5/3) heavy clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; common very fine to medium roots; common fine to medium pores; common thin clay films on ped faces; neutral; abrupt wavy boundary.
- B2t—10 to 20 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; very hard, very firm, sticky and plastic; very few roots; very few pores; many moderately thick clay films on ped faces; neutral; abrupt smooth boundary.
- C1sim—20 to 43 inches; strongly silica-cemented duripan with some strongly cemented lamellae.
- IIC2—43 to 60 inches; light yellowish brown (10YR 6/4) semiconsolidated old alluvial fill and weathered softly consolidated conglomerate with apparent texture of sandy loam to very gravelly sandy clay loam, yellowish brown (10YR 5/4) moist; massive; very hard, firm but very firm in about 25 percent of the area; moderately alkaline.

The thickness of the solum and the depth to the strongly cemented duripan are 20 to 30 inches.

Reaction in the A horizon is commonly slightly acid or neutral but is medium acid in some pedons. The B horizon is slightly acid or neutral. The texture of the Bt horizon is clay that is 40 to 55 percent clay.

Flex Series

The Flex series consists of very shallow, well drained soils on uplands. These soils formed in residuum mainly of altered andesite and metamorphic rock. Slopes are 8 to 50 percent.

Typical pedon of Flex very gravelly sandy loam, 15 to 30 percent slopes, 2,600 feet west and 2,600 feet south of the northeast corner of sec. 22., T. 20 N., R. 19 E.

- A11—0 to 1 inch; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and

nonplastic; very few roots; many very fine interstitial pores; 35 percent pebbles; slightly acid; abrupt smooth boundary.

- A12—1 to 3 inches; light brownish gray (10YR 6/2) very gravelly fine sandy loam, dark brown (10YR 3/3) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores; 35 percent pebbles; slightly acid; clear smooth boundary.
- B1t—3 to 5 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak medium angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; common thin clay films bridging sand grains, 35 percent pebbles; slightly acid; clear smooth boundary.
- B2t—5 to 10 inches; brown (10YR 5/3) very gravelly sandy clay loam, dark brown (10YR 3/3) moist; weak fine angular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine tubular pores; common thin clay films on ped faces, in pores, and bridging sand grains; 35 to 40 percent pebbles; slightly acid; clear wavy boundary.
- Cr—10 to 30 inches; highly weathered metavolcanic bedrock.

The solum ranges from 6 to 12 inches in thickness, and the depth to weathered bedrock ranges from 6 to 12 inches. Reaction in the profile is slightly acid or neutral. The control section is very gravelly sandy loam or very gravelly sandy clay loam that is 18 to 27 percent clay. It is 35 to 50 percent pebbles.

Fralval Series

The Fralval series consists of moderately deep, well drained soils on uplands. These soils formed in residuum mainly of volcanic rocks. Slopes are 30 to 50 percent.

Typical pedon of Fralval very stony loam, in an area of Fralval-Booford-Jumbo association, 2,600 feet east and 200 feet north of the southwest corner of sec. 21, T. 18 N., R. 19 E.

- A1—0 to 9 inches; dark grayish brown (10YR 4/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine to medium roots; many very fine and fine interstitial pores; 10 percent pebbles, 5 percent cobbles, 3 percent stones; slightly acid; clear smooth boundary.
- B2t—9 to 18 inches; brown (10YR 5/3) very gravelly heavy loam, brown (10YR 4/3) moist; weak fine angular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine to

medium roots; many very fine to medium tubular pores; common thin clay films bridging sand grains and few thin clay films in pores; 25 percent pebbles, 10 percent cobbles; slightly acid; gradual wavy boundary.

B3t—18 to 27 inches; light yellowish brown (10YR 6/4) very cobbly loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 10 percent pebbles, 30 percent cobbles, all highly weathered; few thin clay films bridging sand grains; slightly acid; gradual irregular boundary.

Cr—27 to 40 inches; highly weathered tuff.

Depth to weathered bedrock ranges from 20 to 40 inches. Reaction throughout the profile is medium acid to slightly acid. The B2t horizon is loam or clay loam that is 20 to 30 percent clay. It is 35 to 45 percent rock fragments.

Frodo Series

The Frodo series consists of shallow, well drained soils that formed in residuum and colluvium derived mainly from basalt. Frodo soils are on remnants of volcanic flow rock plateaus. Slopes are 2 to 30 percent.

Typical pedon of Frodo very stony loam, in an area of Frodo-Xman-Opio association, 900 feet west and 500 feet south of the northeast corner of sec. 32, T. 21 N., R. 21 E.

A11—0 to 1 inch; dark grayish brown (10YR 4/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak moderate subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine and fine tubular pores; 10 percent pebbles, 30 percent cobbles, 25 percent stones; neutral; abrupt smooth boundary.

A12—1 to 6 inches; dark grayish brown (10YR 4/2) loam, dark brown (10YR 3/3) moist; strong medium subangular blocky structure parting to weak thin and medium platy; slightly hard, very friable, sticky and plastic; many very fine and fine tubular pores; 5 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B2t—6 to 16 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; extremely hard, firm, very sticky and very plastic; common very fine and fine roots; few very fine and fine tubular pores; continuous, moderately thick clay films on ped faces; 5 percent stones; mildly alkaline; clear smooth boundary.

B3tca—16 to 18 inches; dark yellowish brown (10YR 4/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium to fine angular blocky structure; very hard, firm, sticky and plastic; common

very fine and fine roots; few very fine and fine tubular pores; 25 percent pebbles; moderately effervescent; moderately alkaline; abrupt smooth boundary.

C1casim—18 to 23 inches; very pale brown (10YR 7/3) continuous strongly silica-cemented duripan, pale brown (10YR 6/3) moist; massive; extremely hard; strongly effervescent; moderately alkaline; clear wavy boundary.

R—23 to 42 inches; hard, fractured bedrock.

The depth of the solum to the duripan ranges from 14 to 20 inches. The depth to bedrock ranges from 18 to 30 inches. The A horizon is slightly acid or neutral. The B horizon is neutral to moderately alkaline. The Bt horizon is clay or clay loam that is 35 to 60 percent clay. It is 5 to 25 percent rock fragments.

Fugawee Series

The Fugawee series consists of moderately deep, well drained soils on uplands. These soils formed in residuum mainly of volcanic rock. Slopes are 15 to 50 percent.

Typical pedon of Fugawee very stony loam, in an area of Jorge-Boomtown-Fugawee association, 600 feet west and 2,000 feet north of the southeast corner of sec. 9, T. 18 N., R. 18 E.

O1—2 inches to 0; pine and fir litter duff.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine through coarse roots; many very fine through medium tubular pores; 15 percent pebbles, 10 percent cobbles, 15 percent stones; strongly acid; clear wavy boundary.

A12—5 to 17 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine through coarse roots; many very fine through medium tubular pores; 20 percent pebbles, 5 percent cobbles, 5 percent stones; medium acid; clear smooth boundary.

B2t—17 to 29 inches; light yellowish brown (10YR 6/4) cobbly loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine through coarse roots; many very fine through medium tubular pores; few thin clay films on ped faces and pores; 15 percent pebbles, 15 percent cobbles; medium acid; clear smooth boundary.

C1r—29 to 43 inches; highly weathered volcanic rock.

The depth of the solum to weathered bedrock ranges from 20 to 40 inches. The surface horizon does not

qualify as an umbric epipedon. Reaction throughout the profile is medium acid to strongly acid. The Bt horizon is loam or clay loam that is 18 to 35 percent clay. It is 5 to 35 percent rock fragments.

Gabica Series

The Gabica series consists of shallow, well drained soils on uplands. These soils formed in residuum mainly of volcanic rock. Slopes are 8 to 30 percent.

Typical pedon of Gabica very gravelly sandy loam, 8 to 30 percent slopes, 400 feet east and 2,400 feet north of the southwest corner of sec. 33, T. 16 N., R. 19 E.

A11—0 to 1 inch; dark grayish brown (10YR 4/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 50 percent pebbles, 5 percent cobbles; slightly acid; clear smooth boundary.

A12—1 to 9 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; 35 percent pebbles, 5 percent cobbles, 5 percent stones; slightly acid; clear wavy boundary.

A13—9 to 14 inches; grayish brown (10YR 5/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable, slightly sticky and slightly plastic; common very fine to medium roots; few fine pores; few thin clay films coating coarse fragments; 10 percent pebbles, 50 percent cobbles; slightly acid; abrupt irregular boundary.

B2t—14 to 19 inches; dark yellowish brown (10YR 4/4) very cobbly clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few roots; few thin clay films coating coarse fragments and in pores; 10 percent pebbles, 50 percent cobbles; slightly acid; abrupt irregular boundary.

R—19 to 22 inches; hard, fractured porphyritic bedrock.

The thickness of the solum and the depth to unweathered bedrock range from 10 to 20 inches. The mollic epipedon is 7 to 19 inches thick. Reaction throughout the profile ranges from neutral to medium acid. The Bt horizon is clay loam, silty clay loam, or heavy loam that is 24 to 35 percent clay. It is 50 to 80 percent rock fragments.

Galeppi Series

The Galeppi series consists of very deep, well drained soils on dissected alluvial fans and terraces. These soils formed in alluvium derived mainly from granitic and sedimentary rocks. Slopes are 4 to 30 percent.

Typical pedon of Galeppi sandy loam, 4 to 8 percent slopes, 1,000 feet east and 1,800 feet north of the southwest corner of sec. 7, T. 22 N., R. 19 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; many very fine to medium roots; many fine interstitial pores; slightly acid; abrupt smooth boundary.

A12—2 to 10 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine to coarse roots; many fine interstitial and tubular pores; 5 percent cobbles; neutral; clear smooth boundary.

B2t—10 to 15 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure; very hard, friable, sticky and plastic; many very fine to coarse roots; common fine tubular pores; common thin clay films on ped faces and in pores; neutral; clear smooth boundary.

IIB3t—15 to 22 inches; yellowish brown (10YR 5/4) heavy sandy loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, friable, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; common thin clay films in pores; neutral; gradual smooth boundary.

IIC1si—22 to 35 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive; hard, firm, nonsticky and nonplastic; few coarse roots; weak discontinuous silica cementation; neutral; abrupt smooth boundary.

IIIC2si—35 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, nonsticky and nonplastic; few coarse roots; weak discontinuous silica cementation; neutral.

The depth of the solum to the weakly silica-cemented layer ranges from 21 to 39 inches. The mollic epipedon is 8 to 15 inches thick. The reaction throughout the profile is slightly acid to mildly alkaline. The B2t horizon is sandy clay loam or clay loam and averages 22 to 30 percent clay.

Glenbrook Series

The Glenbrook series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in material weathered mainly from granite and granodiorite. Slopes are 8 to 70 percent.

Typical pedon of Glenbrook cobbly sand in an area of Graufels-Glenbrook complex, 8 to 50 percent slopes, 1,800 feet east and 400 feet north of the southwest corner of sec. 7, T. 23 N., R. 19 E.

About 20 percent of the surface is covered by cobbles that broke off from adjacent apatite dikes.

- A11—0 to 2 inches; pale brown (10YR 6/3) cobbly sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; very few roots; many very fine interstitial pores; 15 percent fine pebbles, 15 percent cobbles; slightly acid; clear smooth boundary.
- A12—2 to 7 inches; grayish brown (10YR 5/2) cobbly sand, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine to medium roots; many very fine and fine interstitial pores; 15 percent pebbles, 10 percent cobbles; slightly acid; clear smooth boundary.
- C1—7 to 13 inches; pale brown (10YR 6/3) gravelly sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common very fine to coarse roots; many very fine and fine interstitial pores; 15 percent pebbles, 10 percent cobbles; slightly acid; abrupt wavy boundary.
- C2r—13 to 24 inches; weathered granodiorite; original rock structure is evident; the rock can be dug with a tile spade to a depth of about 4 feet.

The depth to weathered granitic bedrock is 10 to 20 inches. Depth to extremely hard bedrock ranges from 24 to more than 72 inches. Reaction throughout the profile ranges from slightly acid to neutral. The control section is sand, coarse sand, or loamy sand that is 0 to 8 percent clay. The content of rock fragments ranges from 15 to 30 percent.

Godecke Series

The Godecke series consists of very deep, somewhat poorly drained soils on terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Godecke loamy sand, 330 feet east and 1,650 feet south of the northwest corner of sec. 8, T. 16 N., R. 20 E.

- A1—0 to 2 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; many interstitial pores; neutral; clear smooth boundary.
- A2—2 to 5 inches; light brownish gray (10YR 6/2) loamy fine sand, brown (10YR 4/3) moist; weak fine platy structure; slightly hard, very friable, nonsticky and nonplastic; many very fine to coarse roots; many very fine to coarse tubular pores; moderately alkaline; clear wavy boundary.
- B2t—5 to 10 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; very dark brown (10YR 2/2) organic stains on ped faces; moderate medium

- prismatic structure; very hard, firm, sticky and plastic; common very fine and fine roots concentrated along ped faces; common very fine tubular pores; common moderately thick clay films on ped faces and few moderately thick clay films in pores; strongly alkaline; clear wavy boundary.
- B3t—10 to 15 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure; very hard, firm, sticky and plastic; common very fine and fine roots; common very fine tubular pores; few thin clay films on ped faces and common thin clay films in pores; slightly effervescent, some lime occurs in solid masses; strongly alkaline; clear wavy boundary.
- C1—15 to 25 inches; light brownish gray (2.5Y 6/2) light sandy clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; few fine to coarse roots; few very fine and fine tubular pores; slightly effervescent, lime in soft masses; strongly alkaline; clear wavy boundary.
- I1B2tcasi—25 to 33 inches; pale brown (10YR 6/3) light clay, brown (10YR 4/3) moist; weak medium prismatic structure; very hard, firm, very sticky and plastic; common fine to coarse dead roots; few fine and medium pores; common moderately thick clay films on ped faces and in pores; strongly effervescent, lime in filaments; few small durinodes; strongly alkaline; clear wavy boundary.
- I1C2casi—33 to 43 inches; pale brown (10YR 6/3) sandy loam with weakly silica-cemented lamellae, yellowish brown (10YR 5/4) moist; common fine distinct yellowish brown (10YR 5/6) mottles; slightly hard and very hard, friable and brittle, slightly sticky and slightly plastic; strongly effervescent, lime in filaments; strongly alkaline; abrupt wavy boundary.
- I1C3ca—43 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, sticky and slightly plastic; strongly effervescent, lime in thin filaments; moderately alkaline.

The solum ranges from 14 to 20 inches in thickness. Reaction is moderately alkaline to strongly alkaline throughout. The Bt horizon is clay loam or sandy clay loam and averages between 20 and 35 percent clay. The exchangeable bases range from 15 to 35 percent sodium. These soils are generally dry except in late winter and spring when they are moist throughout. The water table is within 40 inches of the surface during the rest of the year. These soils are slightly to strongly affected by salts and alkali. Some pedons are calcareous throughout.

Godecke Variant

The Godecke Variant consists of deep, moderately well drained soils on alluvial fans. These soils formed in

alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Godecke Variant loamy sand, 2,500 feet west and 800 feet north of the southwest corner of sec. 8, T. 16 N., R. 20 E.

- A11—0 to 5 inches; brown (10YR 5/3) loamy sand, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; many interstitial pores; neutral; clear smooth boundary.
- A12—5 to 12 inches; light brownish gray (10YR 6/2) fine sandy loam, brown (10YR 4/3) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to coarse roots; many very fine to coarse tubular pores; moderately alkaline; clear wavy boundary.
- B2t—12 to 25 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure; very hard, firm, sticky and plastic; common very fine and fine roots concentrated along ped faces; common very fine tubular pores; common moderately thick clay films on ped faces and few moderately thick clay films in pores; strongly alkaline; clear wavy boundary.
- C1sica—25 to 42 inches; light brownish gray (10YR 6/2) light sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; few fine to coarse roots; few very fine and fine tubular pores; lime in soft masses; weak silica cementation; slightly effervescent; strongly alkaline; clear wavy boundary.
- C2sim—42 to 60 inches; white (10YR 8/2) strongly cemented duripan.

The depth to the duripan is 40 to 60 inches. The A horizon ranges from neutral to moderately alkaline. The B2t horizon is sandy clay loam that is 20 to 35 percent clay. The depth to the water table is 6 to 7 feet.

Graufels Series

The Graufels series consists of moderately deep, somewhat excessively drained soils on uplands. These soils formed in residuum derived mainly from granitic rocks. Slopes are 4 to 50 percent.

Typical pedon of Graufels bouldery sand, in an area of Graufels-Rock outcrop complex, 15 to 30 percent slopes, 600 feet west and 700 feet north of the southeast corner of sec. 30, T. 17 N., R. 20 E.

- A11—0 to 3 inches; dark grayish brown (10YR 4/2) bouldery sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; very few roots; many fine and very fine interstitial pores; 20 percent fine pebbles, 2 percent boulders; neutral; abrupt smooth boundary.

A12—3 to 10 inches; grayish brown (10YR 5/2) loamy coarse sand, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine and medium roots; many very fine and fine interstitial pores; 10 percent fine pebbles; neutral; gradual smooth boundary.

C1—10 to 22 inches; light yellowish brown (10YR 6/4) gravelly loamy coarse sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine to medium roots; common very fine and medium interstitial and few very fine and medium tubular pores; very few thin clay films coating and bridging sand grains; 25 percent fine pebbles; neutral; clear wavy boundary.

C2r—22 to 24 inches; highly weathered granodiorite bedrock that can be dug relatively easily with hand tools.

The depth to weathered bedrock is 20 to 40 inches. Reaction throughout the profile is slightly acid to neutral. The control section is sand, loamy sand, gravelly coarse sand, or gravelly loamy sand that is 3 to 10 percent clay. Some pedons have strata that are 10 to 35 percent coarse fragments.

Graylock Series

The Graylock series consists of deep, somewhat excessively drained soils on uplands. These soils formed in residuum mainly of granitic rocks. Slopes are 30 to 70 percent.

Typical pedon of Graylock bouldery loamy sand, in an area of Graylock-Temo-Rock outcrop complex, 1,100 feet west and 2,200 feet south of the northeast corner of sec. 20, T. 17 N., R. 19 E.

A1—0 to 10 inches; grayish brown (10YR 5/2) bouldery loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; many fine and very fine and few medium roots; many very fine interstitial pores; 10 percent pebbles, 10 percent stones and boulders; medium acid; clear wavy boundary.

AC—10 to 20 inches; brown (10YR 5/3) very gravelly loamy sand, dark brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; many fine and medium and few very fine roots; many fine interstitial pores; 50 percent pebbles, 5 percent cobbles; medium acid; gradual wavy boundary.

C1—20 to 41 inches; pale brown (10YR 6/3) very gravelly loamy sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine and medium roots; many fine interstitial pores; 40 percent pebbles, 10 percent cobbles, 5 percent stones; medium acid; gradual wavy boundary.

C2—41 to 60 inches; pale brown (10YR 6/3) very cobbly loamy sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; very few roots; many fine interstitial pores; 30 percent pebbles, 15 percent cobbles, 5 percent stones; medium acid; clear irregular boundary.

C3r—60 to 61 inches; highly fractured granitic bedrock.

The depth to bedrock ranges from 40 to 60 inches. Reaction throughout the profile ranges from slightly acid to very strongly acid. The control section is loamy sand or sand that is 0 to 5 percent clay. It is 50 to 75 percent rock fragments.

Greenbrae Series

The Greenbrae series consists of very deep, well drained soils on smooth terraces and alluvial fans. These soils formed in alluvium derived mainly from granodiorite. Slopes are 0 to 8 percent.

Typical pedon of Greenbrae sandy loam, 0 to 2 percent slopes, 200 feet west and 1,000 feet south of the northeast corner of sec. 24, T. 21 N., R. 18 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) loamy sand, very dark brown (10YR 2/2) moist; massive; soft, very friable; many very fine interstitial pores; medium acid; abrupt smooth boundary.

A12—2 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark brown (10YR 2/2) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; many very fine interstitial pores; slightly acid; clear wavy boundary.

A13—5 to 10 inches; grayish brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine and few medium roots; many very fine interstitial pores; slightly acid; abrupt wavy boundary.

B21t—10 to 17 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; common thin clay films on peds; slightly acid; abrupt wavy boundary.

B22t—17 to 30 inches; brown (10YR 5/3) sandy clay, very dark grayish brown (10YR 3/2) moist; strong fine prismatic structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many thin and few moderately thick clay films on peds and in pores; neutral; abrupt wavy boundary.

B3—30 to 41 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; massive; very hard, friable, nonsticky and slightly plastic; few very fine roots; few very fine tubular pores; few thin clay films

coating and bridging sand grains; neutral; clear wavy boundary.

IIC1—41 to 62 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam, brown (10YR 5/3) moist; massive; very hard, friable, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; 15 percent pebbles; neutral; abrupt wavy boundary.

The solum ranges from 28 to 48 inches in thickness. Reaction throughout the profile ranges from medium acid to mildly alkaline. The Bt horizon is clay loam, sandy clay loam, or sandy clay. The clay content averages 27 to 35 percent.

Hawsley Series

The Hawsley series consists of very deep, somewhat excessively drained soils that formed in alluvium and water-reworked eolian deposits derived from mixed rock. Hawsley soils are on fans and terraces. Slopes are 2 to 8 percent.

Typical pedon of Hawsley sand, 2 to 8 percent slopes, 1,000 feet north and 800 feet west of sec. 6, T. 23 N., R. 24 E.

A11—0 to 4 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; many very fine and fine interstitial pores; 5 percent pebbles; moderately alkaline; clear smooth boundary.

A12—4 to 8 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine interstitial and few fine tubular pores; 5 percent pebbles; moderately alkaline; clear smooth boundary.

C1—8 to 23 inches; pale brown (10YR 6/3) stratified fine sand through coarse sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine interstitial and few fine tubular pores; 5 percent pebbles; strongly alkaline; clear smooth boundary.

C2ca—23 to 42 inches; pale brown (10YR 6/3) stratified fine sand through coarse sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine interstitial and few fine tubular pores; 5 percent pebbles; strongly effervescent; strongly alkaline; clear smooth boundary.

IIC2ca—42 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; common very fine and fine interstitial and few fine tubular pores; 10 percent gravel; strongly effervescent; strongly alkaline.

This soil is more than 60 inches deep. Reaction in the A horizon is neutral to moderately alkaline and in the C horizon ranges from mildly alkaline to strongly alkaline. The control section (between depths of 10 inches and 40 inches) is stratified fine sand through coarse sand that is 0 to 5 percent clay. Gravel content ranges from 0 to 15 percent in all strata.

Haybourne Series

The Haybourne series consists of very deep, well drained soils on smooth to convex alluvial fans. These soils formed in mixed alluvium derived from granitic rocks. Slopes are 2 to 15 percent.

Typical pedon of Haybourne loamy sand, 2 to 4 percent slopes, 1,800 feet east and 1,700 feet south of the northwest corner of sec. 15, T. 21 N., R. 19 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; slightly acid; abrupt wavy boundary.

A12—2 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; many very fine interstitial pores; mildly alkaline; abrupt wavy boundary.

A13—7 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine and few fine and medium roots; many very fine interstitial and few fine tubular pores; mildly alkaline; abrupt wavy boundary.

B21—10 to 17 inches; yellowish brown (10YR 5/4) sandy loam, dark brown (10YR 3/3) moist; weak fine to medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine to coarse roots; many very fine interstitial and few fine tubular pores; 10 percent fine pebbles; few thin clay films coating and bridging sand grains; mildly alkaline; clear wavy boundary.

B22—17 to 26 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; weak fine to medium subangular blocky structure; very hard, friable, nonsticky and nonplastic; few very fine to coarse roots; many very fine interstitial and few fine tubular pores; 10 percent fine pebbles; few thin clay films coating and bridging sand grains; mildly alkaline; clear wavy boundary.

C1—26 to 38 inches; pale brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) moist; massive; very hard, friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial and few fine tubular pores; 10 percent fine pebbles; noneffervescent matrix but slightly effervescent in spots; moderately alkaline; abrupt wavy boundary.

C2—38 to 63 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; 10 percent fine pebbles; mildly alkaline.

The solum ranges from 18 to 32 inches in thickness. Reaction throughout the profile is slightly acid to moderately alkaline. The texture in the control section (between a depth of 10 inches and a depth of 40 inches) is fine sandy loam or sandy loam that is 5 to 18 percent clay. It is 10 to 25 percent fine pebbles.

Haypress Series

The Haypress series consists of deep, somewhat excessively drained soils on uplands. These soils formed in materials derived mainly from granitic rocks. Slopes are 15 to 70 percent.

Typical pedon of Haypress extremely bouldery loamy coarse sand, in an area of Haypress-Tanob-Rock outcrop association, 1,030 feet west and 150 feet north of the southeast corner of sec. 29, T. 22 N., R. 18 E.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) extremely bouldery loamy coarse sand, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; 20 percent pebbles, 15 percent stones, 30 percent boulders; medium acid; clear smooth boundary.

A12—4 to 15 inches; grayish brown (10YR 5/2) gravelly coarse sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 20 percent fine pebbles; slightly acid; clear wavy boundary.

AC—15 to 28 inches; brown (10YR 5/3) gravelly coarse sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 20 percent fine pebbles, 5 percent cobbles; slightly acid; clear irregular boundary.

C1—28 to 40 inches; brown (10YR 5/3) gravelly coarse sand, dark grayish brown (2.5Y 4/2) moist; single grained; loose, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 30 percent fine pebbles; slightly acid; abrupt irregular boundary.

C2r—40 to 46 inches; highly weathered granodiorite with soil and roots in fractures.

The depth to weathered bedrock ranges from 40 to 60 inches. The mollic epipedon is 10 to 18 inches thick.

Reaction throughout the profile is medium acid to slightly acid. Texture in the control section is gravelly coarse sand, coarse sand, loamy coarse sand, or gravelly loamy coarse sand that is 0 to 8 percent clay.

Rock fragments make up 15 to 35 percent of the control section and are mostly pebbles.

Hefed Series

The Hefed series consists of very deep, well drained soils that formed in mixed colluvium derived mainly from metavolcanic sources. Hefed soils are on lower colluvial slopes. Slopes are 15 to 70 percent.

Typical pedon of Hefed very stony sandy loam, in an area of Bombadil-Hefed-Rubble land association, 100 feet south and 2,500 feet west of the northeast corner of sec. 18, R. 23 E., T. 20 N.

A1—0 to 2 inches; pale brown (10YR 6/3) very stony sandy loam, dark brown (10YR 3/3) moist; moderate thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular pores and common fine tubular pores; 20 percent pebbles, 15 percent cobbles; 15 percent stones; neutral; abrupt smooth boundary.

B2t—2 to 6 inches; brown (10YR 5/3) very gravelly loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; many very fine to medium roots; many fine to very fine vesicular and tubular pores; common thin and few moderately thick clay films on peds, in pores, and on rock fragments; 35 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B3t—6 to 13 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; few medium and common very fine and fine roots; common very fine and fine tubular pores; few medium tubular pores; common thin clay films in pores and coating rock fragments; 40 percent pebbles, 5 percent cobbles; neutral; gradual wavy boundary.

C1—13 to 24 inches; pale brown (10YR 6/3) very cobbly sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine through medium roots; few very fine through medium tubular pores; 25 percent pebbles, 20 percent cobbles, 5 percent stones; mildly alkaline; gradual wavy boundary.

IIc2—24 to 51 inches; pale brown (10YR 6/3) very cobbly loamy fine sand; dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; few very fine and fine tubular pores; 20 percent pebbles, 15 percent cobbles, 10 percent stones; mildly alkaline; abrupt wavy boundary.

IIIC3sica—51 to 62 inches; yellowish brown (10YR 5/4) very cobbly loamy sand, dark yellowish brown (10YR 3/4) moist; massive; very hard, brittle, nonsticky and nonplastic; strongly effervescent in spots; 30 percent pebbles, 25 percent cobbles, 5 percent stones; continuous weak silica cementation; moderately alkaline; abrupt wavy boundary.

IVC4ca—62 to 75 inches; brown (10YR 5/3) very gravelly loamy sand, dark yellowish brown (10YR 3/4) moist; massive; very hard, friable, nonsticky and nonplastic; very few fine roots; very few fine tubular pores; strongly effervescent with lime occurring in seams; 50 percent pebbles, 10 percent cobbles; moderately alkaline.

The depth of the solum ranges from 10 to 20 inches. Reaction throughout the profile is neutral to moderately alkaline.

The Bt horizon is loam or heavy sandy loam that is 18 to 27 percent clay. It is 35 to 50 percent rock fragments.

Hirschdale Series

The Hirschdale series consists of moderately deep, well drained soils formed in residuum of altered andesite. Hirschdale soils are on uplands. Slopes are 15 to 50 percent.

