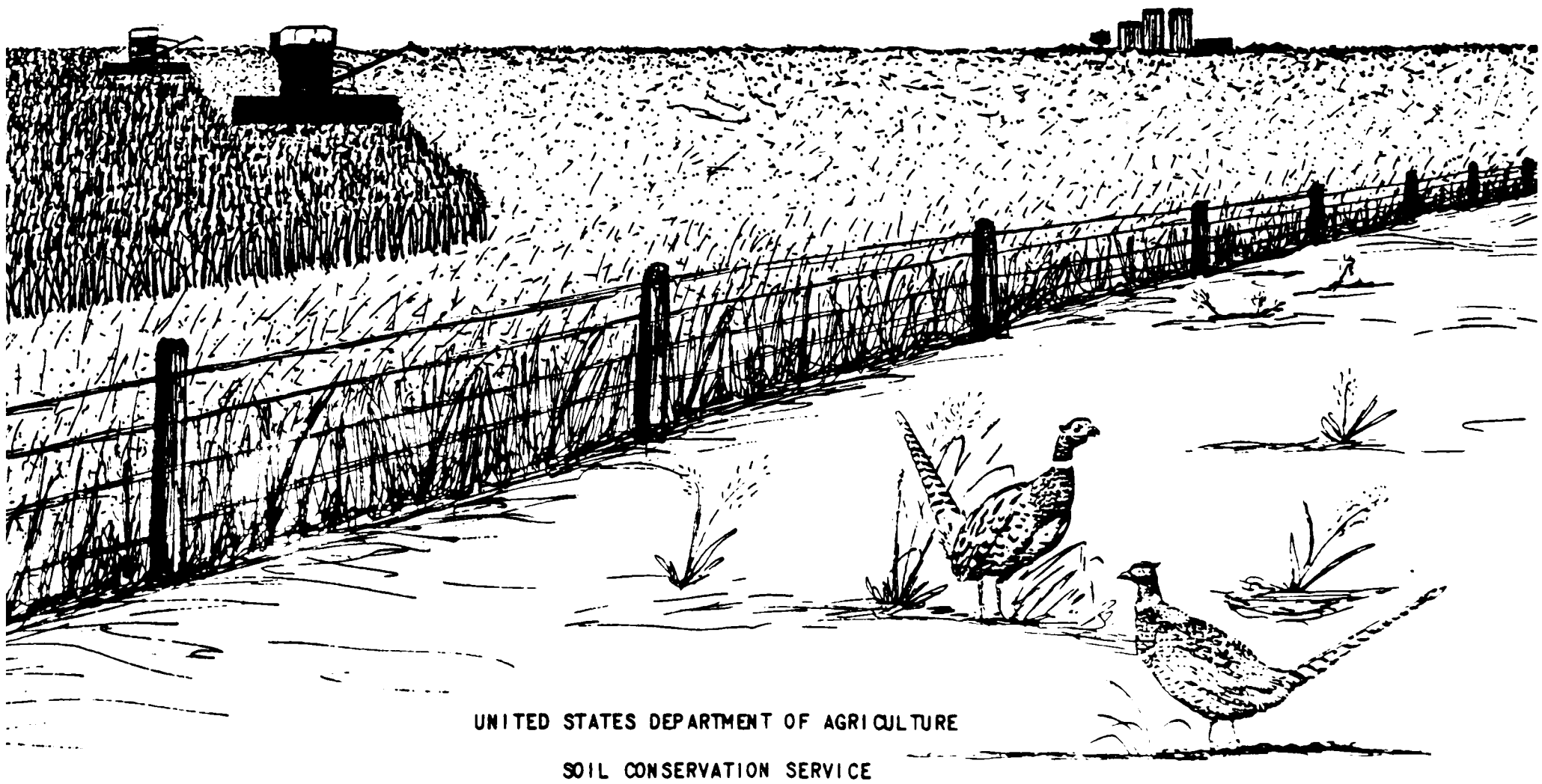
Supplement

to the

SOIL SURVEY

OF

ARMSTRONG COUNTY, TEXAS



UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

SUPPLEMENT TO THE SOIL SURVEY OF ARMSTRONG COUNTY, TEXAS

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SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

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Yields Per Acre

The per acre average yields that can be expected of the principal crops under a high level of management are shown in table B. In any given year, yields may be higher or lower than those indicated in table B because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

Table B. -- Yields per acre of crops

The predicted yields are based mainly on the experience and records of farmers, conservationists and extension agents. Results of field trails and demonstrations and available yield data from nearby counties were also considered.

The latest soil and crop management practice used by many farmers in the county are assumed in predicting the yields. A few farmers may be using more advanced practices and are obtaining average yields higher than those shown in table B.

The management needed to achieve the indicated yields of the various crops depends upon the kind of soil and the crop. Such management provides drainage, erosion control and

TABLE 8.--YIELDS PER ACRE OF CROPS

[Yields in columns N are for nonirrigated soils; those in cclumns I are for irrigated soils. All yields were estimated for a high level of management in 19 . Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Wheat		Grain sorghum		Corn	
	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu
AbA---- Abilene	25	60	35	115	---	140
AbB---- Abilene	25	60	30	110	---	---
BFD, BMD---- Berthoud	---	---	---	---	---	---
BO---- Berthoud	---	---	---	---	---	---
BpB---- Bippus	15	45	20	100	---	140
BrA*---- Bippus	18	60	25	110	---	160
BrB---- Bippus	16	50	20	100	---	140
BaC---- Bippus	14	40	15	80	---	---
Gr**---- Gravelly broken land	---	---	---	---	---	---
Lk---- Likes	---	---	---	---	---	---
La**---- Loamy alluvial land	---	---	---	---	---	---
Lo---- Lofton	15	55	20	140	---	150
MaB---- Mansker	12	25	20	55	---	---
MkB---- Mansker	12	25	18	50	---	---
MkC, MkC2---- Mansker	10	20	14	40	---	---
MsA---- Miles	20	50	35	85	---	---
MsB---- Miles	20	45	30	75	---	---
MsC---- Miles	15	35	25	60	---	---
OcA---- Olton	16	60	20	115	---	150
OcB---- Olton	14	50	15	100	---	130
OcC---- Olton	10	35	12	80	---	---

See footnote at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Wheat		Grain sorghum		Corn	
	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu
Ps---------- Potter	---	---	---	---	---	---
PuA---------- Pullman	15	60	20	125	---	165
PuE, PuE2---------- Pullman	12	50	15	100	---	140
Qc---------- Quinlan	---	---	---	---	---	---
Ra---------- Randall	---	---	---	---	---	---
Rb---------- Roscoe	20	---	30	---	---	---
Ro**, Rs**. Rough broken land	---	---	---	---	---	---
Sa**---------- Sandy alluvial land	---	---	---	---	---	---
UcA---------- Ulysses	18	45	25	100	---	160
UcB---------- Ulysses	15	40	20	90	---	140
VoC---------- Vona	---	---	25	70	---	---
WcB---------- Weymouth	15	---	20	---	---	---
WcC---------- Weymouth	10	---	15	---	---	---
Wf---------- Weymouth	---	---	---	---	---	---
Vernon----------	---	---	---	---	---	---
WhA---------- Wichita	25	60	30	115	---	---
WhB---------- Wichita	20	50	25	100	---	---
WhC---------- Wichita	15	40	20	85	---	---
WoB---------- Woodward	20	---	30	---	---	---
WoC---------- Woodward	15	---	25	---	---	---
WoD---------- Woodward	15	---	---	---	---	---
ZcA---------- Zita	20	55	25	110	---	140
ZcB---------- Zita	16	45	20	100	---	120

* Yields are for areas protected from flooding.
** See mapping unit description for the composition and behavior of the mapping unit.

protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The predicted yields reflect the relative productive capacity of the soils for each of the principal crops. Yields are likely to increase in the future as new production technology is developed.

Crops other than those shown in table B are grown in the survey area, but because their acreage is small, predicted yields for these crops are not included. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the productivity and management concerns of the soils for these crops.

Range

Table C shows, for each kind of soil, the name of the range site, the potential annual production of herbage in

favorable, normal and unfavorable years and the names of major plant species and the percentage of each in the composition of the potential plant community.

Table C. -- Range productivity and characteristic plant communities

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A range site supports a distinctive potential plant community, or combination of plants, that can grow on a site that has not undergone major disturbance. Soils that produce the same kind, amount and proportion of range plants are grouped into range sites. Range sites can be interpreted directly from the soil map where the relationships between soils and vegetation have been correlated. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on range plants and their productivity. Soil reaction, calcium carbonate content and seasonal high water table are also important.

