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JUL 28 1920
U. S. INDIAN SERVICE

U. S.
INDIAN
IRRIGATION
SERVICE
DISTRICT
No. 5.

Annual
Report
1 9 2 0

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Supervising
Engineer.

Original forwarded
to Indian Office
7-24-1920

CV-6417-201

NN008161

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GANADO

The summer of 1919 was the wettest since the project was started. There were five severe storms which amounted practically to cloudbursts and a number of lesser storms, all of which damaged to a greater or less extent the canal system. The North Side ditch which had just been completed was filled with debris for a stretch of two miles. The South Side ditch was washed out in two places and filled in with debris for a stretch of a half mile. No structures were damaged. The arroyo bridged by flume No. 4 ran bank full for twenty-four hours and the cutting of the banks at the ends of the flume made it necessary to build heavy rock walls to prevent further cutting. At Station 5 on the main canal the Rio Pueblo Colorado cut the forty foot bank dangerously near the canal making necessary a considerable amount of heavy riprap. A rock ledge nearby was blasted down and the rock heavily massed at the point of cutting.

A masonry division gate was built at the junction of the North and South Side ditches. A seventy foot steel truss for flume B on the North Side ditch was erected, and material for two other

flumes is on the ground.

We were fortunate during this year in that it was not necessary to divert into the reservoir any of the heavily silt laden flood waters. There was enough flow of clear water to fill the reservoir.

The Indians of the neighborhood are clamoring for land under both South and North Side ditches. This year they have 330 acres in cultivation, planted to corn, alfalfa, oats, potatoes and melons. All land cultivated this year is under the South Side ditch. Some fencing has been done, but in a half hearted way because no Indian can be sure of permanent possession of such land as he may fence.

Under his contract with the Government, Mr. J. L. Hubbell cleaned out the main canal and South Side ditch down to his land. From there on the Indians cleaned out the ditch to their plots, the number of which, in spite of the uncertainty of their holdings, increases each year.

In addition to the 330 acres cultivated by the Indians, Mr. Hubbell has 120 acres in crop,

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mostly alfalfa.

No work was done on the North Side ditch because of lack of funds, although twenty Indians asked for water to irrigate small plots under it. The amount of work remaining to be done is small, and without organizing a regular construction force, we will probably be able to complete the most of it from savings on the maintenance funds, as Foreman Maus with a small amount of Indian labor can be doing this when not busy with other work.

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KIN LE CHEE

The attention of this office was called to what might possibly be a small irrigation project lying from seven to eight miles north of Ganado on the Rio Pueblo Colorado and which we have called the Kin Le Chee Project, the name, being interpreted, means the Red House and is so called from some prehistoric ruins built of red sand stone at this place.

The project was looked over by Mr. Post who reported favorably on it and Mr. Flitman was sent out to make the necessary surveys. It seems that at this point the Rio Pueblo Colorado has a perennial flow of five or six second feet all of which is lost in the sand before it reaches the Ganado Project and therefore the diversion of any part of this water will not materially affect that project. There being a considerable fall to the country the conditions are favorable for diverting the water although the stream bed itself is in a deep cutting. The only drawback is that at several points the walls of this deep cut are of solid rock where it would be very difficult to build a ditch. Hence to cover the land three flumes are necessary.

The Indians living in this section have

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gotten some water out and have been very industrious in their agricultural activities and now stand ready to furnish all of the labor necessary to put the project in shape except the building of the flumes and the headgates.

Surveys show that the area under the ditch is 441 acres and the estimated cost will be $5476.00 or approximately $12.40 an acre.

A report on this project was submitted to you April 21st and some additional information sent you early in May and your approval was received the last week in June. It is thought that the project has considerable merit and as the Indians will donate all of the labor the cost to the Irrigation Service being only for the material and the supervision with perhaps a small amount of labor in erecting the flumes it is believed that the estimate will be sufficient to do all of the work.

The final plans will be submitted and construction begun as soon as practicable.

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LEUPP

In January an investigation was made of the possibility of utilizing the flood waters of what is known as Corn Creek on the opposite side of the Little Colorado river from the Agency at Leupp. All of the drainage from the Hopi country from what is known as the first Mesa wash, the Wepo wash and Oraibi wash, together with the drainage from Corn Creek proper, which drains the lands lying south of Keams Canyon in the vicinity of what is known as Indian Wells, enter the Little Colorado at this point.