Typical pedon of Hirschdale very stony loam, in an area of Fraval-Hirschdale-Duckhill Variant association, 800 feet west and 1,200 feet south of the northwest corner of sec. 6, T. 18 N., R. 19 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 10 percent pebbles, 10 percent cobbles, 15 percent stones; neutral; abrupt smooth boundary.

A12—2 to 6 inches; brown (7.5YR 5/2) cobbly loam, dark brown (7.5YR 3/2) moist; weak medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine through medium roots; common fine and medium vesicular pores; 10 percent pebbles, 10 percent cobbles, 3 percent stones; neutral; clear smooth boundary.

B21t—6 to 12 inches; reddish brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine tubular pores; few very fine through coarse roots; common moderately thick clay films on ped faces and pores; 15 percent pebbles, 5 percent cobbles; neutral; abrupt smooth boundary.

B22t—12 to 39 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium

prismatic structure; hard, firm, sticky and plastic; few very fine and fine roots; few very fine and fine tubular pores; many thick clay films coating rock fragments and on ped faces and pores; 5 percent pebbles, 5 percent cobbles; slightly acid; clear wavy boundary.

Cr—39 to 55 inches; highly weathered altered and bleached andesite with roots and clay loam in pockets.

R—55 inches; hard bleached and altered andesite.

The thickness of the solum and the depth to the paralithic contact range from 20 to 40 inches. Reaction throughout the profile is neutral to slightly acid. The Bt horizon is clay loam or clay that averages 35 to 60 percent clay. It is 10 to 35 percent rock fragments.

Holbrook Series

The Holbrook series consists of very deep, somewhat excessively drained soils on alluvial fans and in drainageways. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 8 percent.

Typical pedon of Holbrook gravelly loamy sand, 2 to 8 percent slopes, 2,640 feet west and 1,400 feet south of the northeast corner of sec. 5, T. 16 N., R. 20 E.

A1—0 to 8 inches; brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; 30 percent pebbles; slightly acid; clear smooth boundary.

B2—8 to 14 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; 20 percent pebbles; slightly acid; clear smooth boundary.

C1—14 to 60 inches; light brownish gray (10YR 6/2) stratified very gravelly fine sandy loam, gravelly sand, and very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 35 percent pebbles, 5 percent cobbles; slightly acid; clear smooth boundary.

The solum ranges from 12 to 20 inches in thickness. The soil profile is more than 60 inches deep. The mollic epipedon is 10 to 20 inches thick and includes part or all of the cambic horizon. Reaction throughout the profile is slightly acid to moderately alkaline. Texture in the control section (between depths of 10 inches and 40 inches) averages sandy loam. It is 5 to 10 percent clay and is 35 to 50 percent rock fragments.

Idlewild Series

The Idlewild series consists of very deep, somewhat poorly drained soils on alluvial fans and terraces. These

soils formed in alluvium derived mainly from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Idlewild clay loam, 1,400 feet west and 660 feet south of the northeast corner of sec. 6, T. 19 N., R. 20 E.

A11—0 to 4 inches; grayish brown (2.5Y 5/2) heavy loam, very dark grayish brown (2.5Y 3/2) moist; many large prominent reddish brown (5YR 4/4) mottles; moderate medium angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to medium roots; many very fine to medium pores; slightly acid; clear wavy boundary.

A12—4 to 8 inches; dark grayish brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; many large prominent reddish brown (5YR 4/4) mottles; weak fine prismatic structure; friable, slightly sticky and plastic; many very fine and fine roots; many very fine and fine pores; slightly acid; clear smooth boundary.

B1—8 to 13 inches; olive brown (2.5Y 4/4) clay loam, olive brown (2.5Y 4/4) moist; many large prominent brown (7.5YR 4/4) mottles; massive; firm, sticky and plastic; common very fine and fine roots; common very fine pores; slightly acid; gradual smooth boundary.

B2t—13 to 23 inches; dark yellowish brown (10YR 4/4) silty clay, olive brown (2.5Y 4/4) moist; many large prominent brown (7.5YR 4/4) mottles; weak coarse prismatic structure; very firm, sticky and very plastic; few very fine roots; common very fine pores; common thin clay films on ped faces; few thin clay films in pores; some manganese concretions; slightly acid; clear wavy boundary.

B3t—23 to 36 inches; olive brown (2.5Y 4/4) heavy silty clay loam, olive brown (2.5Y 4/4) moist; many large prominent brown (7.5YR 4/4) mottles; weak medium angular blocky structure; firm, sticky and plastic; very few roots; very few pores; common thin clay films; some manganese concretions; slightly acid; gradual wavy boundary.

C1—36 to 47 inches; yellowish brown (10YR 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; many large prominent brown (7.5YR 4/4) mottles; weak fine angular blocky structure; firm, sticky and plastic; very few roots; very few pores; neutral; clear smooth boundary.

C2—47 to 62 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; few fine faint brown (7.5YR 4/4) mottles; massive; friable, sticky and plastic; very few roots; very few pores; neutral; abrupt wavy boundary.

IIC2—62 to 68 inches; brown (10YR 5/3) gravelly sand, dark yellowish brown (10YR 4/4) moist; single grained; loose, nonsticky and nonplastic; neutral.

The solum ranges from 30 to 40 inches in thickness. Reaction throughout the profile is slightly acid to neutral. The Bt horizon is clay, silty clay, clay loam, or heavy silty clay loam that averages from 35 to 45 percent clay. These soils are saturated at a depth ranging from 20 to 40 inches during a large part of the year, unless the drainage has been altered.

Incy Series

The Incy series consists of very deep, excessively drained soils on alluvial fans and terraces. These soils formed in sandy eolian deposits and alluvium derived from granitic rock with admixtures from rhyolite, andesite, and other rock. Slopes are 4 to 30 percent.

Typical pedon of Incy sand, 4 to 8 percent slopes, 2,340 feet east and 2,640 feet south of the northwest corner of sec. 14, T. 21 N., R. 19 E.

- A11—0 to 3 inches; pale brown (10YR 6/3) sand, dark brown (7.5YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; neutral; abrupt wavy boundary.
- A12—3 to 9 inches; grayish brown (10YR 5/2) sand, dark brown (7.5YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine and few medium and large roots; many very fine interstitial pores; neutral; clear wavy boundary.
- C1—9 to 26 inches; brown (10YR 5/3) sand, dark brown (7.5YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine to coarse roots; many very fine interstitial pores; neutral; clear wavy boundary.
- C2—26 to 67 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; mildly alkaline.

The soil profile is more than 60 inches deep. Reaction throughout the profile is neutral to mildly alkaline. The control section is sand or fine sand. It is 0 to 5 percent clay.

Indian Creek Series

The Indian Creek series consists of shallow, well drained soils on dissected alluvial fans and terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 15 percent.

Typical pedon of Indian Creek gravelly sandy loam, 0 to 4 percent slopes, 400 feet west and 200 feet south of the northeast corner of sec. 8, T. 20 N., R. 19 E.

About 25 percent of the surface is covered by gravel.

- A11—0 to 3 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR

3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine interstitial pores; 40 percent gravel; neutral; clear smooth boundary.

- A12—3 to 7 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine interstitial pores; neutral; clear smooth boundary.
- B1t—7 to 11 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and plastic; few very fine and fine roots; many very fine interstitial pores; few thin clay films coating and bridging sand grains; neutral; abrupt smooth boundary.
- B2t—11 to 16 inches; light brown (7.5YR 6/4) gravelly clay, reddish brown (5YR 5/4) moist; moderate medium prismatic structure; very hard to extremely hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; pressure faces or cutans on peds; few slickensides; 20 percent pebbles; neutral; abrupt smooth boundary.
- B3t—16 to 18 inches; light brown (7.5YR 6/4) gravelly clay, reddish brown (5YR 5/4) moist; massive; hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; common thin clay films bridging sand grains; 20 percent pebbles; neutral; abrupt smooth boundary.
- C1sim—18 to 25 inches; reddish yellow (7.5YR 7/6) strongly silica-cemented hardpan, strong brown (7.5YR 5/6) moist; extremely hard, extremely firm; slightly effervescent in spots; 50 to 60 percent pebbles; neutral; clear smooth boundary.
- C2si—25 to 35 inches; reddish yellow (7.5YR 7/6) weakly cemented very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; very hard, very firm, nonsticky and nonplastic; 50 percent pebbles, 10 percent cobbles; slightly effervescent in spots; neutral; gradual smooth boundary.
- C3si—35 to 60 inches; light brown (7.5YR 6/4) very gravelly sandy clay loam, strong brown (7.5YR 5/6) moist; massive; very hard, very firm, sticky and plastic; 40 percent pebbles; neutral.

The thickness of the solum and the depth to the strongly silica-cemented hardpan are 14 to 20 inches. Reaction throughout the profile is slightly acid to mildly alkaline. Texture in the argillic horizon averages clay or sandy clay. It is 35 to 55 percent clay and is 5 to 35 percent rock fragments.

Indiano Series

The Indiano series consists of moderately deep, well drained soils on uplands. These soils formed in residuum mainly of metavolcanic and volcanic rock. Slopes are 15 to 50 percent.

Typical pedon of Indiano gravelly loam, 15 to 30 percent slopes, 150 feet west and 475 feet south of the northeast corner of sec. 20, T. 20 N., R. 19 E.

- A11—0 to 1 inch; grayish brown (10YR 5/2) very gravelly loamy sand, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 40 percent pebbles; slightly acid; clear smooth boundary.
- A12—1 inch to 14 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine to medium roots; many very fine to medium interstitial and tubular pores; 10 percent pebbles; slightly acid; clear smooth boundary.
- B2t—14 to 29 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; common moderately thick clay films on ped faces; 10 percent pebbles, 5 percent cobbles; slightly acid; abrupt wavy boundary.
- R—29 to 40 inches; weathered metamorphic bedrock, becomes hard within 1 inch.

The thickness of the solum and the depth to weathered bedrock range from 20 to 40 inches. The bedrock becomes hard within 40 inches. Reaction throughout the profile is slightly acid to neutral. The Bt horizon is clay loam or sandy clay loam. It is 20 to 35 percent clay and is 15 to 25 percent rock fragments.

Inville Variant

The Inville Variant consists of very deep, somewhat poorly drained soils on terraces, fans, and glacial outwashes. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 8 percent.

Typical pedon of Inville Variant gravelly sandy loam, 2 to 8 percent slopes, 1,300 feet west and 2,500 feet south of the northeast corner of sec. 5, T. 15 N., R. 19 E.

- A1—0 to 8 inches; brown (7.5YR 4/4) gravelly sandy loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and many very fine roots; many fine interstitial pores; 15 percent pebbles; medium acid; clear smooth boundary.
- B2t—8 to 14 inches; brown (7.5YR 4/4) very gravelly loam, dark brown (7.5YR 3/2) moist; weak medium angular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine, common fine and medium, and many coarse roots; many fine

interstitial pores; common thin clay films bridging sand grains and few thin clay films on ped faces and in pores; 30 percent pebbles, 5 percent cobbles; medium acid; clear wavy boundary.

- B3t—14 to 25 inches; strong brown (7.5YR 5/6) very gravelly sandy loam, strong brown (7.5YR 5/6) moist; few fine prominent olive gray (5Y 5/2) mottles; weak coarse angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; many fine interstitial pores; few thin clay films on ped faces and bridging sand grains; 35 percent pebbles, 5 percent cobbles; medium acid; gradual wavy boundary.
- C1—25 to 40 inches; strong brown (7.5YR 5/6) gravelly heavy sandy loam, strong brown (7.5YR 5/6) moist; many large distinct strong brown (7.5YR 5/8) and few fine prominent grayish brown (2.5Y 5/2) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium roots; few medium pores; 25 percent pebbles; medium acid; clear smooth boundary.
- IIC2—40 to 78 inches; strong brown (7.5YR 5/6) clay loam, about 50 percent strong brown (7.5YR 5/6) mottles and 50 percent olive gray (5Y 5/2) mottles; moist; massive; hard, friable, sticky and slightly plastic; very few roots; very few pores; 5 percent cobbles; medium acid.

The solum ranges from 20 to 30 inches in thickness. Reaction throughout the profile is medium acid to slightly acid. The Bt horizon is very gravelly loam or very gravelly sandy loam. The clay content ranges from 15 to 27 percent, and the content of rock fragments ranges from 35 to 45 percent. The C and IIC horizons are highly mottled and, in many pedons, are gleyed in the lower part.

Isolde Series

The Isolde series consists of very deep, excessively drained soils that formed in eolian sand derived from mixed rock. Isolde soils are on stabilized dunes over lake beds, playas, terraces, alluvial fans, and uplands. Slopes are 0 to 15 percent.

Typical pedon of Isolde fine sand, in an area of Isolde-Toulon complex, 2,400 feet north and 800 feet east of the southwest corner of sec. 19, R. 24 E., T. 24 N.

- A1—0 to 6 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; moderately alkaline; clear smooth boundary.
- C1—6 to 60 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist;

massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; moderately alkaline.

The soil profile is more than 60 inches deep. Reaction throughout the profile is neutral to moderately alkaline. The control section (between depths of 10 inches and 40 inches) is fine sand. It is 0 to 5 percent clay.

Jorge Series

The Jorge series consists of very deep, well drained soils on uplands. These soils formed in residuum and colluvium derived mainly from andesite. Slopes are 15 to 50 percent.

Typical pedon of Jorge very stony sandy loam, in an area of Jorge-Boomtown-Fugawee association, 1,400 feet east and 1,150 feet north of the southwest corner of sec. 34, T. 19 N., R. 18 E.

O1—1 inch to 0; fir litter duff.

A11—0 to 3 inches; dark brown (10YR 4/3) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common fine interstitial and tubular pores; 15 percent pebbles, 10 percent cobbles, 15 percent stones; slightly acid; clear smooth boundary.

A12—3 to 9 inches; dark brown (10YR 4/3) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine through coarse roots; common fine interstitial and tubular pores; 15 percent pebbles, 20 percent cobbles; slightly acid; clear smooth boundary.

B21t—9 to 24 inches; yellowish brown (10YR 5/4) very stony loam, dark yellowish brown (10YR 3/5) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine through coarse roots; few fine tubular pores; few thin clay films bridging sand grains and pores; 15 percent pebbles, 20 percent cobbles, 15 percent stones; medium acid; clear wavy boundary.

B22t—24 to 52 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; very few very fine and fine roots; few fine tubular pores; few thin clay films bridging sand grains and pores; 50 percent pebbles, 15 percent cobbles; medium acid; clear smooth boundary.

C1—52 to 65 inches; very pale brown (10YR 7/3) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine and fine tubular

pores; 50 percent pebbles, 10 percent cobbles; medium acid.

The solum ranges from 40 to 65 inches in thickness. The depth to bedrock ranges from 60 to 80 inches. The A horizon is less than 10 inches thick. Reaction throughout the profile is slightly acid to medium acid. The B2t horizon is loam or clay loam. It is 20 to 35 percent clay and is 35 to 65 percent rock fragments.

Jowec Series

The Jowec series consists of very deep, well drained soils on low lake terraces. These soils formed in alluvium derived from mixed rock. Slopes are 0 to 2 percent.

Typical pedon of Jowec silty clay loam, 800 feet east and 800 feet north of the southwest corner of sec. 9, T. 21 N., R. 18 E.

A1—0 to 2 inches; light brownish gray (10YR 6/2) silty clay loam, brown (10YR 4/3) moist; weak thick platy structure; slightly hard, friable, sticky and plastic; very few roots; many fine and medium vesicular pores; slightly acid; abrupt smooth boundary.

B21t—2 to 9 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium prismatic structure; very hard, firm, sticky and plastic; many very fine and common fine roots; common very fine and fine tubular pores; common moderately thick clay films on ped faces and in pores; slightly acid; clear smooth boundary.

B22t—9 to 20 inches; light yellowish brown (10YR 6/4) clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; very hard, very firm, sticky and plastic; few fine roots; common fine tubular pores; common moderately thick clay films on ped faces and in pores; neutral; clear smooth boundary.

C1—20 to 38 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; few very fine and fine roots; few very fine and fine tubular pores; neutral; clear smooth boundary.

IIA1b—38 to 54 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; massive; very hard, firm, sticky and slightly plastic; very few roots; very few pores; 15 percent strongly silica-cemented durinodes; effervescent with lime in seams; strongly alkaline; clear smooth boundary.

IIC2—54 to 59 inches; light yellowish brown (10YR 6/4) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few roots; few pores; effervescent; strongly alkaline; abrupt smooth boundary.

IIIAb—59 to 69 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak fine angular blocky structure; very hard, firm, sticky and slightly plastic;

violently effervescent; strongly alkaline; abrupt smooth boundary.

IIC3—69 to 72 inches; pale brown (10YR 6/3) loamy sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, slightly sticky and nonplastic; violently effervescent; strongly alkaline.

The thickness of the solum and the depth to free carbonates range from 15 to 25 inches. Reaction ranges from slightly acid to strongly alkaline throughout the profile. The Bt horizon is dominantly clay, but may include layers of clay loam and silty clay. It is 40 to 50 percent clay.

Jowec Variant

The Jowec Variant consists of very deep, well drained soils on convex alluvial fans and terraces. These soils formed in alluvium derived mainly from granodiorite. Slopes are 4 to 15 percent.

Typical pedon of Jowec Variant sandy loam, 4 to 8 percent slopes, 1,500 feet west and 1,000 feet north of the southeast corner of sec. 24, T. 21 N., R. 18 E.

Ap1—0 to 1 inch; brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) moist; single grained; loose, nonsticky and nonplastic; many very fine interstitial pores; medium acid; abrupt smooth boundary.

Ap2—1 inch to 6 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; slightly acid; clear wavy boundary.

A&B—6 to 10 inches; light brownish gray (10YR 6/2) loamy sand, dark brown (10YR 3/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine to medium roots; many very fine interstitial pores; few thin clay films bridging and coating sand grains; slightly acid; abrupt wavy boundary.

B2t—10 to 20 inches; light brown (7.5YR 6/4) clay, reddish brown (5YR 4/4) moist; strong coarse columnar structure; very hard, firm, very sticky and very plastic; few very fine roots between columns; few fine tubular pores; many thin and few moderately thick clay films coating and bridging sand grains and in pores; slightly acid; abrupt wavy boundary.

B31t—20 to 33 inches; pale brown (10YR 6/3) sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; extremely hard, firm, sticky and plastic; many very fine interstitial and common fine tubular pores; many thin clay films bridging and coating sand grains; mildly alkaline; clear wavy boundary.

B32t—33 to 55 inches; light yellowish brown (10YR 6/4) sandy loam, brown (10YR 4/3) moist; massive; very hard, friable, slightly sticky and plastic; many very fine and common fine tubular pores; many thin clay

films coating and bridging sand grains; moderately alkaline; abrupt wavy boundary.

IIB33t—55 to 66 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; strong fine subangular blocky structure; very hard, firm, sticky and plastic; few very fine tubular pores; many thin and few moderately thick clay films on ped faces; moderately alkaline.

The solum ranges from 40 to more than 60 inches in thickness. Reaction ranges from medium acid to moderately alkaline throughout the profile. The Bt horizon is clay, sandy clay, clay loam, sandy clay loam, sandy loam, or loam. The upper 20 inches of the argillic horizon is 35 to 45 percent clay.

Jubilee Series

The Jubilee series consists of very deep, poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived mainly from granitic rocks. The slopes are 0 to 2 percent.

Typical pedon of Jubilee sandy loam, 2,000 feet west and 2,600 feet north of the southeast corner of sec. 22, T. 16 N., R. 19 E.

A1p—0 to 10 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

A12—10 to 22 inches; dark gray (10YR 4/1) coarse sandy loam, black (10YR 2/1) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

C1—22 to 28 inches; light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) moist; many pockets of black (10YR 2/1) moist; few medium distinct dark yellowish brown (10YR 4/4) mottles; massive; loose, nonsticky and nonplastic; neutral; gradual wavy boundary.

C2—28 to 60 inches; dark grayish brown (10YR 4/2) moist, with pockets of black (10YR 2/1) moist, stratified loamy coarse sand, loamy sand, sandy loam, and fine sandy loam that is highly micaceous; few medium distinct dark yellowish brown (10YR 4/4) mottles; massive; loose, nonsticky and nonplastic; neutral.

The soil profile is more than 60 inches in thickness. The mollic epipedon is 12 to 23 inches thick. Reaction throughout the profile ranges from slightly acid to mildly alkaline. Texture in the control section (between depths of 10 inches and 40 inches) averages sandy loam or coarse sandy loam. The control section is 5 to 18

percent clay. Faint or prominent mottles are in the lower part of the mollic epipedon.

Jubilee Variant

The Jubilee Variant consists of very deep, poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived mainly from granitic rocks. The slopes are 0 to 2 percent.

Typical pedon of Jubilee Variant loam, slightly saline, 600 feet east and 1,400 feet north of the southwest corner of sec. 25, T. 16 N., R. 19 E.

- A1p—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; friable, sticky and slightly plastic; many fine and very fine roots; many very fine pores; strongly alkaline; clear smooth boundary.
- A12—7 to 14 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; friable, sticky and slightly plastic; few fine and very fine roots and common medium and coarse roots; few fine and very fine and common medium and coarse tubular pores; strongly alkaline; gradual smooth boundary.
- AC—14 to 20 inches; pale brown (10YR 6/3) sandy loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; light brownish gray (10YR 6/2) lime mottles; massive; friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; moderately alkaline; gradual smooth boundary.
- C1—20 to 33 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist and olive brown (2.5Y 4/4) moist; light brownish gray (2.5Y 6/2) lime mottles; massive; friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; moderately alkaline; clear smooth boundary.
- C2—33 to 51 inches; olive brown (2.5Y 4/4) moist stratified loamy sand, sandy loam, and loamy coarse sand; common large prominent bluish gray (5B 5/1) mottles; single grained; loose, nonsticky and nonplastic; moderately alkaline; clear smooth boundary.
- C3—51 to 60 inches; 50 percent yellowish brown (10YR 5/6) moist and 50 percent bluish gray (5B 5/1) moist stratified loamy sand and loamy fine sand; single grained; loose, nonsticky and nonplastic; moderately alkaline.

The solum ranges from 12 to 23 inches in thickness. Reaction ranges from moderately alkaline to strongly alkaline throughout the profile. The control section (between a depth of 10 inches and 40 inches) averages sandy loam or coarse sandy loam. It is 8 to 15 percent

clay. Mottles may be present in the lower part of the mollic epipedon.

Jumbo Series

The Jumbo series consists of deep, well drained soils on uplands. These soils formed in colluvium and residuum mainly of volcanic rock. Slopes are 30 to 50 percent.

Typical pedon of Jumbo very stony loam, in an area of Fraval-Booford-Jumbo association, 50 feet east and 1,000 feet south of the northwest corner of sec. 27, T. 18 N., R. 19 E.

- A11—0 to 5 inches; dark grayish brown (10YR 4/2) very stony loam, very dark grayish brown (10YR 3/2) moist; strong very fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine interstitial pores, and common fine tubular pores; 20 percent pebbles, 5 percent cobbles, 5 percent stones; slightly acid; clear smooth boundary.
- A12—5 to 11 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine and very fine and common coarse and medium roots; many very fine and fine interstitial and tubular pores; 20 percent pebbles, 5 percent cobbles; slightly acid; clear wavy boundary.
- A13—11 to 21 inches; grayish brown (10YR 5/2) cobbly loam, dark brown (7.5YR 3/2) moist; moderate medium angular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine and common medium coarse roots; many fine and very fine interstitial and tubular pores; 5 percent pebbles, 15 percent cobbles, 5 percent stones; slightly acid; clear smooth boundary.
- B1t—21 to 34 inches; brown (10YR 4/3) very cobbly loam, dark brown (7.5YR 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine to coarse roots; common fine and medium tubular pores; few thin clay films bridging sand grains; 5 percent pebbles, 40 percent cobbles, 1 percent stones; slightly acid; gradual wavy boundary.
- B2t—34 to 54 inches; brown (10YR 4/3) very cobbly loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine to coarse roots; common fine and medium tubular pores; common thin clay films bridging sand grains and in pores; 5 percent pebbles, 50 percent cobbles, 1 percent stones; slightly acid; gradual irregular boundary.
- Cr—54 to 70 inches; highly weathered volcanic bedrock.

The solum ranges from 40 to 60 inches in thickness. The mollic epipedon is 20 to 30 inches thick. Reaction ranges from medium acid to neutral throughout the profile.

The Bt horizon is loam or clay loam. It is 20 to 30 percent clay and is 40 to 60 percent rock fragments.

Kayo Series

The Kayo series consists of very deep, somewhat excessively drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock. Slopes are 2 to 30 percent.

Typical pedon of Kayo stony sandy loam, 2 to 4 percent slopes, 300 feet west and 300 feet south of the northeast corner of sec. 10, T. 22 N., R. 21 E.

- A11—0 to 3 inches; brown (10YR 5/3) stony loamy sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine roots; many very fine and fine interstitial pores; 1 percent stones, 45 percent pebbles; neutral; clear smooth boundary.
- A12—3 to 11 inches; light brownish gray (10YR 6/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots and common fine and medium roots; many very fine and fine interstitial pores; 40 percent pebbles; neutral; abrupt wavy boundary.
- B2t—11 to 22 inches; brown (10YR 5/3) very gravelly coarse sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine and few medium roots; few very fine and fine tubular pores; many thin and few moderately thick clay films bridging and coating mineral grains; 40 percent pebbles; neutral; clear wavy boundary.
- C1—22 to 37 inches; brown (10YR 5/3) very gravelly loamy coarse sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine, fine, and medium roots; few very fine and fine tubular pores; 55 percent pebbles; neutral; abrupt smooth boundary.
- IIC2ca—37 to 60 inches; grayish brown (10YR 5/2) very gravelly light sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine and medium roots; very few pores; 60 percent gravel; strongly effervescent with lime coating the pebbles; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. Reaction ranges from slightly acid to neutral in the A and B horizons and from neutral to moderately alkaline in the C horizon.

The Bt horizon is coarse sandy loam, sandy loam, or loam. It is 13 to 18 percent clay and is 35 to 50 percent rock fragments.

Kleinbush Series

The Kleinbush series consists of very deep, well drained soils that formed in alluvium from basalt. These soils are on alluvial fans. Slopes are 0 to 8 percent.

Typical pedon of Kleinbush very cobbly loamy sand, in an area of Sutcliff-Kleinbush-Washoe association, 1,000 feet north and 200 feet west of the southeast corner of sec. 7, T. 21 N., R. 25 E.

- A1—0 to 4 inches; light gray (10YR 7/2) very cobbly loamy sand, grayish brown (10YR 5/2) moist; weak subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine tubular pores; 5 percent pebbles, 40 percent cobbles, 1 percent stones; moderately alkaline; abrupt smooth boundary.
- A2—4 to 5 inches; light gray (10YR 7/1) very fine sandy loam, gray (10YR 5/1) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and common medium vesicular pores; moderately alkaline; abrupt smooth boundary.
- B21t—5 to 13 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; strong medium and coarse prismatic structure; very hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; common moderately thick clay films on ped faces and in pores; strongly alkaline; clear smooth boundary.
- B3tca—13 to 19 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; strong medium angular blocky structure; hard, friable, sticky and plastic; few thin clay films on ped faces and in pores; strongly effervescent; strongly alkaline; clear smooth boundary.
- B22tcab—19 to 30 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; strong and medium prismatic structure; hard, friable, sticky and plastic; common fine and medium dead roots; common very fine and fine tubular pores; strongly effervescent; moderately alkaline; gradual smooth boundary.
- B23tcab—30 to 38 inches; reddish brown (7.5YR 6/6) clay, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine dead roots; few very fine and fine tubular pores; few thin clay films in pores; violently effervescent; moderately alkaline; abrupt smooth boundary.
- C1ca—38 to 60 inches; pinkish gray (7.5YR 7/2) cobbly sandy clay loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and

slightly plastic; 5 percent pebbles; 10 percent cobbles; many medium irregularly-shaped disseminated lime filaments; violently effervescent; moderately alkaline.

Thickness of the solum ranges from 20 to 40 inches. Reaction throughout the profile ranges from mildly alkaline to very strongly alkaline.

The Bt horizon is clay or clay loam. It is 35 to 60 percent clay.

Koontz Series

The Koontz series consists of shallow, well drained soils on uplands. These soils formed in residuum of altered igneous and metavolcanic rock. Slopes are 8 to 50 percent.

Typical pedon of Koontz gravelly loam, 8 to 15 percent slopes, about 1 mile east of New Washoe City, about 2,400 feet west and 1,250 feet north of the southeast corner of sec. 20, T. 17 N., R. 20 E.

A11—0 to 1 inch; brown (10YR 5/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; few fine and very fine roots; many very fine and fine vesicular and interstitial pores; 35 percent pebbles; neutral; abrupt smooth boundary.