Potential production refers to the amount of herbage that can be expected to grow on well-managed range that is supporting the potential plant community. It is expressed in pounds per acre of air-dry herbage for favorable, normal and unfavorable years. A favorable year is one in which the amount and distribution of precipitation and the temperatures result in growing conditions substantially better than average; a normal year is one in which these conditions are about average

TABLE C.—RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
AbA, AbB—Abilene	Clay Loam	Favorable	2,500	Sideoats grama	20
		Normal	2,000	Vine-mesquite	15
		Unfavorable	1,300	Arizona cottontop	15
				Buffalograss	10
				Western wheatgrass	5
				Silver bluestem	5
				Texas wintergrass	5
				Tobosa	5
				White tridens	5
BFD*:					
Berthoud	Hiredland Slopes	Favorable	3,000	Sideoats grama	30
		Normal	2,250	Blue grama	15
		Unfavorable	1,500	Little bluestem	10
				Sand bluestem	5
				Plains bristlegrass	5
				Sand dropseed	5
				Indiangrass	5
				Hairy grama	5
Hansker	Loamy	Favorable	2,800	Sideoats grama	30
		Normal	2,100	Blue grama	15
		Unfavorable	1,400	Buffalograss	10
				Little bluestem	5
				Sand dropseed	5
				Plains bristlegrass	5
BHD*:					
Berthoud	Hardland Slopes	Favorable	2,800	Sideoats grama	35
		Normal	2,000	Blue grama	20
		Unfavorable	1,200	Little bluestem	5
				Buffalograss	5
				Wright threeawn	5
				Silver bluestem	5
				Plains bristlegrass	5
Hansker	Loamy	Favorable	2,800	Sideoats grama	30
		Normal	2,100	Blue grama	15
		Unfavorable	1,400	Buffalograss	10
				Little bluestem	5
				Sand dropseed	5
				Plains bristlegrass	5
BO*:					
Berthoud	Hiredland Slopes	Favorable	3,000	Sideoats grama	30
		Normal	2,250	Blue grama	15
		Unfavorable	1,500	Little bluestem	10
				Sand bluestem	5
				Plains bristlegrass	5
				Sand dropseed	5
				Indiangrass	5
				Hairy grama	5
Potter	Very Shallow	Favorable	900	Sideoats grama	30
		Normal	700	Blue grama	10
		Unfavorable	400	Little bluestem	10
				Buffalograss	10
				Arizona cottontop	5
				Hairy grama	5
				Black grama	5

See footnote at end of table.

TABLE C.—RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
BpB, BrA, BrB, BaC-Bippus	Draw	Favorable	3,000	Sideoats grama	25
		Normal	2,400	Vine-mesquite	10
		Unfavorable	1,800	Blue grama	10
				Western wheatgrass	10
				Little bluestem	5
				Arizona cottontop	5
				Plains bristlegrass	5
				White tridens	5
				Buffalograss	5
Gr*-Gravelly broken land	Gravelly	Favorable	1,800	Sideoats grama	30
		Normal	1,500	Little bluestem	15
		Unfavorable	1,000	Black grama	15
				Hairy grama	10
				Blue grama	5
				Sand bluestem	5
				Indiangrass	5
Lk-Likes	Loamy Sand	Favorable	3,000	Little bluestem	20
		Normal	2,100	Sand bluestem	15
		Unfavorable	1,300	Sideoats grama	15
				Indiangrass	10
				Sand lovegrass	10
				Switchgrass	10
				Canada wildrye	5
				Sand sagebrush	5
Ls*-Loamy alluvial land	Loamy Bottomland	Favorable	3,600	Sand bluestem	15
		Normal	2,700	Sideoats grama	15
		Unfavorable	1,750	Indiangrass	10
				Western wheatgrass	10
				Switchgrass	5
				Little bluestem	5
				Vine-mesquite	5
				Arizona cottontop	5
				Texas needlegrass	5
				Plains bristlegrass	5
Lo-Lofton	Clay Loam	Favorable	2,200	Blue grama	35
		Normal	1,800	Buffalograss	30
		Unfavorable	1,200	Vine-mesquite	10
				Western wheatgrass	5
				Sand dropseed	5
MaB-Mansker	Loamy	Favorable	2,800	Sideoats grama	30
		Normal	2,100	Blue grama	15
		Unfavorable	1,400	Buffalograss	10
				Little bluestem	5
				Sand dropseed	5
				Plains bristlegrass	5
MkB, MkC, MkC2-Mansker	Loamy	Favorable	2,400	Sideoats grama	30
		Normal	1,750	Blue grama	20
		Unfavorable	1,200	Buffalograss	10
				Silver bluestem	5
				Little bluestem	5
				Vine-mesquite	5
				Plains bristlegrass	5
				Sand dropseed	5

See footnote at end of table.

TABLE C.—RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
MsA, MsB, MsC Miles	Sandy Loam	Favorable Normal Unfavorable	2,800 2,250 1,800	Blue grama Sideoats grama Plains bristlegrass Arizona cottontop Little bluestem Silver bluestem Hooded windmillgrass Buffalograss Vine-mesquite	20 20 10 10 5 5 5 5 5
OcA, OcB, OcC Olton	Clay Loam	Favorable Normal Unfavorable	2,100 1,600 1,200	Blue grama Buffalograss Vine-mesquite Tobosa Sideoats grama	35 25 10 10 5
Ps* Potter	Very Shallow	Favorable Normal Unfavorable	900 700 400	Sideoats grama Blue grama Little bluestem Buffalograss Arizona cottontop Hairy grama Black grama	30 10 10 10 5 5 5
PuA, PuB, PuB2 Pullman	Clay Loam	Favorable Normal Unfavorable	2,000 1,500 1,000	Blue grama Buffalograss Sideoats grama Western wheatgrass Vine-mesquite Silver bluestem Tobosa	40 25 5 5 5 5 5
Qc* Quinlan	Loamy Prairie	Favorable Normal Unfavorable	2,500 1,800 1,300	Little bluestem Big bluestem Indiangrass Switchgrass Tall dropseed Scribner panicum Sideoats grama Prairie-clover Dotted gayfeather	30 15 10 10 10 5 5 5 5
Ra Randall	Lakebed	Favorable Normal Unfavorable	3,000 1,200 500	Pennsylvania smartweed Blue grama Common spikesedge Buffalograss Western wheatgrass Knotgrass	20 15 15 15 10 5
Rb Roscoe	Clay Flat	Favorable Normal Unfavorable	2,000 1,500 500	Tobosa Buffalograss Alkali sacaton Vine-mesquite Blue grama White tridens Western wheatgrass	45 15 15 10 5 5 5
Sa* Sandy alluvial land	Sandy Alluvial Land	Favorable Normal Unfavorable	3,000 2,280 1,800	Switchgrass Sand bluestem Indiangrass Little bluestem Texas bluegrass Beaked panicum Purpletop Maximilian sunflower Goldenrod Heath aster	30 15 15 5 5 5 5 5 5 5

See footnote at end of table.

TABLE C.—RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES—Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
UcA, UcB Ulysses	Loamy	Favorable	2,200	Blue grama	30
		Normal	1,700	Sideoats grama	25
		Unfavorable	1,300	Buffalograss	15
				Vine-mesquite	5
VoC Vona	Sandy Loam	Favorable	3,200	Sideoats grama	20
		Normal	2,400	Blue grama	20
		Unfavorable	1,600	Little bluestem	10
				Plains bristlegrass	10
				Arizona cottontop	5
				Vine-mesquite	5
				Sand dropseed	5
				Hooded windmillgrass	5
				Buffalograss	5
WcB, WcC Weymouth	Clay Loam	Favorable	2,000	Blue grama	30
		Normal	1,600	Buffalograss	15
		Unfavorable	1,200	Tobosa	15
				Vine-mesquite	10
				Sideoats grama	5
				Arizona cottontop	5
Wf*: Weymouth	Clay Loam	Favorable	2,000	Blue grama	30
		Normal	1,600	Buffalograss	15
		Unfavorable	1,200	Tobosa	15
				Vine-mesquite	10
				Sideoats grama	5
				Arizona cottontop	5
Vernon	Shallow Clay	Favorable	1,400	Sideoats grama	30
		Normal	1,000	Tobosa	15
		Unfavorable	600	Buffalograss	10
				Vine-mesquite	5
				Hairy grama	5
				Silver bluestem	5
				Arizona cottontop	5
				Purple threeawn	5
				Rough tridens	5
				Blue grama	5
WhA, WhB, WhC Wichita	Clay Loam	Favorable	2,600	Sideoats grama	20
		Normal	2,000	Vine-mesquite	15
		Unfavorable	1,400	Buffalograss	15
				Arizona cottontop	10
				Western wheatgrass	10
				Blue grama	10
				Tobosa	5
				Texas needlegrass	5
WoB, WoC, WoD Woodward	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
[illegible] Zita	Clay Loam	Favorable	2,300	Blue grama	30
		Normal	1,750	Buffalograss	25
		Unfavorable	1,200	Vine-mesquite	10
				Tobosa	10
				Sideoats grama	5
				Sand dropseed	5

* See mapping unit description for the composition and behavior of the mapping unit.

for the area; an unfavorable year is one in which growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry herbage produced per acre each year by the potential plant community. All herbage, both that which is highly palatable and that which is unpalatable to livestock, is included. Some of the herbage also may be grazed extensively by wildlife and some of it not. Plant species that have special value for livestock forage are mentioned in the description of each soil mapping unit.

