EROSION SURVEY No. 20

Erosion and RELATED LAND USE CONDITIONS

on the

Chehalem Mountain Demonstration Project

Oregon

by H. N. MAGNESS and M. F. SANDOZ
Assistant Soil Technologists
Physical Surveys Division, Soil Conservation Service

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE • WASHINGTON • 1941

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CONTENTS

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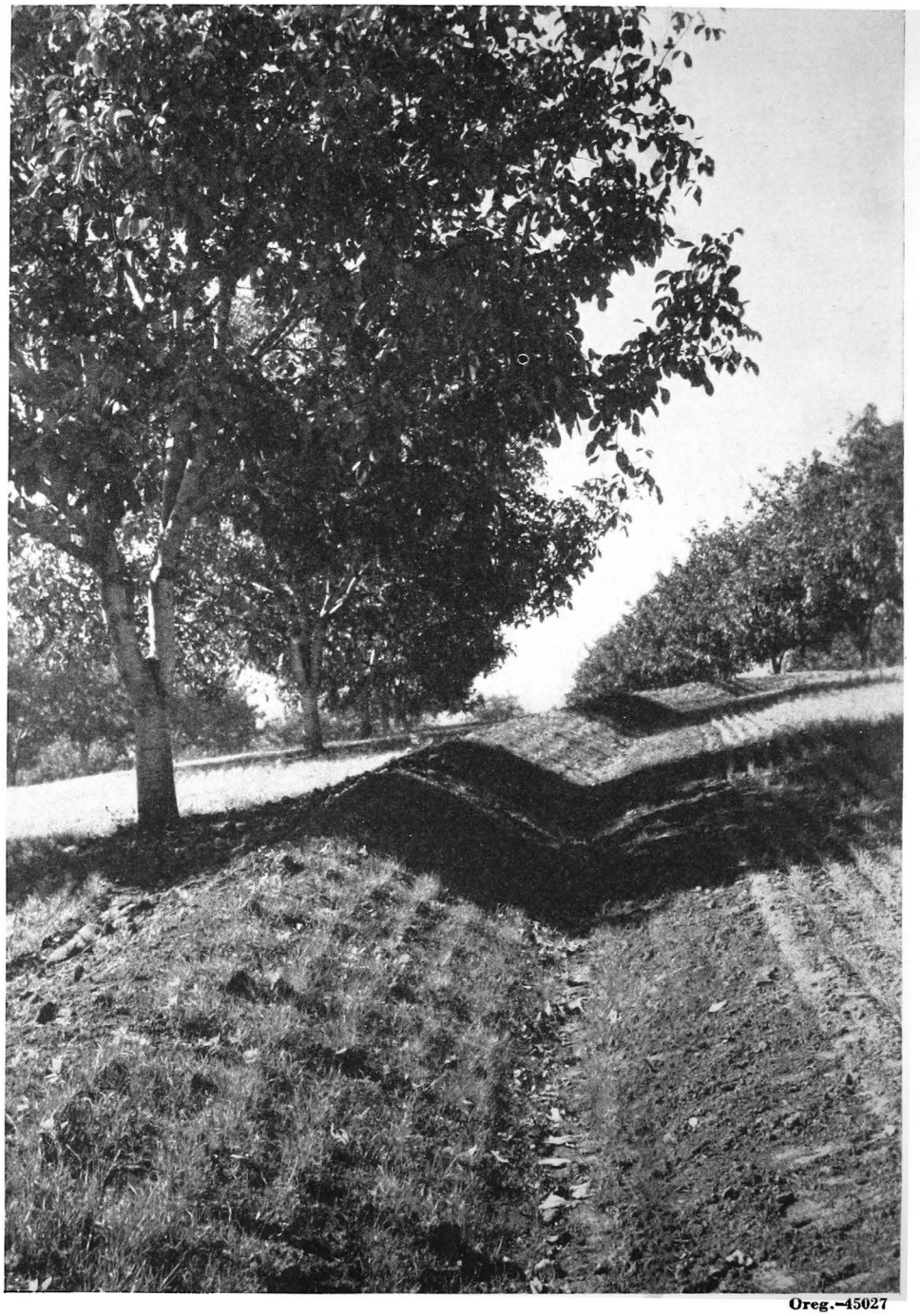

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A field diversion-ditch system constructed in a walnut orchard on a 15 to 20 percent slope in Olympic soil. The trees are spaced 60 feet apart.

Introduction

THE CHEHALEM MOUNTAIN soil conservation project, located on the west side of the Willamette River Valley in northwestern Oregon (fig. 1), is representative of the soils and climate of the entire valley and particularly of the western side. The climate is marked by a season of abundant rainfall beginning usually in the latter part of October and continuing into April. It is succeeded by a period of slight rainfall, scattered rather than general in its distribution. As a result of this distribution of precipitation a twofold problem of conservation arises. The problem is to protect both orchard and general farming land during the rainy season so as to prevent water erosion of exposed soils, and to retain and conserve for use during the succeeding dry periods the amounts of soil moisture needed for the maturing of satisfactory crop yields. The capture and retention of the precipitation of the rainy season is essential both to the prevention of soil erosion at that time and to storing moisture for use during the dry season. Soil and water conservation become doubly important under these climatic conditions.

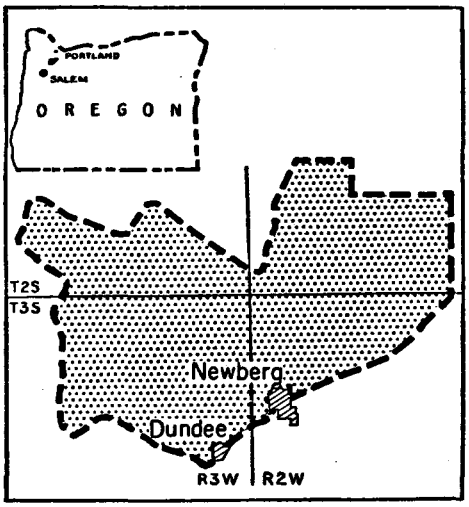

Figure 1.—**Sketch map showing location of Chehalem Mountain project.**

The Soil Conservation Service established a project on the Chehalem Mountain area in March 1937 to demonstrate practical methods for reducing soil losses and for conserving soil moisture. The project covers an area of 45,532 acres, or about 71 square miles, north of Newberg in Yamhill and Washington Counties, Oreg. It includes the Chehalem Mountain and the Dundee Hills, areas of rolling foothills, level valley floor, and alluvial lands along the streamways that originate in the hills and extend across the lower lying lands. The area is a part of a productive section marked by widely varied agricultural interests, chief among which are orcharding, the growing of nut trees and small fruits, dairy farming, and the growing of grass and vetch seeds as commercial crops in conjunction with general farming.

A soil conservation survey of the area was made to secure the physical information necessary to serve as a basis for use in working out plans for complete coordinated erosion control and water conservation. The surveyors determined the soil types, the existing erosion conditions, the dominant slopes classes, and present land uses within the area.

This bulletin presents the information secured and interprets it for planning control of soil erosion and good use of land. It also gives the essential facts of climatic conditions summarized from the records of the United States Weather Bureau, a description of the area, and a detailed discussion of the technical aspects of the survey, supported by the data obtained.

The maps that accompany this bulletin show the physical character of the land in the project and its classification into different classes of land according to use capability. These maps, published on a scale of 4 inches to the mile, show the use capability of the land in colors, the base map in black, drainage in blue, conservation-survey boundaries and symbols that denote erosion, slope, and soil type in brown, and land use in gray. Each full sheet covers an area of about 10.5 square miles. Owing to the irregular boundaries of the

project, 10 sheets are required for the map of the entire area. The index map shows the location of each sheet making up the entire area.

Using the Land in the Chehalem Mountain Project

Character of Land According to Use Capability

EACH OF THE physical factors—soil, slope, and kind and degree of erosion—has its influence on the capability of the land for use, on the erosion processes still taking place, and on the methods that need to be adopted for erosion control and water conservation. In working out the more general relationships of control practices and of good land use on farms, the factors mapped can be grouped into a simple classification that expresses the capability of land for use and gives full recognition to each of the physical factors wherever it is significant.

This classification of land according to its use capabilities furnishes a guide to the kind of cropping practices that may be followed safely and to the intensity and variety of protective measures that need to be applied. Selection of the crops to be grown on cultivated land depends further on the nature of the soil, its relationships to water and air drainage, the steepness and regularity of the slope of the land, the degree to which the soil has already been eroded, and the climatic factors. Nearly all crops suited to the local climatic conditions may be grown on some soil and in some situation in the Chehalem Mountain area.

Five classes of land according to use capability have been recognized in the Chehalem Mountain project.

Class I land is shown on the map in green. It is nearly level, having a slope of less than 5 percent. It has been affected by little or no erosion. It is not subject to destructive overflow and it is sufficiently well drained to permit of growing some farm crops. Its tillage is not prevented by rough or stony surface. It may be covered at present by trees or grass or it may be cropped, since its assignment to the class is based on physical characteristics and freedom from erosion hazards rather than on present use.

Class II land, which is shown on the map in yellow, lies on slopes up to 12 percent and has not been affected by more than slight or moderate erosion; that is, to the removal of not more than one-half of the topsoil by sheet erosion, or not more than one-fourth of the topsoil if accompanied by infrequent and shallow gullying. It requires proper crop rotations, the use of cover crops, and the utilization of crop residues to create a rough surface or to serve as a mulch. Such land may be kept under cultivation without resort to complex or unusual practices for the prevention of soil erosion.

Class III land, which is shown in red, occurs chiefly on slopes of 5 to 12 percent on which sheet erosion has already removed 25 to 50 percent of the topsoil and which is accompanied in some fields by shallow infrequent gullying, and on slopes above 12 percent on which little or no erosion has occurred. It needs special mechanical treatment to support good tillage practices.

Class IV land, which is shown on the map in blue, includes most areas on slopes up to 20 percent where erosion has become severe and on steeper slopes, up to 30 percent, where erosion is only slight or moderate. The largest areas are on slopes greater than 12 percent on cropland. It should be kept under good plant cover with row crops grown only at long intervals.

Class V land, shown in orange, includes areas on which erosion has become very severe, and all the steep areas where signs of erosion more than slight are evident or where erosion is to be expected if the area should be used for any intensive form of cultivation. Grass or forest cover constitutes the best use for land in this class.

Effect of Physical Factors on Use Capability of Land

SOILS

Nineteen different soils were mapped in the Chehalem Mountain area ac-

cording to the methods of the Bureau of Plant Industry of the United States Department of Agriculture. These soils are fully described on pages 22–30. They have been arranged in three main groups, the most extensive of which occurs on the uplands and covers 35,809 acres, or 78.6 percent of the area. The soils in this group have been formed on the basaltic rocks of the ridges and on the shales and sandstones that underlie them at lower elevations. They present the steepest slopes in the area, nearly three-fourths of the area being on slopes greater than 12 percent. Since they vary in their absorptive capacity for water, in their internal drainage, and in their liability to erosion under normal conditions of cultivation, three subclasses are recognized. Another main group consists of soils developed on valley-filling material, forming nearly level terraces between the uplands and the modern streamways. This group includes 6,703 acres, or 14.7 percent of the area. These soils are nearly level or gently sloping. Seven-tenths of the group is well drained, the remainder, imperfectly or poorly drained. The third group of soils comprises those deposited along the streamways in the larger valleys. It has an area of 3,020 acres, or 6.7 percent of the project. Ninety-eight percent of this group has a slope of 5 percent or less. A small part of this group is well drained, and the remainder is imperfectly or poorly drained and subject to overflow.

The cultivated parts of the upland soils present the most serious problems of erosion control, although a higher proportion of the other two groups is in crops. This is a consequence of both slope relationships and the difference in the types of cropping practiced on the different groups.

Slopes

Slope affects the rate of run-off and decidedly influences the liability to erosion. It also affects natural drainage. It is one of the factors determining the capability of land for continued use. In the physical survey, slope classes are designated by letters. A slopes on this survey are less than 5 percent; B slopes, 5 to 12 percent; BB slopes, 12 to 20; C slopes, 20 to 30; and D slopes, 30 percent and over.

Erosion

The character and extent of soil erosion at the present time was also mapped in detail and 13 classes of erosion were found, as shown in table 5, page 31, and in the legend for the map accompanying this bulletin. These include deposition of eroded material, chiefly in bottom lands; no apparent erosion, mapped most extensively on woodland and on pasture; and undifferentiated erosion on farmsteads and other small areas not used for agricultural purposes. The 13 classes were combined into 6 erosion groups: Recent alluvial deposits, no apparent erosion, slight, moderate, severe, and very severe erosion. Sheet erosion, which is the rather uniform removal of topsoil from a field accompanied by the formation of shallow rills that can be cultivated out by ordinary farm operations, is indicated by numbers from 1 to 4. The shallow, infrequent gullies are shown by 7, more frequent, deep gullies by ⑧, and very closely spaced or very large gullies by 9. Gully symbols 7 and ⑧ are used only in combination with sheet erosion symbols. A complete list of the erosion classes mapped is given in table 5, page 31.

Soil losses on the uplands are confined almost entirely to sheet erosion, with small gullies crossable by farm machinery being formed in natural drainageways (fig. 2). Moderate to severe erosion is present on cropland on many slopes greater than 12 percent. It is especially evident on the upland soils of group 1. Deep gully erosion is not prevalent in the area because the heavy clay subsoil present in many of the upland soils retards deep cutting and results in the spreading of the run-off water, forming wide, shallow ditches.

Wind erosion is not a problem in the area.

Damage by soil deposition is not generally serious. Only a few heavy

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Figure 2.—**Sheet and gully erosion in a walnut orchard resulting from cultivation up and down the hill just before a heavy rain.**

rains have occurred of sufficient intensity to carry soil onto the flats in quantities great enough to ruin crops. A relatively small amount of run-off causes flooding with water because of the very flat surface of the bottom land and of the dense brush cover in many drainage channels.

The problems of water loss are nearly, if not fully, as important as those of soil loss in the Chehalem Mountain area. Owing to an unequal seasonal distribution of precipitation and to a small margin of available moisture retained in some of the soil types, all moisture possible must be retained for tree and crop growth after the rainy season ends about April 1. Tillage practices that lead to loss of soil moisture after that date will be reflected in decreased crop yields. This limits to some extent the practices that may be recommended for soil conservation, especially the use of summer cover crops to shield the soil surface from rainfalls of high intensity.

Present Land Use

Present land use is shown on the map by gray symbols. The survey showed that 23,996 acres, or 52.7 percent of the project, are under cultivation at the present time; that 4,810 acres, or 10.6 percent, are in pasture, and 16,347 acres, or 35.9 percent, are in woodland. No idle land was mapped. Farmyards and urban areas occupied 379 acres, or 0.8 percent of the area. The distribution of present land use classes and of land-capability classes is shown in figure 3.

Choosing Practices to Fit the Land

The maps that accompany this bulletin present the physical facts ascertained by the survey. They show the relationships of these facts to the capability of the land for permanent cropland, pasture, and woodland utilization without serious danger of deterioration provided that the practices indicated

as being best suited for each class of land capability are employed.

