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BEFORE THE ARIZONA NAVIGABLE STREAM ADJUDICATION COMMISSION

IN RE DETERMINATION OF THE NAVIGABILITY OF THE GILA RIVER, FROM THE NEW MEXICO BORDER TO THE CONFLUENCE WITH THE COLORADO RIVER	No. 03-007-NAV (Gila) **GILA RIVER INDIAN COMMUNITY'S SECOND SUPPLEMENTAL SUBMISSION**

The Gila River Indian Community hereby submits the following attached materials.

DATED this 13th day of August, 2014.

GILA RIVER INDIAN COMMUNITY

By _____
Thomas L. Murphy

FILED on the 13th day of August, 2014 with:

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Supplemental Information concerning Navigability of the Gila River

by

T. Allen J. Gookin, P.E., R.L.S., P.H., S.W.R.S.

In my testimony there were several points where the questions and/or my answers require follow up. These are discussed below. Several documents are also disclosed.

Pinkerton Report on Canoeing. As pointed out at page 789 of my cross-examination I had mixed up canoe depth with required water depth. As a result of that mistake the estimated of required water depth to float the canoe according to the Pinkerton Report should be about 8 inches less than indicated in my report. This is assuming a 6" freeboard plus the Army Corps Engineers. However, even with modern canoes, two feet of depth is required for paddling. (Cortell, Vol 1 pg 14). Further, the overall ability to canoe improves "markedly" above two feet. (Cortell, Vol 1 pg 23).

Manning's "n". In my testimony at page 765, based upon my disclosure, I indicated that the Manning's "n" should have been 0.022 instead of 0.020. Attached is the new table V-3 showing the proper elevations for that correction. In rereading the Simons and Li Report I realize that the 0.020 is probably the more accurate value for the low flows and would transition to 0.022 as ordinary flow increases. Exactly when that transition would occur would require too many unknown variables to realistically calculate. Although I now understand why I used 0.020, it is more conservative to use the 0.022 value.

Rating Curve. Two issues were brought up concerning my use of the rating curve. One related to whether or not I had included the data from 1915. The second concerned my decision not to split the data into two sets to conform to the Measurement numbers restarting from 1 in the data set acquired from the USGS. Concerning the data from 1915, I did not include the data, due to the 1915 flood events that I reference in chapter II. I failed to correct the year listed at page 11 of chapter V. Concerning the issue of starting a new rating curve, I chose not to due to the short period of record (i.e. between the beginning of the measurements and the first major flood afterwards). However, I did redo the plot showing both curves. These are contained in this disclosure.

Beaver. At pages 973-975, I was requested to provide references concerning beaver dams. The ANSAC website under the San Pedro River exhibits contains two versions of Exhibit 8. The second version has my Appendices attached. The quotations are in Appendix A beginning at page 9. The full citations for those quotations are in Appendix B. In most cases the website is provided or another easy means of acquisition is referenced. Sources that were more difficult to acquire are included in the second Exhibit 8 after Appendix C.

Chapter V Footnote 27. At page 996 of my testimony, I was requested to verify the source for footnote 27 of chapter V in my Report. The reference should have been to the 1993 Fuller Report on the San Pedro River (Old Exhibit 016SanPedro.pdf) at pages 5-8 and 5-9.

Canoes. Included are several documents relating to boats and canoes and some of the changes that have occurred over time.

Cross-Sections. Included are the portions of the maps relating to the two cross-sections I used in my Reach 6 analysis.

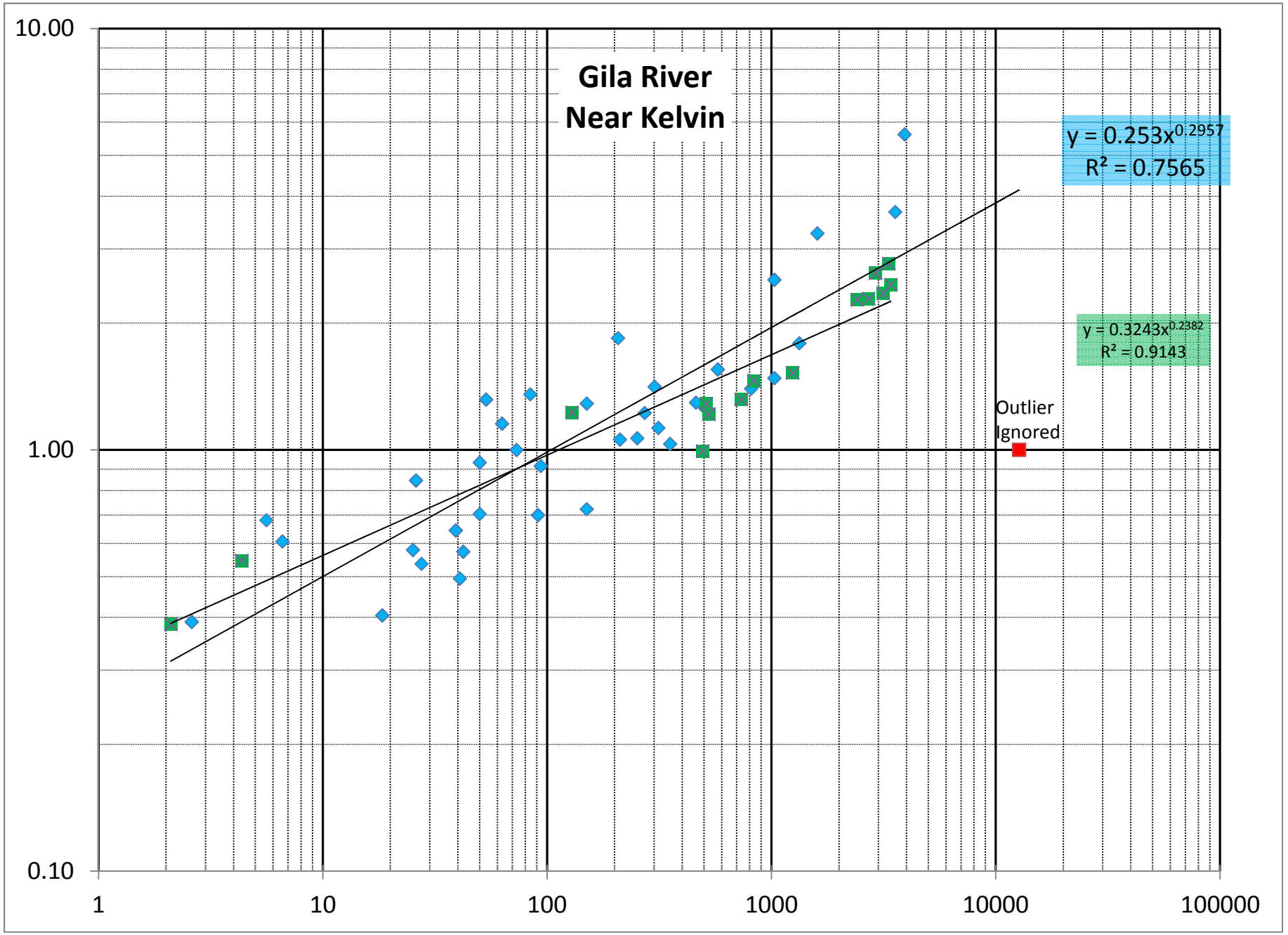
For Manning's "n"=.022

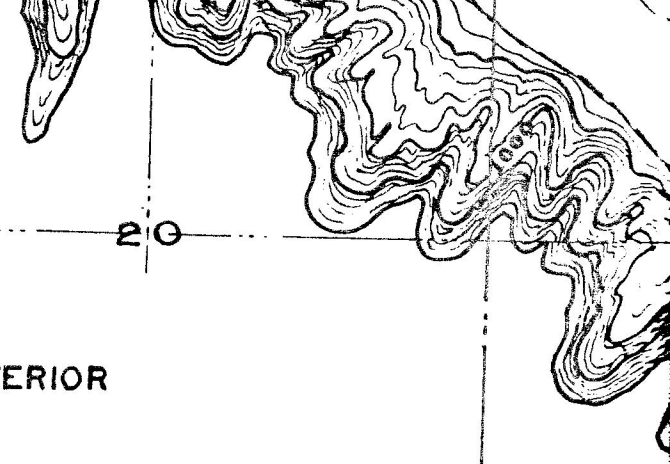
Summary			
	Below Kelvin	Above confluence	Units
Mean Flow	755	637	CFS
Depth	0.73	0.97**	Feet
Velocity	1.27	1.17**	Ft/Sec
Median Flow	345	193	CFS
Depth	0.57	0.76	Feet
Velocity	0.95	0.72	Ft/Sec
Low Flow	175	23*	CFS
Depth	0.45	0.26	Feet
Velocity	0.73	0.33	Ft/Sec

*Flow is questionable (See Text)

** Initial run had not closed properly.

Figure V-3


Gila River
Near Kelvin
y = 0.253x^0.2957
R² = 0.7565
y = 0.3243x^0.2382
R² = 0.9143
Outlier
Ignored
10.00
1.00
0.10
1
10
100
1000
10000
100000



19 20

DEPARTMENT OF THE INTERIOR
U.S. INDIAN SERVICE
IRRIGATION

GILA RIVER SURVEY

SHEET No. 16-17-18 DISTRICT No. 4

Ts. 1 N. & 1 S., R. 1 E. G. & S. R. B. & M.

MARICOPA COUNTY
ARIZONA

PLANE TABLE TOPOGRAPHIC SURVEY
SHOWING
IRRIGATED AND IRRIGABLE LANDS UNDER
DITCHES TAKING WATER FROM GILA RIVER
Scale 1" = 1000'
Contour Interval 5 ft. U.S.G.S. Datum.
Surveyed-May-June, 1914

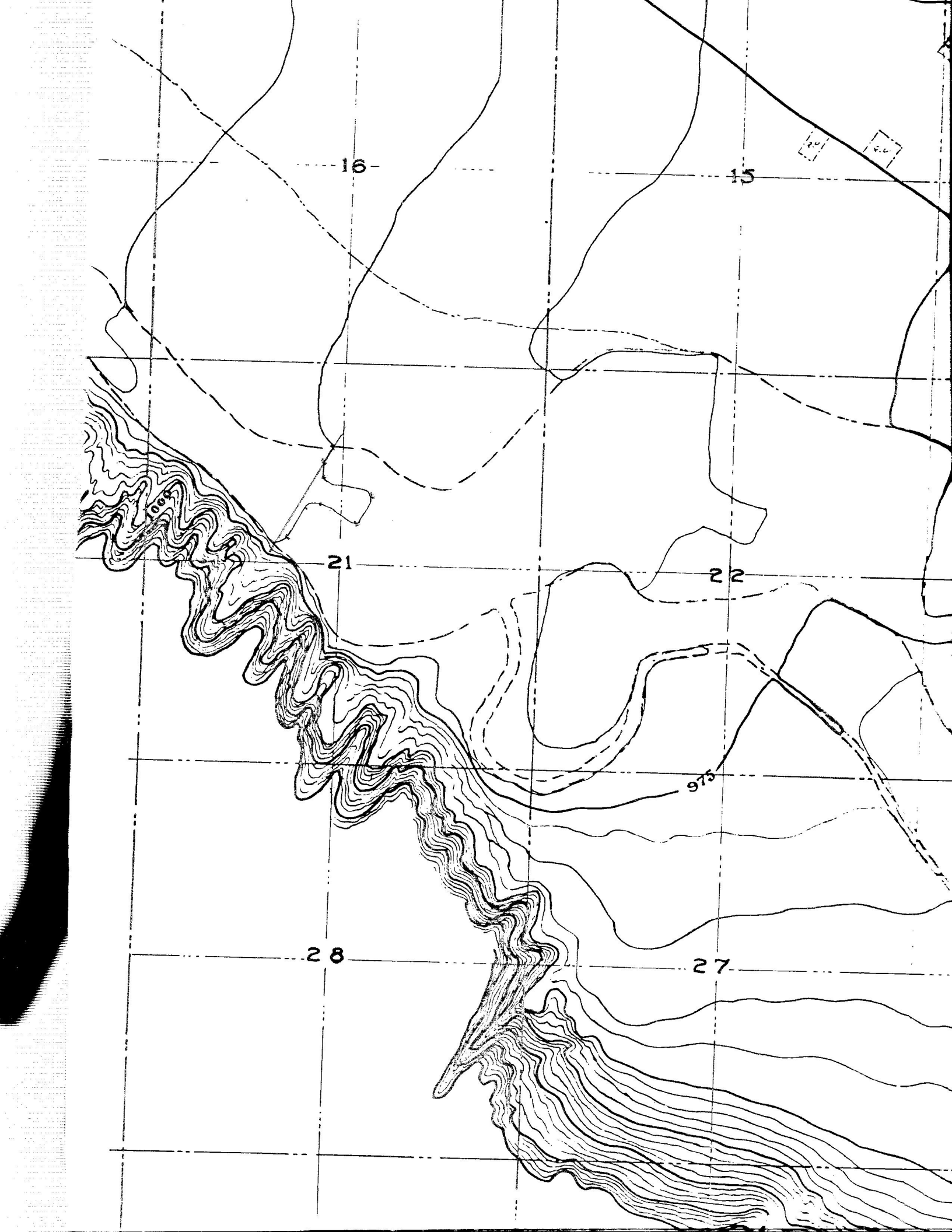
Scale 1/12000

1000 0 1000 2000 3000 4000 5000 6000 feet.

LEGEND

ROAD
FORD
TRAIL
TELEGRAPH OR TELEPHONE LINE
TOWNSHIP LINE
SECTION "
SUB-DIVISION "
FENCE "
BOUNDARIES OF CULTIVATED AREAS
" " IRRIGABLE "
" " LANDS IRRIGATED BY PUMPS
" " " " " TRIBUTARY STREAMS
" " " " " BOTH UPPER & ADJACENT DITCHES
" " " LOCATED UNDER ONE DITCH BUT IRRIGATED BY DITCH ABOVE BY MEANS OF FLUME, ETC.
PRESENT CANALS
PREVIOUS "
RIVER BANKS
DAMS
RAILROAD TRACK SINGLE
RAILROAD " DOUBLE
INDIAN TEEPEES OR HUTS
TRIANGULATION STATION
WELL
WIND MILL
FLUMES
SYPHONS
CULVERTS
HEAD-GATE
SPRING

A - Alfalfa
B Beans
C Corn
Co. Cotton
G Grain
Gd Garden
H Hay, Grass
P Pasture
Pl. Plowed
PC. Previous Culture
O Orchard
N.C. Not cultivated with no evidence of previous culture


16
15
21
22
975
28
27

DEPARTMENT OF THE INTERIOR

U.S. INDIAN SERVICE

IRRIGATION

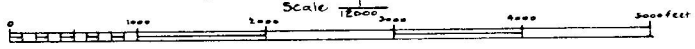
GILA RIVER SURVEY

SHEET No. 2-3- GILA RIVER INDIAN RESERVATION

T. 4 S., R. 7 E. G. & S. R. B. & M.

PINAL COUNTY
ARIZONA

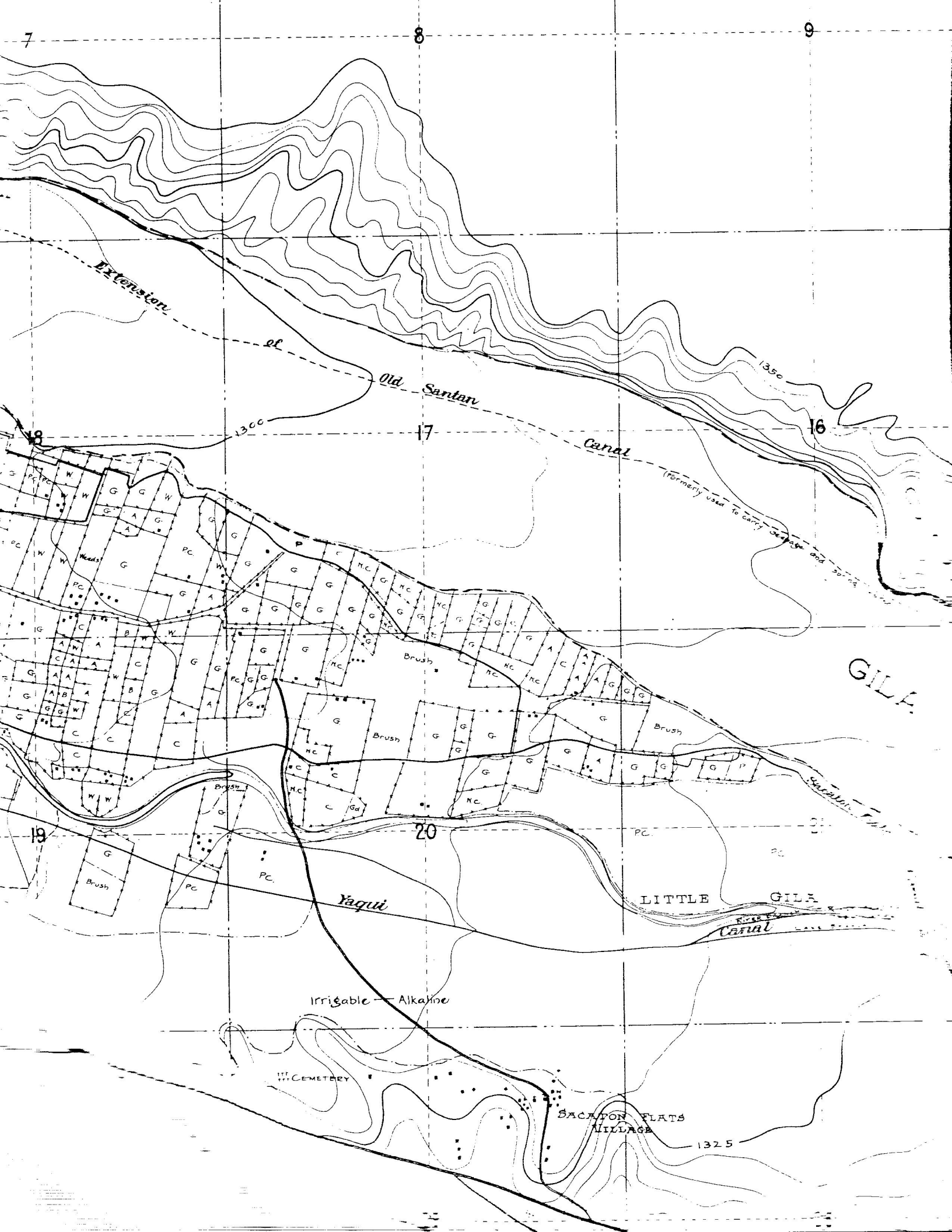
PLANE TABLE TOPOGRAPHIC SURVEY
SHOWING
IRRIGATED AND IRRIGABLE LANDS UNDER
DITCHES TAKING WATER FROM GILA RIVER
Scale 1" = 1000'
Contour Interval 5 ft. - U.S.G.S. Datum
Surveyed 1914.



