IRRIGATION DATA

LONG RANGE PROGRAM

NAVAJO

Los Angeles, Calif.

January 29, 1944

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IRRIGATION DATA FOR LONG RANGE PROGRAM

NAVAJO RESERVATION
PART ONE - BASIC DATA

SECTION 1 - RESOURCES

Location, Date Established and Area of Reservation -

The Navajo Reservation, Coconino, Navajo and Apache Counties, Arizona, San Juan and McKinley Counties, New Mexico, and San Juan County, Utah, occupies a large area in the N.E. corner of Arizona, the N.W. corner of New Mexico, and the S.E. corner of Utah. The reservation is approximately 200 miles across from east to west and 150 miles from north to south, completely surrounding the Hopi Reservation, which is approximately 56 by 70 miles. It extends to the Colorado River on the northwest and to the San Juan, Montezuma Creek, and the Colorado line in the north, about 45 miles into New Mexico on the east, approximately to the A.T. & S.F. Railroad on the south, and somewhat beyond the Little Colorado on the southwest. In addition there are the Navajo community areas of Star Lake near Chaco Canyon National Monument, 50 miles northeast of Grants, N.M.; Canoncito, 15 miles east of Laguna, N.M.; Puertecito, 40 miles south of Laguna, on the Rio Salado, and Ramah, about 40 miles southeast of Gallup. The last three are under the United Pueblos jurisdiction. These are made up principally of trust and fee patents and purchases. There are also other allotments on the public domain outside the reservation. The nearest towns are Winslow, Holbrook and Gallup on the A.T. & S.F. Railroad, 10 miles, 18 miles, and 11 miles, respectively, south of the reservation, and Farmington on the D. & R. G. Railroad near the N.E. corner.

After the Navajos were returned from Fort Sumner they received, under the treaty of June 1, 1868, a block of land covering 3,328,000 acres in Eastern Arizona and Western New Mexico, south of the Utah-Colorado Line.

Executive Order of Oct. 29, 1878, added a strip of land west of the treaty area.

Executive Order of Jan. 6, 1880, added a strip south and east of the treaty area.

Executive Order of Dec. 16, 1882, established the Hopi Reservation of 2,472,166 acres, for use of the Hopis and such other tribes as the Secretary saw fit to settle thereon. Hopi Land Management District No. 6 includes 641,797 acres. The remainder, 1,830,369 acres, is being used by the Navajos.

Executive Order of May 17, 1884, granted the Paiute strip in Utah and Arizona south of the San Juan River. A small area south of the San Juan in the vicinity of Fruitland, originally included in Executive Order of Jan. 6, 1880, and excluded by Executive Order of May 17, 1884, was recovered by Executive Order of Apr. 24, 1886.

Under the Allotment Act of Feb. 8, 1887, approximately 4700 patented allotments of 160 acres each were made from about 1908 to 1930.

Executive Order of Jan. 8, 1900, added about 1,750,000 acres in the vicinity of Tuba City. The Tuba City townsite and adjacent land were bought from the Mormons in 1903.

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Executive Order of Nov. 14, 1901, established the Leupp area.

Executive Orders of Nov. 9, 1907, and Jan. 26, 1909, created the Pueblo Bonita Reservation. This area was restored to public domain by Executive Order of Dec. 30, 1908, and Executive Order of Jan. 6, 1911, excepting the many allotments which had been made to the Indians under the Act of 1887.

Executive Order of Mar. 10, 1905, modified by Executive Order of May 15, 1905, and Act of Mar. 1, 1933, established the area in Utah north of the San Juan.

Executive Orders of Nov. 9, 1907, and Jan. 26, 1908, added approximately 1,500,000 acres to the southern part of the reservation.

Executive Orders of Jan. 19, 1918, May 23, 1930, and Act of June 14, 1934, added the Grey Mountain area west of Cameron and south of the Little Colorado River.

Act of May 25, 1950, also added the area north of the Little Colorado and east of the Colorado River.

Executive Orders of Nov. 19, 1892, -- 1908, and Act of Aug. 17, 1928, restored to public domain part of the Paiute strip established by Executive Order of May 17, 1884, but this was re-established by Act of Mar. 1, 1933.

Act of June 14, 1934, made additions to the reservation north of Winslow and in the vicinity of Houck.

In addition to areas acquired by Executive Orders and Acts of Congress, large areas have been purchased, with gratuity funds prior to Dec. 31, 1938, and thereafter from tribal reimbursable funds.

Purchases to 12/31/38

State	Acreage	Price Paid	Av. per Acre
Arizona	476,240.21	$ 754,499.58	$1.508
New Mexico	187,382.16	378,029.84	2.017
Utah	1,920.11	5,212.00	2.741
Total	665,542.48	$1,139,741.42	1.712

The record to 12/31/38 shows that there were 3732 patented Indian allotments of approximately 160 acres each in trust status on the public domain in New Mexico and 75 Indian homestead entries of 640 acres each on the public domain. The Navajos also had obtained fee patents by citizen homestead entries and small-holding claims for approximately 980 acres.