The farming and conservation practices recommended for use in the Chehalem Mountain area are summarized for each land-capability class in table 1. The soil groups, slopes, and degrees of erosion falling into each class are shown. A distinction is made between land to be used chiefly for annual crops and hay, for orcharding and the growing of small fruits, for pasture, and for that which should remain in woodland or be reforested.

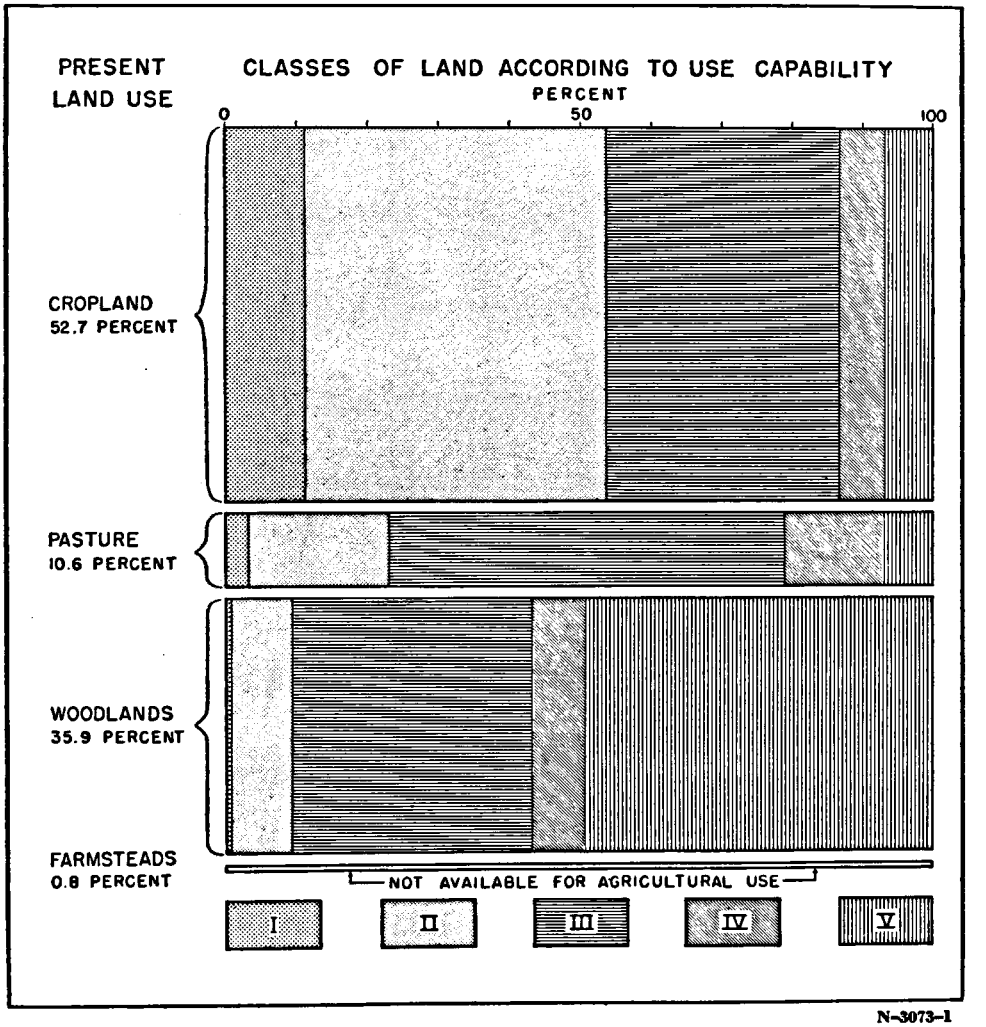

Figure 3.—**Present use of land and use capability of land in the project. Classes I, II and III are suitable for cultivation; class I without special practices, class II with simple practices, and class III with complex or intensive practices. Class IV is suitable only for limited or occasional cultivation. Class V is not suitable for cultivation.**

TABLE 1.—*Farming and conservation practices*

Land-capability class	Soil group [1]	Slope and erosion class [2]	Practices for— Annual crops and hay land: Rotations	Treatments	Supporting practices
I (green) [3]	1, a 2, a 3, a	A: +, 0, 1	Row crops, grain, hay Row crops and grain not to exceed 3 years in 5.	Manure on row crops. Gypsum or lime on clover and alfalfa. Phosphates on alfalfa and grass.	Crop residue utilization.
II (yellow) [3]	1, a	B: 0, 1, 17, 2	do	Fertilizers on row crops and hay. Gypsum or lime on clover and alfalfa. Crop residue utilization.	Contour cultivation. Shallow infrequent summer cultivation. Stubble or a growing winter cover crop. Managed grazing on hay lands.
	1, b, c	A: 0, 1, 17 B: 0, 1, 17			
	2, a	A: 17 B: 0, 1, 17, 2, Θ			
	2, b	A: +, 0, 1, 17, Θ			
	3, a	A: 17 B: 1	Grain, hay, clover Grain and hay 3 years in 5. Spring grain and hairy vetch. Summer truck and winter cover.	Gypsum or lime on clover. Crop residue utilization. Annual green manure crop.	Drainage
	3, b	A: +, 0, 1, 17 B: 1			
III (red) [3]	1, a	B: 27, 3 BB: 0, 1, 17, 2, 27 C: 0, 1	Grain, hay, clover Grain and annual hay not over 3 years in 5.	Lime or gypsum on clover. Green manures Fertilizer Crop residue utilization.	Contour cultivation Strip cropping Diversion ditches Winter cover crop Subsoiling on the contour.
	1, b	B: 2, 27, 3 BB: 0, 1, 17, 2, 27			
	1, c	B: 2, 27 BB: 0, 1, 17, 2			
	2, a	B: 27 BB: 0, 1, 17, 2			
IV (blue) [3]	1, a	B: 37, 4 BB: 3, 37, 4 C: 17, 2	Annual crops not more than 2 years in 7. Grass fall seeded in spring grain stubble.	Lime and fertilizer Crop residue utilization.	Contour cultivation Diversion ditches Dense winter cover
	1, b	A: 4 B: 37, 4 BB: 3, 37 C: 0, 1, 17			
	1, c	B: 3, 37 BB: 27, 3 C: 0, 1, 17			
	2, a	C: 2			
	2, b	C: 0, 2			
	3, b	A: 1Θ, 2 C: 2, 3	Grain, hay, wet-land grasses, and clovers. Truck crops not over 3 years in 7.	Lime, gypsum Fertilizer	Diversion ditches Drainage
V (orange) [3]	1, a	C: 27, 3, 37, 4, 47 D: 0, 1, 2, 3, 37	Convert to grassland	Convert to grassland	
	1, b	BB: 4, 47 C: 2, 27, 3, 37, 47 D: 0, 1			
	1, c	B: 4, 47, 9 BB: 37, 4, 47 C: 2, 27, 3, 37, 4, 47 D: 0, 1, 3			

[1] Soil group symbols: Group 1, soils developed on uplands; a, well drained; b, imperfectly drained; c, imperfectly or poorly drained. Group 2, soils developed on valley-filling material; a, well drained; b, imperfectly or poorly drained. Group 3, soils developed on the flood plains; a, well drained; b, imperfectly or poorly drained.

recommended according to use capability of land

Practices for—Continued				
Orchards and small fruits		Pasture		Woodland
Treatments	Supporting practices	Treatments	Supporting practices	Practices
Winter cover crop. Annual green manure.	Summer cultivation only as needed to control weeds.	Fertilizer. Supplemental irrigation.	Protection from fire. Controlled grazing. Brush suppression. Clipping. Rotation and deferred grazing. Harrowing to spread droppings. Renovation and spot seeding when necessary. Drainage where necessary.	Permanent: Protection from fire and overgrazing. Management to sustain yield. If converted to cropland: Planned schedule for clearing. Seeding to cover immediately after clearing.
Fertilizer. Annual green manure.	Contour cultivation. Infrequent summer cultivation.	do.	do.	Do.
		Fertilizer where needed.	Drainage.	Do.
Fertilizer. Winter cover crop. Green manure. Straw mulch. Summer cultivation.	Contour planting of new orchards. Contour cultivation. Subsoiling on the contour. Diversion ditches.	Reseeding and fertilization.	Control of grazing. Aftermath to be sufficient to protect against run-off and to maintain thrift of plants.	Permanent: Protection from fire and overgrazing. Simple restrictions on clear cutting, logging methods, and slash disposal. If converted to cropland: Planned schedule for clearing. Careful restriction on methods of cutting and clearing. Seeding to cover immediately after clearing.
Perennial grass cover. Permanent straw mulch.	Diversion ditches.	do.	Protection from fire. Controlled grazing. Brush suppression. Diversion ditches.	No conversion to cultivation. Restriction of cutting, slash disposal. Logging to preserve ground cover. Protection from fire and overgrazing.
		do.	do.	Do.
			Protection from fire and overgrazing. Suppression of brush and weeds.	Protection from fire and overgrazing. Systematic management to sustain yields. Replanting of denuded areas.

[1] Slope symbols: A, less than 5 percent; B, 5–12; BB, 12–20; C, 20–30; D, 30 percent and over. Erosion symbols are explained in detail on pp. 21–22. 1, 2, 3, and 4 indicate progressive degrees of sheet erosion; 7, 8, and 9, occasional, frequent, and very frequent gullies, respectively; 0, no apparent erosion; +, deposition; and Θ, undifferentiated erosion.

[2] Color distinguishing class area on the maps accompanying this bulletin.

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All tracts of land in the area assigned to class I must meet three conditions. They must be well drained, otherwise a special practice—artificial drainage—would be required; they must lie on slopes of less than 5 percent, otherwise there would be too great danger of rapid and destructive run-off; they must not have had more than slight erosion, and no gullying, because a greater degree of soil loss would indicate that protective measures should be applied. Land of this class must be capable of being farmed to the crops commonly grown in the region without the use of special precautions beyond good farming practices.

The survey shows that there are 2,954 acres of class I land, comprising 6.5 percent of the area. Only 2 acres are on upland soils, owing chiefly to limitations of slope. The largest area, 2,670 acres, lies on the gently sloping but well-drained soils on valley-filling material, the Salem silty clay loam and the Willamette silt loam. The remainder, 282 acres, is on the well-drained Chehalis silt loam of the flood plains. This area is somewhat limited in its crop adaptations since it is subject to overflow and also occupies a lowland position not usually considered favorable for orcharding.

The row crops, grain, and hay may be grown in regular rotation on class I land provided the row crops and grain do not occupy the land for more than 3 years out of 5. The soil and crop treatment recommended include the use of manure on the row crops, of gypsum and lime with seedings to alfalfa and clover, and of phosphatic fertilizers on alfalfa and grass. Crop residues should be plowed under both to aid in maintaining organic matter in the soil and to improve soil structure. No unusual drainage operations are needed.

The treatment for orchards and small fruit plantations includes the use of winter cover crops, the plowing under of an annual green-manure crop, and summer cultivation only to the extent needed to control weeds.

Pastures should be protected from fire. Grazing should be so controlled that cattle are not permitted on the land when it is wet and are kept off the pasture until a good growth of grass has been made in the spring. Stock should be taken off in the fall in time to permit the grasses to make a good growth before winter. The use of phosphatic fertilizers is desirable on fields or smaller areas indicated by thin grass stands or the invasion of weeds. Brush and weeds should be cut, and on some fields supplemental irrigation may be desirable. Grazing should be rotated or deferred, and a balance of use should be obtained that will provide sufficient aftermath to protect the land from erosion and maintain thrift of plants.

Where permanent woodland is to be maintained on class I land, it should be protected from fire and grazing and a system of cutting and management adopted that will assure the growth of wood products that can be harvested from time to time for use or sale. Technical advice as to woodland management practices should be secured.

All these practices are or should be common on well-managed land of class I and no special practices are required to permit of its continued use for the various forms of occupation desired within climatic limitations.

At the time the survey was made, 2,690 acres of class I land were in crops, 161 acres were pastured, and 103 acres were in woodland. No readjustment of uses would seem to be required except to meet the needs of individual farmers.

Land of such physical character that it may be assigned to class II occurs in all the soil groups to the extent of 12,574 acres, or 27.9 percent of the area used for agricultural purposes. On the well-drained upland soils it includes all B slopes that are not eroded or are only slightly eroded and those moderately eroded that are not gullied. On the other upland soils both A and B slopes that are not eroded or are only slightly eroded are in this class. On the well-drained soils on valley-filling material it includes the slightly eroded A slopes that are gullied and all B slopes except the

areas that have lost more than 25 percent of the topsoil and are gullied. A slopes on the imperfectly or poorly drained soils on valley-filling material are also in this class. Well-drained alluvial soils that are gullied or on B slopes and all imperfectly or poorly drained alluvial soils that are not moderately or severely eroded are in class II. The alluvial soils differ from the soils in the other groups in that some supplemental drainage is necessary on low-lying areas as a supporting practice for the methods generally applicable over all the soils.

Class II lands require simple protective measures in addition to the good farming practices outlined for class I lands. Row crops, grain, and hay may be grown on the upland soils and soils on valley-filling material, provided row crops and grain are not grown for more than 3 years in 5. Fertilizers should be used on the row crops and grain, and gypsum or lime on clover and alfalfa seedings. Crop residues should be turned under to maintain organic matter. In addition, the land should be cultivated on the contour and not uphill and downhill. Summer cultivation should be shallow and infrequent. Stubble on grain fields or a winter cover crop on tilled land should be used to prevent erosion during the winter season. Grazing should be so managed on hay lands as to prevent overgrazing at any season of the year, especially grazing too early in the spring or too late in the fall. Orchards need to be fertilized and an annual green-manure crop plowed under. Cultivation should be infrequent in the summer and on the contour. Pasture treatment and woodland management should be the same as on class I land.

Class II land on the alluvial bottoms is not suited to the same crops as on the higher lying areas. In addition to grain, hay, and clover in rotation, spring grain and hairy vetch may be grown. Summer truck crops should be succeeded by a winter cover crop. Supplementary drainage is needed on some of these lands, but tile drainage is not usually effective because of the dense structure of the subsoils. Drainage by dead furrows or by "bedding up" can be used on A slopes. The management of pastures and woodlands is the same as on other soil groups.

Class III land includes 16,107 acres, or 35.7 percent of the area used for agricultural purposes. Of this total area, 15,570 acres are on upland soils, 537 acres on soils on valley-filling material, and none on alluvial bottoms. Nearly one-third of the cropland is in this class, about the same proportion of woodland, and 55.7 percent of the pasture. No slopes less than 5 percent are in this class. The B slopes, 5 to 12 percent, that show moderate to severe erosion with no gullying and all BB slopes, 12 to 20 percent, that are not yet seriously eroded, are included in this class. The only C slopes in this class are those on the well-drained uplands showing either no erosion or slight erosion with no gullies.

It is estimated that 45 percent of the cultivated land of the area is in orchards and berries, of which 36 percent is orchard and 9 percent berries. The berries are often interplanted between the fruit and nut trees. The soil and site requirements of the berries and trees are similar. A high proportion of the fruit and nut trees and berries is on B and BB slopes, chiefly on the upland soils. Undoubtedly the clean cultivation of orchards in summer, required to conserve moisture and to give maximum yields, has contributed very largely to the prevalence of erosion on cultivated lands on these soils and slopes (fig. 4). This same practice makes difficult the adoption of some of the measures needed for soil protection, such as summer cover or year-round cover crops.

