NAVIGABILITY ALONG THE NATURAL CHANNEL OF THE VERDE RIVER, AZ

Detailed analysis from Sullivan Lake to the USGS gage near Clarkdale.
and
General analysis from Clarkdale gage to mouth.

An assessment based on history, Federal GLO surveys, hydrology, hydraulics and morphology

By

Hjalmar W. Hjalmarson, PE

October 4, 2014

APPENDICES E THROUGH M

APPENDIX E.—Walnut Creek

This appendix presents historic and current information about Walnut Creek that is related to the assessment of navigability of the Upper Verde River. The information includes the original Land Surveys, early newspaper accounts, reports by the USBR, USFS and USGS and aerial photographs.

Federal Land Survey maps (plats) with information, such as channel widths, from selected associated survey field notes for the reach of Walnut Creek are used. The maps and survey notes, when used together, provide valuable morphology, hydrology and hydraulic information for the assessment of navigability for ANSAC. These maps and field notes were obtained from the Bureau of Land Management (BLM) in 2013.

The natural Walnut (Pueblo) Creek was perennial to at least section 8 T18N R4W where streamflow seeped into the porous stream sediments. Downstream of section 8 T18N R4W Walnut Creek was seasonably intermittent. Accounts of the Whipple survey suggest the creek was perennial in its natural state. However, because subsequent observations were of a creek that had been affected by early human diversions, I must assume the lower reach was intermittent.

Of importance for this study of navigability is the fact that there was a supply of water throughout a typical year that was above the basin fill that reached Big Chino Creek and the natural Verde River downstream.

Old Camp Haulapai

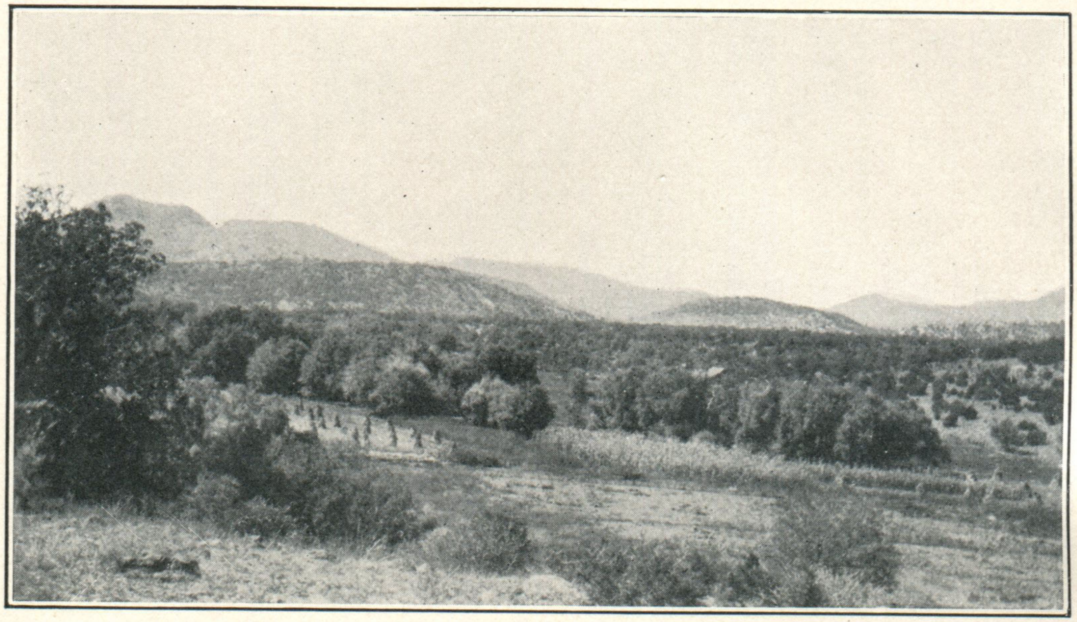
Fewkes, Jesse W., 1912, Antiquities of the Upper Verde River and Walnut Creek Valleys, Arizona: Bureau of American Ethnology, 28th Annual Report, 1906-07, p. 185-220.

Camp Hualapai (1869-1873) – First known as Camp Toll Gate, this post was established in May, 1869, just southeast of Aztec Pass on William H. Hardy's toll road between Prescott and Hardyville (which eventually developed into Bullhead City). In 1870, it was taken over by the military to protect the road from Indian attacks, but the troops abandoned the camp in 1873. A small settlement that grew up around the camp became known as Juniper. Today there are just a very few remnants and a small cemetery, but both are located on private property. The site is located on Walnut Creek Road north of Prescott, AZ.

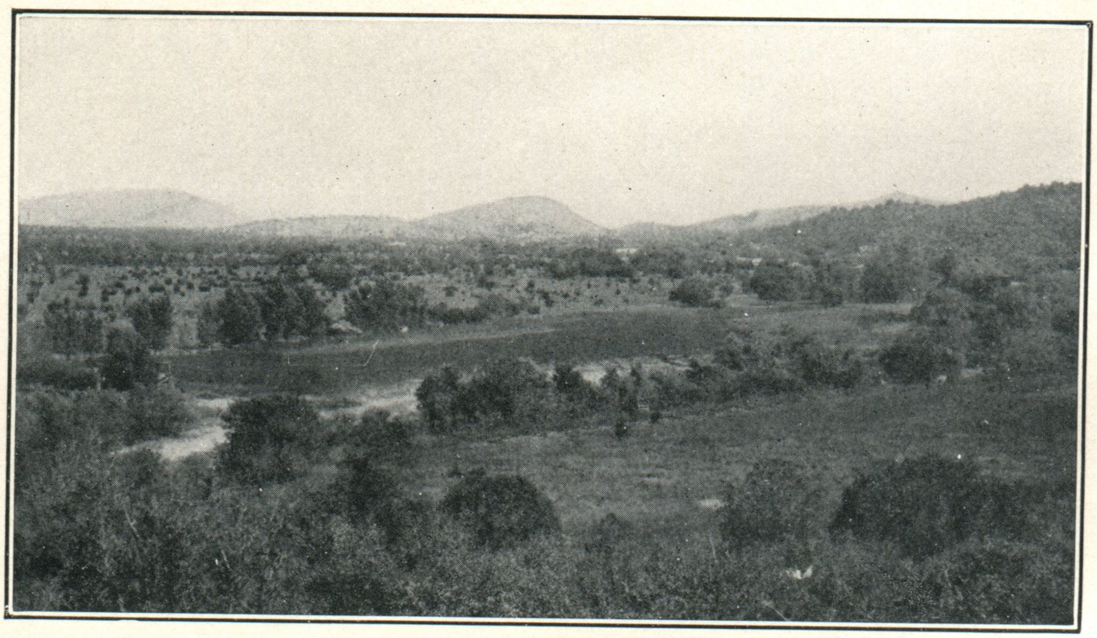
The following two photographs that I scanned from my personal book by Fewkes (1912) show Walnut Creek in 1906. It's important to realize that several settlers had small farms/gardens with diversions from Walnut Creek when these photos were taken. Also, of significant importance with respect to historic accounts of base flow in the area, the original Federal land survey noted on page 36 of book 1690 that there "were several farms under cultivation in the valleys of Walnut Creek." (Omar Case, November 11, 1872).

Obviously, any diversions by early settlers depleted the base flow downstream. Diversions impact the amount of water in streams and there is a lesser amount of water than would be present in the stream had there been no diversions. Thus, the accounts of the streams and Verde River from early settlers around that time frame (post 1860s) do not describe them in the "natural condition."

Fewkes, Jesse W., 1912, Antiquities of the Upper Verde River and Walnut Creek Valleys, Arizona: Bureau of American Ethnology, 28th Annual Report, 1906-07, p. 185-220.



NEAR AINSWORTH'S RANCH



AZTEC PASS

VIEWS IN WALNUT VALLEY

Fewkes, Jesse W., 1912, Antiquities of the Upper Verde River and Walnut Creek Valleys, Arizona: Bureau of American Ethnology, 28th Annual Report, 1906-07, p. 185-220.

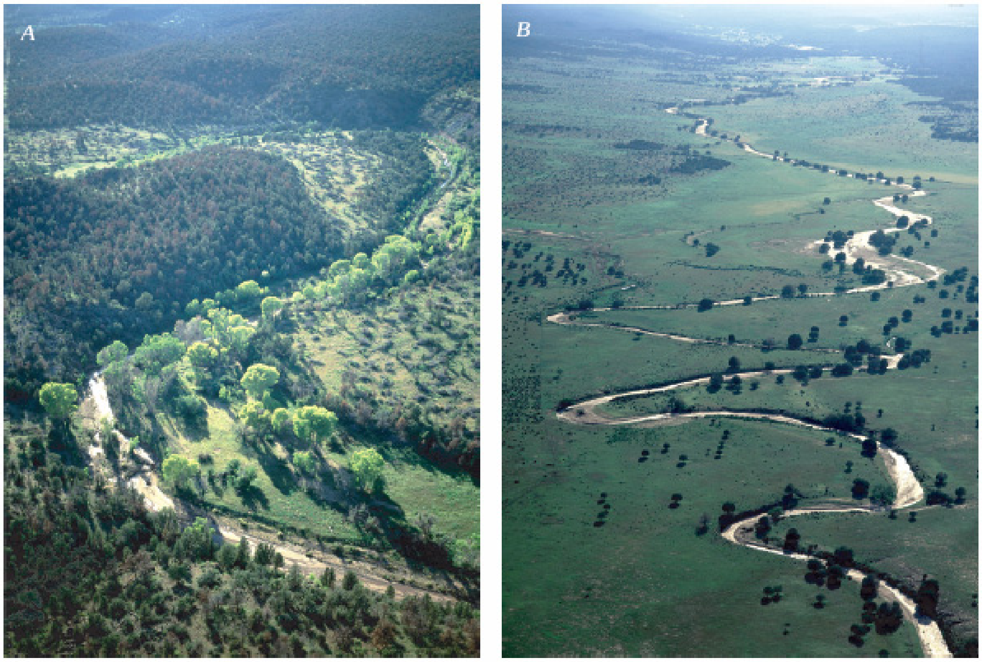
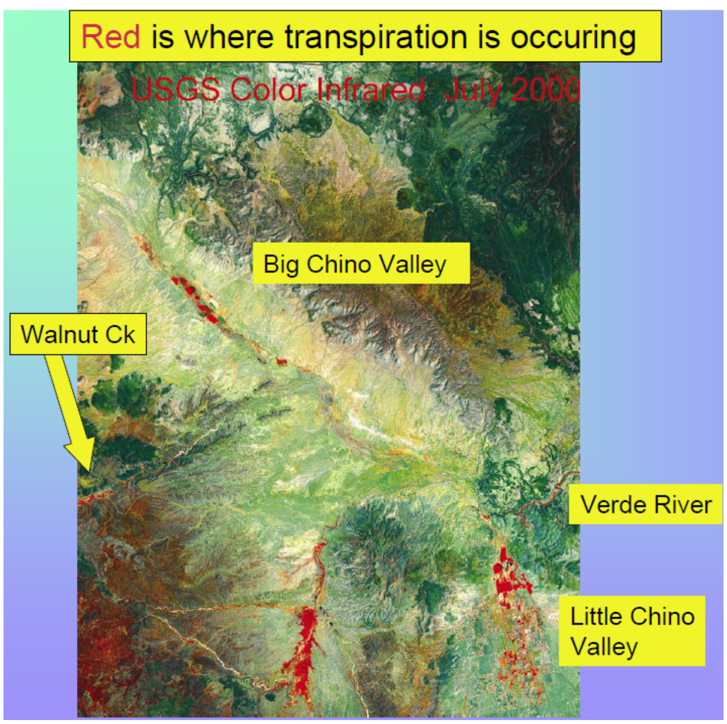


Figure A12. Photographs of Walnut Creek (A) in perennial segment, and (B) near confluence with Big Chino Wash following regional storm of September 2003. Views to west and southwest. Photographs by M. Collier.

Wirt, L., 2005, The Verde River headwaters, Yavapai Count, Arizona *in* Wirt, Laurie, DeWitt, Ed, and Langenheim, V.E., eds., Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River Headwaters, North-CentralArizona: U.S Geological Survey Open-File Report 2004-1411, 33 p.



The following from Fewkes (1912) is a description of Walnut Creek in 1906 and that also supports Whipple's observations.

RUINS ON WALNUT CREEK

Walnut Creek is a small stream the waters of which at times flow into the Chino, but which, on the occasion of the writer's visit, were lost in the sands about 8 miles below old Camp Hualapai. In the report of Whipple's reconnoissance the stream bears the name of Pueblo Creek, from certain "pueblos" on the hills overlooking it, which he described, but the name is no longer applied to it. The ruins of Walnut Creek are of two kinds, one situated on the low terrace bordering the creek, the other on the hilltops. The stream is formed by the junction of two branches and the valley is continuous from Aztec Pass to the point where it merges into Chino Valley.

There is evidence that Walnut Valley had a considerable aboriginal population in prehistoric times. A number of forts and many remains of settlements strewn with pottery fragments and broken stone artifacts were found. Here and there are mounds, also irrigation ditches and pictographs.

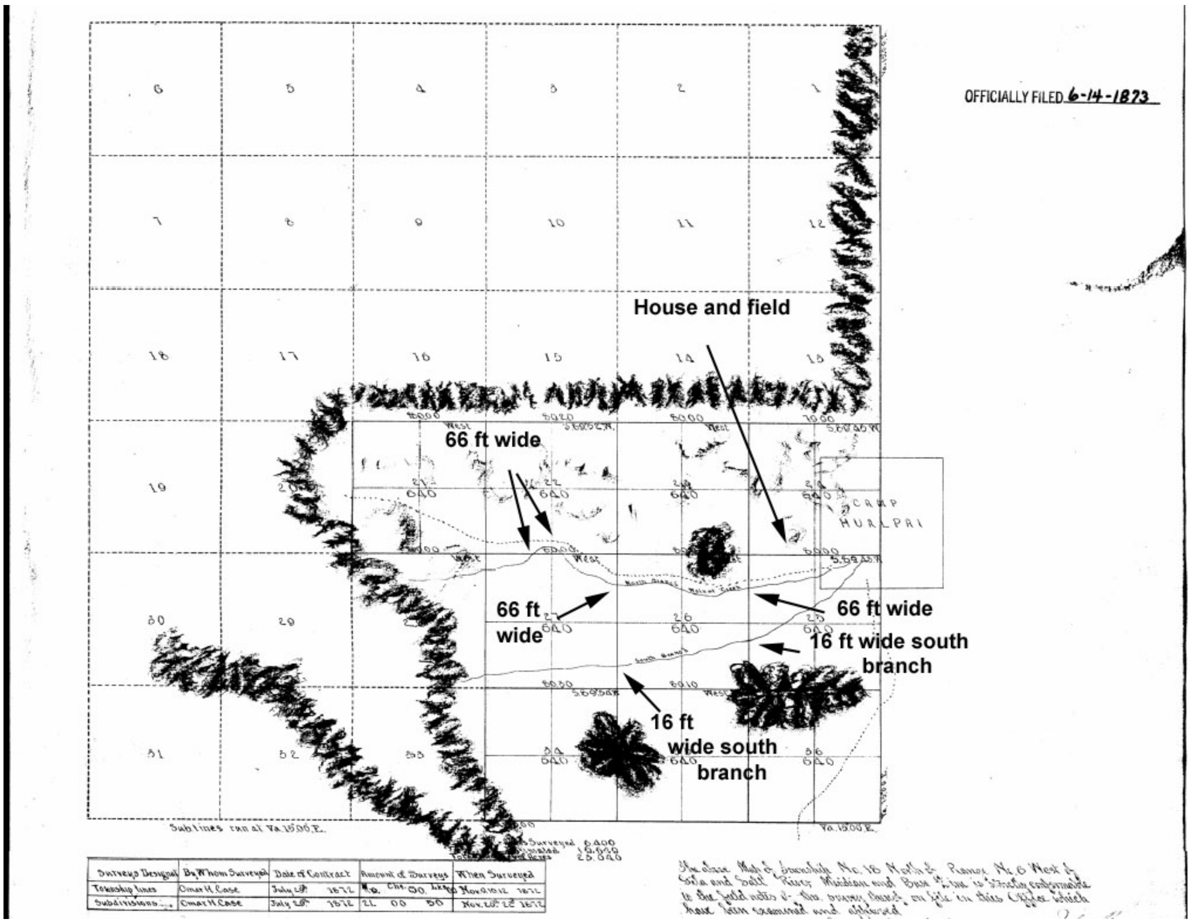
A few years ago Walnut Valley had a number of white settlers and a post office,[1] but the families have now dwindled in number to three or four, and the place is characterized chiefly by abandoned houses. Camp Hualapai is deserted, the adobe houses shown in the accompanying illustration (pl. 92) being almost the only reminder of its former existence.

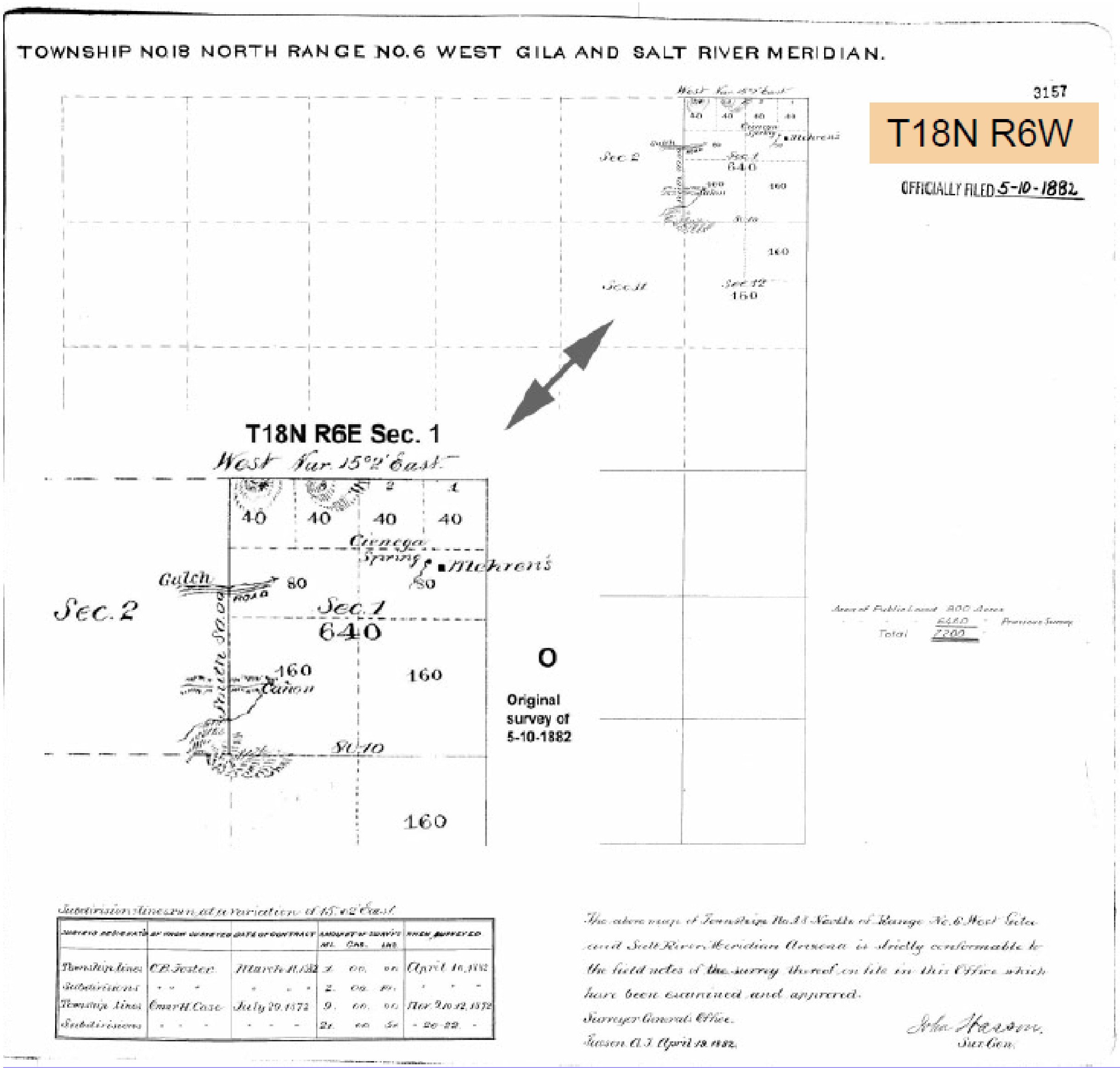
Historical Account

Whipple was the first to mention the numerous ruins ("pueblos" and forts) and other evidences of a former aboriginal population in Walnut Creek Valley. Subsequent to his visit no new observations on them appear in published accounts of the ruins of Arizona, and no archeologist seems to have paid attention to this interesting valley, a fact which gave the author new enthusiasm to visit the region and inspect its antiquities. These seemed of special interest, as Whipple's account was inadequate as a means of determining their relations with other aboriginal ruins in the Southwest. Who built the

T18N R6W
T18N R5W
T18N R4W
T18N R3W
T18N R2W

T18N R6W

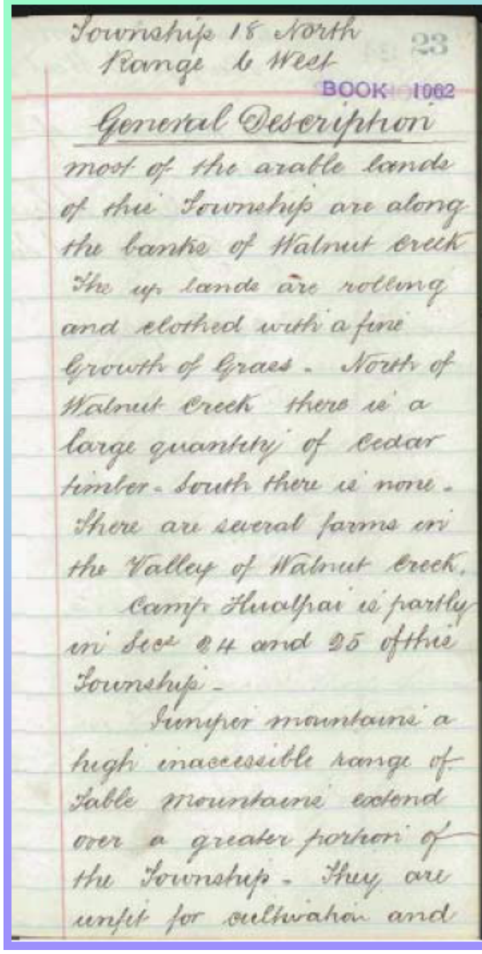




TOWNSHIP NO.18 NORTH RANGE NO.6 WEST GILA AND SALT RIVER MERIDIAN.
3157
T18N R6W
OFFICIALLY FILED 5-10-1882
T18N R6E Sec. 1
West Var. 15°2' East
40
40
40
40
Cienega Spring
Mehren's
Gulch
Road
80
80
Sec. 2
Sec. 1
640
160
Cañon
160
80.10
160
O
Original survey of 5-10-1882
Subdivision lines run at a variation of 15°42' East.
Township lines C.B. Foster March 11.1882 April 10.1882
Township lines Omar H. Case July 29.1872
Surveyor General's Office.
Tucson A.T. April 18 1882.

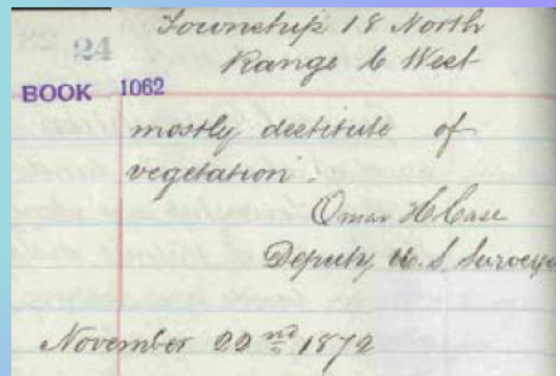
T18N R6W

Federal land surveyor notes.

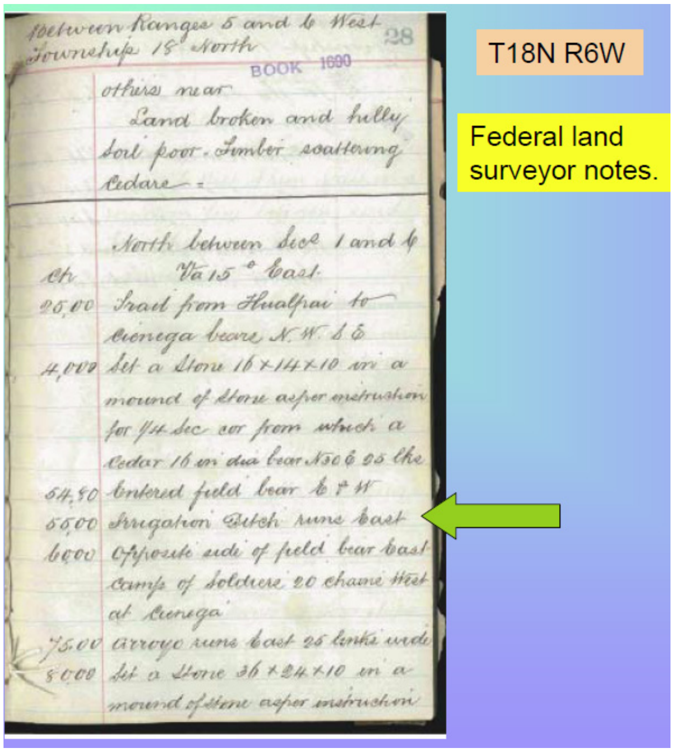

Township 18 North
Range 6 West
23
BOOK 1062

General Description

most of the arable lands
of this Township are along
the banks of Walnut Creek
The up lands are rolling
and clothed with a fine
Growth of Grass. North of
Walnut Creek there is a
large quantity of Cedar
timber. South there is none.
There are several farms in
the Valley of Walnut Creek.
Camp Hualpai is partly
in Sec 24 and 25 of this
Township.
Juniper mountains a
high inaccessible range of
table mountains extend
over a greater portion of
the Township. They are
unfit for cultivation and


24
Township 18 North
Range 6 West
BOOK 1062
mostly destitute of
vegetation.
Omar H. Case
Deputy U. S. Surveyor
November 22nd 1872

There are several farms in the Valley of Walnut Creek. Some of the cultivated areas were in identified on the Federal Land Survey notes but were not shown as shaded or cross-hatched areas on the associated maps.

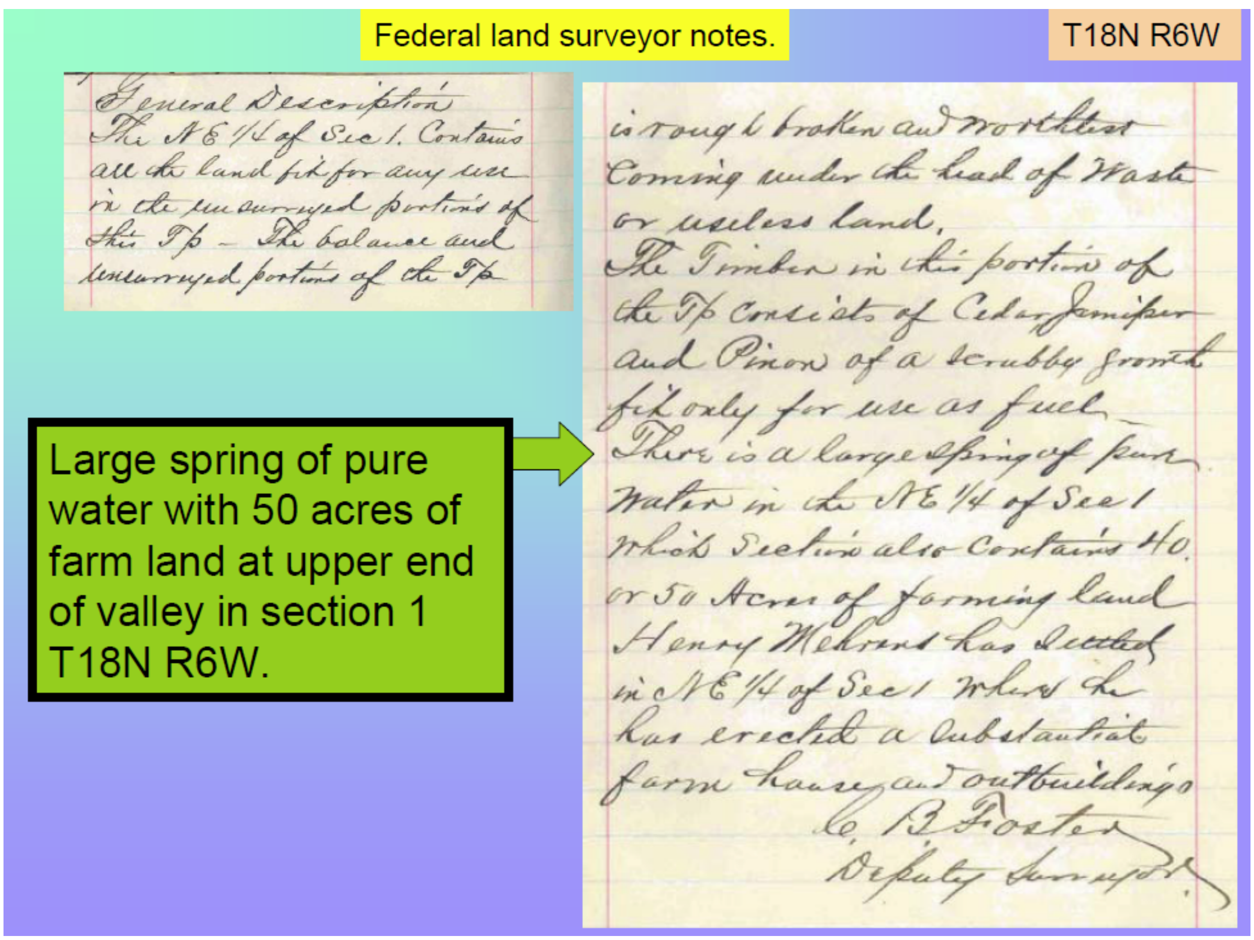


Between Ranges 5 and 6 West
Township 18 North
BOOK 1690
28

others near
Land broken and hilly
Soil poor. Timber scattering
Cedars.

North between Secs 1 and 6
Va 15° East.

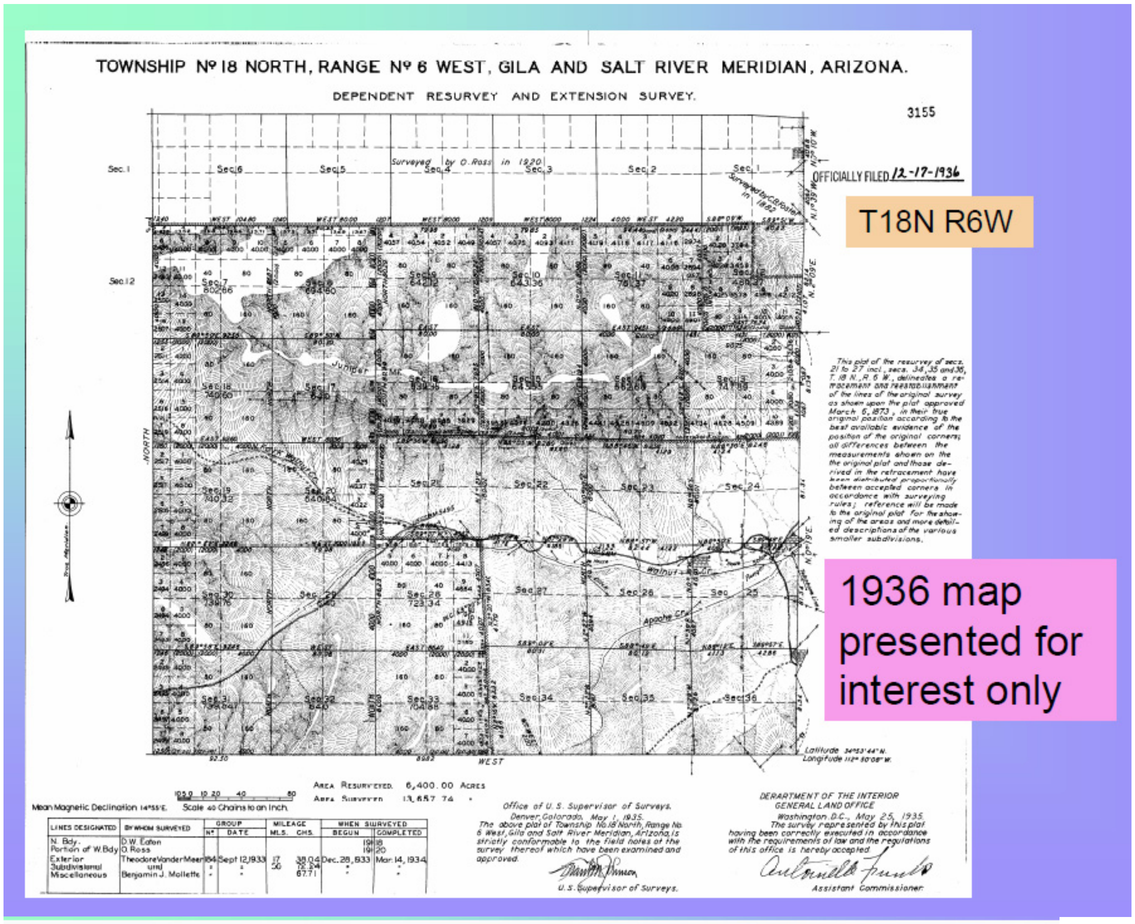
ch	
25,00	Trail from Hualpai to Cienega bears N.W. & S.E.
4,000	Set a Stone 16×14×10 in a mound of Stone as per instruction for 1/4 Sec cor from which a Cedar 16 in dia bear N 50 E 25 lks
54,80	Entered field bear E & W
55,00	Irrigation Ditch runs East
60,00	Opposite side of field bear East camp of Soldiers 20 chains West at Cienega
75.00	Arroyo runs East 25 links wide
80,00	Set a Stone 36×24×10 in a mound of Stone as per instruction

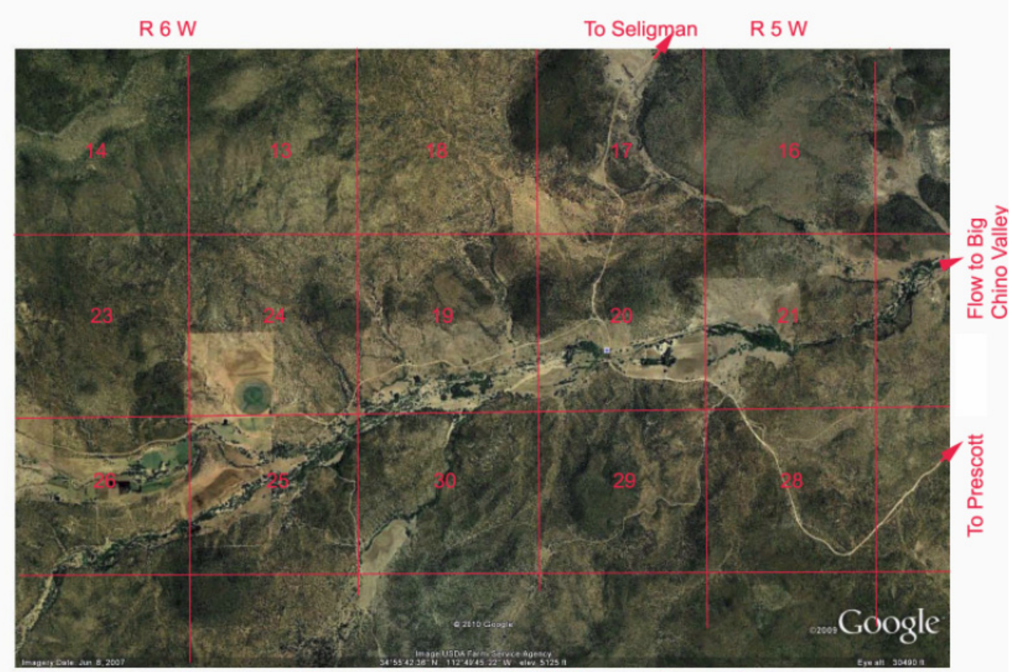


General Description
The NE 1/4 of Sec 1. Contains all the land fit for any use in the unsurveyed portions of this Tp - The balance and unsurveyed portions of the Tp

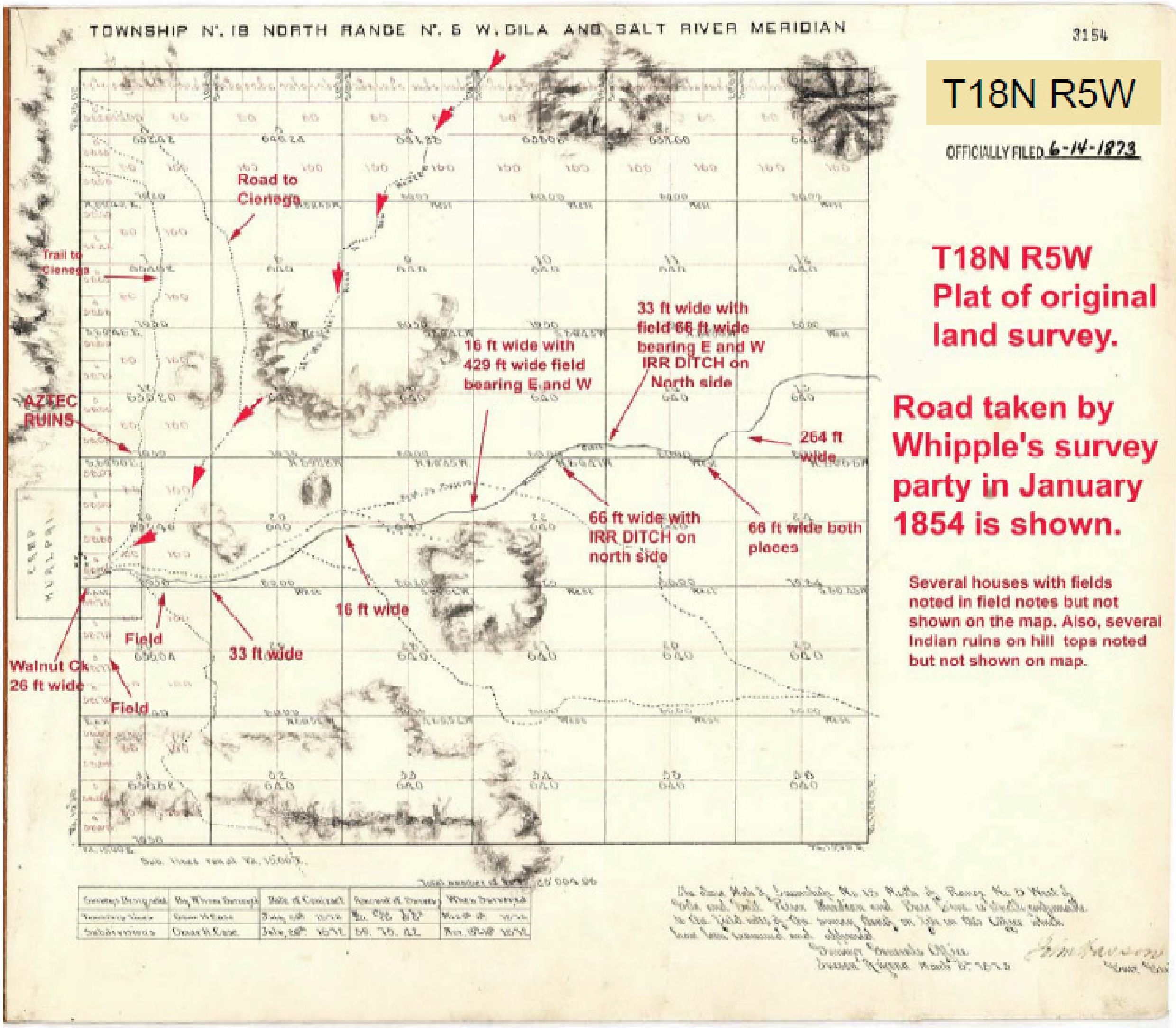
is rough broken and worthless Coming under the head of Waste or useless land.
The Timber in this portion of the Tp Consists of Cedar Juniper and Pinon of a scrubby growth fit only for use as fuel.
There is a large Spring of pure water in the NE 1/4 of Sec 1 which Section also Contains 40 or 50 Acres of farming land
Henry Mehrens has Settled in NE 1/4 of Sec 1 where he has erected a Substantial farm house and outbuildings.

C. B. Foster
Deputy Surveyor

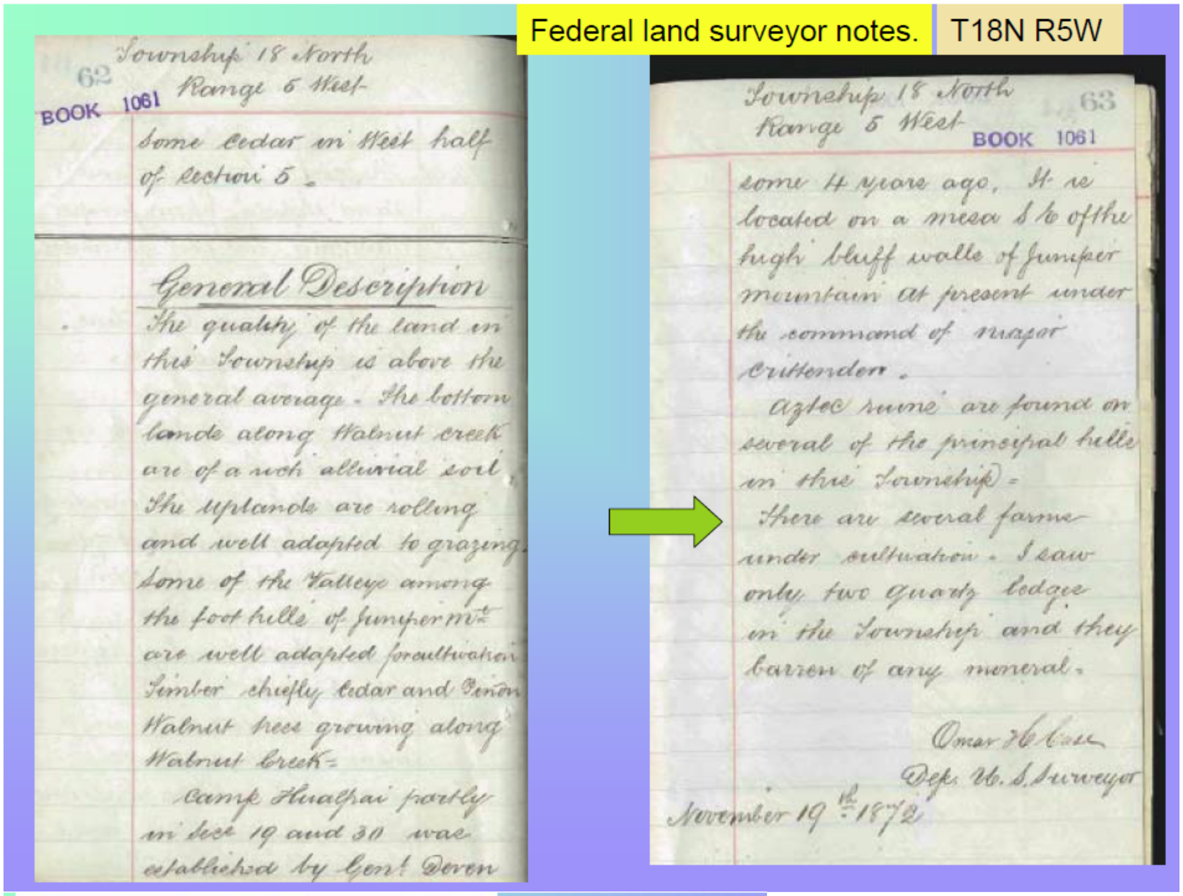


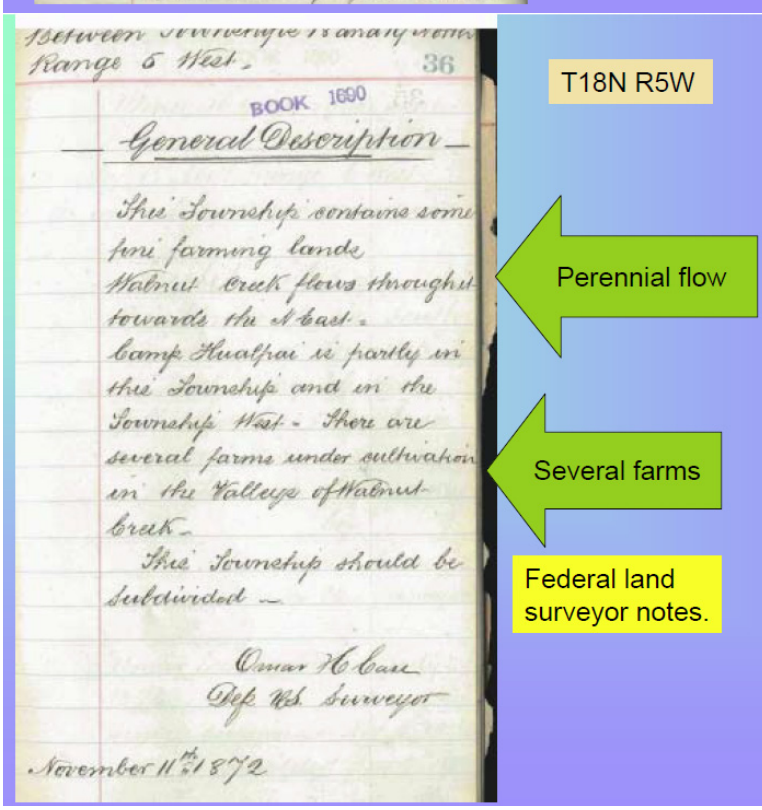


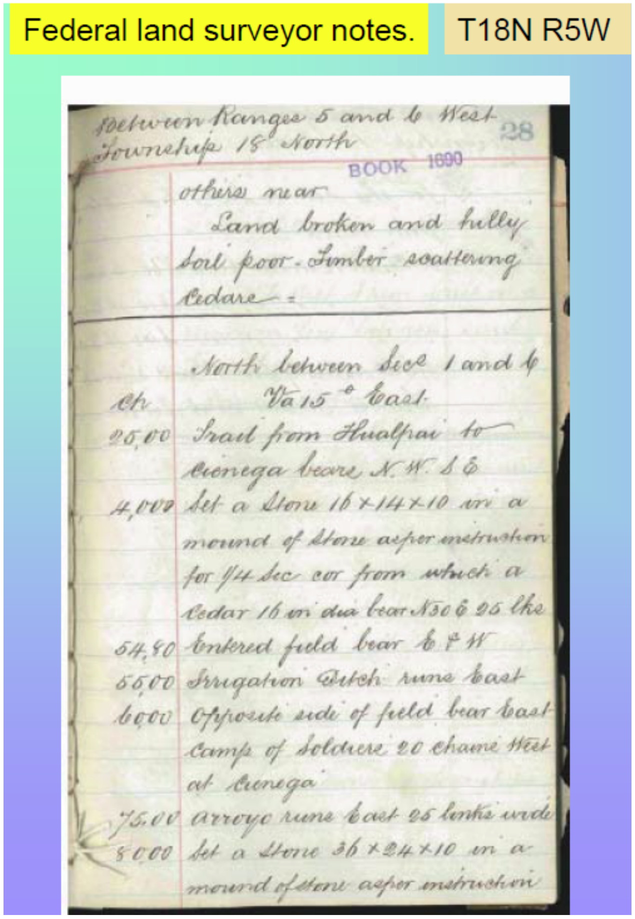
Irrigated land along Walnut Creek upstream of Big Chino Valley



TOWNSHIP N°. 18 NORTH RANGE N°. 5 W. GILA AND SALT RIVER MERIDIAN
3154
T18N R5W
OFFICIALLY FILED 6-14-1873
T18N R5W Plat of original land survey.
Road taken by Whipple's survey party in January 1854 is shown.
Several houses with fields noted in field notes but not shown on the map. Also, several Indian ruins on hill tops noted but not shown on map.
Road to Cienega
Trail to Cienega
AZTEC RUINS
16 ft wide with 429 ft wide field bearing E and W
33 ft wide with field 66 ft wide bearing E and W IRR DITCH on North side
264 ft wide
66 ft wide with IRR DITCH on north side
66 ft wide both places
16 ft wide
33 ft wide
Field
Walnut Ck 26 ft wide
Field


Federal land surveyor notes.
T18N R5W
Township 18 North
Range 5 West
62
BOOK 1061
Some Cedar in West half
of Section 5.
General Description
The quality of the land in
this Township is above the
general average. The bottom
lands along Walnut creek
are of a rich alluvial soil.
The uplands are rolling
and well adapted to grazing.
Some of the Valleys among
the foot hills of Juniper Mts
are well adapted for cultivation.
Timber chiefly Cedar and Pinon.
Walnut trees growing along
Walnut Creek.
Camp Hualpai partly
in Secs 19 and 30 was
established by Genl Devens
Township 18 North
Range 5 West
63
BOOK 1061
some 4 years ago. It is
located on a mesa S.E. of the
high bluff walls of Juniper
mountain at present under
the command of Major
Crittenden.
Aztec ruins are found on
several of the principal hills
in this Township.
There are several farms
under cultivation. I saw
only two quartz ledges
in the Township and they
barren of any mineral.
Omar H Case
Dep. U.S. Surveyor
November 19th 1872

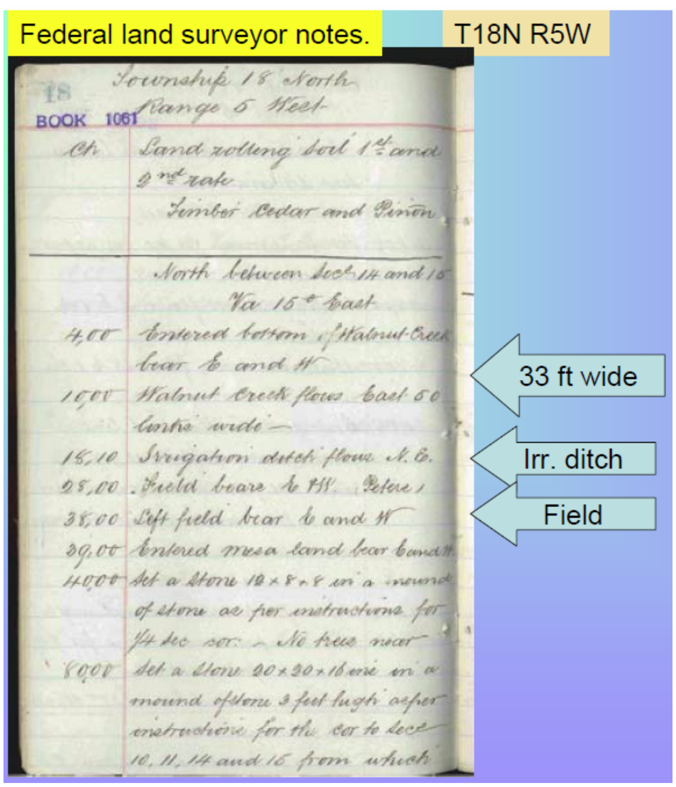

Range 5 West.
36
BOOK 1690
General Description
This Township contains some
fine farming lands.
Walnut Creek flows throughout
towards the N East.
Camp Hualpai is partly in
this Township and in the
Township West. There are
several farms under cultivation
in the Valleys of Walnut
Creek.
This Township should be
Subdivided.
Omar H Case
Dep US Surveyor
November 11th 1872
T18N R5W
Perennial flow
Several farms
Federal land surveyor notes.



Between Ranges 5 and 6 West 28
Township 18 North
BOOK 1090

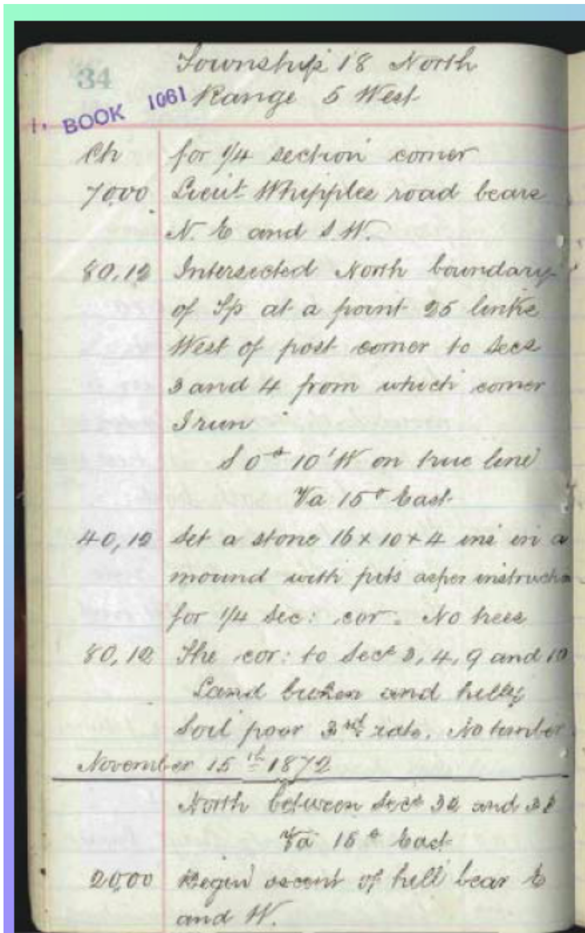
others near
Land broken and hilly
Soil poor. Timber scattering
Cedars.

North between Secs 1 and 6
Ch Va 15° East
25,00 Trail from Hualpai to
Cienega bears N.W. & S.E.
4,000 Set a Stone 16 x 14 x 10 in a
mound of Stone as per instruction
for 1/4 Sec cor from which a
Cedar 16 in dia bears N30 E 25 lks
54,80 Entered field bears E & W
56,00 Irrigation Ditch runs East
60,00 Opposite side of field bears East
Camp of Soldiers 20 chains West
at Cienega
75,00 Arroyo runs East 25 links wide
80,00 Set a Stone 36 x 24 x 10 in a
mound of stone as per instruction



18 Township 18 North
BOOK 1061 Range 5 West
Ch Land rolling soil 1st and
2nd rate
Timber Cedar and Pinon

North between Secs 14 and 15
Va 15° East
4,00 Entered bottom of Walnut Creek
bears E and W
10,00 Walnut Creek flows East 50
links wide
15,10 Irrigation ditch flows N.E.
25,00 Field bears E & W.
38,00 Left field bear E and W
39,00 Entered mesa land bear E and W
40,00 Set a Stone 12 x 8 x 8 in a mound
of stone as per instructions for
1/4 Sec cor. No trees near
80,00 Set a Stone 20 x 20 x 16 ins in a
mound of stone 3 feet high as per
instructions for the cor to Secs
10, 11, 14 and 15 from which



34
Township 18 North
BOOK 1061 Range 5 West

Ch	for 1/4 section corner
70.00	Lieut Whipples road bears N. E. and S. W.
80.12	Intersected North boundary of Tp at a point 25 links West of post corner to Secs 3 and 4 from which corner Iron
	S 0° 10' W on true line
	Va 15° East
40.12	Set a stone 16 × 10 × 4 ins in a mound with pits as per instructions for 1/4 sec: cor. No trees
80.12	The cor: to Secs 3, 4, 9 and 10
	Land broken and hilly
	Soil poor 3rd rate. No timber
November 15th 1872	
	North between Secs 34 and 35
	Va 15° East
20.00	Begin ascent of hill bear E and W.

T18N R5W

Whipple Rd

Federal land surveyor notes.

ON WALNUT CREEK.

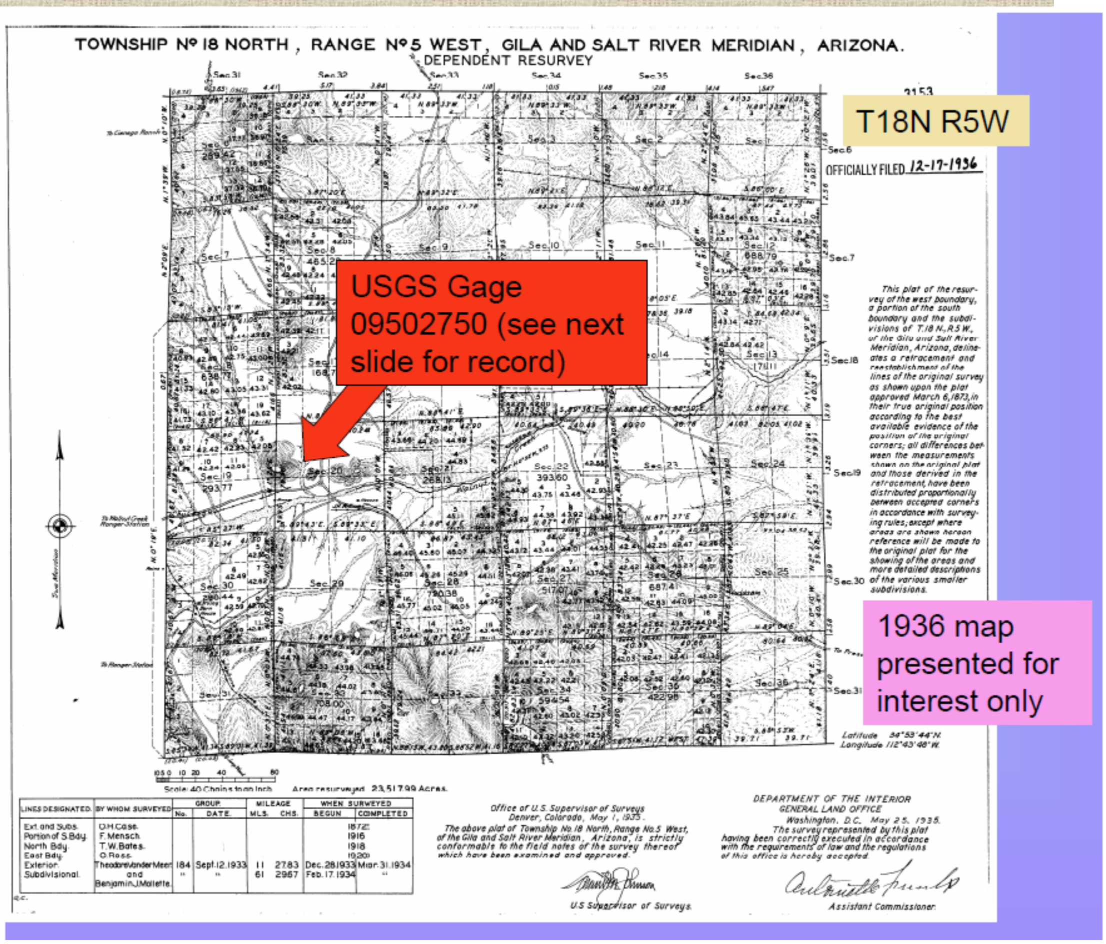
1000 in., Mrs. Fannie Plummer, July 17, 1896; b. 3, p. 128.
500 Wm. G. Shook, June 24, 1887; b. 1, p. 426.
500 W. H. Williscraft, Nov. 15, 1887; b. 1, p. 441.
All water of Walnut Creek, Saml. C. Rodgers, original location of Apr. 13, 1868, recorded Jan. 18, 1900; ———

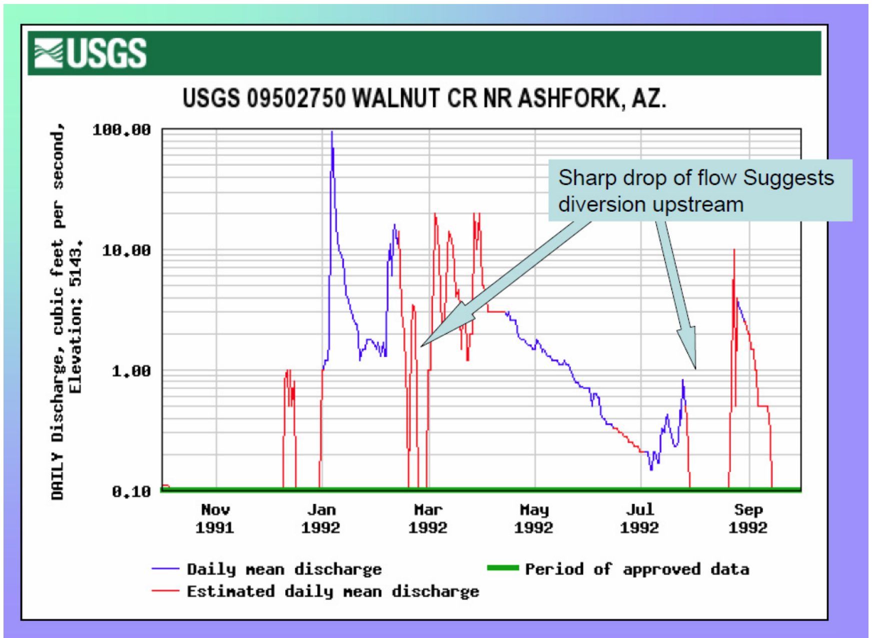
Rights to 2000 miners inches (50 cfs) and even rights to all the water is claimed.

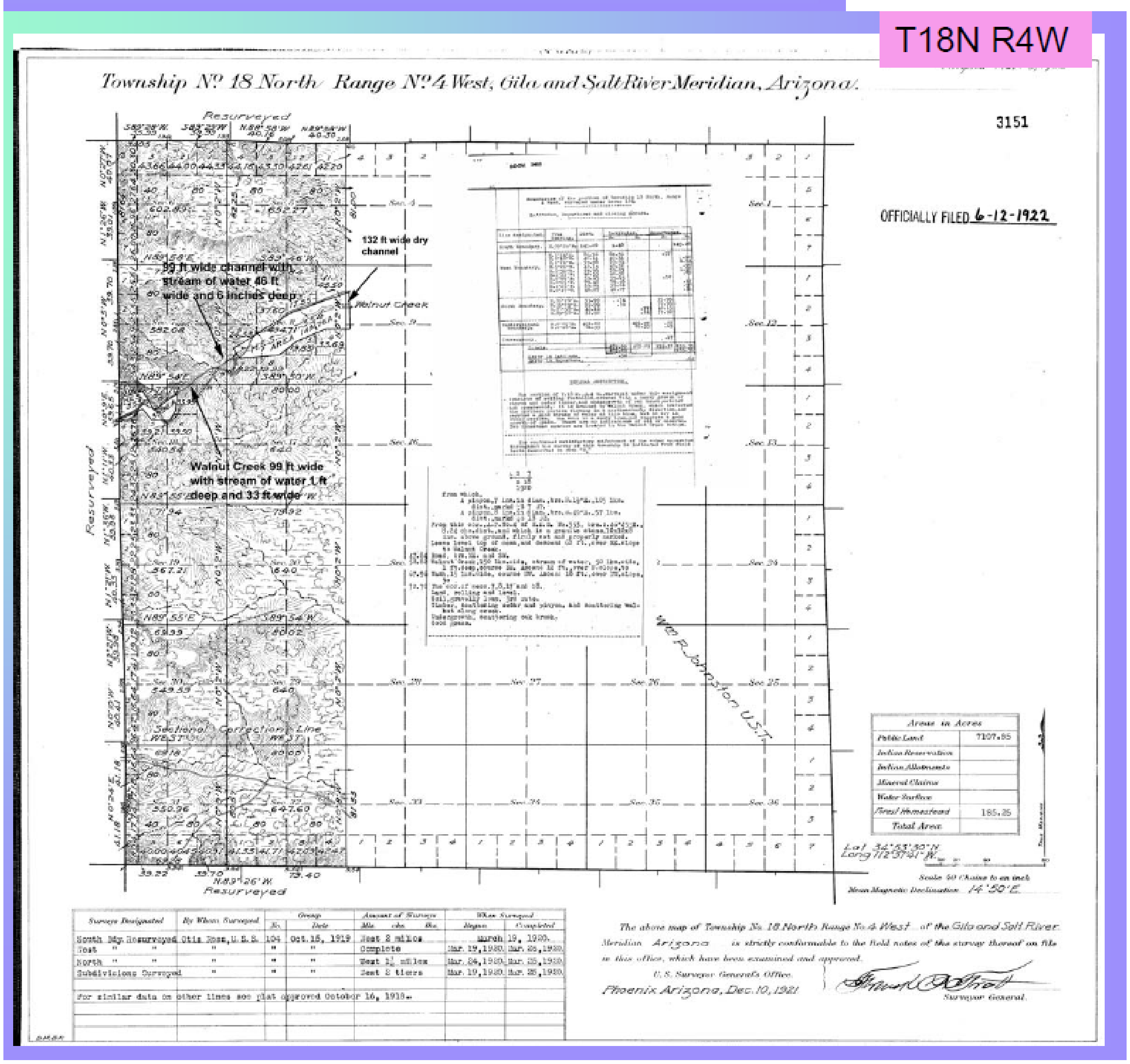
Turney, O. A., 1901, Water Supply and Irrigation on the Verde River and tributaries, Ariizona: Cleaveland Daily Record, print, 87 Wood St., Cleveland. Ohio, 18p.

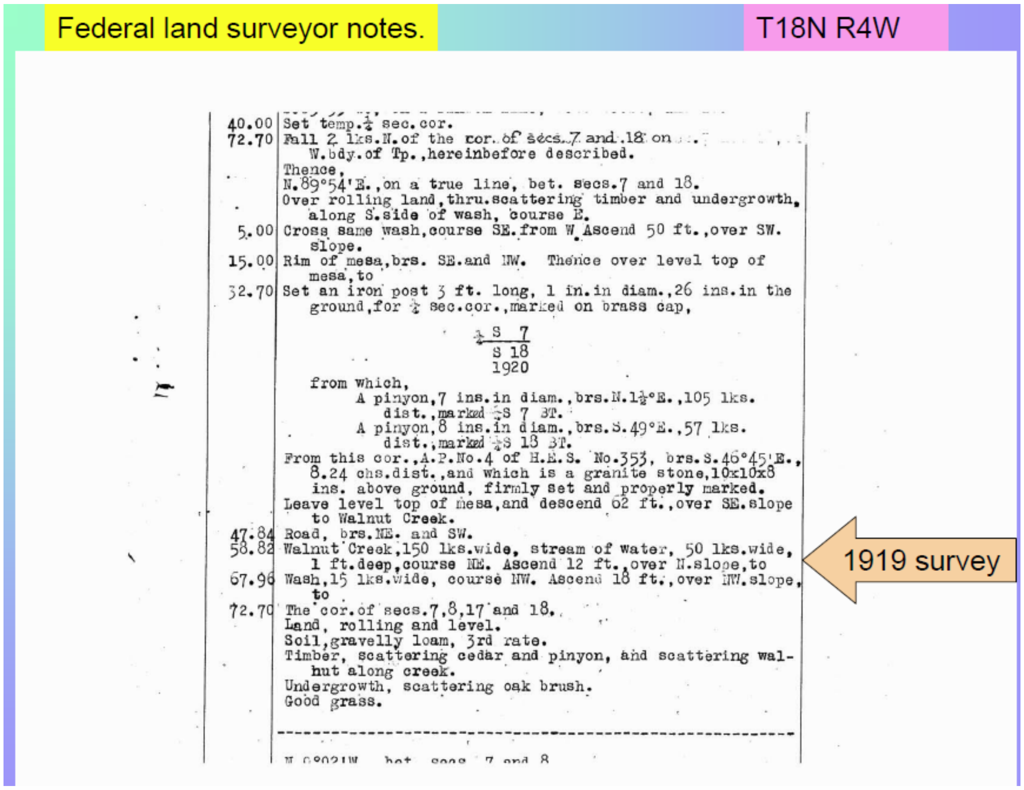
Appears there was about 110 acres of irrigated land based on Federal Survey notes with measured widths of cultivated and also aerial photos. Roughly 30 + acres of cultivated land in addition to the 80 acres as shown on the next slide.


Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, September 07, 1898
Walnut Creek 80 acres of cultivated land
3 Wells (probably shallow and along stream sediments)
BARAGIN IN REAL ESTATE
One of the best known ranches in Northern Arizona situated on Walnut Creek, 35 miles from Prescott, is offered for sale at about
ONE-HALF OF ITS VALUE.
It contains 320 acres, 80 of which are under a high state of cultivation. Nearly 100 acres are susceptible of irrigation. There is a
NEVER FAILING SUPPLY OF WATER
There is a good six room house, two barns, several out houses and three good wells of excellent water on the place.
THE CLIMATE IS UNSURPASSED
Either for a summer resort or for occupation. It produces the best crops of any farm in Arizona and has a
Home Market for All Products.
Water rights go with the place and it controls an
EXCELLENT RANGE FOR STOCK
SATISFACTORY REASONS FOR SELLING.
WILL BE SOLD ON EASY TERMS ON IMMEDIATE APPLICATION
For further particulars apply to or address
JOURNAL-MINER, PRESCOTT, ARI


TOWNSHIP Nº 18 NORTH, RANGE Nº 5 WEST, GILA AND SALT RIVER MERIDIAN, ARIZONA.
DEPENDENT RESURVEY
T18N R5W
OFFICIALLY FILED 12-17-1936
USGS Gage 09502750 (see next slide for record)
1936 map presented for interest only
Scale: 40 Chains to an Inch
Area resurveyed 23,517.99 Acres
DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE
Assistant Commissioner
U.S. Supervisor of Surveys


USGS
USGS 09502750 WALNUT CR NR ASHFORK, AZ.
DAILY Discharge, cubic feet per second,
Elevation: 5143.
100.00
10.00
1.00
0.10
Nov 1991
Jan 1992
Mar 1992
May 1992
Jul 1992
Sep 1992
Sharp drop of flow Suggests diversion upstream
Daily mean discharge
Estimated daily mean discharge
Period of approved data

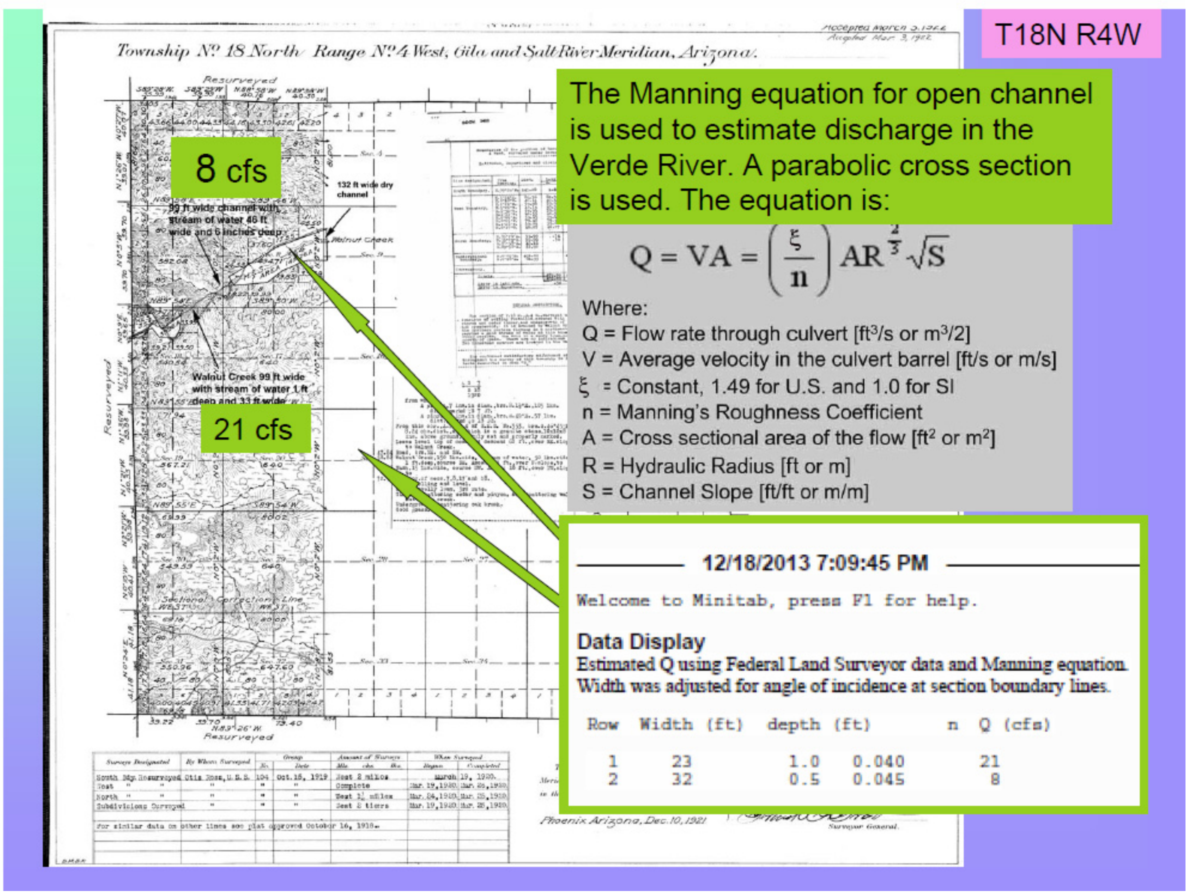

T18N R4W
Township No. 18 North Range No. 4 West, Gila and Salt River Meridian, Arizona.
3151
OFFICIALLY FILED 6-12-1922
132 ft wide dry channel
99 ft wide channel with stream of water 46 ft wide and 6 inches deep
Walnut Creek
Walnut Creek 99 ft wide with stream of water 1 ft deep and 33 ft wide
Resurveyed
Sectional Correction Line
Phoenix Arizona, Dec. 10, 1921
Surveyor General



40.00 Set temp.¼ sec.cor.
72.70 Fall 2 lks.N.of the cor.of secs.7 and 18 on W.bdy.of Tp.,hereinbefore described.
Thence,
N.89°54'E.,on a true line, bet. secs.7 and 18.
Over rolling land,thru.scattering timber and undergrowth, along S.side of wash, course E.
5.00 Cross same wash,course SE.from W Ascend 50 ft.,over SW. slope.
15.00 Rim of mesa,brs. SE.and NW. Thence over level top of mesa,to
32.70 Set an iron post 3 ft. long, 1 in.in diam.,26 ins.in the ground,for ¼ sec.cor.,marked on brass cap,

¼ S 7
S 18
1920

from which,
A pinyon,7 ins.in diam.,brs.N.1½°E.,105 lks. dist.,marked ¼S 7 BT.
A pinyon,8 ins.in diam.,brs.S.49°E.,57 lks. dist.,marked ¼S 18 BT.
From this cor.,A.P.No.4 of H.E.S. No.353, brs.S.46°45'E., 8.24 chs.dist.,and which is a granite stone,10x10x8 ins. above ground, firmly set and properly marked.
Leave level top of mesa,and descend 62 ft.,over SE.slope to Walnut Creek.
47.84 Road, brs.NE. and SW.
58.82 Walnut Creek,150 lks.wide, stream of water, 50 lks.wide, 1 ft.deep,course NE. Ascend 12 ft.,over N.slope,to
67.96 Wash,15 lks.wide, course NW. Ascend 18 ft.,over NW.slope, to
72.70 The cor.of secs.7,8,17 and 18.
Land, rolling and level.
Soil,gravelly loam, 3rd rate.
Timber, scattering cedar and pinyon, and scattering walnut along creek.
Undergrowth, scattering oak brush.
Good grass.



$$Q = VA = \left(\frac{\xi}{n}\right) A R^{\frac{2}{3}} \sqrt{S}$$

Where:
Q = Flow rate through culvert [ft^3/s or m^3/2]
V = Average velocity in the culvert barrel [ft/s or m/s]
ξ = Constant, 1.49 for U.S. and 1.0 for SI
n = Manning's Roughness Coefficient
A = Cross sectional area of the flow [ft^2 or m^2]
R = Hydraulic Radius [ft or m]
S = Channel Slope [ft/ft or m/m]

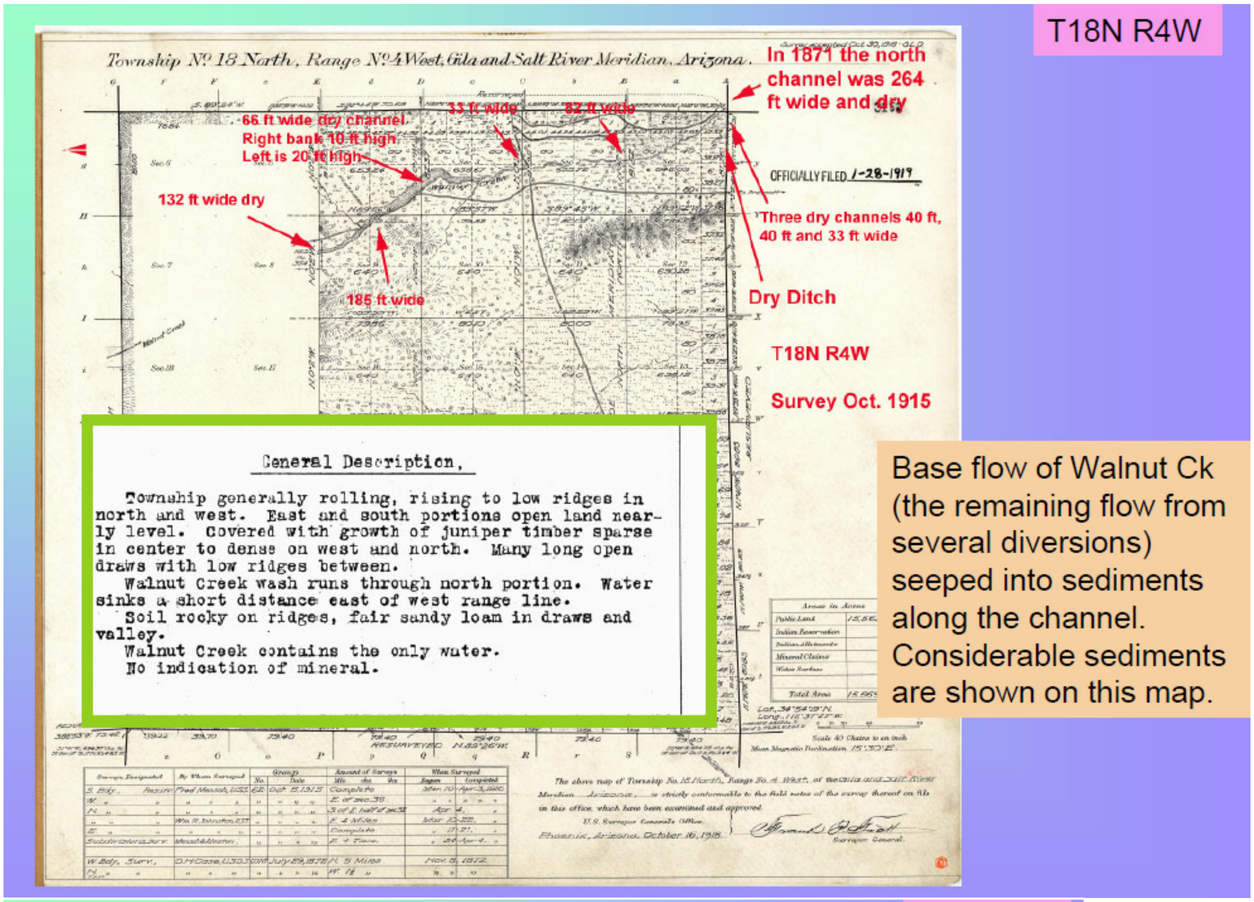
12/18/2013 7:09:45 PM

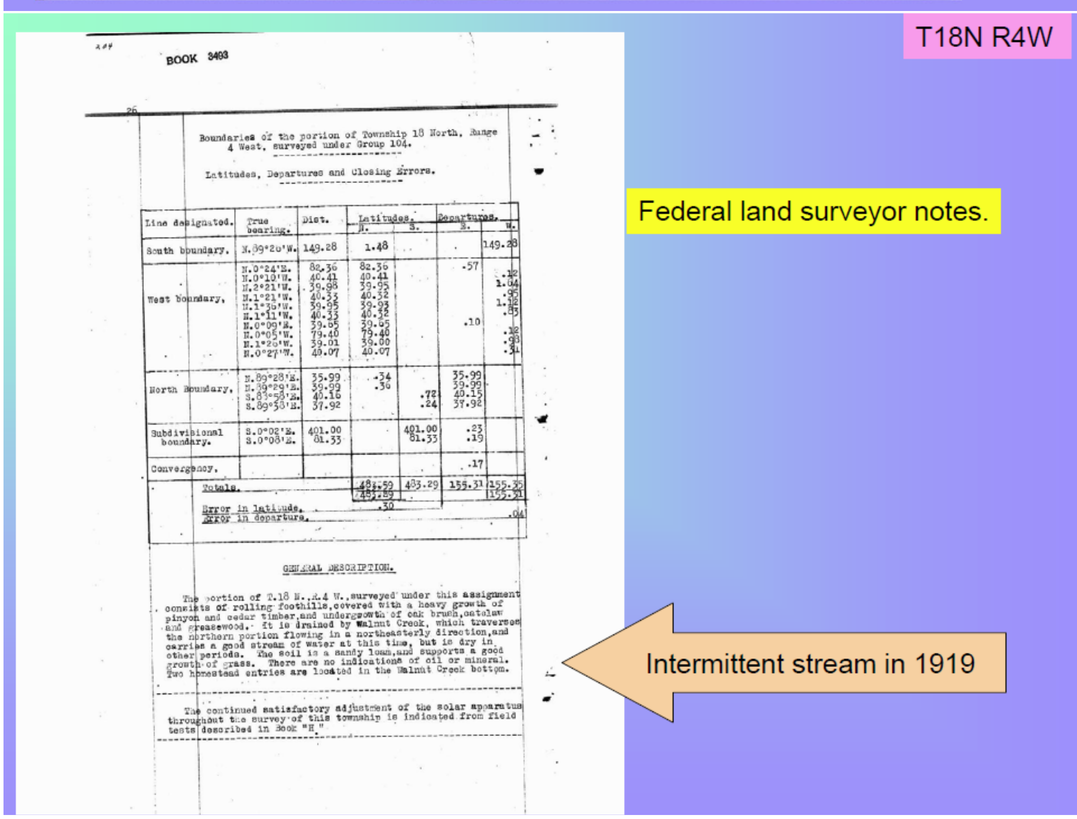
Welcome to Minitab, press F1 for help.

Data Display

Estimated Q using Federal Land Surveyor data and Manning equation. Width was adjusted for angle of incidence at section boundary lines.

Row	Width (ft)	depth (ft)	n	Q (cfs)
1	23	1.0	0.040	21
2	32	0.5	0.045	8





BOOK 3493

26

Boundaries of the portion of Township 18 North, Range 4 West, surveyed under Group 104.

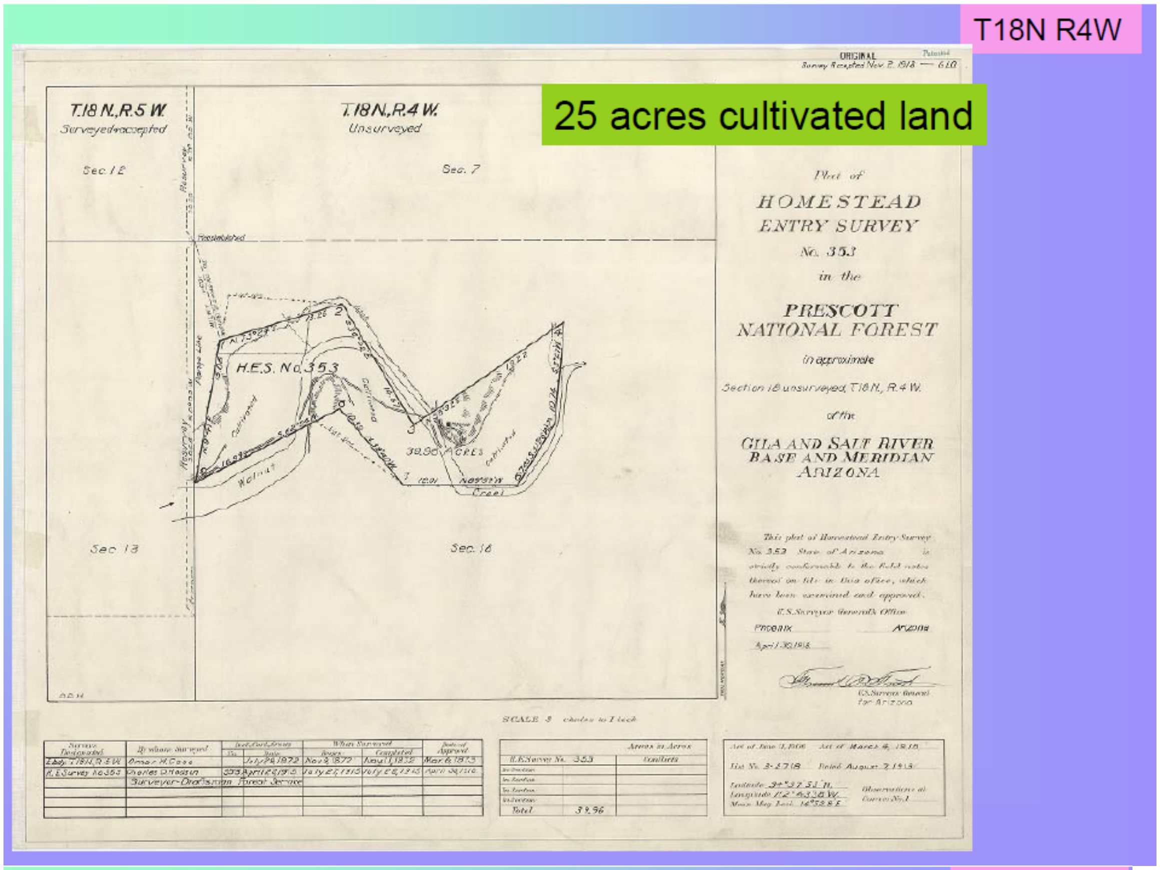
Latitudes, Departures and Closing Errors.

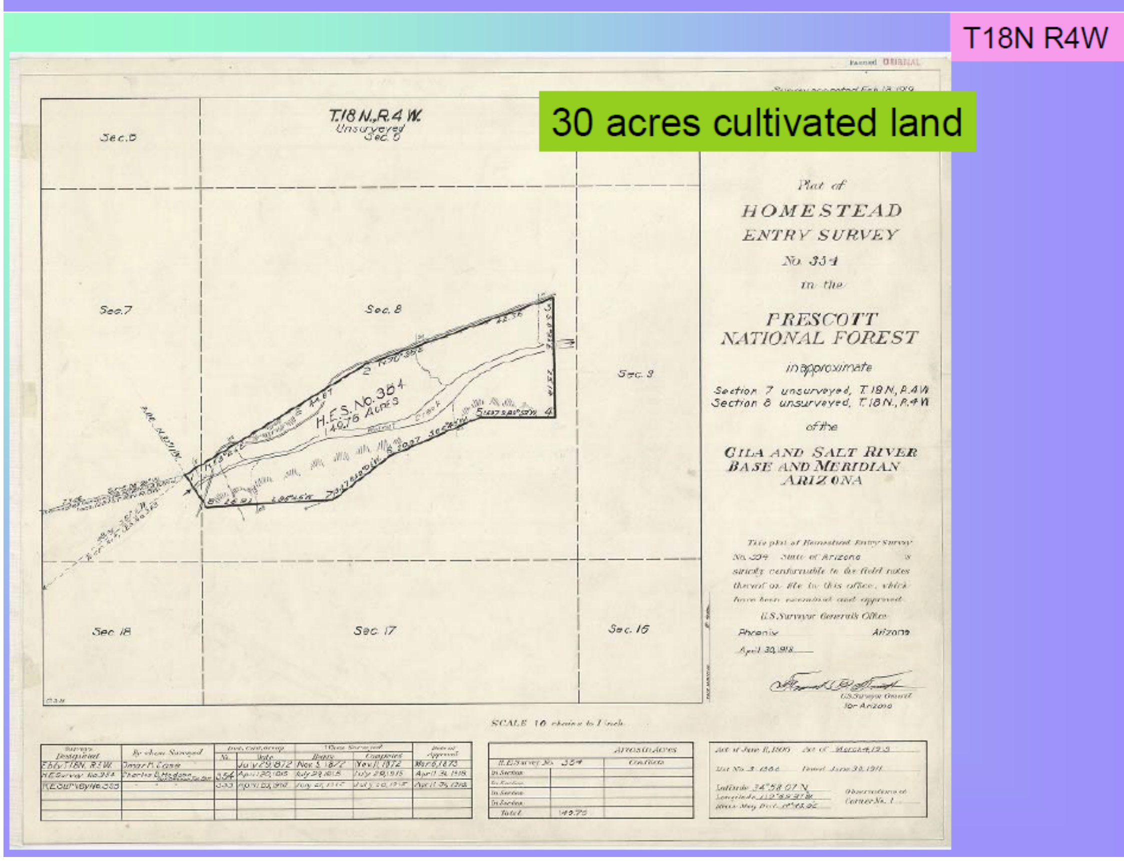
Line designated.	True bearing.	Dist.	Latitudes. N.	Latitudes. S.	Departures. E.	Departures. W.
South boundary.	N.89°20'W.	149.28	1.48			149.28
West boundary.	N.0°24'E. N.0°10'W. N.2°21'W. N.1°21'W. N.1°36'W. N.1°11'W. N.0°09'E. N.0°05'W. N.1°20'W. N.0°27'W.	82.36 40.41 39.98 40.33 39.95 40.33 39.65 79.40 39.01 40.07	82.36 40.41 39.95 40.32 39.93 40.32 39.65 79.40 39.00 40.07		.57 .10	.12 1.04 .95 1.12 .83 .12 .93 .31
North Boundary.	N.89°28'E. N.89°29'E. S.88°58'E. S.89°38'E.	35.99 39.99 40.16 37.92	.34 .36	.72 .24	35.99 39.99 40.15 37.92	
Subdivisional boundary.	S.0°02'E. S.0°08'E.	401.00 81.33		401.00 81.33	.23 .19	
Convergency.					.17	
Totals.			483.59 483.29	483.29	155.31	155.35 155.31
Error in latitude.			.30			
Error in departure.						.04

GENERAL DESCRIPTION.

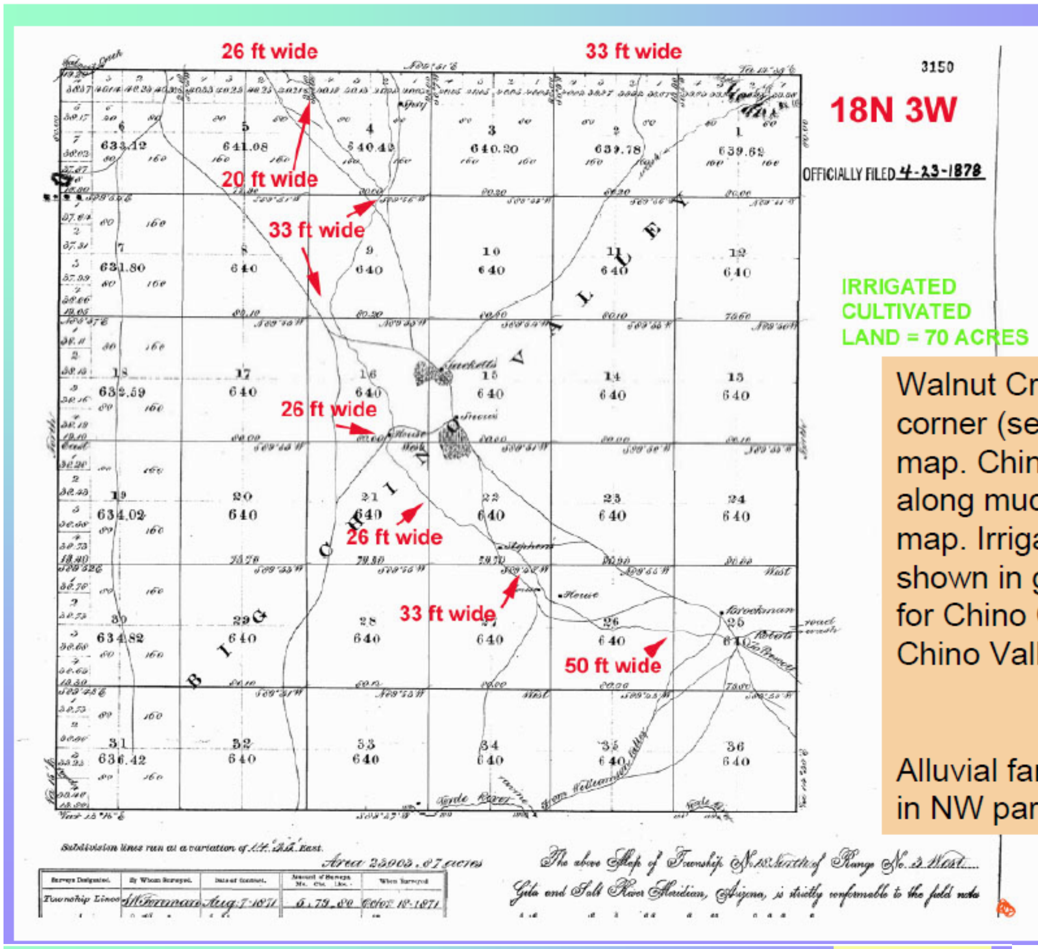
The portion of T.18 N., R.4 W., surveyed under this assignment consists of rolling foothills, covered with a heavy growth of pinyon and cedar timber, and undergrowth of oak brush, catclaw and greasewood. It is drained by Walnut Creek, which traverses the northern portion flowing in a northeasterly direction, and carries a good stream of water at this time, but is dry in other periods. The soil is a sandy loam, and supports a good growth of grass. There are no indications of oil or mineral. Two homestead entries are located in the Walnut Creek bottom.

The continued satisfactory adjustment of the solar apparatus throughout the survey of this township is indicated from field tests described in Book "H."


T18N R4W
25 acres cultivated land
T.18 N., R.5 W.
Surveyed & accepted
T.18 N., R.4 W.
Unsurveyed
Sec. 12
Sec. 7
Sec. 13
Sec. 18
H.E.S. No. 353
39.96 ACRES
Plat of
HOMESTEAD
ENTRY SURVEY
No. 353
in the
PRESCOTT
NATIONAL FOREST
in approximate
Section 18 unsurveyed, T.18 N., R.4 W.
of the
GILA AND SALT RIVER
BASE AND MERIDIAN
ARIZONA
U.S. Surveyor General's Office
Phoenix Arizona
U.S. Surveyor General for Arizona


T18N R4W
30 acres cultivated land
T.18 N., R.4 W.
Unsurveyed
Sec. 5
Sec. 6
Sec. 7
Sec. 8
Sec. 9
Sec. 18
Sec. 17
Sec. 16
H.E.S. No. 354
Plat of
HOMESTEAD
ENTRY SURVEY
No. 354
in the
PRESCOTT
NATIONAL FOREST
in approximate
Section 7 unsurveyed, T.18 N., R.4 W.
Section 8 unsurveyed, T.18 N., R.4 W.
of the
GILA AND SALT RIVER
BASE AND MERIDIAN
ARIZONA
U.S. Surveyor General's Office
Phoenix Arizona
U.S. Surveyor General for Arizona

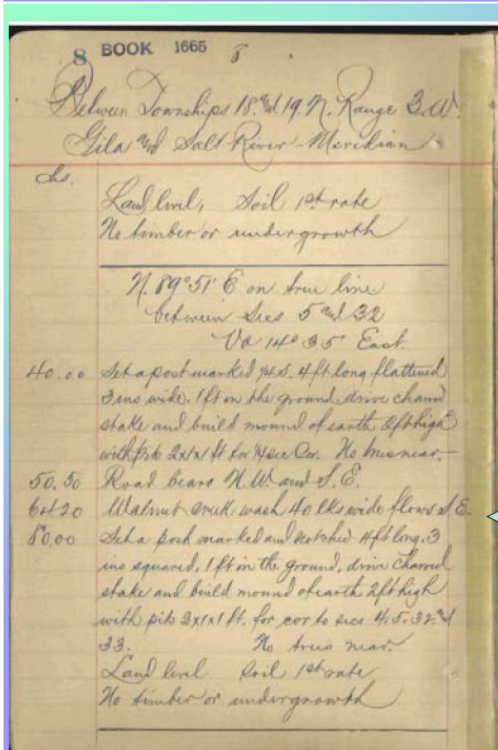
T18N R3W



Walnut Creek in NW corner (sec. 6) of map. Chino Creek is along much of the map. Irrigated acres shown in green are for Chino Creek (Big Chino Valley).

Alluvial fan sediments in NW part of map.

T18N R3W



8 BOOK 1665 8

Between Townships 18 & 19 N. Range 3 W.
Gila & Salt River Meridian

chs.

Land level, Soil 1st rate
No timber or undergrowth

N. 89°51' E on true line
between Secs 5 and 32
Va 14° 35' East

40.00 Set a post marked 1/4 S. 4 ft long flattened 3 ins wide. 1 ft in the ground, drive charred stake and build mound of earth 2 ft high with pits 2x1x1 ft for 1/4 sec Cor. No trees near.

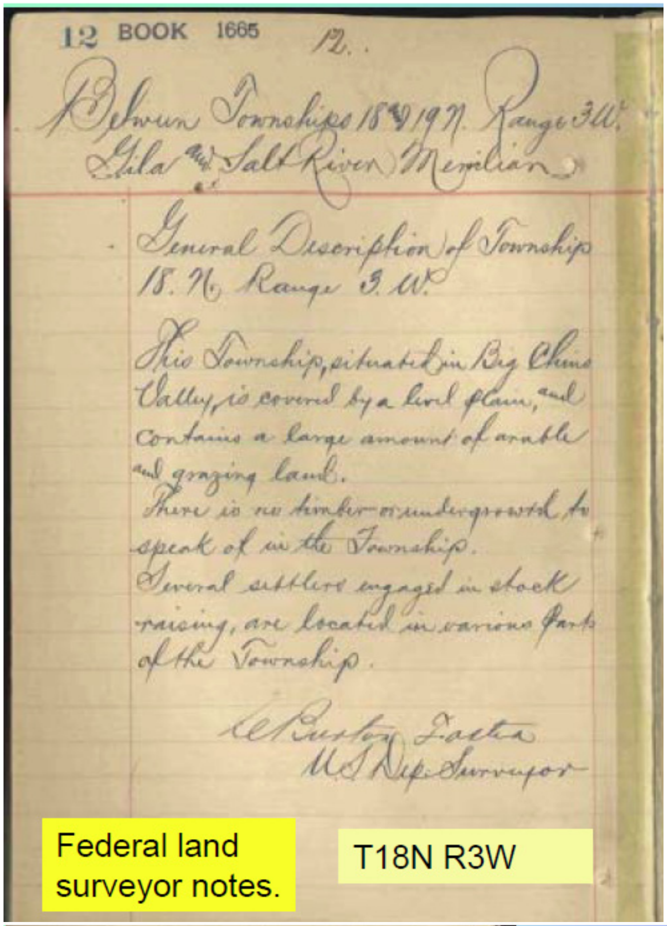
50.50 Road bears N.W. and S.E.