A12—1 inch to 5 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; many very fine and fine interstitial pores and common medium tubular pores; 20 percent pebbles; neutral; clear smooth boundary.

B21t—5 to 10 inches; brown (10YR 5/3) very gravelly clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common medium roots; common medium and coarse pores; common moderately thick clay films on ped faces and in pores; 35 percent pebbles, 10 percent cobbles; neutral; clear smooth boundary.

B22t—10 to 14 inches; yellowish brown (10YR 5/4) very gravelly clay loam, yellowish brown (10YR 5/4) moist; moderate fine prismatic structure; very hard, friable, sticky and plastic; common medium and coarse roots; common medium and coarse pores; many moderately thick clay films on ped faces and in pores; 35 percent pebbles, 5 percent cobbles; neutral; clear wavy boundary.

B23t—14 to 18 inches; light olive brown (2.5Y 5/4) gravelly clay loam, light olive brown (2.5Y 5/4) moist; weak fine angular blocky structure; very hard, firm, sticky and plastic; common fine and medium roots; many moderately thick clay films on ped

faces; 25 percent angular pebbles; neutral; clear wavy boundary.

Cr—18 to 30 inches; weathered metamorphosed tuffaceous sediments.

The solum thickness and the depth to paralithic contact are 14 to 20 inches. The mollic epipedon is 7 to 14 inches thick. Reaction throughout the profile is neutral to mildly alkaline.

The B2t horizon is clay loam or loam. It is 25 to 35 percent clay and is 40 to 45 percent rock fragments.

Lemm Series

The Lemm series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived mainly from granodiorite. Slopes are 4 to 30 percent.

Typical pedon of Lemm very gravelly coarse sandy loam, 4 to 8 percent slopes, 1,000 feet north of the southeast corner of sec. 35, T. 21 N., R. 18 E.

About 15 percent of the surface is covered with gravel.

A11—0 to 3 inches; grayish brown (10YR 5/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; 40 percent pebbles; neutral; clear wavy boundary.

A12—3 to 10 inches; grayish brown (10YR 5/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and common fine roots; many very fine interstitial pores; 30 percent pebbles; neutral; clear wavy boundary.

A13—10 to 19 inches; grayish brown (10YR 5/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium and coarse roots; many very fine interstitial pores; 40 percent pebbles; neutral; clear wavy boundary.

B21t—19 to 29 inches; pale brown (10YR 6/3) very gravelly coarse sandy loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine to medium roots; many very fine interstitial pores; common thin clay films coating and bridging sand grains; 40 percent pebbles; neutral; clear wavy boundary.

B22t—29 to 40 inches; pale brown (10YR 6/3) very gravelly coarse sandy loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine interstitial pores; common thin clay films coating and bridging sand grains; 35 percent pebbles; neutral; clear wavy boundary.

C1—40 to 60 inches; very pale brown (10YR 7/3) very gravelly loamy coarse sand, dark brown (10YR 3/3) moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 35 percent pebbles; neutral.

The solum ranges from 30 to 48 inches in thickness. Reaction throughout the profile is medium acid to neutral.

The Bt horizon is coarse sandy loam, sandy loam, or fine sandy loam and is 35 to 50 percent pebbles. The clay content ranges from 10 to 18 percent.

Leviathan Series

The Leviathan series consists of very deep, well drained soils on terraces and their escarpments and on alluvial fans. These soils formed in alluvium derived from mixed rock. The slopes are 0 to 50 percent.

Typical pedon of Leviathan stony sandy loam, 2 to 8 percent slopes, 750 feet west and 2,600 feet south of the northeast corner of sec. 15, T. 19 N., R. 18 E.

A1—0 to 9 inches; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to coarse roots; many very fine and fine tubular pores; 15 percent pebbles, 10 percent cobbles, 2 percent stones; neutral; clear wavy boundary.

B1t—9 to 14 inches; brown (10YR 5/3) very cobbly sandy clay loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common very fine to coarse roots; common very fine and fine tubular pores; common moderately thick clay films on ped faces and in pores; 20 percent pebbles, 25 percent cobbles, 5 percent stones; neutral; clear wavy boundary.

B21t—14 to 28 inches; brown (7.5YR 5/4) very gravelly heavy sandy clay loam, brown (7.5YR 4/4) moist; moderate coarse and medium prismatic structure; very hard, firm, sticky and plastic; few fine and medium roots; few very fine and fine tubular pores; common moderately thick clay films on ped faces and in pores; 25 percent pebbles, 10 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

B22t—28 to 44 inches; brown (7.5YR 5/4) very gravelly heavy sandy clay loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure; very hard, firm, sticky and plastic; few fine and medium roots; few fine and very fine tubular pores; common moderately thick clay films on ped faces and in pores; some silica coatings on bottom sides of cobbles; 45 percent pebbles, 15 percent cobbles; neutral; clear wavy boundary.

B23t—44 to 55 inches; brown (7.5YR 5/4) very gravelly sandy clay loam, brown (7.5YR 5/4) moist; massive; very hard, friable, sticky and plastic; few fine and medium roots; few fine and very fine pores; common moderately thick clay films in pores and bridging sand grains; some silica coatings on bottom sides of cobbles; 45 percent pebbles, 10 percent cobbles; neutral; gradual wavy boundary.

B24t—55 to 65 inches; brown (7.5YR 5/4) very gravelly sandy clay loam, brown (7.5YR 5/4) moist; massive; very hard, friable, sticky and slightly plastic; few fine and medium roots; few fine and very fine tubular pores; common moderately thick clay films in pores and bridging sand grains; some silica coatings on the bottom sides of cobbles; 45 percent pebbles, 10 percent cobbles, and 5 percent stones that are highly weathered; neutral.

The solum is more than 60 inches in thickness. Reaction throughout the profile ranges from slightly acid to neutral.

The Bt horizon is sandy clay loam. It is 27 to 35 percent clay. In some pedons it has subhorizons of sandy clay that are 40 to 60 percent rock fragments.

Linhart Series

The Linhart series consists of very deep, somewhat excessively drained soils on alluvial fans and terraces. These soils formed in alluvium derived mainly from granitic rocks. The slopes are 4 to 30 percent.

Typical pedon of Linhart stony coarse sand, 4 to 8 percent slopes, 2,400 feet west and 600 feet north of the southeast corner of sec. 4, T. 23 N., R. 20 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) stony loamy coarse sand, very dark grayish brown (10YR 3/2) moist; weak fine to medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and few fine roots; many very fine and fine interstitial pores; few fine and medium tubular pores; 25 percent fine pebbles, 2 percent stones; slightly acid; clear smooth boundary.

A12—4 to 14 inches; dark grayish brown (10YR 4/2) very gravelly coarse sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine to medium roots; many very fine and fine interstitial pores and common fine, medium, and coarse tubular pores; 35 percent fine pebbles, 2 percent cobbles; neutral; gradual wavy boundary.

C1—14 to 27 inches; grayish brown (10YR 5/2) very gravelly coarse sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine to medium and few coarse roots; many very fine and fine interstitial pores; common fine, medium, and

- coarse tubular pores; 45 percent fine pebbles; neutral; abrupt wavy boundary.
- IIC2—27 to 41 inches; light brownish gray (10YR 6/2) very gravelly loamy coarse sand, dark grayish brown (10YR 4/2) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine to coarse roots; common very fine to medium tubular pores; 60 percent fine pebbles; neutral; abrupt smooth boundary.
- IIIA1b—41 to 48 inches; grayish brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores, common very fine and fine tubular pores; 30 percent fine pebbles; neutral; clear smooth boundary.
- IIC3—48 to 60 inches; light brownish gray (10YR 6/2) very gravelly coarse sand, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine and fine interstitial pores, common very fine and fine tubular pores; 40 percent fine pebbles; neutral.

The soil profile is deeper than 60 inches. Reaction throughout the profile is neutral or slightly acid. The control section (between depths of 10 inches and 40 inches) is coarse sand, loamy coarse sand, loamy sand, or sand. It is 2 to 8 percent clay and is 35 to 70 percent pebbles.

Luppino Series

The Luppino series consists of shallow, well drained soils on dissected pediments. These soils formed in alluvium derived mainly from granodiorite. Slopes are 4 to 15 percent.

Typical pedon of Luppino gravelly sandy loam, 4 to 8 percent slopes, 1,200 feet west and 1,300 feet south of the northeast corner of sec. 7, T. 20 N., R. 20 E.

About 65 percent of the surface is covered with gravel.

- A11—0 to 6 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 30 percent gravel; slightly acid; clear smooth boundary.
- A12—6 to 8 inches; yellowish brown (10YR 5/4) sandy loam, dark brown (10YR 3/3) moist; massive; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial and tubular pores; neutral; clear smooth boundary.
- B2t—8 to 14 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine interstitial and tubular pores; many thin clay films bridging sand grains; neutral; abrupt wavy boundary.

- Cr—14 to 23 inches; weathered granitic saprolite (decomposed granodiorite).
- R—23 inches; unweathered granodiorite bedrock.

Solum thickness and depth to paralithic contact range from 12 to 20 inches. The depth to hard bedrock ranges from 20 to 30 inches. Reaction throughout the profile ranges from medium acid to neutral. The Bt horizon is sandy clay loam or sandy loam. It is 18 to 30 percent clay.

Macareeno Series

The Macareeno series consists of very deep, poorly drained soils on hillsides. These soils formed in residuum and colluvium from mixed, but dominantly volcanic, residuum. Slopes are 8 to 15 percent.

Typical pedon of Macareeno loam, in an area of Macareeno-Blackwell-Carioca association, 1,800 feet west and 1,000 feet north of the southeast corner of sec. 21, T. 18 N., R. 18 E.

- O1—1 inch to 0; loose, partially decomposed organic litter.
- A11—0 to 2 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; strong fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine and fine tubular and interstitial pores; 10 percent pebbles; neutral; clear smooth boundary.
- A12—2 to 8 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine through coarse roots; many fine and medium tubular pores; 10 percent pebbles; slightly acid; clear smooth boundary.
- B1t—8 to 11 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and many medium and coarse roots; common fine and medium tubular pores; few fine clay films on ped faces and in pores; 15 percent pebbles, 5 percent cobbles; slightly acid; gradual smooth boundary.
- B21t—11 to 19 inches; light yellowish brown (10YR 6/4) gravelly clay loam, dark yellowish brown (10YR 3/4) moist; weak medium angular blocky structure; hard, friable, sticky and plastic; common coarse and few fine and medium roots; few fine and medium pores; common thin and moderately thick clay films on ped faces and in pores; 20 percent pebbles, 5 percent cobbles; medium acid; gradual smooth boundary.
- B22t—19 to 27 inches; pale brown (10YR 6/3) gravelly clay loam, brown (10YR 4/3) moist; massive; very

hard, friable, sticky and plastic; common coarse and few fine and medium roots; few fine and medium tubular pores; 25 percent pebbles, 5 percent cobbles; medium acid; clear smooth boundary.

- II B23t—27 to 41 inches; pale brown (10YR 6/3) very gravelly clay loam, brown (10YR 4/3) moist; massive; very hard, friable, sticky and plastic; few very fine through medium dead roots; few fine and medium tubular pores; 30 percent pebbles, 5 percent cobbles; slightly acid; abrupt smooth boundary.
- II C1—41 to 54 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 4/3) moist; massive; very hard, friable, sticky and plastic; very few roots; few very fine and fine tubular pores; 20 percent pebbles, 15 percent cobbles; 5 percent stones; slightly acid.

Solum thickness is greater than 40 inches. Reaction throughout the profile ranges from medium acid to neutral. The B2t horizon is clay loam. It is 27 to 35 percent clay and is 15 to 35 percent rock fragments.

Manogue Series

The Manogue series consists of deep, well drained soils on uplands. These soils formed in alluvium and colluvium derived from mixed rock sources. Slopes are 2 to 30 percent.

Typical pedon of Manogue cobbly clay, 8 to 15 percent slopes, 1,320 feet west and 1,320 feet north of the southeast corner of sec. 17, T. 20 N., R. 20 E.

- A1—0 to 3 inches; dark brown (10YR 3/3) cobbly clay, dark brown (10YR 3/3) moist; moderate very fine granular structure; soft, very friable, very sticky and very plastic; very few roots; many very fine interstitial pores; 25 percent pebbles, 5 percent cobbles; neutral; abrupt smooth boundary.
- B21—3 to 15 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 4/4) moist; strong medium and coarse prismatic structure; very hard, very firm, very sticky and very plastic; very few roots; few very fine tubular pores; common slickensides; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- B22—15 to 30 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 4/4) moist; strong coarse prismatic structure; very hard, very firm, very sticky and very plastic; very few roots; few fine tubular pores; 5 percent pebbles; common slickensides; strongly effervescent; moderately alkaline; clear smooth boundary.
- B23—30 to 41 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 4/4) moist; strong coarse prismatic structure; very hard, very firm, very sticky and very plastic; very few roots; few fine tubular pores; 5 percent pebbles; common slickensides;

strongly effervescent; moderately alkaline; clear smooth boundary.

- B3—41 to 57 inches; brown (10YR 4/3) clay, dark yellowish brown (10YR 4/4) moist; weak very coarse prismatic structure; very hard, very firm, very sticky and very plastic; very few roots; very few fine tubular pores; 5 percent pebbles, common slickensides; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- C1ca—57 to 63 inches; pale brown (10YR 6/3) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; weak medium angular blocky structure; hard, firm, sticky and plastic; no roots; very few fine tubular pores; 15 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- C2r—63 to 65 inches; highly weathered andesite.

The depth to weathered bedrock is more than 40 inches. Reaction ranges from slightly acid to moderately alkaline throughout the profile. The control section (between depths of 10 inches and 40 inches) is clay or silty clay. It has an average clay content of 40 to 55 percent. The soil cracks open at the surface during summer and early fall.

Marla Series

The Marla series consists of very deep, poorly drained soils on alluvial fans. These soils formed in alluvium derived mainly from granitic rocks. Slopes are 0 to 8 percent.

Typical pedon of Marla loamy sand, 4 to 8 percent slopes, 1,900 feet west and 1,700 feet south of the northeast corner of sec. 5, T. 16 N., R. 19 E.

- A11—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 10 percent fine pebbles; slightly acid; clear smooth boundary.
- A12—6 to 18 inches; grayish brown (10YR 5/2) gravelly loamy sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine and common medium roots; many very fine and fine interstitial pores; 15 percent pebbles; slightly acid; clear smooth boundary.
- C1—18 to 28 inches; light yellowish brown (10YR 6/4) loamy sand, dark yellowish brown (10YR 4/4) moist; few medium prominent dark brown (7.5YR 3/2) mottles; massive; soft, very friable, nonsticky and nonplastic; many fine and medium roots; many fine tubular pores; 10 percent fine pebbles; slightly acid; clear smooth boundary.
- C2—28 to 34 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/6) moist;

common medium distinct reddish yellow (7.5YR 6/6) mottles; massive; soft, friable, slightly sticky and nonplastic; few fine medium roots; few fine tubular pores; 10 percent fine pebbles; slightly acid; clear smooth boundary.

C3—34 to 44 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; soft, friable, slightly sticky and nonplastic; few medium roots; very few pores; 10 percent fine pebbles; slightly acid; gradual wavy boundary.

C4g—44 to 60 inches; very pale brown (10YR 7/4) loamy sand and thin strata of loam, light yellowish brown (10YR 6/4) moist; loam is light gray (5YR 7/1); massive; soft, very friable, nonsticky and nonplastic; very few roots; very few pores; slightly acid.

Depth of the profile is more than 60 inches. The umbric epipedon is 10 to 20 inches thick. Reaction throughout the profile is strongly acid to neutral. Texture in the control section (between depths of 10 inches and 40 inches) averages loamy coarse sand or loamy sand that is 2 to 8 percent clay. The control section contains 0 to 15 percent fine pebbles.

McQuarrie Series

The McQuarrie series consists of shallow, well drained soils on mountain ridges and slopes. These soils formed in residuum and colluvium mainly derived from basalt. Slopes are 15 to 50 percent.

Typical pedon of McQuarrie very stony sandy loam, in an area of McQuarrie-Tristan-Arzo association, 500 feet west and 1,100 feet north of the southeast corner of sec. 34, T. 22 N., R. 22 E.

A1—0 to 1 inch; brown (10YR 4/3) very stony sandy loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common fine interstitial pores; 25 percent pebbles, 5 percent cobbles; mildly alkaline; abrupt smooth boundary.

B21t—1 inch to 8 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine and few coarse roots; common fine tubular and few fine interstitial pores; common thin clay films; 10 percent pebbles, 3 percent cobbles; mildly alkaline; clear smooth boundary.

B22t—8 to 15 inches; dark yellowish brown (10YR 4/4) gravelly clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine and many coarse and

medium roots; common medium and fine tubular pores; many moderately thick clay films; 20 percent pebbles, 5 percent cobbles; mildly alkaline; clear wavy boundary.

B3ca—15 to 18 inches; pale brown (10YR 6/3) very cobbly clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; common fine tubular pores; 10 percent pebbles, 20 percent cobbles, 5 percent stones; moderately effervescent; moderately alkaline; abrupt wavy boundary.

R—18 inches; hard bedrock.

Thickness of the solum and depth to bedrock range from 10 to 20 inches. The mollic epipedon is 7 to 20 inches thick and includes the upper part of the B2t horizon. Reaction is neutral to moderately alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part. The control section is loam or clay loam and is 20 to 35 percent clay.

Meiss Series

The Meiss series consists of shallow, excessively drained soils on uplands. These soils formed in residuum of andesitic breccia. Slopes are 15 to 50 percent.

Typical pedon of Meiss very cobbly sandy loam, in an area of Meiss-Sibelia-Rock outcrop association, 400 feet west and 500 feet south of the northeast corner of sec. 22, T. 17 N., R. 18 E.

O1—1 inch to 0; pine litter duff.

A11—0 to 7 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine through medium roots; many very fine and fine interstitial pores; 20 percent pebbles, 20 percent cobbles; medium acid; clear smooth boundary.

A12—7 to 20 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine through medium roots; many very fine and fine interstitial pores; 20 percent pebbles, 10 percent cobbles; medium acid; abrupt wavy boundary.

R—20 inches; hard, reddish pyroclastic andesitic rock.

Depth to bedrock ranges from 10 to 20 inches. Reaction throughout the profile is slightly acid to medium acid. The apparent field texture is loam or sandy loam. The profile is 5 to 15 percent clay and averages 10 to 30 percent rock fragments.

Mellor Series

The Mellor series consists of very deep, moderately well drained soils on alluvial fans and terraces. These soils formed in alluvium from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Mellor silt loam, 1,850 feet east and 1,050 feet south of the northwest corner of sec. 32, T. 23 N., R. 21 E.

A11—0 to 6 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate thick platy structure parting to moderate thin platy; slightly hard, very friable, slightly sticky and plastic; common very fine and fine roots; many very fine interstitial and common very fine vesicular pores; slightly effervescent; moderately alkaline; clear smooth boundary.

A12—6 to 11 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium platy structure parting to moderate medium subangular blocky; slightly hard, very friable, sticky and plastic; common very fine and fine roots; common very fine interstitial and vesicular pores; slightly effervescent; strongly alkaline; abrupt smooth boundary.

B21t—11 to 18 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few very fine, fine, and medium roots; common very fine tubular and few fine interstitial pores; few moderately thick clay films bridging sand grains and few thin films on ped faces; strongly effervescent; strongly alkaline; clear smooth boundary.

B22t—18 to 26 inches; light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to strong fine angular blocky; hard, friable, very sticky and plastic; few very fine and fine and common medium roots; common very fine tubular and few fine interstitial pores; few moderately thick clay films bridging sand grains and few thin films on ped faces; strongly effervescent; strongly alkaline; clear smooth boundary.

C1ca—26 to 49 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; massive; hard, very friable, very sticky and plastic; few very fine and fine roots; few very fine tubular pores; few pressure faces along diagonal cracks; few fine filaments of lime; violently effervescent; very strongly alkaline; clear smooth boundary.

C2ca—49 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; common fine distinct white (10YR 8/1) mottles; massive; hard, very friable, very sticky and plastic; few very fine roots; few very fine tubular pores; lime occurs as common fine soft masses in seams and as filaments; violently effervescent; moderately alkaline.

The solum ranges from 15 to 26 inches in thickness. Reaction throughout the profile is moderately alkaline to very strongly alkaline. Texture of the B2t horizon is silty clay loam. The B2t horizon is 27 to 35 percent clay and less than 15 percent fine sand or coarser. The exchangeable bases are 15 to 30 percent sodium.

Mizel Series

The Mizel series consists of very shallow, well drained soils on uplands. These soils formed in residuum mainly of volcanic rocks. Slopes are 15 to 50 percent.

Typical pedon of Mizel very gravelly coarse sandy loam, 15 to 50 percent slopes, 300 feet west and 300 feet south of the northeast corner of sec. 14, T. 20 N., R. 19 E.

About 80 percent of the surface is covered with gravel. About 1 percent of the surface is rhyolite rock outcrop.

A11—0 to 1 inch; very pale brown (10YR 7/3) very gravelly coarse sandy loam, brown (10YR 5/3) moist; massive; loose, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 80 percent pebbles; slightly acid; abrupt wavy boundary.

A12—1 inch to 3 inches; very pale brown (10YR 7/3) gravelly loam, dark brown (10YR 4/3) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many very fine and fine vesicular pores; 30 percent pebbles; medium acid; abrupt wavy boundary.

R—3 to 7 inches; white (10YR 8/2) rhyolite bedrock, fractured and cracked with reddish yellow (7.5YR 6/6) coatings on fragments and in cracks. Few roots in cracks.

Depth to hard bedrock is 3 to 10 inches. Reaction in the profile is medium acid or slightly acid. Texture is gravelly or very gravelly sandy loam, fine sandy loam, or loam and is 5 to 15 percent clay. The gravel content averages 40 to 60 percent.

Mosquet Series

The Mosquet series consists of very shallow and shallow, well drained soils on mountain ridges and slopes. These soils formed in residuum of basalt. Slopes are 4 to 30 percent.

Typical pedon of Mosquet very cobbly fine sandy loam, in an area of Thulepah-Mosquet association, and 1,600 feet east of the southwest corner of sec. 3, T. 24 N., R. 20 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) very cobbly fine sandy loam, very dark grayish brown (10YR 3/2) moist; strong fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very

fine and fine roots; many very fine and fine tubular and interstitial pores; 15 percent pebbles, 25 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

A12—4 to 5 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; strong medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine and fine tubular pores; 20 percent pebbles, 25 percent cobbles; neutral; abrupt smooth boundary.

B21t—5 to 11 inches; brown (10YR 5/3) gravelly clay loam, dark brown (10YR 3/3) moist; weak fine angular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; common moderately thick clay films on ped faces and in pores; 25 percent pebbles, 5 percent cobbles; slightly acid; clear wavy boundary.

B22t—11 to 14 inches; dark yellowish brown (10YR 4/4) gravelly clay, dark yellowish brown (10YR 3/4) moist; weak fine and medium angular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; 20 percent pebbles; slightly acid; abrupt broken boundary.

R—14 inches; fractured basalt bedrock.

Thickness of the solum and depth to bedrock range from 6 to 14 inches in the shallow part and from 8 to 20 inches in the deepest part. The fractures and fissures containing B2t material range from 2 to 6 inches wide at the top to less than 1/4 inch wide within 20 inches of the surface. The mollic epipedon ranges from 6 to 14 inches in thickness and includes part or all of the argillic horizon. Reaction throughout the profile ranges from slightly acid to neutral. The argillic horizon is clay loam or clay. It is 35 to 50 percent clay and is 15 to 35 percent rock fragments.

Mottsville Series

The Mottsville series consists of very deep, excessively drained soils on alluvial fans. These soils formed in alluvium derived mainly from granodiorite. Slopes are 0 to 15 percent.

Typical pedon of Mottsville sand, 0 to 4 percent slopes, 700 feet east and 600 feet north of the southwest corner of sec. 32, T. 17 N., R. 20 E.

A1—0 to 10 inches; grayish brown (10YR 5/2) sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; 10 percent fine pebbles; neutral; gradual smooth boundary.

C1—10 to 29 inches; pale brown (10YR 6/3) stratified sand and loamy sand, brown (10YR 4/3) moist; weak medium subangular blocky structure that

readily parts to single grained; soft, very friable, nonsticky and nonplastic; 10 percent fine pebbles; neutral; gradual smooth boundary.

C2—29 to 34 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; 10 percent fine pebbles; neutral; clear smooth boundary.

C3—34 to 60 inches; pale brown (10YR 6/3) stratified sand and loamy sand, brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; 10 percent fine pebbles; neutral.

Depth of the profile is more than 60 inches. The mollic epipedon is 10 to 20 inches thick. Reaction throughout the profile is neutral to medium acid.

The control section is sand or loamy sand and is 3 to 10 percent clay. It is 0 to 15 percent rock fragments, mostly fine pebbles.

Northmore Series

The Northmore series consists of very deep, well drained soils on dissected alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 15 percent.

Typical pedon of Northmore sandy loam, 2 to 4 percent slopes, 1,000 feet east and 1,000 feet north of the southwest corner of sec. 10, T. 20 N., R. 19 E.

A11—0 to 1 inch; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine interstitial pores; 25 percent pebbles; slightly acid; abrupt wavy boundary.

A12—1 inch to 3 inches; brown (10YR 5/3) sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many very fine vesicular pores; slightly acid; abrupt wavy boundary.

A13—3 to 6 inches; grayish brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; weak very thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; slightly acid; clear smooth boundary.

A14—6 to 11 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; slightly acid; clear smooth boundary.

B1—11 to 15 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; common thin clay films

bridging sand grains and in pores; slightly acid; clear smooth boundary.

- B21t—15 to 19 inches; brown (7.5YR 5/4) sandy clay, dark brown (7.5YR 4/4) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many thin clay films on ped faces and in pores; neutral; clear smooth boundary.
- B22t—19 to 30 inches; yellowish brown (10YR 5/4) sandy clay, brown (7.5YR 5/2) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many thin and few moderately thick clay films on ped faces and in pores; 15 to 20 percent durinodes; slightly acid; clear smooth boundary.
- B3—30 to 45 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate very fine subangular blocky structure; very hard, firm, sticky and plastic; few roots; few very fine tubular pores; neutral; clear smooth boundary.
- C1—45 to 54 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; weak very fine subangular blocky structure; hard, friable, sticky and slightly plastic; few roots; few very fine tubular pores; neutral; clear smooth boundary.
- C2—54 to 60 inches; brown (10YR 5/3) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, friable, slightly sticky and nonplastic; neutral.

The solum ranges from 36 to 60 inches in thickness. Reaction ranges from slightly acid to neutral throughout the profile. The Bt horizon is sandy clay, sandy clay loam, or clay. It has an average clay content of 35 to 45 percent.

Nosrac Series

The Nosrac series consists of very deep, well drained soils on mountain slopes. These soils formed in colluvium and residuum derived from andesite. Slopes are 30 to 50 percent.

Typical pedon of Nosrac stony clay loam, in an area of Cagle-Nosrac-Old Camp association, 100 feet north and 400 feet west of the southeast corner of sec. 16, T. 16 N., R. 20 E.

- A11—0 to 2 inches; grayish brown (10YR 5/2) stony loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many fine interstitial pores; 10 percent pebbles, 10 percent stones; slightly acid; clear smooth boundary.
- A12—2 to 14 inches; brown (10YR 5/3) very gravelly light clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common

very fine through coarse tubular pores; 45 percent pebbles; neutral; clear smooth boundary.

- B21t—14 to 38 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 4/3) moist; strong medium subangular blocky structure; very hard, friable, sticky and plastic; common very fine and fine roots; common very fine through coarse tubular pores; 55 percent pebbles; neutral; clear smooth boundary.
- B22t—38 to 60 inches; yellowish brown (10YR 5/4) very gravelly clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; common very fine through coarse tubular pores; 45 percent pebbles; neutral; clear wavy boundary.
- C—60 to 74 inches; light yellowish brown (10YR 6/4) very cobbly loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and medium roots; few very fine and fine tubular pores; 30 percent pebbles, 20 percent cobbles; neutral; abrupt wavy boundary.
- R—74 inches; hard, fractured bedrock.

The solum is more than 50 inches thick. Depth to bedrock ranges from 60 to 80 inches. The mollic epipedon is 14 to 20 inches thick and includes the upper part of the B2t horizon. Reaction throughout the profile is slightly acid to neutral. The control section is loam or clay loam and is 25 to 35 percent clay. It is 35 to 60 percent rock fragments.

Notus Series

The Notus series consists of very deep soils on alluvial flood plains. Drainage has been altered. These soils formed in alluvium derived from mixed rock sources. Slopes are 2 to 14 percent.

