WORK REPORT

CONSERVATION SURVEY

HOUCK IRRIGATION PROJECT

ARIZONA

NAVAJO AREA

1939

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HOUCK IRRIGATION PROJECT

CONSERVATION SURVEY

Description of Area

The Houck Irrigation Project is located about 32 miles west of Gallup, New Mexico and immediately west of the Houck Trading Post. It has an area of 937 acres of which about 600 acres are under irrigation or irrigable. Paved U. S. Highway No. 66 bisects the area in an east-west direction.

The survey was made: (1) to evaluate the present irrigated land, (2) to determine possibilities of extension of the project, (3) and to make observations as a basis of recommendations for treatment of the alkali, drainage and erosion problems.

The project is an elongate area of approximately 937 acres, lying parallel to, and on the west side of Black Creek with the exception of a small area on the east side in the vicinity of the highway bridge. The portion of the area not bounded by Black Creek is bounded by rough broken upland.

The agricultural area occupies a gently sloping valley floor ten to thirty feet above the elevation of the creek bottom.

The Surface drainage is excessive on the rough broken upland slopes, good on most of the gently sloping upland and terrace, fair to poor on some of the heavy textured level areas.

Subsoil drainage is good to fair over most of the area, even in the heavy textured areas. The subsoil usually contains a large amount of sand which is conducive to drainage and aeration of the soil.

Climate

The elevation of the area is approximately 5900 feet above sea level. The climate is semi-arid with an estimated average annual precipitation of about 12 inches per year. Some dry farming and irrigation is practiced on the area, but the low annual precipitation makes it difficult to produce good crop yields under dry farming and flood irrigation methods.

The maximum summer precipitation occurs during July, August and September, and winter moisture, usually in the form of snow, during December and January.

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Precipitation records 1936 to 1939 at Pine Springs, about 10 miles northwest of Lomak, Arizona, are as follows:

TABLE 1.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936					.13	.07	.34	6.52	2.15	1.34	1.24	3.07	15.[illegible]
1937	2.20		2.10	.01	1.04	.23	2.57	.52	1.88	.13	[illegible]	1.[illegible]	16.[illegible]
1938	2.80	2.60	2.65	.17	.42	1.33	1.15	1.16	2.99	.08	.10	1.15	17.[illegible]

The average low [illegible] of growing season is about 150 days between the last killing frost [illegible] 10 and the first killing frost in the fall, the last of September, or early in October.

[illegible]

Irrigation on the [illegible] project was started about 1911 by the Indians, and is [illegible] mainly by the production of corn, melons, and some small grain. [illegible] of irrigation by means of [illegible] is still practiced in the northeastern portion of the project. [illegible] crisscrossed [illegible] of [illegible]. [illegible] is obtained from a [illegible] well, which may be considered as a [illegible] source of water in the [illegible] project.

[illegible] are a [illegible] of irrigation water. Laboratory analysis of a sample [illegible] the water is satisfactory [illegible] analysis. [illegible] taken [illegible] analysis. [illegible] the [illegible] of the [illegible] analyses.

[illegible]

TABLE 2.

Lab. No.	Date	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible]

[illegible]

Precipitation Records 1936 to 1939 at Pino Springs, about 10 miles northwest of Houck, Arizona, are as follows:

TABLE 1.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1936					.43	.07	.34	6.52	2.15	1.74	1.24	3.07	15.56
1937	2.20		2.10	.05	1.84	.23	2.57	.52	1.86	.43	T	1.02	12.82
1938	2.80	2.60	2.65	.47	.62	1.95	1.75	1.46	2.29	.00	.10	1.15	17.34

The average length of growing season is about 150 days between the last killing frost about May 10 and the first killing frost in the fall, the last of September, or early in October.

Agricultural History and Practices

Irrigation on the Houck project was started about 1900 by the Indians, and was devoted primarily to the production of corn, alfalfa, and some small grain. A very crude method of irrigation by means of buckets is still practiced in the northeastern portion of the project during critical drought periods. The water is obtained from a nearby well, which may be considered as a secondary source of water in the development program.

