Series 1949, No. 6

Issued August 1958

SOIL SURVEY

Island County Washington

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
WASHINGTON AGRICULTURAL EXPERIMENT STATION
Institute of Agricultural Sciences, State College of Washington

How to Use THE SOIL SURVEY REPORT

THIS SURVEY of Island County will help you plan the kind of farming that will protect your soils and provide good yields. It describes the soils, shows their location on a map, and tells what they will do under different kinds of management.

Find Your Farm on the Map

In using this survey, start with the soil map, which consists of the 13 sheets bound in the back of this report. These sheets, if laid together, make a large map of the county. An inch on this map represents about one-half mile on the ground, and a square inch includes about 160 acres.

To find your farm on the large map, use the index to map sheets. This is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located.

When you find the map sheet for your farm, you will notice that boundaries of the various soils are outlined on it and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map.

Suppose you find on your farm an area marked with the symbol Ce. You learn the name of the soil this symbol represents by looking at the map legend. The symbol Ce identifies Casey loam, 0 to 5 percent slopes.

Learn About the Soils on Your Farm

Casey loam, 0 to 5 percent slopes, and all the other soils mapped are described in the section, Descriptions of Soils. Soil scientists walked over the fields and through the woodlands. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, brush, or trees; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming.

After they mapped and studied the soils, the scientists talked with farmers and others about the use and management each soil should have, and then they placed it in a management group. A management group is a group of soils that need and respond to about the same kind of management.

Casey loam, 0 to 5 percent slopes, is in management group 3. Turn to the section, Use and Management, and read what is said about soils of group 3. You will want to study the table, which shows yields received under common management. If improved management is used, yields higher than those indicated in the table should be received.

Make a Farm Plan

For the soils on your farm, compare your yields and farm practices with those given in this report. Look at your fields for signs of runoff and erosion. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for your farm or for any other farm in the county.

If you find that you need help in farm planning, consult the local representative of the Soil Conservation Service or the county agricultural agent. Members of your State experiment staff and others familiar with farming in your county will also be glad to help you.

The fieldwork for this survey was begun in 1947 and completed in 1948. Unless otherwise specifically noted, all statements in the report refer to conditions at the time the survey was in progress.

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Issued August 1958

SOIL SURVEY OF ISLAND COUNTY, WASHINGTON

BY A. O. NESS, SOIL SURVEY,[1] UNITED STATES DEPARTMENT OF AGRICULTURE, IN CHARGE, AND C. G. RICHINS, WASHINGTON AGRICULTURAL EXPERIMENT STATION

CORRELATION BY RAY C. ROBERTS, PRINCIPAL SOIL CORRELATOR, SOIL SURVEY

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH
WASHINGTON AGRICULTURAL EXPERIMENT STATION,
INSTITUTE OF AGRICULTURAL SCIENCES, STATE COLLEGE OF WASHINGTON

General Nature of the Area

ISLAND COUNTY is comprised of five islands located at the northern end of Puget Sound. The climate is temperate in this area. The summers are cool and dry, and the winters are mild and moist. The islands were once nearly covered by dense forests, but some small areas, called prairies, had a cover mainly of grass. The prairies are the principal areas cultivated in the county.

Location and Extent

The islands making up Island County are located in northwestern Washington in the upper reaches of Puget Sound (fig. 1). The county is bounded on the north by Fidalgo Island of Skagit County, on the east by Skagit and Snohomish Counties, on the south by Snohomish and Kitsap Counties, and on the west by Jefferson County and the Strait of Juan de Fuca. The land area is about 206 square miles, or 131,840 acres.

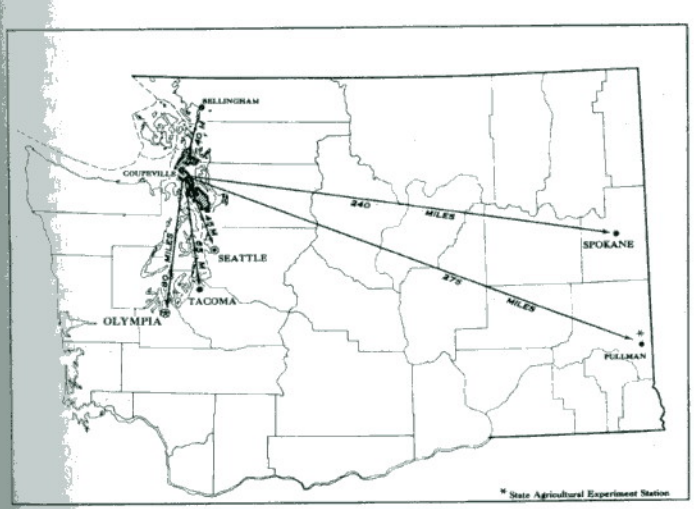

Figure 1.—Location of Island County in Washington.

Whidbey Island, the largest and most important island in Puget Sound, extends in a north-south direction. It is about 40 miles long and is from 1 to 10 miles wide. Camano Island, east of Whidbey, is the second largest island in the Sound. It is about 15 miles long and from 1 to 7 miles wide. It is about a fifth as large as Whidbey Island. Three other islands, which are all small, are included in the county. They are Ben Ure, Strawberry, and Smith. Smith Island, lying west of Whidbey Island in the Strait of Juan de Fuca, was not included in the survey.

Physiography, Relief, and Drainage

Island County is located in the Puget Trough section, Pacific Border province, of the Pacific Mountain division (*2*).[2] Most of the soils occur on undulating to rolling uplands that range in elevation from 100 to 300 feet. In a few places, the uplands rise to an elevation of 500 feet. Several small prairie areas occur along the coast at elevations of less than 100 feet. Others occupy uplands. Some of these small prairie areas are beds of former glacial lakes, and some are lagoons of former seas.

The soils of Island County originated largely from glacial drift. This was deposited in moraines left by glaciers that once moved over the Puget Sound area from the north. The drift consists of sand, gravel, and some clay. In places it is mixed with stones and boulders, some more than a foot in diameter. Locally the drift is stratified.

In the glaciated areas, relief is comparatively regular and uniform. The areas slope upward to fairly well defined crests, or ridges, one of which extends the length of Whidbey Island, the other, the length of Camano Island. The northeastern corner of Camano Island has gently undulating relief and resembles a plateau. The strongest slopes occur in the southern end of Whidbey Island, where many areas have slopes of 15 to 25 percent.

[1] Fieldwork for this survey was done when Soil Survey was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

[2] Italic numbers in parentheses refer to Literature Cited, p. 58.

Except for a few peat bogs, other depressions, and an additional comparatively small acreage in which drainage is somewhat restricted, all of the soils of the county are moderately well drained to well drained. There are no large streams. Most of the streams flow intermittently. During the rainy season, they serve as outlets for excess water. A few streams, most of which are in the southern part of Whidbey Island, are fed by springs and flow throughout the year. There are several small fresh-water lakes.

Climate

Island County has one of the most uniform marine climates of any area in the United States. The islands are sheltered from the cold continental winds by the Cascade Range to the east. Temperatures are modified by the prevailing westerly winds and by the salt air. They rarely go below zero or above 90° F.

Climatic data for Island County, taken from records kept by the United States Weather Bureau at Coupeville, are given in table 1. Records are not available for other parts of the county. Records kept at Everett in nearby Snohomish County, however, are somewhat indicative of the temperatures and precipitation on the southern end of Whidbey Island, near Everett.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Coupeville, Island County, Wash.*

[Elevation, 50 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1938)	Wettest year (1899)	Average snowfall
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	41.5	64	12	2.68	1.18	3.11	1.0
January	38.6	58	6	2.18	1.10	3.33	3.1
February	41.0	65	6	1.67	.86	4.92	2.0
Winter	40.4	65	6	6.53	3.14	11.36	6.1
March	44.2	68	11	1.76	1.47	2.16	1.1
April	49.0	79	27	1.38	1.25	1.68	.1
May	53.2	86	32	1.39	.57	1.87	0
Spring	48.8	86	11	4.53	3.29	5.71	1.2
June	57.6	88	36	1.16	.03	.87	0
July	61.0	94	40	.59	.21	1.59	0
August	61.1	92	40	.74	.59	2.84	0
Summer	59.9	94	36	2.49	.83	5.30	0
September	56.5	88	29	1.24	.65	.77	0
October	50.9	79	26	1.66	1.26	1.86	0
November	44.2	66	12	2.19	1.57	2.88	.5
Fall	50.5	88	12	5.09	3.48	5.51	.5
Year	49.9	94	6	18.64	10.74	27.88	7.8

[1] Average temperature based on a 41-year record, through 1955; highest temperature on a 19-year and lowest on an 18-year record, through 1930.

[2] Average precipitation based on a 53-year record, through 1955; wettest and driest years based on a 53-year record, in the period 1896-1955; snowfall, based on a 28-year record, through 1930.

Records at Coupeville show the average annual precipitation to be 18.64 inches. Records kept at Everett show the average annual precipitation at that location to be nearly 33 inches. In Island County most of the precipitation comes in winter. Though records are not available, it appears that the normal rainfall on the southern end of Whidbey Island is 10 to 15 inches more than at Coupeville.

Differences in precipitation are caused largely by the proximity of the Olympic Mountains on the west. The moisture in the prevailing southwesterly winds condenses when the air strikes these mountains. The winds have lost much of their moisture before they reach the central part of the county, where Coupeville is located, because Coupeville lies to the leeward of the mountains. This is also true of the winds that blow from a southwesterly direction across Camano Island, which lies close to Snohomish County on the west.

Dry and wet seasons are fairly distinct in Island County. During the dry season most of the days are clear. Many of the days in the wet season are foggy and overcast. Humidity is generally high. Snow seldom falls, and when it does, the fall is light. Gentle rains that last for several days fall during the winter. The precipitation generally comes as gentle showers or as fog or mist.

Thunderstorms, cloudbursts, and hail are infrequent. Though yields vary from season to season, the absence of destructive storms, the generally uniform climate, and the well-distributed rainfall help insure the farmer against crop failure.

Winds seldom attain a high velocity in Island County. The total number of windy days is small. During the summer the prevailing winds blow from the northwest. During the winter southwesterly winds prevail. Winds on the northern part of Whidbey Island, however, are modified by the Strait of Juan de Fuca. They are generally stronger than elsewhere in the county and are from the west or northwest.

The growing season averages 202 days. Damaging frosts rarely occur during the growing season. At Coupeville the average date of the last frost in spring is April 8. The average date of the first frost in fall is October 27. In most areas the mild winters make it possible to pasture livestock during most of the year, and shelter is necessary for only a very short time.

Water Supply

Obtaining an adequate supply of water is a critical problem in Island County, particularly in the northern two-thirds of Whidbey Island. This island has no streams or fresh-water lakes large enough to give an adequate supply. The chief sources of water are wells, springs, and cisterns. Wells that are 200 feet or more in depth generally supply enough water during most of the year; late in the summer the supply from this source becomes very limited. The southern part of

Whidbey Island is fairly well supplied by springs. On Camano Island wells and springs generally furnish an adequate supply of water for domestic use and for livestock.

Vegetation

Most of the area that is now Island County was once covered by dense forests. The forests were mainly Douglas-fir, but western hemlock and western redcedar were associated with the fir (fig. 2). The proportion

Figure 2.—A forest in Island County. The trees are mainly Douglas-fir and hemlock; the undergrowth is salal, Oregon grape, fern, huckleberry, and rhododendron.

of western hemlock and western redcedar varies considerably in the forests that are now in the county. Cedar trees are generally more numerous in poorly drained areas. Nevertheless, both cedar trees and old cedar stumps are more numerous in well-drained areas on southern Whidbey Island than elsewhere.

Small peat bogs in the county, coastal areas, and the areas known as "prairies" have never been covered by forest. The prairie soils, originally covered by grass, are the most important agricultural soils of the county. Only about 5 percent of the total county area is made up of the prairie soils, but except for a few acres, all of the areas are farmed. Vegetation on the prairie soils, though mainly grass, in places includes a few scattered Garry oaks and Douglas-firs. Clumps of oak grow in places in the town of Oak Harbor. Rocky Mountain redcedar grows on some dry sites in the county. Red alder and willow predominate on poorly drained areas.

Other common trees and shrubs are vine maple, Oregon maple, elderberry, madrone, cascara, huckleberry, red huckleberry, snowberry, Oregon grape, and salal. Dogwoods and yews grow in a few places. Rhododendron forms a thick undergrowth in a 2-mile-square area east of Coupeville, but little grows elsewhere in the county. Nettles are common along roads and on areas that are newly cleared. Brackenfern forms a dense cover in all open areas; swordfern is common in shaded areas. Various mosses cover the ground and trunks of trees in forested areas. Various sedges, cattails, skunkcabbage, hardhack, Labrador-tea, and sphagnum moss are the most common plants in fresh-water bogs.

All of the virgin timber has been cut from forested areas. In places second and third cuttings have been made. Logged areas that have been protected from fire now are covered by a stand of young Douglas-firs. Most of the forested areas, however, are covered by mixed alder, Douglas-fir, willow, redcedar, hemlock, and maple, and there is a thick undergrowth.

Trees up to 6 feet in diameter were common in the virgin forests. Trees larger than 2 or 3 feet in diameter were much more numerous and the forests were much more dense on Camano Island than on Whidbey. Trees in present-day forests are generally less than 3 feet thick.

Organization and Development

Island County was originally inhabited by Indian tribes who made a living by fishing, digging clams, and growing potatoes and camas bulbs. The Indians offered no serious resistance to the settlement of the island by white people.

In June 1792 Joseph Whidbey, a member of the Vancouver Expedition from England, discovered the narrow passage that is now known as Deception Pass. With the discovery of this pass, the existence of the island now named Whidbey Island was made known. French-Catholic missionaries, who arrived on May 28, 1840, were the first white settlers to come to Whidbey Island. Colonel Isaac N. Ebey was the first permanent white settler. In 1850 the first claims were filed on Whidbey Island in the area known as Ebeys Prairie. Other claims were taken up at Oak Harbor during the same year. Coveland was settled in 1853, and Utsaladdy, on Camano Island, in 1856. In 1857 Captain Coupe laid out the town of Coupeville, which became the county seat.

The several small unwooded prairies at Crescent Harbor, Ebeys Prairie, San de Fuca, Oak Harbor, Smith Prairie, and Keystone were settled first. The extensive upland areas that were under forest were gradually taken up because of the timber. Lumbering is still the principal industry in these areas.

Island County was organized on January 6, 1853. At that time it included a part of the area that is now Snohomish County. In 1861 all of that part of Island County located on the mainland became a part of Snohomish County.

Population

The population of Island County in 1950[3] was 11,079,

[3] Statistics are from reports published by United States Bureau of the Census.

all of which was classed as rural. The population increased 81.7 percent from 1940 to 1950. When, in 1942, the United States Naval Military Reservation was established at Oak Harbor and Crescent Harbor, the population increased sharply in those areas.

The principal towns on Whidbey Island are Oak Harbor, Coupeville, Langley, and Clinton. All of these towns have post offices, and all except Clinton are incorporated. Other towns or communities are San de Fuca, Greenbank, and Freeland, all of which have post offices, and Keystone, Bay View, Columbia Beach, Maxwelton, Glendale, and Saratoga.

Camano Island has no incorporated towns or post offices. The mail is delivered from Stanwood, which is 8 miles east of Utsaladdy, in Snohomish County. The principal towns on Camano Island are Camano, Utsaladdy, New Utsaladdy, Mabana, and Madrona Beach. These consist mainly of summer residences and resorts.

The Soils of Island County

The soils of Island County have developed under the influence of a moist marine climate. Most of them have developed under forest vegetation. They resemble soils of other counties in the Puget Sound basin. The glacial drift that is the parent material of most of the soils varies considerably in texture, permeability, and consistence. In addition there is considerable variation in drainage and relief. As a result the profiles of the soils are extremely variable. All of the well-drained upland soils have numerous hard or cemented concretions, called shot, in the upper part of the profile (*6*). Differences in rainfall have caused the surface layers to range from slightly to very strongly acid; the soils generally become less acid with depth.

Soils of the Whidbey, Alderwood, Hoypus, and Everett series cover most of the county. Only a small proportion of these soils is cultivated because of the difficulty of clearing them and because the soils are low in fertility and productivity. The Alderwood and Whidbey soils, which have a cemented gray hardpan in the substratum, are more widely used than the Hoypus and Everett soils. The Hoypus and Everett soils have a gravelly, loose, and porous substratum. All of these soils are used mainly for pasture or to grow hay.

The prairie soils, which occupy only about 5 percent of the total area of the county, are the most important agricultural soils. Nevertheless, they produce the greatest proportion of the farm crops. These soils have developed under sparse forest or grass. In contrast to the soils that have developed under forest, they have very dark colored or black surface layers. The subsoils and substrata consist of very friable sandy materials, plastic clay, or a cemented hardpan. The prairie soils have a high content of organic matter, an adequate supply of moisture, and comparatively high fertility. Nearly all of them are in farms and are under cultivation. They are used mainly for pasture, and to grow cereal grains (wheat, oats, and barley), alfalfa, and squash and cabbage for seed.

Soil Series and Their Relations

Table 2 shows how the soils of Island County a classified by topographic position and shows fro what kind of parent material and under what co ditions of drainage each of the soils has develope The series are separated into the following six group (1) Soils of glacial uplands; (2) soils of terraces; (soils of depressions in uplands and terraces; (4) so of deltas and tidal flats; (5) organic soils; and (miscellaneous land types.

Soils of glacial uplands

The soils of the glacial uplands occupy appro mately 75 percent of Island County. The Hoyp Keystone, Whidbey, Swantown, Casey, Townsend, a Bozarth soils of glacial uplands occur on Whidb Island. The other soils, members of the Everett, I dianola, Alderwood, and Bow series, occur on Cama Island.

These soils were all derived from coarse- to fi textured glacial drift. Some are loose and poro others are hard and cemented. Most of them hav brownish surface layer that generally contains so shot, or rounded pellets containing iron. Except the Townsend soils, all have developed under fore Their drainage is moderately good to somewhat exc sive. None of the soils but the Townsend has m than fair suitability for agricultural use. Un careful management, however, good yields of common adapted crops can be obtained.

The Hoypus, Everett, Indianola, and Keystone s were derived from loose, porous glacial drift. Hoypus and Everett soils are gravelly throughc The Indianola and Keystone soils are sandy and f of gravel. The surface layers of the Hoypus Keystone soils are more acid than those of the Eve and Indianola soils. All of the soils are too droug for general agricultural use because they are so lc and porous. They can be pastured or used for for

The Alderwood, Whidbey, Swantown, Bozarth, Townsend soils have all developed from cemen gravelly till. The Alderwood soils have less acid s face layers than the Whidbey. The Swantown sc associated with the Whidbey soils, have a m shallower profile than the Whidbey. In the Boza soils, which have been modified by wind, the surf layer is darker colored than that of the other soil the group except the Townsend. The Townsend s are the only soils of the group that have a nearly bl surface layer. They are fairly good for agricult and most of the areas are in farms.

The Bow and Casey soils have developed from t textured till in which a few pebbles are embedde from lake-laid or marine sediments. The Casey s are more acid than soils of the Bow series. Beca the Bow and Casey soils retain a better supply moisture for plants than other soils of the gla uplands, a greater proportion is cultivated. The and Casey soils are used mainly for pasture and in conjunction with dairying.

TABLE 2.—*Physiographic position, parent material, and natural drainage of the soil series*

Soil group and series or land type	Position	Parent materials	Natural drainage
Soils of glacial uplands:			
Alderwood	Uplands	Cemented gravelly till	Good.
Bow	Uplands	Clay till in which a few embedded pebbles occur or fine-textured, lake-laid or marine sediments.	Imperfect.
Bozarth	Uplands	Cemented gravelly till	Good.
Casey	Uplands	Clay till in which a few embedded pebbles occur or fine-textured, lake-laid or marine sediments.	Moderately good.
Everett	Uplands	Gravelly drift	Somewhat excessive.
Hoypus	Uplands	Gravelly drift	Somewhat excessive.
Indianola	Uplands	Sandy drift	Somewhat excessive.
Keystone	Uplands	Sandy drift	Somewhat excessive.
Swantown	Uplands	Cemented gravelly till	Moderately good.
Townsend	Uplands	Cemented gravelly till	Good.
Whidbey	Uplands	Cemented gravelly till	Good.
Soils of terraces:			
Coupeville	Terraces	Fine-textured marine and glacial lake sediments.	Moderately good.
Ebeys	Terraces	Marine and glacial lake sands	Good.
Pondilla	Terraces	Sands reworked by wind over finer textured material that occurs at depths greater than 3 feet.	Excessive.
San Juan	Terraces	Gravelly outwash	Somewhat excessive.
Snakelum	Terraces	Sandy outwash	Good.
Soils of depressions in uplands and terraces:			
Bellingham	Depressions	Glacial lake or marine silts and clays over till or lake sediments.	Poor.
Coveland	Slight depressions	Clay till, marine or lake-laid sediments; some embedded pebbles.	Poor.
Norma	Depressions	Sandy till	Poor.
Soils of deltas and tidal flats:			
Hovde	Coastal beach	Marine sand and gravel	Poor.
Lummi	Tidal flats	Medium- and fine-textured marine sediments.	Poor.
Puget	Deltas	Fine-textured alluvium	Poor.
Organic soils:			
Carbondale muck	Depressions	Woody accumulations	Very poor.
Greenwood peat	Depressions	Moss accumulations	Very poor.
Mukilteo peat	Depressions	Sedge accumulations	Very poor.
Rifle peat	Depressions	Woody accumulations	Very poor.
Semiahmoo muck	Depressions	Sedge accumulations	Very poor.
Tacoma peat	Depressions	Sedge accumulations and marine sediments.	Very poor.
Tanwax peat	Depressions	Sedimentary organic accumulations.	Very poor.
Miscellaneous land types:			
Coastal beach	Coast	Gravelly and sandy coastal beach material.	Variable.
Fresh water marsh	Depressions	Organic accumulations	Very poor.
Made land	Variable	Variable	Variable.
Rough broken land	Variable	Variable	Variable.
Rough stony land	Uplands	Bedrock	Variable.
Tidal marsh	Tidal flats	Mixed marine sediments	Very poor.

Soils of terraces

Soils of the terraces occupy only about 3 percent of the total county area. Though not extensive, they are the most fertile and productive of any of the soils of the county. The soils are members of the Pondilla, San Juan, Snakelum, Ebeys, and Coupeville series. They were derived from a number of different parent materials. Their drainage is moderately good to excessive.

None of these soils has developed under thick forests. The Pondilla soil, however, has developed under a sparse forest cover. All have nearly black surface layers. The Pondilla soil is coarse textured and porous. Consequently, it is too droughty to be of use for cultivated crops.

Members of the San Juan and Snakelum series are prairie soils. They are closely associated. The San Juan soils were derived from gravelly outwash; the Snakelum, from sandy outwash that is free of gravel. Though somewhat droughty the San Juan and Snakelum soils are good agricultural soils if well managed.

Soils of the Ebeys and Coupeville series have black or very dark gray surface layers. The Ebeys soils, which have sandy subsoils, have developed from marine and glacial lake sands. The Coupeville have developed from fine-textured marine and glacial lake materials and have clay subsoils. Soils of the Ebeys and Coupeville series are the most productive and fertile of all the soils in the county. They produce high yields of wheat, oats, squash, cabbage for seed, alfalfa, and other crops.

Soils of depressions in uplands and terraces

The soils that occur in depressions in uplands and terraces belong to the Norma, Bellingham, and Coveland series. They occupy small depressions, basins, or sloping concave areas that receive considerable seepage and runoff from surrounding uplands. The Coveland soils have the best drainage of any of these soils. During the wet season all of the soils are saturated, and they are often under water unless drained artificially.

The Norma and Bellingham soils have developed under forest, and the Coveland, under grasses, sedges, and brush. The surface layers of these soils are darker and finer textured than those of the adjacent better drained soils. Their subsoils and substrata vary considerably.

The Norma soils have developed from sandy till. They have mottled sandy subsoils and substrata. The subsoil and substrata of the Bellingham soil consist of mottled silts and clays of glacial lake, marine, or till origin.

The Coveland soils are important agriculturally. They are used extensively to grow cabbage for seed, squash, wheat, and oats. Yields are high. If drained adequately the Norma and Bellingham soils are good for pasture or for growing hay in conjunction with dairying. The soils generally occur in association with the better drained soils of uplands, however, and are used for the same purposes.

Soils of deltas and tidal flats

The soils of deltas and tidal flats occupy only ab 2 percent of the total county area. They are memb of the Hovde, Lummi, and Puget series. The Ho soil occurs adjacent to, or directly back of, areas Coastal beach, 0 to 2 percent slopes. The Lummi s occupy low deltas next to tidal marshes or mar waters; before being diked, drained, and reclaim they were generally salty. The Puget soil occup river deltas.

The Hovde and Lummi soils have developed fr marine sediments. The Hovde soil is sandy a gravelly. It cannot be used for agriculture beca it is too sandy and because of the effect of salt wat It is very strongly alkaline a few inches below surface. The Lummi soils are medium to fine t tured. If properly diked and drained they prod high yields of most crops. They are generally pastu or used to grow hay.

The Puget soil, which is an important and prod tive soil in nearby counties, is comparatively un portant in Island County. It occupies only abou square mile. The Puget soil has developed from fi textured recent alluvium. It has poor drainage and not suitable for cropping unless drained artificially

Organic soils

The organic soils are composed primarily of pl materials that are in various stages of decompositi These have accumulated in shallow lakes or in perm nently wet depressions. The organic soils belong the Carbondale muck, Greenwood peat, Mukilteo pe Rifle peat, Semiahmoo muck, Tacoma peat, and T wax peat series. All have very poor drainage, a their water table is at, or near, the surface during m of the year. The soils must be drained artificially they are to be used for crops.

The various organic deposits that make up th soils have low bulk density and a high water-holdi capacity. As a rule the soils are high in nitrogen a low in potassium. The content of other plant nut ents is variable. Organic soils are generally stron acid.

These soils are classified according to the predo nant type of plant material in the upper part of t deposit. The material is of four kinds: Woody, sed moss, and sedimentary. If properly drained the woo and sedge soils are highly productive of most of t adapted crops.

Miscellaneous land types

The miscellaneous land types consist of areas th cannot be classified readily into soil types because t soil-forming materials are so variable or because t soil profile has not developed. The two major misc laneous land types in Island County are Rough brok land and Coastal beach, 0 to 2 percent slopes; min ones are Made land; Rough stony land; Tidal mar

0 to 2 percent slopes; and Fresh water marsh. These areas have little or no value for agriculture.

Descriptions of Soils

This section contains descriptions of the soils mapped in Island County. After the name of each soil is shown a symbol, such as Ae, which marks areas of the soil on the map in the back of this report. The symbol is followed by a group number, which stands for the management group to which the soil belongs. The approximate acreage and proportionate extent of each mapping unit are given in table 3.

TABLE 3.—*Approximate acreage and proportionate extent of the soils mapped*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Alderwood fine sandy loam, 0 to 5 percent slopes	103	0.1	Indianola loamy sand, 15 to 30 percent slopes	1,435	1.1
Alderwood fine sandy loam, 5 to 15 percent slopes	998	.8	Keystone loamy sand, 0 to 5 percent slopes	1,900	1.4
Alderwood fine sandy loam, 15 to 30 percent slopes	106	.1	Keystone loamy sand, 5 to 15 percent slopes	6,985	5.3
Alderwood gravelly sandy loam, 0 to 5 percent slopes	285	.2	Keystone loamy sand, 15 to 30 percent slopes	5,152	3.9
Alderwood gravelly sandy loam, 5 to 15 percent slopes	8,814	6.7	Keystone loamy sand, 30 to 40 percent slopes	238	.2
Alderwood gravelly sandy loam, 15 to 30 percent slopes	2,341	1.8	Keystone fine sandy loam, 0 to 5 percent slopes	227	.2
Bellingham silt loam, 0 to 3 percent slopes	1,075	.8	Lummi silt loam, 0 to 2 percent slopes	977	.7
Bow loam, 0 to 5 percent slopes	1,867	1.4	Lummi silty clay loam, 0 to 2 percent slopes	335	.3
Bow loam, 5 to 15 percent slopes	815	.6	Lummi fine sandy loam, 0 to 2 percent slopes	402	.3
Bozarth fine sandy loam, 0 to 5 percent slopes	137	.1	Made land	720	.5
Bozarth fine sandy loam, 5 to 15 percent slopes	74	.1	Mukilteo peat, 0 to 2 percent slopes	788	.6
Carbondale muck, 0 to 2 percent slopes	159	.1	Mukilteo peat, shallow, 0 to 2 percent slopes	34	(1)
Casey loam, 0 to 5 percent slopes	1,898	1.4	Norma loam, 0 to 3 percent slopes	1,071	.8
Casey loam, 5 to 15 percent slopes	809	.6	Norma loam, 3 to 8 percent slopes	230	.2
Casey loam, 15 to 30 percent slopes	72	.1	Norma silt loam, 0 to 2 percent slopes	710	.5
Casey fine sandy loam, 0 to 5 percent slopes	801	.6	Pondilla fine sand, 0 to 5 percent slopes	104	.1
Casey fine sandy loam, 5 to 15 percent slopes	234	.2	Puget clay loam, 0 to 2 percent slopes	680	.5
Casey fine sandy loam, 15 to 30 percent slopes	16	(1)	Rifle peat, 0 to 2 percent slopes	225	.2
Coastal beach, 0 to 2 percent slopes	1,878	1.4	Rifle peat, shallow, 0 to 2 percent slopes	202	.2
Coupeville loam, 0 to 3 percent slopes	1,015	.8	Rough broken land	2,282	1.7
Coupeville silt loam, 0 to 2 percent slopes	494	.4	Rough stony land	74	.1
Coveland loam, 0 to 5 percent slopes	1,794	1.4	San Juan coarse sandy loam, 0 to 5 percent slopes	850	.6
Coveland loam, 5 to 8 percent slopes	145	.1	San Juan coarse sandy loam, 5 to 15 percent slopes	112	.1
Ebeys sandy loam, 0 to 5 percent slopes	802	.6	Semiahmoo muck, 0 to 2 percent slopes	461	.3
Ebeys sandy loam, 5 to 8 percent slopes	20	(1)	Semiahmoo muck, shallow, 0 to 2 percent slopes	113	.1
Everett gravelly sandy loam, 0 to 5 percent slopes	188	.1	Snakelum coarse sandy loam, 0 to 5 percent slopes	540	.4
Everett gravelly sandy loam, 5 to 15 percent slopes	1,058	.8	Snakelum coarse sandy loam, 5 to 15 percent slopes	21	(1)
Everett gravelly sandy loam, 15 to 30 percent slopes	1,201	.9	Swantown gravelly sandy loam, 0 to 5 percent slopes	1,579	1.2
Fresh water marsh	78	.1	Swantown gravelly sandy loam, 5 to 15 percent slopes	1,901	1.4
Greenwood peat, 0 to 2 percent slopes	54	(1)	Swantown loam, 0 to 5 percent slopes	219	.2
Hovde sand, 0 to 2 percent slopes	388	.3	Swantown loam, 5 to 15 percent slopes	185	.1
Hoypus gravelly loamy sand, 0 to 5 percent slopes	1,624	1.2	Tacoma peat, 0 to 2 percent slopes	347	.3
Hoypus gravelly loamy sand, 5 to 15 percent slopes	11,148	8.6	Tanwax peat, 0 to 2 percent slopes	454	.3
Hoypus gravelly loamy sand, 15 to 30 percent slopes	1,861	1.4	Tanwax peat, shallow, 0 to 2 percent slopes	38	(1)
Hoypus coarse sandy loam, 0 to 5 percent slopes	1,751	1.3	Tidal marsh, 0 to 2 percent slopes	946	.7
Hoypus coarse sandy loam, 5 to 15 percent slopes	646	.5	Townsend sandy loam, 0 to 5 percent slopes	1,235	.9
Hoypus coarse sandy loam, 15 to 30 percent slopes	50	(1)	Townsend sandy loam, 5 to 15 percent slopes	831	.6
Indianola loamy sand, 0 to 5 percent slopes	85	.1	Townsend sandy loam, 15 to 30 percent slopes	28	(1)
Indianola loamy sand, 5 to 15 percent slopes	2,630	2.0	Whidbey gravelly sandy loam, 0 to 5 percent slopes	522	.4
			Whidbey gravelly sandy loam, 5 to 15 percent slopes	42,744	32.5
			Whidbey gravelly sandy loam, 15 to 30 percent slopes	4,429	3.4
			Total	131,840	99.8

[1] Less than 0.1 percent.

Alderwood gravelly sandy loam, 5 to 15 percent slopes (Ae; group 6[4]).—This is the most extensive soil on Camano Island. It has developed from gravelly till derived from a number of rocks, mainly granite, quartzite, argillite, slate, basalt, sandstone, and schist. Its predominant slope is 6 to 12 percent.

The soil occupies prominent rolling moraines, or knolls, on Camano Island and is closely associated with other Alderwood soils. It is also associated with Everett and Bow soils, which generally occur at slightly lower elevations where there is less contrast in relief.

This soil is well drained, although moisture does not penetrate the strongly cemented substratum. During the winter and early in spring, the lower part of the subsoil above the hardpan is saturated for long periods. Because of the coarse texture and friable consistence of the surface layer and subsoil, surface runoff is slow to medium.

The native vegetation consisted mainly of coniferous trees, predominantly Douglas-fir mixed with a few hemlocks and cedars. All of these large native trees have been logged. They have been replaced by stands of trees similar to those in the original forests or by stands that are a mixture of coniferous trees, deciduous trees such as alder and willow, and brush.