Common names are listed for the grasses, forbs and shrubs that make up most of the potential plant community on each soil. Under the heading Composition in table C, the proportion of each species is presented as the percentage, in dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the season when the forage is grazed. All of the herbage produced is normally not used.

Wildlife Habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the development of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover and water.

If any one of these elements is missing, inadequate or inaccessible, wildlife will either be scarce or will not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by properly managing the existing plant cover and by fostering the natural establishment of desirable plants.

In table F the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in--

1. Planning the use of parks, wildlife refuges, nature study areas and other developments for wildlife.

2. Selecting soils that are suitable for creating, improving or maintaining specific elements of wildlife habitat.

3. Determining the intensity of management needed for each element of the habitat.

4. Determining areas that are suitable for acquisition to manage for wildlife.

Table F. -- Wildlife habitat potentials

The potential of the soil is rated good, fair, poor or very poor. A rating of good means that the element of wildlife habitat or the kind of habitat is easily created, improved or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated

TABLE F.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
AbA, AbB---------- Abilene	Good	Good	Fair	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Fair.
BFD*, BHD*: Berthoud----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Hansker----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
BO*: Berthoud----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Potter----------	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
BpB---------- Bippus	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
BrA---------- Bippus	Good	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
BrB, BaC---------- Bippus	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
Gr*---------- Gravelly broken land	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Lk---------- Likes	Poor	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
La*---------- Loamy alluvial land	Very poor.	Poor	Fair	---	---	Good	Poor	Very poor.	Poor	---	Very poor.	Fair.
Lo---------- Lofton	Fair	Good	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
MaB, MkB, MkC, MkC2---------- Hansker	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
MsA, MsB, MsC------ Miles	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
OcA, OcB, OcC------ Olton	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Ps*---------- Potter	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
PuA, PuB, PuB2----- Pullman	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Qc*---------- Quinlan	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Ra---------- Randall	Poor	Poor	Fair	---	---	Poor	Poor	Fair	Poor	---	Poor	Poor.

See footnote at end of table.

TABLE F.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Rb---------- Roscoe	Fair	Fair	Fair	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Ro*, Rs*. Rough broken land	---	---	---	---	---	---	---	---	---	---	---	---
Sa*---------- Sandy alluvial land	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
UcA, UcB---------- Ulysses	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
VoC---------- Vona	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
WcB, WcC---------- Weymouth	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Wf*: Weymouth----------	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Vernon----------	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	Very poor.	---	Very poor.	Very poor.
WhA, WhB---------- Wichita	Good	Good	Fair	---	----	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
WhC---------- Wichita	Fair	Good	Fair	---	-----	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
WoB, WoC, WoD------ Woodward	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
ZcA, ZcB---------- Zita	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

* See mapping unit description for the composition and behavior of the mapping unit.

purpose. A rating of fair means that the element of wildlife habitat or kind of habitat can be created, improved or maintained in most places. Moderate intensity of management and fairly frequent attention are required for satisfactory results. A rating of poor means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved or maintained in most places, but management is difficult and requires intensive effort. A rating of very poor means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. Examples are corn, sorghum, wheat, oats, barley, millet, cowpeas, soybeans and sunflowers. The major soil properties 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.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are lovegrass, switchgrass, bromegrass, orchardgrass and clover. Major soil properties 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.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, Indiangrass, goldenrod, beggarweed, pokeweed, partridgepea, fescue and grama. Major soil properties 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.

Shrubs are bushy woody plants that produce fruits, buds, twigs, bark or foliage used by wildlife or that provide cover and shade for some species of wildlife. Examples are hackberry, spiny hackberry, Texas colubrina, wild plum, black brush, honey locust, elm, oak, kidneywood and cactus. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, wild millet, rushes, sedges, reeds, wildrice, saltgrass, cordgrass and cattail. Major soil properties affecting

wetland plants are texture of the surface layer, wetness, reaction, salinity, slope and surface stoniness.

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of croplands, pastures, 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 kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, killdeer, and cottontail rabbit.

Wetland habitat consists of water-tolerant plants in open, marshy or swampy shallow water areas. Examples of wildlife attracted to this habitat are ducks, geese, herons, shore birds, rails, and kingfishers.

Rangeland habitat consists of wild herbaceous plants and shrubs on range. Examples of wildlife attracted to this habitat

are mule deer, jackrabbit, antelope, scaled quail, meadowlark and lark bunting. The Barbary sheep, an exotic from Africa, inhabits the Palo Duro Canyon in huntable numbers.

Recreation

The soils of the survey area are rated in table G according to limitations that affect their suitability for camp areas, picnic areas, playgrounds and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration and frequency of flooding is essential in planning recreation facilities.

Table G. -- Recreational development

In table G the limitations of soils are rated as slight, moderate or severe. Slight means that the soil properties are generally favorable and that the limitations are minor and easily overcome. Moderate means that the limitations can be overcome or alleviated by planning, design or special

TABLE G.—RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
AbA Abilene	Moderate: percs slowly.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.
AbB Abilene	Moderate: percs slowly.	Moderate: too clayey.	Moderate: percs slowly, slope.	Moderate: too clayey.
BFD*, BHD*: Berthoud	Slight	Slight	Moderate: slope.	Slight.
Hansker	Slight	Slight	Moderate: slope.	Slight.
BO*: Berthoud	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Potter	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
BpB Bippus	Slight	Slight	Slight	Slight.
BrA Bippus	Moderate: Too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
BrB, BaC Bippus	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Gr* Gravelly broken land	Severe: slope.	Severe: slope.	Severe: small stones.	Moderate: small stones.
Lk Likes	Moderate: too sandy.	Moderate: toc sandy.	Moderate: too sandy.	Moderate: too sandy.
La* Loamy alluvial land	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Lo Lofton	Severe: percs slowly.	Moderate: too clayey, wetness.	Severe: percs slowly.	Moderate: too clayey.
HaB, HkB, HkC, HkC2 Hansker	Slight	Slight	Moderate: slope.	Slight.
HsA Miles	Slight	Slight	Slight	Slight.
HsB, HsC Miles	Slight	Slight	Moderate: slope.	Slight.
OcA, OcB, OcC Olton	Moderate: percs slowly.	Moderate: too clayey.	Moderate: percs slowly.	Moderate: too clayey.
Ps* Potter	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE G.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
PuA, PuB, PuB2 Pullman	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.
Qc* Quinlan	Moderate: slope.	Moderate: slope.	Severe: depth to rock.	Slight.
Ra Randall	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Rb Roscoe	Severe: floods, too clayey, percs slowly.	Severe: floods, too clayey.	Severe: floods, too clayey, percs slowly.	Severe: too clayey.
Ro*, Rs*. Rough broken land	---	---	---	---
Sa* Sandy alluvial land	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
UcA Ulysses	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
UcB Ulysses	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
VoC Vona	Slight	Slight	Moderate: slope.	Slight.
WcB, WcC Weymouth	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey, slope.	Moderate: too clayey.
Wf*: Weymouth	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
Vernon	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
WhA, WhB, WhC Wichita	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
WoB, WoC Woodward	Slight	Slight	Moderate: slope.	Slight.
WoD Woodward	Slight	Slight	Severe: slope.	Slight.
ZcA, ZcB Zita	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.

* See mapping unit description for the composition and behavior of the mapping unit.

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 G can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table L and interpretations for dwellings without basements and for local roads and streets, given in table M.

Camp areas require such site preparation as shaping and leveling 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 for this use have mild slopes and are not wet nor 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 camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 not wet nor subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over rock should be sufficient to allow necessary grading.