Typical pedon of Notus stony loamy fine sand, 2,340 feet west and 2,640 feet south of the northeast corner of sec. 7, T. 19 N., R. 18 E.

- A11—0 to 12 inches; light brownish gray (10YR 6/2) stony loamy fine sand, dark grayish brown (10YR 4/2) moist; moderate medium platy structure; soft, very friable, nonsticky and nonplastic; many very fine to medium roots; 2 percent stones; neutral; abrupt wavy boundary.
- C1—12 to 24 inches; light brownish gray (10YR 6/2) very gravelly and cobbly coarse sand, dark grayish brown (10YR 4/2) moist; common prominent reddish brown (5YR 5/4) and few fine prominent very dark gray (5Y 3/1) mottles; single grained; loose, nonsticky and nonplastic; common very fine to medium roots; many fine and medium interstitial

pores; 50 percent pebbles and cobbles; neutral; abrupt wavy boundary.

IIA1b—24 to 37 inches; gray (10YR 5/1) stratified cobbly loamy sand and sandy loam, very dark gray (10YR 3/1) and dark gray (10YR 4/1) moist; common medium prominent reddish brown (5YR 5/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine to medium roots; 15 percent pebbles, 15 percent cobbles, 5 percent stones; neutral; abrupt wavy boundary.

IIC2—37 to 55 inches; light yellowish brown (10YR 6/4) and reddish brown (5YR 5/4) extremely gravelly loamy sand, common medium prominent yellowish brown (10YR 5/4) and reddish brown (5YR 5/4) mottles; moist; single grained; loose; nonsticky and nonplastic; common very fine to medium roots; 50 percent pebbles, 20 percent cobbles, 5 percent stones; neutral.

The soil profile is deeper than 40 inches. Reaction throughout the profile ranges from slightly acid or neutral. The control section (between depths of 10 inches and 40 inches) is coarser than loamy fine sand. It is 3 to 10 percent clay and is 35 to 90 percent rock fragments.

Depth to mottles ranges from 7 to 20 inches. Many pedons have a buried A horizon.

Oest Series

The Oest series consists of very deep, well drained soils on terraces, alluvial fans, and escarpments. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 50 percent.

Typical pedon of Oest bouldery sandy loam, 2 to 8 percent slopes, 200 feet north and 600 feet west of the east quarter corner of sec. 19, T. 19 N., R. 18 E.

A1—0 to 14 inches; grayish brown (10YR 5/2) bouldery sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 15 percent pebbles, 5 percent cobbles, 3 percent boulders; slightly acid; clear smooth boundary.

B21t—14 to 28 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common moderately thick clay films on ped faces and rock fragments; 30 percent pebbles, 10 percent cobbles, 5 percent stones; slightly acid; gradual wavy boundary.

B22t—28 to 40 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few moderately thick clay films on rock fragments; 40 percent pebbles, 10 percent

cobbles, 5 percent stones; slightly acid; gradual wavy boundary.

C1—40 to 50 inches; pale brown (10YR 6/3) very gravelly loamy sand, brown (7.5YR 4/4) moist; single grained; loose, nonsticky and nonplastic; 50 percent pebbles, 10 percent cobbles, 1 to 5 percent stones; slightly acid.

The solum ranges from 30 to 54 inches in thickness. Reaction ranges from slightly acid to neutral throughout the profile.

The Bt horizon is heavy sandy loam or sandy clay loam and is 40 to 60 percent rock fragments. The average clay content is 18 to 25 percent.

Old Camp Series

The Old Camp series consists of shallow, well drained soils on uplands. These soils formed in residuum mainly of basic igneous rocks. Slopes are 8 to 50 percent.

Typical pedon of Old Camp stony sandy loam, 15 to 30 percent slopes, 1,200 feet east and 2,000 feet north of the southwest corner of sec. 33, T. 19 N., R. 20 E.

Pebbles cover 30 percent of the surface, cobbles cover 10 percent, and stones cover 3 percent.

A11—0 to 2 inches; grayish brown (10YR 5/2) stony loamy sand, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; 10 percent pebbles, 3 percent stones; neutral; abrupt smooth boundary.

A12—2 to 7 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 20 percent pebbles; neutral; clear smooth boundary.

B2t—7 to 11 inches; brown (10YR 5/3) very cobbly clay loam, dark brown (10YR 4/3) moist; moderate medium angular blocky structure; hard, friable, sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; common thin clay films bridging sand grains and coarse fragments and in pores; 15 percent pebbles, 25 percent cobbles; neutral; clear wavy boundary.

B3t—11 to 17 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and nonplastic; many very fine and fine roots; few very fine tubular pores; few thin clay films coating coarse fragments; 20 percent pebbles, 25 percent cobbles; neutral; gradual wavy boundary.

R—17 to 21 inches; pale brown fractured andesite with lime and silica coating in cracks.

Thickness of the solum and depth to hard bedrock range from 10 to 20 inches. Reaction is neutral to mildly alkaline in the upper part of the solum and neutral to moderately alkaline in the lower part. The surface of the bedrock is lime coated. The control section is clay loam, sandy clay loam, or loam and is 25 to 35 percent clay. It is 35 to 50 percent rock fragments.

Ophir Series

The Ophir series consists of very deep, poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived mainly from granitic rock. Slopes are 0 to 8 percent.

Typical pedon of Ophir loamy sand, 2 to 8 percent slopes, 200 feet east and 2,150 feet south of the northwest corner of sec. 15, T. 16 N., R. 19 E.

All colors are for moist soil.

Ap1—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy sand; weak fine granular structure; very friable, nonsticky and nonplastic; almost continuously matted with roots; slightly acid; clear smooth boundary.

A12—5 to 11 inches; very dark gray (10YR 3/1) loamy sand and loamy coarse sand; common medium prominent dark reddish brown (5YR 3/3) mottles; weak fine granular structure; very friable, nonsticky and nonplastic; many very fine to medium roots; many fine to medium interstitial pores; 5 percent fine pebbles; medium acid; abrupt smooth boundary.

IIA13b—11 to 22 inches; black (10YR 2/1) loamy sand; fine prominent dark reddish brown (5YR 3/3) mottles; massive; very friable, nonsticky and nonplastic; few very fine to medium roots; many fine interstitial pores; 5 percent fine pebbles; medium acid; clear smooth boundary.

IIA14b—22 to 30 inches; very dark gray (10YR 3/1) loamy sand; many large prominent dark reddish brown (5YR 3/3) mottles; massive; very friable, nonsticky and nonplastic; few medium to very fine roots; common fine interstitial and tubular pores; 5 percent fine pebbles; medium acid; clear smooth boundary.

IIC1—30 to 36 inches; dark grayish brown (2.5Y 4/2) loamy sand; many medium common dark reddish brown (5YR 3/3) mottles; massive; very friable, nonsticky and nonplastic; 5 percent fine pebbles; medium acid; clear smooth boundary.

IIC2—36 to 60 inches; dark grayish brown (2.5Y 4/2) loamy sand; many large prominent yellowish red (5YR 5/6) mottles; single grained; loose, nonsticky and nonplastic; 5 percent pebbles; medium acid.

The soil profile is deeper than 60 inches. The mollic epipedon is 10 to 23 inches thick. Reaction throughout the profile ranges from neutral to medium acid.

The control section (between depths of 10 inches and 40 inches) is sand, loamy coarse sand, and loamy sand with thin strata of sandy loam. Clay content in the control section ranges from 3 to 10 percent. Gravel content ranges from 5 to 30 percent.

Oppio Series

The Oppio series consists of moderately deep, well drained soils on uplands. These soils formed in material weathered mainly from andesite and other volcanic rocks. Slopes are 4 to 50 percent.

Typical pedon of Oppio cobbly sandy loam, 8 to 15 percent slopes, 700 feet east and 2,200 feet north of the southwest corner of sec. 13, T. 20 N., R. 19 E.

About 3 percent of the surface is covered with cobbles.

A1—0 to 3 inches; pale brown (10YR 6/3) cobbly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular and interstitial pores; 15 to 20 percent cobbles; slightly acid; clear wavy boundary.

B1t—3 to 8 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate fine prismatic structure parting to strong very fine granular; slightly hard, friable, very sticky and very plastic; common very fine roots; many very fine tubular and interstitial pores; neutral; abrupt smooth boundary.

B21t—8 to 14 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong medium and coarse prismatic structure; very hard, firm, very sticky and very plastic; common very fine to medium roots; few very fine tubular pores; many moderately thick and few thick clay films on ped faces and in pores; neutral; clear irregular boundary.

B22t—14 to 21 inches; pale brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; common fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many moderately thick and few thick clay films on ped faces and in pores; neutral; abrupt broken boundary.

R—21 inches; fractured, weathered andesite bedrock; common very fine roots in cracks; few thin clay films in cracks.

The thickness of the solum and depth to bedrock range from 20 to 40 inches. Reaction ranges from medium acid to mildly alkaline throughout the profile. The Bt horizon is clay, sandy clay, or clay loam and is 35 to 50 percent clay. It is 0 to 35 percent gravel.

Orr Series

The Orr series consists of very deep, well drained soils on terraces and alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 8 percent.

Typical pedon of Orr stony sandy loam, 4 to 8 percent slopes, 1,200 feet east and 1,500 feet south of the northwest corner of sec. 8, T. 19 N., R. 18 E.

- A11p—0 to 5 inches; brown (10YR 5/3) stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure; slightly hard, friable, slightly sticky and nonplastic; many very fine to medium roots; 5 to 10 percent pebbles, 1 percent stones; neutral; clear wavy boundary.
- A12—5 to 10 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to medium roots; 5 percent pebbles; neutral; clear smooth boundary.
- B1t—10 to 31 inches; pale brown (10YR 6/3) heavy sandy loam, brown (10YR 4/3) moist; very dark grayish brown (10YR 3/2) faces; weak medium angular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few very thin clay films on ped faces; 10 percent pebbles; neutral; gradual wavy boundary.
- B2t—31 to 39 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, firm, sticky and plastic; few fine and medium roots; common thin clay films in pores; 10 percent pebbles; neutral; gradual wavy boundary.
- B3t—39 to 50 inches; light yellowish brown (10YR 6/4) gravelly sandy clay loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, sticky and slightly plastic; few fine and medium roots; common thin clay films on ped faces; 20 percent pebbles; neutral; gradual wavy boundary.
- C1—50 to 62 inches; very pale brown (10YR 7/3) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; 30 percent pebbles; neutral.

The soil profile is deeper than 60 inches. Reaction ranges from slightly acid to neutral throughout the profile.

The upper 20 inches of the Bt horizon is sandy loam or sandy clay loam and is 18 to 25 percent clay. The gravel content averages 10 to 35 percent.

Orr Variant

The Orr Variant consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in

alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Orr Variant gravelly sandy loam, 2,500 feet east and 2,000 feet north of the southwest corner of sec. 33, T. 21 N., R. 19 E.

About 30 percent of the surface is covered with gravel.

- A11—0 to 3 inches; brown (10YR 5/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; 60 percent pebbles; neutral; clear smooth boundary.
- A12—3 to 11 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine and fine tubular and interstitial pores; 10 percent pebbles; neutral; clear smooth boundary.
- A13—11 to 18 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine and medium roots; common very fine and fine tubular and interstitial pores; neutral; abrupt wavy boundary.
- B1t—18 to 28 inches; light yellowish brown (10YR 6/4) heavy sandy clay loam, dark yellowish brown (10YR 3/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few very fine tubular pores; few thin clay films in pores; neutral; clear wavy boundary.
- B21t—28 to 39 inches; light yellowish brown (10YR 6/4) sandy clay loam, brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; few very fine tubular pores; many thin clay films coating and bridging sand grains and in pores; moderately alkaline; abrupt wavy boundary.
- IIB3ca—39 to 54 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; many medium distinct white (10YR 8/2) mottles; massive; hard, friable, sticky and plastic; few very fine interstitial pores; common thin clay films bridging sand grains; slightly effervescent; moderately alkaline; abrupt wavy boundary.
- IIC1—54 to 65 inches; light brownish gray (10YR 6/2) silty clay loam, dark brown (10YR 3/3) moist; massive; hard, friable, sticky and plastic; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. Reaction ranges from slightly acid to moderately alkaline throughout the profile. The Bt horizon is sandy clay loam or clay loam. It is 20 to 35 percent clay.

Osobb Series

The Osobb series consists of shallow, well drained soils on rounded ridges and hillsides. These soils formed

in residuum of mixed volcanic rock sources. Slopes are 8 to 50 percent.

Typical pedon of Osobb extremely stony fine sandy loam, in an area of Osobb-Rezave-Fireball association, 500 feet west and 1,200 feet south of the northeast corner of sec. 32, T. 22 N., R. 24 E.

A1—0 to 2 inches; pale brown (10YR 6/3) extremely stony fine sandy loam, brown (10YR 4/3) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular and interstitial pores; 30 percent pebbles, 10 percent cobbles, 50 percent stones; strongly effervescent; moderately alkaline; clear smooth boundary.

B2—2 to 11 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many very fine, fine, and medium tubular pores; 35 percent pebbles, 15 percent cobbles, 5 percent stones; strongly effervescent; strongly alkaline; abrupt wavy boundary.

C1sicam—11 to 13 inches; very pale brown (10YR 8/3) indurated pan, pale brown (10YR 6/3) moist; massive; extremely hard, extremely firm; strongly effervescent; very strongly alkaline; abrupt wavy boundary.

R—13 inches; fractured very hard basalt bedrock.

The depth to the duripan ranges from 8 to 20 inches. Reaction ranges from mildly alkaline in the upper part of the profile to very strongly alkaline in the lower part.

These soils are loam, fine sandy loam, or very fine sandy loam and are 12 to 18 percent clay. They are 55 to 80 percent rock fragments.

Pahrangle Series

The Pahrangle series consists of moderately deep, well drained soils that formed in residuum and colluvium mainly from rhyolite. Pahrangle soils are on mountain slopes. Slopes are 15 to 70 percent.

Typical pedon of Pahrangle very stony sandy loam, in an area of Skedaddale-Pahrangle-Lemm association, 1,200 feet east and 2,600 feet south of the northwest corner of sec. 26, T. 23 N., R. 12 E.

A11—0 to 4 inches; brown (10YR 5/3) very stony sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 25 percent pebbles, 5 percent cobbles, 10 percent stones; slightly acid; clear smooth boundary.

A12—4 to 11 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; moderate fine

and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and medium roots; many very fine and medium tubular pores; few thin clay films on ped faces, in pores, and coating rock fragments; 35 percent pebbles, 5 percent cobbles; neutral; abrupt wavy boundary.

B21t—11 to 20 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine tubular pores; many thin clay films on ped faces, in pores, and coating rock fragments; 20 percent gravel; neutral; gradual smooth boundary.

B22t—20 to 26 inches; brownish yellow (10YR 6/6) clay loam, yellowish brown (10YR 5/6) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; few very fine and fine roots; few very fine and fine tubular pores; 15 percent gravel; neutral; abrupt smooth boundary.

Cr—26 to 39 inches; soft weathered rock with very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist, between fragments.

R—39 to 43 inches; hard, fractured, silica- and clay-coated rhyolitic bedrock.

Thickness of the solum and depth to bedrock range from 20 to 40 inches.

Reaction throughout the profile is slightly acid or neutral. The Bt horizon is clay loam. It is 27 to 35 percent clay and is 15 to 35 percent rock fragments.

Parran Series

The Parran series consists of very deep, poorly drained and somewhat poorly drained soils on basins and low lake terraces. These soils formed in alluvium and lacustrine deposits derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Parran silty clay loam, 2,400 feet north and 400 feet west of the southeast corner of sec. 22, T. 23 N., R. 20 E.

A11—0 to 5 inches; light brownish gray (10YR 6/2) silty clay loam, olive gray (5YR 4/2) moist; moderate medium platy structure parting to moderate fine subangular blocky; slightly hard, firm, sticky and plastic; many very fine, fine, and medium roots; many very fine and fine interstitial and tubular pores; common fine salt crystals form thin surficial crust; slightly effervescent; very strongly alkaline; clear smooth boundary.

A12sa—5 to 13 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist, moderate fine subangular blocky structure; firm, sticky and plastic; many very fine, fine, and medium and few coarse roots; many very fine and fine interstitial and tubular

pores; disseminated salts; slightly effervescent; strongly alkaline; clear smooth boundary.

C1sa—13 to 34 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist; common fine prominent brown (7.5YR 5/4) mottles; massive; firm, sticky and plastic; few fine and common dead roots; common medium tubular pores; many fine and medium salt crystals; slightly effervescent; very strongly alkaline; clear smooth boundary.

C2—34 to 60 inches; light gray (5Y 7/2) silty clay, light olive gray (5Y 6/2) moist; massive; firm, sticky and very plastic; many medium dead roots; common medium tubular pores; strongly effervescent; strongly alkaline.

The solum ranges from 5 to 18 inches in thickness. The salic horizon ranges from 15 to 29 inches in thickness and typically has its upper boundary at the soil surface during the dry season. Reaction throughout the profile is moderately alkaline to very strongly alkaline. The control section (between depths of 10 and 40 inches) averages silty clay or clay. It is 40 to 55 percent clay.

Pirouette Series

The Pirouette series consists of shallow, well drained soils on rounded ridgetops and concave depressions. These soils formed in residuum of basalt, altered andesite, and tuff. Slopes are 0 to 8 percent.

Typical pedon of Pirouette very stony very fine sandy loam, in an area of Pirouette-Osobb-Rock outcrop association, 1,800 feet south and 1,800 feet east of the northwest corner of sec. 34, T. 22 N., R. 24 E.

A1—0 to 3 inches; pale brown (10YR 6/3) very stony very fine sandy loam, brown (10YR 4/3) moist; weak medium platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine vesicular pores; 10 percent pebbles, 20 percent cobbles, 10 percent stones; moderately alkaline; clear smooth boundary.

B2t—3 to 9 inches; light brown (7.5YR 6/4) very gravelly light clay loam, dark brown (7.5YR 4/4) moist; weak fine prismatic structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common very fine tubular pores; common moderately thick clay films coating rock fragments and pores; 25 percent pebbles, 10 percent cobbles; slightly effervescent; moderately alkaline; clear smooth boundary.

B3t—9 to 10 inches; light brown (7.5YR 6/4) very gravelly light clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common very fine tubular pores; few thin clay films coating rock fragments; 25 percent pebbles, 10 percent cobbles;

strongly effervescent; strongly alkaline; clear smooth boundary.

C1sica—10 to 15 inches; light brown (7.5YR 6/4) very cobbly sandy loam, brown (7.5YR 5/4) moist; massive; hard, firm, nonsticky and nonplastic; few very fine roots; few very fine tubular and interstitial pores; 40 percent pebbles, 30 percent cobbles, 5 percent stones; strongly effervescent; strongly alkaline; clear smooth boundary.

C2sicam—15 to 16 inches; indurated silica-cemented hardpan.

R—16 inches; altered tuff bedrock.

The solum is 8 to 14 inches thick. The depth to the duripan capping bedrock ranges from 11 to 20 inches. Reaction throughout the profile is moderately alkaline to strongly alkaline. The control section is clay loam. It is 28 to 35 percent clay and 35 to 50 percent rock fragments.

Pizene Series

The Pizene series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 4 percent.

Typical pedon of Pizene sandy loam, 0 to 4 percent slopes, 2,500 feet east and 1,500 feet south of the northwest corner of sec. 13, T. 23 N., R. 20 E.

A11—0 to 2 inches; light brownish gray (10YR 6/2) gravelly loamy sand, brown (10YR 4/3) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; 25 percent pebbles, 3 percent cobbles; moderately alkaline; abrupt smooth boundary.

A12—2 to 6 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine vesicular and tubular pores; 10 percent pebbles; moderately alkaline; abrupt smooth boundary.

B2t—6 to 14 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and coarse prismatic structure; hard, firm, sticky and plastic; common very fine to medium roots; many very fine and medium tubular pores; common thin and moderately thick clay films on ped faces and in pores; 10 percent pebbles; moderately alkaline; clear smooth boundary.

B3t—14 to 21 inches; light yellowish brown (10YR 6/4) sandy loam with pockets of gravel, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine to medium roots; common very fine to medium tubular

pores; few thin clay films coating sand grains and in pores; 10 percent pebbles; slightly effervescent; very strongly alkaline; gradual smooth boundary.

- C1—21 to 32 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few roots; common very fine to medium tubular pores; 5 percent durinodes; 15 percent pebbles; strongly effervescent; very strongly alkaline; abrupt smooth boundary.
- C2—32 to 36 inches; pale brown (10YR 6/3) very gravelly light coarse sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; common very fine to medium roots; very fine and fine interstitial and few fine and medium tubular pores; 50 percent pebbles, 5 percent cobbles; strongly effervescent; very strongly alkaline; abrupt smooth boundary.
- C3—36 to 41 inches; pale brown (10YR 6/3) coarse sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine to medium roots; many very fine and fine interstitial and few very fine tubular pores; 5 percent pebbles; slightly effervescent; very strongly alkaline; abrupt smooth boundary.
- C4—41 to 61 inches; pale brown (10YR 6/3) loamy very fine sand, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; few very fine and fine tubular pores; slightly effervescent; very strongly alkaline.

Thickness of the solum ranges from 12 to 25 inches. Reaction throughout the profile ranges from moderately alkaline to very strongly alkaline.

The Bt horizon is sandy clay loam or heavy sandy loam. It is 18 to 25 percent clay.

Depth to free carbonates is 12 to 18 inches. The exchangeable bases are 15 to 35 percent sodium.

Railcity Series

The Railcity series consists of very deep, somewhat excessively drained soils on landslides. These soils formed in granitic colluvium derived mainly from giant landslides. Slopes are 8 to 50 percent.

Typical pedon of Railcity very bouldery coarse sand, 15 to 50 percent slopes, 2,500 feet west and 2,600 feet north of the southeast corner of sec. 33, T. 17 N., R. 19 E.

O—1.5 inches to 0; pine needle duff.

- A11—0 to 6 inches; grayish brown (10YR 5/2) very bouldery coarse sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; many fine and very fine roots; many very fine and fine interstitial pores; 20 percent pebbles, 2 percent stones, 3 percent boulders; medium acid; clear smooth boundary.

- A12—6 to 12 inches; brown (10YR 5/3) gravelly sand, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and medium and common very fine roots; many fine to medium interstitial pores; 20 percent fine pebbles, 10 percent coarse pebbles, 5 percent cobbles; slightly acid; clear wavy boundary.

- C1—12 to 25 inches; pale brown (10YR 6/3) very gravelly coarse sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; many medium and coarse, common fine, and few very fine roots; many fine interstitial pores; 20 percent fine pebbles, 5 percent coarse pebbles, 15 percent cobbles that are highly weathered; few thin bands of sandy loam; medium acid; gradual irregular boundary.

- C2—25 to 60 inches; pale brown (10YR 6/3) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; many coarse and medium, common fine, and few very fine roots; many fine interstitial pores; 40 percent fine pebbles, 30 percent decomposed cobbles and stones; few thin bands of sandy loam; medium acid.

The soil profile is deeper than 60 inches. Reaction is medium acid or slightly acid throughout the profile. The control section (between depths of 10 and 40 inches) is coarse sand or loamy sand. It is 2 to 8 percent clay and is 35 to 70 percent rock fragments.

Rednik Series

The Rednik series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slopes are 4 to 15 percent.

Typical pedon of Rednik very gravelly sandy loam, 4 to 8 percent slopes, 50 feet west and 1,300 feet south of the northeast corner of sec. 13, T. 23 N., R. 20 E.

- A11—0 to 1 inch; light brownish gray (10YR 6/2) very gravelly sandy loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 30 percent pebbles, 5 percent cobbles and stones; moderately alkaline; abrupt smooth boundary.
- A12—1 inch to 4 inches; pale brown (10YR 6/3) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium and coarse subangular blocky structure parting to weak thin platy; slightly hard, very friable, nonsticky and nonplastic; common very fine through medium roots; common very fine and fine tubular pores; 30 percent pebbles, 5 percent

cobbles and stones; mildly alkaline; clear smooth boundary.

- B1**—4 to 6 inches; brown (10YR 5/3) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine, fine, and medium tubular pores; 15 percent pebbles, 5 percent cobbles; strongly effervescent; strongly alkaline; clear smooth boundary.
- B2t**—6 to 20 inches; brown (10YR 5/3) very gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium angular blocky structure in matrix; hard, friable, sticky and plastic; common very fine and fine roots; common very fine through medium tubular pores; common thin and moderately thick clay films on ped faces and in pores; 55 percent pebbles, 5 percent cobbles; strongly effervescent; strongly alkaline; abrupt wavy boundary.
- C1ca**—20 to 25 inches; pinkish gray (7.5YR 6/2) gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; common very fine, fine, and medium roots; many very fine and fine interstitial pores and common fine tubular pores; 25 percent pebbles; violently effervescent; strongly alkaline; clear wavy boundary.
- IIC2ca**—25 to 34 inches; pinkish gray (7.5YR 6/2) very gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; common very fine, fine, and medium roots; many very fine and fine interstitial pores and common fine tubular pores; 50 percent pebbles; violently effervescent; strongly alkaline; clear wavy boundary.
- IIIC3ca**—34 to 48 inches; pinkish gray (7.5YR 6/2) gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores and common fine tubular pores; 30 percent gravel; violently effervescent; strongly alkaline; clear wavy boundary.
- IIIC4ca**—48 to 57 inches; pinkish gray (7.5YR 6/2) very gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores and few fine tubular pores; 45 percent pebbles; violently effervescent; strongly alkaline; clear wavy boundary.
- IIIC5**—57 to 65 inches; pinkish gray (7.5YR 6/2) very gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 40 percent pebbles, 5 percent cobbles; violently effervescent; very strongly alkaline.
- The solum thickness is 15 to 30 inches. Reaction ranges from mildly alkaline to very strongly alkaline throughout the profile. The B2t horizon is sandy clay loam, sandy loam, or loam. It is 18 to 27 percent clay and is 35 to 75 percent rock fragments.

Reno Series

The Reno series consists of moderately deep, well drained soils on pediments and river or stream terraces. These soils formed in fluvial sediment and alluvium derived from mixed rock sources. Slopes are 2 to 15 percent.

Typical pedon of Reno very stony fine sandy loam, 8 to 15 percent slopes, 2,000 feet east and 200 feet south of the northwest corner of sec. 29, T. 19 N., R. 18 E.

- A1**—0 to 2 inches; grayish brown (10YR 5/2) very stony fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; loose, friable, sticky and slightly plastic; common very fine and fine roots; many fine interstitial pores; 15 percent pebbles, 15 percent cobbles, 5 percent stones; neutral; abrupt smooth boundary.
- B21t**—2 to 5 inches; yellowish brown (10YR 5/4) clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure; hard, very firm, sticky and plastic; many fine and medium roots; many fine and medium tubular pores; common moderately thick clay films on ped faces and in pores; neutral; clear smooth boundary.
- B22t**—5 to 16 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; strong medium prismatic structure; hard, very firm, very sticky and very plastic; common very fine and few fine and medium roots; common very fine pores; many thick clay films on ped faces; neutral; clear wavy boundary.
- B3t**—16 to 24 inches; light yellowish brown (10YR 6/4) cobbly clay, dark yellowish brown (10YR 4/4) moist; massive; hard, very firm, sticky and plastic; very few roots; very few pores; common thick clay films on undersides of coarse fragments; strong silica coatings on undersides of coarse fragments; 15 percent pebbles, 15 percent cobbles; neutral; abrupt wavy boundary.
- C1sim**—24 to 47 inches; white (10YR 8/2) gravelly and cobbly strongly silica-cemented duripan; neutral; clear smooth boundary.
- C2si**—47 to 60 inches; very pale brown (10YR 7/4) weakly silica-cemented cobbly tuffaceous material that wets up to cobbly fine sandy loam.

Thickness of the solum ranges from 20 to 36 inches. Depth to the indurated duripan ranges from 20 to 40 inches. Reaction ranges from slightly acid to neutral in the upper part of the profile and from neutral to moderately alkaline in the lower part.

The control section is clay that is 40 to 60 percent clay. It averages 0 to 35 percent rock fragments, but the content of fragments ranges higher in the lower part.

Reywat Series

The Reywat series consists of shallow, well drained soils on uplands. These soils formed in residuum mainly of basic igneous rocks. Slopes are 8 to 50 percent.

Typical pedon of Reywat extremely stony loam, in an area of Reywat-Rock outcrop complex, 15 to 50 percent slopes, 215 feet east and 2,425 feet south of the northwest corner of sec. 27, T. 19 N., R. 20 E.

A11—0 to 3 inches; grayish brown (10YR 5/2) extremely stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; 10 percent pebbles, 5 percent cobbles, 20 percent stones; slightly acid; clear smooth boundary.

A12—3 to 6 inches; grayish brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; 10 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; clear smooth boundary.