61.20 Walnut creek wash 40 lks wide flows S.E.

80.00 Set a post marked and notched 4 ft long, 3 ins squared, 1 ft in the ground, drive charred stake and build mound of earth 2 ft high with pits 3x1x1 ft. for cor to secs 4.5.32 & 33. No trees near

Land level Soil 1st rate
No timber or undergrowth

Federal land surveyor notes.



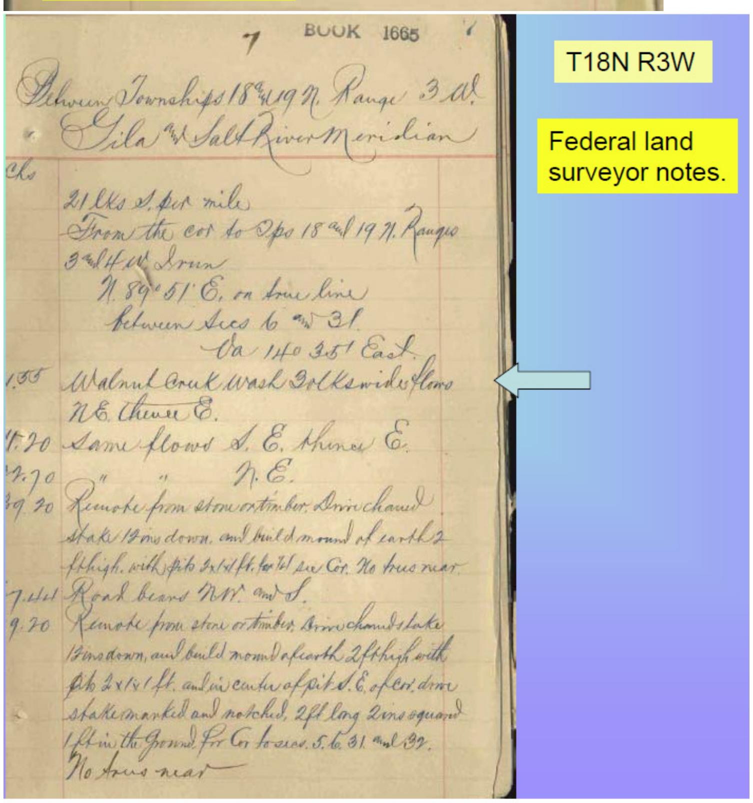
12 BOOK 1665 12.

Between Townships 18 & 19 N. Range 3 W.
Gila and Salt River Meridian

General Description of Township 18 N. Range 3 W.

This Township, situated in Big Chino Valley, is covered by a level plain, and contains a large amount of arable and grazing land.
There is no timber or undergrowth to speak of in the Township.
Several settlers engaged in stock raising, are located in various parts of the Township.

C. Burton Foster
US Dep. Surveyor

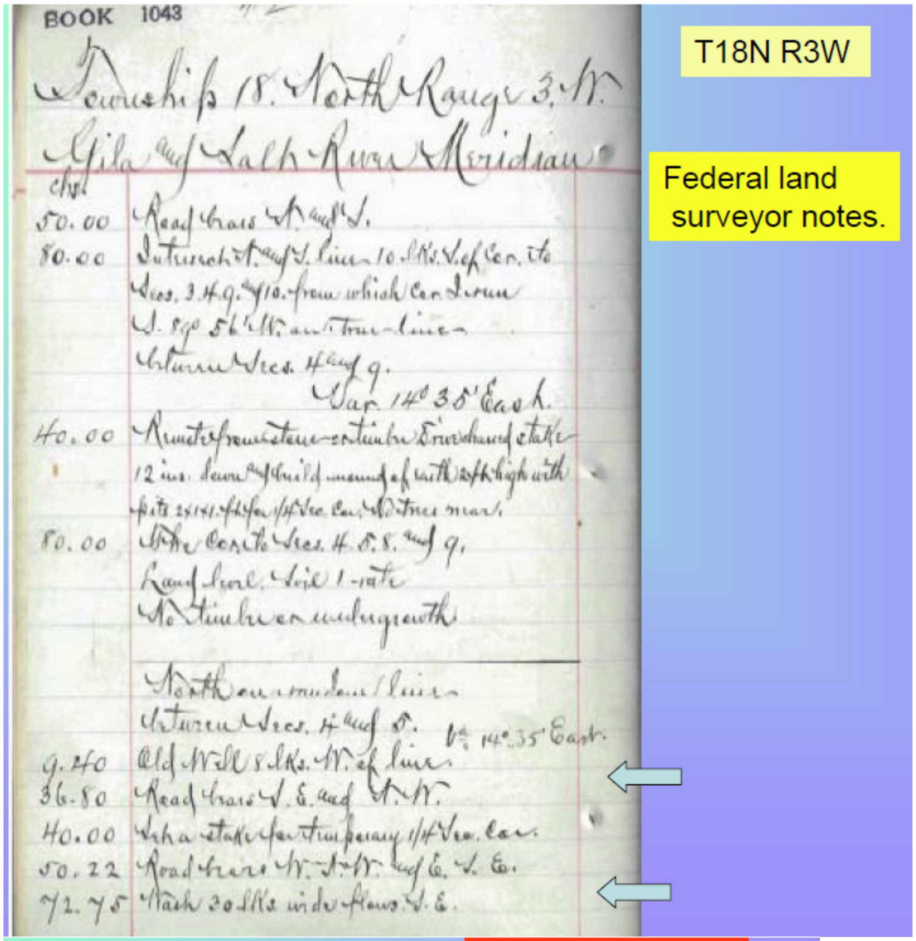


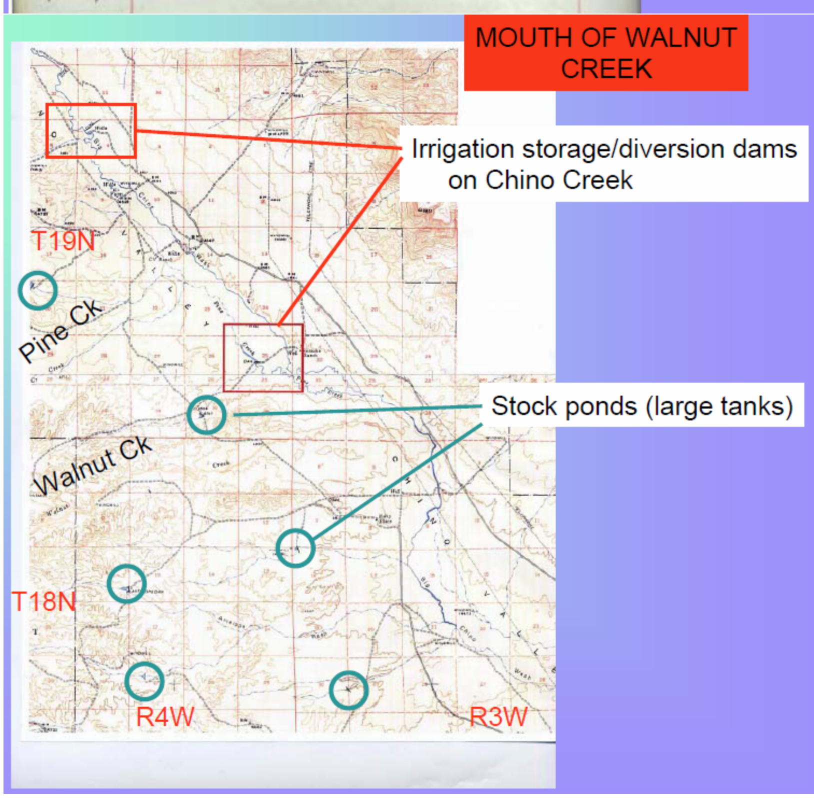
7 BOOK 1665

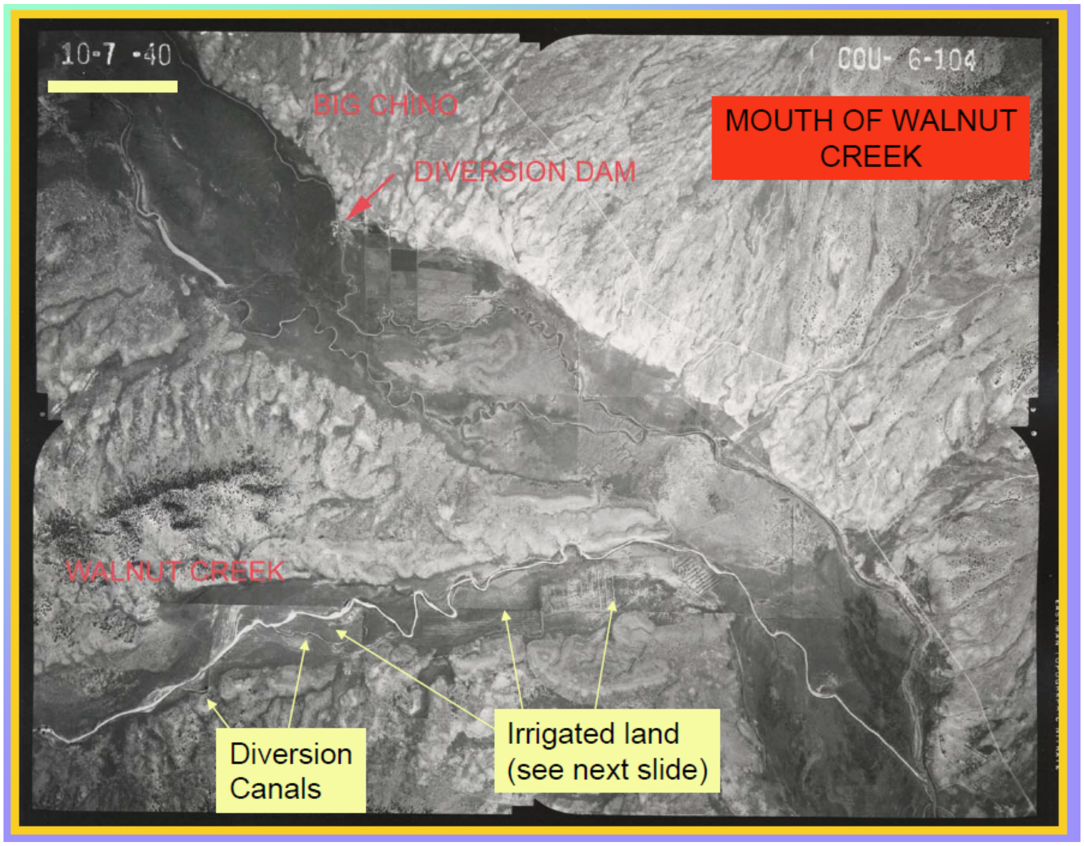
Between Townships 18 & 19 N. Range 3 W.
Gila and Salt River Meridian

Chs

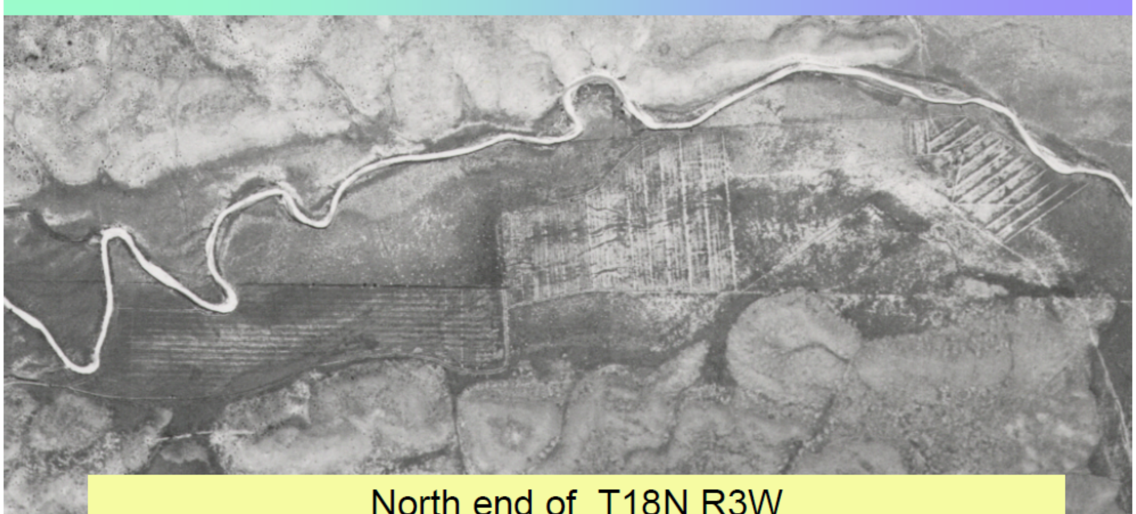
21 lks S. per mile
From the cor. to Tps 18 and 19 N. Ranges 3 and 4 W. I run
N. 89° 51' E. on true line
between Secs 6 and 31.
Va 14° 35' East.
1.55 Walnut Creek Wash 30 lks wide flows N.E. thence E.
4.20 Same flows S.E. thence E.
7.70 " " N.E.
39.20 Remote from stone or timber. Drive chained stake 12 ins down, and build mound of earth 2 ft high, with pits 2x1x1 ft. for 1/4 sec Cor. No trees near.
7.40 Road bears N.W. and S.
79.20 Remote from stone or timber. Drive chained stake 12 ins down, and build mound of earth 2 ft high with pits 2x1x1 ft. and in centre of pit S.E. of cor. drove stake marked and notched, 2 ft long 2 ins square 1 ft in the ground for Cor to secs. 5, 6, 31 and 32.
No trees near


BOOK 1043
Township 18 North Range 3 W.
Gila and Salt River Meridian
T18N R3W
Federal land surveyor notes.


MOUTH OF WALNUT CREEK
Irrigation storage/diversion dams on Chino Creek
T19N
Pine Ck
Stock ponds (large tanks)
Walnut Ck
T18N
R4W
R3W

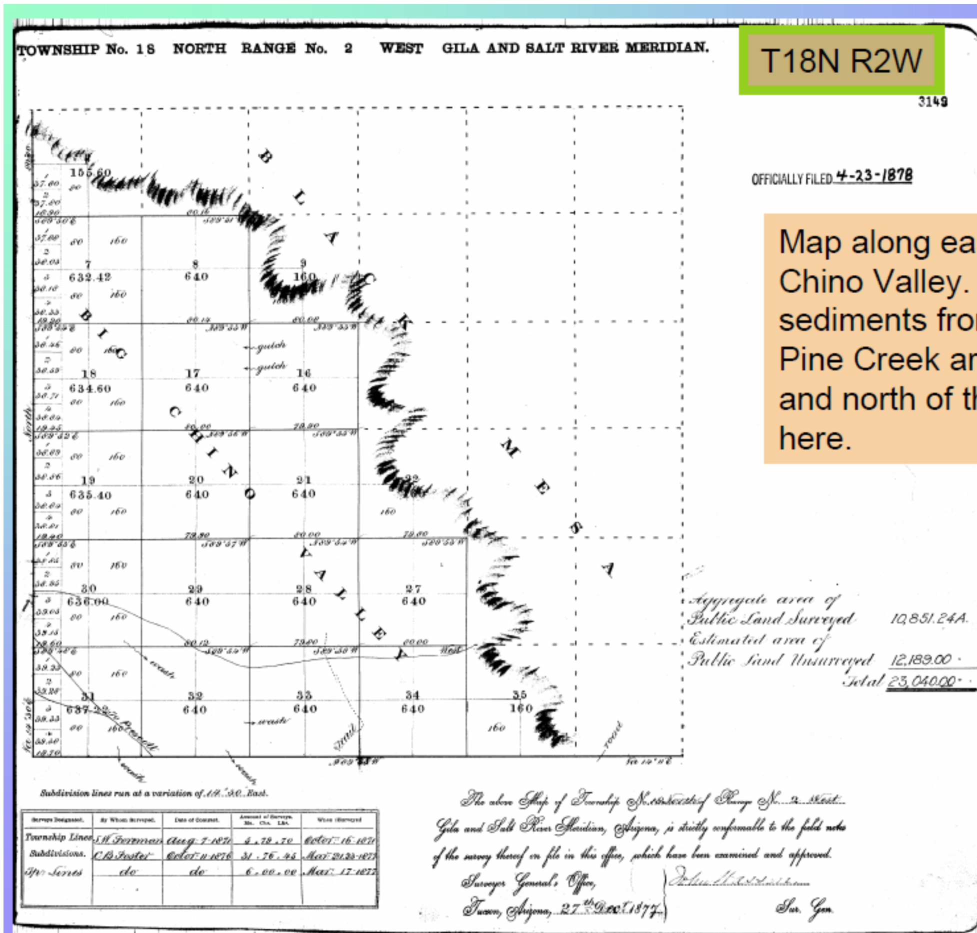


Cultivated land near mouth of Walnut Creek



North end of T18N R3W

3 old fields along right side of Walnut Ck on Lynx Loam. Irrigation was from Surface diversion using low rock dam and also possibly from shallow well.
Cultivated area = 110 acres



Map along eastern side of Big Chino Valley. Alluvial fan sediments from Walnut and Pine Creek are to the west and north of the area shown here.

Walnut Creek

Irrigated areas of land along stream sediments. Irrigation was from stream diversions using small dams and also possibly from shallow wells along the stream sediments.

T18N R6W	50 acres
T18N R5W	110 acres
T18N R4W	55 acres
T18N R3W	110 acres (Walnut Ck. only)
TOTAL	325 acres

Pine Creek (north of Walnut Creek)

The following additional appropriations of water on tributaries of the Verde are also of record:

ON CHERRY CREEK.

All water, Wm. McK. Owen and Robt. Owen, Apr. 21, 1872; b. 1, p. 69.

ON WALNUT CREEK.

1000 in., Mrs. Fannie Plummer, July 17, 1896; b. 3, p. 128.
500 Wm. G. Shook, June 24, 1887; b. 1, p. 426.
500 W. H. Williscraft, Nov. 15, 1887; b. 1, p. 441.
All water of Walnut Creek, Saml. C. Rodgers, original location of Apr. 13, 1868, recorded Jan. 18, 1900; ———

ON GRANITE CREEK.

All water of Granite Creek, R. A. Farrington, Jan. 4, 1866; b. 1, p. 8.
All water of Granite Creek and Willow Creeks at Point Rocks, Mar. 27, 1872; b. 1, p. 81.
75 inches, M. H. Yearborn, Aug. 23, 1873; b. 1, p. 87.
800 Peter Marx, Aug. 1, 1873; b. 1, p. 94.
200 J. H. Lee, July 24, 1875; b. 1, p. 155.
500 M. Maur, Dec. 20, 1887; b. 1, p. 446.

ON BIG CHINO CREEK.

4000 ins., Jno. C. Loy and S. Morrison, Aug. 23, 1890; b. 2, p. 150.
8000 ins., J. C. Snow and J. P. Storm, Mar. 20, 1884; b. 2, p. 394.
2000 ins., J. C. Snow, Apr. 2, 1895; b. 2, p. 496.
1000 ins., J. P. Storm and Thos. R. King, Mar. 16, 1898; b. 3, p. 248.

ON WILLIAMSON VALLEY CREEK.

150,000 by J. W. Sullivan and J. J. Fisher, Mar. 4, 1896; b. 3, p. 94.

ON DEER LICK CREEK.

All water by M. H. Sherman, Aug. 30, 1875; b. 1, p. 160.

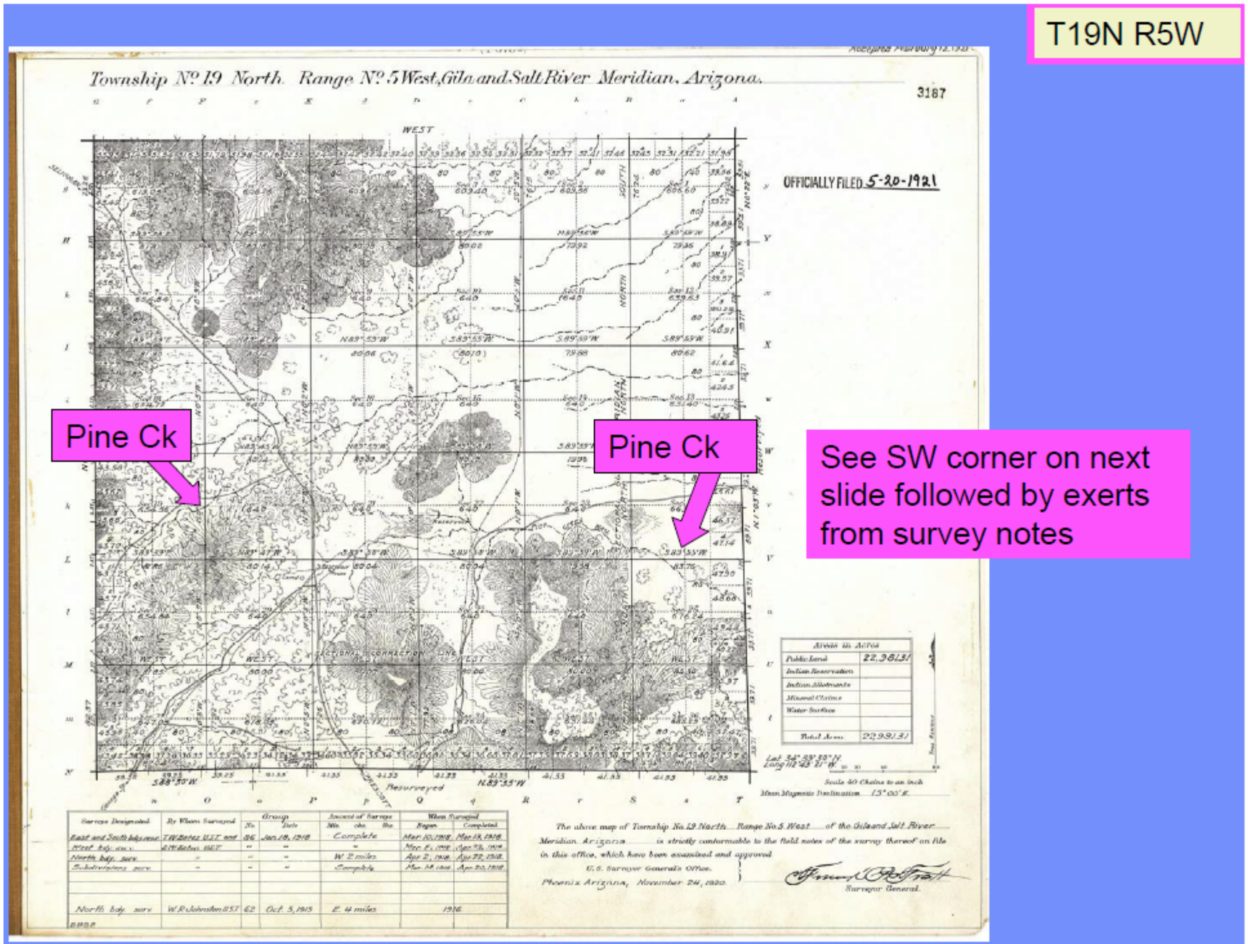
ON WILLOW CREEK.

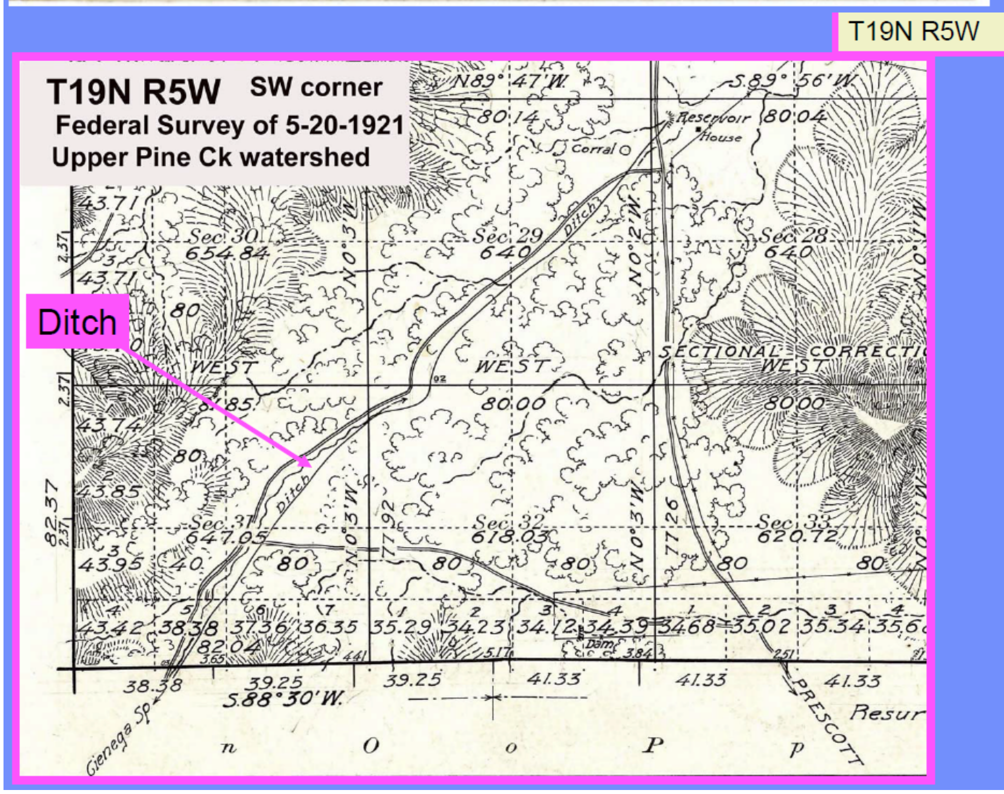
All water by Jos. Garbarins, Aug. 11, 1879; b. 1, p. 419.
20 ins., Jack T. Stone, May 17, 1890; b. 2, p. 121.

ON PINE CREEK.

Sidell Ditch, by Curtis B. Hawley, June 29, 1881; b. 1, p. 2.
5000 ins., Silas M. Lee, Jan. 10, 1891; b. 2, p. 178.
1000 ins., Jno. P. Hough, Jan. 10, 1891; b. 2, p. 179.

ınd Tributaries, Cleveland Daily Record, 20p.


T19N R5W
Township No 19 North Range No 5 West, Gila and Salt River Meridian, Arizona.
3187
OFFICIALLY FILED 5-20-1921
Pine Ck
Pine Ck
See SW corner on next slide followed by exerts from survey notes


T19N R5W
T19N R5W SW corner
Federal Survey of 5-20-1921
Upper Pine Ck watershed
Ditch
Reservoir
House
Corral
Sec 30
Sec 29
Sec 28
Sec 31
Sec 32
Sec 33
Dam
Prescott

T19N R5W

¼S 6
1918

From which
A cedar, 20 ins. diam., brs. S.33°E.,
49 lks. dist., marked ¼S6 BT.
A cedar, 16 ins.diam., brs. S.66°W.,
55 lks. dist., marked ¼S6 BT.

48.86	Irrigation ditch, 3 lks. wide, 4 ins. deep, course NE.
49.46	Wash, course NE. Asc. gradually.
50.51	Road, brs. NE. to Seligman and SW.
77.63	The cor. of Ts. 18 and 19 N., Rs. 5 and 6 W.
	Land, rolling and broken.
	Soil, rocky, 2nd and 3rd rates; limestone and decomposed granite formations.
	Timber, pine and cedar.
	Undergrowth, scrub oak and buck brush.

2 ft wide and
0.33 ft deep.
Est. about 0.7 cfs.

¼ S21/S28
1918

From which
A cedar, 5 ins. diam., brs. S.19½°W.,
26 lks. dist., marked ¼S28 BT.
No other trees within limits. Raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor.

47.90	Draw, course N.
54.55	Fence, brs. N.60°E. and S.60°W.
56.70	Abandoned house brs. S.50¼°W., 12 chs. dist.
65.00	Wash, course NE.
72.00	Wash, course S.
75.00	Reservoir No. 3, old Cienega tank and corral, brs. S. 5 chs. dist.
78.90	Road, brs. N. to Seligman and S. to Cienega Ranch.
80.04	The cor. of secs. 20, 21, 28 and 29.
	Land, rolling.
	Soil, gravelly and clayey loam, 1st and 2nd rate.
	Timber, cedar and pinion.
	Undergrowth, scrub oak, young cedar and buck brush.

Reservoir No. 3
with corral

T19N R5W

S29 | S28
1918

From which
A pine, 8 ins. diam., brs. N.86¼°E.,
58 lks. dist., marked ¼S28 BT.
A pine, 6 ins. diam., brs. N.52¼°W.,
29 lks. dist., marked ¼S29 BT.

49.00	Wash, course E.
59.00	Leave heavy timber, brs. NE. and SW.
59.35	Road, brs. E. and W.
65.70	Wash, course NE. Cienega Corral brs. West 8 chs. dist.
68.00	Ditch from reservoir No. 2 to reservoir No. 3 course NE.
71.05	Wash, course NE.
80.00	Set an iron post, 3 ft. long, 2 ins. diam., 26 ins. in the ground, for cor. of secs. 20, 21, 28 and 29, marked on brass cap.

Ditch between
reservoirs 1 and 2

¼ S29/S32
1918

From which
A cedar, 10 ins. diam., brs.N.20¾°E.,
28 lks. dist., marked ¼S29 BT.
A cedar, 6 ins. diam., brs. S.79½°W.,
18 lks. dist., marked ¼S32 BT.

62.90	Stream of water from Cienega Spring, 2 lks. wide, course N.
68.10	Road, brs. N. to Seligman and S. to Cienega Spring.
80.00	Set an iron post, 3 ft. long, 2 ins. diam., 24 ins. in the ground, for cor. of secs. 29, 30, 31 and 32, marked on brass cap

1.3 ft wide water
in ditch

T19N R5W

From the cor. of secs. 29, 30, 31 and 32,
S.0°3'E., on a random line, bet. secs. 31 and 32.
40.00 Set temp. ¼ sec. cor.
77.92 Intersect the reestablished cor. of secs. 31 and 32, on the S. bdy. of Tp., hereinbefore described.
Thence
N.0°3'W., bet. secs. 31 and 32.
Over rolling land, through heavy timber and dense undergrowth.
Desc. gradually.
28.86 Wash, course E.
31.72 Road, brs. E. and W.
37.92 Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, for ¼ sec. cor., marked on brass cap

¼
S31 | S32
1918

From which
A cedar, 12 ins. diam., brs. East 7 lks. dist., marked ¼S32 BT.
A cedar, 12 ins. diam., brs. N.83½°W., 9 lks. dist., marked ¼S31 BT.
A sandstone boulder, 1 X 2 X 3 ft. above ground, marked Cross (X) on top, brs. S.35°E., 22 lks. dist.
Raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor.
69.00 Ditch from Cienega Spring, course NE.
69.15 Stream of water from Cienega Spring, 2 lks. wide, course NE.
71.00 Road, brs. NE. to Seligman and SW. to Cienega Spring.
77.92 The cor. of secs. 29, 30, 31 and 32.
Land, rolling.
Soil, fine and black, covered with malpais rocks, 3rd rate.
Timber, cedar and pinion.
Undergrowth, scrub oak, young cedar and buck brush.

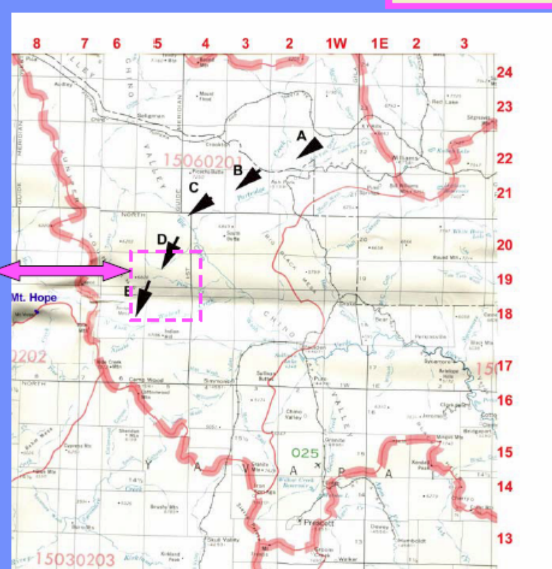
1.3 ft wide water in ditch

T19N R5W

THE sun shone brightly over the hard frozen ground and the frosted vegetation, as we pursued our way along the foot of the mountains, up and down the hills connected with the mountain chain; and we had not gone many miles before our attention was powerfully attracted by a row of cottonwood trees; and on coming nearer we discovered the dry bed of a stream that appeared to proceed from the mountains. Some closely-growing willows that we saw in a ravine led us to infer the neighbourhood of water; and we accordingly turned the steps of our mules in that direction.

As we rode through the long withered grass that covered an opening in the wood, we suddenly came in sight of a numerous flock of wild turkeys, which, startled at our approach, were running at a great rate towards a hiding-place. The shots fired among them were eminently successful; but when several of them fell, the rest spread their wings and flew away as fast as

Moellhauser, B., 1858, Diary of a journey from the Mississippi to the coasts of the Pacific with a United States government expedition; translated by Mrs. Percy Sinnett., British Library, Historical Press Editions, 397p.



Whipple's Pueblo Ck probably is Walnut Creek. His Turkey Creek may be the present Pine Ck.

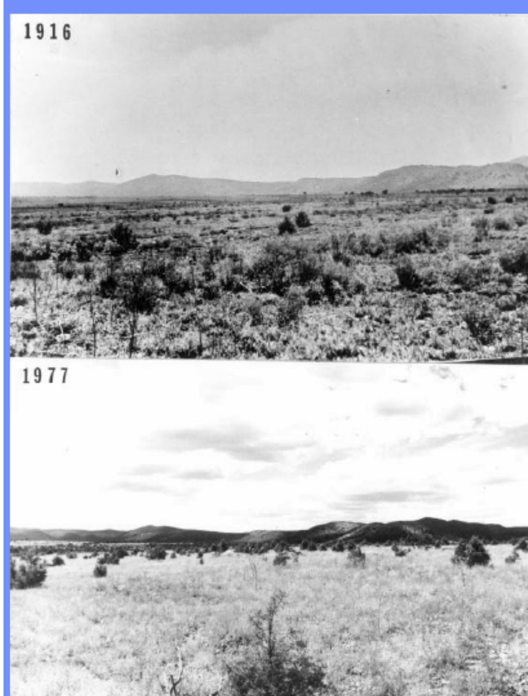
USGS HYDROLOGIC UNIT MAP-1974

Whipple, A. W., 1855, Part 1. Report. Explorations for a Railway Route near the Thirty-Fifth Parallel of North Latitude. from the Mississippi River to the Pacific Ocean: By Lieutenant A W. Whipple. Corps Of Topogrnphical Engineers Assisted by Lieutenant J. C. Ives. Corps of Topographical Engineers.

Table 1. Itinerary of the Whipple Party on the Upper Verde Watershed, starting from Leroux Springs, December 30, 1853. Place names in parentheses are present names.

DATE	DESTINATION, WAGONS	DIARISTS	DESTINATION, WHIPPLE	DIARISTS
12/30/1853	Camp, Leroux Springs	Möllhausen, Sherburne, Stanley	Reconnaissance, Government Prairie vicinity	Whipple
12/31/1853	Government Prairie Vicinity	"	Recon., New Years Spring (Radio Hill, Hitson Tank)	"
1/1/1854	New Years Spring	"	Reconnaissance, Telegraphic Hill (Signal Hill)	"
1/2/1854	Camp, New Years Spring	"	Recon., Topographic Hill (Nagiller Tank vicinity)	"
1/3/1854	"	"	Reconnaissance, (Ash Fork)	Whipple, Tidball
1/4/1854	"	"	Reconnaissance, (Eagle Nest vicinity)	"
1/5/1854	"	"	Recon., East of Cedar Creek (Polson Dam Draw)	"
1/6/1854	"	"	Rejoin wagons, New Years Spring	"
1/7/1854	"	All	With wagons, New Years Spring	All
1/8/1854	Lava Springs (Canyon Tank)	"	With wagons, Lava Springs (Canyon Tank)	"
1/9/1854	Cedar Creek (Polson Dam Draw)	"	With wagons, Cedar Creek	All
1/10/1854	Partridge Creek	"	With wagons, Partridge Creek	"
1/11/1854	Camp, Partridge Creek	Tidball, Stanley, Sherburne	Reconnaissance, Lower Partridge Creek	Whipple, Möllhausen
1/12/1854	Lower Partridge Creek	"	Reconaissance, Picacho Mountain	"
1/13/1854	Picacho Springs	"	Reconnaissance, Chino Narrows	"
1/14/1854	Camp, Picacho Springs	"	Reconnaissance, Upper Big Chino	"
1/15/1854	"	"	Rejoin wagons, Picacho Spring	"
1/16/1854	Moved camp into Chino Valley	"	Reconnaissance, west side of Chino Valley	"
1/17/1854	Camp, Chino Valley	"	Reconnaissance, S. of Pueblo (Walnut) Creek	"
1/18/1854	"	"	Reconnaissance, up Pueblo (Walnut) Creek	"
1/19/1854	West side of Chino Valley	"	Reconnaissance, beyond Aztec Pass	"
1/20/1854	Turkey Creek (Pine Springs Draw)	"	Reconnaissance, Pueblo (Walnut) Creek	"
1/21/1854	Pueblo (Walnut) Creek	All	Joined by wagons at Pueblo (Walnut) Creek	All
1/22/1854	Beyond Aztec Pass	All	With wagons, over Aztec Pass	All

Shaw, H.G., 1998, Wood Plenty, Grass Good, Water None: The Juniper Institute, unpublished draft manuscript, 150 p.



One significant vegetation change along this segment of the route is the apparent disappearance of a cienega. I believe that it is fairly safe to assume that this was in part caused by diversion of a spring upstream from the area. The Cienega Ranch, where this spring surfaces, was first occupied in the very late 1860's or early 1870's. At this time, I do not know how long after settlement of the ranch the spring was diverted. A photograph by Rex King in 1916 of the flat at the convergence of Pine Springs Draw and Cienega Springs Draw (photographs on the left) shows no sign of riparian or wetland vegetation, so the area had apparently been modified well before that time. Increasing juniper on the surrounding uplands that are transpiring more water may also result in less groundwater moving to the drainage.

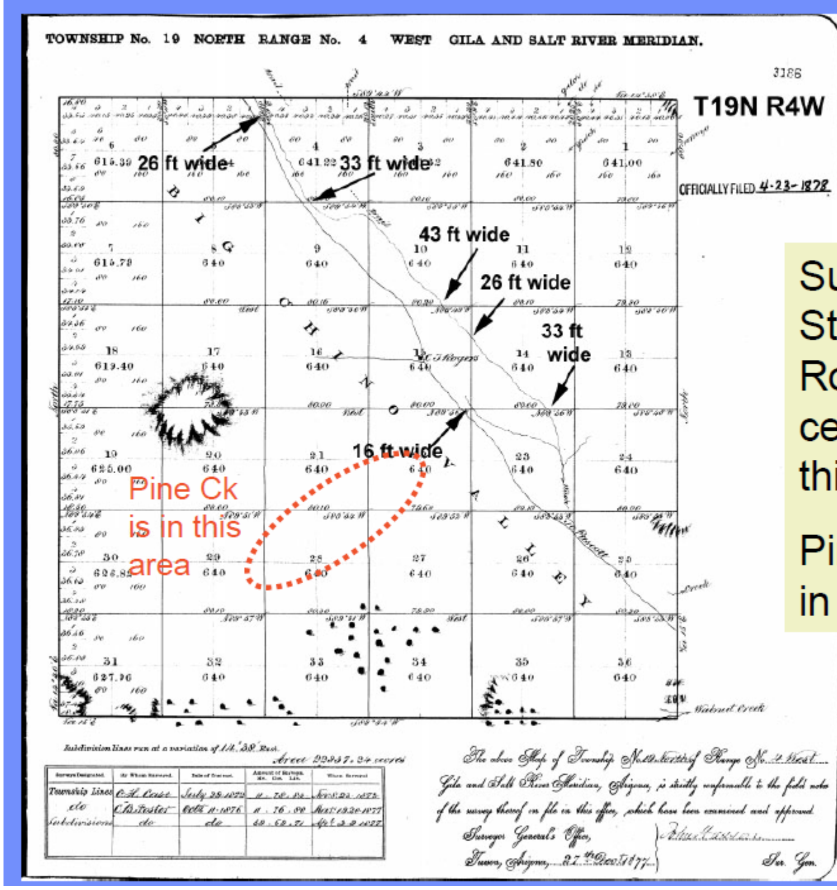
Shaw, H.G., 1998, Wood Plenty, Grass Good, Water None: The Juniper Institute, unpublished draft manuscript, 150 p.

Another area that needs scrutiny is the juncture of Cienega Creek and Pine Springs Draw, called Turkey Creek by Whipple. This area was a riparian drainage in 1854. It is now a dry flat transected by a deep gully. A study of the factors causing this transition would be revealing.

This cienega, as will be seen below, is also mentioned by the wagon train, which camped one night at the site. No such cienega exists in this area now. After considerable searching I have concluded that this site was where Cienega Springs Draw and Pine Springs Draw run together (Map 14:31). A voluminous spring still exists further up Cienega Springs Draw. This spring has been diverted for agricultural purposes and no longer runs directly down the canyon. A dry and barren flat occupies this site at present.

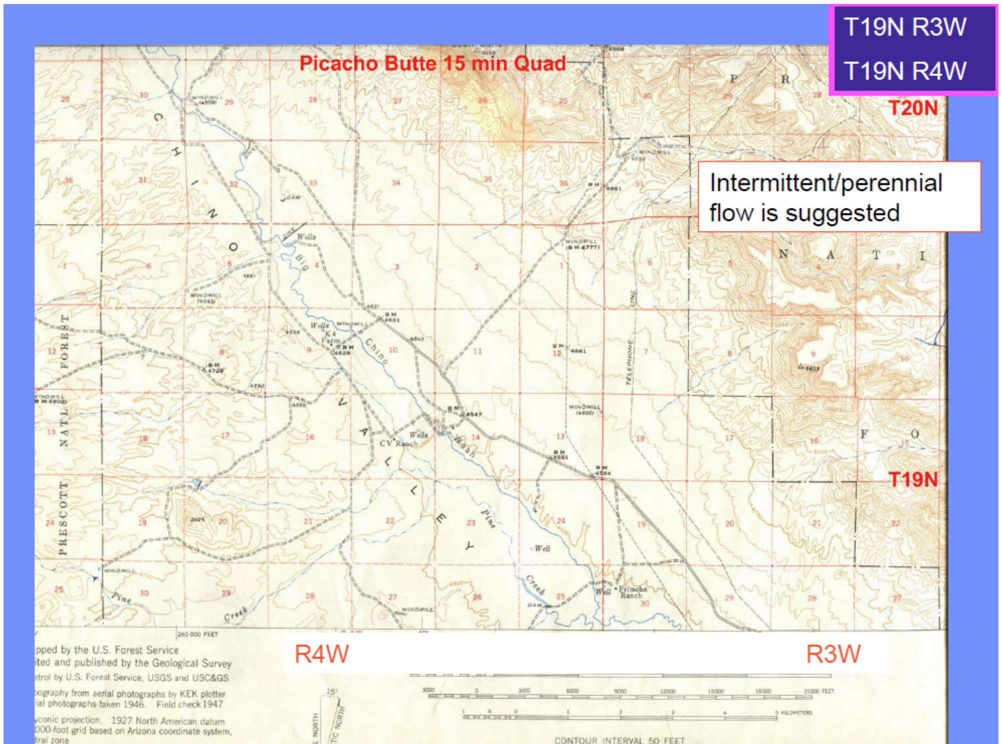
Shaw, H.G., 1998, Wood Plenty, Grass Good, Water None: The Juniper Institute, unpublished draft manuscript, 150 p.

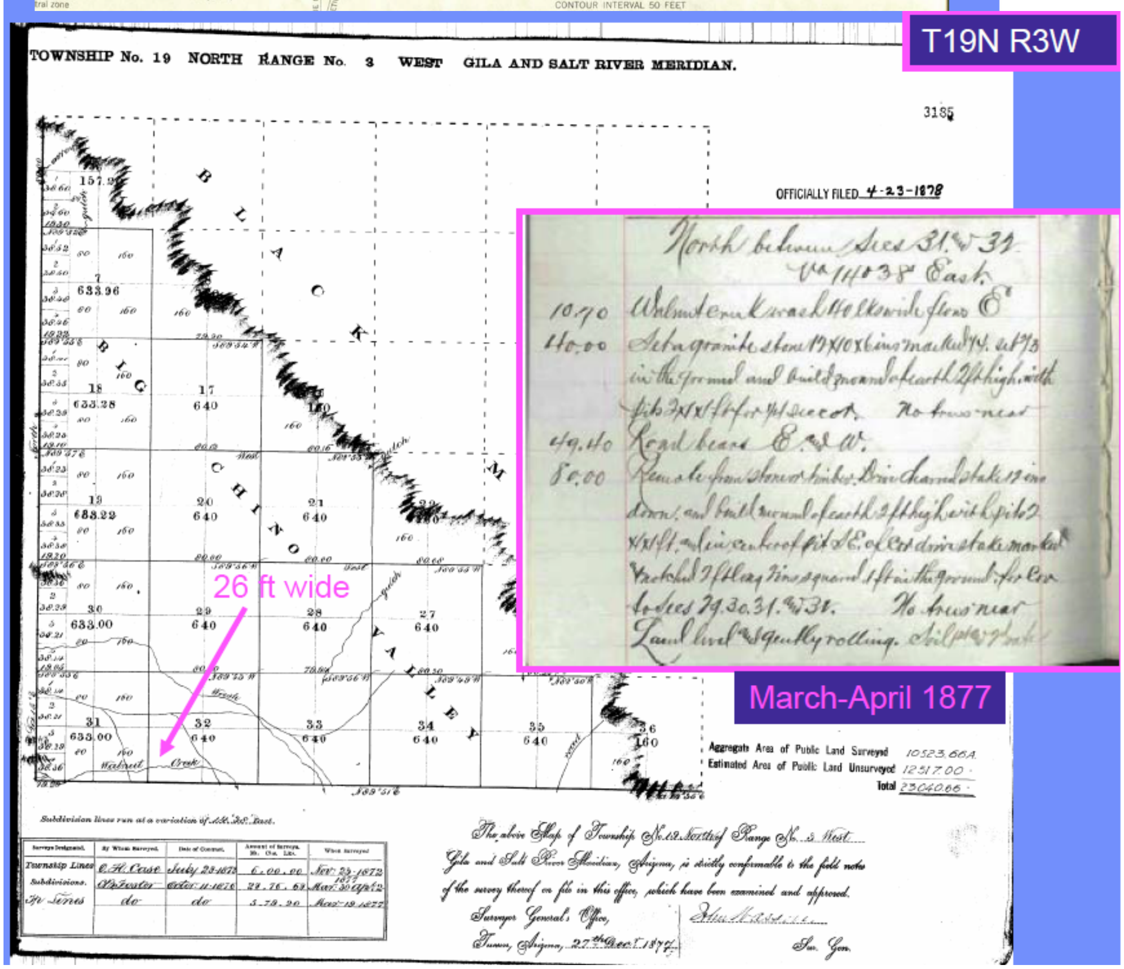
T19N R4W



Surveyors note: Stock ranch of Rogers and Co. is centrally located in this township.

Pine Ck not noted in survey of 1878


T19N R3W
T19N R4W
Picacho Butte 15 min Quad
T20N
Intermittent/perennial
flow is suggested
T19N
R4W
R3W
CONTOUR INTERVAL 50 FEET


T19N R3W
TOWNSHIP No. 19 NORTH RANGE No. 3 WEST GILA AND SALT RIVER MERIDIAN.
3185
OFFICIALLY FILED 4-23-1878
26 ft wide
March-April 1877
Aggregate Area of Public Land Surveyed 10523.66A
Estimated Area of Public Land Unsurveyed 12517.00
Total 23040.66
BLACK
BIG CHINO VALLEY
Subdivision lines run at a variation of 14° 30' East.
Township Lines C.H. Case July 23 1872
Subdivisions. W.Foster
The above Map of Township No. 19 North of Range No. 3 West Gila and Salt River Meridian, Arizona, is strictly conformable to the field notes of the survey thereof on file in this office, which have been examined and approved.
Surveyor General's Office,
Tucson, Arizona, 27th Dec. 1877.
Sur. Gen.

APPENDIX F.—Big Chino Creek

The hydrology of the natural Big Chino Creek (Wash) is complex. Groundwater in the regional aquifer of the upper watershed flows to the north toward the Colorado River and also to the south to the Verde River and was perennial in places such as near the mouth. Across Big Chino Valley, tributary streamflow seeped into the porous stream sediments as some of the groundwater and was perched above the underlying basin fill (Pool and others 2011). Recent USGS study shows: “A thin layer of Quaternary alluvium overlies the fine-grained facies of upper basin fill near the Big Chino Wash and forms a local perched aquifer that has hydraulic heads that are as much as 100 ft above the hydraulic heads of the lower basin fill.” (Pool and others, 2011, p. 31).

Pool, D.R., Blasch, K.W., Callegary, J.B., Leake, S.A., and Graser, L.F., 2011, Regional groundwater-flow model of the Redwall-Muav, Coconino, and alluvial basin aquifer systems of northern and central Arizona: U.S. Geological Survey Scientific Investigations Report 2010-5180, 101 p.

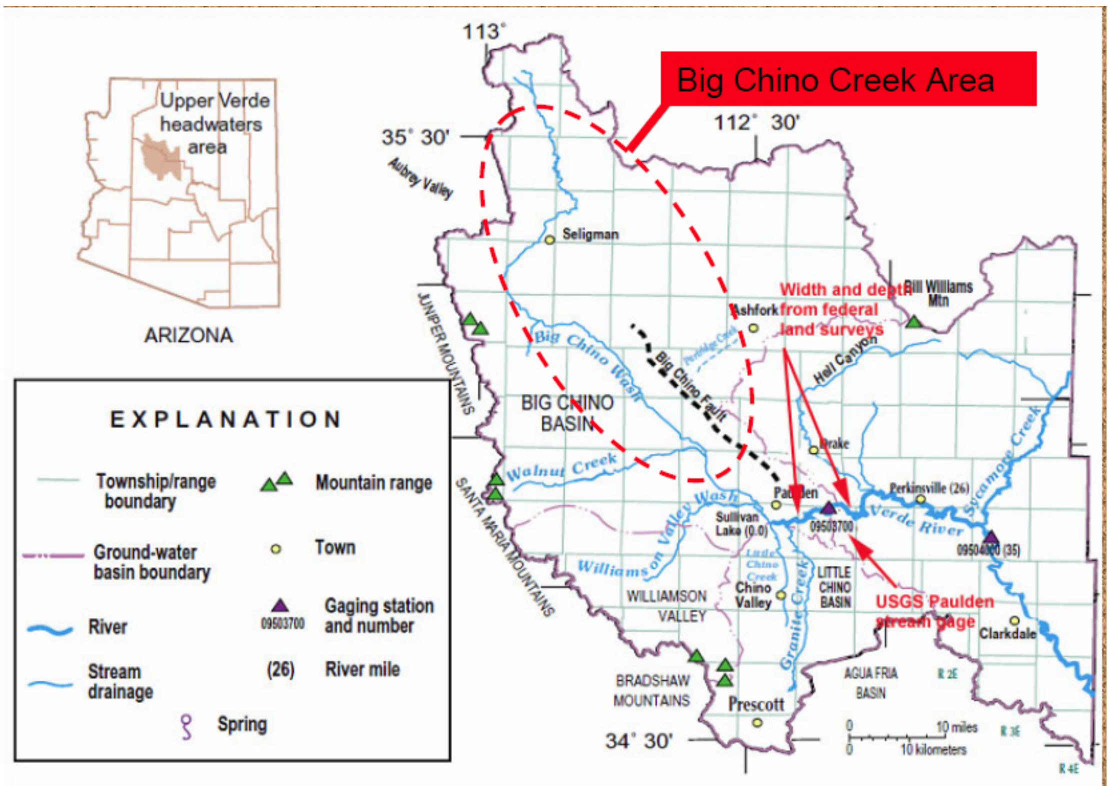
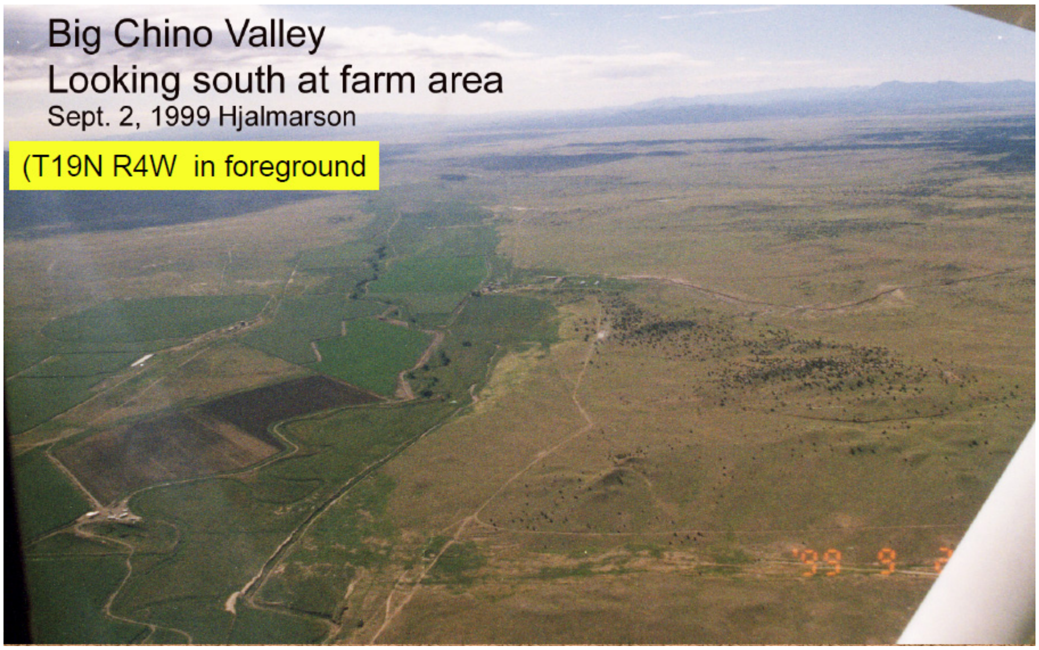


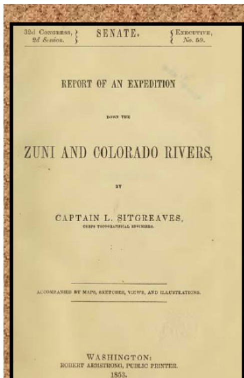
Figure 1. Major geographical features of the Verde River headwaters area.

Wirt, L. and Hjalmarson, H. W., 2000, Sources of springs supplying base flow to the Verde River headwaters, Yavapai County, Arizona: U. S. Geological Survey Open-File Report 99-378, 50 p.

Figure 1. Upper Verde River with Big Chino Creek (Wash) area.

With the exception of alluvial fans at and below Partridge, Pine and especially Walnut Creek, there may have been perennial flow in much of the natural channel of Big Chino Creek downstream from Partridge Creek (See for example p. 7 Appendix B). Even as far north as Seligman there probably was seasonal intermittent flow in places. Partridge Creek was intermittent with perennial pools where underflow in the perched stream sediment surfaced in place. Of importance for this study of navigability is that there was a supply of water throughout a typical year that was perched above the basin fill in Quaterary sediments that reached the natural Verde River.




32d Congress, 2d Session. SENATE. Executive, No. 59.

REPORT OF AN EXPEDITION

DOWN THE

ZUNI AND COLORADO RIVERS,

BY

CAPTAIN L. SITGREAVES,
CORPS TOPOGRAPHICAL ENGINEERS.

ACCOMPANIED BY MAPS, SKETCHES, VIEWS, AND ILLUSTRATIONS.

WASHINGTON:
ROBERT ARMSTRONG, PUBLIC PRINTER.
1853.

On Nov. 5, 1852 Captain Sitgreaves was on the banks of the Colorado River and reflected on his travels since October 24 that included crossing the upper the Big Chino watershed to the north of Partridge Creek.

Very little intermittent/perennial surface water in northern end (north of Seligman) of watershed

The whole country traversed from the San Francisco mountains was barren and devoid of interest. It consists of a succession of mountain ranges and desert plains, the latter having an average height of about 5,000 feet above the level of the ocean. The larger growth, almost exclusively of cedar, was confined to the mountains; and the scanty vegetation of the plains, parched by a long drought, furnished few specimens for the botanist.

The reader should be aware that during early settlement two places were named Chino. One was 4 miles west of Seligman and the other was at Del Rio Springs. Az. Place Names identifies these places. See Item 3 of Appendix H.

.

338 ARIZONA PL

CHINO VALLEY

El.: c. 4000′ Loc.: Yavapai 2, H-3
Pro.: /čiyno/ Spanish: *chino*, "curly hair"
When Lt. Amiel W. Whipple came through this valley in January 1854, he noted that it had an abundant growth of grama grass which was called by local Mexicans "de china." For this reason Whipple called the valley Val de China or Chino. The grass had a somewhat curly appearance, which may account for its name. Until at least September 1871, the valley was known as the Chino Valley and was so recorded in accounts of official scouts or encounters with Indians. Gradually, however, it came to be called Big Chino Valley and is so referred to in newspaper dispatches of 1897.

Settlement in the rich valley was steady and by 1879 there was a need for a post office.

P.O. est. as Chino, October 6, 1879. Benjamin A. Wade, p.m. Discont. July 25, 1891.

Ref.: 178, pp. 15, 90; 85, p. 347, 433; 177, p. 188, (Note 5); *Arizona Journal Miner*, November 16, 1897, 4:2; P.O. Records. Maps: C-5; C-7; C-12; GM-13; GM-14; GM-15; GM-17.

a.n. **Big Chino Wash** Maps: GM-14; GM-15 Yavapai

Chino Creek Yavapai and Coconino
Loc.: T. 26 N., R. 6 W. to T. 17 N., R. 1 W.

Chino Wash Map: GM-15 Yavapai

Chino Loc.: W. of Seligman 4 miles Yavapai

Chino Valley Map: C-12 Yavapai
Where the narrow gauge branch of the United Verde and Pacific Railroad to Jerome joins the Prescott and Arizona Central (later the Santa Fe) a small community developed with the descriptive name of Junction.

P.O. est. as Junction, June 7, 1895. George C. West, p.m. Wells Fargo Station, 1903. Name changed to Jerome Junction, December 23, 1914. Name changed to Chino Valley, April 11, 1923.
Ref.: Gardner; Theobald; 162, p. 9; P.O. Records.

Chino Creek Yavapai and Coconino Cos. Map, Prescott N. F., 1927.

Rises northwest of Mount Floyd southeast end Aubrey cliffs in T. 26 N., R. 6 W., runs through Chino valley entering Verde river in approximately T. 17 N., R. 1 W. See Chino.

Arizona Place Names – 6th edition

Historic and current information about Big Chino Creek that is related to the assessment of navigability of the Upper Verde River follows. The information includes the original Land Surveys and early newspaper accounts related to hydrology and land use for assessment of navigability of the Upper Verde River under natural conditions.

Federal Land Survey maps (plats) with information, such as channel widths, from selected associated survey field notes for the reach of Big Chino Creek from the Seligman area to the Verde River are used. The maps and survey notes, when used together, provide valuable morphology, hydrology and hydraulic information for the assessment of navigability for ANSAC. These maps and field notes were obtained from the Bureau of Land Management (BLM) in 2013.

Sullivan Yavapai Co. G. L. O. Map, 1892.

In T. 21 N., R. 6 W., about 12 miles south of Seligman. Station on abandoned Prescott and Arizona railroad, "The Bullock Road" of 1887 from Seligman (then known as Prescott Junction) to Prescott. Headquarters for Hon. Jerry Sullivan's cattle ranch in upper Chino valley.

Sullivan Peak Coconino Co.

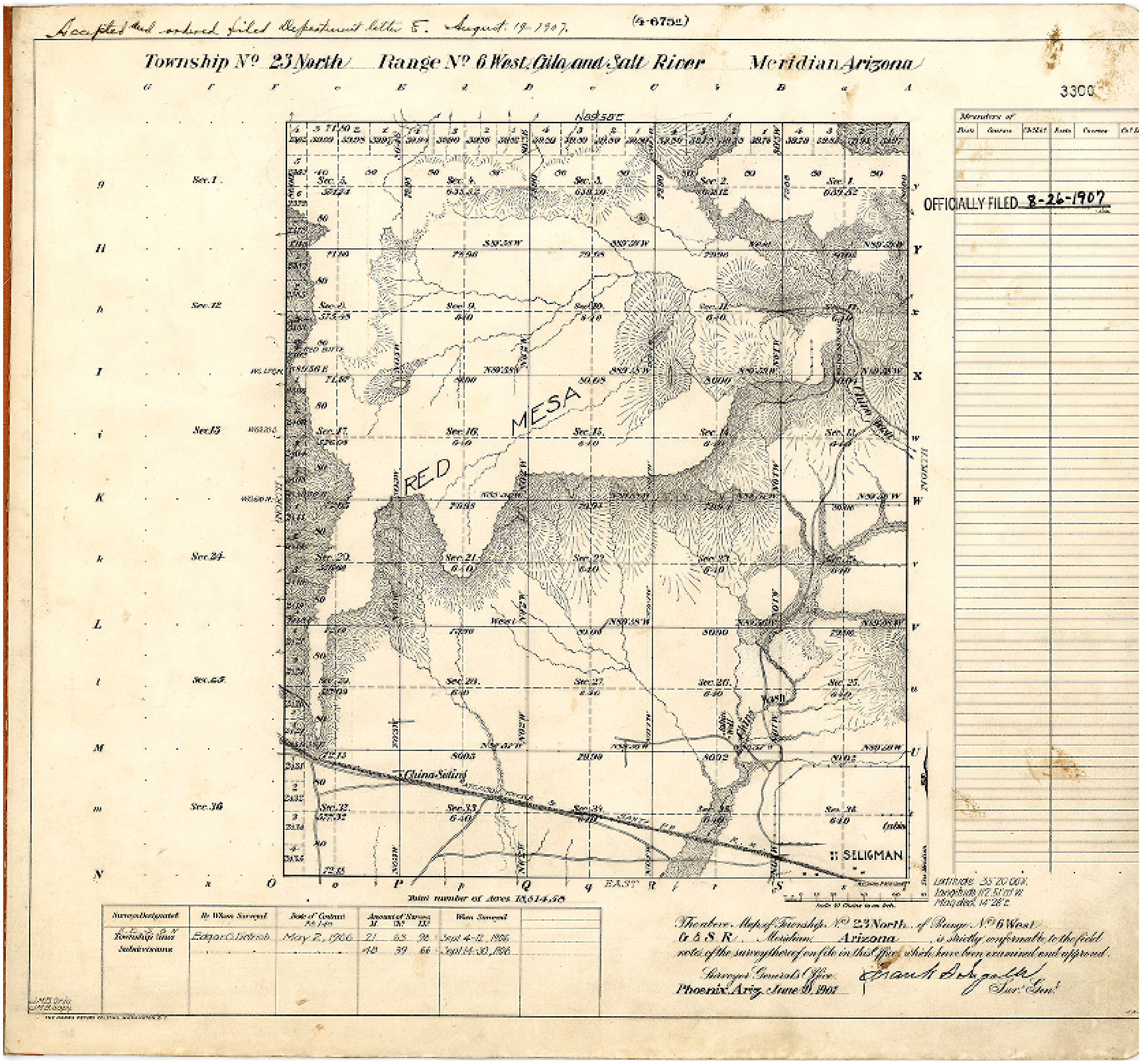
Grand Canyon N. P. near west rim, southwest corner park, near lat. 36° 16′, long. 111° 59′. About one mile southwest of Point Imperial. Named for J. W. "Jerry" Sullivan, Arizona pioneer. Arrived Prescott December 2, 1868, born in Canada, 1844; stock raiser, banker and member Third State Legislature. Sullivan had a large cattle ranch in Chino valley south of Seligman. See Sullivan. Named by the author. Decision U.S.G.B.

T23N R6W

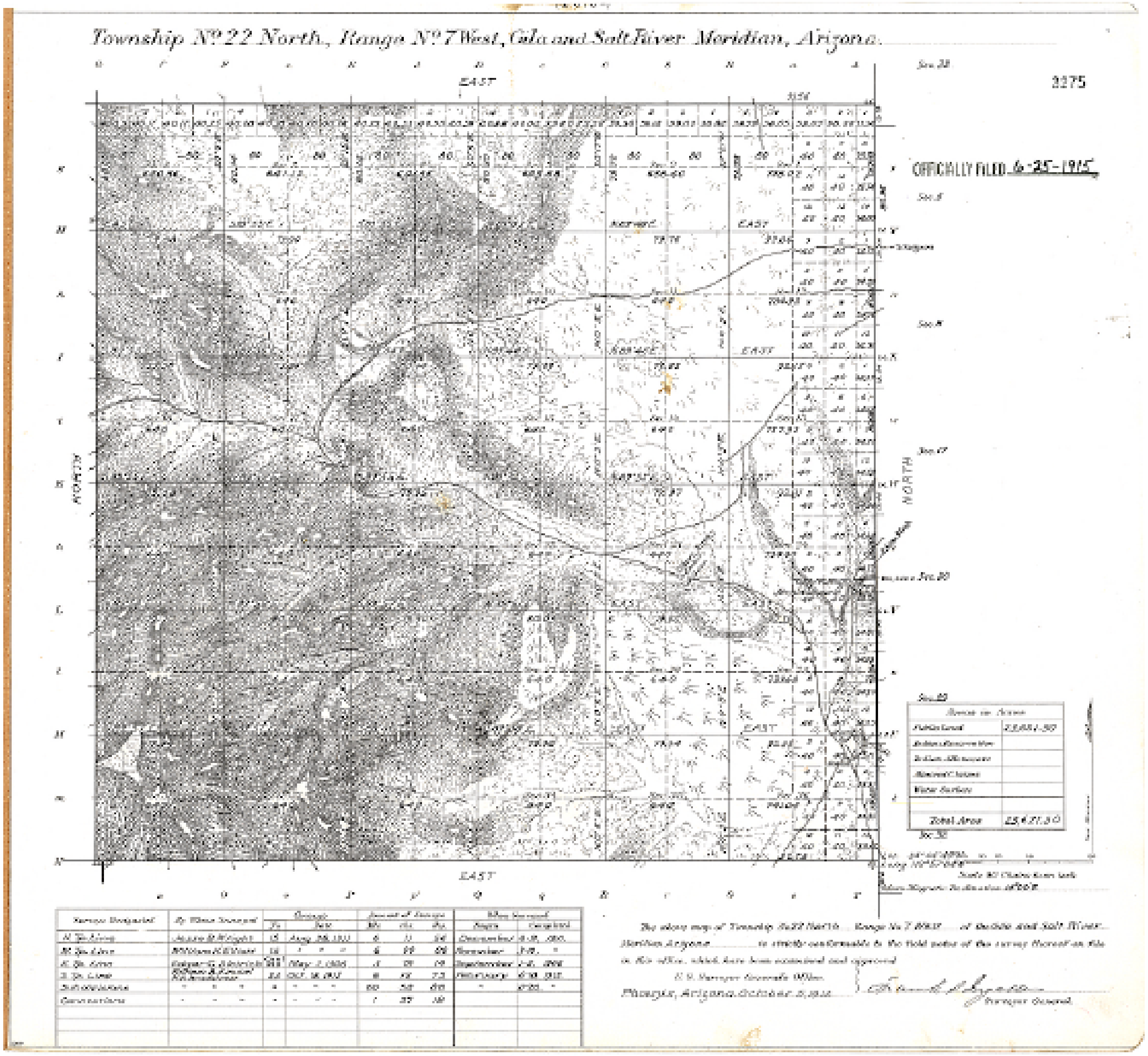
Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	MV-0780-208	BURNS, R B	5/26/1908	3441	AZ	Gila-Salt River	023N - 006W	SE¼NW¼	24	Coconino
---	AZAZAA 001595	BURNS, R B	5/26/1908	3441	AZ	Gila-Salt River	023N - 006W	SE¼NW¼	24	Coconino
	60408	GALE, LAZELLE D	5/11/1909	0899	AZ	Gila-Salt River	023N - 006W	E½W½	36	Yavapai
	40262	LAMPORT, JAMES A	1/18/1909	3670	AZ	Gila-Salt River	023N - 006W	SW¼SE¼	36	Yavapai
	192331	MCBRIDE, MICHAEL, JUNKINS, HENRY A	4/24/1911	0127	AZ	Gila-Salt River	023N - 006W	SW¼SE¼	26	Yavapai

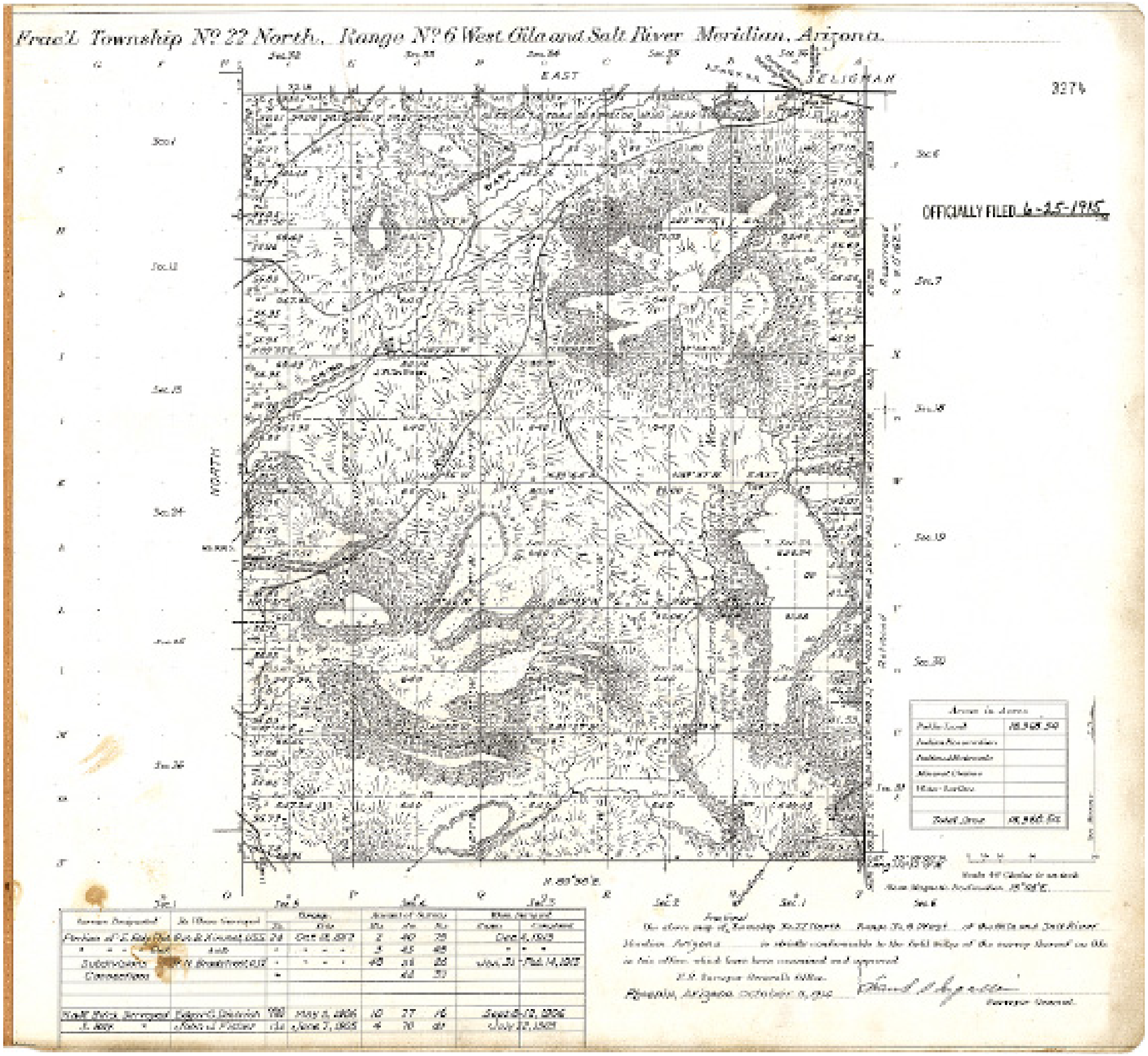
T23N R6W


Accepted and ordered filed Department letter E. August 19 1907.
Township Nº 23 North Range Nº 6 West Gila and Salt River Meridian Arizona
OFFICIALLY FILED 8-26-1907
RED MESA
China Siding
SELIGMAN
Total number of Acres 18,514.56
The above Map of Township Nº 23 North of Range Nº 6 West G & S R Meridian Arizona is strictly conformable to the field notes of the survey thereof on file in this office, which have been examined and approved.
Surveyor General's Office.
Phoenix Ariz. June 11, 1907

T22N R7W


Township No. 22 North, Range No. 7 West, Gila and Salt River Meridian, Arizona.
3275
OFFICIALLY FILED 6-25-1915
EAST
NORTH

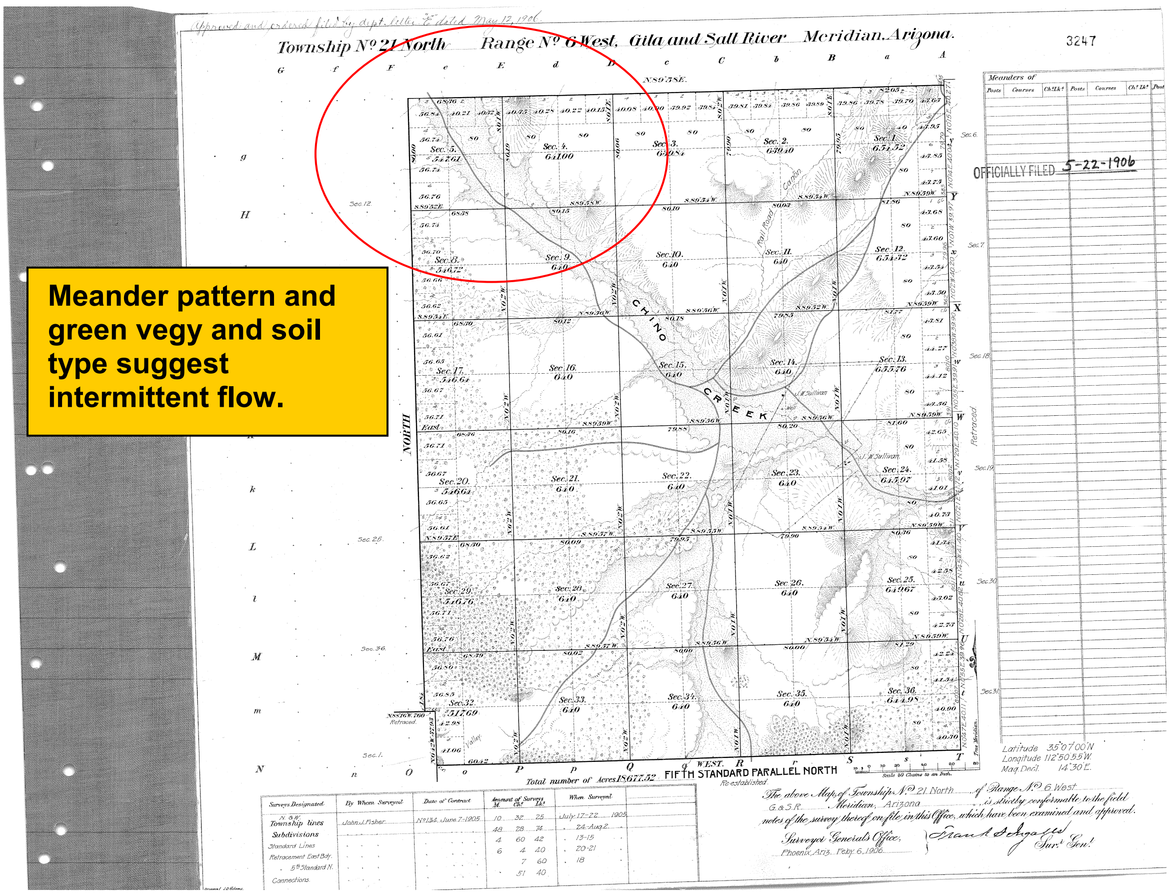
T22N R6W


Frac'l. Township No. 22 North., Range No. 6 West Gila and Salt River Meridian, Arizona.
EAST
SELIGMAN
NORTH
OFFICIALLY FILED 6-25-1915
Areas in Acres

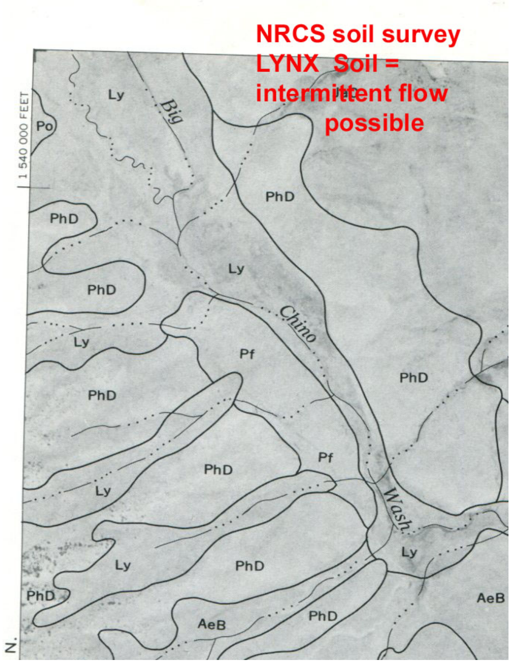
Sullivan Yavapai Co. G. L. O. Map, 1892.

In T. 21 N., R. 6 W., about 12 miles south of Seligman. Station on abandoned Prescott and Arizona railroad, "The Bullock Road" of 1887 from Seligman (then known as Prescott Junction) to Prescott. Headquarters for Hon. Jerry Sullivan's cattle ranch in upper Chino valley.

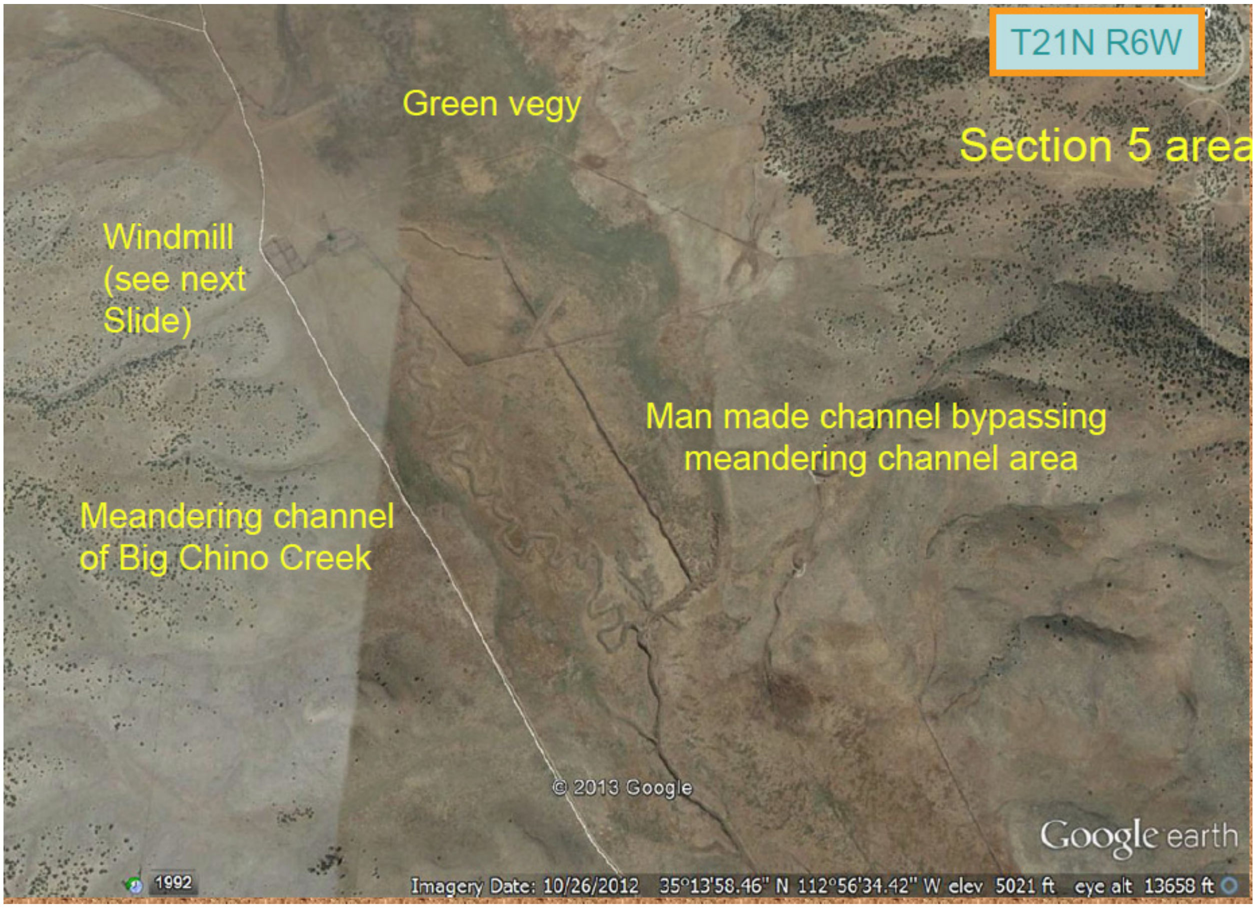
T21N R6W



Meander pattern and green vegy and soil type suggest intermittent flow.



Meander pattern and soil type suggest perennial or intermittent flow likely.


T21N R6W
Green vegy
Section 5 area
Windmill
(see next
Slide)
Man made channel bypassing
meandering channel area
Meandering channel
of Big Chino Creek
© 2013 Google
Google earth
1992
Imagery Date: 10/26/2012 35°13'58.46" N 112°56'34.42" W elev 5021 ft eye alt 13658 ft


T21N R6W
Stock tank
Section 5 area
Windmill
© 2013 Google
Google earth
1992
Imagery Date: 6/4/2012 35°14'15.53" N 112°57'03.13" W elev 5042 ft eye alt 5249 ft

T21N R6W

BOOK 1854

Subdivision of T. 21 N. R. 6 W.

Chains.	
	Land, level and mountaineous. Soil, loam and rocky, 1st.and 4th.rates. No timber. Mountaineous land 49.15 chs.
	Thence I run, N.89°54'W.on a random line bet.Secs.5 and 8.
40.00	Set temporary 1/4 Sec.cor.
68.38	Intersect W.bdy.Tp.[illegible] lks.S.of cor.Secs.5 and 8.
	Thence I run, S.89°52'E. on a true line bet.Secs.5 and 8.
28.00	Cross wash 10 lks.wide, course N.E.
28.38	Set a lime stone 20x12x6 ins.15 ins.in ground, for 1/4 Sec.cor, marked 1/4 on N.face, raised mound of stones 2 ft.base, 1-1/2 ft.high, N.of cor. No trees, pits impracticable.
58.00	Leave hills, enter Chino Valley.
68.38	Cor.Secs.4,5,8 and 9. Land, level and rolling hills. Soil, loam and gravelly, 1st.and 3rd.rates. No timber.
	Thence I run, N.0°2'W.on a random line bet.Secs.4 and 5.
40.00	Set temporary 1/4 Sec.cor.
80.19	Intersect N.bdy.Tp.at 8 lks.W.of cor.Secs.4,5,32 and 33. Thence I run, S.0°1' W. on a true line bet.Secs.4 and 5,over mountaineous country. Descend.
40.19	Set sand stone 20x15x12 ins. ~~10~~ 15 ins.in ground for 1/4 Sec.cor.marked 1/4 on W.face, raised mound of stones 2 ft.base, 1-1/2 ft.high, W.of cor. No trees, pits impracticable.
45.19	Leave mountain, enter Chino Valley.
73.44	Cross Chino Creek,dry, 30 lks.wide, course S.E.
79.00	Cross road, course N.W. and S.E.
80.19	The cor.Secs.4,5,8 and 9. Land, leval and mountaineous. Soil, loam and rocky, 1st. and 4th.rates. No timber. Mountaineous land 45.19 chs. August 2, 1905.
	Note. The latitude observed by me is about 3 minutes less than that furnished by the Surveyor General. I am satisfied that my instrument is in perfect adjustment. GENERAL DESCRIPTION. This Township contains two varieties of land, mountains and valley, and the soil ranges from first to fourth rates. The soil of the valleys is generally a rich sandy loam, capable of producing abundant crops with irrigation; the soil of the mountains and hills is very rocky but produces a fairly abundant growth of nutritious grass. None of this land will produce crops without irrigation. Cedar and pinon are found in the South Western portion of the Township with scattering cedars in other portions of Township. There is one settler in the Township, on Sections 14 and 24. *John J. Fisher* U.S.Deputy Surveyor.

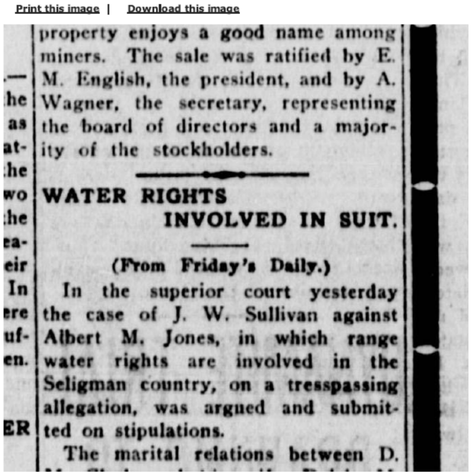
Irrigated land along Big Chino Wash upstream from Big Chino Valley

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, December 18, 1912, Page 2, Image 2

Image provided by Arizona State Library, Archives and Public Records; Phoenix, AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn85032923/1912-12-18/ed-1/seq-2/

Print this image | Download this image



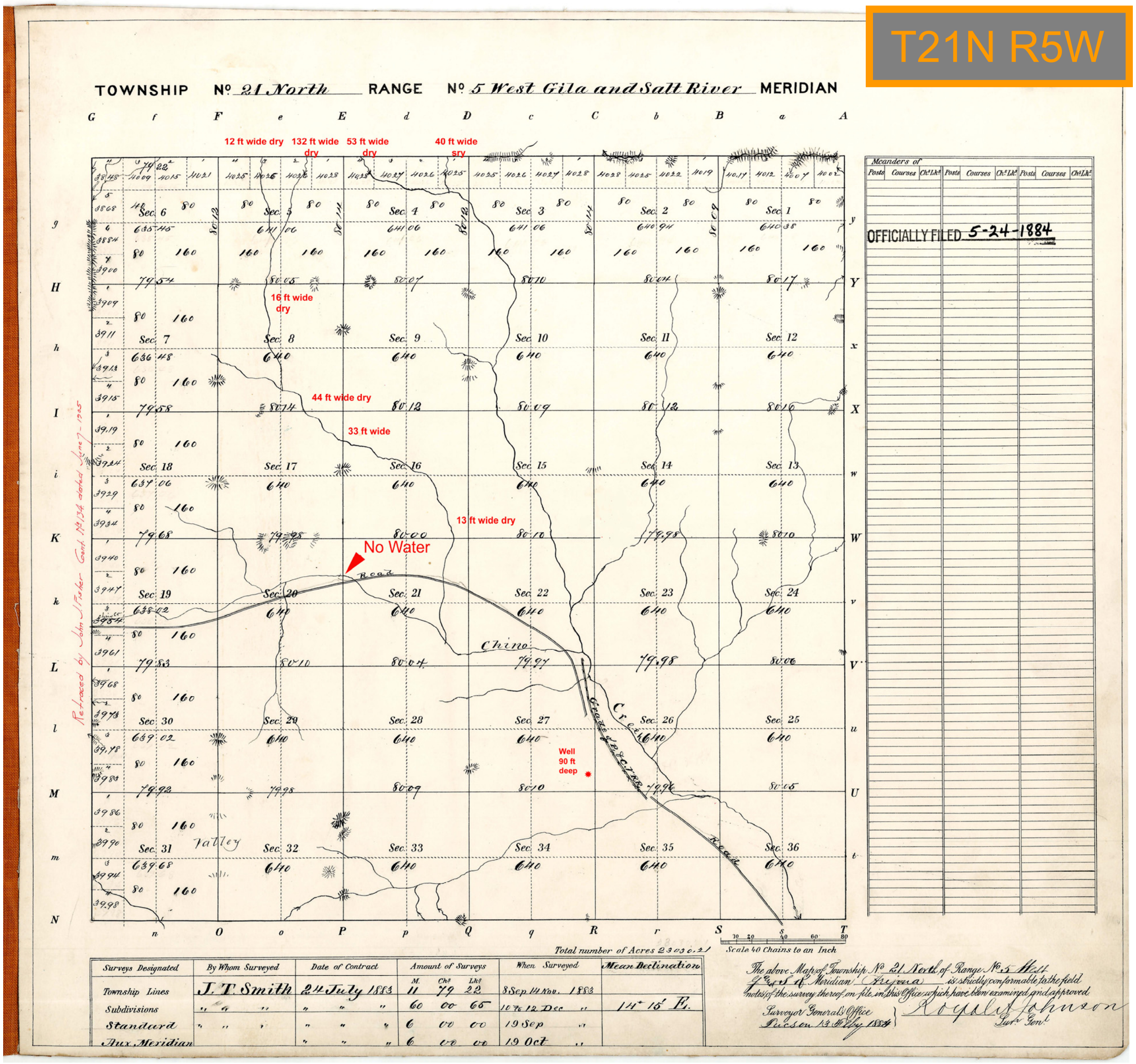
property enjoys a good name among miners. The sale was ratified by E. M. English, the president, and by A. Wagner, the secretary, representing the board of directors and a majority of the stockholders.

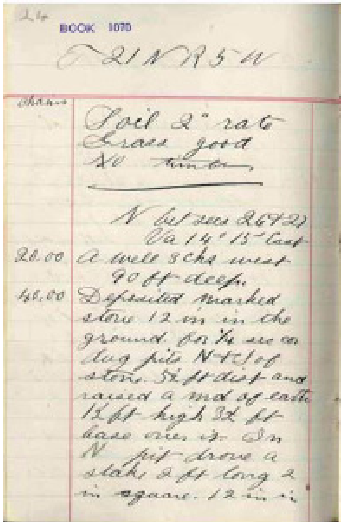
WATER RIGHTS INVOLVED IN SUIT.

(From Friday's Daily.)

In the superior court yesterday the case of J. W. Sullivan against Albert M. Jones, in which range water rights are involved in the Seligman country, on a tresspassing allegation, was argued and submitted on stipulations.

The marital relations between D.


T21N R5W
TOWNSHIP No 21 North RANGE No 5 West Gila and Salt River MERIDIAN
12 ft wide dry
132 ft wide dry
53 ft wide dry
40 ft wide sry
16 ft wide dry
44 ft wide dry
33 ft wide
13 ft wide dry
No Water
Road
Chino
Creek
Well
90 ft
deep
OFFICIALLY FILED 5-24-1884
Meanders of
Total number of Acres 23030.21
Scale 40 Chains to an Inch
Surveys Designated
By Whom Surveyed
Date of Contract
Amount of Surveys
When Surveyed
Mean Declination
Township Lines
Subdivisions
Standard
Aux. Meridian
J. T. Smith
24 July 1883
14° 15' E.
Surveyor General's Office
Tucson



24 BOOK 1070

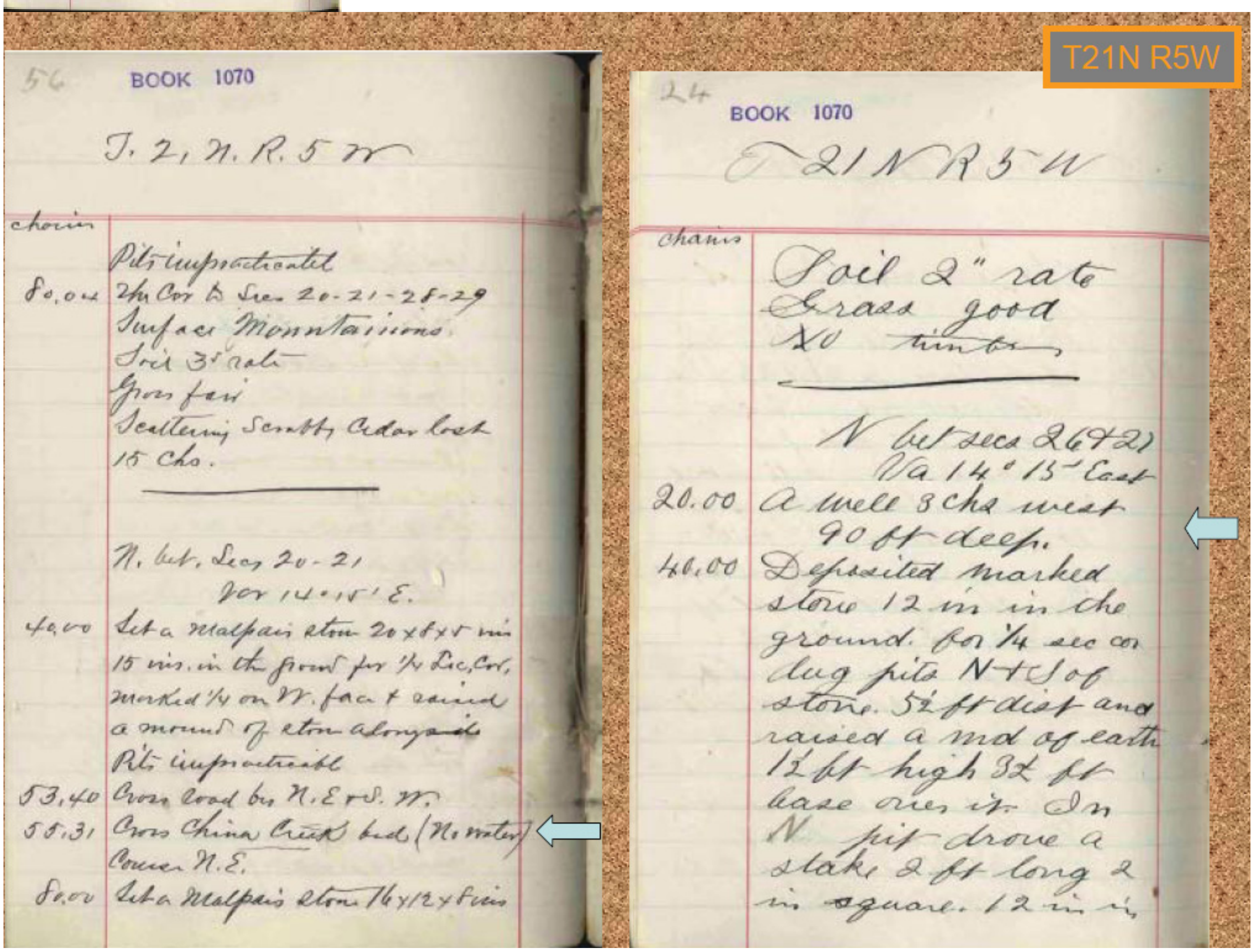
T 21 N R 5 W

chains

Soil 2nd rate
Grass good
No timber

N bet secs 26 & 27
Va 14° 15' East

20.00 A well 3 chs west 90 ft deep.
40.00 Deposited marked stone 12 in in the ground for ¼ sec cor dug pits N & S of stone 5½ ft dist and raised a md of earth 1½ ft high 3½ ft base over it. In N pit drove a stake 2 ft long 2 in square 12 in in



56 BOOK 1070

T. 21, N. R. 5 W

chains

Pits impracticable
80.00 ¼ Cor to Secs 20-21-28-29
Surface Mountainous
Soil 3rd rate
Grass fair
Scattering Scrubby Cedar last 15 Chs.