LEGEND

ROAD
FORD
TRAIL
TELEGRAPH OR TELEPHONE LINE
TOWNSHIP LINE
SECTION "
SUB-DIVISION "
FENCE "
BOUNDARIES OF CULTIVATED AREAS
" " IRRIGABLE "
" " LANDS IRRIGATED BY PUMPS
" " " " TRIBUTARY STREAMS
" " " " BOTH UPPER & ADJACENT DITCHES
" " " LOCATED UNDER ONE DITCH BUT IRRIGATED
BY DITCH ABOVE BY MEANS OF FLUME, ETC.
PRESENT CANALS
PREVIOUS "
RIVER BANKS
DAMS
RAILROAD TRACK SINGLE
" " DOUBLE
INDIAN TEEPEES OR HUTS
TRIANGULATION STATION
WELL
WIND MILL
FLUMES
SYPHONS
CULVERTS
HEAD-GATE
SPRING

A Alfalfa
B Beans
C Corn
Cf. Cotton
G Grain
Gd Garden
H Hay, Grass
P Pasture
Pl. Plowed
Rc. Previous culture
O Orchard
NC. Not cultivated, with no evidence of previous culture.


7
8
9
Extension of Old Santan Canal
(Formerly used to carry Seepage and Storm
1350
1300
18
17
16
Weeds
Brush
GILA
19
20
Yaqui
LITTLE GILA
Canal
Irrigable — Alkaline
CEMETERY
SACATON FLATS VILLAGE
1325

STEALING THE GILA

The Pima Agricultural Economy and Water Deprivation, 1848-1921

David H. DeJong

STEALING THE GILA

The Pima Agricultural Economy and Water Deprivation, 1848-1921

David H. DeJong

The University of Arizona Press Tucson

CHAPTER 2

The Pima Villages and California Emigrants

THE DISCOVERY OF GOLD near Sutter's Mill, California, in 1848, spawned a torrent of migration across northern Sonora, Mexico (modern southern Arizona), with forty thousand emigrants traveling over the four southern trails that converged at the Pima villages. Some eight thousand, mostly Mexican, emigrants journeyed across the Sonoran Desert between April 1848 and January 1849, with twenty thousand emigrants taking one of the southern routes in 1849. These travelers were aware the Pima villages were respites where stock could be recruited, rest assured, food and forage obtained, and protection from marauding tribes secured. Emigrant Robert Green spoke for many when he wrote, "We are all talking strongly of being compelled to eat mule beef on the road as we wont [*sic*] be able to get any provision until we get among the Peima Indians." Louisiana Strentzel, one of the few women on the trail, credited the Pima with the success of her party. "Had it not been for this water, the muskite [mesquite] beans, and the corn at the Pimose village, not one wagon could have come through."[1]

Personal recollections of the forty-niners visiting the Pima villages reveal much more than accounts of half-starved, thirst-craved emigrants in need of food, water, and hospitality. While the journals describe the villages as the last opportunities emigrants had to purchase fresh food and find good forage for their animals before arriving in California, they also provide a window into the economic output of the Pima. While the emigrants contemplated their visit to the villages, the Pima, with little foreknowledge of the torrent of emigrants heading their way, supplied the requisite food for the travelers, a testimony of their agricultural ability.[2]

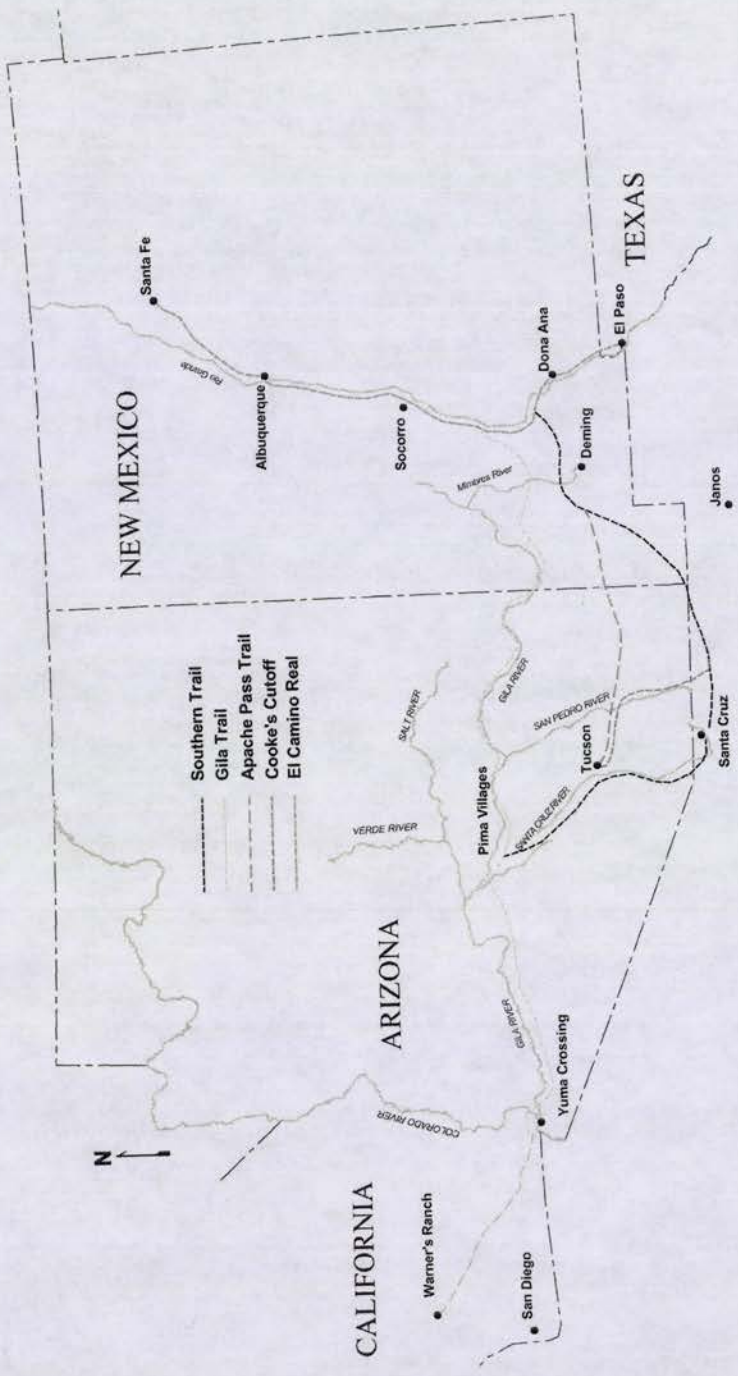
Using as guidebooks the journals of topographical engineer Lieutenant William H. Emory and Colonel Philip St. George Cooke, tens of

thousands of emigrants anticipated their visit to the Pima villages. Here they could acquire food and receive a friendly reception, something they would not have enjoyed since leaving Mexican towns and villages along the Rio Grande and in the upper Santa Cruz River valley. For these travelers, the Pima villages represented an oasis where weary souls could be restored.[3]

Two main southern trails converged at the Pima villages. The more difficult was the Gila Trail, which entered the villages from the east. The more frequently traveled route was the Southern Trail, which left El Camino Real near Doña Ana, New Mexico, and followed a southwesterly direction to the Santa Cruz River valley, whence it turned north into Tucson and then northwest to the Pima villages (see map 2.1). East of the villages, the Southern Trail converged with the Gila Trail and continued down the Gila River to the confluence with the Colorado River near Yuma Crossing.[4]

One of the most difficult parts of the journey for emigrants on the Southern Trail was the *jornada* between Tucson and the Pima villages. It was regarding this portion of the trail that a group of Missouri emigrants "heard awful tales of the route ahead of us, dead animals strewing the road, wagons forsaken, human skeletons, who had famished for want of water."[5] Understanding these difficulties places into perspective the feelings of exhilaration and relief travelers experienced upon reaching the Pima villages. The ninety miles of dry, barren desert represented a challenging test for emigrants en route to California.[6]

An ambitious emigrant party traveling under ideal circumstances could complete the trip from Tucson to the Pima villages in thirty-six hours, although most took between two and six days. While scores of travelers suffered from thirst and dust, there was reason for optimism if emigrants could get within fifty miles of the villages. As the stream of travelers grew to a torrent, and as more suffered from thirst and heat, young Pima men patrolling the desert south and east of the Pima villages began searching for travelers in distress. Seizing an opportunity to improve their economic well-being by providing water to thirsty travelers earned the Pima the reputation as "Good Samaritans of the desert." Carrying "gourds of water, roasted pumpkins, and green corn," Pima men and women encouraged emigrants and advertised their products to travelers in distress.[7]



MAP 2.1. Southern gold trails through the Pima villages, 1849–1852.

The Gila River represented more than just water for parched and famished emigrants. The Pima welcomed the travelers to their riverine villages, "shaking hands as old friends when meeting [as if] being separated for years."[8] The agrarian villages also meant food and forage could be acquired and, consequently, symbolized a sustaining force for man and beast. Plenty of good-tasting water was available and could be packed for the journey across the challenging "Forty-Mile Desert," as the cutoff between the Pima villages and the Gila bend was referred to.[9]

The Gila River, and the Pima villages twelve miles downstream from where the main emigrant road obliquely struck the river, was easily identified due to the gallery of cottonwood, willow, and mesquite that graced its banks. It was "really a beautiful stream, flowing clear & rapidly," Green wrote, allowing us to "quench our rageing thirst."[10] Robert Eccleston, traveling to the villages via Tucson, observed: "It was not long before the road came close to the long-looked-for [Little] Gila. I rode in to see it,

FIGURE 2.1. The Gila River represented rest and recruitment for emigrants. (Photograph by author, 2003)

as the cottonwood, willow, &., obstruct[ed] the view, and found a swift stream about 40 ft. wide, not as clear as I expected to see it, but perhaps this may have been caused by the late rain." One emigrant noted his party paid a Pima guide $10 "to conduct us to the river Gila."[11]

The middle Gila through the heart of the villages was an oasis in the desert and dotted with a series of springs and marshes. John James Audubon noted "a great many lagoons" and an abundance of water and trees along the river, with the cienegas sustaining colonies of birds, ducks, geese, swans, cranes, and quail.[12] Some cienegas were fed by springs and were used by the Pima to irrigate farmland. At least three natural springs, including Blackwater slough east of the villages, were fed by underground water sources. Springs near Maricopa Wells supplied water for crops in addition to providing wildlife habitat.[13]

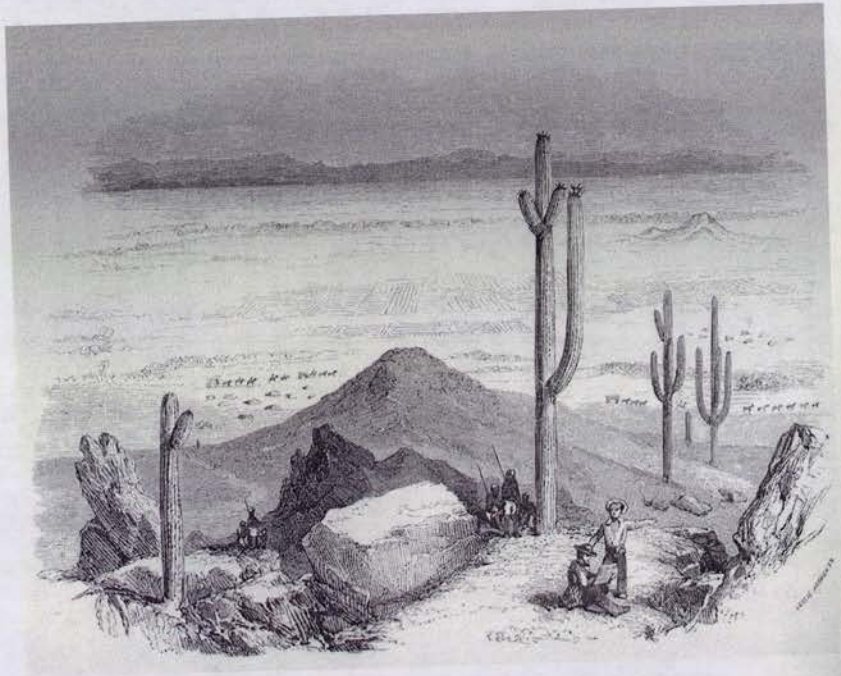


FIGURE 2.2. A view of the Pima villages and fields in the 1850s, looking north. (John Russell Bartlett print, 1852; Bartlett, *Personal Narrative*, 1854, 2:14)

Cave Couts, traversing through the villages in November 1848, described the bottomlands along the river as "far surpass[ing] anything we have ever witnessed for fertility" and hosting "a series of the finest fields" he had ever seen.[14] Emigrant Asa Clarke estimated fields extending along the river for at least five miles, being "laid out in little squares, with sluices in between, to admit the water."[15] One emigrant described "nearly a thousand separate [fields]."[16]

Free to adopt those forms of technology they believed would enhance their economy, the Pima accepted select foreign ideas and tools that correlated with their agricultural values. Economic ventures such as mineral exploitation and sheep raising (Spanish ventures) were rejected. Adoption of Spanish and American tools that facilitated agriculture, however, was coveted. This, in turn, increased agricultural output, fostering a Pima strategy of military preparedness, which enabled them to increase their productivity and position themselves as market players on the Gila and Southern trails.

The Pima used a sophisticated water distribution system and strict social controls to irrigate their lands and ensure the continuation of their economy. Emigrant Benjamin Hayes observed individual Indians "have regular days of work to which they were assigned," with each village under a captain.[17] Committees were set up in three zones along the river to manage the irrigation system, and "there were certain people in each village who decided how each ditch was to be handled," as well as to determine who was to get water. Brush dams diverted water at various points along the river into a series of acequias centered in the Vah ki (Casa Blanca) area.[18] The cooperative distribution of water enabled acequias to serve a "half a dozen fields, giving off branches to each."[19] The Pima drained their fields of excess water, a measure vital to prevent waterlogging and ensure the leaching of salts from the soil. Such processes also deposited fertilizing silt over the land, helping maintain its productivity.[20]

Because of a good supply of water, a high water table, and a fertile soil, the Pima initially did not use ploughs in cultivating their fields, using handmade wooden axes, hoes, and harrows on the "rich and easily worked" soil. Sergeant Daniel Tyler observed the Pima used "only forked sticks . . . to loosen the soil, as it was loose, rich and easily worked."[21] Other emigrants agreed agricultural implements were unnecessary as the

"soil is so easily pulverized that ploughs are not needed." Simple tools such as "a stick of wood for a plow, brush for a harrow, and a stone Muller for a Mill" served the Pima well. While utilizing simple technology, Pima fields were systematically prepared before they were planted and irrigated. Nonetheless, having seen the Americans and Mexicans use modern equipment, the Pima desired to acquire such implements so they could culivate their land more efficiently and effectively and expand production, especially seeking tools from military officials who might have the authority to fill such requests. When Major Lawrence P. Graham passed through the villages from the west in 1848, the Pima asked for "a thousand or two spades, so they might have a great deal of corn for the next time white men came along."[22]

By 1850, change was afoot in the Pima mode of farming. Having learned of them from the Mexicans, the Pima used wooden ploughs, although they lacked a sufficient number of draught animals with which to utilize such implements. While the Pima had good horses, mules and oxen were in short supply. And while a horse might be purchased from the Pima at a high price, mules and oxen were rarely sold, demonstrating the Pima needed these animals in their expanding agricultural endeavors. "Being an agricultural people," emigrant William Chamberlin wrote, "they require what few animals they have for that purpose."[23] In December 1849, Benjamin Hayes noted the Pima had "no good animals to trade," and John Russell Bartlett, entering the villages as part of the U.S.-Mexico boundary survey in 1852, wrote it was "impossible to procure a single mule."[24] William Hunter, however, noted Pima Chief Antonio Culo Azul told him he "could procure from his people whatever we stood in need of," going so far as to indicate the Pima had "plenty of horses, mules and oxen," which it turned out they did not have.[25] What few draught animals the Pima had were carefully guarded because of their desire to increase their economic output.