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

Engineering Properties

Table H gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Table H. -- Engineering properties and classification

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower

TABLE 8.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AbA, AbB---------- Abilene	0-8	Clay loam-------	CL	A-4, A-6	0	95-100	95-100	90-100	60-96	25-35	8-16
	8-42	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	95-100	95-100	90-100	75-95	4-58	22-40
	42-65	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
BFD*:											
Berthoud----------	0-72	Fine sandy loam	CL-ML, SM-SC, SM, ML	A-4, A-2-4	0-5	90-100	90-98	80-95	30-65	18-25	2-7
Hansker----------	0-7	Fine sandy loam	SM, SC, SM-SC	A-2-4, A-4	0	90-100	85-100	70-98	30-50	15-25	3-10
	7-15	Sandy clay loam, clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	80-100	40-80	22-40	7-20
	15-60	Clay loam, sandy clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	65-100	35-80	22-40	7-20
BMD*:											
Berthoud----------	0-10	Loam----------	SC, CL, SM-SC, CL-ML	A-4, A-6	0-3	85-100	85-100	75-95	36-70	20-35	7-20
	10-72	Loam, clay loam, sandy clay loam.	SC, CL, SM-SC, CL-ML	A-4, A-6	0	85-100	85-100	75-95	40-75	20-35	7-20
Hansker----------	0-7	Loam----------	CL, CL-ML, SC, SM-SC	A-4, A-6	0	90-100	85-100	70-98	36-75	20-35	5-17
	7-15	Sandy clay loam, clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	80-100	40-80	22-40	7-20
	15-60	Clay loam, sandy clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	65-100	35-80	22-40	7-20
BO*:											
Berthoud----------	0-72	Fine sandy loam	CL-ML, SM-SC, SM, ML	A-4, A-2-4	0-5	90-100	90-98	80-95	30-65	18-25	2-7
Potter----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	70-95	70-95	60-85	51-70	20-40	5-20
	8-20	Variable--------	GC, SC, GM-GC, SM-SC	A-2-4, A-4, A-6, A-2-6	5-50	30-80	25-75	20-60	13-50	20-40	5-20
BpB---------- Bippus	0-12	Fine sandy loam	CL-ML, CL, SC, SM-SC	A-2-4, A-4	0	100	95-100	80-98	30-60	18-25	4-10
	12-78	Clay loam, loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	95-100	85-98	36-75	22-40	7-20
BrA, BrB, BaC------ Bippus	0-12	Clay loam-------	CL, SC, SM-SC	A-4, A-6	0	100	95-100	85-98	36-80	22-40	7-20
	12-78	Clay loam, loam, sandy clay loam.	SC, CL, SM-SC	A-4, A-6	0	100	95-100	85-98	36-75	22-40	7-20

See footnote at end of table.

TABLE 6.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Gr* Gravelly broken land	0-9	Gravelly sandy loam.	SM, GM, GM-GC, GC	A-1, A-2	0-5	40-65	35-60	25-50	10-26	25-42	5-14
	9-20	Very gravelly loam, very gravelly sandy loam.	SM, GM, GM-GC, GC	A-1	0-5	28-60	20-50	15-45	8-25	25-40	5-14
	20-60	Very gravelly sandy loam, very gravelly loam, gravelly sandy loam.	GM, SM, GC, GM-GC	A-1	0-5	30-60	30-60	15-45	5-15	<32	NP-14
Lk Likes	0-50	Loamy fine sand	SM, SP-SM, SM-SC	A-2-4	0-2	90-100	90-98	75-95	10-30	<25	NP-6
La* Loamy alluvial land	0-60	Very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	98-100	90-100	51-85	<30	NP-12
Lo Lofton	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	70-90	35-45	15-25
	9-52	Clay, silty clay	CL	A-6, A-7	0	100	100	95-100	70-90	38-50	20-30
	52-80	Clay, silty clay, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	60-80	30-45	15-25
MaB Mansker	0-7	Fine sandy loam	SM, SC, SM-SC	A-2-4, A-4	0	90-100	85-100	70-98	30-50	15-25	3-10
	7-15	Sandy clay loam, clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	80-100	40-80	22-40	7-20
	15-60	Clay loam, sandy clay loam, loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0-2	85-100	80-100	65-100	35-80	22-40	7-20
MkB, MkC, MkC2 Mansker	0-7	Loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0	95-100	95-100	80-98	40-75	20-37	5-20
	7-15	Loam, clay loam	CL, SC	A-4, A-6	0	90-100	90-100	85-98	40-80	22-40	7-22
	15-60	Clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	98-100	95-100	85-100	45-85	22-40	7-22
MsA, MsB, MsC Miles	0-8	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-2-4, A-4	0	95-100	90-100	80-98	25-55	18-25	2-7
	8-96	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-2-4, A-2-6	0	95-100	90-100	90-98	30-72	20-40	4-22
OcA, OcB, OcC Olton	0-8	Clay loam	CL	A-4, A-6	0	100	95-100	85-100	55-80	25-35	8-18
	8-46	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	95-100	90-100	90-100	60-95	35-50	18-32
	46-72	Clay loam, sandy clay loam, loam.	CL	A-4, A-6	0	90-100	85-100	80-100	60-85	20-40	8-25
Ps* Potter	0-8	Gravelly loam	CL, CL-ML	A-4, A-6	0-5	70-95	70-95	60-85	51-70	20-40	5-20
	8-20	Variable	GC, SC, GM-GC, SM-SC	A-2-4, A-4, A-6, A-2-6	5-50	30-80	25-75	20-60	13-50	20-40	5-20

See footnote at end of table.

TABLE 8.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PuA, PuB, PuB2---- Pullman	0-7	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	70-90	30-50	15-30
	7-50	Clay, silty clay	CL, CH	A-7-6	0	100	100	95-100	85-98	41-55	22-35
	50-84	Clay loam, clay, silty clay.	CL	A-6, A-7-6	0	95-100	90-100	80-100	75-95	30-50	15-30
Qc*---- Quinlan	0-14	Very fine sandy loam.	SM, ML, CL	A-4	0	100	95-100	90-100	36-75	<30	NP-9
	14-26	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Ra---- Randall	0-65	Clay----	CL, CH	A-7-6	0	100	100	95-100	75-98	41-70	22-45
Rb---- Roscoe	0-45	Clay----	CL, CH	A-7-6	0-2	98-100	95-100	90-100	75-95	49-70	32-49
	45-68	Clay----	CL, CH	A-7-6	0-2	98-100	95-100	90-100	70-95	46-60	30-40
Ro*, Rs*. Rough broken land	---	Too variable to classify.		---	---	---	---	---	---	---	---
Sa*---- Sandy alluvial land	0-10	Loamy fine sand	SM, SM-SP	A-2, A-3	0	90-100	85-100	75-100	8-35	---	NP
	10-60	Fine sand, loamy fine sand.	SM, SM-SP	A-2, A-3	0	90-100	85-100	75-100	8-35	---	NP
UcA, UcB---- Ulysses	0-8	Clay loam----	CL	A-6, A-4	0	95-100	95-100	55-100	51-90	25-40	8-20
	8-30	Clay loam, sandy clay loam.	CL	A-6, A-7-6	0	95-100	95-100	85-100	55-90	30-42	12-25
	30-56	Clay loam, sandy clay loam.	CL	A-6, A-7-6	0	95-100	95-100	80-100	60-95	30-45	13-25
VoC---- Vona	0-9	Fine sandy loam	SM, SM-SC	A-2-4	0	98-100	95-100	75-99	11-35	18-25	2-7
	9-53	Fine sandy loam	SM, SM-SC	A-2-4	0	98-100	95-100	75-99	11-35	18-25	2-7
	53-68	Fine sandy loam, sandy clay loam.	SM, SM-SC, SC	A-2-4, A-4	0	98-100	95-100	75-99	11-45	18-25	2-8
WcB, WcC---- Weymouth	0-9	Clay loam----	CL	A-6, A-7-6	0	95-100	90-100	80-100	65-90	30-42	12-25
	9-29	Clay loam, sandy clay loam, loam.	CL	A-6, A-7-6	0	80-100	75-100	70-98	65-92	30-42	12-25
	29-52	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Wf*: Weymouth----	0-9	Clay loam----	CL	A-6, A-7-6	0	95-100	90-100	80-100	65-90	30-42	12-25
	9-29	Clay loam, sandy clay loam, loam.	CL	A-6, A-7-6	0	80-100	75-100	70-98	65-92	30-42	12-25
	29-52	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Vernon----	0-7	Clay----	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	7-30	Shaly clay, clay	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
WhA, WhB, WhC---- Wichita	0-7	Loam----	CL	A-6, A-4	0	98-100	98-100	90-100	60-80	25-36	8-18
	7-48	Clay loam, clay	CL	A-6, A-7-6	0	95-100	95-100	95-100	70-95	36-50	18-32
	48-74	Clay loam, clay	CL	A-6, A-7-6, A-4	0	95-100	90-100	85-100	70-85	25-45	8-28
WoB, WoC, WoD---- Woodward	0-25	Loam----	ML, CL	A-4	0	100	100	90-100	55-85	<31	NP-10
	25-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE H.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
ZcA, ZcB---------- Zita	0-9	Clay loam--------	CL, CL-ML	A-4, A-6	0	100	100	98-100	51-70	24-32	7-15
	9-37	Clay loam--------	CL	A-6, A-7-6	0	98-100	98-100	95-100	60-75	30-42	12-25
	37-50	Clay loam--------	CL	A-6, A-7-6	0	90-100	80-98	80-98	50-75	30-42	12-25

* See mapping unit description for the composition and behavior of the mapping unit.

boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in "Soil Series Descriptions and Morphology."