N. bet. Secs 20-21
Var 14°15' E.

40.00 Set a Malpais stone 20x8x5 ins 15 ins. in the ground for ¼ Sec. Cor, marked ¼ on W. face & raised a mound of stone alongside
Pits impracticable
53.40 Cross road bears N.E. & S.W.
55.31 Cross China Creek bed (No water)
Course N.E.
80.00 Set a Malpais stone 16x12x8 ins

24 BOOK 1070

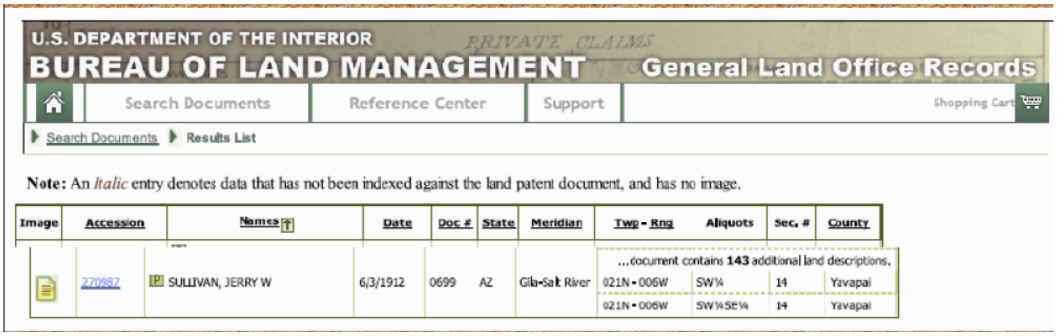
T 21 N R 5 W

chains

Soil 2nd rate
Grass good
No timber

N bet secs 26 & 27
Va 14° 15' East

20.00 A well 3 chs west 90 ft deep.
40.00 Deposited marked stone 12 in in the ground for ¼ sec cor dug pits N & S of stone 5½ ft dist and raised a md of earth 1½ ft high 3½ ft base over it. In N pit drove a stake 2 ft long 2 in square 12 in in



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT General Land Office Records

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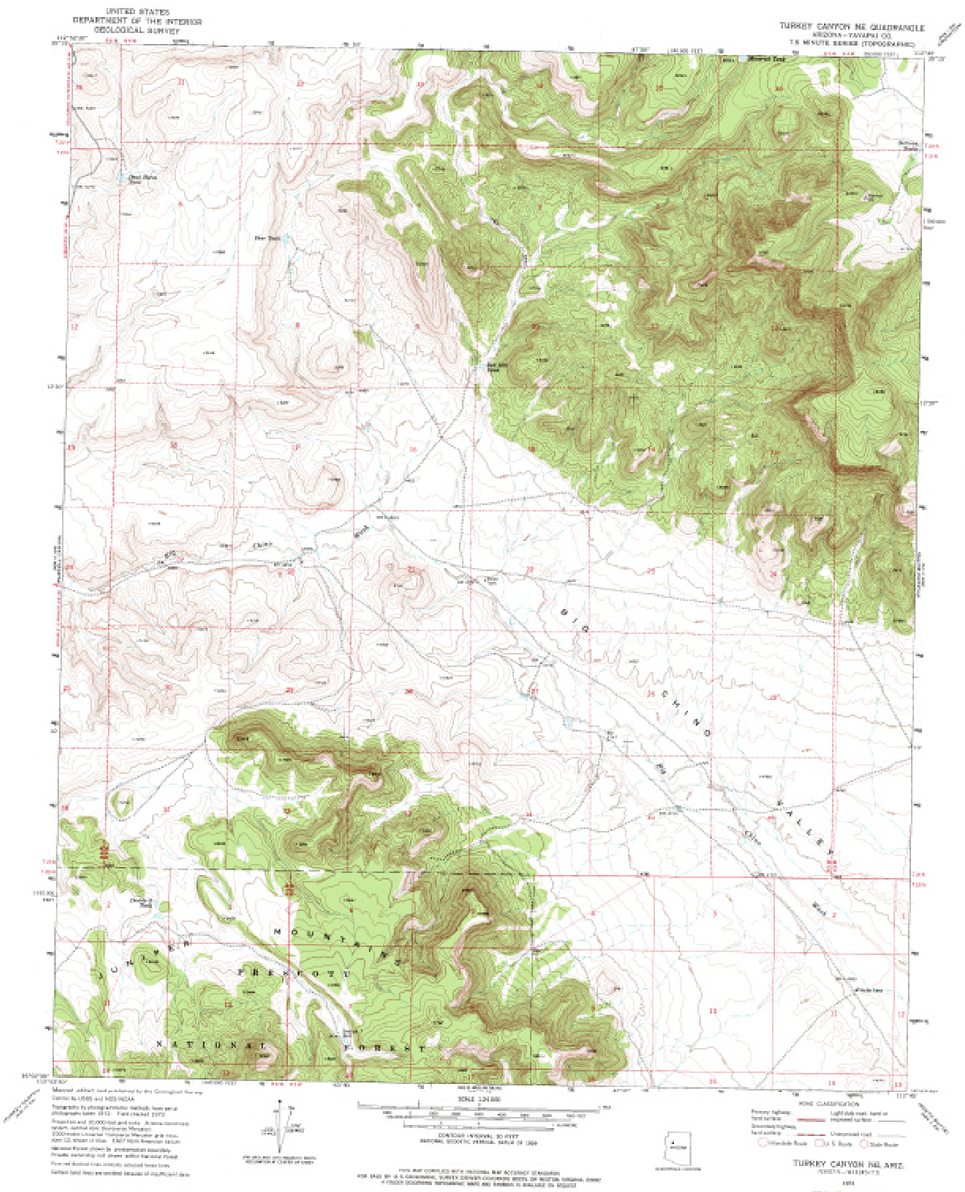
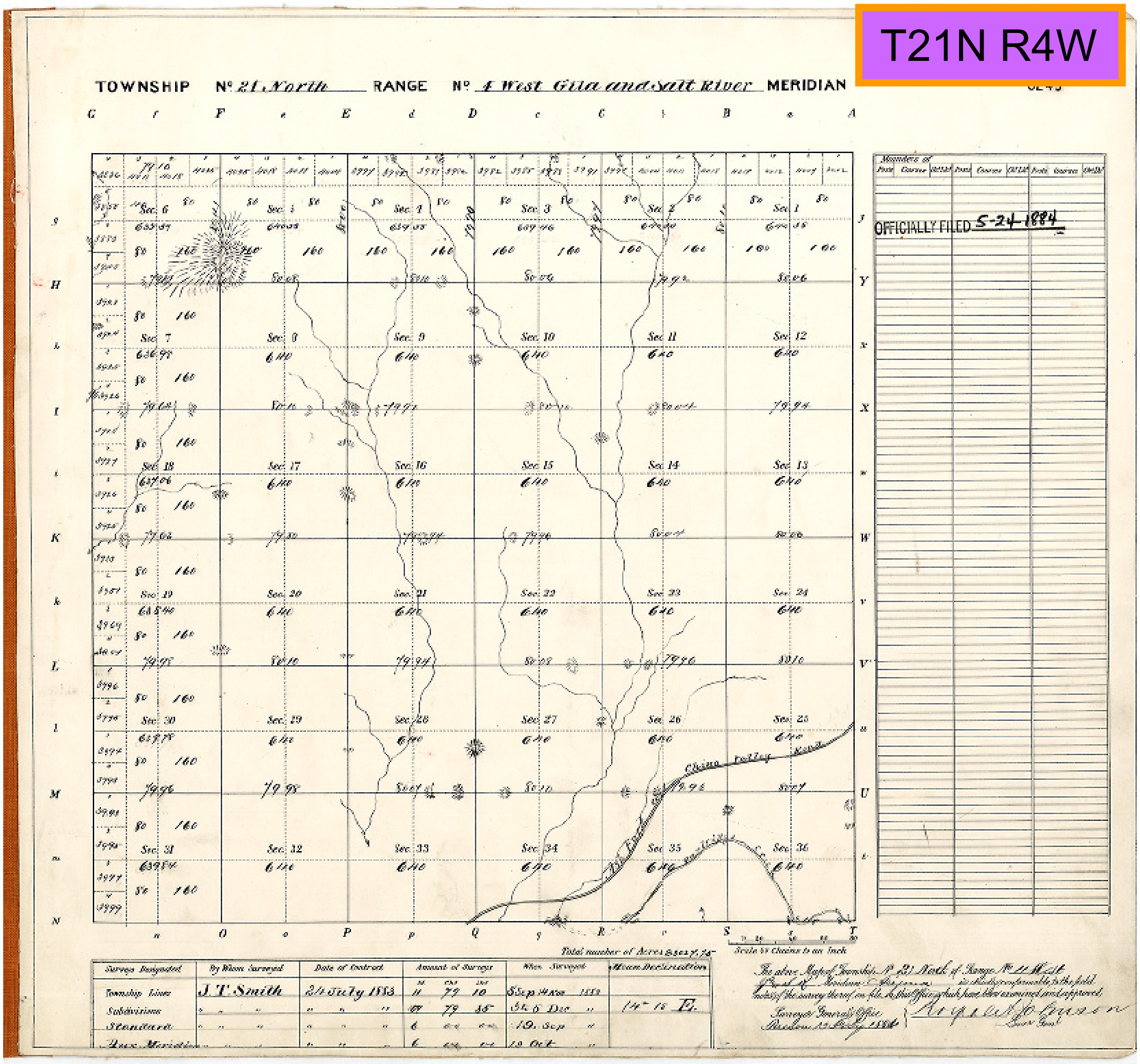
Search Documents ▸ Results List

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
							…document contains **143** additional land descriptions.			
	270987	SULLIVAN, JERRY W	6/3/1912	0699	AZ	Gila-Salt River	021N - 006W	SW¼	14	Yavapai
							021N - 006W	SW¼SE¼	14	Yavapai




T21N R4W
TOWNSHIP Nº 21 North RANGE Nº 4 West Gila and Salt River MERIDIAN
OFFICIALLY FILED 5-24-1884
Sec. 1
Sec. 2
Sec. 3
Sec. 4
Sec. 5
Sec. 6
Sec. 7
Sec. 8
Sec. 9
Sec. 10
Sec. 11
Sec. 12
Sec. 13
Sec. 14
Sec. 15
Sec. 16
Sec. 17
Sec. 18
Sec. 19
Sec. 20
Sec. 21
Sec. 22
Sec. 23
Sec. 24
Sec. 25
Sec. 26
Sec. 27
Sec. 28
Sec. 29
Sec. 30
Sec. 31
Sec. 32
Sec. 33
Sec. 34
Sec. 35
Sec. 36
China Valley Road
Surveys Designated
By Whom Surveyed
Date of Contract
Amount of Surveys
When Surveyed
Mean Declination
Township Lines
Subdivisions
Standard
J. T. Smith
24 July 1883
14° 15 E.

Partridge Wash or Creek Coconino Co. U. S. G. S. Map, 1923; Tusayan N. F., 1927.

Rises in T. 24 N., R. 2 W. Tusayan N. F. Flows southwest into Chino valley in T. 20 N., R. 4 W. Very old name. Ives called it "Partridge Ravine," 1858. Later he called it Partridge creek as does Whipple 1854. Mollhausen, *Diary of a Journey*, 1858, says: "So called from the numerous pretty creatures of that kind."

"January 10, 1854: Many partridges were killed today. Upon their heads are tufted plumes like those of the California partridges." Whipple Report. Evidently our common tufted quail.

Federal land surveyor notes.

T21N R4W

	Thence N.89°57'W., on S. bdy. of sec. 36, over mountainous land.
.10	Rim of canyon, bears NW. and SE.; desc. steep rocky SW. slope to Partridge Creek.
6.40	Ft. of steep descent; desc. gradually.
9.00	Partridge Creek, 50 lks. wide, course NW.; desc. gradually along creek bottom.
27.25	Partridge Creek, 50 lks. wide, course SE.
31.80	Ft. of rocky point, slopes S.
40.35	Partridge Creek, 50 lks. wide, course NW.
40.55	True pt. for standard ¼ sec. cor.,(missing) on low gravel bed of creek, subject to overflow, where a permanent monument cannot be established. Therefore at
41.40	Establish witness cor. as follows: Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, for witness cor. to missing standard ¼ sec. cor., with brass cap, marked

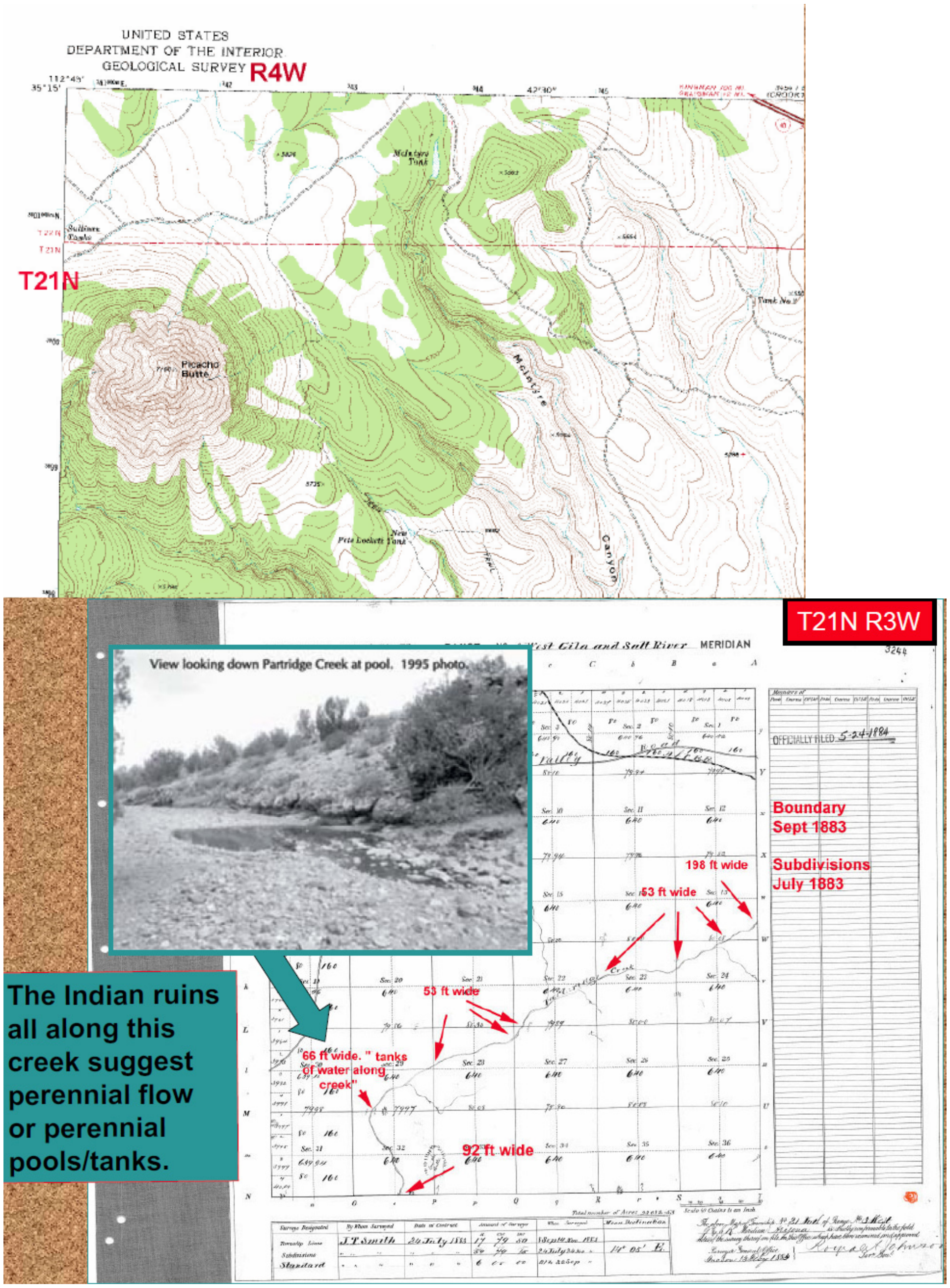
	N. of cor.

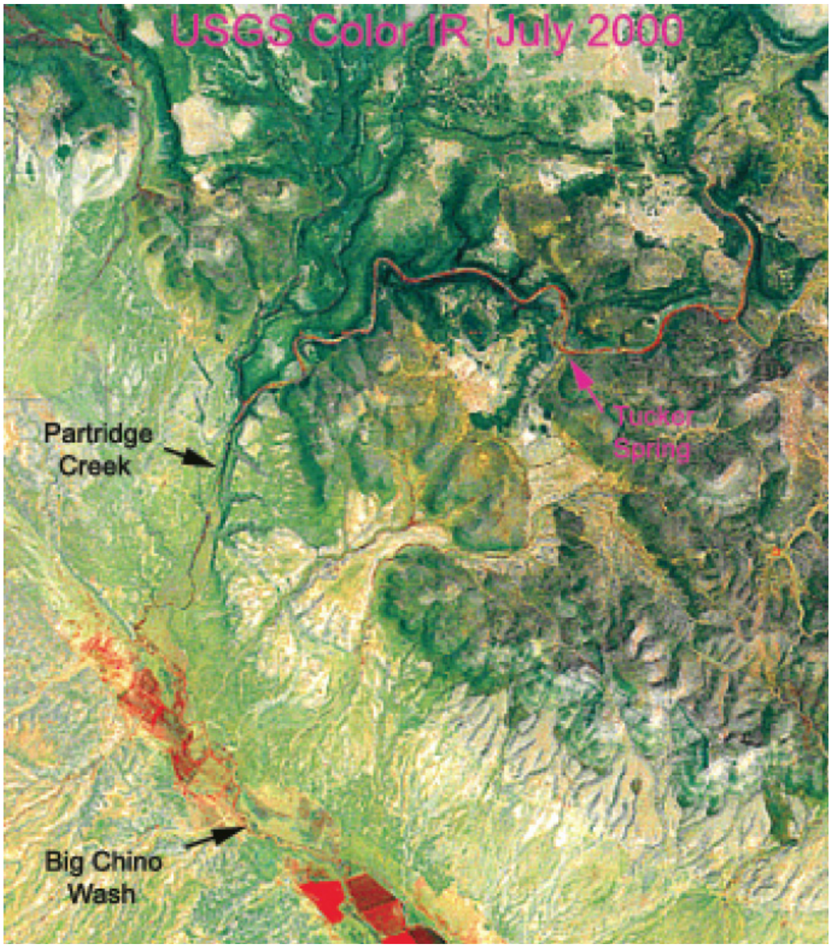
	Thence S.89°24'W., on W. half of S. bdy. of sec. 35.
7.40	Leave scattering timber, bearing N. and S.; begin descent of rocky W. slope into Partridge Creek Canyon.
20.40	Ft. of steep descent.
20.90	Partridge Creek, 50 lks. wide, course SW.; asc. steep rocky SE. slope.
40.00	Rim of canyon bears NE. and SW.
41.72	The standard cor. of secs. 34 and 35, which is a malpais stone, 20x12x6 ins., firmly set in a mound of stone, marked as described by the Surveyor General. I reestablish cor. as follows: With original stone, set an iron post, 3 ft. long, 3 ins. diam., 24 ins. in the ground, with brass cap, marked

T21N R4W

6 Resurvey of 5th St. Par. N., through R. 4 W.

Chains	
35.50	Partridge Creek, 75 lks. wide, course SW.: asc. steep rocky wall of canyon.
36.40	Rim of canyon, bears NE. and SW.; asc. gradually.
41.08	The standard ½ sec. cor., which is a malpais stone, 14x11x5 ins., firmly set in a mound of stone, marked and witnessed as described by the Surveyor General. I reestablish same as follows: With original cor., set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
R4W
T21N
Picacho Butte
Canyon
T21N R3W
Gila and Salt River MERIDIAN
View looking down Partridge Creek at pool. 1995 photo.
OFFICIALLY FILED 5-24-1884
Boundary Sept 1883
Subdivisions July 1883
198 ft wide
53 ft wide
53 ft wide
"66 ft wide. " tanks of water along creek"
92 ft wide
The Indian ruins all along this creek suggest perennial flow or perennial pools/tanks.



Partridge Creek was perennial in places but is classed as intermittent because base runoff seeped beneath porous sediments in many places along the channel.

T. 21 N. R. 3 W. G & S. R. M

Chains	
	East on a random line bet. Secs 29 & 32
	Var. 14° 05' E
12.00	Descend into Partridge creek
21.00	Partridge Creek 100 lks wide Co. S.
	Lots of water along Creek
22.00	Ascend
31.00	Top of hill
40.00	Set temporary ¼ Sec Cor.
55.00	Smiths Butte 10.00 chs S. of line
79.97	Intersect N & S. line 12 lks N of
	the Cor. to Secs 28-29-32 & 33 From
	which Cor. I run N. 89° 55' W. on a
	true line bet Secs 29 & 32 with
	same var
39.98	Set a limestone 20x14x3 ins 10 ins
	in the ground for ¼ Sec. Cor
	marked ¼ on N. face and raised
	a mound of stone alongside
	pits impracticable
79.97	The Cor to Secs 29-30-31 & 32

Ash Fork.

Ash Fork, June 29.—

E. B. Perrin is buying water for his sheep at Fairview.

Charles Howard is gaing to have Contractor M. S. Burhans, of Ash Fork, put in a cement dam for him two miles south of theGold Trap dam in Partridge creek.

One-half an inch of rain fell here on Tuesday and Wednesday.

The Coconino sun [microform]. (Flagstaff, Ariz.) 1898-197?, July 05, 1910, EXTRA EDITION, Page PAGE THREE, Image 3

Arizona silver belt. (Globe City, Pinal County, Ariz.) 1878-19??, September 15, 1904, Page 2, Image 2

Last Sunday the sixty-four miles of track from Williams to the Grand Canyon was put out of commission entirely by heavy rains and high water. Not a bridge was left standing, and the extra gangs now at work on the Canyon road have practically reconstructed the entire line. The Santa Fe made a great showing in repairing the same, as the track was open to traffic on Wednesday. Bluewater, on the first district, was the scene of a second washout on Tuesday which delayed Nos. 1 and 7 for several hours. The Ash Fork dam is full of water, the first time in years, and the Little Colorado river was reported the highest in ten years last Monday afternoon.—Winslow Mail.

Johnson Canyon Dam.

The Santa Fe Pacific Railroad Company have completed their new steel dam across Johnson canyon, east of Ash Fork. The dam is forty feet high and backs up the water for 3,000 feet. The dam is now full of water and the railroad company consider that they have a water supply that will last them a year.

The dam at Seligman has no water in it at present, and water is being hauled to that place from Ash Fork. The Seligman dam is the largest reservoir yet constructed by the Santa Fe Pacific and when filled will hold a two years' supply.

The Walnut canyon dam, southeast of this place, is still dry, but it is expected that the melting snows will fill it during the next few weeks. Fourteen miles of pipe line connect this dam with Angell.

All the pipe lines from the dams are gravity lines. The line from Johnson canyon to Ash Fork being seven miles long and from the Seligman dam to Seligman six miles.

It is said that these dams cost the railroad company nearly $150,000, but that they will save the company that amount of money, should they be filled, within a year. The reservoir at Williams, the first experiment of the kind by the Santa Fe, and which cost $50,000, has in the past three years saved the company several times its cost.

The Coconino sun [microform]., March 12, 1898,

RANGE AND MARKET NEWS

Items of Interest Pertaining to the Live Stock Industry of Arizona—Market for Past Week.

Chas. Howard's Gold Trap dam went out in the last storm.

The Storm Brothers intend to dispose of their range cattle and ranch in Cheno Valley.

Charlie Burton's dam on Partridge Creek 15 miles north of Ash Fork went out during the last rains.

The Martin dam in Dry Wash belonging to Chas. Howard busted during the rains and was totally destroyed.

It is reported that a stock dam belonging to Harry Hibben west of Cedar Ranch filled up then went out during the recent rains.

W. H. Campbell and Chas. Howard will ship their sheep next week to the Phoenix country owing to heavy rains and deep mud on the trail.

The Coconino sun [microform]. (Flagstaff, Ariz.) 1898-197?, January 21, 1910, Image 7

DISASTER OVERTAKES GOVERNOR AND PARTY

(From Sunday's Daily.)

Governor Hunt's first automobile trip out of Phoenix to the Grand Canyon proved disastrous Friday evening at Partridge creek, seven miles from Ask Fork, when the car went into deep water and was wrecked. To add to the intensity of the situation the executive of Arizona was compelled to resort to his pedal extremities and after a terific exertion in hoofing it for seven miles he reached the above railroad station, "all in."

On the road, after the smashup occurred, according to statements made by Lamar Cobb, state engineer, one of the party on the journey north, Governor Hunt fell by the wayside on three different occasions, and slight injuries occurred to his physique, which all the more distressed him in reaching the goal, four hours after the accident took place.

Another interesting matter that

Car wrecked in deep water of Partridge Creek

Weekly journal-miner. (Prescott, Ariz.) September 04, 1912, Page 5, Image 5

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, March 05, 1913, Image 7

ty.

As to Big Chino Valley, the report is that several groups of moneyed men have visited this promising area within the past month and a delegation of San Francisco and Pasadena capitalists will be on the ground early in March, prepared to investigate the possibilities of dry and irrigated farming in this Valley.

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, June 25, 1913, Page 8, Image 8

age concerns.

Summer Rains.

General rains commenced yesterday and heavy downpours were reported to the north and west of the city, with the usual cloudbursts in the vicinity of Big Chino and Williamson Valleys. The benefit to farmers and rangemen will be incalculable, the country passing through the dryest spring known in many years.

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, June 25, 1913, Page 8, Image 8

Image provided by Arizona State Library, Archives and Public Records; Phoe AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn85032923/1913-0 25/ed-1/seq-8/

Print this image | Download this image

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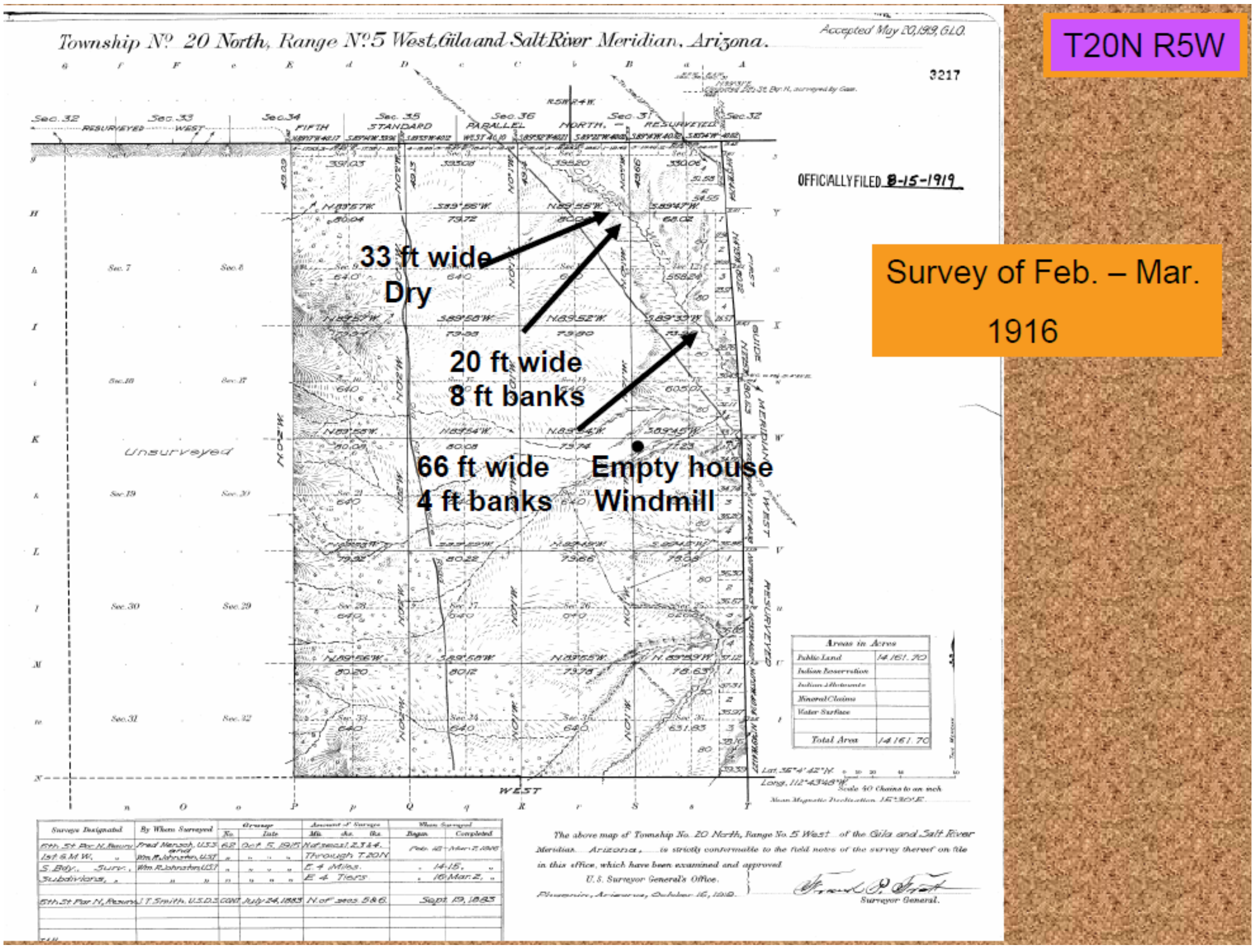
BAR DIAMOND COMPANY

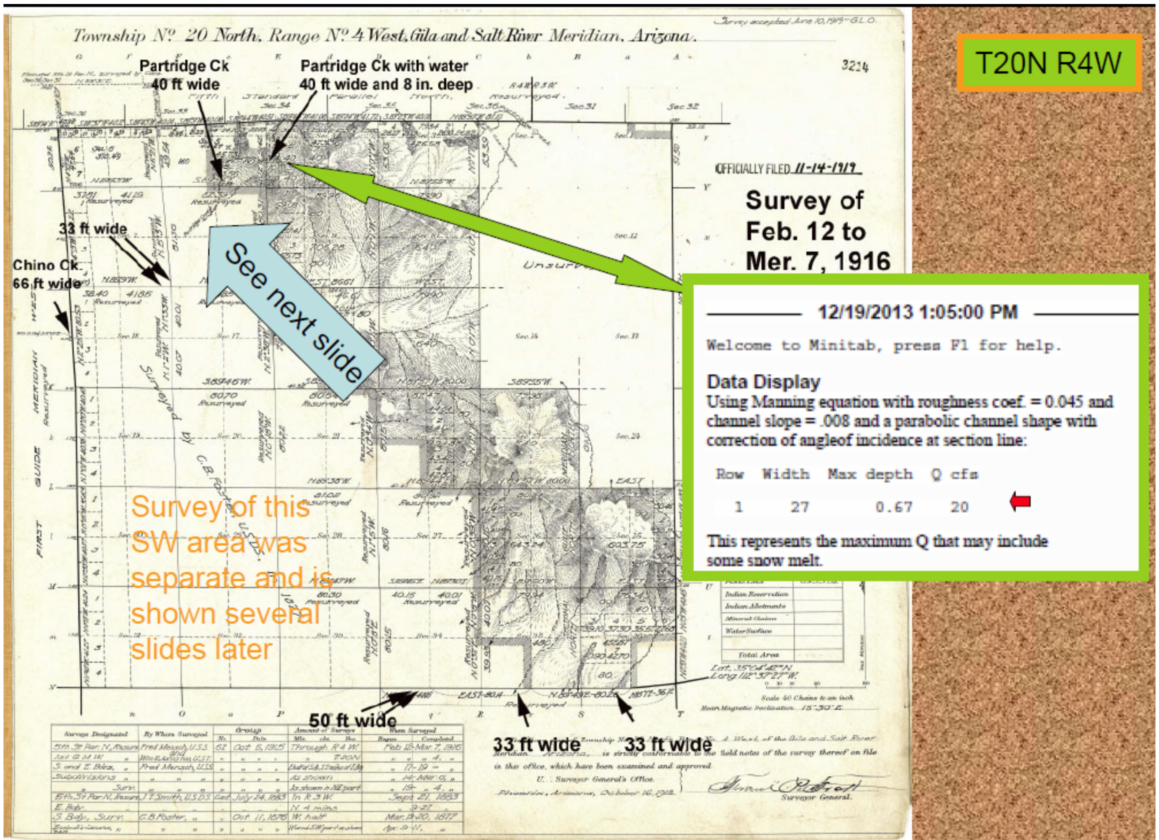
OLD MARR HOMESTEAD IN VERDE VALLEY BECOMES PROPERTY OF CHAS. BABBITT

Another big land and cattle deal in this county has been closed, the Bar Diamond Company of Big Chino valley being taken over yesterday by A. L. Bolin and A. E. Root of Fresno, Cal. The sale was ratified by I. D. L. Williams, the president, and J. F. Hamilton, the secretary, the selling company being an incorporation. While the price paid was not given publicity, it ranges to over $50,000, it was stated by reliable authorities.

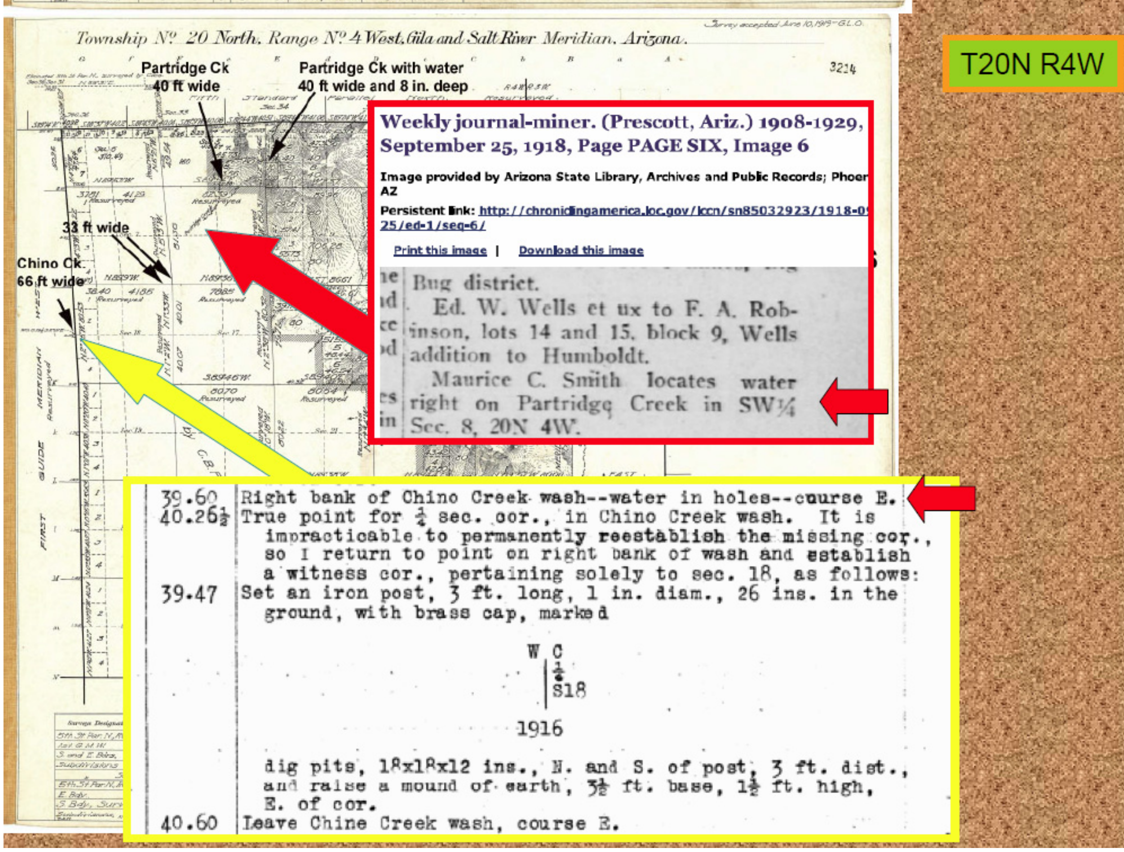
All real and personal property is affected, in which is designated a patented tract of 2,080 acres of land in Big Chino valley, with all cattle and horses carrying the company iron, the number, however, not be-

Weekly journal-miner. (Prescott, Ariz.) February 11, 1914, Page FIVE, Image 5


T20N R5W
Survey of Feb. – Mar. 1916
Township No. 20 North, Range No. 5 West, Gila and Salt River Meridian, Arizona.
33 ft wide
Dry
20 ft wide
8 ft banks
66 ft wide
4 ft banks
Empty house
Windmill
OFFICIALLY FILED 8-15-1919
Unsurveyed
WEST



Township Nº 20 North, Range Nº 4 West, Gila and Salt River Meridian, Arizona.
T20N R4W
Partridge Ck
40 ft wide
Partridge Ck with water
40 ft wide and 8 in. deep
33 ft wide
Chino Ck.
66 ft wide
See next slide
OFFICIALLY FILED 11-14-1919
Survey of
Feb. 12 to
Mer. 7, 1916
12/19/2013 1:05:00 PM
Welcome to Minitab, press F1 for help.
Data Display
Using Manning equation with roughness coef. = 0.045 and channel slope = .008 and a parabolic channel shape with correction of angleof incidence at section line:
Row Width Max depth Q cfs
1 27 0.67 20
This represents the maximum Q that may include some snow melt.
Survey of this SW area was separate and is shown several slides later
50 ft wide
33 ft wide
33 ft wide



Township Nº 20 North, Range Nº 4 West, Gila and Salt River Meridian, Arizona.
T20N R4W
Partridge Ck
40 ft wide
Partridge Ck with water
40 ft wide and 8 in. deep
33 ft wide
Chino Ck.
66 ft wide
Weekly journal-miner. (Prescott, Ariz.) 1908-1929, September 25, 1918, Page PAGE SIX, Image 6
Image provided by Arizona State Library, Archives and Public Records; Phoenix, AZ
Persistent link: http://chroniclingamerica.loc.gov/lccn/sn85032923/1918-09-25/ed-1/seq-6/
Print this image | Download this image
Bug district.
Ed. W. Wells et ux to F. A. Robinson, lots 14 and 15, block 9, Wells addition to Humboldt.
Maurice C. Smith locates water right on Partridge Creek in SW¼ Sec. 8, 20N 4W.
39.60 Right bank of Chino Creek wash--water in holes--course E.
40.26½ True point for ¼ sec. cor., in Chino Creek wash. It is impracticable to permanently reestablish the missing cor., so I return to point on right bank of wash and establish a witness cor., pertaining solely to sec. 18, as follows:
39.47 Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked
W C
¼
S18
1916
dig pits, 18x18x12 ins., N. and S. of post, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, E. of cor.
40.60 Leave Chino Creek wash, course E.

12/19/2013 1:05:00 PM

Welcome to Minitab, press F1 for help.

Data Display

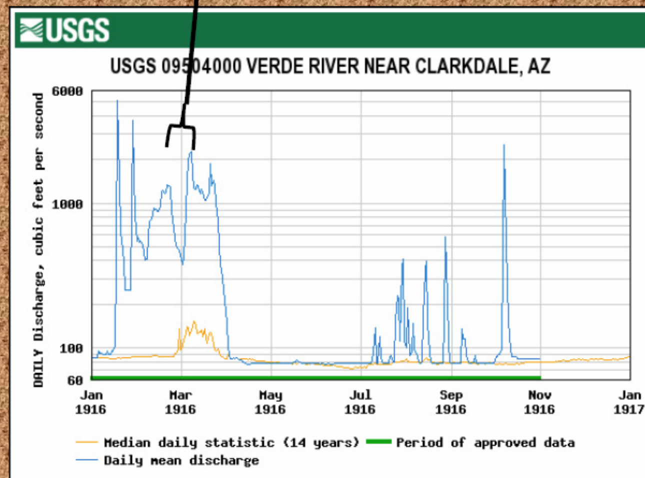
Using Manning equation with roughness coef. = 0.045 and channel slope = .008 and a parabolic channel shape with correction of angleof incidence at section line:

Row	Width	Max depth	Q cfs
1	27	0.67	20

This represents the maximum Q that may include some snow melt.

T20N R4W

Federal Land Survey run Feb. 7-Mar. 12, 1916



Federal land surveyor notes.

T20N R4W

	Thence N.89°57'W., on S. bdy. of sec. 36, over mountainous land.
.10	Rim of canyon, bears NW. and SE.; desc. steep rocky SW. slope to Partridge Creek.
6.40	Ft. of steep descent; desc. gradually.
9.00	Partridge Creek, 50 lks. wide, course NW.; desc. gradually along creek bottom.
27.25	Partridge Creek, 50 lks. wide, course SE.
31.80	Ft. of rocky point, slopes S.
40.35	Partridge Creek, 50 lks. wide, course NW.
40.55	True pt. for standard ¼ sec. cor.,(missing) on low gravel bed of creek, subject to overflow, where a permanent monument cannot be established. Therefore at
41.40	Establish witness cor. as follows: Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, for witness cor. to missing standard ¼ sec. cor., with brass cap, marked

	SC ¼S35 1916
	and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor.
	Thence S.89°24'W., on W. half of S. bdy. of sec. 35.
7.40	Leave scattering timber, bearing N. and S.; begin descent of rocky W. slope into Partridge Creek Canyon.
20.40	Ft. of steep descent.
20.90	Partridge Creek, 50 lks. wide, course SW.; asc. steep rocky SE. slope.
40.00	Rim of canyon bears NE. and SW.
41.72	The standard cor. of secs. 34 and 35, which is a malpais stone, 20x12x6 ins., firmly set in a mound of stone, marked as described by the Surveyor General. I reestablish cor. as follows: With original stone, set an iron post, 3 ft. long, 3 ins. diam., 24 ins. in the ground, with brass cap, marked

Federal land surveyor notes.

T20N R4W

S.89°44'W., on S. bdy. of sec. 34,
over mountainous land, descending gradual SW. slope.

10.00 Begin steep descent into Partridge Creek Canyon.

30.00 Partridge Creek, 75 lks. wide, course NW.; descend along S. side of same.

Chains

35.50 Partridge Creek, 75 lks. wide, course SW.; asc. steep rocky wall of canyon.

36.40 Rim of canyon, bears NE. and SW.; asc. gradually.

41.08 The standard 1/4 sec. cor., which is a malpais stone, 14x11x5 ins., firmly set in a mound of stone, marked and witnessed as described by the Surveyor General. I reestablish same as follows:

With original cor., set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked

---

Chains

N.2°25'W., on W. bdy. of sec. 18,
over level land.

37.88 (40.00 chs. N. of the cor. of secs. 13 and 24) establish 1/4 sec. cor. of sec. 13, as follows:
Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked

1/4
S13 |
1916

dig pits, 18x18x12 ins., N. and S. of post, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.

39.60 Right bank of Chino Creek wash--water in holes--course E.

40.26½ True point for 1/4 sec. cor., in Chino Creek wash. It is impracticable to permanently reestablish the missing cor., so I return to point on right bank of wash and establish a witness cor., pertaining solely to sec. 18, as follows:

39.47 Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked

W C
| 1/4
| S18
1916

dig pits, 18x18x12 ins., N. and S. of post, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, E. of cor.

40.60 Leave Chino Creek wash, course E.

42.94 Wash, 10 lks. wide, course E.

45.84 Begin ascent of S. slope.

51.84 Summit of ascent; thence over rolling mesa.

77.92 (80.00 chs. N. of the cor. of secs. 13 and 24) establish cor. of secs. 12 and 13, as follows:
Set an iron post, 3 ft. long, 3 ins. diam., 24 ins. in the ground, with brass cap, marked

Federal land surveyor notes.

T20N R4W

	N.5°03'W., bet. secs. 7 and 8, over rolling land.
2.00	Partridge Creek, 50 lks. wide, course SW.
40.68	Reestablish missing $\frac{1}{4}$ sec. cor. as follows: Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, with brass cap, marked
	$\frac{1}{4}$
	S 7 | S 8
	1916

	S 5
	$\frac{1}{4}$
	S 8
	1916
	and raise a mound of stone, 2 ft. base, 1$\frac{1}{2}$ ft.high, N. of cor.
46.00	Partridge Creek, 60 lks. wide, course S.; asc. steep rocky E. slope.
52.00	Summit of ascent; thence over rolling land.
61.25	Wash, 100 lks. wide, 30 ft. deep, course SW.
82.39	The cor. of secs. 5 and 8, reestablished as hereinbefore described.

Federal land surveyor notes.

T20N R4W

	From the cor. of secs. 5 and 8, N.0°02'W., bet. secs. 4 and 5. Asc. 95 ft., on rocky SW. slope, through scattering undergrowth.
9.50	Spur, slopes NW. Desc. rocky NW. slope, 210 ft.
20.66	Left bank of Partridge Creek, 60 lks. wide, water 8 ins. deep, course W.
21.26	Right bank of same.
21.50	Asc. rocky SE. slope, 125 ft.
30.30	Thence over rolling mesa.
40.00	Set an iron post, 3 ft. long, 1 in. diam., 26 ins. in the ground, for $\frac{1}{4}$ sec. cor. of sec. 5, marked on brass cap,

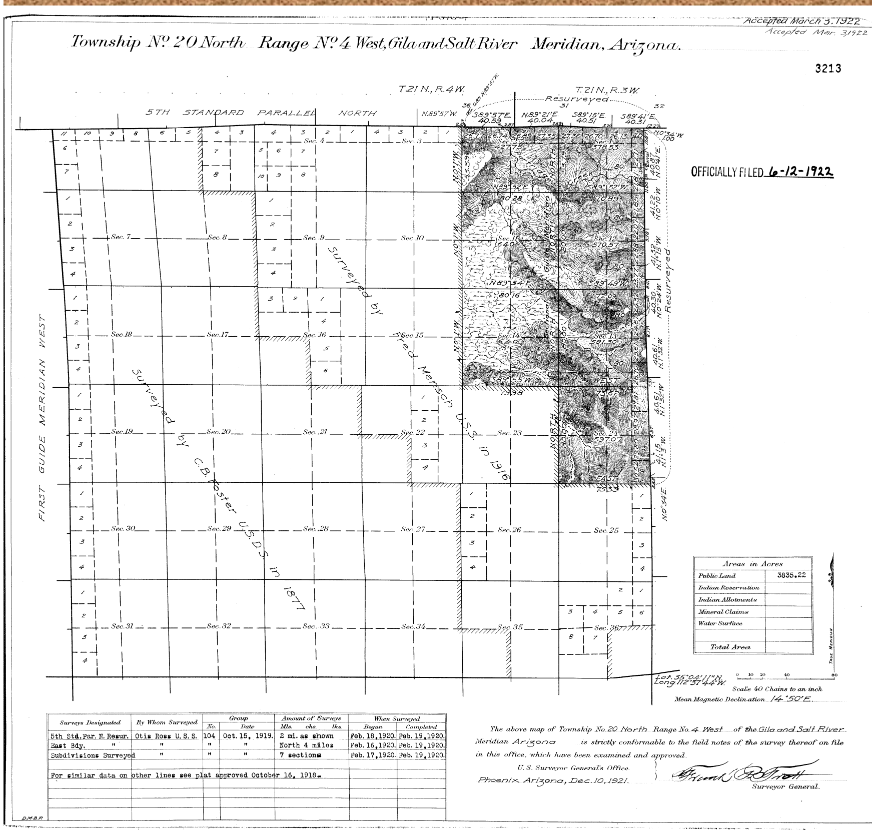
Federal land surveyor notes.

T20N R4W

General Description, Part of T. 20 N., R. 4 W.

The NW. portion of the part of this township surveyed and resurveyed under this group consists of level and rolling land in the bottom of the Big Chino Valley; the NE. edge of which extends in a southeasterly direction through sections 5, 8, 17, 16, 21, 28, 27, 34, 35 and 36. From this valley the land rises over foothills, steep spurs and ridges, to high, broken mesas and buttes. Deeply eroded ravines carry the drainage southwesterly to the Chino Wash, the largest tributary of which is Partridge Creek, which flows through sections 2, 3, 4, 5, 8 and 7, and enters Chino Wash in section 18.

The valley land is open, with a small amount of undergrowth of rabbit brush and cactus. The remainder of the area supports a growth varying from scant to dense, of cedar, juniper, pinyon, scrub oak, greasewood, catclaw cactus, and occasional examples of other species. Fair grazing exists over the entire area, a part of which is under fence. The Bailey Ranch is located on Partridge Creek, in section 18, near the NE. corner.



T20N R4W

The weekly Arizona miner. (Prescott, Ariz) 1877-1885, July 22, 1881, Image 4

Image provided by Arizona State Library, Archives and Public Records; Phoenix, AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn82014897/1881-07-22/ed-1/seq-4/

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Lieut. Wilson and Dan O'Leary, as guide, have returned from a trip in search of water and a suitable location for a military post near the line of the Atlantic and Pacific R. R., somewhere in the vicinity of Partridge creek. With what success their trip was attended, we have not learned.

UNCHRISTIANLIKE.—Some one without the least particle of christian feelings, a night or two since broke the leg of a cow belonging to Mrs. Ferguson, a poor woman, who has to work very hard to earn a living for an aged mother and several small children.

FEARS DISPELLED.—The continued dry spell that hung over Northern Arizona caused an uneasiness in the minds of milk merchants; however that uneasiness has been dispelled since the late rains. Milk will not have to be sold by dry measure.

George Jackson, Sr., is prospecting for

SA

DR.

NO. 11 I

Treats al

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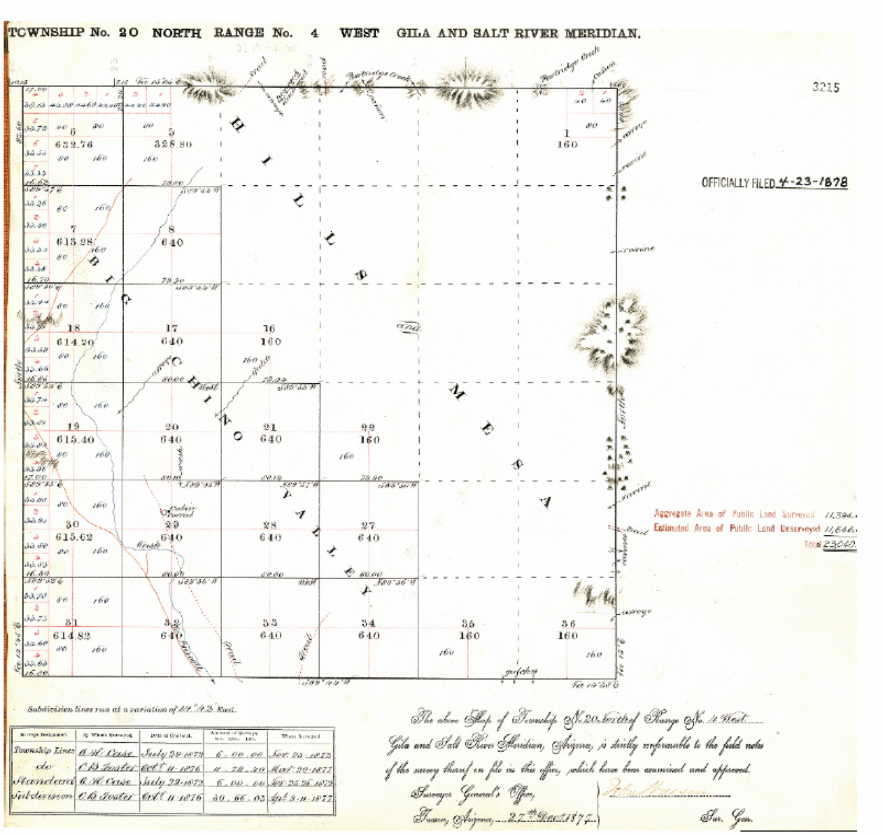


T20N R4W

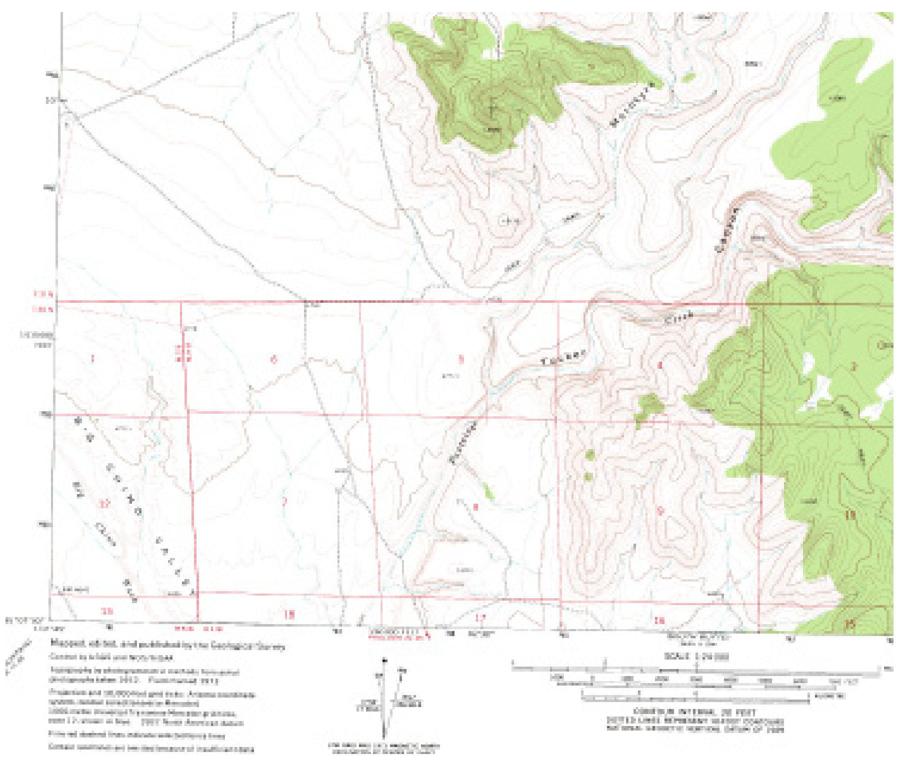
Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

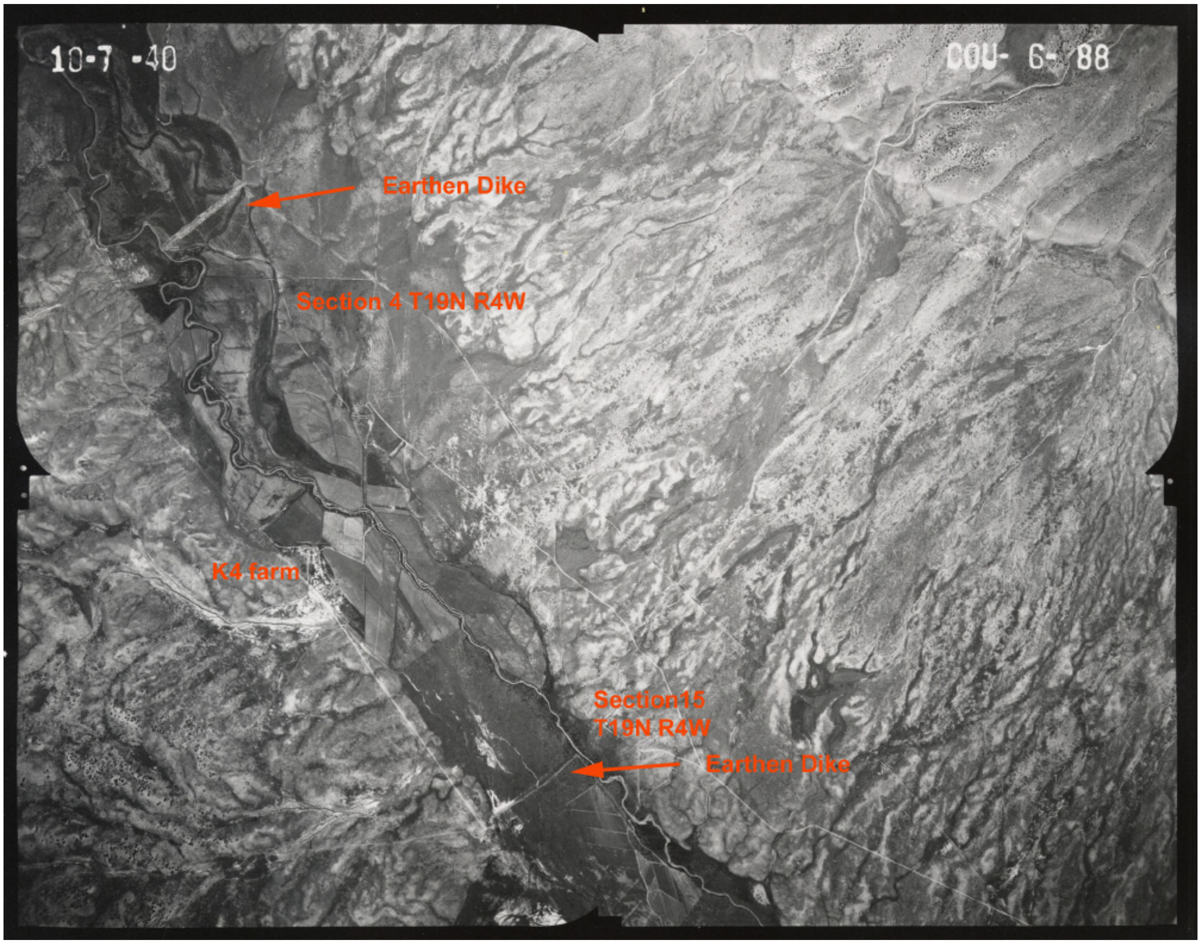
See Appendix H Item H2 for account of flow in Upper Verde River (probably Big Chino Creek) by Spanish explorer in 1598

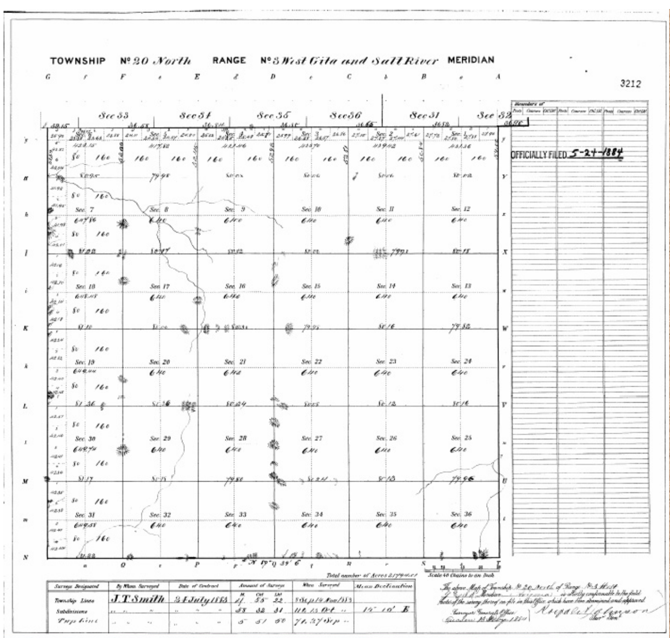
Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
							[document contains 94 additional land descriptions]			
	607317	BAILEY, MARION T	11/10/1917	019998	AZ	Gila-Salt River	020N - 004W	S½NE¼	18	Yavapai
							020N - 004W	E½SW¼	18	Yavapai
							020N - 004W	NE¼NE¼	18	Yavapai
							020N - 004W	NW¼SE¼	18	Yavapai
							020N - 004W	Lot/Trct 3	18	Yavapai
							020N - 004W	Lot/Trct 4	18	Yavapai
	FLS-0578-264	BIXBY, HENRY L	3/28/1905	2519	AZ	Gila-Salt River	020N - 004W	SW¼NW¼	8	Yavapai
							020N - 004W	NE¼NW¼	8	Yavapai
							020N - 004W	NW¼SW¼	8	Yavapai
							020N - 005W	NE¼NE¼	24	Yavapai
—	AZAZAA 001498	DONALDSON, CHARLES E	2/9/1891	194	AZ	Gila-Salt River	020N - 004W	E½E½	30	Yavapai
							014N - 004W	Lot/Trct 2	30	Yavapai
	1101565	ATKINS, JESSE R	3/14/1939	072962	AZ	Gila-Salt River	020N - 005W		34	Yavapai
	FLS-0578-264	BIXBY, HENRY L	3/28/1905	2519	AZ	Gila-Salt River	020N - 004W	SW¼NW¼	8	Yavapai
							020N - 004W	NE¼NW¼	8	Yavapai
							020N - 004W	NW¼SW¼	8	Yavapai
							020N - 005W	NE¼NE¼	24	Yavapai
	919102	SANTA FE PACIFIC RAILROAD CO	10/4/1923	93	AZ	Gila-Salt River	018N - 004W	SW¼	1	Yavapai
							018N - 004W	S½NW¼	1	Yavapai

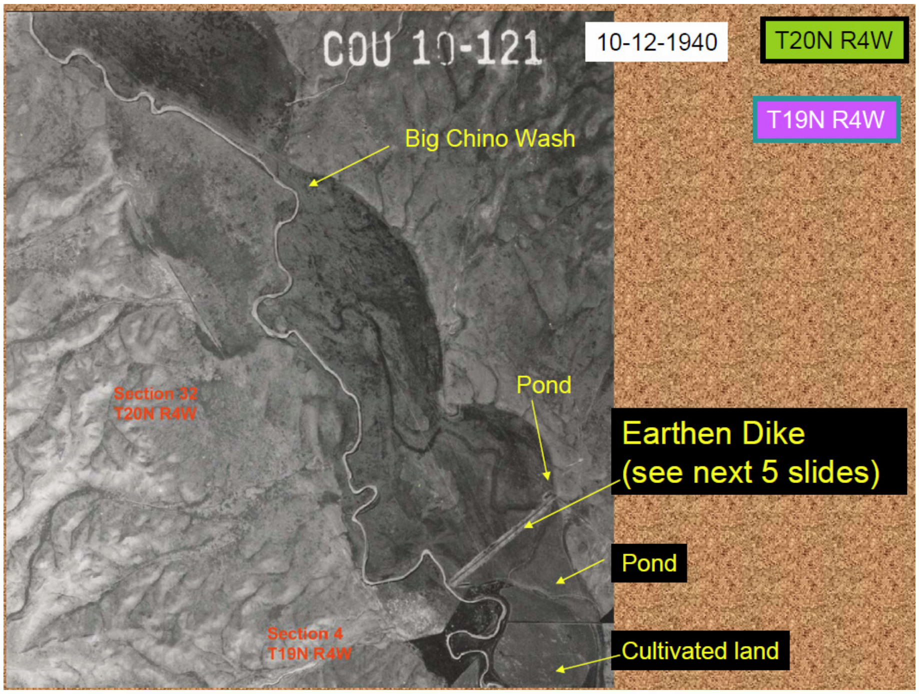
Search Results – BLM GLO Records

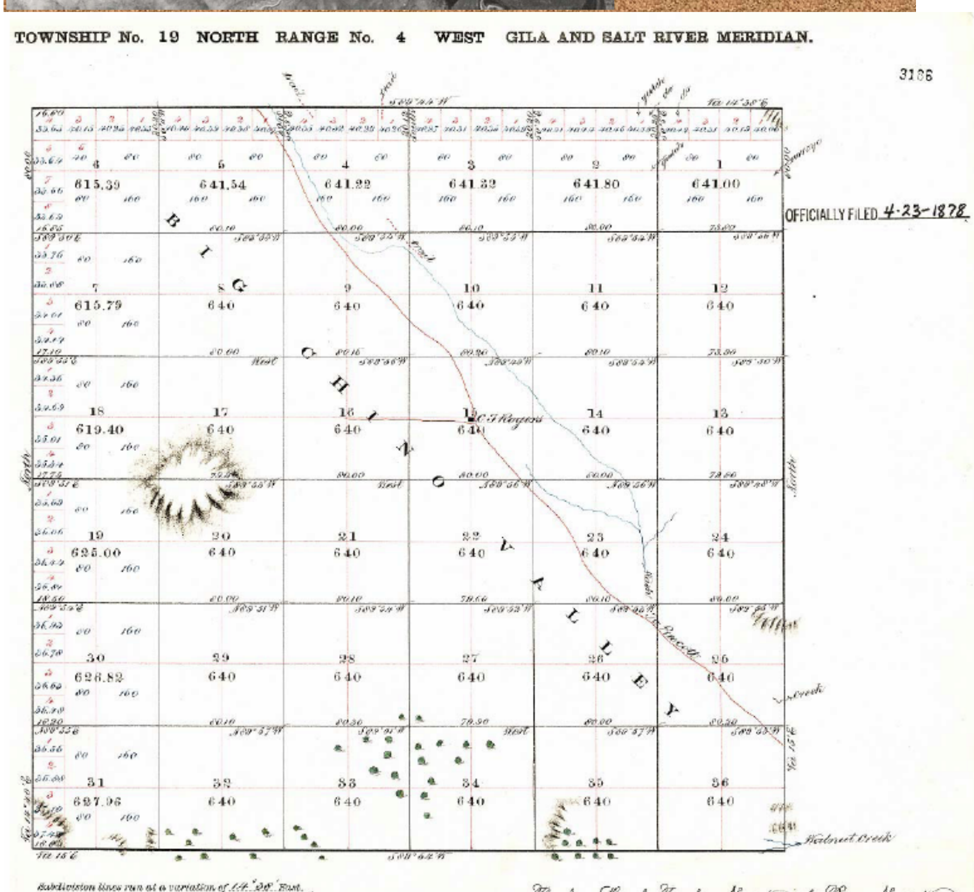



10-7 -40
COU- 6- 88
Earthen Dike
Section 4 T19N R4W
K4 farm
Section15
T19N R4W
Earthen Dike


TOWNSHIP No 20 North RANGE No 3 West Gila and Salt River MERIDIAN
3212
OFFICIALLY FILED 5-24-1884

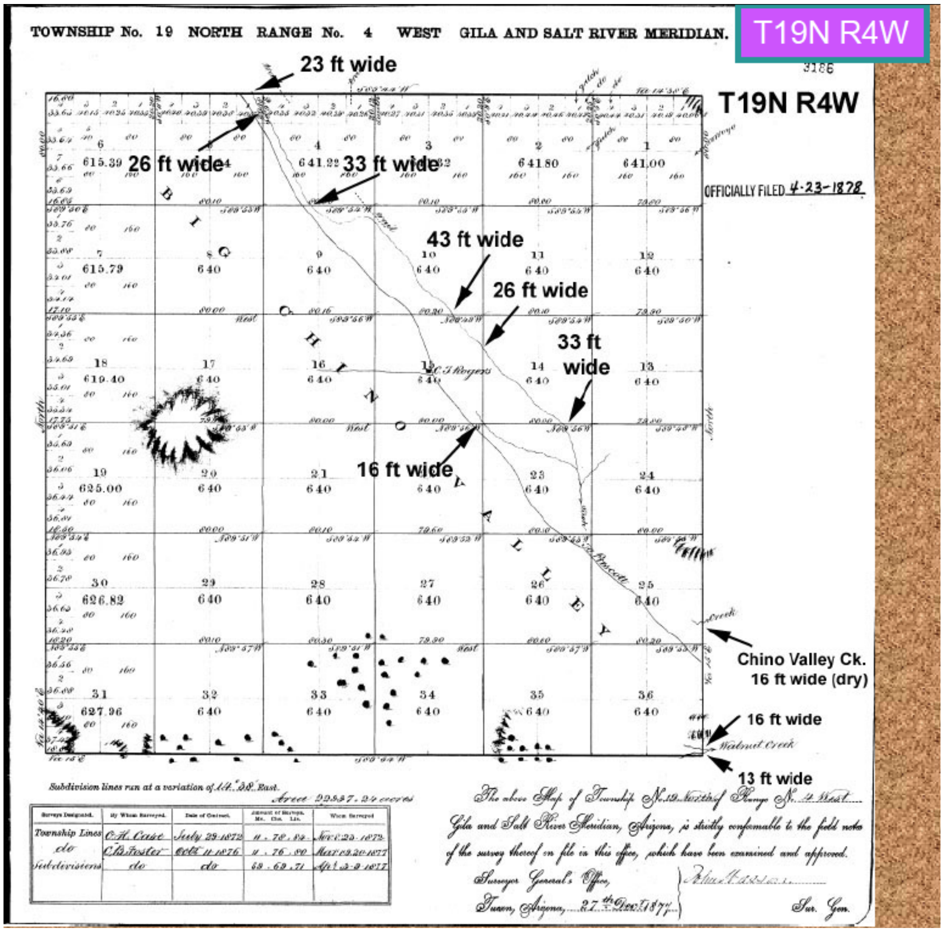
T20N R3W





Survey Designated	By Whom Surveyed	Date of Contract	Amount of Surveys Mi. Ch. Lks.	When Surveyed
Township Lines	C.H. Case	July 29 1873	" . 72 . 64	Nov. 22 1873
do	C.B. Foster	Oct. 11 1876	" . 76 . 60	Mar. 19.20 1877
Subdivisions	do	do	59 . 69 . 71	Apl. 3-9 1877

T19N R4W



In the mid 1960s the author was performing field duties for the USGS and observed a low lift centrifugal pump installation on the upstream side of an earthen dike in Big Chino Valley. Apparently the use of these pumps along Big Chino Creek began in the late 1890s.

T19N R4W

A carload of machinery arrived last night for John Dougherty of Big Chino. Mr. Dougherty is erecting an irrigating pump on his place.

Arizona weekly journal-miner., September 11, 1889

BIG CHINO The weekly Arizona miner. (Prescott, Ariz) 1877-1885, April 14, 1882,

Mr. Puntney, who has a Well at the Upper end of Big Chino, has plenty of water.

T19N R4W

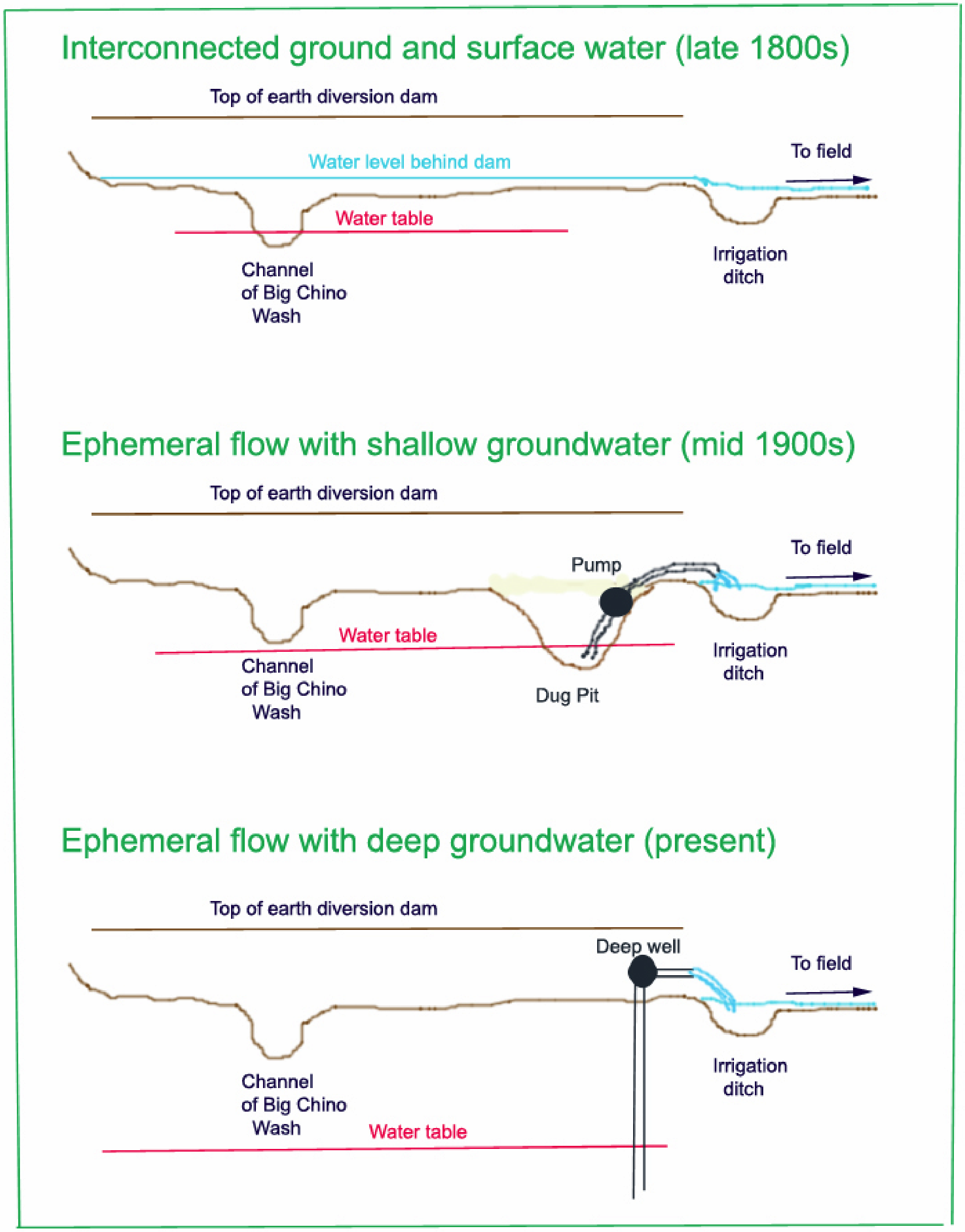
J. W. Dougherty is experimenting in Chino valley with a view of obtaining the best methods for the irrigation of a large tract of land owned by him there. He purchased two sections—1280 acres—from the Atlantic & Pacific railroad, last fall. A large portion of it is very rich, all that is required to make it productive being water for irrigation He sunk a well 12 by 6 feet to a depth of twelve feet and obtained an abundant supply of water, his experiments now being to secure the cheapest method of getting it on the land. He has a centrifugal pump with which, it being run by horse-power, he has thrown a steady stream of 375 gallons per minute without perceptibly lowering the water in the well. He is now in correspondence with manufacturers of wind-mills, and will either procure one or use steam for raising the water. He has already constructed a large reservoir, and expects by another year to put a large area under cultivation.

We have no space or inclination to enter into a newspaper controversy by making a reply to such a remark as appeared in our contemporary this morning about "saying ugly things about Governor Zulick," when it is known to every one in the territory that this paper never has been friendly to him, and never asked any favors of him. Our contemporary seems to be "hard up" for a newspaper controversy when it resorts to such petty assertions, containing no truth whatever.

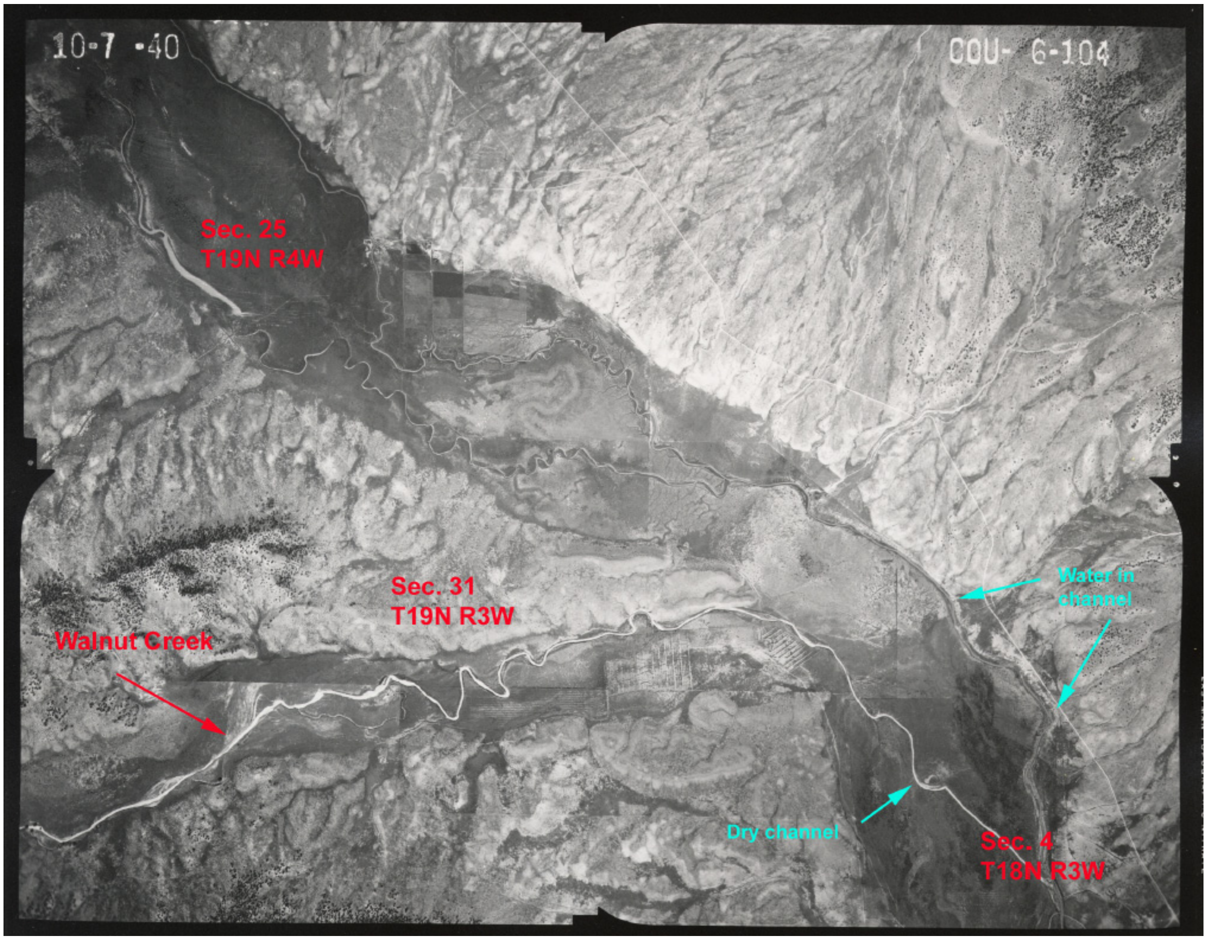
Arizona weekly journal-miner., May 15, 1889

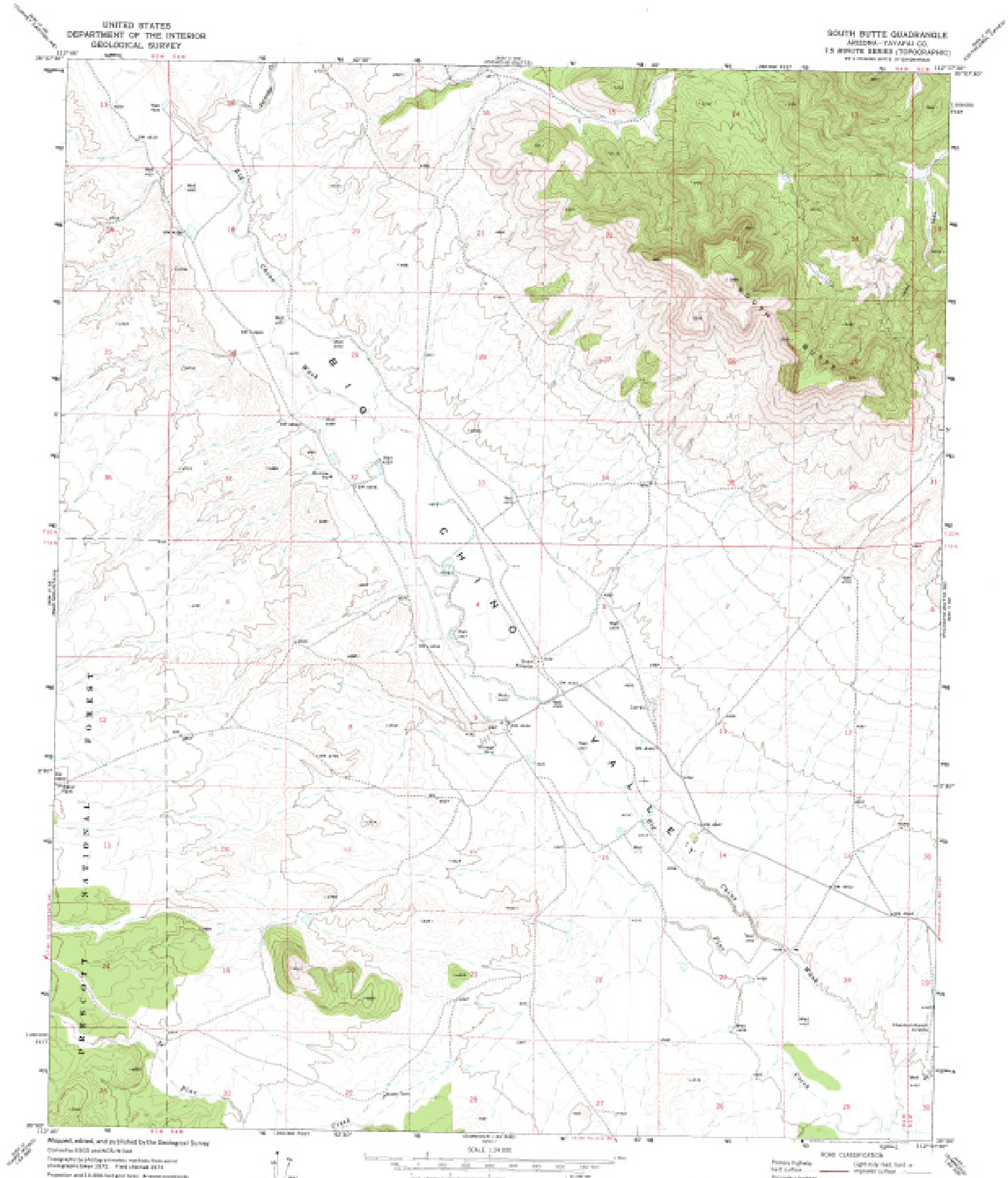
The installation is roughly depicted in the center sketch of the following three cross-section sketches of Big Chino Valley. The suction line was in a dug pit (a shallow well) on the upstream side of the dike or earth dam. It appeared that the pit was dug by a bulldozer to get to the underlying ground-water as the level was dropping from human extraction by deep wells and upstream human diversion. See item 11 of Appendix A for further description of this type of pump installation.

The general response of crop irrigation practices in Big Chino Valley to the declining perched water table is depicted in the three simple sketches shown on the next page. The deep well in the third sketch is in the basin fill aquifer.



Interconnected ground and surface water (late 1800s)
Top of earth diversion dam
Water level behind dam
To field
Water table
Channel of Big Chino Wash
Irrigation ditch
Ephemeral flow with shallow groundwater (mid 1900s)
Top of earth diversion dam
Pump
To field
Water table
Channel of Big Chino Wash
Dug Pit
Irrigation ditch
Ephemeral flow with deep groundwater (present)
Top of earth diversion dam
Deep well
To field
Irrigation ditch
Channel of Big Chino Wash
Water table


10-7-40
COU- 6-104
Sec. 25
T19N R4W
Sec. 31
T19N R3W
Walnut Creek
Water in
channel
Dry channel
Sec. 4
T18N R3W


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SOUTH BUTTE QUADRANGLE
ARIZONA—YAVAPAI CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
B I G
C H I N O
V A L L E Y
P R E S C O T T
N A T I O N A L
F O R E S T
Mapped, edited, and published by the Geological Survey
SCALE 1:24 000
CONTOUR INTERVAL 20 FEET
ROAD CLASSIFICATION
SOUTH BUTTE, ARIZ.

T19N R4W

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
							...document contains 13 additional land descriptions.			
—	AZPHX 0036056	[P] ARIZONA STATE OF	2/21/1919		AZ	Gila-Salt River	019N - 004W	N½	20	Yavapai
							019N - 004W	N½S½	20	Yavapai
	FLS-0567-209	[P] BIXBY, HARRY L	2/6/1904	4991	AZ	Gila-Salt River	019N - 004W	S½SE¼	14	Yavapai
							019N - 004W	S½SW¼	14	Yavapai
	590603	[P] LEAVELL, JOHN LOGAN	7/3/1917	022453	AZ	Gila-Salt River	019N - 004W	S½	22	Yavapai
	981354	[P] LEAVELL, JOHN LOGAN	6/22/1926	046257	AZ	Gila-Salt River	019N - 004W	N½N½	26	Yavapai
	138965	[P] PATTERSON, EDWARD L	6/20/1910	02663	AZ	Gila-Salt River	019N - 004W	N½SW¼	14	Yavapai
							019N - 004W	SW¼NW¼	14	Yavapai
							019N - 004W	NW¼SE¼	14	Yavapai
	455771	[P] PRIDE, JOHN W	1/27/1915	022415	AZ	Gila-Salt River	019N - 004W	N½	22	Yavapai
	FLS-0578-490	[P] SANTA FE PACIFIC RAILROAD CO	5/5/1905	11426	AZ	Gila-Salt River	019N - 004W	SE¼SW¼	10	Yavapai
—	AZAZAA 001350	[P] WILKES, JOHN	4/27/1891	120	AZ	Gila-Salt River	019N - 004W	NW¼SW¼	4	Yavapai
							019N - 004W	SW¼SE¼	24	Yavapai

Leavell is mentioned in the following newspaper of 1913

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, February 19, 1913, Page 7, Image 7

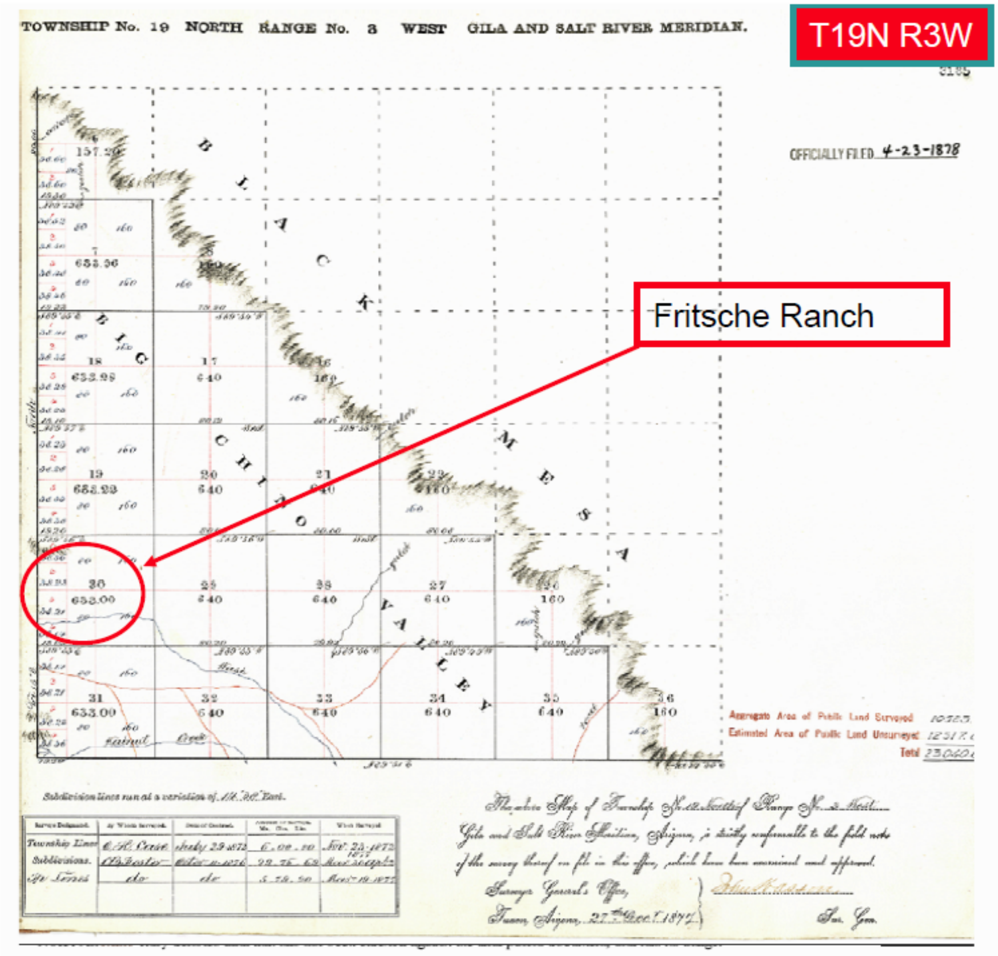
Image provided by Arizona State Library, Archives and Public Records; Phoen AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn85032923/1913-02-19/ed-1/seq-7/

Print this image | Download this image

Visiting Farmer.

John L. Leavell, farming extensively on the dry principle in Big Chino Valley, was in the city yesterday on business, and is satisfied with the outlook for the coming season in the prospects of raising the biggest yield ever known in that locality.


TOWNSHIP No. 19 NORTH RANGE No. 3 WEST GILA AND SALT RIVER MERIDIAN.
T19N R3W
OFFICIALLY FILED 4-23-1878
Fritsche Ranch
BLACK MESA
BIG CHINO VALLEY
Aggregate Area of Public Land Surveyed
Estimated Area of Public Land Unsurveyed
Total

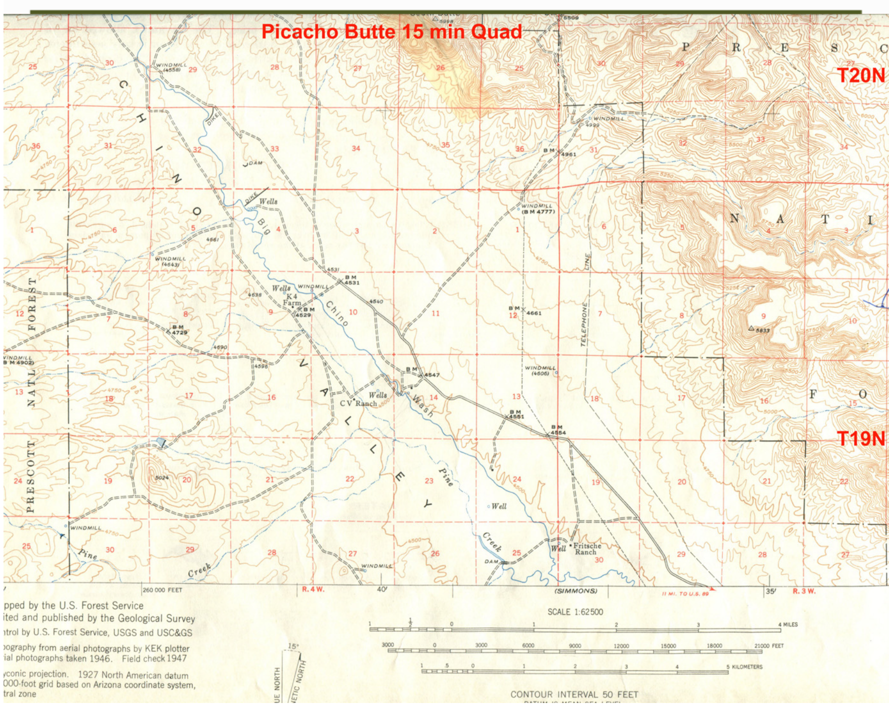
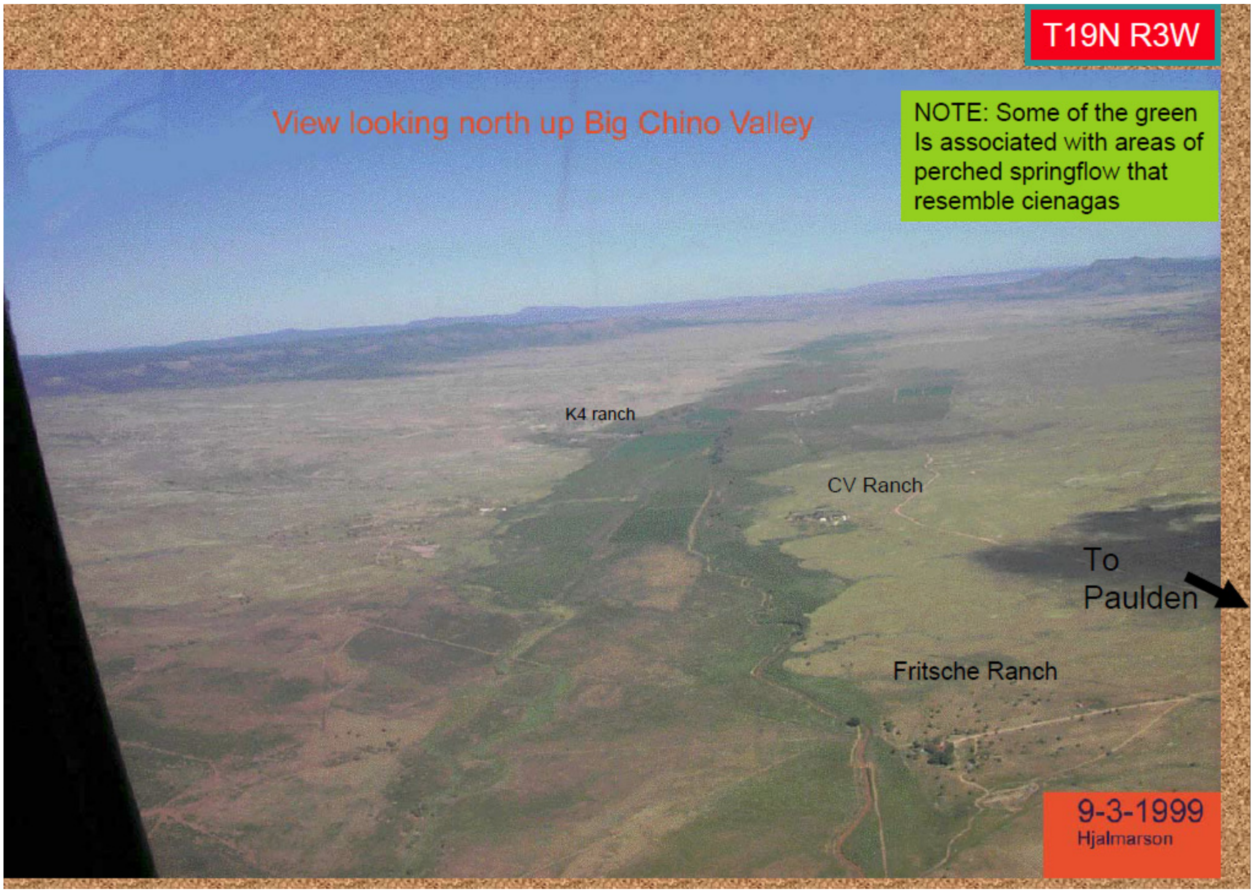
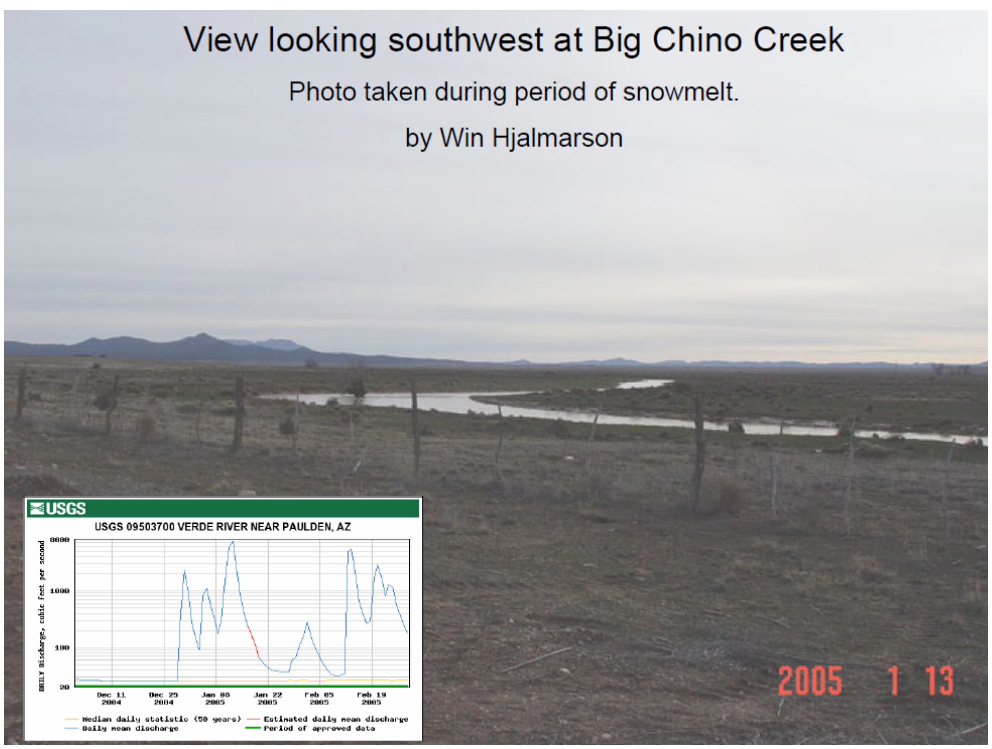
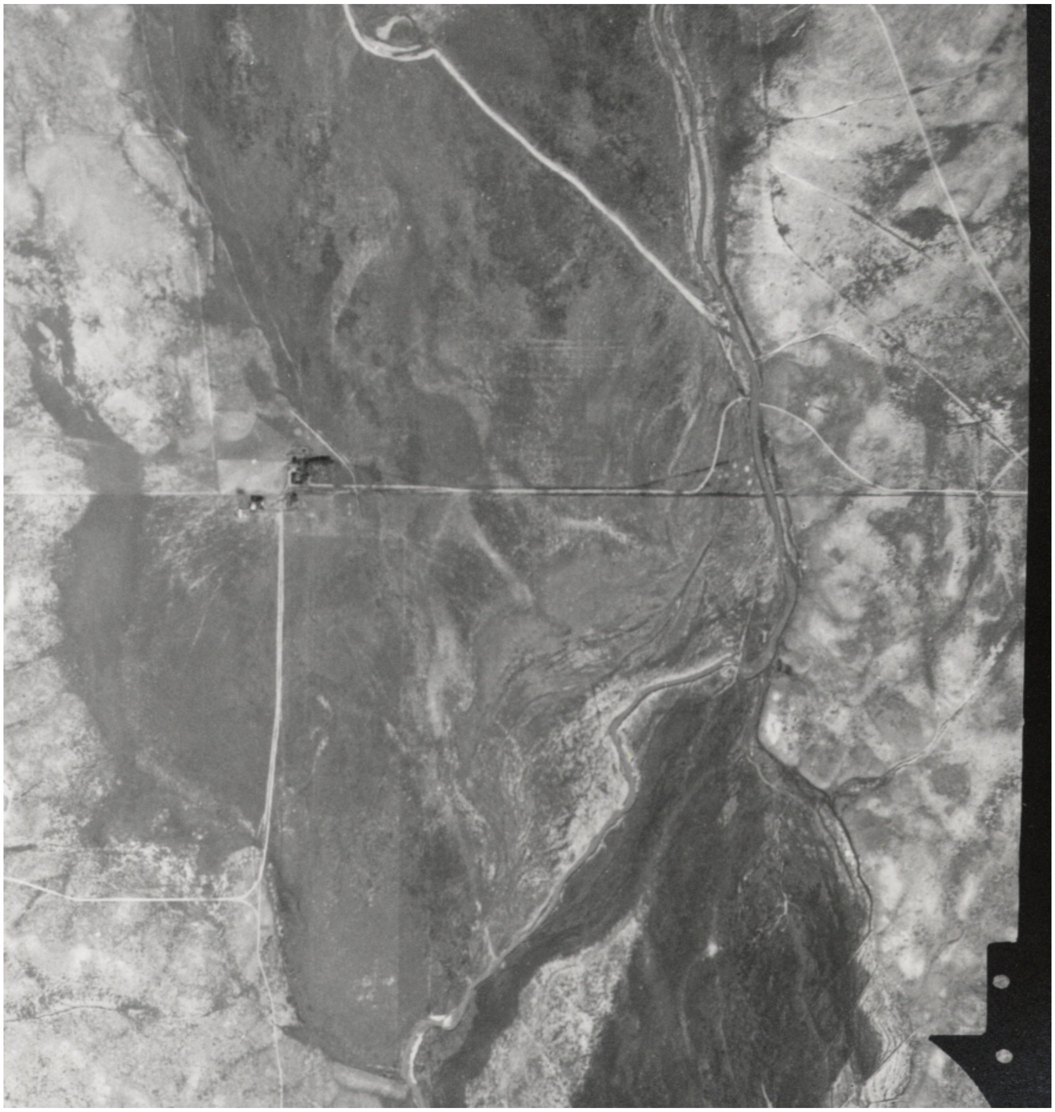
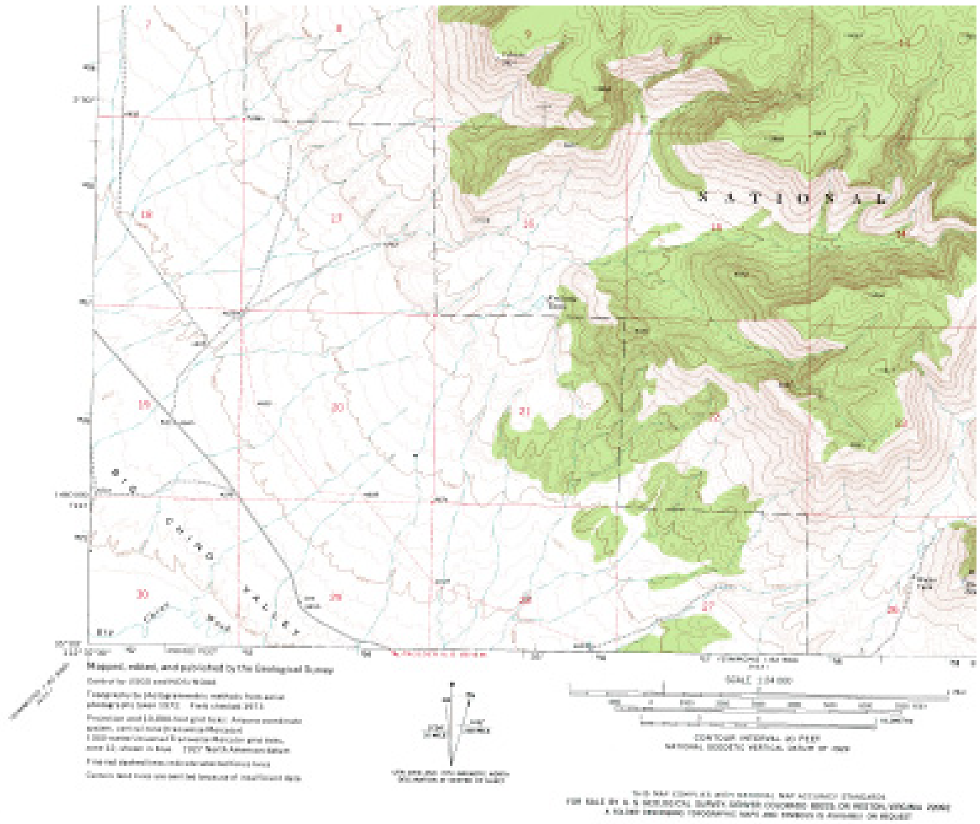

Picacho Butte 15 min Quad
T20N
T19N
CHINO VALLEY
PRESCOTT NATL FOREST
CV Ranch
Fritsche Ranch
Big Chino Wash
Pine Creek
TELEPHONE LINE
R. 4 W.
R. 3 W.
SCALE 1:62500
CONTOUR INTERVAL 50 FEET

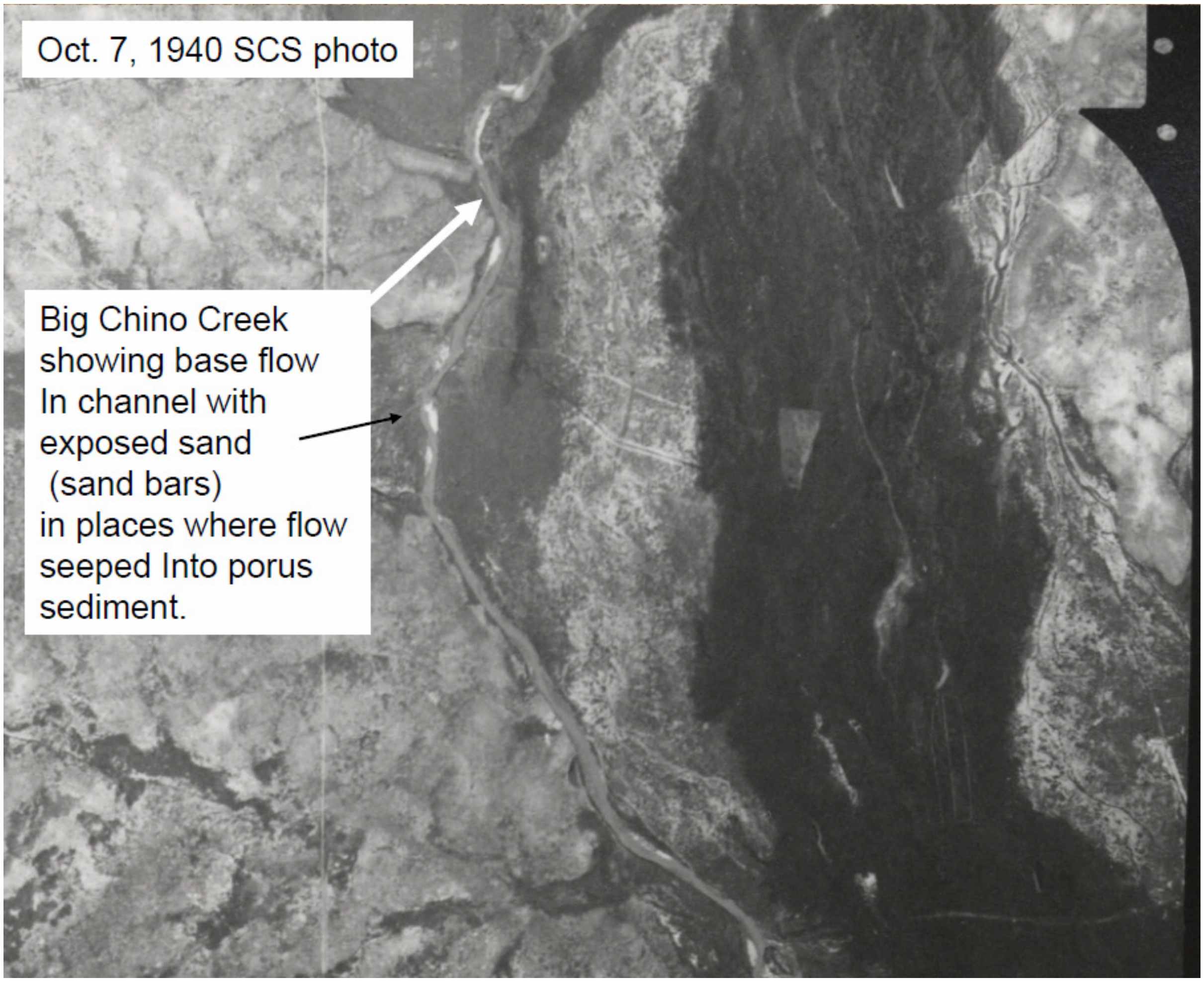
Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	1080866	P AIKEN, WILLIAM R	1/10/1936	070757	AZ	Gila-Salt River	017N - 001W	NE¼NW¼	17	Yavapai
							017N - 001W	SE¼	18	Yavapai
							017N - 001W	E½SW¼	18	Yavapai
							017N - 001W	SE¼NE¼	18	Yavapai
							017N - 001W	N½NE¼	19	Yavapai
							017N - 001W	NE¼NW¼	19	Yavapai
							017N - 002W	NE¼SW¼	24	Yavapai
							019N - 003W	NE¼SE¼	6	Yavapai
							017N - 001W	Lot/Trct 3	18	Yavapai
							017N - 001W	Lot/Trct 4	18	Yavapai
							…document contains 1 additional land descriptions.			
	1097147	P FRITSCHE, HARRIE W, P FRITSCHE, SIDNEY T	5/21/1938	077223	AZ	Gila-Salt River	019N - 003W	S½NE¼	6	Yavapai
	524342	P FRITSCHE, HARRIE W	4/13/1916	016169	AZ	Gila-Salt River	019N - 003W	SE¼SW¼	30	Yavapai
							019N - 003W	Lot/Trct 2	30	Yavapai
							019N - 003W	Lot/Trct 3	30	Yavapai
							019N - 003W	Lot/Trct 4	30	Yavapai
	214707	P FRITSCHE, HARRIE W	10/23/1919	036862	AZ	Gila-Salt River	019N - 003W	NE¼SE¼	30	Yavapai
							019N - 003W	S½SE¼	30	Yavapai
	1064706	P HALEY, HARRY T	6/15/1933	070692	AZ	Gila-Salt River	015N - 003W	NW¼SW¼	10	Yavapai
							016N - 001W	SE¼	24	Yavapai
							016N - 001W	NE¼	25	Yavapai
							017N - 002W	SE¼NW¼	35	Yavapai
							018N - 002W	S½SW¼	25	Yavapai
							018N - 002W	Lot/Trct 10	25	Yavapai
							018N - 002W	Lot/Trct 11	25	Yavapai
							018N - 002W	Lot/Trct 12	25	Yavapai
							019N - 003W	Lot/Trct 9	6	Yavapai

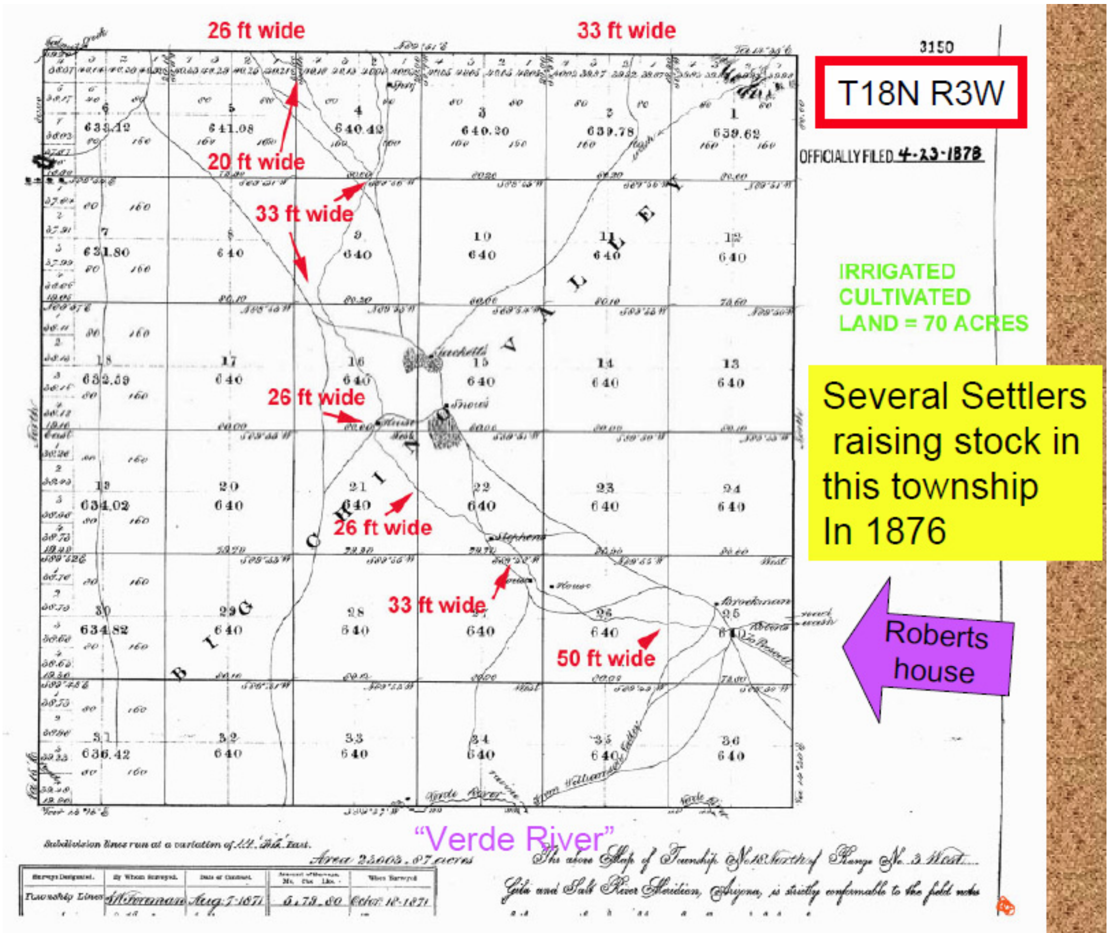

T19N R3W
View looking north up Big Chino Valley
NOTE: Some of the green Is associated with areas of perched springflow that resemble cienagas
K4 ranch
CV Ranch
To Paulden
Fritsche Ranch
9-3-1999
Hjalmarson

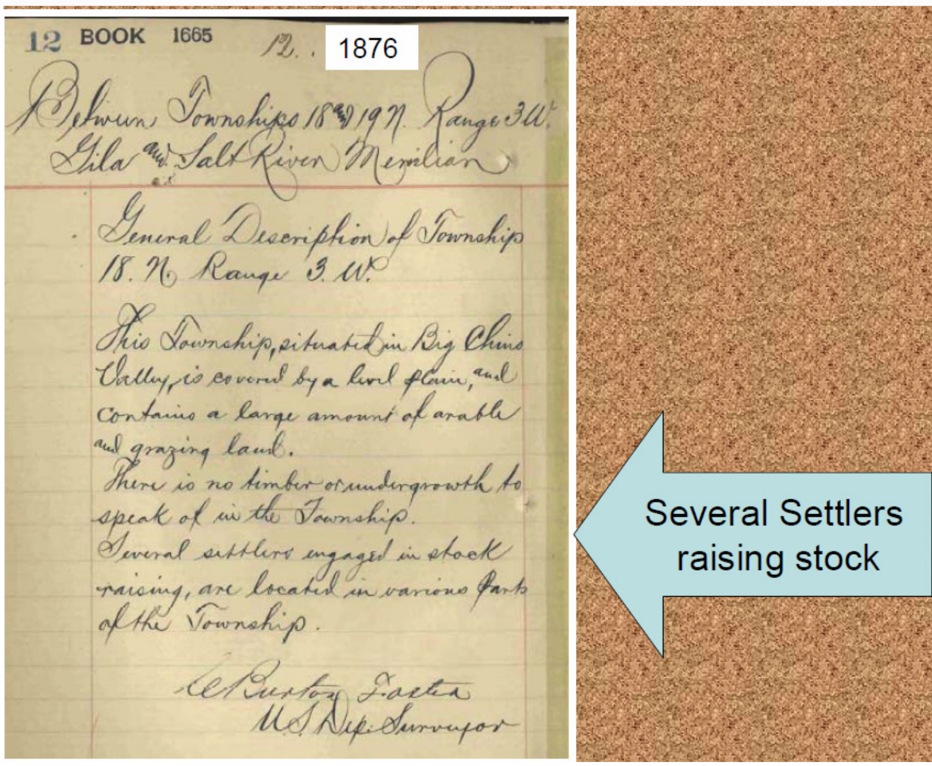

View looking southwest at Big Chino Creek
Photo taken during period of snowmelt.
by Win Hjalmarson
USGS
USGS 09503700 VERDE RIVER NEAR PAULDEN, AZ
2005 1 13




NATIONAL
BIG CHINO VALLEY
CONTOUR INTERVAL 20 FEET


Oct. 7, 1940 SCS photo
Big Chino Creek showing base flow In channel with exposed sand (sand bars) in places where flow seeped Into porus sediment.