The area of the reservation, according to the 1942 Statistical Supplement, was as follows:

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State	Total	Trust Allotted	Tribal	Govt. Owned
Arizona	11,414,450	90,545	11,323,905	-
New Mexico	3,508,232	599,275	2,592,242	316,715
Utah	1,211,043	10,720	1,200,323	-
Total	16,133,725	700,540	15,116,470	316,715

This apparently includes the Hopi Reservation, except 901,942 acres in Hopi Land Management District No. 6, which is shown under Hopi in the statistical data. It is understood that District 6 now includes 641,797 acres, which would reduce the Navajo-Arizona and total by 139,855 acres.

Elevation and Climate -

The elevation of the reservation varies from 2800' at the mouth of the Little Colorado to 10,416' on Navajo Mountain in the northwest. Carrizo Mountain in the northeast rises to 9420', and the Chuska range in the east central part reaches 9575'. About 6 per cent of the area is below 4000', 50 per cent between 4000' and 6000', 32 per cent between 6000' and 7000', 10 per cent between 7000' and 9000', and 2 per cent is over 9000'. Other elevations are given in the following table:

The climate is generally that of the Colorado Plateau, but is variable, being greatly influenced by topography. The general effect of elevation is greatly modified by secondary topographic features. The air is dry and the daily range of temperature is great.

The winters are quite severe, with rather meager snowfalls in the lower regions, ranging to heavy on the mountain tops. Winter precipitation is deficient.

The summers are characterized by warm days, cool nights and sudden short storms of great intensity in widely scattered locations, with considerable precipitation in June, July and August. Occasional hail storms are often of great severity.

Wind storms are frequent, the prevailing direction being from the southwest. Whirling columns of dust are often in sight. There are extensive areas of sand dunes and rippled flats and rocks polished and etched by wind-blown sands. Vegetation buried in sand and fields of corn whipped to shreds are common.

Climatological records are incomplete; a summary of the principal available data at the various stations follows, using the four most important stations for which fairly complete data are available. These are located at widely scattered points typical of most of the irrigation projects.

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The temperature records for Fruitland, New Mexico, and Chinle, Fort Defiance--St. Michaels and Winslow, Arizona, show the following:

Fruitland, N.M., elevation 4800'; 32 years of record, 1891-1914; 1939-1942:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Av.
Ext. Max.	71	86	83	92	97	106	110	109	98	94	90	79	-
Ext. Min.	-21	-14	6	8	13	31	44	39	26	11	-1	-17	-
Mean	28.8	34.8	43.2	51.1	59.9	69.1	74.7	72.8	64.7	52.7	39.9	30.7	51.9

Chinle, Ariz., elevation 5538'; 25 years of record, 1909-1928; 1939-1942:

Ext. Max.	65	70	80	85	95	103	102	102	93	90	73	68	
Ext. Min.	-32	-32	1	10	19	28	38	40	23	15	0	-27	
Mean	27.8	33.9	41.3	49.0	58.4	68.6	74.1	72.1	65.6	51.7	39.1	29.1	50.7

Ft. Defiance, Ariz., elevation 6750'; 37 years of record, 1882-1890; 1897-1905; 1929-1942:

Ext. Max.	60	72	72	80	95	98	97	98	90	81	74	67	
Ext. Min.	-25	-26	-9	12	20	28	31	39	30	18	-23	-26	
Mean	25.6	27.4	29.9	46.5	54.0	64.5	69.1	67.8	59.5	48.3	35.3	27.6	47.3

Winslow, Ariz., elevation 4880'; 22 years of record, 1888-1889; 1892-1895; 1898-1900; 1908-1942:

Ext. Max.	74	75	87	94	103	106	107	104	102	91	81	71	
Ext. Min.	-18	-9	6	14	23	23	32	44	29	17	-8	-19	
Mean	31.4	32.3	38.0	53.6	62.2	72.3	77.6	75.2	68.4	55.9	42.6	35.3	54.9

The frost-free growing period for Fruitland, based on a 27-year record ending 1942, is 157 days, from May 5 to October 9, with the latest killing frost of record on May 27, and the earliest on September 17. For Chinle, based on a 26-year record ending 1942, it is 139 days, from May 22 to October 8, with the latest killing frost of record on June 30, and the earliest on September 9. For Fort Defiance--St. Michaels, based on a 33-year record ending 1942, it is 133 days, from May 21 to October 1, with the latest killing frost of record June 19, and the earliest September 9. For Winslow, based on a 38-year record ending 1942, it is 172 days, from May 3 to October 22, with the latest killing frost of record June 2, and the earliest September 27.