Texture is described in table H in standard terms used by the United States Department of Agriculture. These terms are defined according to percentages of sand, silt and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials Soil Classification System (AASHTO). In table H soils in the survey area are classified according to both systems.

The USCS 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, plasticity index, liquid limit and organic matter content. Soils are grouped into 15 classes--eight classes of coarse-grained soils, identified as GW, GP, GM,

GC, SW, SP, SM, and SC: six classes of fine-grained soils, identified as ML, CL, OL, MH, CH and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL-ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified as A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2 and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5 and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The estimated classification, without group index numbers, is given in table H. Also in table H the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the USCS and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and Chemical Properties

Table J shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Table J. -- Physical and chemical properties of soils

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field--particularly soil structure, porosity and gradation or texture--that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage of such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by

TABLE J.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater then. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
						Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH						
AbA, AbB Abilene	0-8	0.6-2.0	0.15-0.20	6.6-8.4	Moderate	High	Low	0.32	5	6
	8-42	0.2-0.6	0.14-0.18	6.6-8.4	Moderate	High	Low	0.32		
	42-65	0.2-0.6	0.12-0.15	7.9-8.4	Moderate	High	Low	0.28		
BFD*:										
Berthoud	0-72	2.0-6.0	0.10-0.14	7.9-8.4	Low	Low	Low	0.24	3	3
Mansker	0-7	2.0-6.0	0.10-0.15	7.9-8.4	Low	Moderate	Low	0.24	4	3
	7-15	0.6-2.0	0.10-0.18	7.9-8.4	Low	Moderate	Low	0.28		
	15-60	0.6-2.0	0.10-0.15	7.9-8.4	Low	Moderate	Low	0.28		
BHD*:										
Berthoud	0-10	0.6-2.0	0.14-0.18	7.9-8.4	Low	Moderate	Low	0.28	5	4L
	10-72	0.6-2.0	0.14-0.18	7.9-8.4	Low	Moderate	Low	0.28		
Mansker	0-7	0.6-2.0	0.12-0.18	7.9-8.4	Low	Moderate	Low	0.28	4	4L
	7-15	0.6-2.0	0.10-0.18	7.9-8.4	Low	Moderate	Low	0.28		
	15-60	0.6-2.0	0.10-0.15	7.9-8.4	Low	Moderate	Low	0.28		
BO*:										
Berthoud	0-72	2.0-6.0	0.10-0.14	7.9-8.4	Low	Low	Low	0.24	3	3
Potter	0-8	0.6-2.0	0.10-0.16	7.9-8.4	Low	Moderate	Low	0.28	1	8
	8-20	0.6-6.0	0.-0.06	7.9-8.4	Low	Moderate	Low	---		
BpB Bippus	0-12	2.0-6.0	0.11-0.15	7.4-8.4	Low	Moderate	Low	0.24	5	3
	12-78	0.6-2.0	0.14-0.20	7.9-8.4	Moderate	Moderate	Low	0.28		
BrA, BrB, BaC Bippus	0-12	0.6-2.0	0.14-0.20	7.4-8.4	Moderate	Moderate	Low	0.28	5	6
	12-78	0.6-2.0	0.14-0.20	7.9-8.4	Moderate	Moderate	Low	0.28		
Gr* Gravelly broken land	0-9	.60-2.0	0.06-0.12	7.9-8.4	Very low	Low	Low	0.10	4	8
	9-20	.60-2.0	0.05-0.10	7.9-8.4	Very low	Low	Low	0.10		
	20-60	2.0-6.0	0.03-0.07	7.9-8.4	Very low	Low	Low	0.10		
Lk Likes	0-50	2.0-6.0	0.04-0.10	7.4-8.4	Very low	Low	Low	0.15	5	2
La* Loamy alluvial land	0-60	2.0-6.0	0.16-0.22	7.9-8.4	Low	Low	Low	0.49	5	3
Lo Lofton	0-9	0.2-.60	0.16-0.20	6.6-8.4	Moderate	High	Low	0.32	5	6
	9-52	<.06	0.16-0.20	7.4-8.4	High	High	Low	0.32		
	52-80	.06-.20	0.12-0.16	7.9-8.4	Moderate	High	Low	0.32		
MaB Mansker	0-7	2.0-6.0	0.10-0.15	7.9-8.4	Low	Moderate	Low	0.24	4	3
	7-15	0.6-2.0	0.10-0.18	7.9-8.4	Low	Moderate	Low	0.28		
	15-60	0.6-2.0	0.10-0.15	7.9-8.4	Low	Moderate	Low	0.28		
MkB, MkC, MkC2 Mansker	0-7	0.6-2.0	0.13-0.19	7.9-8.4	Low	Moderate	Low	0.28	3	4L
	7-15	0.6-2.0	0.08-0.16	7.9-8.4	Low	Moderate	Low	0.28		
	15-60	0.6-2.0	0.10-0.18	7.9-8.4	Low	Moderate	Low	0.28		
MsA, MsB, MsC Miles	0-8	2.0-6.0	0.10-0.15	6.6-7.8	Low	Low	Low	0.24	5	3
	8-96	0.6-2.0	0.12-0.18	6.6-8.4	Low	Moderate	Low	0.32		
OcA, OcB, OcC Olton	0-8	0.6-2.0	0.15-0.20	6.6-8.4	Moderate	Moderate	Low	0.32	5	6
	8-46	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	Moderate	Low	0.32		
	46-72	0.2-0.6	0.10-0.16	7.9-8.4	Moderate	Moderate	Low	0.32		
Ps* Potter	0-8	0.6-2.0	0.10-0.16	7.9-8.4	Low	Moderate	Low	0.28	1	8
	8-20	0.6-6.0	0.-0.06	7.9-8.4	Low	Moderate	Low	---		

See footnote at end of table.

TABLE 3.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
						Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH						
PuA, PuB, PuB2---- Pullman	0-7	0.2-0.6	0.14-0.19	6.6-8.4	Moderate	High----	Low----	0.37	5	6
	7-50	<0.06	0.12-0.17	7.4-8.4	High----	High----	Low----	0.37		
	50-84	0.06-0.2	0.10-0.16	7.9-8.4	Moderate	High----	Low----	0.37		
Qc*---------- Quinlan	0-14	2.0-6.0	0.07-0.11	7.4-8.4	Low----	Low----	Low----	0.17	2	4L
	14-26	---	---	---	----	----	----	---		
Ra---------- Randall	0-65	<0.06	0.12-0.18	7.4-8.4	Very high	High----	Low----	0.32	5	4
Rb---------- Roscoe	0-45	<0.06	0.12-0.18	6.6-8.4	Very high	High----	Low----	0.32	5	4
	45-68	<0.06	0.12-0.17	7.9-8.4	Very high	High----	Low----	0.32		
Ro*, Rs*. Rough broken land	---	Too variable to classify.		---	---	---	---	---	---	---
Sa---------- Sandy alluvial land	0-10	6.0-20	0.05-0.10	7.4-8.4	Low----	Low----	Low----	0.17	5	2
	10-60	6.0-20	0.05-0.10	7.9-8.4	Low----	Low----	Low----	0.17		
UcA, UcB---------- Ulysses	0-8	0.6-2.0	0.14-0.19	7.9-8.4	Low----	Moderate	Low----	0.28	5	4L
	8-30	0.6-2.0	0.12-0.18	7.9-8.4	Low----	Moderate	Low----	0.32		
	30-56	0.6-2.0	0.10-0.18	7.9-8.4	Low----	Moderate	Low----	0.32		
VoC---------- Vona	0-9	2.0-6.0	0.10-0.15	6.6-7.8	Low----	Low----	Low----	0.20	5	3
	9-53	2.0-6.0	0.10-0.15	6.6-8.4	Low----	Low----	Low----	0.20		
	53-68	0.6-6.0	0.10-0.16	6.6-8.4	Low----	Low----	Low----	0.20		
WcB, WcC---------- Weymouth	0-9	0.6-2.0	0.16-0.20	7.9-8.4	Low----	Moderate	Low----	0.32	3	4L
	9-29	0.6-2.0	0.10-0.18	7.9-8.4	Low----	Moderate	Low----	0.32		
	29-52	---	---	---	----	----	----	---		
Wf*: Weymouth----------	0-9	0.6-2.0	0.16-0.20	7.9-8.4	Low----	Moderate	Low----	0.32	3	4L
	9-29	0.6-2.0	0.10-0.18	7.9-8.4	Low----	Moderate	Low----	0.32		
	29-52	---	---	---	----	----	----	---		
Vernon----------	0-7	<0.06	0.10-0.17	7.9-8.4	High----	High----	Low----	0.32	1	4
	7-30	<0.06	0.00-0.08	7.9-8.4	High----	High----	Low----	---		
WhA, WhB, WhC---- Wichita	0-7	0.6-2.0	0.15-0.20	6.6-7.8	Moderate	Moderate	Low----	0.32	5	6
	7-48	0.2-0.6	0.15-0.20	6.6-8.4	Moderate	Moderate	Low----	0.32		
	48-74	0.2-0.6	0.12-0.18	7.9-8.4	Moderate	Moderate	Low----	0.32		
WoB, WoC, WoD---- Woodward	0-25	0.6-2.0	0.16-0.20	6.6-8.4	Low----	Low----	Low----	0.37	3	5
	25-50	---	---	---	----	----	----	---		
ZcA, ZcB---------- Zita	0-9	0.6-2.0	0.15-0.20	7.9-8.4	Low----	Low----	Low----	0.28	4	5
	9-37	0.6-2.0	0.15-0.20	7.9-8.4	Low----	Moderate	Low----	0.32		
	37-50	0.6-2.0	0.10-0.16	7.9-8.4	Low----	Moderate	Low----	0.32		