12 BOOK 1665 12. 1876

Between Townships 18 and 19 N. Range 3 W.
Gila and Salt River Meridian

General Description of Township 18. N. Range 3. W.

This Township, situated in Big Chino Valley, is covered by a level plain, and contains a large amount of arable and grazing land.
There is no timber or undergrowth to speak of in the Township.
Several settlers engaged in stock raising, are located in various parts of the Township.

C. Burton Foster
U.S. Dep. Surveyor

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

T18N R3W

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
							...document contains 15 additional land descriptions.			
---	AZAZAA 001087	ASHLEY, CHARLES E	6/27/1895	333	AZ	Gila-Salt River	018N - 003W	W½SE¼	4	Yavapai
							018N - 003W	SW¼NE¼	4	Yavapai
							018N - 003W	SE¼SE¼	4	Yavapai
---	AZAZAA 001088	ASHLEY, JAMES R	4/28/1899	515	AZ	Gila-Salt River	018N - 003W	SW¼	22	Yavapai
---	AZAZAA 001082	CANFIELD, THEODORE	8/13/1890	344	AZ	Gila-Salt River	018N - 003W	SE¼	22	Yavapai
	226748	KING, CHARLES W T	9/25/1911	010938	AZ	Gila-Salt River	018N - 003W	S½NW¼	4	Yavapai
							018N - 003W	Lot/Trct 3	4	Yavapai
							018N - 003W	Lot/Trct 4	4	Yavapai
	441963	KING, CHARLES W T	11/12/1914	016999	AZ	Gila-Salt River	018N - 003W	SE¼NE¼	4	Yavapai
							018N - 003W	NE¼SE¼	4	Yavapai
							018N - 003W	Lot/Trct 1	4	Yavapai
							018N - 003W	Lot/Trct 2	4	Yavapai
---	AZAZAA 001091	KING, THOMAS M	6/25/1901	617	AZ	Gila-Salt River	018N - 003W	NE¼	8	Yavapai
---	AZAZAA 001089	KING, THOMAS R	8/14/1899	530	AZ	Gila-Salt River	018N - 003W	SW¼	4	Yavapai
---	AZAZAA 001092	LOMAX, ALBERT E	1/17/1902	655	AZ	Gila-Salt River	018N - 003W	SE¼	26	Yavapai
---	AZAZAA 001083	RUS, ARNIE A	9/15/1891	387	AZ	Gila-Salt River	018N - 003W	SW¼SW¼	24	Yavapai
	FLS-0575-428	SANTA FE PACIFIC RAILROAD	3/10/1905	10661	AZ	Gila-Salt River	018N - 003W	N½SW¼	24	Yavapai

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image

T18N R3W

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
---	AZAZAA 001085	SNOW, JAMES C	6/30/1892	233	AZ	Gila-Salt River	018N - 003W	NW¼	22	Yavapai
---	AZAZAA 001090	SPRINGFIELD, ADELINE L	5/14/1900	548	AZ	Gila-Salt River	018N - 003W	W½NW¼	26	Yavapai
							018N - 003W	SW¼NE¼	26	Yavapai
							018N - 003W	SE¼NW¼	26	Yavapai
---	AZAZAA 001084	STORM, JAMES P	11/23/1891	234	AZ	Gila-Salt River	018N - 003W	NE¼	22	Yavapai
---	AZAZAA 001086	TAYLOR, JAMES	12/9/1892	273	AZ	Gila-Salt River	018N - 003W	N½NE¼	26	Yavapai
							018N - 003W	SE¼NE¼	26	Yavapai
							018N - 003W	NE¼NW¼	26	Yavapai

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, September 30, 1891

J. C. Snow, of Big Chino valley, has been experimenting with raising alfalfa without irrigation, and succeeded in getting three crops this year. Water is found very near the surface there, and it does not take alfalfa long to push its roots down to moisture.

Section 22

J. C. Snow, of Big Chino valley, has been experimenting with raising alfalfa without irrigation, and succeeded in getting three crops this year. Water is found very near the surface there, and it does not take alfalfa long to push its roots down to moisture.

T18N R3W

Section 22

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, September 30, 1891

Dr. R. K. Robinson, under whose care J. C. Snow has been for a few weeks under treatment for a broken leg, has sent his patient home to Big Chino valley, on a pair of crutches.

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, October 02, 1889,

T18N R3W

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, October 08, 1913, Page 4, Image 4

Image provided by Arizona State Library, Archives and Public Records; Phoen AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn85032923/1913-10-08/ed-1/seq-4/

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BIG CATTLE DEAL.

Fuller Brothers of Imperial, Cal., Purchased Several Hundred Head.

(From Sunday's Daily.)

What is reported as one of the biggest deals closed in this section in several months for range cattle was that of yesterday when the King Brothers and M. A. Perkins, of Big Chino valley, sold to Fuller Brothers, of Imperial, Cal., several hundred head. A. L. Spellmeyer, of Flagstaff, represented the buyers.

Delivery is to be made at Del Rio early in November, and the stock will be fattened for market at the large feeding grounds of the purchasers. The price per head paid was not given publicity, but it is said to involve several thousand

Section 4

Weekly journal-miner. (Prescott, Ariz.) 19[...] December 02, 1914, Page SIX, Image 6

Image provided by Arizona State Library, Archives and Public Re[...] AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn850329[...]-02/ed-1/seq-6/

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pleasure. The car is registered at the Overland garage.

Looks Suspicious.

Arrivals from Big Chino valley seem to be quite earnestly concerned over the addition being made to the King Brothers' home, from which it is inferred that cupid is about to select a new habitation at the confirmed bachelor wickiup. There are three of these well known brothers, living under the same roof and who the queen will be for the lucky King, will be announced later.

Kings Ranch Yavapai Co. Map, Prescott N. F., 1933.

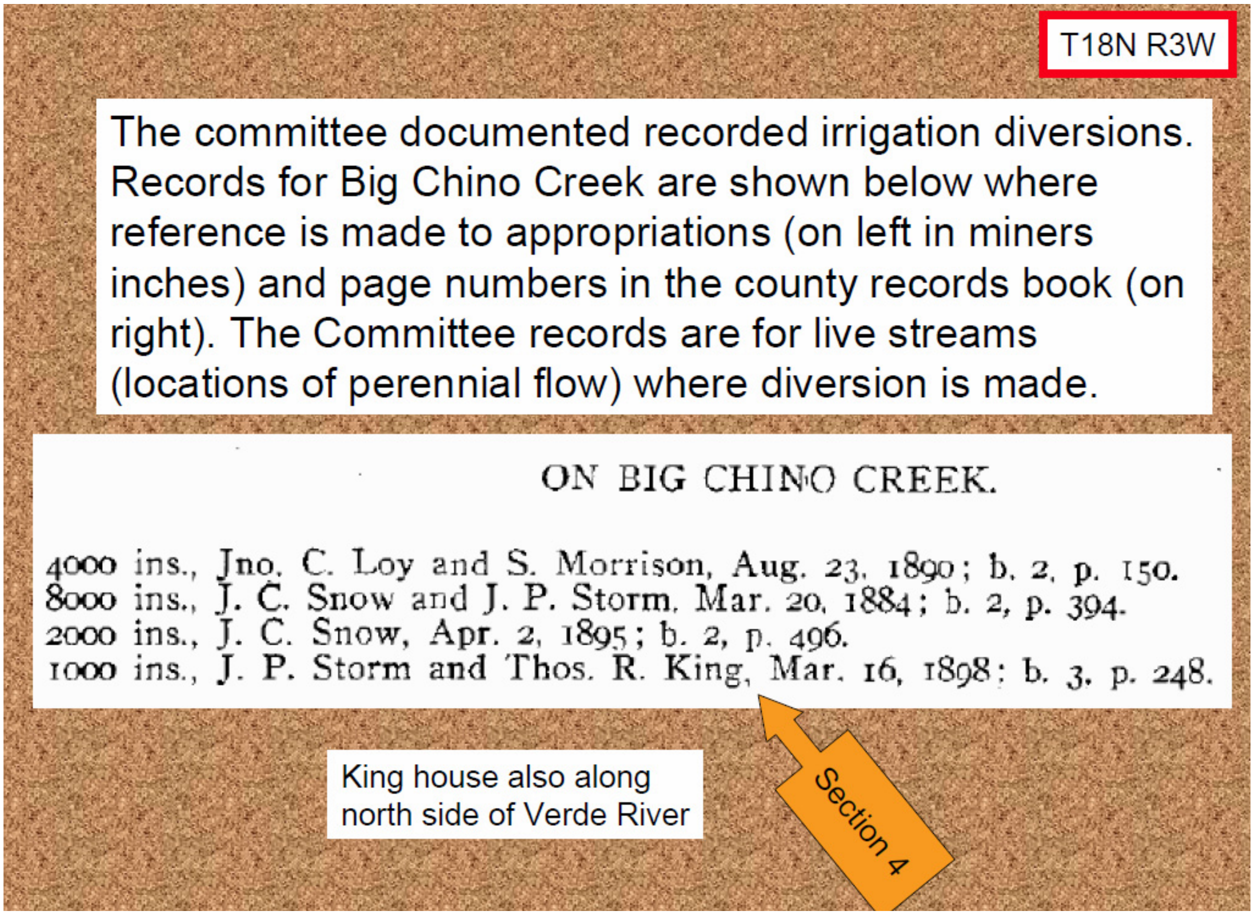
A noted horse ranch in Upper Chino valley. In T. 18 N., R. 3 W. About 3 miles southeast of Fritsche P. O. Established about 1883 by Thomas R. King of California who later brought his three nephews to Arizona. They succeeded him and took over the ranch and managed it for many years. The uncle, Thomas R. King, died Feb. 2, 1932.

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, October 16, 1901

Thomas R. King and his nephew, Thomas W. King, are in town today from their stock ranch in Big Chino valley. They have just finished making a shipment of cattle to Bakersfield, Cal., from Seligman. The cattle were purchased by a cattle buyer named Mitchell, who will place them on pasture there. The night before the cattle were shipped they had quite an exciting experience. The corral at Seligman was too small to hold all of them and they were compelled to herd them on the plains. They had them apparently settled for the night when, about 11 o'clock, without any apparent cause, they stampeded, and a wild chase in the darkness, lasting for several hours ensued. In the race one of the cowboys was thrown from his horse and it got away from him. The saddle was found next day, but no trace of the horse was found. They succeeded in rounding up all but seven of the cattle.

Section 4

T18N R3W



Note: A total of 15000 miner’s inches = 375 cfs or about 270,000 ac-ft/yr. Obviously this amount greatly exceeds any likely base runoff but it suggests the possibility that irrigation diversion was made at the several dikes that intercepted snow melt runoff and storm runoff in addition to base flow.

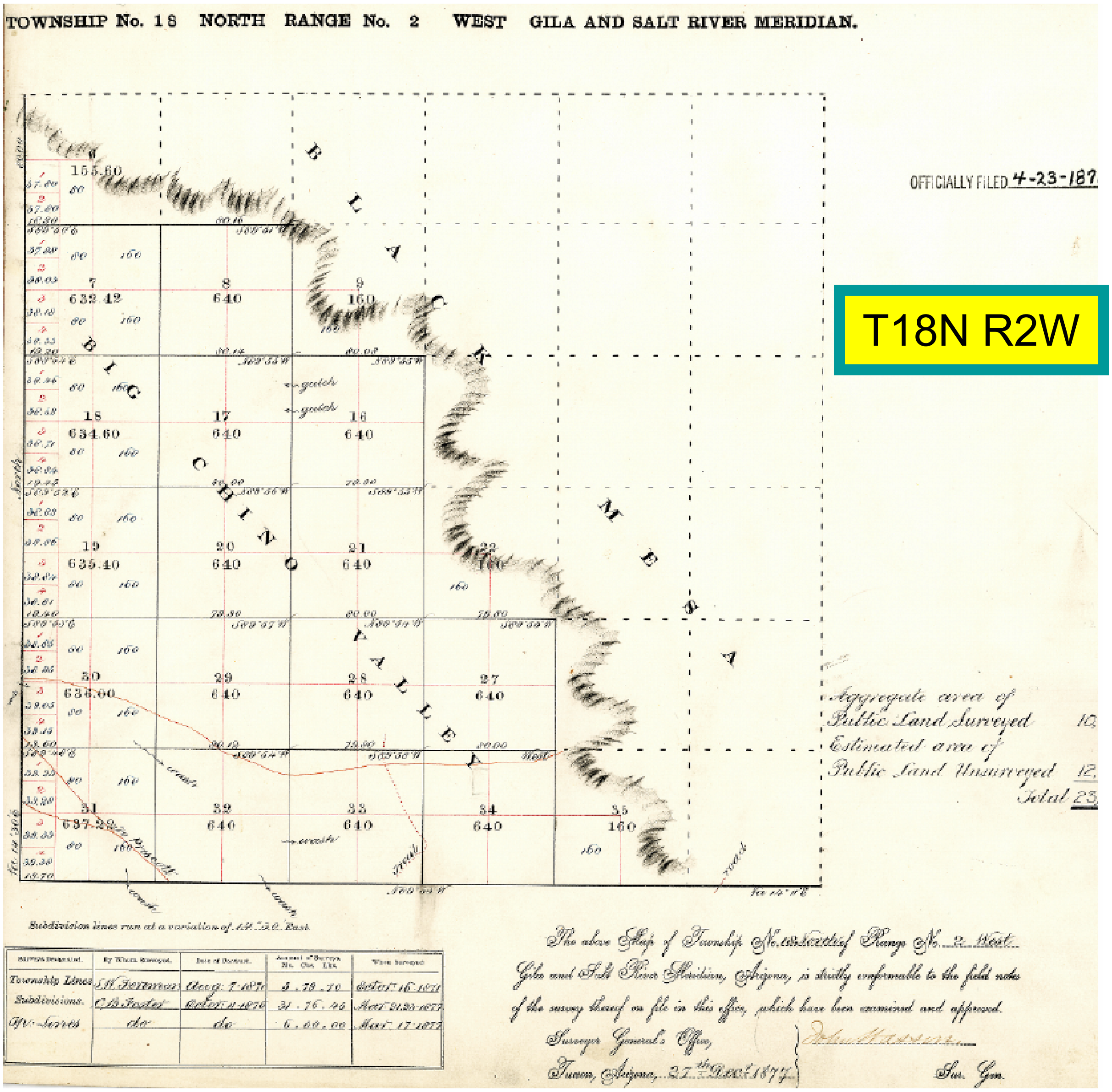

TOWNSHIP No. 18 NORTH RANGE No. 2 WEST GILA AND SALT RIVER MERIDIAN.
OFFICIALLY FILED 4-23-187
T18N R2W
BLACK MESA
BIG CHINO VALLEY
Aggregate area of Public Land Surveyed
Estimated area of Public Land Unsurveyed
Total
Township Lines
Subdivisions.
The above Map of Township No. 18 North of Range No. 2 West Gila and Salt River Meridian, Arizona, is strictly conformable to the field notes of the survey thereof on file in this office, which have been examined and approved.
Surveyor General's Office,
Tucson, Arizona, 27th Dec. 1877
Sur. Gen.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	1070900	AIKEN, CLAUD W	7/18/1934	073711	AZ	Gila-Salt River	017N - 002W	SW¼	10	Yavapai
							017N - 002W	NW¼SE¼	15	Yavapai
							017N - 002W	NE¼	35	Yavapai
							017N - 002W	NE¼NW¼	35	Yavapai
							017N - 002W	N½SE¼	35	Yavapai
							017N - 002W	SE¼SE¼	35	Yavapai
							017N - 002W	SW¼SW¼	35	Yavapai
							018N - 002W	N½SW¼	25	Yavapai

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	1077836	BARKER, GUSTAV HERMAN	8/23/1935	069562	AZ	Gila-Salt River	018N - 002W	Lot/Trct 1	26	Yavapai
							018N - 002W	Lot/Trct 10	26	Yavapai
							018N - 002W	Lot/Trct 11	26	Yavapai
							018N - 002W	Lot/Trct 12	26	Yavapai
							018N - 002W	Lot/Trct 2	26	Yavapai
							018N - 002W	Lot/Trct 3	26	Yavapai
							018N - 002W	Lot/Trct 4	26	Yavapai
							018N - 002W	Lot/Trct 5	26	Yavapai
							018N - 002W	Lot/Trct 6	26	Yavapai
							018N - 002W	Lot/Trct 7	26	Yavapai
							...document contains **2** additional land descriptions.			
---	*AZAZAA 001129*	*BURNELL, GEORGE*	*5/17/1897*	*432*	*AZ*	*Gila-Salt River*	*018N - 002W*	*NE¼SW¼*	*30*	*Yavapai*
							018N - 002W	*Lot/Trct 2*	*30*	*Yavapai*
							018N - 002W	*Lot/Trct 3*	*30*	*Yavapai*
							018N - 002W	*Lot/Trct 4*	*30*	*Yavapai*

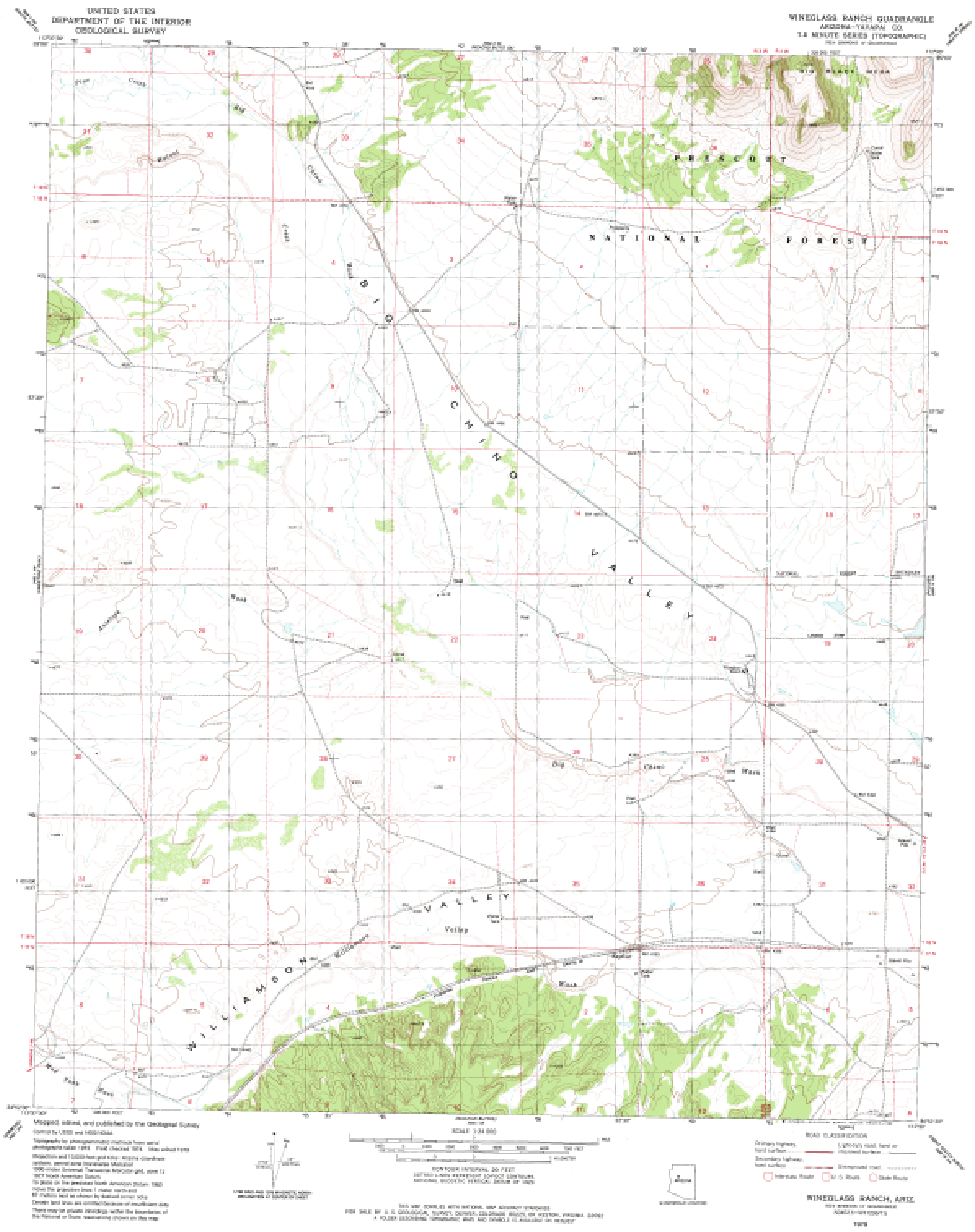
Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

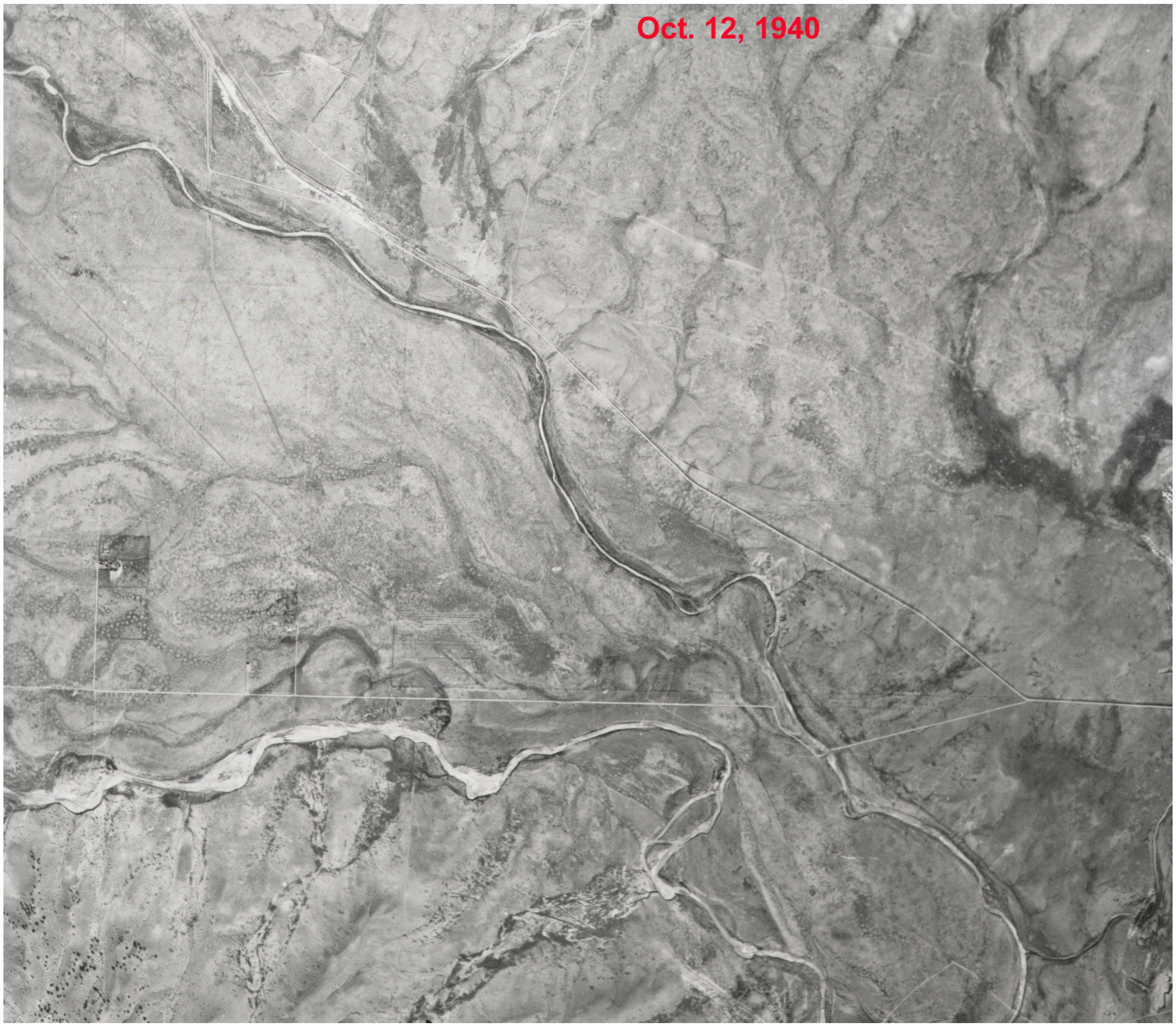
Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	1000385	FIZER, AMOS D	4/20/1927	054779	AZ	Gila-Salt River	018N - 002W	NW¼	25	Yavapai
							018N - 002W	Lot/Trct 1	25	Yavapai
							018N - 002W	Lot/Trct 2	25	Yavapai
							018N - 002W	Lot/Trct 3	25	Yavapai
							018N - 002W	Lot/Trct 4	25	Yavapai
							018N - 002W	Lot/Trct 5	25	Yavapai
							018N - 002W	Lot/Trct 6	25	Yavapai
	1064706	HALEY, HARRY T	6/15/1933	070692	AZ	Gila-Salt River	015N - 003W	NW¼SW¼	10	Yavapai
							016N - 001W	SE¼	24	Yavapai
							016N - 001W	NE¼	25	Yavapai
							017N - 002W	SE¼NW¼	35	Yavapai
							018N - 002W	S½SW¼	25	Yavapai
							018N - 002W	Lot/Trct 10	25	Yavapai
							018N - 002W	Lot/Trct 11	25	Yavapai
							018N - 002W	Lot/Trct 12	25	Yavapai
							019N - 003W	Lot/Trct 9	6	Yavapai
	1066302	MORRISON, CLINTON JAMES	9/27/1933	068805	AZ	Gila-Salt River	018N - 002W	E½	26	Yavapai
							018N - 002W	Lot/Trct 1	35	Yavapai
							018N - 002W	Lot/Trct 2	35	Yavapai
							018N - 002W	Lot/Trct 3	35	Yavapai
							018N - 002W	Lot/Trct 4	35	Yavapai
							018N - 002W	Lot/Trct 5	35	Yavapai
							018N - 002W	Lot/Trct 6	35	Yavapai
							018N - 002W	Lot/Trct 7	35	Yavapai
							018N - 002W	Lot/Trct 8	35	Yavapai
	333131	SANTA FE PACIFIC RAILROAD	5/13/1913	014183	AZ	Gila-Salt River	003N - 001W	NW¼	10	Maricopa

A mammoth water tank stands on Montezuma street, which demonstrates the skill of Prescott artisans in the manufacturing line. It was made by Sam Hill, and has a capacity of 5,000 gallons. It will soon be shipped to Big Chino valley, and, in construction, is a credit to any house n workmanship, and cheap in price, too.

T18N R2W ?

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, November 23, 1898,

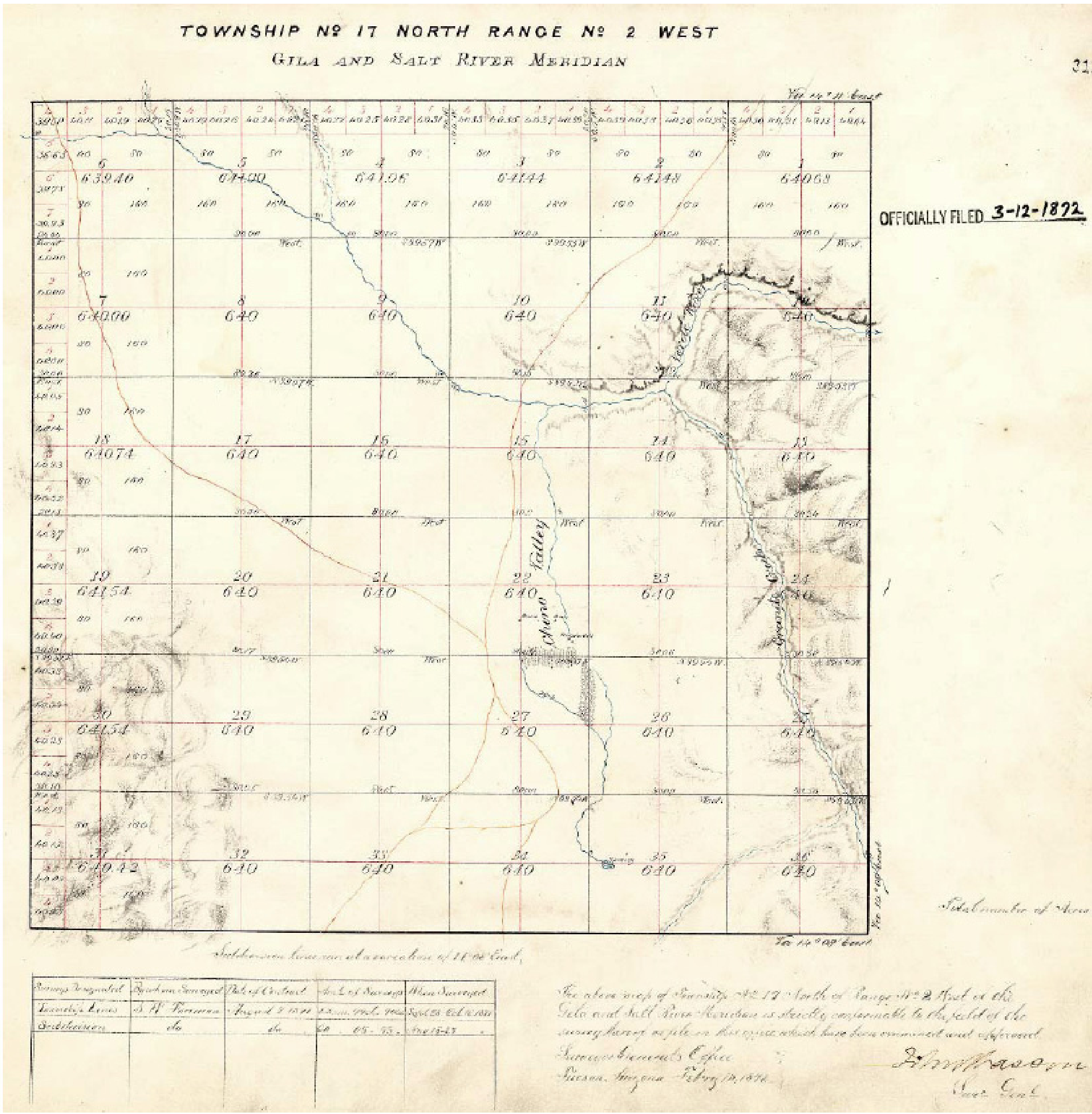

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WINEGLASS RANCH QUADRANGLE
ARIZONA–YAVAPAI CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
PRESCOTT
NATIONAL FOREST
BIG CHINO VALLEY
WILLIAMSON VALLEY
WINEGLASS RANCH, ARIZ.


Oct. 12, 1940

Title : Construction of Sullivan Lake and Dam near Chino Valley, Arizona, C.1934
Date of Photograph : 1934

T17N R2W

Before Sullivan Lake



Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	130282	ACUNO, RAFAEL	5/16/1910	92	AZ	Gila-Salt River	017N - 002W	SW¼SW¼	26	Yavapai
	1070900	AIKEN, CLAUD W	7/18/1934	073711	AZ	Gila-Salt River	017N - 002W	SW¼	10	Yavapai
							017N - 002W	NW¼SE¼	15	Yavapai
							017N - 002W	NE¼	35	Yavapai
							017N - 002W	NE¼NW¼	35	Yavapai
							017N - 002W	N½SE¼	35	Yavapai
							017N - 002W	SE¼SE¼	35	Yavapai
							017N - 002W	SW¼SW¼	35	Yavapai
							018N - 002W	N½SW¼	25	Yavapai
	1080866	AIKEN, WILLIAM R	1/10/1936	070757	AZ	Gila-Salt River	017N - 001W	NE¼NW¼	17	Yavapai
							017N - 001W	SE¼	18	Yavapai
							017N - 001W	E½SW¼	18	Yavapai
							017N - 001W	SE¼NE¼	18	Yavapai
							017N - 001W	N½NE¼	19	Yavapai
							017N - 001W	NE¼NW¼	19	Yavapai
							017N - 002W	NE¼SW¼	24	Yavapai
							019N - 003W	NE¼SE¼	6	Yavapai
							017N - 001W	Lot/Trct 3	18	Yavapai
							017N - 001W	Lot/Trct 4	18	Yavapai
							... document contains 1 additional land descriptions.			

T17N R2W

Note: An *Italic* entry denotes data that has not been indexed against the land patent document, and has no image.

Image	Accession	Names	Date	Doc #	State	Meridian	Twp - Rng	Aliquots	Sec. #	County
	1048666	ARCHER, WILLIAM H	8/6/1931	066587	AZ	Gila-Salt River	017N - 001W	SE¼NW¼	17	Yavapai
							017N - 002W	SW¼	23	Yavapai
							017N - 002W	S½NW¼	23	Yavapai
							017N - 002W	W½SE¼	23	Yavapai
							017N - 002W	SW¼NE¼	23	Yavapai
							017N - 002W	SE¼SE¼	23	Yavapai
							017N - 002W	N½N½	26	Yavapai
							017N - 002W	SE¼NE¼	26	Yavapai
---	AZAZAA 001294	BAKER, JAMES M, BANGHART, GEORGE, ROGERS, CHARLES T	11/3/1876	36	AZ	Gila-Salt River	017N - 002W	SW¼SE¼	15	Yavapai
							017N - 002W	NE¼	22	Yavapai
							017N - 002W	N½SE¼	22	Yavapai
							017N - 002W	SE¼NW¼	22	Yavapai
							017N - 002W	NE¼SW¼	22	Yavapai
---	AZAZAA 001296	BAKER, SARAH F	3/29/1902	21	AZ	Gila-Salt River	017N - 002W	NW¼NW¼	35	Yavapai
	1079411	CUTBIRTH, JAMES W	10/25/1935	067535	AZ	Gila-Salt River	017N - 001W	SW¼	17	Yavapai
							017N - 001W	SW¼NW¼	17	Yavapai
							017N - 001W	SE¼	19	Yavapai
							017N - 001W	NW¼	20	Yavapai
							017N - 001W	W½SW¼	20	Yavapai
							017N - 002W	SE¼SW¼	26	Yavapai

Misc. Information

Weekly journal-miner. (Prescott, Ariz.) 1908-1929, December 03, 1919, Page PAGE THREE, Image 3

200,000 sheep
In
Big Chino
Valley

by high water, and other places to the west are shut out of communication.

Mining camps to the south of Prescott are shut out for the present, and if the storm continues as is indicated, all will be marooned for the winter. Some properties have new plants at the railroad depot here, and future operations will be seriously affected if the storm is not soon broken.

Over 200,000 head of sheep are now in the upper portion of Big Chino valley moving south by the forest trail into Skull valley, and it is believed many head will succumb.

The cattleman, farmer and miner will in the end benefit by the biggest storm to occur in November in over forty years.

1. Arizona Joint Canal Committee

Turney, O. A., 1901, Water Supply and Irrigation on the Verde River and tributaries, Ariizona: Cleaveland Daily Record, print, 87 Wood St., Cleveland. Ohio, 18p.

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.

For those aware of this committee and its report, its important to be aware that little information on water use (irrigation) for the watershed above the USGS Paulden gage was shed by this committee.

Turney, O. A., 1901, Water Supply and Irrigation on the Verde River and tributaries, Ariizona: Cleaveland Daily Record, print, 87 Wood St., Cleveland. Ohio, 18p.

NOTE

For specific recorded diversions reference is made to appropriations and page numbers in the county records book. Records are for live streams (locations of perennial flow) for diversions on the Verde River and many tributaries.

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:

ON WALNUT CREEK.

1000 in., Mrs. Fannie Plummer, July 17, 1896; b. 3, p. 128.
500 Wm. G. Shook, June 24, 1887; b. 1, p. 426.
500 W. H. Williscraft, Nov. 15, 1887; b. 1, p. 441.
All water of Walnut Creek, Saml. C. Rodgers, original location of Apr. 13, 1868, recorded Jan. 18, 1900; ———

ON GRANITE CREEK.

All water of Granite Creek, R. A. Farrington, Jan. 4, 1866; b. 1, p. 8.
All water of Granite Creek and Willow Creeks at Point Rocks, Mar. 27, 1872; b. 1, p. 81.
75 inches, M. H. Yearborn, Aug. 23, 1873; b. 1, p. 87.
800 Peter Marx, Aug. 1, 1873; b. 1, p. 94.
200 J. H. Lee, July 24, 1875; b. 1, p. 155.
500 M. Maur, Dec. 20, 1887; b. 1. p. 446.

ON BIG CHINO CREEK.

4000 ins., Jno. C. Loy and S. Morrison, Aug. 23, 1890; b. 2, p. 150.
8000 ins., J. C. Snow and J. P. Storm, Mar. 20, 1884; b. 2, p. 394.
2000 ins., J. C. Snow, Apr. 2, 1895; b. 2, p. 496.
1000 ins., J. P. Storm and Thos. R. King, Mar. 16, 1898; b. 3, p. 248.

ON WILLIAMSON VALLEY CREEK.

150,000 by J. W. Sullivan and J. J. Fisher, Mar. 4, 1896; b. 3, p. 94.

Claim for water for proposed dam on Williamson Valley Wash. Dam was not constructed

Section second of Smith's irrigation, or riparian rights bill, over which the house waxed warm yesterday, reads as follows: That all persons, corporations, or association [illegible] ns who heretofore appropriated water from any of the streams or water courses in this territory, for mining, milling, manufacturing, agricultural, or domestic purposes, or for the use of stock and who continue to use the same, are hereby declared the owners thereof according to its priority and amount of their appropriation. The vote stood; ayes, Adamson, Ashurst, Baker, Collins, Doran, Felton, Gray, Ming, McKay, Smith, Mr. Speaker, 11; nays, Andrews, Bean, Fisher, Heyne, Leatherwood, Oliver, Scott of Apache, Scott of Pima, Wores. 9.

Arizona weekly journal-miner. (Prescott, Ariz.) 1885-1903, February 16, 1887

The Coconino sun [microform]. (Flagstaff, Ariz.) 1898-197?, September 25, 1908, Image 6

been reported, but it is expected that many sales will be made for fall delivery. Cattle are in fine condition and the sales this fall should be the largest in years.

Eight carloads of sheep selected from the Tyson flocks were shipped to the Los Angeles markets from Del Rio yesterday. A carload of horses, gathered on the Big Chino ranges, was also shipped at the same time, the destination of the equines being Oklahoma.—Journal Miner.

On Monday C. C. Hutchinson shipped 1,200 sheep from Bellemont to the Kansas City market. Next Monday he will make another ship-

The weekly Arizona miner. (Prescott, Ariz.) 1868-1873, February 05, 1870, Image 3

as good as any in this part of the Territory.

Up to the present time but four ranches have been cultivated in Chino Valley—Baker & Campbell's Robt. Postle's, G. W. Banghart's and Mr. Shiver's. These ranches have produced corn, wheat, potatoes, etc. The owners usually irrigate, there being an abundance of water at all seasons for that purpose. Mr. Baker informed us that a great many ranches have of late been located down the valley, by persons who intend settling upon and working them the coming season. There is plenty of good arable land in the vicinity, yet open to settlement, and should the troops at Camp Toll-Gate be moved to Williamson Valley, and a post be there established, the day is not far distant when the farmers of that part of the country will be numbered by the hundred.

FRUIT.—Mr. McFoster got in, Sunday last, from California, with a wagon load of apples,

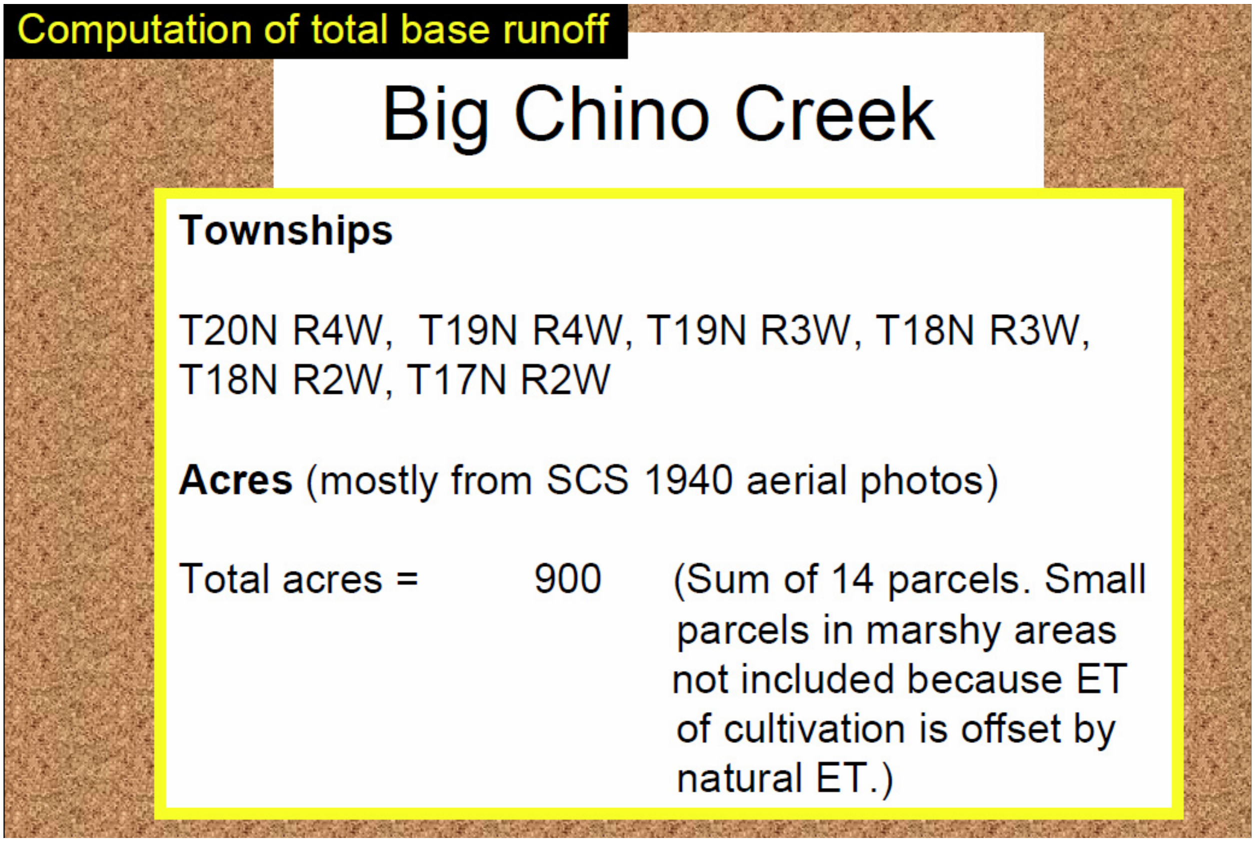
Total number of cattle in the county at the close of—

1882	34,243
1883	49,132
1884	64,008
1885	89,688
1886	116,286

time. Perhaps no better criterion of the superior advantages which Yavapai County, composing as it does the greater portion of Central Arizona, possesses over other sections of the Territory in the matter of stock growing can be given, than the following comparison of the cattle interests of the different counties, as shown by the Territorial Auditor's report of 1886:

Counties.	Number of Head.
Yavapai	116,286
Pima	66,500
Cochise	60,492
Apache	38,461
Graham	29,217
Pinal	28,566
Gila	15,970
Mohave	15,556
Maricopa	9,586
Yuma	3,111

O'Neill, Wm, O, 1887, Central Arizona, for Homes, for Health, for Wealth; Prescott Az., Hoof arid Horn Print, 133p.


Computation of total base runoff
Big Chino Creek
Townships
T20N R4W, T19N R4W, T19N R3W, T18N R3W, T18N R2W, T17N R2W
Acres (mostly from SCS 1940 aerial photos)
Total acres = 900 (Sum of 14 parcels. Small parcels in marshy areas not included because ET of cultivation is offset by natural ET.)

Appendix G.—The natural and ordinary Verde River from USGS Clarkdale gage (09504000) to mouth at Salt River.

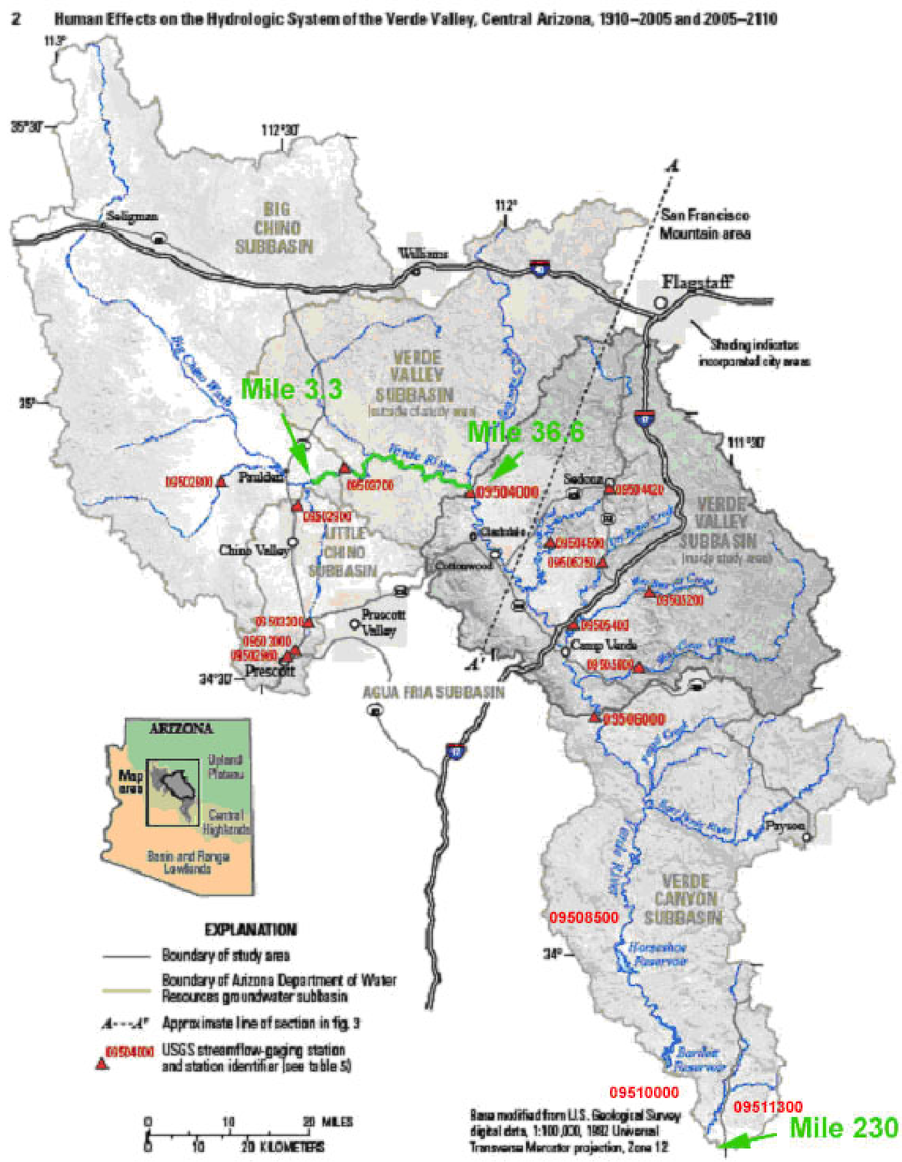
This evaluation of the navigability of the middle and lower Verde River (mile 36.6 to mile 230 at the mouth, Figure G1) focuses on the natural hydrology before the watershed and flow in the Verde River and tributary streams were altered by human activities. The evidence shows that the natural river had a substantial natural base flow considerably greater (about 100 cfs greater, Item F of Table 2 of 2) than the gaged base flow (Q90) at and downstream from USGS gage 09506000. The fact is that the base-flow waters of the Verde River have been materially decreased by diversions mostly for agriculture, ranching and mining since settlers first arrived in the watershed some 50 years before Arizona statehood. Most of the loss of base flow was the result of diversions for irrigation along tributary streams in the Verde Valley and Chino Valleys areas and along the Verde River.

The evidence also suggests that the natural and recent geometry of the channel upstream of Horseshoe Dam are approximately the same probably, to some degree, because of outcrops of bedrock and coarse channel material limited channel adjustment for the lesser base flow. At the very least, the considerable use over the past 25 years of the river by small watercraft suggests a well-defined main channel with adequate depths, widths and velocities for navigability. The evidence also suggests there was a single well defined main channel along the entire river following the large floods of 1891 and even 1993. Downstream of Horseshoe Dam, where nearly all flow is from controlled releases from the two major reservoirs, the main channel typically is well defined but there are a few braided reaches where the recent channel(s) of the lower Verde River is(are) not considered representative of the natural condition. For practical purposes the flow below Horseshoe Dam is considered totally regulated and human altered and the Bartlett and Horseshoe reservoirs serve as sediment traps that cause disequilibrium of the natural channel. Thus, while much of the size and shape of the natural main channel are considered approximately the same as the recent channel for this study, it is likely that flow in the recent channel with the highly regulated flow below Horseshoe Dam is shallower and probably wider than it was in the natural channel.

The few historic accounts of navigating the Verde River occurred with human-impacted conditions where the base flow was significantly depleted. Human impacts to the Verde started in the 1860s. As noted above, navigating the entire river using canoes and kayaks has been a popular activity for about the past 25 years. Because successful boating on the river is greatly dependent on the amount of base flow, predevelopment navigability on the natural river likely would have been better simply because of the greater amount of natural base flow.

This analysis relies heavily on my personal experience, evidence submitted to ANSAC by the Arizona State Land Department (especially reports by Jon Fuller such as Fuller, J. E., 2003) and the descriptions of the Verde River channel by both Pearthree (1993) and Cook and others (2010), of the Arizona Geological Survey.

This appendix includes (1) many recent photographs of a well defined channel of the Verde River, (2) a brief history of the use of the river, (3) an analysis of the hydrology with the base, median and average annual flow along the Verde River with examples of human impacts that support the use of Virgin flow determined by the USBR (Item F of Table 2 of 2), (4) the geometry of the natural channel followed by (5) the assessment of navigability using a comparison with the John Day River that was recently determined to be a navigable river for title purposes in Oregon.



Modified from: Garner, B.D., Pool, D.R., Tillman, F.D., and Forbes, B.T., 2013, Human effects on the hydrologic system of the Verde Valley, central Arizona, 1910–2005 and 2005–2110, using a regional groundwater flow model: U.S. Geological Survey Scientific Investigations Report 2013–5029, 47 p.

Figure G1.—Verde River Watershed showing present (human affected) surface water conditions.

G1. Description of river and watershed

The Verde River watershed is located in north-central Arizona and is bounded on the northeast by the Colorado Plateau and mostly resides in the Basin and Range province. The topography, geology and channel morphology of the Verde River are diverse. The channels of many tributary streams (Oak Creek, Fossil Creek, Wet Beaver Creek, East Verde River, Sycamore Creek, etc.) are bedrock lined. The Verde River is, and has been, entrenched and rather confined in both the alternating bedrock areas and the basin fill areas (alluvial basins). Channel material typically has a lot of gravel and cobbles with boulder riffles separated by long pools that collect finer sediment in the absence of large floods. There are also (1) reaches of predominantly sand and (2) reaches of slightly imbricated small boulders that create armoring of the channel bed.

For a detailed description of the Verde River Holocene channel and floodplain alluvium associated with the Verde River see:

Cook, J. P., and others, 2010, Mapping of Holocene River Alluvium along the Verde River, Central Arizona, Report to the Adjudication and Technical Support Unit Surface Water Division Arizona Department of Water Resources, Arizona Geological Survey, 51p.

Mapping of Holocene River Alluvium along the Verde River, Central Arizona

- Mapping of Holocene River Alluvium along the Verde River, Central Arizona - Report
- Surficial Geologic Map of the Verde River Corridor, Central Arizona - Sheet A & B
- Surficial Geologic Map of the Verde River Corridor, Central Arizona - Sheet C & D
- Surficial Geologic Map of the Verde River Corridor, Central Arizona - Sheet E & F
- Surficial Geologic Map of the Verde River Corridor, Central Arizona - Sheet G & H
- Surficial Geologic Map of the Verde River Corridor, Central Arizona - Sheet I & J

The above maps show active river channel deposits that are mostly unconsolidated, very poorly sorted sandy to cobble beds, often by the low-flow river channel, but can range from fine silty beds to coarse gravelly bars in meandering reaches. The maps also show active stream channel deposits composed of very poorly-sorted sand, pebbles, and cobbles with some boulders to moderately-sorted sand and pebbles. Channels are generally incised 3 to 7 ft below adjacent recent terraces. Channel morphologies generally consist of a single thread high flow channel or, in places, multi-threaded low flow channels with gravel bars. These active channels of recent silt to boulder material convey base flow, direct runoff and flood flow. Downstream of Bartlett Dam where river sediments have been intercepted and stored, the channel banks have eroded with some channel widening.

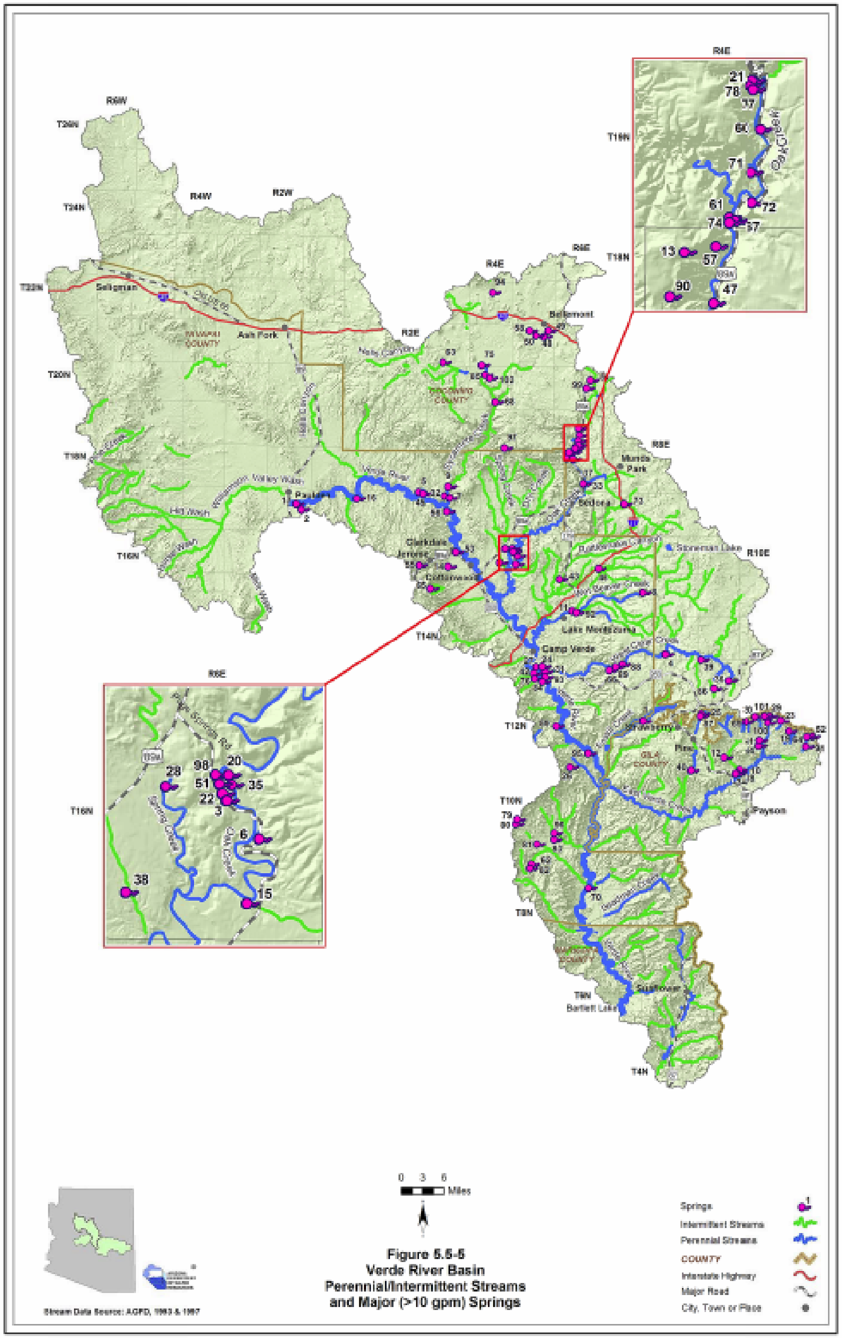


Figure 5.5-5
Verde River Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

Many springs are shown on the map to the left (see also table of largest springs on next page). Note: This map is for the Verde River Basin that is used for management by ADWR. The map is not of the entire Verde River watershed and, for example, does not include the Granite Creek sub-watershed, the Prescott, Del Rio Springs and other springs in the upper watershed. However, the map is useful for showing ANSAC the numerous springs where many, under natural conditions, contributed to the base flow of the Verde River.

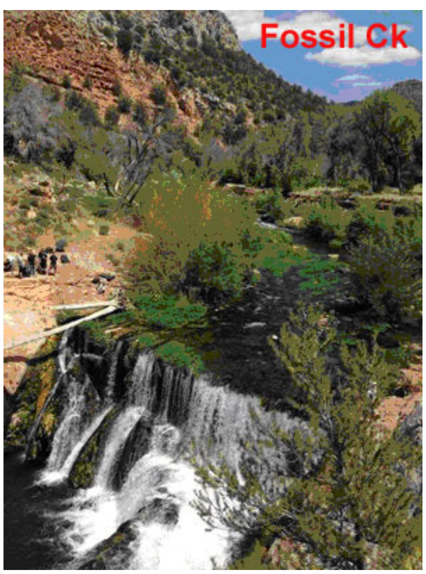
Largest Springs (ADWR records)

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Fossil Creek (multiple)	342523	1113423	21,647	During or prior to 2001
2	Big Chino	345107	1122546	8,941	During or prior to 1997
3	Bubbling Pond	344625	1115403	3,879	5/20/1968
4	Buckhorn	343340	1113108	1,000	5/28/1959
5	Unnamed	345327	1120815	2,917	7/4/1991
6	Page	344542	1115318	2,693	1/20/1975
7	Summers	345250	1120358	2,100	10/12/2003
8	Wet Beaver	344116	1113433	850-1,350[2]	10/28/1999
9	Parson	345410	1120349	1,600	11/27/1999
10	Webber Canyon	341923	1112003	996	During or prior to 2002
11	Montezuma Well	343856	1114503	916	During or prior to 1990
12	Cold	342058	1111547	830	11/11/1952
13	Unnamed	345838	1114507	749	During or prior to 1949
14	Haskell	344407	1120357	600	10/24/1958
15	Lower Newell[3]	344438	1115332	520	2/4/1959
16	Duff	345234	1121727	449	During or prior to 1997
17	Sullivan Lake	345148	1122636	448	During or prior to 1997
18	Grotto	341859	1112026	340	5/15/1952
19	Bonito[3]	342410	1111238	330	11/19/1999
20	Lolo-Mai	344631	1115403	300	7/10/1974
21	Sterling # 1	350130	1114420	300	10/12/2003
22	Tree Root	344627	1115405	264	7/9/1952
23	Dude	342925	1111351	250	11/18/1999
24	Blue	343125	1114959	230	6/11/1981
25	Upper Parsnip[3]	342616	1112543	230	11/9/1999
26	Unnamed[3]	341935	1114515	220	4/21/1976
27	Unnamed[3]	343135	1115015	220	11/6/1980
28	Spring Creek	344633	1115511	207	10/12/2003
29	Pieper Hatchery	342602	1111527	200	10/12/2003

See photos below of 2 largest springs

Being depleted by groundwater withdrawal in Chino Valleys

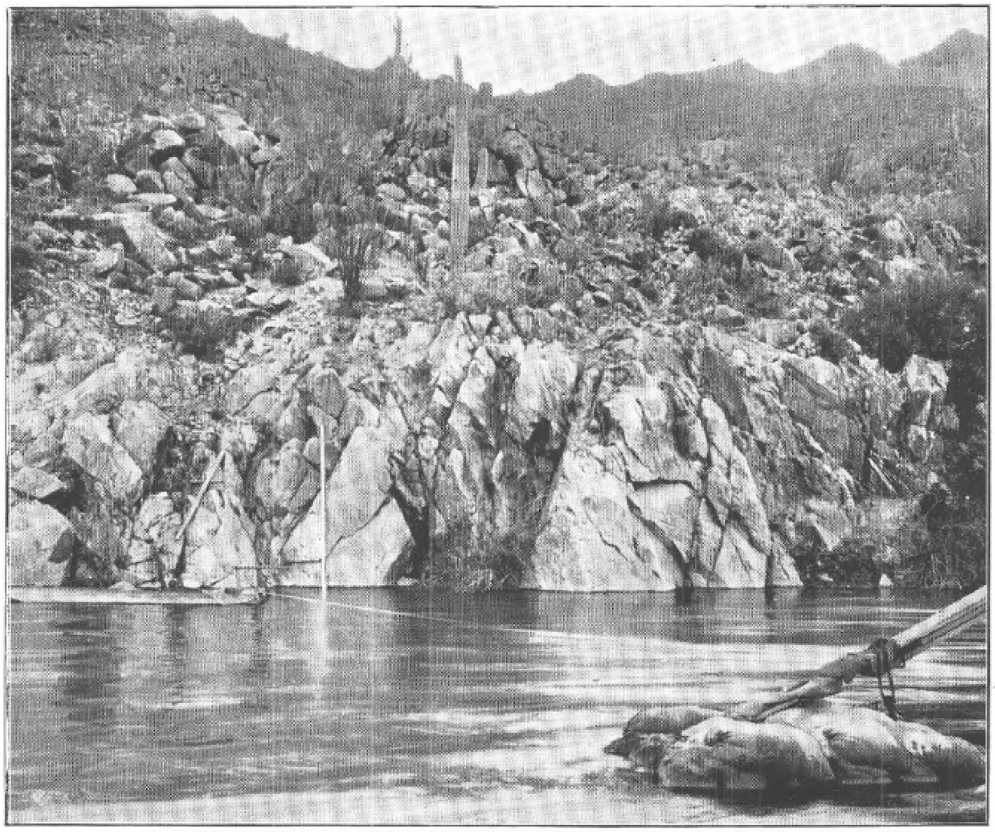
All flow diverted to Clarkdale in late 1800s



Big Chino Springs

G1a.—Photographs and notes (starting near the mouth).

U. S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER NO. 73 PL. VI

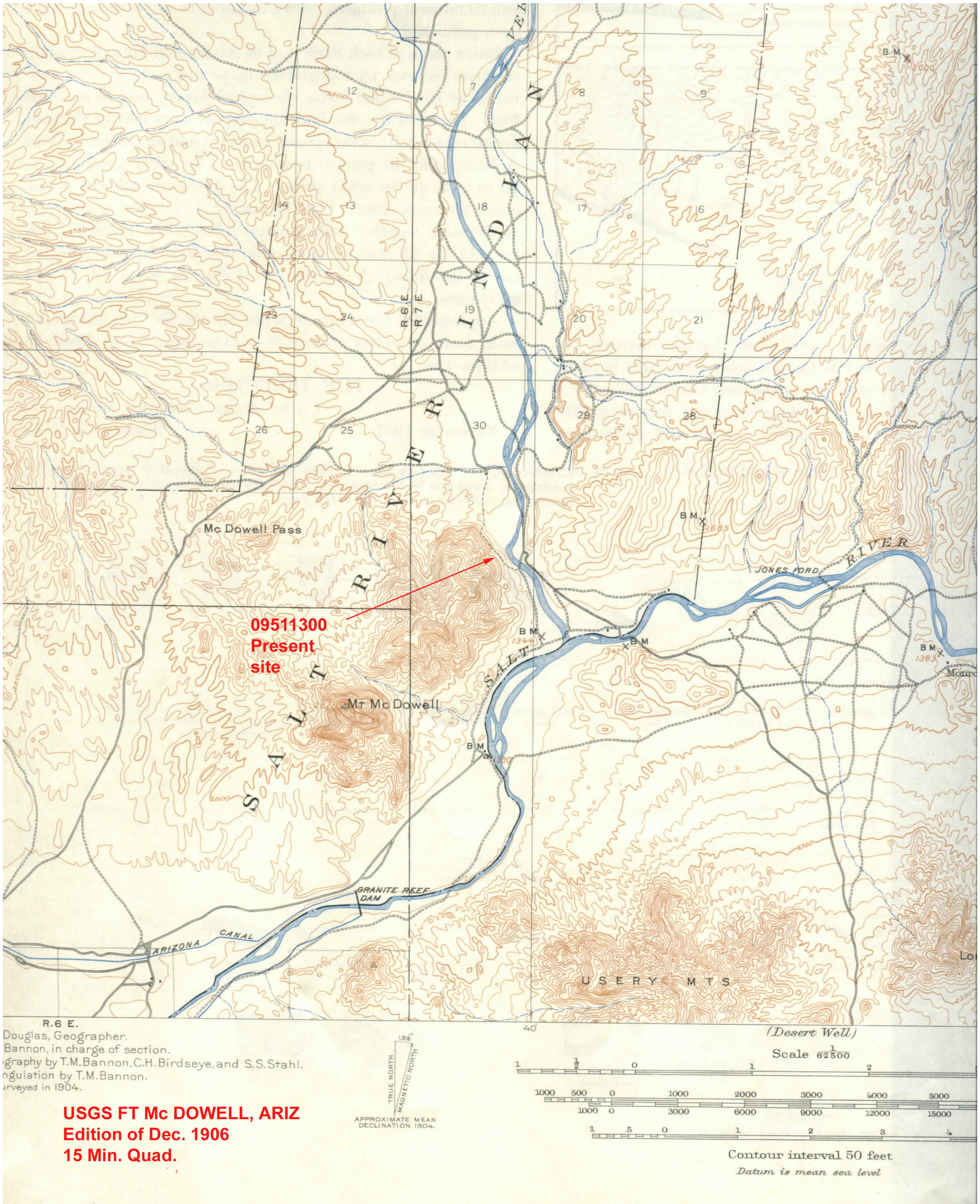


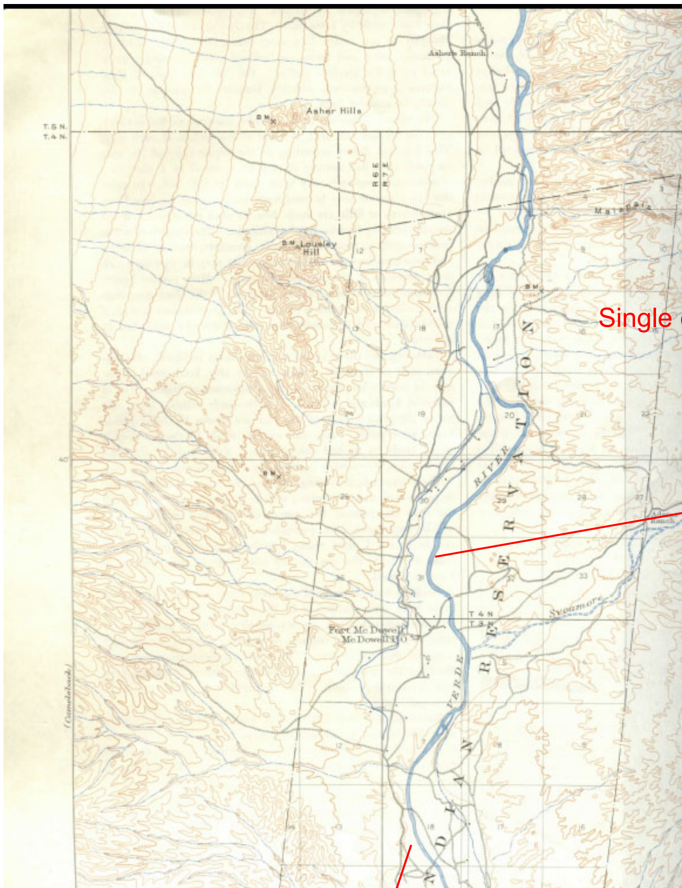
A. WEST ABUTMENT OF McDOWELL DAM SITE, SHOWING GAGE ROD.

Photo in Davis, A. P., 1903,

The bitter rivalry between the Franciscans in New Mexico and the Jesuits in Pimería Alta led, in 1743, to attempts by the Jesuits to reach the obdurate Hopis through Arizona. Padre Keller went up the Gila for this purpose, but his expedition was attacked by the Apaches and forced to return. In the same year Father Jacobo Sedelmair reached the Gila near the Casa Grande. In October he explored Salt and Verde rivers until he was driven out by the Apaches. He then went down the Gila, exploring the big bend for the first time. He left the river, supposedly at the spring known

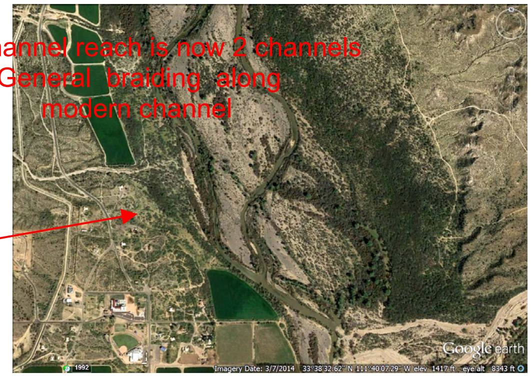
Bryan, Kirk, 1925, The Papago country, Ariz.: U. S. Geol. Survey Bull. Water Supply Paper 499,,436p.


09511300
Present
site
Mc Dowell Pass
Mt Mc Dowell
SALT RIVER INDIAN
SALT
RIVER
JONES FORD
GRANITE REEF
DAM
ARIZONA
CANAL
USERY MTS
R6E
R7E
R.6 E.
Douglas, Geographer.
Bannon, in charge of section.
graphy by T.M.Bannon, C.H.Birdseye, and S.S.Stahl.
ngulation by T.M.Bannon.
rveyed in 1904.
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN
DECLINATION 1904.
(Desert Well)
Scale 1/62500
Contour interval 50 feet
Datum is mean sea level
USGS FT Mc DOWELL, ARIZ
Edition of Dec. 1906
15 Min. Quad.



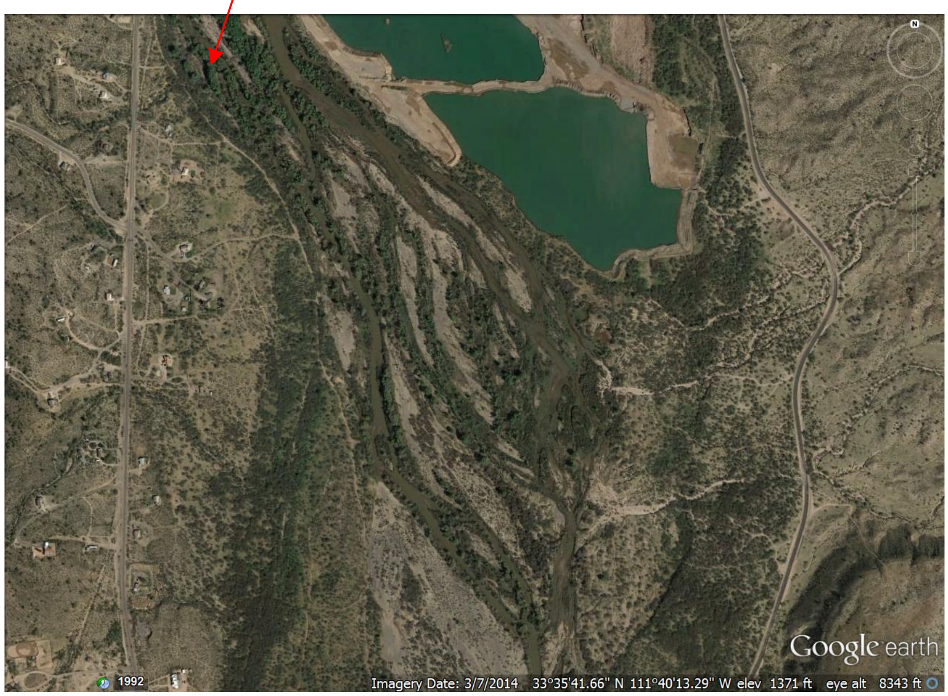
Single channel along most of the Verde River in the Ft Mc DOWELL Area.

FT McDOWELL 15 min Quad. Edition of 1906

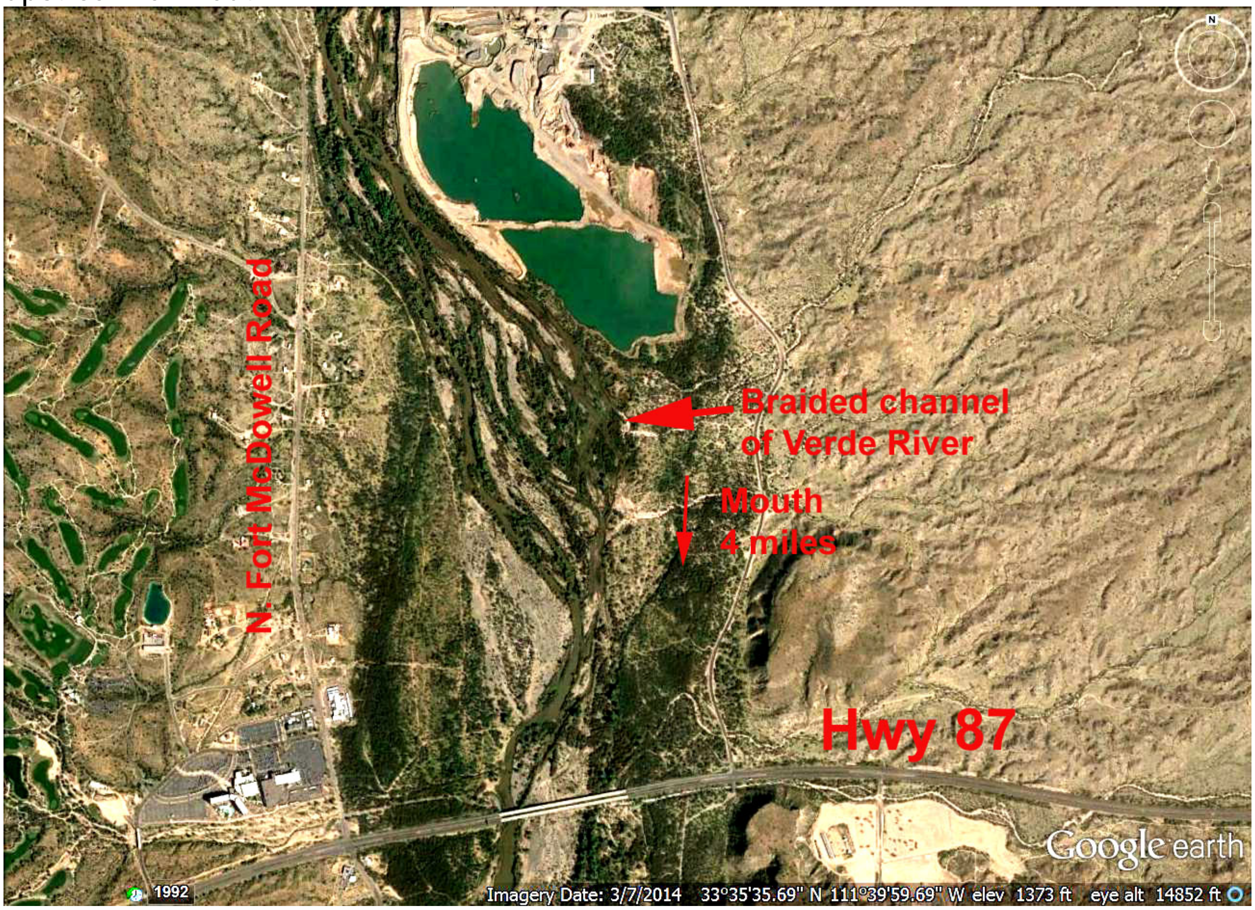


Before Bartlett and Horseshoe Dams a single channel in 1906

5 braided channels in 2014
Shown below



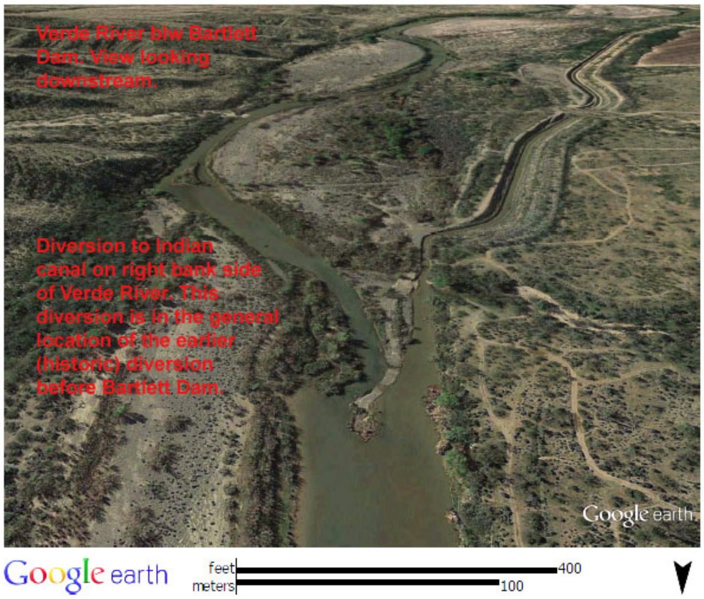
A full view of the braided Verde River (shown on previous page) located 4 miles upstream of mouth.



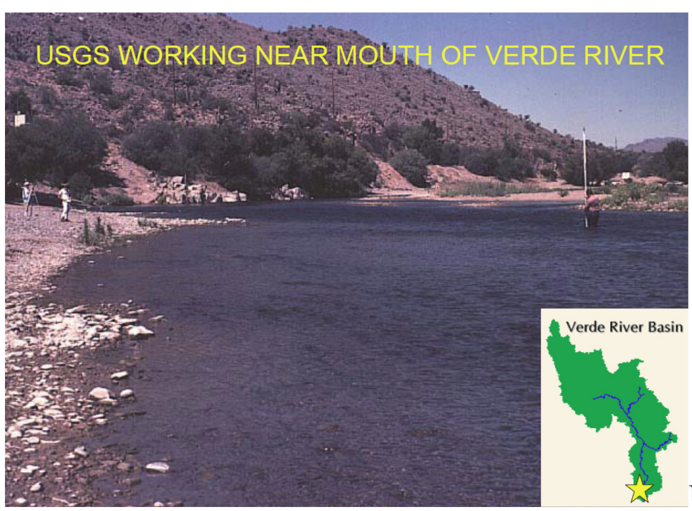
Stream alluvium (to right) along major drainages consists of unconsolidated silt, sand, gravel, and cobbles and where saturated has the greatest well yield of all units in the watershed.

Wide sandy channel and floodplain area at Fort McDowell Indian Reservation

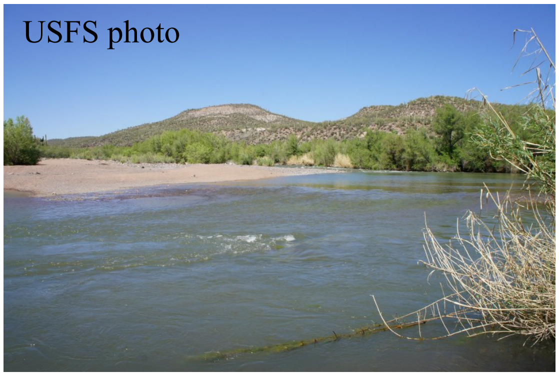
Pearthree, P., and others, Sept. 20, 2011, Mapping of Holocene River Alluvium along the Verde River, Central Arizona; Arizona Hydrological Society, Power Point, 28p.



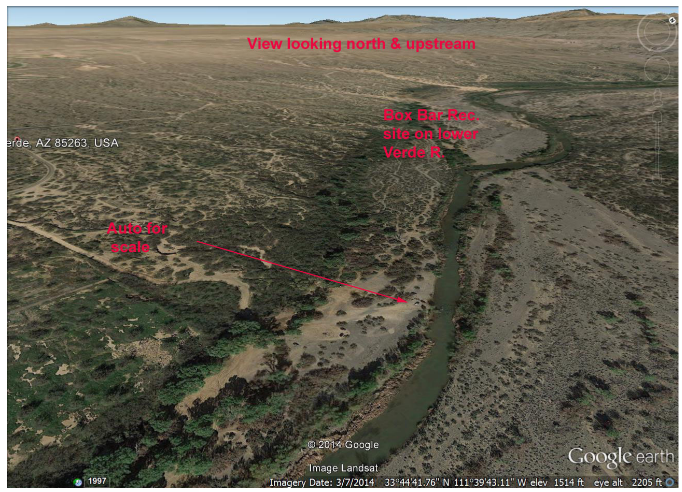
Note: Unless otherwise identified, source of photos in this appendix from https://www.facebook.com/verderiver? (Verde River Facebook page)

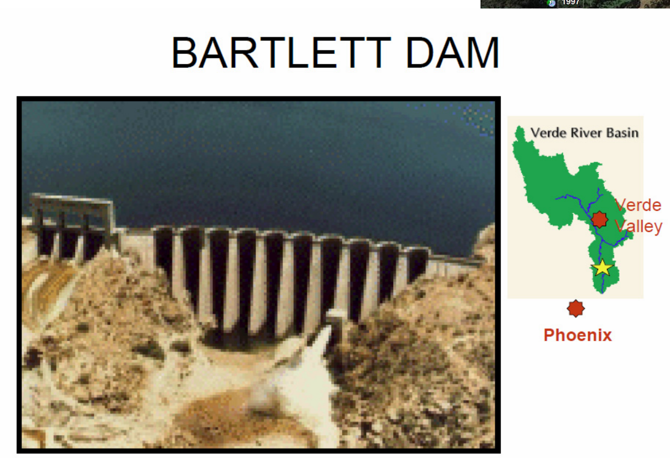


USGS photo



Box Bar Rec. Area-Tonto Nat'l Forest Below Bartlett Dam

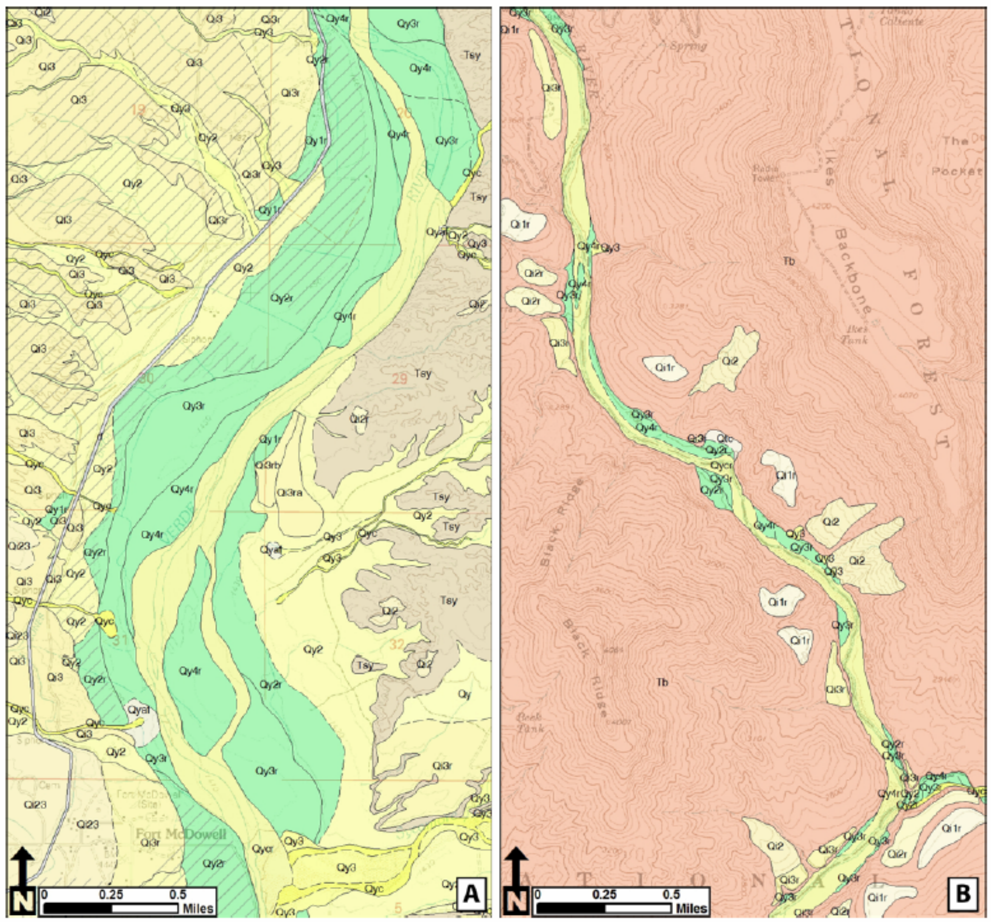




It is generally assumed that armoring results from the winnowing away of fine particles to leave a lag deposit of the coarse fraction at the surface. This is probably the process that causes surface pavement immediately below a dam where a channel is exposed to the discharge of clear water, the sediment having been trapped above the dam. (Leopold, 1994).

Bartlett Dam

In 1939, Reclamation completed Bartlett Dam on the Verde River in central Arizona; it is the highest multiple arch dam in the United States, rising 287 feet at its highest point. It has performed structurally in a satisfactory way since its construction.



A) <u>Example of less confined reach of Verde River.</u> Below Bartlett Reservoir the modern Verde River has incised through basin fill (Tsy) deposits and exhibits wide meanders, secondary channels, and widespread Holocene deposits. B) <u>Example of bedrock confined reach of Verde River below Childs</u>. Almost the entire valley bottom is covered by channel (Qycr and Qy4r) or young terrace (Qy3r) deposits due to flooding and channel migration (From: Cook, J. P., and others, 2010, Mapping of Holocene River Alluvium along the Verde River, Central Arizona, Report to the Adjudication and Technical Support Unit Surface Water Division Arizona Department of Water Resources, Arizona Geological Survey, 51p).

View above to the west toward Horseshoe Dam. High water line above recently drained reservoir marked by white arrows and piled sticks.