B1t—6 to 12 inches; brown (10YR 5/3) very cobbly clay loam, dark brown (10YR 4/3) moist; weak fine angular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine and very fine roots; many fine and very fine pores; common thin clay films on ped faces, few thin clay films in pores; 15 percent pebbles, 20 percent cobbles; neutral; clear wavy boundary.

B2t—12 to 14 inches; yellowish brown (10YR 5/4) very cobbly clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm, sticky and plastic; common very fine roots; common very fine pores; common thin clay films on ped faces; few thin clay films in pores; 10 percent pebbles, 40 percent cobbles; neutral; abrupt irregular boundary.

R—14 to 20 inches; fractured, hard, basaltic bedrock with some clay in the fractures; very slightly effervescent in some spots.

Thickness of the solum and depth to hard bedrock range from 10 to 20 inches. The mollic epipedon is 4 to 10 inches thick. Reaction throughout the profile ranges from slightly acid to mildly alkaline. The control section is loam or clay loam. It is 24 to 35 percent clay and is 35 to 50 percent rock fragments.

Rezave Series

The Rezave series consists of shallow, well drained soils that formed in residuum mainly of basalt. These soils are on uplands. Slopes are 0 to 15 percent.

Typical pedon of Rezave extremely stony very fine sandy loam, in an area of Osobb-Rezave-Fireball association, 1,000 feet north and 1,200 feet west of the southeast corner of sec. 7, T. 21 N., R. 25 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) extremely stony very fine sandy loam, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few very fine and fine tubular pores; 15 percent stones, 5 percent cobbles, 10 percent pebbles; mildly alkaline; abrupt smooth boundary.

B2t—4 to 13 inches; light yellowish brown (10YR 6/4) stony clay, dark yellowish brown (10YR 4/4) moist; strong medium and coarse prismatic structure; hard, friable, sticky and plastic; few very fine and fine and common medium roots; few very fine through medium tubular pores; 10 percent stones, 5 percent cobbles, 5 percent pebbles; common moderately thick clay films on faces of peds and in pores; slightly effervescent; strongly alkaline; abrupt wavy boundary.

B2tcasi—13 to 17 inches; reddish yellow (7.5YR 7/6) very gravelly clay, brownish yellow (10YR 6/6) moist; moderate fine to medium angular blocky structure; hard, brittle, sticky and plastic; few roots; few fine tubular pores; 10 percent stones, 5 percent cobbles, 30 percent pebbles, common thin and few moderately thick clay films on faces of peds and in pores; weak discontinuous silica cementation; violently effervescent; very strongly alkaline; clear broken boundary.

Ccasi—17 to 19 inches; white (10YR 8/1) very stony clay loam, pink (7.5YR 7/4) moist; massive; very hard, brittle, slightly sticky and slightly plastic; few fine roots; few very fine and fine tubular pores; 15 percent cementation; violently effervescent; very strongly alkaline; abrupt wavy boundary.

R—19 to 23 inches; hard, slightly fractured basalt.

Depth to hard bedrock is 14 to 20 inches. Reaction throughout the profile is neutral to very strongly alkaline. The Bt horizon is clay or heavy clay loam and is 35 to 55 percent clay.

Risley Series

The Risley series consists of moderately deep, well drained soils on uplands. These soils formed in material

weathered mainly from altered volcanic rock. Slopes are 8 to 30 percent.

Typical pedon of Risley cobbly loam, in an area of Risley-Xman-Rock outcrop association, 1,900 feet east and 900 feet south of the northwest corner of sec. 14, T. 24 N., R. 18 E.

A11—0 to 2 inches; brown (10YR 5/3) cobbly loam, dark yellowish brown (10YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 10 percent pebbles, 10 percent cobbles; neutral; abrupt smooth boundary.

A12—2 to 6 inches; brown (10YR 5/3) cobbly clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine and common medium roots; many very fine and fine tubular pores; 10 percent pebbles, 10 percent cobbles; neutral; abrupt smooth boundary.

B2t—6 to 18 inches; yellowish brown (10YR 5/4) clay, dark brown (7.5YR 4/4) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, friable, sticky and plastic; few very fine exped roots; few very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; mildly alkaline; clear smooth boundary.

B3ca—18 to 28 inches; brownish yellow (10YR 6/6) clay loam, yellowish brown (10YR 5/6) moist; massive; very hard, friable, sticky and plastic; few fine roots; few very fine and fine tubular pores; strongly effervescent; moderately alkaline; gradual smooth boundary.

Cr—28 to 40 inches; highly weathered and altered andesite bedrock with lime seams and clay films in fractures.

The thickness of the solum and depth to weathered bedrock range from 20 to 40 inches. Reaction throughout the profile ranges from medium acid to moderately alkaline. The Bt horizon is clay, clay loam, or sandy clay and is 35 to 45 percent clay.

Rose Creek Series

The Rose Creek series consists of very deep, poorly drained soils on flood plains. Drainage has been altered. These soils formed in alluvium from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Rose Creek fine sandy loam, 2,000 feet west and 1,600 feet south of the northeast corner of sec. 17, T. 19 N., R. 20 E.

Ap1p—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2)

moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to medium roots; common very fine to medium pores; 10 percent pebbles; effervescent; moderately alkaline; clear smooth boundary.

A12—8 to 16 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine to medium roots; common very fine to medium pores; 10 percent pebbles; effervescent; moderately alkaline; clear smooth boundary.

C1—16 to 60 inches; light brownish gray (10YR 6/2) stratified very fine sandy loam, gravelly loamy sand, sandy loam, dark grayish brown (10YR 4/2) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine to medium roots; few very fine to medium pores; effervescent; moderately alkaline.

The soil profile is deeper than 60 inches. The mollic epipedon is 10 to 18 inches deep. Reaction throughout the profile ranges from mildly alkaline to moderately alkaline. The control section is stratified and has texture of sandy loam, fine sandy loam, very fine sandy loam, or loam. It is more than 15 percent fine or coarse sand and 5 to 18 percent clay. In pedons where texture is the coarser part of the range, the control section is 0 to 20 percent gravel.

Mottles are common below the upper part of the A horizon. The lower part of the C horizon is highly mottled or gleyed.

Rose Creek Variant

The Rose Creek Variant consists of very deep, moderately well drained soils on flood plains. These soils formed in alluvium from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Rose Creek Variant sandy loam, 1,800 feet east and 200 feet north of the southwest corner of sec. 14, T. 23 N., R. 20 E.

A11—0 to 5 inches; light brownish gray (10YR 6/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine through coarse roots; many very fine through medium tubular pores; 10 percent pebbles; slightly effervescent; strongly alkaline; abrupt smooth boundary.

B2—5 to 12 inches; light brownish gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky

structure; hard, very friable, slightly sticky and slightly plastic; many very fine through coarse roots; many very fine through medium tubular pores; 10 percent pebbles; slightly effervescent; strongly alkaline; abrupt smooth boundary.

IIC1ca—12 to 31 inches; light brownish gray (10YR 6/2) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; loose, nonsticky and nonplastic; many very fine through coarse roots; many very fine, fine, and medium interstitial and tubular pores; 15 percent gravel; strongly effervescent; strongly alkaline; abrupt smooth boundary.

IIIA12—31 to 35 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; massive; soft, very friable, slightly sticky and nonplastic; common very fine through medium roots; common very fine through medium tubular pores; 10 percent pebbles; strongly effervescent; strongly alkaline; abrupt smooth boundary.

IVC2—35 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; few fine and medium tubular pores; 10 percent pebbles; strongly effervescent; strongly alkaline.

The thickness of the solum ranges from 12 to 25 inches. Reaction throughout the profile is moderately alkaline to strongly alkaline. The control section is loam, loamy sand, very fine sandy loam, fine sandy loam, or sandy loam and is 10 to 18 percent clay. It is 8 to 20 percent rock fragments.

Ruhe Series

The Ruhe series consists of shallow, well drained soils on tufa-controlled terraces. These soils formed in mixed, sandy alluvium with an admixture of eolian sand. Slopes are 0 to 15 percent.

Typical pedon of Ruhe gravelly loamy sand, in an area of Hawsley-Ruhe-Bluewing association, 2,600 feet west and 1,200 feet north of the southeast corner of sec. 21, T. 24 N., R. 23 E.

A11—0 to 1 inch; pale brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 3/3) moist; single grained; loose, nonsticky and nonplastic; very few fine through medium roots; many very fine interstitial pores; 20 percent pebbles; strongly effervescent; strongly alkaline; clear smooth boundary.

A12—1 inch to 6 inches; pale brown (10YR 6/3) gravelly loamy sand, brown (10YR 4/3) moist; weak thick platy structure; soft, very friable, nonsticky and nonplastic; many very fine through medium roots; many very fine interstitial and common very fine tubular pores; 20 percent pebbles; violently effervescent; strongly alkaline; clear smooth boundary.

C1ca—6 to 14 inches; light brownish gray (10YR 6/2) gravelly loamy sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial and common very fine tubular pores; 20 percent pebbles; violently effervescent; strongly alkaline; abrupt wavy boundary.

IIC2r—14 to 35 inches; light gray (10YR 7/1) tufa, very pale brown (10YR 7/4) moist; massive; extremely hard, brittle; common very fine through medium roots in fractures and channels only; violently effervescent; very strongly alkaline; clear irregular boundary.

IIIC3ca—35 to 60 inches; light brownish gray (10YR 6/2) stratified very cobbly coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; many very fine and fine interstitial pores; 20 percent pebbles, 45 percent cobbles, 10 percent stones; violently effervescent; very strongly alkaline.

Depth to the weathered tufa layer is 14 to 20 inches. Reaction throughout the profile ranges from moderately alkaline to very strongly alkaline.

The control section is sand or loamy sand and is 0 to 5 percent clay. It is 0 to 35 percent rock fragments.

Sagouspe Series

The Sagouspe series consists of very deep, somewhat poorly drained soils on flood plains and low terraces. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Sagouspe sand, 2,800 feet east and 2,200 feet south of the northwest corner of sec. 10, T. 18 N., R. 20 E.

A11—0 to 6 inches; light brownish gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; few medium and fine roots; neutral; clear smooth boundary.

C1—6 to 21 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; common medium to very fine roots; mildly alkaline; abrupt smooth boundary.

IIC2—21 to 22 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; common medium faint strong brown (7.5YR 5/6) mottles; weak thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; strongly alkaline; abrupt smooth boundary.

IIIC3—22 to 32 inches; light gray (10YR 7/2) loamy sand, brown (10YR 4/3) moist; common fine prominent brown (7.5YR 5/4) mottles; single

grained; loose, nonsticky and nonplastic; few medium and fine roots; moderately alkaline; clear smooth boundary.

IVC4—32 to 35 inches; light gray (10YR 7/2) silty loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent strong brown (7.5YR 5/6) mottles; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and fine roots; strongly alkaline; clear smooth boundary.

VC5—35 to 47 inches; light gray (10YR 7/2) gravelly sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; 20 percent pebbles; moderately alkaline; clear smooth boundary.

VIA12b—47 to 60 inches; light brownish gray (10YR 6/2) stratified silty clay loam and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; many large prominent olive brown (2.5Y 4/4) mottles; massive; hard, friable, slightly sticky and slightly plastic; strongly alkaline.

The soil profile is deeper than 60 inches. Reaction ranges from mildly alkaline to strongly alkaline throughout the profile. The control section is stratified and has average texture of loamy sand or loamy fine sand. It is 0 to 10 percent clay. Common fine and medium distinct to prominent mottles occur at depths of 6 to 40 inches.

Sagouspe Variant

The Sagouspe Variant consists of very deep, poorly drained soils on flood plains and lake terraces. These soils formed in alluvium derived from mixed rock. The slope is 0 to 2 percent.

Typical pedon of Sagouspe Variant loamy very fine sand, wet, 2,600 feet east and 2,500 feet south of the northwest corner of sec. 3, T. 16 N., R. 19 E.

O—2.5 inches to 0; root mat.

Ap1—0 to 5 inches; gray (5Y 6/1) loamy very fine sand with thin lenses of heavy silt loam, dark gray (5Y 4/1) moist with pockets of very dark gray (10YR 3/1) moist; many large prominent reddish brown (5YR 4/3) mottles; weak medium platy structure; very friable, nonsticky and nonplastic; many medium to very fine roots; slightly acid; abrupt smooth boundary.

C1—5 to 22 inches; light gray (10YR 7/1) stratified sand and fine sand, light gray (10YR 6/1) moist; many large prominent yellowish red (5YR 4/6) mottles; single grained; loose, nonsticky and nonplastic; common medium to very fine roots; neutral; abrupt smooth boundary.

IIC2—22 to 28 inches; greenish gray (5GY 6/1) stratified loamy very fine sand, greenish gray (5GY 5/1) moist, and silt loam, greenish gray (5GY 6/1) moist; moderate thin and medium platy structure; firm, the

silt loam is slightly sticky and plastic, the loamy very fine sand is nonsticky and nonplastic; few medium to very fine roots; neutral; abrupt smooth boundary.

IIIC3—28 to 50 inches; light gray (N 7/0) sand, light gray (N 6/0) moist; many medium and large prominent greenish gray (5GY 6/1) mottles; single grained; loose, nonsticky and nonplastic; neutral.

The soil profile is more than 60 inches thick. The average texture of the control section (between depths of 10 inches and 40 inches) is loamy sand or loamy fine sand. The control section is 2 to 12 percent clay. Reaction throughout the profile ranges from slightly acid to neutral. Common fine mottles and medium distinct to prominent mottles are at a depth of 15 to 20 inches in most pedons.

Settlemeier Series

The Settlemeier series consists of very deep, poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived from mixed rock. The slopes are 0 to 4 percent.

Typical pedon of Settlemeier fine sandy loam, 0 to 2 percent slopes, 2,500 feet south and 1,000 feet east of the northwest corner of sec. 6, T. 18 N., R. 20 E.

A1—0 to 15 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, sticky and slightly plastic; many fine to coarse roots; many fine to coarse tubular pores; effervescent; moderately alkaline; abrupt smooth boundary.

C1—15 to 25 inches; light gray (N 6/0) clay loam, dark gray (N 4/0) moist; massive; firm, sticky and slightly plastic; common fine and many medium roots; common fine and medium tubular pores; effervescent in spots; moderately alkaline; abrupt smooth boundary.

IIIC2g—25 to 39 inches; light olive brown (2.5YR 5/4) silty clay loam, olive brown (2.5YR 4/4) moist; many large prominent greenish gray (5GY 5/1) mottles and common medium prominent strong brown (7.5YR 5/6) mottles; massive; firm, sticky and plastic; very few roots; very few pores; moderately alkaline; abrupt smooth boundary.

IIIC3g—39 to 60 inches; greenish gray (5GY 5/1) stratified very gravelly loamy sand and silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; very friable, firm, nonsticky and nonplastic; sticky and plastic; very few roots; moderately alkaline.

The soil profile is more than 50 inches thick. The mollic epipedon is 12 to 23 inches thick. Reaction throughout the profile is moderately alkaline to strongly alkaline. The control section is stratified clay loam and

silty clay loam. It averages 25 to 35 percent clay and more than 15 percent fine or coarse sand.

The C horizon is mottled or gleyed.

Sibelia Series

The Sibelia series consists of deep, well drained soils on uplands. These soils formed in colluvium and residuum from mixed rock but dominantly andesite and basalt. Slopes are 15 to 50 percent.

Typical pedon of Sibelia very stony sandy loam, in an area of Meiss-Sibelia-Rock outcrop association, 2,000 feet west and 500 feet south of the northeast corner of sec. 23, T. 17 N., R. 18 E.

O1—7 inches to 0; pine litter duff.

A1—0 to 6 inches; grayish brown (10YR 5/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine through coarse roots; many very fine and fine interstitial pores, many fine through medium tubular pores; 10 percent pebbles, 10 percent cobbles, 10 percent stones; slightly acid; clear wavy boundary.

B2—6 to 14 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine and common medium roots; many very fine through medium tubular pores; 30 percent pebbles, 5 percent cobbles; slightly acid; gradual wavy boundary.

C1—14 to 20 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine and common medium roots; many very fine through medium tubular pores; 30 percent pebbles, 5 percent cobbles; neutral; gradual wavy boundary.

C2—20 to 41 inches; pale brown (10YR 6/3) very cobbly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; common very fine and fine tubular pores; 35 percent pebbles, 20 percent cobbles, 5 percent stones; neutral; clear wavy boundary.

C3—41 to 47 inches; pale brown (10YR 6/3) very cobbly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; common very fine and fine tubular pores; 30 percent pebbles, 30 percent cobbles; neutral; clear wavy boundary.

R—47 inches; highly weathered and fractured andesite.

The solum thickness is 12 to 20 inches. Depth to bedrock is 40 to 60 inches. Reaction throughout the profile is slightly acid to neutral. The control section (between depths of 10 inches and 40 inches) is sandy

loam and is 10 to 18 percent clay. It is 35 to 70 percent rock fragments.

Sibelia Variant

The Sibelia Variant consists of very deep, somewhat poorly drained soils on uplands. These soils formed in colluvium and residuum from mixed rock, but dominantly andesite and basalt. The slopes are 4 to 30 percent.

Typical pedon of Sibelia Variant stony loam, in an area of Carioca-Sibelia Variant-Fugawee association, 200 feet west and 2,200 feet south of the northeast corner of sec. 16, T. 18 N., R. 18 E.

O1—1 inch to 0; pine litter duff.

A1—0 to 10 inches; brown (10YR 5/3) stony loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine through coarse roots; common very fine and fine interstitial and tubular pores; 20 percent pebbles, 5 percent cobbles, 1 percent stones; medium acid; clear smooth boundary.

B2—10 to 21 inches; yellowish brown (10YR 5/4) gravelly loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many very fine through coarse roots; common very fine and fine vesicular and tubular pores; 20 percent pebbles, 10 percent cobbles; medium acid; diffuse wavy boundary.

C1—21 to 41 inches; yellowish brown (10YR 5/4) very cobbly loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; common very fine through coarse roots; common very fine through fine interstitial and tubular pores; 20 percent pebbles, 30 percent cobbles, medium acid; clear smooth boundary.

C2—41 to 60 inches; yellowish brown (10YR 5/4) very cobbly loam, dark yellowish brown (10YR 4/4) moist, common yellow (10YR 7/6) mottles; massive; hard, firm, nonsticky and nonplastic; few very fine through coarse roots; few very fine and fine tubular pores; 25 percent pebbles, 30 percent highly weathered andesitic cobbles; slightly acid.

The solum thickness is 15 to 30 inches. Reaction ranges from medium acid to slightly acid throughout the profile. The control section (between depths of 10 inches and 40 inches) is loam or sandy loam that is 8 to 18 percent clay. It is 35 to 60 percent rock fragments.

Singatse Series

The Singatse series consists of very shallow, somewhat excessively drained soils on rounded hill crests and side slopes. These soils formed in residuum

mainly of rhyolite and basalt. The slope is 8 to 30 percent.

Typical pedon of Singatse very gravelly sandy loam, in an area of Singatse-Fireball-Rednik association, 2,000 feet north and 600 feet east of the southwest corner of sec. 22, T. 24 N., R. 24 E.

A1—0 to 2 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; moderate medium platy structure; soft, very friable, slightly sticky and slightly plastic; very few very fine roots; many fine and medium and few coarse vesicular pores; 35 percent pebbles, 3 percent cobbles; slightly effervescent; strongly alkaline; abrupt smooth boundary.

C1—2 to 6 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine vesicular and few fine tubular pores; 40 percent pebbles, 5 percent cobbles, 10 percent stones; slightly effervescent; moderately alkaline; abrupt wavy boundary.

C2r—6 to 12 inches; volcanic saprolite; very hard, extremely firm; few moderately thick clay films in fractures.

R—12 inches; hard vesicular basaltic bedrock.

Depth to the paralithic contact is 4 to 10 inches, and depth to lithic contact is 10 to 20 inches. Reaction throughout the profile is moderately alkaline to strongly alkaline. The control section from the surface to paralithic contact is very gravelly loam or very gravelly sandy loam and is 5 to 15 percent clay. It is 35 to 60 percent gravel.

Skedaddle Series

The Skedaddle series consists of very shallow, well drained soils on mountain slopes. These soils formed in residuum and colluvium derived mainly from basalt. The slopes are 15 to 70 percent.

Typical pedon of Skedaddle very stony loam, in an area of Skedaddle-Pahrang-Lemm association, 300 feet west and 600 feet north of the southeast corner of sec. 26, T. 23 N., R. 22 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine interstitial pores; 20 percent pebbles, 10 percent cobbles, 15 percent stones; mildly alkaline; clear smooth boundary.

A12—2 to 8 inches; light brownish gray (10YR 6/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and

slightly plastic; common very fine to medium roots; common very fine to medium tubular pores; 30 percent pebbles; neutral; abrupt wavy boundary.

Cr—8 to 11 inches; weathered rock with roots and clay loam pockets.

R—11 inches; hard bedrock.

Depth to bedrock ranges from 4 to 12 inches. Reaction throughout the profile is neutral to mildly alkaline. The control section is sandy loam or loam and is 18 to 27 percent clay. It is 35 to 60 percent rock fragments.

Smallcone Series

The Smallcone series consists of very shallow, well drained soils formed in residuum of weathered andesite. These soils are on eroded mountain side slopes and ridges. The slopes are 15 to 50 percent.

Typical pedon of Smallcone very gravelly coarse sandy loam, 15 to 50 percent slopes, in an area of Duco-Smallcone-Cagle association, 113 feet south and 1,146 feet west of the northeast corner of sec. 1, T. 17 N., R. 20 E.

A1—0 to 3 inches; very pale brown (10YR 7/4) very gravelly coarse sandy loam, yellowish brown (10YR 5/6) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 45 percent pebbles; medium acid; clear smooth boundary.

C—3 to 6 inches; very pale brown (10YR 7/4) extremely gravelly coarse sandy loam, yellowish brown (10YR 5/6) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine and medium roots; common very fine and medium interstitial pores; 50 percent pebbles, 10 percent cobbles, 5 percent stones; strongly acid; abrupt wavy boundary.

R—6 inches; weathered andesite with pockets of clay loam and roots in cracks; strongly acid.

Bedrock is at a depth of 4 to 10 inches. Reaction is medium acid or strongly acid throughout the profile.

Texture from the surface to bedrock is sandy loam or coarse sandy loam. The profile is 5 to 15 percent clay and is 35 to 75 percent rock fragments.

Softscrabble Series

The Softscrabble series consists of very deep, well drained soils that formed in colluvium and residuum from volcanic rocks. These soils are on concave hillside slopes. The slopes are 15 to 50 percent.

Typical pedon of Softscrabble very stony loam, in an area of Softscrabble-Gabica-Burnborough association, about 500 feet west and 1,600 feet south of the northeast corner of sec. 14, T. 24 N., R. 20 E.

- A11—0 to 1 inch; dark brown (10YR 4/3) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine through coarse roots; many very fine and fine tubular pores; 25 percent pebbles, 5 percent cobbles, 10 percent stones; neutral; clear smooth boundary.
- A12—1 inch to 9 inches; dark brown (10YR 3/3) extremely gravelly loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine through coarse roots; many very fine and fine tubular pores; 55 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; clear smooth boundary.
- B21t—9 to 19 inches; brown (10YR 5/3) very cobbly clay loam, dark brown (10YR 3/3) moist; strong fine angular blocky structure; hard, friable, sticky and plastic; common very fine through medium roots; common fine and very fine tubular pores; many moderately thick clay films on ped faces and lining pores; 10 percent pebbles, 20 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.
- B22t—19 to 30 inches; brown (10YR 5/3) extremely cobbly clay loam, dark brown (10YR 3/3) moist; strong fine angular blocky structure; hard, friable, sticky and plastic; common very fine through medium roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; 5 percent pebbles, 55 percent cobbles, 5 percent stones; neutral; gradual smooth boundary.
- IIB23t—30 to 40 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) moist; strong fine angular blocky structure; hard, friable, sticky and plastic; common very fine through medium roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; 1 percent pebbles; neutral; clear wavy boundary.
- IIB24t—40 to 60 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 3/4) moist; common fine light olive brown (2.5Y 5/6) moist mottles; strong fine angular blocky structure; hard, friable, sticky and plastic; common very fine, fine, and medium roots; common very fine and fine tubular pores; many moderately thick clay films on ped faces and in pores; 15 percent pebbles; neutral; gradual smooth boundary.
- IIIB3t—60 to 78 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 3/4) moist; common fine strong brown (7.5Y 5/8) mottles moist; strong fine angular blocky structure; hard, friable, sticky and plastic; common very fine, fine, and medium roots; common very fine and fine tubular

pores; many moderately thick clay films on ped faces and in pores; 5 percent pebbles; neutral.
 IIIC1r—78 to 89 inches; highly weathered andesite.

The solum thickness is 60 to 80 inches. Reaction throughout the profile is neutral or slightly acid.

The control section averages clay loam. It is 27 to 35 percent clay and is 35 to 70 percent rock fragments.

Spasprey Series

The Spasprey series consists of moderately deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived from mixed rock. The slopes are 0 to 8 percent.

Typical pedon of Spasprey sandy loam, 0 to 2 percent slopes, 1,200 feet east and 1,400 feet south of the northwest corner of sec. 1, T. 20 N., R. 20 E.

- A1—0 to 2 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium and thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine vesicular pores; neutral; clear smooth boundary.
- B2t—2 to 12 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium prismatic structure parting to weak medium angular blocky; hard, friable, sticky and plastic; common fine to medium roots; common very fine to medium tubular pores; common thin clay films on ped faces and bridging sand grains and moderately thick clay films in pores; neutral; clear smooth boundary.
- C1ca—12 to 29 inches; light brownish gray (10YR 6/2) sandy loam, brown (10YR 4/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine to medium roots; few very fine to medium tubular pores; 10 percent durinodes; few silica-cemented lamellae; strongly effervescent; moderately alkaline; clear irregular boundary.
- C2casim—29 to 46 inches; pale brown (10YR 6/3) strongly silica-cemented duripan; extremely hard, brittle; strongly effervescent; moderately alkaline; clear irregular boundary.
- C3sica—46 to 60 inches; pale brown (10YR 6/3) weakly silica-cemented sandy loam, brown (10YR 5/3) moist; massive; very hard, brittle, nonsticky and nonplastic; strongly effervescent; moderately alkaline.

The thickness of the solum is 10 to 20 inches. Depth to the strongly silica-cemented duripan is 20 to 30 inches. Reaction ranges from neutral to moderately alkaline throughout the profile. The Bt horizon is light clay loam, sandy clay loam, or heavy loam. It is 20 to 35 percent clay.

Springmeyer Series

The Springmeyer series consists of very deep, well drained soils on terraces. These soils formed in alluvium derived from mixed rock. The slopes are 0 to 4 percent.

Typical pedon of Springmeyer stony loam, 0 to 2 percent slopes, 800 feet west and 2,550 feet south of the northeast corner of sec. 7, T. 19 N., R. 18 E.

- Ap1—0 to 2 inches; grayish brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure parting to weak thin platy; firm, sticky and plastic; many fine and very fine roots; many fine and very fine tubular pores; 5 to 10 percent pebbles, 0.1 percent stones; neutral; clear smooth boundary.
- Ap2—2 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; few fine and common very fine roots; few fine and common very fine tubular pores; 10 percent pebbles; neutral; clear smooth boundary.
- A1—7 to 13 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and common very fine tubular pores; 10 percent pebbles; neutral; clear wavy boundary.
- B1t—13 to 23 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure; firm, slightly sticky and slightly plastic, very few roots; few fine and very fine tubular pores; few moderately thick clay films on ped faces and in pores; 10 percent pebbles; neutral; clear wavy boundary.
- B2t—23 to 40 inches; light yellowish brown (10YR 6/4) light sandy clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; very firm, sticky and plastic; very few roots; few fine and very fine pores; common moderately thick clay films on ped faces and in pores; 10 percent pebbles; neutral; clear wavy boundary.
- C1—40 to 60 inches; light yellowish brown (10YR 6/4) very cobbly sandy clay loam, yellowish brown (10YR 5/4) moist; massive; friable, sticky and slightly plastic; 25 percent pebbles, 15 percent cobbles; neutral.

Solum thickness ranges from 20 to 60 inches. The mollic epipedon is 10 to 19 inches thick. Reaction throughout the profile is slightly acid to neutral but is moderately alkaline in the C horizon in some pedons.

The texture of the control section averages sandy clay loam, loam, or clay loam. The control section is 25 to 35 percent clay and is 10 to 35 percent rock fragments.

Stingdorn Series

The Stingdorn series consists of shallow, well drained soils that formed in residuum of rhyolite. These soils are on uplands. The slopes are 15 to 30 percent.