The Pima occasionally made use of Mexican ploughs. One emigrant noted oxen were used to pull "a long hooked-shaped stick used as a plough."[26] Metal axes and hoes were used more frequently, being acquired via trade for food and forage. According to emigrant William Goulding, the Pima were using oxen to plough their land. Hayes also noted the "Pimos ploughing their lands." Bartlett noted not all land was yet ploughed by draught animals, implying the Pima used ox-driven

ploughs to break new land for cultivation of additional crops to market to emigrants on the western trails.[27] Nonetheless, the Pima did not yet have access to the art of blacksmithing, a skill central to keeping American ploughs and iron tools in good repair.[28]

Emigrants, especially if they carried Robert Creuzbaur's 1849 guide to California or were familiar with Emory's and Cooke's journals, were quick to note the Pima were "all that Colonel Emory has described them—peaceable, quiet, and honest Indians, and possessing considerable intelligence."[29] Benjamin Butler Harris was so struck by their integrity that he opined Americans could learn a lesson from them. "Finding a heathen people so kind, good, sympathetic, simple, honest and hospitable," Harris chronicled, "was indeed a surprise well worth all the toil and privation of the trip, and calculated to make Christianity blush for its meager attainments." In an April 15, 1850, letter to his sister, W. Wilberforce Alexander Ramsey observed the Pima "have the character of being the most honest and virtuous tribe in the West. . . . They are peaceful and never disturb the emigrant."[30] Anxious to exchange food for cloth, tools, and coin, the "Pimos came out to the road to see us," one emigrant chronicled. Another noted the Pima greeted the emigrants by "bringing flour[,] corn meal[,] watermellons [*sic*] &c." to trade.[31]

Since the Gila and Southern trails entered the Pima villages above the Maricopa settlements, the Pima had an advantage over the Maricopa. As thirsty emigrants came down the Southern Trail from Tucson, many were disoriented, were suffering from heatstroke, or were separated from their company. While the Pima assisted emigrants back to their villages to convalesce, they also rounded up stray animals, restored their health, and sold them back to the emigrants. One emigrant noted he met two Pima men in the desert searching for "horses and mules to exchange with the American emigrants."[32] Another observed the Pima rounding up "broken down or abandoned stock" and bringing them to the villages.[33] When one traveler lost a horse in the desert, a young Pima man rode twenty-five miles south searching for it, returning two days later with the horse.[34]

Hospitality was demonstrated by permitting emigrants to recruit their stock on the limited grasslands near the villages. One emigrant explained how his party remained among the Pima "several days for the purpose of recruiting our stock." A party of Texas Argonauts spent thirteen days at

the Pima villages, with one group of weary Texans remaining in the villages for five weeks.[35] When emigrant parties arrived, they were encouraged by the Pima to "dispense with the custody of [their] horses" to be "grazed and herded at good pasture at a distance of two or three miles" from the villages. While there was little forage available en route to the villages and a limited supply near the villages along the river, grasslands did exist in several locations away from the main road along ephemeral water channels. These grasslands restored many an animal.[36]

As head Pima chief, Antonio Culo Azul was justly proud of his people's reputation among the emigrants, as shown by his display of their letters of commendation. Although none of these letters are known to have survived, a number of them are referenced in emigrant journals. Cave Couts records Azul showed "passports," or letters of commendation, from a host of emigrants, including Stephen Watts Kearny. Hayes wrote Azul showed him "an imposing array of certificates of good behavior from emigrants." The New York Free Mill Party commended the chief for "the Pimos being very friendly & accommodating." A traveler from Tennessee applauded the Pima's "kindness and courtesy." The Fremont Association of New York left a letter extolling the kind treatment received from the Pima. John Audubon wrote that Azul, as was his custom, came out to meet the emigrants and presented them with an array of letters "recommending him as honest, kind and solicitous for the welfare of Americans."[37]

Inclined to generosity, the Pima expected the emigrants to engage in gift exchange or "they would think hard of it." But the Pima also knew they were highly venerated. As a result, the 6'4" Azul expected a certain level of homage. Without the requisite regards, emigrants might experience price hikes, increased charges for services, such as rounding up stray stock, or even loss of personal possessions. Powell wrote how Azul, dressed in full military regalia, came out to meet the emigrant train as the emigrants approached. The train leader, however, offended the aged chief by failing to exchange pleasantries and gifts. Such "cavalier treatment" bore just results. When the emigrants later sought to purchase food from the Indians, they found the Pima "difficult to trade with." The situation soon worsened when the Indians "stole a great quantity of things from us," including axes, hatchets, pistols, blankets, and coats. Powell attributed such theft to the train's poor treatment of Azul and inattention to protocol. If the party leader had "made the old chief some

presents," Powell penned in his journal, "and paid his compliments to him in a proper way it would not have happened."[38]

To those in need the Pima did not disappoint. While trade with the Pima commenced only with the permission of Azul, many hundreds, and at times thousands, of Indians entered the fray. Eccleston wrote his party found itself in the midst of a village where Pima men and women wishing to trade bundles of cornstalks used for animal forage soon surrounded them. None would sell, however, "till permission was obtained from the chief. When this was got there was great buying and trading."[39] Another emigrant spent four days in the villages where his train was "bountifully" equipped with enough food to "supply the commissariat of an army."[40]

Already accomplished traders, the Pima welcomed the opportunity to trade with the Americans, and Azul saw it as a means to increase the overall wealth and well-being of his people. The chief, for instance, greeted Kearny while still several miles from the main Pima village, inviting the general "to pass a day in his village to give ourselves an opportunity of trading with his people."[41] John Griffin, assistant surgeon with the Army of the West, observed the Pima "were most eager to trade" and did so

FIGURE 2.3. The Pima stored thousands of pounds of food to sell and trade with emigrants in granaries. (John Russell Bartlett print, 1852; Bartlett, *Personal Narrative*, 1854, 2:236)

with "the greatest confidence, showing not the slightest fear."[42] Audubon wrote many of the Pima "who came to trade had already made up their minds only to do so for some particular article, and in those cases it was not of the least avail to offer anything else."[43]

A desire and willingness to trade and sell emerged from the surplus of food grown by the Pima. To store surplus food required efficient and effective storage capabilities. To trade and sell such quantities of food as demanded by the emigrant market further required the ability to store large quantities of crops. Such care was demonstrated by the fine Pima subterranean and woven granaries kept "full of pumpkins, mellons [*sic*], corn &c." Emory noted corn, beans, and wheat stored in "large baskets," with corn in some places stored "in baskets covered with earth, and placed on the tops of (their homes)."[44] By midcentury every Pima family had "a granary, or store house, which is much larger and better constructed than their huts."[45]

By 1849, the Pima preferred American trade goods and access to American technology, aware they could not get the supplies and trade goods they wanted from the Sonoran towns, including Tucson.[46] As emigrant traffic increased, the Pima shifted almost exclusively to the trading and selling of their products, both of which increased their material prosperity.[47] Considered "a shrewd" and "keen" people who were "willing to trade for anything that will better their present appearance," the Pima initially traded to acquire white domestics, colorful cloth, pants, vests, shoes, stone beads, and red flannel. What emigrants needed most from the Indians were food and forage. Pima corn and wheat, along with beans, pumpkins, and melons, were in demand by emigrants. While there were periodic attempts by emigrants to purchase or effect an exchange for the limited number of Pima mules and oxen, the Pima declined, as these beasts of burden were essential to their economy. Corn sold for fifty cents a basket that contained six to eight pints, and a small bundle of corn stalks to feed livestock sold for a quarter. While emigrants purchased as much food and forage as prudent, the largest single recorded purchase by an individual, outside of the military, was Strentzel's twelve bushels of corn and wheat for the journey down the Gila River.[48]

While corn and wheat were the main trade items, they were not the only items acquired by emigrants. Kearny purchased a cow from the Pima at a cost of $10, and other emigrants did likewise, although at a greater cost—Hayes reported one purchased for $32. Smaller quantities of food, such as dried corn, green corn, beans, peas, pinole, melons, pumpkins, potatoes, yams, tomatoes, corn meal, wheat flour, tortillas, molasses, and salt all sold well. Pima blankets manufactured from indigenous short staple cotton also sold, as did gourds filled with water for use across the Forty-Mile Desert. One traveler noted the Pima had plenty of food and carried "large quantities of corn and corn meal, wheat and flour, also beans [and] squashes to trade for old shirts, old shoes, pants, vests, beads and buttons."[49]

As more emigrants traversed the villages, and as the demand for shirts, cloth, and other trade items abated, the Pima shifted to selling food for cash. An emigrant passing through the villages in the spring of 1849, for instance, observed the Pima "did not appear to know the value of money," with another stating, "Money is well nigh useless to them." This was consistent with Cooke's comment of 1846 that the Pima "know nothing of the value of money or weights and measures." Even when they began accepting coin, the Pima "would not take money for anything near its value . . . prefer[ring] beads, shirts, especially red flannel, pieces of old clothe, etc." Other emigrants wrote that brass buttons, paints, looking glasses, and similar novelties remained in demand among the Indians. One emigrant found the demand for cloth so high he tore red flannel into long strips to extend his trade value. Jewelry and fancy beads were of little value, although the Pima eagerly sought stone beads when they were available. Pima women especially coveted red flannel shirts, with one emigrant noting they "would give anything to get" them.[50]

By 1850 emigrants rarely saw "one of these Indians who had not on a Shirt, Coat or pair of pants."[51] As late as October 1850, the Pima, while more often than not demanding coin, relied on trade. William Miles, in the villages that fall, wrote his party asked for water and, upon receiving it, was told to "pay for it in the way of clothes, red flannel, of which they were excessively fond, and muslin shirts." American gold coins were "indignantly refused." When the emigrants tried to purchase melons using money, the Pima laughed at them, "treating us as though they were independently wealthy, or that our cash was of no value."[52]

Cognizant they had a monopoly on the market, the Pima demanded increasingly higher prices for their commodities, especially when the multitude of emigrants increased. Hunter noted eight hundred Americans at

the villages when he camped outside the main Pima village in the fall of 1849.[53] Eccleston noted the Pima "asked a large price" for everything. John Durivage noted "prices were enormously high, [with] a shirt being demanded for a very small quantity of any of the articles mentioned."[54] While the Pima did not have a set rate for their goods, allowing the market to fluctuate with demand, they were generally "reasonable in their charges." Although white domestics were the medium of exchange in November 1846, red flannel and other brightly colored cloth brought the most trade value by the fall of 1849, and in some instances was the only cloth accepted.[55]

As the Pima economy metamorphosed into more of a market-oriented economy, barter and trade lost its appeal, and the Pima demanded Mexican silver and American gold coins. Mexican silver had more of an immediate utility since Tucson was a Mexican military town that used silver coins as its medium of exchange. Since an array of manufactured items could be purchased in Tucson, it was natural for silver to be accepted in exchange for Pima food supplies. While accepting a limited number of gold coins, the Pima tried to exchange them with other American emigrants as quickly as possible. Hayes, for instance, explained Azul "was anxious to get silver for a ten dollar gold piece we gave him." He also added he met eight Pima men en route to Tucson "to buy cattle." Eccleston noted his train met five or six Pima men en route to Tucson. The men stayed with the emigrants, camped more than a day's ride from the Gila. The Pima were well armed and well mounted, and it is probable they were on the way to Tucson to use the coin acquired from the emigrants to purchase supplies they did not already enjoy. This included agricultural tools and other farming necessities.[56]

To ensure a favorable rate of exchange and perhaps to inflate prices, the Pima brought only "small quantities" of food to exchange with emigrants. They recognized and understood a basic principle of economics: limited supplies artificially inflate prices on the open market. Such economic savvy added to the level of prosperity enjoyed by the Pima. Another ploy in gaining the price they sought was to make emigrants linger before the trading began. Hayes noted the Pima kept his party "waiting half an hour" before opening the market.[57]

With tens of thousands of emigrants passing through their villages, the Pima were cognizant of the economic opportunity facing them.

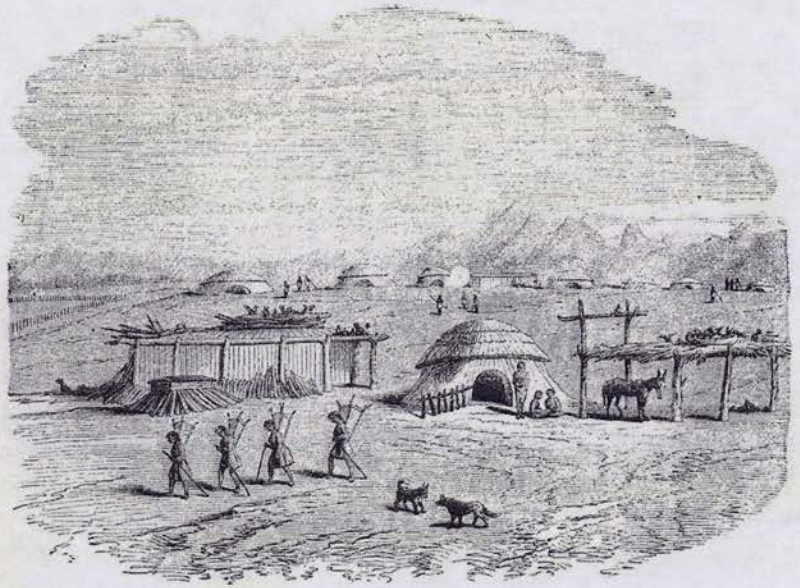


FIGURE 2.4. A Pima village. (J. R. Browne print, 1864)

Emigrant journals support the theory that the Pima increased their agricultural output to accommodate the demands placed on them, perhaps cultivating as many as 12,450 acres of land by 1850.[58] This is seen in Azul's invitation to emigrants to forgo the California adventure and prospect locally for gold. Such an invitation was not lightly given, but proffered with a specific end in mind. "The Pima chief ineffectually solicited us to stop and mine a day or two's journey up the Gila," Harris wrote in the summer of 1849, "promising to furnish us a guard of fifty of his warriors with provisions, representing that gold could be dug there in paying qualities and adding that his object was to have introduced among his people trade and agricultural implements and methods from the United States."[59] Azul recognized from the technology carried by the emigrants that they had the tools and innovation his people needed to engage more efficiently in agricultural production. The Pima heard from the emigrants stories of American know-how, and Azul was mindful this

would benefit his people. In 1848, for instance, Couts explained Azul was "exceedingly anxious to see the white man come and live amongst them, to teach them how to make corn, big horses [houses?], and everything they did."[60] While none of the emigrants permanently remained in the villages at this time, Azul's invitation is intriguing as it provides a glimpse into the mind of the chief as he contemplated the future economy of his people.