* See mapping unit description for the composition and behavior of the mapping unit.

structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table J, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

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

Features that relate to runoff or infiltration of water, to flooding and to grading and excavation of each soil are indicated in table K. This information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table or by the presence of bedrock or a cemented pan in the upper 5 or 6 feet of the soil.

Table K. -- Soil and water features

Hydrologic groups are used to estimate runoff after rainfall. Soil properties that influence the minimum rate of infiltration into the bare soil after prolonged wetting are depth to a water table, water intake rate and permeability after prolonged wetting and depth to layers of slowly or very slowly permeable soil.

Flooding is rated in general terms that describe the frequency, duration and period of the year when flooding is most likely. The ratings are based on evidences in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; absence of distinctive soil horizons that form in soils of the area that are not subject to flooding; local information about floodwater heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods.

TABLE K.—SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
AbA, AbB—— Abilene	C	None——	---	---	>6.0	---	---	>60	---
BFD*, BHD*:									
Berthoud——	B	None——	---	---	>6.0	---	---	>60	---
Hansker——	B	None——	---	---	>6.0	---	---	>60	---
BO*:									
Berthoud——	B	None——	---	---	>6.0	---	---	>60	---
Potter——	C	None——	---	---	>6.0	---	---	>60	---
BpB, BrA, BrB, BaC—— Bippus	B	None to rare.	Very brief	Apr-Oct	>6.0	---	---	>60	---
Gr*—— Gravelly broken land	B	None——	---	---	>6.0	---	---	>60	---
Lk—— Likes	A	None——	---	---	>6.0	---	---	>60	---
La*—— Loamy alluvial land	B	Rare to common.	Very brief	Apr-Nov	>6.0	---	---	>60	---
Lo—— Lofton	D	None——	---	---	>6.0	---	---	>60	---
MaB, MkB, MkC, MkC2—— Hansker	B	None——	---	---	>6.0	---	---	>60	---
MsA, MsB, MsC—— Miles	B	None——	---	---	>6.0	---	---	>60	---
OcA, OcB, OcC—— Olton	C	None——	---	---	>6.0	---	---	>60	---
Ps*—— Potter	C	None——	---	---	>6.0	---	---	>60	---
PuA, PuB, PuB2—— Pullman	D	None——	---	---	>6.0	---	---	>60	---
Qc*—— Quinlan	C	None——	---	---	>6.0	---	---	10-20	Rippable
Ra—— Randall	D	Common——	Long to very long.	May-Nov	>6.0	---	---	>60	---
Rb—— Roscoe	D	Common——	Brief——	May-Sep	>6.0	---	---	>60	---
Ro*, Rs*. Rough broken land	---	---	---	---	---	---	---	---	---
Sa*—— Sandy alluvial land	A	Common——	Very brief to brief.	Apr-Oct	5.0-8.0	Apparent	Nov-May	>60	---

See footnote at end of table.

TABLE K.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
, UcB---------- ysses	B	None----------	---	---	>6.0	---	---	>60	---
---------- na	B	None----------	---	---	>6.0	---	---	>60	---
, WcC---------- ymouth	B	None----------	---	---	>6.0	---	---	>60	---
: ymouth----------	B	None----------	---	---	>6.0	---	---	>60	---
rnon----------	D	None----------	---	---	>6.0	---	---	>60	---
, WhB, WhC------ chita	C	None----------	---	---	>6.0	---	---	>60	---
, WoC, WoD------ cdward	B	None----------	---	---	>6.0	---	---	20-40	Rippable
, ZcB---------- ta	B	None----------	---	---	>6.0	---	---	>60	---

* See mapping unit description for the composition and behavior of the mapping unit.

A seasonal high water table is the highest level of a saturated zone more than 6 inches thick in soils for continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, whether perched, artesian or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at depths of 5 to 6 feet or less. For many soils, limited ranges in depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations

during the soil mapping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200 horsepower tractor, but hard bedrock generally requires blasting.

Sanitary Facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table L shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

Table L. -- Sanitary facilities

If the degree of soil limitation is indicated by the rating slight, soils are favorable for the specified use and limitations are minor and easily overcome; if moderate, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and

TABLE L.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AbA Abilene	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
AbB Abilene	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
BFD*: Berthoud	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
Mansker	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
BHD*: Berthoud	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Mansker	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
BO*: Berthoud	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Moderate: slope.	Fair: slope.
Potter	Moderate: slope.	Severe: slope, seepage, small stones.	Severe: seepage.	Severe: seepage.	Poor: small stones.
BpB Bippus	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
BrA Bippus	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
BrB, BaC Bippus	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Gr* Gravelly broken land	Severe: slope.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
Lk Likes	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
La* Loamy alluvial land	Severe: floods.	Severe: floods, seepage.	Severe: seepage, floods.	Severe: seepage, floods.	Good.
Lo Lofton	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
MaB Mansker	Slight	Moderate: slope, seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE L.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MkB, MkC, MkC2—— Mansker	Slight——	Moderate: seepage, slope.	Moderate: too clayey.	Slight——	Fair: too clayey.
MsA—— Miles	Slight——	Moderate: seepage.	Slight——	Slight——	Good.
MsB, MsC—— Miles	Slight——	Moderate: seepage, slope.	Slight——	Slight——	Good.
OcA—— Olton	Moderate: percs slowly.	Slight——	Moderate: too clayey.	Slight——	Fair: too clayey.
OcB—— Olton	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight——	Fair: too clayey.
OcC—— Olton	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight——	Fair: too clayey.
Ps*—— Potter	Moderate: slope.	Severe: slope, seepage, small stones.	Severe: seepage.	Severe: seepage.	Poor: small stones.
PuA—— Pullman	Severe: percs slowly.	Slight——	Severe: too clayey.	Slight——	Poor: too clayey.
PuB, PuB2—— Pullman	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight——	Poor: too clayey.
Qc*—— Quinlan	Severe: depth to rock.	Severe: depth to rock, slope.	Moderate: depth to rock.	Moderate: slope.	Poor: thin layer.
Ra—— Randall	Severe: wetness, percs slowly.	Slight——	Severe: wetness, too clayey.	Severe: floods.	Poor: too clayey. wetness.
Rb—— Roscoe	Severe: percs slowly, floods.	Slight——	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey.
Ro*, Rs*. Rough broken land	---	---	---	---	---
Sa*—— Sandy alluvial land	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
UcA—— Ulysses	Slight——	Moderate: seepage.	Moderate: too clayey.	Slight——	Fair: too clayey.
UcB—— Ulysses	Slight——	Moderate: slope, seepage.	Moderate: too clayey.	Slight——	Fair: too clayey.
VoC—— Vona	Slight——	Severe: seepage.	Slight——	Slight——	Good.
WcB, WcC—— Weymouth	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight——	Fair: too clayey.
Wf*: Weymouth——	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight——	Fair: too clayey.

See footnote at end of table.

TABLE L.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Wf*: Vernon	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
WhA Wichita	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
WhB, WhC Wichita	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
WoB, WoC, WoD Woodward	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Slight	Fair: thin layer.
ZcA, ZcB Zita	Slight	Moderate: seepage.	Slight	Slight	Fair: too clayey.