Soil and water conservation on class III lands that are used for the growing of row crops, small grain, and hay is not so difficult, since the adoption of proper rotations and tillage practices aids greatly in protecting the soil. In addition to these practices needed on all cropland, contour cultivation and strip cropping at various intervals and in widths adjusted to the slope and degree of erosion should be practiced. Diversion ditches should be installed

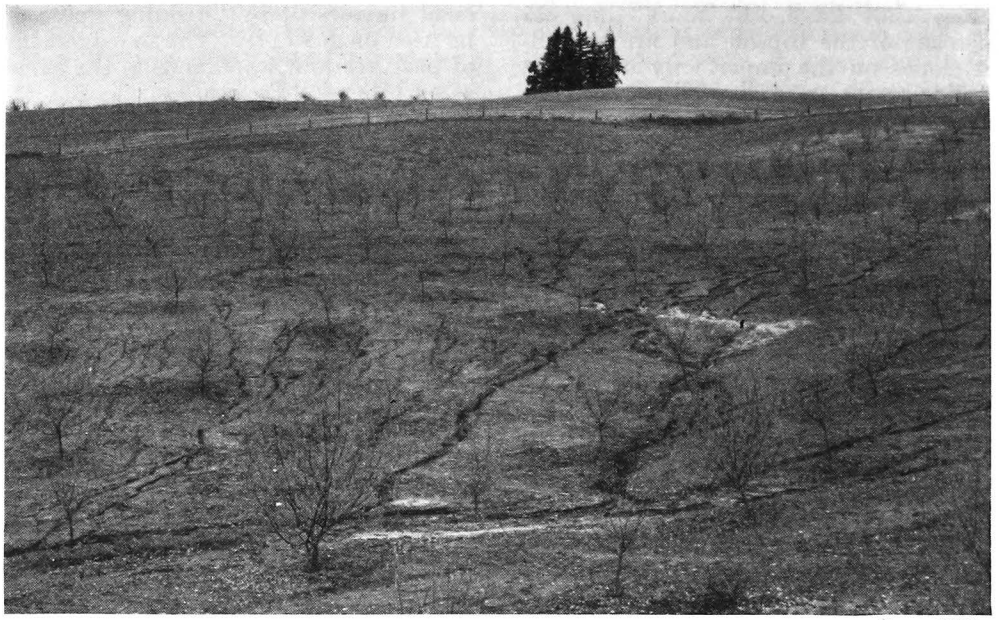

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Figure 4.—**Gullies on a 10-percent slope in a young filbert orchard show the necessity for erosion control on the Willamette Valley hill soils. The gullies are from 8 to 18 inches deep.**

to intercept and carry away run-off from higher-lying land and to break long slopes and prevent the concentration of water in definite channels. Winter cover crops should be sown as early as possible so that they may gain a height sufficient to protect the soil surface from winter rains. Subsoiling on the contour to break up "plow sole" and to permit of the more rapid and deeper penetration of water should be practiced wherever "plow sole" occurs, and especially on the Melbourne soils. Every effort should be made to maintain the organic-matter content of the topsoil by plowing under crop residues and green manures and by using all available animal manures. The restoration of fertility, depleted by cropping and by the leaching of the topsoils, calls for the application of fertilizers both on orchard and other cropland.

On orchard lands of class III, the growing of a winter cover crop, the plowing under of green manure, and the use of fertilizers are necessary both for the benefit of the orchard crop and for the promotion of satisfactory growth of the cover crops employed. Summer cultivation should be shallow and only frequent enough to control weed growth. It should be done on the contour instead of up and down slopes. Some results of tillage up and down the hill are shown in figure 5, *A*. Subsoiling or chiseling on the contour is needed on shallow soils and on soils that have a "plow sole." Contour tillage is the easiest mechanical measure to use in soil and water conservation. It is applicable to all tilled land and adds to the efficiency of other more difficult or complex measures, but it is not considered completely effective on class III land when used alone. The use of strips of permanent vegetation laid out on the contour at required intervals and of contour furrows to intercept water and to aid in holding it until it can sink into the soil, especially on land clean-tilled during the summer months (fig. 5, *B*), are desirable aids. Contour furrows are especially applicable in established orchards where the spacing of the trees is relatively close and the slope is not too steep. Terraces or field diversion ditches may be needed, if the spacing of trees permits, to intercept and

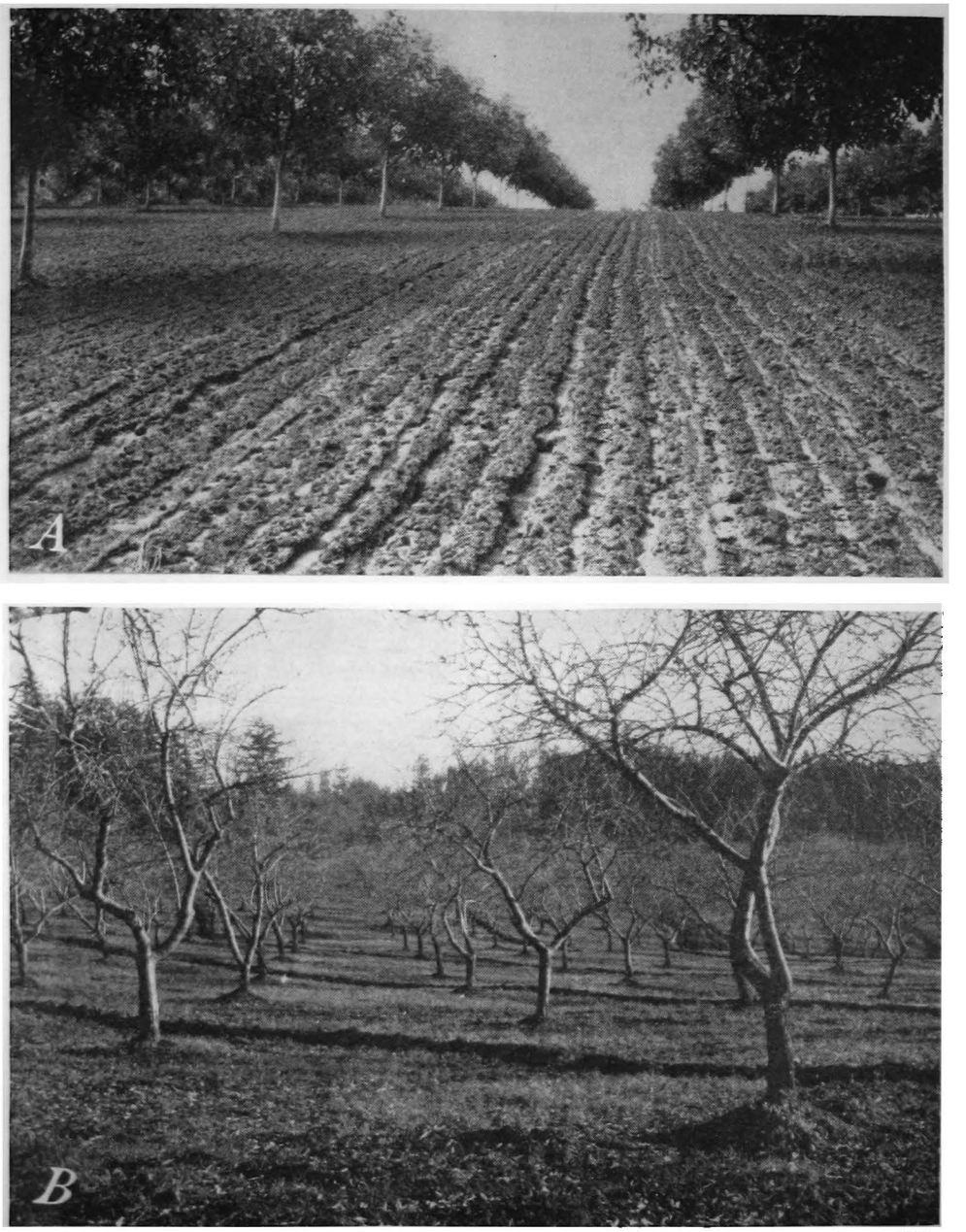

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Figure 5.—A, Sheet erosion is greatly accelerated by tillage operations running up and down the slope. This orchard on Aiken silty clay loam and on a slope of 8 percent was harrowed just previous to a heavy spring rain. *B*, Annual gradient furrows made with a 16-inch plow in a prune orchard to conserve moisture and remove excess surface run-off safely during heavy rains.

retain rainfall or to carry off the excess of heavy or intensive precipitation (frontispiece). Wherever such diversions are installed, suitable outlets must be provided to conduct the run-off to natural and stabilized drainageways. These outlets may be natural draws, heavily vegetated forest or pasture, or especially constructed waterways. A good plant cover must be provided and maintained in all waterways to resist the erosive action of large volumes of water. Where it is necessary to construct new outlets, mechanical retarders should be installed. These may consist of straw checks, rip-rap, plank or log checks, or other structures. Outlets should become well established before any large volume of water is permitted to flow into them.

New orchards should be planted on the contour and provision made for mechanical control structures before planting is undertaken. Dependence upon mechanical controls will not prove effective unless these are aided in every way possible by the maintenance of good ground cover throughout the erosion period from October to April. Such a ground cover, being disked under as a green manure, is shown in figure 6.

A proper combination of plant cover and mechanical structures is necessary on all class III land in order to permit of its continued safe cultivation. Where this is not provided, erosion will proceed on all the steeper slopes, eventually reducing their capability below a point where it is safe or satisfactory to maintain them in cultivated crops.

Land-capability class III includes 2,677 acres of pasture. Some of it is in good condition both for pasturage and for adequate cover to prevent soil erosion. It is possible to improve greatly the condition of most pasture by reseeding, the control of grazing, and the removal of brush and debris. Where a fair stand of grasses exists, fertilization will frequently improve the stand. Keeping stock off pastures until the grasses have made a good spring growth and taking them off early enough to permit the grasses to

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Figure 6.—**A stand of rye and vetch cover crop sufficient to control erosion in orchards on gentle slopes. Disking in the cover provides about 10 tons green weight per acre. The second disking will be across the slope.**

make a fall growth are two important steps in pasture improvement. Liming and fertilization may be required on some areas.

Of the 5,543 acres of woodland that fall into class III land, 195 acres are on the well-drained valley soils and the remainder is on the upland soils. A part of this woodland is in scattered tracts on individual farms, occupying rather poorly drained areas or land not otherwise convenient for cultivation. Other larger tracts are on BB and C slopes. These areas should usually be retained as an essential part of the farm economy, and the timber and wood products should be considered as important and necessary as any other farm product. In a region in which large areas of forest land still persist, farm woodland may not seem of immediate importance, but even under these conditions a supply of woodland products, easily accessible and under the control of the individual farmer, is desirable. Both the economic value of timber properly cared for and judiciously harvested and the protective influence of woodland cover on the steeper slopes must be given consideration.

The difficulty of bringing even level, stone-free areas of woodland under cultivation is so great and the cost so high that the conversion of such land into tilled areas is not to be recommended on any large scale. It is estimated that it costs $100 an acre to clear land covered with large, solid fir stumps. Small areas of land are being cleared by individual owners during the winter season when other work is not pressing. Such clearing should be confined to class II land as far as possible and no large tracts of class III land should be cleared.

The harvesting of timber should be selective. Fully mature trees should be harvested for timber requirements first, and dead or defective trees and undesirable species should be cut to improve the character of the stand. Clean cutting should be avoided, and all slash should be distributed to provide ground cover against erosion and to lessen fire hazards. If any part of an area is clean-cut, every effort should be made to establish at once a close-growing cover of grass. Clean-cutting should take place only on moderate slopes where freedom from run-off from higher lying areas is assured and where very little erosion has already occurred.

All land on which erosion has become very severe is grouped in class IV. Also, except for a small area of well-drained upland soils, all land on slopes in excess of 20 percent even if only slightly eroded fall into this class. Alluvial soils on which moderate or greater than moderate erosion has occurred add small areas to this class. Land of class IV covers an area of 3,530 acres, or 7.8 percent of the project. All but 107 acres are on the upland soils; 1,590 acres are on cropland; 693 acres on pasture; and 1,247 acres on woodland. It is not good practice to crop this land. Where cropping must be done to meet the needs of individual farms, annual crops should not be grown more frequently than 2 years in 7, and grass seedings should be made in the fall on the stubble of spring grain. Crop residues should be utilized by plowing under or as a mulch. Lime and fertilizer should be used in connection with the seedings to grasses and clover. A dense, winter-cover crop should be established as early as possible on row-crop land; contour cultivation should be practiced, and diversion ditches used to care for surplus water from any source.

Areas now in orchard should be protected by a perennial grass cover and new orchards should not be planted on land of this class. A permanent straw mulch is needed on areas not protected by grass. Diversion ditches may be needed in the orchards or to protect them from water running down from higher lying fields.

As much as possible of land in class IV now under cultivation should be converted into pasture or into woodland to protect both this land and other land of wider adaptation lying below it. Thin pastures should be reseeded and fertilized. All pastures should be protected from fire, the brush suppressed, and grazing controlled to fit the season and the rate of growth of the grass.

Furrows or ditches may be needed to protect some areas from excessive run-off or to aid in retaining water during the dry season.

None of the woodland in this land-capability class should be converted to cropland. On existing woodland, cutting should be restricted to the removal of mature trees and undesirable species. A systematic program of cutting to sustain yield should be adopted and logging should be performed in a manner to preserve ground cover. Slash should be scattered so as to reduce fire hazards to a minimum and to protect cut-over areas from excessive run-off. The woodlands should be protected from fire and grazing.

There are 9,988 acres of land in the Chehalem Mountain area that fall into class V. This is 22.1 percent of the area. All class V land in this project is on the uplands. It includes all B and BB slopes on which erosion has been very severe and the poorly drained BB slopes that have lost more than half the topsoil and are gullied, C slopes that have lost more than half of the topsoil and those that have lost one-fourth of the topsoil and are imperfectly or poorly drained or are gullied, and all slopes in excess of 30 percent. Present cropland to the extent of 1,600 acres is in this class, owing to the cultivation of intertilled crops on slopes too steep to be tilled safely. This land should be retired to pasture or woodland to prevent further damage. Pasture to the extent of 329 acres has reached this stage because of improper grazing methods resulting in insufficient cover on steeper slopes. Woodland, as now distributed, includes 8,059 acres of this class of land on the steeper slopes.

All cultivated land in this class, whether in row, grain, or orchard crops, should be retired from cultivation as soon as possible. This should take the form of reforestation on all the steeper slopes and most severely eroded areas. Where pasture is needed on the individual farm, a good sod cover should be established consisting of a grass and legume mixture. Weeds should be kept under control and the sod cover should be maintained by liming and fertilization and reseeding without plowing so far as is possible. The group includes soils and slopes too susceptible to erosion to constitute safe orchard lands.

