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RESEARCH
RFA-#10

Irrigation On
Upper Verde River Watershed
From
Surface Waters

T. A. Hayden
1940

IRRIGATION ON THE UPPER VERDE RIVER
WATERSHED
From
SURFACE WATER

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INTRODUCTION

The following report gives the results of investigations made by the writer in January, May, June and July, 1940 and in the year 1925.

The area covered consists of the entire Verde River watershed above the Camp Verde damsite, excepting only very small uses such as individual domestic consumption, stock-watering, and the irrigation of small home plots, mostly in the mountains.

There was sought to be determined from the best evidence available, the location and areas of all lands now or formerly irrigated, the dates and manner of appropriation of water, and, in the case of land no longer irrigated, the dates when water was last used. In addition some study was made of the water supply, both surface and underground.

SUMMARY

There are 10,000 acres of land now under irrigation from surface waters of the Verde above the Camp Verde damsite. 3,700 acres of this area have water rights in the Seventies or earlier, and 3,700 acres, 1910 and later. 1,300 acres formerly irrigated are abandoned or irrigated from other sources.

There are six natural geographic divisions:

- (1) Chino Valley, near Prescott.
- (2) Upper Verde Canyon.
- (3) Upper Verde Valley - The Clarkdale - Camp Verde area.
- (4) Oak Creek, Upper & Lower.
- (5) Beaver Creek.
- (6) Clear Creek.

The main streams in divisions 3, 4, 5 & 6 are fed along their course by many springs and artesian pressure exists in the main Verde and Chino Valleys.

The irrigation season is approximately five months - May-Sept. inclusive.

Consumptive use of water is approximately two acre-feet per acre for the season in divisions 3, 4, 5 & 6, aggregating 7,000 acres, but approximately 250 second-feet continuous flow (or 75,000 acre-feet for the season) is diverted to supply the 14,000 acre-feet consumptively used, a ratio of 5 to 1.

In Chino Valley the water supply is adequate for only a small part of the land. On the main Verde and on Oak, Beaver and Clear Creeks water is run continuously in all canals and ditches and all lands take unrestricted quantities as they elect, without regard to the rights of older lands.

Increase in water available for Salt River Project from the Upper Verde might be achieved by:

- (1) Improved irrigation practice and facilities to reduce waste.
- (2) Restriction of diversions to water beneficially used.
- (3) Fixing a reasonable duty of water by Court or other competent authority.
- (4) Adjudication of water rights by priority of appropriation and regulation of use in accordance therewith.
- (5) A periodic check of areas irrigated and effective opposition to revival of lapsed water rights and to initiation or perfection of new ones or extension of old.
- (6) Development of artesian or other underground water by pumping in dry seasons in the Upper Verde Valley and running the water down the river channel to the Salt River Project.

* * *

The foregoing summary is briefed from the results of the field investigations by the writer previously mentioned and of a mass of engineering reports, maps and public records later enumerated, some of which are reproduced here.

The investigation made by me in 1925 related solely to the area then being irrigated without regard to date of water right. The determination of areas offered no difficulty except the mere physical problem of checking so many small irregular tracts extending over so large a territory. Very little original field surveying was necessary. Areas were determined from surveys and reports by various agencies listed below, checked by comparing one with the other and by inspecting

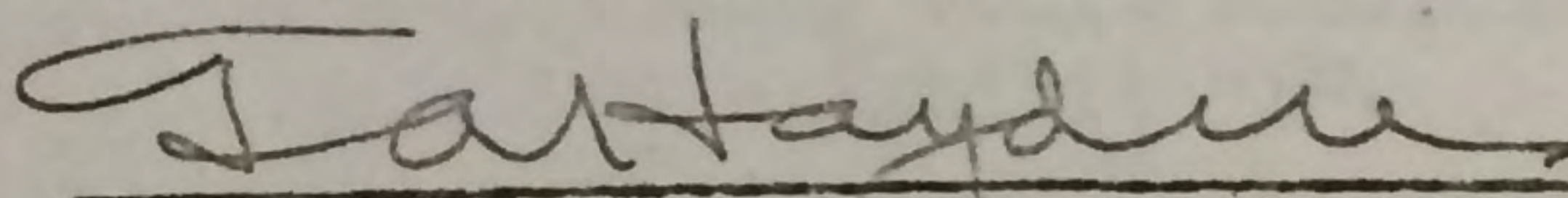
the individual tracts in the field in 1925 and in 1940. In a few cases small areas were estimated or recorded as given by the owner, by forest rangers or someone in a position to know.

The fixing of dates of appropriation of water was a tedious and at times uncertain task, especially as to the older lands. Since much of the land was under irrigation in the early Sixties, testimony of living witnesses with personal knowledge concerning dates of original cultivation is now indefinite or entirely lacking. However, much evidence of this character is recorded in previous engineering reports and surveys, and is in the files pertaining to a number of law suits in the Yavapai County District Court. Water right filings on which many of the developments were made are on file in the office of the Yavapai County Recorder and some of the early ditches and farms are shown on U. S. General Land Office township plats and on U. S. Geological Survey quadrangles. Early land filings are shown by the U. S. Land Office records. All this documentary evidence was carefully studied to determine water right priorities and the results are recorded herein in detail.

Fowler & Frankenberg - 1896, herewith, Exhibit "C-1"

This report was discovered in the secretary's files, Salt River Valley Water Users' Association, after the 1940 report was finished, and a copy was made and inserted for reference and to make the list of exhibits complete. A careful check of data concerning each tract and ditch listed disclosed the omission of ditches and of large areas of irrigated land, the existence of which at the time is proved by documentary evidence elsewhere herein cited. The dates given for construction of ditches are almost invariably later than those given by other authorities and proved by old maps and testimony, court decrees, etc. Nothing was found in the report requiring or justifying any change in the text or tabulations in the 1940 report.

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T. A. Hayden, Oct. 31, 1940.

Robinson & Woolf - Sept. 1, 1895, herewith Exhibit "C".

Stroud & Prothero - Nov. 2, 1899, herewith Exhibit "D".

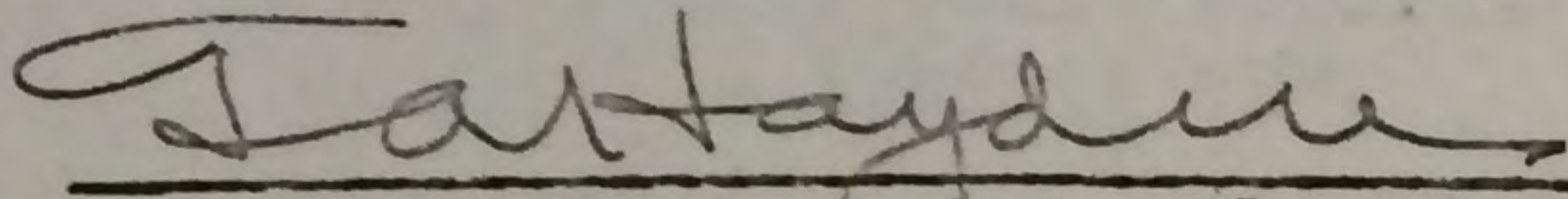
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Sources of data are as follows:

Dates of Water Rights

U.S. Land Office: Township plats giving early ditches and irrigated land. Also tract books giving entries.

U.S. Geological Survey Quadrangles, giving early ditches and irrigated land.

Water Right Filings, Yavapai County Records. Complete list, briefed, herewith, Exhibit "A".

Water Suits, Yavapai County Court Records. List, briefed, herewith - Exhibit "B".

Land Areas. Also Water Rights

Robinson & Woolf - Sept. 1, 1895, herewith Exhibit "C".

Stroud & Prothero - Nov. 2, 1899, herewith Exhibit "D".

Land Areas. Also Water Rights (Cont'd.)

O. A. Turney - July 1901, herewith Exhibit "E" omitting parts not pertaining to this area.

Park W. Latimer, County Surveyor, Yavapai County, May 1908 - map. Copy in Yavapai County Assessor's office and copy in Salt River Valley Water Users' Association's files.

H. L. Hancock, July-Oct., inclusive, 1914, herewith, Exhibit "F".

H. D. Phelps Feb.-June, inclusive, 1920, map in 26 sheets, originals in Phelps-Dodge Mining Corporation files, - copies in files Salt River Valley Water Users' Association.

U.S. Bureau of Reclamation - Survey completed April, 1934 by F. N. Holmquist. Map in 37 sheets - original in U.S. Bureau of Reclamation files. Copies in F.N. Holmquist and Salt River Valley Water Users' Association's files.

Copies of the above mentioned reports not accessible in official public files are included here to preserve them for future reference in the event of the only other known copies being lost. In the case of the Hancock report, a number of typographical errors in the printed edition from which the accompanying copy was made have been corrected. These corrections were checked and verified by Mr. Hancock.

Most of the data as to year of the respective appropriations of water was obtained from the early engineering reports here reproduced. These were compared with each other and checked as far as possible with recorded water right filings, G.L.O. township plats, Court decrees, etc. Each ditch and tract of land has been listed with the earliest priority of appropriation definitely given by any of the authorities quoted. Certain tracts, such, for instance, as parts of the areas under the Hickey, Cottonwood, O.K., Eureka, Pioneer, Wood and other ditches, have been conceded priorities as of the years of completion of the respective ditches. This obviously results in giving some of the lands earlier priorities than they are actually entitled to, unless all the land under the several ditches was brought under cultivation in the respective years

the ditches were built, which is highly improbable. From a practical standpoint, however, no material difference results, because in the case of these very old ditches a matter of even ten years margin would still give them water rights older than the bulk of the land on the watershed, and leave them in the period of time for which even the lowest flow of the river is adequate.

The evidence regarding later lands, whose rights do not date back to years when the irrigated area was small enough to be supplied by low-stage flows, is sufficiently definite to fix their priorities within fairly narrow limits.

Therefore this record, while admittedly approximate in the time factor for the early lands, is believed to afford a fair foundation for any control of use of water which might be attempted on the basis of priorities.