As their perceived level of importance increased and their recognition of the value of money heightened, the Pima's demand for coin as the medium of exchange increased. An emigrant visiting the villages in the latter part of 1849 noted the Pima knew "the value of money," while another remarked they "asked high prices in *money*" (emphasis in original).[61] The Pima were well supplied with clothing and wore only "the most flashy colors," suggesting their demand for trade goods may have been, or was nearly, saturated. When he attempted to buy some ponies, Eccleston was told the Pima would accept cash only, no trade. When he bought corn from the Maricopa a few days later, he paid "a big price" in money.[62]

While there was never a set rate for the buying and selling of Pima commodities, American extravagance contributed to its artificially inflated costs. Audubon complained American improvidence "made it difficult for anyone to make reasonable bargains with either the Pimos or Maricopas."[63] Extravagance may have been a relative concept that might not have matched the true nature of the emigrants, who dumped goods along the trail to lighten the burden on their worn and weary animals. To the Pima mind, the emigrants had a dazzling array of technology, such as metal tools and better-quality and more-colorful cloth. These goods far surpassed the available supply of goods from poverty-stricken soldiers and settlers in Sonora, including those in Tucson. Because the emigrants carried with them the products of industrial America, the Pima concluded that the Americans were a wealthy people. As a literate people, with many keeping or reading journals and making drawings, the emigrants impressed the Pima, who were intrigued with the written word and hand-drawn pictures. When the perceived waste of the emigrants is factored in—the emigrants (especially Graham's column in 1848) discarded wagons; left behind scores of dead or stray animals; littered the trail with a variety of manufactured items, such as wheels, crowbars, blacksmith

bellows, carpenter's tools, stoves, chairs, tents, washing machines, guns, powder, chains, saddles, harnesses, trunks of clothing, cooking utensils, and a vast assortment of tools—the Pima concluded the Americans were wealthy and wasteful. "You can name nothing that was not lost on this road," one emigrant wrote.[64]

Another part of the perceived emigrant extravagance is attributed to "a want of small change" that compelled emigrants to "frequently pay more for an article than we would if we could make the change."[65] Part can also be attributed to the conscious decision of the emigrants to give more in trade than the purchased foods were worth. While some emigrants burned or dumped into the river everything they left behind, others traded it away, giving far more in trade value, knowing it would otherwise be lost and of no value or profit. J. G. Candee noted his train traded extravagantly with the Pima because "we must dispose of it at any rate." As a result, emigrants traded "a good garment for a water melon" that under different circumstances they would not have exchanged.[66] Whatever the reason, by the time Bartlett came through the villages in 1852, most goods were sold for coin.[67]

As the Pima recognized the value of American gold coins and their relative value to Mexican silver, they shifted their economy to one largely based on the gold standard. Concurrently, the Pima (and Maricopa), frustrated by their inability to acquire the requisite new tools from the emigrants to cultivate new fields, grew desirous of American technology, particularly metal tools. Furthermore, mules and oxen were in demand, suggesting a shift from an economy based on manpower to one based on horsepower. Powell recorded the Pima "did not like to part with their horses," although they offered "to give a horse for a yoke of oxen."[68]

Throughout the first year of emigrant traffic, journals bespeak of the honesty and integrity of the Pima, although there were isolated instances of pilferage. When Harvey Wood passed through the Pima villages, a member of his company lost a buffalo robe to theft, although Azul managed to secure its return after admonishing his people to respect the property of the emigrants. Wood was impressed with the effect. "Had the thief been a white man," the emigrant opined, "talking would hardly have restored it."[69] Harris noted Azul specifically informed the emigrants they "need fear no pilfering, as the 'Pimas do not steal.'" Chamberlin adds that Azul "took dinner with us" and inquired regarding how the

Pima "behaved towards us." If his people were caught stealing or misbehaving, the chief explained, the emigrants were to inform him and he "would punish [the Indians] accordingly."[70]

By 1850, Azul informed emigrants "his men are not all honest[.] [T]hey will steal [having] learned to do so by the Appachees [*sic*]." Consequently, an emigrant opined: "From the account given of these injuns they must have improved very much since Mr Emory was through the country for he represents them as having all the virtues of the whites without any of the vices. The only virtue I saw among them was raising corn & wheat to sell to the emigrants at high prices." Regarding the Maricopa, opinions were less kind. "Why Mr Emory has given them so good a character I cant tell unless he was very hungry & Esau like sold his words for a mess of pottage."[71]

New stresses and demands placed on the Pima resulted from market forces, which were more pronounced as the Pima economy shifted. These stresses are demonstrated partially in increased larcenous behavior. The fact that emigrants were neither soldiers under restrictive military authority nor missionaries under strict religious influence points to the beginnings of destabilizing influences in the villages. When stymied in their attempts to acquire goods, and the education that would enable them to efficiently utilize this technology, and when continuing to witness the jettisoning of a wide variety of goods, the Pima's view of integrity was modified and pilfering increased. This is observed in the loss of authority that Azul exhibited over his people. While once able to admonish his people to respect the property of the emigrants, and even able to secure the return of stolen goods through persuasion, Azul could no longer do this by 1850.

Emigrant iron tools and beasts of burden were never sufficient to meet the Pima demand, with the first signs of antisocial behavior among the Indians appearing as their level of frustration over their inability to acquire these tools and animals rose. The Pima recognized the value of American technology and that it could benefit their economy without significantly altering their cultural values. While they might reject a mining economy, they saw American agricultural technology as compatible with their long-entrenched agrarian culture and economy.

The fact that the first complaints of larcenous behavior were leveled against the Maricopa is explained by their geographically disadvantaged

location. Emigrants entered the Indian villages from the east, meaning they reached the Pima villages first. The Maricopa had secondary access to the emigrant market and, as a result, received a lower quantity, and perhaps quality, of goods in trade. Durivage, for instance, wrote his company found the "Pima all that Colonel Emory had described them," yet five days later when leaving the Maricopa villages, he noted "a number of horses and mules were stolen."[72] Other emigrants were "much annoyed" [*sic*] by the Maricopa who "required much watching." Hunter went so far as to note the Pima even condemned their western neighbors and allies for ignoring "the precept 'thou shalt not steal.'"[73]

Emigrants increasingly noted they had to watch the Pima carefully. "You have to keep a sharp look out upon their movements, and your utmost vigilance will probably be insufficient to prevent their depredations," Lorenzo Aldrich observed.[74] Quaker Charles Pancoast was no kinder. "We had barely unyoked our Teams before a hundred or more Indians gathered around us, and a number of our tools (which we carried in straps outside of the wagon) were stolen so adroitly that in not a single instance could we detect the Thief. We lost so many tools we became alarmed." When a yoke of oxen was stolen Wednesday morning, three emigrants, including Pancoast, paid Azul a visit to demand its return. The chief assured the emigrants "he would get them for us" and in the meantime urged the travelers to move their camp five or six miles away from the village "where his People would not be tempted so much to steal from us." Three days later, after the chief intervened, three Pima returned the missing yoke of oxen, having found it well south of the camp.[75] As these larcenous behaviors indicate, the Pima stole that which they could not secure via trade or purchase. The fact that tools and oxen were among the most-often-reported items stolen suggests that these forms of technology were essential to the expanding Pima economy.

More than forty thousand soldiers and emigrants traveled through the villages between 1846 and 1852, finding food, water, and friendship from four thousand Pima. The Pima response to this mass migration was tempered by several factors. Much like earlier Spanish missionaries and American mountain men who simply passed through the villages buying and trading for such items as they needed, the forty-niners were transients. As a result, the Pima, desiring access to new technology and innovation, saw agricultural trade and sale as the means of market enhancement.

Furthermore, since the emigrants sought protection from the Apaches to the south and east of the villages and the Quechan, Yavapai, and Mohave west of the villages, the Pima increased in stature. The Pima found it to their advantage to provide such protection, with their villages serving not only as centers of trade and respite but also as policing centers. Since the villages were the only places between Tucson and Warner's Ranch (California) where good food and forage could be purchased and water was available, they served a vital life-sustaining function.

In the years during and after the Mexican War, the Pima took full advantage of an unprecedented access to markets to cash in on an economic bonanza. They understood they were the center of activity and their crops were in demand. As a result, the Pima leveraged their position by upgrading technology to better provide for the emigrant market. Unfortunately, this economic boom was short-lived. Within twenty years it declined, and within thirty years it was gone, but not before the Indians capitalized on their newfound wealth by expanding their market presence.

CHAPTER 3

Establishment of the Pima Reservation

DESPITE BEING LOCATED ON THE Mexican side of the Gila River, the Pima had strong economic ties to the United States. They incorporated wheat as a staple crop and adopted the Mexican technique of farming with check beds, or border irrigation.[1] By the 1850s, the Pima were poised to enter a market economy.[2] Pima lands were "better irrigated, their crops [were] larger, and the flour which they [made] from their wheat and maize" surpassed all regional growers.[3] Despite assurances from federal officials, the Pima remained concerned about their land and resources. Since the arrival of the U.S. Army in 1846, the Pima had a diplomatic protocol with the United States. The health of Antonio Culo Azul, head Pima chief since the 1820s, was failing, and U.S. Boundary Commissioner John Russell Bartlett was the last American to see Azul, as he died in the winter of 1855. By the time William H. Emory surveyed the Gadsden Purchase boundary later that year, Azul's son, Antonio, had assumed the role of head Pima chief. Antonio Azul's first official protocol ensued after the Pima villages were brought under American administration in the summer of 1855.[4] In June, Azul led a delegation of six Pima, Maricopa, and Papago chiefs to Emory's camp at Los Nogales, 150 miles south of the Pima villages, where they asserted sovereignty over their land and resources.

Meeting on June 29, Emory informed the chiefs that all rights they enjoyed under Mexican administration were guaranteed by the United States. Azul and the other chiefs expressed concern about their land and resources, "manifest[ing] much anxiety to know if the transfer of Territory would affect the grants of lands ceded them by Mexico, which they now cultivate with so much success."[5] Emory assured the men that all titles recognized by the Mexican government would be validated by the United States and issued a public call for American citizens to respect the authority of Azul and the sovereignty of the Pima.[6]

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David H. DeJong earned a Ph.D. in American Indian policy studies from the University of Arizona. He is has been the Director of the PIma-Maricopa Irrigation Project for nine years and has written extensively on the Gila River Indian Community water rights settlement history and implementation, including the publication of *Forced to Abandon Our Fields* (University of Utah Press), which was the first runner up for the 2012 Wallace Stegner Award. He has authored four other books, including *Plagues, Politics and Policy: A Chronicle of the Indian Health Service, 1955-2008* (Lexington Press, 2010); *Stealing the Gila: The Pima Agricultural Economy and Water Deprivation, 1848-1921* (University of Arizona Press, 2009); *The Indian Medical Service: A Chronicle of Indian Health Care, 1908-1955* (Lexington Press, 2008); and *Promises of the Past: A History of Indian Education in the United States* (Boulder, Colorado: North American Press, 1993). He has published over two dozen journal articles. In the spring of 2015 his sixth book, *American Indian Treaties: A Guide American Indian Treaties and Treaty-Making: 1607-1911*, will be published by the University of Utah Press.

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IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH

CENTRAL DIVISION

UNITED STATES OF AMERICA, Plaintiff,	)	No. C-137-59
vs	)	FINDINGS OF FACT AND CONCLUSIONS OF LAW
STATE OF UTAH, GEORGE D. FEHR, EARL E. FEHR, JOE LYON, JR., and UNITED WESTERN MINERALS COMPANY, A Corporation, Defendants.	)	

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The above entitled matter came regularly before the Honorable Willis W. Ritter, Chief Judge, sitting without a jury, for trial on June 6 through June 10 and June 15 through June 17, 1960. The cause was thereafter on October 10, 1960 argued at length to the Court by counsel for the respective parties. The United States of America was represented in each instance by C. Nelson Day, Assistant United States Attorney, and the defendants were represented by Grant H. Bagley, Clifford L. Ashton, Donald E. Schwinn and Frank J. Allen, all Special Assistant Attorneys General of the State of Utah. At the trial evidence both documentary and oral was offered to and received by the Court.

The Court now being fully advised in the premises makes the following

FINDINGS OF FACT

1. This is a civil action brought by the United States of America and the jurisdiction of this Court is invoked under Title 28, Section 1345, United States Code.

2. The action is brought by the United States of America for the purpose of quieting title in itself in and to the bed of that portion of the San Juan River within San Juan County, State of Utah from the Utah-Colorado boundary line downstream to the mouth of Chinle Creek a distance of approximately 55 miles, subject only to: (1) The rights of the Navajo Tribe of Indians under the Executive Order of May 17, 1884, 1 Kapp. 876, the Executive Orders of March 10, 1905 and May 15, 1905, 3 Kapp. 690, and the Act of March 1, 1933, 47 Stat. 1418; (2) The rights of anyone claiming through or under

the Navajo Tribe of Indians; and (3) The rights, if any, of anyone other than the United States of America arising through ownership of lands riparian to or abutting upon said portion of the river.

3. The defendant State of Utah has appeared in the action claiming ownership of the said portion of the bed of the San Juan River, subject only to mineral leases issued by it to the other defendants. The said other defendants George D. Fehr, Earl E. Fehr, Joe Lyon, Jr., and United Western Minerals Company appeared in the matter claiming to be the owners of and the lessees in mineral leases covering the said portion of the bed of the San Juan River duly issued by the State of Utah.

4. The claim of the defendant State of Utah and the other defendants, its said lessees, is based upon their contention that title to the said portion of the bed of the San Juan River vested in the State of Utah upon the said State becoming one of the United States of America and by reason of the "navigable" character of the said river at said time and place, the term "navigable" being within the legal meaning and definition of the term as applicable to a determination of the question of whether or not state title attaches to river bed lands within the several states.

5. The plaintiff United States of America acquired from the Republic of Mexico by the Treaty of Guadalupe Hidalgo of February 2, 1848, 9 Stat. 922, fee simple title to lands within the State of Utah, including all of the bed of the San Juan River from the Utah-Colorado boundary to its confluence with the Colorado River and all lands riparian thereto.

6. Pursuant to the general law of the land and under and by virtue of the provisions of the Act of Congress dated July 16, 1894, 28 Stat. 107, usually referred to as the Utah Enabling Act, the State of Utah became one of the United States of America on January 4, 1896 by Presidential proclamation of that day, 29 Stat. 876.

7. The United States Supreme Court in the case of United States v. Utah, No. 14 Original, decided April 13, 1931, reported at 283 U. S. 64, 51 Supreme Court 438, 75 L. Ed. 844, determined and adjudicated that the San Juan River in Utah from Chinle Creek downstream to its mouth where it joins the Colorado River, a distance of approximately 133 miles, was not a "navigable" stream and that, therefore, the State of Utah as sovereign had no right, title,

interest or estate in the bed of such portion of the San Juan River and that title to the bed of such portion of the San Juan River was vested in the United States except as to lands theretofore granted, and the State of Utah was forever enjoined from asserting any claim to said river bed adverse to the United States of America or its grantees and from in any manner or way interferring with the use, occupation, possession or enjoyment thereof by the United States or its grantees. Said decision also determined and adjudicated that the Green River from immediately below the mouth of the San Rafael River to the mouth of the Green River, and the Grand River (now part of the Colorado River) from Castle Creek to the junction of the Green and Grand Rivers, were "navigable".

8. In the area in controversy in this action, the San Juan River has a substantially uniform rate of fall or gradient of slightly more than seven feet per mile. Downstream from Chinle Creek to its mouth, the San Juan River also has an average rate of fall or gradient of slightly more than seven feet per mile. The 133 mile downstream segment of the San Juan River, previously held to be non-navigable, includes a segment of 48.73 miles (from river mile 21.64 to river mile 70.37) which has an average and practically uniform gradient of 5.46 feet per mile unbroken by any rapids and where the river flows in a single well defined channel except for approximately 4 miles at about river miles 53 to 57 where the river sometimes has a braided channel. Except for this approximate 4 mile stretch, the said 133 mile downstream segment of the San Juan River runs in a single well defined channel, substantially all of the way between deep canyon walls.

9. In the area in controversy herein, the San Juan River flows through a broad, sandy, flood plain which is from 1,000 to 5,000 feet wide and which is encased between rocky cliffs or steep slopes. By reason of the flat and sandy nature of the flood plain, the irregular flow and the gradient or rate of fall, the river is constantly shifting its channels. On many occasions the river has moved its channels over one-half mile in a very short period. The washing and cutting action of the river did not occur in any one year or other particular period but is a continuous action of the river. The river in this area runs in a single channel for only short distances but generally has braided channels and the river runs for

most of the 55 miles in controversy and for most of the time in from two to many channels at the same time with such channels constantly shifting. This braided characteristic of the river over the entire 55 mile stretch in controversy herein presents a continuing and insurmountable obstacle to navigation as none of the several channels presents an adequate or continuous channel for the passage of boats. The testimony, and particularly the defendants' testimony, showed considerable difficulty in this regard even at high stages of water and in modern shallow-draft small rubber rafts and small plastic glass motorboats.

10. In the area in controversy here, the San Juan River has an extremely irregular flow, on a number of occasions running dry and in flood stage running at a recorded high of 70,000 cubic feet per second in 1927, with the flood occurring in the year 1911 estimated as high as 150,000 cubic feet per second. The flow is generally low for most months of the year, running less than 1,000 c.f.s, with the big runoff occurring during the snowmelt period from about April into June. The flow of the river during the snowmelt runoff period ordinarily includes most of the total flow of the stream during the year. Aside from the snowmelt runoff period in the spring, there are a considerable number of flash floods on the river ordinarily occurring during the late summer months and the fall months, although there are flash floods at other times of the year also. While the stream has a long time average rate of flow of 3,000 cubic feet per second, the flow of the San Juan River runs at 1,000 c.f.s, or less during 60.9% of the time or more than 7 months out of each year. It runs at 2,000 c.f.s. or less during 72.3% of the time or almost 9 months each year. It runs at 3,000 c.f.s. or more during only 18.4% of the time and this is not a consecutive period, but represents the aggregate of high water periods resulting from spring runoff and other flood conditions resulting from storms. The river runs at 500 c.f.s. or less during 22% of the time, a longer period than that during which the river flows at or in excess of the long time average rate of flow.