The seedings to permanent cover in this area usually consist of a perennial grass or a grass and legume mixture to aid in maintaining the nitrogen content of the soil. The seedings may be made either in spring or fall. The best results are usually obtained by fall seeding. On severely eroded lands a fertilizer containing both nitrogen and phosphorus should be applied and a mulch may be required while the seeding is becoming established. Care of the pastures after they have been established includes careful control to prevent overgrazing and to keep cattle off the pasture when trampling might pack the soil and thus increase the tendency toward run-off. It should also include cutting of brush and control of weeds. Fire should, of course, be prevented.

There are 8,059 acres of land of class V now in woodland. None of this land should be cleared for cultivation. Instead it should be protected from fire and from grazing to permit renewal of thin stands by natural reseeding. Established stands of desirable timber trees should be maintained by restricting the cutting to mature trees, removal of defective trees and those of undesirable species, and to such logging operations as will enable the young growth to replace that which is cut. Slash should be scattered in order to protect areas susceptible to erosion and to reduce fire hazards.

Results and Significance of the Land Inventory

The acreage in each class of land according to use capability in the different soil groups is shown in table 2. The table also shows the relationship of the different present land use classes to the land-capability classes of the area. Present use and capability of the land is shown graphically in figure 3, page 5.

The figures in table 2 present the actual land use at the time the survey

was made. A small area, 379 acres, is used for homestead and urban occupation, schoolyards, cemeteries, and other nonagricultural purposes and is not included in the table.

Cropland

Of the present cropland, which comprises 52.7 percent of the area, 1,590 acres, or 6.6 percent of all cropland, is rated as class IV land, which should be cropped only at infrequent intervals and then only in order to reestablish a good, protective, grass cover. This land presents a problem both for the area as a whole and for the individual farmer on whose land such areas occur. An additional 1,600 acres is in class V. This land needs to be retired from cultivation for its own protection and frequently for the protection of lower lying land from run-off. The best use for such land is permanent woodland. It should be artificially replanted to desirable species or it should be allowed to replant itself from seed trees of desirable species. It is not cropland; it is not even land that can be readily established as permanent pasture. All but 22 acres of the cropland in classes IV and V are on the upland soils.

TABLE 2.—*Use capability of land by soil groups*

ENTIRE PROJECT[1]

Soil group	Land-capability class										Total
	I (Green)[2]		II (Yellow)[2]		III (Red)[2]		IV (Blue)[2]		V (Orange)[2]		
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*
1. Soils developed on uplands:											
a. Well-drained	2	(3)	3,750	17.2	10,670	48.9	1,156	5.3	6,243	28.6	21,821
b. Imperfectly drained	0	-------	2,916	33.9	3,601	41.8	1,157	13.4	938	10.9	8,612
c. Imperfectly or poorly drained	0	-------	156	2.9	1,299	24.2	1,110	20.7	2,807	52.2	5,372
Total, group 1	2	(3)	6,822	19.0	15,570	43.5	3,423	9.6	9,988	27.9	35,805
2. Soils developed on valley-filling material:											
a. Well-drained	2,670	57.0	1,465	31.3	537	11.5	12	0.2	0	-------	4,684
b. Imperfectly or poorly drained	0	-------	1,602	97.4	0	-------	42	2.6	0	-------	1,644
Total, group 2	2,670	42.2	3,067	48.5	537	8.5	54	0.8	0	-------	6,328
3. Soils developed on flood plains:											
a. Well-drained	282	71.4	113	28.6	0	-------	0	-------	0	-------	395
b. Imperfectly or poorly drained	0	-------	2,572	98.0	0	-------	53	2.0	0	-------	2,625
Total, group 3	282	93	2,685	88.9	0	-------	53	1.8	0	-------	3,020
Entire project[1]	2,954	6.5	12,574	27.9	16,107	35.7	3,530	7.8	9,988	22.1	[1] 45,153
CROPLAND											
1. Soils developed on uplands:											
a. Well-drained	2	(3)	3,241	34.3	4,756	50.4	1,016	10.8	423	4.5	9,438
b. Imperfectly drained	0	-------	2,195	46.2	2,200	46.3	230	4.8	127	2.7	4,752
c. Imperfectly or poorly drained	0	-------	90	3.9	853	36.8	322	13.9	1,050	45.4	2,315
Total, group 1	2	(3)	5,526	33.5	7,809	47.3	1,568	9.5	1,600	9.7	16,505
2. Soils developed on valley-filling material:											
a. Well-drained	2,575	67.9	1,132	29.8	78	2.1	9	0.2	0	-------	3,794
b. Imperfectly or poorly drained	0	-------	1,384	99.8	0	-------	3	0.2	0	-------	1,387
Total, group 2	2,575	49.7	2,516	48.6	78	1.5	12	0.2	0	-------	5,181
3. Soils developed on flood plains:											
a. Well-drained	113	54.3	95	45.7	0	-------	0	-------	0	-------	208
b. Imperfectly or poorly drained	0	-------	2,092	99.5	0	-------	10	0.5	0	-------	2,102
Total, group 3	113	4.9	2,187	94.7	0	-------	10	0.4	0	-------	2,310
All cropland	2,690	11.2	10,229	42.6	7,887	32.9	1,590	6.6	1,600	6.7	23,996

[1] Farmyards and urban areas not included.
[2] Color distinguishing class area on the maps that accompany this bulletin.
[3] Less than 0.1 percent.

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TABLE 2.—*Use capability of land by soil groups*—Continued

PASTURE

Soil group	Land-capability class										Total
	I (Green)[1]		II (Yellow)[1]		III (Red)[1]		IV (Blue)[1]		V (Orange)[1]		
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*
1. Soils developed on uplands:											
a. Well-drained	0		248	10.2	1,890	77.8	109	4.5	181	7.5	2,428
b. Imperfectly drained	0		198	21.7	323	35.3	354	38.7	39	4.3	914
c. Imperfectly or poorly drained	0		35	6.6	200	37.7	187	35.2	109	20.5	531
Total, group 1	0		481	12.4	2,413	62.3	650	16.8	329	8.5	3,873
2. Soils developed on valley-filling material:											
a. Well-drained	43	11.2	77	20.1	264	68.7	0		0		384
b. Imperfectly or poorly drained	0		80	100.0	0		0		0		80
Total, group 2	43	9.3	157	33.8	264	56.9	0		0		464
3. Soils developed on flood plains:											
a. Well-drained	118	93.7	8	6.3	0		0		0		126
b. Imperfectly or poorly drained	0		304	87.6	0		43	12.4	0		347
Total, group 3	118	24.9	312	66.0	0		43	9.1	0		473
All pasture	161	3.3	950	19.8	2,677	55.7	693	14.4	329	6.8	4,810

WOODLAND

1. Soils developed on uplands:											
a. Well-drained	0		261	2.6	4,024	40.5	31	0.3	5,639	56.6	9,955
b. Imperfectly drained	0		523	17.8	1,078	36.6	573	19.4	772	26.2	2,946
c. Imperfectly or poorly drained	0		31	1.2	246	9.7	601	23.8	1,648	65.3	2,526
Total, group 1	0		815	5.3	5,348	34.7	1,205	7.8	8,059	52.2	15,427
2. Soils developed on valley-filling material:											
a. Well-drained	52	10.3	256	50.6	195	38.5	3	0.6	0		506
b. Imperfectly or poorly drained	0		138	78.0	0		39	22.0	0		177
Total, group 2	52	7.6	394	57.7	195	28.6	42	6.1	0		683
3. Soils developed on flood plains:											
a. Well-drained	51	83.6	10	16.4	0		0		0		61
b. Imperfectly or poorly drained	0		176	100.0	0		0		0		176
Total, group 3	51	21.5	186	78.5	0		0		0		237
All woodland	103	.6	1,395	8.6	5,543	33.9	1,247	7.6	8,059	49.3	16,347

[1] Color distinguishing class area on the maps that accompany this bulletin.

Cropland in class III, amounting to 7,887 acres, requires special precautions to permit of its safe permanent use. All but 78 acres of this land lies on the upland soils. It constitutes the most urgent problem in soil and water conservation within the area, but it is also land that may be continued in cultivation if proper protective measures are employed. These have been outlined in the discussion of land-capability classes (pp. 9–13).

Classes I and II include 12,919 acres of cropland. Continued safe cultivation of this land to suitable crops may be carried on with only simple measures for erosion control and water conservation, as has been indicated on pages 8–9.

PASTURE

There are 329 acres of pasture that fall into class V and should be reforested, and 693 acres in class IV, which require

care to maintain a complete sod cover. There is a possibility that some of the 2,677 acres in class III favorably located with regard to land now under cultivation might be brought under cultivation, provided proper precautions were taken to protect it from soil losses. The problem is one for the individual farmer who needs to balance his requirements for pasture against the needs for additional cropland. This class III land is chiefly on the well-drained soils of the upland and on the soils developed on valley-filling materials. The combined area of classes I and II now in pasture amounts to 1,111 acres. Since this land is capable of continued use for cropping with little danger of losses through soil erosion, provided simple means of protection are employed, it constitutes a reserve of land that may be brought into cultivation as may be required by the individual farmer.

Woodland

The situation with respect to land now in woodland is entirely different. Only 103 acres of woodland are in class I. In all probability this is their best use since they are on the well-drained soils on valley-filling material and on the flood plains. Otherwise the present owners would be making a different use of the land. An additional area of 1,395 acres of woodland falls into class II. It has already been pointed out that the cost of stumping off any woodland area after the timber has been cleared is estimated at $100 an acre. It is doubtful whether such a cost is justified except to turn small tracts into valuable orchard lands. This area of class II woodland should remain as a reserve that may be utilized for crops only when the cost of clearing it and the prospective value of crop yields justify its transformation into cropland. The value of the wood and lumber as a farm crop should be given full consideration.

The details of land use adjustment on the individual farm can usually be worked out by the farmer with the aid of the conservation-survey map. The different forms of soil- and water-conservation measures have been demonstrated on land of the different use-capability classes. There are examples of each form of treatment and of the various combinations of treatment required to meet different situations. Technical assistance for laying out strip cropping or structures is needed, but the farmer can apply many of the simpler practices himself.

Description of the Area

Physical Features

The Chehalem Mountain project in Oregon covers an area of 45,532 acres, or about 71.2 square miles, in the northeastern part of Yamhill County and the southeastern part of Washington County. It lies in townships 2 and 3, south, and ranges 2 and 3, west of the Willamette meridian (fig. 1, p. 1). Portland, Oreg., is about 30 miles to the northeast and Newberg is on the southern boundary. The project area includes the Chehalem Creek drainage and the headwaters of the Springbrook Creek drainage to the north and west of U. S. Highway No. 99–W and also the headwaters of several creeks draining into the Tualatin River from the north side of Chehalem Mountain. It also takes in the headwaters of Hess Creek, draining south from the Dundee Hills. It is approximately 12 miles from east to west and 9 miles from north to south.

Chehalem Mountain, forming the divide between the drainage of the Tualatin River and Chehalem Creek, has a central ridge rising to elevations of 1,350 feet and a maximum altitude of 1,400 feet within the project. The slope to the Tualatin Valley is long and gentle but is cut by deep, steep-walled canyons formed by the creeks draining toward the north. These are separated by moderately sloping ridges having a width up to one-half mile. The orchards and croplands of this part of the area are located on these ridges. The southward slope to the Chehalem Valley is very steep.

The Dundee Hills, forming the south boundary of the Chehalem Creek Valley, consist of a group of round-topped hills and ridges without a definite pattern, sloping down to the valley-filling materials that form the floors of the

larger valleys. The Hills rise to an altitude of about 1,000 feet. The valley-filling material reaches elevations of about 300 feet and forms a nearly level border around the slopes of the hill and mountain areas. The larger streams have cut through this material and formed alluvial flood plains. Chehalem Creek has an elevation just less than 100 feet above sea level at Newberg.

The project includes the lava-capped hills and ridges at the higher elevations, the long slopes developed on the sandstones and shales of the foothills, the nearly level benches of valley-filling material in the larger valleys, and the more recent alluvial deposits in the present stream bottoms.

The nature of the soils, the characteristic slopes, the nature of the drainage across and within the various soils, and the present uses of the land are all related to these features of relief. Soil erosion and the capability of the land for continued successful use are similarly related under the existing climatic and economic conditions of the section.

The project is well served by excellent Federal and State highways. U. S. Highway No. 99–W forms the southeastern boundary of the project and State Highways No. 219 and No. 240 cross it. There is a good network of secondary roads, which have been gravelled to meet the necessities imposed by the long rainy season. Truck and bus lines connect Newberg with all nearby towns, and freight service to more distant points is supplied by a line of the Southern Pacific.

Agricultural products are processed and packed at a number of plants in and near the project. These include walnut and filbert drying, processing, and cracking plants; prune and berry driers; fruit and vegetable canneries; milk condenseries; and flour and feed mills. A wood-pulp mill is located at Newberg, and several small sawmills operate on a part-time basis within the area. There are no large industries not connected with agriculture.

Climate

The climate of the Willamette Valley is mild and humid. The average annual precipitation at Newberg is estimated at 43 inches, records at McMinnville showing an average of 43 inches and at Portland, 42 inches. The mean annual temperature recorded at McMinnville, 14 miles southwest of Newberg, is 52° F. and the mean maximum and mean minimum are 63.5° and 40.7°, respectively. The mean maximum for August is 83.5° F. and the mean minimum for January is 32.7°. The highest temperature recorded is 110° and the lowest is −24°. The average annual snowfall at McMinnville is 11.4 inches. Snowfall usually occurs in one or two storms of rather short duration. The average frost-free period is 164 days with the average date of last killing frost in spring coming on April 26 and that of the first killing frost in the fall, on October 7.

The prevailing winds are from the north and northwest in summer and from the south and southwest in winter. Winds seldom reach destructive velocity in this section.

Precipitation and evaporation fall into two very definite seasonal groups having a decided influence on agriculture, on soil and water conservation, and on industry. The winter months of November, December, and January have heavy precipitation and little sunshine. This season may begin at any time after the middle of October and sometimes lasts until March. During this period a monthly rainfall of 8 to 15 inches is common. The intensity is not extremely high, reaching a maximum of 3.53 inches for 24 hours, 0.63 inch for 1 hour, and 0.32 inch in 10 minutes, in a 10-year period.

In contrast, a dry period occurs beginning some time in June and lasting until the latter part of August or into September. During this season there are periods of 30 days or more with no measurable precipitation. The humidity is low, dropping at times to less than 10 percent. This, combined with temperatures above 80° F., gives rise to extremely drying conditions, requiring an agricultural program planned to bring crops either past the critical growth period before this time or to handle the crop and the soil so as to

conserve soil moisture for this period. During this dry period the soil moisture usually drops to the wilting point for plants on all land not under clean cultivation.

As a result of these climatic conditions, cereal grains are planted in this section in both fall and spring. Vetches, cereal grains, Austrian Winter peas, and perennial grasses are most successful when planted in the fall. Fall-planted crops usually begin growing again during February.

The normal monthly, seasonal, and annual temperatures and precipitations at the McMinnville station are given in table 3, which has been compiled from records of the United States Weather Bureau.