Black Creek is the primary source of irrigation water. Laboratory analysis of a sample taken during the time of the survey indicates that the water is satisfactory for irrigation purposes; however, the sample was taken at low stage and additional periodic samples should be submitted for analysis. A water sample taken from a well on the east side of the wash about one-fourth mile north of the highway was classified as good.

Following are the laboratory analyses:
Samples taken late in the afternoon of January 20, 1939.

TABLE 11.

Lab. No.	Desc.	Date ran	T.S.x	Ca.	Mg.	Na.	CO_3	HCO_3	Cl.	SO_4	Alkali Coef.xx A. Coef.	Irr. Rate	Dom. Rate
105	Well	1/25/39	508	94	11	55	15	194	41	150	41.0	Good	Good
106	Creek	1/25/39	622	75	29	85	12	216	60	200	27.5	Good	

x T.S. Total Salts
xx Alkali Coefficient: The quality of water for irrigation reported as good, fair, poor, etc., is based on the value of the "alkali coefficient" designated as "K". The alkali coefficient is an arbitrary quantity intended for use in comparing waters to be used for irrigation. It is defined as the depth in inches of water which on evaporation would yield sufficient alkali to render a four-foot depth of soil injurious to the most sensitive plants. For example, if the alkali coefficient "K" is found to be 14, then 14 inches in depth of that water contains sufficient alkali to render the soil to which it is applied injurious to sensitive crops. It should be clearly understood that the alkali coefficient does not take into account the method of irrigation, the character of the soil, or drainage Resources." "The Quality of the Waters of Southeastern Nevada, Drainage Basin and Water Resources." Hardman Miller, Univ. of Nevada, Exp. Sta. Bul. 136, pp. 19-20.

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Erosion

Sheet erosion is not serious on the irrigated land, but deposition of out-wash from the non-irrigated steeper slopes is detrimental. Gully erosion is active in the flood irrigated field of the northern portion of the project and head cuts threaten parts of the agricultural land. Wind erosion is not critical.

Soils

The soil areas have been classified according to their profile characteristics and subdivided and according to topography, slope and erosion. They have been also classified according to irrigation adaptation into five groups: A, B, B-, C, and D. In the discussion which follows the soils are considered primarialy from a standpoint of land use and secondarly from a standpoint of soil type.

All of the soils of this area are calcareous throughout their profile.

Group A

Only 43 acres of Dennehotso sandy clay loam (No. 57-12) have been classified as group A land. The top soil to a depth of 24 inches is light brown or reddish brown clay loam to sandy clay loam. It is loose and structureless and is underlain to a depth of about 60 inches by a loose yellowish brown loamy sand or sandy loam. The substratum is a darker brown, more compact sandy clay or light clay. Lime occurs throughout the profile. Water penetration is good and the water holding capacity is moderate. The presence of a relatively impervious substratum prevents excessive downward movements of water, but is sufficiently porous to insure adequate drainage.

The soil is free of black alkali and contains less than 0.2 percent of white alkali.

The class A soils occupy the valley floor adjacent to the creek. The surface is nearly level and does not exceed a slope of two percent. Occasional gullies occur but they are of minor importance. Sheet and wind erosion have been classed as slight.

Improvement Program Feasible from a Soils Standpoint

Deep plowing, crop rotation and application of fertilizer are recommended to improve and maintain quality and productivity of the soil. Caution is urged in the application of water to insure against puddling and erosion as a result of over irrigation.

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The introduction of trees and shrubs at critical points along the stream bank is recommended to prevent undercutting and loss of agricultural land.

Group B.

About one third of the area or 378 acres have been classed as group B soils. They are characterized by moderately heavy to light textured topsoils, and friable, heavy textured subsoils. Water penetration varies from slow to rapid but the holding capacity is moderately high. The black alkali content is slight or absent and the white alkali content is less than 0.3 per cent. The water table is below six feet. The slope is less than five per cent. Shallow gullies occur occasionally and sheet and wind erosion ranges from slight to moderate.