B) View to the northeast from above Horseshoe Reservoir. Piedmont fans near the left side of the photo exhibit numerous water lines. Verde River in center of photo B is incised in large deposit of sediment behind the dam. Photos taken 6/09/09, Horseshoe Reservoir 0% full.

From: Cook, J. P., and others, 2010, Mapping of Holocene River Alluvium along the Verde River, Central Arizona, Report to the Adjudication and Technical Support Unit Surface Water Division Arizona Department of Water Resources, Arizona Geological Survey, 51p.

Photo from
Verde River Facebook page.

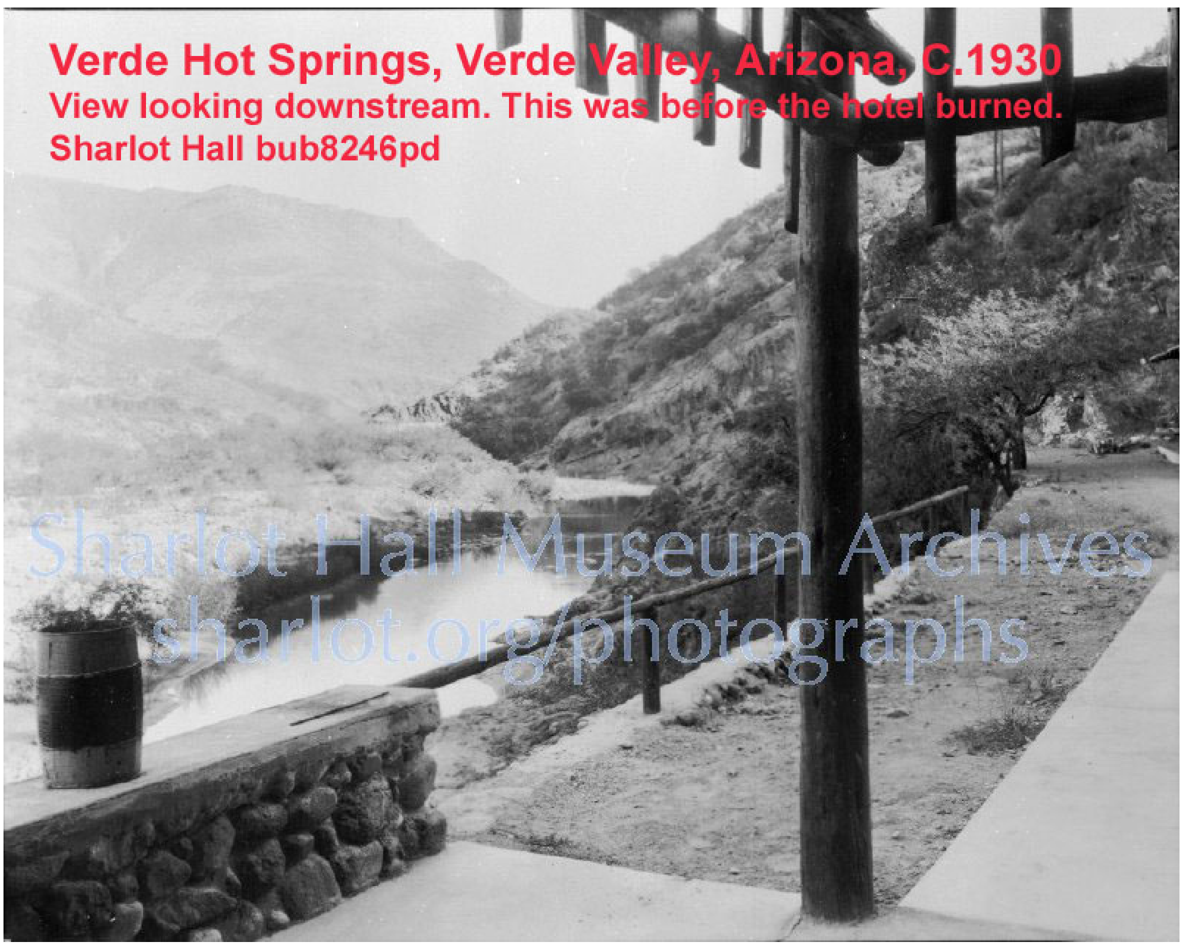


Above Horseshoe Dam

Although before 1870 the Verde River may have been a suitable route of travel by canoe, a serious drawback was the ongoing hostilities and the fact that people in boats or on rafts would be vulnerable to attack from enemies concealed in the vegetation along the banks.

Sharlot Hall Museum photo

Verde Hot Springs




Sharlot Hall Museum Archives
sharlot.org/photographs
Fossil Creek, Verde Valley, Arizona,
C.1870
la322p Sharlot Hall


Title : Childs Electrical Plant, c. 1910
Date of Photograph : C. 1910; 1910
Collection : J. Hawley Collection

Verde Falls Area

“Navigability based on either actual use or susceptibility to use may be established despite the presence of obstacles to free passage, such as rapids, riffles, or occasional areas of low water requiring portage, so long as the ‘natural navigation of the river is such that it affords a channel for useful commerce.” *Northwest Steelheaders v. Simentel*, 199 Ore. App. at 484, 112 P.3d at 390 quoting *The Montello*, 87 U.S.(20 Wall) at 441.

2008

By Hjalmarson

VisitCampVerde ARIZONA THE CENTER OF IT ALL
(http://visitcampverde.com)

The Verde River

The Verde River is one of the Southwest's last free flowing rivers, running 170 miles from its headwaters in the Big Chino Valley to its confluence with the Salt River, east of Phoenix. Along with providing water to millions of Arizonans, the river is home to dozens of species of mammals, reptiles, birds and fish, including several that are threatened or endangered.

The Verde River and the web of irrigation ditches that trail along its banks nourishes a mile-wide greenbelt, which defines Camp Verde in ways that no other natural feature comes close. It and its tributaries, Oak Creek, Wet Beaver Creek and West Clear Creek, is the reason humans have made the valley home for more than 10,000 years. Today it is fueling an agricultural renaissance as well as becoming a recreational asset.

Over the last 25 years, the Verde River's reputation as a destination for canoers and kayakers of all levels of expertise has grown. The 18 miles of river passing through Camp Verde consists of a series of deep pools and riffles, perfect for beginners. For those who prefer a more exhilarating ride, Camp Verde is the jumping off spot for a 41 mile long Wild and Scenic stretch, running south from Camp Verde to the Sheep Bridge upstream of Horseshoe Lake.

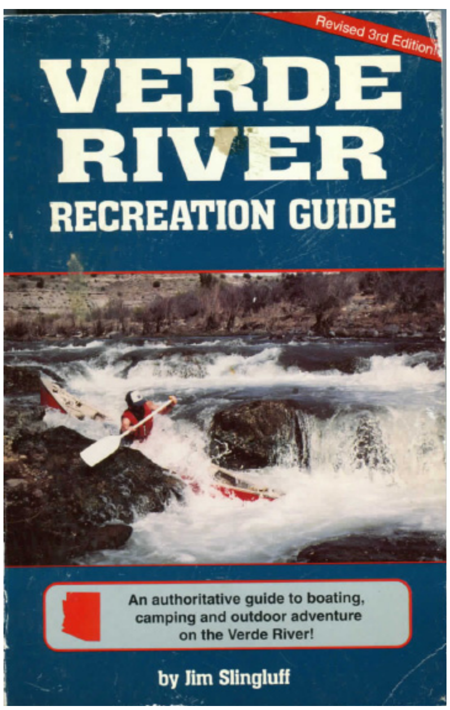
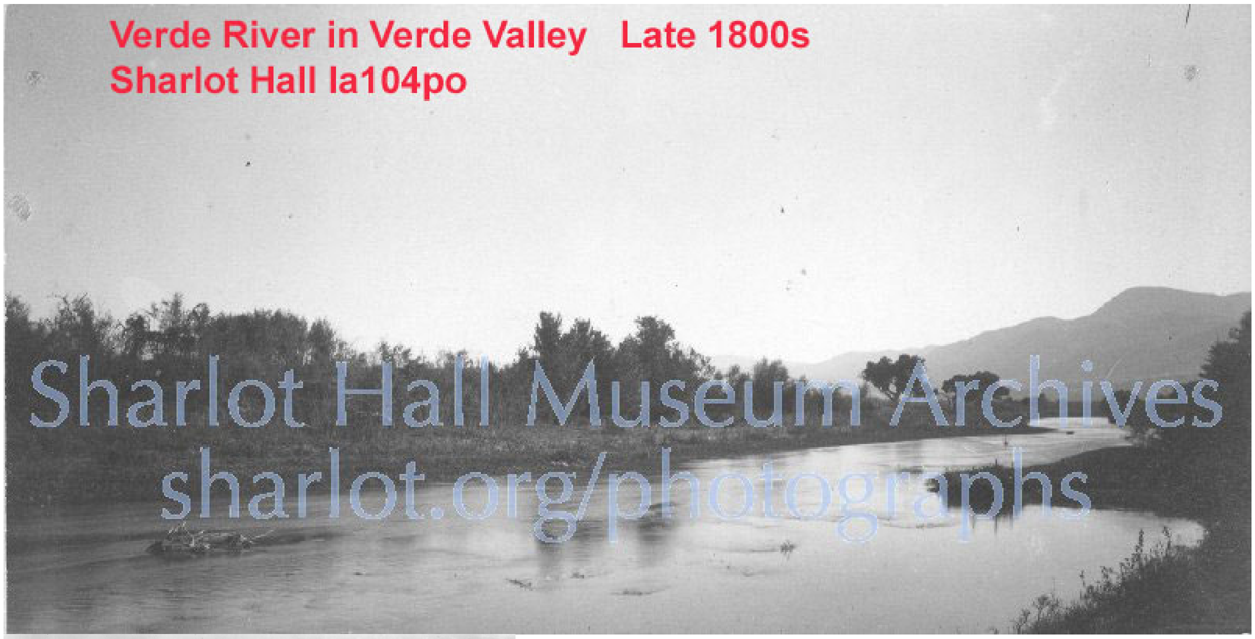


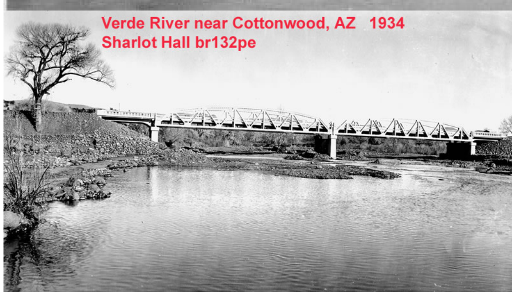
Photo by Hjalmarson

Many diversion dams

"No Indians were seen again until reaching Camp Verde, although throughout Chino and Agua Fria Valley they frequently commit depredations. The ranchmen always take their rifles with them; and it is a common occurrence for herders to be picked off, or men shot, while at work in the fields. The Apache-Mohaves roam through this region, and their country extends east to the mountains beyond the Verde River."
Humphreys, Brigadier General A. A.,1872, PRELIMINARY REPORT Concerning EXPLORATIONS AND SURVEYS PRINCIPALIY IN NEVADA AND ARIZONA; CONDUCTED UNDEE THE IMMEDIATE DIRECTION OF 1st Lieut. GEOEGE M. WHEELER, Corps of Engineers 1871, WASHINGTON,GOVERNMENT PRINTING OFFICE,96p.

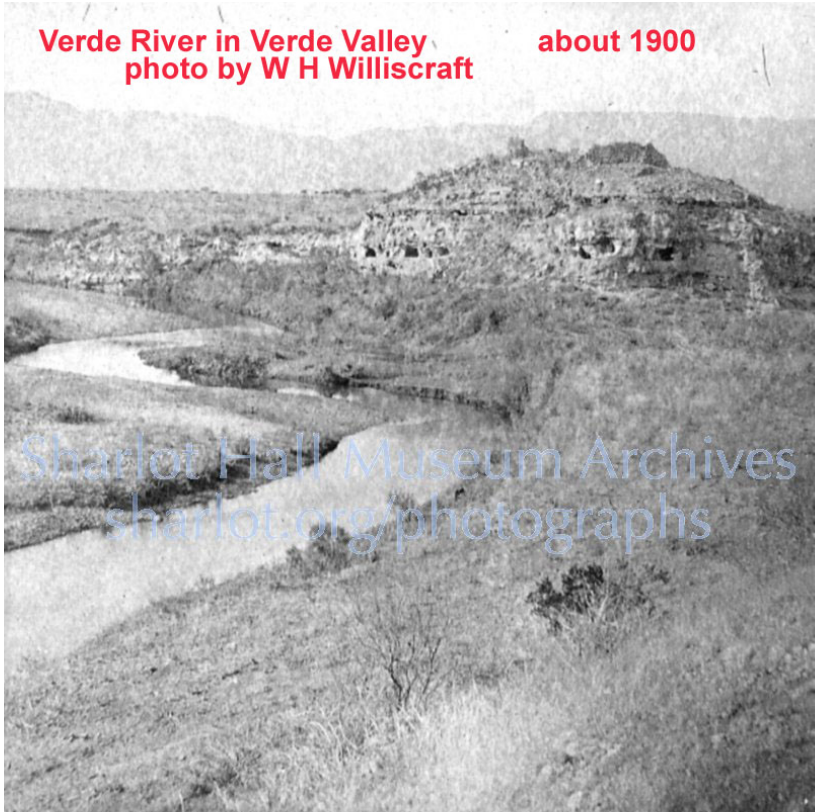


Verde River in Verde Valley Late 1800s
Sharlot Hall la104po



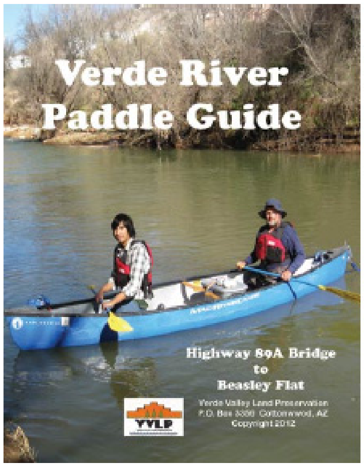
Verde River near Cottonwood, AZ 1934
Sharlot Hall br132pe

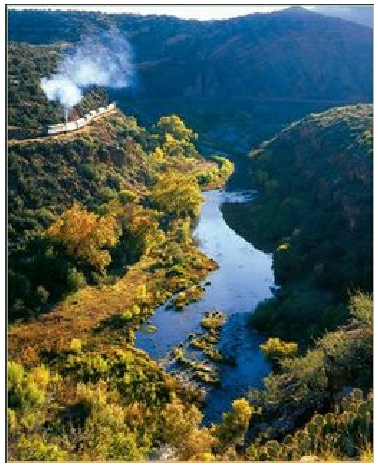
Verde River in Clarkdale area. 1930 Shatlot Hall la107pd

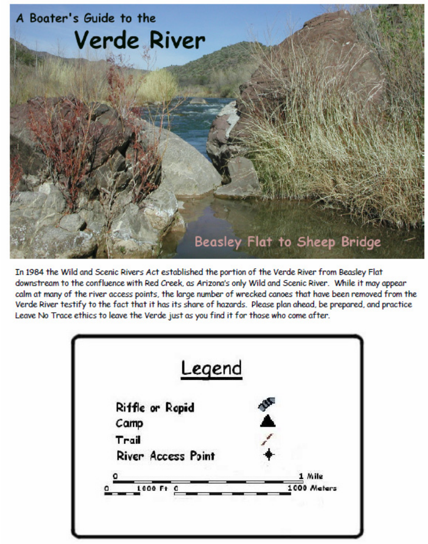

Verde River in Verde Valley
about 1900
photo by W H Williscraft
Sharlot Hall Museum Archives
sharlot.org/photographs


Verde River near Clarkdale, Az
Aug. 2014

Access all along the Verde River
Photos from *Verde River* Facebook page.



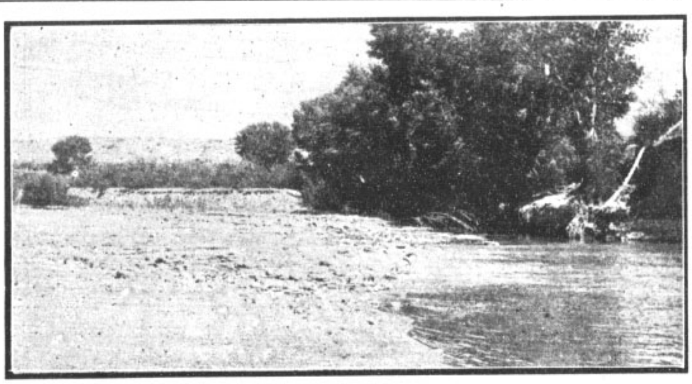




USFS, 2014, A boater guide to the Verde River, 24p. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fswdev3_009800.pdf

4 LOS ANGELES HERALD SUNDAY MAGAZINE NOVEMBER 1, 1908

WITH THE AMATEUR PHOTOGRAPHERS

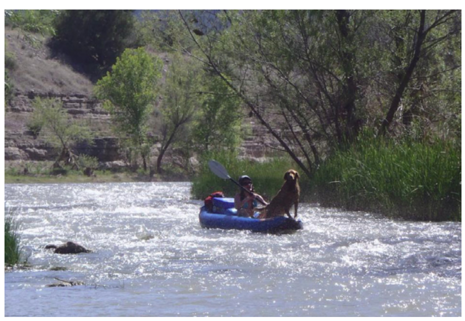


ON VERDE RIVER (Arizona) (First prize) HAROLD J. SCOTT

Cottonwood Ditch Diversion Dam


Navigability does not depend on an absence of occasional difficulties in navigation. *U.S. v. Holt State Bank*, 270 U.S. 49, 56 (1926). See also *United States v. Utah*, 283 U.S. at 84, 86 (noting that conditions created by flood deposits of logs and driftwood “do not constitute a serious obstacle to navigation” and that, with respect to shifting sandbars in the river channel, “the mere fact of the presence of such sandbars causing impediments to navigation does not make a river non-navigable”). See, for example, *Appendix H. - Examples* of navigating troubles along the Missouri River in 1811.

Photos from *Verde River* Facebook page




Upper Verde

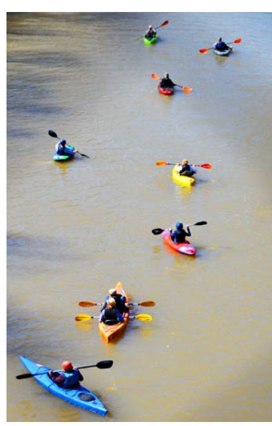
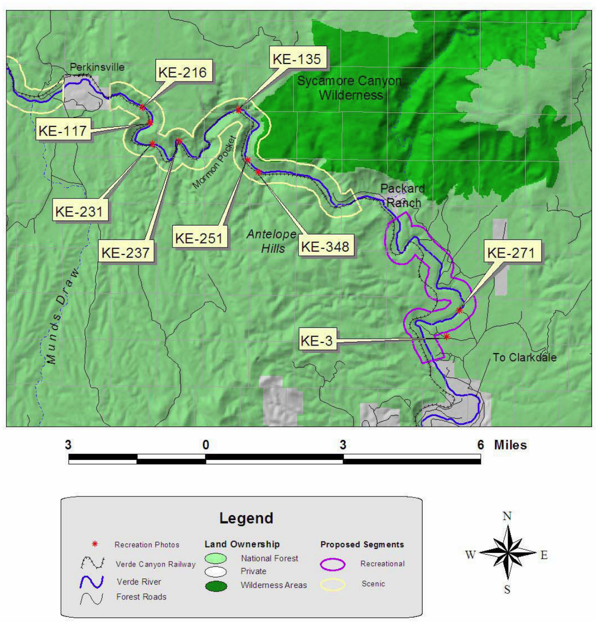




Photo from *Verde River* Facebook page.

KE-251: Canoeist surrounded by spring green box elder maples!

Photo Locations for Recreation ORVs



KE-135: Visitors aboard the scenic Verde Canyon Railroad.

Photos: Evans, K and McClain, C., 2005, Wild and Scenic River Proposal for The Upper Verde River, in conjunction with the Arizona Wilderness Coalition, 179p.

ANSAC held a public meeting in Prescott, Arizona on May 1, 2014 to gather lay testimony on the navigability issue of the Verde River. Several people testified regarding their boating on the Upper Verde River. One woman, who I understand is the County Ag Agent in Prescott area, testified she had kayaked all over the upper Verde River.

Beaver on Upper Verde.

Note person on right bank for scale.

Photo from *Verde River* on Facebook

“In 1826, Ewing Young along with a group of 30 men were working the Gila River and some of its tributaries. The Young party also worked up the Salt River to its junction with the Verde River. Here the party divided, part following the Verde River to its source and the other following the Salt River to its source in the White Mountains. The two groups rejoined and trapped down the Salt and Gila rivers to the Colorado River, where they enjoyed good beaver trapping (Hagen 1997).” (Carrillo, C., and others, 2009, An Overview of Historical Beaver Management in Arizona, *Wildlife Concerns Updates,* Proceedings of the 13th WDM Conference, p. 216-224.)

G1b.--Newspaper accounts related to navigability of Verde River

There is little evidence of early pioneer use of the Verde River for navigation. The area was remote and exploration of the watershed was dangerous, especially before about 1870, because of hostile Apache Indians.

The following newspaper account of April 2, 1892 indicates that the experienced Day brothers actually used a small boat for trapping beaver along the Verde River from Camp Verde (Verde River) to Yuma (Gila River). The reported trip took 6 months along 800 meandering river miles on the Verde, Salt and Gila Rivers. Reportedly, this was the 5th trip made by Mr. J. K. Day. When Mr. Day was appointed fish and game commissioner for Arizona a few years later, he reportedly knew as much about game than anyone else in the territory, According to the newspaper account, this was the 5th trip by Mr. Day and the brothers planned another trip the following September. There is no evidence that this newspaper account was in any way inaccurate. Also, because to the present day beaver occupy the upper Verde River. There is no reason to assume similar trapping with boats did not extend upstream to the mouth of Granite Creek.

A Long Journey.

On the first of September last J. K. Day and his brother George left Camp Verde, Yavapai county, in a small boat on a trapping expedition. They arrived in Yuma on Sunday, having made the journey in a little less than six months.

J. K. Day has been engaged in trapping for some years past and says that it requires only experience and a little patience to make a very remunerative profit out of the business. He brought a large quantity of furs, consisting of beaver and otter, which always command good prices, the demand for such pelts being always greater than the supply. The journey began on the beautiful limpid Verde river, which received its name of "green river," on account of the apparent color of the water, which is really clear as crystal, but its mirror-like surface reflects the verdure from each bank, giving it the appearance of being colored like the surrounding foliage. After leaving the Verde, the Rio Salado, or Salt river was entered, from which the trappers came down the Gila and soon found themselves at Yuma, their boat floating upon the waters of the great Colorado of the west. The distance traveled by the Messrs. Day by river is a trip over 800 miles, and is the fifth one made by J. K. Day.

The two trappers will leave by rail for Prescott within a few days and will repeat the trip next September.

The Arizona sentinel. (Yuma, Ariz.) 1872-1911, April 02, 1892, Image 1

Image provided by Arizona State Library, Archives and Public Records; Phoenix, AZ

Persistent link: http://chroniclingamerica.loc.gov/lccn/sn84021912/1892-04-02/ed-1/seq-1/

The above account is especially interesting because by using a small boat for beaver trapping shortly following two large floods in 1891, a well defined main channel is implied. Clearly, the channel recovers quickly following large floods.

Arizona republican. (Phoenix, Ariz.) 1890-1930, October 15, 1898, Page 5, Image 5

GAME COMMISSIONERS. — John McCarty and J. K. Day have been appointed fish and game commissioners for Arizona. The new commissioners know more about game, especially big game, than anybody else in the territory. Heretofore the duties of commissioner have not been onerous. There was nothing to do but draw salaries and make reports. It is not within the memory of any man now living that a report was ever submitted. As to the salary, no legislature ever made an appropriation or any other provision for it. It was not even fixed. So the commissioners have practically had nothing to do. The new commissioners, though, say they are willing to make work of it even if

yesterday morning.

J. C. Hall of Redlands, Cal., was i town yesterday.

V. Verney came down from Castl Creek hot springs last night.

J. H. W. Jensen returned to the cit last night.

—:0:—

THAT JOYFUL FEELING.

With the exhilerating sense of re newed health and strength and interna cleanliness, which follows the use c Syrup of Figs, is unknown to the fe who have not progressed beyond th old-time medicines and the cheap sub stitutes sometimes offered, but neve accepted by the well informed. Bu the genuine. Manufactured by the Cal ifornia Fig Syrup Co.

Arizona silver belt. (Globe City, Pinal County, Ariz.) 1878-19??, April 27, 1905, Page 2, Image 2

in the history of the section.

From the Prescott Journal-Miner.

Visitors here from Jerome state that Charles Hooker, William Cox, Ralph Smith and Walter Miller are preparing to leave that city to cruise to Phoenix on the Verde river. They will have about 200 miles of boating, and expect to make the trip in seven days. In places they will have to shoot rapids, and in others it will be necessary to carry their boat.

Weekly Arizona journal-miner. (Prescott, Ariz.) 1903-1908, May 10, 1905, Image 3

Wm. H. C. Blain's confectionery store in future.

Campbell Leaves.

Postmaster Tom Campbell left Jerome yesterday for California and expects to be absent for about two weeks.

Change in Date.

The date on which the Jerome fire department meets has been changed from May 17 to May 26.

MORE

Down Verde River.

The party of Jerome business men who will make the trip down the Verde river from Van Dering's crossing to Phoenix, are making preparations to leave here on May 20. The party expects two iron boats to arrive here shortly which they will use in making this cruise. It is stated now that as many as ten may make up the party.

RECEIVED WELL

Arizona Medicos Will Be Here In Early June

An Interesting Session Promised to The Visitors

THE SAN FRANCISCO CALL, SUNDAY, JANUARY 12, 1908.

Arizona Watershed to Be Saved for Conservation of Moisture to Reclaim Desert

SPECIAL DISPATCH TO THE CALL

WASHINGTON, Jan. 11.—The president has just signed a proclamation creating the Verde national forest in Arizona. This new national forest has an area of 721,780 acres and is located in Maricopa and Yavapai counties. It lies on the west side of the Verde river and includes a large portion of the watershed of this stream. Jerome, the headquarters of the United Verde copper mine, is situated in the northern part of this forest. West and southwest of Jerome are the Mingus mountains. There is a small area of commercial forest, which has been badly abused in the past, but which under proper management will furnish a small supply of timber to the local mining camp.

The greater part of the area of this forest is covered with a growth of brush without commercial value. The protection of this, however, is just as important as heavily forested land, for, as in the case in southern California, this scrubby growth is the only thing that conserves the water supply and protects the watershed of the Verde river from serious erosion.

The creation of this new national forest is considered necessary by the reclamation service for the best administration of the reclamation act, and the watershed has an important relation to the full development of the irrigable lands of Salt River valley. In order that the rich lands in this part of Arizona be brought to their highest development the watershed of the Verde river will be protected from damage through wasteful lumbering and overgrazing. Many parts of the forest have suffered from overgrazing by large bands of goats, and the protection of the brush cover will prevent further erosion and impairment of the water supply.

The forest service will by no means prohibit grazing in this new forest, but will endeavor so to regulate it that the watershed of the Verde river will not be injured. In this way an important source of water which converges toward Salt river and its tributaries will be protected for the ultimate development of the irrigated lands.

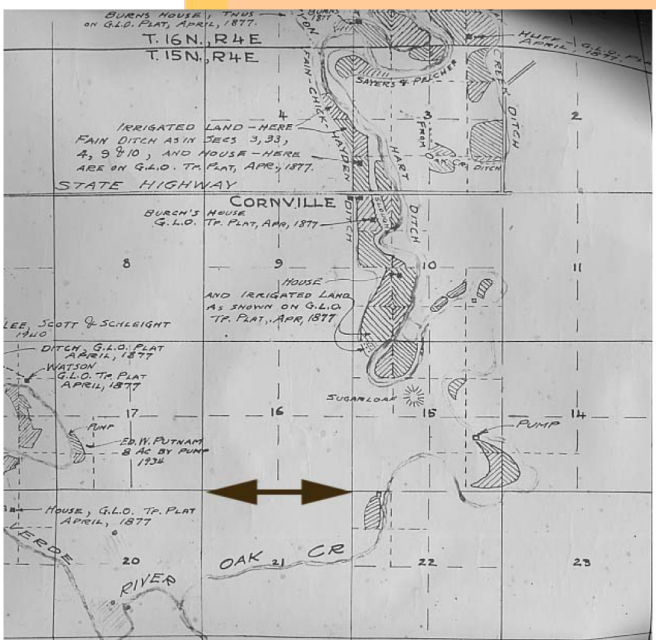
G1c. Cultivated land

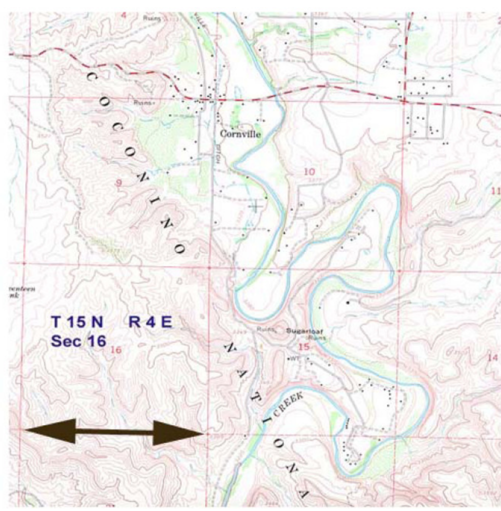
Black, John A., 1890, ARIZONA THE LAND OF SUNSHINE AND SILVER HEALTH AND PROSPERITY, THE PLACE FOR IDEAL HOMES, COMMISSIONER OF IMMIGRATION, Republican Book and Job Print, Phoenix, Arizona, 143p.

“As to areas now under cultivation and which may be brought under cultivation,the table here shown is based upon careful estimates closely verified by much inquiry from reliable sources, the first column showing the acreage now under cultivation and the second the estimated cultivable area:”

24 ARIZONA.

Flagstaff	2,500	10,000
Williams	1,200	5,000
Agua Fria	5,000	7,500
Prescott and vicinity to Little Chino	8,000	15,000
Upper Kirkland	1,000	5,000
Lower Kirkland	3,000	6,000
Thompson Valley	1,000	1,200
Skull Valley	2,500	8,000
Hassayampa	5,000	8,000
Peeples Valley	1,500	7,500
Upper Verde	570	2,000
Middle Verde	600	2,500
Lower Verde	1,500	4,500
Oak Creek	500	1,200
Beaver Creek	500	1,300
Williamson Valley	7,500	12,500
Turkey Creek	1,000	2,000
Chino Valley	2,000	75,000
Spring Valley	500	1,200
Mint Valley	300	600
Cataract Creek	1,200	2,000
The Mormon country	2,500	8,000
Outlying settlements	1,500	10,000
Total	50,870	196,000





Hayden, T. S., 1940, Irrigation on upper Verde River watershed from surface waters: unpublished report of SRP, 329 pages.

G1d.—Early descriptions of Verde River

Hodge, H. C., 1877, ARIZONA AS IT IS; OR, THE COMING COUNTRY, COMPILED FROM NOTES OF TRAVEL DURING THE YEARS 1874, 1875, AND 1876. NEW YORK: PUBLISHED BY HURD AND HOUGHTON. BOSTON : H. O. HOUGHTON AND COMPANY, 273p.

“The Verde River is one of the largest northern branches of Salt River, its upper branches rising at different points to the east, north, and northwest from Prescott. It becomes a fine river of eighty feet in width about fifty miles northeast from Prescott,and thence runs a southerly course to its junction with Salt River near Camp McDowell. Its whole course is about one hundred and fifty miles.” (Hodge,1877).

Greely, General A. W. and Glassford, Lieut. W. A., 1891, Report on the Climate of Arizona; EXTRACT FROM A LETTER OF THE SECRETARY OF WAR ON IRRIGATION AND WATER STORAGE IN THE ARID REGIONS, 51st Congress 2nd Session, House of Representatives, Exec. Doc. 287, 88p.

“The recent Indians when discovered by the Spanish conquerors lived by farming and then as now their farming was made possible by the artificial storage and carriage of water. Their period may be said to begin with the time when the present ruins along the valley of the Rio Verde were efficient channels watering rich lands, and has been continued to the present day.”

The following is from Chapter 7 of: Sabin, Edwin L., 1914, Kit Carson Days (1809-1868), CHICAGO, A. C. McCLURG & CO., 669p.

> “The Salido, wherever its banks were wooded, was a beaver resort. The Ewing Young party trapped down it until they reached the mouth of the Verde, or San Francisco a tributary coming from the north. As was the custom, they turned and trapped up the San Francisco, to its head.”
>
> "A fine, large stream," has been said of the San Francisco, in some cases rapid and deep, in others spreading out into wide lagoons. The ascent * * *by gradual steppes, which,, stretching into plains, abounded in timber. The river banks were covered with ruins of stone houses and regular fortifications; which * * *appeared to have been the work of civilized man, but had not been occupied for centuries. They were built upon the most fertile tracts of the valley, where were signs of acequias and cultivation.[14]
>
> Indians bothered the trappers almost nightly from the time they reached the San Francisco. Trapped animals were killed and animals and traps stolen. Meanwhile much fur was "caught." Twenty-two of the men were dispatched back to Taos, with the pelts, there to sell them and to buy more traps, for a fall hunt.”

"14, p. 46. Extract from the journal of Antoine Leroux, of Taos, who was a guide for Lieutenant A. W. Whipple, through the country, upon one of the Pacific Railroad explorations (Vol. 3, Pacific Railroad Surveys. Washington, 1856). Upon modern maps the San Francisco River is entitled the Verde."

Camp McDowell

Camp McDowell is on the west bank of the Rio Verde, eight miles above its junction with Salt river, in latitude 33 deg. 40 min., longitude 34 deg. 37 min., 1,800 feet above sea level. Cottonwood, willow and alder grow along the banks of the river, intermixed with grape vines yielding a small acid fruit. Mesquite, iron-wood, polo verde, artemisia, and species of *opuntia* and *cereus* cover the mesa, of which the more open parts furnish indifferent grazing. Scrub oak, live oak, and large pine are found on the Mazatsal range. There are quail and rabbit on the mesa, and a few deer on the mountains. The post garden furnishes a liberal supply of vegetables, raised by irrigation; the climate is warm and dry, but very extreme, ranging from 18 to 24 deg. in winter and 108 to 140 deg. in summer. Snow falls on the Mazatsal, but not on the mesa. The annual rain-fall varies from five to twenty inches. The fish of the Rio Verde are abundant, but soft and flavorless. The post was established by five companies of California volunteers in 1865. It is now commanded by Captain A. W. Corliss, eighth infantry, and is occupied by company C of that regiment and company I, sixth cavalry, numbering 5 officers and 87 enlisted men.

Hinton, J. R., 1878, The Hand-book to Arizona, Resources, history, towns, mines, ruins and scenery: Payot, Upham & Co., San Francisco, 593p.(with appendix)

Camp Verde

Hinton, J. R., 1878, The Hand-book to Arizona, Resources, history, towns, mines, ruins and scenery: Payot, Upham & Co., San Francisco, 593p.(with appendix)

Camp Verde is in latitude 34 deg. 33 min., longitude 34 deg. 57 min., at an elevation of 3,500 feet above the sea, and eighty feet above the Rio Verde, distant about a mile from its western bank; forty-seven miles east of Prescott, and ninety miles, by a rough trail, north of Camp McDowell. The valley of the Verde, though generally very narrow, is here about seven miles in width, with a rich, alluvial bottom and a luxuriant growth of cottonwood, willow, and alder. With irrigation, good crops of corn, barley, and vegetables are produced; and the company gardens, about a mile and a half above the post, furnish an excellent, varied, and abundant supply of vegetables. Pine timber is obtained from the Black mountains, which rise 3,000 feet

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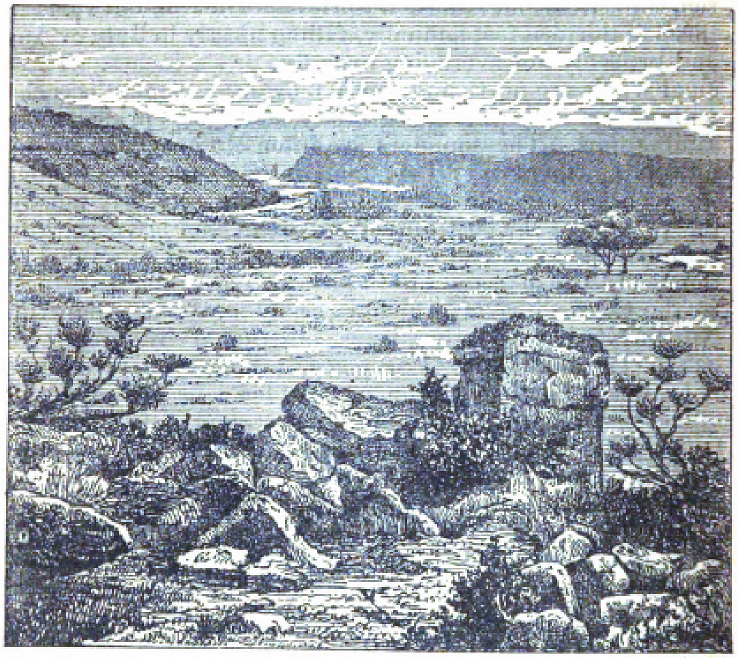
above the river. Deer, antelope, and wild turkeys abound. The annual rainfall varies from six to fourteen inches. The climate ranges from five to one hundred and thirteen degrees, with frosts as early as October. Companies A sixth cavalry, A and D eighth infantry, and B Indian scouts, are here stationed, under command of Captain C. Porter, eighth infantry;



VALLEY OF THE VERDE.

a total of 6 officers, 117 enlisted men, and 40 Indian scouts. The post was established under the name of Camp Lincoln, by Arizona volunteers, in 1861, as an outpost of Fort Whipple. It was first occupied by regular troops in 1866. Its location was, in 1871, on account of malaria, removed south about one mile, and it is now about half a mile south of the confluence of Beaver creek with the Verde.

Yavapai County

Hinton, J. R., 1878, The Hand-book to Arizona, Resources, history, towns, mines, ruins and scenery: Payot, Upham & Co., San Francisco, 593p.(with appendix) p. 43

it was removed back. The Territorial Governors have been John A. Goodwin, Levi Bashford and A. P. K. Safford — the latter of whom served over six years. Charles D. Poston was the first delegate to Congress. He was succeeded by Richard C. McCormick, who retained his position until 1875–6, when he was succeeded by Mr. Stevens, who is now serving in Congress. Florence was started not a very great while before. The census of 1870 gives the following distribution of population:

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YAVAPAI COUNTY.

Big Bug and Lynx Creek	96
Tollgate and Walnut Grove	107
Chino and Lower Granite Creeks	80
Date, Kirkland and Skull Creeks	90
People's Valley, etc	45
Prescott	668
Rio Verde	174
Salt River Valley†	240
Vulture Works	155
Vulture Mine	133
Walnut Grove	40
Wickenburg†	174
Williamson Valley	160

Ancient irrigating ditch in the Verde Valley.

Mindeleff, Cosmos, 1892, ABORIGINAL REMAINS In VERDE VALLEY, ARIZONA; THIRTEENTH ANNUAL REPORT, BUREAU OF ETHNOLOGY, TO THE SECRETARY OF THE SMITHSONIAN INSTITUTION, 1891-92, p.185-257.

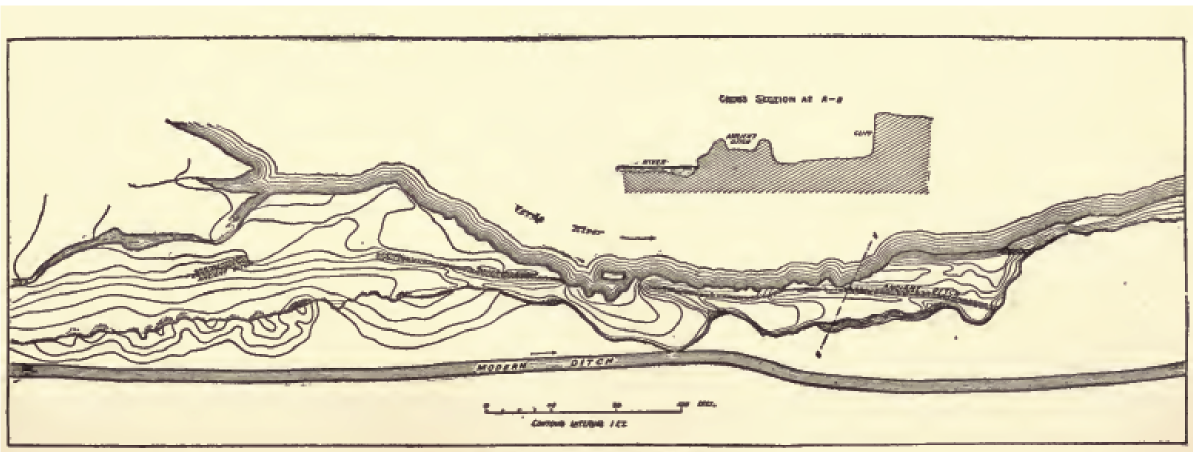


FIG. 299.—Map of an ancient irrigating ditch.

"[T]here is no reason to suppose that the ancient ditch did not irrigate nearly the whole area of bottom land. The ancient ditch is well marked by two clearly defined lines of pebbles and small bowlders, as shown in the illustration. Probably, these pebbles entered into its construction, as the modern ditch, washed out at its head and abandoned more than a year ago, shows no trace of a similar marking."(Mindeleff, 1892).

BUREAU OF ETHNOLOGY THIRTEENTH ANNUAL REPORT PL. XXXVII

OLD DITCH NEAR VERDE, LOOKING EASTWARD.

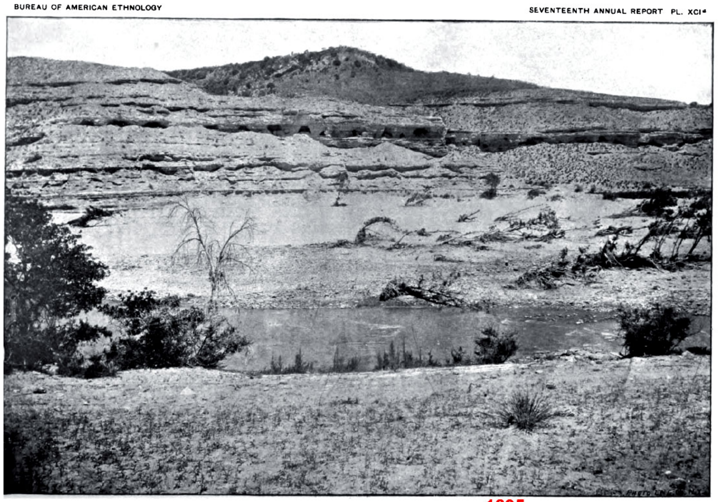
Old ditch near Verde in Verde Valley

The author Mindeleff presents a few hypotheses about when the ditches were used and the areas irrigated (Mindeleff, 1892,). Several ditches along the Verde River and tributary streams were identified by Mindeleff. According to Mindeleff the ditches could have been a few tens of years old rather than hundreds of years old.

This ditch was uncovered by the Feb. 1891 flood (Powell, 1906, p. 240). The flood of 1891 widened the channel greatly but in subsequent years vegetation became established and the width gradually became restricted (Leopold and Wolman , 1957, p.5). Note the defined single channel shortly following the 1891 flood.

Looking across from right side of Verde River in 1895 in Camp Verde area.

BUREAU OF AMERICAN ETHNOLOGY SEVENTEENTH ANNUAL REPORT PL. XCI



CAVATE DWELLINGS—RIO VERDE 1895

Fewkes, J. W., 1895, Archeological Expedition to Arizona in 1895; Seventeenth ANNUAL REPORT, BUREAU OF ETHNOLOGY, TO THE SECRETARY OF THE SMITHSONIAN INSTITUTION, 1895-96, 752p..

CLIFF DWELLERS.

The *Prescott Journal* thus speaks of a trip lately made to the cliff dwellers: The party of ladies and gentlemen left Prescott and had a picnic in a picturesque glen near the military post, and General Crook went out for a hunt, while the Governor and Lieutenants Morgan, Maus, and McCreery procured a small boat and were ferried part way across the river, wading the balance of the way, and proceeded a distance of five miles on foot, when they came to a place where well-preserved ruins of these cliff dwellers are to be found.

VERDE RIVER at Camp Verde

Elliott, W.W., 1884, History of Arizona Territory, showing its resources and advantages; Wallace W. Elliott and Co., 374p.

The Verde River is one of the largest northern branches of Salt River, its upper branches rising at different points to the east, north, and northwest

from Prescott. It becomes a fine river of eighty feet in width about fifty miles northeast from Prescott, and thence runs a southerly course to its junction with Salt River near Camp McDowell. Its whole course is about one hundred and fifty miles. The

Hodge, H. C., 1877, Arizona as it is, or The Coming Country, NOTES OF TRAVEL DURING THE YEARS 1874, 1875, AND 1876; NEW YORK:PUBLISHED BY HURD AND HOUGHTON. BOSTON : H. O. HOUGHTON AND COMPANY. 273p.

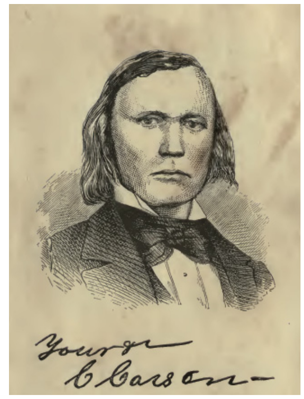
Sacramento Daily Union, Volume 32, Number 4877, 14 November 1866 — LETTER FROM ARIZONA. [ARTICLE]

granite to a sort of burnt lava rock. In the evening we had a heavy rain. July 16th— Went northeast twelve miles over a lava, and, in some places, granite country, which was covered with good grass to the Rio **Verde**, or, as some call it, the San Francisco **river.** We descended to the **river** through a long and rather ugly canyon. The stream was low at the time we crossed it ; it was, nevertheless, very rapid, and is about as large as the north fork of your Feather **river,** and runs through some large tracts of rich cotton land, which are already under cultivation. We caught plenty ot lish in the **river.** We saw cottonwood, mezquit, ash, willow and sycamore ; pine grows on the mountains near by. Found about twenty-five men who were engaged in farming. Corn, wheat and vegetables looked well. Two companies of the **Arizona** First (Mexicans) were stationed here. Formation lava and shale ; to the south it is granite. For fifty miles above the settlement/I was told, there are good ranches to be had, and I think I will live to see the day when every acre of it will be tilled or grazed." It has an excellent climate and is certain to be occupied by the white man. All over this long valley there "are ruins of ancient dwellings, vestiges of former civilization and industry, which, no doubt were destroyed by the hands of the ruthless Apache. A few miles below the settlements the **river** runs through a long, deep canyon, roaring, boilingand surging until its confluence with Suit **river.** This **river** takes its rise in the San Francisco mountain and in the mesa to the east of said mountain! Above the crossing a large stream named Beaver creek flows into the valley ; below, Clear creek conies rushing down, until it reaches the dam built by the settlers, from whence it is carried in ditches to irrigate the various farms. July 17th— Lay over in camp. July 18th — Lay over in camp. July 19th— Struck out southeast, crossed ! Clear and Sycamore creeks, and camped in a valley where we found Mexican soldiers with Apache prisoners and Apache scalps. They were commanded by the famous Lieutenant Gallego3, he who has so often carried terror to the heart of Apachedom. When a boy he was among these Indians, learned their language and became acquainted with their haunts. The country passed over to-day is lava formation, with plenty of timber on the creek bottoms, and excellent water and grass. The climate is warm. July 20th— To-day we went over a very rugged country and camped on a large, beautiful mountain stream called " Fossil Creek "—formation, lava. I also saw white bed rock, resembling porphyry. Prickly pears plenty. July 21st— Climbed very steep mountain to top of Mesa, and after traveling some nine miles camped in a beautiful valley, surrounded by mountains covered with pine and oak. Water and grass plenty. July 22d— Climbed still higher, to top of the great range of mountains "that divides the waters of the Little Colorado from those of the Gila. To the north, we saw the giant form of the San Francisco Mountains; to the northeast, the plains of the Little Colorado, and to the south, Tonto Basin and another large range of bald mountains — iormation, sandstone and lava. Camped on creek running north. To the northwest there are forests of pine, oak, etc., for

Carson trapped along the Verde.

"A common misconception is that trappers used canoes. They used mules to transport beaver pelts. Also, accounts of beaver trapping are sparse partly because they entered Spain's territory illegally and did not wish to become Spain's prisoners. It could be said they were men of deeds and of few words but, in fact, some could neither read or write." (Peters, 1875),

After this fight, Young's party trapped down the Salt River to San Francisco River, and thence on up to the head of the latter stream. The Indians failed not to hover on their pathway, and to make nightly attacks upon their party. Frequently they would crawl into camp and steal a trap, or kill a mule or a horse, and do whatever other damage they could secretly. At the head of the San Francisco River the company was divided. It was so arranged, that one party was to proceed to the valley of the Sacramento in California. Of this detachment Kit Carson was a member.



Peters, D. C., 1875, Kit Carson's Life and Adventures, from facts narrated by himself; Dustin, Gilman and Co., 604p

Davis, A.P., 1897, Irrigation near Phoenix Arizona, USGS Water Supply Paper 2, 98p.

Record of precipitation at Fort Verde, Yavapai County.

[Latitude 34° 32′, longitude 111° 47′; elevation, 3,160 feet. Authority, Signal Service and United States Hospital Service.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Total.
1868–69...	......	......	......	0.27	0.34	1.72	1.00	0.09	0.03	0.83	0.07	7.26	....
1869–70...	0.00	0.02	4.04	0.00	0.50	0.01	0.50	0.15	0.00	0.22	3.06	0.89	9.39
1870–71...	0.00	0.60	0.10	0.58	0.20	0.00	0.04	0.73	0.00	0.00	0.84	0.26	3.35
1871–72...	1.00	1.10	0.39	0.26	0.47	1.12	0.16	1.56	0.54	0.22	2.22	4.35	13.39
1872–73...	1.12	0.10	0.00	0.83	0.00	1.16	0.00	0.00	0.15	0.20	0.14	2.52	6.22
1873–74...	0.26	0.00	0.74	3.26	2.65	2.05	1.05	1.48	0.08	0.00	1.88	2.48	15.93
1874–75...	0.00	1.45	3.52	0.66	2.91	0.05	0.30	T.	0.06	0.00	3.33	2.01	14.29
1875–76...	1.35	0.00	0.65	0.13	2.06	0.75	1.00	0.75	0.00	0.98	5.31	12.08	25.06
1876–77...	2.40	2.10	0.15	0.00	0.71	0.51	0.89	0.85	1.70	0.00	0.70	0.41	10.42
1877–78...	2.08	0.45	0.05	2.23	0.14	1.12	1.84	1.75	0.16	C.06	2.10	4.60	16.56
1878–79...	0.98	0.00	0.36	1.24	0.20	0.14	0.00	0.10	0.00	0.00	0.97	0.53	4.52
1879–80...	1.40	0.23	2.40	3.03	1.08	0.13	0.30	0.27	0.00	0.16	1.85	0.97	11.82
1880–81...	0.19	0.57	0.13	1.56	0.07	0.12	2.64	0.97	0.07	T.	1.41	7.53	15.26
1881–82...	1.88	0.20	0.21	0.27	2.72	0.93	0.01	0.03	0.19	1.35	1.25	1.18	10.22
1882–83...	2.16	0.25	1.73	0.07	0.44	1.35	1.63	0.12	0.27	0.04	3.35	1.14	12.55
1883–84...	0.00	0.45	0.00	4.30	0.39	3.59	3.60	1.43	0.72	0.23	0.19	1.24	16.14
1884–85...	0.68	0.84	0.15	4.66	0.00	0.80	2.25	0.69	0.19	0.05	0.84	3.01	14.16
1885–86...	0.03	0.61	1.88	0.52	1.90	1.48	2.09	0.82	0.02	0.01	0.18	3.18	12.72
1886–87...	0.20	0.13	0.55	0.60	0.04	0.78	0.02	0.58	0.60	0.18	3.11	2.96	9.75
1887–88...	4.72	0.00	1.37	0.87	0.96	1.56	1.78	0.43	0.96	0.00	2.21	0.73	15.59
1888–89...	0.56	4.47	2.80	3.15	1.95	0.25	1.66	0.00	0.00	0.02	3.10	0.75	18.71
1889–90...	1.60	1.74	0.08	5.08	1.39	1.97	1.35	0.82	0.01	0.00	1.83	2.30	18.17
1890–91...	0.55	[1.50]	[3.65]	[1.72]	......	......	......	......	......	......	......	......	....
Mean...	1.05	0.76	1.13	1.53	0.96	0.96	1.10	0.62	0.26	0.21	1.82	2.84	13.24

G1e.—Mines in the watershed with a sample of water use at one mine.

PREFACE

Yavapai, the treasure county of Arizona, has developed its mines beyond the speculative stage and is now regarded as one of the richest mineral fields in the country. Yet it is merely on the threshold of activity, and although accredited with more patented mines than any other subdivision of the Territory, its mineral resources still far outstrip its developments.

The records give to this county a greater number of mining locations and operators than is contained by the combined number of any other three counties in Arizona. Hinton, the statistician, states that up to October 1, 1876, of 11,605 mines located and recorded in the Territory, 7, 298 were in the county of Yavapai. Since then, however, the proportion has materially changed.

Arizona mines are being worked to much greater depth than in former years, and the once much-mooted story that "Arizona mines don't go down," has been disproved repeatedly. At mines where early developments consisted merely in burrowing the surface for rich free metal and which finally were said to have "pinched out," modern operators have discovered that by the use of recent and heavy machinery greater profits can be made to accrue than ever before. It has been demonstrated very fully that the prime value of the mineral industry in this region lies in the deep mining.

This mining directory—the first ever issued in the Territory—has been difficult of compilation, but after months of careful preparation is presented to the public as a work that furnishes a ready guide to any mining property of importance located between the long boundary lines of Yavapai county. The selection of the more prominent mines, and groups of mines, including a complete list of all patented claims and those surveyed for patent on record in the United States Land Office has been so arranged as to afford easy reference.

Courtesies and valuable assistance from Mr. Ernest A. Haggott, M. E., from the Register and the Receiver of the United States Land Office, and from the County Recorder are gratefully acknowledged.

RUSSELL H. MILLWARD.

Arizona Mining Directory

A DIRECTORY OF

Arizona's Mines, Mining Districts
Owners or Operators

AND

POSTOFFICE ADDRESSES
(Yavapai County)

Published by
The Arizona Mining Directory
Prescott, Arizona
Price $2.50

Millwood, R. H., 1903, Arizona's Mines, Mining Districts Owners and Operators and post office addresses (Yavapai County), The Arizona Mining Directory, 60p.

The following are many of the mines in the Verde River Watershed. Several mines in the Prescott area (Bradshaw District) are not included because of the difficulty in separating mines in the Hassayampa, Agua Fria and Verde River watersheds.

CHERRY CREEK DISTRICT

Allen Group	W. D. Powell, et al
Angora, et al	W. S. Golden
Anthony	Pfau Gold Mining & Reduction Company
Big Rattler (Golden Idol Group)	Dick Lyons
Black Dyke Group	A. H. Lyons, D. M. Bartholdi & C. E. Nathorst
Blue Bell	Richard Brown
Bobolink, et al	E. R. Hotsenpiller
Brindle Pup	Mingus Mountain Copper Company
Buffalo	M. Bradley & W. Christman
Bugler	R. H. Burmister
Cactus Mill Site, P	L. M. Wombacher & J. R. Boyer
Conger, P	L. M. Wombacher & J. R. Boyer
Cornucopia Group	Cornucopia Gold & Copper Mining Co.
Cross Cut, P	L. M. Olden, M. A. Carrier & W. Munds
Delta	Mona Gold Mining & Milling Company
Eagle	J. G. Allen
Etta, P. (Etta Group)	Etta Mining & Milling Company
Etta Mill Site, P. (Etta Group)	Etta Mining & Milling Company
Golden Idol (Golden Idol Group)	Dick Lyons
Gold King	W. D. Powells, et al
Gold Queen	Mrs. Martha Withers
Gold Ring, P	Mrs. Martha Withers
Grand View	Mrs. Martha Withers
Gold Load	R. H. Burmister

Name of Claim or Group.	Name of Owner or Operator.
Gulchh, P.	L. M. Olden, M. A. Carrier & W. Munds
Hillside	J. R. Boyer
Hopper Group	James Brockman
Ida, P.	Mrs. Martha Withers
Iowa Group	L. M. Wombacher
Lagonda (Cornucopia Group)	Cornucopia Gold & Copper Mining Co.
Leghorn	R. H. Burmister
Lion Group	Lion Gold Mining Company
Little Johnnie	R. H. Burmister
Lyons Group	Dick Lyons
Mammoth	F. A. Briffar
Mocking Bird	Monarch Mining Company
Monarch Group	Monarch Mining Company
Monarch Group	Monarch Gold and Copper Mining Company
Mona Group	Mona Gold Mining & Milling Company
Myrtle Group	Myrtle Gold Mines, Ltd.
O. K. Lode	R. H. Burmister
Omega (Golden Idol Group)	Dick Lyons
Pitman (Cornucopia Group)	Cornucopia Gold & Copper Mining Co.
Porphyry (Cornucopia Group)	Cornucopia Gold & Copper Mining Co.
Potomac, P	Mrs. Martha Withers
Quo Vadis	Federal Mining & Milling Company
Racine (Cornucopia Group)	Cornucopia Gold & Copper Mining Co.
Red Cloud	R. H. Burmister
Red Hill	Pfau Gold Mining & Reduction Company
Red Horse	Willis Cross
Royal	R. H. Burmister
Safe (Cornucopia Group)	Cornucopia Gold & Copper Mining Co.
Side Issue (Golden Idol Group)	Dick Lyons
Sitting Bull, P.	Mrs. Martha Withers
Standard	R. H. Burmister
St. Clair	Pfau Gold Mining & Reduction Company
The Ernest	E. R. Hotsenpiller
Valley, et al	Pfau Gold Mining & Reduction Company

MINT VALLEY DISTRICT.

Name of Claim or Group.	Name of Owner or Operator.
Bald Butte	W. A. Cline
Cline Group	W. A. Cline
Jerome Canon Group	Jerome Canon Copper Company
Val Menta	Val Menta Mines Company

VERDE DISTRICT.

Admiral (Verde Queen Group)	Verde Queen Copper Company
Alice, P. (News Group)	Charles R. Leonard
Aipha	Verde Apex Copper Mining Company
Amazon, P. (Badger Group)	George A. Treadwell Mining Co.
Amity, P	United Verde Copper Company
Anchor (Verde Queen Group)	Verde Queen Copper Company
Anita, P. (News Group)	Charles R. Leonard
Azure Northwestern No. 1, P	United Verde Copper Company
Azure Southeastern No. 1	United Verde Copper Company
Badger, P. (Badger Group)	George A. Treadwell Mining Co.
Bear Lode P. (Badger Group)	George A. Treadwell Mining Co.
Bear Lode, P	Copper Chief Mining Company
Bellevue, P	United Verde Junior Copper Mining Co.
Bessie (Verde Queen Group)	Verde Queen Copper Company
Binnacle (Verde Queen Group)	Verde Queen Copper Company
Bitter Creek, P	United Verde Extension Mining Co.
Black Horse	Verde Apex Copper Mining Company
Black Horse, P. Badger Group)	George A. Treadwell Mining Co.
Black Nine (Verde King Group)	Verde King Copper Co.
Blind Fraction (Lucky Verde Group)	Lucky Verde Copper Co.
Blizzard (Decatur Group)	Decatur Copper Mining Company
Blow Out, P	Consolidated King Dev. & Columbia Copper M. Co.
Blue Bell, P. (Cliff Group)	George A. Treadwell Mining Co.
Blue Bird (Verde King Group)	Verde King Copper Company
Bowsprit (Verde Queen Group)	Verde Queen Copper Company
Brookshire Group	Brookshire Mining Co., Geo. A. Treadwell M. Co.
Buncomb	Cleopartra Copper Company
Butte (Verde King Group)	Verde King Copper Company

Name of Claim or Group.	Name of Owner or Operator.
Capstain (Verde Queen Group)	Verde Queen Copper Company
Champion, P.	C. W. Clark & J. L. Giroux
Chatauqua, P.	L. Gadette, E. O. Allison, et al
Cherry, P. (Cliff Group)	George A. Treadwell Mining Co.
Chrome No. 1, S. E. Ext., P.	United Verde Copper Company
Chrome Northwest No. 1, P.	United Verde Copper Co.
Chrome Mill Site, P.	United Verde Copper Company
Cleopatra	Cleopatra Copper Company
Cleopatra Fraction	Consolidated King Dev. & Columbia Copper M. Co.
Cliff, P. (Cliff Group)	George A. Treadwell Mining Co.
Climax (Verde King Group)	Verde King Copper Company
Cloverdale, P. (Badger Group)	George A. Treadwell Mining Co.
Columbia (Verde Queen Group)	Verde Queen Copper Company
Columbia Group	Consd. King Dev. & Columbia Copper M. Co.
Columbian, P.	United Verde Junior Copper Mining Co.
Columbus, P.	Consd. King Dev. & Columbia Copper M. Co.
Commander (Verde Queen Group)	Verde Queen Copper Company
Commodore (Verde Queen Group)	Verde Queen Copper Company
Compass (Verde Queen Group)	Verde Queen Copper Company
Conglomerate, P.	United Verde Extension Mining Co.
Copper Bell, P.	Equator Mining & Smelting Company
Copper Chief, P. (Copper Chief Group)	Copper Chief Mining Co.
Copper Chief, P.	G. W. Hull
Copper Glance, P.	United Verde Junior Copper Mining Co.
Copper Plate, P. (Badger Group)	George A. Treadwell Mining Co.
Copper Prince (Lucky Verde Group)	Lucky Verde Copper Co.
Copper Wonder (Verde Queen Group)	Verde Queen Copper Co.
Coxswain (Verde Queen Group)	Verde Queen Copper Company
Crandell Group	Mrs. L. S. Crandell, E. H. Meek, Agent
Crown Point	Verde Apex Copper Mining Company
Crystal	C. W. Woods
Daisy, P.	United Verde Copper Company
Decatur Group	Decatur Copper Mining Company
Deer Trail, P.	United Verde Junior Copper Mining Co.
Descansco	Black Hills Copper Company, Ltd.
Diamond, P.	United Verde Copper Company
Domingo	Black Hills Copper Company, Ltd.
Dwarf, P.	Equator Mining & Smelting Company
East Ext. Grand Bounce, P. (Brookshire Group)	G. A. Treadwell M. Co.
East Red Rock (Decatur Group)	Decatur Copper Mining Co.
"1888," P.	Consd. King Dev. & Columbia Copper M. Co,
"1899," P.	Equator Mining & Smelting Company
E. L. D.	Venture Hill Mining Company
Elenor	Verde Apex Copper Mining Company
Ella	Cleopatra Copper Company
El Paso, P. (Badger Group)	George A. Treadwell Mining Co.
End Line, P.	Copper Chief Mining Company
Ensign (Verde Queen Group)	Verde Queen Copper Company
Equator Group	Equator Mining & Smelting Co.
Eureka, P.	United Verde Copper Company
Eureka (Lucky Verde Group)	Lucky Verde Copper Company

Name of Claim or Group.	Name of Owner or Operator.
Eureka S. Ext., P	Consd. King Dev. & Columbia Copper M. Co
Eureka Group	Eureka Gold & Copper Mining Company
Exchange (Pastime Group)	George A. Treadwell Mining Co.
Expectation	Consd. King Dev. & Columbia Copper M. Co.
Fisher's Corner, P	Consd. King Dev. & Columbia Copper M. Co.
Florencia, P	W. A. Clark, et al
Forecastle (Verde Queen Group)	Verde Queen Copper Company
Fraction, P. (Brookshire Group)	George A. Treadwell Mining Co.
Fraction, P	United Verde Copper Company
Fractional Claims A B C D & E	George A. Treadwell Mining Co.
Galveston, P. (Badger Group)	George A. Treadwell Mining Co.
Gertrude (Verde Queen Group)	Verde Queen Copper Company
Gift, P	United Verde Copper Company
Globe, P. (News Group)	Charles R. Leonard
Golden Eagle, P. (Badger Group)	George A. Treadwell M. Co.
Gold Hill (Verde King Group)	Verde King Copper Company
Gold Reef	Ross & O'Sullivan
Good Enough, P	Equator Mining & Smelting Co.
Grand Bounce, P. (Brookshire Group)	George A. Treadwell M. Co.
Grand Prize	Venture Hill Mining Company
Great Verde Group	Great Verde Copper Company
Green Flower, P	A. W. Whittaker, L. M. Olden & W. W. Nichols
Green Monster, P	George A. Treadwell M. Co. & G. W. Hull
Green Monster Ext., P	George A. Treadwell M. Co. & G. W. Hull
Greenup, P	A. W. Whittaker, L. M. Olden & W. W. Nichols
Ground Hog, P. (Badger Group)	George A. Treadwell M. Co.
Gunsite	Cleopatra Copper Company
Harryhausen Group	Chris Harryhausen
Hermit, P	United Verde Copper Company
Homestead	J. J. Milliken, M. A. Milliken & J. A. Milliken
Hope, P	Consd. King Dev. & Columbia Copper M. Co.
Iron Carbonate, P	United Verde Extension Mining Company
Iron King, P	United Verde Copper Company
Iron King Group	United Verde Copper Company
Iron Range (Verde King Group)	Verde King Copper Company
Jackstaff (Verde Queen Group)	Verde Queen Copper Company
January, P. (News Group)	Charles R. Leonard
Jerome, P	Consd. King Dev. & Columbia Copper M. Co.
Jesse James	Verde Apex Copper Mining Company
Jibstay (Verde Queen Group)	Verde Queen Copper Company
John, P. (Cliff Group)	George A. Treadwell Mining Co.
Jonathan, P. (Cliff Group)	George A. Treadwell Mining Co.
Juniper	Venture Hill Mining Company
Kendrick	Consd. King Dev. & Columbia Copper M. Co.
Key West	Black Hills Copper Company, Ltd.
Klondike, P. (News Group)	Charles R. Leonard
Last Chance (Verde King Group)	Verde King Copper Co.
Legal Tender	Venture Hill Mining Company
Leotta	Decatur Copper Mining Company
Limbo, P. (Badger Group)	George A. Treadwell Mining Co.
Lime Point (Verde King Group)	Verde King Copper Co.

Name of Claim or Group.	Name of Owner or Operator.
Lime Cap, P	Consd. King Dev. & Columbia Copper M. Co.
Lion, P	Copper Chief Mining Company
Lion, P	Consd. King Dev. & Columbia Copper M. Co.
Little Daisy, P	J. J. Fisher
Little Joe, P. (Badger Group)	George A. Treadwell Mining Co.
Loan Pine, P. (Badger Group)	George A. Treadwell Mining Co.
Lone Pine (Verde King Group)	Verde King Copper Company
Lone Pine No. 2 (Verde King Group)	Verde King Copper Co.
Lone Pine No. 3 (Verde King Group)	Verde King Copper Co.
Lone Star	J. C. Talbott, et al
Lost, P	Consd. King Dev. & Columbia Copper M. Co.
Lost Chord, P	United Verde Copper Company
Lucky Boy, P	Consd. King Dev. & Columbia Copper M. Co.
Lucky Boy, P	United Verde Copper Company
Lucky Boy S. Ext., P	United Verde Copper Company
Lucky Verde Group	Lucky Verde Copper Company
Lulu (Verde Queen Group)	Verde Queen Copper Company
Magazine (Verde Queen Group)	Verde Queen Copper Company
Maine, P	Consd. King Dev. & Columbia Copper M. Co.
Mainstop (Verde Queen Group)	Verde Queen Copper Company
Manilla, P. (News Group)	Charles R. Leonard
March, P	United Verde Extension Mining Company
March Group	United Verde Extension Mining Company
Marietta (Verde Queen Group)	Verde Queen Copper Company
Marion, P. (News Group)	Charles R. Leonard
Master (Verde Queen Group)	Verde Queen Copper Company
May Queen, P	Consd. King Dev. & Columbia Copper M. Co.
Meek-Smith Group	E. H. Meek, Agent
Mineral Point, P	Consd. King Dev. & Columbia Copper M. Co.
Mising Link	Verde Apex Copper Mining Company
Missing Link, P	Consd. King Dev. & Columbia Copper M. Co.
Missouri, P. (Brookshire Group)	George A. Treadwell Mining Co.
Monmont, P	L. Gadette & W. S. Owen
Mountain Key	Thomas Carroll
Mountain Vein	Thomas Carroll
Mountain View	Black Hills Copper Company, Ltd.
Muscal, P	L. Gadette & W. S. Owen
Muscal, P	Consd. King Dev. & Columbia Copper M. Co.
Nancy, P	L. Gadette, E. O. Allison, et al
Needle Point (Verde King Group)	Verde King Copper Co.
Nelly	George A. Treadwell Mining Co.
Neutral Strip, P. (News Group)	Charles R. Leonard
News, P. (News Group)	Charles R. Leonard
New Year, P	Equator Mining & Smelting Company
Ninety Eight, P. (Badger Group)	George A. Treadwell Mining Co.
Noel, P	Equator Mining & Smelting Company
Nos. 1, 2, 3	Cleopatra Copper Company
Nos. 6, 7, 19	Consd. King Dev. & Columbia Copper M. Co.
No. 6 Fraction	Consd. King Dev. & Columbia Copper M. Co.
No. 12, P	Consd. King Dev. & Columbia Copper M. Co.
No. 13, P	Consd. King Dev. & Columbia Copper M. Co.

Name of Claim or Group.	Name of Owner or Operator.
No. 99	Cleopatra Copper Company
Oddity	United Verde Copper Company
Olympia (Olympia Group)	Black Hills Copper Company, Ltd.
Omega	Verde Apex Copper Mining Company
101, 102, 103, P	G. W. Hull, et al
Oregon, P. (Brookshire Group)	George A. Treadwell Mining Co.
Oversight, P. (Brookshire Group)	George A. Treadwell Mining Co.
Pastime (Pastime Group)	George A. Treadwell Mining Co.
Pinnacle (Verde King Group)	Verde King Copper Company
Ponce, P	Equator Mining & Smelting Company
Porrus Iron, P	Archie St. Peter
Prince, P. (Brookshire Group)	George A. Treadwell Mining Co.
Prosperity	Verde Consolidated Copper Company
Protector, P. (Brookshire Group)	George A. Treadwell Mining Co.
Quarter Deck (Verde Queen Group)	Verde Queen Copper Co.
Railroad, P	Consd. King Dev. & Columbia Copper M. Co.
Red Jacket, P	United Verde Copper Company
Red Line, P	Consd. King Dev. & Columbia Copper M. Co.
Red Rock (Verde King Group)	Verde King Copper Company
Red Willow, P	United Verde Junior Copper Mining Co.
Reservation, P	United Verde Junior Copper Mining Co
Revenue, P. (Badger Group)	George A. Treadwell Mining Co.
Rock Butte (Verde King Group)	Verde King Copper Company
Sand Reef	George A. Treadwell Mining Co.
Seep, P	United Verde Copper Company
Sherman, P	Copper Chief Mining Company
Sibony, P	Equator Mining & Smelting Co.
Side Issue (Decatur Group)	Decatur Copper Mining Company
Side Line, P. (News Group)	Charles R. Leonard
Signal (Verde Queen Group)	Verde Queen Copper Company
Sigsbee	Venture Hill Mining Company
Silent	Cleopatra Copper Company
Silver Cliff No. 2 (Verde King Group)	Verde King Copper Co.
Silver Giant, P	Consd. King Dev. & Columbia Copper M. Co.
Silver Plate, P	Equator Mining & Smelting Co.
Silver Top, P. (Brookshire Group)	George A. Treadwell Mining Co.
16 to 1, P	L. Gadette
Smoke House, P	United Verde Copper Company
Snow Flower, P	Copper Chief Mining Company
Socrates	Venture Hill Mining Company
South Hampton, P	Consd. King Dev. & Columbia Copper M. Co.
South Plat, P	Equator Mining & Smelting Co.
Spoke & Stone Wall	George A. Treadwell Mining Co.
Spring, P	Consd. King Dev. & Columbia Copper M. Co.
Station, P	Consd. King. Dev. & Columbia Copper M. Co.
Steamboat, P	L. Gadette & W. S. Owen
Sullivan (Verde King Group)	Verde King Copper Company
Sunny South	Cleopatra Copper Company
Three Sisters, P	Consd. King Dev. & Columbia Copper M. Co.
Topaz, P	Equator Mining & Smelting Co.
Toughnut, P	Copper Chief Mining Company

Name of Claim or Group.	Name of Owner or Operator.
Tower, P (News Group)	Charles R. Leonard
Treadwell (Pastime Group)	George A. Treadwell Mining Co.
Treadwell	Cleopatra Copper Company
Tufa (Verde King Group)	Verde King Copper Company
Union Jack, P. (Cliff Group)	George A. Treadwell Mining Co.
United States, P	Copper Chief Mining Company
Van Zandt, P. (News Group)	Charles R. Leonard
Venture No. 1 N., P	United Verde Copper Company
Venture No. 1 S., P	United Verde Copper Company
Venture Hill Group	Venture Hill Mining Company
Verde (Verde King Group)	Verde King Copper Company
Verde, P	W. A. Clark, et al
Verde Group	United Verde Copper Company
Verde Consolidated Group	Verde Consolidated Copper Co.
Verde King (Verde King Group)	Verde King Copper Co.
Verde Queen Group	Verde Queen Copper Company
Verno (Decatur Group)	Decatur Copper Mining Co.
Victor, P	United Verde Copper Company
Vulcan	Black Hills Copper Company, Ltd.
Wade Hamton & Sleeping Beauty, P	G. W. Hull
Walnut Creek (Verde Queen Group)	Verde Queen Copper Co.
Warrior	United Verde Copper Company
Wayside (Pastime Group)	United Verde Copper Company
Wealth (Decatur Group)	Decatur Copper Mining Company
West Champion No. 2, P	Equator Mining & Smelting Co.
West Copper Chief, P	Copper Chief Mining Company
Windlass (Verde Queen Group)	Verde Queen Copper Co.
Windup	George A. Treadell Mining Company
Wonderful & Toughnut, P	Copper Chief Mining Company
Yard Arm (Verde Queen Group)	Verde Queen Copper Company
Yeoman (Verde Queen Group)	Verde Queen Copper Company

The following, by means of a single example, shows that it takes water to produce copper. According to the July l8, 1908 issue of The Engineering and Mining Journal, p.149, the United Verde Jerome mine produced 3,000,000 pounds of copper per month or 36,000,000 pounds/yr. Using the value of the average water used only for smelting of 10.3 gallons per pound of copper produced (Mussey, 1961, Table 17) the estimated amount of water use was about 2 cfs/yr. Also, carrying this example further, according to the USGS a little more than 25 gallons of water is used for the production of one pound of copper from domestic ore in 1961 (abstract of USGS WSP 1330-E). This amount compares well with the use of 28 gallons per pound given by Singh (2010). These average annual amounts suggest about 4 cfs was used by the United Verde Jerome mine. Thus, my estimate of the water use at statehood by the largest of the many mines in the Verde River watershed was about 2-4 cfs. Thus, the total water use by the mines at statehood is unknown but obviously impacted the base flow of the Verde River.

Copper production of the United Verde mine near the time of statehood is shown on pages 106 and 345 (Mining and Scientific Press, 1911, Vol. 102, Copper Production in 1910 by States, Jan. to June 1911, 866p.):

At Jerome the United Verde mine was operated throughout the year and the output will probably show but little variation from the 36,700,000 lb produced in 1909. The Sasco smelter of the South-

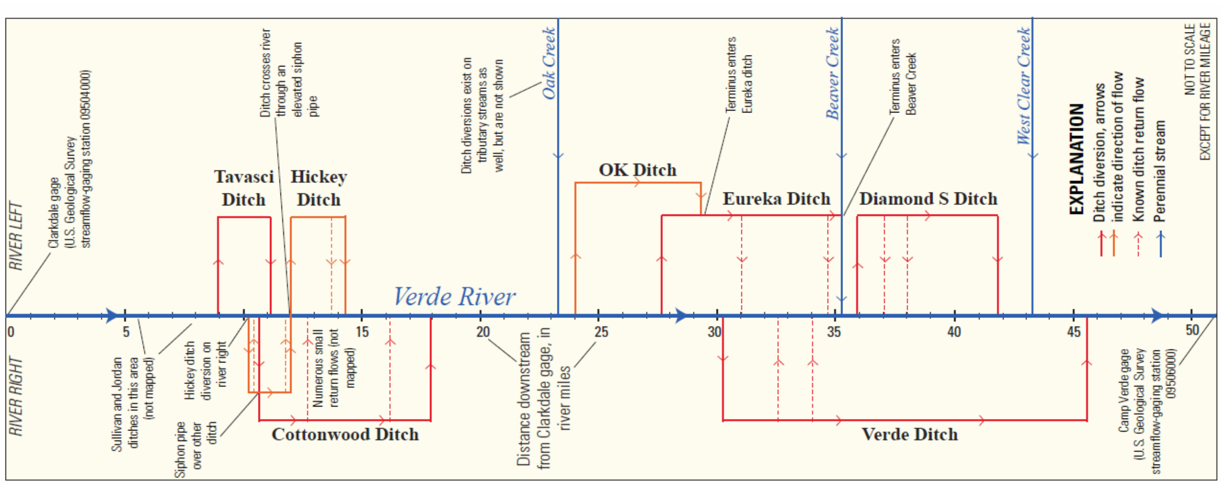
the porphyry mines." His position is not altogether supported by the figures on the United Verde production, which show 38,663,880 lb. for 1910, as compared with 36,694,063 in 1909, and 36,183,089 in 1908, while in 1907, the year of high prices, the property turned out but 33,012,339 lb. If the

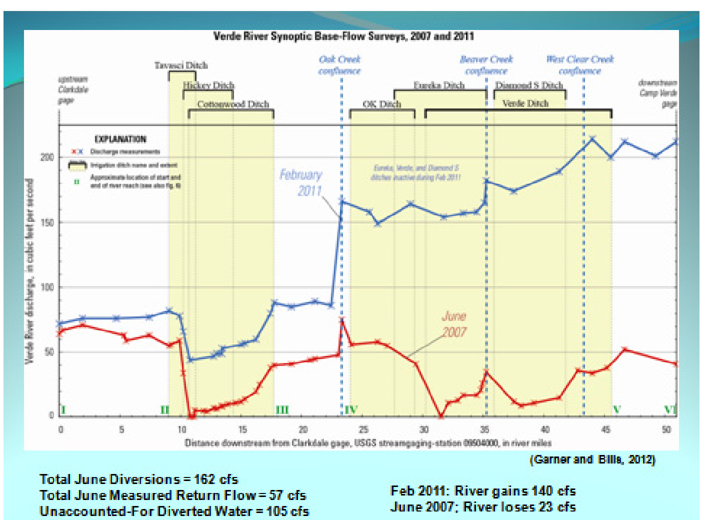
UNITED VERDE SMELTER.

Mining and Scientific Press, 1911, Vol. 103, NEW YORK- State of the Copper Market.—Production for June— United Verde Dividend.—Superior & Boston.—Interest in Pioche.—Little Interest in Poncupine, July 1911, 854p. Photo on page 87 is to the left:

G1f.—Diversions (a sample of present conditions)

The USGS recently conducted a study of base flow in the Verde Valley and found that the Upper Verde River, Oak Creek, Beaver Creek, and West Clear Creek are major sources of base flow in the Verde River. Groundwater discharge directly into the Verde River also was an important contributor of base flow to the Verde River. The schematic diagram below shows major irrigation ditches along the Verde River as a function of river mileage along the Verde Valley. (Garner, B.D., and Bills, D.J., 2012, Spatial and seasonal variability of base flow in the Verde Valley, central Arizona, 2007 and 2011: U.S. Geological Survey Scientific Investigations Report 2012–5192, 33 p.). The USGS found that the dozens of surface-water diversions from streams, including gravity-fed ditch diversions along the Verde River, are the most prominent human alterations in the Verde Valley.





The summer and winter base flow along the Verde River in the Verde Valley are significantly different (See figure to left). The difference is mostly because of diversions and also high ET during summer months.

The amount of predevelopment base runoff also varied seasonally because of seasonal differences of ET along springs and from riparian vegetation along tributary streams and the Verde River.

G2. Hydrology

Under present, and recent, conditions there is considerable travel by canoes and kayaks along much of the Verde River downstream of Granite Creek. Exceptions are areas affected by SRP reservoirs—namely Bartlett and Horseshoe where there is also boating on the river. General speaking, there is considerable recreational boating along the Verde River. Also, there are a few commercial businesses providing small boating opportunities for visitors and local residents.

The amount of base runoff in the Verde River obviously is a potential factor limiting navigability. As explained previously in the Hydrology section of this report, the natural and ordinary perennial/intermittent stream flow is comprised of surface runoff and base runoff. Surface runoff is derived from precipitation and snowmelt. Base runoff is maintained by ground-water discharge all along the Verde River. Base flow is comprised of ground-water discharge from mountain front springs and seeps (Base Qmf on Figure 3 of this report) and Quaternary aquifers (Base Qqa) and basin fill and deeper aquifers (Base Qbfa). Base runoff Qqa and Qmf was first used by settlers for farming and mining because it was on or near the surface at springs and along streams and could be rather easily diverted using small dams or shallow wells.

The computation of base runoff of the upper Verde River above the USGS gage near Clarkdale (09504000) is discussed in detail in the Hydrology section.

Important parts of this analysis of the hydrology below USGS gage 09504000 are (1) USGS records of stream flow at gages 09503700, 09504000, 0950600 and 09510000; (2) a report by the USBR (1952) that calculated the Virgin flow for the mouth of the Verde River; and (3) a report by the USGS (HA-664 by Freethey and Anderson (1986)) that estimated base runoff (Qbfa, the 90th percentile of daily discharge) for the basin fill and underlying aquifers. An important part of the hydrologic analysis was the distribution of the 100 cfs difference between the Virgin average annual runoff and the gaged average annual runoff at gage 09510000 (See Item F of Table 2 of 2).

Base runoff of the lower reach of the Verde River is simply computed by adding (1) the 100 cfs difference (Item F of Table 2 of 2) that was associated with early settler use of base flow such as for mining (section G1e) and irrigation (section G1f) and (2) the base flow (from USGS HA664) at and below the USGS gage 09506000. The base runoff associated with Qqa and Qmf was simply distributed across the middle Verde River between USGS gages 09504000 and 09506000. The resulting natural base flow is shown in Figure G3.

The larger springs in the Verde River Watershed are mostly carbonate springs in tributaries such as West Clear Creek, Sycamore Creek, Oak Creek and Fossil Creek where they discharge from the lower Paleozoic rocks of the Redwall Limestone or the Martin Formation (Parker and others, 2005 and Bills and others, 2007). Springs in the lower part of Sycamore Canyon maintain a perennial flow in lower Sycamore Creek within the primitive area. The discharge of Sycamore Creek during the dry months of July and August ranges from 4,550 to 5,125 gallons per minute. About half this discharge comes from Summer's Spring. Fossil Spring, for example, has a very steady flow of about 21,647 gal/year or about 48 cfs (Figure G2). The rather steady discharge from these springs supports the rather steady base flow of the Verde River.

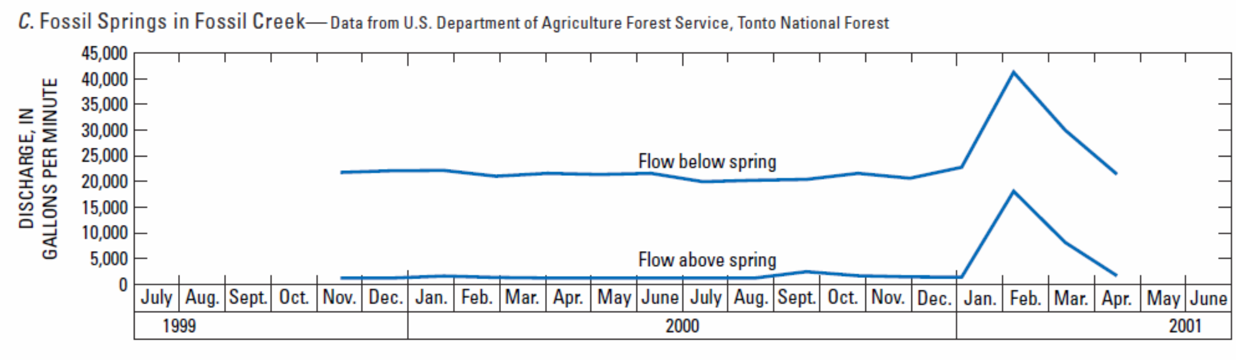


Figure G2. Discharge of Fossil Springs from intermittent current-meter measurements in Fossil Creek above and below springs (Parker and others, 2005).

Natural average annual runoff and median runoff (Figure G3) were computed in a similar manner as base runoff using records of stream flow at USGS gages 09506000 and 09510000.

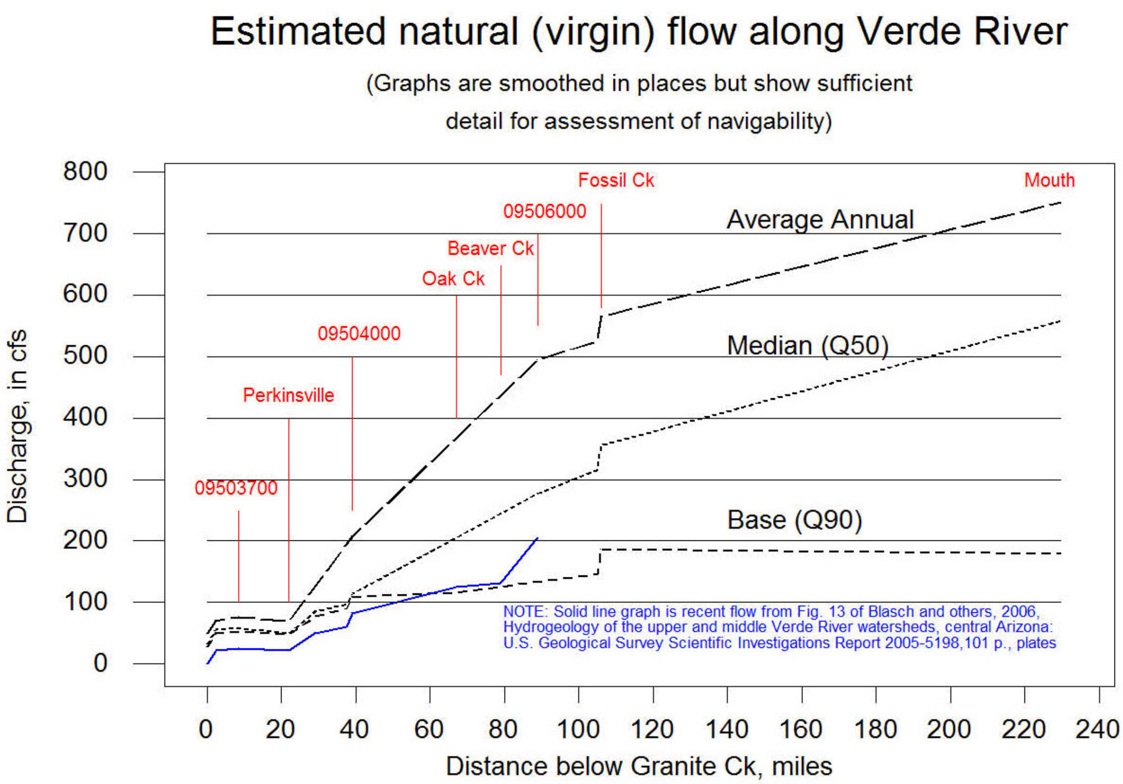


Figure G3.—Natural and recent flow in the Verde River from mouth of Granite Creek to the mouth.

G3. Channel geometry

G3a.--Geomorphology of Verde River Channel

Because the subject of geomorphology of the natural channel of the middle Verde River is ably treated by Phil Pearthree, PhD, the following is from: Pearthree, P. A., 1996, Historical Geomorphology of the Verde River, Arizona Geological Survey Open-File Report 96-13, 29p.

"Even though the Verde River is entrenched in a deep valley and young alluvial deposits are thin along all of its course, most of the streambed and many of the banks of the river are formed in very young, unconsolidated alluvium. Everywhere along the river, a low-flow channel exists that conveys perennial discharges. Low-flow channels typically are shallow and 15 to 60 m wide, although the width and depth of these channels is quite variable. The bed forms of the low-flow channels are characterized by a repeating sequences of pools (deeper water areas) and riffles or rapids (shallow water areas typically dominated by cobbles and small boulders). Alternating pool and riffle sequences are characteristic of streams that carry coarse bed load sediment."

"Low-flow channels of the Verde River are invariably located within a much larger channel that is shaped by large floods. These larger flood channels are typically 100 to 300 m wide, and are as wide as 1,200 m along the lower Verde River. Deposits associated with the flood channels typically are coarse gravel bars and finer sandy areas. Flood channels are evident because of freshly deposited sediment and the lack of abundant large vegetation; in many reaches, the margins of flood channels correspond with prominent banks. Young river terraces commonly exist along the margins of and slightly higher than flood channels. These terraces typically are heavily vegetated unless they have been altered by human activity. Many of these young terraces are part of the floodplain, as they are inundated during large floods. Flooding on terraces is relatively shallow and the impact of flooding on the terrace vegetation is typically is not great."

"The young alluvium that forms the channel bed and low banks of the Verde River is generally composed of coarse gravelly deposits and much finer sandy overbank or slack water deposits. This young sediment does not have much cohesion and is susceptible to scour and bank erosion during large flow events. Older river deposits typically are coarse, and underlying rock units are indurated to a greater or lesser degree. These units are much more resistant to lateral bank erosion than young stream deposits. Thus, the potential for changes in channel morphology and shifts in channel position during large floods is greatest in areas where young terraces are extensive. However, young terraces commonly have relatively dense and large vegetation, which tends to stabilize these deposits."

"The geologic floodplain of the Verde River is coincident with the extent of young channel deposits and low terraces along the river. As used in this report, the geologic floodplain is the area along the river that has been subject to erosion and deposition by the Verde River in the past few thousand years. Changes in channel position that have occurred during the past few thousand years have occurred within the limits of the geologic floodplain. The geologic floodplain is bounded by older geologic units such as bedrock, basin-fill sediments, older deposits of the Verde River, or alluvial fan or terrace deposits of tributary streams. Usually, the margins of the geologic floodplain are associated with significant topographic relief that constrains lateral migration of the Verde River channel."

"Low-Flow Channels. Cadastral surveys from the 1870's record evidence of a continuous low flow channel throughout Verde Valley that was very similar to the modern low-flow channel of the Verde River. Surveys conducted by Foster in 1873 and 1877 documented a through-going stream about 0.5 m (1.5 ft) deep and 15 to 30 m (50 to 100 ft) wide with a sandy bottom. It is not clear from the survey notes whether this low-flow channel was within a well-defined flood channel. The Verde River of the 1870's was described as "a beautiful stream of clear, pure water with an average width of 100 links (66 ft) and an average depth of 3 feet" (Foster, C.B., 1877, General Land Office Survey Notes, Books 217 and 1665: microfiche on file with U.S. Bureau of Land Management, Phoenix.; see Table 4). The banks of the low-flow channel were estimated to be 3 ft (consistent with the depth estimate). Cottonwoods, willows, and mesquite lined much of the river bank. The low-flow channel clearly existed within a much broader geologic floodplain, described in the survey as bottomland with large amounts of fine farming and grazing land (Foster, C.B., 1873, General Land Office Survey Notes, Book 137: microfiche on file with U.S. Bureau of Land Management, Phoenix.). A significant amount of irrigated farming was underway in the bottomlands by 1873-77. The land surveys of the 1870's did not describe marshy land adjacent to the Verde River, nor did they document any areas where the low-flow channel was ill-defined. A resurvey conducted in 1916 in the Camp Verde area records wetted channels about 60 to 120 m (200 to 400 ft)wide, and in a number of places the surveying team could not directly survey across the river because it was too swift and deep (Richards, 1916). It may be that 1916 was an unusually wet winter, resulting in increased flow in the Verde River relative to 1873 and 1877."

"The low-flow channel along the lower Verde River documented in 1911 was shallow and some what wider than the low-flow channel in Verde Valley. The land survey of 1911 recorded wetted channel ranging from about 3 to 6 chains (180 to 360 ft) wide and 1 to 4 ft deep (Farmer, RA., 1911; General Land Office Survey Notes, Book 2398: microfiche on file with U.S. Bureau of Land Management, Phoenix.) This low-flow channel was within a much larger flood channel. The flood channel evidently was quite obvious, as it was the primary channel noted in the survey data and notes. The banks of the flood channel were fringed with cottonwoods and mesquite."

"Positions of low-flow channels clearly have changed substantially through the pastcentury. Substantial changes in the positions of the banks of flood channels have dictated changes in the areas within which the low-flow channels can flow. In addition, the positions of low-flow channels have changed after floods in reaches where the flood channel has remained fairly stable. An example of the extent of change in low-flow

Quadrangle	Township	Section Line	Channel Width		
			1873-76		modern
			Chains	(ft)	(ft)
Horner Mtn. (1967)	T13NR5E	36S	1.10	73	80
		35/36	1.00	66	120
		35S E	1.00	66	160
		35S W	1.00	66	80
		26/35	1.00	66	160
		27/26	1.20	79	200
		34/27	1.20	79	120
		27/34	1.20	79	200
		22/27	1.00	66	120
Camp Verde (1969)		21/22	1.10	73	160
		20/21	1.00	66	160
		17/20	0.75	50	120
		16/17	0.60	40	200
		9/16	0.75	50	120
		8/9	0.80	53	120
		7/8	1.00	66	120
		6/7	1.00	66	80
		5/6	1.50	99	120
	T14NR5E	32/5	1.20	79	80
		14/13	1.00	66	160
		11/14	1.10	73	120

Table 4. Low-flow channel widths of the Verde River in the 1870's and around 1970. Channel widths from the 1870's were documented by the original cadastral surveys of the area. Surveys noted channel conveying water at the time of the survey, most likely equivalent to the modern low-flow or base-flow channels. Low-flow channel widths from around 1970 were obtained from 1:24,000-scale U.S. Geological Survey topographic quadrangles. Publication dates for the quadrangles are indicated in parentheses.

Quadrangle	Township	Section Line	Channel Width		
			1873-76		modern
			Chains	(ft)	(ft)
Cornville (1968)	T14NR4E	2/11	0.90	59	120
		3/2	0.90	59	80
		4/3	1.20	79	80
	T15NR4E	33/4	1.00	66	80
		21/28	1.00	66	80
		20/21	1.25	83	120
		19/20	0.70	46	80
		18/19	0.70	46	80
		17/18	0.80	53	80
		18/17	0.65	43	80
		7/18	0.75	50	60
	T15NR3E	1/12	0.90	59	20
		2/1	1.00	66	80
	T16NR3E	35/2	1.00	66	80
		26/35	1.10	73	60
Clarkdale (1973)		28/27	0.65	43	100
		22/27	1.10	73	80
		21/22	2.00	132	80
		20/21	1.10	73	240
		17/20	1.00	66	80
		17/7	1.10	73	120
		7/8	0.90	59	60
		8/9	1.00	66	80
		8N	0.80	53	80

Table 4. (Continued).

channel position in Verde Valley is shown in Figure 6. In this area, many substantial changes in channel position occurred between the original survey in 1877 and 1950. Several large floods occurred during this period, as was noted above, and substantial changes in flood-channel positions probably occurred as well. In the Clarkdale area, human activity likely significantly altered the position of the low-flow channel as well. Changes in position of low-flow channels between 1950 and 1970 were very limited, but the floods of 1978 and 1980 evidently caused some substantial changes in channel position."

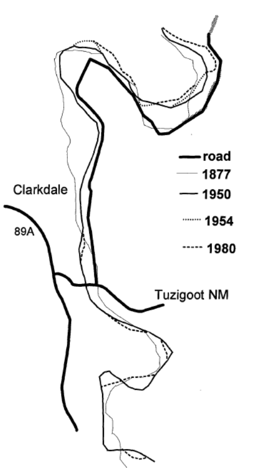


Figure 6. Historical changes in low-flow channel positions in the Clarkdale-Tuzigoot area.

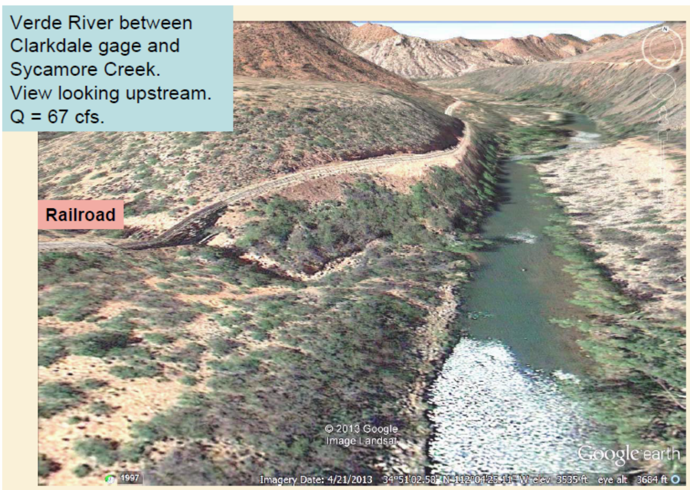
"Historical land surveys in the Camp Verde area and along the lower Verde River reveal that the general form of the flood channels of the Verde River have not changed substantially since the time of statehood. Low-flow channels have shifted position to a greater degree than the larger flood channels. The size and general form of low-flow channel in Verde Valley, however, was about the same in the 1870's as it is today."

Examination of available information shows that the low-flow or main channel changes position in the two basin-fill areas but the general cross-sectional size and shape of the main channel has remained rather uniform. In other words, there is enough width and depth for small watercraft.

G3b. Notes on channel material and sediment transport using photographs of the Verde River

These notes are related to the question: was the Verde River navigable under natural and ordinary conditions? The following, along with other information in this report for ANASC, satisfies what I consider useful information for assessment of navigability along the entire Verde River. Also, to me, natural means what it says—no effect of humans. A couple of the photos that follow are also shown in other places of this report. This section is best used in conjunction with section 4. -- *Energy and morphology considerations* of this report for ANSAC.