USE AND DUTY OF WATER

Determination of the amount of water running in streams and ditches and used on the land was attempted only in an approximate way and to a sufficient extent to give a comprehensive general picture of conditions as a whole.

Water is used for approximately five months from May to September inclusive - the period being shorter in the higher elevations around Prescott and on Upper Oak Creek and longer in and near the main Verde Valley. A rough estimate was made in July of the continuous flow of water running simultaneously in the main ditches of the Verde area as follows:-

Main Verde Ditches

Allen Ditch	10	Sec.-ft.	
P-D Pumps	9	" "	
Hickey Ditch	20	" "	
Cottonwood Ditch	45	" "	
Pete's Ditch	5	" "	
O.K. Ditch	30	" "	
Wood Ditch	35	" "	
Eureka Ditch	15	" "	
Eaman Ditch	10	" "	
Pumps	<u>5</u>	" "	184 Sec.-ft.
Oak Creek Ditches	35	" "
Beaver Creek Ditches	17	" "
Clear Creek Ditches	<u>17</u>	" "
Total	253	Sec.-ft.

This is 1.45 Miners' Inch continuous flow diverted for each of the 7,000 acres of land irrigated, or 230 Miners' Inches per 1/4-Section of land, compared to the amount of 48 Miners' Inches per 1/4-Section allowed at the farm headgates (equivalent to an average of about 65 Miners' Inches diverted) to Salt River Project lands under the Kent Decree. The only record found of an attempt to fix duty of water was in the judgment by Judge R. E. Sloan dated September 7, 1900, in favor of plaintiffs in Case 3013, Yavapai County District Court, Wilber et al, vs. Head, et al, in which it was decreed that plaintiffs had just right to the use of 475 Miners' Inches for their lands, of which 325 acres were then under irrigation. The duty of water computed from these figures is 1.46 Miners' Inch per acre, or 234 Miners' Inches per 1/4-Section, which coincides closely with the amount of 230 Miners' Inches arrived at by the approximate estimates previously given above.

The amount of diverted water on the Verde is higher compared to delivered water than in the canal systems of the Salt River Valley, owing to the small size of the ditches, their proximity to the main streams, with consequent high seepage losses, and the number of leaky wooden flumes and structures. Out of a total of 83 independent ditches

only about ten carry 10 or more second-feet of water. As far as could be ascertained, water is diverted and run continuously during the irrigation season in all canals and ditches, with the possible exception of the Allen, or Tunnel ditch, which has a permanent steel and concrete diversion dam and wooden headgate, by which the diversion may be controlled.

There are provisions under Court decrees for the distribution of water by a Water Master or Commissioner to be appointed by the Court, on the Cottonwood, Wood, and Beaver Creek ditches and water rights were adjudicated as of 1900 by year of priority on Clear Creek. With the exception of the latter, where all the flow is diverted for most of the irrigation season, there is no restriction on use of water except as to rotation among individuals on the same ditch. On the basis of 250 sec.-ft. flow in all ditches, 500 acre-feet daily, or 75,000 acre-feet annually, is being diverted over a five-months period for 7,000 acres of land in Upper Verde Valley, Oak, Beaver & Clear Creeks. Assuming two acre-feet per acre applied to the land as a reasonable consumptive use under the soil and climatic conditions, around 14,000 acre-feet at the lands would give them an adequate water supply with no restriction whatever due to prior rights of older users. The diversion of 75,000 acre-feet to give net water use of only 14,000 (a ratio of more than 5 to 1) is believed excessive. It is impossible from data available to make even an approximate estimate of how much, if any, of this excess could be saved and made available for use of lands in Salt River Valley.

PHYSIOGRAPHY AND HYDROLOGY, UPPER VERDE

Surface flow in the Verde River occurs in such a manner as to make its measurement in conjunction with the numerous diversions and the return seepage, with contributions from natural ground water and springs,

a highly complex and difficult problem.

A brief touch on the conditions as observed in June and July 1940 over the 40-mile course of the river below Sycamore Canyon will give a general idea of the great number of indefinite factors to be considered. Starting out with an estimated flow of 75 sec.-ft. below Sycamore Creek, this stream was observed to have diminished to not over 10 or 15 sec.-ft. six miles below, near Tapco. A mile or so lower down, at Clarkdale, 20 sec.-ft. was diverted and about the same flow remained in the river. The Hickey Ditch, 1/2 or 3/4-mile downstream diverted 20 sec.-ft. and the Cottonwood, 1/4-mile below that, 45 sec.-ft. In the 35-mile course of the river to Clear Creek an estimated total of 184 sec.-ft. was being taken out, with approximately 25 sec.-ft. coming in at Oak Creek and none visible from Beaver or Clear Creeks. Yet below Clear Creek there still remained a flow estimated at 50 sec.-ft. These figures give a total of 144 sec.-ft. excess observed diversions over observed inflow, which, added to the 50 sec.-ft. in the river below Clear Creek gives a total of 234 sec.-ft. ^{for} the main Verde flow, which, had there been no diversions, would have been in the river below Clear Creek, less, of course, the amount of contributions which came from canal and land losses. It is not admitted locally that any system of control would result in a net saving of water over a period of years or even temporarily. It is claimed that due to the location of the irrigated lands and ditches close to the streams in the long narrow Valleys of the main Verde and its tributaries, all water not consumptively used is returned directly to the stream.

That a considerable portion of this diverted water does find its way back to its natural channel is a certainty, unless the absurd claim be made that this district is unlike all others known. Also it is true that

physical conditions are such as to favor the speedy return of seepage or leakage to the stream beds. Only bottom lands are irrigated and at no place do they extend over a half-mile from the main channel. The live flow of streams and springs at all times keeps porous underground beds saturated, and the limited storage space between the permanent water table and the ground surface leaves no room for accumulated reserves.

No evidence of any such accumulations was found in the entire basin to an extent which would threaten the land with waterlogging and the natural drainage is such that continuous irrigation in the same manner for periods from 40 to 75 years has disturbed but little, if any, the balance between inflow and outflow.

The main Verde river channel may be considered as a fairly deep drain extending down the approximate center of a narrow basin 40 miles long and from 1/4-mile to a mile wide, with three secondary and similar drains (Oak, Beaver and Clear Creeks) and basins entering from the east. The Valley is from 3,300 to 3,500 ft. above sea level. On the west mountains rise to a height of over 7,000 ft. in less than 10 miles, giving an area of about 200 square miles draining toward the Valley. On the east, after the first comparatively low benches and foot-hills the rise is more gradual, until the slope is reversed on the Colorado River side of the watershed at altitudes of 5,000 to 12,000 ft. The area sloping toward the Verde from the east and northeast is around 1,400 square miles. This makes a total of 1,600 square miles of high steeply sloping mountain land, the surface run-off from which enters the Verde. The superficial conditions are such as to lead anyone (at least a layman without a technical knowledge of geology) to the conclusion that most underground water as well as all surface flow from this area and possibly some from outside must eventually all reach the Verde. The great number and large flow of springs is striking evidence of the truth of this conclusion.

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Flowing artesian wells have been in operation in the Upper Verde Valley for many years, and the manner in which water alternately rises in and is absorbed by the river channel, as before described, furnishes positive evidence of free inflow from many lateral sources and of the freedom of movement through the underground structure which enables the underflow to maintain fairly uniform slopes regardless of local differences in grade of the river bottom or local seepage from irrigation. The large flow of some of the springs mentioned, which range up to as much as 40 sec.-ft. (1,600 Miners' Inches) is thought to have its origin in open channels or caverns dissolved in the "Verde limestone" which is peculiar to this region. This formation consists of a white lime rock of all degrees of hardness, occurring in sedimentary beds, mostly level, but sometimes tilted, folded and faulted, alternating with sandstone, agglomerates and volcanic flows and intrusions, over and surrounding the entire area. Logs of artesian wells show these alternate strata to exist for hundreds of feet below the river plane. The existence of extensive caverns, pot-holes and sinks is common. Notable among the caverns is a little known one on the north side of the Main Verde above Sycamore Creek which has been explored for a half-mile. Montezuma Well, a Sink over 300 ft. in diameter and of unknown depth, located on Beaver Creek, is the outstanding feature of its class. Exposed faces of lime ledges everywhere are honeycombed with pot-holes. These open passages permit free movement of any water present and this is true to a lesser degree of the deep porous beds of sandstone. Where enclosing caps, blankets or barriers of volcanic rock, clay, etc., prevent easy escape of water, artesian pressure is created as in the Little Chino and Upper Verde Valleys. The Chino basin is limited and has recently been developed by at least 18 wells. The extent of the Verde basin and its possibilities of production are not known. With a steeply sloping area of

over 1,500 square miles draining directly towards it, these possibilities may well be worth investigation.

WATER CONSERVATION ON UPPER VERDE

The manner in which irrigation is practised in the Verde Valley and on Oak, Beaver and Clear Creeks, and the absence of discrimination between old and late water rights suggests that changes might be made resulting in more water reaching the lower lands on the Salt River Project. Such changes would fall into two general classes:-

- (1) Changes to reduce waste.
- (2) Enforcing prior rights of old lands.

Under the first heading would be included (a) the better maintenance of flumes and other structures to prevent unnecessary spread of water over beds of washes and waste land, and (b) restricting the amount of water diverted to the amount beneficially used. This would entail, among other things, determination of seepage losses in ditches and the reasonable duty of water. Since there are over 80 ditches in all, only a few carrying as much as 10 sec.-ft. of water, most of them being short and close to the main stream channel, and since they are distributed over a large geographical area, it is obvious that effective supervision and control of water would constitute a major problem in administration. Water is now distributed on the Cottonwood and Wood ditches and on the Beaver Creek and Clear Creek lands under Court decrees, (See Exhibit B - "Water Suits") the first three by a ditch master or Commissioner appointed by the Court. However, since the quantity of water available and diverted is more than enough to permit practically unrestricted irrigation, little, if any attempt is made to measure the water. No system of complete control could be carried out without some method of measuring the water and the physical difficulties involved in doing this on so many widely scattered farms and ditches would

be great and would require a number of men continuously for over five months out of each year. The expense would be a relatively high charge per acre of local land affected, unless such expense should be spread out over the entire acreage interested, including the Salt River Valley lands.