Agriculture

The agricultural occupation of this part of Oregon began before 1840, when cattle were driven in and pastured on the prairie grasses of the Willamette Valley. Land was taken up for farming purposes on the bench lands and grazing was pushed back gradually into the hills as the growing of wheat and other cereals on the valley lands increased in importance. Spring wheat dominated the cropping system for more than 20 years. Later, decreased yields and the invasion of the fields by wild oats necessitated summer fallowing. Clover was introduced and gave rise to rotation farming at a slightly later date. The diversification of the farming enterprises began about 1900 when fruit trees, mainly prunes, were planted and dairying became important. Land use has been gradually changed from wheat growing to diversified cropping. Cereal crops are still produced for marketing. Dairying has become well established. Fruit, nut, and berry production is now important. Vegetable farming has been developed and grass, vetch, and clover seeds are produced on some farms. General farming, which combines two or more of these lines, is most widespread in the project. The hill-lands have been utilized ex-

TABLE 3.—*Normal and extreme monthly, seasonal, and annual temperature and precipitation at McMinnville, Yamhill County, Oreg.*[1]

[Elevation, 145 feet]

Month	Temperature			Precipitation			
	Mean [2]	Absolute maximum [3]	Absolute minimum [3]	Mean [4]	Total for the driest year (1918) [4]	Total for the wettest year (1896) [4]	Average snowfall [3]
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	40.4	72	−24	7.11	4.76	11.13	2.2
January	38.9	69	−15	7.17	6.04	9.32	6.0
February	42.1	69	−2	5.27	7.44	4.68	2.1
Winter	40.4	72	−24	19.55	18.24	25.13	10.3
March	46.2	87	19	4.30	3.66	3.25	.7
April	50.6	99	25	2.78	1.20	4.55	.1
May	55.6	100	28	1.86	.85	5.46	.0
Spring	50.8	100	19	8.94	5.71	13.26	.8
June	60.6	110	33	1.30	(5)	.80	.0
July	66.1	110	34	.39	.25	.00	.0
August	66.3	108	34	.51	.26	1.57	.0
Summer	64.3	110	33	2.20	.51	2.37	.0
September	60.6	106	25	1.95	.09	.78	.0
October	53.6	90	29	3.00	2.83	2.91	.0
November	45.5	80	14	7.43	4.11	20.47	.3
Autumn	53.2	106	14	12.38	7.02	24.16	.3
Year	52.2	110	−24	43.07	31.48	64.92	11.4

[1] U. S. Weather Bureau reports.
[2] 42-year record through 1930. [3] 41-year record through 1930. [4] 43-year record through 1930. [5] Trace.

tensively for the production of fruit, berries, and nuts. Prunes and walnuts are the most common orchard crops. Wheat, oats, potatoes, and clover are the important field crops.

There are about 450 farms within the project falling into two overlapping types. On about 45 percent of the farms the chief enterprise is producing fruits, nuts, and berries. These farms have an average size of 64 acres, of which 35 are in fruit and berries, 8 are in other crops, and 21 are not cultivated. The average diversified farm, supporting livestock and producing grain, hay, orchards, and berries, has 151 acres, of which 16 are in orchards and berries, 51 are other cropland, and 84 are in woodland and uncultivated pasture. Farms range in size from less than 10 acres on subsistence farms to 500 acres or more on diversified stock, grain, and fruit farms. Labor on the farms is supplied almost entirely by the operator and his family except during harvest time. Some fairly permanent labor is hired on the larger farms on a monthly basis. Nearly all the labor is secured from neighboring farms or from adjoining towns. Very little transient labor is employed.

According to the census of 1930, 80 percent of the farms are operated by the owners and half of the others are under long-term lease. About 10 percent are leased from year to year.

Horses are used on the majority of the farms for light tillage and hauling operations. Tractors of various sizes are in common use. There is some deficiency in tillage equipment to meet the needs of good farming practice and to utilize the power available to full advantage.

A large part of the grain grown on the farms is now used for feeding livestock. On the average diversified crop and livestock farms there are 10 cows, 20 to 30 sheep, and some chickens and hogs, the latter kept chiefly for family consumption.

The uncultivated land on the project is nearly all grazed. Approximately one-half of this land supports a fair to heavy cover of Douglas fir, oak, cedar, and browse. This land is used for the production of wood for fuel and saw timber and for grazing in the open spaces.

The cropland in the project is undergoing a progressive change from the more extensive grain and hay farming to the more intensive grass-seed, legume-seed, and a grain-legume-rotation type of farming. The amount of land in orchard is not increasing at the present time, but there is some removal of prunes and new planting of walnuts and filberts.

The use of soil amendments to neutralize acidity and to increase crop production is becoming necessary. It is almost always necessary to apply from 1 to 3 tons of limestone per acre in order to establish a satisfactory stand of alfalfa and this is also of great benefit to red clover and alsike clover. It is generally recognized that soils are becoming deficient in organic matter. This can only be remedied by turning under manure and straw, where available, and by growing green-manure crops periodically. The use of mineral fertilizers has not been considered necessary on grain crops, but the difficulties being experienced in securing satisfactory stands of green-manure crops and clover and the declining yields of other crops show that fertility is decreasing. The use of nitrogenous and phosphatic fertilizers has been profitable in many places.

The Conservation Survey

Methods and Definitions

IN MAKING the conservation survey of the Chehalem Mountain soil conservation project, aerial photographs were used. The different soil types, the prevailing slopes, and the kind and degree of existing erosion were mapped in their relationships to the present use of the land. Copies of the field survey on a scale of 1,320 feet to the inch, or 4 inches to the mile, are published with this bulletin. They are available for use in working out cropping plans and for applying the protective measures needed to prevent erosion and to aid in the retention of water in the soil for the

production of crops. They are of use to the individual farmer in determining the needs of his farm and in selecting the proper measures that he needs to adopt to give him the best possible protection against soil and water losses. The suggested treatments for each tract of land are in accordance with the different classes of land according to use capability as developed from the survey. These treatments serve as a guide for the immediate betterment of soil conditions and as a basis for determining a long-term plan for land use and improvement. As conditions on the individual farm and in the project are improved, modifications of the treatments may become desirable.

The capability of the land for safe, continued use under different forms of utilization is shown on the maps in colors, according to the land-capability classes defined on page 2. The type of soil, the dominant slopes, and the kind and degree of erosion are shown by brown boundary lines and symbols. The present land use is shown by gray symbols. The maps also show the roads, houses, railroads, streams, and other important and easily recognized features, such as churches, schools, and cemeteries.

Four present land use classes were mapped. Cropland includes all land on which crops were being grown at the time the survey was made and all land showing evidence that a crop had been grown during the preceding year and, also, that on which preparation for a crop was in progress. This includes all orchard land, all land in hay, and all tilled land. Pasture includes all land used primarily and with some degree of permanence for grazing purposes. Areas on which 40 percent or more of the surface was covered by the shade of trees was mapped as woodland. Land occupied by farmsteads, urban areas, and other community uses was mapped separately.

The soil types were mapped according to the standards of the Division of Soil Survey of the Bureau of Plant Industry and correspond very closely with the soil classification and mapping of the Soil Survey of Yamhill County, Oreg.,[1] and of the Soil Survey of Washington County, Oreg.,[2] which surveys were made on the scale of 1 inch equals 1 mile. The larger scale of the present maps permits of showing smaller areas than appear on those maps and recent work has made possible some changes in soil correlation.

Nineteen different soil types were mapped. These are described and discussed on pages 22–30.

Slope classes have been outlined on page 3. In the Chehalem Mountain project, A slopes are those with a slope of less than 5 percent, or 5 feet in 100; B slopes, 5 to 12 percent; BB slopes, 12 to 20; C slopes, 20 to 30; and D slopes, 30 percent and over.

Running water is the only agent that has given rise to apparent erosion in the area. There is no appreciable wind erosion. Water erosion that removes a small amount of soil more or less uniformly from the surface of a field is known as sheet erosion. Small rills may be formed. When rills become too deep to be plowed or cultivated out in ordinary farm operations, they are classed as gullies.

The degree of sheet erosion was determined by examining the present topsoil (plow depth or A horizon, whichever is deeper) and subsoil, and estimating the depth to which the original soil profile had been changed by erosion. Comparison of existing soils with those of undisturbed areas on similar slopes was valuable in making this estimate.

Erosion was designated by the following symbols:

Sheet erosion:

1. Less than 25 percent of topsoil removed.
2. 25 to 50 percent of topsoil removed.
3. 50 to 75 percent of topsoil removed.
4. Over 75 percent or all of topsoil removed, or all topsoil and some subsoil removed.

Gully erosion:

7. Occasional gullies: More than 100 feet apart.

[1] KOCHER, A. E., CARPENTER, E. J., RUZEK, C. V., and COOTER, J. E. SOIL SURVEY OF YAMHILL COUNTY, OREGON. U. S. Dept. Agr., Field Oper., Bur. Soils, 66 pp., illus. 1917.

[2] WATSON, E. B., ECKMANN, E. C., FLUHARTY, A. L., and RUZEK, C. V. SOIL SURVEY OF WASHINGTON COUNTY, OREGON. U. S. Dept. Agr., Field Oper., Bur. Soils, 51 pp., illus. 1923.

Gully erosion—Continued.

8. Frequent gullies: Occurring less than 100 feet apart but including less than 75 percent of the area delineated.
9. Very frequent or large gullies: Including 75 percent or more of the area delineated.

○. Indicates gullies too deep to be crossed with tillage implements, as ⑧.

Miscellaneous:

+. Recent alluvial or colluvial deposits.
0. No apparent erosion.
Θ. Undifferentiated erosion (farmyards, urban areas).

Sheet-erosion symbols, miscellaneous symbols, gully symbol 9 alone, or combinations of sheet-erosion symbols with gully symbols 7 and 8 were used to designate the different erosion classes. Thirteen different classes of erosion were mapped. These are grouped to indicate the severity of erosion in table 5, page 31.

Soils

The soil series mapped in the Chehalem Mountain project are representative of soils occurring in the Willamette Valley.[3] The acreage and percentage of the nineteen soil types mapped are shown in table 4.

The soils of the region were developed under the influence of a relatively high rainfall, coming chiefly during the winter and spring months, a relatively warm winter, and a moderately hot and dry summer season. The soils on the uplands were timbered, whereas those on the valley-filling material were partly grassland and partly timbered. There are no true prairie soils, all soil types are more closely related to the soils of the timbered regions of Ohio, Indiana, and southern Wisconsin than to soils developed under grass cover.

The soils of the project fall into three main groups (table 4). The most extensive, group 1, includes the upland soils formed on the consolidated rocks of the hills and slopes; on the basalts of the higher elevations and on the lower lying shales and sandstones of the foothills. They occupy 35,809 acres, or 78.6 percent of the project. They differ among themselves in elevation above the main stream drainages, which affects run-off; in relief, which is expressed by the slope classification; in depth to the underlying, consolidated materials on which they have been formed; in both surface and internal drainage conditions; in the nature of the parent materials; and, as a consequence of these differences, in their liability to erosion and their capabilities for continued satisfactory land use.

The soils of group 2 have been formed on much more recent materials, derived from different upland sources and lying nearly level at a moderate elevation above the modern stream drainages. This soil group has been designated as soils developed on valley-filling material. It is divided into two subgroups, chiefly according to characteristics of internal drainage.

Similarly, the soils of the present flood plains, group 3, differ as to drainage characteristics and are divided into two subgroups.

The Aiken clay loam is the "red hill" soil of the Willamette Valley. It covers the greater part of the Dundee Hills and large areas on the south side of Chehalem Mountain. It was mapped on a total area of 4,725 acres, or 10.4 percent of the project. The topsoil is a reddish-brown clay loam to a depth from 5 to 18 inches. It has a relatively high organic-matter content. It is granular and friable in structure, containing many granular concretions and fragments of basalt, which renders it easy to cultivate and gives it a very high capacity for the infiltration of water. The subsoil is a moderately compact, red, silty clay loam to clay, with nut structure and good internal drainage. This grades down through a compact, red clay into the weathered basalt on which the soil type has developed. On some areas cultivation while wet has destroyed the granular structure and developed a "plow sole," which adds to the erodibility of the soil. This is especially prominent on orchard lands on which the ground is clean cultivated

[3] Soils of the Willamette Valley are discussed more fully in the following Soil Surveys in Oregon, published by the U. S. Dept. of Agriculture: Yamhill County, 1917; Multnomah County, 1919; Washington County, 1919; Benton County, 1920; Clackamas County, 1921; Polk County, 1922; Linn County, 1924; Marion County, 1927; and Columbia County, 1929. See also POWERS, W. L., JONES, J. S., and RUZEK, C. V. COMPOSITION, RATING, AND CONSERVATION OF WILLAMETTE VALLEY SOILS. Oreg. Agr. Expt. Sta. Bul. 365, 38 pp., illus. 1939.

and no cover crop or other organic manure is added to the soil. Slopes range from 10 percent or less to 50 percent or more. The steeper slopes are used for timber production, the orchards commonly being confined to slopes of less than 25 percent. The total depth of surface soil and subsoil to underlying rock is extremely variable. Except where "plow sole" is present, this soil type is naturally resistant to erosion.

The Olympic clay loam is the most extensive soil type mapped in the area, covering 17,096 acres, or 37.5 percent of the project. It occurs on all of the higher portions of the Chehalem Mountain and extensively on the north slopes of the Dundee Hills. The topsoil, to a depth of 7 to 10 inches, is a dark-brown, mealy clay loam. This is underlain by a brown to reddish-brown clay loam. Both contain large amounts of concretions and rock fragments, "shot," and are friable and fairly retentive of moisture. There is good internal drainage. The depth to underlying rock ranges from 3 to 5 feet or more. This soil type is not excessively eroded owing to its relatively high organic-matter content; its granular, open structure; and the absence of a heavy, impervious subsoil. It is an excellent orchard soil and is also valued for the production of berries, potatoes, and grain crops in rotation. The relief of the Olympic clay loam is typical, consisting of long, gently sloping ridges separated by deep, steep-walled canyons. The survey showed that nearly 40 percent of the soil is now under cultivation and that considerably more of its area is suitable for cultivation if cleared.

The Cascade silt loam, having an area of 4,503 acres, or 9.9 percent of the project, also has been formed on the basaltic rocks of the region but may include some materials derived from shales and sandstones such as give rise to the Melbourne series. The topsoil to a depth of 6 inches or more is a dark-brown silt loam, friable and crumbly. The subsoil is a yellowish-brown to yellow clay loam, increasingly yellow with depth and sometimes mottled. The soil section is deep and bedrock is rarely exposed. It occurs on the north and east side of Chehalem Mountain, occupying the foothills below soils of the Olympic series. Surface drainage is well developed, but the internal drainage of the subsoil is not as complete as that of the Aiken and Olympic soils. The relief consists chiefly of long, gentle slopes, ranging from 5 to 15 percent. The soil type is dominantly used for grain and hay production. About half of the area has been cleared, the remainder carrying the native cover of fir and underbrush. The soil is less resistant to erosion than the Aiken and Olympic soils. Additional areas could be cleared and brought under cultivation if proper precautions were used to prevent accelerated erosion.