Profile description.—To a depth of about 8 inches, the soil is brown to dark-brown[5] friable weakly granular gravelly sandy loam that contains many rounded shot pellets. When the soil is dry the color is brown to pale brown. Except that it is slightly lighter in color and contains a few more shot pellets, the material at depths of 8 to about 15 inches resembles closely the 0- to 8-inch layer.

The subsoil, to a depth of about 24 inches, is yellowish-brown or brown friable gravelly sandy loam. When dry, the material is light yellowish brown or very pale brown. The number of shot pellets in the subsoil decreases with depth. The lower subsoil, to a depth of 30 to 36 inches, is yellowish-brown to light yellowish-brown friable to firm gravelly sandy loam or gravelly loam. It is weakly mottled with yellow and brown, especially in the lower part. When dry it is slightly hard and of very pale brown color.

The boundary is abrupt between the subsoil and the underlying dark-gray or dark grayish-brown strongly cemented till that is many feet thick. Many small rounded pebbles are embedded in the till. Depth to the cemented till, or hardpan, generally is 28 to about 36 inches, although in some places the depth ranges from 24 to 48 inches. Roots do not penetrate the hardpan but form a mat above it. Moisture seeps through it only slowly if at all. The uppermost 6 to 12 inches is generally platy and is strongly mottled with brown and yellow. The hardpan, when dry, is light gray.

In thickly forested areas, forest litter and leaf mold cover the surface of the soil to a depth of an inch or more. Pebbles and some boulders, generally not numerous enough to interfere with tillage, are scattered throughout the profile. In some areas the substratum is only weakly cemented; the degree of cementation varies within short distances. Areas of weak cementation are most common north of Elger Bay on Camano Island.

The surface soil is moderately high in organic matter. It is slightly acid to medium acid but is slightly less acid at greater depths. Because of the hardpan in the soil, the water-holding capacity is higher than that of most soils of uplands. The soil above the hardpan is moderately permeable to roots, moisture, and air.

Use and suitability.—The rolling relief, typical of this soil, promotes good natural drainage; the hardpan helps to retain moisture for plants to use during the growing season. As a result the soil is suited to most of the general crops grown in the area. It is especially well suited to hay and pasture. Nevertheless, most of the soil is under forest, and only a small part is farmed. Farms are generally only about 40 acres in size and are largely in pasture or woodland, though some hay is grown.

Wheat, barley, and oats for grain are not grown extensively. Some fruits and vegetables are grown, but they are generally used at home. The common hay crops are red and alsike clovers mixed with grasses. Oats grown alone or with legumes are also cut for hay. As a rule areas used for hay are seeded to an oats-legume-grass mixture or to oats grown alone once in 2 to 5 years. After the first hay crop has been harvested, the soil is generally pastured for the rest of the season.

Permanent pastures are mainly areas of woodland or partly cleared woodland. Only a few have been seeded to legumes or tame grasses.

Barnyard manure is the fertilizer most commonly used. Commercial fertilizers are not used extensively, but occasionally superphosphate is applied to pastures and hay crops with the manure. So little of the soil is used for tilled crops that the crops are not commonly rotated.

Alderwood gravelly sandy loam, 0 to 5 percent slopes (Ad; group 6).—A few areas of this inextensive soil occur in the northern half of Camano Island. The soil generally occupies the crest of the glacial moraine. It is closely associated with areas of Alderwood gravelly sandy loam, 5 to 15 percent slopes, which it resembles. Depth to the cemented substratum of Alderwood gravelly sandy loam, 0 to 5 percent slopes, is more uniform than in the more strongly sloping phase. Surface drainage is very slow in this soil. Internal drainage is slightly more restricted than in Alderwood gravelly sandy loam, 5 to 15 percent slopes.

Use and suitability.—Only a few acres of this soil are under cultivation. The rest is covered by trees and brush. Yields are a little higher than on the more sloping Alderwood gravelly sandy loams because this soil supplies slightly more moisture to plants during the latter part of the growing season.

Alderwood gravelly sandy loam, 15 to 30 percent slopes (Af; group 13).—This soil generally occurs on hillsides. It occupies steeper slopes than the closely associated Alderwood gravelly sandy loam, 5 to 15 percent slopes. Except that its profile is more variable, it closely resembles the associated Alderwood

[4] Management group to which soil belongs.
[5] Unless otherwise indicated, color is that of moist soil.

soil. The degree of cementation in the substratum varies within short distances. In places the substratum resembles that of the Everett and Indianola soils.

Included with this mapping unit are areas in which slopes are more than 30 percent.

Use and suitability.—Little of this soil has been cleared, but a small acreage is in woodland pasture. If well managed some slopes that do not exceed 25 percent can be pastured or used for hay with fair success. Because of the steep slopes, however, the soil is generally considered of more value for growing trees than for cropping.

Alderwood fine sandy loam, 5 to 15 percent slopes (Ab; group 6).—This soil occupies a well-defined moraine on the southern end of Camano Island. It is associated with the Indianola loamy sands. Except that it has a very hard to strongly cemented sandy substratum, it resembles the Indianola soils. The surface texture differs from that of Alderwood gravelly sandy loam, 5 to 15 percent slopes. In addition the color is a brighter brown or a reddish brown and the profile is free of gravel.

Profile description.—The surface layer, to depths of 6 to 10 inches, is dark-brown to reddish-brown friable moderately granular fine sandy loam. It contains a few shot pellets and an occasional pebble. When dry the color is brown.

The upper subsoil, to depths of 20 to 24 inches, is generally brown to dark-brown friable fine sandy loam, but there are some areas in which the consistence is firm. It contains fewer shot than the surface soil and only a few pebbles.

At depths of 22 to 30 inches, the soil is yellowish-brown firm fine sandy loam or loam, slightly mottled with yellow and brown. The lower boundary of this layer is abrupt.

Depth to the cemented substratum is 28 to 40 inches. The substratum is dark-gray weakly to strongly cemented sandy till many feet thick. A few pebbles are embedded in the till. The uppermost 4 to 8 inches is strongly mottled with yellowish brown and brown.

In places, where the soil is closely associated with the Indianola loamy sands, the soil beneath the surface layer is somewhat stratified and there are soft, firm to very firm layers of sandy loam or fine sandy loam. This material grades to a very hard or weakly cemented sandy hardpan.

The surface layer of Alderwood fine sandy loam, 5 to 15 percent slopes, is slightly to medium acid. At greater depths it is slightly less acid than near the surface. The soil above the cemented substratum is moderately permeable to roots, moisture, and air. Roots form a mat just above the hardpan. The substratum is nearly impervious to moisture, and seepage is lateral.

Use and suitability.—Only a few acres of this soil is farmed; the rest is covered by trees and brush. Areas in farms are pastured or used to grow hay.

The soil is generally slightly more productive than Alderwood gravelly sandy loam, 5 to 15 percent slopes, because of its finer texture and freedom from gravel. Also springs are more numerous, the soil retains moisture better during the latter part of the summer, and rainfall is higher in the southern part of Camano Island, where this soil occurs, than in the northern part where Alderwood gravelly sandy loam, 5 to 15 percent slopes, occurs.

Alderwood fine sandy loam, 0 to 5 percent slopes (Aa; group 6).—This soil occupies only a few scattered areas. It resembles, and is closely associated with, areas of Alderwood fine sandy loam, 5 to 15 percent slopes. Its profile is more variable, however, than that of the associated soil, and its surface drainage is slower because of its milder slopes.

Use and suitability.—Except for a few acres in pasture, this soil is covered by trees and brush. If cropped it is slightly more productive than Alderwood fine sandy loam, 5 to 15 percent slopes.

Alderwood fine sandy loam, 15 to 30 percent slopes (Ac; group 13).—Areas of this inextensive soil are scattered. The soil is associated with Alderwood fine sandy loam, 5 to 15 percent slopes, and with Indianola loamy sand, 5 to 15 percent slopes. Except for its surface texture, it closely resembles Alderwood gravelly sandy loam, 15 to 30 percent slopes.

Use and suitability.—A small part of Alderwood fine sandy loam, 15 to 30 percent slopes, is used for residences or for farms on which the products are grown mainly for home use. The rest is covered by trees.

Bellingham silt loam, 0 to 3 percent slopes (Ba; group 9).—This soil is dark colored and poorly drained. It occurs in depressions or on flats in the glaciated upland areas, where it is closely associated with the Bow soils, and, to a lesser extent, in small depressions in association with the other soils of uplands. Slopes are generally less than 1 percent.

The parent materials from which the soil has developed are glacial lake sediments or marine silts and clays that overlie till or lake sediments. Normally the parent material is free of gravel. In some areas, however, at depths below 3 or 4 feet, many pebbles are embedded in the silts or clays.

During the rainy winter season, water stands on the surface of the soil for long periods. By ditching or tiling, most areas can be drained well enough so that crops can be grown. Deciduous trees are the principal vegetation on uncleared areas. The native vegetation was a mixture of coniferous and deciduous trees—mainly Douglas-fir, cedar, alder, willow, ash, and hemlock—and some shrubs and vines.

Profile description.—To depths of 6 to 8 inches, the surface layer is very dark gray, or nearly black, friable granular silt loam. This layer is generally dark gray when dry.

To depths of 20 to 24 inches, the material that underlies the surface layer is gray to dark-gray firm very fine sandy loam, loam, or silt loam, moderately mottled with yellow and brown in the lower part.

The material below this layer is gray to light brownish-gray, massive, plastic silty clay loam or clay, very prominently mottled with brown and reddish brown. Below depths of about 4 feet, the mottlings are fewer in number, and a few pebbles are generally embedded in the fine-textured material.

When dry the surface layer is of various colors;

tilled fields are generally gray, but areas of darker color are evident when the fields are freshly plowed. Some areas of Bellingham silt loam, 0 to 3 percent slopes, associated with Alderwood and Whidbey soils, have gravelly clay till at a depth of about 3 feet.

The surface layer of Bellingham silt loam, 0 to 3 percent slopes, has a moderately high content of organic matter. The soil is slightly acid throughout but is nearly neutral in the substratum. It is slowly permeable to moisture and plant roots, and the roots do not penetrate the lower subsoil and substratum readily.

Included with this soil are small areas that have a clay loam or silty clay loam surface layer. Such areas, which have a lighter color, are generally small. As a rule they occupy only slight depressions and have slightly better drainage than is typical of Bellingham silt loam, 0 to 3 percent slopes.

Use and suitability.—Bellingham silt loam, 0 to 3 percent slopes, is generally not suited to crops if it has not been drained artificially. Most of the areas associated with the Bow soils in the northern part of Camano Island have been cleared and drained. Many of the areas in other parts of the county are small and isolated and are still covered by trees and brush.

Areas in farms are generally pastured or used to grow hay. The soil retains more moisture during the dry summer months than is retained by the well-drained associated upland soils. Consequently, the carrying capacity of pasture on this soil is higher.

Areas of the soil are so small that they are usually put to the same use as associated soils. In addition to being pastured or used to grow hay, larger areas are used to grow oats, barley, and wheat. Yields vary greatly because of differences in artificial drainage.

Bow loam, 0 to 5 percent slopes (Bb; group 3).—This soil occurs on a gently undulating plateau in which there are a few steeper slopes. Except for a few scattered areas, the soil is all in the northeastern part of Camano Island. It has developed from a mixture of clay till and fine-textured glacial lake or marine sediments. In places it consists of a very fine textured till in which a few pebbles are embedded.

Natural drainage is imperfect. Internal drainage is slow, and slight variations in slope affect the rate of drainage. Artificial drainage is beneficial in some areas where early seeded crops are to be grown.

The native vegetation resembles that on well-drained upland soils of the county. It consists largely of Douglas-fir.

Profile description.—The surface layer, to depths of 6 to 9 inches, is brown, dark-brown or dark grayish-brown, friable, moderately granular loam. It contains a few shot pellets and scattered pebbles. When the soil is dry, the color is brown to grayish brown.

From 8 to 15 inches, the soil is brown. In other ways it resembles the surface layer.

The subsoil, to a depth of 20 inches, is olive-gray or grayish-brown firm to very firm loam or sandy clay loam, distinctly mottled with yellowish brown. The structure is massive, but the soil breaks to irregular fragments. The subsoil is 2 to 12 inches thick.

The boundary is abrupt between the subsoil and the material that directly underlies it. This underlying material, a gray or olive very plastic clay, is distinctly mottled with yellow and yellowish brown. This clay has a weakly developed prismatic structure but breaks readily to subangular blocky aggregates.

Below depths of 30 to 48 inches, the substratum is olive-gray, gray, or dark-gray, very firm, massive clay till in which mottlings are much less numerous than in the layer immediately above. This material, when moist, is light olive gray. A few pebbles are embedded in the till, and in some areas the substratum is very gravelly below depths of 3 feet.

The profile is generally free of stones and pebbles, but they occur in varying amounts in some areas. A few stones occur on the surface in places. The texture of the surface soil ranges from heavy sandy loam to silt loam. In a few places depth to the clay substratum is 12 to 30 inches. These shallow areas have grayer surface soils.

The profile is medium to slightly acid throughout but is less acid with increasing depth. The upper part of the soil is moderately permeable to plant roots, moisture, and air, but the fine-textured material in the lower part of the profile is much less permeable.

Use and suitability.—Because of its favorable relief, good water-holding capacity, and fair to moderate fertility, most of this soil is in farms. About half is cultivated, and the rest is in woodland pasture or trees. The cultivated areas are used principally for pasture and for hay crops in conjunction with dairying (fig. 3). Cash crops, such as oats and wheat, are also grown. In recent years green peas have been grown to a limited extent with fair success, but the acreage has decreased somewhat during the past 10 years.

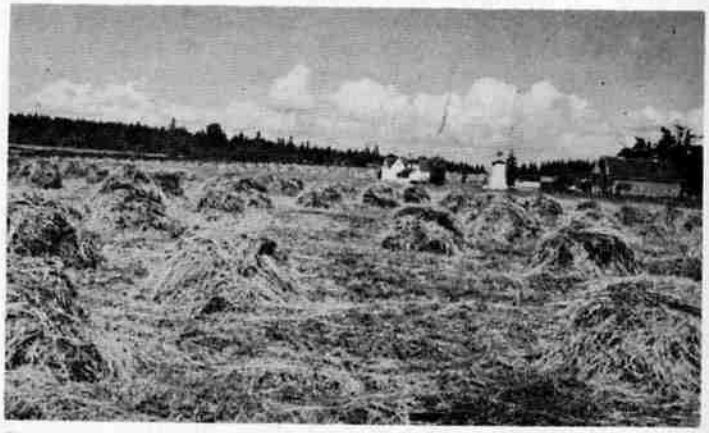

Figure 3.—Mixed grass-and-clover hay on Bow loam, 0 to 5 percent slopes. The field will be pastured after the second cutting.

The principal hay crop is a mixture of red or alsike clover and grasses, mainly timothy. Usually only one hay crop is cut in a season, and the field is then pastured. As a rule a field is left in hay for 2 years, pastured the third year, and then plowed and planted to a cash crop, such as oats, wheat, or peas, the fourth year. Oats are used either as grain or hay.

Barnyard manure and phosphate are generally used to fertilize green peas. Little fertilizer is used on other crops, but barnyard manure is used on pastures.

Bow loam, 5 to 15 percent slopes (Bc; group 3).—This soil is similar to Bow loam, 0 to 5 percent slopes, with which it is associated. Its surface texture is generally not so fine, and pebbles and stones occur more frequently. Surface runoff is medium instead of slow, and natural drainage is not quite so restricted.

Included with Bow loam, 5 to 15 percent slopes, are a few small areas that have slopes greater than 15 percent.

Use and suitability.—Slightly less than a fourth of this soil has been cleared. The present use and cultural practices are similar to those of Bow loam, 0 to 5 percent slopes. Areas that are not cultivated are used largely as woodland pasture.

Bozarth fine sandy loam, 0 to 5 percent slopes (Bd; group 6).—This soil occupies long narrow strips near the western coast of Whidbey Island opposite the Strait of Juan de Fuca. Here strong westerly winds blow for short periods during the winter. The soil occurs between areas of Pondilla soil, which are adjacent to the coast on the west, and Whidbey or Swantown soils, which occur on the opposite side to the east.

Bozarth fine sandy loam, 0 to 5 percent slopes, has developed in part from windborne materials, similar to the materials from which the associated Pondilla fine sand, 0 to 5 percent slopes, originated, but the two soils differ in texture. At a depth of about 20 inches, this Bozarth soil overlies strongly cemented gravelly till that is similar to that which underlies the Whidbey and Swantown soils. Natural drainage is good in the Bozarth soil because the cemented substratum prevents too rapid internal drainage.

The soil occurs on the edges of the forested areas and was never entirely covered by thick forests. Some areas are thickly forested, but in other places the forest is sparse and grasses predominate.

Profile description.—To a depth of about 6 inches, the surface layer is very dark grayish-brown friable fine sandy loam. The structure is weakly developed fine granular. When dry the soil is brown to dark grayish brown.

The surface layer grades to material that, except for a slightly lighter color, is similar to that of the 0- to 6-inch layer. Darker colored organic stains occur in the lower part in places. This horizon is 4 to 8 inches thick. The boundary between this horizon and the subsoil is abrupt.

Beginning at depths of 11 to 12 inches, the subsoil is dark grayish-brown firm to very firm fine sandy loam strongly mottled with yellow and brown. When dry the soil is light gray.

The boundary is abrupt between the subsoil and the dark-gray or dark grayish-brown strongly cemented gravelly till. Mottles are common in the upper part of the till but decrease in number with increasing depth. Except where it merges with Whidbey or Swantown soils, the soil above the cemented substratum is free of gravel and stones.

The color of the surface soil ranges from dark brown to very dark grayish brown. In one area, about a half mile north of Ault Field and Clover Valley, the soil is deeper over the cemented substratum than typical. The depth in this area ranges from 30 to 48 inches, and in places the substratum is weakly cemented. The origin of this area of deeper soil has not been determined. It is surrounded by Keystone and Hoypus soils, which originated mainly from gravelly or sandy drift; however, the area of Keystone loamy sand that lies to the west of the area of Bozarth soil appears to have been modified by wind action.

Bozarth fine sandy loam, 0 to 5 percent slopes, is slightly acid above the substratum and neutral below. Roots form a mat just above the cemented substratum, which is very slowly permeable to moisture and air.

Use and suitability.—About 75 percent of this soil is cultivated. The rest is idle or covered by trees and brush. Grass for seed, hay, oats, and wheat are grown, and some areas are pastured. Italian ryegrass, grown for seed, has been an important crop in recent years. The soil is fairly well suited to bulb and row crops, but because of the occasional strong winds and resulting wind erosion, the growing of these crops has been discontinued.

This soil is so small in total acreage that yields are difficult to estimate. Also some areas are so small that they are farmed with other soils, and yields therefore may not be typical. The water-holding capacity is higher and the content of organic matter greater than in the Whidbey and Swantown gravelly sandy loam soils. Consequently, yields are a little better than on the Whidbey and Swantown soils under similar management.

Bozarth fine sandy loam, 5 to 15 percent slopes (Be; group 6).—Except that its predominant slope is 6 to 10 percent, this soil resembles Bozarth fine sandy loam, 0 to 5 percent slopes. The surface soil is generally lighter in color and ranges from brown to grayish brown when dry. Forests are more extensive than on areas that are more nearly level.

Use and suitability.—Only a few acres of this soil are cultivated. The rest is covered by trees or brush. Hay and grains are grown, and some areas are pastured. Yields are approximately the same as those obtained on Bozarth fine sandy loam, 0 to 5 percent slopes.

Carbondale muck, 0 to 2 percent slopes (Ca; group 7).—Carbondale muck, 0 to 2 percent slopes, consists of well-decomposed woody organic matter that overlies woody and fibrous materials in various stages of decomposition. It occupies depressions left by glacial lakes or occurs along the edges of stream channels or bays. It may occur alone or in association with one or more other organic soils. The areas have no natural drainage outlets, so they are generally ponded during part of the year.

Profile description.—The surface layer, to depths of 8 to 12 inches, is very dark brown to nearly black muck or peaty muck, granular in structure, that contains a few fragments of partly rotted wood. In cultivated fields the color is nearly black.

The surface layer is underlain by very dark brown, partly decomposed woody or fibrous organic materials

in which individual particles are easily recognized. Below 24 inches the material is largely sedge peat, which in places grades to a sedimentary or colloidal peat.

Except for about 12 acres, half of which is within the boundaries of the Naval Reservation near Clover Valley, depth to the mineral soil is more than 2 feet and is generally more than 6 feet. In the 12-acre area, organic materials are only about 20 inches deep over the mineral soil.

Use and suitability.—Drainage is the chief problem in the use of Carbondale muck, 0 to 2 percent slopes. Areas in which drainage has been improved are highly productive of many crops, such as oats, hay, and truck crops. Most of this soil is cultivated. About a third is within the boundaries of the Naval Reservation near Clover Valley, and its use is generally limited to hay and oats.

Casey loam, 0 to 5 percent slopes (Ce; group 3).—This soil has developed from till and lake-laid or marine sediments. The parent material is generally fine textured, but a few pebbles occur in the surface layer and subsoil and at depths below 3 or 4 feet in the substratum. Most of this soil occupies areas southwest of Prairie Center. None of it occurs on Camano Island. Its predominant slope is 3 to 5 percent.

Natural drainage is moderately good. The soil becomes saturated during the winter, but there is enough slope so that excess water runs off. Artificial drainage will benefit early crops.

The native vegetation consisted of coniferous species, largely Douglas-fir and a little hemlock and cedar. All of the native trees have been cut. Areas that are not under cultivation are now covered by a mixture of coniferous trees, deciduous trees such as alder, willow, and maple, and brush.

Profile description.—To a depth of about 6 inches, the surface layer is dark grayish-brown, friable, granular loam. When dry it is hard and the color is grayish brown to brown. In undisturbed forested areas, organic forest litter covers the surface. Immediately below the organic cover is a distinct ½- to 2-inch light-gray horizon of loamy sand.

At depths of 6 to about 12 inches, the material is grayish-brown, very firm, massive sandy loam or loam that contains some pebbles. Some mottling occurs. When dry this layer is extremely hard in places and its color is light brownish gray.

The boundary is abrupt between the 6- to 12-inch layer and the underlying very plastic, strongly mottled olive or olive-gray clay in which a few pebbles are embedded. This material has a weak columnar or prismatic structure, but it breaks readily to subangular blocky fragments. Dark-gray and purplish-gray stains occur along the cleavage lines. Depth to this clay material is 10 to 24 inches.

At a depth of about 36 inches, the clay is olive gray and is almost free of mottling. When dry its color is light gray and the clay is compact, is very hard, and breaks to subangular blocky pieces.

Gravelly glacial material occurs at depths of 4 to 6 feet or more. Some embedded gravel generally occurs in all parts of the profile.

Within short distances, the color of the surface layer ranges from grayish brown to dark brown. In areas of the soil about 3½ miles southwest of Oak Harbor, the depth to clay is 20 to 24 inches.

The surface layer of Casey loam, 0 to 5 percent slopes, is strongly acid to medium acid. The profile is less acid at greater depths. At depths below about 36 inches, the substratum is neutral. Though the subsoil and substratum are very hard when dry, plant roots and moisture penetrate. Moisture, however, moves very slowly through the clay substratum.

Use and suitability.—About 70 percent of this soil has been cleared, and the rest is covered by trees and brush. Parts of the wooded areas are used as woodland pasture. The soil has a high water-holding capacity, but cultivation is difficult. It is better suited to pasture or to growing hay and grass for seed than to grain and row crops (fig. 4). The farms are generally dairy farms.

***Figure 4.*—Alfalfa pasture and forest on Casey loam, 0 to 5 percent slopes. Because of their low fertility and the high cost of clearing, many areas of Casey loam are still under forest.**

On cultivated areas Alta fescue and Italian ryegrass are grown for seed. Yields vary greatly because of the method of seeding and difficulty of harvesting but are better when the crop is seeded in rows. Soft winter wheat and spring-seeded oats and barley are also grown. Squash and cabbage grown for seed have been moderately successful as crops.

Casey loam, 5 to 15 percent slopes (Cf; group 3).—This soil generally occurs along the outer edges of areas of Casey loam, 0 to 5 percent slopes. Its profile varies more than that of the less sloping Casey soil, especially in depth to the fine-textured material. Natural drainage is slightly better because of the stronger slope. Consequently, the surface layer is browner and not quite so dark and variable as that of the less sloping soil. The predominant slope is 8 to 12 percent.

Use and suitability.—Only about 25 percent of this soil has been cleared. Crops are the same as those grown on Casey loam, 0 to 5 percent slopes, and management is similar. A little more than one-fifth of the

soil is within the boundaries of the military reservation east of Oak Harbor and is used mainly to grow hay.

Casey loam, 15 to 30 percent slopes (Cg; group 14).—This soil is not extensive. It occurs in a few widely scattered areas and is associated with less sloping areas of Casey loam. Although its profile is more variable, the soil resembles Casey loam, 0 to 5 percent slopes.

Use and suitability.—This soil is better suited to growing trees than to other uses, and most of it is covered by trees and brush. A few acres, associated with less sloping areas, are pastured.

Casey fine sandy loam, 0 to 5 percent slopes (Cb; group 3).—This is not an extensive soil. Most of it occurs in one area east and southeast of Coupeville, where it is associated with the Hoypus soils. Except for its lighter color and coarser textured surface layer, the soil closely resembles Casey loam, 0 to 5 percent slopes. The parent materials from which it was derived are similar to those from which the Casey loams originated, but they are not so plastic or fine textured and are more variable. The predominant slopes are 3 to 5 percent.

This soil is moderately well drained but has slow internal drainage. The native vegetation consisted largely of Douglas-fir, but there were a few hemlocks and cedars. In areas that have not been cleared, alder, willow, maple, and other deciduous trees and brush are now mixed with the native species.

Profile description.—To a depth of about 6 inches, the surface layer is brown to grayish-brown friable fine sandy loam that is faintly stained with yellow and brown. It contains a few shot pellets. The soil is very pale brown to light brownish gray when dry. In undisturbed areas under forest, a 1- to 3-inch layer of organic forest litter, overlying a 1-inch gray sandy horizon, covers the surface. The surface soil grades to very firm fine sandy loam, of similar color, that is difficult to penetrate when dry.

At depths of 16 to 18 inches, there is an abrupt transition to faintly mottled olive or olive-gray, compact, very plastic clay, silty clay, or silty clay loam. When dry this material has a faint prismatic structure, but it breaks readily to fine subangular blocky aggregates. In some areas this layer is silt loam or clay, which is stratified in places.

The substratum, beginning at depths of 24 to 36 inches, is dark-gray, gray, and light-gray gravelly and sandy glacial material that is loose and porous. In some places the substratum is weakly cemented by finer material.

The surface layer of Casey fine sandy loam, 0 to 5 percent slopes, is very strongly acid to strongly acid. The profile below the surface layer is strongly acid to medium acid.

Use and suitability.—Although the soil is fairly well suited to the crops commonly grown in the county, less than 10 percent has been cleared. Most of it is covered by trees and brush. Some is used as woodland pasture. Cleared areas are generally pastured or used to grow hay. Management practices are much the same as those used for Casey loam, 0 to 5 percent slopes. Yields, especially those of cereal grains, are a little lower because the water-holding capacity of this soil is not quite so high as that of Casey loam.

Casey fine sandy loam, 5 to 15 percent slopes (Cc; group 3).—This soil is closely associated with Casey fine sandy loam, 0 to 5 percent slopes, but it is much less extensive. The surface layer is deeper than that of the more gently sloping soil, and the texture is generally slightly coarser.

Use and suitability.—Most of this soil is in forest or in woodland pasture. A small part is in hay and pasture. Yields are about the same as those on Casey fine sandy loam, 0 to 5 percent slopes.

Casey fine sandy loam, 15 to 30 percent slopes (Cd; group 14).—Only two areas of this soil occur in Island County, and the total acreage is very small. Except for slope, the soil resembles the less sloping areas of Casey fine sandy loam. The surface texture ranges from sandy loam to a light loam.

Use and suitability.—This soil is best suited to growing trees. All of it is covered by trees and brush.

Coastal beach, 0 to 2 percent slopes (Ch; group 15).—This miscellaneous land type consists of narrow strips of shore-washed beach sand and gravel that lie parallel to the coast. The narrower strips are about 100 feet in width, but some areas are much wider. The widest occur on West Beach southwest of Deception Pass. Here, the strong westerly winds have piled low sand dunes that are moving eastward very slowly. Some areas occupy low, narrow ridges, or successive ridges, behind which may be trapped fresh or salt water marshes. The marshes are comprised of Lummi soils; Tidal marsh, 0 to 2 percent slopes; and organic peats.

The materials from which Coastal beach, 0 to 2 percent slopes, has formed are predominantly gravelly, but a few areas are sandy. The West Beach areas are generally free of gravel and are comprised of medium to coarse sand.

During high tides or storms, these areas may be under water, and they are often littered with driftwood. The areas are generally bare of vegetation, but in places short-lived grasses or shrubs grow along the margins farthest from the water.

Use and suitability.—This miscellaneous land type is not suited to agricultural use. It can be used only as a source of roadbuilding and construction materials, for homesites, or for recreational purposes. Many of the areas not affected by storms or high tides are used as sites for summer homes or for resort areas.

Coupeville loam, 0 to 3 percent slopes (Ck; group 1).—This is one of the most important agricultural soils in the county. It occurs on nearly level to gently undulating terrain near Puget Sound, chiefly in the vicinity of Ebeys Prairie and Keystone. It is associated with Ebeys sandy loams. The soil occupies lower positions than the adjacent moderately well drained forested soils.

The areas where the soil occurs appear to have been occupied at one time by marine waters or by glacial lakes and sloughs. They may have served as broad glacial channels that emptied into the heads of small bays and inlets. The fine-textured parent materials

from which the soil was derived were probably glacial in origin but were reworked and later deposited in the marine and glacial-lake waters.

The soil is moderately well drained, but because of its fine-textured substratum, it has slow internal drainage. During the winter the lower subsoil becomes saturated unless the soil is drained artificially. Most of the soil, however, is drained by tiles or by open ditches. The water-holding capacity is high, and crops seldom lack sufficient moisture.

The native vegetation was mostly grass. There were a few scattered Douglas-firs and oaks.

Profile description.—The surface layer, to a depth of about 10 inches, is black granular friable loam. The dark color of the surface soil is probably a result of the grass cover under which the soil developed. An abrupt boundary separates this layer from a layer of dark grayish-brown sandy loam or light sandy clay loam that is hard when dry and breaks to subangular blocky or prismatic fragments.

At a depth of about 18 inches, the material grades to olive-gray or gray sandy loam, faintly mottled with yellow and brown. This is firm in place but crumbles readily to small irregular fragments or single grains when removed. When dry the material is light gray. The boundary is abrupt between this horizon and an underlying layer of gray very plastic clay in which there is little or no mottling. This clay layer is also light gray when dry.

The texture of the surface layer ranges from heavy sandy loam to sandy clay loam. In places sandy lenses occur in the subsoil and substratum. A few pebbles are embedded in the soil in areas that lie next to areas of San Juan soils. In places the upper part of the clay substratum is strongly mottled.

The surface soil is medium acid. The soil becomes less acid with increasing depth, and the clay substratum is neutral or mildly alkaline. The organic-matter content of the surface soil is high.

Use and suitability.—This is one of the best soils in the county for general crops and truck crops. Because of its fine-textured subsoil and low-lying position, it retains a good supply of moisture and crops are seldom affected by drought. The lower lying areas, however, sometimes receive too much moisture and are flooded for short periods after heavy rains.

The soil is all in farms and all under cultivation. Most of the farms are diversified; that is, dairying and cropping are done in combination. Cereal grains and truck crops predominate among the crops grown. The common crops are alfalfa for hay and pasture; wheat, oats, and barley; and squash and cabbage for seed (fig. 5).

Seasonal variations in yields are not so great on this soil as they are on most of the soils of the county. Yields of alfalfa hay and wheat are high. The frequent rains in early summer sometimes ruin the first cutting of alfalfa. Generally two cuttings are made, however, and the areas are then pastured for the rest of the year.

A soft-grained winter variety of wheat is usually grown. This is used mainly for feed. During the past few years, much of the wheat grown on Ebeys Prairie has been harvested by turkeys. Half-grown to full-grown turkeys, put in the fields when the wheat is nearly ripe, will leave practically no grain in the fields. This practice reduces the cost of feeding the turkeys and eliminates the expense of harvesting. In addition organic matter from the straw and turkey droppings is added to the soil.

Figure 5.—Squash growing on Coupeville loam, 0 to 3 percent slopes. The field in the background is in winter wheat.

The acreage in oats and barley is smaller than that in wheat, but yields are high. Cabbage grown for seed is an important cash crop. Squash, principally green hubbard, is an important crop, but yields vary considerably. Storage of squash is a major problem because only a small part of the crop can be marketed as soon as it is picked. The best and most economical way to prevent spoiling is to pack the squash between layers of straw and keep them in well-ventilated buildings.

Complete commercial fertilizers are generally used for squash and cabbage. In the spring fertilizers that are high in potassium are added to fall-planted cabbage to encourage seed to develop.

Coupeville silt loam, 0 to 2 percent slopes (Cm; group 1).—This soil is closely associated with Coupeville loam, 0 to 3 percent slopes, but occupies slightly lower positions. Surface runoff is very slow. The water table is high, and during the rainy season it is at, or near, the surface. Artificial drainage is helpful.