The net amount of water (if any) which may be saved by such regulation is, as before stated, uncertain. Local water users, (among whom there is a well defined feeling of uneasiness that a legal controversy may some day arise with Salt River Valley lands over use of Verde water) are quick to assert that no amount of control would affect the flow reaching the lower river, since they claim that all leakage and seepage is returned quickly to the natural stream channels, and that, over the entire year, all surplus diversion above the water consumptively used is automatically accounted for in this manner. This contention has much to support it and the question arises as to whether or not the physical difficulties and expense of regulation would be warranted by the uncertainty of the savings. To establish and enforce such control would require first a legal determination of the questions involved and machinery to carry out Court orders. This also is a prerequisite to the adjudication and enforcement of prior rights of old Salt River Project lands as against late upper Verde lands. Of the 7,000 acres of land irrigated on the upper Verde, Oak, Beaver and Clear Creeks, 3,400 acres is prior to ¹⁸⁸⁰ ~~1,880~~ and would but seldom be out of water. The use of water on the remaining 3,600 acres is all that would be involved in any practical regulation attempted. The benefits from such regulation would be limited to low-flow periods only, but the expense would be a continuing charge. Assuming roughly that as much as a third of the water used by these lands is taken at times when older lands have a prior right to it, and assuming further a 100 percent

control, the saving would amount to 1/3 of 7,200 acre-feet, or 2,400 acre-feet a year. To effect this saving there would first be required Court action to determine and enforce the regulation aimed at, which action would have to be preceded or accompanied by elaborate and expensive Engineering work.

Following the establishment of the basis and machinery for regulation would be the cost of maintaining it. This is estimated at not less than three men for five or six months a season, costing probably \$5,000, more or less, including incidental expense, each year, or \$2.00 per acre-foot for all water saved.

CHINO DISTRICT

The foregoing concerns the Verde Valley, Oak, Beaver and Clear Creek areas. The Chino Valley area is separated from it about 50 miles by road and constitutes a distinctly separate problem. The main factor in the latter area is the Chino Valley Irrigation District, claiming water right for 2,538 acres under 1911 water filings under the old law and later filings, permits and water right certificates under the 1919 State water code. (See accompanying maps)

They depend solely on water stored in Lake Watson (4,800 acre-feet) and Willow Creek Reservoir (6,000 acre-feet) supplemented lately by artesian wells. The combined drainage area above these reservoirs is less than 70 square miles and the total water available is adequate for only a part of the lands. The practice is to leave some areas fallow or "dry-farmed" and double up available water on the remainder. Since the earliest date which can be claimed for any of the land is that of the first water filings in 1911, most of the water is stored at times when older lands below on the Salt River Project have a prior right to it. To this extent there is a continuing infringement on Salt River Project water rights, in

effect since the lands were first irrigated in 1916. So far no action has been prosecuted in defense of these rights.

It is currently proposed to increase the height of the Watson dam so as to add to the storage capacity of the reservoir and raise the water high enough to spill surplus over into the adjacent Willow Creek reservoir, which has a large excess capacity over the run-off from its watershed. An attempt was made to connect the two reservoirs by an open earth cut through the low ridge separating them, but due to an error in determining levels, the cut as made was found to be actually over eight feet higher than the Granite Creek (Lake Watson) dam - and would either have to be deepened about 15 feet or the dam raised 15 feet. (See diagrams of reservoirs)

The problem of fixing respective water rights here is simple, as the filings and various steps of development are matters of public record. To enforce such rights it would only be necessary to require the turning back to the stream of any water stored to which older lands had a prior right.

The effect of the assertion, establishment and enforcement of such older rights would undoubtedly be to almost eliminate the practical storage of water in these reservoirs, since it is only in rare floods that water flowing in Granite or Willow Creeks may be stored without taking water which might be claimed and used on the older land. The artesian wells now used to supplement the general District supply are only two in number and are privately owned. Water must be pumped 80 ft. in one and 150 ft. in the other. Additional wells might be developed and, in fact, it is understood such wells are proposed. Something of the sort would have to be done if the attempt to cultivate more than a small fraction of the present area were to be continued in face of the practical value of their storage rights being nullified as above described.

The total area of watershed draining into the Chino artesian basin is

approximately 200 square miles (about 130,000 acres). Eighteen wells were noted in operation in 1940, of which fourteen were free flowing. The Del Rio Springs near the north, or low rim of the basin, flow about 175 Miners' Inches (4-1/2 second-feet) which is used for irrigation of about 140 acres. These springs are the natural overflow or spill from the basin and roughly represent the excess over the exact amount of water which must be fed into the basin to maintain the present water level and pressure. (See maps and profiles of Chino District and logs of wells) From 600 to 800 acres outside the Chino Valley Irrigation District are said to be irrigated from the wells now operated. This would mean a draft of 1,500 to 2,000 acre-feet annually above the discharge of Del Rio Springs and it must eventually affect the natural water level and pressure and the flow of the springs.

These factors will have a definite bearing on the success of future attempts to expand artesian development here. The Chino Irrigation District is in the least favorable situation of any lands in this area as any water from wells would have to be pumped from 80 to 225 feet or more. (See profile of artesian basin)

This matter is of interest to the Salt River Project only from the fact that all of this water not intercepted would otherwise find it's way to the Verde.

An irrigation project in this vicinity now dormant but very active in 1925 is the plan once proposed and still talked of to build a dam on Williamson Valley Wash. This would store 17,000 acre-feet of water from approximately 185 square miles of mountain watershed. Efforts are being made to revive this development either privately or as a Bureau of Reclamation development, which, if made, would amount to a serious infringement on project water supply.

NEW DEVELOPMENT

The idea has been suggested by Mr. Lee L. Smart, who now lives in Phoenix but formerly owned the old Packard ranch at the mouth of Sycamore Creek, that relief for the time being from acute water shortage in dry seasons in Salt River Valley might be obtained by development work, pumps, etc., to increase the flow of Montezuma Well and other large springs on the Upper Verde. This idea is sufficiently plausible to warrant consideration and in July the writer made a trip over the entire upper Verde area in company with Mr. S. F. Turner, Associate Engineer, U.S. Geological Survey, in charge of underground water investigations in Arizona. The purpose of the trip was to note the general topography and geology of the region and to learn something of the occurrence and origin of surface and underground water. The main Verde and its tributaries were covered from Prescott down to the lower canyon above the Camp Verde damsite. Data were obtained on springs, wells and surface streams and samples of water taken and analyzed (See Table IV). The time available and area covered in such a preliminary reconnaissance did not furnish an adequate basis for any conclusive report. This would require much field work and study by technical geologists trained in this work. It was hoped that the importance and interesting nature of the problem and of the factors involved would result in such a study being included in the program of work going on or proposed under Mr. Turner's direction and this is being seriously considered. As to the likelihood of developing immediate new water from this area for relief of Salt River Valley lands, it was my personal conclusion based on such data as were available that the results of such an attempt are too uncertain to warrant the Salt River Valley Water Users' Association committing itself to any contract or proposition whereby it would be bound to take and pay for water developed by any such operation. Such a commitment would involve determination of the net quantity of water added to the Salt River Project

supply, a matter of the greatest practical difficulty, if not in fact impossible. All surplus water, whether percolating or flowing from the surrounding high country or seeping back from local irrigation, now finds its way into the river and down to the Salt River Project.

Intercepting any part of this flow before it reaches its natural channel must necessarily at some time, whether immediately or in the more remote future, decrease the later flow by approximately the amount of the present increase. In addition to absorption of rainfall into the soil, springs and streams are fed from the accumulated underground storage of thousands of years and it may be that such storage is large enough to be drawn on indefinitely without making any noticeable immediate difference in the ordinary surface run-off or the flow of springs or yield of wells. The existence of artesian pressure in the Verde and Chino Valleys is cited in support of this view. Only the actual tapping of these subterranean reservoirs and observation of the effect over a period of years can give the answer to this question. The effect of drawing water from any underground source faster than it comes in is always to lower the water table and lessen artesian pressure, where such exists. When this balance is upset and the accumulations of ages are removed by pumping or releasing water through free-flowing wells, the surplus thus "mined" from the ground is not replaced within a time when it could be useful to human beings now living. However, where such accumulated storage is sufficiently great, large drafts may be made on it for long periods of time without material effect. Especially is this true when such drafts are made only intermittently, at periods of extreme drought.

The foregoing does not consider land and water rights in the vicinity which would be affected by any such proposition as Mr. Smart's, which would undoubtedly be an expensive and highly complex factor, in addition to the practical impossibility of determining to the satisfaction of both parties

whether a net increase in water actually results.

My judgment is that from a practical standpoint the most favorable plan for a temporary increase in Salt River Project water supply from underground sources in the upper Verde region would be the drilling of wells in the main valley close to the river and discharge of the water directly into the live stream. It is my understanding that this is possible under existing State law without incurring the danger of legal complications. Such an attempt on a large scale is not recommended, but the drilling of an experimental well and observation of results might be worth consideration. A test of the extent and prospective yield of the artesian basin could thus be started and operations terminated or continued as found to be warranted by conditions disclosed by the investigation.

Reference is made to the maps, profiles, etc., immediately following:

Key Map of Upper Verde Valley	8½ x 11
Key Map of Chino District	8½ x 11
Map of Chino Valley Irrigation District	8½ x 11
Map of Watson & Willow Creek Reservoirs	11 x 14
Profile Chino Artesian Basin & diagrams of artesian wells.	
Logs of Artesian Wells.	