Typical pedon of Stingdorn extremely stony loam, in an area of Stingdorn-Singatse-Rock outcrop association, about 2,200 feet north and 2,000 feet west of the southeast corner of sec. 2, T. 24 N., R. 24 E.

- A1—0 to 4 inches; pale brown (10YR 6/3) extremely stony loam, brown (10YR 4/3) moist; weak medium and thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine vesicular pores; 45 percent pebbles, 5 percent cobbles, 15 percent stones; moderately alkaline; clear smooth boundary.
- B2t—4 to 9 inches; yellowish brown (10YR 5/4) very gravelly clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, very friable, sticky and plastic; many very fine, fine, and medium roots; many very fine and fine tubular pores; many thin clay films on ped faces and lining pores; 50 percent pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.
- C1sica—9 to 12 inches; very pale brown (10YR 7/3) weakly silica-cemented extremely gravelly sandy loam, pale brown (10YR 6/3) moist; massive; hard, brittle, nonsticky and nonplastic; common very fine and fine roots in pockets; many very fine and fine interstitial pores; 75 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- C2sicam—12 to 12 1/2 inches; white (10YR 8/2) indurated duripan.
- R—12 1/2 inches; unweathered rhyolite.

Depth to the indurated duripan over hard bedrock ranges from 8 to 20 inches. Reaction throughout the profile is moderately alkaline or strongly alkaline.

The B2t horizon is clay loam. It is 28 to 35 percent clay and is 35 to 55 percent rock fragments.

Stodick Series

The Stodick series consists of shallow, well drained soils on back slopes of pediments. These soils formed in pedisements derived from mixed rock. The slopes are 15 to 50 percent.

Typical pedon of Stodick very stony loam, 15 to 30 percent slopes, 350 feet west and 950 feet south of the northeast corner of sec. 29, T. 19 N., R. 19 E.

- A1—0 to 4 inches; light brownish gray (10YR 6/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; soft, very friable,

slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine interstitial pores; 15 percent pebbles, 3 percent stones; neutral; clear smooth boundary.

B1t—4 to 11 inches; light brownish gray (10YR 6/2) very gravelly light clay loam, brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; common fine tubular pores; common moderately thick clay films on ped faces and common thin clay films in pores; 35 percent pebbles; neutral; clear wavy boundary.

II B2t—11 to 14 inches; yellowish brown (10YR 5/4) very gravelly heavy clay loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure; very hard, firm, sticky and plastic; few fine and medium roots; very few pores; few thick clay films; 35 percent pebbles; neutral.

II Cr—14 to 60 inches; tuff, highly fractured in the upper part and interbedded with mudstone and sandstone.

The thickness of the solum and the depth to soft bedrock are 14 to 20 inches. Reaction throughout the profile ranges from neutral to slightly acid.

The control section is loam or clay loam and averages 25 to 35 percent clay. It is 35 to 50 percent rock fragments.

Stumble Series

The Stumble series consists of very deep, somewhat excessively drained soils on alluvial fans and terraces. These soils formed in alluvium derived from mixed rock. The slopes are 4 to 15 percent.

Typical pedon of Stumble loamy sand, in an area of Stumble-Ruhe-Bluewing association, 1,400 feet south and 1,200 feet west of the northeast corner of sec. 17, T. 23 N., R. 24 E.

A1—0 to 2 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; 10 percent pebbles; moderately alkaline; clear smooth boundary.

C1—2 to 14 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and medium roots; many very fine and fine interstitial pores; 3 percent fine pebbles; strongly alkaline; clear smooth boundary.

C2ca—14 to 24 inches; pale brown (10YR 6/3) loamy sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and medium roots; many very fine and fine interstitial pores; 3 percent fine pebbles;

strongly effervescent; strongly alkaline; clear smooth boundary.

II C3ca—24 to 35 inches; light brownish gray (10YR 6/2) gravelly loamy sand, dark brown (10YR 4/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; 30 percent pebbles; violently effervescent; strongly alkaline; clear smooth boundary.

II C4ca—35 to 43 inches; light brownish gray (10YR 6/2) loamy sand, dark brown (10YR 4/3) moist; massive; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; 10 percent fine pebbles; violently effervescent; strongly alkaline; clear smooth boundary.

I V C5ca—43 to 60 inches; stratified gravelly sand and very gravelly sand; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 35 percent pebbles; violently effervescent; strongly alkaline.

The profile is more than 60 inches. Reaction throughout the profile ranges from mildly alkaline to strongly alkaline. Depth to free carbonates ranges from 10 to 22 inches. The control section is stratified and has an average texture of loamy sand or loamy fine sand. It is 3 to 10 percent clay and is 0 to 35 percent pebbles.

Sumine Series

The Sumine series consists of moderately deep, well drained soils on mountain slopes. These soils formed in mixed colluvium and residuum. The slope is 30 to 50 percent.

Typical pedon of Sumine very stony loam, in an area of Softscrabble-Gabica-Sumine association, 450 feet east and 2,400 feet south of the northwest corner of sec. 36, T. 21 N., R. 22 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 15 percent pebbles, 15 percent cobbles, 15 percent stones; neutral; clear smooth boundary.

A12—4 to 6 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 10 percent pebbles, 15 percent cobbles, 15 percent stones; neutral; clear wavy boundary.

B21t—6 to 13 inches; brown (10YR 5/3) very cobbly clay loam, dark brown (10YR 3/3) moist; moderate and strong fine and medium angular blocky structure; hard, friable, sticky and plastic; many very fine, fine, and medium roots; common very fine and fine tubular pores; common thin clay films on peds and in pores; 20 percent pebbles, 20 percent cobbles; neutral; clear wavy boundary.

B22t—13 to 29 inches; pale brown (10YR 6/3) very gravelly clay loam, dark yellowish brown (10YR 4/4) moist; strong medium angular blocky structure; very hard, very friable, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; common thin and moderately thick clay films on peds and in pores and coating coarse fragments; 35 percent pebbles, 10 percent cobbles; neutral; clear irregular boundary.

B3t—29 to 34 inches; brown (7.5YR 5/4) extremely cobbly loam, dark brown (7.5YR 4/4) moist; massive; very hard, friable, sticky and plastic; few very fine roots; very few very fine tubular pores; common moderately thick clay films on coarse fragments; 20 percent pebbles, 30 percent cobbles, 10 percent stones; neutral; gradual broken boundary.

R—34 inches; hard fractured basaltic bedrock.

Thickness of the solum and depth to hard bedrock range from 20 to 40 inches. The mollic epipedon is 8 to 15 inches thick and includes the upper part of the B2t horizon. The control section is clay loam or loam and is 25 to 35 percent clay. It is 35 to 60 percent rock fragments.

Surgem Series

The Surgem series consists of moderately deep, well drained soils on uplands. These soils formed in residuum mainly of granodiorite. The slope is 8 to 50 percent.

Typical pedon of Surgem stony sandy loam, 8 to 15 percent slopes, 1,000 feet west and 1,700 feet south of the northeast corner of sec. 8, T. 20 N., R. 20 E.

Pebbles cover about 25 percent of the surface; cobbles, 1 percent; and stones, 2 percent. The surface is about 1 percent granodiorite rock outcrop.

A11—0 to 2 inches; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; 60 percent pebbles, 2 percent stones; slightly acid; abrupt wavy boundary.

A12—2 to 4 inches; pale brown (10YR 6/3) gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular pores; 35 percent pebbles; slightly acid; abrupt wavy boundary.

B1t—4 to 10 inches; brown (10YR 5/3) very cobbly clay loam, dark yellowish brown (10YR 3/4) moist; weak very fine subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; few very fine tubular pores; few thin clay films on ped faces and in pores; 25 percent pebbles, 25 percent cobbles; neutral; clear irregular boundary.

B2t—10 to 24 inches; brown (7.5YR 5/4) very cobbly clay, dark brown (7.5YR 4/4) moist; strong medium angular and subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular pores; 60 percent cobbles; neutral; abrupt irregular boundary.

R—24 to 30 inches; fractured granodiorite bedrock with clay in the fractures.

Solum thickness and depth to bedrock are 20 to 30 inches. Reaction ranges from slightly acid to mildly alkaline throughout the profile. The B2t horizon is clay or sandy clay. It is 35 to 50 percent clay and is 50 to 60 percent rock fragments.

Surprise Series

The Surprise series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed rock. The slopes are 2 to 8 percent.

Typical pedon of Surprise loamy sand, 2 to 4 percent slopes, 2,400 feet west and 1,200 feet north of the southeast corner of sec. 17, T. 16 N., R. 20 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many fine and very fine tubular pores; slightly acid; clear smooth boundary.

A11—8 to 14 inches; brown (10YR 5/3) light sandy loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine and fine pores; slightly acid; clear smooth boundary.

B2—14 to 26 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; very few roots; very few pores; 20 percent fine pebbles; slightly acid; gradual smooth boundary.

C1—26 to 37 inches; light yellowish brown (10YR 6/4) gravelly light sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; very few roots; very few pores; 20 percent fine pebbles; slightly acid; gradual smooth boundary.

C2—37 to 66 inches; light yellowish brown (10YR 6/4) stratified gravelly loamy sand and sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent pebbles; slightly acid.

Depth of the solum ranges from 23 to 28 inches. The mollic epipedon is 10 to 14 inches thick. Reaction throughout the profile ranges from slightly acid to neutral.

The control section has average texture of sandy loam or loam. It is 10 to 18 percent clay. It is 15 to 35 percent rock fragments.

Sutcliff Series

The Sutcliff series consists of deep, well drained soils that formed in alluvium from mixed rock. These soils are on alluvial fans. The slope is 4 to 15 percent.

Typical pedon of Sutcliff very stony loam, in an area of Sutcliff-Kleinbush-Washoe association, about 400 feet east and 25 feet north of the southwest corner of sec. 19, T. 22 N., R. 25 E.

A11—0 to 2 inches; brown (10YR 5/3) very stony loam, pale brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to weak thin platy; soft, very friable, sticky and plastic; common very fine and fine roots; few very fine and fine tubular pores; 30 percent pebbles, 20 percent cobbles, 10 percent stones; moderately alkaline; clear smooth boundary.

A12—2 to 5 inches; brown (10YR 5/3) very stony loam, pale brown (10YR 4/3) moist; weak thin and medium platy structure; slightly hard, very friable, sticky and plastic; many very fine and fine roots; few very fine and fine tubular pores; 30 percent pebbles, 20 percent cobbles, 10 percent stones; effervescent; moderately alkaline; clear smooth boundary.

B21t—5 to 15 inches; light yellowish brown (10YR 6/4) very cobbly clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; few very fine and fine tubular pores; common thin and few moderately thick clay films on the faces of peds and lining pores; 5 percent pebbles, 20 percent cobbles, 10 percent stones; effervescent; moderately alkaline; clear wavy boundary.

B22tca—15 to 25 inches; light brown (7.5YR 6/4) very stony clay loam, brown (7.5YR 4/4) moist; strong medium angular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; common moderately thick clay films on faces of peds and lining pores; 10 percent pebbles, 10 percent cobbles, 20 percent stones; violently effervescent with lime coatings on

underside of rock fragments; strongly alkaline; clear irregular boundary.

C1ca—25 to 42 inches; pinkish gray (7.5YR 6/2) very cobbly loam, brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; 20 percent pebbles, 20 percent cobbles, 5 percent stones; violently effervescent; strongly alkaline; abrupt wavy boundary.

C2sicam—42 to 53 inches; white (10YR 8/2) strongly silica-cemented hardpan; violently effervescent with lime in seams.

Thickness of the solum ranges from 20 to 40 inches. Depth to the strongly cemented duripan is 40 to 60 inches. Reaction throughout the profile is moderately alkaline or strongly alkaline.

The Bt horizon is clay loam that is 28 to 35 percent clay. It is 35 to 50 percent rock fragments.

Tallac Series

The Tallac series consists of deep, well drained soils on uplands. These soils formed in glacial deposits derived from mixed rock. The slope is 4 to 50 percent.

Typical pedon of Tallac very bouldery sandy loam, 4 to 30 percent slopes, 2,200 feet east and 100 feet north of the southwest corner of sec. 3, T. 17 N., R. 18 E.

O1—1 inch to 0; pine litter duff.

A11—0 to 6 inches; dark grayish brown (10YR 4/2) very bouldery sandy loam, very dark brown (10YR 2/2) moist; weak to moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine through coarse roots; many very fine through medium tubular and interstitial pores; 5 percent pebbles, 5 percent cobbles, 10 percent stones, 5 percent boulders; medium acid; clear smooth boundary.

A12—6 to 13 inches; brown (10YR 5/3) very bouldery sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine through coarse roots; many very fine through medium tubular and interstitial pores; 5 percent pebbles, 5 percent cobbles, 20 percent stones, 10 percent boulders; medium acid; clear wavy boundary.

A13—13 to 26 inches; brown (10YR 4/3) extremely bouldery sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine through medium roots; many very fine and fine tubular pores; 10 percent durinodes, 5 percent pebbles, 5 percent cobbles, 25 percent stones, 20 percent boulders; medium acid; clear wavy boundary.

C1—26 to 45 inches; light yellowish brown (10YR 6/4) very stony sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine through medium roots; common very fine and fine tubular and interstitial pores; 5 percent pebbles, 5 percent cobbles, 30 percent stones, 10 percent boulders; slightly acid; clear wavy boundary.

C2si—45 to 50 inches; dark brown (10YR 4/3) very bouldery loamy sand, dark brown (10YR 4/3) moist; massive; hard, firm nonsticky and nonplastic; few very fine and fine roots; few very fine and fine tubular and interstitial pores; 5 percent pebbles, 5 percent cobbles, 30 percent stones, 20 percent boulders; slightly acid.

Depth of the soil profile is more than 50 inches. Depth to the Csi horizon is 40 to 60 inches. The umbric epipedon is 20 to 35 inches thick. Reaction throughout the profile is medium acid or slightly acid. The control section is coarse sandy loam, sandy loam, or loam. It is 5 to 15 percent clay and is 35 to 65 percent rock fragments.

Tanob Series

The Tanob series consists of moderately deep, well drained soils on uplands. These soils formed in residuum mainly of acid igneous rocks. Slopes are 8 to 30 percent.

Typical pedon of Tanob gravelly loamy coarse sand, in an area of Haypress-Tanob-Rock outcrop complex, 15 to 50 percent slopes, 700 feet west and 700 feet south of the northeast corner of sec. 20, T. 23 N., R. 18 E.

A11—0 to 2 inches; light brownish gray (10YR 6/2) gravelly coarse sand, very dark grayish brown (10YR 3/2) moist; single grained; loose, nonsticky and nonplastic; common very fine roots; many very fine and fine interstitial pores; 20 percent fine pebbles; strongly acid; abrupt smooth boundary.

A12—2 to 17 inches; dark grayish brown (10YR 4/2) loamy coarse sand, very dark grayish brown (10YR 3/2) moist; soft, very friable, nonsticky and nonplastic; many very fine through medium roots; many very fine through medium tubular pores; 10 percent fine pebbles; medium acid; clear smooth boundary.

B1t—17 to 22 inches; yellowish brown (10YR 5/4) heavy loamy coarse sand, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable, nonsticky and nonplastic; many very fine and medium roots; many very fine and fine tubular pores; 10 percent fine pebbles; few thin clay films bridging sand grains and in pores; medium acid; clear smooth boundary.

B2t—22 to 28 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, friable, slightly sticky and slightly

plastic; many very fine and common fine roots; many very fine tubular pores; 5 percent pebbles; common moderately thick clay films bridging sand grains and in pores; slightly acid; clear smooth boundary.

C1r—28 to 32 inches; weathered granodiorite.

The thickness of the solum and the depth to weathered bedrock range from 20 to 40 inches. Reaction ranges from slightly acid to strongly acid throughout the profile. The B2t horizon is sandy loam that is 8 to 18 percent clay. It averages 5 to 15 percent coarse fragments, mostly in the form of fine pebbles.

Temo Series

The Temo series consists of shallow, excessively drained soils on uplands. These soils formed in residuum mainly of acid igneous rocks. Slopes are 30 to 50 percent.

Typical pedon of Temo bouldery coarse sand in an area of Temo-Witefels-Rock outcrop association, 2,000 feet east and 1,700 feet south of the northwest corner of sec. 30, T. 16 N., R. 19 E.

O1—0.5 inch to 0; pine and fir litter duff.

A11—0 to 2 inches; grayish brown (10YR 5/2) bouldery coarse sand, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many fine and very fine interstitial pores; 25 percent fine pebbles, 1 percent boulders; medium acid; clear wavy boundary.

A12—2 to 10 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots and few medium and coarse roots; many fine and very fine interstitial pores; 25 percent fine pebbles; slightly acid; abrupt wavy boundary.

C1—10 to 16 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few fine to coarse roots; many very fine and fine interstitial pores; 35 percent pebbles; medium acid; clear wavy boundary.

C2r—16 to 35 inches; granitic gruss.

Depth to the granitic gruss ranges from 8 to 20 inches. Reaction ranges from slightly acid to medium acid throughout the profile. The control section is loamy coarse sand or coarse sand. It is 2 to 8 percent clay and is 10 to 35 percent pebbles.

Thulepah Series

The Thulepah series consists of very deep, well drained soils that formed in residuum and colluvium from

volcanic rocks. These soils are on eroded hilltops and plateaus. Slopes are 8 to 30 percent.

Typical pedon of Thulepah very stony loam, in an area of Thulepah-Mosquet association, 2,200 feet south and 1,500 feet east of the northwest corner of sec. 3, T. 24 N., R. 20 E.

A11—0 to 2 inches; dark brown (7.5YR 3/2) very stony loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; common very fine, fine, and medium roots; common very fine and fine tubular and interstitial pores; 30 percent pebbles, 15 percent stones; neutral; abrupt smooth boundary.

A12—2 to 6 inches; dark grayish brown (10YR 4/2) cobbly loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; many very fine through coarse roots; common very fine and fine tubular and interstitial pores; 10 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

IIb21t—6 to 13 inches; dark brown (10YR 4/3) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine through coarse roots; common moderately thick clay films on ped faces, lining pores, and coating coarse fragments; 10 percent pebbles; neutral; clear smooth boundary.

IIb22t—13 to 22 inches; dark brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few roots; few tubular pores; few thin clay films on ped faces and lining pores; 25 percent pebbles; neutral; clear smooth boundary.

IIb23t—22 to 28 inches; yellowish brown (10YR 5/4) very gravelly clay loam, dark yellowish brown (10YR 3/4) moist; brownish yellow (10YR 6/8) and olive yellow (2.5Y 6/6) mottles; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few medium roots; common fine tubular pores; common moderately thick clay films on ped faces and in pores; 40 percent pebbles; neutral; clear smooth boundary.

IIb24t—28 to 37 inches; yellowish brown (10YR 5/4) gravelly clay loam, dark yellowish brown (10YR 3/4) moist; brownish yellow (10YR 6/8) and olive yellow (2.5Y 6/6) mottles; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few roots; common fine tubular pores; common moderately thick clay films on ped faces and in pores; 25 percent pebbles; neutral; clear smooth boundary.

IIb31t—37 to 50 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) moist; brownish yellow (10YR 6/8) and light olive brown

(2.5Y 5/6) mottles; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few roots; few pores; common moderately thick clay films on ped faces and lining pores; neutral; clear smooth boundary.

IIb32t—50 to 62 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 3/4) moist; brownish yellow (10YR 6/3) and light olive green (2.5Y 5/6) mottles; weak fine subangular blocky structure; hard, friable, sticky and plastic; few roots; few fine tubular pores; few thin clay films on ped faces and lining pores; slightly acid.

The solum is more than 60 inches thick. Reaction ranges from slightly acid to neutral throughout the profile. The B2t horizon is clay loam, silty clay loam, or loam. It is 27 to 35 percent clay and is 5 to 35 percent rock fragments.

Ticino Series

The Ticino series consists of moderately deep, well drained soils on hillsides. These soils formed in residuum and colluvium from mixed but predominantly metasedimentary rocks, rhyolite, and andesite. Slopes are 4 to 30 percent.

Typical pedon of Ticino gravelly fine sandy loam, in an area of Burnborough-Ticino-Softscrabble association, 1,400 feet east and 400 feet north of the southwest corner of sec. 24, T. 20 N., R. 18 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) gravelly fine sandy loam, very dark gray (10YR 3/1) moist; weak medium and coarse subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots; many fine and very fine interstitial and tubular pores; 20 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

A12—4 to 11 inches; dark brown (10YR 4/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 15 percent pebbles; neutral; clear smooth boundary.

B21t—11 to 17 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine through coarse roots; many very fine and fine tubular pores; common thin clay films coating ped faces and pores; 15 percent pebbles; neutral; clear smooth boundary.

B22t—17 to 22 inches; yellowish brown (10YR 5/4) gravelly loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; few fine

and very fine and common medium and coarse roots; many very fine and fine and few medium tubular pores; common thin clay films coating ped faces and pores; 20 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

Cr—22 to 50 inches; highly weathered metasedimentary rock with some roots and clay films in fractures.

The thickness of the solum and the depth to paralithic contact range from 20 to 40 inches. Reaction ranges from neutral to slightly acid throughout the profile. The B2t horizon is loam or clay loam. It is 18 to 35 percent clay and is 15 to 35 percent coarse fragments.

Toiyabe Series

The Toiyabe series consists of shallow, excessively drained soils on uplands. These soils formed in residuum mainly of granodiorite. Slopes are 15 to 70 percent.

Typical pedon of Toiyabe bouldery coarse sand, in an area of Toiyabe-Corbett-Rock outcrop association, moderately steep, 2,200 feet east and 600 feet north of the southwest corner of sec. 20, T. 16 N., R. 19 E.

A11—0 to 3 inches; dark grayish brown (10YR 4/2) bouldery coarse sand, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 5 percent fine pebbles, 2 percent boulders; neutral; clear smooth boundary.

A12—3 to 8 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 15 percent fine pebbles; neutral; clear wavy boundary.

AC—8 to 13 inches; pale brown (10YR 6/3) gravelly coarse sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine to medium roots; many very fine and fine interstitial pores; 10 percent fine pebbles; neutral; clear irregular boundary.

Cr—13 to 29 inches; weathered granodiorite.

The depth to weathered bedrock ranges from 10 to 20 inches. Reaction throughout the profile ranges from medium acid to neutral. The control section is loamy coarse sand, sand, coarse sand, or very coarse sand. It is 0 to 4 percent clay and is 5 to 35 percent rock fragments, mostly fine gravel.

Toulon Series

The Toulon series consists of very deep, excessively drained soils on relict shoreline terraces and beaches.

These soils formed in alluvium from mixed rock sources. Slopes are 2 to 8 percent.

Typical pedon of Toulon very gravelly loam, in an area of Isolde-Toulon complex, 0 to 15 percent slopes, 400 feet west and 2,600 feet north of the southeast corner of sec. 25, T. 24 N., R. 23 E.

A11—0 to 1 inch; pale brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; very few fine roots; many very fine and fine interstitial and few fine tubular pores; 30 percent pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

A12—1 to 6 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 4/3) moist; moderate medium and thick platy structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; many medium and coarse vesicular and interstitial pores; 40 percent pebbles; strongly effervescent; strongly alkaline; clear smooth boundary.

B2—6 to 13 inches; light brownish gray (10YR 6/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; common fine strong brown (7.5YR 5/8) stains; weak fine and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and medium roots; common very fine and fine tubular pores; 40 percent pebbles; slightly effervescent; strongly alkaline; clear smooth boundary.

C1ca—13 to 60 inches; gray (10YR 6/1) stratified very gravelly loamy sand and very gravelly coarse sand; gray (10YR 5/1) moist; single grained; loose, nonsticky, nonplastic; 40 percent pebbles, 15 percent cobbles; strongly effervescent; thick lime coats on bottom of rock fragments; moderately alkaline.

The solum ranges from 13 to 20 inches in thickness. Reaction throughout the profile is moderately alkaline or strongly alkaline. The control section averages loamy sand or coarse sand. It is 0 to 15 percent clay and is 40 to 60 percent rock fragments.

Tristan Series

The Tristan series consists of deep, well drained soils that formed in residuum and colluvium from basalt. Tristan soils are on convex mountain slopes. Slopes are 15 to 50 percent.

Typical pedon of Tristan very stony loam, in an area of McQuarrie-Tristan-Arzo association, 900 feet east and 1,800 feet south of the northwest corner of sec. 35, T. 22 N., R. 22 E.

- A11—0 to 3 inches; brown (7.5YR 4/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate thick platy structure parting to moderate fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few medium tubular and many fine and very fine interstitial pores; 20 percent pebbles, 15 percent cobbles, 10 percent stones; mildly alkaline; gradual smooth boundary.
- A12—3 to 7 inches; brown (7.5YR 4/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate medium to fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular pores; 20 percent pebbles, 10 percent cobbles, 15 percent stones; neutral; clear smooth boundary.
- B1t—7 to 11 inches; brown (7.5YR 4/2) very gravelly loam, dark brown (7.5YR 3/2) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; common fine through coarse roots; common fine tubular pores; many thin clay films on peds and in pores; 30 percent pebbles, 10 percent cobbles; neutral; gradual wavy boundary.
- B21t—11 to 17 inches; brown (7.5YR 5/2) very stony clay loam, dark brown (7.5YR 3/2) moist; strong medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; common fine and medium roots; common fine tubular pores; many moderately thick clay films on peds and in pores; 10 percent pebbles, 15 percent cobbles, 20 percent stones; neutral; clear wavy boundary.
- B22t—17 to 28 inches; brown (7.5YR 5/4) very gravelly clay loam, brown (7.5YR 4/4) moist; strong medium and coarse angular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; common fine and very fine tubular pores; many thin and moderately thick clay films on peds and in pores; 30 percent pebbles, 5 percent cobbles, 5 percent stones; neutral; clear wavy boundary.
- B3t—28 to 49 inches; brown (7.5YR 5/4) extremely cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine through medium roots; common very fine and fine tubular pores; many thin and moderately thick clay films in pores and on mineral grains; 20 percent pebbles, 40 percent cobbles, 20 percent stones; neutral; gradual wavy boundary.
- R—49 inches; highly fractured basaltic bedrock; soil and roots extend into the fractures.

Thickness of the solum and depth to bedrock range from 40 to 60 inches. The reaction throughout the profile is neutral or mildly alkaline.

The upper 20 inches of the Bt horizon is loam or clay loam. It is 18 to 35 percent clay and 35 to 60 percent rock fragments.

Trocken Series

The Trocken series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium from mixed rock sources. Slopes are 4 to 30 percent.

Typical pedon of Trocken very stony sandy loam, in an area of Trocken-Stumble-Bluewing association, 1,000 feet north and 1,200 feet east of the southwest corner of sec. 18, T. 24 N., R. 23 E.

- A11—0 to 1 inch; brown (10YR 5/3) very stony sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 20 percent pebbles, 3 percent cobbles, 3 percent stones; slightly effervescent; moderately alkaline; clear smooth boundary.
- A12—1 to 3 inches; pale brown (10YR 6/3) gravelly sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine, fine, and medium interstitial pores; 15 percent pebbles; slightly effervescent; very strongly alkaline; clear smooth boundary.
- B2—3 to 7 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium and common very fine and fine roots; common very fine and fine tubular pores; 15 percent pebbles, 5 percent cobbles; effervescent; very strongly alkaline; clear wavy boundary.
- C1ca—7 to 11 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; 15 percent pebbles, 5 percent cobbles; moderately thick lime coatings on undersides of pebbles and cobbles; violently effervescent; very strongly alkaline; clear wavy boundary.
- C2ca—11 to 19 inches; grayish brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine and fine roots; few very fine and fine tubular pores; 30 percent pebbles, 5 percent cobbles; moderately thick lime coatings on undersides of pebbles and cobbles; strongly effervescent; very strongly alkaline; clear wavy boundary.
- IIC3—19 to 24 inches; grayish brown (10YR 5/2) very gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine roots; very few very fine and fine tubular and many very fine and fine interstitial pores; 50 percent pebbles, 10 percent cobbles; lime occurs in few

filaments and is moderately thick on undersides of pebbles and cobbles; effervescent; very strongly alkaline; abrupt wavy boundary.

- IIC4—24 to 33 inches; brown (10YR 5/3) very gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few roots; very few tubular and interstitial pores; 45 percent pebbles, 15 percent cobbles, 5 percent stones; effervescent; very strongly alkaline; clear smooth boundary.
- IVC5—33 to 40 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and nonplastic; 15 percent pebbles, 5 percent cobbles; slightly effervescent; very strongly alkaline; clear smooth boundary.
- VC6—40 to 52 inches; brown (10YR 5/3) extremely cobbly sandy loam, brown (10YR 4/3) moist; massive; hard, very friable, nonsticky and nonplastic; 35 percent pebbles, 35 percent cobbles, 5 percent stones; slightly effervescent; strongly alkaline.