* See mapping unit description for the composition and behavior of the mapping unit.

design; and if severe, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs or intensive maintenance are required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that effect the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock and susceptibility to flooding. Stones, boulders and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result ground water supplies in the area may be contaminated. Soils having a hazard of inadequate filtration are indicated by footnotes in table L.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock and

susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread compacted in layers and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table L apply only to soil properties and features within a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for sanitary landfills should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter and the best potential for growing plants. Thus, for either the area or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility and potential for plant growth.

Building Site Development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings and local roads and streets are indicated in table M. A slight limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A moderate limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A severe limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Table M. -- Building site development

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils, the tendency of soils to cave in or slough and the presence of very firm, dense soil layers, bedrock or large stones. In addition, excavations are affected by slope

of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and small commercial buildings referred to in table M are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns and gardens. Depth to bedrock, slope and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
AbA, AbB Abilene	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
BFD*: Berthoud	Slight	Slight	Slight	Moderate: slope.	Slight.
Hansker	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
BHD*: Berthoud	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.
Hansker	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
BO*: Berthoud	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Potter	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
BpB Bippus	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate low strength, shrink-swell.
BrA Bippus	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.
BrB, BaC Bippus	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.
Gr* Gravelly broken land	Severe: small stones.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lk Likes	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Ln* Loamy alluvial land	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Lo Lofton	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.
MaB Hansker	Slight	Slight	Slight	Slight	Moderate: low strength.
MkB, MkC, MkC2 Hansker	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
MsA, MsB Miles	Slight	Slight	Slight	Slight	Moderate: low strength.
MsC Miles	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
OcA, OcB, OcC----- Olton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Ps*---------- Potter	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
PuA, PuB, PuB2---- Pullman	Severe: too clayey, cutbanks cave.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Qc*---------- Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: slope.	Moderate: low strength, depth to rock.
Ra---------- Randall	Severe: too clayey, wetness.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.
Rb---------- Roscoe	Severe: floods, too clayey.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, low strength.
Ro*, Rs*. Rough broken land	---	---	---	---	---
Sa*---------- Sandy alluvial land	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
UcA, UcB---------- Ulysses	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
VoC---------- Vona	Slight----------	Slight----------	Slight----------	Moderate: slope.	Slight.
WcB---------- Weymouth	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
WcC---------- Weymouth	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.
Wf*:					
Weymouth--------	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength.
Vernon----------	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
WhA, WhB, WhC----- Wichita	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: shrink-swell, low strength.
WoB, WoC, WoD----- Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
ZcA, ZcB---------- Zita	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.

* See mapping unit description for the composition and behavior of the mapping unit.

Local roads and streets referred to in table M have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and soil texture, density, shrink-swell potential and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers and content of large stones, all of which affect stability and ease of excavation, were also considered.

Construction Materials

The suitability of each soil as a source of road fill, sand, gravel and topsoil is indicated in table N by ratings of good, fair or poor. The texture, thickness and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Table N. -- Construction materials

Road fill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table H provide more specific information about the nature of each horizon that can help determine its suitability for road fill.

According to the Unified soil classification system, soils rated good have low shrink-swell potential, low potential frost action and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated fair have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness or many stones. If the thickness of suitable materials is less than 3 feet, the

TABLE N.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AbA, AbB Abilene	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
BFD*: Berthoud	Good	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Hansker	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: excess lime.
BHD*: Berthoud	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Hansker	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: excess lime.
BO*: Berthoud	Good	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Potter	Good	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, small stones.
BpB Bippus	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
BrA, BrB, BaC Bippus	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Gr* Gravelly broken land	Fair: slope.	Fair: excess fines.	Fair: excess fines.	Poor: small stones.
Lk Likes	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
La* Loamy alluvial land	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Lo Lofton	Poor: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
MaB Hansker	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: excess lime.
MkB, MkC, MkC2 Hansker	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, excess lime.
MsA, MsB, MsC Miles	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
OcA, OcB, OcC Olton	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Ps* Potter	Good	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, small stones.

See footnote at end of table.

TABLE N.—CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PuA, PuB, PuB2 Pullman	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Qc* Quinlan	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Ra Randall	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Rb Roscoe	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Ro*, Rs*. Rough broken land	---	---	---	---
Sa* Sandy alluvial land	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
UcA, UcB Ulysses	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
VoC Vona	Good	Poor: excess fines.	Unsuited: excess fines.	Good.
WcB, WcC Weymouth	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Wf*: Weymouth	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Vernon	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
WhA, WhB, WhC Wichita	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
WoB, WoC, WoD Woodward	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
ZcA, ZcB Zita	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

* See mapping unit description for the composition and behavior of the mapping unit.

entire soil is rated poor, regardless of the quality of the suitable material.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table N provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated good or fair has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction and stratification are given in the soil series descriptions and in table H.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

Soils rated good have at least 16 inches of friable, loamy material at their surface. They are free of stones, are low

in content of gravel and other coarse fragments and have gentle slopes. They are low in soluble salts, which can limit plant growth. They are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated fair are loose sandy or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones or soluble salt.

Soils rated poor are very sandy soils, very firm clayey soils, soils with suitable layers less than 8 inches thick, soils having large amounts of gravel, stones or soluble salt, steep soils and poorly drained soils.

Although a rating of good is not based entirely on high content of organic matter a surface horizon is much preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons is desirable.

Water Management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table P the degree of soil limitation and soil and site

features that affect use are indicated for each kind of soil. This information is significant in planning, installing and maintaining water control structures.

Table P. -- Water management

Soil and site limitation are expressed as slight, moderate and severe. Slight means that the soil properties and site features are generally favorable for the specified use and that any limitation is minor and easily overcome. Moderate means that some soil properties or site features are unfavorable for the rated use but can be overcome or modified by special planning and design. Severe means that the soil properties and site features are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design or intensive maintenance is required.

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

Embankments, dikes and levees require soil material that is resistant to seepage, erosion and piping and is of favorable stability, shrink-swell potential, shear strength and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes and levees.

TABLE P.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
AbA, AbB--------- Abilene	Moderate: seepage.	Moderate: piping, compressible.	Slow intake------	Favorable--------	Favorable.
BFD*: Berthoud---------	Severe: seepage.	Moderate: piping, seepage.	Complex slope, fast intake, erodes easily.	Complex slope, erodes easily, too sandy.	Droughty, erodes easily, slope.
Mansker---------	Moderate: seepage.	Moderate: low strength, piping.	Complex slope, droughty, excess lime.	Erodes easily, slope.	Droughty, erodes easily, slope.
BHD*: Berthoud---------	Moderate: seepage.	Moderate: piping, erodes easily.	Slope, erodes easily, soil blowing.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
Mansker---------	Moderate: seepage.	Moderate: low strength, piping.	Complex slope, droughty, excess lime.	Erodes easily, slope.	Droughty, erodes easily, slope.
BO*: Berthoud---------	Severe: seepage.	Moderate: piping, seepage.	Complex slope, fast intake, erodes easily.	Complex slope, erodes easily, too sandy.	Droughty, erodes easily, slope.
Potter----------	Severe: seepage.	Severe: thin layer, seepage.	Rooting depth, droughty, complex slope.	Slope, rooting depth.	Droughty, rooting depth, slope.
BpB--------- Bippus	Moderate: seepage.	Slight----------	Erodes easily----	Favorable--------	Favorable.
BrA--------- Bippus	Moderate: seepage.	Slight----------	Favorable----------	Favorable--------	Favorable.
BrB, BaC--------- Bippus	Moderate: seepage.	Slight----------	Erodes easily----	Favorable--------	Favorable.
Gr*--------- Gravelly broken land	Severe: seepage.	Moderate: piping.	Slope, droughty.	Slope----------	Slope, droughty.
Lk--------- Likes	Severe: seepage.	Severe: erodes easily, seepage, piping.	Erodes easily, fast intake.	Too sandy--------	Erodes easily.
Lm*--------- Loamy alluvial land	Severe: seepage.	Moderate: piping, unstable fill, seepage.	Floods, fast intake.	Not needed-------	Not needed.
Lo--------- Lofton	Slight----------	Moderate: compressible.	Slow intake------	Not needed-------	Favorable.
MaB--------- Mansker	Moderate: seepage.	Moderate: low strength, piping.	Complex slope, droughty, excess lime.	Erodes easily, slope.	Droughty, erodes easily, slope.

See footnote at end of table.