The average precipitation is distributed as follows:

Fruitland; 33 years of record, 1891-1924; 1939-1942:

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
.52"	.63"	.47"	.54"	.44"	.22"	.87"	.75"	.93"	.72"	.44"	.53"	6.95"

Chinle; 25 years of record, 1909-1928; 1939-1942:

.46"	.47"	.44"	.42"	.34"	.38"	1.63"	1.53"	.87"	.68"	.53"	.54"	8.34"

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Fort Defiance; 31 years of record, 1852-1860; 1897-1905; 1929-1942;

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
.92"	1.02"	.79"	.72"	.57"	.72"	1.82"	2.25"	1.60"	.60"	.90"	.85"	12.76"

Winslow; 36 years of record, 1888-1889; 1892-1905; 1898-1900; 1908-1942;

.68"	.49"	.49"	.40"	.30"	.30"	1.61"	1.84"	.76"	.52"	.61"	.68"	8.79"

The percentage of possible sunshine at Fruitland, for a 4-year period, 1939-1942, is 72; at Chinle, for a 20-year period, 1917-1928, 1935-1942, it is 57; at Fort Defiance-St. Michaels, for a 24-year period, 1917-1927, 1930-1942, it is 66; and at Winslow, for a 26-year period, 1917-1942, it is 67. The monthly averages are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Av.
Fruitland:	60	52	66	62	88	91	81	74	68	77	76	67	72
Chinle:	56	51	52	57	62	69	40	43	61	70	69	54	57
Fort Defiance-St. Michaels:	69	64	68	69	75	81	60	54	65	76	72	65	68
Winslow:	63	59	63	66	75	81	57	56	71	78	70	59	67

The approximate average number of hours between sunrise and sunset are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Fruitland (lat. 36°-45'):	309	306	370	393	438	439	447	420	373	349	307	301	4,452
Chinle (lat. 36°-45'):	309	306	370	393	438	439	447	420	373	349	307	301	4,452
Fort Defiance (lat 35°-45')--St. Michaels (lat. 35°-39'):	311	304	370	392	435	436	444	418	373	350	310	304	4,450
Winslow (lat. 35°-01'):	313	305	370	392	434	434	442	417	373	351	311	305	4,450

The approximate average number of hours of sunshine, using the above percentages is:

Fruitland:	185	159	244	244	385	399	362	311	254	269	233	202	3,247
Chinle:	173	156	192	224	272	303	179	181	227	244	212	162	2,525
Fort Defiance-St. Michaels:	215	195	252	271	320	353	266	226	242	266	225	198	3,033
Winslow:	197	185	233	259	326	351	252	234	265	274	218	180	2,971

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Erosion is a serious factor in the development of this reservation and has been given a great deal of attention by the Soil Conservation Service. The soils, owing to the nature of the rock formations from which they are derived, are mostly of fine sand and silt, which is easily broken down by action of wind and water. Large areas of the reservation are being denuded of vegetation, the best soils whipped out and drifted into sand dunes by the wind and washed away by water. The valleys are cut by ever-increasing arroyos, farm lands eroded or covered with sand, reservoirs filled with silt, diversion structures washed out and canals broken by cross-washes. These conditions make agricultural operations very hazardous. The cost of irrigation works is very high and maintenance very difficult and expensive.

Topography (1)

The Navajo Reservation is a part of the Colorado Plateau, a region of flat-lying or slightly tilted rocks, cut by canyons and surmounted by mesas and buttes on a grand scale. In general, the depth of canyons below 5500' is about equal to the height of the mountains above that elevation. Navajo and Carrizo Mountains are laccolithic in origin and rise domelike above the surrounding country. Chuska Mountains, Black and Sagi Mesas are bordered by sheer cliffs of commanding proportions. There are many mesas of the second and third order and innumerable buttes of both igneous and sedimentary origin. Mesas, buttes, volcanic necks, canyons, washes and sand dunes are repeated indefinitely. Alcoves, recesses and erosion forms of great variety, color and rare beauty stand as ornamental carvings on the larger architectural features. Approximately 54 per cent of the area drains into the San Juan, 39 per cent into the Rio Puerco and Little Colorado, and 7 per cent into the Colorado River. A small amount drains into the Rio Grande from the Star Lake, Canyoncito and Puertecito areas outside the main reservation.

Geology and Soils (1)

Pre-Cambrian is exposed at only one point, Quartzite Canyon near Fort Defiance. During Permian time the land was near sea level and was probably repeatedly submerged.