Four soil types of the Dennehotso and one of the Hunt series are represented in this group. Portions of the Dennehotso sandy clay loam, described under Group A, have been included because of restricted subdrainage.

Dennehotso loamy sand (No. 57-4) is one of the most extensive types. It usually consists of a loose light reddish brown loamy sand to a depth of from 10 to 12 inches. The subsurface material from 12" to 30" is loose, friable yellowish brown sand which some times has a slight grayish cast. The substratum is usually heavier textured and darker colored than the layer above. In a few places this layer is slightly stratified with fine sand and light clay. The profile is calcareous throughout. This type was classified in the B- group because of its loose sandy profile which tends to be droughty, and is highly susceptible to wind erosion.

Dennehotso sandy loam (No. 57-7) differs only in the surface texture from Dennehotso loamy sand. This type is slightly heavier textured and therefore better suited to agricultural irrigation than the loamy sand type. It is limited in extent and occurs at the north end of the project and on the east side of Black Creek. This type has been classified as B land because of a tendency toward droughness. However, with proper application of irrigation water, it should prove as productive as class A Land.

Dennehotso clay loam (No. 57-13) occurs mostly in the northern part of the area. The surface to a depth of 10 to 12 inches is a light reddish brown clay loam with a platy structure. Below 12" to a depth of 36 to 40 inches is a lighter textured more friable sandy loam having a light reddish brown color. The substratum is light yellowish brown sandy material mixed with some gravel. The entire profile is calcareous. This type has been classed in the B group because of its present erosion status and the topographic position which renders it susceptible to detrimental outwash material from uplands.

Dennehotso heavy clay (No. 57-18) is a grayish brown or light gray platy heavy clay to medium light clay extending to a depth of

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8 to 12 inches. The subsoil to a depth of 20 to 40 inches is variable, but predominantly heavy sandy loam to clay loam with a light reddish brown color. The substratum is usually more friable, loose yellowish brown or light reddish brown heavy sandy loam to light clay loam. In places this layer is loose yellow sand which has a slight pinkish cast. Lime occurs throughout its profile.

It has been classed as B soil because of a tendency of the surface soil to puddle when wet and form large cracks when dry. This type was mapped west of Black Creek in the immediate vicinity of the highway.

Hunt light clay (no. 60-16) occurs extensively in the irrigated area west of Black Creek. It is similar to the Dennehotso clay but is heavier textured throughout the profile.

The surface of Hunt light clay is a light brown, light grayish brown, or light reddish brown light clay to sandy clay with a laminated structure to a depth of 10 to 14 inches. Below this depth the soil material usually becomes more compact and lighter in color to a depth of 24 to 36 inches. The profile is limy. Often it is difficult to penetrate this clay layer with an auger. Small bodies of Dennehotso heavy clay occur within this soil type but have not been delineated. The substratum to a depth of 54 to 60 inches is light reddish brown and usually becomes more friable and sandy downward. From 60 to 72 inches plus, the soil material is a heavy sandy loam and light brown or reddish brown in color.

Precautions and Suggested Improvement Program

Where the slope is greater than 2 percent, Dennehotso clay loam is subject to moderate sheet erosion and occasionally to some frequent gullies. This is especially true in areas subject to excessive runoff from adjacent uplands. Mechanical treatment will be necessary to correct this condition and should be supplemented by grazing control and revegetation where satisfactory results can be anticipated.

The puddling and cracking tendency of the Dennehotso heavy clay and the Hunt light clay can be eliminated to some extent by deep cultivation and application of organic matter. Water should be applied in small quantities and the soil should not be cultivated when it is wet.

It should be recognized that drainage of these soils may be necessary eventually, especially in the low areas. Adequate surface water drainage will be necessary to prevent accumulation of surplus irrigation and runoff water from accumulating in low areas.