Three soil types of the Carlton series were mapped. These soils have been formed on the shales and sandstones of the lower lying hills and ridges in the western part of the project and on the foothills below the basaltic ridges.

The Carlton clay was mapped on only 107 acres. The surface soil is a dark-gray clay, 8 inches deep. The subsoil is a mottled yellow and gray heavy clay, resting on shale and sandstone at a depth of about 2 feet. It occurs along the bases of slopes occupied by Melbourne and other Carlton soils. It is poorly drained, difficult to till, and unimportant agriculturally. The greater part is in oak and annual grasses.

The Carlton clay loam was mapped on 1,524 acres. The surface soil to a depth ranging from 3 to 10 inches is a grayish-brown clay loam. The subsoil is grayish-brown, compact, clay loam with poor internal drainage. This soil lies on the lower foothills and around the heads of streams, below the Melbourne soils. It is of scattered occurrence and is unimportant agriculturally. Cultivated areas are used for growing filberts, grain, and hay; uncultivated areas are in oak, brush, and pasture. Clearing additional areas cannot be recommended except as needed for pasturage.

TABLE 4.—*Characteristics of soil series and acreage of each soil type*

Soil group and series	Types mapped	Area		Soil profile		Parent material
				Surface soil	Subsoil	
		Acres	*Percent*			
1. Soils developed on uplands:						
a. Well-drained:						
Aiken	Clay loam	4,725	10.4	Reddish-brown clay loam 5 to 18 inches deep. High organic-matter content, granular "shot."	Red silty clay loam or clay, moderately compact.	Basalt
Olympic	Clay loam	17,096	37.5	Dark-brown mealy clay loam 7 to 10 inches deep. Much "shot."	Brown to reddish-brown clay loam; much "shot." Deep.	do
Total		21,821	47.9			
b. Imperfectly drained:						
Carlton	Clay	107	.2	Dark-gray clay 8 inches deep.	Mottled yellow and gray heavy clay.	Shale or sandstone.
	Clay loam	1,524	3.3	Grayish-brown clay loam 3 to 10 inches deep.	Grayish-brown compact clay loam; rock at about 30 inches.	do
	Silty clay loam.	2,482	5.5	Brown silty clay loam to 6 inches. Dark-gray clay loam to 18 inches.	Yellow-gray clay loam, some mottling with red.	Shales
Cascade	Silt loam	4,503	9.9	Dark-brown silt loam, friable, 6 inches or more deep.	Yellow-brown to yellow clay loam. Deep to rock.	Basalt
Total		8,616	18.9			
c. Imperfectly or poorly drained:						
Melbourne	Loam	3,865	8.5	Dark-brown loam 4 inches or more deep.	Yellow loam to 16 inches. Yellow sandy clay to 36 inches, resting on sandstone.	Sandstone.
	Silty clay loam.	1,455	3.2	Brown silty clay loam 4 to 14 inches deep.	Reddish-yellow clay, compact to 40 inches, resting on sandstone.	do
Sites	Clay loam	20	(1)	Brown clay loam 6 inches deep.	Red-brown heavy clay loam to 15 inches, over red clay.	Shale
Viola	Clay loam	32	.1	Dark-brown clay loam 6 to 14 inches deep.	Yellow or gray plastic clay to 32 inches.	Mixed
Total		5,372	11.8			
Total, group 1		35,809	78.6			
2. Soils developed on valley-filling material:						
a. Well-drained:						
Salem	Silty clay loam.	385	.8	Dark-brown silty clay loam, mealy, 6 to 12 inches deep.	Yellowish-brown silty clay loam, waterworn gravel below 24 inches.	Transported terrace material.
Willamette	Silt loam	4,447	9.8	Rich-brown silt loam, friable, 9 to 15 inches deep.	Light-brown to yellowish-brown friable clay loam.	do
Total		4,832	10.6			
b. Imperfectly drained:						
Amity	Silt loam	1,756	3.9	Grayish-brown silt loam 5 to 10 inches deep.	Light-brown silty clay loam, mottled, over clay loam.	do
Dayton	Silt loam	115	.2	Light-gray silt loam to 12 inches deep.	Mottled gray silty clay to 22 inches. Plastic blue-gray clay to 36 inches.	do
Total		1,871	4.1			
Total, group 2		6,703	14.7			

[1] Less than 0.1 percent.

mapped in Chehalem Mountain soil conservation project, Oreg.–3

Relief	Natural drainage		Native vegetation	Distribution in the project	Utilization	Dominant class of use capability	Remarks
	Surface	Internal					
Gentle or steep slopes on hills.	Good	Good	Fir, shrubs, fern.	Dundee Hills; Chehalem Mountain.	Orchards, grass and grain, timber	II, III, V	
Gently sloping ridges.	do	do	do	Higher portions of Chehalem Mountain; north slopes of Dundee Hills.	Orchard, berries, grass and grain.	II, III, V	
Gentle slopes.	Imperfect.	Imperfect.	Oak, grass.	Base of slopes below Melbourne and Carlton soil.	Trees and grass	IV, V	Very little cultivated.
Rolling to steep.	Good	Poor	Oak	Lower foothills, heads of streams below Melbourne soils.	Grain, hay, filberts, pasture.	II, III, IV	Relatively unimportant agriculturally.
Gently sloping to rolling.	do	Imperfect.	do	Lower slopes of hills. Low ridges.	Orchards, berries, grain, hay, corn.	II, III	Extensively cultivated. No serious erosion except on steep slopes.
Long slopes.	do	Fair	Fir	Lower mountain slopes and foothills.	Grain, hay	II, III	Considerable areas could be cleared for cultivation.
Gently to steeply sloping.	do	do	Fir, oak, ferns.	Lower hills and ridges.	Orchards, berries, grain, hay.	III, IV, V	One of the most erodible soils on the project.
Steep to broken.	do	do	do	do	Grain, hay	III, IV, V	Chiefly in cut-over timber and brush.
do	do	do	do	do	do	III, IV, V	Similar to Melbourne silty clay loam.
Depressed	Poor	Poor	Oak	Heads of drains. Base of long slopes.	Timber, pasture	IV, V	Unimportant agriculturally.
Level	Good	Good	Oak, fir, grass.	Terraces above Chehalem Creek.	All general farm crops.	I, II	Droughty, not severely eroded.
do	do	do	Prairie grass.	Valleys above winter flood level.	All general farm crops. Orchards, small fruits.	I, II	Orchards on frost-free sites.
do	Imperfect.	Poor	Oak, fir	Valleys	Small grain, hay	II	Benefited by tile drain.
do	Poor	do	Scrub oak, grass.	do	Pasture, hay	III	Drainage by surface ditches.

TABLE 4.—*Characteristics of soil series and acreage of each soil type mapped*

Soil group and series	Types mapped	Area		Soil profile		Parent material
				Surface soil	Subsoil	
		Acres	*Percent*			
3. Soils developed on flood plains:						
a. Well-drained:						
Chehalis	Silt loam	395	0.9	Dark-brown to rich-brown silt loam 8 inches deep.	Brown or rich-brown silt loam.	Alluvial.
b. Imperfectly to poorly drained:						
Cove	Clay	665	1.5	Black clay to 15 inches deep.	Dark-gray clay, impervious to 48 inches deep.	...do....
Wapato	Clay loam	320	.7	Brown clay loam to 15 inches deep.	Yellow-brown clay to 30 inches deep. Mottled.	...do....
	Silty clay	577	1.3	Gray-brown silty clay to 12 inches deep.	Gray clay mottled with red and yellow to 23 inches, gray clay to 48 inches.	...do....
	Silty clay loam.	1,063	2.3	Brown silty clay loam to 18 inches deep.	Yellow-brown clay to 30 inches. Heavy gray clay to 46 inches deep.	...do....
Total		2,625	5.8			
Total, group 3		3,020	6.7			
Entire project		45,532	100.0			

in Chehalem Mountain soil conservation project, Oreg.–3—Continued

Relief	Natural drainage		Native vegetation	Distribution in the project	Utilization	Dominant class of use capability	Remarks
	Surface	Internal					
Level	Good	Good	Oak, fir, cottonwood, ash, elder.	Higher bottom lands.	All general farm crops. Truck.	I, II	Subject to overflow on low area.
Depressed	Poor	Poor	Shrubs, grass.	Low bottom lands.	Grain, grass, clovers, pasture.	II	Tile drainage unsuccessful.
Level	Imperfect.	Imperfect.	Vine maple.	Bottom lands	Grain, clover, filberts.	II	
do	do	Poor	Brush, grass.	do	Grass, grain	II	Subject to overflow.
do	do	do	do	do	Grain, clover, truck crops.	II	Subject to overflow. Improved by tiling.

The Carlton silty clay loam, also derived from shales and sandstones, has an area of 2,482 acres. The surface soil to a depth of about 6 inches is a brown silty clay loam, usually underlain by a dark-gray clay loam to 18 inches. The deeper subsoil is a yellowish-gray clay loam having some red mottlings. Surface drainage is good, internal drainage in the subsoil is imperfect. This soil lies on the more gentle slopes northwest of Newberg and near Sunnycrest. A large part of it is under cultivation for orchards, berries, grain, clover, corn, and grass. Under proper management it does not constitute a serious erosion hazard. Loss of organic matter and leaching of fertility through improper soil management have reduced yields and increased erosion dangers on the steeper slopes.

The Melbourne loam covers the lower hills and ridges in the western part of the area, occupying 3,865 acres, or 8.5 percent of the project. The surface soil to a depth of 4 inches or more is a dark-brown loam, well supplied with organic matter. Immediately below this is a yellowish-brown structureless loam rather high in fine sand. This extends to a depth of about 16 inches and is underlain by a yellow sandy clay having some red mottlings. Penetration of water into this layer is poor. There is a strong erosion hazard on this soil owing to the loose sandy texture of the surface soil, to the presence of the impermeable layer below, and to "plow sole" development. It is probably the most erodible soil on the project. It puddles readily, giving rise to sheet erosion and to the formation of rills reaching down to plow depth. These spread into shallow gullies because of the compact subsoil. The soil has developed on the sandstone of the lower foothills and ridges, and the depth to underlying rock is variable. Under virgin conditions it supports a good growth of fir, oak, ferns, and brush. Most of this has been removed and uncultivated areas now yield cordwood. About one-half of this soil is under cultivation to orchards and berries and to the field crops commonly grown in the section. Under proper management the Melbourne loam has a wide crop adaptation but requires careful attention to the maintenance of organic matter, the use of lime as an amendment, and the use of nitrogenous and phosphatic fertilizers. It is shallower than the soils formed on the basalts and not so well suited to deep-rooted crops. Nearly all of the soil falls into land-capability classes III, IV, and V. The more gentle slopes require complex, protective practices to prevent further erosion. These include contour cultivation, contour subsoiling to break up "plow sole," contour strip cropping and the use of buffer strips on orchards, and field and diversion terracing to carry away water from long slopes and from higher lying fields.

The Melbourne silty clay loam was mapped to the extent of 1,455 acres. Its occurrence is similar to that of the Melbourne loam but on steeper slopes and with more broken relief. The surface soil is a brown silty clay loam, from 4 to 14 inches deep. The subsoil is a reddish-yellow, compact clay, resting at a depth of about 40 inches on the sandstone from which it was derived. It falls into land-capability classes III, IV, and V. Less than one-third of it is cultivated. Erosion hazards are considerable, owing to rather steep slopes. On the more gentle slopes, crop adaptations are similar to those of the Melbourne loam and the same precautions are necessary for its continued successful use. A large part is in cut-over timber or brush. Some of this could be seeded to grasses and used as pasture. The remainder should either be replanted to trees or be given an opportunity to reseed naturally from selected seed trees of valuable species. In either case, protection from fire and grazing are essential.

Only 20 acres of the Sites clay loam were mapped. The deeper, red clay subsoil distinguishes it from the Melbourne silty clay loam, with which it is associated. It is derived from shale rock and is of little agricultural importance.

The 32 acres of Viola clay loam occur in small pockets and seepage spots at the heads of drains or at the base of

long slopes occupied by other upland soils. It is unimportant agriculturally, since seepage keeps it wet until late in the spring and summer heat dries it out early. Over two-thirds of its area is in pasture or woodland.

The soils developed on the old valley-filling materials, deposited during the glacial epoch, have a total extent of 6,703 acres, or 14.7 percent of the area. They occupy relatively level areas, 4,625 acres occurring on slopes of less than 5 percent, 1,476 acres on slopes between 5 and 12 percent, and the remainder on slopes up to 30 percent. The steeper slopes occur only where ravines have been cut by the deeper drainageways. These valley soils were originally partly in prairie grasses and partly in timber. At present more than 77 percent of their area is cultivated and small areas are in pasture and woodland. Farmyards and urban areas take up 375 acres, or 5.6 percent of this group.

Drainage is very important in the utilization and capability of these soils, owing to the prevailingly gentle slopes and to the presence of some nearly flat and depressed areas. The valley soils have been farmed longer than the upland soils and organic matter has been depleted. They are acid in reaction, having a lime requirement of 1 to 2 tons of limestone to the acre. Erosion is not a serious menace on the gentle slopes, but it becomes a problem on slopes in excess of 10 percent.

The Willamette silt loam is the most extensive and agriculturally important soil in the valley. It was mapped to the extent of 4,447 acres, or 9.8 percent of the survey. The surface soil is a dark-brown mealy silty clay loam to a depth of 9 to 15 inches. It is underlain by a light-brown to yellowish-brown friable clay loam. At a depth of about 3 feet, this may contain some streaks or pockets of gray material. Drainage of surface soil and subsoil is good. The original vegetation was chiefly prairie grasses with scattered clumps of fir. The soil was first used for grazing, then for wheat production, and now for diversified farming of a rather intensive nature. Orchards are successful on frost-free sites. The erosion problems are simple except on the few steep slopes. The Willamette silt loam consequently falls into land-capability classes I and II, where good farming practices and simple erosion-prevention measures are sufficient to maintain it as a valuable agricultural soil. About 80 percent of its area is now under cultivation.

The Salem silty clay loam occupies only 385 acres. It lies on terrace locations from 10 to 40 feet above the present flood level of Chehalem Creek. It is nearly level except on terrace breaks and is well drained. In fact, the presence of gravel layers at depths of about 2 feet tend to make this soil somewhat droughty. The surface soil is a dark-brown mealy silty clay loam, having a depth of 6 to 12 inches. The subsoil is a yellowish-brown silty clay loam down to the gravel layers. There is little danger of erosion on this soil except on the steeper slopes. It is in land-capability classes I and II. It requires green-manure crops and should be farmed with regular crop rotations planned to maintain and restore organic matter in the topsoil. In common with the other soils on valley-filling material, the Salem silty clay loam needs lime to promote the growth of legumes in the regular rotation.

The Amity silt loam, with an area of 1,756 acres, covers 3.9 percent of the project. The surface soil is a grayish-brown silt loam, 5 to 10 inches deep. The subsoil is a mottled light-brown silty clay loam overlying a friable clay loam. It is nearly level and has imperfect surface drainage and poor subsoil drainage. The original cover of oak and fir has been cleared to a large extent for the production of small grain and hay. It falls into land-capability class II, since it requires tile drainage and the use of lime and phosphatic fertilizers. It does not present an erosion hazard because of its level surface.