The first recorded deposit of Triassic Age is the Shinarump conglomerate which followed the Permian deposits after a long erosion interval. During Jurassic time there was increasing aridity and elevation with bodies of water--salt, brackish and fresh--and sufficient forage for animals as indicated by evidences of dinosaurs. There was vigorous erosion, marked by the unconformity at the base of the Dakota, which has removed all traces of lower Cretaceous. During upper Cretaceous time streams were active and the Dakota was laid down. Repeated submergence and re-elevation occurred and shales and sandstones containing marine fossils and lignitic coal were deposited.

With the coming of the Tertiary the sea is believed to have been permanently excluded. Fresh water shells indicate lakes and cross-bedded sandstones suggest the work of winds. Volcanism was active and probably continued into the Quaternary. Major folds and consequent uplifts, several times repeated, have brought the land to its present position. Erosion became dominant during the Pliocene and reduced

(1) Extracts from W.S.P. 380, The Navajo Country, by H. E. Gregory. 1916.

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parts of the area to a peneplain. The gradient was increased later by a regional uplift, greatly reducing the area occupied by Mesozoic and Cenozoic strata. Other uplifts of 3000' to 4000' enable the streams to cut the canyons which form so conspicuous a feature of Navajo topography.

The pre-Cambrian is represented only at Quartzite (Blue) Canyon near Fort Defiance. The Carboniferous-Pennsylvanian is found in the Canyon of the San Juan and at Grand Falls and several other points along the Little Colorado. Strata of this buff and brown Kaibab limestone are well exposed. The Permian beds consist of arenaceous shales and thin bedded sandstone, brown to chocolate in tone, charged with lime and gypsum, known as Moenkopi and the massive cross-bedded De Chelly sandstone.

The upper Triassic is represented by Shinarump conglomerate consisting of coarse sandstone in cross-bedded lenses with fossil wood and by the Chinle formation of calcareous shales and sandstones highly colored in pink, purple, gray and brown, and eroded into badland forms of singular beauty.

The Jurassic-La Plata group consists of two formations of massive cross-bedded friable red sandstones of great thickness. The lower Wingate sandstone is, in many places, separated by a band of limestone or of calcareous Todilto shale and sandstone from the upper Navajo sandstone. Above the La Plata group lies the McElmo formation of friable greenish-white sandstones and subordinate shales, easily eroded into scalloped and curtained cliffs and badlands.

The upper Cretaceous is represented by the Dakota sandstone, the Mancos shale, prevailingly argillaceous but containing many beds of sandstone and thin seams of coal, and the Mesa Verde, consisting of sandstones, shales and coal widely extended in Northeastern Arizona and Northwestern New Mexico.

The tops of Black Mesa, of Dutton, Chaco and Manuelito plateaus and the floor of Chuska Valley are formed of the resistant members of the Mesa Verde, within which are found deposits of coal of high commercial value.

Tertiary strata cap the Chuska Mountains and cover a portion of Black Mesa. These include the Tohatchi shale and Chuska sandstone, the volcanic flows on top of Chuska Mountains, those in the Hopi Buttes region and along the Little Colorado River. Volcanic necks and dikes are distributed widely over the reservation.

The Quaternary deposits of post Tertiary erosion are represented by extensive deposits of alluvium forming the floor of wide washes and fringing canyon and mesa walls. Sand dunes ranging in size from small mounds to crescentic ridges 30' to 50' in height are found at many points, except in the forested highland areas.

Soils,[1] two types of soils are found--residual or local soils, which have resulted from decomposition of the rocks immediately under the surface; and transported soils, which have been carried by natural agencies from their place of origin and redeposited. The scantiness of vegetation, severe showers, rapid runoff and strong winds, characteristic of this region, are unfavorable for the development and retention of soil in place, hence transported soil predominates.

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Residual soil, a few inches thick, is found on the flat tops of Chuska Mountains, of Defiance, Dutton and Chaco plateaus and of Black and Segi mesas. Large patches are found also on Carriso and Navajo Mountains, in Monument and Chuska Valleys, and to a less extent elsewhere.

Transported soil, however, is widespread. The broad washes and their innumerable tributaries are flooded with stream-borne debris to depths exceeding 100 feet. Alluvial soil is also displayed in fans and slopes along valley sides and in terraces clinging to canyon walls, and a small amount marks the beds of extinct and ephemeral lakes. Eolian soils are found along the Little Colorado in the Tusayan washes, on Moenkopi, Kaibito and Shato plateaus and in the Chinle Valley, and blow dust is found on highland and lowland alike.

The soil of the Navajo country is derived from rocks relatively poor in mineral plant food. Limestone underlies probably less than 5 per cent of the area. The shales and sandstones of the Moenkopi formation contain relatively little plant food and are, in most places, charged with gypsum and other objectionable salts. The Shinarump conglomerate furnishes no soil of value to plants and the shales of the Chinle formation develop characteristically into infertile, bad-land areas. The sandstones of the La Plata group and the McElmo formation are prevailingly quartzose and are sparingly provided with plant food.