The soil has developed from the same parent material as that from which Coupeville loam, 0 to 3 percent slopes, originated. Except for differences in the texture of the surface layer and in the depth to clay, the two soils have similar profiles and were formed under similar native vegetation.

Profile description.—The surface layer, to a depth of 9 inches, is black, granular, friable silt loam. Immediately below this, and separated from it by an abrupt boundary, is a layer of dark grayish-brown sandy loam or sandy clay loam, which is firm in place,

weakly prismatic, and faintly mottled with yellow and brown. Dark-gray organic seams occur along root channels. From 12 to about 36 inches, the material is olive-gray or gray very plastic clay, strongly mottled with yellow and brown. When dry this layer is light gray. Below 36 inches the clay is finer textured, lighter colored, and not so strongly mottled. Flecks and coatings of white lime occur. At a depth of about 48 inches, the material is light gray to gray but is nearly white when dry.

The surface layer is high in organic matter. It is medium to slightly acid, but the rest of the profile is mildly to moderately alkaline. An accumulation of lime occurs at depths below about 36 inches.

Use and suitability.—Except that it requires more careful drainage and tillage, this soil is managed in about the same way as Coupeville loam, 0 to 3 percent slopes (fig. 6). The area located at Prairie Center on

Figure 6.—**Squash and a small grain growing on Coupeville silt loam, 0 to 2 percent slopes, on Ebeys Prairie.**

Ebeys Prairie is more in need of drainage than other areas. The soil dries out later in spring than Coupeville loam, 0 to 3 percent slopes, so crops are somewhat later. Average yields are slightly lower and more variable, although similar crops are grown.

Coveland loam, 0 to 5 percent slopes (Cn; group 2).—This soil occupies slight depressions in uplands or terraces next to bays and inlets. It is associated with the Townsend soils but occupies lower lying positions. It is also closely associated with the Casey loams.

Because of its position in depressions, the soil receives runoff and seepage from higher lying areas. Although surface runoff is slow, the soil has enough slope so that excess water runs off. During rainy seasons the soil becomes saturated, but the water stands on the surface for only a short time. Artificial drainage would benefit most crops grown on this soil.

The native vegetation was mainly grass. It included also some brush and a few scattered trees.

Profile description.—The surface layer, to depths of 8 to 15 inches, is black, friable, moderate medium granular loam. Scattered angular and subangular pebbles and small stones occur in places. When dry, the surface layer is very dark gray to very dark grayish brown.

The boundary is abrupt between the surface layer and the horizon immediately below, which is light olive-gray or light brownish-gray strongly mottled, massive, firm loam or heavy sandy loam in which there are a few embedded pebbles. When dry this material is hard to extremely hard. The horizon is 4 to 14 inches thick. Transition is gradual to the clay material immediately below.

Beginning at a depth of about 24 inches is a layer of olive or olive-gray clay, very strongly mottled with brownish yellow and yellow. It is light gray when dry. The material is very plastic when wet and hard when dry. It breaks readily to small blocky fragments.

Below about 36 inches, the material is massive compact clay or clay loam, slightly darker colored and less strongly mottled than the layer just above. It contains a few embedded pebbles.

The amount of gravel increases with depth. The material is generally coarser textured and very gravelly at depths below about 54 inches, but the depth to this gravelly substratum ranges from 3 to 5 feet.

In an area of this soil about 2 miles south of Oak Harbor, the depth to clay is more variable and in places is as much as 4 feet. The subsoil in this area is coarser textured and more friable than in the normal profile and contains few pebbles.

The soil is high in organic matter. The surface layer is medium acid, but the soil becomes less acid with depth. At a depth of about 36 inches it is mildly alkaline, but there is no apparent lime accumulation.

Use and suitability.—This soil is one of the most productive agricultural soils in the county (fig. 7). Its high content of organic matter and good supply of

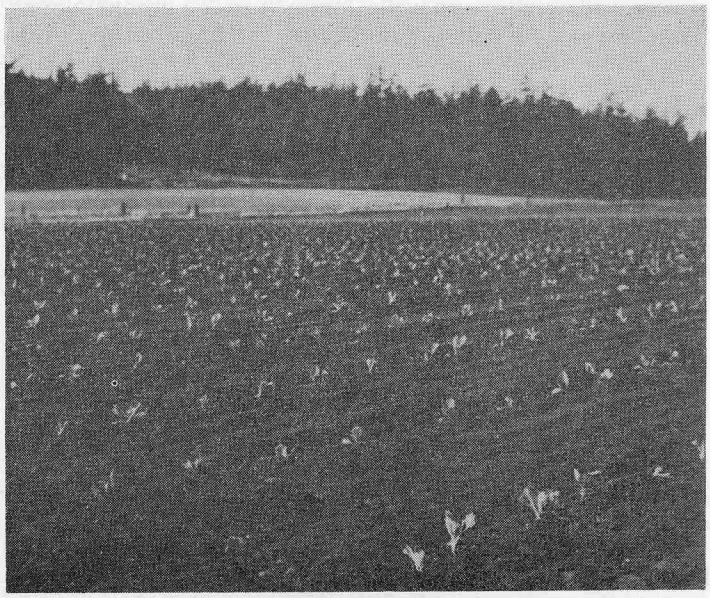

Figure 7.—**Cabbage being grown for seed on Coveland loam, 0 to 5 percent slopes. Forests in the background are on Whidbey gravelly sandy loam, 5 to 15 percent slopes.**

moisture make it suitable for the same crops as are grown on Coupeville loam, 0 to 3 percent slopes. Yields, however, are slightly lower.

Approximately half of the soil is within the boundaries of the Naval Reservation. Part of that area is leased for farming, but its use is limited to growing hay and cereal grains.

The remaining half of the soil is in farms. Much of the cabbage grown for seed was grown on areas of this soil, but diseases such as blight have reduced yields in some years. Squash grows well.

Coveland loam, 5 to 8 percent slopes (Co; group 2).—Like Coveland loam, 0 to 5 percent slopes, with which it is associated, this soil occupies slight depressions in uplands or terraces next to bays and inlets. It is also associated with the Whidbey soils. It is not an extensive soil, and individual areas are small.

The profile resembles that of Coveland loam, 0 to 5 percent slopes, but in some areas the color of the surface layer is not quite so dark, and in places the texture of the surface layer is sandy loam. Slopes are generally greater than 6 percent.

The soil is slightly better drained than Coveland loam, 0 to 5 percent slopes, even though it receives considerable seepage from the areas nearby. Surface runoff is medium.

Use and management.—Most of this soil is pastured or is used to grow hay. Crops commonly grown in the county, however, should grow as well on this soil as on Coveland loam, 0 to 5 percent slopes.

Ebeys sandy loam, 0 to 5 percent slopes (Ea; group 1).—This soil is fertile and friable and is important agriculturally. It occupies low-lying positions at the head of, or next to, bays or inlets. These areas were apparently covered at one time by marine or glacial-lake waters. The parent materials were probably glacial in origin, but they were redeposited and reworked by marine and glacial-lake waters. The soil is closely associated with Coupeville loam, 0 to 3 percent slopes. The associated soil is underlain by fine-textured materials similar to those underlying Ebeys sandy loam, 0 to 5 percent slopes, but deposited in much quieter water.

The soil is well drained. Surface runoff is very slow, and internal drainage is rapid. Although the soil is very permeable, the moisture supply is adequate throughout the year because the soil receives runoff and seepage from adjacent higher lying areas.

The native vegetation was mainly grass with some brush and a few scattered trees.

Profile description.—To a depth of about 12 inches, the surface layer is black, friable, granular sandy loam, which is very dark gray when dry. In the lower part of the horizon, the structure is weak subangular blocky.

Between 12 and 18 inches, the soil is dark grayish-brown light sandy loam that contains a few yellow and brown stains. When dry this material is slightly compact or hard, but when removed it crumbles readily to single grains and very small pieces. This layer is light brownish gray or pale brown when dry. The material grades to slightly lighter colored, grayish-brown or olive-gray medium sand, fairly uniform in size, which is firm in place but loose when disturbed. This material is stained yellow or brown in places.

At a depth of about 36 inches the soil is a mixture of light-gray and dark-gray loose coarse sands, stained with brown in places.

The surface texture ranges from coarse sandy loam to loam in areas where the soil occupies small swales or low spots. In places a fine-textured material, similar to that underlying the Coupeville soils, occurs at various depths below 4 feet.

The profile of Ebeys sandy loam, 0 to 5 percent slopes, is medium to slightly acid near the surface but is less acid as depth increases. Below about 3 feet the soil is nearly neutral.

Use and suitability.—Most of this soil is cultivated. It can be tilled easily at almost any time during the year, and it has a fair supply of moisture during the growing season. Consequently, the soil is well suited to row crops and to other crops commonly grown.

Average yields are generally slightly lower than those obtained on the associated Coupeville soil, because the Coupeville soil supplies more moisture during the dry season. In wet years, however, higher yields are obtained from the Ebeys soil because the Coupeville soil is too wet. In some years grain lodges badly on the Ebeys soil. Lodging is a less serious problem on the Coupeville soil because small grains grown on that soil generally have stronger stems.

Ebeys sandy loam, 0 to 5 percent slopes, is well suited to squash and to cabbage grown for seed. Management is the same as for these crops grown on the Coupeville soils. Potatoes were once an important crop, but diseases have caused the acreage to be reduced greatly. Alfalfa grows well; alfalfa fields are usually pastured after the second cutting.

Although crop rotations, in a strict sense, are not used, alfalfa is generally followed by a cultivated crop, such as squash or cabbage, then by wheat or other grains, and then by squash or cabbage for another year. Complete fertilizers are used for cultivated crops.

Ebeys sandy loam, 5 to 8 percent slopes (Eb; group 1).—This soil occupies a small area next to an area of Ebeys sandy loam, 0 to 5 percent slopes. It has essentially the same profile characteristics as the more gently sloping soil, except that the black surface layer is not quite so thick and the texture is coarser. Lenses of gravel occur in places in the lower part of the subsoil and substratum.

Use and suitability.—This soil is managed in the same way as Ebeys sandy loam, 0 to 5 percent slopes. Yields are slightly lower, especially in the drier years.

Everett gravelly sandy loam, 5 to 15 percent slopes (Ed; group 11).—This is one of the principal upland soils of the Puget Sound area, though only about a thousand acres occur in Island County. It occupies rolling glacial moraines and outwash plains on Camano Island. It is associated with the Alderwood soils, but generally occupies slightly lower positions. Its predominant slope is 6 to 12 percent.

The gravelly and stony parent materials from which this soil originated are poorly assorted and somewhat stratified. They were derived from many different rocks.

Natural drainage is somewhat excessive. The ca-

pacity of the soil for holding water is low, so the soil is droughty and productivity is low.

The areas were originally covered by coniferous forest, largely Douglas-fir with some hemlock, cedar, alder, and maple. The undergrowth consisted of Oregon grape, salal, fern, and similar plants. All of the original trees have been cut, and the areas are now covered by second- or third-growth forests. The species are the same as the ones that grew in the native forests, but the proportion of deciduous trees is much higher.

Profile description.—The surface layer, to a depth of 6 to 8 inches, is brown friable to very friable gravelly sandy loam that contains numerous rounded shot pellets and a high proportion of gravel. The soil is pale brown when dry. In undisturbed forested areas, a 1- to 2-inch layer of very dark grayish-brown forest litter covers the surface of the soil. This consists of needles, leaves, twigs, cones, roots, and moss.

To a depth of 20 to 24 inches, the subsoil is dark yellowish-brown very friable gravelly loamy sand, which is loose when dry. The upper part of this horizon contains few shot pellets and a large proportion of pebbles. In places the pebbles are slightly coated or stained.

The subsoil grades to poorly assorted sand, gravel, and stony material, which is extremely loose and porous, although in places it will stand up in cut banks. The color of the horizon is largely determined by the color of the gravel and stones, which are light yellowish brown, light brownish gray, gray, and dark gray. The predominant color, however, is yellowish brown. The depth to this gravelly and sandy substratum ranges from 18 to 36 inches.

The amount of gravel in the subsoil and substratum varies. Where the soil is associated with the Indianola soils, which contain no gravel, there is much less gravel than in the normal profile.

The surface layer of Everett gravelly sandy loam, 5 to 15 percent slopes, is medium to slightly acid. The soil becomes less acid with depth.

Use and suitability.—The loose, coarse-textured subsoil makes this soil too droughty for most tilled crops, and it dries out too early for crops to mature properly. Only a small part is cultivated; the rest is covered by trees and brush. Yields are generally low.

Some areas that have been partly cleared are used as woodland pasture. Other small cleared areas are pastured, especially those that occur next to more desirable pasture soils. The soil is so droughty that pastures can be grazed for only short periods, and their carrying capacity is low. The soil is best used for forests.

Everett gravelly sandy loam, 0 to 5 percent slopes (Ec; group 11).—This soil occurs in association with the other Everett soils but is much less extensive. It is similar to Everett gravelly sandy loam, 5 to 15 percent slopes, except that its surface layer is generally thicker, there is less gravel in the subsoil, and the underlying material appears to be more stratified, especially in areas that have milder slope.

Use and suitability.—The present use and management of this soil is similar to that of Everett gravelly sandy loam, 5 to 15 percent slopes. Only a small part is pastured or cropped. The rest is covered by trees and brush, and part is used as woodland pasture. Like the other Everett soils, this soil is better suited to growing trees than to farm crops.

Everett gravelly sandy loam, 15 to 30 percent slopes (Ee; group 12).—This soil occupies the steeper slopes of glacial moraines. It is associated with other Everett soils and with Alderwood soils.

The profile resembles that of Everett gravelly sandy loam, 5 to 15 percent slopes, but is more variable. The texture of the surface layer ranges from gravelly sandy loam to gravelly loamy sand. Where the soil is closely associated with the Alderwood soils, the substratum in places is compact or weakly cemented.

Included are a few small areas in which slopes are slightly greater than 30 percent.

Use and suitability.—Because of its steep relief, droughtiness, and low fertility, Everett gravelly sandy loam, 15 to 30 percent slopes, is suitable only for forest.

Fresh water marsh (Fa; group 15).—This miscellaneous land type occupies depressions that are ponded most of the time. The water is generally shallow, and for a short time in summer the areas may dry out. The total acreage is small. The largest area, known as Hastie Lake, covers about 50 acres and is located approximately 3 miles southwest of Oak Harbor.

The soils of this miscellaneous land type are generally organic and consist of either sedge (fibrous) or sedimentary peat. The areas have little or no agricultural value. Artificial drainage would be very difficult or impractical to install. The vegetation consists largely of grasses, sedges, cattails, and hardhack.

Greenwood peat, 0 to 2 percent slopes (Ga; group 8).—This organic soil consists of moss peat formed largely from sphagnum moss. It occupies deep flat-bottomed depressions or basinlike areas. It is associated with the upland soils, and a few areas are associated with other organic soils that occupy the same depressions. The areas are small and isolated. They are very poorly drained because most of the depressions have no outlet, and they are usually ponded for many months of the year.

The vegetation is mainly a thick growth of Labrador-tea, spirea, huckleberry, cranberry, and skunkcabbage. A few scattered white pines, spruces, cedars, hemlocks, and Douglas-firs grow along the outer edges.

Profile description.—The surface layer, to a depth of about 4 inches, is brown, raw, fibrous moss peat. It contains some dark-brown partly decomposed organic material consisting of leaves, sedges, and wood. In places this horizon consists of growing sphagnum moss, which grades to the material below.

Between 4 and 36 inches, the material is yellowish-brown raw spongy fibrous moss peat, which is pale yellow when dry. In places this horizon is many feet thick.

The underlying materials vary. Generally they consist of stratified or mixed sedimentary and sedge peat.

The surface layer is very strongly acid; the 4- to 36-inch layer is very strongly to strongly acid; and the underlying material is strongly acid.

Use and suitability.—Greenwood peat, 0 to 2 per-

cent slopes, is not suitable for general farming, as it either does not decompose at all or decomposes very slowly. Where the moss peat horizon is thick enough, it is of commercial value as a source of peat for packing material and for other purposes.

Hovde sand, 0 to 2 percent slopes (Ha; group 15).—The parent material of this soil contains no gravel but otherwise resembles the parent material of Coastal beach, 0 to 2 percent slopes. The soil occupies nearly level ocean beach areas adjacent to areas of coastal beach material.

The soil is poorly drained, and the water table is at, or near, the surface during the rainy season. In places, when tides are high or storms occur, the ocean water breaks over the areas of coastal beach and temporarily floods the Hovde soil. As a rule, however, the coastal beach material serves as a levee between the ocean and the areas of Hovde sand. Vegetation on the Hovde soil consists of sedges, reeds, water-tolerant grasses, and some saltgrass.

Profile description.—The soil profile shows very little differentiation. To a depth of 6 inches, it consists of dark-gray and brown, loose, medium and coarse sand that contains many plant roots. This part of the profile is light gray when dry. Between 6 and 18 inches, the material grades to a dark-gray and light-gray, loose, coarse and medium sand. The underlying material, below a depth of 18 inches, is dark-gray and gray loose sand, stratified in places with gravelly sand.

To a depth of 6 inches, the soil is slightly acid. It becomes less acid with depth. It is approximately neutral at a depth of about 18 inches, and below that it is very strongly alkaline.

Included with this soil are areas in which the surface layer is a loamy sand that contains considerable dark organic matter.

Use and suitability.—Except for pasture, Hovde sand, 0 to 2 percent slopes, is not suitable for agriculture because of its low fertility and poor drainage.

Hoypus gravelly loamy sand, 5 to 15 percent slopes (Hf; group 11).—This is one of the most extensive soils on Whidbey Island, but it is too droughty to be of much use for agriculture. It occupies moraines and outwash plains. It is associated with the other Hoypus soils and with the Whidbey and Keystone soils on Whidbey Island. The predominant slope is 6 to 12 percent.

The parent materials of this soil are comprised of a number of different kinds of rock. Rocks of acid igneous and metamorphic origin predominate, but some basic rocks are included.

Natural drainage is somewhat excessive. Internal drainage is very rapid, and the water-holding capacity is low.

The native vegetation consisted largely of Douglas-fir mixed with some hemlock, spruce, and cedar. All of the original trees have been cut. The present forest consists of native species mixed with a large proportion of alders, willows, maples, and other deciduous trees and brush and vines.

Profile description.—A 1- to 2-inch layer of organic litter, consisting of fir needles, leaves, roots, twigs, fern fronds, and moss, covers the surface of the soil in undisturbed forested areas. The lower part of the layer consists of very dark brown well-decomposed material. In a few places the cover of forest litter is underlain by a distinct horizon of very friable gray loamy sand. The boundary between the two layers is abrupt. The gray horizon is up to 2 inches thick. It occurs only where the surface has not been disturbed by logging operations. Elsewhere, to depths of 4 to 10 inches, the surface layer is brown, friable, weak fine granular loamy sand that contains a few pebbles; when dry it is yellowish brown to pale brown.

The subsoil, to a depth of about 18 inches, is dark yellowish-brown very friable or loose gravelly loamy sand that contains a few rounded shot pellets. In places the soil is so firm it will stay in place in cut banks. In some places the gravel is stained.

At depths below 18 to 24 inches, the substratum is loose, porous, gray, yellowish-brown, and olive gravelly sand or sandy gravel that is compacted in some places. The substratum contains subangular and rounded stones of various sizes up to 12 inches in diameter.

The material below 36 inches is mainly gravel similar to that in the layer immediately above but is stratified in varying degrees. The pebbles and stones vary greatly in size and shape. Soft or partly decomposed rocks are common in some areas.

The amount of gravel and stones in the soil varies. Areas in the southern part of Whidbey Island have considerably more gravel in the topmost 6 inches than areas in the northern part. Hoypus soils that contain little or no gravel to depths of about 12 inches are mapped as Hoypus coarse sandy loams. Areas where there are numerous stones on the surface and throughout the profile are shown on the soil map by symbols.

Use and suitability.—Because it is so droughty and low in fertility, Hoypus gravelly loamy sand, 5 to 15 percent slopes, is not well suited to tilled crops. Little of it has been cleared. Some wooded areas are used as woodland pasture, usually as part of a pasture that consists largely of soils that have a higher water-holding capacity. Most of the areas that are cultivated are included in areas of more productive soils. Yields are somewhat comparable to those obtained on Everett gravelly sandy loam, 5 to 15 percent slopes. The Hoypus soil, however, supplies less moisture than the Everett soils, because it is coarser textured and because there is less rainfall on Whidbey Island than on Camano, where the Everett soil occurs. Consequently, slightly lower yields are derived from the Hoypus soil under similar management.

Hoypus gravelly loamy sand, 5 to 15 percent slopes, provides excellent dry sites for poultry farms, and many are located on areas of this soil. Its best use, however, is for forest.

Hoypus gravelly loamy sand, 0 to 5 percent slopes (He; group 11).—This soil occupies outwash plains and the lower gently undulating slopes of glacial moraines. Its predominant slope is 2 to 5 percent. Except that the surface layer is generally a little deeper and materials in the substratum are more stratified, the profile resembles that of Hoypus gravelly loamy sand, 5 to 15 percent slopes.

Use and suitability.—Use and management practices are similar to those described for Hoypus gravelly loamy sand, 5 to 15 percent slopes. Slightly higher yields are obtained from Hoypus gravelly loamy sand, 0 to 5 percent slopes, largely because it occupies slightly lower positions where the moisture supply is more adequate.

Hoypus gravelly loamy sand, 15 to 30 percent slopes (Hg; group 12).—This soil occupies the steeper slopes of glacial moraines. It is associated with less strongly sloping areas of Whidbey and Keystone soils and with other Hoypus soils. In a few places slopes are slightly more than 30 percent. The profile is more variable, especially in the amount of gravel and in depth of the surface layer, but otherwise this soil resembles the other Hoypus soils. It is generally shallow and contains considerable gravel.

Use and suitability.—Except that it can provide limited grazing, this soil is of little or no agricultural value. At present it is covered by trees and brush. Its best use is for forest.

Hoypus coarse sandy loam, 0 to 5 percent slopes (Hb; group 11).—This gently undulating soil occupies moraines or outwash plains. Most of it occurs in one area east of Coupeville on Whidbey Island. It is closely associated with areas of Hoypus gravelly loamy sand, 0 to 5 percent slopes. Its predominant slope is less than 3 percent.

The soil is somewhat excessively drained. Surface runoff is very slow because the water penetrates the soil rapidly. The water-holding capacity is low, but it is greater than that of the Hoypus gravelly loamy sands.

Vegetation is similar to that on the other Hoypus soils. The undergrowth, however, includes a greater proportion of rhododendron, huckleberry, salal, and Oregon grape than that on the other Hoypus soils.

Profile description.—The surface layer is extremely variable in depth. It generally ranges from 12 to 24 inches, but in some places it extends to a depth of 36 inches.

In forested areas that have not been greatly disturbed, the cover of organic litter is underlain by a distinct 1- to 3-inch gray sandy horizon. In other places the surface layer, to depths of 8 to 10 inches, is very friable coarse sandy loam of various shades of brown. It is pale brown when dry. This material grades to slightly lighter colored or very pale brown coarse loamy sand, which contains a few compacted spots that are faintly stained with brown and yellow. These are yellowish brown when moist.

Beginning at a depth of about 18 inches, the material is dark yellowish-brown gravelly sand that is loose and porous. It is light yellowish brown when dry. The amount of gravel increases with depth. At depths of about 30 to 36 inches, the substratum consists of a mixture of gravel and sand in which gravel predominates. The substratum shows considerable stratification. It contains a few stones or fragments that are more than 10 inches in diameter.

The forest litter and the 1- to 3-inch gray sandy horizon are very strongly acid. The upper part of the surface layer, below the gray sandy horizon, is strongly acid; the lower part is only slightly acid. At depths below about 18 inches, the material is slightly acid to neutral.

Use and management.—Most of this soil is covered by trees and brush. Little of it is cropped or pastured. Some areas that have been partly cleared are used as woodland pasture. Although fertility is low and water-holding capacity is poor, yields of early maturing crops are fair, and pastures are fairly good early in the season. By midsummer both crops and pasture are adversely affected by a lack of moisture.

Management is approximately the same as for Hoypus gravelly loamy sand, 0 to 5 percent slopes. Yields are slightly higher under the same management.

Hoypus coarse sandy loam, 5 to 15 percent slopes (Hc; group 11).—Except that the surface layer is shallower, this soil is very much like Hoypus coarse sandy loam, 0 to 5 percent slopes. Depth to the gravelly substratum ranges from 12 to 18 inches. The predominant slope range is 6 to 12 percent.

Use and suitability.—The management of this soil is similar to that of Hoypus coarse sandy loam, 0 to 5 percent slopes, and its use is much the same. Yields are slightly lower. The soil, like the other Hoypus soils, is best used for forest.

Hoypus coarse sandy loam, 15 to 30 percent slopes (Hd; group 12).—The total area of this soil is small. It occupies the steeper slopes of glacial moraines, where it is associated with the other Hoypus coarse sandy loams. Except for more variation in surface texture and in the amount of gravel, the profile resembles that of Hoypus coarse sandy loam, 0 to 5 percent slopes.

Use and suitability.—Hilly relief, droughtiness, and low fertility limit the use of this soil to forest.

Indianola loamy sand, 5 to 15 percent slopes (Ib; group 11).—This soil, which is scattered throughout Camano Island, has developed from glacial drift. It occupies glacial moraines in which the predominant slope is 6 to 12 percent. Associated with it are smaller areas of Indianola loamy sand, 0 to 5 percent slopes, and Indianola loamy sand, 15 to 30 percent slopes. In the southern half of the island, where most of this soil occurs, it is closely associated with the Alderwood fine sandy loams. Drainage is somewhat excessive, and the water-holding capacity is very low.

The native vegetation consisted largely of Douglas-fir and associated trees and shrubs common to the better drained areas.

Profile description.—To a depth of 8 inches, the surface layer is brown very friable loamy sand that contains a few rounded shot pellets and many fine roots. When dry this layer is brown to yellowish brown. In forested areas a 1- to 2-inch litter of needles, cones, leaves, wood fragments, and fern fronds covers the surface. In places a faint, thin, gray horizon occurs immediately below the organic layer.

From 8 inches to between 20 and 24 inches, the material is similar to that in the surface layer except that it is dark yellowish brown. When dry the material is loose, but in places it is firm enough so that it will stay in place in cut banks. The lower subsoil, to a depth of about 36 inches, is yellowish-brown, light

brownish-gray, and gray medium sand, which is loose and porous.

Below a depth of about 36 inches, the substratum consists of coarser, looser, gray or dark-gray sands. It is slightly firm in place, but crumbles readily to single grains when removed. Some pebbles occur in the profile, especially where this soil merges with areas of Everett or Alderwood soils.

The surface soil is medium acid, but the soil is less acid at greater depths. At depths of about 36 inches, the soil is slightly acid.

Use and suitability.—This soil is so droughty and low in fertility that its agricultural uses, except for pasture or for hay, are limited. Grain crops yield fairly well in seasons when moisture is plentiful, but in dry years yields are very low or the crop may fail entirely. In other counties, especially where the moisture supply is more favorable, strawberries and raspberries do fairly well on this soil. Most areas are covered by a second or third growth of Douglas-fir and hemlock in which there are numerous alders, willows, maples, and other trees and shrubs.

Indianola loamy sand, 15 to 30 percent slopes (Ic; group 12).—This soil generally occupies short steep slopes in association with areas of Indianola loamy sand, 5 to 15 percent slopes, and with soils of the Everett and Alderwood series. Except for differences in slope, the soil closely resembles Indianola loamy sand, 5 to 15 percent slopes. Normally, however, its surface layer is thinner than that of the less strongly sloping soil, and its depth is more variable. In places gravel occurs in lenses or is scattered throughout the profile. Some areas are included in which slopes are more than 30 percent.

Use and suitability.—Practically all of this soil is covered by trees and brush. Its best use is for forest.

Indianola loamy sand, 0 to 5 percent slopes (Ia; group 11).—This inextensive soil has slopes that are generally less than 3 percent. It is closely associated with areas of Indianola loamy sand, 5 to 15 percent slopes. Profile characteristics are essentially the same as those of the associated soil but are more variable. Normally the moisture supply is greater because there is less runoff and because the soil generally occurs at the bases of steeper slopes from which it obtains some moisture.

Use and suitability.—Only a small part of this soil is cultivated, and the rest is covered by trees and brush. Yields are slightly better than on Indianola loamy sand, 5 to 15 percent slopes. Use and management practices are similar.

Keystone loamy sand, 5 to 15 percent slopes (Kc; group 11).—This somewhat excessively drained soil is one of the most extensive of the upland soils. It has developed from sandy drift. The soil occupies moraines. It is closely associated with soils of the Whidbey series and with other less strongly sloping soils of the Keystone series. It is sandier and more open and porous throughout than the associated Whidbey soils and is comparatively free of gravel. Its predominant slope is 6 to 12 percent. The soil resembles the Indianola soils that occur on Camano Island. It has a much more acid surface layer, however, and its color is lighter brown.

Because of the open porous texture, water is absorbed readily and drains very rapidly through the soil. Consequently, surface runoff is very slow.

The native vegetation consisted largely of Douglas-fir and associated trees, shrubs, and vines common to the area. All of the virgin forests have been cut. They have been replaced by trees and shrubs similar to those in the original forests, but there is a greater proportion of deciduous trees, particularly alder. In areas northeast of Freeland, the proportion of red-cedar, huckleberry, salal, and Oregon grape is greater than elsewhere.

Profile description.—The surface in undisturbed forested areas is covered by 1 to 3 inches of dark brown to very dark brown partly decomposed litter consisting of fir needles, leaves, twigs, cones, and roots. The lower part of this layer is in an advanced stage of decomposition. Immediately below it is a distinct 1- to 2-inch horizon of leached gray loamy sand. This occurs only in forested areas that have not been disturbed for many years. It is largely destroyed when the trees are cut.

To a depth of about 8 inches, the surface layer is brown very friable loamy sand that contains a few rounded shot pellets.

Between 8 and 18 inches, the subsoil is brown very friable loamy sand that contains fewer shot pellets than the surface layer. When dry the material is loose and light yellowish brown or pale brown.

Between 18 and about 36 inches, the material is dark yellowish-brown to olive-brown sand that contains some dark-gray particles of sand. When the soil is moist, firm irregular aggregates are scattered throughout the horizon, but when dry it is very loose and its color is light yellowish brown or very pale brown.

Below a depth of about 36 inches, the substratum consists of coarse sand, which is light gray to dark gray or light yellowish brown. There are a few fine pebbles.

In places the surface soil and upper subsoil are light brownish gray. Here and there in the surface layer are a few hard aggregates, slightly darker colored than the typical soil. In places the lower subsoil is hard or very weakly cemented. In some areas lenses of gravel occur; in others gravel is thinly scattered throughout the profile.

The leached, gray sand horizon underlying the forest litter is very strongly acid, and the surface layer is very strongly to strongly acid. At depths below about 18 inches, the soil is slightly acid.

Use and suitability.—Because of its coarse sandy porous texture and comparatively low fertility, this soil is suitable only for pasture or for growing early maturing crops or hay. Most of the soil is still covered by trees and brush. Farms are small. On most farms a few dairy cattle are raised and enough land is pastured or cultivated to provide part of their feed.

Crop yields are about the same as those obtained on Indianola loamy sand, 5 to 15 percent slopes, under similar management. Yields of oats cut for grain are extremely variable from year to year, depending upon

the supply of moisture and the time of seeding. Strawberries and raspberries grow fairly well if well managed and if the moisture supply is better than average.

Commercial fertilizers are not commonly used. Some fertilizers that are high in nitrogen and phosphorus are applied, but barnyard manure is the principal fertilizer used.

Keystone loamy sand, 15 to 30 percent slopes (Kd; group 12).—This soil occurs in close association with Keystone loamy sand, 5 to 15 percent slopes, and with areas of Keystone loamy sand, 30 to 40 percent slopes. Its predominant slope is 16 to 25 percent. Except that the depth and texture of its surface layer is more varied, the profile resembles that of Keystone loamy sand, 5 to 15 percent slopes. Water is rapidly absorbed and drained off through the soil; consequently, surface runoff is slow, though not so slow as on the more gently sloping Keystone soil.

Vegetation is about the same as that on Keystone loamy sand, 5 to 15 percent slopes.

Use and suitability.—Because the soil is hilly and droughty, its best use is for forest. Most of it is now forested.

Keystone loamy sand, 30 to 40 percent slopes (Ke; group 12).—This soil occurs mainly on short steep slopes and steep rough areas near the southern end of Whidbey Island. It is closely associated with areas of Keystone loamy sand, 15 to 30 percent slopes. Except for slope it is similar to the associated soil and to Keystone loamy sand, 5 to 15 percent slopes. Included are some areas in which slopes are more than 40 percent.

Use and suitability.—All of this soil is covered by trees or stumps. Because of its steep slopes, the soil should remain under forest.

Keystone loamy sand, 0 to 5 percent slopes (Kb; group 11).—This soil is closely associated with areas of Keystone loamy sand, 5 to 15 percent slopes. Its profile characteristics are fairly uniform and closely resemble the profile characteristics of Keystone loamy sand, 5 to 15 percent slopes.

Use and suitability.—The use and management of this soil are about the same as for Keystone loamy sand, 5 to 15 percent slopes. Yields of most crops are slightly higher, mainly because the soil has a slightly higher moisture content during the growing season. Areas that are next to steeper soils from which they receive runoff and seepage water are better supplied with moisture than other areas.