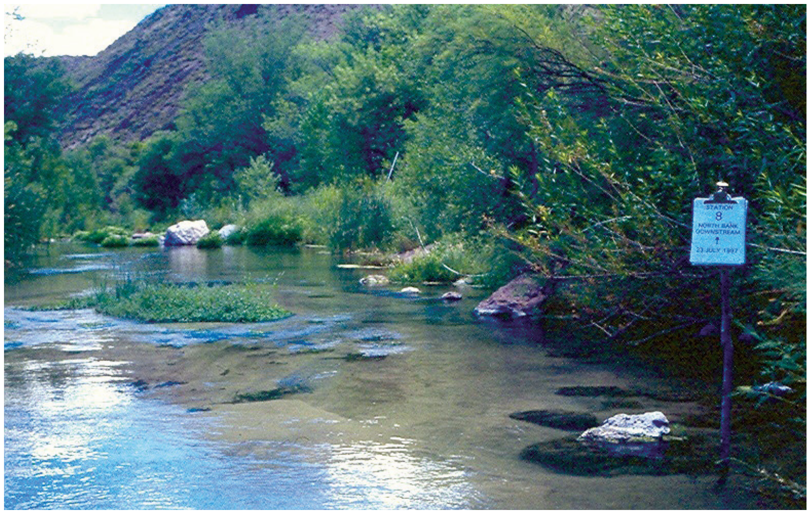
The riffle near the center this scene is associated with the small tributary wash on the left side of the photo (right bank side). Sediment load consisting of silt, sand, gravel, cobbles and boulders is deposited at the mouth of the wash in the Verde River. Such deposits are the source of many of the riffles along the Verde River. Also, tributary sediment below Sullivan Lake Dam is a major source of the suspended and bed load along the Verde River.



Much, but not all, of the entire Verde River is a gravel or cobble bed stream. Typical gravel-bed streams have bed surface median sizes Ds_{50} in the range from 8 to 256 mm. Boulder-bed streams have median sizes in excess of 256 mm. Sand-bed streams have median sizes between 0.062 and 2 mm. Particle sizes are shown below:

Diameter (mm)		Wentworth Size Class
4096		
		Boulder
256		
	Gravel	Cobble
64		
	Gravel	Pebble
4		
	Gravel	Granule
2		
	Sand	Very Coarse Sand
1		
	Sand	Coarse Sand
0.5		
	Sand	Medium Sand
0.25		
	Sand	Fine Sand
0.125		
	Sand	Very Fine Sand
0.0625		
	Silt	Coarse Silt
0.0313		
	Silt	Medium Silt
0.0156		
	Silt	Fine Silt
0.0078		
	Silt	Very Fine Silt
0.0039		
	Mud	Clay
0.00006		

The following two USFS photographs (Neary and others, 2012) show pools with deposited sand. The sand can be seen in the shallow areas of the pools. This sand is remobilized during direct runoff and carried as suspended and bed load great distances downstream toward the Horseshoe reservoir sediment trap. Pools along the river act as small sediment traps that partially fill during small discharges and are flushed during large discharges.



For many years river engineers have noticed a channel forming discharge along rivers that is associated with bank full stage. There continues to be some debate on this subject but the natural mean annual discharge computed for this ANSAC study of the Verde River appears to conform to the “channel forming discharge.” Many river engineers also believe that over a long period of time the total maximum bed load is transported by the “channel forming discharge” or the *effective discharge*. Supposedly at discharges both smaller and larger, less bed load is transported. For more discussion see section 4 of this report.

As stated previously much of the channel of the Verde River is cobbles and gravel but there are reaches of predominantly sand and reaches with many boulders—especially the riffles. The riffles formed by tributary dumps of sediment load into the Verde River channel had a wide range of sediment size but the finer sediment washed away leaving the coarser material.

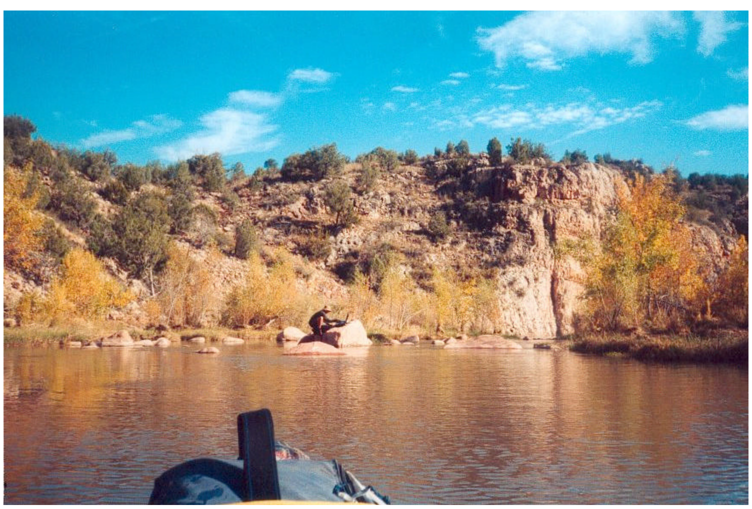
Generally speaking, riffles also form along natural perennial gravel bed rivers independent of tributary dumps. Also, the coarse surface of the channel bed, called armoring, occurs when the smaller sediment is carried away. It's common that when discharge increases and motion of the bed material begins, nearly all sizes of the heterogeneous bed material move at the same time. The finer material moves faster leaving behind the coarser material.

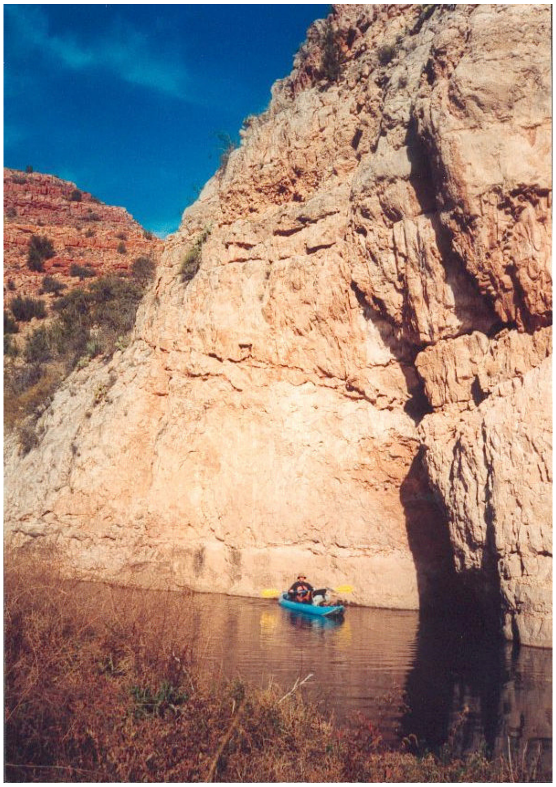
There are also reaches that are laterally and also vertically confined by bedrock or erosion resistant rock.

Photograph by Hjalmarson looking upstream at Verde River Channel from below Black bridge in Camp Verde. The river channel has scoured through the alluvial sediments (Holocene material) into the Verde Formation (light colored material).

Huge boulders that are difficult to move by large floods are shown in photograph below.

Photo from: Bowman, S. N., 2001, VERDE RIVER TMDL FOR TURBIDITY, Arizona Department of Environmental Quality, 33p.





Bedrock bank

Photo from: Bowman, S. N., 2001, VERDE RIVER TMDL FOR TURBIDITY, Arizona Department of Environmental Quality, 33p.

There obviously is a considerable amount of silt, sand and gravel at this location.

Photo from Evans, K and McClain, C., 2005, Wild and Scenic River Proposal for The Upper Verde River, In conjunction with the Arizona Wilderness Coalition, 179p.

A mixture of sand, gravel, cobbles and small boulders from basalt, sandstone, limestone, etc. areas. The sediment clearly reflects the wide range of geology in the watershed upstream of this location. Some of the stones are rounded and some are angular suggesting a wide range of possible channel resident times and distances from rock source area.

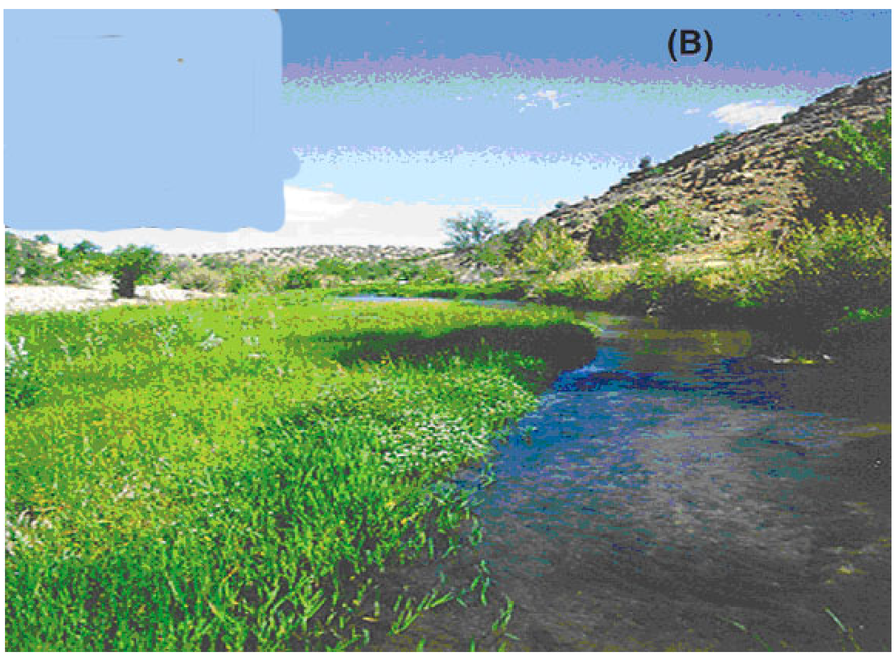
Photos from: Evans, K and McClain, C., 2005, Wild and Scenic River Proposal for The Upper Verde River, in conjunction with the Arizona Wilderness Coalition, 179p.

Gravel-bed streams usually show a surface armor. That is, the surface layer is coarser than the substrate below.

A gravel and cobble channel bottom that probably has some armoring effect.
(Neary and others, 2012—both photos on this page)

Mostly small boulders and cobbles.

Effect of 1993 floods in upper Verde River (UVR) shown below. Comparison of UVR vegetation next to the channel a decade before (A: 1979) and after (B: 2003) the 1993 floods, Verde River Ranch. (Photo A by James Cowlin and photo B by Alvin L. Medina, USFS.)



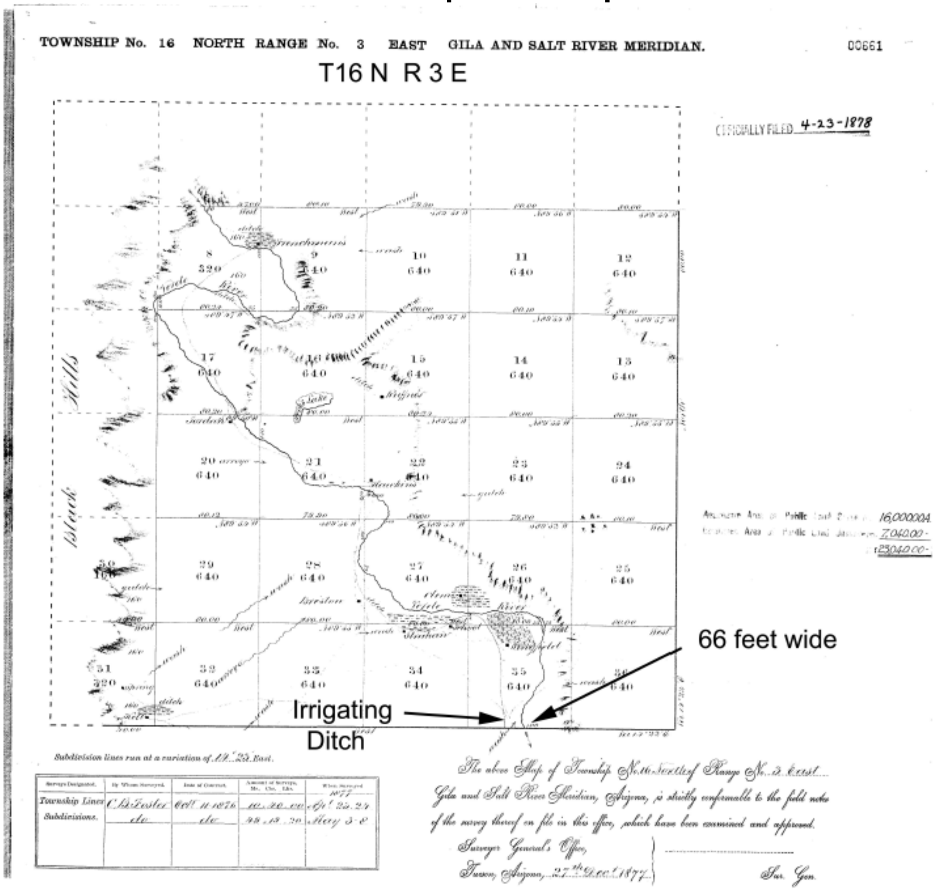
Vegetation along the banks tends to stabilize channel banks and cause scour of the main channel. This scene is along the upper Verde following the 1993 flood. Flood debris (of 1993 flood) is on the trees with a beaver fallen tree in the left bank foreground of the scene. All along the Verde River the main channel bed generally stabilized and recovered to a navigable channel within days after the 1993 flood.
(Photo from Neary and others, 2012)

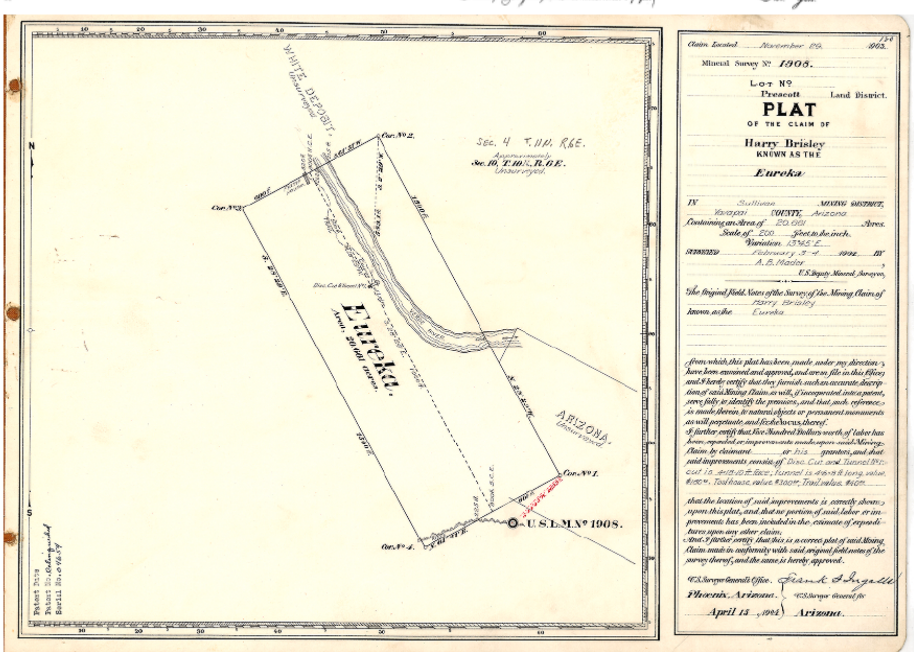
View looking north at Verde River that is incised in large deposit of sediment behind Horsehoe Dam on 6/09/09. Horseshoe reservoir acts as a sediment trap for suspended and bed loads (the sediment yield above this location) transported down the river. There is more movement of sediment than the sediment yield at this location because the coarser material typically moves only short distances along the channel during direct runoff (floods, snowmelt and storm runoff).

In contrast, some of the very large boulders that have rolled onto the channel and flood plain from steep side slopes appear to have not moved for many years.
(Photo from Cook, J. P., and others, 2010)

Summary: (1) There is a wide variety of channel material along the entire river that ranges from predominantly sand reaches to cobble and boulder covered reaches to huge boulders to bedrock channel bottoms and banks. The gravel, cobbles and boulders do not move much during a typical year. (2) Some reaches and most riffles have many boulders that can be moved only by high-energy large floods. (3) Some of the larger boulders from the steep side slopes for all practical purposes may have such a large threshold shear value that they don’t move. In reaches with these huge boulders the concept of “channel forming discharge” may not apply because of the impact of boulders on channel roughness and the flow velocity distribution. (4) The sediment yield (deposition at Horseshoe reservoir) is predominantly sand, silt and small gravel. (5) All along the Verde River the main channel bed generally stabilized and recovered to a navigable channel within days after the 1993 flood.

G3c.—Selected GLO townships and maps





A single well defined channel is shown on the left.

The page below is from GLO survey notes for the survey plat on the following page. This page shows a 4ft depth of flow for March 1911. Also, the channel was a maximum of about 400 ft. wide. See plat on next page for additional information.

T4N R7E book 2397

BOOK 2397

8

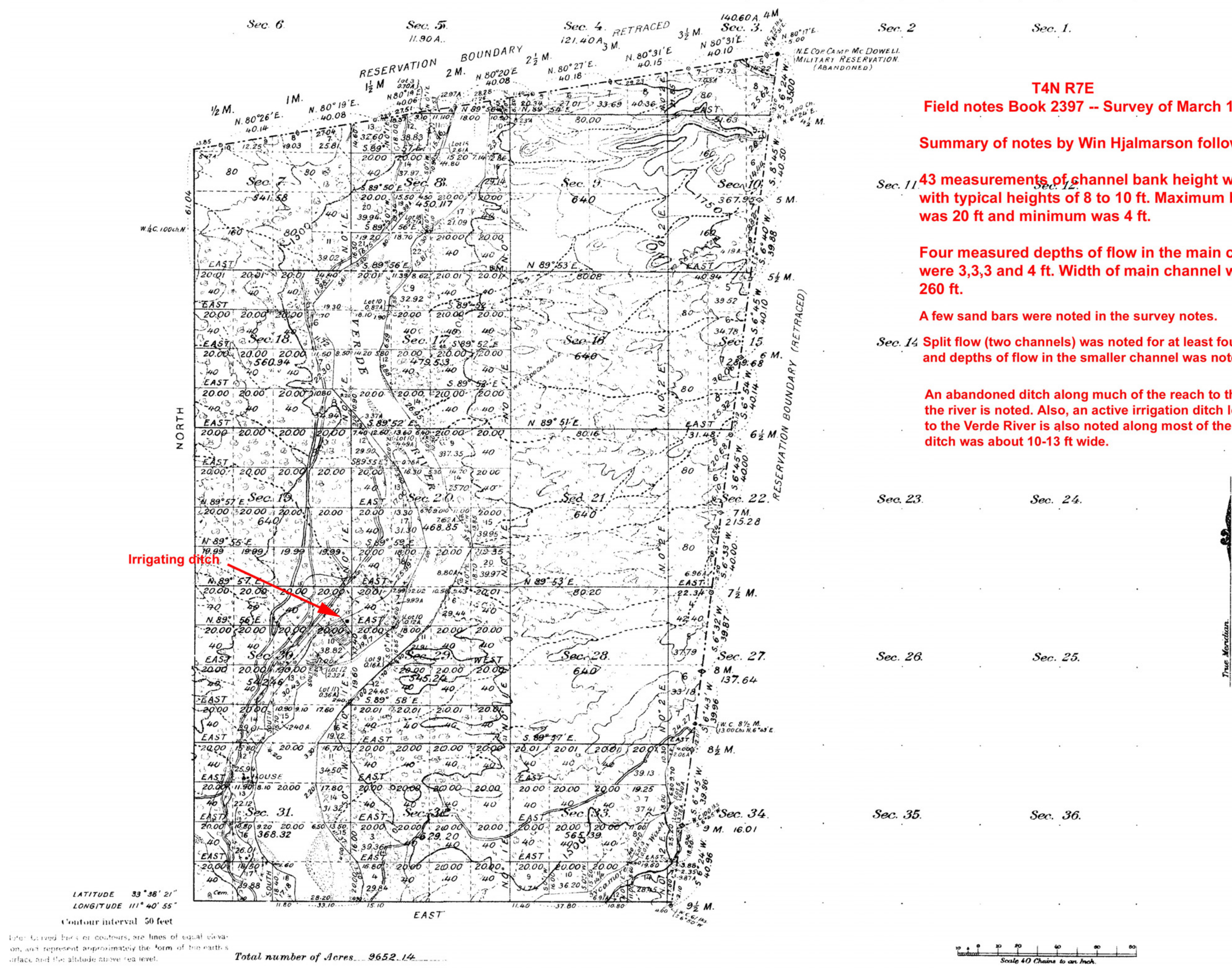
Subdivision T. 4 N., R. 7 E.

Chains	
	Enter level river bottom, brs. NE. and SW.
18.00	Dry wash, 30 lks. wide, course NE.
20.00	Set an iron post for 1/16 sec. cor. No. 3 in the center of the NW. ¼ of sec. 31, with brass cap stamped No 3 in N. 1/16 S 31 in center 1911 in S.
	Dig pits 18x18x12 ins. E. and W. of post 3 ft. dist.; and raise mound of earth 3½ ft. base, 1½ ft. high, N. of cor.
24.90	Wire fence brs. N. and S.
26.00	Frame house 25x40 ft. brs. N. 2.25 chs. dist.
27.40	Irrigation ditch, 20 lks. wide, course S. 10° E.
	Leave brush; enter field, brs. N. and S.
31.90	Right bank of Verde River, 8 ft. high, course S.
	Set an iron post for M. C. of sec. 31, with brass cap stamped M C in E. 1911 in S. 1/16 S 31 in W.
	Dig pit 36x36x12 ins. 8 ft. W. of post and raise mound of earth 4 ft. base, 2 ft. high, W. of cor.
	Enter channel of river, 4 ft. deep, course S.
37.90	Leave channel of river; thence over sand bar.
40.00	Point for 1/16 sec. cor. No. 4 falls in river.
60.00	Point for 1/16 sec. cor. No. 5 falls in river.
62.20	Left bank of Verde River, 4 ft. high.
	Set an iron post for M. C. of sec. 31, with brass cap stamped 1/16 M C in W. 1911 in S. S 31 in E.
	Dig a pit 36x36x12 ins. 8 ft. E. of post and raise mound of earth 4 ft. base, 2 ft. high, E. of cor.
	Thence over river bottom.
66.00	Enter dense mesquite thicket, along river bank.
80.00	The 1/16 sec. cor. No. 6 bet. secs. 31 and 32, N½.
	Land, mostly river bottom. Soil, 1st rate. Greasewood brush. Dense mesquite thicket.

Resurvey of Township No. 4 North Range No. 7 East of the Gila and Salt River Meridian, Arizona. 800181

SALT RIVER INDIAN RESERVATION

OFFICIALLY FILED 6-16-1913



T4N R7E

Field notes Book 2397 -- Survey of March 1-20, 1911

Summary of notes by Win Hjalmarson follows:

43 measurements of channel bank height were recorded with typical heights of 8 to 10 ft. Maximum bank height was 20 ft and minimum was 4 ft.

Four measured depths of flow in the main channel were 3,3,3 and 4 ft. Width of main channel was about 260 ft.

A few sand bars were noted in the survey notes.

Split flow (two channels) was noted for at least four locations and depths of flow in the smaller channel was noted as 1-2 ft.

An abandoned ditch along much of the reach to the west of the river is noted. Also, an active irrigation ditch located closer to the Verde River is also noted along most of the reach. This ditch was about 10-13 ft wide.

Total number of Acres 9652.14

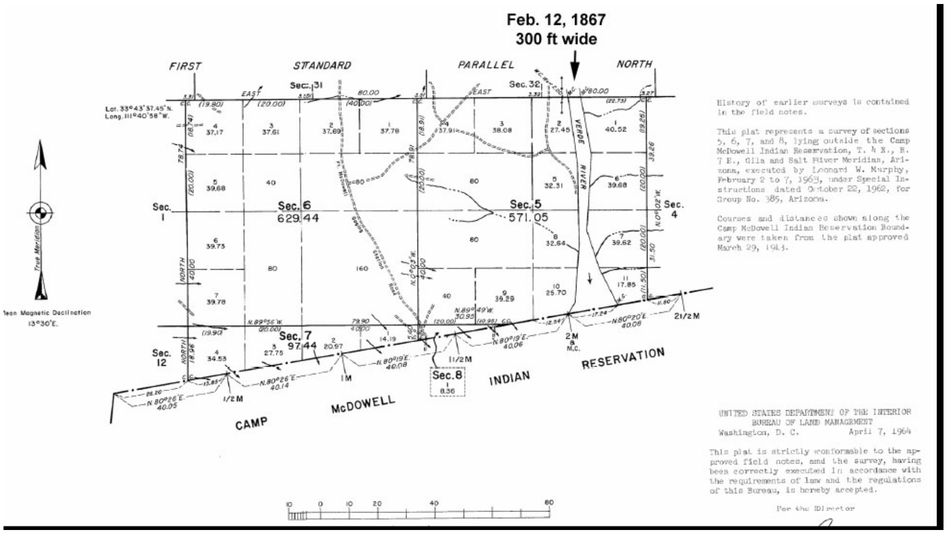
Surveys Designated	By Whom Surveyed		When Surveyed
Standard lines			
Township "	R. A. Farmer		Feb 27-28, 1911
Subdivision "	"		Mar. 1-16, 1911
Meander "	"		Mar. 17-20, 1911
Boundary "	"		Feb. 18-23, 1911

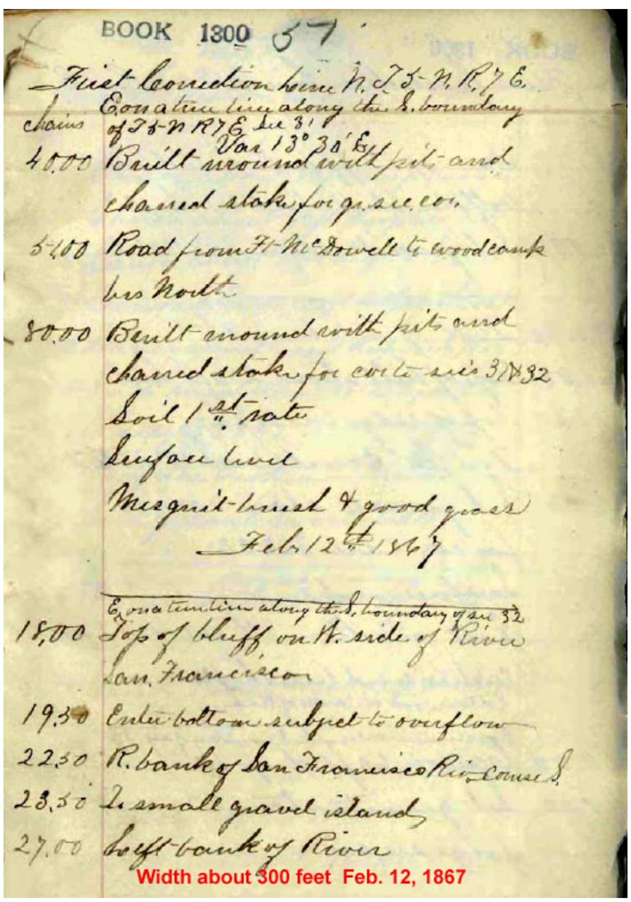
A. F. DUNNINGTON,
Topographer in charge.
Instructions October 11, 1910.

The above Map of Township No. 4 North, of Range No. 7 East, of the Gila and Salt River Meridian, Arizona, is strictly conformable to the field notes of the survey thereof on file in this Office, which have been examined and approved.

U. S. GENERAL LAND OFFICE
Washington, D. C.
March 29, 1913.

Commissioner.




BOOK 1300 57

First Correction Line N. T. 5 N. R. 7 E.

chains E on a true line along the S. boundary of T 5 N R 7 E Sec 31

Var 13° 30' E

40.00 Built mound with pit and charred stake for qr. sec. cor.

54.00 Road from Ft McDowell to wood camp bears North

80.00 Built mound with pits and charred stake for cor to secs 31 & 32

Soil 1st rate

Surface level

Mesquit brush & good grass

Feb. 12th 1867

E on a true line along the S. boundary of sec 32

18.00 Top of bluff on W. side of River San Francisco

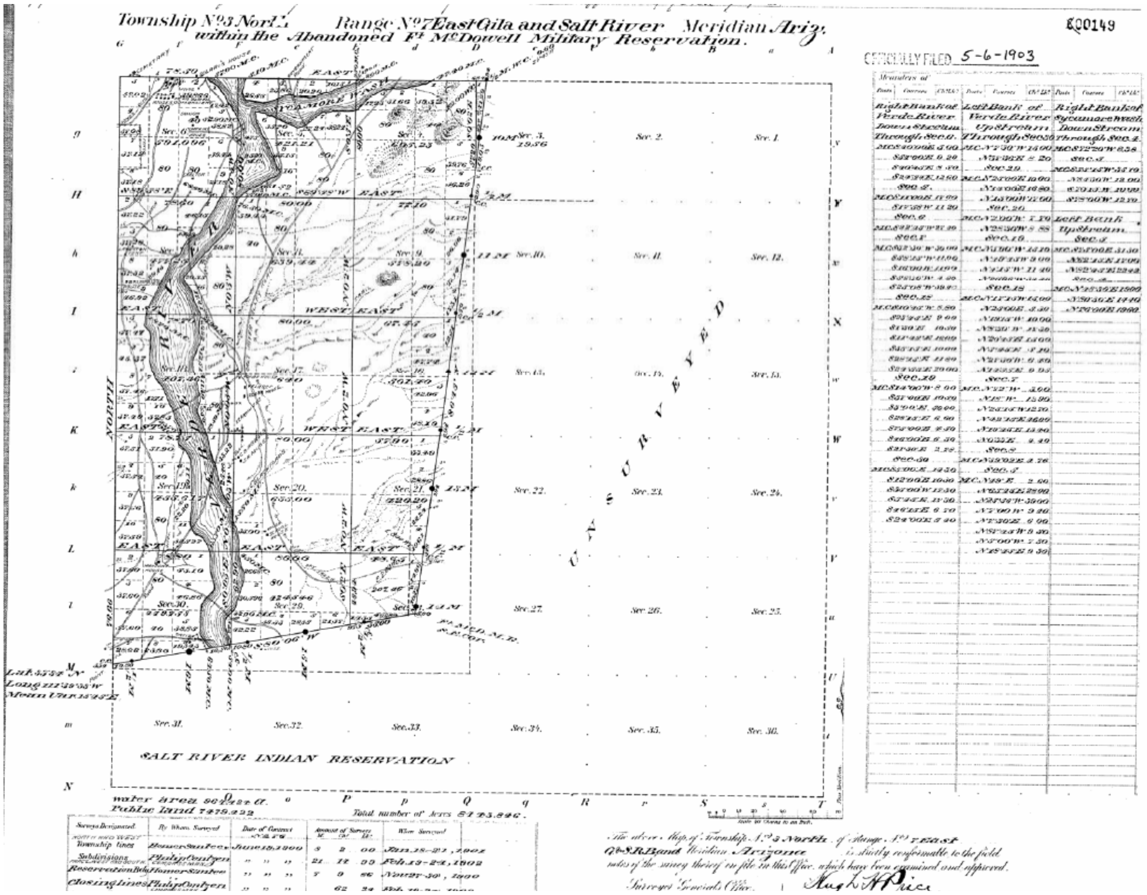
19.30 Enter bottom subject to overflow

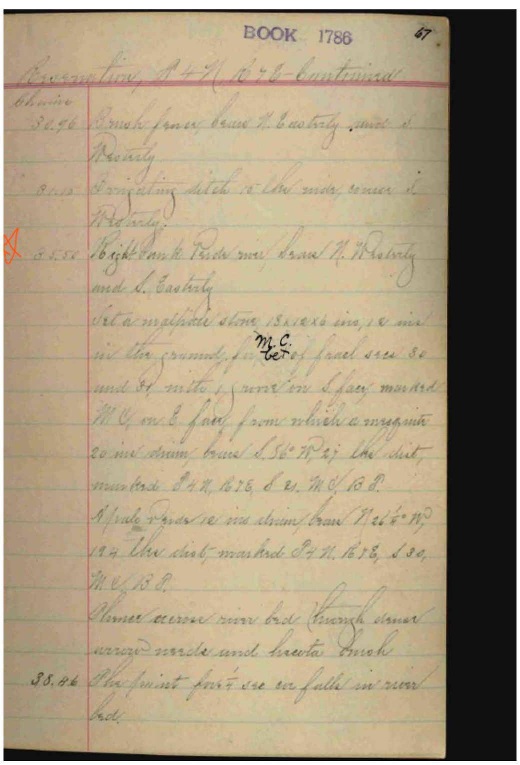
22.50 R. bank of San Francisco River, course S.

23.50 To small gravel island

27.00 Left bank of River

This measurement of the channel width (300 ft.) for the San Francisco (Verde) River is one of the earliest available for the lower Verde. Even at this time (1867) the watershed was not in a fully natural state because of diversions for mining and crop irrigation.

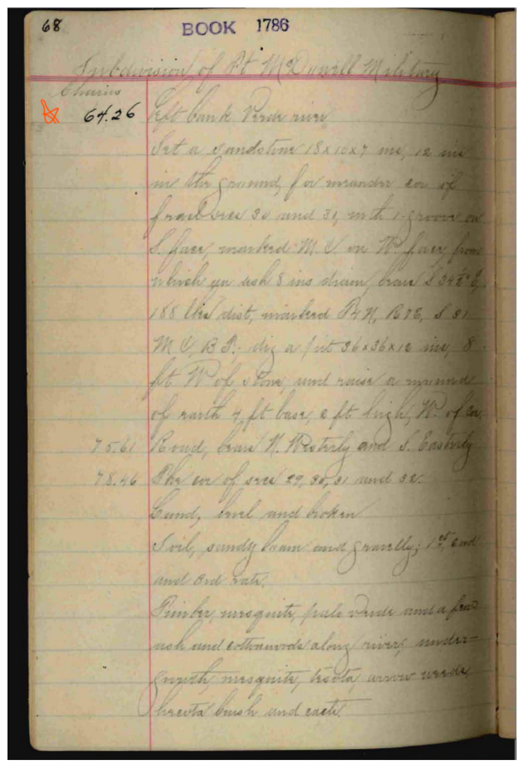




BOOK 1786 67

Reservation, T 4 N R 7 E - Continued

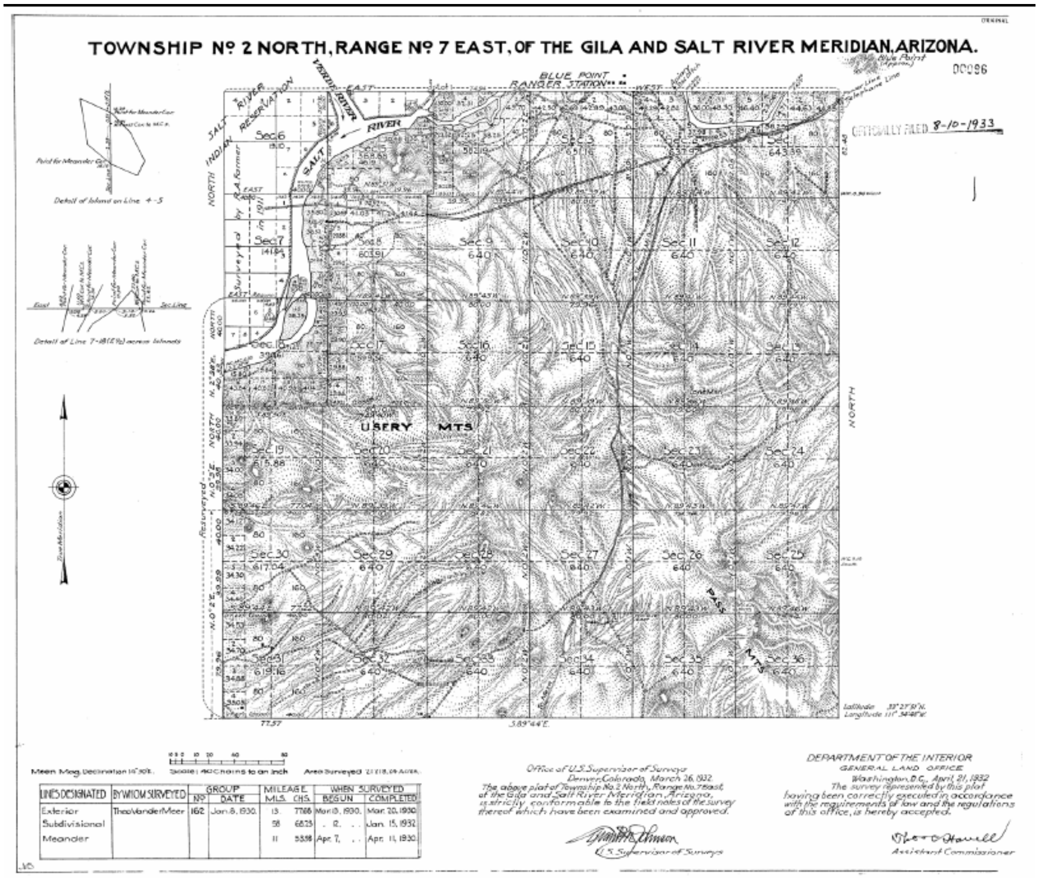
Chains	
30.96	Brush fence, bears N. Easterly and S. Westerly
31.10	Irrigating ditch 10 lks wide, course S. Westerly.
35.50	Right bank Verde river, bears N. Westerly and S. Easterly
	Set a malpais stone 18x12x6 ins, 12 ins in the ground, for M.C. cor. of fracl secs 30 and 31, with 1 groove on S face, marked M C on E face, from which a mesquite 20 ins diam, bears S. 56° W, 27 lks dist, marked T 4 N, R 7 E, S 31, M C, B T.
	A palo verde 12 ins diam, bears N 26½° W, 192 lks dist, marked T 4 N, R 7 E, S 30, M C, B T.
	Thence across river bed through dense arrow weeds and hieota brush
38.46	The point for ¼ sec cor falls in river bed.



68 BOOK 1786

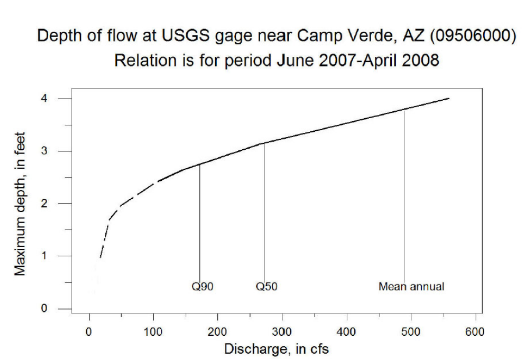
Subdivision of Ft McDowell Military

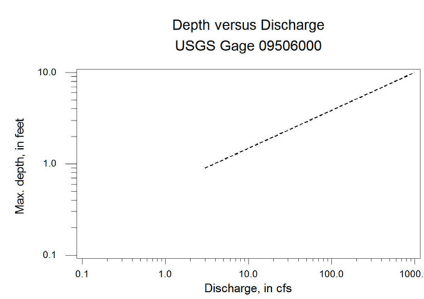
Chains	
64.26	Left bank Verde river
	Set a sandstone 18x10x7 ins, 12 ins in the ground, for meander cor of fracl secs 30 and 31, with 1 groove on S. face, marked M. C. on W. face, from which an ash 8 ins diam, bears S 34½° E, 188 lks dist, marked T 4 N, R 7 E, S 31 M C, B T. dig a pit 36x36x12 ins, 8 ft W of stone, and raise a mound of earth 4 ft base, 2 ft high, W. of cor.
75.61	Road, bears N. Westerly and S. Easterly
78.46	The cor. of secs 29, 30, 31 and 32.
	Land, level and broken
	Soil, sandy loam and gravelly; 1st 2nd and 3rd rate.
	Timber, mesquite, palo verde and a few ash and cottonwoods along river; undergrowth mesquite, hieota, arrow weeds, hieota brush and cacti



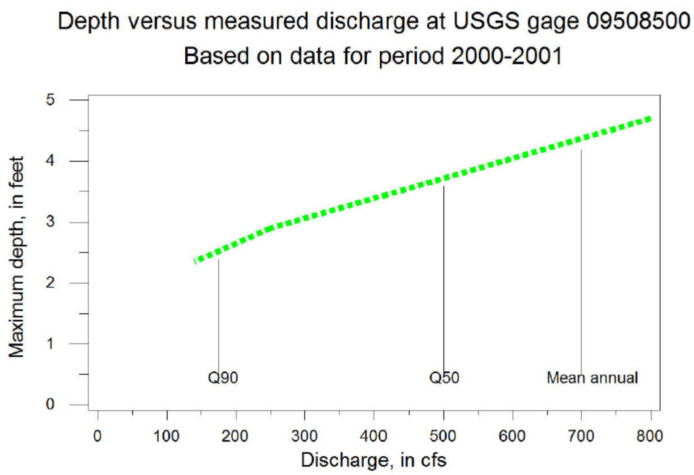
G3d.—Depth-discharge relations for recent channel in the vicinity of USGS gages 09506000, 09508500 and 09511300.

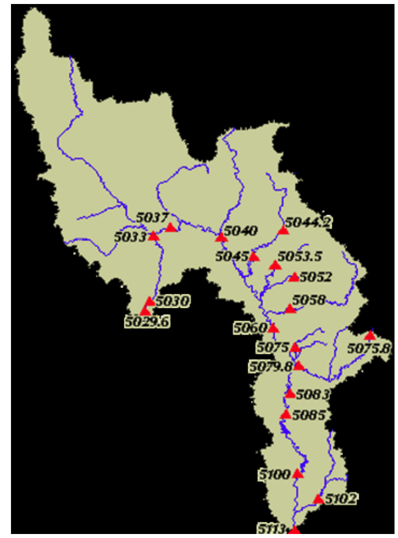
The following three sets of depth-discharge relations for the middle and lower Verde River were determined mostly using USGS current-meter measurement information available on the USGS National Water Information System (http://waterdata.usgs.gov/az/nwis/si). The maximum depth is for a width-segment of roughly 5 ft. or more across the river channel.

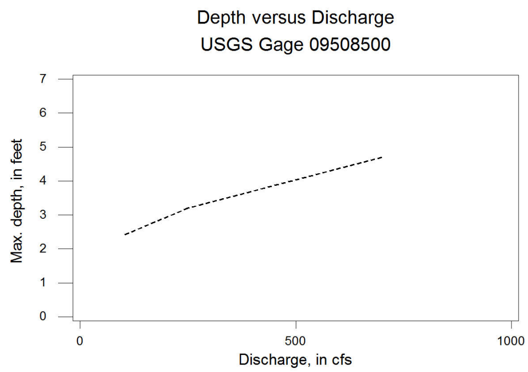




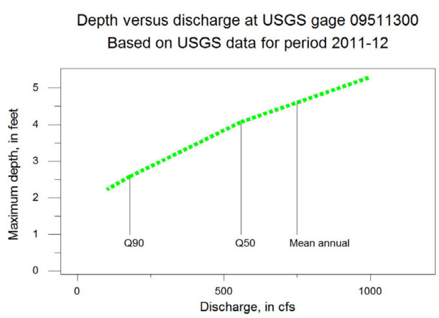
Relations above and below gage.



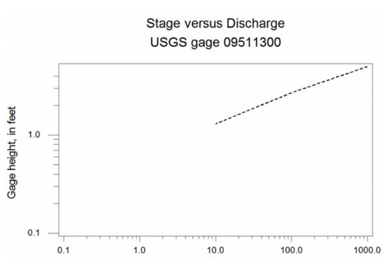


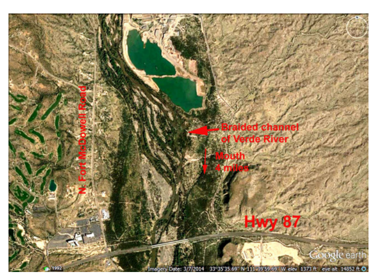


Depth-discharge relations for gage and cableway.



The depth-discharge relation to the left is considered representative of the modern lower Verde River near the mouth. Braided reaches like that shown below are obviously human impacted and not considered representative of natural conditions.





G3e. Discussion and summary of Section G3

Use of Verde River: The entire river is currently used by small watercraft such as canoes and kayaks. See, for example, items 6 and 10 of Appendix A, section G1a, and Appendix I. Because small water craft are used along the Verde River, navigability under natural conditions with a much greater amount of base runoff would be considerably improved. In fact, in the absence of diversions for irrigation and mining and with the beautiful scenery, the natural Verde River would be ideal for small watercraft.

Channel material: The diverse and colorful gravel, cobble and small boulder sediment reflects the diverse geology. There is a wide range of sediment size. Most of the channel is gravel and cobbles. There are very large boulders in the upper Verde and there is a lot of coarse sand in the basin fill areas of the Verde Valley and lower Verde. The many riffles typically are boulders and cobbles and during periods of low flow silt and sand collects in the long pools behind the riffles.

Movement and form of channel: The evidence in this Appendix and in the Report shows the Verde River behaves like a typical channel where "A natural channel migrates laterally by erosion of one bank, maintaining on the average a constant channel cross section by deposition on the opposite bank. In other words, there is equilibrium between erosion and deposition. The form of the cross section is stable, meaning more or less constant, but the position of the channel is not." (As described by Leopold, 1994, p.5 for rivers in general.). Also, the Verde River appears to be carrying a load of sediment at or near carrying capacity and tends to erode and deposit sediment in equilibrium and flow is in curved meandering, or slightly meandering, paths and in the basin fills areas has a wide-eroded floodplain.

Channel shape: The Federal Surveys indicate a fairly deep base flow and a rather wide channel with a few sand islands in the lower Verde River.

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Depth of base flow: Depths typically are at least 3 ft. Federal surveyors recorded and average depth of 3 ft. at one crossing in the middle Verde. Depths of base flow of 3 and 4 ft. were recorded at a few crossings in the lower Verde River. Even the depths of flow at the time of the Federal Surveys were depleted to some degree by diversions for irrigation and mining. So those depths were measured even though the river was not in its natural condition and its base flow had been adversely impacted by humans.

G4. --Navigability ---John Day River versus the Verde River

G4a.-Natural hydrology

Some of the hydrology (especially the base flow) (Figure G3 and Table G1 below) and physical characteristics of both the Verde River and the John Day River in Oregon are similar. These and other similarities are important because the Oregon Court of Appeals held particular segments of the John Day River navigable based on the reaches' susceptibility to navigation by Indian canoes. In the Oregon case navigability for title was found to be based on susceptibility to navigation even where evidence of actual navigation was lacking.

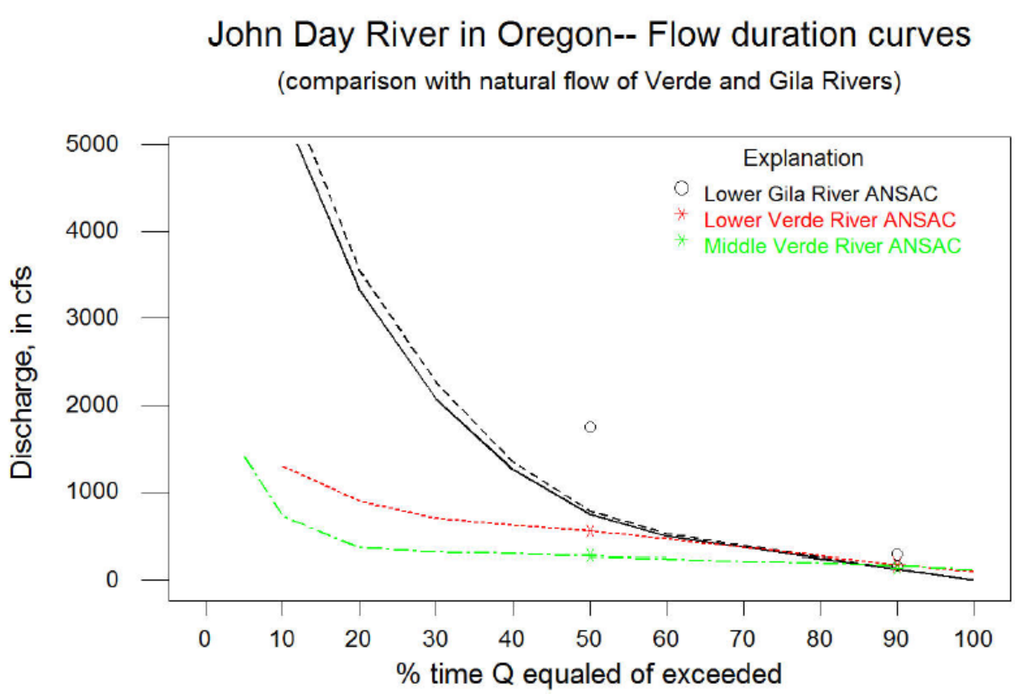


Figure G3. Flow-duration curves for the middle and lower Verde River and USGS gages 14046500 (solid line) and 14048000 (dashed line) on the John Day River in Oregon.

Table G1.—Virgin or predevelopment discharge, in cfs, at indicated USGS gages on the Verde and John Day Rivers.

Flow type	Camp Verde 09506000	Bartlett 09510000	John Day (Oregon) 14046500	John Day (Oregon) 14048000
Mean annual	489	749	1940	2060
Median (Q50)	272	558	746	787
Base (Q90)	172	179	130	137

Northwest Steelheaders Association Inc. v. Simantel, Decided: May 11, 2005, Court of Appeals of Oregon.: http://caselaw.findlaw.com/or-court-of-appeals/1419601.html, 10p.

The John Day River is 284 miles long and the second longest free-flowing/undammed river in the continental United States (the longest being the Yellowstone River). The river drains an area of nearly 8,100 square miles, which is approximately 8% of the total area of Oregon. By contrast, the Verde River is 230 miles long with a drainage area of 6,188 square miles at the Salt River confluence, which is about 6% of the total area of Arizona. Both rivers drain mountainous areas with spring snowmelt and the channels have numerous pools and riffles. The John Day and Verde Rivers are shown below.


Photo of John Day River on left from Eric Mortenson of The Oregonian, October 02, 2009 , “John Day River property will become Oregon's largest recreation site”
http://www.oregonlive.com/environment/index.ssf/2009/09/john_day_river_property_will_b.html

The flow-duration curves of mean daily discharge for the Verde and John Day Rivers are average (ordinary) curves that represent natural, or approximately natural, conditions (Figure G3). “The stream flow record integrates the effects of climate, topography, and geology, and gives a distribution of runoff both in time and in magnitude. When the flows are arranged according to frequency of occurrence and a flow-duration curve is plotted, the resulting curve shows the integrated effect of the various factors that affect runoff.” (Searcy, 1959). The shapes of the curves for the USGS gages on the two rivers obviously are different because the rather steep slope for the wide range of higher flows of the John Day curve denotes a more variable and larger direct runoff than for the Verde River. However, the curves for low flows are similar and it is the low flows that are most important in determining navigability. The flatter slope for the Verde River indicates the presence of base runoff from ground-water storage in the basin fill and lower Paleozoic rocks of the Redwall Limestone and Martin Formation (both typically large aquifers). For example, at Fossil Creek, springs discharge from a limestone aquifer supplied at least in part from the leakage through the overlying Permian-Pennsylvanian rocks from the C aquifer and thus ground water must travel through the Naco Formation at some locations beneath the Colorado Plateau

(Parker and others, 2005). The flat slope of the lower end of the duration curves for both rivers shows there is a large amount of aquifer storage in both the Verde River and John Day River watersheds.

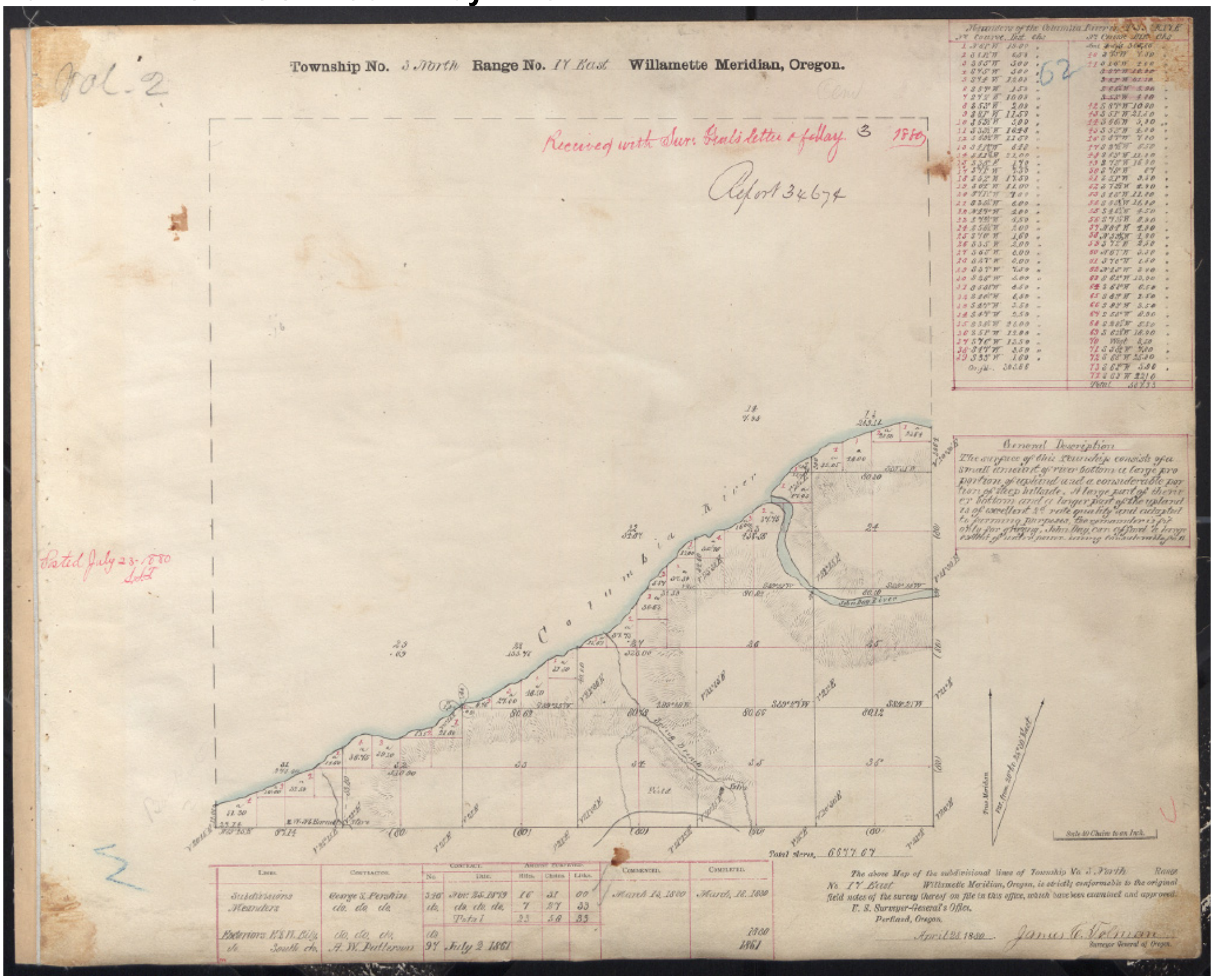
The timing, duration, and sequence of water discharges in the Verde River, or any river for that matter, is important for determining navigability. On the Verde River, the base flow is very important because snowmelt is seasonal and not present a large portion of the time during a typical year. The flat slope of the flow-duration curves of the Verde River (Figure G3) shows that base flow is all or a large portion of the runoff at least 70% of the time during a typical year.

The similarity of the lower ends of the flow-duration curves for the John Day and Verde Rivers suggests the rivers have similar navigability characteristics (Figure G3). Both rivers have pools and riffles with defined channels and similar amounts of base flow for approximately 50% of the time. Thus, if the John Day River is navigable then it follows that the Verde River also is navigable.

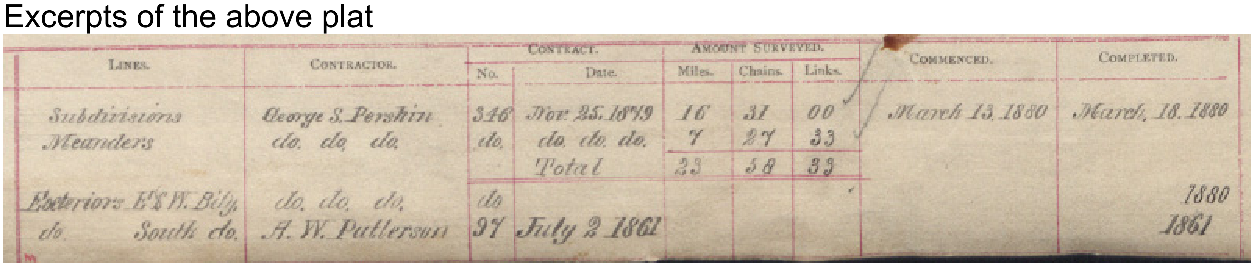
G4b.- Federal Land Surveys along the John Day River

The following three original Federal survey plats in Oregon for T3N R17E, T3N R18E and T2N R19E each include both the Columbia and John Day Rivers. On each plat the Columbia River was meandered but the John Day River was not. The John Day River is considered navigable for title purposes in Oregon (Northwest Steelheaders Ass'n v. Simantel 199 Ore. App. 471, 112 P.3d 383 (2005)).(Plats were obtained by Hjalmarson from BLM website in 2014)

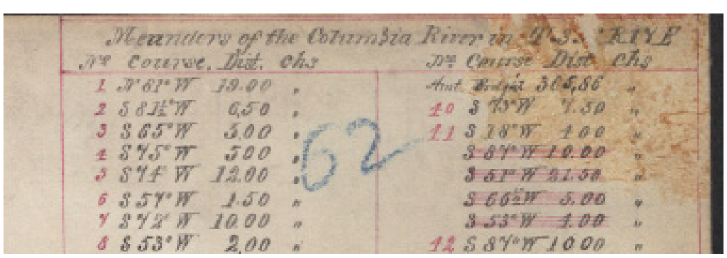
T3N R17E OREGON John Day River



Excerpts of the above plat



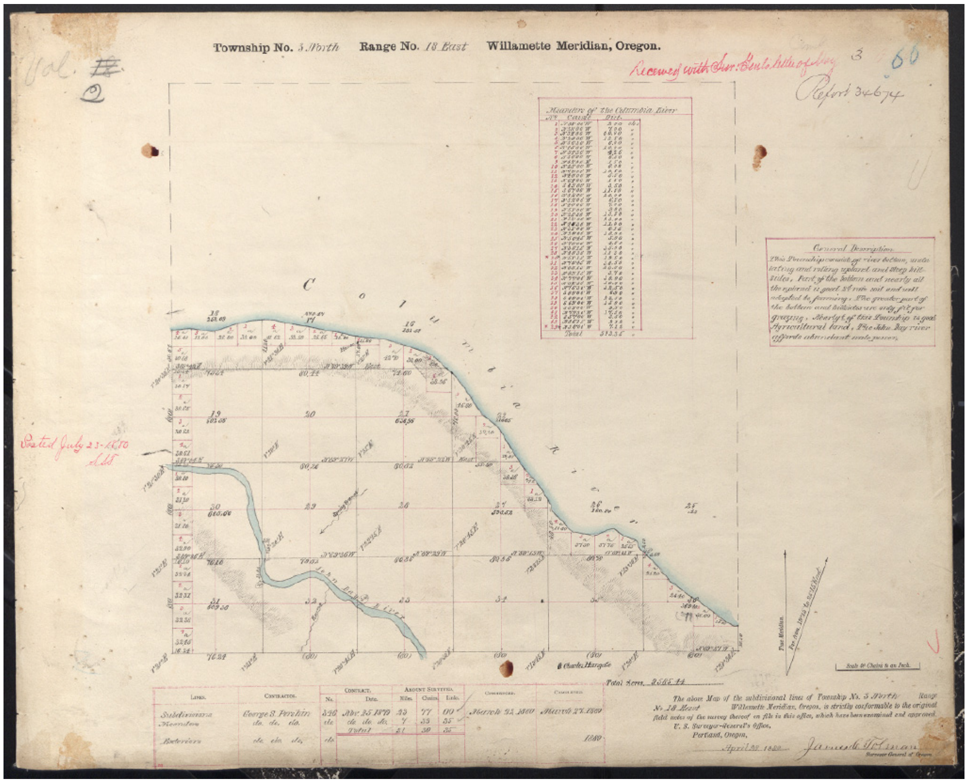
Lines.	Contractor.	Contract. No.	Contract. Date.	Amount Surveyed. Miles.	Chains.	Links.	Commenced.	Completed.
Subdivisions	George S. Perskin	346	Nov. 25. 1879	16	31	00	March 13. 1880	March 18. 1880
Meanders	do. do. do.	do.	do. do. do.	7	27	33		
			Total	23	58	33		
Exteriors E&W Bdy.	do. do. do.	do						1880
do. South do.	A. W. Patterson	97	July 2 1861					1861



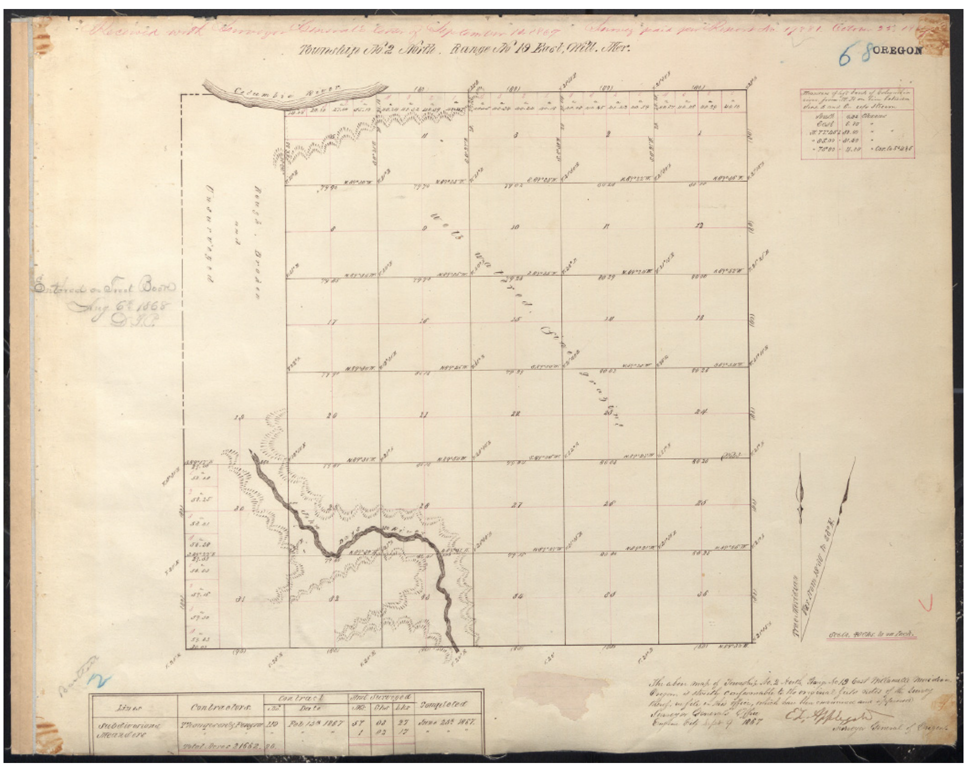
Meanders of the Columbia River in T3N R17E

No.	Course	Dist. chs	No.	Course	Dist. chs
				Amt. Brought	305.86
1	N 81° W	19.00	10	S 30° W	7.50
2	S 81½° W	6.50	11	S 18° W	4.00
3	S 65° W	3.00		~~S 87° W~~	~~10.00~~
4	S 75° W	5.00		~~S 51° W~~	~~21.50~~
5	S 74° W	12.00		~~S 66½° W~~	~~5.00~~
6	S 57° W	1.50		~~S 53° W~~	~~1.00~~
7	S 72° W	10.00	12	S 87° W	10.00
8	S 53° W	2.00			

Only the Columbia River was meandered. Survey was completed on March 18, 1880.



Township No. 3 North Range No. 18 East Willamette Meridian, Oregon.
Columbia River
Meanders of the Columbia River
General Description



Township No. 2 North Range No 19 East, Will. Mer.
OREGON
Columbia River

G4c.- Verde River Channel

The Verde River is incised into bedrock or basin deposits and the overall width of the modern and historical Verde floodplain has been relatively stable. There are shifts in channel position in the basin deposit areas during large floods. In bedrock reaches the Verde floodplain is typically less than 400 ft across. The historic surveys (Federal Surveys) define a 300-400 ft. wide channel within defined banks along the basin sediment area of the lower watershed and with flow depths of 3-4 ft. A Federal Survey in the 1870's described the middle Verde as "a beautiful stream of clear, pure water with an average width of 66 ft and an average depth of 3 feet" (Pearthree, 1996). The modern and historic Verde channel is/was largely confined within well defined channel banks in most, if not all, places.

Sediments within the active Verde channel are generally coarser than Holocene terrace deposits exposed in channel walls. There are imbricated small boulders and cobbles in places. There is evidence of coarse gravelly sediment with cobbles and small bounders below tributary streams. There is also evidence of large boulders that rolled in and along the river channel and floodplain from adjacent steep slopes.

The available evidence for the Verde River (depth-discharge relations at USGS gages, cadastral surveys from the 1870's to early 1900's, recent boating on the river, geomorphology, etc.) suggests the depth of natural flow was at least 2.6 feet 90% of the time during a typical year (Table G2). The median depth was at least 3 feet and the depth corresponding to the mean annual discharge was at least 3.5 feet.

Table G2. -- Computed and estimated depths for natural flow along the Verde River.

Location	Mean annual Q	Median (Q50)	Base (Q90)	
			Modern channel	Adjusted for Fed. surveys
Mile 3.3 to gage 09504000	> 3.5 ft.	> 3.0 ft.	> 2.9 ft.	3 ft.
Gage 09506000	3.8 ft.	3.1 ft.	> 2.8 ft.	3 ft.
Gage 09508500	4.5 ft.	3.7 ft.	> 2.6 ft.	3 ft.
Downstream of Gage 09510000	4.5 ft.	4.0 ft.	> 2.6 ft.	3 ft.

The evidence also suggests the natural and recent geometry of the channel upstream of Horseshoe Dam are approximately the same probably because (1) there is roughly ½ the natural base flow to maintain channel geometry and size, (2) there is bedrock and erosion resistant rock adjacent to the river channel, (3) the channel is not dry and

(4) there is coarse channel material in many places. According to Pearthree (1996) "the general form of the flood channels of the Verde River has not changed substantially since the time of statehood. Low-flow channels have shifted position to a much greater degree than the larger flood channels. The size and general form of low-flow channels in Verde Valley, however, was about the same in the 1870's as it is today."

At the very least the considerable recent use of the river by small watercraft suggests a well defined main channel with adequate depths, widths and velocities for navigability. Downstream of Horseshoe Dam where nearly all flow is from controlled releases from the two major reservoirs, the main channel typically is well defined but there are braided reaches where the recent channel(s) of the lower Verde River are not considered representative of the natural condition. For practical purposes the flow below Horseshoe Dam is considered totally regulated and human altered and the Bartlett and Horseshoe reservoirs serve as sediment traps. Also, flow is diverted for irrigation of Indian lands in the lower reach. Thus, while much of the size and shape of the natural main channel are considered approximately the same as the recent channel for this study, the recent channel of the highly regulated flow below Horseshoe Dam probably is wider and shallower than was the natural channel.

G4d.- Navigability

Consider the following table of required drafts for recreational watercraft on the John Day River shown below. The table is from page 30 of "JOHN DAY RIVER FINAL NAVIGABILITY REPORT" of March 25, 2005. This report presents the findings and conclusions of the Oregon Department of State Lands (DSL) concerning the ownership or "navigability" of a 174-mile segment of the John Day River extending from Kimberly at River Mile (RM) 184 to Tumwater Falls at RM 10. The Oregon State Land Board ("Land Board" or "Board") directed DSL to conduct this study in October 2002 after receiving a request in early 1997 from the John Day River Chapter of the Association of Northwest Steelheaders.

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Table 9

Drafts Required by Various Recreational Watercraft Used on the John Day River and River Segments Most Often Used

Type of Watercraft	Typical Draft (inches)	Segment	Comments
Whitewater kayaks	6	Kimberly-Tumwater	one person
Inflatable kayaks	3-4	Kimberly-Tumwater	one person
Canoes	6	Kimberly-Tumwater	two persons with gear
Drift boats	3-8	Kimberly-Tumwater	depending on number of persons and amount of gear
Large rafts/sweep boats	6-8	Service Creek-Tumwater	summer use
Jet boats (powered)	12	Service Creek-Clarno Cottonwood Bridge-Tumwater	winter use only

Source: Shelby, 2002; Campbell, 1980; Garren, 1991; Willamette Kayak & River Club, 1994

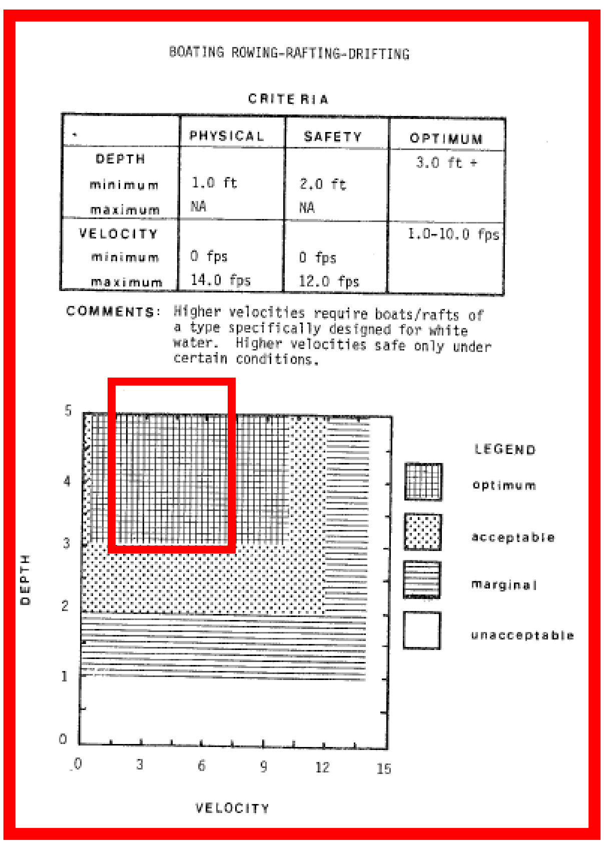
As indicated from Table 9, with the exception of jetboats, all of the current watercraft used on the John Day River require 8 inches or less of draft, and many less than 6 inches of draft.

Based on the analysis of the significant hydrologic and hydraulic evidence in this Appendix and the analysis for the upper Verde River of this report for ANSAC, the depths along the entire Verde River are several times greater than the drafts required for canoes and kayaks shown in the above table (Table 9). Like the John Day River, the Verde River is navigable.

However, as is evident in the assessment of navigability for the Upper Verde River, my assessment uses a high standard associated with the optimun conditions defined by the Fish and Wildlife Service of the Dept. of the Interior (Hyra, 1978). While such a high standard in not necessary, I find it useful to eliminate any doubt regarding the navigability the Verde River.

Early (pre-1870) explorers and beaver trappers typically did not use canoes or boats on the Verde River. The mode of travel by trappers was on mules because they entered the area from the east (e.g. Taos) and travelled overland to various rivers such as the Gila, Salt, San Pedro, San Francisco and Verde Rivers. Also, potential boating along the Verde River before about 1870 was hazardous because persons in boats would be exposed to attack from Indians concealed in the vegetation along the banks.

Modern small watercraft such as canoes and kayaks easily travel along the entire length of the Verde River. It's important to note that hydrologic and hydraulic conditions under natural conditions (pre 1860s) probably were considerably more conducive for boating when there were few or no withdrawals for irrigation, mining, railroad and domestic use. Thus, for about the past 25 years the Verde River has been popular for boating even under depleted base flow conditions.



	PHYSICAL	SAFETY	OPTIMUM
DEPTH			3.0 ft +
minimum	1.0 ft	2.0 ft	
maximum	NA	NA	
VELOCITY			1.0-10.0 fps
minimum	0 fps	0 fps	
maximum	14.0 fps	12.0 fps	

The Fish and Wildlife Service method is easy to use and is based on hydraulics of a single channel cross section that is representative of channel conditions (Figure G4a). These navigation requirements (Instream Flow Information No. 6) were developed by R. Hyra (1978) for the Fish and Wildlife Service of the Dept. of the Interior. Channel depth and width requirements are defined for types of watercraft such as rafts and rowboats (Figure G4a) and canoes and kayaks (Figure G4b). Optimum suitability conditions are shown for canoes, kayaks on the Verde River.

Figure G4a. Acceptable and optimal depths and velocities for small watercraft.

BOATING CANOEING-KAYAKING

CRITERIA

	PHYSICAL	SAFETY	OPTIMUM
DEPTH			2.5 ft +
minimum	0.5 ft	1.0 ft	
maximum	NA	NA	
VELOCITY			0.5-7.0 fps
minimum	0 fps	0 fps	
maximum	10.0 fps	9.0 fps	

COMMENTS: Higher velocities exclude open canoes. Higher velocities safe only under certain conditions.

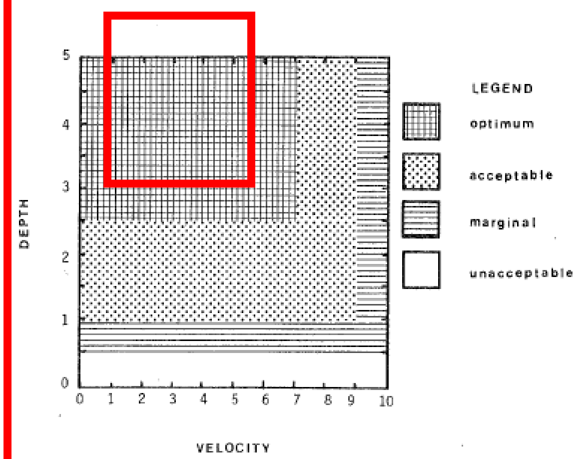


Figure G4b. Acceptable and optimal depths and velocities for small watercraft.

It is my opinion the Verde River from river mile 36.6 (USGS Gage near Clarkdale) to mile 230 (mouth at Salt River) was susceptible to navigation at the time of statehood (February 14, 1912) in its natural condition. During ordinary years the river conditions were optimal for navigation using canoes and kayaks 95% of the time and river conditions were acceptable and optimal for small boats and rafts about 95% of the time. Evidence relied upon to form this opinion is in this report and in the references for this report.

See the main report for my assessment of the Upper Verde River.

Appendix H.-- Miscellaneous subjects

Item H1.--Example of navigating troubles on the Missouri River.

These are notes of troublesome areas while navigating along the Missouri River in 1811—a river considered navigable for title purposes. The small boat had a sail. This is presented to ANSAC as a simple demonstration that navigable rivers have conditions at times and in places that make navigation difficult.

Brackenridge, H. M., 1816, Journal of a Voyage up the River Missouri, performed in 1811, Baltimore, Published by Gould and Maxwell, Early western travels 1784-1846, 166p.

A TABLE OF DISTANCES[illegible]

From the mouth of the Missouri to the Mandan Villages — Rivers — Latitudes, &c.

Places	Width of rivers, yds.	Side of Missouri	Distance	Total Dist.	Latitude
St. Charles		N. E.	21		38° 59′
Osage river, (Little,)	30	N. E.	20		
Charles' creek	20	S. W.	27		
Shepherd's creek		S. W.	15		
Gasconade river	157	S. W.	17	100	38° 45′
Muddy river	50	N. E.	15		
Great Osage	397	S. W.	18	133	38° 31′
Marrow Creek	20	S. W.	5		
Cedar Creek and island	20	N. E.	7		
Lead Mine hill		S. W.	9		
Hamilton's creek	20	S. W.	8		
Split Rock creek	20	N. E.	8	170	
Saline or Salt river	30	S. W.	3		
Manitoo river	30	N. E.	9		
Good Woman's river	35	N. E.	9		
Mine river	70	S. W.	9	200	
Arrow prairies		S. W.	6		
The Charitons	30 70	N. E.	14		
Ancient village of Missouri Indians, near which, fort Orleans formerly stood		N. E.	16		
[244] Grand River	90	N. E.	4	240	
Snake creek	18	N. E.	6		
Ancient village of the Little Osage Indians		S. W.	10	256	
Tiger creek and Island	25	N. E.	20		
A creek and island		S. W.	12		
Fire prairie and creek		S. W.	12		

[illegible] By comparison of this table with the more detailed list in Lewis and Clark's *Narrative* (Biddle ed., Philadelphia, 1814), ii, pp. 462-464, it will be noticed that several changes have been made by Brackenridge, both in the data and orthography, while the latitude is added. From internal evidence, there is some reason to believe that Brackenridge had access to the original journals of Lewis and Clark, but failed properly to interpret some of the proper names in the manuscript.— Ed.

Passed an island, where the river widens considerably; the current rapid, obliged to abandon oars and poles, and take the towing line.

Places	Width of rivers, yds.	Side of Missouri	Distance	Total Dist.	Latitude
Fort Clark or Osage .		S. W.	6	306	
Hay Cabin creek . .	20	S. W.	6		
Coal bank		S. W.	9		
Blue Water river . .	30	S. W.	10		
Kansas river . . .	233	S. W.	9	340	39° 5′
Little river Platte . .	60	N. E.	9		
1. Old Kansas village .		S. W.	28		
Independence creek .		S. W.	28		
2. Old Kansas village .		S. W.	1		
St. Michael's prairie .		N. E.	24		
Nodawa river . . .	70	N. E.	20	450	39° 40′
Loup or Wolf river .	60	S. W.	14		
Big Nihema . . .	80	S. W.	16		
Tarkio creek . . .	23	N. E.	3		
Nish-na-botona . .	50	N. E.	25	508	
Little Nimeha . . .	48	S. W.	8		
Bald-pated prairie — the river Nish-na-bo-tona is at this place not more than 150 yards from the bank of the Missouri.		N. E.	23		
Weeping-water creek .	25	S. W.	29		
RIVER PLATTE . . .	600	S. W.	32	600	41° 4′
Butterfly creek . .	18	S. W.	3		
Moscheto creek . .	22	N. E.	7		
Ancient village of Ottoes		S. W.	11		
do. of Ayuwas		N. E.	6		
[245] —— river . . .	28	N. E.	11		
Council Bluffs . . .		S. W.	12	650	41° 17′
Soldier's river . . .	40	N. E.	39		
Little Sioux . . .	80	N. E.	44		
Bad Spirit river . .		S. W.	55	788	
A bend in the river, 20 miles round, and but 900 yards across.			21	809	
An island 3 miles N. E. of Floyd's village.			27	836	
Floyd's river and bluff	35	N. E.	14	850	
Big Sioux river . .	110	N. E.	3	853	38° 48′
Commencement of the Cobell, Alum, and Copperas bluffs . .		S. W.	27	880	

Monday I3th. Water. falling - continued with the towing line. At ten, a fine breeze springing up, hoisted sail. Passed the river *a Boyer,* and the houses of M'Clelland, who formerly wintered here. Some woody country hereabouts; but that on the upland is very inferior, chiefly shrubby oak. A short distance above this place we encountered a very difficult and rapid current, but being luckily a little aided by the sail, we passed tolerably well.

Tuesday 2Ist. This morning fine, though somewhat cool. Wind increasing from the N. E. Current rapid, but for the eddies in the bends, it would be almost impossible to ascend. There are but few embarras, or collection of trees, &c. The sand bars are fringed with a thick growth of willows, immediately behind which there are young cottonwood trees, forming a handsome natural avenue, twenty or thirty feet wide.

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Places	Width of rivers, yds.	Side of Missouri	Distance	Total Dist.	Latitude
Hot or Burning bluffs .		S. W.	30		
White Stone river . .	30	N. E.	8		
An old village at the mouth of Little Bow creek		S. W.	20		
River a Jaque or James R.	90	N. E.	12	950	42° 53′
Calumet bluff . . .		S. W.	13		
Ancient fortification, Good Man's Isle		S. W.	13	976	
Plumb creek . . .	12	N. E.	10		
White Paint creek . .	28	S. W.	8		
Qui Courre creek . .	150	S. W.	6	1000	
Poncas river and village	30	S. W.	10		
The village of dog prair.		S. W.	20		
The island Cedar . .			40		
WHITE RIVER . . .	300	S. W.	60	1130	
The 3 rivers of the Sioux	36	N. E.	22		
An island in the upper part of the Big Bend		S. W.	20		
[246] Upper part of the Big Bend, the gorge 1½ mile across		S. W.	30		
Tyler's river . . .	35	S. W.	6	1208	
L'Oiselle's post, Cedar island			18		44° 12′
Titon river . . .	70	S. W.	37		
The upper part of five old record villages of Arikaras, reduced by the Sioux		S. W.	42		
Chienne river . .	400	S. W.	5	1310	44° 20′
Old record village . .			47		
Ser-war-cerna . . .	90	S. W.	40	1397	
Waterhoo	120	S. W.	25	1422	45° 35′
Old village on an island		S. W.	4		
Arikara, 2 villages .		S. W.	4		
Stone Idol creek . .	18	N. E.	18		
Warecore	35	N. E.	40		
Cannon-ball river . .	140	S. W.	12	1500	46° 29′
Old Mandan village .		S. W.	40		
do. . . .		S. W.	40		
Mandan village . .		S. W.	20	1600	47° 13′
Company's Fort . .			40	1640	

THE END

The high waters enable us to cut off points, which is no small saving of the distance. The waters begin to fall, though great quantities of drift wood descend, and thirty or forty drowned buffaloes pass by us every day.
(Approx. location)

This report gives a view of the difficulties of navigation from the mouth to the western part of North Dakota (far downstream of Great Falls Montana) which Henry Marie Brackenridge well described - the changes and rapidity of the current, the falling in of the banks, the snags, and the shifting nature of the river bed. He returned to civilization with beaver pelts.

Brackenridge lived to see steam navigation and transportation transform the entire Missouri Valley into a thriving centre of civilization; on the sites which his eye had selected for towns, to be established in a far-distant future, there soon arose large cities.

Item H2--Spanish explorer in the upper Verde

A very early account of the Verde River in December of 1598 from: Bolton, H., 1916, *Spanish Exploration in the Southwest,* Scribners Co., New York, 487p.

As part of the Don Juan de Onate expedition on pages 243-244:

"As it was late they camped for the night about two arquebus shots from there, on the bank of a river[3] of fair width and much water, with good pasture and a cottonwood grove. The following morning, as the chief whom they had as a guide wished to return, the witness begged the chief of this rancheria to go with him and show him the mine from which they got ores. He consented willingly, and having travelled about four leagues through very fine, fertile land, with extensive pastures, they came to another river, wider than the first, where they spent the night. This river flowed almost from the north. They crossed it, and having travelled about two leagues they came to another river, much larger, which flowed from the north. They crossed it, and having travelled about a league, arrived at the slopes of some hills[1] where the Indian chief said the mines were whence they got the ore."

> "[3] This would seem to correspond with the northwestern branch of the Verde River, which was crossed between Bill Williams Mountain and Prescott. The old trail from Antelope Springs, south of Bill Williams Mountain, crossed the river at Postal's Ranch. It is just possible that they crossed Black Forest farther north, and went through old Camp Hualpai, where the trail forked, but I doubt it." Win's Comment: This probably would be Big Chino Creek.
>
> "[1] I am in doubt as to whether the last stream was the Big Sandy or the Spenser River, a branch of the Santa Maria, but the indications seem to point to the latter. In that case the mines were in the Aquarius Range; in the other case, they were in the Hualpai Range. Both of these ranges have become mining districts."

Item H3.—Fish in upper Big Chino Valley

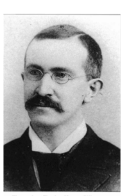


Figure 1.—Charles Henry Gilbert, ca. 1903.

Gilbert, Charles H. 1898, Notes on a collection of fishes from the Colorado Basin in Arizona: Proceedings of the United States National Museum, Volume: 20: 1898-01-19, pp 487—499.

Gilbert collected several fish specimens near Chino and other places in Arizona on or before 1898. There is possible confusion of the location of Chino but I've relied on Arizona Place Names and the date of Gilbert's and Scofield's sampling. Also, I've considered Wirt's (2005) interpretation of the location. Thus, I assume the samples were collected from Chino Creek that is near Chino and located a couple of miles west of

Seligman. It is noted that both men were prominent scientists and would not have incorrectly confused the Del Rio Springs area with “Chino.” Chino Creek (Map, Prescott N. F., 1927) rises near the southeast end of Aubry Cliffs and flows through Big Chino Valley to the Verde River near Paulden.

The stream Chino Creek is so named on early topographic maps and thus a perennial or intermittent stream is implied. More recent USGS maps show the stream as Big Chino Wash and thus an ephemeral stream is implied. With all of the impoundment of direct runoff, upstream groundwater withdrawal and the lowering of groundwater levels in Big Chino Valley by groundwater withdrawal it’s easy to understand how the creek became a lowly wash.

ARIZONA PLACE NAMES gives the following location for Chino AZ

Chino Yavapai Co. G. L. O. Map, 1921.
Station A. T. & S. F. R. R., 4 miles west Seligman. At head
Big Chino valley. See Chino valley.

Also,
Chino Creek (wash) Yavapai and Coconino Cos. Map, Prescott N. F., 1927.
Rises northwest of Mount Floyd southeast end Aubrey cliffs
in T. 26 N., R. 6 W., runs through Chino valley entering Verde
River in approximately T. 17 N., R. 1 W. See Chino.

Wirt, L., 2005, The Verde River headwaters, Yavapai Count, Arizona *in* Wirt, Laurie, DeWitt, Ed, and Langenheim, V.E., eds., Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River Headwaters, North-Central Arizona: U.S Geological Survey Open-File Report 2004-1411, 33 p.

The fishes suggest Big Chino Wash was perennial or intermittent. There is a meander pattern in T21N R6W (See Appendix F) that also suggests perennial or intermittent flow in the upper Big Chino Wash.

T23N

T22N

T21N

The following are descriptions of the fish from Gilbert's report.

9. LEUCISCUS INTERMEDIUS Girard.

Gila gracilis BAIRD & GIRARD, Proc. Ac. Nat. Sci. Phila., 1853, p. 369 (preoccupied in *Leuciscus*).—GIRARD, Pac. R. R. Surv., X, 1858, p. 287.—JORDAN & GILBERT, Synopsis, 1883, p. 229.

Gila gibbosa BAIRD & GIRARD, Proc. Ac. Nat. Sci. Phila., 1854, p. 28, RIO SANTA CRUZ (preoccupied in *Leuciscus*).

Tigoma gibbosa GIRARD, Proc. Ac. Nat. Sci. Phila., 1856, p. 207.—GIRARD, U. S. Mex. Bound. Surv., Zool., 1859, p. 64.

Tigoma intermedia GIRARD, Proc. Ac. Nat. Sci. Phila., 1856, p. 206.

Squalius intermedius JORDAN & GILBERT, Synopsis, 1883, p. 238.

Leuciscus intermedius JORDAN & EVERMANN, Fishes of N. and M. A., 1896, p 235.

Gila nigra COPE, Zoöl. Wheeler's Expl. W. 100th Mer., V, 1875 (1876), p. 663.

Squalius nigra JORDAN & GILBERT, Synopsis, 1883, p. 239.

Leuciscus niger JORDAN & EVERMANN, Fishes of N. and M. A., 1896, p. 235.

Squalius lemmoni ROSA SMITH, Proc. Cal. Ac. Sci., 1884, p. 3.

Leuciscus zunnensis GÜNTHER, Cat., VII, 1868, p. 241. Substitute for *L. gracilis*, preoccupied.

Numerous specimens about 3 inches in length were obtained at Tempé, and at Chino, Arizona. It is more robust than the young of *Gila robusta*, and has the scales a little larger, those below the lateral line specked with black. The specimens taken at Chino differ from the Tempé specimens in the slightly deeper caudal peduncle. This species varies greatly in its scale formula, as can be seen from the accompanying table. Like *G. elegans* and *G. robusta* it is found throughout the Colorado River Basin. It has been commonly known as *L. niger*, but there is no reason to consider the two nominal species distinct. *Squalius lemmoni* is described as having the scales 68, but in one of the types we find them 21–75–10. It may therefore well belong here.

Table of measurements.

D.	A.	Scales.	Rud. C. rays.	Least depth of C. ped. in length.	Length of C. ped. in length.	Head in length.	Eye in head.	Depth.
8	8	24–84–10	10–10	$12\frac{1}{2}$	$4\frac{1}{3}$	$3\frac{1}{3}$	$3\frac{1}{3}$	$4\frac{1}{3}$
9	9	18–91–10	9–10	12	$4\frac{1}{3}$	4	$3\frac{2}{3}$	$4\frac{1}{3}$
8	8	18–83–10	10	$12\frac{1}{2}$	$4\frac{3}{5}$	$3\frac{3}{4}$	$3\frac{1}{4}$	4
8	8	18–92–10	10–10	$12\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{3}$
9	8	18–94–10	10–10	12	$4\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{1}{3}$	$4\frac{1}{2}$
9	8	18–92–10	10–10	$11\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{3}$
8	8	19–82–10	10–10	$11\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{4}{5}$	$3\frac{1}{2}$	4
8	8	20–95–10	10–10	10	$4\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$3\frac{1}{2}$
8	8	18–87–9	10–10	$10\frac{1}{4}$	$4\frac{1}{4}$	$5\frac{3}{4}$	$3\frac{1}{3}$	$3\frac{4}{5}$
8	9	19–87–10	10–10	12	$4\frac{1}{2}$	$3\frac{4}{5}$	$3\frac{1}{4}$	$4\frac{1}{5}$
9	8	20–79	10–9	11	$4\frac{1}{3}$	$3\frac{4}{5}$	$3\frac{1}{2}$	$4\frac{1}{5}$
8	8	20–87–11	10–10	11	$4\frac{1}{3}$	$3\frac{4}{5}$	$3\frac{1}{2}$	$3\frac{4}{5}$
8	8	18–80–10	10–10	$11\frac{1}{2}$	$4\frac{1}{3}$	$3\frac{3}{4}$	$3\frac{2}{3}$	4
9	8	19–87–10	9–9	11	$4\frac{1}{3}$	$3\frac{4}{5}$	$3\frac{2}{3}$	4
9	9	19–87–10	10–10	11	$4\frac{1}{4}$	$3\frac{3}{4}$	$3\frac{3}{4}$	4
8	8	18–83–10	10–10	11	$4\frac{1}{8}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$4\frac{1}{4}$
8	8	20–82–10	10–10	$10\frac{1}{2}$	$4\frac{1}{3}$	$3\frac{1}{2}$	$3\frac{1}{4}$	4
8	8	21–76–10	10–10	$10\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{4}$

10. TIAROGA COBITIS Girard.

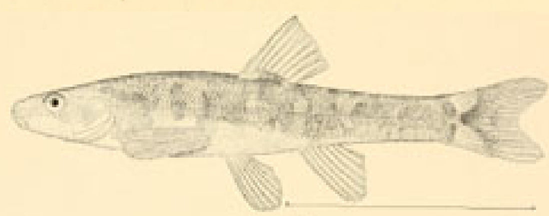
(Plate XXXVII.)

Several specimens of this interesting species were obtained at Chino, Arizona, from a tributary of the Rio Verde, which belongs to the Gila Basin. It is of unusual interest, not having been taken since the discovery of the types in 1851. Girard's specimens were from the Rio San Pedro, a tributary of the Gila.

Head 4 to $4\frac{1}{2}$; depth $5\frac{1}{3}$; eye small, 4 to $4\frac{1}{2}$ times in the head, $1\frac{1}{2}$ in the snout, $\frac{3}{4}$ interorbital space. The snout is contained 3 to $3\frac{1}{8}$ times in the length of the head. D. 8; A. 7. Isthmus very wide, 2 in head.

In five specimens examined, four have the teeth 1, 4–4, 1, and one 2, 4–4, 1, without grinding surface. The lateral line is median and about straight, with seventy pores to base of caudal fin. The belly and the back in front of the dorsal are destitute of scales. Least depth of caudal peduncle $2\frac{1}{3}$ in head. Mouth very small, terminal, oblique; the lips fleshy. The maxillary is without barbels and is contained $1\frac{1}{3}$ in snout. The mandible is contained a little less than three times in head; premaxillary not protractile. The pectoral fins reach two-thirds distance to ventrals. The ventrals reach the front of the anal. The third ray of the anal is the longest, $2\frac{2}{5}$ in head. The front of the dorsal is slightly behind the origin of the ventrals, and considerably nearer the base of the caudal than the tip of the snout. The edge of the dorsal fin is straight, its second ray longest, $1\frac{2}{5}$ in head, its rudimentary rays not enlarged.

Color (in alcohol), pale gray or yellowish, mottled with reddish-brown on sides and back; a dark elongate black spot on base of middle caudal rays broadening posteriorly into a vertical bar, which follows the posterior outline of the caudal fin; this followed by a second and in some by a third fainter bar with lighter interspaces; a conspicuous white patch above and below caudal spot; there is a small but conspicuous white spot under the first rays of the dorsal and one under posterior end of dorsal, the two encroaching slightly on the fin; dorsal with two broad but faint dark bars parallel to its free edge. Length averages $2\frac{1}{2}$ inches.



11. AGOSIA OSCULA Girard.

About thirty specimens were obtained at Chino. This species is at once distinguished from the other species of *Agosia* in the Colorado Basin by its very small scales and its definite lateral band. We give here a description based on our specimens, as there is no good current description.

Head 4 in length; depth 4 to $4\frac{3}{4}$; eye 4; snout $3\frac{1}{4}$; scales 17 to 19–80 to 86–15 to 17; D. 8; A. 7; least depth of caudal peduncle $2\frac{1}{4}$ in head; teeth 1, 4–4, 1, hooked and with grinding surface. Body terete and rather elongate, the caudal peduncle not much compressed. The head tapers to an elongate but obtuse snout. The mouth is slightly oblique; the lips not fleshy; maxillary with a small barbel at its tip. Free margin of dorsal and anal straight. The front of the dorsal is slightly behind the origin of the ventrals and midway between the center of the orbit and the base of the middle caudal rays. Length of dorsal 2 in head; its longest ray $1\frac{1}{3}$ in head. The pectorals are short, reaching two-thirds distance to ventrals. The ventrals do not quite reach the front of the anal. Dusky olive above, silvery below; a definite dark lateral band about width of eye, expanding at the base of the caudal and narrowing abruptly to a faint caudal spot. In some specimens the sides are slightly mottled with darker. Our specimens are about 2 inches in length.

13. AGOSIA CHRYSOGASTER Girard.

Only one specimen was obtained at Chino.

Head 4 in length; depth $4\frac{1}{2}$; eye $3\frac{1}{2}$; snout $3\frac{1}{2}$; interorbital 4; D. 8; A. 7; scales 16–80–14; teeth 4–4, without grinding surface.

15. MEDA FULGIDA Girard.

This species was found extremely abundant in the upper course of the Rio Verde, near Chino, Arizona, and was taken also in the Salt River at Tempé. It had previously been taken only in the Rio San Pedro. Following is a description of our specimens:

Head 4 in length; depth $5\frac{1}{2}$; eye $3\frac{1}{2}$ in head, equal to snout and to interorbital width. Least depth of caudal peduncle $3\frac{1}{2}$ in head, equaling diameter of eye. D. II, 6, counting last divided ray as one; A. 8, 9, or 10, usually 9. Front of dorsal behind origin of ventral considerably nearer base of caudal than tip of snout. The character of dorsal rays is the same as in *Plagopterus argentissimus*, the first spine curved nearer its tip than in the latter, the second spine shorter than the first; first spine $1\frac{3}{4}$ in head, longer than base of fin, which is contained twice in head; anal $1\frac{4}{5}$ in head; pectorals reach two-thirds distance to vent; the rays osseous at base; ventrals reaching almost to vent, and structurally the same as in *P. argentissimus;* caudal forked for a little less than half its length, the lobes rounded. Mouth moderate, terminal, slightly oblique, the lower jaw included; mandible reaching vertical from center of pupil; maxillary reaching front of pupil, without barbel. The teeth were examined in ten specimens, eight having them 1, 4–4, 1; one 2, 4–4, 1, and one 1, 4–5, 1. Lateral line gradually descending backward to beneath the dorsal, where it bends rather

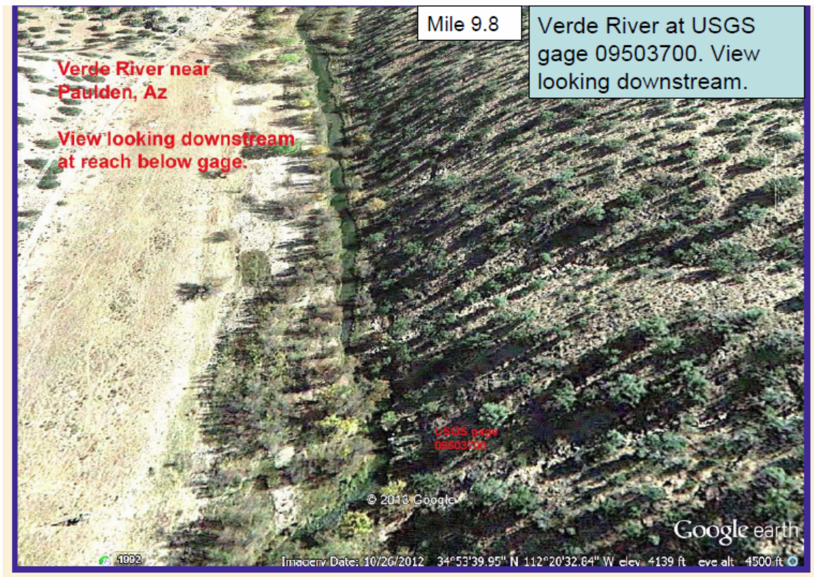
abruptly upward to axis, and thence straight to caudal; no trace of rudimentary scales.

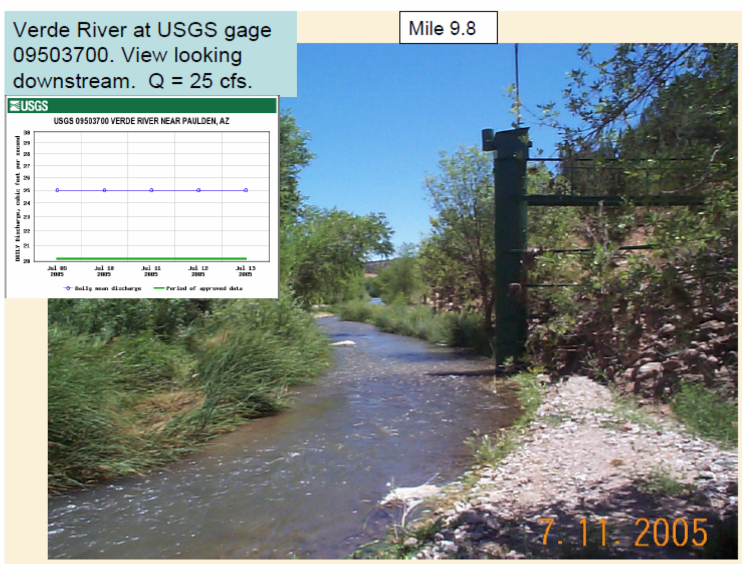
Color bright silvery, with reddish brown mottlings along back; a band of scattered black specks along lateral line, extending across opercle and around snout; body pale yellowish below; peritoneum and gill cavity silvery, with a few black specks. A few specimens have the second dorsal spine longer than the first, agreeing thus with the original description.