* * *

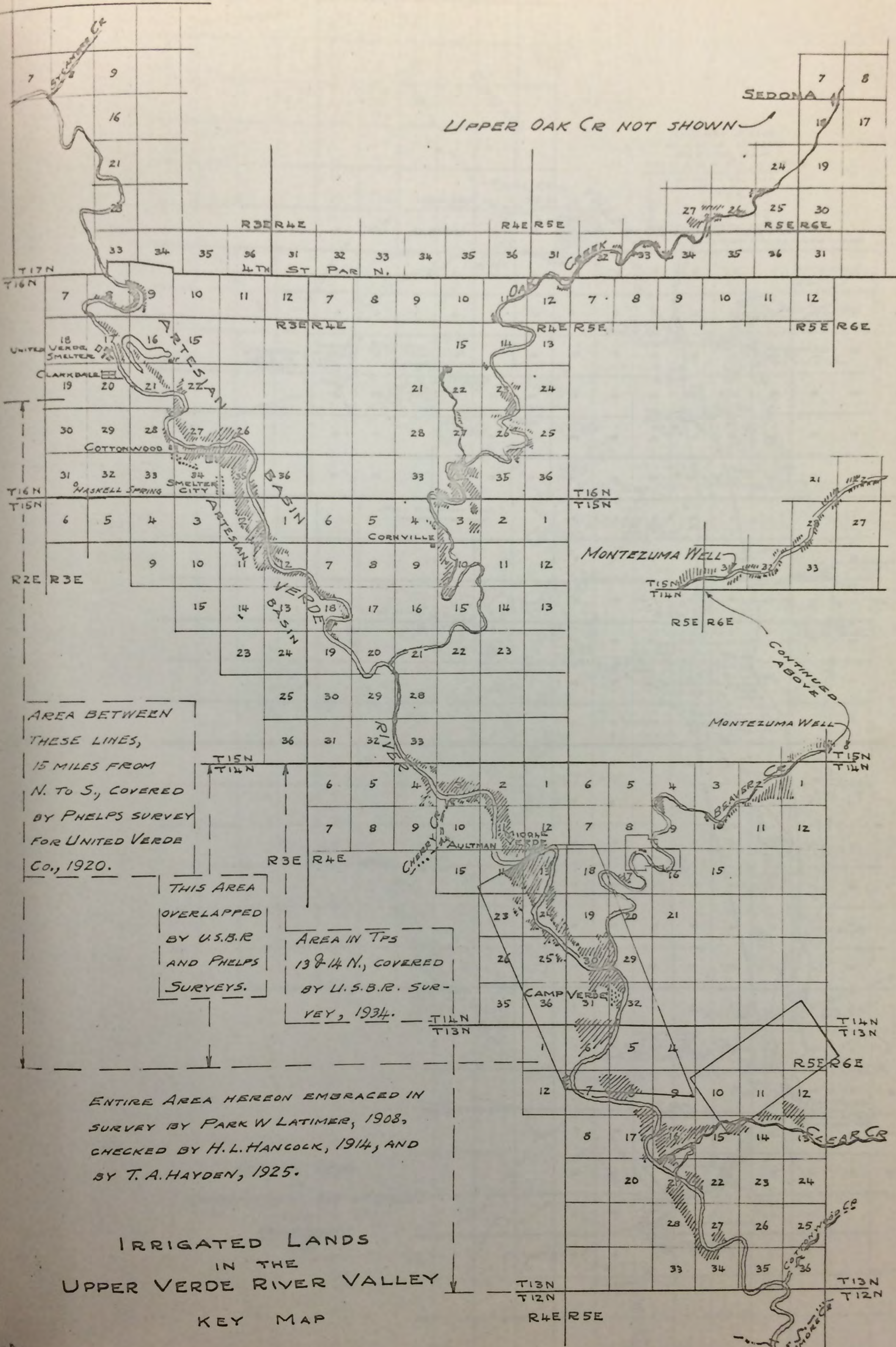
Reference is also made to general map of area covered by this report, in envelope at back.

* * *

T. A. Hayden

T. A. HAYDEN

10/23/40



UPPER OAK CR NOT SHOWN

AREA BETWEEN THESE LINES, 15 MILES FROM N. TO S., COVERED BY PHELPS SURVEY FOR UNITED VERDE CO., 1920.

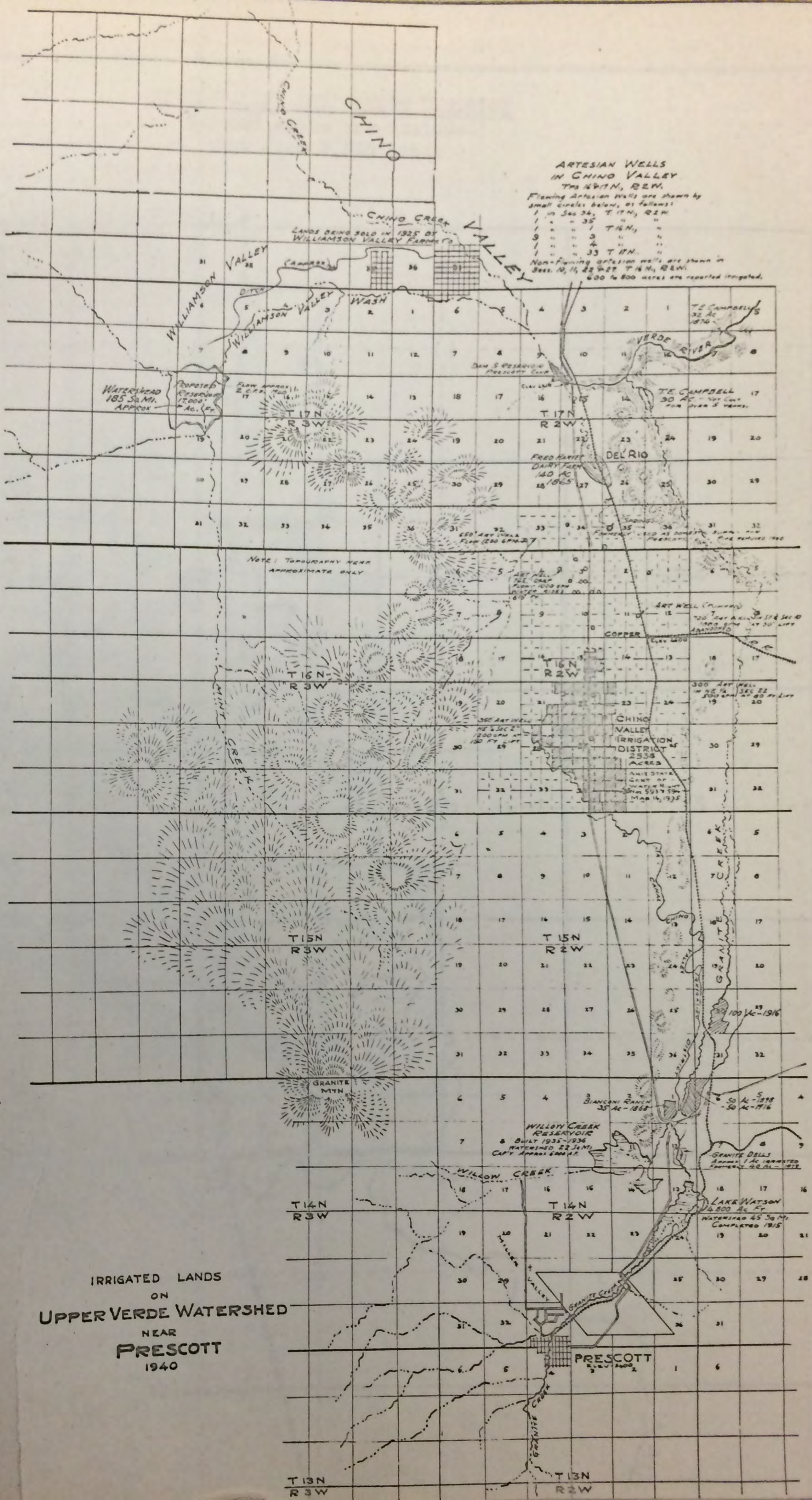
THIS AREA OVERLAPPED BY U.S.B.R. AND PHELPS SURVEYS.

AREA IN Tps 13 & 14 N., COVERED BY U.S.B.R. SURVEY, 1934.

ENTIRE AREA HEREON EMBRACED IN SURVEY BY PARK W. LATIMER, 1908, CHECKED BY H. L. HANCOCK, 1914, AND BY T. A. HAYDEN, 1925.