The Cretaceous strata--Dakota, Mancos and Mesa Verde--contain a higher proportion of plant food than any of the other formations and the lavas (largely basaltic) furnish a soil of high fertility. However, in spite of its origin, the soil of the reservation is not lacking in fertility--a condition which is due largely to the arid climate. The plant foods, sparingly distributed in the rocks, are accumulated in the soils of the washes and alluvial fans and stored for long periods because continuous, vigorous ground-water movement is lacking, and the leaching of soluble constituents is correspondingly checked. The fertility of the soil is renewed by continuous redistribution of alluvium by showers, seasonal rains and wind, thus incorporating within the soil the vegetation which springs up rapidly where conditions allow.

Agronomy -

Dry-farming, as commonly known, is not practicable on the reservation, except in a few isolated places in the higher altitudes where certain crops can be raised without irrigation in favorable years. However, the practice of farming on sandy fans of the washes, which receive and hold moisture for long periods, has been developed to a remarkable degree. Crops, principally corn, are planted deep in large hills to reach the moisture and protect the interior stalks from the cutting action of wind-blown sand.

Irrigation farming has become the mainstay of agriculture and a large number of units have been developed or partially developed, most of them in the first instance, by the Indians in a small way. Assistance has been provided by the Government in the investigation, improvement and development of a large number of units.

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A great many crops are raised. However, the majority are of the subsistence variety, consisting of corn, beans, squash and garden vegetables. Many difficulties are encountered in making efficient use of the irrigation projects. The land is usually rough, requiring subjugation, and is subject to erosion along stream channels or by cross-washes. Head-works and canal systems rarely can be constructed so well that frequent damage is not caused by floods, requiring heavy maintenance. The water supply, except where storage is available, is of flashy nature, requiring close attendance and often causing considerable damage. The Indians do not have the facilities or do not attain perfection in farming operations, all of which results in low production per acre.

Summary Crop Report for Calendar Year 1942

Crop	Irrigated Acres	Yield Per Acre	Yield Total	Market Value Per Acre	Market Value Total	No. Indians Farming
Total	17,838			$16.65	$297,037	

SECTION 2 - PRESENT DEVELOPMENT & USE

Irrigation -

Irrigation on the Navajo Reservation dates from 1885, when some small ditches were constructed by the Indians. Investigations and surveys were made by the Indian Service as early as 1904. Several small projects were constructed within a few years after this, and development has continued at an ever-increasing rate. The work was carried on through the Albuquerque office of the Supervising Engineer until the beginning of the fiscal year 1936, when it was turned over to the reservation Superintendent. Cooperative work has been done on many projects by Irrigation, E.C.W., CCC-ID, S.C.S., and Rehabilitation.

The following tabulation shows, by States, all the units on which work has been done, investigations made or work proposed, with costs, irrigation data and estimates of cost to complete.

There are 120 units listed. Irrigation funds, totaling $2,908,[illegible]02.35, have been expended on 93 of these, and other agencies have spent $354,150.75 on 41 units, plus an unknown amount on three units, eight of which were not covered by

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irrigation funds, making a total of 101 on which funds have been expended. This includes several investigated or partly constructed but now abandoned, two Hopi projects, several school units, subsistence gardens, experimental well, drainage and quarters, 26 in all which are not strictly Indian irrigation projects. This leaves 75 active projects and 19 proposed projects on the list. Seventy of the active projects are completed or partially completed, with 26,198 acres ready for cultivation (the principal works are constructed for a considerably larger acreage). On 67 of these, 17,833 acres were cropped in 1942 with a crop value of $297,037.

Additional surveys, investigations and construction are proposed on 82 projects, of which only 15 are new in the sense that no funds have been expended on them heretofore. The total estimate of $2,358,700 is incomplete, as detailed surveys and plans have not been made in most cases and as it includes only the cost of surveys on 15 of the projects, some of which are quite large.

It is contemplated that the above estimate would complete the existing units to a point where the approximate ultimate acreage of 67,000 could be satisfactorily cropped.

The economic unit of irrigated land is probably about 10 acres per family under conditions which exist on the Navajo Reservation. This is more in the nature of a compromise subsistence unit, based upon the limited agricultural possibilities, rather than the full acreage required for economic independence. Even so, it would involve more than twice the acreage of irrigable land now in sight. When considered in connection with stock-raising, which is the major industry, the 10-acre unit affords a good measure of assistance in the economic status of the Indians.