The solum thickness is 5 to 10 inches. Reaction ranges from neutral to very strongly alkaline throughout the profile.

The control section (between depths of 10 inches and 40 inches) averages sandy loam or loam. It is 8 to 18 percent clay. When mixed, it is 35 to 70 percent rock fragments.

Trosi Series

The Trosi series consists of shallow, well drained soils on terraces and alluvial fans. These soils formed in alluvium derived from mixed but predominantly basic volcanic rock. Slopes are 4 to 8 percent.

Typical pedon of Trosi very stony sandy loam, in an area of Barnard-Trosi association, 660 feet west and 760 feet south of the northeast corner of sec. 31, T. 21 N., R. 18 E.

- A11—0 to 1 inch; light brownish gray (10YR 6/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial and tubular pores; 40 percent pebbles, 5 percent stones; neutral; clear smooth boundary.
- A12—1 to 7 inches; light brownish gray (10YR 6/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; 20 percent pebbles; neutral; clear smooth boundary.
- A13—7 to 12 inches; pale brown (10YR 6/3) very gravelly loam, dark yellowish brown (10YR 3/4) moist; massive; hard, very friable, sticky and plastic;

few very fine to medium roots; common very fine and fine tubular pores; 25 percent pebbles, 10 percent cobbles; slightly acid; gradual smooth boundary.

- B2t—12 to 19 inches; brown (10YR 5/3) very cobbly heavy clay loam, dark brown (10YR 4/3) moist; massive; very hard, firm, sticky and plastic; few very fine through coarse roots; common very fine and fine tubular pores; 20 percent pebbles, 15 percent cobbles, 1 percent stones; common thin and moderately thick clay films in pores and bridging sand grains; slightly acid; abrupt smooth boundary.
- IIC1sim—19 to 34 inches; indurated hardpan.
- IIC2—34 to 60 inches; stratified, consolidated sedimentary deposits.

The thickness of the solum and depth to the strongly silica-cemented hardpan range from 12 to 20 inches. Reaction throughout the profile is slightly acid or neutral. The Bt horizon is heavy clay loam or clay. It is 35 to 50 percent clay and 35 to 50 percent rock fragments.

Truckee Series

The Truckee series consists of very deep, somewhat poorly drained and poorly drained soils on flood plains. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Truckee silt loam, 75 feet east and 625 feet south of the northwest corner of sec. 21, T. 19 N., R. 20 E.

- O1—3 inches to 0; dark grayish brown (10YR 4/2) sod, dark brown (10YR 3/3) moist; very strongly calcareous; abrupt wavy boundary.
- A11—0 to 3 inches; gray (10YR 5/1) loam, black (10YR 2/1) moist; massive; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; very strongly calcareous; moderately alkaline; clear smooth boundary.
- A12—3 to 12 inches; grayish brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; very strongly calcareous; moderately alkaline; abrupt smooth boundary.
- C1—12 to 15 inches; light brownish gray (10YR 6/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable to firm, slightly sticky and plastic; roots and pores same as in the A12 horizon; very strongly calcareous; moderately alkaline; abrupt smooth boundary.
- IIA13b—15 to 18 inches; gray (10YR 5/1) heavy silt loam, very dark brown (10YR 2/2) moist; massive; hard, friable to firm, slightly sticky and plastic; roots and pores same as in the C1 horizon; very strongly

calcareous; moderately alkaline; clear smooth boundary.

IIC2—18 to 22 inches; light gray (10YR 6/1) clay loam, very dark grayish brown (10YR 3/2) moist; many coarse faint very dark brown (10YR 2/2) organic stains and few fine faint dark yellowish brown (10YR 4/4) iron mottles; massive; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; strongly calcareous; strongly alkaline; clear smooth boundary.

IIC3—22 to 27 inches; light brownish gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; few fine faint dark yellowish brown (10YR 4/4) iron mottles; massive; slightly hard; friable, slightly sticky and nonplastic; very few very fine roots; many very fine tubular pores; moderately calcareous; moderately alkaline; clear smooth boundary.

IIC4—27 to 31 inches; stratified light gray (10YR 6/1) and gray (10YR 5/1) fine sandy loam, very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) moist; very few fine distinct white (10YR 8/2) lime mottles; massive; slightly hard, very friable, slightly sticky and nonplastic; very few very fine roots; common very fine tubular pores; moderately calcareous; moderately alkaline; abrupt smooth boundary.

IIIA14b—31 to 60 inches; gray (10YR 5/1) clay loam, black (10YR 2/1) moist; weak fine angular blocky structure; hard, friable to firm, sticky and plastic; no roots apparent; common very fine tubular pores; moderately calcareous; moderately alkaline.

The soil profile is deeper than 60 inches. Reaction ranges from moderately alkaline to very strongly alkaline.

The control section (between depths of 10 inches and 40 inches) is stratified loam, clay loam, silt loam, or fine sandy loam. It is 20 to 35 percent clay.

Iron mottling is common in the profile. Some pedons are gleyed below 36 inches.

Turria Series

The Turria series consists of very deep, well drained soils on alluvial fans and low terraces. These soils formed in alluvium from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Turria loam, 1,000 feet north and 1,000 feet east of the southwest corner of sec. 11, T. 22 N., R. 19 E.

A1—0 to 2 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; moderate thick platy structure; soft, very friable, slightly sticky and nonplastic; few very fine roots; many very fine and fine vesicular and common very fine interstitial pores; neutral; abrupt smooth boundary.

B1t—2 to 5 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine and fine roots; many very fine interstitial and common very fine vesicular and tubular pores; many thin clay films on ped faces and in pores; neutral; abrupt smooth boundary.

B2t—5 to 8 inches; pale brown (10YR 6/3) crushed clay loam, dark brown (10YR 3/3) moist; moderate fine prismatic structure parting to moderate medium subangular blocky; hard, very friable, sticky and plastic; common very fine and fine roots; common very fine tubular pores; common moderately thick and common thin clay films on ped faces and in pores; neutral; clear smooth boundary.

B3t—8 to 12 inches; pale brown (10YR 6/3) crushed loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine and fine roots; few very fine interstitial and common very fine tubular pores; common thin clay films on ped faces and in pores; neutral; clear smooth boundary.

C1—12 to 25 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine interstitial pores; 15 percent weakly silica-cemented durinodes; neutral; gradual smooth boundary.

IIC2—25 to 45 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; massive; very hard, friable, slightly sticky and nonplastic; very few roots; few very fine interstitial pores; 15 percent weakly silica-cemented durinodes; slightly effervescent; mildly alkaline; clear wavy boundary.

IIC3—45 to 67 inches; pale brown (10YR 6/3) stratified gravelly sandy loam and gravelly loamy sand, dark brown (10YR 3/3) moist; massive; loose, nonsticky and nonplastic; very few roots; many very fine and fine interstitial pores; 20 percent pebbles; mildly alkaline.

Solum thickness is 12 to 20 inches. Reaction throughout the profile is slightly acid to mildly alkaline. The B2t horizon is loam or clay loam and is 25 to 35 percent clay.

Updike Series

The Updike series consists of very deep, moderately well drained soils on low-lying, concave lake terraces. These soils formed in valley fill material from mixed but predominantly granodiorite sources. Slopes are 0 to 2 percent.

Typical pedon of Updike loam, 2,200 feet east and 1,400 feet north of the southwest corner of sec. 23, T. 21 N., R. 19 E.

- A1—0 to 2 inches; light gray (10YR 7/2) loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; many very fine and fine tubular and vesicular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- B21t—2 to 6 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; strong fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; common very fine tubular pores; many thin clay films on ped faces and in pores; finely segregated lime; strongly effervescent; very strongly alkaline; clear smooth boundary.
- B22t—6 to 11 inches; light gray (10YR 7/2) clay, brown (10YR 5/3) moist; strong fine and medium prismatic structure; very hard, firm, very sticky and very plastic; few fine and medium roots; common very fine tubular pores; many moderately thick clay films on ped faces and in pores; segregated lime; strongly effervescent; very strongly alkaline; clear smooth boundary.
- B3—11 to 20 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak medium prismatic structure; very hard, firm, very sticky and very plastic; common few fine roots; common very fine tubular pores; many thin clay films in pores and bridges; violently effervescent; very strongly alkaline; clear wavy boundary.
- C1—20 to 36 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few thin strata of light brownish gray (2.5Y 6/2); strong fine prismatic structure; hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; violently effervescent; very strongly alkaline; clear wavy boundary.
- IIC2—36 to 47 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; pockets of light yellowish brown (10YR 6/4) sand, yellowish brown (10YR 5/4) moist; massive; hard, friable, sticky and plastic; common very fine tubular pores; violently effervescent; very strongly alkaline; abrupt wavy boundary.
- IIIC3—47 to 63 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine prismatic structure; hard, firm, very sticky and very plastic; common very fine tubular pores; violently effervescent; very strongly alkaline.

Solum thickness is 15 to 30 inches. Reaction ranges from moderately alkaline to very strongly alkaline. The B2t horizon is clay or sandy clay. It is 35 to 50 percent clay. The IIC2 and IIIC3 horizons range from very gravelly sand to clay.

Vamp Series

The Vamp series consists of moderately deep, somewhat poorly drained soils on flood plains and low terraces. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Vamp silt loam, strongly saline-alkali, 2,590 feet east and 250 feet north of the southwest corner of sec. 29, T. 19 N., R. 20 E.

- A1—0 to 3 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure; slightly hard, friable, nonsticky and nonplastic; common very fine to medium roots; common fine and very fine tubular and many very fine interstitial pores; moderately alkaline; clear smooth boundary.
- C1—3 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; slightly effervescent; very strongly alkaline; clear smooth boundary.
- IIA1b—10 to 15 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; strongly effervescent; very strongly alkaline; clear smooth boundary.
- IIC2—15 to 30 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; slightly effervescent; very strongly alkaline; clear smooth boundary.
- IIC3—30 to 36 inches; light brownish gray (10YR 6/2) loam, brown (10YR 4/3) moist; common fine distinct dark grayish brown (2.5Y 4/2) mottles; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular and many very fine interstitial pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.
- IIC4sicam—36 to 42 inches; light brownish gray (10YR 6/2), strongly silica-cemented duripan, dark grayish brown (2.5Y 4/2) moist; massive; very hard, extremely firm; strongly effervescent; strongly alkaline; clear smooth boundary.
- IIC5—42 to 60 inches; yellowish brown (10YR 5/4) and light olive gray (5Y 6/2) stratified loam, sandy loam, and loamy sand, dark yellowish brown (10YR 4/4) and olive gray (5Y 4/2) moist; massive; slightly sticky and slightly plastic; strongly alkaline.

The depth to the strongly silica-cemented duripan ranges from 20 to 40 inches. Reaction ranges from moderately alkaline to very strongly alkaline throughout

the profile. The control section is silt loam, fine sandy loam, very fine sandy loam, and loam. It is 12 to 18 percent clay.

Verdico Series

The Verdico series consists of moderately deep, well drained soils on strath terraces and pediments. These soils formed in residuum mainly of lacustrine sedimentary rock. Slopes are 4 to 30 percent.

Typical pedon of Verdico extremely stony sandy loam, 15 to 30 percent slopes, 200 feet east and 2,200 feet north of the southwest corner of sec. 27, T. 19 N., R. 19 E.

A1—0 to 2 inches; pale brown (10YR 6/3) extremely stony sandy loam, brown (10YR 4/3) moist; weak medium platy structure; soft, very friable, slightly sticky and slightly plastic; few fine pores; common medium vesicular pores; 15 percent pebbles, 15 percent cobbles, 15 percent stones; slightly acid; abrupt smooth boundary.

B21t—2 to 15 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; strong medium prismatic structure; extremely hard, very firm, very sticky and very plastic; common very fine to medium roots; few fine tubular pores; continuous thick clay films on pressure faces; 5 percent pebbles, 5 percent cobbles; neutral; clear wavy boundary.

IIB22t—15 to 22 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure; very hard, very firm, sticky and plastic; few fine and common medium roots; few fine tubular pores; continuous thick clay films on ped faces; 10 percent gravel; neutral; gradual wavy boundary.

IIIC1—22 to 29 inches; light yellowish brown (10YR 6/4) gravelly clay, yellowish brown (10YR 5/4) moist; massive; very hard, very firm, sticky, plastic; few fine and medium roots; few fine tubular pores; few moderately thick clay films; 25 percent pebbles; mildly alkaline; gradual wavy boundary.

IIIC2r—29 to 60 inches; highly weathered, water-laid tuff with some discontinuous lime and silica in fractures.

The solum ranges from 20 to 30 inches in thickness. Reaction ranges from slightly acid to moderately alkaline throughout the profile. The Bt horizon is clay. It is 45 to 60 percent clay and 0 to 10 percent pebbles.

Verdico Variant

The Verdico Variant consists of moderately deep, well drained soils on uplands and pediments. These soils formed in material weathered mainly from granodiorite. Slopes are 8 to 30 percent.

Typical pedon of Verdico Variant stony sandy loam, 8 to 15 percent slopes, 1,400 feet west and 2,500 feet north of the southeast corner of sec. 8, T. 20 N., R. 20 E.

Pebbles cover about 75 percent of the surface; cobbles, 1 to 5 percent; and stones, 1 percent. About 1 percent of the surface is granodiorite Rock outcrop.

A11—0 to 2 inches; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; 60 percent pebbles, 5 percent cobbles, 1 percent stones; neutral; abrupt wavy boundary.

A12—2 to 5 inches; light gray (10YR 7/2) gravelly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine and fine vesicular pores; 20 percent gravel; neutral; abrupt wavy boundary.

A&B—5 to 12 inches; brown (10YR 5/3) gravelly clay loam, dark brown (7.5YR 3/2) moist; weak very fine subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; few very fine and fine tubular pores; few thin clay films in pores; 15 percent pebbles; neutral; abrupt wavy boundary.

B2t—12 to 21 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; strong coarse prismatic structure; very hard, firm, very sticky and very plastic; common very fine exped roots; few very fine tubular pores; few slickensides; neutral; clear wavy boundary.

B3t—21 to 28 inches; brown (7.5YR 5/4) very gravelly clay, dark brown (7.5YR 4/4) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; few very fine tubular pores; many thin clay films on ped faces and in pores; 40 percent pebbles; neutral; clear wavy boundary.

Cr—28 to 30 inches; highly weathered, fractured granodiorite bedrock.

Thickness of the solum and depth to weathered bedrock range from 20 to 30 inches. Reaction ranges from slightly acid to neutral throughout the profile. The Bt horizon is clay or gravelly clay. It is 40 to 50 percent clay and 10 to 35 percent rock fragments.

Voltaire Series

The Voltaire series consists of very deep, poorly drained and very poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 2 percent.

Typical pedon of Voltaire loam, slightly saline, 600 feet east of the northwest corner of sec. 36, T. 16 N., R. 19 E.

Ap—0 to 8 inches; black (10YR 2/1) moist loam; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; strongly alkaline; clear smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) moist clay loam; weak medium subangular blocky structure; hard, friable, sticky and plastic; strongly alkaline; strongly effervescent; clear smooth boundary.

C1—15 to 32 inches; dark grayish brown (2.5Y 4/2) moist silty clay loam with strata of loamy coarse sand; common medium prominent dark yellowish brown (10YR 4/4) and dark gray (5Y 4/1) mottles; massive; friable, slightly sticky and slightly plastic; strongly alkaline; strongly effervescent; gradual smooth boundary.

C2—32 to 60 inches; dark yellowish brown (10YR 4/4) moist silty clay loam with thin strata of fine sandy loam and one stratum of coarse sand at a depth of about 48 inches; many medium prominent strong brown (7.5YR 5/6) mottles; massive; slightly sticky and slightly plastic; moderately alkaline.

The soil profile is deeper than 60 inches. Reaction ranges from mildly alkaline to very strongly alkaline throughout the profile. The control section (between depths of 10 inches and 40 inches) is stratified. It is 35 to 45 percent clay in the upper half, but the average texture is clay loam or silty clay loam that is 27 to 35 percent clay.

Washoe Series

The Washoe series consists of very deep, well drained soils on river terraces and alluvial fans. These soils formed in alluvium derived from mixed rock sources. Slopes are 0 to 15 percent.

Typical pedon of Washoe gravelly sandy loam, 0 to 4 percent slopes, 940 feet east and 1,700 feet south of the northwest corner of sec. 18, T. 19 N., R. 20 E.

A11—0 to 3 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 20 percent pebbles, 10 percent cobbles; slightly acid; clear smooth boundary.

A12—3 to 8 inches; pale brown (10YR 6/3) cobbly sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine and fine roots; many fine and very fine interstitial pores; 15 percent pebbles, 15 percent cobbles; slightly acid; clear smooth boundary.

B1t—8 to 11 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 4/3) moist; weak fine angular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine pores; common thin clay films on faces of peds and in pores; 25 percent pebbles, 10 percent cobbles, 2 percent stones; slightly acid; clear smooth boundary.

B2t—11 to 24 inches; brown (7.5YR 5/4) very gravelly light sandy clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky and slightly plastic; common fine and very fine roots; common fine and very fine pores; common moderately thick clay films in pores and bridging sand grains; 25 percent pebbles, 10 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

B3t—24 to 38 inches; light brown (7.5YR 6/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and very fine pores; few moderately thick clay films coating the coarse fragments; 20 percent pebbles, 10 percent cobbles, 10 percent stones and boulders; neutral; gradual wavy boundary.

C1—38 to 60 inches; light yellowish brown (10YR 6/4) very gravelly loamy coarse sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; very few roots; many very fine interstitial pores; 40 percent pebbles; neutral.

The solum ranges from 32 to 45 inches in thickness. Reaction throughout the profile is slightly acid or neutral.

The control section has an average texture of sandy loam or sandy clay loam. It is 18 to 27 percent clay and 35 to 50 percent rock fragments.

Waspo Series

The Waspo series consists of moderately deep, well drained soils on uplands and side slopes of pediments. These soils formed in sediment derived mainly from tuffaceous materials. Slopes are 2 to 50 percent.

Typical pedon of Waspo clay, 15 to 30 percent slopes, 100 feet east and 660 feet north of the southwest corner of sec. 10, T. 19 N., R. 18 E.

A11—0 to 7 inches; dark grayish brown (10YR 4/2) clay, dark brown (10YR 4/3) moist; moderate medium prismatic structure; extremely hard, very firm, very sticky and very plastic; few medium and coarse roots; few medium and coarse tubular pores; 10 percent pebbles; slightly acid; gradual wavy boundary.

A12—7 to 24 inches; dark grayish brown (10YR 4/2) clay, dark brown (10YR 4/3) moist; moderate coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few medium and coarse

roots; few medium pores; many slickensides close enough to intersect; 10 percent pebbles; slightly acid; gradual wavy boundary.

Cr—24 to 35 inches; light gray, weathered tuff.

Depth to weathered bedrock ranges from 20 to 40 inches. Reaction ranges from slightly acid to mildly alkaline throughout the profile. The control section is clay. It is 45 to 60 percent clay and 5 to 15 percent coarse fragments.

These soils have cracks 1 to 3 centimeters wide that remain open in most years from June to November.

Wedekind Series

The Wedekind series consists of shallow, well drained soils on uplands. These soils formed in residuum mainly of volcanic rocks. Slopes are 8 to 50 percent.

Typical pedon of Wedekind gravelly loam, 15 to 30 percent slopes, 1,300 feet east and 1,200 feet south of the northwest corner of sec. 14, T. 20 N., R. 19 E.

About 30 percent of the surface is covered with gravel.

A1—0 to 2 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; 30 percent fine pebbles; slightly acid; abrupt wavy boundary.

B1t—2 to 6 inches; brown (10YR 5/3) coarse sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and few fine tubular pores; neutral; abrupt wavy boundary.

B2t—6 to 14 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine interstitial and few very fine tubular pores; few thin clay films bridging sand grains; neutral; abrupt irregular boundary.

Cr—14 to 20 inches; strong brown (7.5YR 5/6), extremely weathered andesite, fractured and plugged with clay; dark brown (7.5YR 3/2) moist; massive; few very fine roots in cracks.

Solum thickness and depth to paralithic contact to weathered bedrock are 10 to 20 inches. Reaction ranges from slightly acid to neutral throughout the profile. The B2t horizon is sandy clay loam or clay loam. It is 22 to 32 percent clay and 5 to 35 percent rock fragments.

Wedertz Series

The Wedertz series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in alluvium derived from mixed rock sources. Slopes are 2 to 8 percent.

Typical pedon of Wedertz sandy loam, 2 to 4 percent slopes, 200 feet west and 2,550 feet south of the northeast corner of sec. 3, T. 20 N., R. 20 E.

A1—0 to 1 inch; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine interstitial pores; 20 percent pebbles; slightly acid; abrupt smooth boundary.

A2—1 to 6 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; moderate thick platy structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine vesicular pores; slightly acid; abrupt wavy boundary.

B2t—6 to 11 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common very fine to medium roots; common very fine to medium tubular pores; common thin clay films on ped faces, in pores, and bridging sand grains; neutral; clear wavy boundary.

B3t—11 to 17 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; common fine roots; common fine tubular pores; common thin clay films in pores and bridging sand grains; neutral; clear wavy boundary.

C1—17 to 22 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; very hard, friable, sticky and plastic; very few roots; very few tubular pores; neutral; abrupt smooth boundary.

C2si—22 to 34 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; massive; friable to firm, slightly sticky and slightly plastic; continuous weak silica cementation with 25 percent firm and very hard durinodes; very few roots; many very fine interstitial pores; neutral; clear wavy boundary.

C3—34 to 50 inches; pale brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; very few roots; very few pores; 30 percent fine gravel; neutral.

Thickness of the solum to the weakly cemented horizon ranges from 20 to 35 inches. Reaction is slightly acid or neutral throughout the profile.

The control section has an average texture of sandy clay loam or clay loam. It is 20 to 30 percent clay.

Witefels Series

The Witefels series consists of moderately deep, somewhat excessively drained soils on upland slopes. These soils formed in weathered material derived mainly from acid igneous rocks. Slopes are 15 to 70 percent.

Typical pedon of Witefels coarse sand, in an area of Witefels-Rock outcrop complex, 15 to 30 percent slopes, 2,640 feet east and 2,000 feet south of the northeast corner of sec. 3, T. 16 N., R. 19 E.

O1—1 inch to 0; fir needle duff.

A11—0 to 3 inches; dark grayish brown (10YR 4/2) coarse sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many very fine and fine pores; 5 percent pebbles; medium acid; clear wavy boundary.

A12—3 to 8 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and few medium and coarse roots; many very fine and fine interstitial pores; 20 percent pebbles; medium acid; clear wavy boundary.

AC—8 to 13 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium and coarse roots; many very fine and fine interstitial pores; 25 percent pebbles; medium acid; clear wavy boundary.

C1—13 to 25 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and few medium and coarse roots; many fine and very fine interstitial pores; 25 percent pebbles; medium acid; clear wavy boundary.

C2—25 to 35 inches; light gray (10YR 7/2) gravelly coarse sand, brown (10YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; very few roots; many very fine and fine interstitial pores; 30 percent pebbles; medium acid; clear wavy boundary.

C3r—35 to 45 inches; granitic gruss with rock structure that lacks roots.

The depth to the gruss ranges from 20 to 40 inches. Reaction ranges from strongly acid to slightly acid throughout the profile.

The control section is loamy coarse sand, loamy sand, or sand. It is 3 to 10 percent clay and is 15 to 30 percent rock fragments.

Wrango Series

The Wrango series consists of very deep, excessively drained soils on alluvial fans. These soils formed in alluvium from mixed rock sources. Slopes are 4 to 8 percent.

Typical pedon of Wrango gravelly loamy sand, in an area of Wrango-Ruhe complex, 4 to 8 percent slopes, 2,800 feet east and 600 feet south of the northwest corner of sec. 31, T. 24 N., R. 22 E.

A1—0 to 2 inches; pale brown (10YR 6/3) gravelly loamy sand, dark brown (10YR 3/3) moist; single grained; loose, nonsticky and nonplastic; few very fine roots; many very fine and fine interstitial pores; 30 percent gravel; mildly alkaline; clear smooth boundary.

C1—2 to 8 inches; pale brown (10YR 6/3) gravelly sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine through coarse roots; many very fine and fine interstitial pores; 25 percent gravel; mildly alkaline; abrupt smooth boundary.

IIC2ca—8 to 60 inches; light gray (10YR 7/2), stratified extremely gravelly sand and very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine through coarse roots; many very fine and fine interstitial pores; 60 percent pebbles, 5 percent cobbles; moderately alkaline.

Depth to nonconforming very gravelly loamy sand ranges from 6 to 10 inches. Reaction throughout the profile is mildly alkaline to moderately alkaline. The control section is loamy coarse sand or sand. It is 0 to 8 percent clay and 60 to 75 percent rock fragments.

Xman Series

The Xman series consists of shallow, well drained soils on uplands. These soils formed in residuum derived mainly from altered volcanic rocks. Slopes are 4 to 50 percent.

Typical pedon of Xman very stony loam, 15 to 30 percent slopes, 1,320 feet west and 1,320 feet north of the southeast corner of sec. 29, T. 20 N., R. 20 E.

A1—0 to 2 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine interstitial pores; 20 percent pebbles, 5 percent stones; neutral; abrupt smooth boundary.

B21t—2 to 4 inches; brown (7.5YR 4/4) light clay, dark yellowish brown (10YR 4/4) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; many fine and very fine roots; many fine and very fine tubular pores; common moderately thick clay films on ped faces and in pores; neutral; clear smooth boundary.

B22t—4 to 11 inches; brown (7.5YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; strong fine and medium prismatic structure that parts to subangular blocky; firm, sticky and very plastic; many fine and very fine exped roots; few fine and very fine tubular pores; many moderately thick clay films on clay faces and in pores; neutral; clear wavy boundary.

B3t—11 to 14 inches; yellowish brown (10YR 5/4) gravelly clay, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; firm, sticky and plastic; common very fine exped roots; very few pores; common moderately thick clay films on ped faces; 20 percent gravel (decomposing rhyolite); moderately alkaline; abrupt smooth boundary.

Cr—14 to 29 inches; weathered rhyolite; chains of lime in spots with discontinuous silica coatings; becomes hard at 29 inches.

The solum thickness and depth to weathered bedrock range from 10 to 20 inches, and the depth to hard bedrock ranges from 20 to 40 inches. Reaction ranges from slightly acid to moderately alkaline throughout the profile. The Bt horizon is clay or gravelly clay. It is 40 to 50 percent clay and 0 to 30 percent gravel.

Yuko Series

The Yuko series consists of shallow, well drained soils on uplands. These soils formed in residuum mainly of volcanic rock. The slope is 15 to 50 percent.

Typical pedon of Yuko stony loam, 15 to 30 percent slopes, 500 feet east and 1,100 feet north of the southwest corner of sec. 13, T. 20 N., R. 19 E.

Pebbles cover about 10 percent of the surface; cobbles, 1 to 2 percent; and stones, 2 to 3 percent. The surface is about 1 to 2 percent andesite rock outcrop.

A1—0 to 2 inches; brown (10YR 5/3) stony loam, dark brown (10YR 3/3) moist; massive; soft, friable, nonsticky and nonplastic; many very fine and fine vesicular pores; neutral; abrupt wavy boundary.

B2t—2 to 8 inches; yellowish brown (10YR 5/6) silty clay loam, dark yellowish brown (10YR 4/4) moist; strong very fine subangular blocky structure; hard, friable, sticky and plastic; common very fine to medium roots; few fine tubular pores; many thin clay films on ped faces and in pores; neutral; abrupt irregular boundary.

Cr—8 to 40 inches; strong brown (7.5YR 5/6) highly weathered andesite bedrock, dark brown (7.5YR 3/2) moist; massive; fractured; common very fine roots in fractures; clay in fractures.

The solum thickness and the depth to weathered bedrock are 6 to 14 inches. Reaction ranges from slightly acid to mildly alkaline throughout the profile. The B2t horizon is dominantly silty clay loam. It includes clay loam or sandy clay loam. It is 32 to 35 percent clay.

Zephan Series

The Zephan series consists of moderately deep, well drained soils on uplands. These soils formed in residuum and colluvium derived mainly from rhyolite and andesite. Slopes are 15 to 50 percent.

Typical pedon of Zephan stony sandy loam, 15 to 30 percent slopes, 1,700 feet east and 2,300 feet south of the northwest corner of sec. 23, T. 20 N., R. 19 E.

A11—0 to 2 inches; brown (10YR 5/3) stony sandy loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine to medium roots; many very fine to medium pores; 20 percent pebbles, 5 percent cobbles, 2 percent stones; medium acid; clear smooth boundary.

A12—2 to 8 inches; pale brown (10YR 6/3) gravelly loam, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores; 25 percent pebbles; medium acid; clear smooth boundary.