For a great many years the Indians have been cultivating lands along the river, using the flood water from this stream but have been greatly handicapped by the large amount of silt which was deposited on the lands, for at times these washes bring down a flow of practically nothing but mud. It was determined that by building a small dike to keep this flow from the land and then cutting a short ditch through a ridge, provided with a headgate, the flood waters could be controlled and when they were too muddy would be allowed to flow down the wash and at such times as they were carrying a less amount

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of silt the water could be turned through the ditch on the lands.

Your approval was received for this construction and work was commenced in May. It was found that the Indians were so busy with their own work, planting and care of stock that it would be impossible to secure sufficient labor to finish the work before the end of the fiscal year but it will be pushed as rapidly as possible and should be completed during July.

Survey

General examinations were made of the valley above the work above described and it was found that in a narrow valley from seven to eight miles long the combined water of these washes could be spread out over the land, in all probability, with a comparatively small amount of work which would enable the Indians to raise corn in it with the two or three soakings the land would get from the flood waters.

It was also noticed that the waters were beginning to concentrate themselves in a small channel which was beginning to erode very rapidly and that unless some work was done there at an early date

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the erosion would be so deep that it would be impossible with a reasonable expenditure of money to spread or control that water.

In order to decide what was necessary and what could be done a good topographical survey was necessary and Mr. Flitman was detailed about the first of June to make a plane table map of this valley. As soon as the field work is completed plans will be made for the control of this water as outlined above and submitted to you for your approval. There is an area in this vally estimated at fully twenty square miles and the utilization of even a part of this for raising of corn will be of great benefit to the Indians.

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MARSH PASS

This project was practically complete over a year ago but it was found that through some error, probably on the part of the man who made the final location at the upper end of the ditch, for a distance of a little over a mile a mistake had been made in the grade leaving it too flat.

An outfit was started on the work to remedy this, about the end of September and the ditch was cleaned of its accumulated silt and the grade corrected by some additional excavating, quite a proportion of which was in rock. The additional work of excavation was caused by a large accumulation of silt at the upper reaches of the ditch. The amount of this silt and the new excavation aggregated about 4200 cubic yards, of which 75 yards were rock.

It was also found that the diversion dam had settled a little unevenly and some of the apron below had been damaged by high water and both of these things were remedied.

On the completion of the work a thorough test was made by running water through the canal and it was found to be in perfect condition and the project was thereupon turned over to the Superintendent

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in charge of the reservations. The Superintendent was unable to visit the project personally but the Farmer and the Principal in charge of the Marsh Pass School both went over it with the Engineer from this service and knew at the time that everything was working correctly.

There have been no reports received in this office from this project this irrigation season to indicate whether any damage had been done to the project during the past winter, but we have reports that only about fifteen acres of land have been put under cultivation this year.

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WEPO WASH

This is a project to control the flood waters of the Wepo Wash, which lies on the Northwest side of the First Mesa and is the site of the largest cultivated area of the Hopi Indians.

The waters had, for generations, spread out over a wide portion of the valley wetting the land and putting it in good condition for crops. The summer rains would bring down additional floods which would irrigate the growing corn and bring it to maturity. Of late years this water has been cutting deep channels, refusing to spread over the lands and damaging the fields with deep arroyas.

It was proposed to control the flood waters and prevent erosion by means of wire fences to hold back the floating debris and automatically terrace the ground. These fences were to be constructed by setting cedar posts deep into the ground and putting on a heavy mesh hog wire twenty inches wide, the lower edge of which would rest on the ground. This work was commenced last year but owing to misunderstandings by the man doing the work it was not being done in the manner to have the desired effect and as the saason was getting late he

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was transferred to other work. This last winter Instrumentman V. J. Lewy was sent out to complete the work. I went with him and we personally went over the details and the work was laid out on the ground.

It was found that in addition to the so-called fences it was advisable to build a few small dikes and to put in little earth dams in many of the samll washes to hold back the flood waters more completely than the wire fences would. This work was completed and some of the details are shown very clearly in the accompanying pictures.

There has been no runoff of any magnitude and no floods since then; the summer rains which usually commence early in July will soon commence and Foreman Womack has been instructed to keep in close touch with the situation there to report the effect of the construction and whether it is accomplishing the work as was planned.

Great hopes are placed on this construction and if it proves effective there is a considerable area of land around these Hopi regions that will need considerable work to save them from des-

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truction by the erosive action of the streams. The necessity of the work cannot be too strongly put, and if this method is not sufficient to do the required work other methods must be found, or these Indians will be left helpless and without food.