Group B-

This group is represented by 231 acres of Dennehotso loamy sand which is highly susceptible to wind erosion.

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The profile of the Dennehotso sand is yellowish brown to light reddish brow calcareous sand or gravelly sand to a depth of at least thirty-six inches. It has proved moderately productive in the past because of its topographic position and relation to the water table. It occurs at the north end of the project above the diversion dam, and will be subject to excessive flooding.

Group C.

Group C, represented by 12 acres of Dennehotso sand, because of steep slope and severe erosion can not be recommended for normal farming. Mechanical treatment and seeding to permanent grass are recommended for this area.

This group, having a total area of 273 acres, includes lands not recommended for subjugation such as soils which can not be irrigated because of topographic position and rough, broken land, and river wash.

Grazing control is recommended and should be supplemented by artificial revegetation and mechanical treatment wherever economically feasible. The mechanical treatment should be designed to protect the agricultural lands from detrimental floods and deposition of silt arising on the D class lands.

Alkali

Several small white alkali spots were observed in the extreme southwest part of the area, but analyses of soil smaples representing the entire area indicate that alkali is not a serious problem. Four of the samples indicated a trace of black alkali in the upper foot, but these are not serious at present.

Excessive use of irrigation water should be avoided on the heavier textured soils, especially the clay types, to insure against raising the water table and concentrating toxic quantities of alkali.

Drainage

Inadequate drainage is evident in some of the depressed areas, but at the present time, it is not of sufficient importance to affect land use. It however should be recognized that excessive use of water, intensified farming, or inadequate surface drainage may eventually require subsoil drainage.

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TABLE III

Analysis of Samples from Houck Area

Finley & Adair January 24, 1939

Lab. No.	Field No.	Depth	%*** T S.	P.P.M. Na_2CO_3	% Sand	% Silt	% Clay	%**** Disp.	Textures	Mapped ***** Soil Type
4667*	S 1-1	0-12	.10	0	85.0	12.7	2.3	25.2	L.S.	57.4
4668	S-1-2	12-40	.02-	0	76.0	11.0	13.0		S.L.	
4669	S 1-3	30-72	.02-	0	77.3	8.0	14.7		S.L.	
4675	S 4-1	0-12	.13	0	85.0	7.0	8.0	20.3	L.S.	57.4
4676	S 4-2	12-30	.02-	0	84.8	4.2	11.0		L.S.	
4677	S 4-3	30-72	.02-	0	78.7	7.6	13.7		S.L.	
4678	S 5-1	0-12	.12	0	82.0	4.7	13.3	9.9	L.S.	57.4
4679	S-5-2	12-30	.02-	0	86.3	3.4	10.3		S	
4680	S 5-3	30-42	.02-	0	64.4	18.0	17.6		S.L.	
4681	S 5-4	42-54	.02-	0	92.2	3.0	4.8		S	
4693	S 9-1	0-12	.09	T	87.7	2.3	10.0	21.4	S	57.4
4694	S 9-2	12-36	.02-	0	90.0	1.3	8.7		S	
4695	S 9-3	36-60	.02-	0	86.0	4.7	9.3		S	
4696	S 9-4	60-72	.02-	0	70.4	12.9	16.7		S.L.	
4686	S 7-1	0-12	.18	0	70.0	10.7	19.3	12.5	S.L.	57.12
4687	S 7-2	12-54	.02-	0	83.0	6.2	10.8		L.S.	
4688	S 7-3	54-72	.02-	0	56.0	23.4	20.6		S.C.L.	
4689	S 8-1	0-12	.13	0	26.0	30.4	43.6	8.2	L.C.	57.12
4690	S 8-2	12-20	.06	0	38.8	36.2	25.0		C.L.	
4691	S 8-3	20-60	.02-	0	66.7	10.3	23.0		S.C.L.	
4692	S 8-4	60-72	.05	0	51.0	23.4	25.6		S.C.L.	
4717	S15-1	0-12	.14	0	63.0	13.3	23.7	11.2	S.C.L.	57.12
4718	S15-2	12-24	.11	0	39.1	29.3	31.6		L.C.	
4719	S15-3	24-60	.03	0	82.7	7.0	10.3		L.S.	
4720	S15-4	60-72	.14	0	40.8	25.2	34.0		L.C.	
4670	S 2-1	0-12	.04	0	41.7	30.3	28.0	11.0	C.L.	57.13
4671**	S 2-2	12-36	.08	0	50.7	24.3	25.0		S.C.L.	
4682	S 6-1	0-12	.18	0	19.1	15.6	65.3	6.6	H.C.	57.18
4683	S 6-2	12-24	.07	0	55.7	30.0	14.3		S.L.	
4684	S 6-3	24-40	.08	0	54.7	19.7	25.6		S.C.L.	
4685	S 6-4	40-72	.02-	0	94.8	1.0	4.2		S	
4672	S 3-1	0-12	.20	0	14.1	39.0	46.9	10.4	L.C.	60.16
4673	S 3-2	12-54	.09	0	58.0	19.4	22.6		S.C.L.	
4674	S 3-3	54-72	.08	0	76.4	7.6	16.0		S.L.	