TABLE P.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
MkB, MkC, MkC2---- Mansker	Moderate: seepage.	Moderate: piping, seepage.	Slope, erodes easily. excess lime.	Slope, erodes easily.	Droughty, erodes easily, slope.
MsA, MsB, MsC----- Miles	Moderate: seepage.	Moderate: piping, seepage.	Fast intake, soil blowing, slope.	Soil blowing-----	Favorable.
OcA, OcB, OcC----- Olton	Moderate: seepage.	Moderate: piping.	Slow intake------	Favorable-------	Favorable.
Ps*---------- Potter	Severe: seepage.	Severe: thin layer, seepage.	Rooting depth, droughty, complex slope.	Slope, rooting depth.	Droughty, rooting depth, slope.
PuA, PuB, PuB2---- Pullman	Slight----------	Moderate: shrink-swell, low strength.	Slow intake------	Favorable-------	Favorable.
Qc*---------- Quinlan	Severe: depth to rock.	Severe: thin layer.	Droughty, slope, rooting depth.	Depth to rock, slope.	Droughty, slope, rooting depth.
Ra---------- Randall	Slight----------	Moderate: unstable fill, hard to pack.	Slow intake, wetness.	Not needed-------	Not needed.
Rb---------- Roscoe	Slight----------	Moderate: compressible.	Percs slowly, floods.	Percs slowly, wetness.	Wetness.
Ro*, Rs*. Rough broken land	---	---	---	---	---
Sa*---------- Sandy alluvial land	Severe: seepage.	Moderate: unstable fill, piping.	Seepage, fast intake.	Not needed-------	Favorable.
UcA, UcB---------- Ulysses	Moderate: seepage.	Slight----------	Erodes easily, slope.	Favorable-------	Favorable.
VoC---------- Vona	Severe: seepage.	Moderate: seepage, piping.	Fast intake, erodes easily.	Too sandy, erodes easily.	Erodes easily.
WcB, WcC---------- Weymouth	Moderate: seepage.	Moderate: low strength, piping.	Slope, rooting depth.	Slope, piping, rooting depth.	Slope, rooting depth.
Wf*: Weymouth----------	Moderate: seepage.	Moderate: low strength, piping.	Slope, rooting depth.	Slope, piping, rooting depth.	Slope, rooting depth.
Vernon----------	Slight----------	Moderate: low strength, shrink-swell.	Not needed-------	Not needed-------	Not needed.
WhA, WhB, WhC----- Wichita	Moderate: seepage.	Moderate: compressible, piping.	Slow intake------	Favorable-------	Favorable.
WoB, WoC, WoD----- Woodward	Severe: depth to rock.	Moderate: thin layer, unstable fill, compressible.	Erodes easily, rooting depth.	Favorable-------	Favorable.
ZcA, ZcB---------- Zita	Moderate: seepage.	Moderate: seepage.	Favorable-------	Favorable-------	Favorable.

* See mapping unit description for the composition and behavior of the mapping unit.

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

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

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

Windbreaks and Environmental Plantings

Windbreaks are established to protect livestock, buildings, and yards from winds and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of both broad-leaved and coniferous species 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 depending on erodibility of the soil. They protect cropland and crops from wind and hold snow on the fields, and they also provide food and cover for wildlife.

Environmental plantings help to beautify and screen homes and other buildings and to abate noise around them. The plants, mostly evergreen shrubs and trees, are closely spaced. Healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table U1 shows the height that locally adapted trees and shrubs are expected to reach on various kinds of soils in 20 years. The estimates in table U1, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks

and screens and the planting and care of trees can be obtained from the local office of the Soil Conservation Service, Extension Service, or local nurserymen.

Table U1. -- Windbreaks and environmental Plantings

TABLE 31.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Absence of an entry means soil does not normally grow trees of this height class]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
AbA, AbB. Abilene	---	Green Ash, Osage-orange, Russian-olive, eastern red cedar, Arizona cypress	Honeylocust, oriental arborvitae.	Siberian elm---------	---
BFD*: Berthoud----------	---	Eastern redcedar, Russian-olive, osageorange.	Arizona cypress, oriental arborvitae, green ash, honeylocust.	Siberian elm------	---
Mansker----------	---	Oriental arborvitae, Rocky Mt. juniper, Russian-olive, osageorange, eastern redcedar.	Honeylocust, Siberian elm.	---	---
BMD*: Berthoud----------	---	Osageorange, eastern redcedar, oriental arborvitae.	---	Siberian elm------	---
Mansker----------	---	Oriental arborvitae, Rocky Mt. juniper, Russian-olive, osageorange, eastern redcedar.	Honeylocust, Siberian elm.	---	---
BO*: Berthoud----------	---	Eastern redcedar, Russian-olive, osageorange.	Arizona cypress, oriental arborvitae, green ash, honeylocust.	Siberian elm------	---
Potter.	---	---	---	---	---
BpB, BrA, BrB, BaC---------- Bippus	---	Russian-olive, eastern redcedar, Rocky Mt. juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
Gr*. Gravelly broken land	---	---	---	---	---
Lk. Likes	---	---	---	---	---
Ls*. Loamy alluvial land	---	---	---	---	---
Lo---------- Lofton	---	Russian-olive, Rocky Mt. juniper.	Honeylocust, oriental arborvitae, eastern redcedar.	Siberian elm------	---
MaB---------- Mansker	---	Oriental arborvitae, Rocky Mt. juniper, Russian-olive, osageorange, eastern redcedar.	Honeylocust, Siberian elm.	---	---

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
MkB, MkC, MkC2. Mansker	---	Osage-orange, eastern redcedar, oriental arborvitae.	Honey locust, Arizona cypress.	Siberian elm--------	---
MsA, MsB, MsC----- Miles	---	Russian-olive, eastern redcedar, Rocky Mt. juniper.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
OcA, OcB, OcC----- Olton	---	Green ash, osageorange, Russian-olive, eastern redcedar, Arizona cypress.	Honeylocust, oriental arborvitae.	Siberian elm------	---
Ps*. Potter	---	---	---	---	---
PuA, PuB, PuB2---- Pullman	---	Osageorange, Russian-olive.	Eastern redcedar, honeylocust, Arizona cypress, oriental arborvitae.	Siberian elm------	---
Qc*---------- Quinlan	---	Eastern redcedar	---	---	---
Ra. Randall	---	---	---	---	---
Rb. Roscoe	---	---	---	---	---
Ro*, Rs*. Rough broken land	---	---	---	---	---
Sa*. Sandy alluvial land	---	---	---	---	---
UcA, UcB--------- Ulysses	---	Osageorange, eastern redcedar, oriental arborvitae, Rocky Mt. juniper.	---	Siberian elm------	---
VoC---------- Vona	---	Russian-olive, eastern redcedar.	Green ash, osageorange, oriental arborvitae, Arizona cypress.	Siberian elm, honeylocust.	---
WcB, WcC---------- Weymouth	---	Osage-orange, eastern redcedar, oriental arborvitae, Rocky Mt. juniper.	---	Siberian elm---------	---
Wf*: Weymouth.---------	---	Osage-orange, eastern redcedar, oriental arborvitae, Rocky Mt. juniper.	---	Siberian elm---------	---
Vernon.	---	---	---	---	---
WhA, WhB, WhC----- Wichita	---	Green ash, osageorange, Russian-olive, eastern redcedar, Arizona cypress.	Honeylocust, oriental arborvitae.	Siberian elm------	---
WoB, WoC, WoD----- Woodward	---	---	Austrian pine, eastern redcedar.	---	---

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
ZcA, ZcB---------- Zita	---	Green ash, osageorange, Rocky Mt. juniper, Russian-olive.	Eastern redcedar, oriental arborvitae, desertwillow, honeylocust.	Siberian elm------	---

* See mapping unit description for the composition and behavior of the mapping unit.

GLOSSARY

Area reclaim. 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 mapping 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--

	Inches
Very low	0 to 3
Low	3 to 6
Medium	6 to 9
High	9+

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

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.

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. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

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 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

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 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 for 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, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by running 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 a bare surface.

Excess alkali. Excess exchangeable sodium. The resulting poor physical properties restrict the growth of plants.

Excess fines. Excess silt and clay The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

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 ovendry 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 (heavy textured) soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that is unlikely but possible under unusual weather 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. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

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.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

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 characterisitcs produced by soil-forming processes. The major horizons of mineral soil are as follows:

> O horizon.--An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.
>
> A horizon.--The mineral horizon, formed or forming at or near the surface, in which an accumulation of humidified organic matter is mixed with the mineral material Also, a plowed surface horizon most of which was originally part of a B horizon.
>
> A2 horizon.--A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have 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.

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.

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.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

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 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.

Invaders On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

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.

Low strength. Inadequate strength for supporting loads.

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

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

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 single 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.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, hardpan, fragipan, plowpan, and traffic pan.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

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. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to 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.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

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

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are--excellent, good, fair, and poor. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree 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--

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

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.

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

Series, soil A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

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.

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.

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.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

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. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that 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 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature 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 other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining 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.

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 soil. 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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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 Otherwise suitable soil material too thin for the specified use.

Tilth, soil The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high non-capillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

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

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.