11. There was a marked change in the conditions of the flood plain of the river in the area in controversy herein as a result of a big flood in the year 1884, which flood washed out the small Mormon community of Montezuma at Montezuma Creek and also came up into Bluff City washing out much of the bottom lands in that area. There were recurrent marked changes in the conditions of the flood plain of the river in the area in controversy herein as a result of the big flood of 1911 and as a result of the big flood of 1927 which was recorded

at 70,000 c.f.s. These big floods and even larger ones have occurred at irregular intervals on the San Juan River in the past. In the San Juan River segment in controversy herein, the prevalence of quicksand conditions is dangerous to animals and persons unfamiliar with it.

12. The San Juan River with approximately one-half the runoff of the Green River and approximately one-third the runoff of the Colorado River above its junction with the Green carries a total sediment load of twice that of either the Green or Colorado in the areas determined to be "navigable" in the said former case. The degree of concentration of sediment in the San Juan during flood periods is between five and six times greater than that of either the Green or Colorado in said areas. The high sediment content in the San Juan River water gives rise to sand waves, while none are noted on the Green or Colorado in said areas. These sand waves reach a height of up to 12 feet or more according to one of the defendants' witnesses. The silt and sand in the San Juan River water would render its use in steam boilers impracticable and the sand waves present an additional and dangerous obstacle to use of the river by small boats.

13. The San Juan River drainage area near Bluff exceeds 23,000 square miles and is about the same as that of the Colorado River above Cisco, Utah and about one-half of that of the Green River above Green River, Utah. The San Juan River long time annual runoff is about one-half that of the Green and about one-third that of the Colorado in the said "navigable" areas. The San Juan River has little sustained flow during non-snowmelt period, with zero flows recorded, while the Green and Colorado in said areas have relatively large sustained flows.

14. The flow of the San Juan River is much more variable than the Green or Colorado in said areas.

15. The average slope of the San Juan River in the area in controversy exceeds seven feet per mile in contrast to 1.17 feet per mile on the Green River from the San Rafael down to its mouth and 1.63 feet per mile on the Colorado River from Castle Creek downstream to its junction with the Green River. The San Juan River in the area in controversy has an unstable channel throughout, in contrast with relatively stable channels on the Green and the Colorado Rivers in the areas above noted. A medium rise in stage on the San Juan River in the area in controversy herein would flood approximately an additional 330 acres of shifting bottom lands per mile of length compared to only 2.7 acres for the Colorado and 1.4 for the Green in the areas above noted. The characteristics of the San Juan River in the area in controversy permit an

increase in volume of flow to spread out over the wide flat flood plain without an appreciable rise in depth, while the Green and Colorado in the areas noted flow in stable banks where an increase in flow results in a corresponding increase in depth of water. The characteristics of the San Juan River in the area in controversy are such that the stream flow is very rapid for relatively shallow depths. This condition persists at low stages and high stages of water. The velocity of the San Juan River in the area in controversy is consistently and considerably higher, and its depth is consistently and considerably lower than that of the Green River and Colorado River in the respective areas noted.

16. The records of the Geological Survey, Department Of The Interior, show the annual discharge in acre feet at the mouth of the San Juan River as being 2,080,000 for the year 1895, 1,530,000 for the year 1896, with a mean annual discharge from 1915 through 1950 of 2,174,500 acre feet at the Bluff, Utah station.

17. The San Juan River has not changed its general characteristics as noted in these findings during the time in which white men have been in the area. In the area in controversy herein, this has been since 1879 when "Mormon" pioneers settled at Bluff and at Montezuma Creek.

18. On the various occasions when the river has run dry, the fish died in pools causing a great stench and the Indians found it necessary to dig in the river bed to secure water for their animals and themselves. One of the witnesses, Fletcher B. Hammond, testified that in the year 1896 he dammed the entire flow of the San Juan River at Bluff by using a team of horses and a scraper. Another witness, Otto J. Zahn, testified that in about 1904 he diverted the entire flow of the San Juan River by simply using a hand shovel. This was at his mining camp about 60 miles below Bluff.

19. The climate of the San Juan River country is "spotted". The river rises in Southeastern Colorado, flows into New Mexico, back into Colorado at a point approximately one or two miles east of the corners of Utah, Colorado, New Mexico and Arizona and thence into Utah approximately one mile north of such four corners. It then meanders through Utah in a general westerly direction for approximately 188 miles to join the Colorado River. Through most of its distance it flows through typically Southwestern United States desert country. The region is arid and even if the rainfall was evenly distributed the average result would be small and might be largely counter-

balanced by evaporation during the dry hot days of summer. The most significant feature of the rainfall in the desert area is the violence of the showers. Most rains are short lived, widely spaced, torrential downpours. The precipitation for a month or even two months may be the result of a single storm that lasts only half an hour and covers only a few miles.

20. The Indians who resided in the area of the San Juan River in Utah were Navajos. They have made no use of the river except as a source of water for personal use and as drinking water for their livestock. They, of course, did cross the river, usually on foot or horseback, although during high water periods on occasion they used small homemade boats for this ferry purpose.

21. The white people who came into Southeastern Utah as settlers attempted to use the river in a very limited way for irrigation of some of the bottom lands along the stream. These attempts at irrigation were particularly unsuccessful in that the river filled the small irrigation ditches with silt, cut them out entirely or moved away from the diversion points. The river in flood washed out much of the bottom lands, carried away the settlers' homes, haystacks and livestock and in general was more of a hindrance than a help, except as a source for drinking water. There were a number of trading posts established from the Four Corners area downstream along the San Juan River and the traders usually kept small skiffs or rowboats to enable the Indians and others who came to trade to cross the river during high water. These boats were many times washed away downstream but it was a simple matter to build another.

22. There was a gold rush along the San Juan River in about 1892 and 1893 during which time several hundred persons came into the San Juan country in Utah in search of gold. Almost all of them came overland by foot, by horse or burro, or by wagon, although the evidence showed that possibly 3 or 4 came downstream in small rowboats on the San Juan River to Bluff. Most of the mining activity on the San Juan River was of placer type and was carried on below Chinle Creek. Most of the miners and prospectors who came into the area came through Bluff and went downstream overland from there. Bluff is approximately 12 miles upstream on the San Juan River from Chinle Creek. Some small, rowboat type flat-bottomed boats were constructed in

Bluff and used to carry some of the prospectors with small amounts of supplies, bedrolls, etc. downstream. The use of the San Juan River above Chinle Creek by these small rowboats was not different or greater than the use of the river by such small rowboats downstream from Chinle Creek. Most of the prospectors went downstream on horseback, by burro or wagon, and most supplies were taken downstream in this manner. A few of the miners and prospectors, as above indicated, went downstream in these small rowboats; none of them ever came upstream in a boat.

23. Some years after the gold rush, above referred to, there was some oil prospecting in the San Juan River country in Southeastern Utah and again a number of persons came into the area in connection with this oil prospecting. All machinery and equipment, as well as supplies, used in this activity were transported into the area by freight wagon. As above indicated, the country is typical desert country, and at the time of the gold rush and the oil activity above referred to the area was very primitive, with roads almost non-existent and with trails hand carved from the rocky canyon areas.

24. During the past 20 years, there has been a very limited use of the San Juan River by two or three so-called "river runners" who have generally used small, rubber, pontoon type boats in transporting a relatively few passengers downstream on the San Juan River for "thrill" purposes. Most of this "river running" has been from Bluff, Utah downstream past Chinle Creek to Mexican Hat, Utah, a total distance of approximately 31 miles, approximately 19 miles of which are downstream from Chinle Creek. A very small amount of such "river running" has been from the Four Corners down to Bluff with a slightly larger amount from Mexican Hat down to the mouth of the San Juan River. None of such "river running" has been upstream.

25. In connection with preparation for the present law suit, there were several boat trips on the San Juan River in the area in controversy in small, rubber, pontoon type and small flat bottom type boats drawing only a few inches of water. One or two of the said boats were powered by both inboard and outboard motors which required a depth of up to 24 inches for the propellor and shaft. These particular boats went both up and downstream in parts or segments of the area in controversy herein when the stream flow was in excess of 4,000 c.f.s. One of these boats made two trips upstream and one boat made one trip upstream. Neither of the upstream trips was for the full

distance fromChinle Creek to the Four Corners. There were only two occasions when upstream travel was attempted when the river flow was under 4,000 c.f.s. and on each of these occasions, the upstream travel was only for 3 or 4 miles. The persons engaging in making these trips both up and downstream, encountered sandbars, rocks, braided channels and other obstacles requiring them to stop, get out of their boats and pull them off the obstructions, turn their boats around and try other channels, and similar actions. The modern rubber pontoon-type boats and the modern small flat bottomed plastic-glass and aluminum boats and the modern high-powered inboard and outboard motors used in making the trips referred to in this paragraph were unknown in 1896.

26. At low stages, the San Juan River in the area in controversy herein has insufficient water to permit the passage of any but small, rowboat type boats or small rubber rafts and then only downstream with no commercial load and with considerable difficulty. At high stages the San Juan River in the area in controversy herein becomes torrential, cutting and tearing its banks, swiftly changing channels, carrying excessive debris and an extremely high sediment load. The high stages of water persist for only relatively short period of time each year,and the river current is then too swift and too dangerous as well as too uncertain to permit any use of the river for commercial navigation. These same conditions existed in 1896 and have persisted since that time.

27. Except as herein noted there has never been any attempt to carry passengers and there has never been any attempt, either successful or unsuccessful, to carry on freighting on the San Juan River in the area in controversy herein.

28. In 1896, the year Utah was admitted into the United States of Americaas a state, there was considerable commerce on the various rivers of the United States, which commerce was then usually and ordinarily accomplished by means of the sternwheel and sidewheel type steam engine boat. The boats usually and ordinarily carried the passengers and freight on the boat itself. The boilers, engines, beams, sternwheels, sidewheels, and other equipment, including the necessary cord wood fuel were all heavy, cumbersome and occupied a large part of the boat's carrying capacity. There was no evidence that any type of steam boat or any craft at all, except small skiffs or rowboats, were ever used on the San Juan River in the area in controversy. By reason of the lack of sustained flow, the shifting sandbars, the shifting and unstable channel, the comparatively steep slope and the other features

of the San Juan River in the area in controversy, as above set forth, it would have been impossible to navigate a boat of any substantial size or such as would have been suitable for carrying passengers or freight in the then ordinary and customary mode of travel on water at the time Utah became a state.

29. The San Juan River in the area in controversy herein on January 4, 1896 was not used and never has been used, and was not then susceptible of use and never has been susceptible of use in its ordinary condition as a highway of commerce over which trade and travel was or might have been conducted in the customary mode of trade and travel on water. In its natural and ordinary condition it did not and never has afforded a channel for useful commerce. The San Juan River in the area in controversy herein as a matter of fact on January 4, 1896, was not, ever since has not been, and is not now a "navigable" stream.

From the above and foregoing Findings Of Fact, the Court now makes the following

CONCLUSIONS OF LAW

1. The plaintiff United States of America acquired from the Republic of Mexico by the Treaty of Guadalupe Hidalgo of February 2, 1848, 9 Stat. 922, fee simple title to lands within the State of Utah, including all of the bed of the San Juan River from the Utah-Colorado boundary to its confluence with the Colorado River and all lands riparian thereto.

2. Pursuant to the general law of the land and under and by virtue of the provisions of the Act of Congress dated July 16, 1894, 28 Stat. 107, usually referred to as the Utah Enabling Act, the State of Utah became one of the United States of America on January 4, 1896 by Presidential proclamation of that day, 29 Stat. 876.

3. The San Juan River in the area in controversy herein on January 4, 1896 was not susceptible of use and never has been susceptible of use in its ordinary condition as a highway of commerce over which trade and travel was or might have been conducted in the customary mode of trade and travel on water. In its natural and ordinary condition, it did not afford and never has afforded a channel for useful commerce.

4. The San Juan River between the Utah-Colorado boundary and Chinle Creek, all in San Juan County, State of Utah, on the date of Utah's statehood, January 4, 1896, was not a "navigable" water within the legal meaning and definition of the term "navigable" as applicable to a determination of the

question of whether or not state title attaches to river bed lands within the several states.

5. Title to the said river bed is vested in the United States of America subject only to (1) the rights of the Navajo Tribe of Indians under the Executive Order of May 17, 1884, 1 Kapp. 876, the Executive Orders of March 10, 1905 and May 15, 1905, 3 Kapp. 690, and the Act of March 1, 1933, 47 Stat. 1418; (2) the rights of anyone claiming through or under the Navajo Tribe of Indians; and (3) the rights, if any, of anyone other than the United States of America, arising through ownership of lands riparian to or abutting upon said portion of the river; and the State of Utah and the other defendants herein, its lessees, have no right, title, interest or estate in and to said river bed, and should be forever enjoined from asserting any estate, right, title or interest in or to said river bed, or any part thereof, adverse to the United States of America, or its grantees, and from in any manner or way disturbing or interferring with the possession, use and enjoyment thereof by the United States of America or its grantees.

6. The United States of America is entitled to its costs herein.

Let Judgment Be Entered Accordingly.

DATED this 14 day of November, 1960.

WILLIS W. RITTER
Chief Judge

Filed Dec. 15, 1960.

3

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF UTAH

CENTRAL DIVISION

UNITED STATES OF AMERICA,	)	
Plaintiff,	)	No. C-137-59
vs	)	JUDGMENT AND DECREE
STATE OF UTAH, GEORGE D. FEHR, EARL E. FEHR, JOE LYON, JR., and UNITED WESTERN MINERALS COMPANY, A Corporation,	)	
Defendant.	)	

The above entitled matter came regularly before the Honorable Willis W. Ritter, Chief Judge, sitting without a jury, for trial on June 6 through June 10 and June 15 through June 17, 1960. The cause was thereafter on October 10, 1960 argued at length to the Court by counsel for the respective parties. The United States of America was represented in each instance by C. Nelson Day, Assistant United States Attorney, and the defendants were represented by Grant H. Bagley, Clifford L. Ashton, Donald E. Schwinn and Frank J. Allen, all Special Assistant Attorneys General of the State of Utah. At the trial evidence both documentary and oral was offered to and received by the Court, and the Court being fully advised in the premises, and having made and entered its Findings Of Fact And Conclusions Of Law and having ordered judgment entered pursuant thereto; now, therefore,

It is hereby ORDERED, ADJUDGED and DECREED that the United States of America is the owner in fee simple and entitled to the exclusive possession of the bed of that portion of the San Juan River within San Juan County, State of Utah from the Utah-Colorado boundary downstream to the mouth of Chinle Creek, a distance of approximately 55 miles, subject only to: (1) the rights of the Navajo Tribe of Indians under the Executive Order of May 17, 1884, 1 Kapp. 876, the Executive Orders of March 10, 1905 and May 15, 1905, 3 Kapp. 690, and the Act of March 1, 1933, 47 Stat. 1418; (2) the

rights of anyone claiming through or under the Navajo Tribe of Indians; and (3) the rights, if any, of anyone other than the United States of America arising through ownership of lands riparian to or abutting upon said portion of the river. The State of Utah and the other defendants, its lessees, have no right, title, interest or estate in or to said river bed and any claim or claims of the defendants, or any of them, in and to the said river bed adverse to the plaintiff, are without right or basis in law and in fact.

It is hereby ORDERED, ADJUDGED and DECREED that the State of Utah and the other defendants, its said lessees, are forever enjoined and restrained from in any manner or way disturbing or interferring with the use, occupation, possession or enjoyment of said river bed lands by the United States of America or its grantees, and the said defendants and each of them are forever enjoined from asserting any right, title, interest or estate in and to said river bed lands or any part thereof adverse to the United States of America or its grantees.

It is further ORDERED, ADJUDGED and DECREED that the plaintiff recover its costs in this matter.

DATED this 14 day of ~~November~~ December, 1960.

WILLIS W. RITTER
Chief Judge

Clerk's Note: Notation of entry of Judgment made in civil docket on December 15, 1960, in accordance with Rule 79 of Rules of Civil Procedure.

Entered Dec. 15, 1960.

304 F.2d 23
United States Court of Appeals Tenth Circuit.

STATE OF UTAH; George D. Fehr; Earl E. Fehr; Joe Lyon, Jr.; and United Western Minerals Company, a corporation, Appellants,
v.
UNITED STATES of America, Appellee.

No. 6677. | May 10, 1962.