Keystone fine sandy loam, 0 to 5 percent slopes (Ka; group 11).—This soil is deeper and finer textured than the other Keystone soils. It is not so droughty and consequently is more productive. It is associated with the other Keystone soils, but it occupies slightly lower positions. Its slopes are generally less than 3 percent.

Profile description.—To a depth of about 8 inches, the surface soil is brown friable fine sandy loam or sandy loam that contains a few shot pellets.

Between 8 and about 24 inches, the subsoil is dark yellowish-brown loamy sand that contains a few hardened or compact spots or aggregates. When dry the loamy sand is soft to loose and breaks readily to single grains.

The underlying material resembles the substratum of the other Keystone soils. One area, 5 miles northwest of Langley, has silty and clayey layers at depths below about 4 feet. Consequently it has better moisture-holding capacity than most of this soil.

Use and suitability.—Keystone fine sandy loam, 0 to 5 percent slopes, has much the same uses as Keystone loamy sand, 5 to 15 percent slopes, and its management is about the same. A slightly greater proportion is cultivated. Strawberries grow well on this soil.

Lummi silt loam, 0 to 2 percent slopes (Lb; group 10).—This soil consists of raw or slightly altered gray silty marine sediments interstratified with sedge remains. It occurs at the heads of bays or inlets on nearly level tidal salt-marsh areas that have been artificially drained. The areas have only recently been reclaimed by building dikes to keep out the salt water and by digging drainage ditches to lower the water table enough so the soil can be farmed. Even with artificial drainage, water stands on the surface after heavy rains and during most of the rainy season. The excess water can be removed by pumping, and the water table can be kept below the surface most of the time. The natural vegetation consists mainly of sedges, reeds, and water-tolerant grasses.

Profile description.—To depths of 8 to 12 inches, the surface layer is olive-gray to gray friable silt loam, weakly mottled with yellowish brown and brown. The material is light gray when dry.

The subsoil, to depths of 24 to 28 inches, resembles the surface layer closely except that it is more strongly mottled, firm, somewhat massive in place, and plastic when wet.

Beginning at depths of 24 to 28 inches, the material consists of stratified gray to olive-gray silts and clays that are strongly mottled, firm, massive, and plastic when wet. The material is light gray when dry. This layer extends to depths of 36 to 60 inches. Normally it ends at about 48 inches.

Below an abrupt boundary, at a depth of about 48 inches, are very dark gray or dark gray silts and sands that have little or no mottling. Fragments of seashells are embedded in this material. The reaction of this material is alkaline, though the entire profile above is very strongly acid.

Flattened fibrous roots, in various stages of decomposition, occur throughout the profile in varying amounts.

Mottling in the surface layer varies as a result of differences in drainage. In some areas there is none; in others the soil is strongly mottled. The salt content of the soil varies from place to place because of differences in drainage. Except in a few small areas, however, the salt has not been detrimental to plants.

Use and suitability.—Most of this soil is used for agriculture, mainly for pasture or for hay crops. It has no agricultural use unless it is artificially drained, but if it is protected by dikes and drained by ditches, it is highly productive of most crops. In some areas pumps are used to remove excess surface water during the rainy season, but the soil can be farmed without this protection. Clover-and-grass hay, oats, and some barley are grown. Green peas and corn have been

grown to a limited extent with fair success. Because the soil within the root zone is strongly to very strongly acid, lime is very beneficial.

Lummi silty clay loam, 0 to 2 percent slopes (Lc; group 10).—This soil is closely associated with Lummi silt loam, 0 to 2 percent slopes, but occupies slightly lower positions and has somewhat poorer drainage than the associated soil. The water table is at or near the surface for many months of the year. The soil is not suitable for agriculture unless it is drained.

The surface layer is a plastic heavy silt loam or silty clay loam very strongly mottled with brown and yellow. It contains flattened sedges in the lower part. The stratified marine sediments contain a greater proportion of fine-textured material than those in the profile of Lummi silt loam, 0 to 2 percent slopes. In other ways the profiles of the two soils are similar.

Use and suitability.—The soil is used mainly for pasture. Many areas are unimproved except that dikes have been built to keep out the salt water. Yields of hay and other crops are good on areas that are adequately drained. Because of more restricted drainage, however, yields are lower than those obtained on Lummi silt loam, 0 to 2 percent slopes.

Lummi fine sandy loam, 0 to 2 percent slopes (La; group 10).—This soil occurs near the head of Useless Bay on Whidbey Island. It is closely associated with Lummi silt loam, 0 to 2 percent slopes. The soil occupies positions similar to those occupied by the other Lummi soils, and its drainage is about the same. It contains more areas, however, in which a high concentration of salt occurs at or near the surface.

Profile description.—To a depth of about 12 inches, the surface layer is olive-gray to gray strongly mottled fine sandy loam, in which lenses of coarser material occur in places. When dry the material is gray to light gray.

Beginning at a depth of about 12 inches, the material is gray to olive-gray, stratified, firm, massive fine sandy loam and silt loam strongly mottled with brown and yellow. It contains a few lenses of coarser material. This layer extends to depths of 40 to 60 inches; normally it ends at a depth of about 48 inches. West of Deer Lagoon is an area where water stands on the surface most of the year. An area to the northeast has somewhat better drainage. A few patches of saltgrass grow on the soil.

The boundary is abrupt between the mottled gray to olive-gray layer and an underlying layer of dark-gray marine sediments, similar in texture to the material immediately above but with little or no mottling. This underlying material is alkaline, although the entire profile above it is very strongly acid to extremely acid.

Use and suitability.—Except for a few acres, this soil is used for unimproved pasture. If better drained, the soil should produce crop yields approximately as high as those obtained on Lummi silt loam, 0 to 2 percent slopes.

Made land (Ma; group 15).—Most of this miscellaneous land type is within the Naval Reservation on Whidbey Island, where it is used for airfields and building sites. It consists of areas that have been filled and leveled. Usually this has been done to overcome the effects of poor drainage and to smooth, uneven surfaces so that landing strips could be constructed.

Use and suitability.—Made land is not suited to agriculture, and ordinarily it is not farmed. Hay crops can be grown in small areas near, and parallel to, the landing strips in Clover Valley, and in an area (sec. 29, T. 33 N., R. 1 E.) where the upper part of the profile has been removed and the material heaped together to form embankments for use in military training.

Mukilteo peat, 0 to 2 percent slopes (Mb; group 8).—This soil consists largely of the organic remains of various sedges and coarse water-tolerant grasses, mixed with some woody and sedimentary organic material. The material is in various stages of decomposition. In the uppermost 6 to 12 inches, the original fibers are recognizable. This is the most extensive of the organic soils. About half of it occurs in the vicinity of Midvale Corner and Miller Lake on Whidbey Island.

The soil occupies depressions or basins of various sizes. These areas have drainage outlets only when the water table is at, or near, the surface. Except for a part of the dry summer season, the areas are ponded unless they are drained artificially. Most areas can be drained well enough so that they can be used for agriculture, but for some, drainage would be difficult. Drainage often requires the cooperative action of a group of landowners.

The original vegetation consisted mainly of sedges, tules, and water-tolerant grasses. In addition to these species, some spirea and fern and a few scattered willows, alders, and cedars also grow on the soil at the present time.

Profile description.—To depths of 6 to 12 inches, the surface layer is dark-brown or dark grayish-brown partly decomposed organic material consisting primarily of sedge fibers, roots, and some woody fragments and sedimentary material. The original fibers can be distinguished, but the layer also contains considerable well-decomposed, very dark brown, granular organic material. The material in this layer grades to horizontal layers of dark yellowish-brown and dark-brown, matted, coarsely fibrous sedge peat, which contains some woody material in places.

In some places there is an abrupt transition, below a depth of about 36 inches, to an underlying horizon of mineral material of variable texture. In most places, however, the underlying material consists of fine fibrous sedge peat that overlies sedimentary material. The sedge peat is generally more than 6 feet deep over the sedimentary peat, but it ranges from 2 feet to many feet in thickness. Areas in which the organic material is less than 2 feet thick are mapped as Mukilteo peat, shallow, 0 to 2 percent slopes.

The profile of Mukilteo peat, 0 to 2 percent slopes, is strongly to very strongly acid throughout. It becomes less acid with increasing depth.

Use and suitability.—Many areas of this organic soil are not well enough drained to be suitable for general agricultural use but can be pastured. In some areas tillage is difficult because so much undecomposed coarse fibrous material remains in the surface layer. Areas that are adequately drained and that have been

cultivated for many years are very productive of most crops. In neighboring counties this soil has been used to grow truck crops, which are well adapted to it.

Mukilteo peat, shallow, 0 to 2 percent slopes (Mc; group 8).—This organic soil consists of peat that is less than 24 inches thick over the mineral material. The soil generally occurs next to areas that have a steeper slope and in a back-bottom position that is difficult to drain. The plant cover is the same as that on Mukilteo peat, 0 to 2 percent slopes.

The 6- to 24-inch surface layer consists of dark-brown sedge peat that is fairly well decomposed, though the fibers are still recognizable. In many places the lower part of this material is a mixture of very fine fibrous and sedimentary materials.

The underlying mineral material consists of fine-textured marine sediments.

Use and suitability.—Because it is so difficult to drain the back-bottom areas where this soil occurs, it can generally be used only for pasture. Areas that can be drained are managed in the same way as Mukilteo peat, 0 to 2 percent slopes, and would give about the same yields.

Norma loam, 0 to 3 percent slopes (Na; group 9).—This poorly drained soil occurs in depressions in the glaciated uplands. Though the total acreage is fairly large, individual areas are generally small and occupy only a few acres. The water table is high and is usually at, or near, the surface during the winter rainy season.

The natural vegetation consists mainly of alder, willow, maple, and ash with some cedar, hemlock, and Douglas-fir. The undergrowth is spirea, sedges, vines, skunkcabbage, and water-tolerant grasses and other plants common to fresh-water bogs. These plants grow also in open places.

Profile description.—To a depth of 6 to 8 inches, the surface layer is very dark gray granular friable loam that is comparatively high in organic matter.

From about 6 to between 18 and 24 inches, the subsoil is grayish-brown to dark grayish-brown moderately mottled very firm loam or fine sandy loam that is permeable to moisture. The material is light grayish brown to grayish brown when dry.

Beginning at depths of 18 to 24 inches is a layer of strongly mottled dark-gray, gray, or olive-gray sandy loam or sandy clay loam that is compact or very firm in places, but not impervious.

Below a depth of about 3 feet is a layer of mottled gray to olive sandy or gravelly till. This material is moderately compact or weakly cemented, and it restricts the penetration of water.

The underlying material varies in permeability and texture. It is very sandy and permeable to moisture in some places. In other places the material is gravelly and sandy cemented till.

Acidity decreases with depth in this soil. The surface layer is medium to strongly acid, and the subsoil is medium acid. The material overlying the compact or cemented till is slightly acid, and the substratum is very slightly acid.

Included with this soil are a few areas in which the subsoil is very gravelly and others in which the texture is finer than that of the typical soil. In places there is some gravel throughout the profile. Areas of Norma loam, 0 to 3 percent slopes, that are associated with areas of Swantown soils are generally shallower than areas that occur elsewhere.

Use and suitability.—None of the virgin forests remain on this soil. In most places they have been replaced by trees of the same species as those in the original forests and by brush. Only a small part of the soil is cultivated, mainly because the areas are so small and are associated with droughty soils. The soil usually makes up only a small part of a farm. It is generally pastured or used with other soils to grow hay.

The soil cannot be used for cultivated crops unless it is artificially drained. It usually can be pastured without being drained, but drainage generally benefits pasture. The soil is well suited to pasture and hay and can be pastured late in the summer when upland pastures have dried up. Many cleared areas were once seeded to clover and grasses but have been pastured for many years without reseeding. These pastures are now covered by a mixture of wild and tame grasses, sedges, and weeds. Other areas, however, are replowed every 2 to 4 years and reseeded to oats. The oats are followed by grass and clover, which are retained as long as the stand remains good.

Norma loam, 3 to 8 percent slopes (Nb; group 9).—This soil occurs on slightly concave slopes next to nearly level depressions. It is also associated with higher, steeper areas from which it receives considerable runoff and seepage water. Drainage is poor. The parent material was similar to that of Norma loam, 0 to 3 percent slopes, but was generally more gravelly and less permeable. The profile, in many characteristics, is similar to that of Norma loam, 0 to 3 percent slopes, but the surface soil is not so dark colored nor so high in organic matter, and the subsoil is firmer and more gravelly, especially in the lower part. The substratum of this soil consists of a strongly mottled, moderately cemented sandy till. Depth to the substratum ranges from 2 to 4 feet.

The native vegetation is about the same as that of Norma loam, 0 to 3 percent slopes, but a larger proportion of it consists of Douglas-fir, hemlock, and cedar.

Use and suitability.—Because of its slightly stronger slopes, this soil is more easily drained than Norma loam, 0 to 3 percent slopes. Consequently, a greater proportion is farmed. Most of it is pastured, a use to which it is well suited. Yields of hay and other crops are slightly lower and more variable than on the more nearly level areas of Norma loam.

Norma silt loam, 0 to 2 percent slopes (Nc; group 9).—This soil occupies positions similar to those occupied by Norma loam, 0 to 3 percent slopes. It is associated with the same soils, but a greater proportion is associated with the Casey and Bow soils, which are finer textured than the other upland soils. Except that the surface layer is finer textured, the profile closely resembles that of Norma loam, 0 to 3 percent slopes.

Profile description.—To a depth of about 8 inches, the surface layer is very dark gray to black, friable, granular silt loam that grades to slightly coarser tex-

tured grayish-brown or dark brownish-gray mottled material.

The substratum is predominantly coarse textured to medium textured and is moderately permeable to moisture and roots. In places part or all of the profile is gravelly. At depths of 3 to 4 feet, the substratum in places is weakly to strongly cemented.

Use and suitability.—The soil is less extensive than Norma loam, 0 to 3 percent slopes, but about the same proportion is farmed. The management is about the same as that of the Norma loams, and crops are about the same. Generally yields are slightly higher than on the loam soils.

Pondilla fine sand, 0 to 5 percent slopes (Pa; group 11).—This excessively drained upland soil, near the coast, occupies areas that resemble terraces. It occurs in association with the Bozarth fine sandy loams on Whidbey Island, west and southwest of Oak Harbor. The areas are from 100 to 250 feet in elevation. They are separated from the coastal waters by bluffs, narrow steep slopes, and areas of Rough broken land. The surface is somewhat hummocky in places.

The native vegetation consists largely of grasses, ferns, shrubs, and an occasional Douglas-fir or other conifer.

The soil resembles the associated Bozarth soils, except that the Bozarth soils have strongly cemented gravelly till at a depth of about 24 inches.

Profile description.—This soil shows very little profile development. The surface soil is dark grayish-brown very friable fine sand to loamy fine sand that is grayish brown to brown when dry. At depths between 6 and 10 inches, the material grades to grayish-brown loose fine sand.

Below about 24 inches, the material is mixed dark-gray to light-gray sand, slightly coarser than that in the upper part of the soil. In places logs and woody fragments are embedded in the lower part of the profile.

The color of the surface layer ranges from brown to dark grayish brown when dry. The area 1 mile northwest of San de Fuca is darker colored than the one next to the coast and directly west of Oak Harbor.

Use and suitability.—Except for a few acres that are farmed with the associated Bozarth soils, Pondilla fine sand, 0 to 5 percent slopes, is in unimproved pasture. It is too loose and porous and, consequently, too droughty to be used successfully for cultivated crops. If tilled it is subject to severe wind erosion.

Puget clay loam, 0 to 2 percent slopes (Pb; group 10).—This gray, mottled, poorly drained soil is of minor importance in Island County, although it is the most important and extensive alluvial soil in neighboring counties to the east and north. It is forming in recent alluvial materials that have accumulated in ponded areas along sluggish streams and in their deltas. The alluvium consisted largely of glacial flour derived from a number of kinds of rock. It was carried and deposited by streams that originated in mountain glaciers.

In Island County this soil is a part of the delta of the Stillaquamish River of Snohomish County. The mouth of the river is opposite the northeast corner of Camano Island. The delta adjoins Camano Island. Davis Slough cuts through the delta and separates Camano Island from the mainland.

The water table is at, or near, the surface during the rainy season. Dikes have been built to protect the areas from flooding by high tides.

The native vegetation, before the areas were diked and drained for agricultural use, consisted largely of sedges, tules, and other water-tolerant plants.

Profile description.—To a depth of about 8 inches, the surface layer is dark grayish-brown, friable, weakly developed granular clay loam that is faintly mottled in places.

Between depths of 8 and 24 inches, the material is olive-gray stratified silt loam, clay loam, and silty clay loam, distinctly mottled with yellow and brown. This is firm when moist but plastic when wet.

From about 24 inches to between 40 and 48 inches, the material is similar to that in the 8- to 24-inch layer, but it is lighter in color and slightly more mottled. The transition to the underlying material is abrupt.

The material below depths of 40 to 48 inches is gray or dark gray and has a distinct bluish tinge. It is mottled only slightly or not at all. When dry the material is gray to light gray.

The texture of the surface soil ranges from silt loam to silty clay loam. In places the surface layer is mottled; in others the profile is nearly free of mottling to a depth of about 12 inches. In some places fibrous material is embedded in the profile at depths below about 8 inches.

The surface layer of Puget clay loam, 0 to 2 percent slopes, is slightly acid to medium acid. Between 8 and 24 inches the material is medium acid to strongly acid. Below about 24 inches the material is very strongly acid.

Use and suitability.—Most of this soil is cultivated. It is used mainly to grow oats, peas, strawberries, and hay. Some is pastured. When properly drained it is very productive of most crops. Average yields are generally not so high as those obtained on areas of this soil that occur in Snohomish and Skagit Counties, however, because the drainage is poorer.

Rifle peat, 0 to 2 percent slopes (Ra; group 7).—This organic soil is comprised of accumulations of plant remains, largely originating from trees and shrubs. The soil occupies comparatively small depressions or basins. In some of these areas it is associated with other organic soils or with poorly drained mineral soils.

Drainage is very poor. The water table is near the surface much of the year. Areas that are not artificially drained are swampy and saturated during the winter but are fairly dry during the summer.

The native vegetation consisted of cedar, hemlock, and Douglas-fir and a few deciduous trees, shrubs, and vines. The virgin forests have been cut. The present vegetation consists of the same species as those in the original forest but contains a greater proportion of deciduous trees and shrubs.

Profile description.—The surface layer, to a depth of about 12 inches, is very dark brown to nearly black woody peat that is partly decomposed. It contains

some sedimentary and sedge materials. To a depth of at least 10 inches, individual decomposing wood fragments can be recognized readily.

To an average depth of 36 inches, a mixture of dark-brown woody and sedge peat underlies the surface layer. This material is stratified in some places, and in others it contains very fine fibrous and sedimentary materials.

Below an average depth of 36 inches, the material is largely sedge peat in which there are some woody fragments. In some areas sedimentary peat predominates at depths below 36 to 48 inches. The depth of the organic material is everywhere more than 2 feet, and in most places it is more than 6 feet.

The underlying mineral material is gravelly medium-textured or coarse-textured glacial material that is partly cemented. In areas that are associated with the Lummi soils, the underlying material consists of fine-textured marine sediments. Logs and limbs of trees in various stages of decomposition occur in many places throughout the profile.

The surface layer is strongly acid, but the profile becomes less acid with depth. One area associated with Tacoma peat, 0 to 2 percent slopes, (sec. 9, T. 29 N., R. 2 E.) is alkaline at depths below 12 inches. This area probably is high in salts.

Use and suitability.—Next to Carbondale muck, 0 to 2 percent slopes, this is the most fertile and productive of the organic soils in Island County. It is not suitable for agriculture unless it is cleared and artificially drained. The cost of clearing and draining is high; in addition the soil generally occurs in small isolated areas in association with fair to poor upland soils. Therefore only a small part is cultivated, but if properly managed these areas are very productive.

After this soil has been cultivated a few years, the material in the surface layer, to a depth of about 6 inches, becomes decomposed to the extent that the soil is classified as Carbondale muck, 0 to 2 percent slopes.

The management of this soil is similar to that of Carbondale muck, 0 to 2 percent slopes, and it is used in about the same way. Yields of crops are only slightly lower than those obtained on the Carbondale soil. Yields increase, however, after the soil has been cropped for a year or two.

Rifle peat, shallow, 0 to 2 percent slopes (Rb; group 7).—In this soil the peat deposit is only 1 to 2 feet deep over mineral material. The soil occupies the outer edges of depressions in association with other organic soils or with poorly drained mineral soils. In places the relief is very gently sloping. Slopes generally do not exceed 2 or 3 percent. These areas receive considerable seepage from the higher and steeper slopes.

The peat deposit in many places consists entirely of woody peat mixed with some sedge and sedimentary peat. The underlying mineral soil ranges from fine to coarse in texture.

Use and suitability.—This is not an extensive soil, and little of it has been cleared. Yields on cropped areas are slightly lower than on Rifle peat, 0 to 2 percent slopes, because the layer of organic material is so much thinner. This soil is used and managed in about the same way as Rifle peat, 0 to 2 percent slopes.

Rough broken land (Rc; group 15).—This miscellaneous land type consists of so many kinds of material that it was not feasible to classify them into soil types. Its most important characteristic is the steepness of its slope, which ranges from 50 to 70 percent. Many areas are badly gullied or broken by intermittent drainageways. Stones are not numerous, and no rock outcrops occur.

As a rule, Rough broken land occupies long narrow strips along the perimeter of the islands (fig. 8). The areas generally consist of steep broken bluffs, or

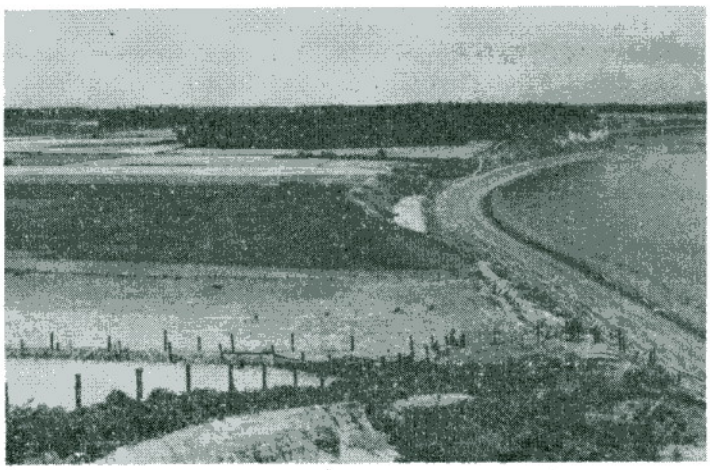

Figure 8.—**Rough broken land of the sea cliffs, and below it Coastal beach, 0 to 2 percent slopes. The cultivated fields are mainly Ebeys sandy loam near the coast; Coupeville loam in the background; and San Juan coarse sandy loam in the foreground.**

breaks, that jut out to the beach or coastal beach areas. Areas that are unusually narrow and precipitous are shown on the soil map by the symbol for escarpments.

Rough broken land has developed from glacial materials that are extremely variable in texture and consistence. Normally the materials are coarse textured and very loose, particularly along the lower slopes. Other areas consist of strongly cemented till and have slopes that are nearly perpendicular. As a rule, deep soils occur at the bases of slopes and in small pockets where colluvial and local alluvial deposits have accumulated.

This land is generally under forest, but many areas are almost bare as a result of water erosion and landslides. One area along the coast northwest of Ebeys Landing at Ebeys Prairie is covered by grass. The soil material in this area is very sandy, but the grass cover has checked erosion.

Use and suitability.—This land type is not suited to agriculture. It has some value for forestry, and some areas can be used as a source of roadbuilding material.

Rough stony land (Rd; group 15).—This miscellaneous land type consists of areas that cannot readily be classified into soil types. Relief varies widely; slopes are generally at least 30 percent, but some small areas are included in which the slope gradient is much less.

Rock outcrops, boulders, and stones are common. In most places the outcrops and boulders occupy 15 to 50 percent of the surface. The Ben Ure and Strawberry Islands are very stony, and rock outcrops occur along their outer edges; many of the slopes in these areas are less than 15 percent. Other areas of Rough stony land, which are much steeper, occur in the northern part of Whidbey Island next to Deception Pass.

Use and suitability.—Areas of Rough stony land in Island County are all within the Deception Pass State Park, which is used for recreational purposes. Most of this land is under forest. Small bare patches of rock outcrop occur, however, especially on parts of Goose Peak. The land is too rocky and steep to be used for either crops or pasture. It has some value for the timber it produces.

San Juan coarse sandy loam, 0 to 5 percent slopes (Sa; group 5).—This soil has developed from gravelly glacial outwash that originated from many different kinds of rock. The materials are not consolidated and are irregularly stratified. The soil occupies a few large areas in which slopes are generally less than 3 percent, but an occasional steeper short slope occurs as a terrace front or as the side of a shallow trough.

Most of this soil in Island County occurs in association with Snakelum coarse sandy loams on an area known as Smith Prairie, and in that area it is the principal soil. Smith Prairie is surrounded mainly by forested areas of Hoypus coarse sandy loams.

The soil is somewhat excessively drained. Surface runoff is very slow because of the mild slope and the open, porous texture of the profile. Internal drainage is very rapid.

The native vegetation consisted of grasses and an occasional oak or Douglas-fir.

Profile description.—To depths between 6 and 12 inches, the surface layer is black, friable, weakly to moderately granular coarse sandy loam that contains some pebbles and stones. The content of organic matter is high. When dry, the material is very dark brown to very dark gray.

At depths of about 8 to 18 inches, the material grades to very dark grayish-brown, loose, porous, very gravelly loamy sand.

From 18 to between 24 and 30 inches, the material is brown to dark yellowish-brown, loose, porous gravelly sand or sandy gravel that becomes lighter in color and more gravelly with depth.

The substratum, at depths below 24 to 30 inches, is yellowish-brown, olive, gray, and dark-gray gravel and sand that is somewhat stratified, loose, and porous.

In some small lower lying areas, little gravel occurs in the uppermost 18 inches. In places the brown subsoil is very thin between the dark-colored surface layer and the coarse-textured substratum. A small isolated area of this soil that occurs southwest of Ault Field on Whidbey Island has a lighter colored and more gravelly surface layer than the areas on Smith Prairie and has an occasional lens of finer textured material in the lower part of the profile.

The entire profile of San Juan coarse sandy loam, 0 to 5 percent slopes, is medium acid, but it becomes less acid with depth.

Use and suitability.—Although this soil is very porous and its drainage somewhat excessive, it is fairly productive of some crops because of the large amount of organic matter in the surface layer. Nearly all of the soil has once been cropped or pastured. The acreage in farms is much smaller, however, than formerly. A State game reserve and a military airfield occupy nearly half of Smith Prairie, where San Juan coarse sandy loam, 0 to 5 percent slopes, is the principal soil. Another small area occurs within the boundaries of the Fort Casey Military Reservation. The game reserve has been seeded to permanent grass pasture to make it more desirable for wildfowl.

Farms are generally diversified. Hay, small grains, and grass grown for seed are the principal crops. Much of the soil is in pasture for dairy cattle. Winter varieties of wheat and oats are grown. As a rule most spring crops or late-seeded crops do not do well because of the shortage of moisture in the soil during the summer. Little barley is grown. Oats cut green, clover-and-grass mixtures, and vetch seeded with timothy are the principal hay crops.

Some commercial fertilizers that are high in nitrogen are used where ryegrass is grown. Except for barnyard manure, little other fertilizer is used. Yields of ryegrass grown for seed are variable.

San Juan coarse sandy loam, 5 to 15 percent slopes (Sb; group 5).—Nearly all of this soil occurs in one area on a single slope, or terracelike front, in Ebeys Prairie. The predominant slope is 6 to 12 percent.

Bordering this soil, at the base of the slope, are Ebeys sandy loams and Coupeville loam, 0 to 3 percent slopes. At the upper side of this soil is Snakelum coarse sandy loam, 0 to 5 percent slopes. Particularly on the lower part of the slope, this soil is more variable because there is no distinct boundary line between it and the Ebeys and Coupeville soils.

The parent material of this soil is the same as that of San Juan coarse sandy loam, 0 to 5 percent slopes, and the native vegetation was the same. Surface runoff is faster because of the steeper slope, but it is still very slow because of the high absorptive capacity of the soil.

Except that it is more variable, the profile resembles that of San Juan coarse sandy loam, 0 to 5 percent slopes.

Use and suitability.—This soil is more droughty than the less strongly sloping San Juan soil, so its use is mainly restricted to pasture. A small part is used for the same purposes as adjoining soils. Gooseberries, for which the soil is well suited, are grown on a small acreage. Because the market has been poor for several years, however, the berries have not been harvested.

Semiahmoo muck, 0 to 2 percent slopes (Sc; group 7).—This organic soil has developed largely from accumulations of various sedges and water-tolerant grasses. It closely resembles the organic soils of the Mukilteo series. The material in the uppermost 6 to 10 inches, however, is in an advanced state of decomposition so that the original fibers are not so easily distinguished as they are in the Mukilteo soils.

The soil occupies depressions, basins, or flats where

drainage is very poor. In some of these areas it is associated with other organic and mineral soils.

In areas that are not artificially drained, the soil is ponded or the water table is at, or near, the surface during much of the year. Even when the soil is adequately drained for most crops, it becomes saturated in winter.

Vegetation on areas that are not cultivated consists largely of sedges, tules, cattails, spirea, and some cranberries.

Profile description.—The surface layer, to a depth of about 6 inches, is very dark brown to dark reddish brown friable granular sedge muck. This muck is decomposed to such a degree that the original sedge fibers are not recognizable. The muck overlies dark-brown, brown, and dark yellowish-brown matted sedge peat in which the plant remains can be readily distinguished.

In some places the sedge peat continues to depths of many feet; in other places it is stratified with sedimentary peat below a depth of 2 feet.

The underlying mineral soil varies, but generally it is gravelly medium-textured glacial material. The depth to the mineral material is generally at least 4 feet, and in places it is much greater.

Use and suitability.—A large part of Semiahmoo muck, 0 to 2 percent slopes, has been cleared and drained and is now used for agriculture. The soil is highly productive under proper management, especially for feed grains and forage and as pasture for livestock. The carrying capacity of pastures remains high on this soil throughout the summer when pastures on the adjacent uplands are poor.

Oats cut for hay and mixtures of clover and grasses grown for hay yield well. Oats grown for grain yield well, but wheat is poor because it lodges badly, the growth is too rank so that the straw is coarse, and the grain does not ripen properly. Barley is grown occasionally. Potatoes are grown to some extent, and if the crop is protected from diseases and insects, good yields are usually obtained.

Semiahmoo muck, shallow, 0 to 2 percent slopes (Sd; group 7).—This soil consists of areas of Semiahmoo muck in which the organic material is less than 2 feet deep over the mineral material. The soil occurs in small depressions or along the outer edges of areas of deeper organic soils.

The organic material overlying the mineral soil closely resembles the organic material in the upper part of the profile of Semiahmoo muck, 0 to 2 percent slopes, but it is only 12 to 24 inches thick. In areas where the muck and peat are less than 12 inches deep over the mineral soil, considerable mineral soil is mixed with them. In most areas some sedimentary material is mixed with the sedge peat at depths below 6 to 8 inches.

The underlying mineral soil is generally medium-textured gravelly glacial till.

Use and suitability.—So much of this soil occurs in small areas that little of it is under cultivation. Management of cultivated areas is about the same as that of areas of Semiahmoo muck, 0 to 2 percent slopes, and the use is about the same. Yields are slightly lower, especially on areas in which the organic materials are the shallowest.

Snakelum coarse sandy loam, 0 to 5 percent slopes (Se; group 5).—This soil has developed from unconsolidated sandy outwash that is somewhat stratified. It occurs in only a few areas and is associated with San Juan coarse sandy loam, 0 to 5 percent slopes, and with other prairie soils. Generally the areas adjoin forested Keystone loamy sands. The topography is smoother than that of the associated San Juan soil. Slopes are generally less than 3 percent.

The soil is well drained. It is less droughty than the associated San Juan soil because the subsoil is moderately compact and both the subsoil and the substratum are less porous and finer textured.

The native vegetation consisted mainly of wild grasses, ferns, and an occasional Douglas-fir or tree of some other species.

Profile description.—The surface layer, to depths of 8 to 11 inches, is black friable granular coarse sandy loam that contains a high content of organic matter.

The boundary is abrupt between the surface layer and a layer of very dark brown to very dark gray, firm, massive sandy loam. In place this material, even when moist, is difficult to spade, but if removed it crumbles readily to fine aggregates and single grains. Its structure is slightly vesicular. When dry this material is very dark brown. The lower boundary is gradual.

Between 18 and 25 inches, the texture is slightly finer than that of the horizon immediately above, and the material is dark grayish brown or gray and very faintly mottled. When dry it is pale brown or light brownish gray. Roots and moisture penetrate easily.

At depths below about 25 inches, the substratum is dark grayish-brown to olive-gray, loose, coarse loamy sand that contains considerable light-gray, gray, dark-gray, or olive coarse sand. This material is coarser in texture at greater depths.

Below depths of about 48 inches, the material is light-gray, dark-gray, or olive-gray coarse sand that contains some gravel.

The amount of gravel in the substratum varies. An area of this soil on Smith Prairie is comparatively free of gravel throughout. An area along the western edge of Ebeys Prairie contains extremely variable amounts at depths below 3 or 4 feet. In places in this area, the subsoil contains lenses of material that are finer textured than typical .