The Dayton silt loam was mapped only on 115 acres. The surface soil is a light-gray silt loam about 1 foot deep. The subsoil is a mottled gray silty clay to about 22 inches and is

underlain by a plastic blue-gray clay. Its surface is level, and both surface soil and subsoil are poorly drained. It originally supported a vegetation of scrub oak and grass but is now utilized for hay and pasture. It is in land-capability class III because of its need for drainage, which is supplied through open ditches.

The soils of the flood plains along the existing streamways are all of alluvial origin and are subject to occasional or annual overflow in all the lower lying positions. They differ from one another in elevation above streamways and in present natural drainage conditions.

The Chehalis silt loam covers 395 acres, chiefly along Chehalis Creek and the Tualatin River. It is subject to overflow but drains out readily, having a sufficient amount of fine sand to facilitate drainage and early cultivation. The surface soil, to a depth of about 8 inches, is a dark-brown to rich-brown silt loam, high in organic matter and containing considerable sand. The subsoil to about 2 feet is a brown to rich chocolate-brown silt loam, more compact than the surface soil. It rests on a hard chocolate-brown silt loam that has a granular structure. It is recognized as a very fertile soil adapted to growing all grain crops, clover, alfalfa, and truck crops. It is especially valuable for the latter use where irrigation water is available. It originally supported a growth of oak, fir, cottonwood, ash, and elder, but is now chiefly cropped where not subject to dangerous overflow. It is in land-capability classes I and II, the latter class including areas subject to serious overflow. It presents erosion problems only along streamways where bank cutting may occur.

The Cove clay, with an area of 665 acres, lies in depressed areas in the bottom lands where drainage is poor and overflow is frequent. The surface soil to a depth of about 15 inches is a black clay; the subsoil to 4 feet or more is a dark-gray impervious clay. Tile drainage is not successful on this soil because of the dense nature of soil. Protection from overflow and the use of surface drains render it a good soil for the growing of spring grains, clover, and grasses, and for pasture. It is in land-capability class II because of drainage deficiencies.

The Wapato clay loam occupies nearly level terraces 10 to 20 feet above the level of the streams and has a total area of only 320 acres. The surface soil is brown to dark-brown friable clay loam to a depth of about 15 inches and is underlain by a yellowish-brown clay to about 30 inches. This is usually mottled and rests on a layer of stone, sand, and finer material. Drainage is inadequate in both surface soil and subsoil. The surface soil is in poor physical condition and puddles readily if cultivated when wet. Small grains, clover, and filberts are grown. It falls into land-capability class II, chiefly because of poor drainage.

The Wapato silty clay and silty clay loam are closely similar in all characteristics except texture. The former occupies 577 acres; the latter, 1,063 acres. The surface soils are brown to gray-brown and have depths of 12 to 18 inches. The subsoils are yellow-brown to gray clay, mottled with red in the silty clay. They occupy level areas along the flood plains of the streams and are subject to overflow. The silty clay loam is improved by tiling, the silty clay by drainage through open ditches. Their chief use is for growing small grains, grass, and short-season truck crops. Requiring artificial drainage, they fall into land-capability class II.

Erosion

The different classes of erosion mapped in the survey of the Chehalem project are given in detail on pages 21–22. Some of these occur alone, but commonly some gullying accompanies the more advanced stages of sheet erosion. The simple classes of erosion were combined into erosion groups that express the existing degree of damage on each distinct area (table 5).

Recent alluvial and colluvial deposits were mapped on 83 acres only, 72 acres of which are in the alluvial bottoms and

11 acres on the soils on valley-filling material. These consist of materials carried down from higher lying areas and deposited, with some sorting of materials, where the strength of the current was no longer sufficient to carry the load.

TABLE 5.—*Acreage and percentage of each erosion group and class*

Erosion group and class [1]	Area	
	Acres	*Percent*
Recent alluvial and colluvial deposits: +	83	0.2
No apparent erosion: 0	14,872	32.7
Slight erosion:		
1	16,576	36.4
17	1,573	3.5
Θ	292	.6
Total	18,441	40.5
Moderate erosion:		
1Θ	43	.1
2	7,679	16.9
27	1,956	4.3
Total	9,678	21.3
Severe erosion:		
3	986	2.2
37	1,264	2.7
Total	2,250	4.9
Very severe erosion:		
4	69	.2
47	136	.2
9	3	(2)
Total	208	.4
Total	45,532	100.0

[1] For explanation of erosion symbols, see pp. 21–22 or the legend on the maps accompanying this bulletin.
[2] Less than 0.1 percent.

No apparent erosion was observed on 14,872 acres, or 32.7 percent of the area. The upland soils have 14,172 acres in this class, nearly 40 percent of this area, and woodland has 13,750 acres. Pasture has 968 acres and cropland only 154 acres. The efficiency of trees and grass in protecting soils from erosion even on steep slopes is indicated by the fact that 10,667 acres of this erosion class are on slopes greater than 20 percent, 74.4 percent of which is in woodland and 13.5 percent in pasture.

Slight erosion was mapped on 18,441 acres, or 40.5 percent of the area. Land in this class has undergone a removal of not more than 25 percent of the topsoil and, in some areas, shallow and infrequent gullies have started. It is not a negligible condition since it marks the start toward serious erosion, especially if gullying has already started. Slight erosion was mapped on 9,646 acres of the upland soils, or 26.9 percent of their total area; on 6,065 acres, or 90.5 percent, of the soils on valley-filling material; and on 2,730 acres, or 90.4 percent, of the alluvial soils. It occurs chiefly on slopes less than 12 percent, and two-thirds of it is on cropland. Pasture and woodland also showed large areas in this class wherever the plant cover was not sufficiently dense to afford complete protection on the steeper slopes.

Moderate erosion signifies a loss up to one-fourth of the topsoil accompanied by deep gullying or the loss of one-fourth to one-half of the topsoil with or without shallow gullying. It exists to the extent of 9,678 acres, or 21.3 percent of the area, chiefly on the upland soils (9,536 acres), on cropland (9,155 acres), and on slopes from 5 to 20 percent (8,760 acres). Moderate erosion characterizes much land that is now productive but that needs special precautions to hold the soil in place. Additional sheet and rill erosion of the topsoil will lead to gullying, and the increase in depth and number of the gullies will require expensive methods of gully and water control at the same time restricting the uses to which the land may profitably be put. Erosion will also result in reduced water-holding capacity for crop growth during the dry seasons because the depth of the soil reservoir is reduced and the water table is often lowered in the proximity to gullies. This stage of erosion throws land so affected into land-capability class III, where good farming methods need to be supported by special mechanical devices for prevention of erosion. It is the chief cause for so rating croplands on the project, just as steep slope is the main reason for the same classification of areas of pasture and woodlands.

Severe erosion is the loss of one-half to three-fourths of the topsoil with or without the formation of infrequent gullies. It was mapped on 2,250 acres, or 4.9 percent of the project. All but

3 acres is on the upland soils; all but 68 acres, on cropland; more than 2,000 acres on slopes in excess of 12 percent. The relationship to the cultivation of land on excessive slopes is very apparent. Land of this erosion classification occurring on slopes less than 12 percent can be protected by proper soil conservation methods and is in land-capability class III; on steeper slopes it falls into classes IV and V and should be grassed over as pasture or permanent hay or reforested.

Very severe erosion was mapped where more than three-fourths of the topsoil has been lost and where there are deep and frequent gullies. It occurs on 208 acres in the project, exclusively on the upland soils and chiefly on cropland with slopes from 12 to 30 percent, with the exception of 4 acres on woodland areas. The greater part of this very severely eroded land is in land-capability class V, requiring reforestation, with a small amount in class IV where regrassing might prove to be an adequate protection.

Slopes

Slope exerts a strong influence on the destination of water falling on a soil surface. On nearly level areas, water remains long enough for most of it to sink into the surface soil and subsoil even on rather fine-textured soils. On steeper slopes, other conditions remaining the same, it runs off more rapidly, taking the finer soil particles with it, and is lost for crop-producing purposes. The steepness of the slope, the length of the slope, and the form of the slope all influence the behavior of water. On different soils, some open and porous, others more compact, the behavior of water is different. The slope class was shown for each area delineated on the map. The distribution of slope classes is shown in table 6. The A slopes have an inclination of less than 5 percent. Seventeen percent of the area, 7,783 acres, is in this slope class. Ninety-eight percent of the flood-plain area (2,958 acres), 69 percent of the valley soils (4,625 acres), and 200 acres of the upland soils are on A slopes. Very little erosion has occurred on this slope class, although 83.4 percent of its area is under cultivation.

The B slopes, 5 to 12 percent, are found on 10,764 acres, or 23.7 percent of the project. Upland soils occupy 9,233 acres, alluvial bottoms 55 acres, and the soils on valley-filling material the remainder. Over 83 percent of this slope class is under cultivation. Moderate erosion or worse has affected 34.8 percent of its area. In general where it is but slightly eroded it falls into land-capability class II, moderate erosion places it in class III, and more severe erosion in classes IV or V.

TABLE 6.—*Distribution of the slope classes in each soil group*

Soil group	A slopes (less than 5 percent)		B slopes (5–12 percent)		BB slopes (12–20 percent)		C slopes (20–30 percent)		D slopes (30 percent and over)		Total
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*
1. Soils developed on uplands:											
a. Well-drained	2	(1)	4,035	18.5	7,689	35.2	4,251	19.5	5,844	26.8	21,821
b. Imperfectly drained	198	2.3	4,224	49.0	2,289	26.6	1,138	13.2	767	8.9	8,616
c. Imperfectly or poorly drained	0		974	18.1	1,482	27.6	1,200	22.3	1,716	32.0	5,372
Total, group 1	200	.5	9,233	25.8	11,460	32.0	6,589	18.4	8,327	23.3	35,809
2. Soils developed on valley-filling material:											
a. Well-drained	2,807	58.1	1,465	30.3	226	4.7	334	6.9	0		4,832
b. Imperfectly or poorly drained	1,818	97.2	11	0.6	0		42	2.2	0		1,871
Total, group 2	4,625	69.0	1,476	22.0	226	3.4	376	5.6	0		6,703
3. Soils developed on flood plains:											
a. Well-drained	377	95.4	18	4.6	0		0		0		395
b. Imperfectly or poorly drained	2,581	98.3	37	1.4	0		7	0.3	0		2,625
Total, group 3	2,958	98.0	55	1.8	0		7	0.2	0		3,020
Entire project	7,783	17.1	10,764	23.7	11,686	25.7	6,972	15.3	8,327	18.2	45,532

[1] Less than 0.1 percent.

BB slopes are between 12 and 20 percent. They occur on 11,686 acres, or 25.7 percent of the project. An area of 226 acres is on the well-drained soils on valley-filling material, the remainder on the uplands, 7,689 acres being on the Aiken and Olympic soils. Moderate, severe, or very severe erosion was mapped on 6,680 acres, or 57.2 percent of the area of this slope class. About the same area was in cropland, a marked coincidence. BB slopes with slight to very moderate erosion are in land-capability class III; more serious erosion places them in class IV or in class V.

C slopes are those between 20 and 30 percent. These, also, are chiefly on the upland, although 376 acres out of a total area of 6,972 acres occur on the well-drained soils on valley-filling material. Over 50 percent of the area of this slope class is in woodland; 26.2 percent is in pasture; and 23.4 percent, or 1,631 acres, is cultivated. Moderate or more severe erosion has occurred on 1,641 acres, or 23.5 percent of this slope class. C slopes with slight erosion are in land-capability class IV; with a greater degree, they are in class V.

D slopes of 30 percent or over are found on 8,327 acres, exclusively on the upland soils. Only 47 acres are in cropland, 245 acres in pasture, and the remaining 8,035 acres very properly are in woodland where they should remain, since all such steep slopes are in land-capability class V.

It is very evident that slope classes in their relationships to use capability are well understood in the section and that generally the more intensive forms of agriculture have been developed on the lower slopes with the exception of orcharding, where a desire to secure both good air and water drainage has led to planting on some rather steep slopes. The dangers of increasing soil erosion have apparently not been fully appreciated, and moderate or severe erosion has resulted from the clean cultivation of slopes greater than 5 percent. This has been markedly the case with soils on BB slopes, of which 45 percent have been moderately eroded and 12.2 percent either severely or very severely eroded. The results of the survey show that land having a greater slope than 12 percent, amounting to nearly 60 percent of the total area of the project, needs to be treated carefully in order to prevent serious and increasing erosion.

Land Use

Land use in any well-established, agricultural section, like that of the Willamette Valley, has generally become fairly well adjusted to the soils of the locality and to the main features of relief. The extent to which this has taken place in the Chehalem Mountain project is shown in tables 7 and 8.

Thus, cropland occupies 46.1 percent of the upland soils, 77.3 percent of the soils on valley-filling material, and 76.5 percent of the alluvial soils of the area; pasture about 11 percent of the upland and 16 percent of the alluvial soils but only about 7 percent of the soils on valley-filling material; and woodland 43 percent of the upland soils, nearly 8 percent of the alluvial soils, and about 10 percent of the terrace soils. This relative distribution is not caused directly by water drainage conditions but is dependent to quite an extent on air drainage suitable for orcharding and on favorable local relief.

Cropland on slopes less than 12 percent occupies 15,452 acres. This is 64.4 percent of all cropland on the project. Slopes from 12 to 20 percent carry 6,866 additional acres, so that 93 percent of all cropland lies on slopes less than 20 percent. Pasture occupies 3,349 acres on BB and C slopes. This is nearly 70 percent of all pasture. About 25 percent of the pasture is on slopes of less than 12 percent, chiefly on rather poorly drained areas and in association with farms devoted to general farming and dairying. By contrast, the largest areas of woodland remain on slopes above 12 percent with 11,531 acres, or about 70 percent of all woodland, on slopes above 20 percent.

It would not be correct to conclude that land use was more closely adjusted to slope than to soil type, since the two factors operate together to determine the preferable forms of land

TABLE 7.—*Distribution of the land use classes in each soil group*

Soil group	Cropland		Pasture		Woodland		Farmyards and urban areas		Total
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*
1. Soils developed on uplands:									
a. Well-drained	9,438	43.3	2,428	11.1	9,955	45.6	0	.....	21,821
b. Imperfectly drained	4,752	55.2	914	10.6	2,946	34.2	4	(1)	8,616
c. Imperfectly or poorly drained	2,315	43.1	531	9.9	2,526	47.0	0	.....	5,372
Total, group 1	16,505	46.1	3,873	10.8	15,427	43.1	4	(1)	35,809
2. Soils developed on valley-filling material:									
a. Well-drained	3,794	78.5	384	7.9	506	10.5	148	3.1	4,832
b. Imperfectly or poorly drained	1,387	74.1	80	4.3	177	9.5	227	12.1	1,871
Total, group 2	5,181	77.3	464	6.9	683	10.2	375	5.6	6,703
3. Soils developed on flood plains:									
a. Well-drained	208	52.7	126	31.9	61	15.4	0	.....	395
b. Imperfectly or poorly drained	2,102	80.1	347	13.2	176	6.7	0	.....	2,625
Total, group 3	2,310	76.5	473	15.7	237	7.8	0	.....	3,020
Entire project	23,996	52.7	4,810	10.6	16,347	35.9	379	.8	45,532

[1] Less than 0.1 percent.