Action by United States to quiet title to river bed. The United States District Court for the District of Utah, Willis W. Ritter, J., entered judgment quieting title in the United States, and the state in which the river bed was situated and other aggrieved parties appealed. The Court of Appeals, Bratton, Circuit Judge, held that evidence supported finding that 55-mile portion of San Juan River within State of Utah was not navigable at time of Utah's admission to union.

Judgment affirmed.

West Headnotes (12)

[1] Water Law
Rights incident to state's admission to Union in general

Titles to beds of rivers within state, if navigable, pass to state on admission to union.

1 Cases that cite this headnote

[2] Water Law
Rights to bed in general

Title to bed of river not navigable at time of state's admission to union remains in United States.

Cases that cite this headnote

[3] Water Law
Susceptibility of waters for use in commerce in general

Test for determining question of navigability of river is whether stream in its natural and ordinary condition is used or susceptible of being used as channel for commerce over which trade and travel is conducted or may be conducted in customary modes on water.

Cases that cite this headnote

[4] Water Law
Susceptibility of waters for use in commerce in general

Navigability does not depend upon mode or modes by which trade and travel is conducted upon stream, but upon whether stream in its natural condition is one which affords channel for useful commerce.

Cases that cite this headnote

[5] Water Law
Effect of sandbars, falls, or other obstructions or impediments to navigation

Navigability is not negatived or destroyed merely because of watercourse interruption caused by occasional natural obstructions or portages, and it is not essential to navigability that stream be open to navigation at all seasons of year or at all stages of water.

1 Cases that cite this headnote

[6] Water Law
Evidence as to navigability

Evidence supported finding that 55 mile portion of San Juan River within State of Utah was not navigable at time of Utah's admission to union.

1 Cases that cite this headnote

[7] Federal Civil Procedure
Nature and Purpose

Purpose of rule requiring court, in action tried upon facts without jury, to state facts specially, is to aid appellate court in acquiring clear understanding of basis of decision of trial court. Fed.Rules Civ.Proc. rule 52(a), 28 U.S.C.A.

4 Cases that cite this headnote

[8] **Federal Civil Procedure**
Sufficiency

Findings of district court relative to navigability of portion of river within state sufficiently complied with rule requiring court, in action tried without jury, to state facts specially. Fed.Rules Civ.Proc. rule 52(a), 28 U.S.C.A.

Cases that cite this headnote

[9] **States**
Costs

In absence of authorizing constitutional or statutory provision, state court may not tax costs against state.

1 Cases that cite this headnote

[10] **States**
Costs

State was not immune from taxation of costs in action by United States in United States District Court against state and others to quiet title to river bed located within state.

Cases that cite this headnote

[11] **Costs**
Discretion of Court

Federal Courts
Costs and attorney fees

Except as otherwise provided by statute, taxing of costs rests in sound judicial discretion of trial court, and exercise of such discretion will not be disturbed on appeal except in case of abuse.

6 Cases that cite this headnote

[12] **Federal Civil Procedure**
Result of Litigation

In action by United States against state and persons asserting mineral interests in river bed, to quiet title to such river bed in United States, taxation of costs against persons asserting mineral interests, who had unsuccessfully counterclaimed for judgment quieting their title to such interests, was not abuse of discretion.

1 Cases that cite this headnote

Attorneys and Law Firms

***24** Grant H. Bagley, Salt Lake City, Utah (Walter L. Budge, Atty. Gen., State of Utah, Clifford L. Ashton, and Van Cott, Bagley, Cornwall & McCarthy, Salt Lake City, Utah, were with him on the brief), for appellants.

Parker M. Neilsen, Asst. U.S. Atty. (Ramsey Clark, Asst. Atty. Gen., William T. Thurman, U.S. Atty., C. Nelson Day, Asst. U.S. Atty., Roger P. Marquis, and A. Donald Mileur, Attorneys, Department of Justice, Washington, D.C., were with him on the brief), for appellee.

Before BRATTON, HUXMAN, and BREITENSTEIN, Circuit Judges.

Opinion

BRATTON, Circuit Judge.

In United States v. Utah, 283 U.S. 64, 51 S.Ct. 438, 75 L.Ed. 844, sometimes hereinafter referred to as the earlier case, it was determined that the San Juan River from the mouth of Chinle Creek downstream to its confluence with the Colorado River, a distance of 133 miles, was non-navigable at the date of the admission of Utah to the Union on January 4, 1896. That case was decided in 1931.

In 1959, the United States instituted in the United States Court for Utah this action to quiet title in the United States to the land constituting the bed of the San Juan River in Utah from the boundary line between Colorado and Utah downstream to the mouth of Chinle Creek, a distance of approximately 55 miles, subject to rights of third parties not having pertinency here. Utah, George D. Fehr, Earl E. Fehr, Joe Lyon, Jr. and United Western Minerals Company, a corporation, were joined as parties defendant. By answer, Utah asserted ownership of such land, subject only to mineral leases which it had executed to the defendants George D. Fehr and Joe Lyon, Jr.; and by counterclaim it sought to have its title thereto quieted. By answer, the defendants, George D. Fehr, Earl E. Fehr, Joe Lyon, Jr. and United Western Minerals Company, asserted interests in the land under mineral leases issued by Utah; and by counterclaim,

they sought to have such interests quieted. A stipulation was filed in the case in which it was agreed that the first issue to be determined was whether the segment of the river in question was navigable at the time Utah was admitted into the Union. It was further agreed that if it was determined that the river between such points was not navigable at that time, no other issues remained in the case. And it was further agreed that if it was determined that the river ***25** between such points, or any significant part thereof, was navigable on such date, certain other issues would emerge for consideration. A pretrial order was entered that there would first be a trial and determination of the question of navigability of the stream between the two points mentioned. The case was tried upon the sole issue of navigability. The court found and determined that no significant part of the river between the two points was navigable at the time Utah was admitted into the Union. Judgment was entered quieting title in the United States, and the appeal is from that judgment.

[1] **[2]** Title to the land constituting the bed of the San Juan River within Utah passed to the State when it was admitted to the Union if the river was then navigable; and if it was not navigable, title remained in the United States. United States v. Utah, supra.

[3] **[4]** **[5]** While applying the rule sometimes presents difficulty, it has been held without deviation over a long period of time that the test for determining the question of navigability of a river is whether the stream in its natural and ordinary condition is used or is susceptible of being used as a channel for commerce over which trade and travel is conducted or may be conducted in the customary modes on water. The Daniel Ball, 10 Wall. 557, 563, 19 L.Ed. 999; The Montello, 20 Wall. 430, 22 L.Ed. 391; United States v. Rio Grande Dam and Irrigation Co., 174 U.S. 690, 698, 19 S.Ct. 770, 43 L.Ed. 1136; United States v. Cress, 243 U.S. 316, 37 S.Ct. 380, 61 L.Ed. 746; Economy Light & Power Co. v. United States, 256 U.S. 113, 121, 41 S.Ct. 409, 65 L.Ed. 847; Oklahoma v. Texas, 258 U.S. 574, 586, 42 S.Ct. 406, 66 L.Ed. 771; Brewer-Elliott Oil & Gas Co. v. United States, 260 U.S. 77, 86, 43 S.Ct. 60, 67 L.Ed. 140; United States v. Holt State Bank, 270 U.S. 49, 56, 46 S.Ct. 197, 70 L.Ed. 465; United States v. Utah, supra; United States v. Oregon, 295 U.S. 1, 14, 55 S.Ct. 610, 79 L.Ed. 1267; United States v. Appalachian Electric Power Co., 311 U.S. 377, 406, 61 S.Ct. 291, 85 L.Ed. 243. Navigability does not depend upon the mode or modes by which trade and travel is conducted upon the stream, but upon whether the stream in its natural condition is one which affords a channel for useful commerce. Brewer Oil Co. v. United States, supra. And navigability, in the sense of law, is not negatived or destroyed merely because of watercourse interruption caused by occasional natural obstructions or portages. Neither is it essential to navigability that the stream be open to navigation at all seasons of the year, or at all stages of the water. Economy Light & Power Co. v. United States, supra; United States v. Appalachian Electric Power Co., supra. But the general rule which emerges clearly from these cases considered collectively is that in order to be navigable in fact and in law, a river in its natural and ordinary condition must be used or be susceptible of use as a channel for commerce in one or more of the customary modes of trade and travel by water.

[6] The substance of the major attack upon the judgment is that, tested by the general rule for determining navigability of a stream, there was insufficient basis of fact for the finding and determination that the San Juan River in the area in question was not navigable at the time Utah was admitted into the Union. The trial was extended and the evidence was voluminous. Some of the witnesses were aged persons with personal knowledge of parts of the stream area in question in the late years of the last century and the early years of the present century; and the testimony given by some witnesses at the trial of the earlier case with like knowledge was read in evidence. In general, the testimony of such witnesses concerning the river related to volume, flow, width, depth, irregularity, floods, dry periods, sediment content, quick-sand, sand bars, sand ***26** waves, shifts in channel, braided channel, freezes, use of boats, ferrying in going to and from trading posts, crossing on foot, crossing on horseback, crossing in wagons, driving animals across, and other activities. Films were exhibited. Expert witnesses testified, including persons with experience as pilots of river craft. And reports, records, and documents were placed in the record. According to these various types of evidence the weight to which it thought they were appropriately entitled, the court made these findings, among others. Except as noted in the findings, the river in the area in question has not changed its general characteristics since 1879. The river is unstable. It flows through a broad, sandy, flood plain which is from 1,000 to 5,000 feet wide and which is encased between rocky cliffs or steep slopes. The average slope of the river exceeds seven feet per mile. The river is exceedingly irregular in flow. By reason of the flat and sandy nature of the flood plain, the irregularity in flow, and the rate of fall, the river is constantly shifting its channels. It runs in a single channel for only a short distance and generally has braided channels. For most of the time and most of the distance in question, it runs in from two to many channels at the same time; and none of

such channels presents an adequate or continuous channel for the passage of boats. The flow is generally low for most of the months in the year. On more than one occasion when the river ran dry, fish died in pools; and Indians found it necessary to dig in the river bed to secure water for themselves and their animals. Indians crossed the river frequently, usually on foot or on horseback; but they made and used small boats for ferrying purposes in going to and returning from trading posts. There was a gold rush along the river in about 1892 and 1893. Several hundred prospectors came into the country in search of gold. Most of them went along the stream to the point or points of activities by horseback, by burro, or by wagon; and most of their supplies were taken there in that manner. A few of the prospectors went downstream in small rowboats constructed locally and took with them small amounts of supplies, bedrolls, and equipment. None of them came upstream in boats. The record as a whole makes it clear that the court in its grapple with the ultimate question of navigability was sensitive to the general rule for determining the question; and that in reaching its conclusion upon the question, the court gave consideration to the several factors which threw light upon the question. The findings are adequately supported by the evidence and are not plainly wrong, due consideration being given to the opportunity of the court to observe the witnesses, to weigh their credibility, and to weigh their testimony, particularly the recollections of aged persons relating to long-past conditions and events. In United States v.Appalachian Electric Power Co., supra, it was stated that in some cases involving the navigability of a water course, the court entered into consideration of the facts found below to determine for itself whether the proper legal tests had been applied to the facts found. We have exercised that function in this case. We think the trial court applied the proper legal tests to the facts found; and moreover, we share with the trial court the view that the part of the river in question was in fact and in law non-navigable at the time Utah was admitted into the Union.

[7] **[8]** The findings of fact are challenged on the ground that they fail to meet the requirements of Federal Rule of Civil Procedure 52(a), 28 U.S.C., which provides in presently pertinent part that in actions tried upon the facts without a jury, the court shall state the facts specially. It is argued that the findings consist of elaborate dissertations upon various isolated bits of evidence, erroneous statements of other items of evidence, exaggerated descriptions of events, contortions of various incidents, and inaccurate and misleading comparisons sons of the San Juan River with other ***27** rivers; and that they fail to disclose how the court arrived at its decision. The intended purpose of the rule is to aid the appellate court in acquiring a clear understanding of the basis of the decision of the trial court. Tulsa City Lines v. Mains, 10 Cir., 107 F.2d 377; United States v. Horsfall, 10 Cir., 270 F.2d 107. We think the findings meet the requirements of the rule and therefore are not open to the criticism directed against them.

[9] **[10]** **[11]** **[12]** Complaint is made that the court erred in taxing costs against Utah. It is argued that being a sovereign state, Utah was immunized from liability for costs. It is the general rule that in the absence of an authorizing constitutional or statutory provision, a state court may not tax costs against the State. But this case was not in a state court. It was in the United States Court for Utah. Utah was a party litigant as a defendant and as a cross-complainant. The court had jurisdiction of the cause and of the parties. The incidents of the hearing in the exercise of the jurisdiction of the court included power to tax costs. And in such circumstances, the attributes of sovereignty did not immunize the State against the taxing of costs against it. Fairmont Creamery Co. v. Minnesota, 275 U.S. 70, 48 S.Ct. 97, 72 L.Ed. 168. And it is further argued that the other defendants were not necessary parties to the litigation and therefore costs should not have been taxed against them. These parties asserted mineral interests in the lands in the river bed, and they sought judgment quieting their title to such interests. Except as otherwise provided by statute, the taxing of costs rests in the sound judicial discretion of the trial court, and the exercise of such discretion will not be disturbed on appeal except in case of abuse. Crutcher v. Joyce, 10 Cir., 146 F.2d 518; T. & M. Transportation Co. v. S. W. Shattuck Chemical Co., 10 Cir., 158 F.2d 909; Euler v. Waller, 10 Cir., 295 F.2d 765. There was no abuse of discretion in this instance.

The judgment is affirmed.

83 S.Ct. 47
Supreme Court of the United States

UTAH et al., petitioners,
v.
UNITED STATES.

No. 284. | October 8, 1962

Facts and opinion, 304 F.2d 23.

Attorneys and Law Firms

Ronald N. Boyce, Asst. Atty. Gen., of Utah, and Dennis McCarthy, for petitioners.

Solicitor General Cox, Roger P. Marquis and A. Donald Mileur, for the United States.

Opinion

Petition for writ of certiorari to the United States Court of Appeals for the Tenth Circuit.

Denied.

Parallel Citations

83 S.Ct. 47 (Mem), 9 L.Ed.2d 65

Aluminium in shipbuilding

Light, strong, and corrosion-resistant aluminium is the ideal metal for shipbuilding.

It was first used for building a steam passenger boat in 1891. The boat named Le Migron was designed in Switzerland on the order of Alfred Nobel and was intended to carry 8 passengers. This was the first boat partially made of aluminium, which confirmed the very opportunity of using aluminium in shipbuilding.

It is notable that just three years later, in 1894, the Scottish shipbuilding yard Yarrow & Co presented a 58-m motor torpedo boat made of aluminium. This boat named 'Falcon' was manufactured for the navy of the Russian Empire. The boat reached a speed of 32 knots, a record for those times.

A year later, the aluminium boat 'Defender' won one of the most prestigious regattas in America (The America's Cup), which was final proof of the advantage of the new metal. But in 1895 the cost of aluminium was 35 higher than the cost of steel, which hampered active use of the 'light metal'. Another shortcoming was discovered later on: corrosion. Although it sounds strange today, it turned out that the yachts made of aluminium at the beginning of the century were exposed to severe corrosion in salt water. The service life of all these vessels turned out to be significantly less than that of similar vessels made of steel. Imperfect manufacturing processes and a lack of understanding of all aluminium properties and its capabilities hampered wide dissemination of this metal in shipbuilding. Engineers faced a complex problem which they managed to solve only a few decades later.

Throughout the years, steel was the most popular material in shipbuilding, leaving no alternative, due to its strength and low cost. Though steel has many advantages, its major drawback is its considerable weight. Construction of vessels with more and more carrying capacity made them bulky and led to poor control. For example, during the past century since 1910 the maximum weight of vessels increased more than twice: from 46,000 t ('Titanic') to 109,000 ('Golden Princess'). The weight factor is very important in shipbuilding, because finally it determines the vessel speed and the transported payload weight. And the faster the vessels and the more weight they carry, the faster the return of investments in construction and the more profits received by ship owners. This was what motivated the studying of aluminium and its capabilities. It is known that using the 'light metal' allows reducing the ship weight by over 50%.

The first studies of aluminium alloy properties were initiated in the very beginning of the century, but only by the forties did the researchers who studied the issue of aluminium corrosion in seawater discover that adding a small amount of magnesium and silicon, made aluminium resistant to salt water. Alloy 5083 is considered the base alloy of the shipbuilders; it was registered by the Aluminium Association in 1954. Although this alloy is often called the 'shipbuilding' alloy, it is also widely used in many other industries. Alloy 5083 initially won popularity in shipbuilding thanks to its properties, such as high strength, corrosion resistance, good mouldability, and excellent welding characteristics.