Use and suitability.—Snakelum coarse sandy loam, 0 to 5 percent slopes, has all been cropped at some time. Now, slightly more than one-third of the acreage is in a military reservation used as a naval airfield. Areas in farms are used about the same as areas of San Juan coarse sandy loam, 5 to 15 percent slopes. The area on Ebeys Prairie is also used to grow gooseberries and squash.

Yields are higher than those obtained on the associated San Juan soils. They are considerably lower than those on the Ebeys and Coupeville soils. The soil is less fertile than the Ebeys and Coupeville soils, and its moisture supply is lower during the dry months. In dry years crops are damaged by lack of moisture. In moist years they yield as well as on the Coupeville soils.

Snakelum coarse sandy loam, 5 to 15 percent slopes (Sf; group 5).—This very inextensive soil occurs in only one area, which is not associated with Snakelum coarse sandy loam, 0 to 5 percent slopes. Its predominant slope is 5 to 10 percent. The vegetation is about the same as that on the less strongly sloping Snakelum soil. Surface runoff is slightly greater but is still very small because of the high capacity of the soil to absorb moisture.

Except that the surface layer is deeper, or about 15 to 20 inches thick, it resembles that of Snakelum coarse sandy loam, 0 to 5 percent slopes. The subsoil is not so firm or compact as that in the less sloping Snakelum soil. At depths below 3 or 4 feet, the material is gravelly loamy sand or gravel and sand, somewhat compacted in places.

Use and suitability.—The soil was once used to grow hay and small grains or was pastured. More recently it has been used to grow Alta fescue for seed. The fescue is sown in rows 18 inches apart and is cultivated. A planting will usually produce for about 8 years. Yields range from 400 to 800 pounds per acre.

Swantown gravelly sandy loam, 0 to 5 percent slopes (Sg; group 6).—This upland soil has developed on cemented gravelly till similar to that from which the Whidbey soils were derived. Except that it is shallower and the surface layer is not so bright a brown, it resembles Whidbey gravelly sandy loam, 0 to 5 percent slopes.

The soil occurs on Whidbey Island in gently sloping or gently undulating areas next to depressions or on foot slopes below slightly steeper Whidbey soils. Slopes are generally less than 3 percent.

As a result of its shallow depth to the nearly impervious till and its position in slight depressions, the soil is only moderately well drained. The slope is strong enough that excess water can drain off, but drainage through the soil is restricted. During the rainy season the subsoil is saturated for long periods. Nevertheless, the soil generally can be farmed without being artificially drained.

The natural vegetation is the same as that on the associated upland soils. In some areas the proportion of deciduous trees, particularly alder, is greater than on the Whidbey or Hoypus soils.

Profile description.—In undisturbed forested areas, a 1- to 2-inch layer of organic litter covers the soil. This is composed of leaves, fir needles, roots, cones, and wood fragments. The lower part of the material is generally in an advanced state of decomposition and is very dark brown.

Immediately below the forest litter a very thin, gray, sandy horizon occurs in some places. This layer varies in thickness, but as a rule it is not more than 1 inch thick.

To depths of 6 to 8 inches, the surface layer is dark-brown to dark grayish-brown friable gravelly sandy loam that contains a few shot pellets. When dry, the surface soil is pale brown to light brownish gray or grayish brown.

The subsoil is 6 to 12 inches thick. It consists of grayish-brown, strongly mottled, firm gravelly sandy loam; it contains numerous hard concretions that are a mottled reddish brown or brown on the inside. When dry, the subsoil is light gray to light brownish gray.

The boundary is abrupt between the subsoil and the underlying dark-gray strongly cemented gravelly till. The till is many feet thick. In its uppermost 12 inches, it is generally highly mottled with yellow and brown.

Some stones and boulders occur on the surface and throughout the profile. Generally they must be removed before the soil can be tilled. Areas in which stones are so numerous that they affect the soil use are shown on the soil map by symbols.

Plant roots do not penetrate the cemented till layer; instead they spread horizontally and form a mat just above it. Moisture penetrates the cemented till very slowly.

The color of the surface layer varies greatly. Variations in color are particularly noticeable in plowed fields.

Except for the organic litter, which is strongly acid, Swantown gravelly sandy loam, 0 to 5 percent slopes, is strongly acid to medium acid throughout. Acidity decreases with depth.

Use and suitability.—A greater proportion of this soil than of the associated upland soils has been cleared for agricultural use. Approximately one-third is pastured or cropped. Pasture is the principal use; hay crops are second. Dairy and poultry products are the chief sources of income.

Because of its nearly level relief and its position in depressions or near the base of slopes, the soil provides more moisture during the critical early growing period than most of the forested upland soils. Even though it is shallow, it is better suited to pasture and hay than these other soils. A small part is seeded to small grains such as oats and wheat. Alfalfa, which needs a deeper soil, is not generally grown.

Although the moisture supply is good during the early part of the growing season, the soil retains less moisture late in summer than soils of the Whidbey series. Yields of oats and wheat are therefore lower than on the Whidbey soils.

Swantown gravelly sandy loam, 5 to 15 percent slopes (Sh; group 6).—This soil is associated with Whidbey gravelly sandy loam, 5 to 15 percent slopes, or with soils of the Coveland and Townsend series. The predominant slope is 6 to 12 percent.

The soil has developed from parent material similar to that from which Swantown gravelly sandy loam, 0 to 5 percent slopes, originated, and the native vegetation is the same. The profile is essentially the same as that of the less strongly sloping soil, but because of the stronger slopes there is more runoff; consequently, drainage is slightly better. Because of the better surface drainage, the color of the surface layer is less variable.

The depth to the hardpan in Swantown gravelly sandy loam, 5 to 15 percent slopes, ranges from 15 to 20 inches.

Use and suitability.—Though this soil is slightly more extensive than Swantown gravelly sandy loam, 0 to 5 percent slopes, the proportion that is farmed is much less. Use is much the same as that of the less

strongly sloping soil, and management is about the same.

Swantown loam, 0 to 5 percent slopes (Sk; group 6).—This soil generally occupies positions at lower elevations than Swantown gravelly sandy loam, 0 to 5 percent slopes. In most places it occurs in valleys between steeper areas of Whidbey gravelly sandy loams.

In some places drainage is somewhat more restricted than that of Swantown gravelly sandy loam, 0 to 5 percent slopes. Because of the very slow runoff and shallow depth to the nearly impervious substratum, the soil is saturated for long periods during the rainy season. The vegetation is similar to that on Swantown gravelly sandy loam, 0 to 5 percent slopes.

Except for texture of the surface layer, profile characteristics are essentially the same as those of Swantown gravelly sandy loam, 0 to 5 percent slopes. Although the predominant texture of the surface layer is loam, the range is from gravelly loam to silt loam. Considerably less gravel occurs in the profile, and there are but few stones.

Use and suitability.—Swantown loam, 0 to 5 percent slopes, is used in the same way as Swantown gravelly sandy loam, 0 to 5 percent slopes, and is managed in about the same way. Many of the areas are so small, however, that they are used for the same purposes as adjoining soils. Yields are slightly higher than those obtained on the Swantown gravelly sandy loams.

Swantown loam, 5 to 15 percent slopes (Sm; group 6).—This soil occurs in only two areas south of Greenbank. It is associated with Whidbey gravelly sandy loams and with Casey loams, but it occurs at lower elevations. It receives considerable seepage from the higher associated areas and is saturated during the rainy winter months. There is a little more surface runoff than on Swantown loam, 0 to 5 percent slopes. The vegetation is similar to that on Swantown gravelly sandy loam, 0 to 5 percent slopes.

The profile closely resembles that of Swantown loam, 0 to 5 percent slopes. Because of better drainage, however, the color of the surface layer is not so variable.

Use and suitability.—Except for a few acres that are pastured, used to grow hay, or used for homesites or gardens, this soil is covered by trees and brush. Some of the wooded areas are pastured.

Tacoma peat, 0 to 2 percent slopes (Ta; group 8).—This organic soil occupies low, level coastal areas. It is protected from flooding by salt water by areas of Coastal beach, 0 to 2 percent slopes, that form natural levees. During very high tides, however, the water table is near the surface, and during the rainy season water stands on the soil most of the time.

The soil is comprised of the remains of sedges, salt-tolerant grasses, and other plants in various stages of decomposition, mixed with some sedimentary peat and fine marine sediments. The vegetation consists of sedges and salt-tolerant grasses. Native grasses other than the salt-tolerant ones grow where drainage has been improved.

Tacoma peat, 0 to 2 percent slopes, is associated with Coastal beach, 0 to 2 percent slopes, and in places with Hovde sand, 0 to 2 percent slopes, and Lummi silt loam, 0 to 2 percent slopes.

Profile description.—The surface layer, to depths of 6 to 12 inches, is very dark brown to very dark grayish brown, fibrous, spongy sedge peat that is partly decomposed near the surface.

From 12 to about 30 inches, the material is very dark brown coarsely fibrous sedge peat that contains very little mineral matter.

The underlying material consists of darker colored fine fibrous sedge peat, sedimentary peat, and marine sediments in varying proportions and in varying degrees of stratification.

The surface layer is medium acid to alkaline in places. The material at depths of 12 to 30 inches is alkaline.

Use and suitability.—None of this soil is cultivated, because it is too wet. If the levees are improved and drainage ditches are built, some of the areas can be used for pasture, but their carrying capacity is low.

Tanwax peat, 0 to 2 percent slopes (Tb; group 8).—This organic soil is made up of remains of microscopic plants and colloidal or sedimentary materials. These have accumulated in depressions formerly occupied by glacial lakes, so drainage is ponded. In most places the soil occupies the entire depression, but in a few places it is associated with one or more of the other organic soils that occur in the county. The depressions are deeper and more poorly drained than those occupied by the other organic soils. The areas that have not been artificially drained are flooded or saturated throughout the year except for a short time in summer.

The vegetation is mainly spirea and some huckleberry, Labrador-tea, sedges, and moss.

Profile description.—The surface layer, to a depth of about 6 inches, is very dark brown, friable, massive, spongy, colloidal peat that is very smooth when moist and hard when dry. It breaks to irregular hard to very hard pieces. The layer contains some fibrous material.

At depths between 6 and 24 inches, the material is dark-brown to very dark grayish-brown massive, firm, colloidal peat. The material is hard when dry. It contains only a little fibrous material. In some places the colloidal peat extends to depths of many feet; in other places it is underlain at a depth of about 24 inches by fine fibrous sedge peat.

The depth to mineral material is everywhere more than 2 feet and averages more than 5 feet.

The amount of fibrous material varies. In some areas the topmost few inches is very fibrous, and in others there is fibrous sedge peat below its normal lower boundary of 20 to 24 inches.

To depths of 24 inches, the material is strongly acid.

Use and suitability.—Except for a few areas, none of this soil is used for agriculture. It is not so easily drained as the organic soils that have developed from sedge and woody materials and is not so productive.

In other counties in western Washington, this soil is used successfully for hay and pasture if improved by drainage. At present the areas in Island County are

covered by a thick growth of spirea and are usually flooded for many months of the year.

Tanwax peat, shallow, 0 to 2 percent slopes (Tc; group 8).—The total area of this soil is not large, and individual areas are small and isolated. The soil occurs in depressions in the upland soils. It is slightly better drained than the deeper Tanwax soil. The vegetation is mainly spirea, but a few alders and willows grow along the outer edges.

The peaty deposit consists largely of very dark brown to very dark grayish brown, friable, spongy colloidal peat in which there are varying amounts of fibrous materials and roots. This material is from 12 to 24 inches thick. It is underlain by medium- to coarse-textured till that is comparatively impervious to moisture.

Use and suitability.—None of this soil is cropped. If it were used for crops, yields would be about the same as those on the deeper Tanwax soil.

Tidal marsh, 0 to 2 percent slopes (Td; group 15).—This miscellaneous land type consists of areas of marshy land that are bordered by salty, or brackish, water. At high tide the areas are generally completely submerged. They remain marshy at low tide.

Coastal deposits of widely varying texture make up the soil material in this land. The deposits are largely medium to fine in texture, gray or blue gray in color, and highly mottled. Remains of flattened fibers and sedge roots occur in the uppermost 2 or 3 feet. The material contains large amounts of salts.

The vegetation consists of salt-tolerant and associated tidal-marsh plants.

Use and suitability.—These areas have little or no value for agriculture. Some of the higher lying areas can be used for pasture, but the carrying capacity is low. Nevertheless, if dikes are built and the areas are drained properly, this marsh is fairly productive and has characteristics similar to those of the Lummi soils.

Townsend sandy loam, 0 to 5 percent slopes (Te; group 4).—This soil occurs very near to or adjoining the coast. It occupies moraines that generally have slopes of less than 3 percent. The soil is closely associated with areas of steeper Townsend soils. It is also associated with Coveland loams and with Whidbey gravelly sandy loams. Most of the soil is in two areas on Whidbey Island—one in and near Oak Harbor and the other at San de Fuca.

The soil has developed from cemented gravelly till. Because it is so near the coast, its parent materials are mixed with marine and glacial lake sediments.

The soil is well drained. Internal drainage is medium, however, because of the nearly impervious hardpan.

The native vegetation consisted of grasses. A few clumps of Garry oak were scattered over the areas, and a few Douglas-firs grew along the outer edges.

Profile description.—To an average depth of 10 inches, the surface layer is nearly black, friable, granular sandy loam that is very dark grayish brown when dry. It contains a few rounded and angular pebbles and stones and many fibrous roots. The thickness of the surface layer ranges from 6 to 15 inches. Its lower boundary is abrupt.

The upper part of the subsoil, to a depth of 18 inches, is dark-brown, brown, or grayish-brown gravelly friable sandy loam that contains many angular pebbles. This material is 4 to 12 inches thick. At depths below 18 inches it grades to olive-gray, olive, or grayish-brown firm gravelly sandy loam to gravelly loamy sand, which contains many disintegrated and partly decomposed stones and pebbles. The lower part of this material is moderately mottled with yellow and brown and has a slightly finer texture. When dry, the material is light gray to light olive gray.

The subsoil is underlain, at a depth of about 28 inches, by gray to olive-gray moderately to strongly cemented till that contains many rounded and subangular pebbles and stones. Some of these are disintegrated and partly decomposed. Some of the disintegrated stones embedded in the till are granite. To a depth of a few inches, the upper part of the till is mottled with yellow and brown and its structure is somewhat platy. Lenses or pockets of medium- and fine-textured material occur erratically. When dry, the material is light gray. The boundary between the subsoil and the cemented substratum is not so distinct or so abrupt as it is in the Whidbey and Alderwood soils.

The upper part of the subsoil varies greatly in color and in the amount of gravel it contains. The depth of the soil over the substratum varies, as does also the degree of cementation of the substratum. In the large area north of San de Fuca, the soil is 30 to 40 inches deep over a weakly to strongly cemented substratum. The surface soil in this area is from 12 to 18 inches deep. In the area northwest of Oak Harbor, the surface soil is shallower than normal—about 6 to 8 inches deep—and lighter colored.

The surface layer of Townsend sandy loam, 0 to 5 percent slopes, is high in organic matter, and it is medium to slightly acid. The subsoil is slightly acid, and the underlying material is neutral or very slightly alkaline.

Use and suitability.—This soil needs little or no clearing to prepare it for cultivation. Consequently, a large part is farmed. Areas that are not farmed are used as building sites. Part of the town of Oak Harbor is located on this soil.

The soil is used principally for pasture or for growing hay, small grains, and cabbage for seed. Livestock and livestock products are generally the chief sources of farm income, and the soil is used largely to produce feed. Most of the wheat, oats, and barley are fed to stock, though some grain is marketed. Oats are the most important grain crop. Alfalfa is not grown extensively.

This soil is moderately fertile, but its water-supplying capacity is lower than that of some of the other prairie soils; consequently, yields are lower. Yields of late-maturing crops are poor, and the carrying capacity of pasture is low during the latter part of the summer. Nevertheless, the soil is more productive than adjacent areas of forested Whidbey, Swantown, and Hoypus soils.

A small part of the soil is used to grow cabbage and grass for seed, squash, and green peas. Yields of peas

grown for canning or coldpack are fairly low. Yields of squash and cabbage seed vary.

Definite crop rotations are rarely used. Following a hay crop or pasture, however, such crops as peas, squash, or cabbage are planted, and grain is then planted for a year or two. Some commercial fertilizer is used for peas, squash, and cabbage.

Townsend sandy loam, 5 to 15 percent slopes (Tf; group 4).—This soil generally occupies single slopes, and it is associated with areas of Townsend sandy loam, 0 to 5 percent slopes. Its predominant slope is 6 to 12 percent. Parent materials, drainage, and vegetation are similar to those of the less sloping Townsend soil.

The profile resembles that of Townsend sandy loam, 0 to 5 percent slopes. The surface soil, however, is shallower—generally 6 to 8 inches thick. The depth to the cemented substratum is also less, or from 18 to 24 inches. This soil generally occurs next to the coast. Consequently, the substratum contains lenses and pockets of finer sediments, and stones and boulders are more common.

Use and suitability.—The principal parts of the towns of Oak Harbor and Coupeville are located on areas of Townsend sandy loam, 5 to 15 percent slopes. The surface layer of the area at Coupeville is not so dark colored as that of the typical soil. On cropped areas yields are about the same as those obtained on Townsend sandy loam, 0 to 5 percent slopes.

Townsend sandy loam, 15 to 30 percent slopes (Tg; group 13).—This soil occurs in only two small areas near San de Fuca. It occupies the moderately steep slopes of intermittent drainageways and short single slopes, where it is associated with Townsend sandy loam, 5 to 15 percent slopes. It has developed from parent material similar to that from which Townsend sandy loam, 5 to 15 percent slopes, originated.

The surface runoff is medium, but erosion is not severe unless the soil is cultivated.

Except that the surface layer is shallower and is dark brown to very dark brown when dry, the profile closely resembles that of Townsend sandy loam, 0 to 5 percent slopes.

Use and suitability.—The best use for Townsend sandy loam, 15 to 30 percent slopes, is pasture. All of it is pastured at the present time.

Whidbey gravelly sandy loam, 5 to 15 percent slopes (Wb; group 6).—This is by far the most extensive soil in Island County. It covers approximately 32 percent of the total county area. The soil is closely associated with less extensive areas of other Whidbey soils, and with soils of the Keystone, Hoypus, and Swantown series. The predominant slope range is 6 to 12 percent.

The cemented gravelly till from which this soil has developed is somewhat similar to that from which the Alderwood soils originated. It was derived largely from granite, quartzite, schist, basalt, slate, and sandstone. The parent materials probably originated to a greater extent from acidic rocks than the parent materials of the Alderwood soils.

Natural drainage is good in this soil. Surface runoff is slow, however, because the surface layer and subsoil absorb the water readily. During the rainy season the lower part of the subsoil immediately above the hardpan remains saturated for long periods. Nevertheless, artificial drainage is not required.

The native vegetation consisted largely of conifers, predominantly Douglas-fir with a few hemlocks and cedars. The native trees have been logged, but trees and shrubs similar to those originally on the soil have grown up. Some areas have a cover of deciduous trees such as alder, willow, and maple.

Profile description.—In undisturbed forested areas, the surface layer is overlain by organic litter consisting of fir needles, leaves, twigs, cones, roots, and moss in various stages of decomposition. The lower part is very dark brown, and the material is in an advanced stage of decomposition. The thickness of this organic layer ranges from 1 to 3 or 4 inches.

Immediately below the organic layer is a distinct, thin, gray sandy horizon that is ½ to 3 inches thick. This layer occurs only in areas that have not been disturbed to a great extent by logging or clearing operations. In cultivated or pastured areas, this material is mixed with the surface soil and the gray horizon can no longer be distinguished.

In cultivated and pastured areas, the surface layer, to a depth of about 7 inches, is brown friable gravelly sandy loam that contains considerable shot. The gravel in this layer is coated with fine material. When dry the surface soil is pale brown.

From 7 to about 22 inches, the material is slightly grayer and lighter in color and is yellowish-brown, olive-brown, or grayish-brown friable to nearly loose gravelly sandy loam or gravelly loamy sand. It contains less shot than the surface layer. It is pale brown or light yellowish brown to very pale brown when dry. This material grades to olive-brown or light olive-brown, mottled, firm gravelly sandy loam or gravelly loamy sand that is weakly cemented. It is very hard when dry and is light gray.

Below a depth of about 30 inches, the material is strongly cemented dark-gray till composed of gravelly loamy sand. This hardpan, or cemented substratum, is many feet thick, in some places as much as 50 feet. The uppermost 6 to 24 inches of the hardpan is generally mottled with yellow and brown and has a somewhat platy structure. When dry the hardpan is light gray. Roots do not penetrate it but spread laterally just above it to form a mat. Moisture penetrates it very slowly.

The texture of the surface layer and subsoil varies. Depth to the hardpan ranges from 20 to as much as 48 inches. In areas west of Oak Harbor the soil over the hardpan is shallower than elsewhere. The hardness, or degree of cementation, in the hardpan varies from weakly cemented to indurated within small areas. This variation is most common in the southern part of Whidbey Island.

The profiles in areas in the southern part of Whidbey Island, particularly those on the peninsula northeast of Freeland, are not so gravelly as those in the northern part of the island. Here and there throughout the island are areas that have a very gravelly coarse-textured subsoil. Areas in which numerous stones and boulders are strewn over the surface or

occur throughout the profile are shown on the soil map by symbols. These areas generally occur in the northern half of Whidbey Island.

The forest litter covering undisturbed areas of Whidbey gravelly sandy loam, 5 to 15 percent slopes, and the underlying thin, gray sandy horizon are extremely to very strongly acid. The surface layer is very strongly to strongly acid. The material immediately below the surface layer is strongly to medium acid and at lower depths grades to material that is medium acid. The cemented substratum is slightly acid in most places, but in some it is very slightly acid.

Use and suitability.—A large part of this soil is under forest. All of the virgin forests have been logged, but logging is carried on to a small extent on second- and third-growth stands of Douglas-fir and associated trees. Much of the soil is covered by deciduous trees, mainly alder, and by brush and stumps.

About one-fourth to one-third of the total area of this soil is in farms. Of this about one-fourth is under cultivation. The cost of clearing the brush and stumps is partly the reason for the low proportion under cultivation.

If cleared, the soil is fairly productive. Because of the rolling relief surface drainage is adequate, and because of the relatively impervious substratum a good moisture supply is retained during the growing season.

Farms are generally diversified. Dairying and poultry raising are the major agricultural enterprises. The cropland is used largely for pasture or to grow hay for livestock. Only a small part is used to grow small grain as a cash crop. Uncleared land in farms is used as woodland pasture, to grow trees, or is left idle.

Crop yields are about the same as those obtained on Alderwood gravelly sandy loam, 5 to 15 percent slopes. Yields of oats and wheat are extremely variable. Soft winter wheat is grown.

Alfalfa is the principal hay crop. Many farmers cut the alfalfa once and then pasture it for the rest of the season. Red or alsike clover mixed with grasses gives an average yield of slightly less than 2 tons an acre. Pastures range in quality from good stands of alfalfa or clover and grass mixtures to poor stands of native and tame grasses.

Manure is the only fertilizer generally used.

Whidbey gravelly sandy loam, 15 to 30 percent slopes (Wc; group 13).—This soil is closely associated with Whidbey gravelly sandy loam, 5 to 15 percent slopes, and with soils of the Keystone series. It occurs most extensively in the southern part of Whidbey Island. Its predominant slope is 16 to 25 percent.

The profile is similar to that of Whidbey gravelly sandy loam, 5 to 15 percent slopes, but is more variable in texture, stoniness, and depth. In some areas the depth to the hardpan and the degree of cementation are extremely variable. In areas closely associated with the Keystone soils, the soil contains less gravel and the substratum is weakly to strongly cemented.

Use and suitability.—Whidbey gravelly sandy loam, 15 to 30 percent slopes, is used largely for forests, which is its best use. Small areas are used as woodland pasture or for homesites and gardens.

Whidbey gravelly sandy loam, 0 to 5 percent slopes (Wa; group 6.)—This soil occurs mainly in the northern part of Whidbey Island. It is generally associated with areas of Whidbey gravelly sandy loam, 5 to 15 percent slopes. Its slopes are generally less than 3 percent. Because of the mild slopes, surface runoff is very slow.

This soil, except for slope, resembles Whidbey gravelly sandy loam, 5 to 15 percent slopes. Depth of the soil over the hardpan is generally less, or from 18 to 24 inches. In most places the color of the soil is not so bright and the lower subsoil is more highly mottled.

Use and suitability.—Use and management are about the same as for Whidbey gravelly sandy loam, 5 to 15 percent slopes. A greater proportion of this soil is in farms. Most of the acreage in farms is used for hay or pasture. Because of the milder slope, moisture is more plentiful than in Whidbey gravelly sandy loam, 5 to 15 percent slopes. Consequently, crop yields are slightly higher under similar management.

Management of Island County Soils

This section describes the use, management, and conservation practices that are commonly followed in Island County. The discussion is in three parts: The first covers general use suitability and management needs by groups of soils; the second is concerned with rotations and the use of fertilizers and amendments; the third gives estimated yields of crops grown on the various soils.

Farmers who would like help in deciding what crops and rotations are best suited to their farms and how much lime and fertilizer to use on a particular field for a particular crop may call on the county agent or write to the State agricultural experiment station for advice.

Soil Management Groups

For the purpose of discussing management requirements, the 80 soils and miscellaneous land types in Island County have been separated into 15 management groups. All of the mapping units in any one group have similar use suitability and management needs. For ease in identifying the soils that need about the same kind of management, each management group is shown by a different color on the soil map at the back of this report. Suitable crops for the soils in the various management groups, and the fertilizer needs for each crop, are given in table 4.

Adequately drained, undulating to rolling soils

Management groups 1, 2, 3, 4, 5, and 6 are made up of adequately drained, undulating to rolling soils. Group 2 soils have poor natural drainage but can be artificially drained. All of the soils of these groups are suited to about the same crops and need about the same type of management. Management groups 1 and 2 are suitable for specialized fruit and vegetable

TABLE 4.—*Suitable crops and fertilizer applications for the soils*[1]

Management groups 1 through 6: Adequately drained, undulating to rolling soils

Crops	Fertilizers	Method of application
Specialized crops:[2]		
Squash	If no manure has been used, add a complete fertilizer.	
Cabbage for seed	If no manure has been used, add a complete fertilizer containing the equivalent of 30 pounds nitrogen, 85 pounds phosphorus, and 30 pounds potassium.[3]	Place in bands 2 inches to side of plant and about 3 inches deep at planting time.
Peas, green	With or without manure, add a fertilizer containing the equivalent of 60 pounds phosphorus and 60 pounds potassium.	Place in bands 1 to 1½ inches to the side of row and below seed level.
Grain crops Winter wheat. Spring wheat. Winter oats. Spring oats. Winter barley. Spring barley. Corn for silage.	If 6 to 8 tons manure have been used, add a fertilizer high in phosphorus; without manure add a mixed fertilizer containing the equivalent of 30 pounds nitrogen[4] and 40 pounds phosphorus; if deficient in potassium, add a complete fertilizer containing the equivalent of 30 pounds nitrogen, 40 pounds phosphorus, and 20 pounds potassium.	Broadcast or drill in with grain drill at about the time of planting.
Legumes Alfalfa. Red clover. Common vetch. Hairy vetch. Alsike clover. White clover. Subterranean clover. Birdsfoot trefoil.	To establish stands add 8 to 10 tons manure and a commercial fertilizer containing the equivalent of about 15 pounds nitrogen and 60 pounds phosphorus. Where needed on alfalfa, apply 40 to 60 pounds borax; lime will benefit alfalfa on some soils. On old stands add only a fertilizer high in phosphorus. Where needed a fertilizer containing boron should be added to old stands of alfalfa every 3 years at the same rate as that used for establishing stands. Some nitrogen may be needed for clover and vetch on soils of groups 3 through 6.	To establish stands plow manure under in fall or early spring; work commercial fertilizer into surface layer when preparing seedbed. Broadcast fertilizer on old stands in early spring. Apply lime in fall or early spring.
Grasses Tall fescue. Orchardgrass. Perennial ryegrass. Tall oatgrass. Creeping red fescue. Italian ryegrass.	Add a fertilizer containing the equivalent of about 30 pounds nitrogen and 60 pounds phosphorus annually. Some potash may be beneficial on soils deficient in potassium.	Apply as top dressing on solid stands and as side dressing to grass seeded in rows.
Hay mixtures:[5]		
Alfalfa (15)	Same as for **Legumes**	To establish stands broadcast and work into soil lightly before seeding. On old stands broadcast fertilizer in early spring.
Oats (70) and vetch (30)	Same as for **Grain Crops**	
Alta fescue (6) or orchardgrass (6), and alfalfa (10). Alta fescue (6) or orchardgrass (6), and birdsfoot trefoil (4). Perennial ryegrass (8) or Italian ryegrass (8) and red clover (10) or alsike clover (4).	Same as for **Grasses,** except nitrogen is reduced from 30 to 20 pounds annually. If manure is used, nitrogen is not needed.	
Pasture mixtures[5] Perennial ryegrass (3), Alta fescue (6), orchardgrass (4), white-clover (2), and alsike clover (2). For dry sites: Creeping red fescue (4), orchardgrass (4) or tall oatgrass (4), and subterranean clover (5).	Add a fertilizer containing the equivalent of about 20 pounds nitrogen and 60 pounds phosphorus annually. If manure is used, nitrogen is not needed. Some potash may be beneficial for soils deficient in potassium.	Same as for **Hay mixtures.**

See footnotes at end of table.

Management groups 7 through 10: Poorly drained, nearly level soils[6]

Specialized crops:[7]		
Carrots	*For muck or peat soils.*—With or without manure, add commercial fertilizer that contains the equivalent of about 35 pounds nitrogen, 140 pounds phosphorus, and 140 pounds potassium; or 20 pounds nitrogen, 60 pounds phosphorus, and 140 pounds potassium. *For mineral soils.*—Add 10 to 15 tons manure and a commercial fertilizer containing the equivalent of 35 pounds nitrogen, 105 pounds phosphorus, and 105 pounds potassium; or 30 pounds nitrogen, 90 pounds phosphorus, and 60 pounds potassium. With no manure add a commercial fertilizer containing the equivalent of 50 pounds nitrogen, 100 pounds phosphorus, and 100 pounds potassium.	Broadcast and disk in fertilizer before planting; use a grain drill with fertilizer attachment or a lime spreader to broadcast.
Celery	*For muck or peat soils.*—Add a commercial fertilizer containing the equivalent of 125 pounds nitrogen, 250 pounds phosphorus, and 250 pounds potassium.	Disk into soil before transplanting celery.
Cabbage, cauliflower, broccoli, brussels sprouts.	*For muck or peat soils.*—With 10 to 15 tons manure, add a commercial fertilizer containing the equivalent of 25 pounds nitrogen, 75 pounds phosphorus, and 100 pounds potassium; 25 pounds nitrogen, 75 pounds phosphorus, and 75 pounds potassium; or 15 pounds nitrogen, 45 pounds phosphorus, and 105 pounds potassium. If no manure is used, add a commercial fertilizer that contains the equivalent of 35 pounds nitrogen, 105 pounds phosphorus, and 140 pounds potassium; or 20 pounds nitrogen, 60 pounds phosphorus, and 140 pounds potassium. *For mineral soils.*—With 10 to 15 tons manure, add a commercial fertilizer containing the equivalent of 25 pounds nitrogen, 75 pounds phosphorus, and 25 pounds potassium; if no manure is used, add a commercial fertilizer containing the equivalent of 45 pounds nitrogen, 90 pounds phosphorus, and 90 pounds potassium.	Place in bands 2 inches to side of plant and about 3 inches deep when plants are set out in field; if fertilizer is broadcast, increase rate by one-quarter and apply before planting.
Peas, green	*For either mineral or organic soils.*—With or without manure, add a commercial fertilizer containing the equivalent of 60 pounds phosphorus and 60 pounds potassium.	Place in bands 1 to 1½ inches to the side of row and below seed level, or fertilizer may be predrilled or broadcast.
Potatoes	*For muck or peat soils.*—With or without manure, add a commercial fertilizer containing the equivalent of 30 pounds nitrogen, 90 pounds phosphorus, and 210 pounds potassium; or 50 pounds nitrogen, 150 pounds phosphorus, and 200 pounds potassium. *For mineral soils.*—Whether or not manure has been applied to previous crop, add a commercial fertilizer containing the equivalent of 50 pounds nitrogen, 100 pounds phosphorus, and 100 pounds potassium up to 100 pounds nitrogen, 200 pounds phosphorus, and 200 pounds potassium.	Place in bands 2 inches to each side of the seed pieces and on a level slightly below the bottom of the seed pieces.
Blackberries	*For muck or peat soils.*—With 8 to 12 tons manure, use 200 pounds treble superphosphate or 400 to 500 pounds 18- or 20-percent superphosphate; with no manure add a commercial fertilizer containing the equivalent of 30 pounds nitrogen, 120 pounds phosphorus, and 120 pounds potassium; or 30 pounds nitrogen, 100 pounds phosphorus, and 100 pounds potassium. *For mineral soils.*—If manure has been added, use commercial fertilizers at the same rate as suggested for blackberries on muck and peat soils; with no manure add a commercial fertilizer containing the equivalent of 50 pounds nitrogen, 100 pounds phosphorus, and 100 pounds potassium.	Spread manure in early spring or before planting cover crop in fall. Apply commercial fertilizer in furrow nearest the berries when plowing between the rows in the spring.
Strawberries	*For mineral soils.*—Apply 10 to 15 tons manure or grow cover crop before plowing for strawberries and add a commercial fertilizer containing the equivalent of 45 pounds nitrogen, 90 pounds phosphorus, and 90 pounds potassium; if less foliage growth is desired, add a commercial fertilizer containing the equivalent of 30 pounds nitrogen, 90 pounds phosphorus, and 60 pounds potassium.	Apply ½ to ⅔ in spring and the remainder after harvest.
Grain crops Spring oats. Spring barley. Corn for silage.	If 6 to 8 tons manure have been used, add a fertilizer high in phosphorus; if manure has not been used, add a mixed fertilizer that contains the equivalent of 30 pounds nitrogen and 40 pounds phosphorus; if deficient in potassium, add a complete fertilizer that contains the equivalent of 30 pounds nitrogen, 40 pounds phosphorus, and 20 pounds potassium.	Broadcast or drill in with grain drill at about the time of planting.