Item H4.—USGS gages on Verde River are not at channel constrictions.

At the ANSAC hearing on the Gila River in Phoenix on Aug, 20, 2014 Dr. Mussetter said the USGS installed gages at channel constrictions. His is mistaken. Based on my experience with approximately 2000 USGS gages in the western US, gages at constrictions are the exception and definitely not the rule. In 1993 when I retired from the USGS, I had personally inspected all the gage sites in Arizona. The six USGS gages on the Verde River are not on constrictions as shown below.

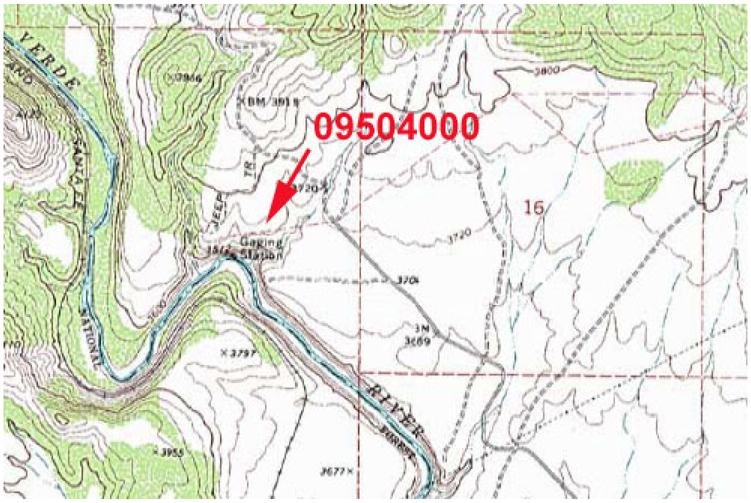
09503700 Gage at upper end of straight reach. No constriction.

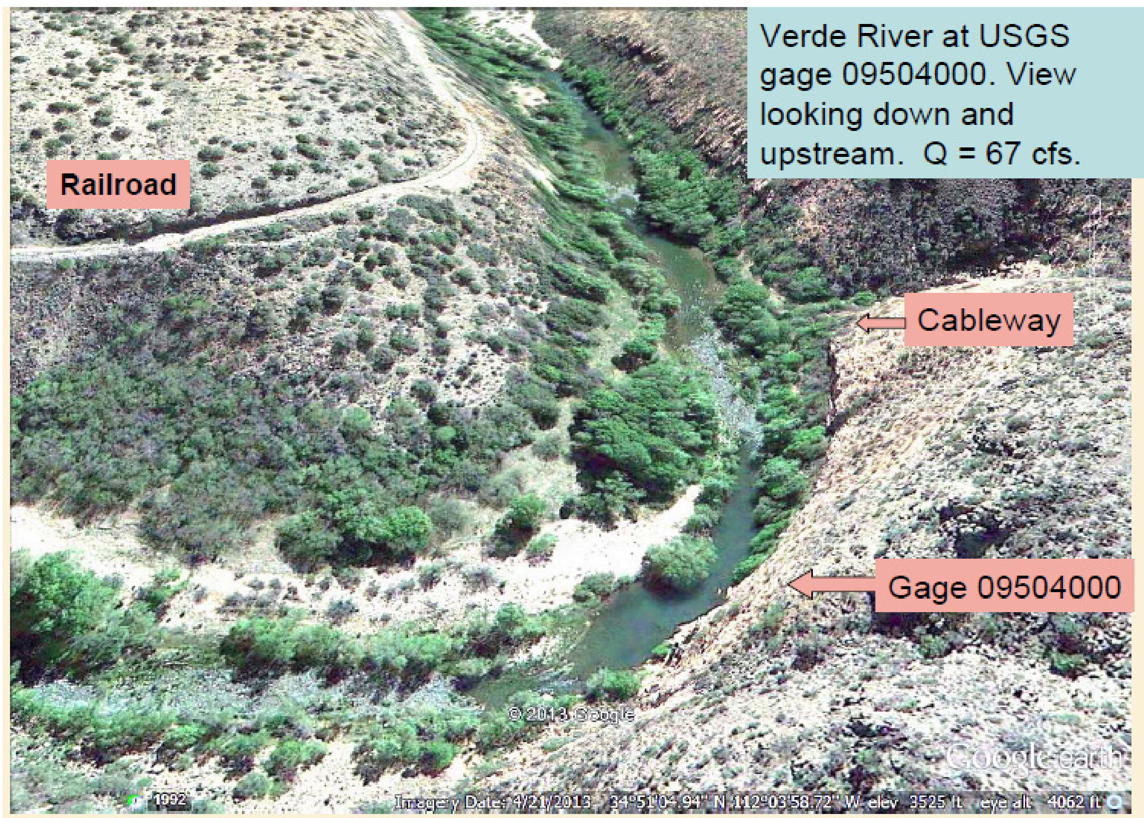




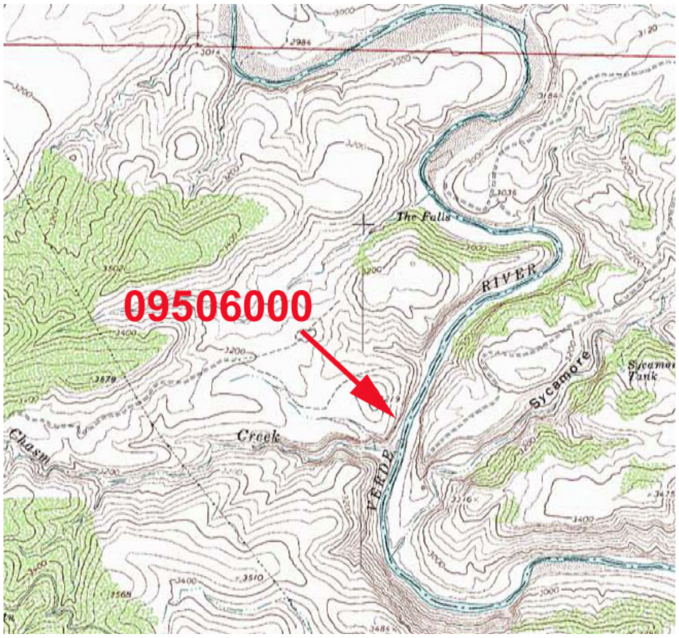
USGS photo

095040000 Gage on outside of bend at upper end of rather straight reach.
No constriction--just a small riffle control for the low-flow rating.

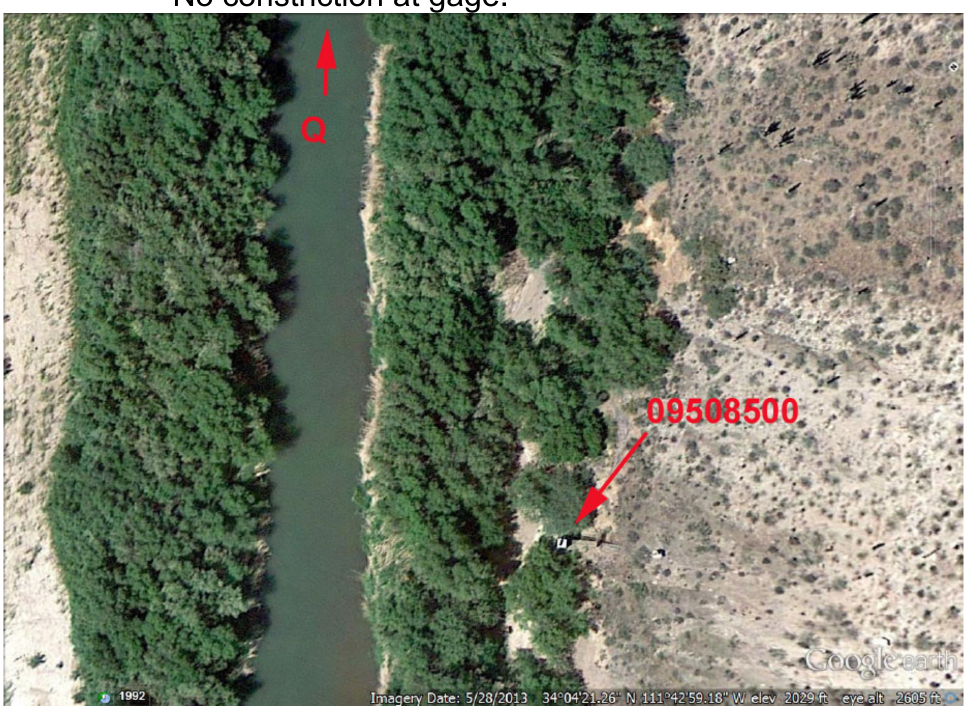




09506000 Gage 600 ft upstream from Chasm Creek on straight reach.
No constriction at gage.

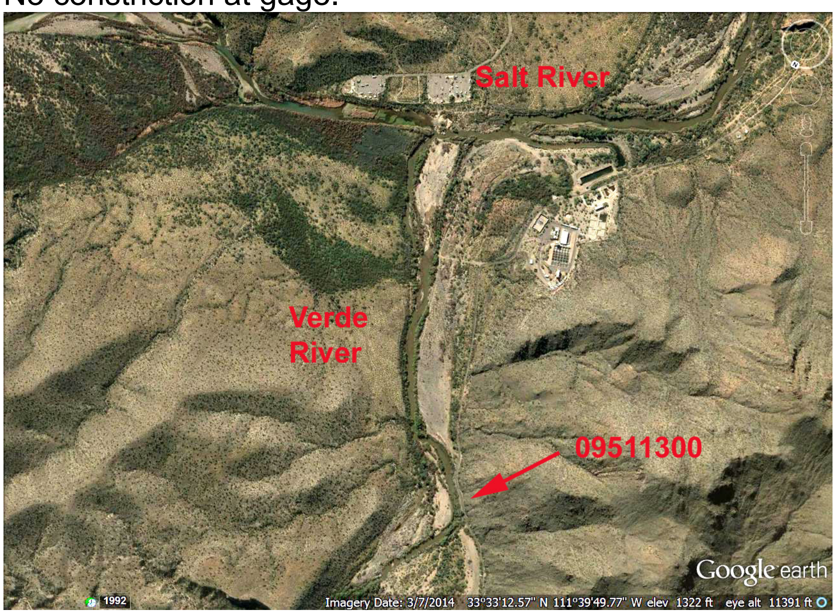


09508500 Gage below sheep crossing on straight reach.
No constriction at gage.



09510000 Gage 2.7 mile below Bartlett Dam on straight reach.
No constriction at gage. Trees cover view of banks and gage.

09511300 Gage 1 mile above mouth on rather straight reach.
No constriction at gage.



Item H5.--General effect of dams

The following general effects of dams on downstream river channels may apply to the Verde River below Bartlett Dam and Granite Creek below Watson Lake Dam.

Williams, G.P. and Wolman, M.G., 1984, Downstream Effects of Dams on Alluvial Rivers. USGS Professional Paper 1286. U.S. Government Printing Office, Washington, DC, 83p.

ABSTRACT
This study describes changes in mean channel-bed elevation, channel width, bed-material sizes, vegetation, water discharges, and sediment loads downstream from 21 dams constructed on alluvial rivers. Most of the studied channels are in the semiarid western United States. Flood peaks generally were decreased by the dams, but in other respects the post-dam water-discharge characteristics varied from river to river. Sediment concentrations and suspended loads were decreased markedly for hundreds of kilometers downstream from dams; post-dam annual sediment loads on some rivers did not equal pre-dam loads anywhere downstream from a dam. Bed degradation varied from negligible to about 7.5 meters in the 287 cross sections studied. In general, most degradation occurred during the first decade or two after dam closure. Bed material initially coarsened as degradation proceeded, but this pattern may change during later years. Channel width can increase, decrease, or remain constant in the reach downstream from a dam. Despite major variation, changes at a cross section in streambed elevation and in channel width with time often can be described by simple hyperbolic equations. Equation coefficients need to be determined empirically. Riparian vegetation commonly increased in the reach downstream from the dams, probably because of the decrease in peak flows.

Commonly, the section of maximum degradation in most cases was close to the dam, and degradation then decreased progressively downstream. However, large and small depths of degradation commonly were distributed somewhat irregularly with distance downstream from the dam. Also, the downstream location of zero degradation ranged from several to about 2,000 channel widths (4 to 125 km). For these reasons a smooth longitudinal profile is rare. In some cases not even the anticipated downstream decline in degradation was observed within the distance covered by the cross sections. Further, although the longitudinal profile downstream from many dams tended to flatten with time as expected, this did not occur in all cases. Changes in channel elevation limited even to 1 or 2 m can significantly affect the longitudinal profile on many rivers.

Many analyses were performed in seeking correlations of variables that would characterize conditions before and after dam closure. No simple correlations could be established between channel size, channel gradient, particle size, or quantities of flow, with the exception of a tentative relation for channel width. This reflects the number of variables and great variability of conditions in the sample. In several of the rivers studied, bank erosion appears to account for more than 50 percent of the sediment eroded from a given reach. Bank erosion is related to bank composition. Erosion may be particularly severe where the river impinges on a bank of readily credible sand. Fine-

grained cohesive sediments may slow the rate of erosion at specific points. In large rivers flowing on sand beds, such as those found in many areas of the western plains of the United States, the location of controls, discharge, and fluctuations of discharge appear to be principally responsible for varying rates of bank erosion.

Many large dams trap virtually all (about 99 percent) of the incoming sediment. The erosion of sediment immediately downstream from the dam, therefore, is not accompanied by replacement. Thus, although the rate of removal by the post-dam regulated flows may be less than that prevailing prior to regulation within a reach, the process does not result quickly in a new equilibrium. Both lateral erosion and degradation cease when the flow no longer transports the available sediments. Such cessation of net erosion may occur through local controls on boundary erosion, downstream base-level controls, decrease in flow competence (generally associated with armoring), infusion of additional transportable sediment, and through the development of channel vegetation. Armoring (increase in d50) appeared to be approximately proportional to the depth of bed degradation downstream from three dams for which data were available.

Hundreds of kilometers of river distance downstream from a dam may be required before a river regains, by boundary erosion and tributary sediment contributions, the same annual suspended load or sediment concentration that it transported at any given site prior to dam construction.

Channel vegetation blocks part of the channel, resulting in reduced channel conveyance, faster flow velocities in the channel thalweg, or both. Conveyance is decreased both by physical reduction of flow area by the vegetation and by impeding the sediment transport process and inducing bed aggradation.

Item H6. --Desert Land Act

Evolving Federal law encouraged use of water along semiarid (desert) streams and according to Bull (1997) the Desert Land Act (March 3, 1877) encouraged settlers to divert water from the streams of semiarid regions such as the Verde River watershed in order to claim homestead rights to farmland. Diversion dams were constructed that diverted streamflow into rather straight ditches. Such diversion of base runoff along some tributary streams may have served to locally increase unit stream power by increasing gradient, thereby causing a reach close to equilibrium to become degradational. Also, the ditches became paths for floodwater and eroded farmland along flood plains. The part of the Desert Land Act related to this study is:

> "That it shall be lawful for any citizen of the United States, or any person of requisite age 'who may be entitled to become a citizen, and who has filed his declaration to become such,' upon payment of twenty-five cents per acre, to file a declaration under oath with the register and receiver of the land district in which any desert land is situated, that he intends to reclaim a tract of desert land not exceeding one section, by conducting water upon the same, within the period of three years thereafter: *Provided, however,* That the right to the use of water by the person so conducting the same, on or to any tract of desert land of six

> hundred and forty acres shall depend upon *bona fide* prior appropriation; and such right shall not exceed the amount of water actually appropriated, and necessarily used for the purpose of irrigation and reclamation; and all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers, and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes subject to existing rights * * *": 19 Stat. (U. S.), 377; 6 Fed. Stat. Ann., 393.

Other early impacts, in addition to deep well pumping in the basin fill aquifers starting in the early 1900s, on base runoff of streams in the Verde River watershed include stock tanks, reservoirs for railroad and municipal use, diversions for mining and municipal use, cattle grazing and large diversions by irrigation organizations including Indians. These depleted the base flow along the Verde River and most perennial/intermittent tributary streams and rivers throughout the watershed.

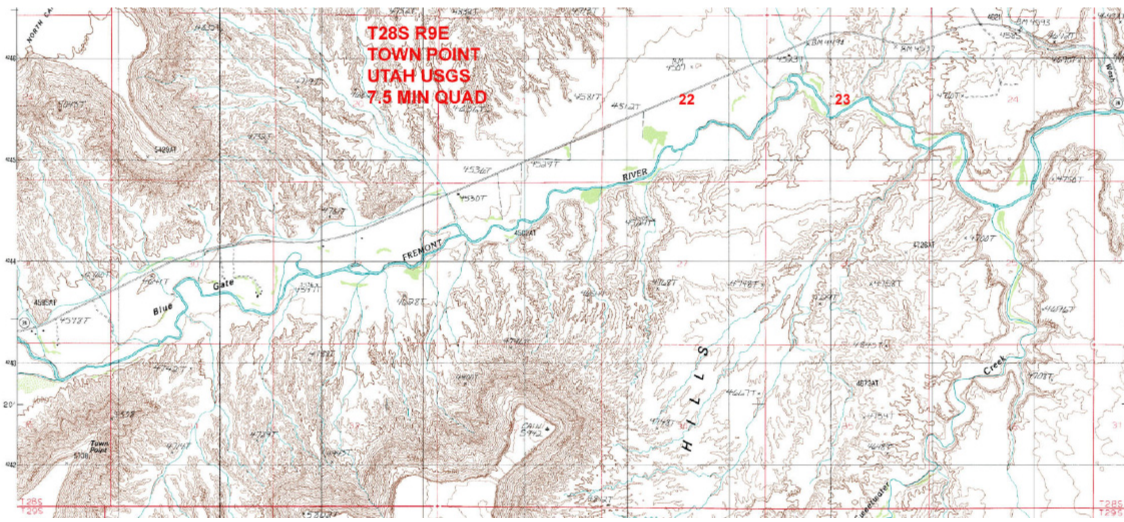
Obviously there were significant human impacts on the natural and ordinary flow of streams long before withdrawal of water from the large basin-fill and carbonate aquifers using deep wells.

Also, before human development, the groundwater systems of the Verde River watershed that yielded to base flow were in a quasi state of equilibrium. Long-term inflow was equal to long-term outflow with no net change of water stored in the ground. Obviously there was natural climate variability (drought and wet periods), forest fires, plant disease, etc. that affected recharge to and discharge from aquifers but in the long term, there was no change in groundwater storage that supplied base runoff to streams. Hydrologists, engineers and geologists have quantified the pre-development (possibly natural) conditions (eg, USBR, 1952) using available data and hydrologic knowledge.

Item H7.--Historic irrigation diversion (three examples)

H7a. (Fremont River of Utah)

In his testimony before ANSAC on the Gila River, Dr. Mussetter recently relied upon work by W. L. Graf (Graf, W.L., 2002. *Fluvial Processes in Dryland Rivers*. The Blackburn Press, Section 5.4, pp. 196-218.) Specifically, he referred to Graf's discussion of channel change from "catastrophic" floods and applied that to the Gila River. Graf uses the Fremont River in Utah (p. 207-208) to argue his catastrophic theory of changing channel pattern. He attributes the change of channel pattern of the Fremont River to a large flood (in 1896) while ignoring human effects. On p. 207 Graf states that the original meandering Fremont River changed to a braided channel during a large flood event but he ignores human activity as a related cause.



The fact is the Fremont River was affected by diversions for irrigation long before the 1896 flood. See the following USGS record that also shows reservoir regulation:

09330000 Fremont River near Bicknell, UT

Christensen, R., Johnson, E, and Plantz. G, 1987, Streamflow characteristics of the Colorado River basin in Utah through Sept. 1981, UTAH HYDROLOGIC-DATA REPORT NO. 42, USGS Open-File Report 85-421, 674p.

DIRTY DEVIL RIVER BASIN

09330000 FREMONT RIVER NEAR BICKNELL, UT

LOCATION.--Lat 38°18'25", long 111°31'03", in SW¼NE¼NW¼ sec.7, T.29 S., R.4 E., Wayne County, Hydrologic Unit 14070003, on left bank at upstream side of county road bridge and 2.9 mi southeast of Bicknell along State Highway 24.

DRAINAGE AREA.--751 mi^2.

PERIOD OF RECORD AVAILABLE.--May 1909 to December 1912 (monthly mean discharge for some periods, published in WSP 1313), October 1937 to March 1944, April 1944 to December 1945 (monthly mean discharge for some periods, published in WSP 1313), January 1946 to September 1958, October 1976 to September 1981. Published as "near Thurber", 1909-12.

REVISED RECORDS.--WDR UT-78-1: Drainage area.

GAGE.--Water-stage recorder and bubble gage. Altitude of gage is 6,920 ft from topographic map. May 1909 to December 1912, staff gage near present site at different datum. October 1937 to June 28, 1949, staff gages on two canals and river station about 0.25 mi downstream at different datums. June 28, 1949 to Apr. 29, 1958, water-stage recorders replaced staff gages on river and canal site using same datum. Apr. 29 to Sept. 30, 1958, staff gage on river at site 600 ft further downstream from water-stage recorder at datum 1.67 ft lower.

REMARKS.--Diversions for irrigation of about 10,600 acres above station. Flow regulated by Fish Lake and Johnson and Forsythe Reservoirs.

AVERAGE DISCHARGE.--26 years (water years 1910-12, 1938-43, 1947-58, 1977-81), 86.2 ft^3/s, 62,450 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1,200 ft^3/s Apr. 5, 1942, gage height, 5.8 ft from floodmarks, site and datum then in use, from rating curve extended above 700 ft^3/s; minimum observed, 18 ft^3/s June 2, 4, 13-15, 17, 18, 1912.

LOWEST MEAN DISCHARGE, IN CUBIC FEET PER SECOND, AND RANKING FOR THE INDICATED NUMBER OF CONSECUTIVE DAYS FOR EACH CLIMATIC YEAR, APRIL 1-MARCH 31

For the same USGS gage in 1912 (USGS Water Supply Paper):

FREMONT RIVER NEAR THURBER, UTAH.

Location.—In sec. 6, T. 29 S., R. 4 E., at the ranch of John Smith, 2 miles below the town of Thurber.

Records presented.—May 13, 1909, to December 31, 1912, when station was discontinued.

Drainage area.—720 square miles.

Gage.—Vertical staff.

Channel.—Shifts during high water.

Discharge measurements.—Made by wading at low stages and from a cable and car during high stages.

Winter records.—Ice affects discharge relation at times during the winter months.

Diversions.—Nearly all of the low-water flow of the river above Thurber is diverted and used for irrigation, most of the water in the channel at such periods being derived from springs southwest of Thurber. Mill ditch and the Torrey canal head about 500 feet below the station.

100 COLORADO RIVER AND ITS UTILIZATION.

Artificial regulation.—The flow of the river is regulated by Johnson reservoir (capacity, 4,800 acre-feet), which is about 4 miles north of Fish Lake, the source of Fremont River.

Accuracy.—Records approximate at times, owing to shifting of the stream bed and possible backwater at gage from dam below.

Monthly discharge of Fremont River near Thurber, Utah, for the years ending Sept. 30, 1909–1913.

Fremont River.—Fremont River rises in the eastern slope of the Wasatch Mountains in Sevier County, Utah, one of its sources being Fish Lake. It flows in a general southerly direction to Thurber, thence easterly to Hanksville, where it turns southward and joins the Colorado at a point 45 miles below the junction of the Green and Grand. The Fremont has one important tributary, Curtis Creek,[3] In its lower course the river flows through deep canyons. In the upper regions of the Fremont basin, irrigation has been practiced for many years, although only a comparatively small area is being irrigated at the present time. The total drainage area of the Fremont is approximately 4,560 square miles. The mean annual run-off is estimated at approximately 200,000 acre-feet.

Irrigated and irrigable lands in upper basin of the Colorado, including Virgin River.

From—	Area irrigated in 1913.	Additional area that may be irrigated.
	Acres.	*Acres.*
Green River and tributaries in Wyoming	280,000	300,000
Henry's Fork in Utah	5,000	10,000
Sheep Creek	200	0
Carter Creek	200	0
Pot and Grouse creeks	600	100
Brush Creek	2,000	4,000
Ashley Creek	30,000	15,000
Duchesne River	60,000	180,000
Minnie Maud Creek	2,000	0
Price River	15,000	50,000
San Rafael River	35,000	30,000
Fremont River	15,000	40,000
Escalante River	1,500	12,000
Paria River	2,000	10,000
Kanab Creek	2,000	1,500
Virgin River	20,000	48,000
Yampa River	40,000	260,000
White River	26,000	150,000
Grand River	302,200	475,000
San Juan River	117,000	595,000
Little Colorado River	20,000	30,000
Green River direct, in Utah	4,000	170,000
Colorado River direct	300	0
	980,000	2,380,000

Following from: MSE Environmental Science and Engineering Solutions for the 21st Century, September 27, 2002, Fremont River Watershed, Water Quality Management Plan, 97p.

Page 5: The first white man to enter the area was probably Dennis Julian. By the time he arrived, Ute Indians inhabited the area. Julian's name and the date 1836 can be found scratched on local rocks. Between 1876 and 1880, the first permanent homesteaders came to the region. A Mormon missionary named Franklin Wheeler Young settled and named Loa, the present day county seat, after the Hawaiian Volcano, Mauna Loa in 1876. Fremont was settled at roughly the same time (Wayne County Commission, 1978). Page 11: "The primary land uses in the watershed are associated with livestock production, including grazing on rangelands and alfalfa and grass hay production on croplands. Approximately 5% of the watershed is in private ownership, while only 2.3% of the land in Wayne County is privately owned. The basin contains approximately 16,000 acres of irrigated land and approximately 70,000 acres of private and state rangelands." Page 14: Johnson Valley Reservoir is located northeast of Fish Lake, on Fish Lake Plateau. It is a shallow, intermediate sized impoundment of a mountain meadow. The dam at Johnson Valley was completed in 1899 (Fremont Irrigation Company, 2001).

The following is from page 19 of: Hunt, C. B., Averiti, P., and Miller, R. L, 1953, Geology and Geography of the Henry Mountains Region, Utah; GEOLOGICAL SURVEY PROFESSIONAL PAPER 228, 224 p.

> "According to reports of old timers and records in the Church Historian's office the erosion started abruptly on September 22, 1897, when a large flood swept down the Fremont River. Every town in the valley was inundated, their dams and irrigation systems were swept away or filled with silt, much of the farm land was buried with silt, and the river channel was widened and deepened. From that day to this the procurement of water has been a serious problem, as dam after dam has been swept away in the continuing erosion.
>
> At Hanksville a dam across the Fremont River, 1½ miles above the mouth of the Muddy River, was destroyed when the river cut around it. Another dam was built just above the Muddy and two others were built above the site of the present dam but each failed in turn. The present dam, built about 1910, had a reservoir depth of 25 ft, but~ by 1913 this reservoir was filled with silt and an ample steady supply of water for irrigation is still a pressing problem.
>
> At Giles the irrigation system was so badly damaged by the 1897 flood that repairs were not completed until the following June when crops were planted again even though the season was late. Several dams were built at Bluevalley but, as floods repeatedly destroyed them, the town was finally abandoned about 1909.
>
> In Caineville not less than 10 homes, or half the village, have been swept away. The Elephant ditch below Cairreville was abandoned when the river cut several feet

> below the ditch; and the settlers at Mesa then had to take their water from the Caineville ditch. A dam built where the Fremont cuts through the Caineville Reef was destroyed in subsequent floods and this necessitated moving the intake for the Caineville ditch about a mile upstream.
>
> A few people moved away immediately after the large flood; Mesa was practically abandoned by 1898, but at the other communities the settlers made the best of the circumstances until1909, when the Church of the Latter Day Saints granted honorable release to the people who wished to leave. Giles was practically abandoned and Caineville nearly so, and the Church assisted those leaving to establish homes in Rabbit Valley. The early floods did less damage at Hanksville so that few persons moved away.
>
> Church records indicate a population of 552 persons in the area in 1893. The census of 1900 records 372. Further decline is recorded in the census of 1910 which records a population of 256. The present population, less than 225, was reached about 1920."

Given this history, I find Graf 's decision to ignore human impact as a contributing cause of the change from a meandering channel with perennial flow to a braided channel indefensible. The human impacts documented in USGS Professional Paper 228, a classic document, show a major and futile human effort to protect homes and farms, that in fact contributed to more erosion along the flood plains. Probable impacts as a part of those efforts include:

- Diversion dams and orientation of canals
- Leveling of land adjacent to the river
- Cultivating (plowing) flood plain farmland
- Levees
- Removing bank protecting vegetation
- Diversion and consumption of base flow
- Dam construction and dam failure

Canals directed flood water directly on cultivated flood plains that were easily eroded and destroyed. Natural restoration of the channel was hindered by the massive amount of flood plain destruction and the lack of base flow due to upstream diversion.

H7b. South Platte River of Colorado

According to: Eschner, T., Hadley, R., and Crowley, K., 1983, Hydrologic and Geomorphic Studies of the Platte River Basin; USGS Professional Paper 1277, 258p., “The channels of the Platte River and its major tributaries, the South Platte and North Platte Rivers in Colorado, Wyoming, and Nebraska, have undergone major changes in hydrologic regime and morphology since about 1860, when the water resources of the basin began to be developed for agricultural, municipal, and industrial uses. These water uses have continued to increase with growth in population and land development. Diversion of flow from channels, storage of water in reservoirs, and increased use of ground water have affected the distribution and timing of stream flows and the transport of fluvial sediments. All these factors have contributed to changes in channel geometry and the riverine environment.“

On pages A31-A32: “As part of this study of the relation of discharge regulation to channel change along the South Platte River there was no reduction of peak flows on the South Platte River upstream of Julesburg during the period of record because of a relatively small amount of reservoir construction. It was found that transbasin diversions into the South Platte River had offset diversions of water for irrigation, resulting in no net change of mean annual flows during the period of record. In contrast, Schumm (1968) attributed decrease in size of the South Platte River channel to the decrease in the annual peak discharge. “

“However, a decrease in the annual peak discharge of the South Platte River upstream of Julesburg,Colorado, had not occurred during the period of record (Kircher and Karlinger, 1981). Thus, morphologic change apparently had occurred in response to irrigation development in the basin prior to the period of record. Nadler (1978) proposed that irrigation development along the South Platte River changed the river from intermittent to perennial. This hydrologic change caused a change in the vegetation that stabilized the channel. The temporary reduction of discharge during the drought of the 1930's allowed vegetation to occupy and become established in areas of channel. Subsequent floods were not able to widen the channel, as they presumably might have, prior to the encroachment of vegetation.”

Human impacts again faced Dr. Schumm as he acknowledged their existence but resisted considering them, instead deferring to experts in other disciplines in his introduction to Schumm, S. A., 2005, River Variability and Complexity, Cambridge University Press, 220p. “Human activity takes place everywhere, but these impacts will not be considered, except as an upstream control, as they are usually obvious. For example, riprap, dikes, diversions, etc. can be constructed anywhere, and they are fully discussed in the engineering literature (Peterson, 1986) and by experts in the field of human impacts on rivers (Brizga and Finlayson, 1999; Wohl, 2000a; Anthony *et a!.,* 2001). Nevertheless, human involvement with rivers for better or worse is considered in Part 6 (Chapters 18, 19, and 20).”

The implied message is that human impacts are a snake pit. Thus, it is not surprising that human effects in the 1800s have been overlooked in studies of rivers such as the Gila (Arizona), Platte (Colorado) and Cimarron (Kansas) Rivers of the western US.

H7c—The Cimarron River in Kansas

A very early account of the Cimerron River in December of 1598 from: Bolton, H.,1916, *Spanish Exploration in the Southwest,* Scribners Co., New York, 487p.

As part of the Don Juan de Onate expedition on pages 255-256:

"Having travelled to reach this place one hundred and eleven leagues, it became necessary to leave the river, as there appeared ahead some sand dunes[2] and turning from the east to the north, we travelled up a small stream until we discovered the great plains covered with innumerable cattle. We found constantly better roads and better land, such that the carts could travel without hindrance or difficulty, and although we encountered some large ravines and broken hills, nowhere were there any over which the carts had to pass, as the land was in general level and very easy to traverse. We continued in this direction for some days, along two small streams[1] which flowed toward the east, like the one previously mentioned. We wandered from the direction we had been following, though it did not frighten us much, as the land was so level that daily the men became lost in it by separating themselves for but a short distance from us, as a result of which it was necessary to reconnoiter the country from some of the stopping places. Therefore the camp continued its march by the most direct route possible."

> "[2] Sand dunes are found at various places along the Canadian. The place where the turn was made seems to have been the Antelope Hills, just east of the Texas Panhandle. In this case the arroyo ascended was Commission Creek. From this point the route was apparently close to the line of the present Santa Fe Road from the Canadian to Wichita, Kansas."

> "[1] These were Beaver Creek (North Fork) and Cimarron River."

On pp. 256-257 is a description of a good country of many small streams "bounded on both sides by the coolest of rivers and by pleasant groves." "The fields there were covered with flowers of a thousand different kinds, so thick that they choked the pasture."

The good country was not to last: "The channel of the Cimarron River in southwestern Kansas has changed significantly during historic times. The average width of the river was 50 feet in 1874. During and after the major flood of 1914, the river widened until an average width of 1,200 feet was reached in 1942."

Schumm, S.A. and Lichty, R.W., 1963. Channel widening and flood-plain construction along Cimarron River in southwestern Kansas. U.S. Geol. Survey Prof. Paper 352-D, pp. 71-88.

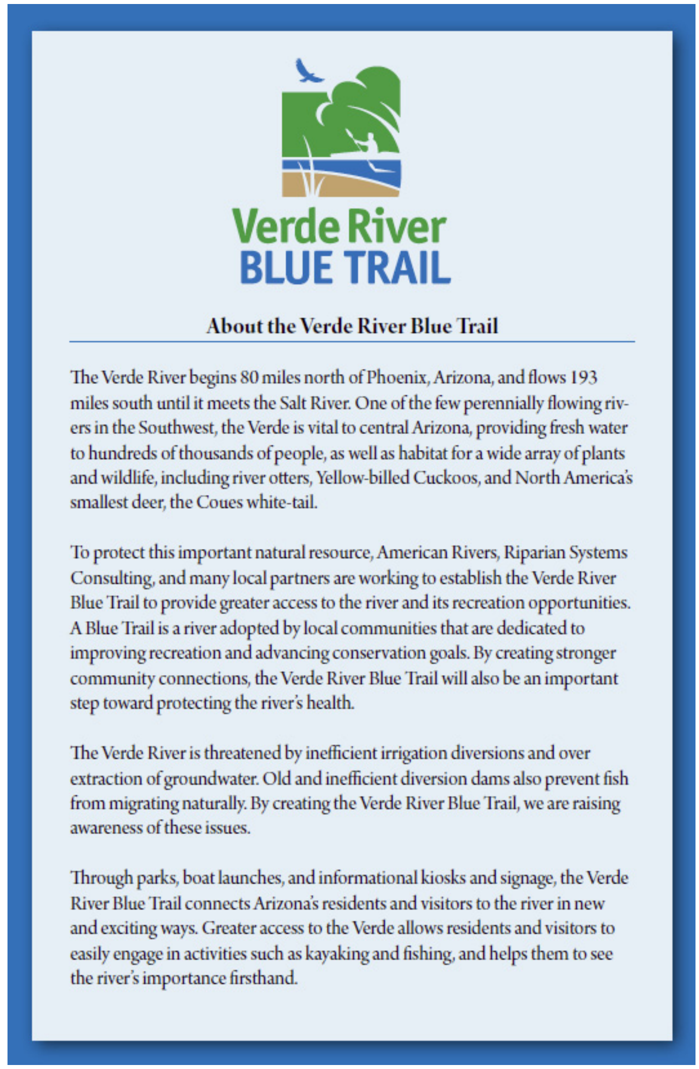
The Cimarron River in Kansas appeared to be typical of streams in a more humid environment at the turn of the century. "The Cimarron seems to have reached base-level and to have begun meandering across its flood plain. Beautiful oxbow curves are frequent, and a sluggish nature is everywhere manifest during times of low water." According to Johnson (1902, p. 664) Wherever within the High Plains belt the Cimarron Valley shows a living stream, it is always a meandering looping stream of uniform width, narrow, clear and deep * * *. The bottom land upon which it wanders supports a coarser and longer stemmed grass than the uplands. the grass roots reaching to the ground water, which lies at a depth here, as a rule, of only 2 or 3 feet * * *."

"The Cimarron River elsewhere, upstream to the southwest in the Oklahoma Panhandle and downstream to the southeast in Oklahoma, during historic times has always been typically a wide, shallow, sandy river. As suggested by Johnson, the great difference between the Cimarron River in Kansas and the river elsewhere may be that, in Kansas, a perennial flow was maintained by ground water. Additional testimony, confirming that the Cimarron River was a narrow, meandering perennial stream at the turn of the century, was presented by McLaughlin (1947)."

Before the major flood of 1914 there were, or had been, considerable farming along the low lands adjoining the Cimarron River. Water was diverted using small diversion dams and the flood plains were leveled, plowed and planted. Small wells lowered water levels and upstream diversions reduced the available base flow for downstream use. Thus, in addition to the flood, a natural event, there was considerable human impact all along the river. Leopold (1959) described the condition of the Cimarron River as follows: "In searching for a solution to the gully problem we are plagued by an inability to discern the differential effects of changing climatic factors and land use by man. For example, in Kansas near where Onate spoke of numerous small streams, * * * within the last half century channels have widened tremendously."

Leopold, Luna B., 1959, Climatology and the Problems of Western Grasslands, Grasslands, American Association for the Advancement of Science, 8p.

Appendix I.—Verde River Blue Trail



Verde River
BLUE TRAIL

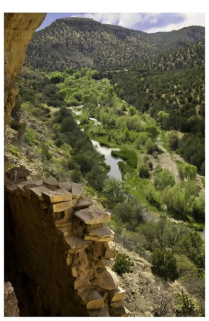
About the Verde River Blue Trail

The Verde River begins 80 miles north of Phoenix, Arizona, and flows 193 miles south until it meets the Salt River. One of the few perennially flowing rivers in the Southwest, the Verde is vital to central Arizona, providing fresh water to hundreds of thousands of people, as well as habitat for a wide array of plants and wildlife, including river otters, Yellow-billed Cuckoos, and North America's smallest deer, the Coues white-tail.

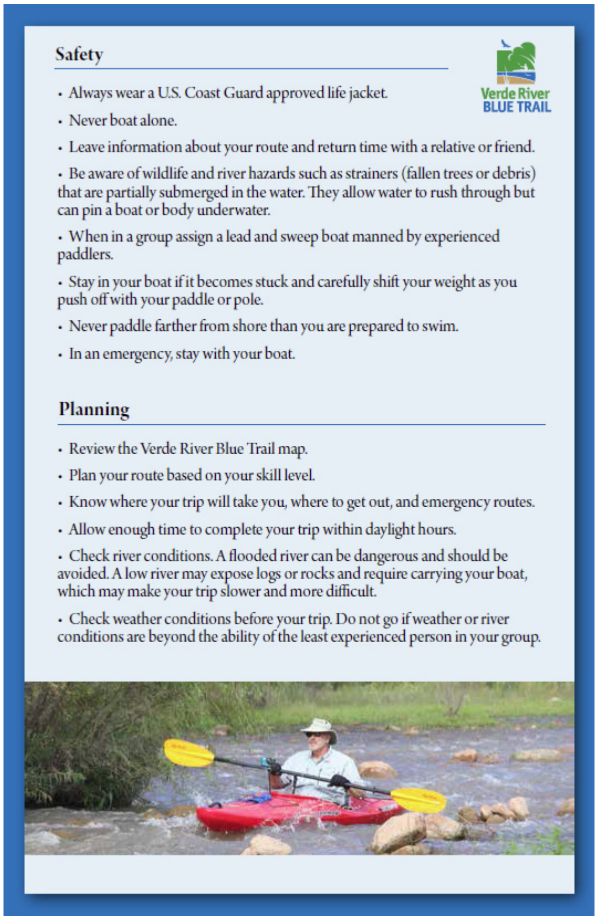
To protect this important natural resource, American Rivers, Riparian Systems Consulting, and many local partners are working to establish the Verde River Blue Trail to provide greater access to the river and its recreation opportunities. A Blue Trail is a river adopted by local communities that are dedicated to improving recreation and advancing conservation goals. By creating stronger community connections, the Verde River Blue Trail will also be an important step toward protecting the river's health.

The Verde River is threatened by inefficient irrigation diversions and over extraction of groundwater. Old and inefficient diversion dams also prevent fish from migrating naturally. By creating the Verde River Blue Trail, we are raising awareness of these issues.

Through parks, boat launches, and informational kiosks and signage, the Verde River Blue Trail connects Arizona's residents and visitors to the river in new and exciting ways. Greater access to the Verde allows residents and visitors to easily engage in activities such as kayaking and fishing, and helps them to see the river's importance firsthand.



Note: Several of the photos in this Appendix that correspond the Blue Trail index map are from the *Verde River* Facebook page. Sources of a few other photos have been referenced elsewhere in this report. I have personally verified that each photo in this Appendix is of the Verde River and the purpose of the photos is simply to provide visual supplementation to the maps for viewer interest.

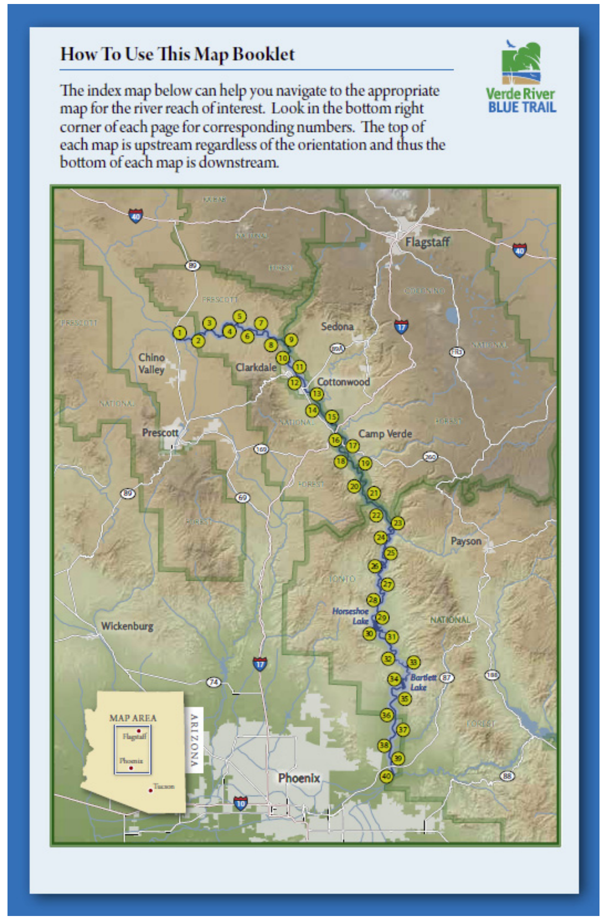


Safety

- Always wear a U.S. Coast Guard approved life jacket.
- Never boat alone.
- Leave information about your route and return time with a relative or friend.
- Be aware of wildlife and river hazards such as strainers (fallen trees or debris) that are partially submerged in the water. They allow water to rush through but can pin a boat or body underwater.
- When in a group assign a lead and sweep boat manned by experienced paddlers.
- Stay in your boat if it becomes stuck and carefully shift your weight as you push off with your paddle or pole.
- Never paddle farther from shore than you are prepared to swim.
- In an emergency, stay with your boat.

Planning

- Review the Verde River Blue Trail map.
- Plan your route based on your skill level.
- Know where your trip will take you, where to get out, and emergency routes.
- Allow enough time to complete your trip within daylight hours.
- Check river conditions. A flooded river can be dangerous and should be avoided. A low river may expose logs or rocks and require carrying your boat, which may make your trip slower and more difficult.
- Check weather conditions before your trip. Do not go if weather or river conditions are beyond the ability of the least experienced person in your group.

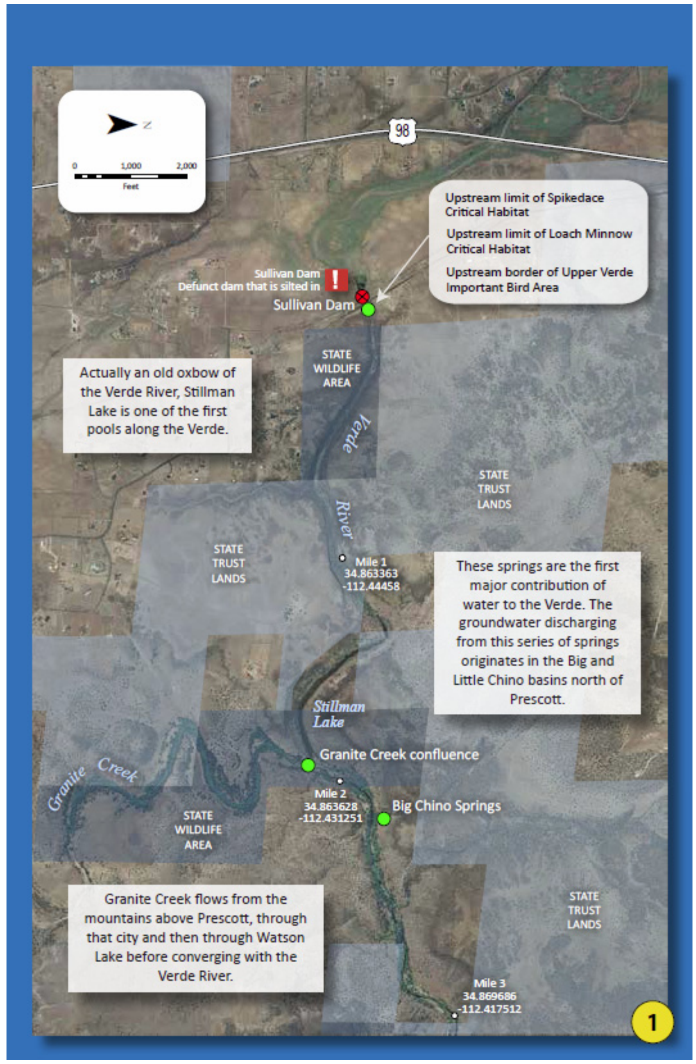


How To Use This Map Booklet

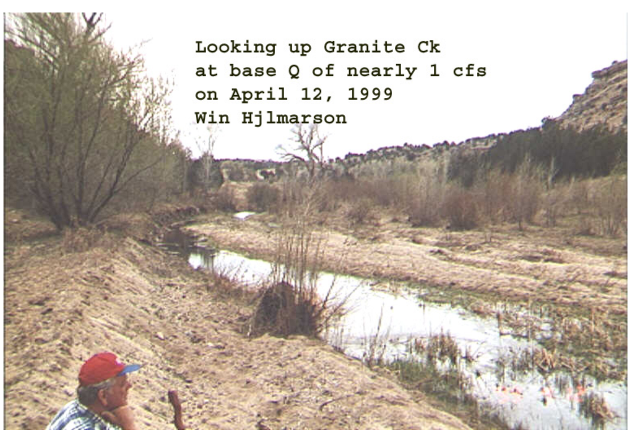
The index map below can help you navigate to the appropriate map for the river reach of interest. Look in the bottom right corner of each page for corresponding numbers. The top of each map is upstream regardless of the orientation and thus the bottom of each map is downstream.

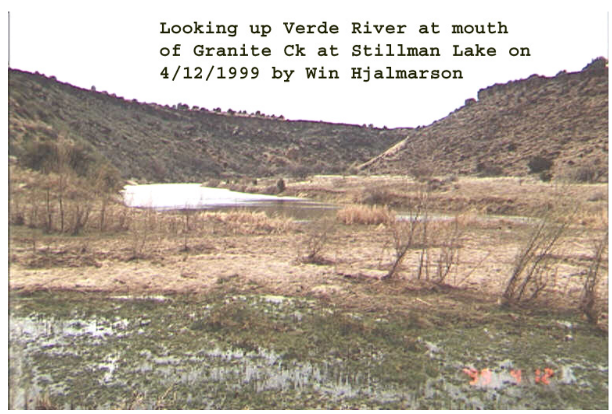
Big Chino Springs below Granite Creek

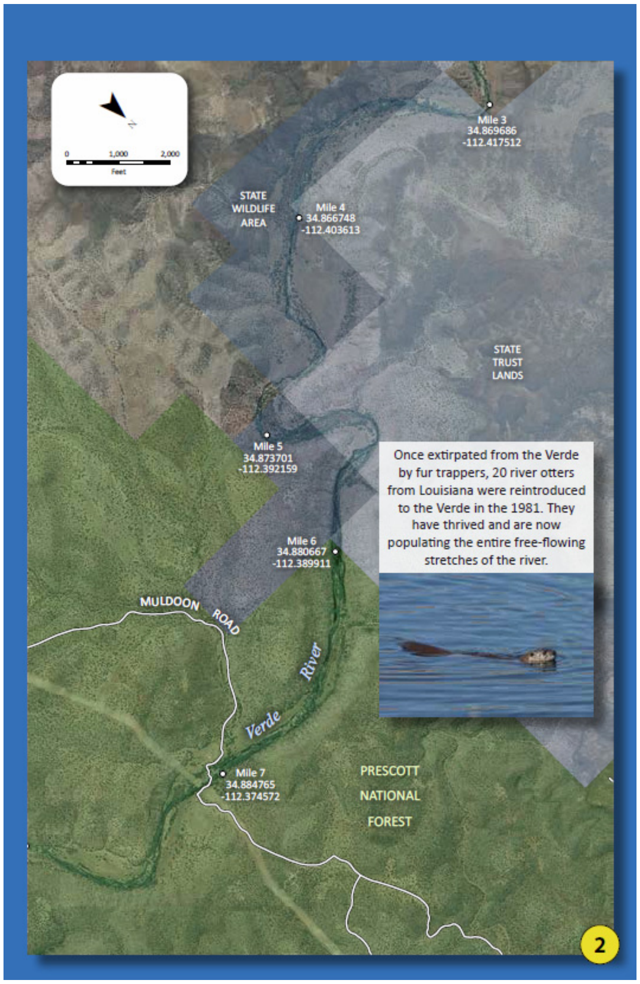
Hjalmarson 1999

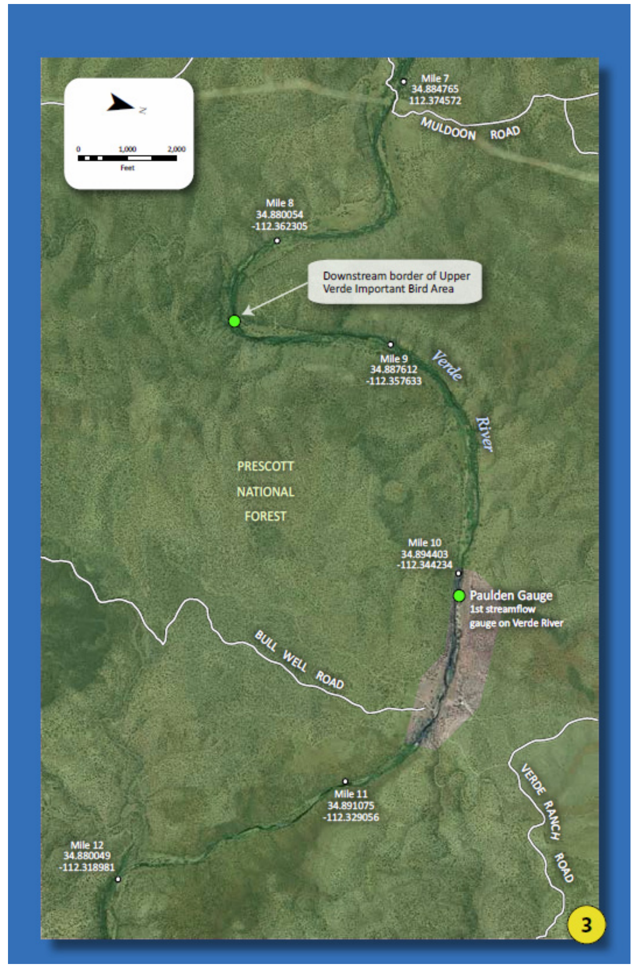


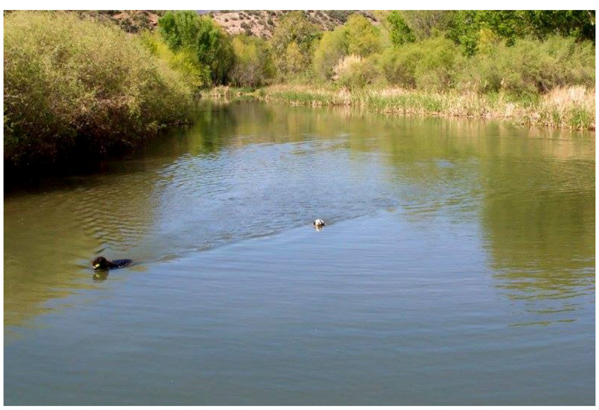
Note: Miles along river shown here are different than miles for ANSAC study. Miles for ANSAC study more closely follow the thalwag.






0 1,000 2,000
Feet
Mile 3
34.869686
-112.417512
STATE
WILDLIFE
AREA
Mile 4
34.866748
-112.403613
STATE
TRUST
LANDS
Mile 5
34.873701
-112.392159
Once extirpated from the Verde by fur trappers, 20 river otters from Louisiana were reintroduced to the Verde in the 1981. They have thrived and are now populating the entire free-flowing stretches of the river.
Mile 6
34.880667
-112.389911
MULDOON ROAD
Verde River
Mile 7
34.884765
-112.374572
PRESCOTT
NATIONAL
FOREST
2

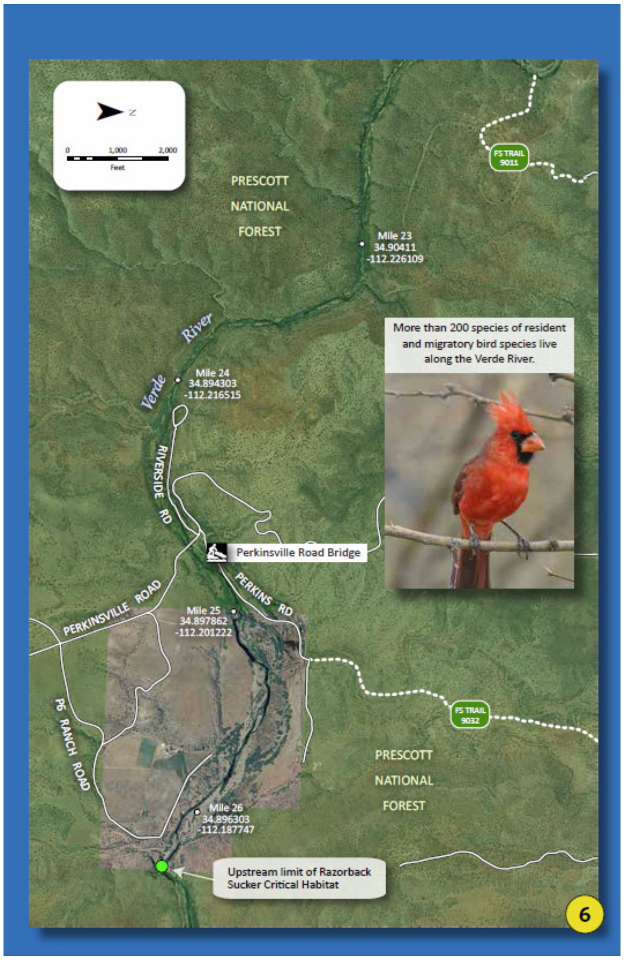

0 1,000 2,000
Feet
Mile 7
34.884765
112.374572
MULDOON ROAD
Mile 8
34.880054
-112.362305
Downstream border of Upper Verde Important Bird Area
Mile 9
34.887612
-112.357633
Verde River
PRESCOTT
NATIONAL
FOREST
Mile 10
34.894403
-112.344234
Paulden Gauge
1st streamflow gauge on Verde River
BULL WELL ROAD
Mile 11
34.891075
-112.329056
VERDE RANCH ROAD
Mile 12
34.880049
-112.318981
3

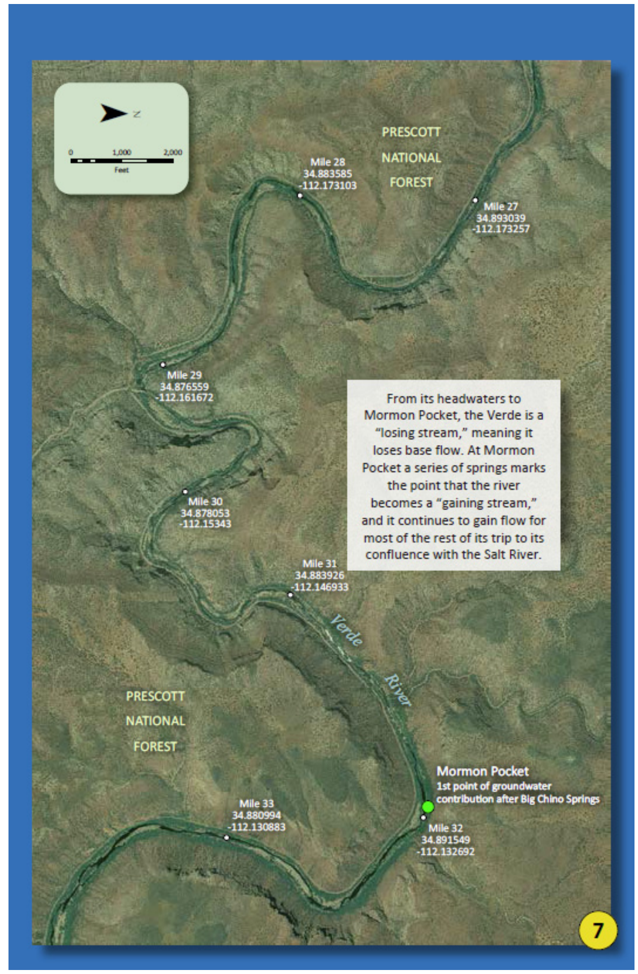



0 1,000 2,000
Feet
Mile 12
34.880049
-112.318981
Mile 13
34.875036
-112.310574
FS TRAIL
9097
FS TRAIL
9016
Mile 14
34.878485
-112.298844
PRESCOTT
NATIONAL
FOREST
PROSPECT ROAD
Mile 15
34.88218
-112.290992
Verde
River
Mile 16
34.891915
-112.297055
PRESCOTT
NATIONAL
FOREST
ROBERT E TANK ROAD
Mile 17
34.905664
-112.294075
4

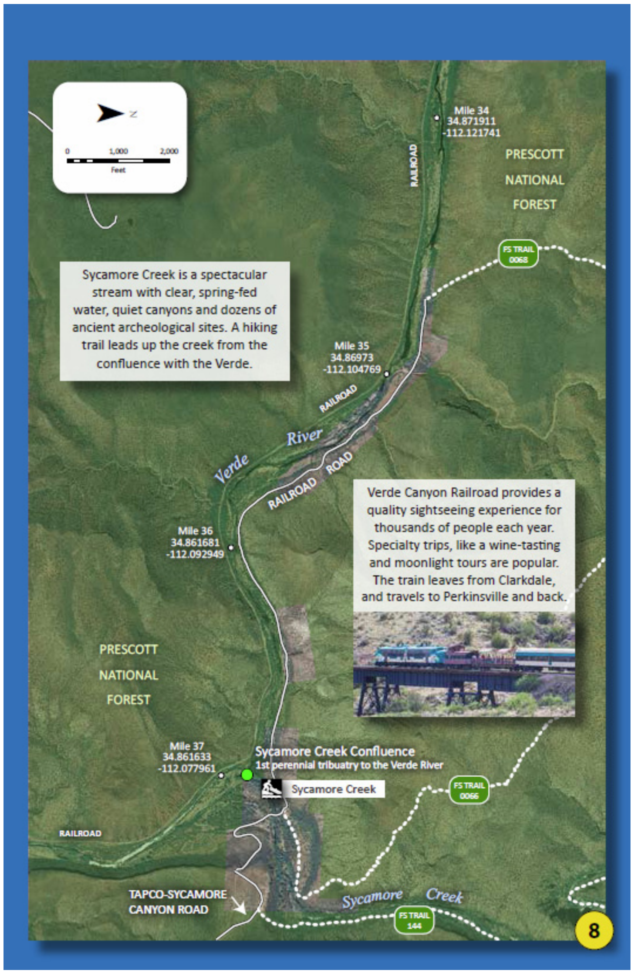

0 1,000 2,000
Feet
PRESCOTT
NATIONAL
FOREST
ROBERT E TANK RD
Mile 18
34.915192
-112.281882
FS TRAIL
9012
FS TRAIL
9013
Grindstone Wash
FS TRAIL
9006
The most common large trees along the river are Freemont cottonwoods, Goodding willows, Arizona Ash, Arizona Sycamore (pictured below) and Arizona Alder.
Mile 19
34.913157
-112.267543
Verde
River
Mile 20
34.910096
-112.258706
BEAR SIDING ROAD
PRESCOTT
NATIONAL
FOREST
Mile 21
34.910266
-112.246937
FS TRAIL
9007
SAND TRAP ROAD
Mile 22
34.909645
-112.239627
FS TRAIL
9011
5

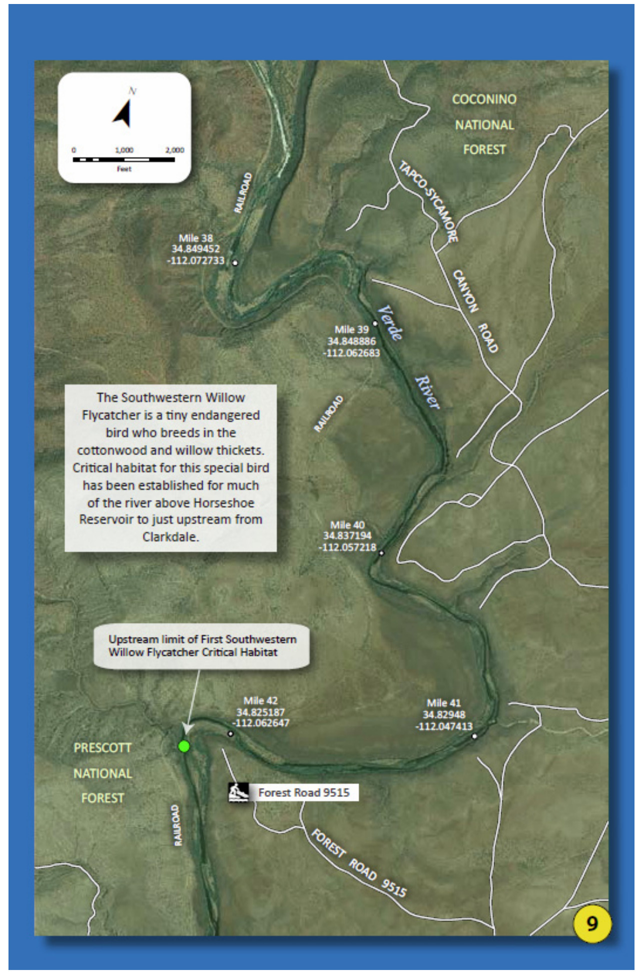

Verde River Poker Run
1st Annual
2014
Clarkdale, AZ
Verde River Poker Run
April 19th, 2014
$1000 First Prize!
Sign Up Now at clarkdale.az.gov/

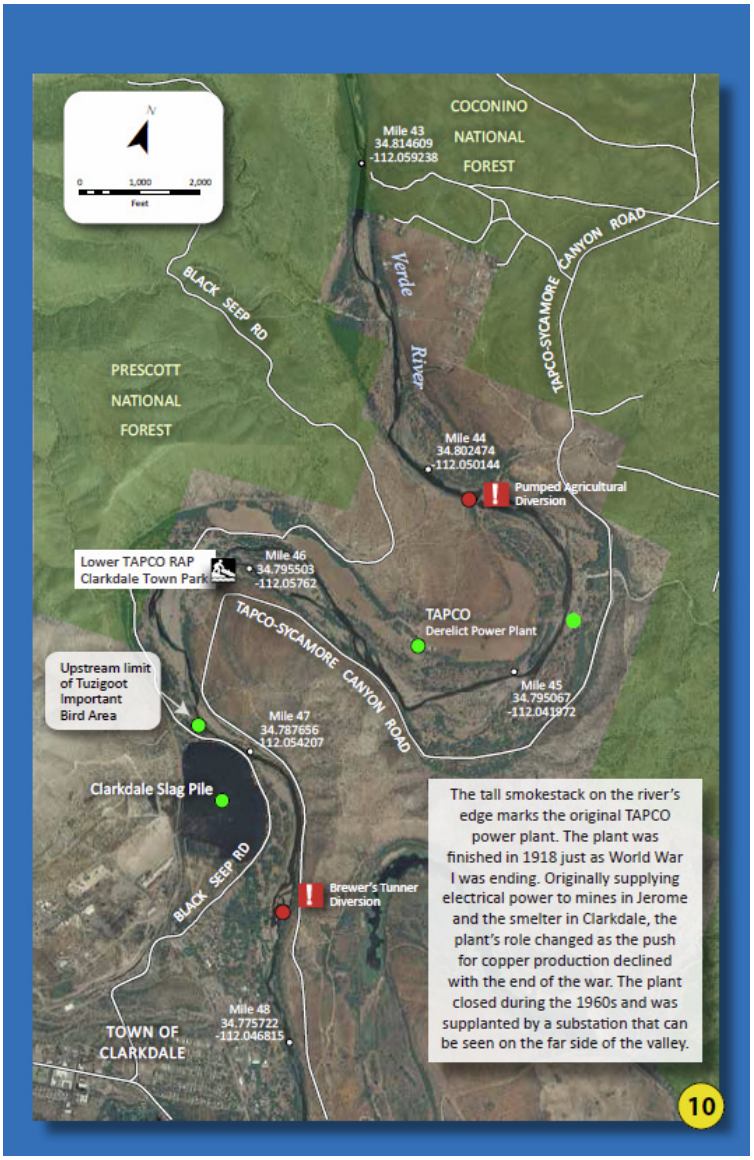




Mound built by beavers to make sure all the other beavers know their place! They're called "castor mounds" because the beavers who build them coat them liberally with their "castorium," which is their musk or scent."


0 1,000 2,000
Feet
Mile 34
34.871911
-112.121741
RAILROAD
PRESCOTT
NATIONAL
FOREST
FS TRAIL
0068
Sycamore Creek is a spectacular stream with clear, spring-fed water, quiet canyons and dozens of ancient archeological sites. A hiking trail leads up the creek from the confluence with the Verde.
Mile 35
34.86973
-112.104769
RAILROAD
Verde
River
RAILROAD ROAD
Verde Canyon Railroad provides a quality sightseeing experience for thousands of people each year. Specialty trips, like a wine-tasting and moonlight tours are popular. The train leaves from Clarkdale, and travels to Perkinsville and back.
Mile 36
34.861681
-112.092949
PRESCOTT
NATIONAL
FOREST
Mile 37
34.861633
-112.077961
Sycamore Creek Confluence
1st perennial tributary to the Verde River
Sycamore Creek
FS TRAIL
0066
RAILROAD
TAPCO-SYCAMORE
CANYON ROAD
Sycamore Creek
FS TRAIL
144
8


N
0 1,000 2,000
Feet
COCONINO
NATIONAL
FOREST
RAILROAD
TAPCO-SYCAMORE
CANYON ROAD
Mile 38
34.849452
-112.072733
Mile 39
34.848886
-112.062683
Verde
River
RAILROAD
The Southwestern Willow Flycatcher is a tiny endangered bird who breeds in the cottonwood and willow thickets. Critical habitat for this special bird has been established for much of the river above Horseshoe Reservoir to just upstream from Clarkdale.
Mile 40
34.837194
-112.057218
Upstream limit of First Southwestern Willow Flycatcher Critical Habitat
Mile 42
34.825187
-112.062647
Mile 41
34.82948
-112.047413
PRESCOTT
NATIONAL
FOREST
Forest Road 9515
RAILROAD
FOREST ROAD 9515
9

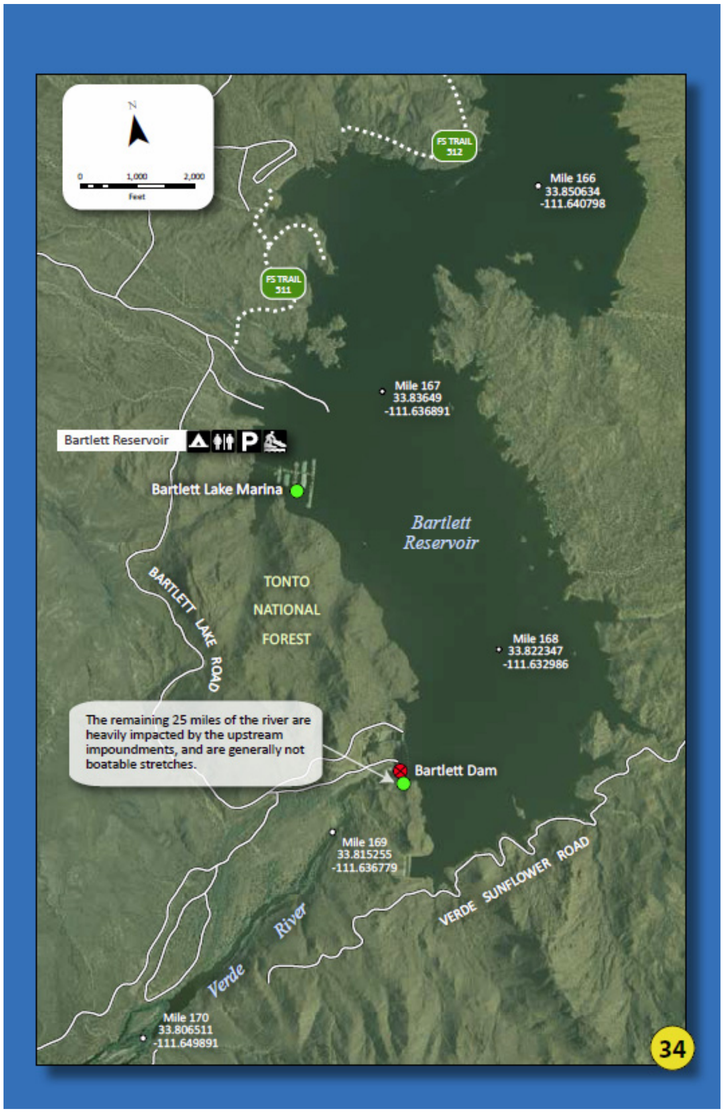


In this photo: Mona Haskill
Tapco swinging bridge. Here's one from the 60's - notice the trees are coming back by then.

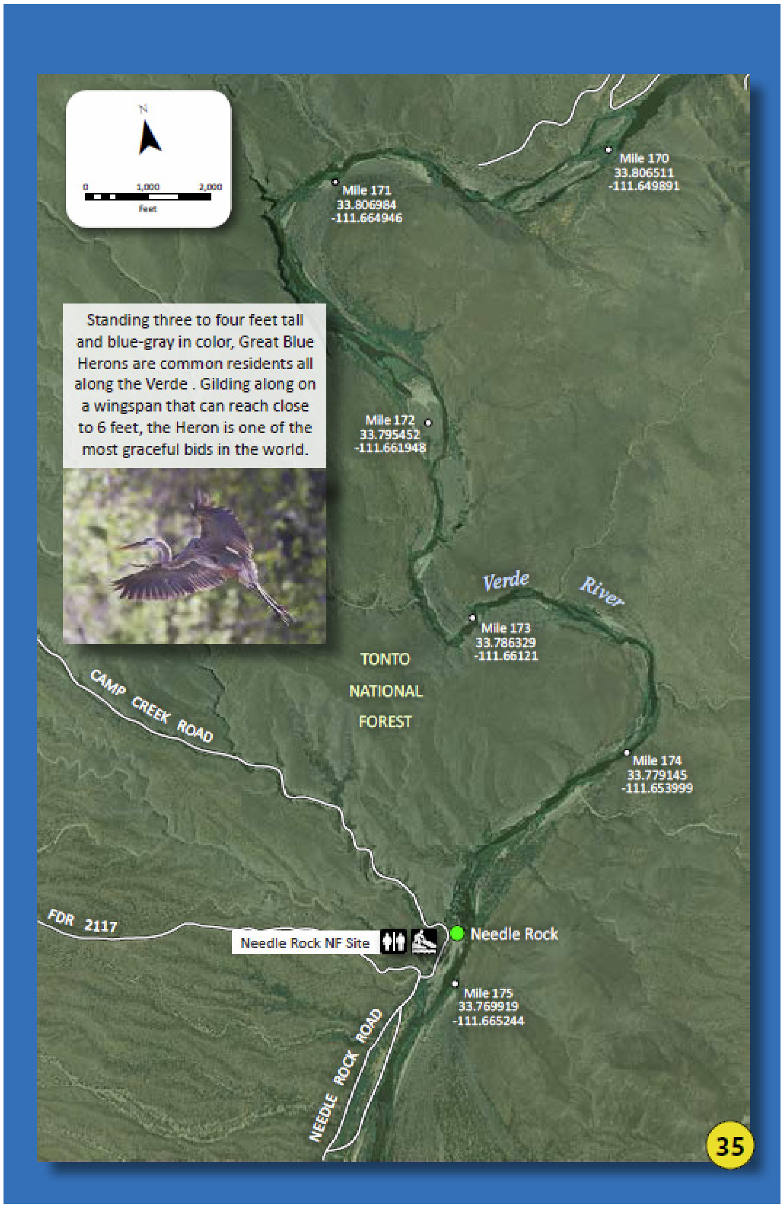
After 1917 – possibly 1929

Verde at Tapco recent photo

The Verde River Blue Trail continues to the mouth at the Salt River. See https://www.facebook.com/verderiver for photos for segments 11 through 33.
The photographs restart at Bartlett Dam on next page.

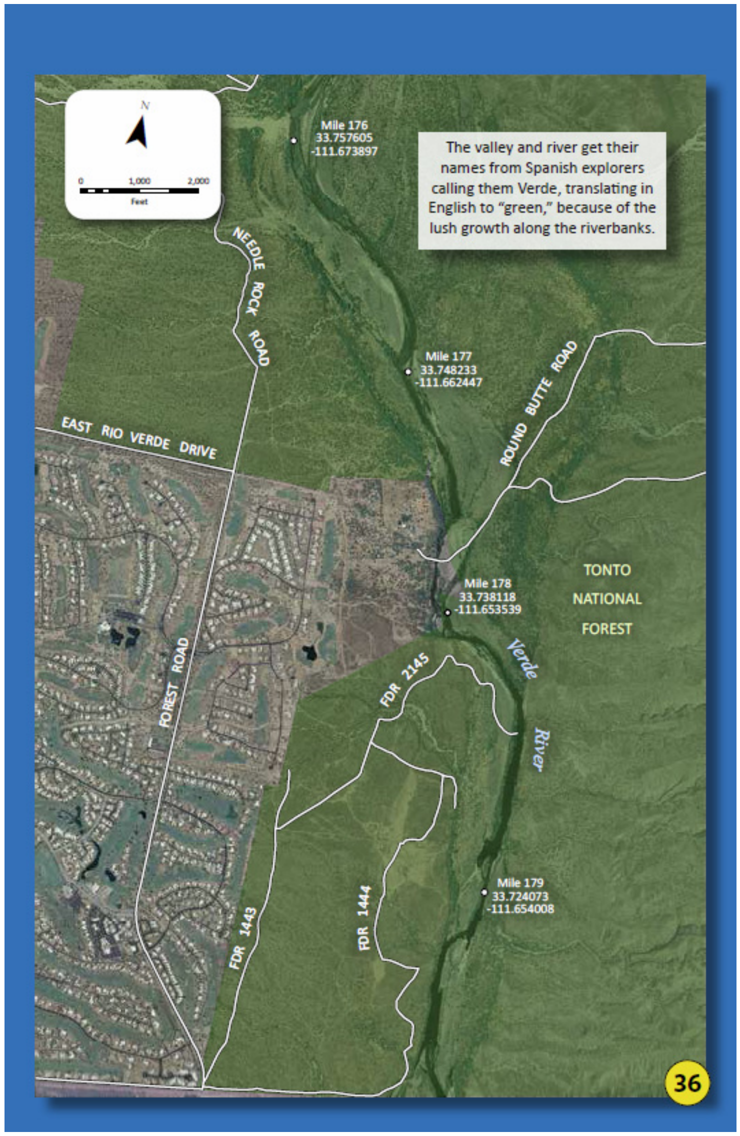


Bartlett Dam—
Reservoir's impact on natural Verde River

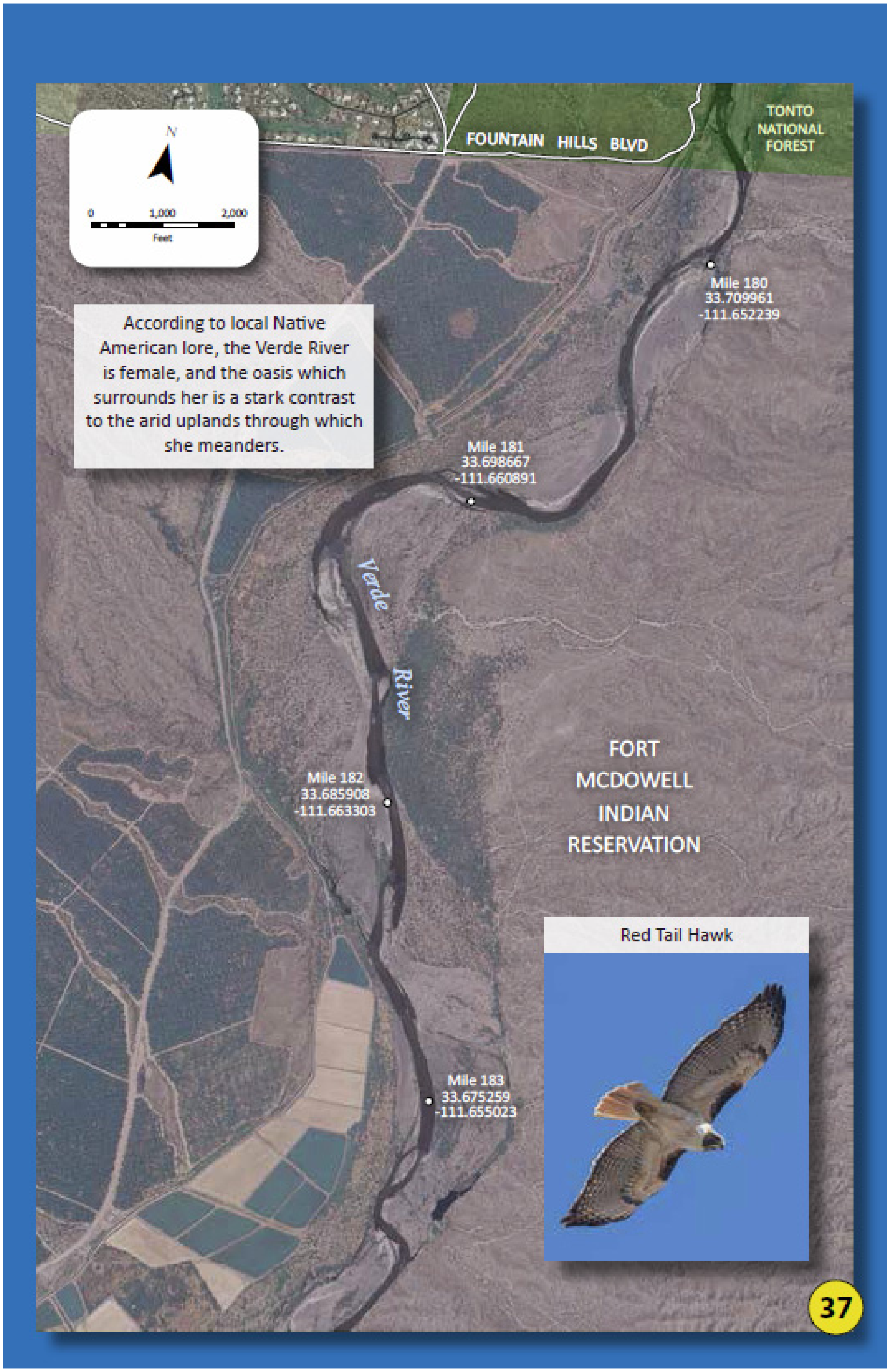


EAGLES

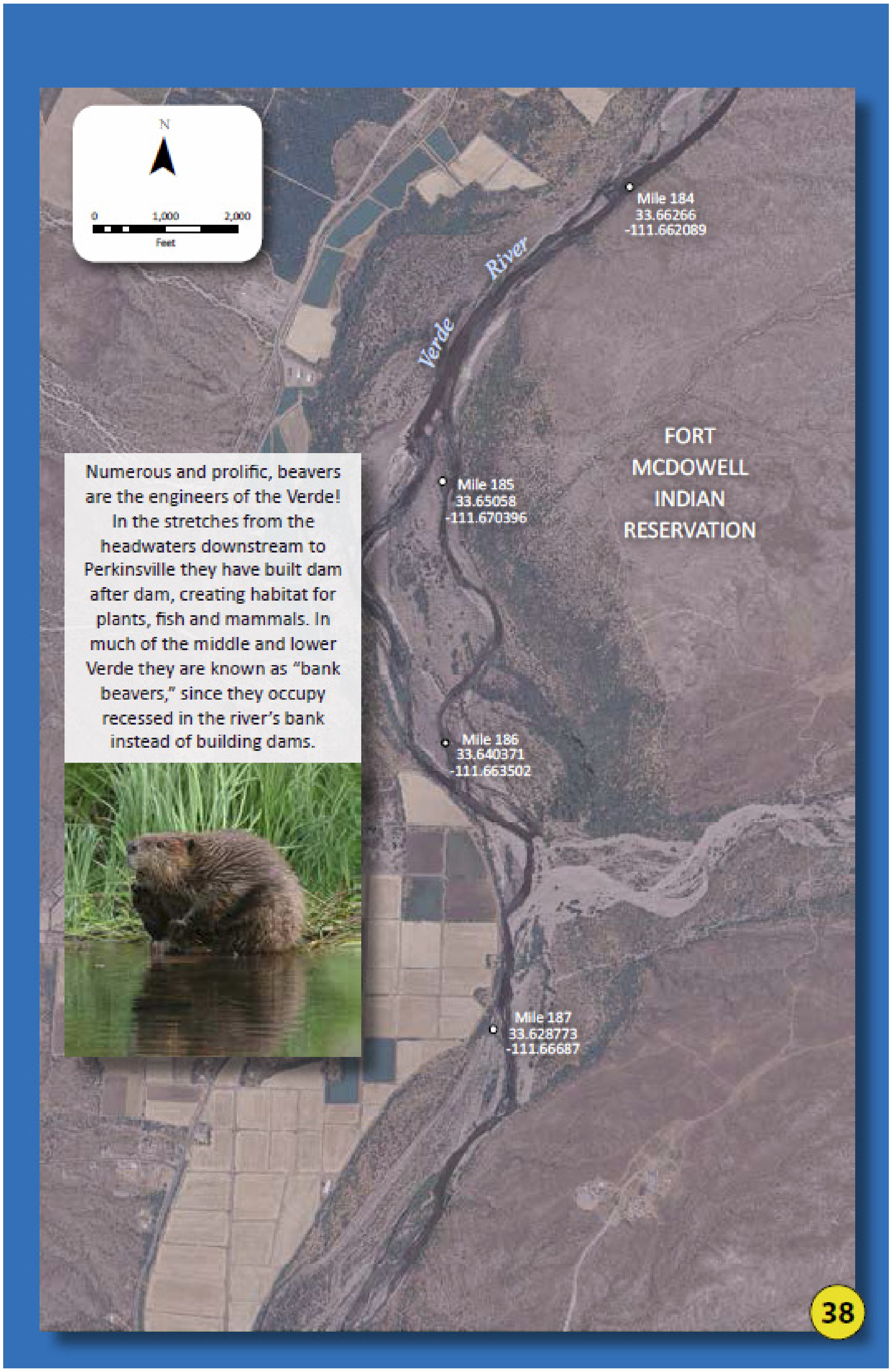
- Verde River at the Needle Rock Recreation area (Needle Rock / Box Bar) is closed to foot and vehicle entry on the east side of the river from December 1 to June 30. Floating through is allowed, but no stopping in the river or landing on the east side of the river is permitted. Contact Tonto National Forest, Cave Creek Ranger District, (480) 595-3300.

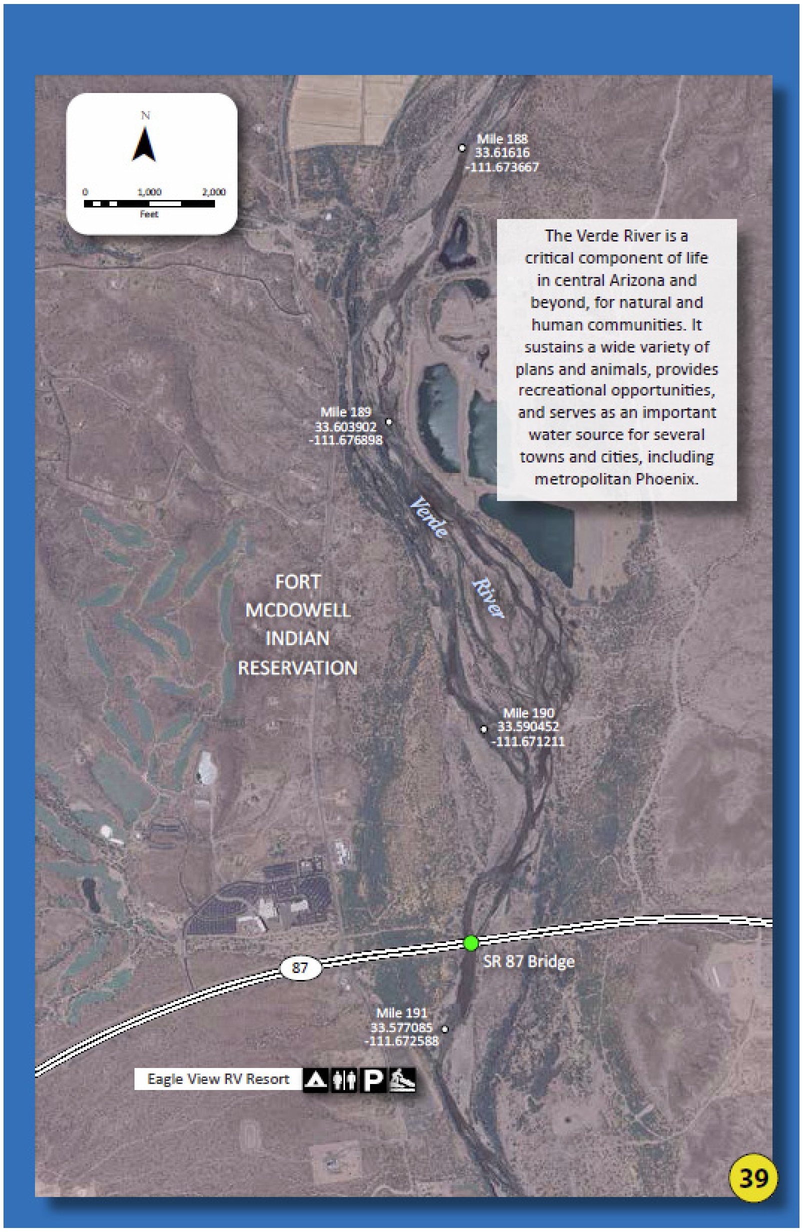


Mile 176
33.757605
-111.673897
The valley and river get their names from Spanish explorers calling them Verde, translating in English to "green," because of the lush growth along the riverbanks.
0 1,000 2,000
Feet
NEEDLE ROCK ROAD
Mile 177
33.748233
-111.662447
ROUND BUTTE ROAD
EAST RIO VERDE DRIVE
TONTO
NATIONAL
FOREST
Mile 178
33.738118
-111.653539
FOREST ROAD
FDR 2145
Verde
River
Mile 179
33.724073
-111.654008
FDR 1443
FDR 1444
36



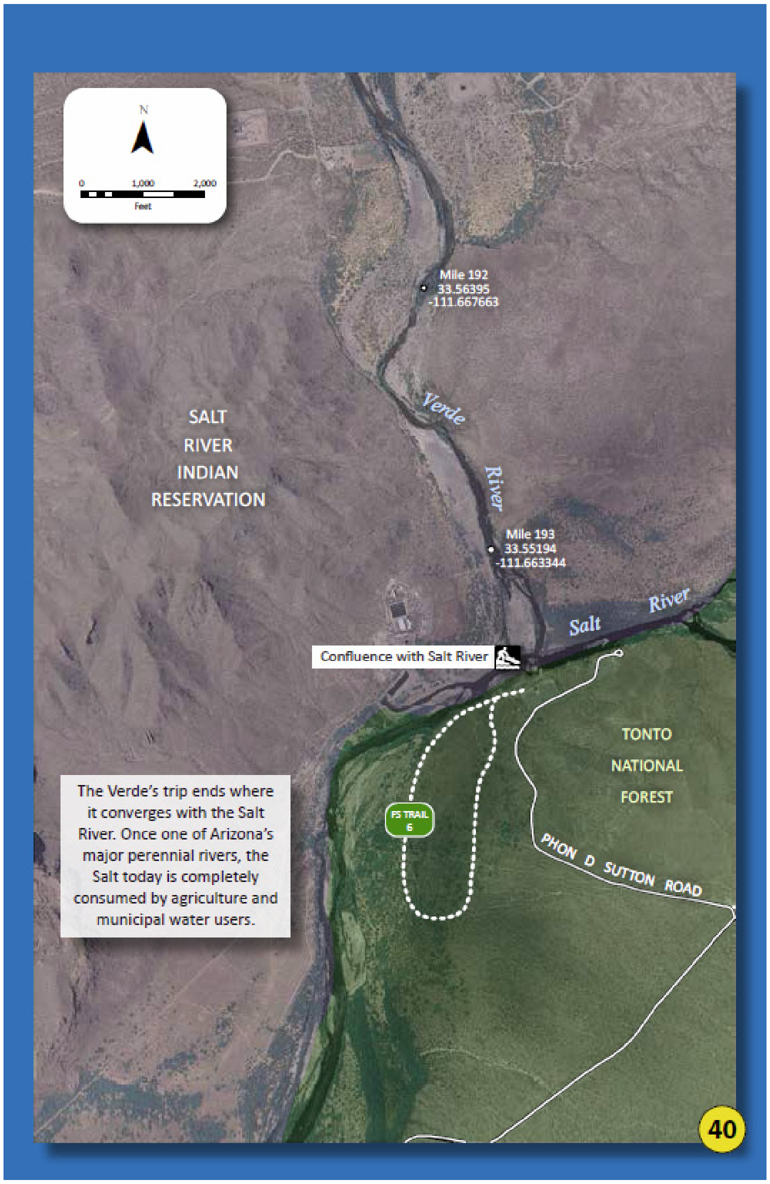
FOUNTAIN HILLS BLVD
TONTO NATIONAL FOREST
N
0
1,000
2,000
Feet
According to local Native American lore, the Verde River is female, and the oasis which surrounds her is a stark contrast to the arid uplands through which she meanders.
Mile 180
33.709961
-111.652239
Mile 181
33.698667
-111.660891
Verde
River
Mile 182
33.685908
-111.663303
FORT MCDOWELL INDIAN RESERVATION
Red Tail Hawk
Mile 183
33.675259
-111.655023
37

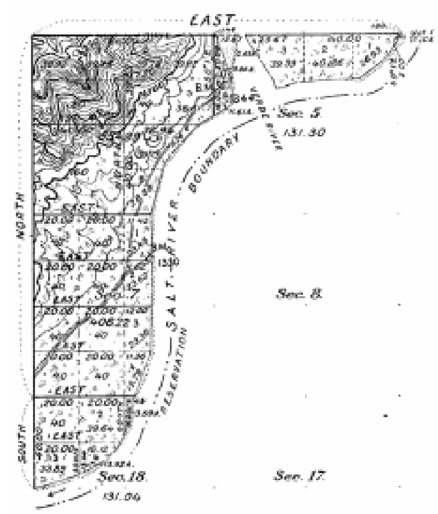

N
0 1,000 2,000
Feet
Mile 184
33.66266
-111.662089
Verde River
FORT MCDOWELL INDIAN RESERVATION
Mile 185
33.65058
-111.670396
Numerous and prolific, beavers are the engineers of the Verde! In the stretches from the headwaters downstream to Perkinsville they have built dam after dam, creating habitat for plants, fish and mammals. In much of the middle and lower Verde they are known as "bank beavers," since they occupy recessed in the river's bank instead of building dams.
Mile 186
33.640371
-111.663502
Mile 187
33.628773
-111.66687
38



N
0
1,000
2,000
Feet
Mile 188
33.61616
-111.673667
The Verde River is a critical component of life in central Arizona and beyond, for natural and human communities. It sustains a wide variety of plans and animals, provides recreational opportunities, and serves as an important water source for several towns and cities, including metropolitan Phoenix.
Mile 189
33.603902
-111.676898
Verde
River
FORT MCDOWELL INDIAN RESERVATION
Mile 190
33.590452
-111.671211
87
SR 87 Bridge
Mile 191
33.577085
-111.672588
Eagle View RV Resort
39

FORT MCDOWELL RV RESORT
EAGLE VIEW





Township No. 2 North Range No. 7 East of the Gila and Salt River Meridian, Arizona.
SALT RIVER INDIAN RESERVATION.

Surveys Designated	By Whom Surveyed		When Surveyed
Standard lines			
Township "	R. A. Farmer	————	January 4, 1911.
Subdivision "	" " "	————	" 24-25, 1911.
Meander "	" " "	————	" 25, 1911.
Boundary "			

Appendix J. -- Historic stream flow and/or floods using tree rings and paleohydrology

Historic annual flow for the Verde River has been reconstructed based on tree ring data by three investigators. As explained more fully below, reconstructed discharge based on tree rings has limited utility in the navigability assessment of the Verde River because the relation of the tree ring data to measured discharge is not strong.

First Reconstruction:
The first reconstruction was by House, Pearthree and Klawon (2002). The following is taken directly from their report:

> *An annual dendrohydrologic (tree-ring-based) reconstruction of annual flow for the Verde River is available that spans the period 1984 AD to 570 AD [Graybill, 1989; Van West and Altschul, 1997] (Figure 3). These data provide a relatively accurate record of annual flow volumes on the Verde River**, but their relation to the occurrence of large peak discharges is not particularly strong**. Historically, most periods of particularly high flow volumes are associated with a higher probability of the occurrence of one or more large floods comprising a portion of that volume. Major peaks in the tree-ring record in 1839, 1866, and 1868 correspond directly to only one year with a particularly notable flood (Fall, 868). In fact, the reconstructed value for 1868 AD is the second largest departure from the mean in a 1414-year record (the largest is 1793 AD). **It is notable that large floods in 1862 and 1891 are not associated with large departures in the tree-ring data, and large floods in the 20th century are not well represented. Thus, the linkage is indirect and variable,** but the data provide an important point of comparison and a valuable record of hydrologic variability. (emphasis added)*

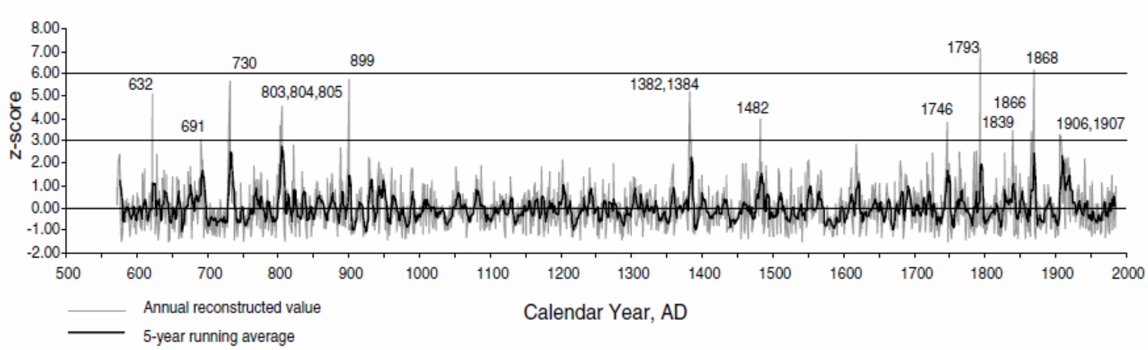


Figure 3. Dendrohydrologic reconstruction for the Verde basin [data from Graybill 1989; Van West and Altschul, 1997]. Positive Zscores indicate relatively wet years and large flow volumes.

House, Pearthree, and Fuller (1995) performed a detailed analysis of the 1993 flood including the physical evidence of the Verde River's largest paleofloods at a site near USGS gage 09508500 located above Horseshoe Dam.

> *The Verde River experienced very large floods in January and February of 1993 during a major episode of flooding that affected most of the large drainages in*

> *Arizona. The January flood peak discharge on the lower Verde River (4,100 cms or 145 000 cfs) was the largest of the gage record, and the February flood peak (3,650 cms or 129000 cfs) was the second largest. These large, very recent floods provide an exceptional opportunity to investigate the genesis of large floods on the Verde River, to compare the sizes of the 1993 floods with other large historical and prehistoric floods, and to evaluate the fidelity with which slackwater deposits and other paleostage indicators reflect the peak water surface.*

There is little doubt that the 1891 and 1993 floods were very large (see graph on next page). It's interesting that the evidence suggests that a few days following these historic floods there was a defined main channel along the Verde River above Horseshoe Dam reservoir.