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Proposed Work

ersion dam, canals and structures, $8,500; subj. 100 acres, $4,000; surveys, $200.
D' canal, inc. flume, wasteway, drop and T.O.'s, and subj. 300 acres.
bution system to conserve water.
rveys, plans and estimates.
ersion dam, 1 mile main canal, laterals and structures.
vement and extension 4,000', subj. 800 acres.

an and distribution system for 75 acres.
estimate for diversion dam and rehabilitation distribution system.

ned account infeasible diversion.
div. dams, $5,000; canals, $4,000; subj., 350 acres, $14,000; surveys, $500.
for 100 acres if feasible.
3 miles canal, $8,000; subj. 800 acres, $18,500; surveys, $1,000.

s and str. for improvement and extension to include Cornfields.
rsion dam, $1,600; improve distrib. system, $10,000; subj. 710 acres, $32,000.

ateral system and subj. 50 acres.
supply questionable.
investigations for possible irrigation development.
" " " " "

dam, $4,000; canals, $700; structures, $800; surveys, $200.
protection. Project turned over to W.R.A.
supply questionable.
diversion dam, canals to 270 acres; subj. 270 acres.
teral system, spillway, weir at intake, and subj. 1,200 acres.
l, rehab. Priest Lake storage, and subj. 100 acres.
ribution system, 800' metal flume, pumping plant, and subj. 7,000 acres.
feeder canal, extend laterals, windbreak and subjugation.

rings and raise several reservoirs.
diversion dam, spillway, laterals, flood protection and subjugation.
75 acres.
rage dam, const. diversion dam, new canal & structures, & subj. 2,000 acres
investigations to determine feasibility.

l through deep cut and reconstruct flumes.
n canal and subjugate 50 acres.
a Nepi project—Hardrocks.
diversion dam, construct laterals and structures, and subjugate 175 acres.

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ady Cultivation	Cropped 1942	Crop Value	Est. Cost to Complete		Proposed
0	0	$ 0	$ 0		None.
0	0	0	10,700	N	Masonry diversion dam, canals and structures, $6,500; sub
234.5	199.5	2,125	31,700		Rehab. 3,000' canal, line. flume, wasteway, drop and T.
67	67	920	3,500		Pipe distribution system to conserve water.
0	0	0	1,000$		Complete surveys, plans and estimates.
0	0	0	10,300	N	Masonry diversion dam, 1 mile main canal, laterals and st
0	0	0	28,000		Canal improvement and extension 4,000', subj. 600 acre .
0	0	0	0		None.
0	0	0	5,260	N	Diversion dam and distribution system for 75 acres.
1,470	1,100	8,825	1,000$		Survey and estimate for diversion dam and rehabilitation
0	0	0	0		None.
0	0	0	0		"
0	0	0	0		None; abandoned account infeasible diversion.
138	121.5	1,395	23,500		Reconstruct div. dams, $5,500; canals, $4,000; subj., 35
0	0	0	2,700	N	Masonry dam for 100 acres if feasible.
657	302.2	1,081	27,500		Reconstruct 3 miles canal, $8,000; subj. 600 acres, $18,
268.5	118	4,194	0		None.
0	0	0	0		"
1,451	1,030	25,098	1,000$		Surv., plans and est. for improvement and extension to i
185	154.5	2,045	[illegible],000		Repair diversion dam, $1,000; improve distrib. system, $
0	0	0	0		None.
52	51	2,212	0		"
[illegible]	150	3,100	15,000		Construct lateral system and subj. 50 acres.
[illegible]	200	6,016	0		None, water supply questionable.
0	0	0	200$		Surveys and investigations for possible irrigation devel
57	30	782	200$		" " " " " "
0	0	0	5,700	N	Diversion dam, $4,000; canals, $700; structures, $900; s
0	0	0	0		None, flood protection. Project turned over to W.R.A.
234	209.2	3,095	0		None, water supply questionable.
130	41	665	10,500		Reconstruct diversion dam, canals to 270 acres; subj. 27
590	719.5	12,500	102,200		Complete lateral system, sluiceway, weir at intake, and
970	627.6	8,032	77,000		Extend canal, rehab. Priest Lake storage, and subj. 100
1,081.5	947	6,906	409,000		Extend distribution system, 930' metal flume, pumping pl
363.25	150.7	2,320	16,250		Reconstruct feeder canal, extend laterals, windbreak and
0	0	0	0		None.
0	0	0	0		"
55.5	55.5	2,995	9,000		Develop springs and raise several reservoirs.
640	578	9,440	20,500		Reconstruct diversion dam, sluiceway, laterals, flood pr
100	61	152	4,200		Subjugate 75 acres.
28.5	15.5	595	195,000		Enlarge storage dam, const. diversion dam, new canal &
51	50.0	947	300$		Surveys and investigations to determine feasibility.
0	0	0	0		None.
20	15.5	511	1,150		Rehab. canal through deep cut and reconstruct flumes.
42.25	41.8	972	3,100	N	Improve main canal and subjugate 50 acres.
0	0	0	0		This is now a Hopi project—Hardrocks.
172.25	172.2	2,368	15,800		Reconstruct diversion dam, construct laterals and struc
0	0	0	0		None.