See footnotes at end of table.

Grasses Tall fescue. Orchardgrass. Perennial ryegrass. Meadow foxtail. Kentucky bluegrass. Reed canarygrass. Italian ryegrass.	Add a commercial fertilizer each year containing the equivalent of 30 pounds nitrogen and 60 pounds phosphorus. Some potash may benefit grasses on soils deficient in potassium.	Apply as top dressing on solid stands and as side dressing to grass seeded in rows.
Legumes Alsike clover. White clover. Ladino clover. Birdsfoot trefoil. Big trefoil.	To establish stands add 8 to 10 tons manure and a commercial fertilizer containing the equivalent of 15 pounds nitrogen and 60 pounds phosphorus. On old stands add only a fertilizer high in phosphorus. Potash may be beneficial on some soils. Some nitrogen may be needed for clover and vetch on soils of groups 8, 9, and 10.	To establish stands plow manure under in fall or early spring; work commercial fertilizer into surface layer when preparing seedbed. On old stands broadcast fertilizer in early spring.
Hay mixtures[5] Italian ryegrass (8) and alsike clover (4) or birdsfoot trefoil (4). Meadow foxtail (6) and alsike clover (4), or birdsfoot trefoil (4), or big trefoil (2). Alta fescue (6) or orchardgrass (6) and alsike clover (4) or birdsfoot trefoil (4) or big trefoil (2).	Sames as for **Grasses** except that nitrogen is reduced from 30 to 20 pounds applied annually. With manure nitrogen is not needed.	To establish stands broadcast and work into soil lightly before seeding. On old stands broadcast fertilizer in early spring.
Pasture mixtures[5] Perennial ryegrass (3) or Italian ryegrass (3), Alta fescue (6), or orchardgrass (6), Kentucky bluegrass (2), alsike clover (2) and Ladino clover (2), or white clover (2). Meadow foxtail (6) or Alta fescue (6), and big trefoil (2) or birdsfoot trefoil (4). Reed canarygrass (10) and big trefoil (2) or birdsfoot trefoil (4).	Same as for **Hay mixtures**	Same as for **Hay mixtures.**

Management group 11: Somewhat excessively drained to excessively drained undulating to rolling soils

Grain crops Spring oats (early seeding). Winter oats. Rye.	If 6 to 8 tons manure have been used, add a fertilizer high in phosphorus; without manure add a mixed fertilizer containing the equivalent of 30 pounds nitrogen and 40 pounds phosphorus. If soils are deficient in potassium, add a complete fertilizer containing the equivalent of 30 pounds nitrogen, 40 pounds phosphorus, and 20 pounds potassium.	Broadcast or drill in with grain drill about planting time.
Grasses Creeping red fescue. Chewings fescue. Orchardgrass. Tall oatgrass. Bentgrass. Alta fescue.	Add each year a commercial fertilizer containing the equivalent of 30 pounds nitrogen and 60 pounds phosphorus. Some potash may be beneficial on soils deficient in potassium.	Apply as top dressing on solid stands and as side dressing to grass seeded in rows.

See footnotes at end of table.

Legumes	To establish stands add 8 to 10 tons manure and a commercial fertilizer containing the equivalent of about 15 tons nitrogen and 60 pounds phosphorus. On old stands add only phosphate and manure. Potash may benefit crops on some soils.	To establish stands plow manure under in fall or early spring; work commercial fertilizer into surface layer when preparing seedbed. On old stands broadcast fertilizer in early spring.
Vetch. Red clover. Alsike clover. Subterranean clover.		
Hay mixtures	If 6 to 8 tons manure have been used, add a commercial fertilizer containing the equivalent of 40 pounds phosphorus or 30 pounds nitrogen, 40 pounds phosphorus, and 20 pounds potassium.	Broadcast and work into soil lightly before seeding.
Winter oats and vetch.		
Pasture mixtures[5]	Add each year a commercial fertilizer containing the equivalent of 30 pounds nitrogen and 60 pounds phosphorus. Some potash may be beneficial.	To establish stands broadcast and work into soil lightly before seeding. On old stands broadcast fertilizer in early spring.
Creeping red fescue (4) or Chewings fescue (4), orchardgrass (4), and alsike clover (3) or subterranean clover (5).		
Orchardgrass (4), or tall oatgrass (4), Alta fescue (6), and alsike clover (3) or subterranean clover (5).		
Management groups 12 through 14: Hilly and steep soils		
None	None	None.
Management group 15: Miscellaneous land types and nonagricultural soils		
None	None	None.

[1] Consult State agricultural experiment station for more detailed suggestions concerning management (*4*).

[2] Suited only to soils in management groups 1 and 2.

[3] Pounds per acre: Nitrogen (N); Phosphorus (P_2O_5); and Potassium (K_2O_5).

[4] Less nitrogen needed for soils developed under grass.

[5] Figures in parentheses refer to number of pounds seeded per acre of each plant in mixture.

[6] Crop and fertilizer suggestions apply only to sites that are adequately drained.

[7] Specialized crops also adapted to soils in management groups 1 through 5.

crops, in addition to the grain, hay, and pasture to which the soils of all six groups are suited (see table 4). General characteristics of each of the six management groups and their relative suitability for the adapted crops are discussed in the following pages.

GROUP 1

Soils of group 1 have nearly level to gently sloping relief and are moderately well drained to well drained. They are underlain by glacial lake and marine sediments. The soils have all developed under grass; as a result they have black, deep surface layers and their content of organic matter is high. None of these soils has any pronounced adverse characteristics. The following soils are in management group 1:

Coupeville loam, 0 to 3 percent slopes.
Coupeville silt loam, 0 to 2 percent slopes.
Ebeys sandy loam, 0 to 5 percent slopes.
Ebeys sandy loam, 5 to 8 percent slopes.

Suitability for use.—The soils of group 1 are all well suited to tilled crops. They generally have a better supply of nutrients than other soils in the county. Nevertheless, even the most fertile ones respond to additions of manure and commercial fertilizer. Permeability is good in these soils; roots and moisture penetrate readily to all parts of the subsoils, though movement of air and moisture downward through the soil is somewhat retarded in Coupeville silt loam, 0 to 2 percent slopes.

These soils can be tilled within a comparatively wide range of moisture content. The range for Ebeys sandy loam, 5 to 8 percent slopes, is narrower than for the other soils of the group. During the latter part of the growing season, it dries out more than the other soils. Ebeys sandy loam, 0 to 5 percent slopes, and Coupeville loam, 0 to 3 percent slopes, retain a more favorable supply of moisture than the others. Coupeville silt loam, 0 to 2 percent slopes, is not so well drained and needs to be drained artificially for maximum yields.

Relief is favorable; the soils are easy to conserve and to till. They are not erodible.

Use and management.—The soils of management group 1 have a wide range of use. They are used mainly to grow winter wheat, alfalfa for hay and pasture, and specialized crops such as squash and cabbage for seed. Productivity can be kept at a high level if rotations are used that include a year of legumes after 2 or 3 years of grain crops, cabbage, or squash.

Phosphate is the principal fertilizer required. In some places potash is needed. A small amount of nitrogen is very beneficial, particularly in helping to establish a new stand of alfalfa.

GROUP 2

Group 2 consists of very gently sloping to gently sloping poorly drained soils underlain by fine-textured till, marine sediments, or lake-laid sediments. Like the soils of group 1, these soils have developed under grass. They have deep, black-colored surface layers. The following soils are in group 2:

Coveland loam, 0 to 5 percent slopes.
Coveland loam, 5 to 8 percent slopes.

Suitability for use.—The soils of group 2 have no pronounced adverse characteristics. Some areas of Coveland loam, 0 to 5 percent slopes, however, contain a few stones that should be removed to make tillage easier. The soils are among the most productive in the county. Their content of organic matter is high, and they are fairly well supplied with nutrients.

In contrast to the soils of group 1, these soils are poorly drained; for maximum yields they must be drained artificially. Nevertheless, there is enough slope so that surface water runs off and water stands on the soils for only short periods during rainy seasons. Movement of moisture and air downward through the soil is somewhat slow, but air, moisture, and roots penetrate to all parts of the subsoil.

Good tilth is easy to maintain. Relief is favorable for tillage, and the soils are not erodible. The range of moisture over which the soils can be tilled is comparatively wide. It is narrower in Coveland loam, 0 to 5 percent slopes, than in most of the soils of groups 1 and 2.

Use and management.—The soils of group 2 have a wide range of use but are used mainly to grow hay, cereal grains, squash, and cabbage for seed. They can be kept highly productive if rotations are used that include 1 year of legumes after 2 or 3 years of grain, cabbage, or squash.

Phosphorus is the chief fertilizer needed. In some places potassium is required. In the spring fertilizers high in potassium may sometimes be added to fall-planted cabbage to encourage the seed to develop. Though the soils contain considerable organic matter, a small amount of nitrogen is highly beneficial, particularly in establishing a new stand of alfalfa.

GROUP 3

Soils of group 3 have very gently sloping to rolling relief and moderately good to poor drainage. They are underlain by fine-textured till, marine sediments, or lake-laid sediments. Depth to the clayey subsoil is 12 to 20 inches. Each of the soils has at least one defect that detracts from its value for cropping. These include slow internal drainage, shallow depth, or coarse texture. The following soils are in management group 3:

Bow loam, 0 to 5 percent slopes.
Bow loam, 5 to 15 percent slopes.
Casey loam, 0 to 5 percent slopes.
Casey loam, 5 to 15 percent slopes.
Casey fine sandy loam, 0 to 5 percent slopes.
Casey fine sandy loam, 5 to 15 percent slopes.

Suitability for use.—The soils of group 3 are not entirely unsuited to tillage, but their adverse characteristics make them less suitable for tilled crops than soils in group 1. They become very hard and are difficult to till when they dry out in summer. The range of moisture over which they can be tilled is narrower than in soils of groups 4 and 5.

Soils of both the Bow and Casey series have developed under forest. As a result their content of organic matter is low. They retain moisture moderately well so are well suited to pasture and hay. Yields of crops

grown on these soils are lower than yields on soils of group 1.

Use and management.—The soils of group 3 should be pastured or used to grow hay. They do not retain enough moisture for spring crops or late-maturing crops. Therefore, if crops other than hay are grown, they should be winter grains or early seeded crops.

Fertilizer requirements are shown in table 4. These soils require more nitrogen than other adequately drained, undulating to rolling soils of the county.

GROUP 4

Group 4 consists of very gently sloping to sloping well-drained soils underlain by compact gravelly till. The soils are fairly good for crops but have a nearly impervious hardpan that slows internal drainage. The following soils are in management group 4:

Townsend sandy loam, 0 to 5 percent slopes.
Townsend sandy loam, 5 to 15 percent slopes.

Suitability for use.—The soils of group 4 have developed under grass. Consequently, they have a fairly high content of organic matter. They are coarser textured than the soils of group 3 and are somewhat droughty, which reduces their productivity. The soils are easy to till and can be tilled over a wide range of moisture content.

Soils of group 4 are moderately well suited to tilled crops but are better suited to hay and pasture than to grain crops. They have a wider range of suitability than the soils of group 3. If grain is grown it should be an early seeded variety or winter grain, because the soils do not retain enough moisture so that crops will do well during the latter part of the growing season.

Use and management.—Fertilizers and amendments suggested in table 4 are suitable for use on soils of group 4. The grasses for which these soils are best suited are orchardgrass, tall oatgrass, creeping red fescue, Chewings fescue, bentgrass, and Alta fescue. Vetch, red clover, alsike clover, and subterranean clover are the best-suited legumes.

The following pasture mixtures are suitable for these soils: Creeping red fescue (4 pounds) or Chewings fescue (4 pounds); orchardgrass (4 pounds); and alsike clover (3 pounds) or subterranean clover (5 pounds). Another suitable mixture is orchardgrass (4 pounds) or tall oatgrass (4 pounds); Alta fescue (6 pounds); and alsike clover (3 pounds) or subterranean clover (5 pounds).

GROUP 5

The soils of group 5 are very gently sloping to sloping and are somewhat excessively drained to well drained. They are underlain by loose gravelly outwash or sandy outwash. These soils are fairly productive of some crops, but they are so coarse textured that they do not retain a good supply of moisture. The following soils are in group 5:

San Juan coarse sandy loam, 0 to 5 percent slopes.
San Juan coarse sandy loam, 5 to 15 percent slopes.
Snakelum coarse sandy loam, 0 to 5 percent slopes.
Snakelum coarse sandy loam, 5 to 15 percent slopes.

Suitability for use.—The soils of group 5 have developed under grass, so the content of organic matter in the surface layer is high. The soils are very porous, and drainage in the San Juan soils is somewhat excessive. The Snakelum soils are not so droughty as the San Juan.

The soils are easy to till. They can be tilled over a wide range of moisture content. They are moderately well suited to tilled crops but are more suitable for pasture and hay than for grain. If grain is grown winter and early seeded varieties should be used because there is not enough moisture for crops that mature late.

Use and management.—Fertilizer requirements are shown in table 4. The grasses and legumes and the pasture mixtures that are adapted to the soils of group 4 are suitable for these soils also.

GROUP 6

Soils of group 6 are gently undulating to rolling. They are well drained to moderately well drained. The soils have all developed from similar parent materials. All are underlain, at varying depths, by strongly cemented gravelly till. All of the soils have developed under forest vegetation. They are light colored and are all fairly low in organic matter. The following soils are in management group 6:

Alderwood fine sandy loam, 0 to 5 percent slopes.
Alderwood fine sandy loam, 5 to 15 percent slopes.
Alderwood gravelly sandy loam, 0 to 5 percent slopes.
Alderwood gravelly sandy loam, 5 to 15 percent slopes.
Bozarth fine sandy loam, 0 to 5 percent slopes.
Bozarth fine sandy loam, 5 to 15 percent slopes.
Swantown gravelly sandy loam, 0 to 5 percent slopes.
Swantown gravelly sandy loam, 5 to 15 percent slopes.
Swantown loam, 0 to 5 percent slopes.
Swantown loam, 5 to 15 percent slopes.
Whidbey gravelly sandy loam, 0 to 5 percent slopes.
Whidbey gravelly sandy loam, 5 to 15 percent slopes.

Suitability for use.—Soils of group 6 are poorly suited to tilled crops. Many of them are gravelly. They are more difficult to till than soils in groups 4 and 5, but all can be worked over a wide range of moisture content. Because most of them have coarse texture, they are generally somewhat droughty. Consequently, row crops are severely damaged in dry years. Nevertheless, the nearly impervious cemented substratum helps materially to retain moisture for plants.

The Bozarth and Swantown are the shallowest soils of this group. The Alderwood and Whidbey are comparatively deep. The Bozarth and Swantown occupy more favorable positions for retaining rainfall than the others. Their water-holding capacity is moderate. The Bozarth soils have developed under a sparse forest vegetation. Consequently, they have a slightly higher content of organic matter than the other soils of the group.

These soils are all better suited to pasture and hay than to tilled crops. They are not suited to specialized crops except for those grown in home gardens. Suitable legumes, grasses, and hay and pasture mixtures are listed in table 4. Crops that were described as

particularly well suited to groups 4 and 5 are suitable for the drier parts of group 6 soils.

Use and management.—A considerable acreage of these soils is used to grow small grains for hay, especially oats. The small grains are planted annually on many of the soils, either in the spring or fall. If oats are grown for hay, vetch should be mixed with them.

Small grains grown on the soils of uplands generally show a nitrogen deficiency. An application of 200 pounds of sodium nitrate or calcium nitrate, or 100 pounds of ammonium nitrate, applied before the grain is 8 inches tall, should be used on these soils. Fertilizers high in nitrogen should not be used on small grains that have developed large green leaves and have made good growth early in the season. The grain will lodge if the soil has too much nitrogen. If large amounts of manure have been used, applications of commercial fertilizers will not be needed.

Poorly drained, nearly level soils

Management groups 7, 8, 9, and 10 include some very poorly drained organic soils; some poorly drained soils underlain by lake-laid sediments or sandy till; and some poorly drained soils that occupy flood plains and tidal flats. The soils are all suited to about the same general crops and need about the same type of management. Drainage is the chief difference between these soils and the adequately drained, undulating to rolling soils of the preceding group. Most of the poorly drained, nearly level soils occupy small areas in depressions or basins. Many occur in association with upland soils that are very poor for agriculture, and this somewhat restricts their use. General characteristics of each of the four management groups, and their relative suitability for the adapted crops, are discussed in the following pages.

GROUP 7

Group 7 consists of very poorly drained organic soils. They are all well suited to tilled crops if artificially drained. The soils differ in the type of plant remains that predominate in the organic accumulation and in depth to the underlying mineral material. The following soils are in management group 7:

Carbondale muck, 0 to 2 percent slopes.
Rifle peat, 0 to 2 percent slopes.
Rifle peat, shallow, 0 to 2 percent slopes.
Semiahmoo muck, 0 to 2 percent slopes.
Semiahmoo muck, shallow, 0 to 2 percent slopes.

Suitability for use.—The soils of group 7 are similar in their general physical suitability for agricultural use. They are all fairly well supplied with plant nutrients. Nevertheless, some crops grown on them will respond to applications of fertilizer. Good tilth is easy to maintain. The range of moisture over which the soils can be tilled is comparatively wide.

The soils are very permeable to air and moisture. During the rainy season, however, it is practically impossible to keep the areas well drained, because the soils become saturated and water often stands on the surface. Partly because of poor drainage, the crops grown on these soils differ from ones grown on adequately drained soils that are well suited to tilled crops. Organic soils are highly productive of spring-sown crops and crops that are adapted to wet areas.

Use and management.—The only grain crops for which the soils of group 7 should be used are spring-sown oats and barley. The soils are too wet during the winter for fall-sown grains. Wheat grown on these soils attains rank growth, lodges badly, and produces poor quality grain. Crops and fertilizer applications suitable for these soils are listed in table 4.

GROUP 8

The soils of group 8 are very poorly drained. They are moderately well suited to poorly suited to tilled crops. All are organic soils. The following soils are in management group 8:

Greenwood peat, 0 to 2 percent slopes.
Mukilteo peat, 0 to 2 percent slopes.
Mukilteo peat, shallow, 0 to 2 percent slopes.
Tacoma peat, 0 to 2 percent slopes.
Tanwax peat, 0 to 2 percent slopes.
Tanwax peat, shallow, 0 to 2 percent slopes.

Suitability for use.—Greenwood peat, 0 to 2 percent slopes, is not suited to general crops, pasture, or forests because it decomposes so slowly or not at all. The Mukilteo peats do not make good cropland when first cultivated because they are not decomposed enough; after several years of cropping, they are much better for crops. Tacoma peat, 0 to 2 percent slopes, is not cultivated because it is too wet. If properly diked and drained it has limited use for pasture, but its carrying capacity is low. The Tanwax soils are very difficult to drain. They are not so productive as the other organic soils. When dry they become hard and are more difficult to work than the other soils.

Use and management.—The soils of group 8 need to be drained. Most areas should be pastured rather than planted to tilled crops. Greenwood peat, 0 to 2 percent slopes, though not suited to tilled crops, can be used as a source of peat for packing material if the moss peat horizon is thick enough. Some areas can be used for cranberry beds. The Mukilteo peats have not decomposed enough to be good for crops when they are first cultivated. After a few years of cropping, they improve. Fertilizer applications described in table 4 will improve cropped areas.

GROUP 9

Group 9 consists of nearly level to gently sloping poorly drained soils, underlain by lake-laid sediments or sandy till. The following soils are in management group 9:

Bellingham silt loam, 0 to 3 percent slopes.
Norma loam, 0 to 3 percent slopes.
Norma loam, 3 to 8 percent slopes.
Norma silt loam, 0 to 2 percent slopes.

Suitability for use.—Soils of management group 9 are moderately well suited to tilled crops. They are not so productive as the adequately drained, undulating to rolling soils of the preceding groups. Soils of

both the Bellingham and Norma series are fairly well suited to a number of crops. They are well suited to hay and pasture.

Use and management.—The soils of management group 9 are generally pastured or used to grow hay. Small areas are usually put to the same use as adjoining soils.

GROUP 10

The soils of group 10 occupy flood plains and tidal flats. All are poorly drained. If adequately drained they are moderately good for row crops. The following soils are in management group 10:

Lummi fine sandy loam, 0 to 2 percent slopes.
Lummi silt loam, 0 to 2 percent slopes.
Lummi silty clay loam, 0 to 2 percent slopes.
Puget clay loam, 0 to 2 percent slopes.

Suitability for use.—Soils of group 10 are more productive than the Bellingham and Norma soils of group 9; they are not so productive as the adequately drained, undulating to rolling soils of preceding groups. The Lummi soils are very strongly acid. Below a depth of about 24 inches, the Puget soil is very strongly acid, but its surface layer is slightly acid to medium acid. The soils of this group have a comparatively low content of organic matter.

Use and management.—Drainage is the chief problem in managing the soils of group 10. Dikes are used to protect a large part of the soils, and ditches are used for drainage. The Lummi soils are used mainly for pasture, but they must be drained before being pastured or cropped. If protected by dikes and drained by ditches, Lummi fine sandy loam, 0 to 2 percent slopes, is highly productive of most crops. The Puget soil is used mainly to grow oats, peas, strawberries, and hay, and some is pastured. The soils of this group should be limed, and applications of complete fertilizer should be used.

Somewhat excessively drained to excessively drained undulating to rolling soils

Only one management group, number 11, is in this group. The soils are mainly under forest. They cover a large part of the county. All have somewhat excessive or excessive drainage and undulating or rolling relief.

GROUP 11

Soils of group 11 are gently undulating to rolling. They are somewhat excessively drained to excessively drained. All are coarse textured and are underlain by loose, porous, gravelly or sandy drift or by sands reworked by wind. They are poorly suited to tilled crops or pasture and are best used for forests. The following soils are in management group 11:

Everett gravelly sandy loam, 0 to 5 percent slopes.
Everett gravelly sandy loam, 5 to 15 percent slopes.
Hoypus gravelly loamy sand, 0 to 5 percent slopes.
Hoypus gravelly loamy sand, 5 to 15 percent slopes.
Hoypus coarse sandy loam, 0 to 5 percent slopes.
Hoypus coarse sandy loam, 5 to 15 percent slopes.
Indianola loamy sand, 0 to 5 percent slopes.
Indianola loamy sand, 5 to 15 percent slopes.
Keystone loamy sand, 0 to 5 percent slopes.
Keystone loamy sand, 5 to 15 percent slopes.
Keystone fine sandy loam, 0 to 5 percent slopes.
Pondilla fine sand, 0 to 5 percent slopes.

Suitability for use.—Soils of management group 11 are so difficult to conserve or so unproductive that tillage is generally not feasible. The soils are so droughty and so low in plant nutrients that they are poorly suited to pasture or crops. Trees grow more slowly than on soils of the other groups; nevertheless, the soils are more suitable for growing trees than for crops or pasture. Some areas of Indianola loamy sand, 0 to 5 percent slopes; Keystone loamy sand, 0 to 5 percent slopes; Keystone loamy sand, 5 to 15 percent slopes; and Keystone fine sandy loam, 0 to 5 percent slopes, are less droughty than the others in the group because they have milder relief and occupy lower lying positions. Consequently, they are more productive than other soils of the group.

Use and management.—Soils of group 11 should be kept under forest if feasible. Because some areas are closely associated with more productive soils, however, they are pastured or cropped though not well suited to these uses. The crops and pasture mixtures suggested in table 4 are suitable for droughty soils. In addition to those listed, the following pasture mixture is suggested for partly cleared areas that have been logged: Orchardgrass (6 pounds); tall oatgrass (6 pounds); Chewings fescue (4 pounds); white clover (2 pounds); and subterranean clover (5 pounds).

Hilly and steep soils

Management groups 12, 13, and 14 are composed of upland soils of many different types. All of them have hilly or steep relief; slopes are generally 15 to 30 percent, but a few slopes are more than 30 percent. Use of the soils is generally influenced by relief rather than by the profile characteristics. Because of their hilly or steep relief, the soils are better suited to forests than to crops or pasture. The general characteristics of the soils in management groups 12 to 14, inclusive, are discussed in the following pages.

GROUP 12

Soils of group 12 are hilly and steep and are somewhat excessively drained to excessively drained. They are underlain by loose gravelly or sandy drift. The following soils are in group 12:

Everett gravelly sandy loam, 15 to 30 percent slopes.
Hoypus gravelly loamy sand, 15 to 30 percent slopes.
Hoypus coarse sandy loam, 15 to 30 percent slopes.
Indianola loamy sand, 15 to 30 percent slopes.
Keystone loamy sand, 15 to 30 percent slopes.
Keystone loamy sand, 30 to 40 percent slopes.

Suitability for use.—The soils of group 12 are suitable only for growing forest. Each is so difficult to work, so difficult to conserve, or so unproductive that tillage is not feasible. All have hilly to steep relief.

All are droughty. The content of organic matter is low in these soils, and the soils are low in plant nutrients. Some contain many pebbles and stones.

Use and management.—All of these soils should be kept under forest. They are not suited to pasture or crops, but some areas must be used for those purposes if it is feasible to do so. Areas used as woodland pasture should be seeded to the pasture mixture suggested for soils of group 11. For the areas that are the least droughty, the following pasture mixture is good: Perennial ryegrass (3 pounds); orchardgrass (6 pounds); creeping red fescue (4 pounds); alsike clover (2 pounds); white clover (2 pounds); and subterranean clover (5 pounds). On partly cleared soils, flat peas, sown at the rate of 5 pounds to the acre, grow fairly well once they are established. These areas should be seeded to orchardgrass after the flat peas are established.

GROUP 13

Group 13 consists of well-drained soils underlain by cemented gravelly till. The soils are hilly or moderately steep. They are best used for forest. The following soils are in management group 13:

Alderwood gravelly sandy loam, 15 to 30 percent slopes.
Alderwood fine sandy loam, 15 to 30 percent slopes.
Townsend sandy loam, 15 to 30 percent slopes.
Whidbey gravelly sandy loam, 15 to 30 percent slopes.

Suitability for use.—Soils of group 13 are unsuited to crops and have only limited use for permanent pasture. They are suited only to forest. The soils have hilly or moderately steep relief that makes them difficult to work and difficult to conserve. Some areas contain gravel.

Use and management.—Soils of group 13 should be left under forest if feasible. If it is necessary to use areas as woodland pasture, the pasture mixture suggested for soils of group 11 should be sown. The least droughty areas should be seeded to the mixture suggested for the least droughty parts of group 12.

GROUP 14

Group 14 consists of hilly, moderately well drained to somewhat poorly drained soils. The underlying material is clay till to fine-textured lake-laid or marine sediments. The total area of these soils is small. The following soils are in management group 14:

Casey loam, 15 to 30 percent slopes.
Casey fine sandy loam, 15 to 30 percent slopes.

Soils of group 14 are poorly suited to crops or pasture and are best suited to growing trees. If feasible they should be left under forest. It may be desirable to pasture some areas associated with less strongly sloping soils.

Miscellaneous land types and nonagricultural soils

This group consists of miscellaneous land types and soils that are poorly suited or not suited at all to forest, pasture, or crops. Some areas are covered by forest, though they are poorly suited to that purpose.

GROUP 15

Group 15 consists of miscellaneous land types and very sandy soils. The land is poorly suited to forests, pasture, and crops. The following miscellaneous land types and soils are in management group 15:

Coastal beach, 0 to 2 percent slopes.
Fresh water marsh.
Hovde sand, 0 to 2 percent slopes.
Made land.
Rough broken land.
Rough stony land.
Tidal marsh, 0 to 2 percent slopes.

The miscellaneous land types and very sandy soils of group 15 are not suitable for agricultural use and are only poorly suited to growing forests. The areas of Rough broken land and Rough stony land are poorly suited to forests because of stoniness or rough steep relief. The others are not forested and have little, or no, value for agriculture.

Management Requirements and Practices

The organic residues in many of the soils of Island County are largely raw and fibrous and very strongly acid. They contain little organic matter and hold little nitrogen available for crops. Some of the soils of the county need phosphorus and potassium, and some need lime. The general principles of soil management as they apply to Island County, including crop rotations and fertilizers and amendments in common use, are discussed in the following pages.

Rotations.—Crops are generally not rotated systematically in Island County because so much of the land is pastured or used to grow hay. Rotations used on dairy farms are usually simple. They consist chiefly of 2 or 3 years of pasture and hay crops, followed by a cultivated crop such as peas or oats.

Some hayfields are pastured after one cutting of hay has been made. In others the hay is cut for 2 years and the field is pastured the third year. The field is then plowed and used for oats, peas, or a tilled crop. Wheat usually follows the tilled crop and is grown for 1 year. A second tilled crop is sometimes planted before the field is again seeded to a hay crop.

In areas suited to squash or to cabbage grown for seed, the squash or cabbage usually follows a legume such as alfalfa. As a rule a legume should be used in the rotation at least every fourth year, or preferably 1 year out of every 3. Green-manure crops and all the available manure should be used to supplement rotations.

Fertilizers.—Manure is in common use as a fertilizer in Island County, but little commercial fertilizer is used. Commercial fertilizers high in nitrogen are generally not economical for use except for specialized crops. Superphosphate is the most important commercial fertilizer used. Response to superphosphate is particularly evident when it is applied either with

barnyard manure or with a commercial fertilizer high in nitrogen. Some specialized crops, such as vegetables, respond to applications of a complete fertilizer that is high in potassium.

The amount of manure used varies considerably. Applications range from 6 to 15 tons of manure and 200 to 400 pounds of 18- to 20-percent superphosphate an acre for pasture or for soils used to grow hay. Small grains are generally not fertilized if they follow legumes in a rotation, especially when the legume has been fertilized with superphosphate. A complete fertilizer is generally used on tilled crops such as squash and cabbage grown for seed.

Lime.—Applications of lime will benefit crops on some of the soils of Island County that have strongly acid or very strongly acid root zones. Before applying lime, however, tests should be made to determine whether the soil needs lime for the crop that is to be grown. The county agent may be consulted for help in testing the soils.

Estimates of Yields

Table 5 lists the soils of Island County and gives for each the estimated average acre yields that may be expected over a period of years. These yields are based on the management most farmers in the county were using in 1948, the time when fieldwork for this survey was completed.

Some of the management practices commonly used in the county are described in the section, Management Requirements and Practices. Other practices have included draining or diking some areas so that the soils could be used for pasture or crops. Improved yields probably can be obtained by using better adapted crop varieties, balanced fertilizers, and improving drainage on some of the soils.

Capability Groups of Soils

Land-capability classification is widely used as a guide in choosing uses of land and combinations of management and conservation practices to fit particular kinds of soils. The classification is a practical grouping of soils. The soils are placed in eight classes according to their general, all-round suitability for crops, grazing, forestry, and wildlife, and according to the risks of erosion or other damage. Each soil is placed in one of these eight general classes after study of the number of uses that can be made of it; of the things that must be done to the soil, that is, inputs required for each type of use; of the limitations of soil and climate; of the risks of erosion whenever cover becomes thin or is removed; and of the risks of other kinds of damage. Soils in one class, in a broad way, offer a similar range in choice of use and are subject to about the same degree of natural limitation. Often, however, one class contains different kinds of soils, and the characteristics that limit the use of the soils are of different kinds although of about the same degree.

The eight general classes range from class I, which is composed of soils that are nearly level and favorable in all characteristics, to class VIII, which is composed of soils that produce little or no useful vegetation. Each of the classes is defined briefly here, although classes I, V, and VII are not represented in Island County. Soils in class I are nearly level, easy to farm, and have no serious limitations for cultivation or other uses. They are good soils for crops, grazing, or forestry. The farmer usually can choose among several types of use and systems of cropping.

A soil is placed in class II if it is a little more limited in any way than the soils in class I and if its limitations, all taken together, are of moderate degree for cropland use. Gently sloping areas of the best soils, for example, are in class II because of the risk of runoff and erosion. Also in class II are soils that are slightly wet and others that are somewhat sandy or that have dense clay subsoils. Others are located in a climate not dependable enough for the usual crops or have other moderate limitations. Obviously, class II and most of the other classes can contain different kinds of soils. The class alone suggests general suitability for cultivation or other uses but must be used with other information to furnish a guide to suitable crops, cropping systems, management practices, or conservation needs for the particular soil.

Class III contains the soils that are severely limited for cropland use but that under suitable treatment can be used regularly in a practical cropping system. Some are moderately sloping and require control of erosion; some are wet and require drainage; and some have other natural limitations.

Class IV contains soils that, because of the risk of erosion or for some other reason, cannot be used in a regular cropping system but that can be used for tillage part of the time or if special precautions are taken. They are more limited than the soils of class III because they have steeper slopes, greater stone content, less favorable climate, or some other unfavorable feature or combination of unfavorable features.