IRRIGATED LANDS IN THE UPPER VERDE RIVER VALLEY

KEY MAP



**ARTESIAN WELLS
IN CHINO VALLEY**
Tps N47N, R2W.

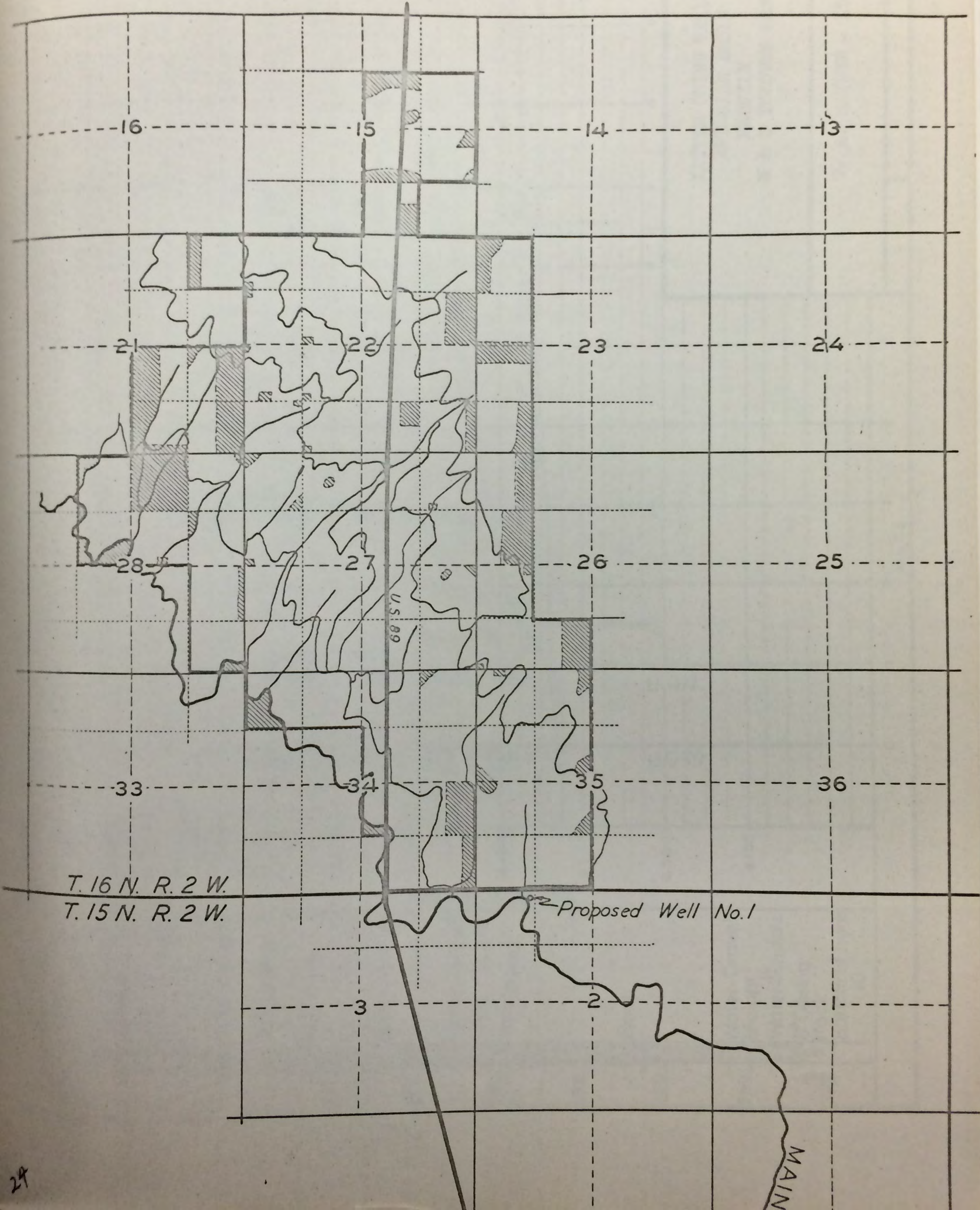
Flowing Artesian Wells are shown by
small circles below, as follows:
1 in Sec 34, T17N, R2W
1 " " " 35 " " "
1 " " " 1 T16N, " "
9 " " " 3 " " "
1 " " " 4 " " "
1 " " " 33 T17N, " "

Non-flowing artesian wells are shown in
Secs. 10, 14, 22 & 27 T16N, R2W.
600 to 800 acres are reported irrigated.

NOTE: TOPOGRAPHY HERE
APPROXIMATE ONLY

IRRIGATED LANDS
ON
UPPER VERDE WATERSHED
NEAR
PRESCOTT
1940

CHINO VALLEY IRRIGATION DISTRICT
(Shaded areas are excluded)
Net Area 2,538 Acres



UPPER VERDE RIVER WATERSHED
Summary of Areas Irrigated, by
Year of Appropriation

Year	Division or Group	Area - Acres		Totals
1864	Chino Valley - Del Rio	140.0		
	Upper Verde Canyon Perkins Ranch	75.0		
			215.0	215.0
1865	Upper Verde Valley Eaman Ditch	110.5		
	Clear Creek	201.5		
			312.0	527.0
1868	Chino Valley Duke & Bianconi	35.0		
	Upper Verde Valley Wood Ditch	563.8	45.7	
	Clear Creek	117.0		
			715.8	1,242.8
1869	Upper Verde Valley Cottonwood Ditch	304.7		
			304.7	1,547.5
1870	Upper Verde Valley Newman Ditch		25.0	
	Beaver Creek	101.0		
			101.0	1,648.5
1871	Beaver Creek	280.0		
	Clear Creek	29.3	30.0	
			309.3	1,957.8
1872	Clear Creek	40.0		
			40.0	1,997.8
1873	Upper Verde Valley O. K. Ditch	472.2		
			472.2	2,470.0
1874	Upper Verde Canyon Campbell Ranch	32.0		
	Upper Verde Valley Hickey Ditch	146.1		
			178.1	2,648.1
1875	Oak Creek - Upper	25.0		
	Clear Creek	60.0		
			85.0	2,731.1

Year	Division or Group	Area - Acres			Totals
1876	Upper Verde Valley		35.0		
	Allen Ditch	1.0	29.0		
	Haskel Spring	257.0	5.0		
	Oak Creek - Lower			258.0	69.0
					2,989.1
1877	Oak Creek, Upper	10.0			
	Oak Creek, Lower	63.0	4.0		
				73.0	4.0
					3,062.1
1878	Upper Verde Valley				
	Cottonwood Ditch	386.5			
	Central Verde Ditch	44.2	39.6		
	Oak Creek, Lower	177.0			
				607.7	39.6
					3,669.8
1879	Chino Valley				
	Granite Dells	1.0	39.0		
	Upper Verde Valley				
	Duff Ditch	28.0	14.0		
	Beaver Creek	30.0			
				59.0	53.0
					3,728.8
1880	Upper Verde Valley				
	Sycamore Creek		22.0		
	W. A. Jordan Ditch		35.0		
	Allen Ditch		102.0		
	Cottonwood Ditch	49.7			
	Oak Creek, Upper	162.0			
	Beaver Creek		15.0		
				211.7	174.0
					3,940.5
1881	Upper Verde Valley				
	E. L. Jordan Ditch	50.0			
				50.0	
					3,990.5
1883	Beaver Creek	3.0			
				3.0	
					3,993.5
1884	Oak Creek, Upper	8.0	24.0		
	Beaver Creek	18.0			
				26.0	24.0
					4,019.5
1889	Upper Verde Valley				
	Wood Ditch	509.6	60.0		
	Beaver Creek	15.0			
				524.6	60.0
					4,544.1
1890	Oak Creek, Upper	15.0			
	Beaver Creek	14.0			
				29.0	
					4,573.1

Summary of Years, Cont'd.

Year	Division or Group	Areas - Acres			Totals	
1891	Oak Creek, Lower Beaver Creek	8.0				
		48.0		56.0	4,629.1	
1892	Upper Verde Valley Eman Ditch	210.6	5.0			
				210.6	5.0	4,839.7
1893	Upper Verde Valley Sullivan Ditch Eureka Ditch Oak Creek, Upper Oak Creek, Lower	50.0				
		417.2				
		4.0				
		15.0				
				486.2	5,325.9	
1894	Oak Creek, Upper Oak Creek, Lower Beaver Creek Clear Creek	20.0	3.0			
		282.0				
		20.0				
		10.0				
				332.0	3.0	5,657.9
1895	Beaver Creek	20.0				
				20.0		5,677.9
1896	Upper Verde Valley Allen Ditch Oak Creek, Upper	223.0				
		35.0				
				263.0		5,940.9
1897	Oak Creek, Upper Oak Creek, Lower Beaver Creek	2.0				
		60.0				
			8.0			
				62.0	8.0	6,002.9
1898	Chino Valley Duke & Bianconi Upper Verde Valley Humbert Ditch Central Verde Ditch Wood Ditch Oak Creek, Lower Beaver Creek	50.0				
			5.0			
			450.2			
			15.0			
		73.0				
			10.0			
				123.0	480.2	6,125.9
1900	Oak Creek, Upper	10.0				
				10.0		6,135.9
1901	Upper Verde Canyon Alvarez Ranch Upper Verde Valley Hickey Ditch Beaver Creek	9.0				
			32.1			
		12.0	24.0			
				21.0	56.1	6,156.9

Summary of Years, Cont'd.

Year	Division or Group	Areas - Acres		Totals
1904	Oak Creek, Lower	12.0		
			12.0	6,168.9
1906	Beaver Creek	12.0		
			12.0	6,180.9
1908	Upper Verde Valley	20.4	50.1	
	Hickey Ditch	59.0		
	Cottonwood Ditch	41.0		
	Oak Creek, Upper	20.0		
	Oak Creek, Lower			140.4
1909	Clear Creek	25.0		
		20.0	45.0	6,366.3
1910	Oak Creek, Upper	25.0		
			25.0	6,391.3
1911	Chino Valley			
	Chino Valley Irr. Dist.	2,538.0		
	Oak Creek, Lower	6.0		
			2,544.0	8,935.3
1912	Upper Verde Valley			
	Watson Ditch & Pumps	14.7	12.0	
	Oak Creek, Lower	61.0		
			75.7	9,011.0
1913	Chino Valley			
	Campbell Ranch		30.0	
	Upper Verde Valley			
	Haskell Spring (Clarkdale)	20.0		
	Watson Ditch & Pumps	12.7		
	Central Verde Ditch	255.9	42.5	
Oak Creek, Lower	33.0			
			321.6	9,332.6
1914	Upper Verde Canyon			
	Armon Ranch	4.0		
	Upper Verde Valley			
	Sycamore Creek		14.0	
	Hickey Ditch	5.0		
	Cottonwood Ditch	2.8	27.6	
	Pete's Ditch	77.2		
	Watson Ditch & Pump	26.3		
	O.K. Ditch	15.0	22.7	
	Wood Ditch	56.8		
	Oak Creek, Upper	60.0		
Oak Creek, Lower	17.0			
Clear Creek	39.2			
			303.3	9,635.9

Summary by Years, Cont'd.