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WIDE RUINS

During June and July of 1919 Superintendent of Construction Flitman was sent out to make a survey and report on the feasibility of constructing a reservoir and ditch at Wide Ruins on the Navajo reservation about twenty-five miles south of Ganado.

The data secured by Mr. Flitman was incomplete in part but a report was submitted to you and you directed that some additional surveys be made to secure the data needed to give all of the information necessary to determine the feasibility of the project.

At the end of January 1920 Mr. Flitman was sent back to complete the work and when you were here in March you went over the drawings and information at hand and decided that the project did not warrant construction. For that reason no completed report was sent you and because of your action the further consideration of the project was abandoned.

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UNDERGROUND WATER NAVAJO AND HOPI

Each year since 1912 I have devoted a considerable space in my annual reports to the needs and value of the well drilling and underground water development in general on these reservations, and under date of February 9th, 1918 I submitted a lengthy report (some 30 pages) devoted to this subject.

It would seem that this phase of the subject has been very thoroughly covered and that it was fully understood in Washington that this work was probably the most important and valuable work being done in this District.

When the Congressional Committee were here this spring they were very outspoken in their views in favor of not only continuing this work but increasing its scope.

For these reasons I will confine myself in this report to a more general statement of what is being done and to the program prepared in this office for the next fiscal year and submitted to the Office for approval on July 1st.

During the past year the progress in

new wells drilled was smaller than for several years past. This is to be accounted for by several different facts. With the increase in wells, the operation and maintenance expenses increased, as is fully understood. The great demand for drillers throughout the country owing to the increased activities in oil drilling where they were paying high prices for skilled men has made it difficult to secure competent men, and we were unfortunate enough to get two different men as drillers, both of whom came with good recommendations and both of whom turned out to be anything but competent men, who did poor work and really accomplished nothing.

In addition to this all materials and supplies for this kind of work has increased from 50 to 200 per cent. The amount of money given us last year was insufficient to carry us through the year and all work was closed down in May. We also purchased a new drill rig during the year for this work which further cut down our supply of funds for actual development of new wells and new water.

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Owing to all of these combined circumstances a different program was suggested for the new year, and the following was submitted for approval.

July 1st, 1920.

The Commissioner of Indian Affairs,
Washington, D. C.

(Through the Chief Engineer)

Sir:-

Last year I submitted to you a program for the water development on the Navajo and Hopi Reservations, which was approved by you. The approval of work then would carry on through much of this year, but investigations in the field, long discussions of the various points involved with Foreman Womack and other employees and the general impressions gathered from the Congressional Committee when they were in this section has led me to believe that we can work to a better advantage by modifying the present program, and I submit the following for your consideration and approval.

Owing to the very high cost of all material entering into this work, the wells and the equipment left there for pumping the water, will cost perhaps double what it would have cost three years ago.

As has been heretofore presented to you at considerable length, it is absolutely necessary to operate and maintain the wells put down as the Indian cannot do it for himself and if they are allowed to go for sixty days without attention the whole plant any any one well is liable to be a partial if not a total wreck. This work will take considerable money.

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The development of water on these reservations has involved building surface lakes or ponds, development of springs and similar work in addition to the drilling equipment and maintenance of wells. Some years ago we did considerable of the former work, but of late years, becuase of shortage of money have neglected it in favor of the wells.

Now that the area already worked over with springs has all been covered and it is necessary to go further out with the well drilling, it seems to be necessary, to preceed the well rigs with the other work that the water already existant be located and made to serve the best possible use, as the location of the springs and the amount of water developed will influence to a certain extent the location of the wells.

If this work is to be done and the maintenance work continued, it will be necessary to close down on the well work in part in order to make the available funds hold out.

During the fiscal year 1920 we run out of money by May and were obliged to close down all of the work for the last seven weeks of the year. To avoid the necessity of this another year and to provide for the additional work this modified plan has been worked out.

The approved plan is for continuing the work on the San Juan Navajo by a line of wells along east of the Lukachukai Mountains. To complete a row of wells along the southern part of the Hopi reservation and then move the rig over into the Western Navajo Reservation to such localities as may be decided upon between the Irrigation Service and the Superintendent in charge.