Soils so limited by their characteristics that cultivation is not practicable, that require excessive inputs, or that are highly erodible are placed in classes V, VI, VII, or VIII. Class V contains the soils that are nearly level and not subject to erosion, but that are too wet, too frequently overflowed, or too stony for cultivation. Soils placed in class VI are more limited in one or more ways than those in class IV, but they will produce forage, orchard crops, or forest products. Some class VI soils can be cultivated enough to prepare them for longtime forage or orchard crops or for forest trees. Soils in class VII are more limited than those in class VI. Generally they must be used for vegetation that grows as a result of natural or partly controlled succession. The choices in management are fewer, production is less, or the risk of erosion is greater than on the soils in class VI.

Class VIII consists of soils so severely limited that they produce little useful vegetation. They may provide attractive scenery or may be parts of valuable watersheds. Some may have value as refuges for wildlife.

TABLE 5.—*Estimated average acre yields of the principal crops grown under common management* [1]

[Italic figures based on yields reported from the same soils in nearby counties; information not available on yields from these soils in Island County. Leaders in columns indicate crop not commonly grown because soil not well suited to it]

Soil	Alfalfa hay	Clover-grass hay	Oats	Wheat	Barley	Oat hay	Pasture	Straw-berries	Rasp-berries	Black-berries	Pota-toes	Peas (green)	Squash	Cab-bage-seed
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Cow-acre-months* [2]	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Lb.*	*Tons*	*Lb.*
Alderwood fine sandy loam, 0 to 5 percent slopes	*3.0*	*2.0*	*32*	*18*	*28*	2.8	6.6	*2,200*	*3,000*	———	*150*	———	———	———
Alderwood fine sandy loam, 5 to 15 percent slopes	*2.8*	*1.8*	*25*	*15*	*25*	2.8	5.5	*2,000*	*3,000*	———	*130*	———	———	———
Alderwood fine sandy loam, 15 to 30 percent slopes	———	*1.7*	———	———	———	———	5.5	———	———	———	———	———	———	———
Alderwood gravelly sandy loam, 0 to 5 percent slopes	2.8	1.8	30	16	25	2.6	6.6	2,000	*2,700*	———	*110*	———	———	———
Alderwood gravelly sandy loam, 5 to 15 percent slopes	2.5	1.5	25	14	20	2.3	5.5	1,800	*2,700*	———	*100*	———	———	———
Alderwood gravelly sandy loam, 15 to 30 percent slopes	———	1.5	———	———	———	———	5.5	———	———	———	———	———	———	———
Bellingham silt loam, 0 to 3 percent slopes	———	2.7	80	35	35	2.8	8.8	———	———	*6,000*	*200*	*3,000*	———	———
Bow loam, 0 to 5 percent slopes	*3.5*	3.0	65	25	35	2.6	7.9	*3,500*	*4,000*	———	200	2,800	———	———
Bow loam, 0 to 15 percent slopes	*3.5*	3.0	65	25	35	2.6	7.9	*3,500*	*4,000*	———	200	2,800	———	———
Bozarth fine sandy loam, 0 to 5 percent slopes	———	2.5	35	20	30	2.6	7.0	———	———	———	———	———	———	———
Bozarth fine sandy loam, 5 to 15 percent slopes	———	2.3	32	18	28	2.5	7.0	———	———	———	———	———	———	———
Carbondale muck, 0 to 2 percent slopes	———	3.5	90	———	40	3.2	11.0	———	———	*8,000*	300	3,600	———	———
Casey loam, 0 to 5 percent slopes	3.5	3.0	65	30	45	2.6	7.9	*3,500*	*4,000*	———	*200*	*2,500*	7.0	600
Casey loam, 5 to 15 percent slopes	3.5	3.0	65	30	45	2.6	7.9	*3,500*	*4,000*	———	*200*	*2,200*	6.0	500
Casey loam, 15 to 30 percent slopes	———	———	———	———	———	———	6.6	———	———	———	———	———	———	———
Casey fine sandy loam, 0 to 5 percent slopes	*3.0*	*2.8*	*50*	*20*	*30*	2.3	7.3	3,500	*3,800*	———	*200*	*2,200*	———	———
Casey fine sandy loam, 5 to 15 percent slopes	*3.0*	*2.8*	*40*	*18*	*30*	2.2	6.6	3,500	*3,500*	———	*200*	*2,000*	———	———
Casey fine sandy loam, 15 to 30 percent slopes	———	———	———	———	———	———	———	———	———	———	———	———	———	———
Coastal beach, 0 to 2 percent slopes	———	———	———	———	———	———	———	———	———	———	———	———	———	———
Coupeville loam, 0 to 3 percent slopes	4.5	4.0	90	65	80	3.0	(3)	(4)	(4)	(4)	(4)	(4)	8.0	800
Coupeville silt loam, 0 to 2 percent slopes	4.0	3.5	85	60	75	3.0	(3)	(4)	(4)	(4)	(4)	(4)	7.0	700
Coveland loam, 0 to 5 percent slopes	4.0	3.0	80	50	60	3.0	8.8	(4)	(4)	(4)	(4)	(4)	8.0	800
Coveland loam, 5 to 8 percent slopes	4.0	3.0	80	50	60	3.0	8.8	(4)	(4)	(4)	(4)	(4)	7.5	750
Ebeys sandy loam, 0 to 5 percent slopes	5.0	4.0	85	65	75	3.0	8.4	(4)	(4)	(4)	(4)	(4)	7.0	650
Ebeys sandy loam, 5 to 8 percent slopes	4.0	3.0	75	50	45	2.8	7.9	(4)	(4)	(4)	(4)	(4)	6.5	600
Everett gravelly sandy loam, 0 to 5 percent slopes	———	*1.6*	*25*	*10*	*15*	1.8	5.5	*1,800*	———	———	*100*	———	———	———
Everett gravelly sandy loam, 5 to 15 percent slopes	———	*1.5*	*20*	*10*	*15*	1.6	5.5	*1,500*	———	———	*100*	———	———	———
Everett gravelly sandy loam, 15 to 30 percent slopes	———	1.4	———	———	———	———	5.3	———	———	———	———	———	———	———
Fresh water marsh	———	———	———	———	———	———	———	———	———	———	———	———	———	———
Greenwood peat, 0 to 2 percent slopes	———	———	———	———	———	———	———	———	———	———	———	———	———	———
Hovde sand, 0 to 2 percent slopes	———	———	———	———	———	———	———	———	———	———	———	———	———	———
Hoypus gravelly loamy sand, 0 to 5 percent slopes	———	1.5	25	10	15	1.8	5.5	*1,800*	———	———	*100*	———	———	———
Hoypus gravelly loamy sand, 5 to 15 percent slopes	———	1.4	20	10	15	1.6	5.5	*1,500*	———	———	*100*	———	———	———
Hoypus gravelly loamy sand, 15 to 30 percent slopes	———	———	———	———	———	———	5.3	———	———	———	———	———	———	———
Hoypus coarse sandy loam, 0 to 5 percent slopes	*2.5*	1.7	28	10	18	1.8	5.5	2,000	———	———	*100*	———	———	———
Hoypus coarse sandy loam, 5 to 15 percent slopes	*2.3*	1.6	25	10	18	1.6	5.5	2,000	———	———	*100*	———	———	———
Hoypus coarse sandy loam, 15 to 30 percent slopes	———	1.4	———	———	———	———	5.3	———	———	———	———	———	———	———
Indianola loamy sand, 0 to 5 percent slopes	*2.0*	1.6	30	10	15	1.8	5.5	*2,500*	*2,800*	———	*125*	———	———	———
Indianola loamy sand, 5 to 15 percent slopes	*2.0*	1.5	25	10	15	1.7	5.5	*2,300*	*2,600*	———	*125*	———	———	———
Indianola loamy sand, 15 to 30 percent slopes	———	1.4	———	———	———	———	5.3	———	———	———	———	———	———	———
Keystone loamy sand, 0 to 5 percent slopes	2.0	1.6	30	15	18	1.8	5.5	*2,500*	*2,800*	———	*125*	———	———	———
Keystone loamy sand, 5 to 15 percent slopes	2.0	1.5	25	12	15	1.7	5.5	*2,500*	*2,600*	———	*125*	———	———	———
Keystone loamy sand, 15 to 30 percent slopes	———	1.4	———	———	———	———	5.3	———	———	———	———	———	———	———

See footnotes at end of table.

TABLE 5.—*Estimated average acre yields of the principal crops grown under common management* [1]*—Continued.*

Soil	Alfalfa hay	Clover-grass hay	Oats	Wheat	Barley	Oat hay	Pasture	Straw-berries	Rasp-berries	Black-berries	Pota-toes	Peas (green)	Squash	Cab-bage-seed
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Cow-acre-months* [2]	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Lb.*	*Tons*	*Lb.*
Keystone loamy sand, 30 to 40 percent slopes														
Keystone fine sandy loam, 0 to 5 percent slopes	2.5	1.8	32	18	20	2.0	6.2	3,200	*3,500*		*125*			
Lummi silt loam, 0 to 2 percent slopes		3.3	85			3.5	8.8					(4)		
Lummi silty clay loam, 0 to 2 percent slopes		3.0	65			3.0	8.8							
Lummi fine sandy loam, 0 to 2 percent slopes		3.3	80			3.2	8.8					(4)		
Made land														
Mukilteo peat, 0 to 2 percent slopes		2.8	70		30	2.5	7.3			*5,000*				
Mukilteo peat, shallow, 0 to 2 percent slopes		2.8	70		30	2.5	7.3			*5,000*				
Norma loam, 0 to 3 percent slopes		2.3	60	25	30	2.5	9.9			*4,000*		*2,000*		
Norma loam, 3 to 8 percent slopes		2.0	50	25	25	2.0	9.9	*2,500*	*3,000*	*4,000*	*250*	*2,000*		
Norma silt loam, 0 to 2 percent slopes		2.5	65	25	35	2.5	10.2			*4,500*		*2,500*		
Pondilla fine sand, 0 to 5 percent slopes		1.4					3.9							
Puget clay loam, 0 to 2 percent slopes	4.0	3.0	85	55	65	3.5	8.8	4,000	*4,500*	(4)	(4)	3,600		800
Rifle peat, 0 to 2 percent slopes		3.0	90		40	3.0	9.9			*5,500*	190	*3,000*		
Rifle peat, shallow, 0 to 2 percent slopes		3.0	85		40	3.0	9.9			*5,500*	180	*3,000*		
Rough broken land														
Rough stony land														
San Juan coarse sandy loam, 0 to 5 percent slopes		3.5	55	40	45	2.5	6.6	(4)	(4)					
San Juan coarse sandy loam, 5 to 15 percent slopes		3.2	50	35	40	2.3	6.6	(4)	(4)					
Semiahmoo muck, 0 to 2 percent slopes		2.8	70		30	2.5	9.9			*5,000*	*190*	*2,800*		
Semiahmoo muck, shallow, 0 to 2 percent slopes		3.0	70		30	2.5	9.9			*5,000*	*200*	*2,800*		
Snakelum coarse sandy loam, 0 to 5 percent slopes	3.0	3.8	60	50	50	2.8	7.0	(4)	(4)		(4)	(4)		
Snakelum coarse sandy loam, 5 to 15 percent slopes	3.0	3.8	60	45	45	2.8	7.0	(4)	(4)		(4)	(4)		
Swantown gravelly sandy loam, 0 to 5 percent slopes		2.1	28	15	25	2.5	7.0							
Swantown gravelly sandy loam, 5 to 15 percent slopes		**2.1**	26	14	20	2.5	7.0							
Swanton loam, 0 to 5 percent slopes		2.2	30	16	28	2.8	7.0							
Swantown loam, 5 to 15 percent slopes		2.2	30	16	28	2.8	7.0							
Tacoma peat, 0 to 2 percent slopes														
Tanwax peat, 0 to 2 percent slopes		2.5	50		20	2.3	6.6			4,500				
Tanwax peat, shallow, 0 to 2 percent slopes		2.5	50		20	2.3	6.6			4,200				
Tidal marsh, 0 to 2 percent slopes														
Townsend sandy loam, 0 to 5 percent slopes	3.0	2.5	60	50	45	2.8	7.0	(4)	(4)				4.5	500
Townsend sandy loam, 5 to 15 percent slopes	2.8	2.5	50	40	42	2.5	7.0	(4)	(4)				4.2	450
Townsend sandy loam, 15 to 30 percent slopes														
Whidbey gravelly sandy loam, 0 to 5 percent slopes	2.8	2.0	30	18	25	2.8	6.6	*2,000*	*2,700*					
Whidbey gravelly sandy loam, 5 to 15 percent slopes	2.5	1.8	25	15	20	2.6	5.5	*1,800*	*2,700*					
Whidbey gravelly sandy loam, 15 to 30 percent slopes							5.5							

[1] Common management includes use of available manure and in some places a small amount of commercial fertilizer. Systematic rotations not generally practiced because so much of the soil is pastured or used to grow hay. Yields should improve if better adapted varieties were planted and properly balanced fertilizers used.

[2] The term "cow-acre-months" is the product of animal units carried per acre multiplied by the number of months the animal can be grazed without injury to the pasture. For example a soil that supports 1 animal unit per acre for 12 months rates 12; a soil that supports 1 animal unit on 2 acres for 6 months rates 3.

[3] Soil generally not used for pasture, except for hayfields that are pastured after hay has been cut.

[4] Crop not generally grown, but soil suited to it.

Subclasses: Each of the eight general classes contains soils that have limitations and management problems of about the same degree. The soils, and therefore the limitations within one class, however, can be of different kinds. Subclasses are recognized according to the dominant kind of limiting soil characteristics. As many as four subclasses may be recognized, although usually not all of them will occur in one area the size of a county. Subclasses are designated by the class number and a small letter, such as IIe or IIw. The four possible subclasses are those having as the dominant limitation the danger of erosion if cover is not maintained (e); excess water (w); shallow, droughty, or unusually infertile soil (s); and unusually hazardous climate (c). Subclass (c) does not occur in any of the classes in this county.

The classes and subclasses in Island County, and the soils in each, are as follows:

CLASS II. Soils good for cultivation and other uses, subject to moderate limitations in use or moderate conservation problems.

IIs: Nearly level or gently sloping soils of moderate fertility and moisture capacity.

Coupeville silt loam, 0 to 2 percent slopes (Cm).
Coupeville loam, 0 to 3 percent slopes (Ck).
Ebeys sandy loam, 0 to 5 percent slopes (Ea).
Ebeys sandy loam, 5 to 8 percent slopes (Eb).

IIw: Deep organic soils and fine-textured slowly permeable soils of bottom lands, limited by excess water; highly productive if drained and well managed.

Carbondale muck, 0 to 2 percent slopes (Ca).
Lummi silt loam, 0 to 2 percent slopes (Lb).
Lummi silty clay loam, 0 to 2 percent slopes (Lc).
Lummi fine sandy loam, 0 to 2 percent slopes (La).
Mukilteo peat, 0 to 2 percent slopes (Mb).
Puget clay loam, 0 to 2 percent slopes (Pb).
Rifle peat, 0 to 2 percent slopes (Ra).
Semiahmoo muck, 0 to 2 percent slopes (Sc).
Tanwax peat, 0 to 2 percent slopes (Tb).

CLASS III. Soils moderately good for cultivation subject to severe limitations in use for cropland; severe risks of erosion or other damage if not protected.

IIIs: Soil of low fertility or fine-textured, very slowly permeable glacial till.

Bow loam, 0 to 5 percent slopes (Bb).

IIIw: Poorly drained soils that have slowly permeable subsoils or substrata, and shallow organic soils over slowly permeable material.

Bellingham silt loam, 0 to 3 percent slopes (Ba).
Coveland loam, 0 to 5 percent slopes (Cn).
Coveland loam, 5 to 8 percent slopes (Co).
Mukilteo peat, shallow, 0 to 2 percent slopes (Mc).
Norma loam, 0 to 3 percent slopes (Na).
Norma loam, 3 to 8 percent slopes (Nb).
Norma silt loam, 0 to 2 percent slopes (Nc).
Rifle peat, shallow, 0 to 2 percent slopes (Rb).
Semiahmoo muck, shallow, 0 to 2 percent slopes (Sd).
Tanwax peat, shallow, 0 to 2 percent slopes (Tc).

CLASS IV. Soils suitable for tillage only part of the time or under extreme care.

IVs: Medium and moderately coarse textured soils; slopes of less than 15 percent.

Alderwood fine sandy loam, 0 to 5 percent slopes (Aa).
Alderwood fine sandy loam, 5 to 15 percent slopes (Ab).
Alderwood gravelly sandy loam, 0 to 5 percent slopes (Ad).
Alderwood gravelly sandy loam, 5 to 15 percent slopes (Ae).
Bozarth fine sandy loam, 0 to 5 percent slopes (Bd).
Bozarth fine sandy loam, 5 to 15 percent slopes (Be).
Casey loam, 0 to 5 percent slopes (Ce).
Casey loam, 5 to 15 percent slopes (Cf).
Casey fine sandy loam, 0 to 5 percent slopes (Cb).
Casey fine sandy loam, 5 to 15 percent slopes (Cc).
Keystone fine sandy loam, 0 to 5 percent slopes (Ka).
Snakelum coarse sandy loam, 0 to 5 percent slopes (Se).
Snakelum coarse sandy loam, 5 to 15 percent slopes (Sf).
Swantown loam, 0 to 5 percent slopes (Sk).
Swantown loam, 5 to 15 percent slopes (Sm).
Townsend sandy loam, 0 to 5 percent slopes (Te).
Townsend sandy loam, 5 to 15 percent slopes (Tf).
Whidbey gravelly sandy loam, 0 to 5 percent slopes (Wa).
Whidbey gravelly sandy loam, 5 to 15 percent slopes (Wb).

IVe: Strongly sloping soils underlain by very slowly permeable glacial till, highly subject to erosion if not protected.

Bow loam, 5 to 15 percent slopes (Bc).

CLASS VI. Soils not suitable for cultivation. Well suited to grazing or forestry but subject to moderate limitations or risks of erosion or other damage if not protected.

VIs: Coarse and moderately coarse textured, droughty soils.

Everett gravelly sandy loam, 0 to 5 percent slopes (Ec).
Everett gravelly sandy loam, 5 to 15 percent slopes (Ed).
Everett gravelly sandy loam, 15 to 30 percent slopes (Ee).
Hovde sand, 0 to 2 percent slopes (Ha).
Hoypus gravelly loamy sand, 0 to 5 percent slopes (He).
Hoypus gravelly loamy sand, 5 to 15 percent slopes (Hf).
Hoypus gravelly loamy sand, 15 to 30 percent slopes (Hg).
Hoypus coarse sandy loam, 0 to 5 percent slopes (Hb).
Hoypus coarse sandy loam, 5 to 15 percent slopes (Hc).
Hoypus coarse sandy loam, 15 to 30 percent slopes (Hd).
Indianola loamy sand, 0 to 5 percent slopes (Ia).
Indianola loamy sand, 5 to 15 percent slopes (Ib).
Indianola loamy sand, 15 to 30 percent slopes (Ic).
Keystone loamy sand, 0 to 5 percent slopes (Kb).
Keystone loamy sand, 5 to 15 percent slopes (Kc).
Keystone loamy sand, 15 to 30 percent slopes (Kd).
Pondilla fine sand, 0 to 5 percent slopes (Pa).
San Juan coarse sandy loam, 0 to 5 percent slopes (Sa).
San Juan coarse sandy loam, 5 to 15 percent slopes (Sb).
Swantown gravelly sandy loam, 0 to 5 percent slopes (Sg).
Swantown gravelly sandy loam, 5 to 15 percent slopes (Sh).

VIe: Coarse- and medium-textured steep soils that have slowly permeable substrata; highly erodible if not protected.

Alderwood fine sandy loam, 15 to 30 percent slopes (Ac).
Alderwood gravelly sandy loam, 15 to 30 percent slopes (Af).

Casey loam, 15 to 30 percent slopes (Cg).
Casey fine sandy loam, 15 to 30 percent slopes (Cd).
Keystone loamy sand, 30 to 40 percent slopes (Ke).
Townsend sandy loam, 15 to 30 percent slopes (Tg).
Whidbey gravelly sandy loam, 15 to 30 percent slopes (Wc).

VIw: Poorly drained organic soils on low coastal areas, subject to flooding by salt water unless protected by levees.

Tacoma peat, 0 to 2 percent slopes (Ta).

CLASS VIII. Land types not suitable for cultivation, grazing, or forestry.

Coastal beach, 0 to 2 percent slopes (Ch).
Fresh water marsh (Fa).
Greenwood peat, 0 to 2 percent slopes (Ga).
Made land (Ma).
Rough broken land (Rc).
Rough stony land (Rd).
Tidal marsh, 0 to 2 percent slopes (Td).

Additional Facts About Island County

The preceding sections have described the location and extent of Island County, the climate, and various general information about it, and have given detailed descriptions of each soil mapped there. The following subsection gives some additional facts about the county, including information about industries; transportation and markets; schools, churches, and hospitals; recreational facilities; and farm and home improvements.

Industries

Lumbering has always been important in Island County, though none of the virgin forests remain. Because there are no large tracts of second- and third-growth timber that are fit for market, lumbering is carried on by small operators. A few sawmills that require only a few men to operate them are located in the county, but most of the logs are taken to larger mills outside. Many small Douglas-firs and hemlocks are cut for use as poles for telephone and electric power-lines, but no manufacturing plants for wood products are located in the county.

Most of the logging is done locally. The loggers include some part-time farmers. Some farmers who have merchantable timber sell it to logging operators. Some hire the necessary men and equipment and supervise the logging operations themselves.

No industrial establishments of importance are located in Island County. Most of the agricultural products are shipped elsewhere. A marketing cooperative, which handles a large part of the poultry products and livestock feed, is located at Oak Harbor. There is a chicken hatchery at Langley. There are no mines in the county.

Transportation and Markets

Roads are excellent on Whidbey and Camano Islands. A hard-surfaced State highway runs the length of Whidbey Island. All agricultural communities have hard-surfaced roads or maintained gravel roads. The connecting dirt and gravel roads are kept in fair condition the year round. At the time of the 1950 Federal census, 421 farms in Island County were located on hard-surfaced roads; 191 farms were on gravel, shell, or shale roads; and 190 were on dirt or unimproved roads.

The mainland can be reached by going over the Deception Pass Bridge at the northern end of Whidbey Island or by taking the ferry that operates between the mainland and Columbia Beach, at the southern end of Whidbey Island. In addition, except during the winter, a ferry operates between Fort Casey on Whidbey Island and Port Townsend in Jefferson County. The buses that operate over the State highway on Whidbey Island connect with U. S. Highway 99 on the mainland either by way of the ferry at Columbia Beach or by way of Deception Pass Bridge.

A bridge connects Camano Island with the mainland. At the present time no ferry operates between Camano and Whidbey Islands.

There are no railroads on the islands. The Portland, Tacoma, Seattle, and Vancouver branch of the Great Northern Railroad passes through Stanwood in Snohomish County and through Mount Vernon in Skagit County. The Rockport and Anacortes branch terminates at Anacortes in Skagit County, which is about 7 miles north of the northern tip of Whidbey Island. Freight and mail are carried to towns on the islands by motorcar or truck.

The principal farm products that are marketed are eggs, poultry, milk, vegetables, and small grains. The eggs, poultry, and small grains are generally sold locally through the Washington Cooperative. Most of the other products are marketed on the mainland in Mount Vernon, Everett, Stanwood, Bellingham, and Seattle.

Schools, Churches, and Hospitals

School buses transport students from outlying areas on Whidbey Island to the consolidated grammar schools and high schools located at Oak Harbor, Coupeville, and Langley. From Camano Island, which has no public schools, buses transport the students to Stanwood on the mainland. Churches of various denominations are located conveniently. No public hospitals are located within the county, but hospital facilities are available in the larger cities on the mainland.

Recreational Facilities

Outdoor recreational facilities are excellent in Island County. The long coastline and the sheltered bays and beaches provide sites for many camping and fishing resorts. Many families who have permanent homes in Seattle and in other cities on the mainland have built summer homes on the islands.

Salmon fishing is one of the chief forms of recreation, not only for the people who live on the islands, but for numerous sportsmen who come from neighbor-

ing counties. The waters at many points offshore offer some of the best salmon fishing of any place in the Puget Sound area.

Deception Pass State Park is located on the northern end of Whidbey Island. The area is well equipped for camping and picnicking.

Many Grange and other community halls are located throughout the rural sections.

Farm and Home Improvements

Rural mail routes extend to nearly all parts of Island County. Telephone service is available to most parts of the county. In 1950, 491 farms had telephones. Rural electrification has been extended rapidly to all parts of the county. Most farms had electricity in 1950, and 582 had electric pumps to bring running water into the homes.

Agriculture

Of the 131,840 acres in Island County, about 39 percent, or 51,455 acres, was in farms in 1950. This was about 3,500 acres less than the acreage in farms in 1940. The number of farms decreased from 1,044 in 1940 to 810 in 1950. Most of the acreage removed from cultivation was that taken over for the United States Military Reservation, established in 1942, and for the United States Naval Reservation, located in areas around Crescent Harbor, Clover Valley, and Smith Prairie.

The farms are concentrated largely in the northern half of Whidbey Island; near the towns of Freeland, Langley, and Clinton in the southern part of Whidbey Island; and in the northeastern corner of Camano Island.

Land in Farms According to Use

The 51,455 acres in farms in Island County was classified in 1950 according to use as follows:

	Acres
Cropland harvested	11,680
Cropland used only for pasture	6,010
Cropland not harvested and not pastured	3,584
Woodland pastured	7,360
Woodland not pastured	17,398
Other pasture (not cropland and not woodland)	1,624
Other land (house lots, roads, wasteland, etc.)	3,799

Shifts in land use have not been extensive. The prairie areas have been cropped or pastured since the county was first settled. Up to about 1920, acreage of forested uplands cleared for crops or pasture increased rapidly. Since that time little additional land has been cleared.

Crops

Potatoes, hay, wheat, and oats were the leading crops in Island County for many years. Except for potatoes these crops still lead; potatoes are now a minor crop because disease, insects, and low prices have forced farmers to decrease potato acreage. Acreage in hay has increased. It is greater than the acreage of small grain and specialized crops. The total acreage in crops has decreased to some extent during the past few years because land that was formerly cropped has been taken over for military and naval reservations. Table 6 lists the acreage of principal crops and the number of fruit trees, nut trees, and grapevines in Island County in stated years.

TABLE 6.—*Acreage of principal crops and numbers of fruit and nut trees and grapevines [1] in stated years*

Crop	1929	1939	1949
	Acres	*Acres*	*Acres*
Corn for all purposes	89	314	16
Small grains threshed or combined:			
Wheat	2,951	1,336	1,236
Winter	2,923	1,336	1,223
Spring	28	[2]	13
Oats	872	2,107	1,661
Barley	514	612	192
Rye	4	28	1
All hay	[3] 5,318	[3] 6,649	[4] 6,013
Alfalfa	239	1,912	2,127
Timothy and clover, alone or mixed	2,068	1,866	1,838
Small grains cut for hay	1,119	1,421	236
Wild hay	164	299	633
Other hay cut	1,728	1,151	1,179
Irish potatoes	219	173	[5] 70
Vegetables harvested for sale [6]	119	988	673
Green peas	3	717	296
Squash	64	203	[2]
Other	52	68	366
Fescue seed harvested	[2]	[2]	136
Other field seed crops harvested	10	56	132
	Number [7]	*Number* [7]	*Number* [7]
Apple trees	9,483	7,446	5,689
Cherry trees	4,762	4,590	1,709
Peach trees	242	217	644
Pear trees	2,017	2,067	1,452
Plum and prune trees	1,776	1,979	1,460
Apricot trees	21	80	123
Filberts and hazelnuts trees	1,607	4,574	11,093
Grapevines	1,712	300	439

[1] Trees and vines of all ages.
[2] Information not available.
[3] Does not include sorghum grown for hay.
[4] Does not include sorghum, soybeans, cowpeas, and peanuts grown for hay.
[5] Does not include acres for farms with less than 10 bags harvested.
[6] Other than Irish potatoes or sweetpotatoes.
[7] Number in the census year, which is 1 year later than the crop year given at the head of the column.

Specialized crops.—Squash, cabbage, and other specialized crops have largely replaced potatoes on the prairie soils. The county is particularly noted for the high yield and quality of its vegetable seed crops, especially of cabbage seed. In 1949, according to the census, 30 farms reported the sale of vegetables grown under glass, flower seeds, vegetable seeds, vegetable plants, bulbs, and mushrooms produced for sale. Vegetable seed crops, besides cabbage, include beet, mangel, turnip, rutabaga, onion, radish, and kale. In addition to the vegetable seed crops grown in the county, 136 acres of fescue grown for seed was harvested as a field crop in 1949, and 132 acres of other field seed crops was harvested. The vegetable seed crops are usually grown under contract and are sold to commercial seed companies.

Much of the squash crop is stored on the farm because the canneries cannot handle all of it at the time of harvest. The squash is placed between layers of straw in well-ventilated storage houses on the farm and will keep for several months before being canned.

Tree fruits, nuts, and grapes.—The number of fruit trees, nut trees, and grapevines in Island County is comparatively small, but the number of filbert trees has increased during the past few years. Most of the fruit grown in the county is used on the farm, but some is sold to canneries on the mainland.

Hay and small grains.—Most of the hay that is grown is used to feed dairy cattle. Of the hay crops the largest acreage is in alfalfa, but timothy and clover, alone or mixed, and other tame and wild grasses cut for hay are also important. Small grains, largely oats, are used to feed dairy cattle or as feed for poultry, and some are cut for hay. Wheat is of poor milling quality. It is generally used on the farm or is sold locally for feed.

Livestock and Livestock Products

Of the total income derived from the sale of farm products in Island County in 1949, 80.9 percent was from livestock and livestock products. Poultry and poultry products are the most important source of farm income in the county. Dairying is second. Table 7 shows the livestock population of the farms in Island County in stated years.

Island County is one of the leading poultry-producing counties in the State of Washington. In 1949 approximately 56 percent of the total farm income was derived from the sale of poultry and poultry products, which included 167,266 chickens and 1,019,871 dozens of chicken eggs sold. Most of the poultry farms are located in the northern half of Whidbey Island.

Turkeys have become very important. In 1949, 127,449 turkeys were raised in the county. During recent years many have been raised in the section known as Ebeys Prairie. The soils in this area are well suited to wheat, and the turkeys are turned in the fields to feed on the grain when the wheat is ripe. Most of the feed, however, is purchased.

TABLE 7.—*Specified livestock on farms in stated years*

Livestock	1930	1940	1950
	Number	*Number*	*Number*
Horses and colts, including ponies	790	[1] 759	350
Mules and mule colts	6	[1] 22	15
Cattle	5,553	[1] 5,676	6,053
Swine	940	[2] 700	828
Sheep and lambs	5,507	[3] 1,429	1,162
Goats and kids	369	[2] 231	[4]
Chickens	[1] 198,879	[2] 128,104	[2] 65,325
Turkeys	[5] 6,120	[5] 65,447	[5] 127,449

[1] Over 3 months old.
[2] Over 4 months old.
[3] Over 6 months old.
[4] Figure not available.
[5] Number of turkeys raised the year preceding year of census.

Dairy cattle have increased in numbers in Island County since 1930, but only a few beef cattle are raised. Except for a few herds of Holstein cattle, most of the cattle on Whidbey Island are Guernseys. On Camano Island the herds are comprised of a number of dairy breeds, but Guernseys and Holsteins predominate. Most of the dairies sell their products as whole milk. In 1949, 12,599,499 pounds of whole milk was sold in the county. The milk is collected by creameries that provide daily pickup service in most areas.

Much of the feed for the cattle is grown on the farm. Many dairymen, however, buy grain from grain farmers or from local feed dealers.

The dairy farms are scattered throughout the county. They are generally located on the better upland soils. These include some of the poorly drained Norma and Bellingham soils, which occur in depressions in uplands, and on some areas of peats and mucks. On Camano Island most of the dairies are located on areas of Bow loam, which are well suited to hay and pasture.

Types and Sizes of Farms

Of the 810 farms in Island County in 1950, 423 were miscellaneous and unclassified. The remaining farms were listed by type of farm as follows:

Cash grain	4
Vegetable farms	17
Fruit-and-nut farms	13
Dairy farms	112
Poultry farms	150
Livestock farms other than dairy and poultry	39
General farms:	
Primarily crop	26
Primarily livestock	17
Crop and livestock	9

Most of the cultivated land is used to grow feed for livestock or is pastured. The principal crops grown are oats, wheat, barley, hay, and row crops such as squash and vegetables for seed. Many farms are small, and the products are grown mainly for home use. Most of these small farms are operated by people who have retired from active work or who have outside employment as their major source of income.

The size of the average farm in 1950 was 63.5 acres. The greatest number of farms, however, ranged in size from 10 to 29 acres. The prairie areas, which have always had the most productive soils, did not have to be cleared before they could be cultivated. Consequently, the larger farms and the ones having the greatest proportion of improved land are located on the prairies. The smaller farms are in the forested uplands where the cost of clearing is almost prohibitive.

Farm Tenure

Most of the farms are operated by full owners. Of the 810 farms in the county in 1950, only 95 were operated by part owners, 4 by managers, and 39 by tenants. The proportion of tenancy has remained fairly constant for many years. More of the tenants

live on general farms or grain farms than on other types of farms.

Formation and Classification of Soils

Soil results from the interaction of soil-forming processes on materials deposited or accumulated by geologic action. The characteristics of the soil at any given point are determined by (1) the type of parent material; (2) the climate under which the soil material has accumulated and existed since it accumulated; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material (*5*).