Year	Division or Group	Area - Acres			Totals
1916	Chino Valley	150.0			
	Duke & Bianconi Oak Creek, Upper	8.0		158.0	9,793.9
1929	Oak Creek, Lower	6.0		6.0	9,799.9
	Chino Valley Williamson Wash Upper Verde Valley Allen Ditch Oak Creek, Upper Oak Creek, Lower	5.0 1.0 99.0 38.0	20.0	143.0	9,942.9
1934	Upper Verde Valley Putnam Pump	8.0		8.0	9,950.9
1935	Oak Creek, Lower	40.0		40.0	9,990.9
1936	Chino Valley, Prescott Club	15.0		15.0	10,005.9
1937	Upper Verde Valley Pete's Ditch	6.0		6.0	10,011.9

Totals

10,011.9 1,295.5 10,011.9 1,295.5

IRRIGATED LANDS,
UPPER VERDE WATERSHED

Summary of Areas, by Divisions or Groups

	- - -	
Chino Valley	2,929.0	89.0
Upper Verde Canyon	120.0	
Upper Verde Valley	4,098.9	1,083.5
Oak Creek		
Upper	565.0	27.0
Lower	1,189.0	9.0
Beaver Creek	573.0	57.0
Clear Creek	537.0	30.0
	10,011.9	1,295.5

IRRIGATED LANDS,
UPPER VERDE WATERSHED

Summary of Areas, by Divisions or Groups

Chino Valley	2,929.0	89.0
Upper Verde Canyon	120.0	
Upper Verde Valley	4,098.9	1,083.5
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Upper	565.0	27.0
Lower	1,189.0	9.0
Beaver Creek	573.0	57.0
Clear Creek	<u>537.0</u>	<u>30.0</u>
	<u>10,011.9</u>	<u>1,295.5</u>

YAVAPAI RECORDS

Water Rights Recorded in
"Millsites and Water Rights" (M & W)
to and including Page 198
of Book 8 - M & W, and including
Filings recorded in "Promiscuous Records"
prior to the making of special books for
"Millsites and Water Rights".

Verde River and Tributaries from
the head down to and including Clear Creek.

- - -

The following list of locations and filings of record in the County Recorder's office of Yavapai County, Arizona contain all recorded appropriations of material size affecting the watershed, including many known never to have been perfected. Very small appropriations of one or two Miner's inches were not listed, and also stock watering, mining and milling appropriations. Some old filings on Big Chino and Williamson Valley washes and some power filings, attempting to appropriate water for projects known to me personally have been long ago abandoned, were also omitted.

Recorded permits and water right certificates issued since 1919 by the State Water Commissioner are included. Large tributaries are listed under their own names. Small ones, under the name of the main river or tributary. These records were taken from Book One (1) of "Promiscuous Records" and from Books One (1) to eight (8), inclusive of "Millsites and Water Right Records". These records were examined page by page and not by referring to the index only. This was found necessary because in many cases the indexing gave little, if any, clue to the subject matter of the filing. The records were compared carefully with lists of filings contained in reports on use of water made by H. L. Hancock in 1914, O. A. Turney in 1901, Stroud and Prothero in 1899 and Robinson and Woolf in 1895. Where discrepancies were found in their lists with the names and/or other data in the County Records, a careful comparison was made to see that the correct data was entered in this compilation.

ABBREVIATIONS USED

"Prom" means Promiscuous Records.
"M & W" " Millsites and Water Right Records.
"abt" " about.
"Mi." " mile or miles.
"N, S. E & W" means North, South, East and West.
"bet" means between.
"Sec" " Section.
"T & R" " Township & Range.
"opp" " opposite.
"approx." " approximate.
"Cor." " Corner.
"div." " diversion.

WATER SUPPLY AND IRRIGATION
ON THE
VERDE RIVER AND TRIBUTARIES

* *
*

O. A. Turney
Arizona
1901.

WATER SUPPLY AND IRRIGATION
ON THE
VERDE RIVER AND TRIBUTARIES

* *
*

O. A. Turney
Arizona
1901.

- - -

UNITS OF MEASUREMENT EMPLOYED

THE SECOND-FOOT is one cubic foot of water, or 1,728 cubic inches, delivered every second. This is a convenient unit of measurement, and is the one usually employed by text book writers.

THE MINER'S INCH in Arizona is the flow of one-fortieth part of a second foot. In Southern California it is held to be the one-fiftieth part of a second foot, other equivalents are also held in California and other states. The Montana Legislature has passed an act making the miner's inch equal to the flow of one-fortieth of a second-foot. Both these units, the second-foot and the miner's inch, presuppose motion of the water measured; they are measurements of flowing water.

THE ACRE-FOOT is a newer unit, and has advantages not possessed by the former. It contains 43,560 cubic feet and is equivalent to a volume of water sufficient to cover one acre of ground to a depth of one foot. It is then not a measurement of water in motion, but of depths on an acre of land. The delivery of 0.5 acre-feet to an acre means a depth of 0.5 of a foot over one acre of ground. It is the best unit for calculating the amount of water required to produce given crop results. In places in Europe the amount of water required is calculated in tons per acre.

The states of Nebraska, Wyoming and Idaho have fixed the amount of water per acre which may be appropriated. In two of these states no one may appropriate exceeding one second-foot for each 70 acres irrigated. This must be measured at the point of diversion and all losses from seepage, evaporation, etc., fall upon the land. While working a hardship on the water user, it affords an incentive to good canal management. The above maximum diversion permissible affords 5.95 acre-feet in 7 months. It is well to compare this figure with the diversions on the Verde hereafter given.

All measurements were made current meter invented by W. G. Price, U. S. Engineer. Lack of space has prevented summarizing the results obtained; net results only are given which would have appeared more clearly in tabular form.

ITINERARY.

The Sub-Committee of the Joint Canal Committee was composed of J. W. Woolf, W. B. Cleary and J. W. Stewart, who represented the Arizona Water Co., The Arizona Canal Co., The Grand Canal Co., The Maricopa Canal Co., The Salt River Valley Canal Co., the Consolidated Canal Co., the Mesa Canal Co., the Utah Canal Co., the Tempe Canal Co., and the San Francisco Canal Co.

This committee left Phoenix, Arizona, July 8th, 1901, and arrived at Camp Verde on the 13th. The total amount of water herein reported as diverted from the Verde River and its tributaries may be accepted as the smallest amount taken during the Summer season. According to all reports ✓

the water was lower there than the Summer before, which was the dryest we have ever known. On one stream, Beaver Creek, rotation had never been practiced before. Even this shortage was not such as to induce the users to look after the water at night; it was uniformly turned on the land and permitted to take care of itself. All these lands have a much greater fall than in the Salt River Valley, so much so that very little good is accomplished by the water turned loose at night.

Soon after commencing work, Mr. Geo. Hance came to our camp; he seems to be Major Domo of the valley; Mr. Dan. Head, the one older settler, being away. Hance urged on us that Fossil Creek, a tributary 23 miles south, was of equal importance to us as the Verde.

MEASUREMENT OF THE VERDE

We went down the river as far as possible to go with wagon to a place where the rock, rising in the channel, apparently brings all the water to the surface. This afforded a perfect place to determine its flow below all ditches in Yavapai County. Here the Verde measured 2,509 miner's inches (62.7407 sec-ft.) On the day of our arrival at Camp Verde the entire head ordinarily diverted by the Woods Canal was turned into the river to permit repair to overflowed banks and to allow the moss to die. Be it noted that the flow of water in all ditches in this country is constant, and is only interrupted at considerable intervals. This Woods water was very annoying. Afterwards the Woods Canal was found to carry 1,042 inches. We do not know whether this water had reached the point of measurement, called the Falls, or had not, but believe it had. It had been turned out two days prior; the distance was about 12 miles of ponds and rapids. If deducted, it leaves the Verde River, 1467 inches.

MEASUREMENT OF FOSSIL CREEK

Two of the party took saddle animals at this point and went down to Fossil Creek. This was a very hard trip, over mountain spurs, and down a channel cut through granite and porphyry. There could be little see-page here, while as far as the eye could reach to the southward the channel appeared the same. Camp McDowell was 70 miles below.

Fossil Creek enters from the East, it rises in springs West of Baker Butte. It is indeed a wonderful stream, its water is clear, cold, never muddy, and uniform throughout the year. It is an ideal for power purposes, but can be reached only by the wagon road over Baker's Butte. At the mouth the flow measured 1,353 inches (33.8128 sec-ft.), or over twenty million gallons per 24 hours.

The Verde was measured just below, from which Fossil Creek being deducted, leaves the Verde 2273 inches (56.7987 sec-ft.) Both measurements were on sandy bottoms. The Verde measurement was 236 inches less than at the rock-bottomed Falls, 12 miles higher up. We desired the comparative values, but the Woods canal water interfered. The distance to the Woods waste gate was 24 miles, and four days had elapsed since the water had been turned down. If deducted at the Falls, as above, then it must be here.

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settler had taken the entire flow of the stream. He was irrigating his fields and the remainder, his neighbors stated, was running out on "buck brush." The oldest appropriators frequently turn what they cannot use into aroyos, or any other place handy, or let it go where it will. We visited a fine old apple orchard on this creek which was not receiving water at all for its maturing crop, as the oldest appropriator had the entire flow. We did not visit the remaining ranches on the stream, as we had no level to calculate the capacity of dry ditches.

There are nine ditches on Clear Creek, location and owners are shown on map; they cover a little over three hundred acres, for which, when there is water for all, from 400 to 700 inches are taken. The larger part of this land has been in cultivation for twenty-five years, although some has been reclaimed since 1894, the latter acreage being small. Although the water of Clear Creek was not reaching the Verde during the Summer, it unquestionably would do so were it not all diverted.

APPROPRIATIONS ON CLEAR CREEK

There are only two appropriations on Clear Creek of record in Yavapai County, as follows:

500 inches - Thos. A. Smith, Jan. 28, 1888; Book 2, page 24.

100 inches - M. B. Ricketts, May 9, 1891; Book 2, page 209.

BEAVER CREEK

Beaver Creek is just above Camp Verde. We found a good irrigating head flowing from Beaver Creek, which proved to waste water from the Enterprise Canal, a ditch farther up on the Verde. Above this the creek was dry to Montezuma Castle, then a very small stream for a mile to a rock-and-brush dam. Said dam diverts water into the Williams ditch, No. 12, capacity 30 inches; was dry; in the end of the dam is a spring, also diverted by ditch, running about 10 inches. Both ditches unite and irrigate a 25-acre garden; owner, Gus Williams, Groom Creek, Yavapai Co. Location amounting to 500 inches made Feb. 27th, 1897, by J. A. Rokhl, County records, Book 3, page 314.