* 1/8 Mile South of Diversion Gate.

** Stopped by gravel at 3'. Indications of sand underlying 6" stratum of gravel.

*** T.S. - Total Salts.

**** Disp. - Dispersion

*****See map legend for soil type names.

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Lab. No.	Field No.	Depth	% T.S.	P.P.M. Na CO	% Sand	% Silt	% Clay	% Disp.	Textures	Mapped Soil Type
4697	S10-1	0-12	.11	T	58.7	11.3	30.0	14.5	S.C.L.	60.16
4698	S10-2	12-24	.12	0	35.7	18.7	45.6		L.C.	
4699	S10-3	24-60	.08	0	65.0	12.7	22.3		S.C.L.	
4700	S10-4	60-72	.06	0	66.4	14.3	19.3		S.L.	
4701	S11-1	0-12	.10	T	60.7	17.7	21.6	9.9	S.C.L.	60.16
4702	S11-2	12-24	.02-	0	72.0	9.0	19.0		S.L.	
4703	S11-3	24-60	.11	0	40.0	25.7	34.3		L.C.	
4704	S11-4	60-72	.14	0	63.4	11.3	25.3		S.C.L.	
4705	S12-1	0-12	.11	T	38.4	23.3	38.3	9.5	L.C.	60.16
4706	S12-2	12-36	.08	0	31.1	43.3	25.6		C.L.	
4707	S12-3	36-60	.13	0	37.4	30.3	32.3		L.C.	
4708	S12-4	60-72	.08	0	54.4	26.3	19.3		S.L.	
4709	S13-1	0-12	.16	0	30.0	29.0	41.0	14.0	L.C.	60.16
4710	S13-2	12-36	.12	0	26.1	31.9	42.0		L.C.	
4711	S13-3	36-60	.15	0	34.1	34.3	31.6		S.L.	
4712	S13-4	60-72	.14	0	73.7	13.0	13.3		S.L.	
4713	S14-1	0-12	.12	0	30.4	32.3	37.3	13.6	L.C.	60.13
4714	S14-2	12-24	.10	0	40.8	24.6	34.6		L.C.	
4715	S14-3	24-48	.02-	0	73.0	8.4	18.6		S.L.	
4716	S14-4	48-72			58.1	22.3	19.6		S.L.	

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TABLE IV
Acreage of Soil Types in Agricultural
Soil Groups

Type	A	B	B-	C	D	Total
21.7					109	109
21.12					12	12
57.1				12		12
57.4			231		12	243
57.7		40				40
57.12	43	78				121
57.13		23				23
57.18		65				65
60.16		172				172
71.7					4	4
19 S					13	13
35					123	123
	43	378	231	12	273	937

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