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SUMMARY OF NAVAJO IRRIGATION PROJECTS
(Nos. refer to Nos. in Budget Estimates 6/30/43)

No.	ARIZONA Name		Irrig. Cost to 6/30/42	CCC-ID Cost to 6/30/42	Ultimate Irrig. Area	Current Estimate
106	Agua Sal	P	$ 0	$ 0	0	
2	Balanced Rock	P	0	0	100	
3	Beautiful Valley		0	4,504.56	800	254.5
4	Begashibito		10,755.41	0	200	67
6	Big Sage Mesa	P	1,106.84	0	600	
8	Bita Ho Chee	P	0	0	500	
9	Black Falls		2,345.76	51,660.80	600	
109	Canyon Diable		232.12	0	0	
14	Chilchinbito	P	0	0	75	
15	Chinle	A	21,[illegible].75	5,501.09	1,7[illegible]	[illegible]
	Chinle School	B	0	0	0	
110	Coldfields	B	0	0	0	
17	Corn Wash	P	685.05	0	0	
18	Cove	A	0	1,163.43a	35[illegible]	138
19	Cow Canyon	P	0	0	10[illegible]	
24	Dennehotso	A	30,467.68	8,958.68	80[illegible]	657
25 & 10	Fort Defiance & Bonita Ck.	A	0	5,938.44	200	263.5
	Fort Defiance School	B	15,087.61	0	0	
27	Ganado and Cornfields	A	197,196.55	32,769.61	2,82[illegible]	1,45[illegible]
31	Houck	A	17,380.86	0	7[illegible]	353
111	Indian Wells	B	634.30	0	0	
106	Joddite	A	31,296.75	0	52	52
35	Kinlochee	A	34,545.42	0	250	200
36	Klagetoh	A	23,425.14	0	400	[illegible]
37	Klethla Valley	A	437.35	10,355.00	250	
38	Lukachukai	A	54.20	40,238.00	300	
39	Left Hand	P	0	0	7	
40	Leupp (Flood protection)	B	28,377.46	0	0	
43	Lower Dennehotso	A	61,414.78	339.95	300	
44	Lower Moencopi	A	36,232.85	6,329.52	400	
45	Lower Rock Point	A	208,877.62	0	2,000	[illegible]
47,62 & 94	Lukachukai-Tohatsa, Priest Lake	A	2,248.78	4,435.90	1,000	[illegible]
48	Many Farms	A	299,479.86	6,686.00	8,400	1,0[illegible]
50	Marsh Pass	A	71,349.97	7,978.00	400	[illegible]
	Marsh Pass School	B	2,138.40	0	0	
117	Mexican Waters	B	242.05	0	0	
52	Moenave	A	3,754.41	1,791.33	95	[illegible]
53	Moencopi (Tuba)	A	54,905.29	923.00	640	640
61	Natani's	A	12,178.70	11,019.00	175	100
62	Natural Bridge	A	9,031.20	0	2,000	[illegible]
33	Navajo and Jones Canyon	A	187.13	14,526.00	100	81
	Navajo Tribal Fair	B	968.62	0	0	
63	Naslini	A	23,355.07	3,615.00	100	20
64	Oak Springs	P	0	0	50	[illegible]
65	Oraibi Wash (Hopi)	A	16,019.561	1,297.00	450	
67	Paiute Canyon	A	7,021.22	0	175	
112	Pinon	B	894.00	0	0	

F. W. 95

Area	Investigation	
0		nd no information.
0		canal and subjugate 500 acres.
0		and estimate for greater proje
0	234.5	dicowy and subjugate 500 acres.
0	87	flume and subjugate 200 acres.
0		-survey, map and investigate to
0		ersion dam, canal,
0		voir to 600 ac. ft.
0		diversion dam, constr
0		diversion dam, impr
0		ersion dam, feeder
0	1,470	
0		tig
0		vestigation to deter
0		-way diversion dam, & canals and
0	138	structures, erosion control, fl
0		00' canal from storage dam, sur
0	637	n and imp
0	263.5	anal, structures on s.
		and
	1,457	nt un
	225	vestigation
		dam improve main canals and st
	52	
	200	
	370	
	870	
	1,081.5	ms, feeder
	338.5	
	85.5	carrier and outlet
	640	
	100	and estimate for diversion dam,
	28.5	to determine feasibility of
	51	ment, small
		diversion dam,
	20	ere, improve and extend
	12.5	supply q artesian

SUMMARY OF NAV
(Nos. refer to Nos.

ARIZONA (contd.)