B1—8 to 11 inches; light yellowish brown (10YR 6/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; friable, sticky and slightly plastic; common fine and very fine roots; common fine and very fine pores; few thin clay films on ped faces; 15 percent pebbles; slightly acid; clear wavy boundary.

B1t—11 to 26 inches; brown (7.5YR 5/4) very cobbly clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; firm, sticky and plastic; few medium and coarse roots; few medium tubular pores; common moderately thick clay films on ped faces; 40 percent decomposing rock fragments; slightly acid; clear wavy boundary.

Bt—26 to 35 inches; brown (7.5YR 5/4) very cobbly clay, strong brown (7.5YR 5/6) moist; massive; firm, sticky and plastic; very few roots; very few pores; few moderately thick clay films in pores; 60 percent decomposing rock fragments; slightly acid; gradual irregular boundary.

Cr—35 to 42 inches; weathered rhyolite bedrock; hard and very firm grading to very hard and extremely firm; slightly acid; clear wavy boundary.

R—42 inches; hard rhyolite bedrock.

The solum thickness and depth to weathered bedrock range from 25 to 40 inches. Hard bedrock is below a depth of 40 inches. Reaction ranges from slightly acid to strongly acid throughout the profile. The Bt horizon is clay, sandy clay, or heavy clay loam. It is 35 to 45 percent clay and 35 to 60 percent rock fragments.

Formation of the Soils

Soil is a natural body on the earth's surface in which plants grow. It is a mixture of varying proportions of rocks, minerals, organic matter, water, and air. The rocks and minerals are fragmented and are partly or wholly weathered. Soils have distinctive layers, or horizons, that are the product of environmental forces acting upon material deposited or accumulated through geologic activity.

Soils differ one from the other in different localities and within short distances. The differences are the result of the interaction of five soil-forming factors. These factors are (1) climate, mainly temperature and the kind and amount of precipitation, that has existed since accumulation of the parent material; (2) relief, mainly as it affects internal and external soil properties such as drainage, aeration, susceptibility to erosion, and exposure to sun and wind; (3) biological forces, mainly the plant cover and the organisms living in and on the soil; (4) parent material, including the texture and structure of the material as well as its mineral and chemical composition; and (5) the length of time that the soil-forming factors have been operating.

The overall landscape of the area, the sequence of mountains and valleys, is the result of geologic stratigraphic and structural control. The present topography and landforms, however, are the result of events during Quaternary time. The kinds of soil that formed are indicative of the stability and age of the surfaces of the landforms on which they occur.

Climate

The average annual precipitation ranges from about 4 inches at the lowest elevation, in the east near Pyramid Lake, to about 60 inches or more in the west near Mount Rose in the Carson Range. The average annual air temperature ranges from about 52 degrees F. in the eastern part of the area to as low as 38 degrees F. in the high mountain ranges. Major climatic variations are the result of the effects of relief and distance from the Sierra Nevada Mountains. Temperature decreases with elevation. Precipitation increases with elevation but, as a result of the rain shadow effect of the Sierras, the rate of increase is higher in the western than in the eastern part of the survey area. As a consequence, the soils in the survey area reflect a general zonation with respect to elevation and longitudinal location. Because of the rain

shadow effect, the survey area becomes progressively drier toward the east.

In the eastern part of the survey area, the average annual precipitation is about 4 to 8 inches and elevation is 3,800 to 7,000 feet. In this arid part of the area, weathering of parent material is slow, leaching is incomplete, and eluviation and illuviation proceed at a very slow rate. The plant cover is sparse and consists mainly of drought- and salt-tolerant shrubs. Typically, the soils are low in content of organic matter and have a thin, light-colored A horizon. Soluble salts and calcium carbonate accumulate in the soil profile at a relatively shallow depth. Typic Camborthids (Toulon series) are typical soils in this arid part of the area.

In the mid part of the survey area, the average annual precipitation is about 8 to 20 inches and elevation is 4,400 to 8,500 feet. At lower elevations (4,400 to 6,500 feet) in this part of the area, the precipitation is 8 to 12 inches. As elevation increases, precipitation increases resulting in deeper leaching of salts and calcium carbonate, decreased reaction, changes in the kind and density of vegetation, and a thicker and darker A horizon. Xerollic Haplargids (Washoe series) are typical soils formed at the lower elevations where precipitation is about 10 inches. Aridic Argixerolls (Cassiro series) are examples of soils that formed at the higher elevations.

At the higher elevations (6,500 to 8,500 feet) in the mid part of the survey area, precipitation is 14 to 20 inches and the temperature is 40 degrees to 45 degrees F. The vegetation is mostly sagebrush with a greater amount of and variation in kinds of grasses. Leaching of salts and carbonates has been more intensive, the soils are neutral or slightly acid, and the A horizon is thick and is high in content of organic matter. Pachic Argixerolls (Softscrabble series) are typical soils.

In the western part of the survey area in the Carson Range, the elevation is 5,600 to 10,000 feet. The average annual precipitation is 16 to 60 inches and the mean annual air temperature is 38 degrees to 45 degrees F. In this area also, as elevation increases precipitation increases and temperature decreases.

Typically, at the lower elevations, where precipitation is lower and temperatures are warmer, the vegetation is mostly mountainmahogany, sagebrush, and perennial grasses. The soils have high base saturation and are neutral or slightly acid. Typic Argixerolls (Ticino series) are examples of soils that have these properties. With an

additional increase in elevation and precipitation, the vegetation changes from shrub-grass to conifer trees. The base saturation of the surface layer decreases; Ultic Argixerolls (Fraval series) are examples of soils that reflect this property. With further increases in elevation and precipitation, leaching increases and the base saturation of the surface layer decreases still more. Mollic Haploxeralfs (Hirschdale series) are examples of soils that reflect this property. At the higher elevations where precipitation is highest, the soils are generally medium acid to strongly acid and have a low base saturation throughout the solum. The Ultic Haploxeralfs (Fugawee series) are typical of these soils.

In winter, freezing and thawing generally occur throughout the survey area, except in those areas that generally are insulated by snow cover. The effects of frost action are discernible in the heaving of plants and the erosion of the surface soil resulting from solifluction. At some higher elevations, freezing and thawing have fractured and displaced the bedrock. Typic Cryorthents (Graylock series), which have sandy-skeletal control sections, are examples of soils at high elevations that have been affected by frost action.

Relief

Relief, through its effects on drainage, runoff, erosion, and exposure to the sun and wind, has had an important effect on soil formation in the survey area. The mountain ranges, valleys, and flood plains reflect the gross variations in relief within the area.

The mountain ranges are mainly characterized by steep relief. Runoff is rapid or very rapid, and the hazard of erosion is high. The removal of material by erosion inhibits or prevents soil development. On unstable mountain surfaces that are subject to a high rate of geologic erosion, development in soils is limited mainly to accumulation of organic matter to form a dark-colored horizon. A cambic or an argillic horizon has formed in the soils on more stable mountain surfaces where the rate of geologic erosion has been slower. Xerollic Haplargids (Xman series), Aridic Argixerolls (Indiano series), and Mollic Haploxeralfs (Hirschdale series) are examples of soils that formed on the more stable mountain slopes and have an argillic horizon. Lithic Torriorthents (Singatse series), Lithic Xeric Torriorthents (Smallcone series), and shallow Typic Cryopsamments (Temo series) are examples of soils on less stable mountain slopes where soil formation has been unable to act on parent material long enough for any of the aforementioned horizons to have developed.

On concave and north-facing slopes, snowpockets form and remain into late spring and early summer. Soils on these slopes support a dense stand of shrubs, grass, and in some places, aspen. The soils in these areas have developed a thick, dark-colored A horizon that has a high content of organic matter. Pachic Argixerolls

(Softscrabble series), Pachic Ultic Argixerolls (Jumbo series), and Argiaquic Argixerolls (Macareeno series) are examples of these soils.

Soils on strongly sloping to steep slopes developed in materials that have resulted from landslides. These soils are very deep, somewhat excessively drained soils with medium to slow runoff. These soils are coarse textured and contain boulders, stones, cobbles, and pebbles. They have not been stable for long periods of time and lack discernible soil development. Typic Xerorthents (Railcity series), which have a sandy-skeletal control section, are examples of soils that formed on a landslide.

The valleys within the survey area are essentially basins that receive drainage water from the surrounding mountain ranges. They are of three general types.

One type, characterized by the Truckee Valley and the Truckee Canyon, consists of a series of terraces cut in Tertiary-Quaternary valley-fill material and steep canyon walls cut from volcanic rock. Stream erosion has deeply dissected the valley fill. Downcutting of the valley has been interrupted several times; these interruptions are marked by the development of terraces. The dissection patterns in this area have resulted in a sloping interfluvial surface, steep interfluvial side slopes, and narrow flood plains along drainageways. The interfluvial areas and side slopes have been relatively stable over a long period of time because drainage water from uplands has bypassed these areas and flowed through dissecting channels. Aridic Argixerolls (Springmeyer series), which have a fine-loamy argillic horizon, and Abruptic Xerollic Durargids (Reno series), which have a clayey argillic horizon, are examples of soils on stable interfluves. Xerollic Haplargids (Stodick series), which have a loamy-skeletal argillic horizon, are examples of soils on steep side slopes. Aquic Xerofluvents (Notus series), which have a sandy-skeletal control section, are examples of soils in drainageways.

The second valley-type is characterized by nearly level alluvial flats bordered by sloping alluvial fans or coalesced fan piedmonts. Lemmon, Warm Springs, and Cold Springs Valleys are typical. Small playas, lakes, or intermittent lakes are located within these valleys. The nearly level alluvial flats (14) are, in a sense, extensions of the alluvial fan slopes. Runoff on these flats is slow, drainage is somewhat restricted, and the soils contain soluble salts. These areas are typified by Xerollic Natragids (Mellor series), which have a fine-silty natric horizon. The gently sloping to strongly sloping alluvial fans bordering basin-fill areas in Lemmon, Warm Springs, and Cold Springs Valleys have a relatively smooth, undissected surface. Soils that formed on these surfaces are well drained. Xerollic Camborthids (Haybourne series) with a coarse-loamy control section, Durixerollic Haplargids (Wedertz series), and Aridic Calcic Argixerolls (Orr Variant) with a fine-loamy argillic horizon are examples of soils on alluvial fans.

The third valley-type, which is characterized by the Pyramid Lake basin, consists of several levels of lake-shore terraces cut by Pleistocene Lake Lahontan. These shore-line features have been covered at many locations by recent alluvial fans. Typic Camborthids (Toulon series) are examples of the soils on lake terraces, and Typic Torriorthents (Bluewing series) are examples of the soils on alluvial fans.

The nearly level flood plains and low terraces along the Truckee River have a high water table and have been subject to flooding. Unless drained, the soils in these areas support dense stands of meadow vegetation that has contributed a large amount of organic matter to the soils, producing a dark-colored A horizon. Some of these soils have excess soluble salts in their upper horizons. Fluvaquent Haplaquolls (Truckee and Voltaire series) and Duric Haplaquolls (Cradlebaugh series) are examples of soils formed on the wet bottomlands.

Biological Forces

Plants, animals, insects, and microflora are important biological forces that affect soil formation. Although animals, such as badgers and ground squirrels, and insects, such as cicadas, have had some effect on soil development, plants appear to have had the major biological influence on the soils in this survey area.

The vegetation in the area has been particularly important in reducing erosion. It has helped to maintain the stability of the land surfaces so that soil formation could take place.

On the flood plains where drainage is restricted, the dense growth of meadow vegetation has supplied the organic matter that gives Fluvaquent Haplaquolls (Voltaire series) and Fluvaquent Haploxerolls (Truckee series) soils a dark-colored A horizon.

Because of climatic differences, the kinds and amounts of plants vary considerably as elevation increases. On alluvial flats, terraces, and alluvial fans at low elevations, especially in the eastern part of the area, the main plants are drought- and salt-tolerant shrubs. Because of the scarcity of available moisture, plants cover only a small part of the surface. They add little organic matter to the soils and provide little protection from the wind and sun. Salt-tolerant shrubs tend to recycle salts from the deeper layers to the surface soil.

Alluvial fans, terraces, and foothills at higher elevations support a plant cover of shrubs and grass that is transitional from desert shrubs.

The central mountainous areas support a denser stand of shrubs, grasses, and in some places, trees. Because the vegetation is more abundant, the A horizon of the soils in these areas is thick, is high in organic matter, and is dark in color.

The mountainous area of the Carson Range supports mostly coniferous forest. The soils that formed under this plant cover have a thin mat of litter and duff one-half

inch to about 3 inches thick. The forest litter is attacked by fungi and other microorganisms. The fungi are particularly effective because of their ability to decompose surface litter where moisture content is low and air circulation is good. They are especially active in acid soils such as those formed under forest cover and contribute to the development of these soils.

Parent Material

Parent material is the weathered rock or unconsolidated material from which soils form. The hardness, grain size, and porosity of the parent material and its mineral and chemical composition greatly influence soil formation.

The main sources of parent material in the survey area are intrusive and extrusive igneous rocks, metamorphic rocks, sedimentary rocks, colluvium, alluvium, and eolian material, including volcanic ash and sand (3).

Of the intrusive igneous rocks, granodiorite and quartz monzonite are the most abundant. These rocks occur mainly in the Carson Range, Peterson Mountains, and Dogskin Mountains; on Hungry Mountain; and on the hills north of Sun Valley. The intrusive rocks contain minerals that weather to clay. Soils formed in materials derived from these kinds of rocks have an argillic horizon if the surfaces of the landforms have been stable for a sufficiently long period of time. Aridic Argixerolls (Acrelane series) and Xerollic Haplargids (Surgem series) are examples of these soils. Soils that formed in material from granitic rock that are on steeper slopes and receive more precipitation generally are eroding. Consequently, they may lack soil development except for some accumulation of organic matter in the A horizon. They are generally sandy and contain rock fragments. Typic Xeropsamments (Toiyabe series) and Typic Cryorthents (Graylock series) are examples of these soils.

The extrusive igneous rocks include basalt, andesite and rhyolite, flow breccias, basaltic andesite, and pyroxene andesite flows. Some of these volcanic rocks occur in all mountain ranges. Because extrusive rocks contain appreciable quantities of minerals that weather to clay, most soils that formed in these materials on stable slopes of mountains and foothills have an argillic horizon. The argillic horizon is generally quite clayey. Typic Argixerolls (Booford series), Aridic Calcic Argixerolls (Arzo series), and Xerollic Haplargids (Xman series) are examples of these soils.

Metamorphic rocks are the source of the parent material in a limited area, mainly on Peavine Mountain, the Virginia Range, Peterson Mountain, and Freds Mountain. Most of these rocks contain minerals that weather to clay. Xerollic Haplargids (Flex series) and Aridic Argixerolls (Koontz and Indiano series) are examples of soils that have an argillic horizon and formed in material derived from metamorphic rocks.

Pliocene sedimentary rocks occur extensively in the Truckee River Valley and Hungry Valley and, less extensively, in Warm Springs Valley. These rocks consist of old alluvial and lakebed deposits containing interbedded volcanic ash, tuff, and some diatomaceous earth. Xerollic Haplargids (Chalco and Verdico series) are examples of soils that formed on stable surfaces in material derived from these rocks. In areas where the protective vegetation has been lost, the soils have been eroded and soft parent rock has been exposed. Badland is a common component of soil map units in areas where erosion has been active in these parent materials.

Colluvium is parent material that has accumulated on steep mountain slopes as a result of gravitational forces. Colluvium generally is poorly sorted and contains many rock fragments. In this survey area, most colluvial landscapes have been stable long enough for a weak argillic horizon to have formed. Typic Haplargids (Fireball series) and Xerollic Haplargids (Hefed series) are examples of soils that formed in colluvial material on stable landscapes.

Alluvium deposited as alluvial fans, alluvial flats, and flood plains consists of sandy, loamy, and clayey material of generally mixed mineralogy that has been eroded from surrounding mountains.

Alluvium from mixed rock sources deposited as alluvial fans is mostly loamy and contains variable amounts of pebbles, cobbles, and stones. It is porous and contains minerals that weathered to produce clay and soluble silica for cementation of duripans. Xerollic Durargids (Trosi series) and Haploxerollic Durargids (Spasprey series) are examples of soils with an argillic horizon and a duripan that formed in alluvium on stable alluvial fans. Alluvium derived from granitic rock usually results in sandy soils that contain various amounts of pebbles, cobbles, and stones. Torriorthentic Haploxerolls (Linhart series) and Torripsammentic Haploxerolls (Mottsville series) are examples of sandy soils formed in granitic alluvium.

Alluvium from mixed rock sources deposited as alluvial flats is silty or clayey and contains soluble salts. The soils that formed in this material typically have a natric horizon. Xerollic Natrargids (Mellor series) that have a fine-silty natric horizon and Xerollic Natrargids (Updike series) that have a clayey natric horizon are typical examples.

Sandy eolian materials are of limited extent in this survey area. They occur mainly as dunes east of Washoe and Pyramid Lakes. Typic Torripsamments (Isolde series) and Xeric Torripsamments (Incy series) have formed in parts of these areas where the parent materials have been stabilized by vegetation.

Time

Time is required for the formation of soils. The amount of time required depends upon the other soil-forming

factors. The thickness and other characteristics of the A and B horizons and other horizons reflect the relative age of soils. The age or strength of expression of the horizons is a reflection of the amount of weathering of parent material resulting from the interaction of moisture, temperature, and biological activity over time.

The soils in this survey area range from a few years to possibly a few hundred thousand years or more in age. This range in age is a major reason for the many kinds of soil in the area.

The interaction of time and other soil-forming factors is not well understood by soil scientists and geologists. Many soil scientists and some geologists think that weathering of parent material and development of soil profiles have been essentially continuous, with little change in rate throughout Quaternary time (11, 12, 15, 18). Recently, however, geologists concerned with differentiating Quaternary deposits have proposed that soil development has not proceeded continuously at the same rate but has taken place intermittently at rapid rates (8, 9, 10, 14).

These geologists have developed a system for mapping soil stratigraphic units that uses weathering profiles as stratigraphic markers to differentiate and correlate Quaternary deposits. This system is based on the assumption that weathering profiles formed as a result of infrequent combinations of climatic factors that induced minimal rates of erosion and deposition and greatly accelerated the rate of chemical weathering.

In spite of these disagreements concerning the relative influences of time and other soil-forming factors, the concept of intermittency of soil formation has been supported by numerous studies and provides a practical basis for discussing the age of soils in the survey area in relation to geologic and climatic units in Quaternary time.

The kinds of subsurface diagnostic horizons and other subsurface diagnostic properties and their strength of expression provide general clues to the age of the soils. Important subsurface diagnostic horizons in soils in the area are argillic, natric, and cambic horizons and horizons exhibiting silica cementation.

In this area, prominent argillic horizons generally occur only in soils that formed mainly during the Pleistocene. This has been established by studies in the Southwest (5, 6) and is further supported in Soil Taxonomy (17). As age increases and other conditions remain constant, argillic horizons become finer in texture, become somewhat thicker, and tend to develop an abrupt upper boundary. Weakly expressed, thin argillic horizons may have formed during very late Pleistocene or early Holocene time.

A natric horizon is a kind of argillic horizon that formed under the influence of a high content of exchangeable sodium. The effect of sodium on the dispersion of clay may tend to accelerate the rate of formation of an argillic horizon. This factor is not believed to be significant, however, except in weakly expressed natric horizons that

formed on Holocene surfaces. Following earlier development as argillic horizons, prominent natric horizons may have developed their present characteristics as a result of sodium supplied in eolian deposits. Transportation and deposition of sodium salts in eolian material are believed to be important present-day processes that affect the physical and chemical properties of soils in the area.

The strength of expression of diagnostic subsurface horizons in the soils in the area indicates a sequence of soils that range in age from present-day (Holocene) to early-late Pleistocene or possibly older.

The youngest soils in the area are those that formed in recently aggraded material or in material recently exposed by erosion. Included among these soils are: Typic Torriorthents (Bluewing and Trocken series), which formed in recent alluvium; Lithic Xeric Torriorthents (Skedaddle series), which formed in material weathered from igneous rocks on upland slopes where erosion has been active; and Torripsamments (Isolde and Incy series), which formed on stabilized sand dunes.

Somewhat older than the youngest soils are soils that formed in alluvium on wet flood plains or on slowly aggrading inset fans and soils on mountain slopes that have relatively recently eroded. These soils have been stable long enough to have accumulated organic matter and formed a dark-colored A horizon. They do not have an argillic, natric, or cambic horizon, a duripan, or durinodes. They are probably less than about 1,000 years old. Typic Haplaquolls (Jubilee series) and Fluvaquent Haploxerolls (Truckee series) are examples of soils that formed on wet flood plains. Torriorthentic Haploxerolls (Linhart series) are examples of soils that formed on slowly aggrading alluvial fans. Entic Haploxerolls (Haypress series) are examples of soils that formed on steep mountain slopes.

Soils that formed in alluvium and have either subsurface horizons containing durinodes or horizons with very weak silica cementation are also older than the youngest soils and possibly are slightly older than the soils that have a dark-colored A horizon as their only major diagnostic feature. These soils are on alluvial flats and low stream terraces and formed in saline and alkali parent material containing an appreciable amount of volcanic ash. The presence of volcanic ash as a source of soluble silica with alkaline reaction probably contributes to relatively rapid formation of durinodes and incipient silica cementation. Duric Haplaquolls (Cradlebaugh series) and Aquentic Durorthids (Vamp series) are examples of soils that have horizons with incipient silica cementation as a major diagnostic feature.

Stable Holocene land surfaces less than about 10,000 years and more than about 2,000 years old are not extensive in the survey area. The soils that formed on these surfaces have a cambic horizon. Xerollic Camborthids (Haybourne series) and Aridic Haploxerolls (Surprise series) have a cambic horizon and formed on

alluvial fans. Typic Camborthids (Toulon series) that formed on the shore-line deposits of Pleistocene Lake Lahontan also have a cambic horizon.

Members of about 85 series, more than 50 percent of the soils series mapped in the survey area, have a relict argillic horizon and are believed to be of late-Pleistocene age. These soils occur extensively on mountains, foothills, alluvial fans, and terraces. The existence of extensive areas of these kinds of soils is evidence that major erosional and depositional events have not occurred or have been minor in extent since late Pleistocene time.

Late Pleistocene time is the time period from approximately 10,000 to 250,000 years before present time (13). For purposes of discussion, this time period is separated into latest Pleistocene or earliest Holocene, late-late Pleistocene, mid-late Pleistocene, and early-late Pleistocene.

Stable latest Pleistocene or earliest Holocene land surfaces are not believed to be extensive in this area. Soils that formed on these surfaces have a thin, weak or minimal argillic or natric horizon. Xerollic Haplargids (Flex series), which have a loamy-skeletal argillic horizon underlain by bedrock at a depth of less than 14 inches, are an example of a soil of this age that formed on mountain slopes. Typic Haplargids (Fireball series) and Xerollic Haplargids (Hefed series), which have a thin loamy-skeletal argillic horizon, are examples that formed in colluvium on foothills and mountains. Xeralfic Haplargids (Kayo series), which have a weak loamy-skeletal argillic horizon, are examples of soils formed on alluvial fans. Xerollic Natrargids (Mellor series), which have a minimal fine-silty natric horizon, are examples of soils formed on low terraces or alluvial flats.

Stable late-late Pleistocene land surfaces are very extensive in the survey area. Xerollic Haplargids (Yuko series), which have a relatively thin loamy (silty clay loam) argillic horizon less than 20 inches thick over bedrock, are examples of soils of this age that formed on foothills. Aridic Argixerolls (Indiano series) and Ultic Haploxeralfs (Fraval series), which have a loamy-skeletal argillic horizon, are examples of soils that formed on mountain slopes. Duric Haplargids (Aladshi series) and Aridic Argixerolls (Orr series), which have a fine-loamy argillic horizon, are examples of soils of this age that formed on alluvial fans and terraces. Aridic Argixerolls (Oest series), which have a loamy-skeletal argillic horizon that is 18 to 25 percent clay, occur on lower terraces of the Truckee River and have been correlated with late-late Pleistocene age (7). Xerollic Haplargids (Stodick series), which have a loamy-skeletal argillic horizon over soft bedrock, formed on side slopes of pediments. These surfaces are believed to have been stable since the last active erosion took place during late-late Pleistocene.

Stable mid-late Pleistocene land surfaces are also extensive. Xerollic Haplargids (Surgem series), which

have a clayey-skeletal argillic horizon formed in granitic residuum, and Xerollic Haplargids (Risley series) and Aridic Argixerolls (Cagle series), which have a clayey argillic horizon and formed in volcanic residuum, are examples of soils of mid-late Pleistocene age on foothills. Typic Argixerolls (Booford series) and Mollic Haploxerafals (Hirschdale series), which have a clayey argillic horizon, are examples of these kinds of soils formed on mountain slopes. Xerollic Haplargids (Greenbrae series), which have a fine-loamy argillic horizon, are examples of soils of this age on alluvial fans and terraces. Aridic Argixerolls (Leviathan series), which contain a thick argillic horizon and are on high terraces

along the Truckee River, have been correlated with a mid-late Pleistocene age (7).

Stable early-late Pleistocene or possibly older land surfaces are generally limited to dissected alluvial fan remnants, terrace remnants, and pediment surfaces cut in soft Tertiary rock. Aridic Durixerolls (Bernard series) and Abruptic Xerollic Durargids (Reno series), which have a thick clayey argillic horizon and a thick duripan, formed on these old alluvial fan or terrace remnant surfaces. Xerollic Paleargids (Verdico series), which have a thick clayey argillic horizon that is 45 to 60 percent clay, formed on pediment surfaces.

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Glossary

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

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

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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

Animal-unit-month. The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	<i>Inches</i>
Very low.....	0 to 3.5
Low.....	3.5 to 5
Moderate.....	5 to 7.5
High.....	more than 7.5
Very high.....	More than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from

25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

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

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

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

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

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

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Component landform. Commonly, a small landform that makes up part of the area of a major landform and was created by partial dissection of, or by alluvial or eolian accretion on that larger, major landform. A component landform is about the smallest landform that can be usefully conceived of as a single unit. Its morphological parts are landform elements, and the sideslope element may be subdivided into slope components (13).

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

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

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

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

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons.

Well drained soils are commonly medium textured. They are mainly free of mottling.

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

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

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

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

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the

building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion. *Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fast intake (in tables). The rapid movement of water into the soil.

Fan apron. A component landform consisting of a sheet-like mantle of relatively young alluvium covering part of an older fan piedmont (and occasionally alluvial fan) surface. It somewhere buries a pedogenic soil that can be traced to the edge of the fan apron, where the soil emerges as the land surface, or relict soil. No buried soils occur within a fan-apron mantle; rather, they separate mantles (13).

Fan collar. A component landform consisting of a thin, short, relatively young mantle of alluvium along the very upper margin of a major alluvial fan at a mountain front. The mantle somewhere buries a pedogenic soil that can be traced to the edge of the fan collar where it emerges as the land surface, or relict soil (13).

Fan remnant. A generic term for component landforms that are the remaining parts of various older fan landforms that have been either dissected (erosional fan remnants) or partly buried (nonburied fan remnants). Erosional fan remnants must have a flattish summit of relict fan surface; nonburied fan remnants are all relict fan surface. Fan remnants may be specifically identified—for example, fan-piedmont remnants and inset-fan remnants (13).

Fan skirt. A major landform consisting of laterally coalescing, small alluvial fans that issue from gullies that are cut into, or that are extensions of, inset fans of the fan piedmont and that merge along their toe slopes with the basin floor. Fan skirts are smooth or only slightly dissected and ordinarily do not comprise component landforms (14).

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when

light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Frost heaving. Upward movement of soil caused by freezing and thawing of free water in the soil.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced

by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

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

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

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

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

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

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow

over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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

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

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

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

Inset fan. A flood plain of a commonly ephemeral stream that is confined between fan remnants, basin-floor remnants, ballenas, or closely opposed fan toe slopes. Its transversely-level cross section is evidence of alluviation of a fluve. It must be wide enough that raw channels cover only a fraction of this component landform's surface (14).

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

Less than 0.2.....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low
0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5.....	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

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

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

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

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

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

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

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

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

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

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

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

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

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that

water moves downward through the saturated soil. Terms describing permeability are:

Very slow.....	less than 0.06 inch
Slow.....	0.06 to 0.20 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate.....	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches
Rapid.....	6.0 to 20 inches
Very rapid.....	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of

species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	<i>pH</i>
Extremely acid.....	Below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

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

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

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

types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

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

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

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

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

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

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

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

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Snow pockets. Concave areas where snow accumulates and remains for longer periods than in adjacent areas.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $\text{Ca}^{++} + \text{Mg}^{++}$. The degrees of sodicity are—

	SAR
Slight.....	Less than 13:1
Moderate.....	13-30:1
Strong.....	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millime- ters
Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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

Subsolling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

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

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tillth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated

regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

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

changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