Factors of Soil Formation

The climate is fairly uniform throughout Island County and, except for the prairie areas, the vegetation is fairly uniform. Therefore, though climate and vegetation were the most important factors that affected the formation of the soils, they do not account for the pronounced differences among the soils. These differences were caused largely by differences in parent materials, relief, and age of the soils.

Climate

Island County has a maritime or somewhat modified continental climate, influenced by winds from the Pacific Ocean. The winters are mild and wet. The summers are cool and dry. Temperatures rarely go as low as zero or as high as 90° F. The average temperature is about 50° F.

Most of the precipitation falls between December and March, and there is a distinct dry season during the summer. The annual rainfall at Coupeville averages between 18 and 19 inches, but the rainfall is apparently somewhat heavier south and east of Coupeville. The southern part of Whidbey Island and most of Camano Island are believed to receive approximately the same amount of rainfall (about 35 inches annually) as Everett, which is on the mainland.

The precipitation falls as gentle rains. During the winter many of the days are overcast or foggy. The relative humidity is high during most of the year, but occasionally drops to 50 percent or less during the summer. Little snow falls, and the ground freezes only occasionally below a surface crust.

Vegetation

The predominant vegetation consists of a dense growth of conifers—largely Douglas-fir and hemlock—and a ground cover of ferns, mosses, and vines. A few shrubs grow in the more open areas, and maple trees, shrubs, and vines grow in the depressions. The marshy areas are covered by sedges, reeds, and other water plants. In a few areas, known as prairies, the soils have developed mainly under grass and there are only scattered shrubs and trees.

Parent materials

The soils of Island County were derived mainly from materials deposited by glaciers. Granite, gneiss, and schist were the principal rocks from which these materials originated, but considerable amounts also came from quartzite, argillite, sandstone, and other rocks. A very small part of the parent material was derived from marine deposits or from glacial lake sediments.

The glacial ice that came from the north was a lobe, or tongue, of the Cordilleran icecap (*1*). The Vashon glacier, the most recent of the glaciers, left the extensive deposits from which most of the soils were formed. Older Pleistocene deposits are exposed in the sea cliffs at various places on the islands. These older deposits, however, did not contribute to the parent materials of any of the soils because they were later covered by deposits left by the Vashon glacier.

During the interglacial periods the land rose to higher elevations, became eroded, and than sank. Apparently, all these processes contributed to the formation of the principal land features and the regional drainage systems. Though the glacial till deposits vary considerably, they are partially or strongly cemented, which suggests that the parent materials may have been submerged by glacial waters for long periods.

The gray glacial till that covers most of the county is of a sandy texture. Many rounded pebbles and cobblestones are embedded in it. In many places boulders occur, especially in the surface materials. The glacial outwash is loose in consistence. In some places it is very gravelly, but in other places it is sandy. A small part of the parent materials consisted of marine and glacial lake sediments.

Relief

The topography of the county has been affected by glacial action. It is predominantly morainic. The relief is generally undulating to rolling, but a few slopes are steeper than 15 percent. Most of the soils occur at elevations of 100 to 300 feet. They occupy only a few areas at elevations of more than 500 feet. Except for the depressional areas, which are not extensive, the soils have enough slope so that natural drainage is adequate.

Time

The soils of Island County have been developing since the retreat of the Vashon glacier, the last glacier that covered the Puget Sound area. The glacial materials from which the soils were formed were deposited near the close of the Pleistocene epoch.

Classification of Soils by Higher Categories

The lower categories of soil classification—phases, types, and series—are explained in the section, Soil Survey Methods and Definitions. Briefly, a soil type consists of one or more phases, and a soil series, of one or more soil types. Soil types or phases are the units shown on the detailed soil map.

Soil series are classified into the next broader category, the great soil groups. Each great soil group is made up of soils that have certain internal characteristics in common (*5*). The broadest categories of soil classification are the three soil orders—zonal, intrazonal, and azonal—into which all of the great soil groups are classified.

Table 8 shows the classification of the soil series of Island County by great soil groups and soil orders. The six great soil groups represented in the county, by order, are as follows: Zonal—Podzolic and Brown Podzolic soils; Intrazonal—Planosols and Humic Gley soils; and Azonal—Regosols and Organic soils. The three orders and each of the great soil groups represented in the county are discussed in the following pages. A typical soil of each great soil group is described.

In some areas the pattern of the great soil groups is complex and there are transitional soils, which have characteristics of two or more great soil groups. Such soil series have been placed in the groups to which they appear most nearly to belong. A number in parentheses after series names indicates that the soil resembles in some ways the soils of the series indicated by that number.

TABLE 8.—*Soil series classified by soil orders and great soil groups and some factors that have contributed to their morphology*

Great soil group and series	Relief	Natural drainage	Parent material
ZONAL SOILS			
(1) Podzol:			
Hoypus	Gently undulating to hilly.	Somewhat excessive.	Loose gravelly drift.
Keystone	Gently undulating to steep.	Somewhat excessive.	Loose sandy drift.
Whidbey	Gently undulating to hilly.	Good	Cemented gravelly till.
(2) Brown Podzolic:			
Alderwood	Gently undulating to hilly.	Good	Cemented gravelly till.
Bozarth	Gently undulating to rolling.	Good	Cemented gravelly till.
Everett	Gently undulating to hilly.	Somewhat excessive.	Loose gravelly drift.
Indianola	Gently undulating to hilly.	Somewhat excessive.	Loose sandy drift.
Swantown	Gently undulating to rolling.	Moderately good.	Cemented gravelly till.
INTRAZONAL SOILS			
(3) Planosol:			
Bow (2)	Very gently sloping to sloping.	Imperfect	Clay till with embedded gravel or lake-laid or marine sediments.
Casey (1)	Gently undulating to hilly.	Moderately good.	Clay till with embedded gravel or lake-laid or marine sediments.
(4) Humic Gley:			
Bellingham	Nearly level	Poor	Glacial lake or marine silts and clays over till or lake sediments.
Coveland	Very gently sloping to gently sloping.	Imperfect	Clay till, marine or lake-laid sediments with some gravel.
Hovde	Nearly level	Poor	Marine sand and gravel.
Lummi	Nearly level	Poor	Medium- and fine-textured marine sediments.
Norma	Nearly level to gently sloping.	Poor	Sandy till.
Puget	Nearly level	Poor	Fine-textured alluvium.
AZONAL SOILS			
(5) Regosol:			
Coupeville	Nearly level to very gently sloping.	Moderately good.	Marine and glacial lake silts and clays.
Ebeys	Very gently sloping to gently sloping.	Good	Marine and glacial lake sands.
Pondilla (2)	Gently undulating.	Excessive	Wind-worked sands of glacial and marine origin.
San Juan	Very gently sloping to sloping.	Somewhat excessive.	Loose gravelly outwash.
Snakelum	Very gently sloping to sloping.	Good	Loose sandy outwash.
Townsend	Very gently sloping to moderately steep.	Good	Cemented gravelly till.
(6) Organic:			
Carbondale muck.	Nearly level	Very poor	Woody accumulations.
Greenwood peat.	Nearly level	Very poor	Moss accumulations.
Mukilteo peat	Nearly level	Very poor	Sedge accumulations.
Rifle peat	Nearly level	Very poor	Woody accumulations.
Semiahmoo muck.	Nearly level	Very poor	Sedge accumulations.
Tacoma peat	Nearly level	Very poor	Sedge accumulations and marine sediments.
Tanwax peat	Nearly level	Very poor	Sedimentary organic accumulations.

Zonal soils

Zonal soils have well-developed soil characteristics that reflect the influence of climate and vegetation. The zonal soils in the county, which have developed throughout the timbered uplands, are brown, coarse textured, and permeable. They are acid in reaction.

The zonal soils of Island County have been classified as either Podzol or as Brown Podzolic rather than as Gray-Brown Podzolic (*5*). They have characteristics of the typical Brown Podzolic soils that occur on other timbered uplands in the Puget Sound area.

PODZOLS

In Island County Podzols occur only on Whidbey Island. They have developed under a coniferous forest and have been influenced by a maritime climate. Podzolization has been the dominant process in their development.

A thin layer of very strongly acid organic litter covers Podzols. This directly overlies a thin, light-gray, leached, very strongly acid horizon. This A_2 horizon has been largely destroyed by logging operations but is a distinct characteristic in undisturbed areas.

Below the A_2 horizon, the profile is generally fairly uniform in color and in texture. At depths between 6 and 8 inches, the soil material immediately below the A_2 horizon is pale brown, yellowish brown, or light grayish brown and is shotty, coarse textured, and strongly acid. The profile becomes lighter colored, less shotty, coarser textured, and less acid at greater depths.

Shot pellets occur in the typical Podzol profiles in the county. Wheeting (*7*) suggested that these pellets were formed during dry periods in the summer, when little leaching was taking place and the development of the B horizon was consequently retarded. During these dry spells, soluble iron and aluminum compounds were precipitated and dehydrated at focal points around sand grains or other nuclei. The shot pellets contain more sesquioxides and more phosphorus than the surrounding soil; they may represent an imperfectly developed B horizon consisting of scattered concentrations of sesquioxides that resemble ortstein.

The shot pellets occur to some extent in excessively drained soils, which suggests that they were not formed under restricted drainage. Moisture affects their formation to some extent, however, for they are much more numerous in soils that have slower internal drainage.

The reason the Podzols on Whidbey Island are so strongly podzolized in comparison to somewhat similar soils on Camano Island is obscure. The amount of rainfall on Whidbey Island is about the same or is generally less than on Camano Island. There is a smaller basic mineral content in the Podzols on Whidbey Island than there is in the Brown Podzolic soils. Judging by the size of the stumps, the trees on most of Whidbey Island did not grow so large as those on Camano Island. Also, the present vegetation on Whidbey Island is much less dense and is slower growing than that on Camano Island.

In Island County the Whidbey, Hoypus, and Keystone soils are classified as Podzols. These soils originated from different parent materials, which accounts for differences in their profiles.

Whidbey series.—The Whidbey soils, developed from cemented gravelly till, occupy about 36 percent of the county. The present vegetation on these soils consists largely of second-growth Douglas-fir and hemlock with a scattering of deciduous trees, shrubs, and ferns.

The profile of Whidbey gravelly sandy loam that follows is typical of the Podzols. It was observed about 3 miles south of Langley (NW¼ sec. 15). The area had been disturbed by logging operations, so the A_2 horizon was absent in many places. In the least disturbed areas, the organic litter was 2 to 3 inches thick.

Profile of Whidbey gravelly sandy loam:

A_0	3 to 0 inches, dark-gray (10YR 4/1, dry)[6] to very dark grayish-brown (10YR 3/2, dry) decomposing organic litter composed of fir needles, leaves, fern fronds, and moss bound together by fine roots; becomes darker colored, more highly decomposed, and mixed with mineral matter near the abrupt lower boundary; pH 4.2.
A_2	0 to 1 inch, light-gray (10YR 7/1, dry) to gray (10YR 5/1, moist) very friable sandy loam; massive, weakly coherent; very strongly acid (pH 4.5); abrupt irregular lower boundary.
B_{21ir}	1 to 4 inches, pale-brown (10YR 6/3, dry) to dark-brown or brown (10YR 4/3 to 5/3, moist) friable to firm gravelly sandy loam; contains aggregates weakly cemented with iron and many rounded darker colored accretionary shot pellets about 1/10 to 1/4 inch in diameter; gravel is iron coated; many fine roots; fairly low in organic matter; pH 5.2. Gradual wavy lower boundary.
B_{22ir}	4 to 10 inches, pale-brown (10YR 6/3, dry) to brown or olive-brown (10YR 5/3 to 2.5Y 4/4, moist) friable gravelly sandy loam; contains many shot pellets; massive; gravel is iron coated; slightly less acid than horizon immediately above. Gradual wavy lower boundary.
B_{31}	10 to 24 inches, pale-brown (10YR 6/3, dry) to yellowish-brown, olive-brown, or light yellowish-brown (10YR 5/4, 2.5Y 4/9, or 10YR 6/4, moist), nearly loose gravelly sandy loam to gravelly loamy sand; slightly coherent mass; contains fewer shot pellets and is slightly less acid than horizon immediately above.
B_{32}	24 to 30 inches, variegated light-gray, very pale brown, and white (dry) gravelly loamy sand with some brown and yellow iron stainings; olive brown (2.5Y 4/4, moist); massive; when dry the material is hard or weakly cemented; pH 5.6; contains many matted roots that rest directly on the cemented substratum below. Abrupt lower boundary.
C_m	30 to 48 inches +, light-gray (10YR 7/1, dry) to dark-gray (10YR 4/1, moist), strongly cemented or indurated, sandy gravelly till; upper part contains successive thin wavy fragmental plates; brown and yellow iron stains in upper 12 inches; when the material is crushed, its texture is gravelly loamy sand; a few roots penetrate between the plates and into more softly cemented materials; pH 6.1, but in places nearly neutral. The cemented till continues to undetermined depths.

Hoypus and Keystone series.—The Hoypus and Keystone soils have developed from loose, permeable,

[6] Symbols express Munsell color notations, which are explained in Soil Survey Manual, Agriculture Handbook No. 18.

coarse-textured glacial drift. These two series are alike in morphological characteristics, but the soils differ in texture of the parent material, topographic position, and relief.

The Hoypus soils have developed from somewhat modified gravelly and stony drift. They occur on uplands that are not so highly dissected as those on which the Keystone and Whidbey soils occur.

The Keystone soils originated from sandy drift. Compared to the Hoypus soils, they occupy more highly dissected morainic uplands in which hummocks and kettleholes occur. Scattered pebbles occur in some places in the Keystone soils, and in some places the soils are weakly cemented.

Like soils of the Whidbey series, the Hoypus and Keystone soils have distinct, very strongly acid, light-gray A_2 horizons. Their B horizons have no distinct zone of illuviation and are very strongly acid to strongly acid. The soils contain shot pellets but not nearly so many as occur in the Whidbey soils.

Brown Podzolic Soils

The Brown Podzolic soils are well drained to somewhat excessively drained and are medium acid. The dark-colored organic layer in these soils is comparatively thin. The boundary is abrupt between the organic layer and the pale-brown or brown mineral material immediately below. The color of the mineral material grades with increasing depth to yellowish brown, light yellowish brown, or light gray. There is no appreciable increase in content of clay, organic colloids, or sesquioxides at greater depths, but scattered shot pellets occur. These pellets range from about 1/10 inch to 1/4 inch in diameter. They are most abundant in the upper part of the profile. The underlying material in some places is cemented gravelly till and in others is loose porous gravelly or sandy drift.

The Brown Podzolic soils have developed in an environment similar to that in which the Podzols developed, but they are much more weakly or imperfectly podzolized. The organic litter is much less acid than in the Podzols. In most places it is medium acid. The A_2 horizon is only weakly developed and in places is absent. The mineral soil is medium acid (pH 5.7 to 6.0) but becomes less acid with increasing depth.

In Island County, soils classified as Brown Podzolic belong to the Alderwood, Bozarth, Everett, Indianola, and Swantown series. The Alderwood, Bozarth, and Swantown soils have developed from cemented gravelly till. Their drainage ranges from good to moderately good. The Everett and Indianola soils were derived from loose gravelly or sandy drift. They have somewhat excessive drainage.

Alderwood series.—The profile of Alderwood gravelly sandy loam described below is typical of the Brown Podzolic soils in the county. It was observed on Camano Island about 1½ miles northeast of Camano, in the northern half of section 12. The vegetation in this area consists largely of young Douglas-firs and hemlocks and a few alders, maples, and shrubs.

A_{00} and A_0 2 to 0 inches, very dark grayish-brown (10YR 3/2, dry) partially decomposed, strongly acid (pH 5.4), loose organic litter consisting of fir needles, leaves, wood fragments, fern fronds, moss, and roots; lower part much more highly decomposed and darker colored than upper part, and contains some mineral matter; abrupt lower boundary.

B_{21ir} 0 to 6 inches, pale-brown (10YR 6/3, dry) to dark-brown (10YR 4/3, moist), medium acid, friable, weakly granular gravelly sandy loam; contains many rounded darker colored accretionary shot pellets ranging from about 1/10 inch to 1/4 inch in diameter; pellets too hard to crush between the fingers but can be cut with a knife; a few firm, irregular, strong-brown orterde lumps in upper part of the horizon; many fine roots; clear wavy lower boundary.

B_{22ir} 6 to 13 inches, pale-brown to light yellowish-brown (10YR 6/3 to 6/4, dry) dark yellowish-brown (10YR 4/4, moist), friable, medium acid gravelly sandy loam; contains a few more shot pellets than horizon immediately above; weak fine granular structure; roots less numerous than in layer immediately above; gradual wavy lower boundary.

B_{31} 13 to 22 inches, light yellowish-brown (10YR 6/4, dry) to yellowish-brown (10YR 5/4, moist) loose gravelly sandy loam; contains a scattering of shot pellets, which are much less numerous than in the horizon immediately above; single-grain structure; few fine faint yellow and brown mottles.

B_{32} 22 to 34 inches, very pale brown (10YR 7/3, dry) to light yellowish-brown (10YR 6/4, moist), slightly to medium acid, firm gravelly sandy loam with some brown iron mottling; massive; hard when dry and contains horizontally matted roots resting directly on the underlying cemented substratum; abrupt smooth lower boundary.

C_m 34 to 48 inches +, light-gray (10YR 6/2, dry) to dark-gray (10YR 4/1, moist), slightly acid, strongly cemented or indurated sandy gravelly till; contains successive thin wavy fragmental plates in the upper few inches; texture is gravelly loamy sand when crushed; upper 6 to 12 inches strongly mottled with brown iron stains; except in areas only weakly cemented, few plant roots penetrate the hardpan, which is believed to be cemented by siliceous compounds. The cemented till continues to undetermined depths.

A very thin A_2 horizon occurs in some areas of Alderwood gravelly sandy loam that have not been disturbed by logging operations. Except that the typical profile does not contain an A_2 horizon, this soil resembles closely the profile of the strongly podzolized Whidbey gravelly sandy loam. The upper part of the profile is much less acid than the upper part of the Whidbey soils.

Bozarth series.—The well-drained Bozarth soils have developed from cemented till similar to that from which the Alderwood soils originated. Unlike the parent material of the Alderwood soils, however, the parent material of the Bozarth soils has been reworked by wind. The Bozarth soils have developed mainly under grass. Consequently, the surface color is darker than that of the Alderwood soils. It ranges from brown to very dark grayish brown. The B horizon is light gray or light brownish gray and is mottled. It is firm in consistence and has a texture similar to that of the surface soil. The depth to the cemented substratum ranges from 18 to 24 inches. The Bozarth soils are closely associated with the Pondilla soil, which has also developed under grass from sandy materials worked by wind.

Everett and Indianola series.—The Everett and Indianola soils have developed from loose permeable drift. They are similar in morphological characteristics but differ in the texture of the parent material and in topographic position and relief. The color of these soils resembles that of the Alderwood soils. The soils contain fewer shot pellets than the Alderwood soils.

The Everett soils have developed from gravelly and stony drift. They occupy areas of smoother relief than the Indianola and Alderwood soils. These soils are coarse textured, porous, and gravelly throughout.

The Indianola soils have developed from sandy drift. These soils occupy areas of pronounced morainic relief. They are coarse textured and porous. In most places they contain no gravel, but a few scattered pebbles occur in places. In some areas weak cementation occurs in the profile.

Swantown series.—The Swantown soils have a partly decomposed layer of organic litter, or A_0 horizon, over a very thin A_1 horizon of mixed mineral matter and organic matter. The weakly developed A_2 horizon is gray or yellowish brown, platy, and somewhat leached. It overlies a thin podzolic B horizon.

The Swantown soils occur in association with the Whidbey soils. They occur at lower elevations, however, so are not so well drained as the Whidbey soils. Their somewhat restricted drainage has influenced their morphological characteristics.

Intrazonal soils

The intrazonal soils have more or less well-developed characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation (*5*). In Island County the intrazonal soils have been affected by poor drainage. The soils have developed in depressions under forest. They have dark-colored acid A horizons that contain a large amount of organic matter. The B horizons of the different soils are of different textures. They are strongly mottled, grayish in color, and acid in reaction.

PLANOSOLS

The Planosols are intrazonal soils that have one or more horizons abruptly separated from, and sharply contrasting to, an adjacent horizon because of cementation, compaction, or high clay content. The group includes hydromorphic soils, which are excessively wet. The Planosols in Island County, members of the Casey and Bow series, are generally imperfectly drained to moderately well drained soils of the uplands. The A horizon is strongly leached; the B horizon is a heavy claypan.

Casey series.—The soils of the Casey series are moderately well drained. They contain a dense claypan. The Casey soils are more highly leached than the Bow soils. They are associated with the Podzol soils.

The following profile of Casey loam is typical of the Planosols of Island County:

A_{00} and A_0	2 to 0 inches, very dark grayish-brown (10YR 3/1, dry) decomposing organic litter composed of fir needles, leaves, fern fronds, cones, wood fragments, moss, and roots; the lower part is more highly decomposed and darker colored; it is mixed with mineral matter at the abrupt lower boundary; very strongly acid.
A_2	0 to ½ inch, light-gray (10YR 7/1, dry) to gray (10YR 5/1, moist) very friable sandy loam; massive, only slightly coherent; very strongly acid; clear smooth lower boundary.
A_{21} B_{21ir}	½ to 6½ inches, mottled grayish-brown and brown (10YR 5/2 and 5/3, dry) to dark grayish-brown and dark-brown (10YR 4/2 and 3.5/3, moist) friable, moderate fine granular loam; few small round concretions; hard when dry; strongly to medium acid; clear wavy lower boundary.
A_2	6½ to 12 inches, light brownish-gray (10YR 6/2, dry) to grayish-brown (10YR 5/2, moist) firm, massive sandy loam to loam; contains some pebbles and some faint mottles; when dry this layer is very hard; medium acid; abrupt lower boundary.
B_{21}	12 to 24 inches, light-gray (5Y 7/2, dry) to olive-gray or olive (5Y 5/2 or 5/3, moist) very plastic clay with few embedded pebbles; weak prismatic structure, but breaks readily to moderate medium subangular blocky aggregates when dry; common distinct medium yellow and brown mottles; dark-gray and purplish-gray organic and clay coatings occur on surfaces of aggregates.
B_{22}	24 to 36 inches, similar to horizon immediately above but more massive and has fewer mottlings; slightly acid.
C	36 inches +, light-gray (5Y 7/2, dry) to olive-gray (5Y 5/2, moist) very plastic massive clay, almost free of mottling; very firm; breaks to very hard irregular blocky fragments when dry; neutral.

Bow series.—The Bow soils, like the Casey soils, have developed from fine-textured till and from glacial-lake or marine sediments. They contain a dense claypan. The surface layer of these soils is brown or grayish brown and is friable in consistence. It is medium acid. The A_2 horizon is light gray, massive, and very hard. It is prominently mottled. This horizon overlies a much finer textured, strongly plastic, subangular blocky or weakly prismatic, slightly acid, textural B horizon. The Bow soils are imperfectly drained. Surface drainage is adequate, but internal drainage is slow.

HUMIC GLEY

The Humic Gley soils are poorly drained or very poorly drained hydromorphic soils. They have moderately thick dark-colored organic mineral horizons, underlain by mineral gley horizons.

The Humic Gley soils in Island County are members of the Bellingham, Coveland, Hovde, Lummi, Norma, and Puget series. These soils occur in low areas that have restricted drainage. They are saturated in winter and spring. These soils have dark-colored A_1 horizons and B and C horizons of different textures. The soils are generally gray or olive gray with distinct mottlings of brown, yellow, yellowish brown, blue, or green. The

color of the mottlings has resulted from repeated changes in moisture conditions and the reduction, oxidation, and hydration attending such changes.

Bellingham and Norma series.—The Bellingham soil has developed largely from glacial-lake sediments or from marine silts and clays. It is generally free of pebbles and stones to a depth of 3 or 4 feet.

The Norma soils have developed from sandy till over compact or cemented till. They are more permeable than the Bellingham soil, and the A_1 horizon is not so dark colored. The B horizon is medium to coarse textured.

The Bellingham and Norma soils have developed under a dense growth of mixed deciduous trees and conifers, brush, and water-tolerant vegetation. These plants have added to the soils large quantities of organic residues that have a high content of bases.

The following profile of Bellingham silt loam is typical of the Humic Gley soils in Island County:

A_1 0 to 6 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist) friable moderate medium granular silt loam; high content of organic matter; plastic when wet. Abrupt smooth lower boundary.

A_2 6 to 14 inches, gray (10YR 5/1, dry) to dark-gray (10YR 4/1, moist) firm to friable fine sandy loam to loam; weak fine granular to massive structure; hard when dry; few distinct yellow and brown mottles. Clear smooth lower boundary.

A_{2g} 14 to 24 inches, light-gray (10YR 7/2, dry) to light brownish-gray (2.5Y 6/2, moist) firm, massive loam to silt loam; common distinct yellow and brown mottles. Abrupt wavy lower boundary.

B_{2g} 24 to 40 inches, light-gray (10YR 7/2, dry to 5Y 6/1, moist) very plastic silts and clays, strongly mottled with reddish brown, brown, yellowish brown, and yellow; breaks to moderate medium blocky or subangular blocky aggregates; organic and clay skins on ped surfaces. Clear wavy lower boundary.

C 40 to 48 inches +, light-gray (10YR 7/1, dry) to (5Y 6/1, moist) clay; massive; very firm when moist; very plastic or very sticky when wet; few distinct mottles.

The surface layer is slightly acid. The soil becomes less acid with increasing depth; it is neutral at depths of 30 inches.

Coveland series.—The soils of the Coveland series resemble the Bellingham soil but have developed from clay till mixed with marine and glacial lake sediments. Embedded pebbles and stones are common in the profile. The soils have developed mainly under grass.

The position and relief of the Coveland soils differ in many places from those of the Bellingham and Norma soils. The Coveland soils occur on very gently sloping concave areas, which receive considerable seepage. Surface drainage is more rapid than that of the nearly level Bellingham and Norma soils.

The Coveland soils are closely associated with the Casey and Townsend soils. The Coveland soils are not so well drained as the Casey soils and did not develop under forest. The Coveland soils have a darker colored surface layer than the Casey soils. They have developed from finer textured till and are more poorly drained than the Townsend soils.

Puget series.—The Puget soil has developed from fine-textured, stratified alluvium left by glacial streams. The alluvium is mixed with marine sediments. This soil is grayish in color and is prominently mottled with yellow, brown, and purple. It is strongly to very strongly acid.

Lummi series.—The Lummi soils occur on reclaimed tidal flats. They resemble the Puget soil closely in some characteristics but were derived from marine sediments. The remains of flattened sedges are embedded in the lower part of the profile. These soils are generally more strongly acid than the Puget soil. In places they have a high content of salts as a result of having recently been flooded by salt water.

Hovde series.—The Hovde soil has developed from very coarse textured marine materials, but otherwise it resembles the Lummi soils with which it is closely associated. The profile of the Hovde soil is weakly developed. A slight accumulation of organic matter is evident in the A horizon, however, and mottling occurs in the B horizon.

Azonal soils

The azonal soils lack distinct, genetically related horizons commonly because of youth, resistant parent material, or steep topography. In Island County the Regosols and the Organic soils belong to this order.

Regosols

The Regosols are an azonal group of soils consisting of deep, unconsolidated rock, or soft mineral deposits, in which few or no clearly expressed soil characteristics have developed. The Regosols in Island County, members of the San Juan, Snakelum, Townsend, Ebeys, Coupeville, and Pondilla series, have developed from several different parent materials. Differences in their morphological characteristics have been brought about by differences in parent materials. The San Juan and Snakelum soils have developed from glacial outwash, the Townsend from cemented gravelly till, and the Ebeys and Coupeville soils from marine and glacial lake sediments.

The Regosols range from moderately well drained to excessively drained. They all have very dark colored or black surface soils. The soils have developed in the prairie areas under a vegetative cover consisting mainly of grass with scattered trees and shrubs. These areas occur in the belt that receives the least rainfall.

These prairie areas may once have formed the floors of glacial lakes or the beds of brackish lagoons that drained into Puget Sound; they may have originally been peaty soils that became highly decomposed and mineralized and developed into the present black prairie soils. This would not be a likely origin of the porous and permeable soils, however, such as the San Juan and Snakelum. The San Juan and Snakelum soils are similar to the soils that resemble Prairie soils in Pierce and Thurston Counties in western Washington.

The Regosols have been referred to as "black-brown" soils by Nikiforoff (*3*), who states that they may be considered a transitional link between the true Chernozems and the most weakly podzolized Meadow soils of the forested belt. He also states that these soils are

not true Chernozems in spite of their very dark color but should be classed as an independent group.

San Juan, Snakelum, Townsend, Ebeys, and Coupeville series.—The San Juan and Snakelum soils were derived from porous permeable glacial outwash, and the Townsend soils from cemented sandy gravelly till. The parent materials of the Ebeys and Coupeville soils consisted of marine and glacial lake sediments.

The Ebeys soils are coarse textured, open, and permeable, and the Coupeville are fine textured and much less permeable. The surface layer of most of these soils is very dark gray, black, or nearly black when moist and is 10 to 12 inches thick. The subsoils vary in color and texture in the different soils.

The surface layers range from strongly acid to medium acid and become less acid with depth. At depths below 30 to 36 inches, the soils are neutral or slightly alkaline. Traces of calcium carbonate occur in the lower part of the subsoil in the Coupeville soils. None of these soils contains the shot pellets so characteristic of the forested upland soils.

The following description of Ebeys sandy loam is typical of the Regosols in Island County. The profile described occurs on Ebeys Prairie in a cultivated field near the northeastern corner of section 8, about 1½ miles southwest of Coupeville.

A_p 0 to 12 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), friable, moderate fine granular sandy loam having a sooty feel; contains a large amount of organic matter; medium to slightly acid; lower part has a weak structure that breaks readily to medium granular soft aggregates; abrupt lower boundary.

AC 12 to 18 inches, pale-brown (10YR 6/3, dry) or light brownish-gray (10YR 6/2, dry) to dark grayish-brown (10YR 4/2, moist), firm, massive sandy loam, coarser textured than the surface soil; slightly hard when dry; it crumbles easily to single grains when removed; faintly mottled with yellow and brown stains; slightly acid; clear wavy lower boundary.

C_{11} 18 to 36 inches, light olive-gray (5Y 6/2, dry) to olive-gray (5Y 5/2, moist) medium sand containing few faint yellow and brown stains; in place the material is firm, but when removed it crumbles readily to single grains; very permeable to moisture and plant roots; nearly neutral; gradual wavy lower boundary.

C_{12} 36 to 54 inches +, mixed light-gray, gray, olive, and dark-gray loose medium and coarse sands moderately mottled with brown; about neutral.

Pondilla series.—The Pondilla soil is believed to have originated from materials of glacial and marine origin that were reworked by wind. The soil is not so dark colored as the other Regosols. It is porous and permeable and is excessively drained. Except for its darker colored surface layer, there has been little profile development in this soil. The surface layer is nearly neutral in reaction, and the soil is only slightly more acid at greater depths.

Organic soils.—The Organic soils have a muck or peat surface layer that is underlain by peat. These soils occur in low basins or depressions where the water table is high. They have developed under a swamp or marsh type of vegetation, generally in a humid or subhumid climate. These soils were derived from the remains of plants in various stages of decomposition. In Island County, Tanwax peat has developed mainly from aquatic vegetation that grew in open water, and Mukilteo peat, from sedges and reeds that grew in open marshes. Tacoma peat is a sedge peat that was derived largely from salt-tolerant vegetation; and Rifle peat has developed from the brush, shrubs, trees, and water-tolerant vegetation of swamps and forests. After the bases have become exhausted and the soil has become too acid for other plants, sphagnum, lipnum, and other mosses form the predominant vegetation.

The organic soils in which the plant remains can be identified as partly decomposed fibers and matted materials are classified as peat. In this county woody, sedge, sedimentary, and moss peats occur—the Rifle, Mukilteo, Tanwax, and Greenwood peats, respectively.

Organic soils in which the plant remains are well decomposed and cannot be identified readily in the upper 6 to 12 inches are classed as mucks. Those recognized and mapped are the woody and sedge mucks—the Carbondale and Semiahmoo mucks, respectively.

Miscellaneous Land Types

In Island County miscellaneous land types not classified by higher categories are Coastal beach, 0 to 2 percent slopes; Fresh water marsh; Made land; Rough broken land; Rough stony land; and Tidal marsh, 0 to 2 percent slopes.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

Field study.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart, and sometimes they are much closer. In most soils such a boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about the soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the amount of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying rocks or other parent material from which the soil has developed; and the acidity or alkalinity of the soil as measured by chemical tests.

Classification.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variation, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices, therefore, can be specified more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture but that are otherwise similar in kind, thickness, and arrangement of soil layers are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which the soil was first mapped.

As an example of soil classification, consider the Casey soils of Island County. This series is made up of two soil types, both subdivided into phases, as follows:

Series	*Type*	*Phase*
Casey	Casey loam	5 to 15 percent slopes.
		15 to 30 percent slopes.
	Casey fine sandy loam.	0 to 5 percent slopes.
		5 to 15 percent slopes.
		15 to 30 percent slopes.

Miscellaneous land types.—Stony land, beaches, swamps, or other areas that have little or no true soil are not classified into types and series but are identified by descriptive names, such as Fresh water marsh, Rough stony land, or Coastal beach.

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