No.	Name
107	Tolacca-Wepo Wash
	Quarters
69	Redhouse
70	Red Lake
71	Red Rock
72	Red Rock Valley
73 & 66	Reservoir Canyon (Hopi)
74	Rocky Point
75	Round Rock
78	Segihotsooi
79 & 98	Sehili
81	Slim Whiskers
[illegible]	[illegible]
85	Tanner Springs
86	Tesnospos
87	Tochinlini
88	Todenstani
93	Toh De Nee Ho Lake
95	Tolani Lakes
97	Tolthlakan
99	Tuba City School
114	Upper Gr[illegible] Wash
102	Wepo Wash
103,28,46	Wheatfields, inc. {Greasewood / Lr. Wheatfi
104	Whiskey Creek
115	Wide Ruins

[illegible]rizona

[illegible]ehab. $2,486.

[illegible]	Captain Tom
116	Casamera
	[illegible] School
20	Crown Point School
21	Cr[illegible] ([illegible] Lr. Crystal)
22	Cudai
23	Dalton Canyon
26	Fruitland
29	Grey Mesa
30	Hogback
34	Juan's Lake
[illegible]	[illegible]

SUMMARY OF NAVAJO IRRIGATION PROJECTS
(Nos. refer to Nos. in Postwar Estimates 6/30/43)

	ARIZONA (contd.) Name		Irrig. Cost to 6/30/43	CCC-ID Cost to 6/30/43
[illegible]	[illegible] Wash	B	$ 4,582.69	$ 0
	Quarters	B	33,320.65	0
69	Redhouse	A	3,855.48	901.00
70	Red Lake	A	39,752.16	0
71	Red Rock	A	2,050.40	901.00
72	Red Rock Valley	A	15,164.50	680.00
73 & 88	Reservoir Canyon (Hopi)	A	2,788.30j	0
74	Rocky Point	A	97.47	4,834.71
75	Round Rock	A	56,622.36	0
78	Segihotsoci	A	1,265.70	0
79 & 98	Sehili	A	6,343.21	5,225.00
81	Slim Whiskers	P	0	0
[illegible]	[illegible]	B	1,707.12	0
85	Tanner Springs	P	0	0
86	Teamospos	A	27,136.69	0
87	Teohinlini	A	4,605.79	0
88	Todemstani	A	7,106.78	0
93	Teh De Nee Ho Lake	P	0	0
95	Telani Lakes	A	2,813.46	4,405.00
97	Telthlakan	A	9,399.66	1,875.00
99	Tuba City School	A	0	0
114	Upper Oraibi Wash	B	633.96	0
102	Wepo Wash	P	0	0
103,28,46	Wheatfields, inc. (Greasewood and Lr. Wheatfields)	A	14,171.47	10,112.00
104	Whiskey Creek	A	273.54	0
115	Wide Ruins	B	1,481.90	0
	Arizona		$1,465,365.55	$249,719.78

Rehab. $2,486.14, i,j-Hopi projects, m-May inc

		A	$ 382.63	$ 1,163.43
		P	0	0
		A	95.13	0
[illegible]	Captain Tom	A	101,621.86	6,011.94
116	Cassmera	B	7,535.95	0
	[illegible] School	A	12,001.71	0
		A	69,722.83	3,080.40
20	Crown Point School	A	0	0
21	Cr[illegible] (Lr. Crystal)	A	20,123.95	0
22	Cudei	A	291.52	0
23	Dalton Canyon	P	0	0
26	Fruitland	A	640,710.83	46,759.00
29	Grey Mesa	A	0	677.93a
30	Hogback	A	418,327.23	10,541.07
34	Juan's Lake	A	9,902.74	0
[illegible]	[illegible]	B	9,899.02	0

F. W. 98

NN000773

Proposed Work

- to determine cooperation with U.S.R.S. in Animas Project.
- 0; distribution system, $1,500; subj. 100 acres, $6,000.
- ion dam, install sluice and head-gates, and subj. 200 acres.
- m for feeder canal.
- rvoir and poor soil do not justify expansion.

- back.
- and plans for major project.

- and structures, build additional canal structures, and subjugation.
- dams, 5 mi. canal, and subj. 500 acres.

- on this project.
- al, and subjugation.
- dam with cone. Reconstruct Hudson Lake storage dam, stabilize main canal, and subjugation.
- on system, and subjugation.
- structures on main canal and subj. 500 acres.
- in div. dam, T.O.'s and checks in main canal, and subjugation.
- completion main canal.
- d riprap slopes.
- ruct canal system.
- subjugation.

- San Juan, rehab. canal system.
- dam, canal structures, and subj. 1,000 acres.
- 71. storage dams.
- dam and canal.

.075 For assistance on miscellaneous Indian tracts.

F. W. 99