TABLE 8.—*Distribution of the land use classes in each slope class*

Land use class	A slopes (less than 5 percent)		B slopes (5–12 percent)		BB slopes (12–20 percent)		C slopes (20–30 percent)		D slopes (30 percent and over)		Entire project	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Cropland	6,488	83.4	8,964	83.3	6,866	58.8	1,631	23.4	47	0.6	23,996	52.7
Pasture	587	7.5	629	5.8	1,524	13.0	1,825	26.2	245	2.9	4,810	10.6
Woodland	427	5.5	1,093	10.2	3,296	28.2	3,496	50.1	8,035	96.5	16,347	35.9
Farmyards and urban areas	281	3.6	78	.7	0	.....	20	.3	0	.....	379	.8
Total	7,783	100.0	10,764	100.0	11,686	100.0	6,972	100.0	8,327	100.0	45,532	100.0

occupation. Nor is it possible to consider the present distribution of land uses as the best form of land occupation. The physical conditions, especially the existing degree of soil erosion, must be considered, as is done in table 1, pages 6–7, in order to determine the capability of land for future, permanent occupation. The soil-erosion data not only point out the localities where damage has already occurred, but they indicate the conditions of soil, slope, and present land use under which an extension and deepening of soil removal by erosion may be expected. The relationship of erosion to slope has already been shown on page 32 and is summarized in table 9. Erosion becomes increasingly prevalent and serious with increases of slope up to 20 percent. It becomes less serious for steeper slopes because a high proportion of the steeper slopes remains in woodland. In other words, they have not been subjected to accelerated erosion but have been adequately protected by the native vegetation.

The distribution of soil erosion in each land use class is shown in table 10, which is in some ways the most important tabulation made possible by the conservation survey. This table shows that 11,541 acres, or 48.1 percent of the cropland, has already lost one-fourth or more of the topsoil or has experienced destructive gullying. This is in marked contrast with pasture, where only 8.5 percent has been seriously eroded, and with woodland, 1.1 percent. Nearly all the severe and very severe erosion is on cropland. It is, thus, plainly evident that this form of soil damage has resulted in the past from bad adjustments of cropping practices and lack of protective forms of land management. A continuance of such practices would be even more dangerous in the future.

TABLE 9.—*Distribution of the erosion groups in each slope class*

Erosion group	A slopes (less than 5 percent)		B slopes (5–12 percent)		BB slopes (12–20 percent)		C slopes (20–30 percent)		D slopes (30 percent and over)		Entire project	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Recent alluvial and colluvial deposits	83	1.1	0	-------	0	-------	0	-------	0	-------	83	0.2
No apparent erosion	315	4.0	910	8.5	2,980	25.5	2,767	39.7	7,900	94.9	14,872	32.7
Slight erosion	7,335	94.2	6,116	56.7	2,026	17.3	2,564	36.8	400	4.8	18,441	40.5
Moderate erosion	46	.6	3,507	32.6	5,253	45.0	861	12.3	11	.1	9,678	21.3
Severe erosion	0	-------	223	2.1	1,363	11.7	648	9.3	16	.2	2,250	4.9
Very severe erosion	4	.1	8	.1	64	.5	132	1.9	0	-------	208	.4
Total	7,783	100.0	10,764	100.0	11,686	100.0	6,972	100.0	8,327	100.0	45,532	100.0

TABLE 10.—*Distribution of the erosion groups in each land use class*

Erosion group	Cropland		Pasture		Woodland		Farmyards and urban areas		Entire project	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Recent alluvial and colluvial deposits	48	0.2	15	0.3	20	0.1	0	-------	83	0.2
No apparent erosion	154	.6	968	20.1	13,750	84.2	0	-------	14,872	32.7
Slight erosion	12,253	51.1	3,417	71.1	2,392	14.6	379	100.0	18,441	40.5
Moderate erosion	9,155	38.2	362	7.5	161	1.0	0	-------	9,678	21.3
Severe erosion	2,182	9.1	48	1.0	20	.1	0	-------	2,250	4.9
Very severe erosion	204	.8	0	-------	4	(1)	0	-------	208	.4
Total	23,996	100.0	4,810	100.0	16,347	100.0	379	100.0	45,532	100.0

[1] Less than 0.1 percent.

The distribution of erosion in the different soil groups is shown in table 11. As has been pointed out, erosion is most closely associated with the cultivation of land on steep slopes without adequate measures to protect the soil from washing. However, the Melbourne soils dominate soil group 1, c, and this group includes by far the largest acreage of land which has undergone severe or very severe erosion. Including also land with moderate erosion, this soil group has been seriously affected by erosion on 2,336 acres, so that 43.5 percent of the area of the group must be farmed carefully with special practices to prevent additional destructive soil washing and to correct damage already done. It is also evident from table 11 that soil erosion is not a pressing problem on any of the soils on valley-filling material or on the alluvial soils but is very important on all the upland soils. Only 145 acres of the lower lying areas are seriously affected as against 11,991 acres on the uplands. Slight erosion is a condition common to nearly all soils and is prevalent on croplands and pastures alike but not on woodlands. The easily applied preventives of good crop rotation, contour tillage operations, contour strip cropping, the use of winter cover crops to be turned under as green manures, and the use of lime and proper fertilizers should meet the situation on these slightly eroded areas.

TABLE 11.—*Distribution of the erosion groups in each soil group*

Soil group	Recent alluvial and colluvial deposits		No apparent erosion		Slight erosion		Moderate erosion		Severe erosion		Very severe erosion		Total
	Acres	*Pct.*	*Acres*	*Pct.*	*Acres*	*Pct.*	*Acres*	*Pct.*	*Acres*	*Pct.*	*Acres*	*Pct.*	*Acres*
1. Soils developed on uplands:													
a. Well-drained	0	------	9,434	43.2	5,337	24.5	6,235	28.6	753	3.4	62	0.3	21,821
b. Imperfectly drained	0	------	2,927	34.0	3,084	35.8	2,254	26.2	339	3.9	12	.1	8,616
c. Imperfectly or poorly drained	0	------	1,811	33.7	1,225	22.8	1,047	19.5	1,155	21.5	134	2.5	5,372
Total, group 1	0	------	14,172	39.6	9,646	26.9	9,536	26.6	2,247	6.3	208	.6	35,809
2. Soils developed on valley-filling material:													
a. Well-drained	2	(1)	366	7.6	4,379	90.6	85	1.8	0	------	0	------	4,832
b. Imperfectly or poorly drained	9	0.5	169	9.0	1,686	90.1	7	.4	0	------	0	------	1,871
Total, group 2	11	.1	535	8.0	6,065	90.5	92	1.4	0	------	0	------	6,703
3. Soils developed on flood plains:													
a. Well-drained	51	12.9	99	25.1	245	62.0	0	------	0	------	0	------	395
b. Imperfectly or poorly drained	21	.8	66	2.5	2,485	94.7	50	1.9	3	.1	0	------	2,625
Total, group 3	72	2.4	165	5.5	2,730	90.4	50	1.6	3	.1	0	------	3,020
Entire project	83	.2	14,872	32.7	18,441	40.5	9,678	21.3	2,250	4.9	208	.4	45,532

[1] Less than 0.1 percent.

Summary

THE CHEHALEM MOUNTAIN area in northwestern Oregon is representative of the Willamette Valley section, especially of the western side.

The climate is marked by heavy precipitation between November 1 and April 1 and low precipitation, sometimes amounting to a short drought, from June to August. This gives rise to a double problem: The conservation of soil during the fall and winter months through the prevention of excessive run-off, and the necessity for the conservation of water to the utmost possible extent in order to serve crop needs during the summer. It also complicates the measures that may be taken for soil conservation, since summer cover crops in orchard lands compete with the tree crops for water supply.

A physical survey of the demonstration project, an area of 45,532 acres, has been made to determine the conditions of soil, slope, existing kind and degree of erosion, and the present distribution of cropland, pasture, and woodland in the area. The results obtained have been combined into a map, showing these conditions in detail and presenting the capabilities of the land for continued safe use.

The cropping and the protective practices needed on each land-capability class are presented. They have been demonstrated on the farms of cooperating farmers within the area and may be seen in use.

The survey showed that 1,600 acres of land now in crops is for various reasons not suited to such occupation. It is in land-capability class V and should be retired to forest. An additional area of 1,590 acres of cropland is in class IV and should be under a permanent cover of trees or grass with only occasional use for row crops. Orchards on this class should be retired as they become old and past the best bearing stage and no new orchards should be planted. Class IV land occupies 693 acres of the present pasture and should be brushed off to supply better pasture. Weeds should be controlled on pasture and steps taken to establish a good stand of grass or else the land should be reforested. There are 329 acres of present pasture that fall into class V and should be reforested. Woodland covers land on all land-capability classes and the needs of the individual farm owner should guide him in maintaining this stand or reducing it on land-capability classes I and II; it should definitely be maintained by careful cutting and protection from fire and grazing on the other three classes.

The results of the survey lead to the very definite conclusion that the chief damage by water erosion has arisen from attempts to cultivate land that is too steeply sloping by methods not capable of preventing erosion during the rainy months. The different methods for preventing this are stated. They vary with the soils, slopes, existing degree of erosion, and the crops that are to be grown. Erosion control on orchard lands, coupled with an adequate degree of water retention, is the major soil conservation problem in the area. Methods for accomplishing this control have been demonstrated on the project on lands of cooperating farmers.

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SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

OREGON

EROSION AND LAND-USE CONDITIONS

Sample Copy

CHEHALEM MTN. AREA
YAMHILL COUNTY
Sheet No 9

Sheet No 3 | Sheet No 4 | Sheet No 6

Sheet No 8 | Sheet No 10

Sheet No 11

Chehalem Center School
West Chehalem Church
Chehalem Creek
NEWBERG
Pacific College
HIGHWAY NO 240
HIGHWAY NO 99W
STATE HIGHWAY
SOUTHERN PACIFIC
Hess Branch
U.S. HWY. NO. 99W
USGS PTS. 63-1913
USGS PTS. 64-1913
R.3 W. R.2 W.
T-3-S

Base map compiled from aerial photographs by Soil Conservation Service.

Horizontal control by S.C.S. and U.S.G.S.

Lambert projection. 5000 foot grid based upon Oregon system (North Zone) of plane coordinates with last three digits of grid numbers omitted.

Polyconic projection, North American 1927 datum, indicated by marginal ticks.

CLASSES OF LAND ACCORDING TO USE CAPABILITY

I - Suitable for cultivation without special practices

II - Suitable for cultivation with simple practices

III - Suitable for cultivation with complex or intensive practices

IV - Not suitable for continuous cultivation

V - Not suitable for cultivation

1°46'39" S. W. corner of map

True North

Magnetic North

22°

Approximate Mean Declination, 1940
Annual Magnetic Change 1'45" West

Scale 1:15,840

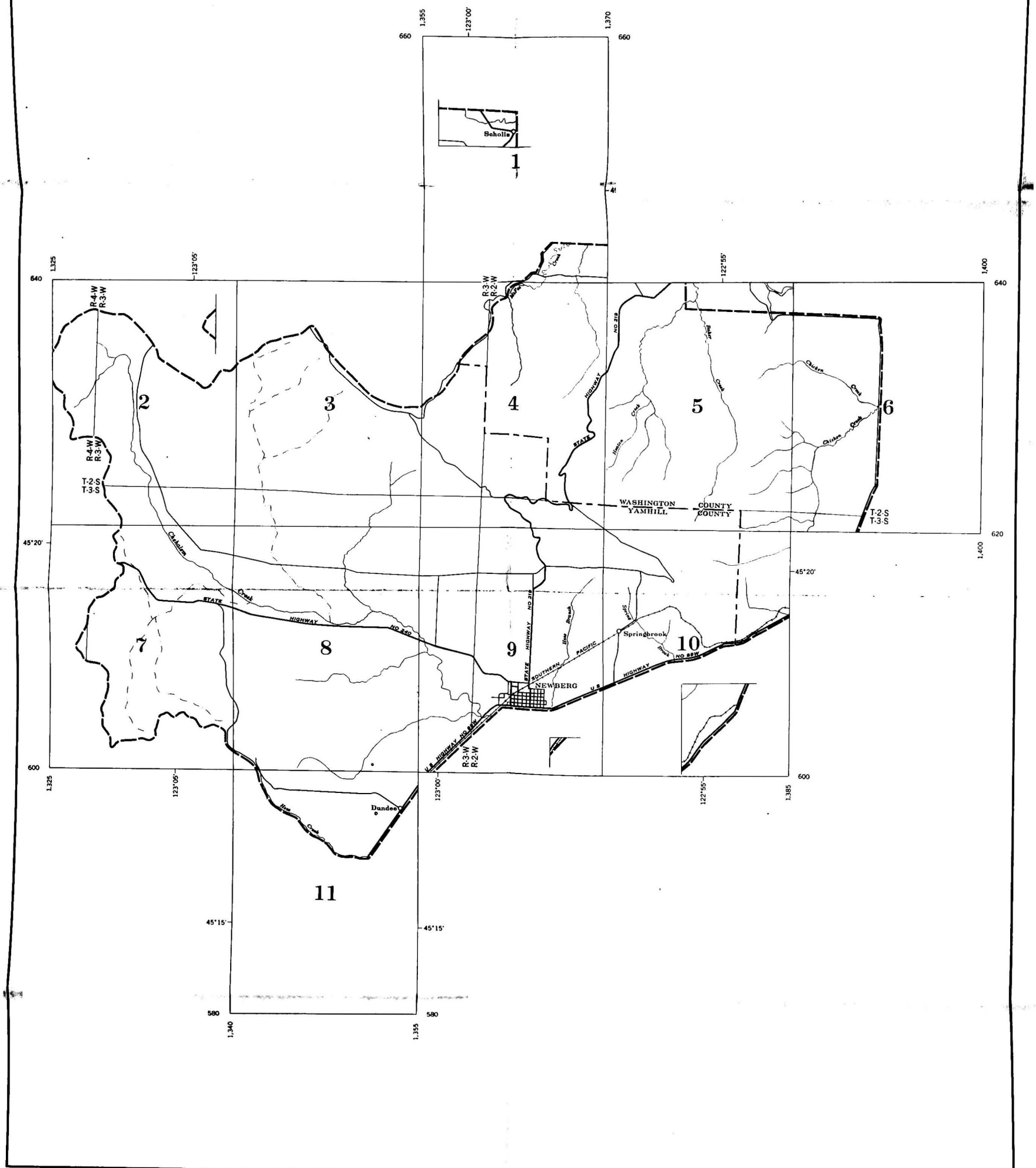
0 ½ 1 Mile

1000 0 1000 2000 3000 4000 Feet

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

OREGON
EROSION AND LAND-USE CONDITIONS

INDEX
CHEHALEM MTN. AREA
Ore-3



1 ½ 0 1 2 3 4 5 Miles

5000 0 5000 10000 15000 20000 25000 Feet

U.S. and State highways
Second class roads
Railroads
U. S. township lines
County lines
Project boundary