One of the very important questions to be settled in this country is that of the encroachments of the Navajos on the Hopi country, and something is to be done to remove the pressure. There is talk of removing Navajos from a certain area,

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by force if necessary, and other plans to keep them back.

There is a large area of the central part of the Moqui Reservation upon which the population is several times as dense as on any other part of the Navajo-Hopi country. In addition to being over populated for the resources of the country it is overstocked and consequently is being overgrazed.

This is because there is more water there, most of it water developed by this Service. The Navajo is nomadic, and if, in the further outlying districts where there is grass additional water should be developed, it is believed that these Navajos would voluntarily move out, relieving the pressure around the Hopi mesas.

The above should be a good argument for continuing the drilling in the Moqui reservation, especially in the region lying north of the present development. With the present amount of money this cannot be done if Rig No. 6 goes to the Western Navajo.

There is no question but that additional water is needed on Western Navajo but any work there is going to be much more expensive and the results for the expenditure of a given amount of water will be smaller than at other points. The geology of that section is not indicative of shallow wells or of water at reasonable depths over much of the area. I do not care to go into an extensive discussion regarding the reasons, but the principal ones are as follows: The entire formation dips to the south and all underground water would move, generally in that direction. The country has been cut through from east to west by the Moencopi Wash and all of the water bearing strata cut through to the shale so that all water movement is cut off. This would leave only the water that originates on the mesas lying south of this point and the annual average rainfall is less than six inches. Of course in this I am not including the lands lying to the North of Tuba.

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The population being smaller there is greater range for a given number of cattle. I am not saying that they don't need the water development over there, for they do, and with more money they should have their share of the development, but I am saying that with a limited amount of money, the largest results in developed water, and by far the largest amount of good can be realized by working in the Hoqui Reservation for at least another year, covering the lands north of the present area on which wells have been put.

The following program is recommended for the Fiscal Year 1921.

That Well Rig No. 7, now located in the extreme eastern part of the Navajo Reservation be laid off for at least a part of the year, say six months.

That Well Rig No. 6 which is now in the south-western part of the Moqui Reservation be moved on north to cover lands indicated above.

That before No. 7 is closed down, Mr. Cravath drill the one well where it is located, and then return to take charge of Rig No. 6, and Mr. Jameson who has gone to California on leave, be given leave without pay until later in the season.

The usual maintenance be continued with the outfit located at Chin Lee for the Navajo country and at Polacca for the Hopi Country.

That for the development of springs and building of surface tanks a good man be employed for the Navajo country and another outfit for the Hopi country. Each of these outfits will consist of a good mechanic at say $4.50 a day, with a good team and wagon, equipped with the necessary tools. He will need one or two Indian Helpers, and will try and have as much additional labor donated as possible.

We will have the sum of $35,000. for this work this year and it will be distributed about as follows:

Running one well rig for year	5,500.
Navajo maintenance crew	5,000.
Betterment of existing well equipment Navajo	400.
New outfit for spring development	5,000.
Hopi maintenance crew	6,000.
Betterment of Hopi well equipment	500.
Spring development crew	7,000.
Construction of tanks and troughs at wells developed during year	300.
	$29,700.

There will be superintendence and the purchase of certain equipment that may be needed, and unexpected expenses and from any surplus run Rig No. 7 part of year.

By following this program for the balance of this calendar year it will be demonstrated whether we will have sufficient money to again put No. 7 rig into operation for the balance of the fiscal year.

Trusting this will receive your early attention and approval I am,

Sincerely yours,

(Signed) H. F. Robinson,

Supervising Engineer.

It is probable that we will be able to put Rig No. 7 into commission for the latter part of the fiscal year, but in the meantime we will get the natural water over a considerable area developed to

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do its utmost good, will be able to develop some tanks or reservoirs on high ground where we are not able to develop wells and have the general plan for the entire reservation better planned out for the future work. So far we have only considered a comparatively limited are which we now have fairly well covered, and this year should demonstrate the work needed for the other parts of the reservation.

Investigations will be made over other parts of the country and a detailed program for as much as possible will be made out and submitted to the Indian Office for approval or suggestions.

During the year a new rig was bought for the west part of the Navajo and the Hopi country to take the place of Rig No. 4 which was entirely worn out. This is one of the up-to-date, modern type, gasoline tractor with a capacity up to 350 feet. With this rig we should be able to do more and better work than we have in the past.

With additional money for another year promised, the program outlined for this year should allow us to make the work for the next year more effective.

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