By the 1960s, improvements in the technology, as well as reduction of the cost of aluminium led to extensive use of the 'light metal' in shipbuilding. Aluminium was used in manufacturing the shells of yachts, superstructure, masts, and port infrastructure. In the seventies, high-speed passenger vessels first appeared in Scandinavia - catamarans made of aluminium. Being light and quick, they proved their profitability and speed advantage, and became standard for passenger transportation for many years.

At present, aluminium alloys used in shipbuilding corrode 100 times slower than steel. During the first year of operation, steel corrodes at a speed of 120 mm/year, while aluminium – at a speed of 1 mm/year.

Therefore, aluminium vessels do not require such extensive care as steel vessels, which has an impact on the cost of their maintenance. As a rule, all sports vessels are made of aluminium, from the shell to the superstructures, which provides a significant gain in speed; shells of higher-capacity vessels are made of steel, while superstructures and other auxiliary equipment is made of aluminium alloys, reducing the total weight of the vessel and increasing its carrying capacity.

Until recently, alloy 5083 virtually had no competitors among other aluminium alloys. In 1995, Pechiney Co. (France) registered aluminium alloy 5383, which is an improved version of alloy 5083. The corrosion resistance of the metal was increased, and its impact strength was increased by 10%. These improvements potentially allow for a considerable reduction

in the mass of welded vessels, and include the increase of the yield point of welded constructions by 15%. Together with the characteristics dealing with shaping, fold, cutting, and weldability, which are at least equal to the characteristics of alloy 5083, they make alloy 5383 very attractive for manufacturers of larger and high-speed vessels.

In 1999, Corus Aluminium Walzprodukte GmbH (Koblenz, Germany) registered aluminium-based alloy 5059 with the American Aluminium Association, which was called Alustar. This new alloy proved that aluminium can be stronger than steel. The alloy has the values of ultimate strength and yield point comparable with the corresponding values of low-alloy steel S235, AlCu4SiMg (AA2014). This alloy developed for the shipbuilding industry also has considerably improved strength characteristics compared to the traditional alloy 5083. The yield point before welding is increased by 26% and by 28% after welding (welding of heat-treated sheets H321/H116 made of AA5059 alloy grade).

Studies continue, and probably, very soon the scientists will present us even lighter and stronger aluminium alloys, which will allow manufacturers to create vessels and structures of the new generation.

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OUTDOORPLACES.COM BUYING A CANOE

Buying The Right Canoe

Buying the right canoe is a hard decision. If you are a first time purchaser, the task can be quite confusing. Canoes come in a variety of materials, sizes, weights, and they all have unique purposes. The first time buyer will also be quick to discover that the cost of all of the accessory equipment may equal that of the canoe!

Buying the right canoe for your needs can be made a little easier if you know the right questions to ask. A little education before visiting your outfitters to select your canoe (and the OutdoorPlaces.Com e-Store for your gear) will go a long way and could potential save you thousands of dollars by avoiding making the wrong choice in your canoe and/or gear.

Materials

Canoes are made from a variety of materials and they all have their separate merits. While one material may excel in whitewater conditions, another may be a better choice for flat water touring. The material used to make a canoe has tremendous impact on the cost. Recently, due to the weak Canadian dollar to the US dollar, American's are enjoying incredible pricing on materials that would be out of reach under less than ideal economic times.

Aluminum and Aluminum Alloy: Once the standard for the middle-of-the-line canoe, aluminum has been taking a back seat to all of the new resin and synthetic materials on the market today. True aluminum is about the heaviest material you can get in a canoe. It is tough, durable, and will take being dragged over the bottom very well. It does not have a gel coat or polyethylene skin that makes it subject to abrasion. The outer hull is not subject to fading or degradation from long term exposure to sunlight, and extremes of hot and cold do not effect the material.

On the other hand aluminum does not have a memory and will dent if it takes a hard hit. Aluminum is "sticky," that is it will tend to grab if it hits an underwater object which can be big trouble when in whitewater. The heavy weight makes the canoe difficult to maneuver for an amateur paddler, and even more difficult to portage (carry on your back). If aluminum is punctured from hitting a rock, it is very difficult to repair and the evidence of the repair will be impossible to hide. Aluminum canoes usual require buoyancy chambers to assist in keeping it afloat.

Aluminum canoes are idea for flat water, especially lake front property where the canoe will be stored outside year round and used for casual paddling and flat water excursions. If you plan to do whitewater or be in a very rocky environment, aluminum is probably not your best choice. If you plan to do any kind of touring, you should probably stay away from aluminum due to it's weight for portage.

Aluminum alloy canoes are thinner, lighter, and stronger than true aluminum. Some alloy constructed canoes can be lighter than their synthetic cousins. If you are evaluating an aluminum alloy boat, make sure to ask a lot of questions. If you plan to use your boat for portage and touring, you will probably want to test out an alloy boat to make sure their claims of lightness are true. Not all alloy boats are created equally and when considering a lightweight aluminum canoe you need to be careful.

Polyethylene: Polyethylene is the same material used to make bleach, milk, and other plastic bottles we use every day. It is very flexible, yet durable, and has a memory, that is, if it is flexed, it will return back to it's original shape. Two of the most popular polyethylene models on the market today are made by Coleman™, branded under the Ram-X™ name, and by Old Town Canoe™ branded under the CrossLink 3™ name and used in their Discovery™ series.

The problem with polyethylene is that is very flexible, imagine walking on a suspended floor made out of bleach bottle material! Coleman™ overcame this problem by creating a frame work of aluminum to form a keel, ribs, gunwales, and cross braces to stiffen the canoe. Factors including a low price point, do-it-yourself assembly, strong brand recognition, and broad distribution has made this the number one selling canoe. Polyethylene is flexible, and takes to smoothed dings very well. However, it is relatively soft, and branches, rocks, and sharp edges tend to cut the material. The material is not naturally buoyant, and most true poly canoes have buoyancy chambers. Abrasion is the number one cause of death for a polyethylene canoe. Polyethylene is relatively easy to repair, but due to it's relatively low cost, most canoes damaged to that point are usual disposed of and replaced.

Old Town Canoe™ came up with a different solution for Polyethylene. By taking two layers of polyethylene and sandwiching a 3/8" thick layer of polyethylene foam they created a material called CrossLink 3™. The resulting material had almost all of the positive qualities of Royalex, it is naturally buoyant due to the foam core, yet is more resistant to abrasion then straight polyethylene. The resulting product line was called Discovery™ and the line still sells today. Due to the stiffness of the foam core, the Old Town Canoe™ does not require a framework of keel, ribs, and supports. Also because it has a foam core, the canoe is naturally buoyant, leaving the bow and stern section of the canoe open for storage.

Polyethylene canoes as a class are lighter than true aluminum (alloy can be lighter than polyethylene), and in some cases even lighter than a poorly designed fiberglass canoe. However long term portage of a polyethylene canoe will test the endurance of any paddler.

Polyethylene canoes made from solid material like Ram-X™ are good for flat water, and Class I and II- rivers that do not have jagged rocks, and numerous strainers that could lance the hull of the canoe. Composite foam core materials like CrossLink3™ are also good for flat water, but will withstand Class I, II-, II+, and III water much better and are more cut and abrasion resistant.

More canoe materials...

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OUTDOORPLACES.COM BUYING A CANOE

Buying The Right Canoe - Materials

Royalex: Royalex is made out of layered ABS plastic (bowling balls are made from ABS plastic) with a 1/2" foam core. Some canoes are made with as many as fourteen layers, while others only have a few. The outer-hull should have a vinyl coating to protect the ABS, which is very sensitive to the suns UV rays. Knowing this you need to ask how many layers of ABS are in Royalex, as not all canoes in this category are created equal.

Royalite, which is a sub-set of Royalex is probably the material of choice today for a middle of the line canoe. Lightweight, extremely durable, and extremely slippery, it is an ideal material for whitewater running. Because it has a foam core, it is natural buoyant, and because it is multiple layers of material it is very rigid yet has a strong memory. If you plan to wrap a canoe around the rocks, this should be your material of choice.

Royalex and Royalite is not the perfect material, however. Because it requires a vinyl skin, dragging it across branches and rocks will cause a lot of abrasion on the hull. Royalex and Royalite does not do well to long term sun exposure and will require indoor storage. The cells in the foam core contract and expand, and temperature extremes in storage (above or below "normal" North American temperature extremes) can stress the material. Royalex and Royalite is more difficult to repair if the hull is breeched then polyethylene, but damage to the hull of that extent is less likely.

Royalex is best the best all around material whether your plans are flat water, to extreme whitewater conditions. Royalite in particular is very lightweight, and can be half the weight of an equal sized polyethylene canoe making it ideal for portage. If you plan to use a canoe with only limited frequency and want to store it outside, you might be better off considering aluminum or an alloy canoe.

Kevlar: Kevlar was made famous by it's application in bullet proof vests. Extremely light weight and extremely durable, Kevlar is an excellent choice if you plan to operate in more extreme conditions. It is even lighter than Royalite, but it can be very expensive. Some of the best deals on Kevlar canoes can be found in Canada, where the US exchange rate plays into the cost of manufacturing.

Kevlar is a weaved material, similar to a cloth fabric, and appears honey-gold in it's raw form. This material weave is soaked in resin, shaped and cured to create the canoe hull. Kevlar frizzes if it gets damaged so the hull should have an outside coating made up of a number of possible materials, including fiberglass (also possible weaved in with the Kevlar), composites, polyethylene, and resin gel coat. Some manufacturers are taking Kevlar fibers and weaving them with fiberglass, which makes for a somewhat heavier but more durable canoe (but still typically lighter than Royalite and almost 1/2 the weight of full fiberglass). It is the easiest material to portage being very light weight. It is also very slippery which in part makes it extremely ideal for whitewater.

Kevlar in it's pure form is not the most ideal material for a canoe. Although it is very durable and can take shock very well, severe shock can crack a hull. Kevlar is very difficult to repair and the repairs are next to impossible to hide. The gel coat is easily abraded, and exposed Kevlar will shred out in fine fibers, next to impossible to repair. Materials blended with fiberglass are much better for extreme whitewater, and Kevlar is the material of choice for extreme paddlers.

Kevlar is very expensive and unless you plan to paddle in Class III+ or above, or plan to do frequent and long portages, if you are new to paddling, it is probably a case of over kill. However, if you can get a good Kevlar composite canoe for the cost of a Royalex one, you may do very well to consider the bargain that is available today, but be sure to invest in a gel coat repair kit and learn from some one who has used a repair kit in the past.

Fiberglass: Like aluminum, fiberglass has been around a long time as a material for canoes. The fiberglass canoes of twenty and thirty years ago have given way to a whole new breed of materials that are integrated with other fibers including Dacron and carbon fiber. A top of the line fiberglass canoe reinforced with Kevlar can be just as durable.

Fiberglass is more difficult to repair, but not as bad as Kevlar or aluminum. Repairs are easier to hide and the canoes tend to be very resistant to abrasion. S-glass and Gel-coat are the best materials for abrasion resistance. Like Kevlar, composite fiberglass is a good canoe for whitewater while basic fiberglass (which can be cheaper than polyethylene) is not. Fiberglass is not very resistant to shock, and a hull slammed up against rocks can crack. The outer materials are sensitive to sunlight and require indoor storage.

Fiberglass composite may be an excellent alternative to Royalex or Kevlar for whitewater. In it's pure form, it is best suited for limited use in flat water. Weight can vary from manufacturer and the composite blend used. Some fiberglass canoes can weight as much as an aluminum hull! If you are new to buying canoes, fiberglass is a difficult material to decide upon, and has a lot of variables. Just because a canoe is lightweight, does not mean it is high quality. Make sure to ask a lot of questions when considering a fiberglass canoe, and if you plan to whitewater, make sure to get a durable composite material.

Wood, Canvas, Cedar Strip, and Birch Bark Canoes: If money is no object, there can be a lot of satisfaction in owning a classic natural material canoe. Lightweight, wood, canvas, cedar strip, and birch bark canoes paddle like a dream, and will draw a lot of attention where ever you go. There hulls can be damaged very easily, and some designs require buoyancy chambers. Unless you have a trust fund, or have headed up five internet startups that have IPO'ed, you probably are not going to take a natural material canoe into whitewater. These canoes are ideal for flat water touring, and nothing can beat paddling in a remote area in a natural material canoe.

Natural material canoes are high maintenance, and do not do well to long term outside exposure. They are not the lightest materials (when compared to their very expensive synthetic counterparts), nor the most durable. They can be repaired very easily, but require training or in some cases craftsmen to issue repairs. Natural materials canoes are very expensive, and can cost over $4,000 US. Quality manufacturers are typically backlogged in production, as these canoes have to be hand built and the skill set required to make these beauties are in short supply.

Deciding on what style of boat...

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Paddling a Canoe to Success

By Lawrence Striegel
Staff Writer

Photo

John Achilich, one of the creators of the Grumman canoe in 1945, takes his fiancée, Olga Baumann, for a paddle in a 15-foot model recently in Arrowhead Lake in Baiting Hollow. (Newsday/Daniel Goodrich)

William Hoffman, left, was the Grumman executive who sold the idea of the aluminum canoe to Leroy Grumman, the company president. (Northrop Grumman Corp.)

Grumman himself showed off its buoyant qualities for a publicity photo. (Northrop Grumman Corp.)

A GRUMMAN CORP. executive was portaging a heavy wood-and-canvas canoe in the Adirondacks in 1944 when he wondered if the activity might be easier if the vessel were made of aluminum.

World War II was drawing to an end and William Hoffman, a company vice president, knew that defense contractors would be looking to convert their factories for peacetime production. As he heaved the old-style canoe around, he figured that Grumman could make lighter, sturdier aluminum models with the same metal-working expertise it had used to make thousands of Hellcat, Tigercat and Bearcat warplanes.

Company heads Leroy Grumman and Jake Swirbul liked the idea. Soon, 17-foot-long prototypes were being built in the employees' bowling alley in Bethpage. After a successful test in the rapids of the Allagash River in Maine, the Grumman canoe was launched. A model was displayed in the window of Abercrombie & Fitch in Manhattan and in October, 1945, Leroy Grumman announced that the company had invented a 13-foot, 38-pound model that "even a woman can carry." The New York Times described it as lighter "than Hiawatha's birchbark vessel ... and impervious to either porcupines or termites."

The Aluminum Company of America provided a special aluminum alloy for the hull -- and an expert, too. Russell Bonetcou, a sportsman who years earlier had worked with Alcoa on the aluminum canoe idea, joined Grumman on the project.

As Grumman geared up for mass production, Hoffman tapped John Achilich, a Grumman tooling engineer, to design larger canoes of 15, 17 and 19 feet. Achilich, a lanky 27-year-old, was excited about the assignment. As a teen growing up in the Bronx, he had built his own wood-and-cloth kayak. And before and during his college years at Pratt Institute, he had worked as a lifeguard and canoe instructor.

With instructions to keep quiet about the project, he was sent to work alone in a remote office in a hangar at Bethpage Plant 2. Over the course of about a month, Achilich, often working into the night, laid out paper on top of long pieces of thin aluminum to draw hull lines. From his designs, hard-wood molds would be created over which sheets of aluminum would be "stretched" on presses to make each half of the canoe.

Part of Achilich's challenge was to engineer smooth lines that would prevent the aluminum from wrinkling during pressing. Eventually the halves would be held together with rivets and extrusions at the seams, as well as ribs and seats reaching from side to side.

"A canoe is a canoe is a canoe," Achilich, now 81 and living in Bethpage, said recently. "The important thing about the Grumman canoe was that it was so strong. It had a nice flat bottom for stability and had a nice prow."

In a 1976 company book called "The Grumman Story," Hoffman said the corporation improved the conventional canoe by adding water-tight compartments at the bow and stern so the vessel "would not only remain afloat when swamped, but also support several people while awash."

Grumman canoes -- known for the booming sound they make when hitting a dock or rock -- became fixtures at summer camps and rental sites on rivers and lakes. They were so popular that Grumman built a separate boat manufacturing plant in Marathon, 40 miles south of Syracuse, to open up space in Bethpage for Korean War aircraft production in 1952.

This past winter, Paddler, a national boating magazine, honored Hoffman and Achilich by naming them two of 100 "Paddlers of the Century."

"Hoffman and Achilich influenced canoeing in the last half of the twentieth century like few others, by introducing light, rugged boats at an easily affordable price," the magazine wrote. A Grumman canoe, Paddler publisher and editor Eugene Buchanan said recently, could take a beating. "You could put the wife and kids and kitchen sink in the thing and ram it into rocks," he said. The public bought thousands. A 1975 brochure cited sales of more than 300,000 Grumman canoes in 30 years. Demand peaked in 1974 with sales of 33,000, propelled by the 1972 movie "Deliverance" and concerns about fuel consumption during the mid-'70s energy crisis.

Grumman through the years expanded into several types of aluminum vessels, including square-backed canoes, fishing boats, pontoon boats and hovercraft, and even found a way to rig its canoes for sailing. But aluminum canoe sales eventually dropped to perhaps 4,000 a year as plastic and fiberglass models became popular, according to Kip Towl, a former head of Grumman Boats who is now retired in Centerport.