Next ditch, No. 13, belonging to Leonard Maxwell, measured 15 inches (0.3773 sec-ft.); was taken out 27 years ago and irrigates 30 to 40 acres, as it was measured where tunnelled through a solid stone cliff, we know this is its maximum.

Next ditch, No. 14, owned by J. C. Maxwell, covers 30 acres, and measured 91 inches (2.2705 sec-ft.) was taken out about 10 years ago. Next above are two ditches of Wm. Schoder, No. 15, carrying 25 inches (0.6371 sec-ft.), and No. 16, carrying 44 inches (1.0966 sec-ft.), a total of 69 inches; this was less than half their usual flow; normal head, 150 to 175 inches; acreage in cultivation, 100 to 125.

Beyond is the nicely improved farm of C. F. Mahan. At this place we broke our front axle squarely in two for the second time. We stated who we were and the object of our investigations; we were given everything our needs demanded without charge. Our work was everywhere heralded in advance

we
of our progress; were commonly treated with some suspicion, but were usually given all the information we asked. Mr. Mahan being one of the earliest settlers on the creek, had, the week before, demanded of the later comers that water be rotated, and in such a manner that he would have what he needed for his farm; rotation had never been practiced before. In his ditch, No. 17, we found 39 inches (0.9703 sec-ft.), called stock water; his normal use was about 200 inches, acreage 180, appropriation 25 to 30 years old. He as well as his neighbors states that Beaver Creek was usually difficult fording in Winter, but that for three months in the Summer it never reached the Verde; farther that where no water diverted during the summer the flow would not reach the Verde; we believe it would reach it at all times were it not all taken.

Between this place and the next above is supposed to run the line of the Black Mesa Forest Reserve in which the people of the Salt River Valley are especially interested. The location of this line seems to be anywhere within six miles or so. These lands are not surveyed. Wm. Back, whose place is next above, claims continuous use of the water since 1870, yet his only right to his finely improved place is a squatter's title.

None of the lands we visited except on the lower part of Oak Creek and the central Verde are surveyed. The object is to escape taxation, as only the improvements are taxed on unsurveyed lands. Mr. Back stated his place was reasonably worth ten thousand dollars, but that he was only taxed on \$800.00. He has a ready and constant market in Flagstaff for all he can raise on his 150 acres, of which only ten acres are in recent cultivation. He irrigates through a ditch heading in Beaver Creek, which also catches the water escaping from Montezuma Well. This ditch, No. 18, was carrying 153 inches (3.8201 sec-ft.), which appeared to be about half its normal flow, with a capacity even greater. A hasty measurement of the water coming from underneath the wall of Montezuma Well gave 132 inches (3.2384 sec-ft.).

The County records contain only two appropriations on Beaver Creek. 500 inches, Wales Arnold, in 1863, from Beaver Creek and Montezuma Well, and not recorded until Dec. 12, 1899; Book 3, page 4. Also "the entire flow of Montezuma Well," by Wm. Back, July 23, 1890; Book 2, page 132.

Next ranch, Thos. Bristow, ditch No. 19, carrying 58 inches (1.4611 sec-ft.), which appeared to be one-third of normal head. He also has another ditch capable of carrying 10 inches, temporarily dry. (Above was Mr. Finney, owner of a beautiful place with cut stone dwelling; this is the well-known Soda Springs. There are two ditches, the smaller carrying 10 inches (0.2468 sec-ft.); the larger one, No. 20, was dry. He has 25 or 30 acres, and is using 50 to 75 inches.

Above him, Hollingshead, No. 21, 12 to 15 acres, and using about 30 inches. Mrs. Cliff's ditch, No. 22, contained 15 inches (0.3648 sec-ft.), normal flow about 30 inches, 15 acres, claims use since 1839. Skaggs has No. 23, 15 to 20 acres, all in alfalfa, normal head about 35 inches, is also an old place.

Last place visited was Reiley Casner's, No. 25, an old fruit ranch, 25 acres. Mr. Casner claims continuous occupation for 17 years, but owing

The O. K. Canal, No. 74, just below the mouth of Oak Creek, was carrying 517 inches (12.920 sec-ft.), full capacity about 600 inches, irrigates 610 acres, taken out in 1873. The Eureka Canal, No. 75, contained 448 inches (11.194 sec-ft.), which was about 80 per cent of its recent flow and about 60 per cent of maximum flow. It irrigates 420 acres belonging to four owners, was taken out in 1893 and increased two years ago.

The Woods, or Verde Canal, No. 76, was now taking water, was carrying 1,042 inches (26.0663 sec-ft.), about its maximum. Canal is fifteen miles long and irrigates land both above and below Camp Verde, amounting to 1,200 acres, about half of which are among the oldest lands on the river, and half more recent, having been added from time to time. There are perhaps a dozen owners under this canal, being more than under any other in the valley.

The Central Verde or Ralston Canal, No. 77, was temporarily dry, is stated to irrigate 1,000 acres, the Stroud report gives it 600 acres; the ditch probably diverts certainly not less than 600 inches. 300 acres of this land was first irrigated three years ago. The Enterprise ditch, No. 78, was carrying about 60 per cent of its capacity, measured 94 inches (2.342 sec-ft.), covers 50 acres, taken out in 1893.

The Eman ditch, No. 79, measured 235 inches (5.8728 sec-ft.), its maximum capacity; was taken out in 1893, covers 340 acres. Formerly the old lands under the Eman ditch were irrigated from Clear Creek, but six years ago the Clear Creek water was sold to newer lands and water taken from the Verde for the Eman lands; owners, Haywood Cattle Co., Aurora, Ill. Manager, C. B. Eman, Garden City, Kan.

The total amount of water found in ditches on the main channel of the Verde, plus the probable normal capacity of those ditches found temporarily dry, is 4,572 inches, an estimated full head, as shown by high water line, is 5,710 inches. Whether our presence had anything to do with the recent reduction in the amount of water that many of the ditches had been carrying we do not know. It is not probable that all of the ditches carry their maximum capacity at any one time, or if so, for only a short period. This was considered a time of great scarcity of water. The greatest diversion is during June and July.

TOTAL DIVERSIONS ON ALL STREAMS

	Measured Head.	Full Head.
Clear Creek	273 inches	655 inches
Beaver Creek	482 "	1200 "
Oak Creek	1562 "	2111 "
Verde River	<u>4572</u> "	<u>5710</u> "
	6889 inches	9676 inches

The water leaving the Verde Valley as measured at the Falls is probably 1467 inches. The above total measured head is presumably less than the usual summer diversion, hence with a total taken from the river of more than 6889 inches there is left 1467 for us. If they were taking no more, they were still taking 83 per cent, and leaving 17 per cent to come down to us.

RAINFALL AND ALTITUDE

The rainfall at Phoenix from March 1 to Nov. 1, 1901, was 2.97 inches. The amount of rainfall on the Upper Verde is unknown; the nearest stations are at Prescott, Congress and Flagstaff, no one of which has as heavy a Summer rainfall as the Verde Valley. We are convinced that the Summer rainfall is at least double the rainfall at Phoenix, and is probably greater than double. Again, the altitude is from 3,000 to 4,000 feet, making the Summer delightfully cool. Farmers in this valley know how much faster they can irrigate in the Summer during the early morning hours than the heat of the day.

WATER AND ACREAGE

There are nine other canals supplying water in the district above; some were not visited, others were temporarily dry; the total area under them is approximately 1292 acres. Calculating this acreage on the proportions as for that above, we have for them a diversion of from 1346 to 1792 inches. If these be added we have the following summary:

	Measured head in inches	Estimated full head in inches	Acreage covered.
22 canals above	4611	6100	4399
9 canals additional	1346	1792	1292
Total	5957	7892	5691

The total water diverted from the Verde and all its tributaries was from 6889 to 9676 inches, of this amount from 5957 to 7892 inches is in this district over which was advised daily supervision. It is probable a commissioner, assisted by one ditch rider to road gauges and adjust gates, could take care of the above area. A greater area would require more help.

SEEPAGE

We were constantly told that all the water they used soaked quickly back into the river, that none of it was lost. Measurements could be made to determine this, both as to amount and time required for its return. As none have been made we can only form an opinion by consideration of results elsewhere.

The Colorado State Agricultural College published in 1896 a report of investigations to determine the amount of water returning to the rivers from irrigated sections, and the comparative losses incurred where the same rivers passed through unirrigated sections. Since that time observations have been continued by the State engineer and others. A summary of all these measurements is contained in the tenth biennial report of the State Engineer, as follows:

1. "There is a real increase in the volume of the streams as they pass through the irrigated sections.
2. There is no such increase in the streams as they pass through the unirrigated sections. On the contrary, there is an actual loss, even when the drainage of a large area enters.
3. There is no perceptible underflow from the side channels (drywashes), even where they drain several thousand square miles.
4. The inflow is practically the same throughout the year. It is more in Summer, less in winter, principally because of the effect of the temperature

of the soil.

5. The passage of the seepage water through the soil is very slow, so that it may take years for the seepage from the outlying lands to reach the river.

6. On the Poudre River about 30 per cent of the water applied in irrigation returned to the river.

7. The use of water on the upper portions of a stream, when water is not immediately needed by prior appropriators, will increase the flow of the stream late in summer, and prevent such low stages as it would have without this regulating action."

Elwood Mead, in a pamphlet published by the U. S. Department of Agriculture, says :

"Much of the water which escapes from canals finds its way to the surface below in the form of springs in what were originally dry ravines. Irrigators have filed on these springs and secured thereby an ample water supply without having to pay the canal company which furnishes it anything for operating expenses or for the purchase of a water right. On the South Platte River alone there are over 400 of these filings on seepage water. The report of the State Engineer of Colorado for 1898 shows that 5,000 acres in the Poudre Valley were irrigated with seepage water in that year. In a number of instances canal companies have sought to establish a title to the water of these springs and to collect for its transportation from their users; but the decisions of the courts in these cases have been conflicting and no settled policy has as yet been established.