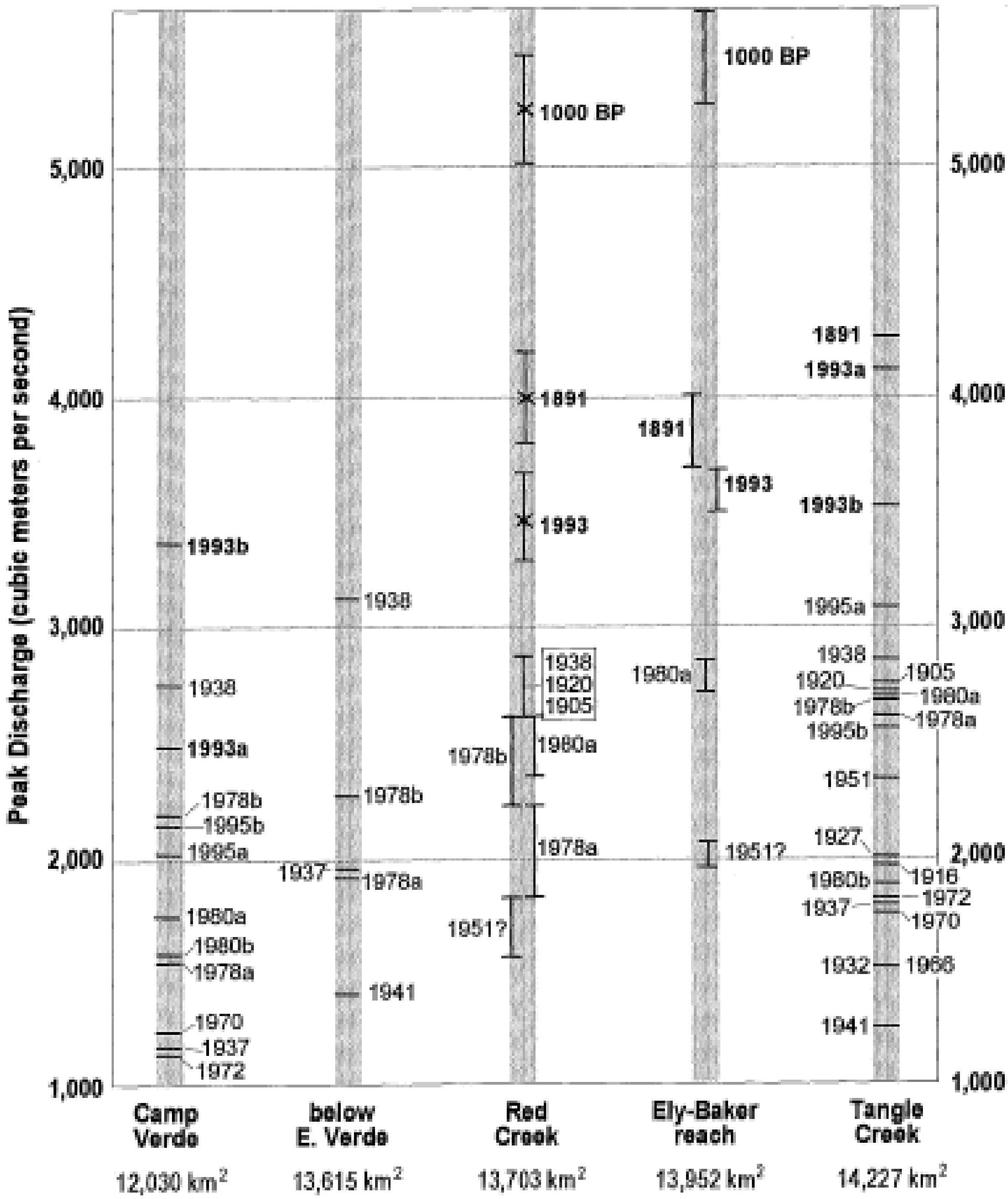
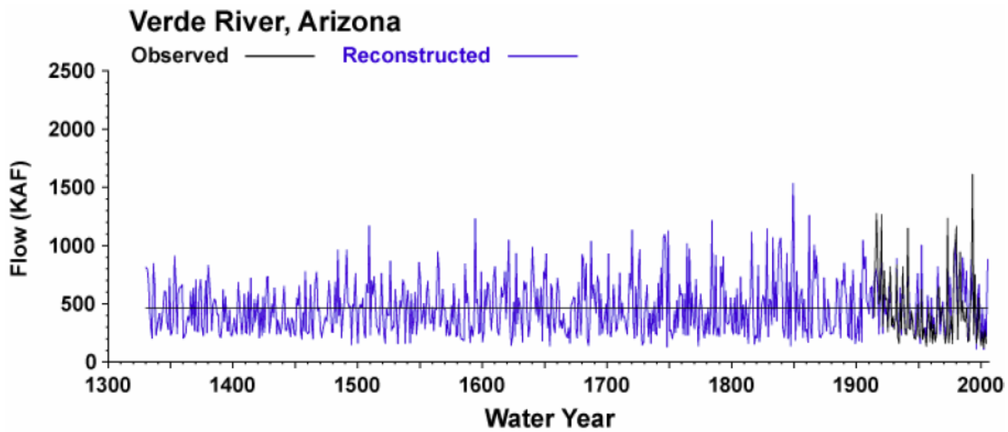


Figure 8. Summary diagram of gaged, historical, and paleoflood peak discharge estimates for the lower Verde River. Total drainage area to each site is shown. The gage record is longest for Tangle Creek and its predecessors; the Camp Verde record begins in 1936, and only a few large floods were recorded at the now defunct gage near the E. Verde River confluence. Paleoflood estimates from the Red Creek and Ely-Baker reaches are shown as ranges, with a x marking the preferred estimate. They are based on our 1993 field s tudies and upward adjustment of previous paleoflood discharge estimates from Ely and Baker (1985) and O'Connor et al (1986), based on our recent work.

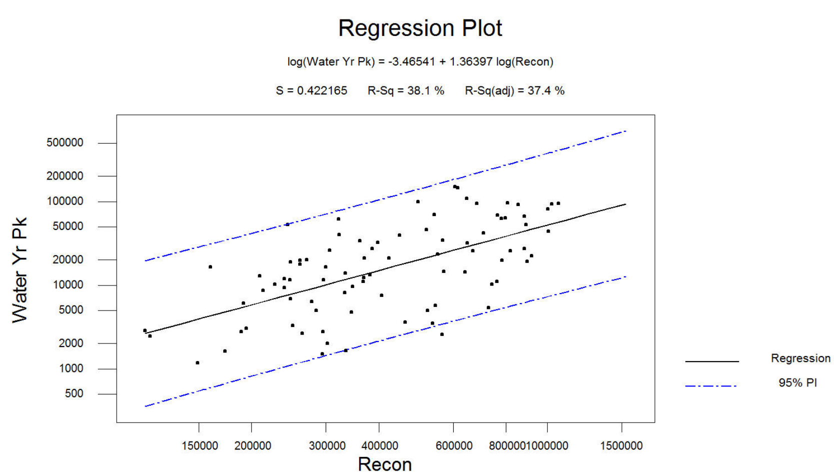
Second Reconstruction:

The second reconstruction was by Treeflow (2014). In 2008 David Meko and Katie Hershboeck from the University of Arizona Laboratory of Tree-Ring Research also developed a reconstruction of the Gila River flow in central Arizona. This reconstruction was part of a larger research project funded by the Salt River Project. Individual reconstructions were developed for the Verde River. The long-term reconstructed flow for the Verde River in thousands of ac-ft is shown in blue below. Observed flow is shown in black and the long-term mean is shown by the horizontal black line.



The following analysis uses (1) reconstructed water year streamflow data from the Treeflow website for Verde River below Tangle Creek for the period 1330-2005 and (2) USGS water year streamflow and water year peak flow data for gage 09508500:

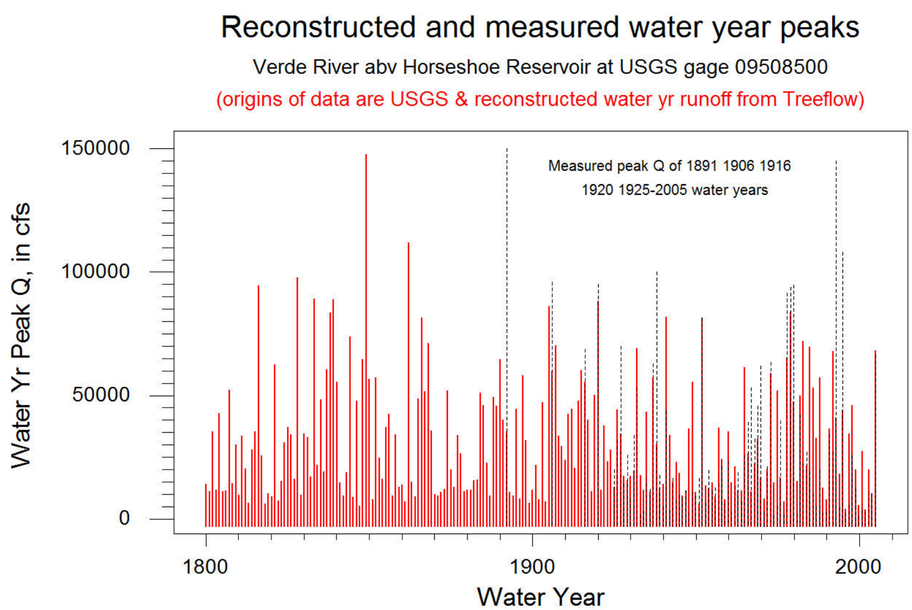
Testimony at a previous ANSAC hearing claimed that there is a general relation between water year runoff and the corresponding peak discharge but the regression plot below shows a very poor relation.



Minitab statistical software.

Water year peaks for 1891, 1906, 1916, 1920,
1925-2005.

The following plot further demonstrates the poor agreement between the measured and reconstructed peaks as exemplified by the peak of 1891. The poor relation can easily be observed with the naked eye. There is an interesting similarity between the 148,000 cfs reconstructed peak of 1849 and the measured peak discharge of 150,000 cfs for 1891 (I recognize it is poor practice to compare measured and reconstructed peaks). This close agreement roughly agrees with the slackwater flood analysis of House, Pearthree and Klawon (2002) but the date does not correspond to any known large flood. However, the reconstructed peak of 112,000 cfs does correspond to a known flood of 1862 and contradicts the findings of House, Pearthree and Klawon (2002) discussed above. Thus, the evidence is clear to me that the use of tree rings for reconstruction of the magnitude and timing of the peak discharge of past large floods can result in large errors that render the method of minimal value.



I generally agree with Pearthree (1996):

The history of the flood channel of the Verde River is more complete and interesting in the Camp Verde area because of the land survey conducted there 1892 (Drummond, 1892). In addition, aerial photographs from 1946, 1954, 1972, and 1980 cover this area. The flood of 1891 was the largest during the historical period, and probably was one of the largest floods on the Verde River during the past 1,000 years (Ely and Baker, 1985; House and others, 1995). The flood channel that existed immediately after the flood had dimensions similar to the modern channel. The 1891 flood probably caused a considerable amount of change in flood-channel position and possibly morphology. The survey of 1892 specifically recorded the new positions of "meanders" of the Verde River *in the Camp Verde area, and several hundred acres of "fine bottomland" were washed away in the flood and replaced by channel gravel (Drummond, 1892).*

In his January 8, 2014 Declaration Navigability of the Gila River Between the Arizona-New Mexico Stateline and the Confluence with the Colorado River presented to ANSAC at the Gila River hearing in Phoenix, AZ on Aug. 20, 2014, Dr. Mussetter stated "As is true for most dryland rivers, there is strong correlation between the annual flood peak and the annual runoff in the Gila River (Figure 5 below); thus, the low flow period in the mid-1800s also very likely corresponded to with an absence of major flooding."

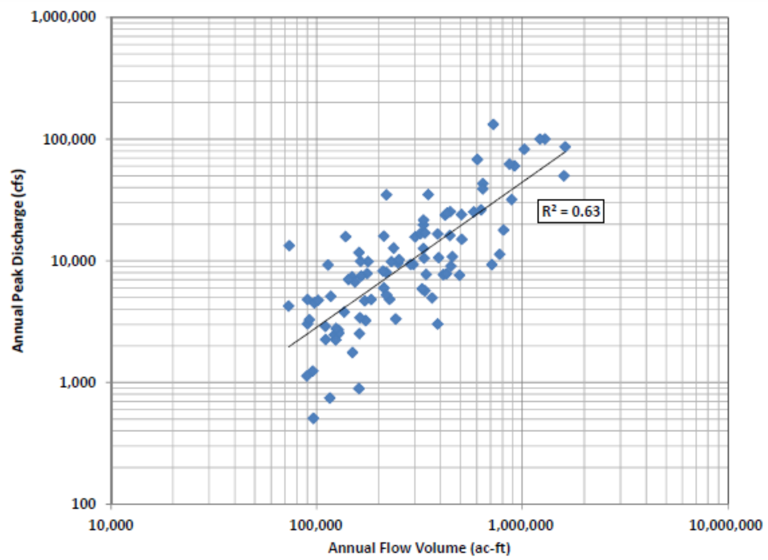


Figure 5. Annual peak discharge and corresponding annual flow volume for the period of record from 1915 through 2012 at the Gila River at Head of Safford Valley gage (USGS Gage No. 09448500).

However, there is an error with the regression in Dr. Mussetter's Figure 5 shown above which suggests that he may be unfamiliar with retrieving USGS data from its website. His annual flows (x axis) are for water years (Oct 1-Sept 30) but his annual peaks are for calendar years (Jan. 1-Dec. 31). There is only a 9 month period common to the annual pairs of data and 3 important months of Oct. 1-Dec. 31 are not common to the data pairs. Thus, a water-year data pair can have a large volume of annual flood flow but the peak discharge corresponding to that flow is in another water-year data pair. Large floods are known to occur during Oct. 1-Dec. 31 and neglecting this period of flood record renders the analysis meaningless. As a result, this relation presented to ANSAC by Dr. Mussetter is fatally flawed.

Also, I performed a reconstruction of water year peaks, like that shown above for the Verde River, for the upper Gila River at USGS gage 09448500 and obtained similar results with the same conclusion as for the Verde River. Based on my 53 years experience with surface water hydrology in the southwestern and western United States, it is my opinion that there is not a strong correlation between the annual flood peak and the annual runoff. Generally speaking, large flood peaks are associated with (1) winter storms that originate from large-scale low-pressure frontal systems from the Pacific Ocean, (2) late summer and early fall storms with widespread and intense rainfall from hurricanes and tropical storms, and (3) monsoonal storms. Winter storms, for example, result from intense rainfall for rather long periods under a variety of snowpack conditions that may have accumulated for a month or more. Also, a large peak from a hurricane may have a much shorter duration than a smaller peak from a winter storm, with a much longer duration. The result of these variable storm types and variable antecedent watershed conditions typically is a poor relation between flood peak discharge and associated runoff volume.

There is another important technical error with Dr. Mussetter's regression shown in his Figure 5. Assuming Dr. Mussetter had not committed the error discussed above and had correctly used pairs of annual data (flood peak discharge and corresponding flood runoff for water years), there is the issue of carry-over storage of groundwater that supplies base runoff. Base runoff for each water year is not the result of precipitation that produced the tree ring for the particular water year. Rather, base runoff is from stored groundwater for many previous years of recharge from precipitation. This fact is especially important for water years with little direct runoff. Large springs in the Verde River watershed have huge amounts of carry-over storage. By failing to account for this, Dr. Mussetter's statistical analyses are inaccurate. The issue of carry-over storage is addressed in the third reconstruction.

Third Reconstruction:

The third reconstruction used only the discharges for the periods from October through April and December through March for the model because of surface water diversion for agriculture in the Verde basin. The reconstructed October-April discharge is plotted with the gaged data on Figure 5 shown below.

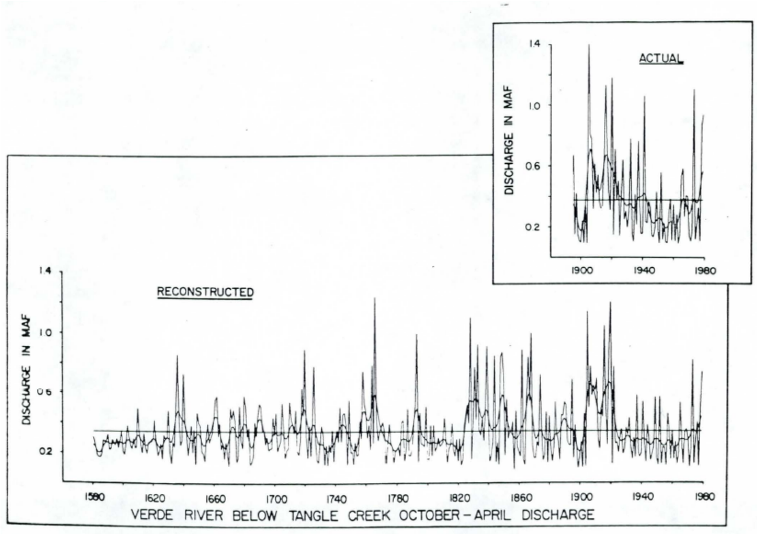


Figure 5. Actual and Reconstructed Stream Flow of the Verde River Below Tangle Creek (calibration period is from 1895-1979).

945 WATER RESOURCES BULLETIN

Smith, L. P. and Stockton, C. W., 1981, RECONSTRUCTED STREAM FLOW FOR THE SALT AND VERDE RIVERS FROM TREE-RING DATA: WATER RESOURCES BULLETIN VOL. 17, NO. 6, AMERICAN WATER RESOURCES ASSOCIATION, p 939-947.

This third reconstruction had fair agreement with measured data; however, for those periods of low flow where all flow was base flow, the agreement was poor. This is because much of the base flow of the Verde River is from springs with large source volumes that are recharged over long periods of time (many years). In other words there is carry-over storage of spring source water that is not accounted for in the analysis of annual data. Much of the base flow of the Verde River is not influenced by reconstructed discharge for only a single year.

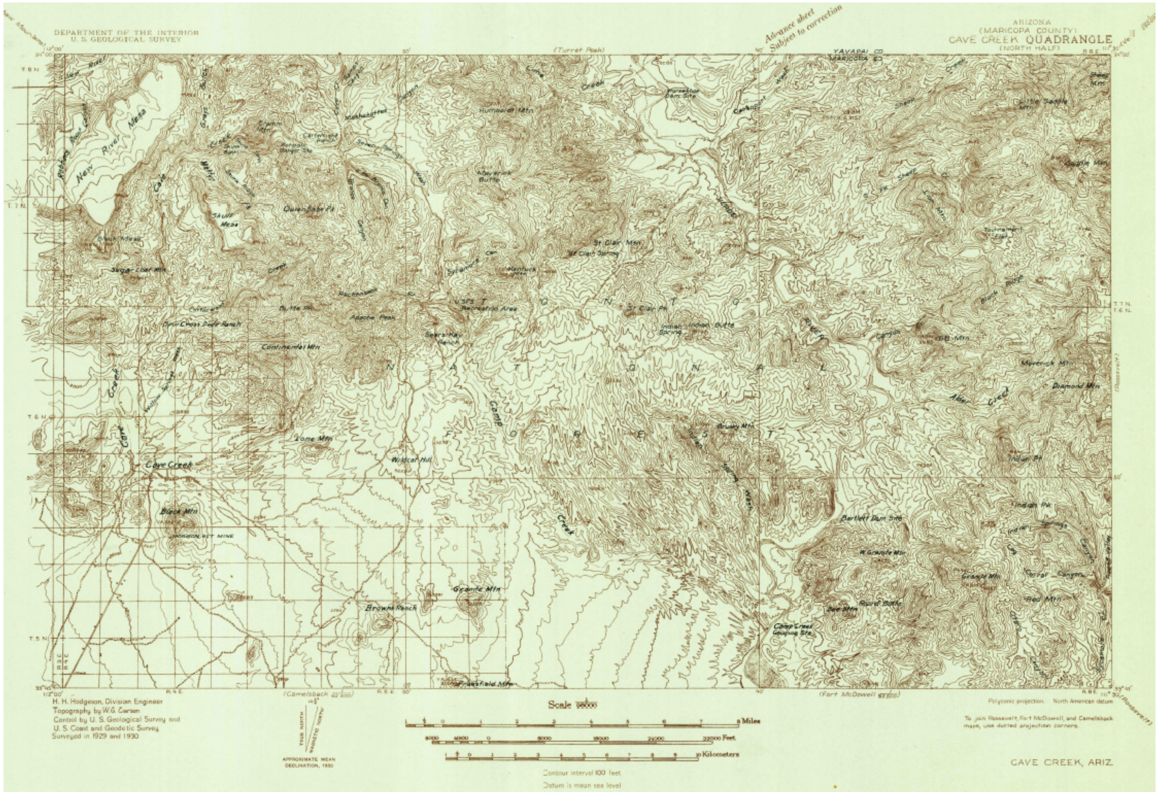
APPENDIX K.-- Early USGS topographic maps

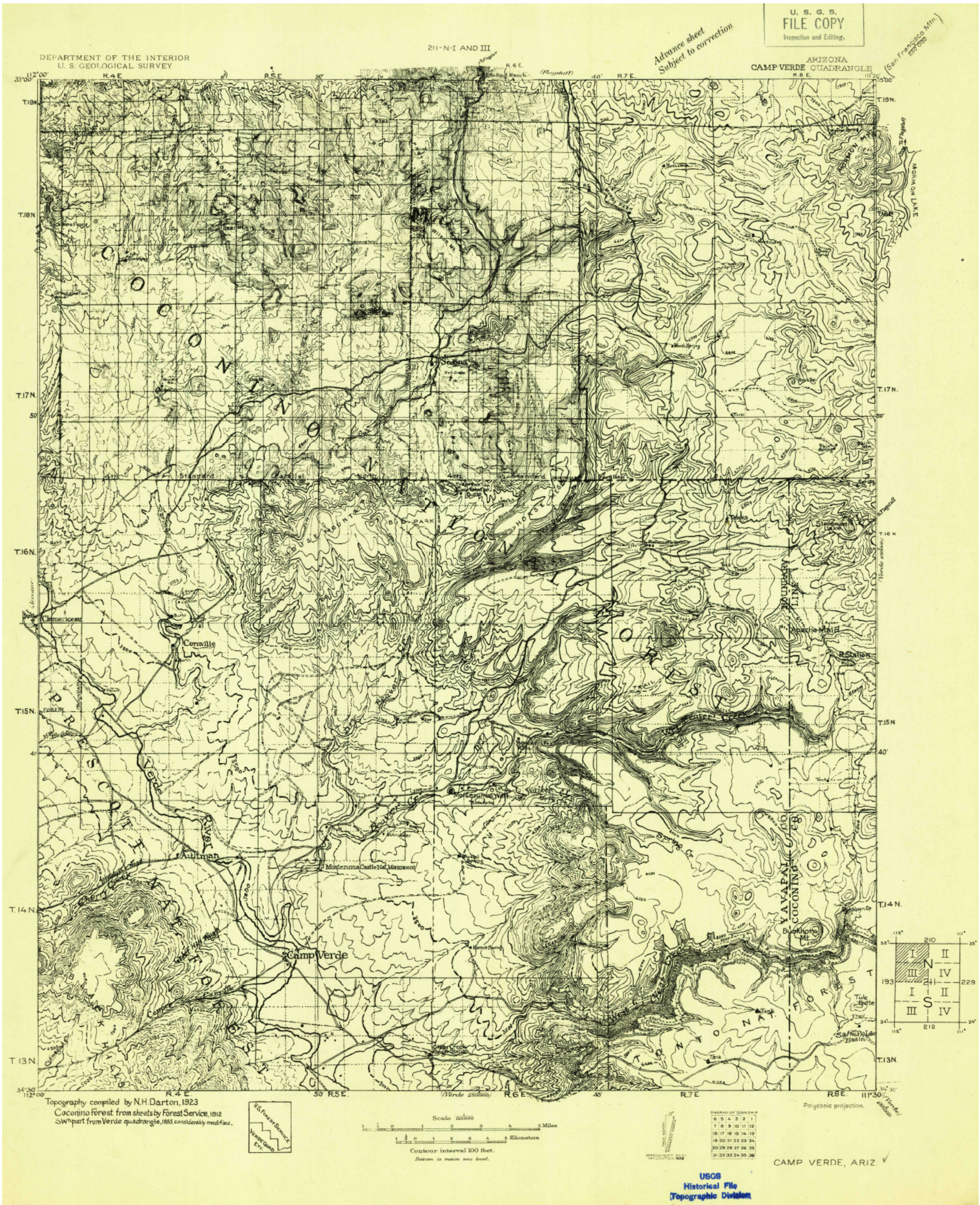
Early USGS maps of the Verde River area are included in this appendix. Maps are arranged starting at the mouth of the Verde River at the Salt River. The reconnaissance maps should be used with caution because, in places, later USGS topographic maps showed different topography and locations of stream channels.

NAME	YEAR	SURVEY	COMMENT
Fort McDowell	1906	1904	Shows two channels in a few places. Secondary channels are small and generally agree with original Federal Land surveys.
Cave Creek	1930	1929	Single channel. Shows Bartlett and Horseshoe dam sites.
Camp Verde	1923	1912	Single sinuous channel.
Verde	1910	1892	Recon. Map. Single sinuous channel.
Jerome	1906	1902-03	Single channel. Shows irrigation ditch at Perkins Ranch.
Prescott	1892	1885	Recon. Map. Shows Verde River and Granite Ck. as single sinuous channels. Jerome map of 1906 shows Granite Ck. as braided—probably the effect of the numerous human diversions upstream.
Chino	1891	1880	Recon. Map, Powell Survey. Shows area north of upper Verde River.

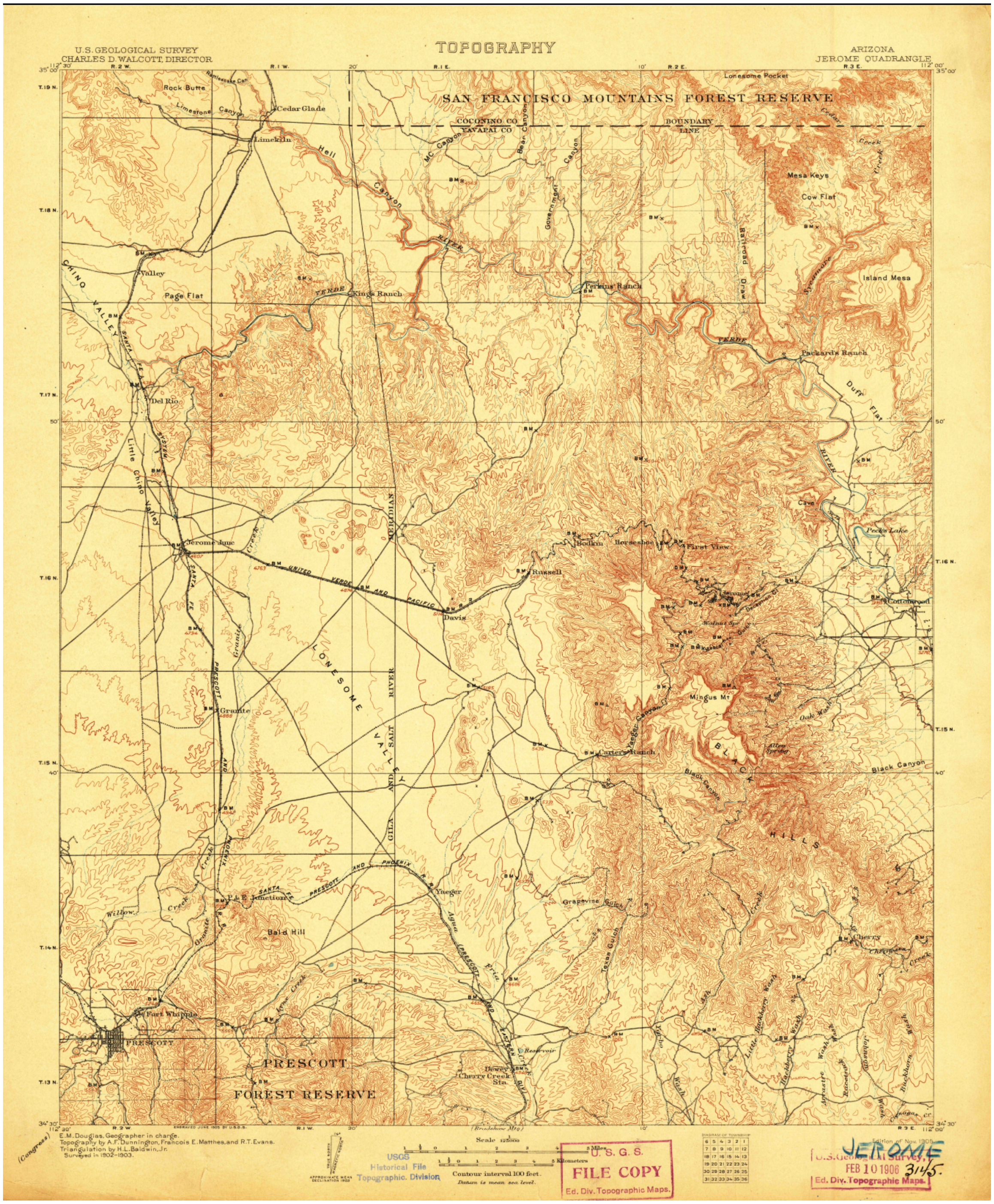
Note: For the best available resolution of the early USGS topographic maps see: http://store.usgs.gov/b2c_usgs/b2c/start/(xcm=r3standardpitrex_prd)/.do

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ARIZONA
(MARICOPA COUNTY)
FORT MC DOWELL QUADRANGLE
Herder Mtn
Asher Hills
Lone Mtn
Black Mtn
Sugarloaf Mtn
Lousley Hill
Adams Mesa
Stewart Mtn
Mc Dowell Pass
Mt Mc Dowell
USERY MTS
Lone Mtn
Dome Mtn
GOLDFIELD MOUNTAINS
SALT RIVER INDIAN RESERVATION
TONTO NATIONAL FOREST
VERDE RIVER
SALT RIVER
Sycamore Creek
ARIZONA CANAL
GRANITE REEF DAM
E.M.Douglas, Geographer
T.M.Bannon, in charge of section.
Topography by T.M.Bannon, C.H.Birdseye, and S.S.Stahl.
Triangulation by T.M.Bannon.
Surveyed in 1904.
SCALE 1:62500
CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL
Polyconic projection. To place on 1927 North American datum move projection lines 460 feet south and 350 feet west
FT. MC DOWELL, ARIZ.
N3330—W11130/15
1904
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 25, COLORADO OR WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
USGS Library Reston, VA. Topo Archive


DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY
Advance sheet
Subject to correction
ARIZONA
(MARICOPA COUNTY)
CAVE CREEK QUADRANGLE
(NORTH HALF)
YAVAPAI CO
MARICOPA CO
(Turret Peak)
Cave Creek
Black Mtn
Continental Mtn
St Clair Mtn
Granite Mtn
Browns Ranch
Bartlett Dam Site
Camp Creek
Little Saddle Mtn
Saddle Mtn
Red Mtn
Bee Mtn
Round Butte
Maverick Mtn
Diamond Mtn
Sugar Loaf Mtn
Wildcat Hill
Cone Mtn
Verde
H. H. Hodgeson, Division Engineer
Topography by W.G. Carson
Control by U. S. Geological Survey and
U. S. Coast and Geodetic Survey
Surveyed in 1929 and 1930
(Camelsback)
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1930
Scale
Miles
Feet
Kilometers
Contour interval 100 feet
Datum is mean sea level
(Fort McDowell)
Polyconic projection. North American datum
To join Roosevelt, Fort McDowell, and Camelsback maps, use dotted projection corners.
(Roosevelt)
CAVE CREEK, ARIZ.


U. S. G. S.
FILE COPY
Inspection and Editing.
DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY
211-N-I AND III
Advance sheet
Subject to correction
ARIZONA
CAMP VERDE QUADRANGLE
(San Francisco Mtn.)
COCONINO
NATIONAL FOREST
PRESCOTT NATIONAL FOREST
TONTO NATIONAL FOREST
YAVAPAI
COCONINO
Cornville
Aultman
Montezuma Castle Nat. Monument
Camp Verde
Verde River
Mormon Lake
Polyconic projection.
Topography compiled by N.H. Darton, 1923
Coconino forest from sheets by Forest Service, 1912
SW part from Verde quadrangle, 1885, considerably modified.
U.S. Forest Service
Verde Quad Etc.
Scale 1/125000
Contour interval 100 feet.
Datum is mean sea level.
DIAGRAM OF TOWNSHIP
CAMP VERDE, ARIZ.

U.S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR
RECONNAISSANCE MAP
ARIZONA
VERDE SHEET
(San Francisco Mt.)
Mormon Mountain
MORMON LAKE
CANYON DIABLO
Oak Creek
Chaves Pass
Cornville
Beaver Head
Aultman
Montezuma Well
Beaver Creek
Antelope Tank
Pine Spring
Stoneman Lake
Rattlesnake Tank
U.S.G.S. FILE COPY Ed. Div. Topographic Maps.
SUNSET CANYON
CLEAR CREEK CANYON
Fort Verde
Y A V A P A I
Clear Creek
Cienega
Squaw Peak
Bald Mt
VERDE RIVER
MOGOLLON MESA
Potato Ranch
Baker Butte
THE TUNNEL
Fossil Creek
Strawberry
Pine
NATURAL BRIDGE
Pine Creek
Sycamore Creek
Indian Creek
Turret Peak
DEADMANS CANYON
EAST VERDE RIVER
Payson
TONTO BASIN
Tonto Creek
Diamond Butte
Spring Creek
BLOODY BASIN
North Peak
Rye
Rye Creek
MAZATZAL MOUNTAINS
Mazatzal Peak
New River Wash
MARICOPA
(Roosevelt)
(Prescott)
(Holbrook)
Willow Creek
Henry Gannett, Chief Geographer.
A.H. Thompson, Geographer in charge.
Triangulation and Topography by A.P. Davis.
Surveyed in 1885.
Contour Interval 200 feet
Edition of April 1892, reprinted Apr. 1910.
VERDE
U.S.G.S. FILE COPY Ed. Div. Topographic Maps.
USGS Historical File Topographic Division
JUN 10 1910 1559


TOPOGRAPHY
U.S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR
ARIZONA
JEROME QUADRANGLE
SAN FRANCISCO MOUNTAINS FOREST RESERVE
COCONINO CO.
YAVAPAI CO.
BOUNDARY LINE
Rock Butte
Cedar Glade
Limestone Canyon
Limekiln
Hell Canyon
Lonesome Pocket
Mesa Keys
Cow Flat
Island Mesa
Government Canyon
Railroad Draw
Perkins Ranch
Kings Ranch
VERDE RIVER
Valley
Page Flat
CHINO VALLEY
Del Rio
Little Chino Valley
Packards Ranch
Duff Flat
Peck's Lake
Jerome Junc
UNITED VERDE AND PACIFIC R.R.
Russell
Davis
Bedkin
Horseshoe
First View
Cottonwood
Mingus Mt
LONESOME VALLEY
GILA AND SALT RIVER MERIDIAN
Granite
Carters Ranch
Black Canyon
BLACK HILLS
Oak Wash
P.&E. Junction
SANTA FE PRESCOTT AND PHOENIX R.R.
Yeager
Grapevine Gulch
Bald Hill
Willow Creek
Granite Creek
Agua Fria
Fort Whipple
PRESCOTT
PRESCOTT FOREST RESERVE
Reservoir
Dewey
Cherry Creek Sta.
Cherry
Cherry Creek
Little Hackberry Wash
Hackberry Wash
E.M. Douglas, Geographer in charge.
Topography by A.F. Dunnington, Francois E. Matthes, and R.T. Evans.
Triangulation by H.L. Baldwin, Jr.
Surveyed in 1902-1903.
Scale 1:125000
Contour interval 100 feet.
Datum is mean sea level.
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Historical File
Topographic Division
U.S.G.S.
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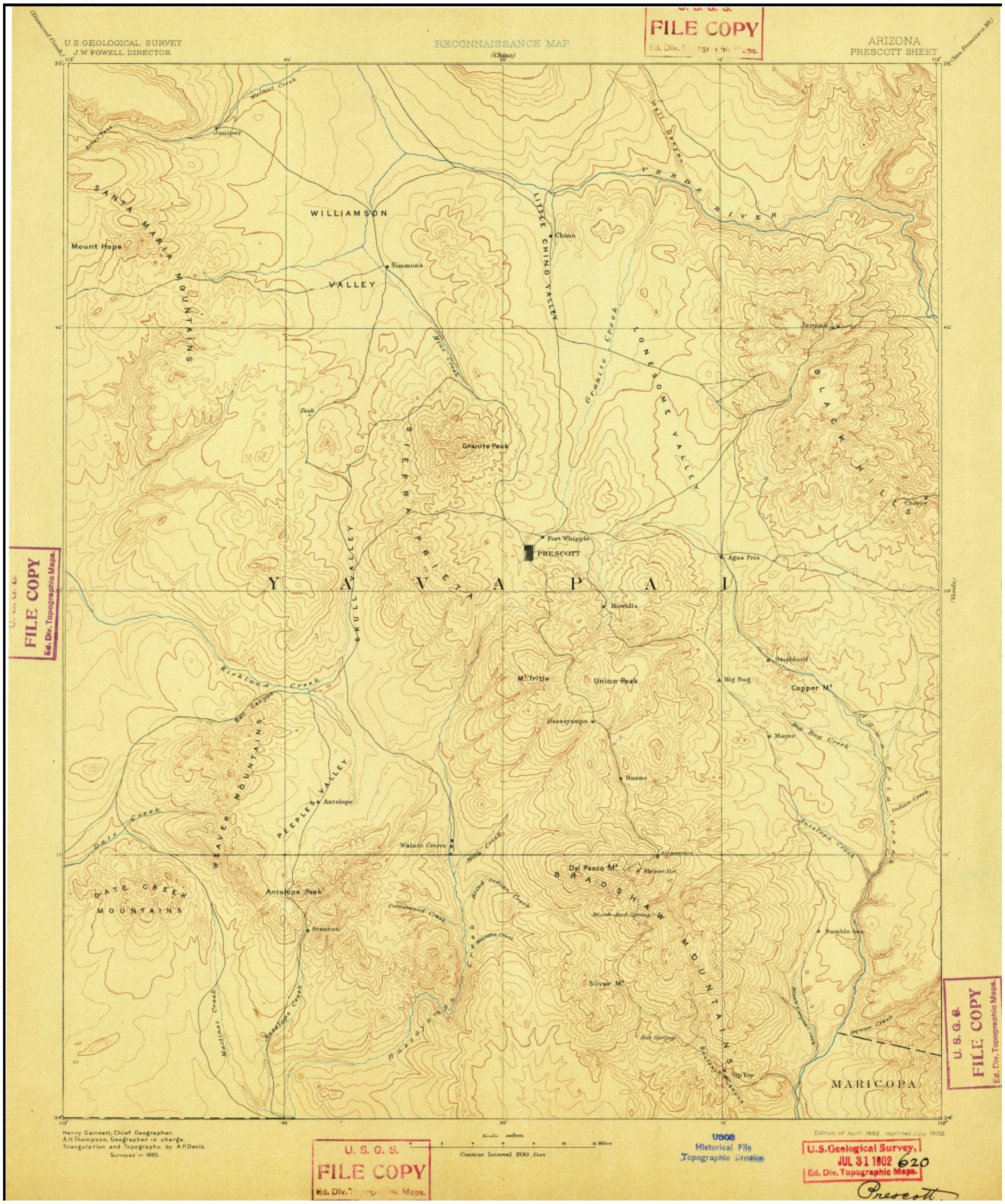
JEROME
U.S. Geological Survey
FEB 10 1906
Ed. Div. Topographic Maps.


U.S. GEOLOGICAL SURVEY
J.W. POWELL DIRECTOR
RECONNAISSANCE MAP
(Chino)
ARIZONA
PRESCOTT SHEET
FILE COPY
Juniper
Walnut Creek
SANTA MARIA MOUNTAINS
Mount Hope
WILLIAMSON VALLEY
Simmons
LITTLE CHINO VALLEY
Chino
VERDE RIVER
Granite Creek
LONESOME VALLEY
Jerome
BLACK HILLS
Cherry
Granite Peak
SIERRA PRIETA
SKULL VALLEY
Fort Whipple
PRESCOTT
Agua Fria
Y A V A P A I
Rowells
Kirkland Creek
Mt Tritle
Union Peak
Big Bug
Copper Mt
Hassayampa
Big Bug Creek
Mayer
Bueno
WEAVER MOUNTAINS
PEEPLES VALLEY
Antelope
Date Creek
Walnut Grove
Indian Creek
Antelope Creek
Del Pasco Mt
BRADSHAW MOUNTAINS
DATE CREEK MOUNTAINS
Antelope Peak
Stanton
Bumble bee
Silver Mt
Hot Spring
Martinez Creek
Squaw Creek
Tip Top
MARICOPA
Henry Gannett, Chief Geographer.
A.H.Thompson, Geographer in charge.
Triangulation and Topography by A.P.Davis.
Surveyed in 1885.
Contour Interval 200 feet
Edition of April 1892 reprinted July 1902.
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USGS
Historical File
Topographic Division
U.S.Geological Survey,
JUL 31 1902 620
Prescott

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U. S. G. S.
FILE COPY
Ed. Div. Topographic Maps.
RECONNAISSANCE MAP
ARIZONA.
CHINO SHEET
Red Butte
COLORADO PLATEAU
YAVAPAI
AUBREY CLIFFS
Beale Wagon road
Mt. Floyd
Mt. Sitgreaves
Chino
Crookton
Pineveta
Ash Fork
Fairview
Johnson Canyon
Supai
Williams
Bill Williams Mt.
Picacho Butte
Garland Ranch
AUBREY VALLEY
ATLANTIC AND PACIFIC RAILROAD
Chino Valley
Black Forest
Walnut Creek
Williamson Valley
Dow Spring
Henry Gannett, Chief Geographer.
A. H. Thompson, Geographer in charge.
Triangulation by H. M. Wilson.
Topography by the U.S. Geological and Powell Surveys.
Powell Survey
R. U. Goode 1880
Contour Interval 250 feet
Edition of Nov. 1891, reprinted Dec. 1900.
USGS
Historical File
Topographic Division
U.S. Geological Survey,
JAN 31 1901
Ed. Div. Topographic Maps.
1042
Chino.

APPENDIX L. -- Meandering, channel forming discharge and human impact – A discussion for beginners and historians.

It's common knowledge among river engineers that river channels contain ordinary discharges and that floods exceed channel capacity and flow onto the floodplain. The Verde River is no exception where the typically single meandering natural channel was formed and maintained by common flows rather than limited to large flood flows. The processes involved are erosion and deposition, and their effectiveness increases with increased discharge. Large floods are most effective in forming the river channel over very short periods. But also operative is the frequency of events of various magnitudes. Leopold has discussed these channel forming processes in nontechnical or elementary terms (Leopold and Langbein, 1960) and in highly technical scientific language (Leopold,1992 and 1994).

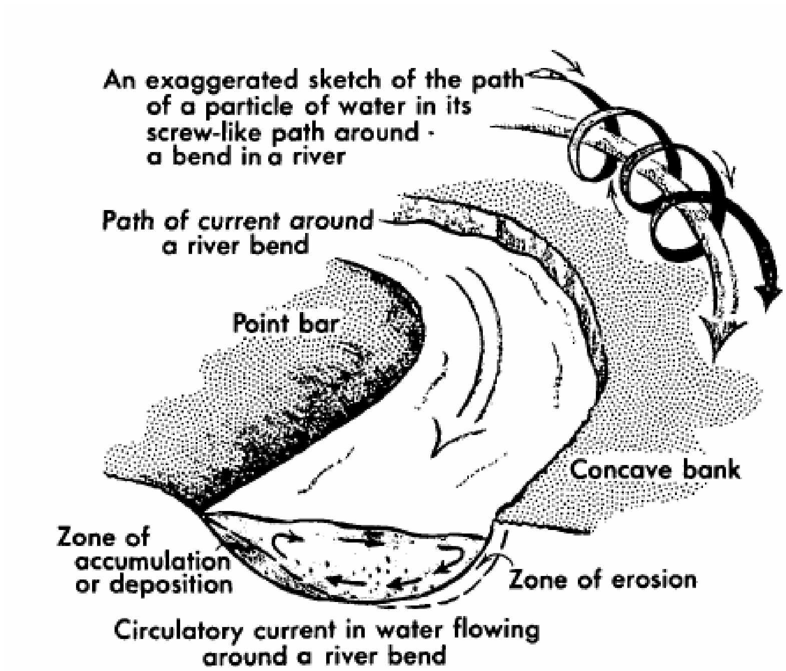
Although I prefer the elementary description of river processes in "A Primer on Water" by Leopold and Langbein (1960) because it describes the Verde River rather well, the concept of frequency effectiveness, set forth by Wolman and Miller (1959), elucidates this matter. They pointed out that the work done by a river in erosion and deposition--in simple terms, effectiveness--increases with discharge. But low discharges that are less effective and do little work are common. The higher the discharge, the more uncommon it is (see for example Fig. G3 of Appendix G.). High discharges, when they do occur, are very effective in the erosion-deposition process. It follows that some intermediate discharge, neither high nor low, is both sufficiently frequent and sufficiently effective to be most important in forming and maintaining the channel. (Leopold, L. B.,1960 and 1994).

The Upper Verde River appears to have a channel-forming (dominant) discharge as shown by the US Forest Service cross sections where the average annual flow is approximately the bank-full discharge. The uniformity among the USFS cross sections suggests the Upper Verde River is a stable stream. Cross sections by other agencies also suggest a stable or slightly degrading stream because, at a few places, the level of the average annual flow is less than bank full. As discussed in the preceding paragraph, the average annual flow may be considered the effective discharge, which is defined as the discharge that transports the largest fraction of the average annual bed-material load and is most important in forming and maintaining the channel.

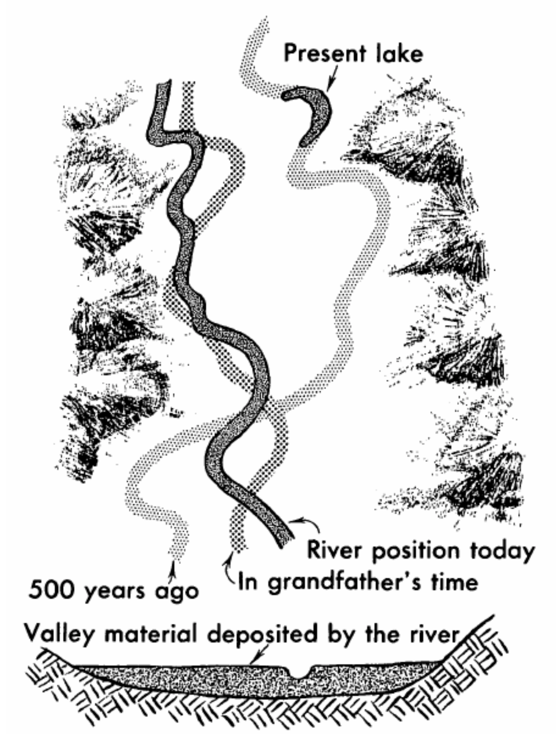
Most of the time, the flow of the Verde River is in a definite channel commonly bordered on both sides by river alluvium (Holocene material). In the canyon areas the alluvium area is rather narrow and channel movement is limited by adjacent bedrock and vegetation along the banks. In the basin fill areas the channel movement is less constrained by bedrock because the alluvial area is wider (See for example Appendix G section G3a.--Geomorphology of Verde River Channel by Pearthree). The channel, like channels of most rivers, is seldom straight and the bends in the channel have an important effect on the manner of flow.

At the outside banks of bends there is erosion and on the inside bank there is deposition of transported sediment (deposits are known as bars). There is progressive sideways movement of the channel and given sufficient time, the channel will eventually occupy each and every position within the valley (Holocene area).

As a flowing stream enters a bend in its channel (see following figure from (Leopold and Langbein, 1960), the water at the surface being swifter than that near the bottom, moves toward the concave bank and tends to erode it. The water near the bottom carries sand or gravel toward the inside of the curve by the slower moving water. “As indicated by the small arrows on the cross section on the left, water near the surface tends to move toward the concave bank and bed water toward the convex bank of the point bar. Thus, material tends to accumulate on the convex edge of the bend and in doing so builds up the bed on that side, giving it a gradual slope. In a curving channel a particle of water, therefore, not only moves downstream but also describes a circular path within the channel, as it does so. Its path is somewhat like a loosely coiled spring and is sketched with some exaggeration of the circular motion in the upper right portion of the figure below.”

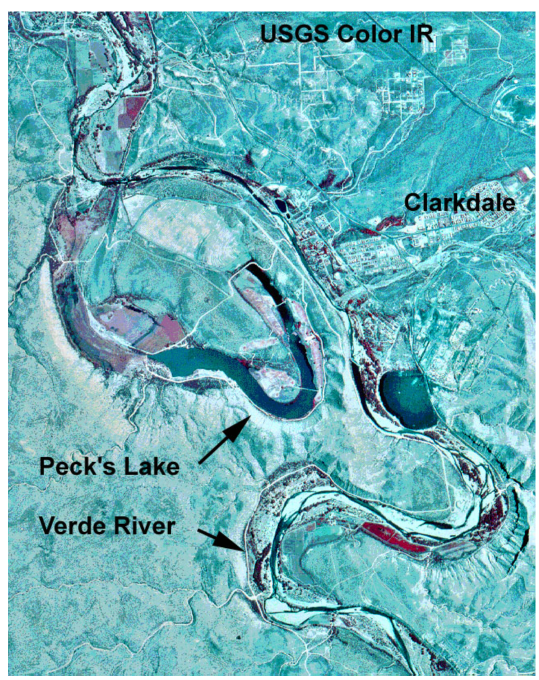


Leopold and Langbein (1960) continue: “Now try to visualize what happens: If material is eroded off one bank of a channel and is deposited on the opposite bank, the channel is going to move gradually sideways. Because in most channels the bends are somewhat irregularly distributed along the length of the stream and the bends consist of both curves to the right and curves to the left, the progressive sideways movement of the channel is to the left in one place and to the right an another. Thus, given sufficient time, the channel will eventually occupy each and every position within the valley; each sideward motion leaves a flat or nearly level deposit which was caused by deposition on the inside of the curve. This flat bordering the channel is the flood plain.”



Note: The different meandering channel locations to the right are very similar to those of the Verde River in section G3a by Pearthree.

I imagine that since my grandfather (see grandfather’s time in preceding figure from Leopold and Langbein (1960)) arrived in the area that the course of the river has changed a little in the Holocene area along the Verde River. Movement of the channel is natural. A former position of the river is indicated by Pecks Lake shown in the USGS photo on the right. Peck's Lake is an oxbow remnant perpetuated by means of a man made water tunnel from the adjacent Verde River.

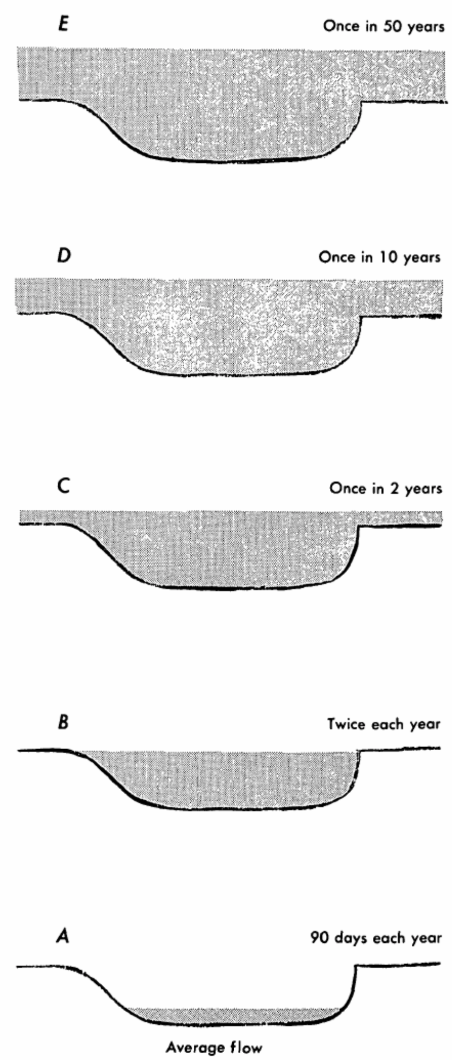


Returning to the USGS report *A Primer on Water* by Leopold and Langbein (1960): “The processes of erosion on one bank and deposition on the other are about equal on the average, and this gradual movement of the channel over the whole valley takes place without appreciable change in the size of the channel.”

“The channel is constantly shifting position, though slowly, and the valley floor, or flood plain, is actually the result of this shifting. As long as the river is continually making its channel, why is the channel not made large enough to carry all the water without overflow?”

“We know from our own experience that most places in the world have more days of no rain than days of rain. Light rains occur more frequently than do moderate ones; a truly great downpour occurs only once in a great while.”

“A river channel will have only a moderate or small amount of water flowing in it on most days. On a few days each year there is usually sufficient rain or snowmelt to raise the river to a peak that just fills the channel but does not overtop its banks. The great amounts of flow which cause the largest floods occur only once in a while, generally a long while. The river channel is shaped principally by the more frequent moderate flood flows, and it is large enough to accommodate these. Overflow of the flood plain takes care of the water of rare major floods that cannot be carried within the channel.”



Many hydrologic studies suggest that the mean annual flood, that has a recurrence interval of 2.3 years, is approximately the channel forming discharge. This 2.3 yr. “flood” has a discharge slightly larger than bank full and typically occurs only a few days each year.

The sketches from Leopold and Langbein (1960) on the right depict the amount of water in a river channel and the frequency with which such amounts occur.

Note: The base flow discharge for the Verde River varies considerably less than that shown in the preceding diagram. The Q_{50} (median) and Q_{90} or Q_{95} amounts of discharge fill the channel considerably more than the sketches to the right imply. (See for example section in this report HYDRAULICS AND CHANNEL GEOMETRY, 3 -Recent channel geometry with several photos, channel cross sections, and current meter measurements.)

Readers interested in this subject are encouraged to read Chapter 8 – Relationships between Channel and Discharge-- by Leopold (1994).
(I've owned this excellent book for some time.)

Leopold, L. B., 1994, A View of the River; Harvard University Press, 298p.

In addition to the commonly accepted channel forming discharge concept, the channel morphology is also related to sediment size (Leopold, 1992) of gravel-bed streams like much of the Verde River. Leopold shares his observations about bed-load transport along a river and its relation to the source of bed material. Transported material has a smaller grain size than material seen on the channel bed and the major volume of bed-load is sand. Channel bed material and riffles in the pool-riffle sequence (clearly like the Upper Verde River) are all made up of gravel and larger material that moves at a low transport rate where the gravel, cobbles and boulders of which move only occasionally, and for short distances when they do move. Thus, this coarse fraction appears to make up the principal morphological features of the channel. Leopold's highly technical observations appear to also describe, to some degree, the Verde River as evidenced in the photographs of the channel bed and banks and also the large deposit of predominantly sand sediment behind Horseshoe Dam (See Appendix G).

A potentially useful engineering perspective of stream meanders that is related to the Verde River is given by Lagasse, P. F., W. J. Spitz, L. W. Zevenbergen, and D. W. Zachmann in the *Handbook for Predicting Stream Meander Migration:*
"Most streams that present a hazard through lateral migration at road crossings are alluvial. In alluvial streams, the channel is formed by the action of flowing water on boundary materials that have been deposited by the stream and that can be eroded and transported by the stream. In alluvial streams, it is the rule rather than the exception that the banks will migrate through erosion and accretion and that floodplains, islands, and side channels will undergo modification with time. This is particularly the case in actively meandering streams, which continually change their positions and shapes as a consequence of fluvial processes and hydraulic forces exerted on their beds and banks. These changes may be incremental or episodic, gradual or rapid, and system wide or local in scale. Meanders grow and move naturally, but human activities may accelerate the rate of change or trigger new changes caused by morphological response in the stream system."

“Predicting channel migration requires consideration of both system wide and local factors. The morphology and behavior of a given river reach are strongly determined by the water and sediment discharges from upstream. In dynamically adjusted systems, the rate of lateral shifting increases with the supply of water and sediment from upstream. Changes in runoff and sediment yield, as a result of natural processes or human activities, will trigger changes in rates and modes of channel migration.”

“Locally, the distribution of velocity and shear stress and the characteristics of bed and bank materials will control channel behavior. Therefore, local channel morphology such as dimensions (width, depth, meander wavelength, and amplitude), pattern (sinuosity and bend radius of curvature), shape (width/depth ratio), and gradient will not only reflect upstream controls but also provide information on the direction and rate of channel migration.”

“While geomorphologists may view channel stability from the perspective of hundreds or thousands of years, for highway engineering purposes, a stream channel can be considered unstable if the rate or magnitude of change is such that the planning, location, design, or maintenance considerations for a highway crossing are significantly affected during the life of the facility. In the context of a bridge crossing, meanders may be regarded as stable if they do not migrate appreciably during the design life of a bridge crossing (75 to 100 years).” This should give the reader a feeling of why the term *stable* can have different meanings for engineers, geomorphologists and even geologists.

A note about human impacts is appropriate at this point. When the base runoff of a river is diverted or stored for irrigation, mining, railroad and urban use, the amount of stream flow in the river downstream obviously is decreased. When the amount of flow is less, the amount of energy is less and when high-energy floods move channel material and alter channel shape, there is little or no flow and associated energy available to reform the channel. Also, when there is little or no flow, there is little vegetation to restrict erosion of channel banks. Thus, a human-impacted meandering channel, when exposed to a large flood, can become a braided channel and remain braided for long periods. For further related discussion see section G3b of Appendix G and also Appendix M.

An interesting book that I own (retails for as much as $700) on the *Dynamics of Gravel-bed Rivers* edited by Billi and others (1992) contains scholarly articles with discussion by leading international experts in a variety of subjects including sediment transport dynamics, armoring processes and the impact of engineering works and catchment development projects on channel stability. Several of the authors have their own data bases for specific rivers and meander bends and the associated analyses reflect rather subtle and often highly technical site specific characteristics. I also like the following two *free* books: (1) USGS *A Primer on Water* by Leopold and Langbein (1960) a great general reference and (2) for other issues such as the impact of humans, the *Handbook for Predicting Stream*

Meander Migration Using Aerial Photographs and Maps by Lagasse and others (2004).

Summary: The meandering channel of the Verde River is similar to the example used by Leopold and Langbein (1960) to explain typical river processes in "A Primer on Water".

(1) Channel size is related to a discharge on the order of the 2.3 yr. "flood" or roughly the average annual discharge. There is not reason to be picky over the precise amount of discharge.

(2) The channel is constantly shifting position especially in the basin fill areas. This is how meandering rivers behave and the map of the varying channel locations of the Verde River by Pearthree in section G3a is very similar to the general map in the "A Primer on Water".

(3) Meanders grow and move naturally, but human activities may accelerate the rate of change or trigger new changes caused by morphological response in the stream system.

(4) Changes in runoff and sediment yield, as a result of natural processes or human activities, will trigger changes in rates and modes of channel migration.

(5) Human impacts on channel size and shape upstream of Horseshoe Reservoir should have little effect on this assessment of navigability. Downstream from Bartlett Dam there are human-related changes such as channel braiding.

(6) The processes of erosion on one bank and deposition on the other are about equal on the average, and this gradual movement of the channel over the Holocene area of the canyons and basin-fill valleys takes place without appreciable change in the size of the channel.

Appendix M.—A technical report on the lower Verde River vegetation and associated channel stability written for the Salt River Project.

Several years ago the Salt River Project ("SRP") hired consultants to evaluate the effect of Horseshoe and Bartlett reservoirs on tall woody riparian vegetation along the lower Verde River. A report by ERO Resources Corporation (2004) ("Report") summarizes several studies related to the vegetation that to some degree also relates to the ANSAC navigability issue along the Verde River.

> ERO Resources Corporation, 2004, TECHNICAL REPORT, LOWER VERDE RIVER RIPARIAN VEGETATION; Prepared for Salt River Project, P.O. Box 52025, Phoenix, Arizona 85072-2025, 43p.

Although I disagree with some of the comments in the Report (for example, the fact that the braiding that is shown in Appendix G section G1a is not mentioned) I found a few observations that have a bearing on navigability to be interesting. Specifically, these include the following:

1. Vegetation along the river channel was affected by humans,
2. Channel morphology has not changed much since Bartlett Dam was built,
3. There is more vegetation along the flood plains since Bartlett Dam was built,
4. Cattle grazing affects the amount of vegetation along the channel,
5. The active channel is smaller since Bartlett Dam was built,
6. The frequency of inundation and mobilization of sediments has been reduced by the dams—therefore the formation of the channel has changed.
7. More recently, the minimum flow of 100 cfs below Bartlett since 1994 has likely benefitted tall woody vegetation downstream of the dam—thus the banks are less susceptible to erosion.

I disagree with the observation (discussed *infra* in Items M1 - 4) that "Given the small size of the SRP reservoirs on the Verde in relation to annual runoff, the natural hydrograph is not substantially modified by reservoir operations." See Item M6 for comparison of inflow and outflow hydrographs for 5 periods. The inflow hydrograph is substantially different than the outflow hydrograph based on simple visual comparison.

Also, the reference in the Report to the pre-Bartlett hydrograph as natural is incorrect. There were human impacts to the river long before Bartlett Dam was built. Thus, the Report is interesting but should be used with caution.

Introduction

As part of the Salt River Project's evaluation of the effect of Horseshoe and Bartlett reservoirs on tall woody riparian vegetation along the lower Verde River, ERO Resources investigated the current (2002) and historical (1934 to 1997) riparian plant communities along the lower Verde River. This study of tall woody vegetation focuses on cottonwood (*Populus fremontii*) and Goodding willow (*Salix gooddingii*) because these trees are nesting habitat for various species of birds, including the threatened bald eagle, endangered southwestern willow flycatcher, and candidate yellow-billed cuckoo. The purpose of the study was to examine habitat trends for these three species of birds, not to examine the rate of woody vegetation establishment, or changes in amounts of individual species. Vegetation was investigated at three sites along the lower Verde River. Site 1 (Above Horseshoe) is located directly upstream of the Horseshoe high water mark. Site 2 (KA Ranch) is located about 2.5 miles downstream of Horseshoe. Site 3 (Box Bar Ranch) is located about 4 miles south of Bartlett (see Figure 1). The investigation was designed to evaluate historical vegetation trends relative to dam construction and operations, and as a baseline study to monitor future changes in vegetation communities. Historical photography was analyzed to identify trends in tall, woody vegetation stands. The earliest available aerial photographs (1934) predate the construction of Bartlett Dam, which was completed in 1939, and Horseshoe Dam, which was completed in 1946, with additional storage added in 1951.

Mussetter Engineering, Inc. (MEI) conducted a companion study of fluvial geomorphology at the three study sites in support of this vegetation analysis (MEI 2004). The MEI analysis focused on inundation and substrate stability at each of the three study sites. A summary of the conclusions of the MEI study are provided at the end of the Literature Review section below.

Mussetter Engineering Inc. (MEI). 2004. Inundation and substrate stability study to support Verde River vegetation analysis, November 2003 Draft. Prepared for Salt River Project, Phoenix, Arizona. May 20, 2004.

"This study did not collect depth to ground water in relationship to tall woody vegetation cover. No data currently exists for ground water depths along the lower Verde River. However, field observations and substrate sampling by MEI revealed that the soils in the study areas are composed of coarse material with relatively little clay and silt content (MEI 2004). In this coarse alluvium, ground water should flow freely. It is a reasonable assumption that the ground water table is closely tied to the surface water level in the lower Verde River. Thus, depths to ground water can be estimated using the cross sections in Appendix A of the MEI (2004) report." Report, p. 3.

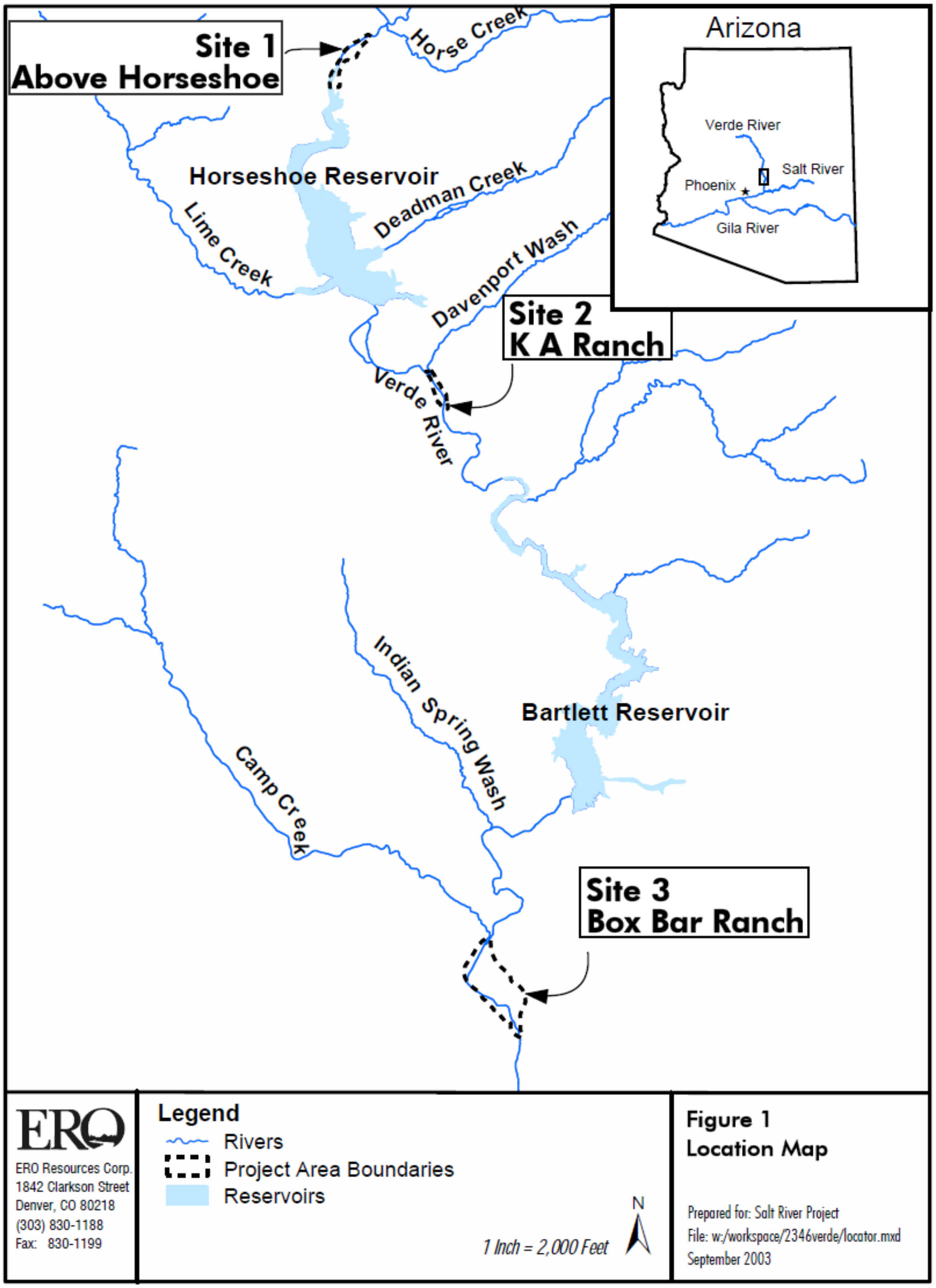


Figure 1
Location Map

<u>Item M1—Studies of 1986 and 2001</u>

The Report included a summary of a past study on the Lower Verde River below Horseshoe and Bartlett Reservoirs: "In 1986, as a part of water right negotiations among SRP, the United States, the Fort McDowell Indian Community, and other parties, ERO evaluated the riparian vegetation communities on the Fort McDowell Reservation using ground and aerial vegetation surveys, analysis of historical aerial photos dating from 1934, coring of cottonwoods to determine age, soil studies, and analysis of surface and ground water hydrology (SRP 2002a). In 2001, SRP did extensive hydrological analysis on the effect of Horseshoe and Bartlett on river flow (*Id.*). Findings from the 1986 and 2001 studies are summarized below:

1. The status of cottonwood and willow along the lower Verde River results from a combination of natural fluctuations and man-induced changes, including such factors as channel migration, land use, pumping, drought, and dam operations.
2. Broad, extensive areas of riparian woodland were not present prior to dam construction.
3. River morphology has not changed significantly since the construction of Bartlett Dam.
4. Given the small size of the SRP reservoirs on the Verde in relation to annual runoff, the natural hydrograph is not substantially modified by reservoir operations.
5. Vegetation density on the active floodplain of the lower Verde River has increased since the late 1930s when river flows became regulated as the result of the construction of Bartlett Reservoir.
6. Some cottonwood regeneration continues to occur on the Reservation; for example, a number of saplings near the Highway 87 bridge resulted from high flow events in 1978 and 1980.
7. Recreational use of riparian areas and grazing by cattle and horses are major impacts on establishing cottonwood/willow communities along the lower Verde. As a result, recruitment of new trees and shrubs from high flow events has been limited.
8. Upstream from the Fort McDowell Reservation, above Needle Rock, a relatively high-gradient channel and riparian land uses (e.g., grazing) appear to be the biggest factors limiting riparian vegetation.
9. Management of recreation and livestock impacts or re-establishing by direct plantings have the greatest potential to promote perpetuation of cottonwood and willow on the Reservation.
10. High bank cottonwood trees that are overly mature have been a focus of concern due to bald eagle nests. These cottonwood trees appear to be decadent primarily as a result of age and disease and a declining water table due to the natural migration of the channel to the other side of the floodplain.
11. A minimum stream flow of 100 cfs would have a beneficial effect on sustaining cottonwood and other riparian vegetation by helping to maintain stable ground water levels."

Report, citing SRP (Salt River Project). 2002a. Appendix 1: SRP Perspectives, Verde River hydrology and other factors in relation to potential flycatcher habitat below HorseshoeRe servoir.

In comments of designation of critical habitat for *Empidonax traillii extimus* submitted to FWS Arizona Ecological Services Office. June 13 (year?).

<u>Item M2—Mussetter studies of 2004</u>

The Report also cites to MEI's fluvial geomorphology study of the Verde River as follows: "As noted in the introduction, a companion study of fluvial geomorphology was conducted in association with this vegetation analysis (MEI 2004). In summary, the MEI report concludes:

- Bartlett and Horseshoe have caused little, if any, morphological or sedimentological adjustment of the Verde River.
- The changes in hydrology caused by the dams reduce the frequency of inundation and mobilization of sediments. The effect downstream of Horseshoe is less than the effect downstream of Bartlett because of the smaller capacity of Horseshoe.
- The reduction in frequency of flood events below Bartlett enables vegetation to become better established and withstand higher magnitude floods.
- Alternative reservoir operations, ranging up to the full release of flood flows, would have an insignificant effect on the duration of inundation and sediment mobilization on geomorphic surfaces.
- Changing reservoir operations would have little effect on the disturbance regime important for establishing and maintaining the health of riparian vegetation.
- Increased summer flows of 200 to 1,400 cfs below Bartlett may be responsible for supporting additional vegetation along the Verde River channel."

Report at p. ____

<u>Item M3—Graf study of 1999</u>

The Report also discusses an interesting hydrological analysis of the Verde River by Dr. Graf that was made before SRP established a minimum flow below Bartlett Dam:
"In 1999, Dr. William Graf prepared a paper on the fluvial hydrology of regulated rivers for incorporation into the Southwestern Willow Flycatcher Recovery Plan (FWS 2002, Appendix J). Dr. Graf used 1945-1991 gage data above and below the dams and 1904-1944 gage data at the lower gage location to evaluate the effects of storage and releases of water on Verde River flows. Major findings in the paper are:

- The dams created conditions of numerous periods of very low flow and no flow, which result in a loss of the surface water stream and less recharge to the alluvial aquifer.

- Larger “ordinary low flows” for most of the year provide ecological benefits by increasing ground water recharge and a larger surface water stream.
- Reduced mean annual peak flow and increased variability of annual peak flows have resulted in a smaller active channel.
- Fine sediment is stored behind the dams and is not deposited along the channel downstream resulting in poor substrate for cottonwood, willow and tamarisk.”

FWS (U.S. Fish and Wildlife Service). 2002. Southwestern willow flycatcher recovery plan. Albuquerque, NM.

Item M4—Mussetter Study of 2004

Finally, the Report also discusses an interesting fluvial geomorphology study of the Verde River:

Mussetter Engineering Inc. (MEI). 2004. Inundation and substrate stability study to support Verde River vegetation analysis, November 2003 Draft. Prepared for Salt River Project, Phoenix, Arizona. May 20, 2004.

“As noted in the introduction, a companion study of fluvial geomorphology was conducted in association with this vegetation analysis (MEI 2004). In summary, the MEI report concludes:

- Bartlett and Horseshoe have caused little, if any, morphological or sedimentological adjustment of the Verde River.
- The changes in hydrology caused by the dams reduce the frequency of inundation and mobilization of sediments. The effect downstream of Horseshoe is less than the effect downstream of Bartlett because of the smaller capacity of Horseshoe.
- The reduction in frequency of flood events below Bartlett enables vegetation to become better established and withstand higher magnitude floods.
- Alternative reservoir operations, ranging up to the full release of flood flows, would have an insignificant effect on the duration of inundation and sediment mobilization on geomorphic surfaces.
- Changing reservoir operations would have little effect on the disturbance regime important for establishing and maintaining the health of riparian vegetation.
- Increased summer flows of 200 to 1,400 cfs below Bartlett may be responsible for supporting additional vegetation along the Verde River channel.”

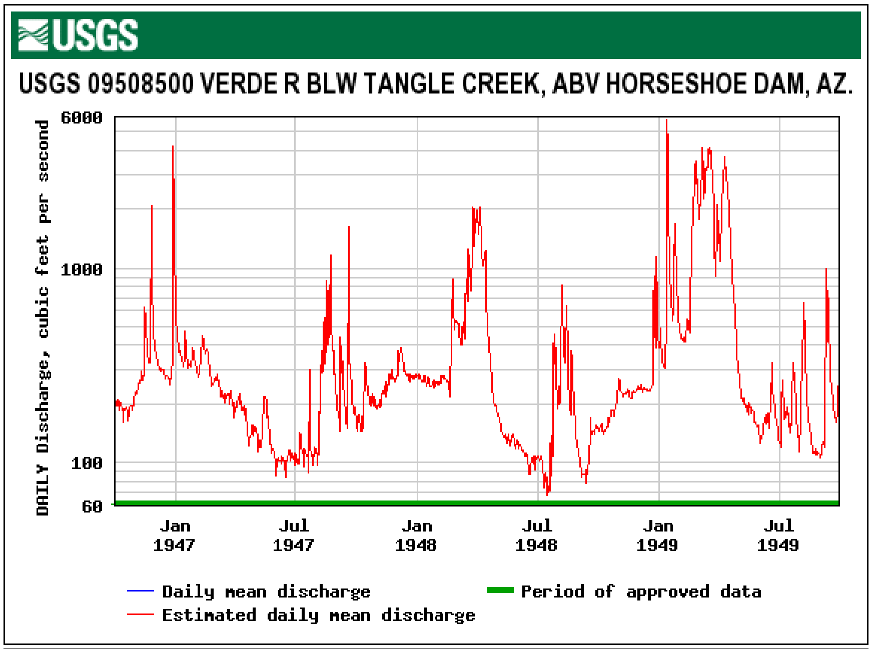
Item M5-- Conclusion

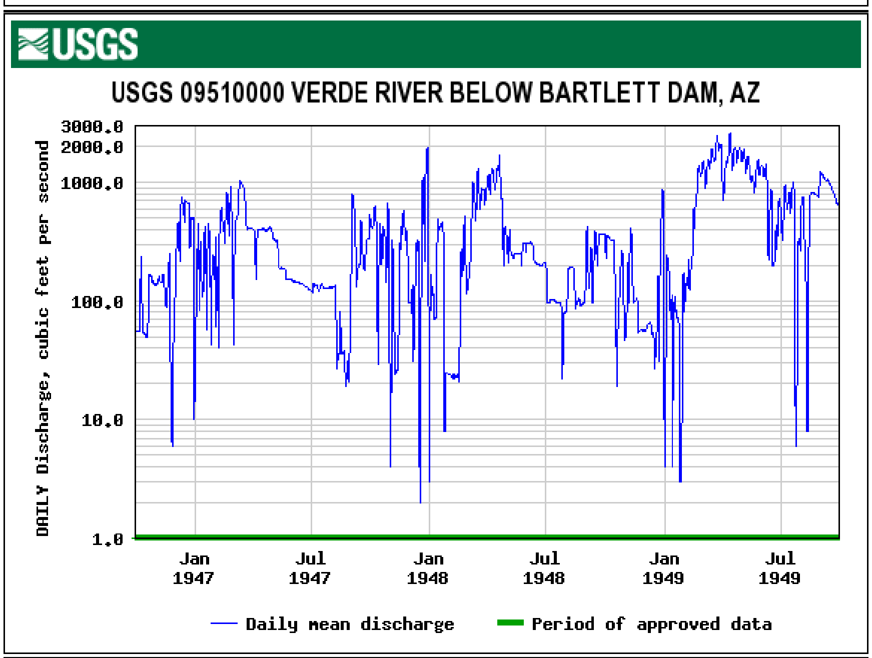
“Along the lower Verde River, the area covered by tall woody riparian vegetation is dynamic in both the regulated and unregulated reaches. In general, the acreage of tall woody vegetation has increased at all study sites since aerial photos first became available in 1934, prior to the construction of Bartlett and Horseshoe dams in the late 1930s and early 1940s. Some of this increase in tall woody vegetation may be due to invasion of tamarisk. Although the study was not designed to determine whether the reservoir or reservoir operations have a specific effect on cover of specific species such as tamarisk, long-term trends for native vegetation types for the study sites indicate that flow regulation has not had a significant adverse effect overall on establishment and maintenance of native tall woody vegetation stands. The slight increase in tall woody vegetation at the two regulated sites over the past 60 years suggests that the dams may have provided a slight long-term benefit to persistence of woody stands by reducing the frequency and magnitude of scouring. More recently, the minimum flow of 100 cfs below Bartlett since 1994 has likely benefitted tall woody vegetation downstream of the dam, including the Box Bar Ranch study site. Prior to 1994, the lower Verde would occasionally have no flow, which could cause phreatophytes to become stressed or die, depending on the duration that the stream did not run.

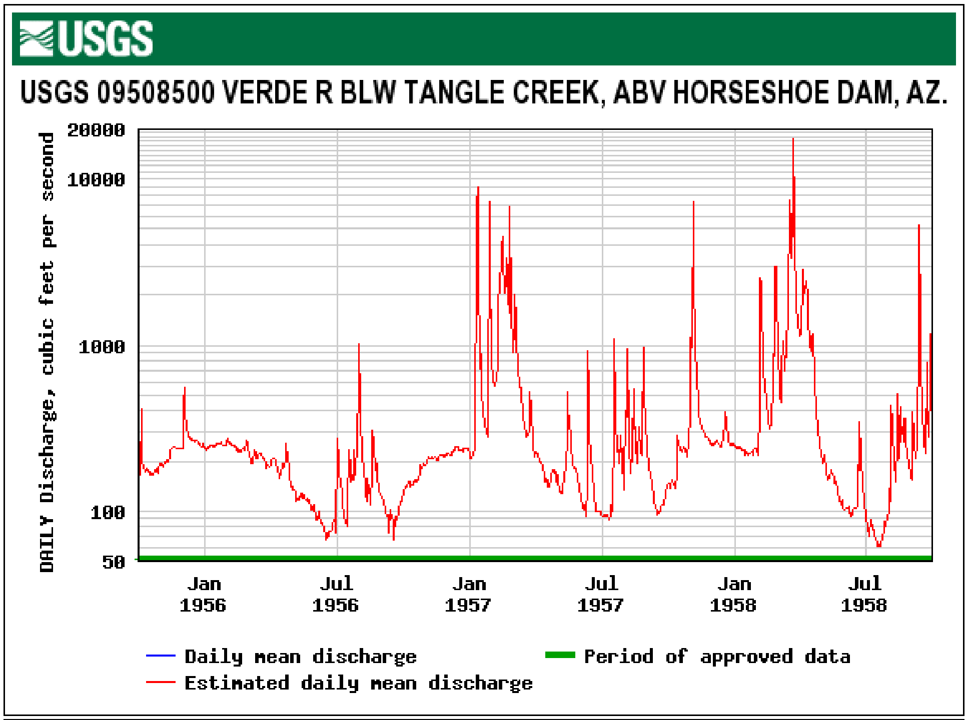
The findings of the vegetation study are consistent with the findings of the fluvial morphology study conducted by MEI (2004). The fluvial geomorphology study concluded that alternate reservoir operations ranging up to the full release of flood flows would have an insignificant effect on the duration of inundation and sediment mobilization on geomorphic surfaces, that Bartlett and Horseshoe operations have caused little, if any, morphological or sedimentological adjustment of the Verde River, and that the reduction in frequency of flood events below Bartlett Reservoir enables vegetation to become better established and withstand higher magnitude floods (MEI 2004).”

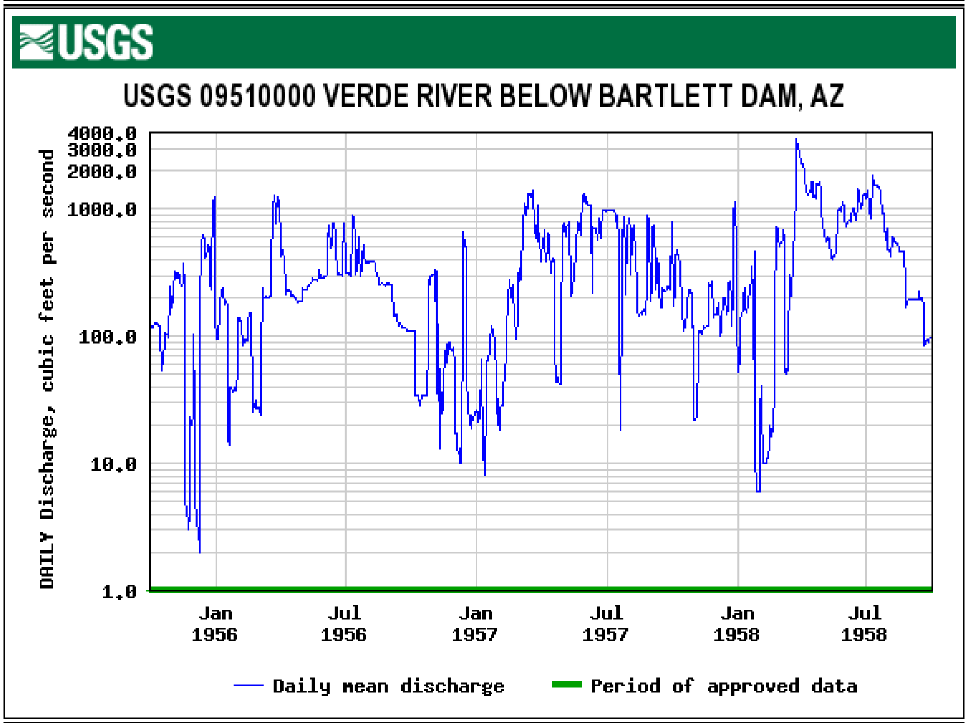
Item M6—Inflow (above Horseshoe) and outflow (below Bartlett) hydrographs

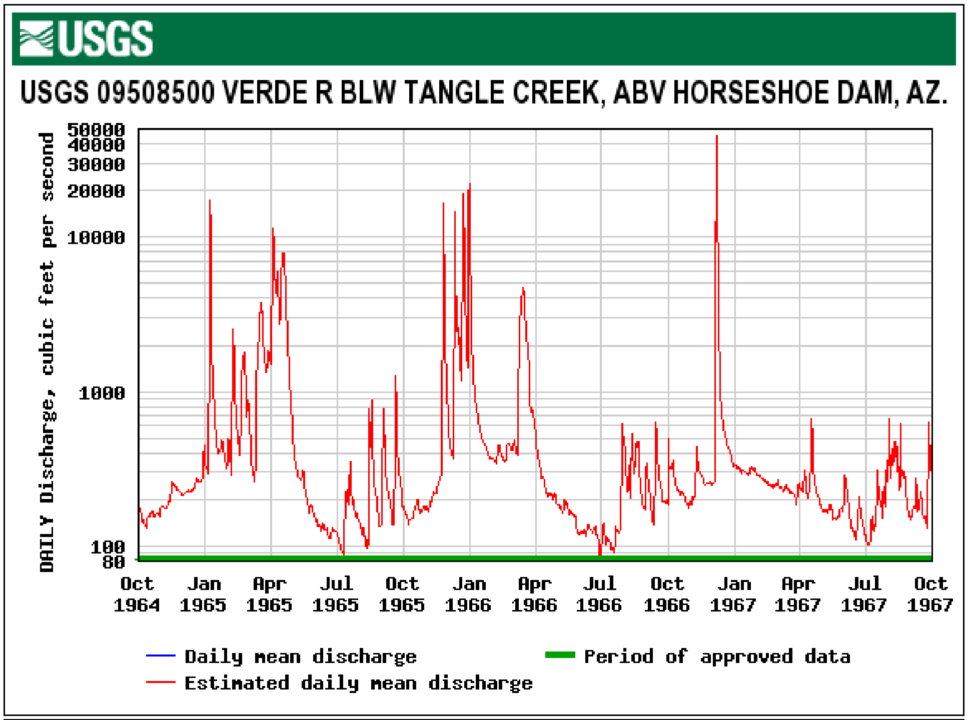
As noted earlier, the inflow hydrograph is substantially different than the outflow hydrograph based on simple visual comparison.

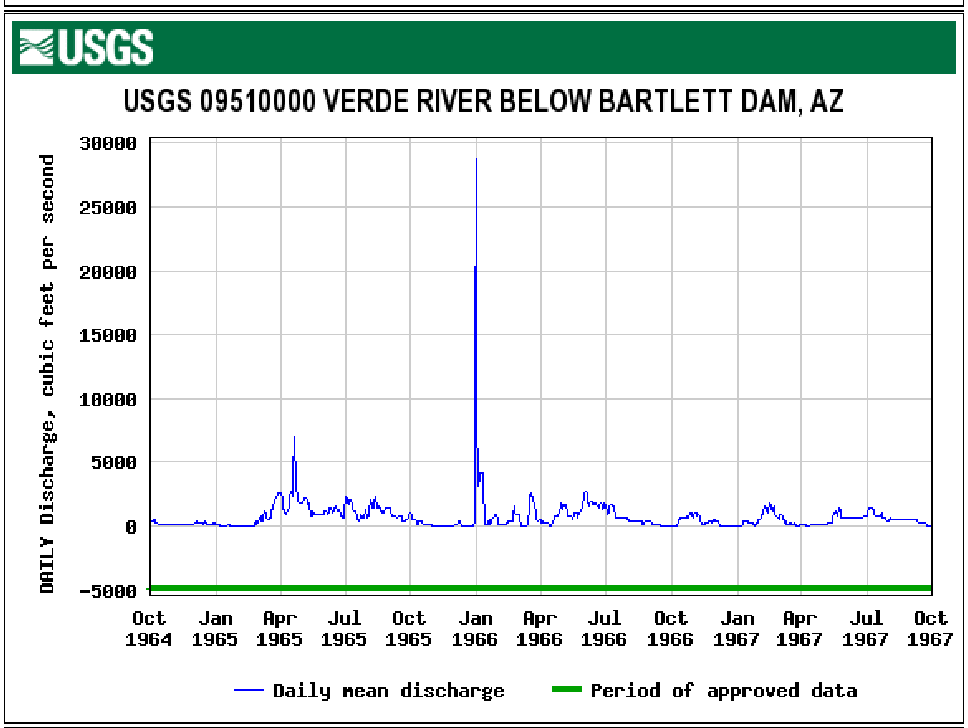


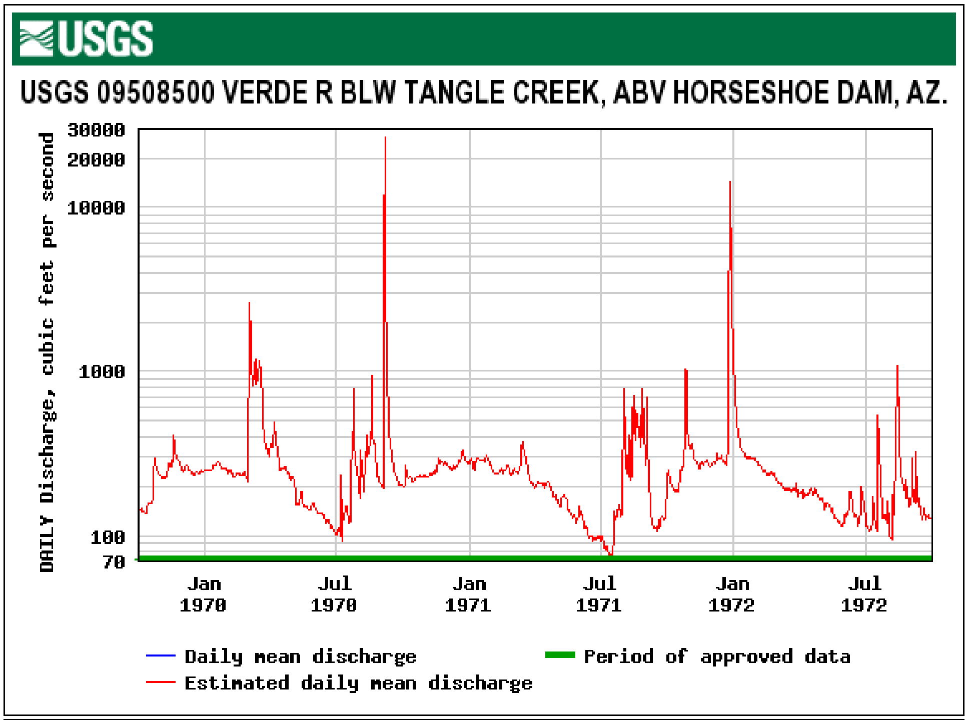


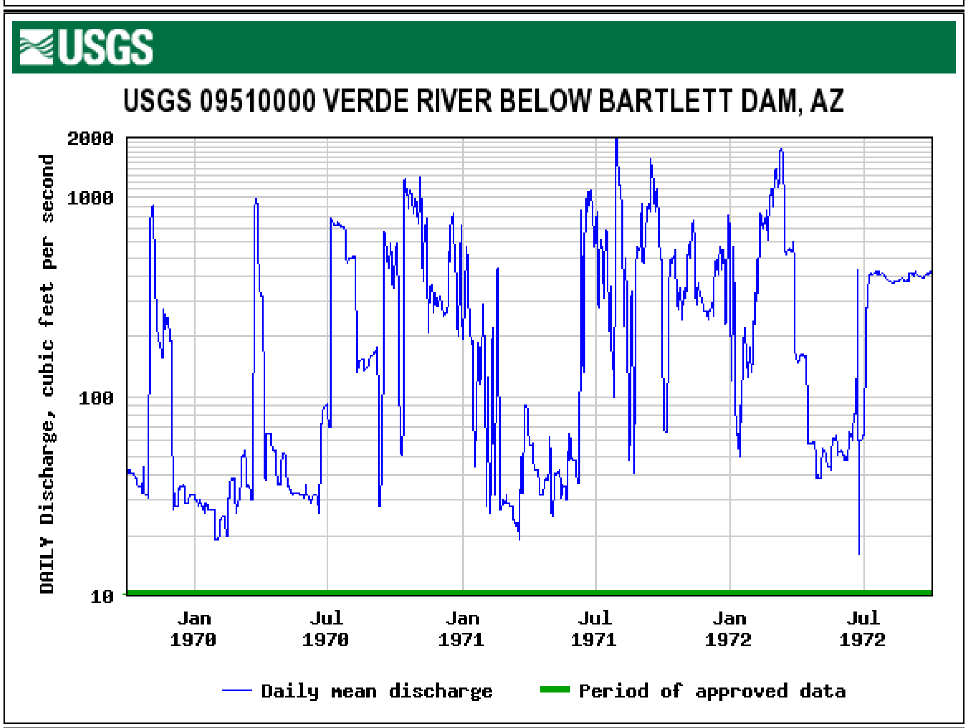

USGS
USGS 09508500 VERDE R BLW TANGLE CREEK, ABV HORSESHOE DAM, AZ.
DAILY Discharge, cubic feet per second
20000
10000
1000
100
50
Jan 1956
Jul 1956
Jan 1957
Jul 1957
Jan 1958
Jul 1958
Daily mean discharge
Period of approved data
Estimated daily mean discharge

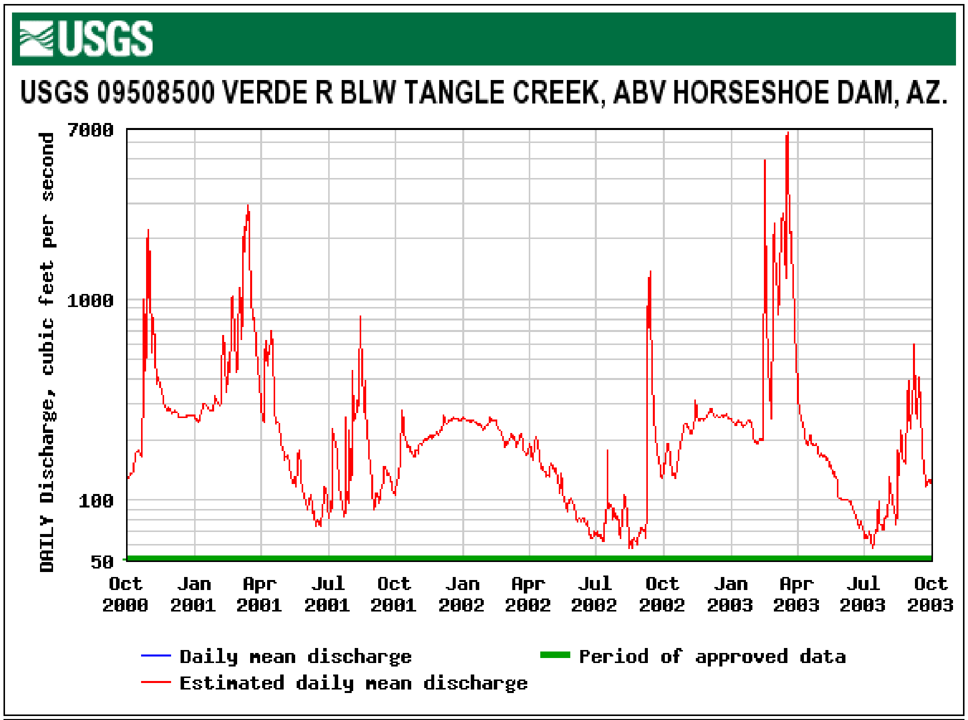

USGS
USGS 09510000 VERDE RIVER BELOW BARTLETT DAM, AZ
DAILY Discharge, cubic feet per second
4000.0
3000.0
2000.0
1000.0
100.0
10.0
1.0
Jan 1956
Jul 1956
Jan 1957
Jul 1957
Jan 1958
Jul 1958
Daily mean discharge
Period of approved data

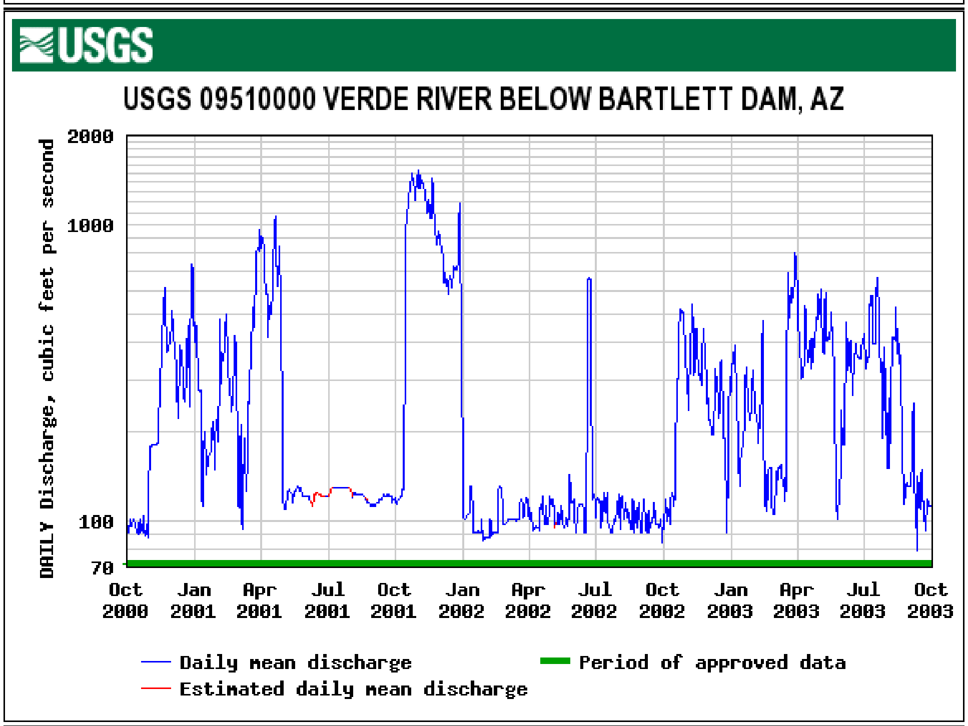

USGS
USGS 09508500 VERDE R BLW TANGLE CREEK, ABV HORSESHOE DAM, AZ.
DAILY Discharge, cubic feet per second
50000
40000
30000
20000
10000
1000
100
80
Oct 1964
Jan 1965
Apr 1965
Jul 1965
Oct 1965
Jan 1966
Apr 1966
Jul 1966
Oct 1966
Jan 1967
Apr 1967
Jul 1967
Oct 1967
Daily mean discharge
Period of approved data
Estimated daily mean discharge


USGS
USGS 09510000 VERDE RIVER BELOW BARTLETT DAM, AZ
DAILY Discharge, cubic feet per second
30000
25000
20000
15000
10000
5000
0
-5000
Oct 1964
Jan 1965
Apr 1965
Jul 1965
Oct 1965
Jan 1966
Apr 1966
Jul 1966
Oct 1966
Jan 1967
Apr 1967
Jul 1967
Oct 1967
Daily mean discharge
Period of approved data


USGS
USGS 09508500 VERDE R BLW TANGLE CREEK, ABV HORSESHOE DAM, AZ.
DAILY Discharge, cubic feet per second
30000
20000
10000
1000
100
70
Jan 1970
Jul 1970
Jan 1971
Jul 1971
Jan 1972
Jul 1972
Daily mean discharge
Period of approved data
Estimated daily mean discharge


USGS
USGS 09510000 VERDE RIVER BELOW BARTLETT DAM, AZ
DAILY Discharge, cubic feet per second
2000
1000
100
10
Jan 1970
Jul 1970
Jan 1971
Jul 1971
Jan 1972
Jul 1972
Daily mean discharge
Period of approved data


USGS
USGS 09508500 VERDE R BLW TANGLE CREEK, ABV HORSESHOE DAM, AZ.
DAILY Discharge, cubic feet per second
7000
1000
100
50
Oct 2000
Jan 2001
Apr 2001
Jul 2001
Oct 2001
Jan 2002
Apr 2002
Jul 2002
Oct 2002
Jan 2003
Apr 2003
Jul 2003
Oct 2003
Daily mean discharge
Period of approved data
Estimated daily mean discharge


USGS
USGS 09510000 VERDE RIVER BELOW BARTLETT DAM, AZ
DAILY Discharge, cubic feet per second
2000
1000
100
70
Oct 2000
Jan 2001
Apr 2001
Jul 2001
Oct 2001
Jan 2002
Apr 2002
Jul 2002
Oct 2002
Jan 2003
Apr 2003
Jul 2003
Oct 2003
Daily mean discharge
Period of approved data
Estimated daily mean discharge