Grumman's boat division was sold in 1990 to Outboard Marine Corp. and then in July, 1996, OMC produced its last Grumman-brand canoe. Only a few months later, however, four former Grumman and OMC employees and an upstate investor formed Marathon Boat Group Inc. and began pressing out canoes again at the old Grumman plant in Marathon. Today's 17-footer sells for $775, plus shipping, compared with about $205 in 1953, according to Greg Harvey, Marathon's sales manager.

"Aluminum is no longer the king, but it has its own market," said Harvey. "We virtually kept the canoe from disappearing."

For his part, Achilich was involved in the canoe project at Grumman for only about a year. He later worked in engineering for a variety of companies and in research for the U.S. Navy. In 1966, he returned to Grumman, where he was in charge of training-equipment facilities for the F-14.

In his off hours, he sometimes paddled Grumman canoes with his sons, Steve and Ken, on the Delaware River and as a Suffolk County Boy Scout commissioner. Achilich said he never spoke much about his role in creating the canoe, although friends filled a Grumman model with ice and beverages at his retirement party in 1989.

"It isn't until you're old and white-haired that you think, gee, that was a pretty good thing we were doing," he said.

WOODEN CANOE HERITAGE ASSOCIATION

CANVAS FILLER FORMULAS

Canvas filler formulas have been guarded for decades by wood canvas canoe builders all over the world. The formulas below have been published or made available in a legal manner and not "stolen" or otherwise "borrowed" without permission. If you have another formula that is not listed here, please send it in!

One note about filler formulas. The materials that were used in the early 1900's may not be the same as materials with the same names today. In addition, canvas is certainly different today than it was in 1900, so some of these formulas may not provide the best coverage for your money.

Commercially prepared formulas are available from builders in the Online Builders & Suppliers Directory.

- Reprinted from Wooden Canoe #16 (no lead)
  - 43 ounces boiled linseed oil
  - 21 ounces mineral spirits
  - 34 ounces enamel paint
  - 2 ounces Japan drier
  - 6 1/4 pounds 300 grit silica
  - 2 ounces spar varnish

- "Rushton's Filler" - Reprinted from Wooden Canoe #20
  - 5 pounds silica
  - 1 1/2 quarts turpentine
  - 1 quart boiled linseed oil
  - 1 pint Japan drier
  - 2 pounds white lead

- Reprinted from Wooden Canoe #31
  - 1 quart boiled linseed oil
  - 4 pounds silica
  - 7 ounces Japan drier
  - 3 quarts turpentine
  - 4 pounds white lead

- From Scott E. Marks, picked off the USENET group rec.boats.building by Phil Gingrow.

I can suggest a recipe, the best I remember it from 20 years ago. It was based on glaziers putty and floor varnish - we used Hippo Oil brand at the time. Glaziers putty is basically clay and linseed oil. We warmed the varnish and mixed (kneaded) the putty into it by hand. I honestly don't remember the proportions, but we ended up with something like a thick pancake batter. To this we would add some japan drier to accelerate drying. This mixture was worked into the nap of the canvas by hand, in thin coats. If allowed to dry between coats, it wouldn't build up into a single soft thick layer. It would remain flexible, and as many layers were applied as were required to fill the canvas. Two coats of orange shellac with light sanding between were applied over it prior to painting with enamel paint. This recipe originated from someone in the Dwight, Ontario area, who was generous enough to teach a few of us to repair and re-canvas the fleet of Chestnut canoes we battered on the rocks of Algonquin park.

More from Dom Williams: I used your site to prepare a filler based on the floor varnish/glaziers putty/indian dryers mixture listed in the site; the author could not remember proportions. 0thers using this formulation may be surprised to find how much putty is required versus varnish. I wound up with a mix of 1cup varnish/ 2 1/2 lb putty and 1 tablespoon of dryers and probably would have been better to increase the putty to 3lb. To refinish a 16 ft canoe with the existing filler largely worn away by use and/or paintstripping I used 4 batches ie 1 quart of varnish and 10lb of putty; the final batch was not all used. I found it applied best using a cheap 8 inch plastic drywall knife (the more flexible the better) and applied it from the gunwales up and then from the centerline to meet the "upstroke". I "spot-primed " the areas where the old filler had largely washed out of the canvas by hand rubbing glops into the weave before doing the overall trowelling.

NOTES

1. **Silica** can be purchased at pottery supplies under the brand name Silex. Silex dust can cause breathing problems, so please *always* use a respirator when sanding filler.
2. **Lead** is known to cause brain damage when absorbed through the skin or inhaled as dust. *Be very cautious* using and disposing of white lead in your filler.

NAVIGATION AIDS

[WCHA Home Page]

CHOOSING YOUR CANOE

By John Winters

Choosing the best canoe for your purposes from among the many different models available would be difficult under the best of circumstances, but given the claims, counter claims and advertising exaggerations, the job is nearly impossible. Even the best paddlers have different opinions on the best canoe for any given purpose. Short of undertaking a full scale study of hydro-dynamics, the buyer is on his own. Fortunately, a knowledge of design fundamentals can help you separate the most promising canoes for your needs from those that are unsuitable.

The following explanation of how canoe performance is affected by shape, is written by designer John Winters. It should allow you to evaluate, in an objective manner, the merits of different canoes. If you have an interest in the more technical aspects of design, we recommend you to read John's articles at Green Valley Boat Works:
http://www.greenval.com/jwinters.html

FACTORS AFFECTING PERFORMANCE

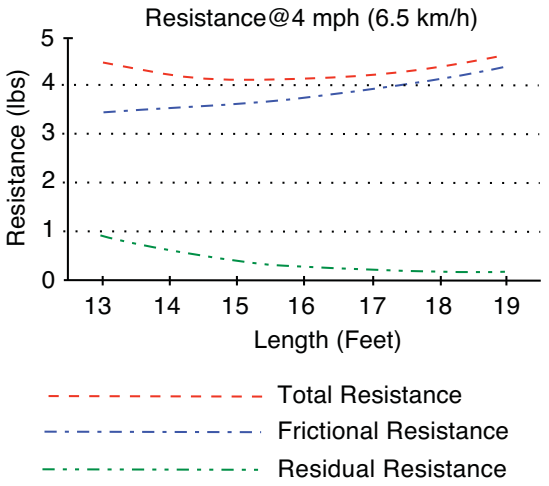
Every canoe is a compromise between conflicting needs. For example, many of the characteristics that make a canoe stable also make it hard to paddle, and many of the features that make a canoe track will also make it hard to turn. Obviously we can't have everything we want in the same boat and must find the best compromise to suit our requirements. The designer faces the task guessing what compromises will appeal to the costumer. How well he does this will determine how many canoes of his design are sold. You might think that after thousands of years of development, canoes would be pretty standardized, but they aren't. In fact, the variety has increased as boats are designed for ever smaller niches in the market.
Further complicating is the fact that only recently, rudimentary scientific principles have been applied to canoes and their design has lagged well behind that of yachts and other watercraft.

Nevertheless, canoeing is catching up and more and more designers are applying scientific principles to their designs in an effort to optimize performance. Newer designs can be a significant improvement over traditional types. Their shapes are based on sound rational thinking rather than opinion and subjective guesswork. The down side of this is that the technical aspects are often confusing for the paddler who just wants a good canoe and not an education...

To help you wade through – or avoid – the technical swamps, the following is a general guide for the effects of various hull characteristics. Keep in mind that this is neither all inclusive nor can it be applied to canoes carelessly. *Canoe are complicated subjects and the more we know, the more it seems we have to learn*.

Length — Length is measured at two points, at the waterline and overall. Of the two, the waterline is most important as this is a primary influence on how easily a boat will paddle and, to some extent, how much load it will safely carry. It is commonly believed that longer canoes are faster or easier to paddle than short canoes. This is, however, not the case, for with greater length comes increased wetted surface, and at typical cruising speeds wetted surface accounts for over 80% of all resistance. If you paddle consistently at 40 or more strokes per minute or regularly carry in excess of 500 lb (230 kg) load (all gear plus people!) then you will need a tandem canoe of 18 feet (5.5 m) or longer. On the other hand, if you paddle at about 30 strokes per minute and carry between 400 and 560 lb (180–250 kg) load (people & gear) most of the time, then a 16 to 17 foot (4.8–5.2 m) canoe will be best — and so on down the scale. Too large a canoe will simply mean extra work paddling at your cruising speed.
The designer must take these factors into account when he shapes the hull and determines the dimensions.

The figure below shows a typical graph of resistance used to determine the ideal length at a particular speed. This can be done for any speed, but here it is done at a typical cruising speed for recreational canoeing.

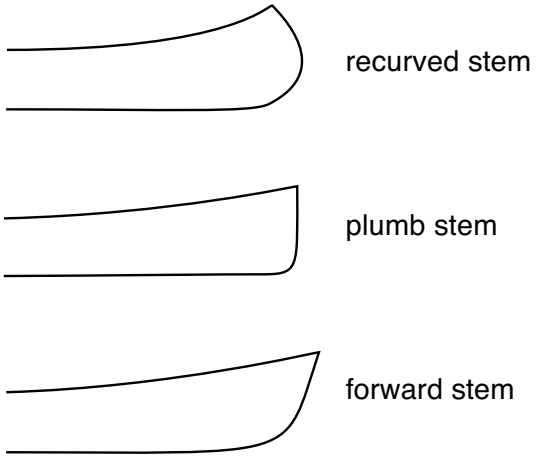


Wavemaking and frictional resistance (bottom and middle curves) are plotted for a single shape but for varying lengths. The two are added together and a curve of total resistance is drawn. You can see that the ideal length for this speed is where the curve is at its lowest point on the red line — in this case 15 feet (457 cm). Designers can choose somewhat greater length though for increased speed potential for stronger paddlers or emergency situations.

Every canoe has a speed at which it is most efficient. This speed is a function of both hull shape and dimensions. The problem for the designer is to match that speed with the power output of the paddler. As you can appreciate, every paddler has a different stroke rate and strength. To determine the proper cruising speed then, a large number of paddlers of varying abilities were observed to arrive at a typical power output. If you are an 'average paddler' and do about 30 strokes per minute, your cruising speed should range between 5.3 km/h when paddling a 15 feet (4.5 m) and 6 km/h for an 18 feet (5.5 m) long canoe.

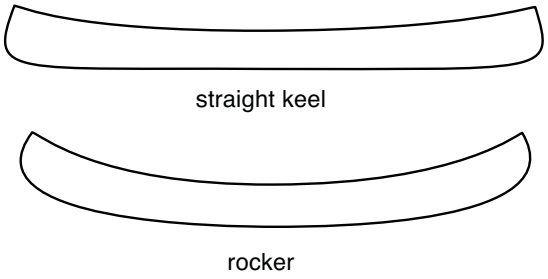
The important thing to be aware of is that even though the longer canoe has a higher cruising speed, you do not get something for nothing and will have to work harder to maintain that speed in the longer canoe. Canoes only go faster if you are strong enough to push them that hard.

The amount of reserve buoyancy a hull will have is a function of overall length and topside shape. Canoes with bows that re-curve in the traditional fashion or have tumblehome have relatively less buoyancy than those with vertical bows which, in turn, have less than those with ends that extend beyond the waterline.

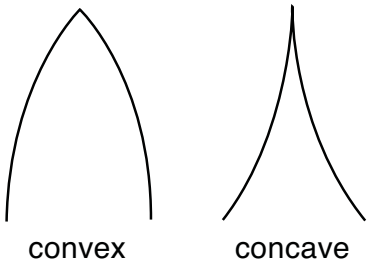


Beam — Waterline beam, properly measured at the actual waterline when loaded, is a good indicator of many canoe characteristics. The familiar 4 inch (10 cm) waterline beam is of little use, as it is simply a measurement of convenience. From a positive standpoint, wide beams provide stability, but the negative aspect is increased resistance. A waterline beam in excess of 18% of the waterline will usually produce a slow stable canoe, while one of less than 14% will make a fast but tippy canoe. The ideal beam for you will depend upon your goals and experience.

Underwater profile — This profile has a major impact on maneuverability and tracking. The greater the amount of rocker, the more easily a canoe will turn but the more poorly it will track. The reverse is of course, and straight keel lines improve tracking to the detriment of maneuverability and also increase wetted surface. A more recent development in the evolution of profiles is that of a straight keel aft to promote good tracking and rocker forward for good maneuverability. Such canoes are not only easier to handle but have more predictable handling in large waves.

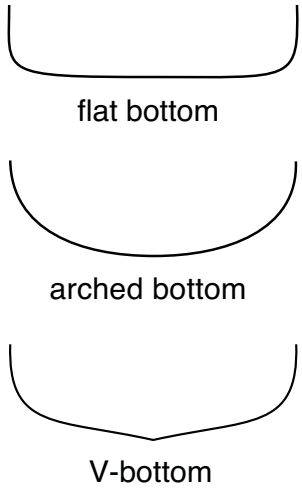


Waterline Shape — The designer's art has its most varied expression in waterline shapes. Over 100 years of scientific testing and research in universities and the leading hydrodynamic labs has taught us what shapes are most efficient, and to vary significantly from them usually results in substandard performance. The most efficient shape for speeds associated with canoe touring is one with straight or slightly concave waterlines forward with a gradual increase in waterline beam to a point 1–5% aft of the middle.



Past that point the waterline can remain full and taper to concave waterlines at the stern. If the waterlines are too concave forward the result is an abrupt increase in volume about one quarter of the way along the hull which will slow the canoe almost as badly as convex waterlines seen on so many thermoformed and aluminum hulls. These same fine ends also bury deeply into waves making maneuvering difficult just when you may need it most. Conversely, full convex entries will pound in waves and allow the hull to be pushed off course by wind and waves. Somewhere between those two lies the best shape. The waterlines aft are largely responsible for how the boat tracks and concave waterlines produce the best tracking while convex waterlines produce greater maneuverability.

Section Shape — There are three basic types of hull section: flat bottom, arched bottom and V-bottom, and some canoe hulls will combine all three in the same hull. How these are combined or used will determine stability, speed and maneuverability. Arched bottoms generally have less initial stability, a more predictable motion in waves and less wetted surface than the other types.



Test data indicates that the best combination is that of 'U' shaped sections at the bow, rounded sections midships, and 'V'd sections aft. The "U'd" forward sections allowing the bow paddler to make effective control strokes while the "V'd" aft sections provide directional control.

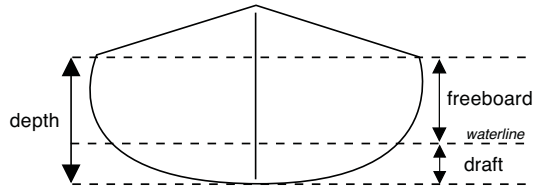
Shape above the water — Hulls can have flare, tumblehome or any combination or degree of these. Tumblehome, when it is located at the paddling position, improves efficiency by keeping the paddle closer to the paddler. What you sacrifice for this efficiency is reduced seaworthiness and a wetter ride through rough water. For wilderness or open water paddling flared sides provide an essential safety margin and, if well thought out, do not hamper paddling significantly.

flare

tumblehome

Stability — The most important aspect of stability is neither the ultimate stability nor the initial stability but how the two work together to give the canoe its 'feel'. Ideally there should be a gradual impression of greater resistance to capsize as heel increases. Canoes with rounded bottoms and flared hull sides will most often have these characteristics. Flat bottomed, 'V' bottomed and canoes with tumblehome can feel good initially but become more tippy as they are leaned. It is far easier to adapt to a little initial tenderness than it is to anticipate and react to an abrupt change under difficult conditions. A simple test is to heel the boat until water begins to pour over the gunwales. At that point it should still right itself. If it keeps going or requires a quick response from the paddler, the boat may very well let you down at the worst possible moment.

Freeboard — While the more common term is 'depth', which is the distance from the sheer to the keel, what you really want to know is how much canoe will be above the water when it is loaded. This is called freeboard. Too much freeboard and the canoe will be blown about by the wind too much. Too little freeboard and waves slop in easily. Tandem touring canoes should have at least 7–8 inches (17–20 cm) of freeboard amidships to assure reasonable dryness, while solo canoes can get by with about 6–7 inches (15–18 cm).



The ends should normally be 1/10 of the overall length, although it is permissible to be a few inches lower in the stern. What is not shown by these dimensions is what shape the sheer profile should be. Since waves come aboard about 2–3 feet (60–90 cm) aft of the bow, the sheer should not have a sharp curvature towards the ends but rise gradually in a smooth uniform sweep.

Summary — There is much, much more to design than the above, but if you search for a boat that fits within the parameters given here you will probably get a good boat. In every case, you should test paddle the boat loaded as you would normally load it and paddle it as you would normally paddle it. The advice of experts is valuable and useful, but you are the one who will have to paddle the boat so it should suit you first and foremost.

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