"The percolating water from canals and irrigated fields materially increases the water supply of Western rivers. Measurements of this return or seepage water have shown that this reaches in many instances 30 per cent of the original volume."

Now on the Verde there are no "springs" where once were "dry gulches;" there are no thousands of acres of land irrigated from seepage water; there are no filings on seepage waters; there is not a sign of rising water anywhere; everything is dry except where river water is diverted to the land; not a sign of any of the conditions of return waters as described above. Yet, be it noted, where all of these conditions exist of "springs," or "running arroyos once dry," there, after careful calculations by competent engineers, covering years of time, the amount of seepage water returning to the stream from which it was once diverted is set down at 30 per cent of the amount diverted. If 30 per cent returns under such conditions, then certainly less than 30 per cent returns on the Verde.

The diversion in Colorado begins early in the Spring and the engineer reports that in some places this percentage does not return for years, but in the larger number, it returns late in the Summer. If such is the case there, of the large amounts of water diverted on the Verde in June and July for the corn crop whatever returns comes to us late in the Fall, when our period of greatest need is past. As a matter of fact, our greater need occurs in June, July and August, when their diversion is greatest.

In Antelope Valley, California, the velocity of the underground flow has been shown to be 3.52 miles per year. (U. S. Geological reports)

When the river was dry below the Tempe dam in June, '96, 3200 inches was running at the Joint Head; in '99, river dry below Tempe dam, 2400 inches flowing at the Joint Head. (U. S. Geological Survey) It has never been contended that this was returning irrigation water, but only river water which has passed under the dams. The river drops off 14 feet to the mile to the West, soon the water level should be reached, and nine miles lower down it comes to the surface on the South side of the channel; there is very little irrigation within several miles of the place. Wherever boulder bars cross the river there more water rises, and the amount rising in the South side of the channel is greater than that in the North side. There is practically no irrigation to bring in water from the South. The writer has been making measurements of this flow for the Government. The total water diverted by all the ditches plus that in the river passing the Indian Reservation is 634 acres. (15.8546 sec-ft.)

We hardly need mention Kellner's artesian well which was confidently expected would strike the flow of returning irrigation water from the whole North side. The well was certainly deep enough, but was dry. The inferences are that this water is largely river water, not returning irrigation water. The water at Buckeye is largely Gila water.

When the Agua Fria dam was completed on the bed rock, it was expected there would be developed a constant flow of from five hundred to one thousand inches on account of the large drainage area. The flow amounted to only 30 inches, which soon dropped to 15 inches, where it remained.

RECORDED APPROPRIATIONS

There are other small ditches on other streams emptying into the Verde and on its own head waters, but their value is small. Many of the appropriations on the Verde are not of record; the following in addition to those heretofore given are of record: - ditch, by P. W. Burford, Jan. 7, 1877; b.1, p.254. ALL the waters of the Verde River, by Jos. Melvin, July 23, 1877; b.1, p. 298. ALL the water of the Verde River 1/2 mile above Oak Creek, by M. R. Vernon, Sept. 23, 1882; b. 1, p. 56.

- 3000 by Jno. H. Wilkerson and Wm. Sherard, Feb. 12, 1871; b. 1, p. 65.
- 3000 Albert Young and Chas. F. Bennett, Sep. 18, 1875; b. 1, p. 162.
- 3000 by J. H. Wingfield, D. W. Strahan, Mrs. Mary E. Cleft, L. B. Barney and Bristow, for Reservation ditch, Dec. 4, 1877; b. 1, p. 317.
- 1000 R. W. Pleasant and Isaac C. Jones, Feb. 16, 1876; b. 1, p. 324.
- 6000 F. E. Jordan, Jan. 10, 1878; b. 1, p. 363.
- 1000 Saml. Loy, Mar. 1, 1878; b. 1, p. 365.
- 1500 by Jno. Duke and F. Krell, Feb. 10, 1883; b. 1, p. 124.
- 6000 Z. L. Kay, near Oak Creek, Jan. 2, 1884; b. 1, p. 183.
- 6000 J. C. & J. W. Ralston and Z. L. Kay, below Oak Creek, for Ralston ditch, Mar. 20, 1884; b. 1, p. 202.
- 500 Chas. D. Willard, Oct. 20, 1885; b. 1, p. 293.
- 2000 J. B. Ezell and J. W. Ezell, East fork Verde, Mar. 21, 1889; b. 2, p. 50.
- 5000 Jno. Davis, Jno. Wood and Jas. Brown, Mar. 10, 1891; b. 2, p. 224.
- 275000 Rio Verde Canal Co., Dec. 21, 1891; b. 2, p. 252.
- 1000 Thos. A. Smith, July 12, 1892; b. 2, p. 294.
- 300 W. S. Head, Thos. J. & Chas. B. Eman, July 23, 1892; b. 2, p. 298.
- 250 R. M. Rodgers, Sarah Arnold and J. W. Ralston, near Cherry Creek, Feb. 14, 1884; b. 2, p. 400.

Report on the
IRRIGATED LANDS
OF THE
VERDE RIVER
AND ITS TRIBUTARIES
IN 1914

By

H. L. HANCOCK

Phoenix - - Arizona.

Hon. John C. Phillips,

Superior Judge of Maricopa County,

State of Arizona.

Sir:

I respectfully submit the following report of my investigations of the Verde River and its tributaries, commencing July 12th, and ending October 31st, 1914.

Mr. C. N. Fitch, Project Engineer, of the United States Reclamation Service requested me in a letter dated July 8th, 1914, to make this investigation and after I had taken it up with the Tempe Canal Company, you authorized me to proceed with the same.

Yours respectfully,

Harry L. Hancock,
Court Water Commissioner.

Phoenix, Arizona, July 8, 1914.

Mr. Harry Hancock,
Court Water Commissioner,
Phoenix, Arizona.

Dear Sir:-

The impression prevails in some quarters that water is being diverted from the Verde River and its tributaries in Yavapai County, and utilized for irrigation purposes in derogation of the rights vested in the land owners under the Salt River project under the terms of the Kent Decree.

It is assumed that in the exercise of your duties as Water Commissioner in executing and carrying out the provisions of the Decree, you will desire to take such steps as appear necessary in order to determine whether there is any basis for this impression, and to take appropriate corrective measures if it is found that such are necessary.

As to the manner of carrying on such an investigation my suggestions as to a proper procedure to follow are embodied in the following paragraphs:

The report of Mr. O. A. Turney covering investigations made by him and others in 1901, purports to show the approximate location, date of construction and capacity of the ditches taking water for irrigation from the Verde River and the various creeks which are tributary to it. It also shows the names of the then owners of the land irrigated from these ditches, and the acreage irrigated. The description of the various tracts is not shown. The report further shows all notices of appropriation of these waters, giving the date, amount, name of appropriator and reference to the County records.

These data should be thoroughly checked on the ground and the description of the lands being irrigated with the names of the present owners secured. If the acreage to which water is being applied has been enlarged, the dates when such new land was brought into cultivation from year to year should be

ascertained; also, as to both old and new lands whether water has been continuously used and if not the dates and lengths of the periods when the land was not irrigated. So far as possible the amounts of water actually used should be ascertained. If the ditches themselves have been enlarged the date and the increased capacity should be noted.

As to all notices of appropriation subsequent to Mr. Turney's report which are of record, the date, name of parties, amount of water, purpose, and, so far as is shown, the land to which it is proposed the water shall be applied should be ascertained. The names, locations and capacities of any new ditches should be secured, together with the names of the owners, the description of the lands irrigated, the dates of construction, the amounts of water diverted and the acreage brought into cultivation from year to year.

If water has been appropriated for power purposes, as full information as possible should be secured especially with reference to the disposition of the water after it has served its purpose in the matter of power development.

Altogether, for the purposes in mind, it seems to me that it is desirable to secure as complete information as possible relative to all notices of appropriation which are of record and more particularly relative to all lands for the irrigation of which water is being diverted from the Verde River and its tributaries, including the description of the land, the location, date of construction and capacity of the ditches, together with information as to dates of enlargements and increased capacity the dates when additional acreages were brought into cultivation and the facts as to whether the amount of water used or claimed has been applied to a reasonably continuous use since the date of appropriation.

Very truly yours,

(Signed) C. H. Fitch,
Project Manager.

JLC-EFY

vate 400 to 500 acres. This land has been irrigated more or less continuously ever since 1866. They have two ditches on the west side of river. About 1300 acres of reservation have been cultivated, though not all at the same time.

Total lands irrigated on Verde River water shed above the proposed reservoir at Horse Shoe Bend:

	Number of Ditches.	Maximum Capacity	Ordin. Used. Amt.	Total Acres Irrigated.	Add for Irrigation.
Del Rio	1	175	175	140	100
Granite Creek	4	170	170	125	30
Upper Verde - above mouth of Sycamore Creek	6	315	315	137	7
Verde - between Sycamore and Oak Creeks	10	2435	1900	1590	300
Verde - between Oak & Clear Creeks	8	4100	3050	2721	2167
Small Creeks and springs tributary to Verde	9	210	190	152	30
Oak Creek in Forest Reserve	18	875	795	432	282
Lower Oak Creek	16	2110	1625	1065	629
Beaver Creek	11	879	740	565	25
Clear Creek	7	710	635	445	100
East Fork	<u>12</u>	<u>575</u>	<u>550</u>	<u>272</u>	<u>...</u>
	102	12554	10045	7644	3870

APPROPRIATIONS ON VERDE RIVER IN YAVAPAI COUNTY.

- Ditch by P. W. Burford, January 7, 1877.
- All water of Verde River by Jos. Melvin, July 23, 1877.
- All water of Verde River 1/2 mile above Oak Creek, M. R. Vernon, September 23, 1882.
- 3,000 inches in J. H. Wilkerson and Wm. Sherrard, Feb. 12, 1871.
- 3,000 " Albert Young and C. F. Bennett, Sept. 18, 1875.
- 3,000 " J. H. Wingfield, D. W. Strahan, Mrs. Mary E. Clift, L. B. Barney, and Jas. Bristow for Reservation ditch, Dec. 4, 1877.