Barbara Tellman
for SLD
11-16-05

- **Libraries**

Arizona Historical Foundation - Tempe, Arizona
Arizona State Library and Archives - Phoenix, Arizona
Arizona State University Library, Arizona Collection and Indian Collection - Tempe, Arizona
Huntington Research Library - San Marino, California
National Archives and Records Administration Library - San Bruno, California
National Guard Library - Phoenix, Arizona*
Phoenix Historical Society - Phoenix, Arizona
University of Arizona Library, Special Collections - Tucson, Arizona
University of California at Berkeley, Bancroft Library - Berkeley, California
Water Resources Center Archives, University of California - Berkeley, California

- **Other Sources**

Arizona State Land Department - Phoenix, Arizona
Central Arizona Paddlers' Club - Phoenix, Arizona*
Center for Law in the Public Interest - Tucson, Arizona
Lynne Clark Photography (Historic photos) - St. George, Utah

* Contacted by mail to obtain photos or information, not visited.

3.2 A BRIEF HISTORY OF BOATING IN ARIZONA

> *"... Then one day Montezuma's friend Coyote, came by and told him he should build a big dugout canoe. Montezuma could make anything, but didn't know why he needed a canoe. Coyote told him to build it anyway, so he did, and kept in on a mountaintop. Coyote made himself a little boat out of a hollow log.*
>
> *Before long, Montezuma found out why he needed the canoe. A great flood engulfed the land, and Montezuma and Coyote floated on its surface while everything else perished. The two friends tried to find dry land, and when they scouted out the north, they found it. The Great Mystery had already begun to make more people and animals there, and he put Montezuma in charge again, telling him to teach the people all the things they would need to know to survive. ..."*
> *Tohono O'odham Creation Story.*

3.2.1 Introduction

The following is a brief overview of the history of boating in Arizona. Appendix B-2 contains a list of boat illustrations available in libraries and museums and other sources. Appendix B-4 consists of a series of quotes describing boating in Arizona.

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3.2.2 Chronological Summary

Prehistoric Boating - Flood stories are common throughout the world from the Hebrews to the Tohono O'odham, Pima and other Arizona Indian tribes. Many of those stories include boats, as does the story quoted above. The Apache flood story, on the contrary, has people going on foot to the top of the mountain to be saved. Whether or not boats were actually used by those peoples, it seems clear that the concept of boating was prevalent in some Arizona prehistoric societies.

Boats were used on the Colorado River long before the arrival of the Spaniards. One of the names the Spanish explorers gave the Colorado River was "Rio del las Balsas" because of the large number of rafts (balsas) Indians were using on the river. These rafts were made of reed-like materials, wood, or a combination. Rafts were sometimes made of bundles of reeds, agave stalks, or willows fastened together either so that one or both ends was pointed and the sides elevated - in the shape of a canoe or so the raft lay flat in the water. Such rafts are known from California, all along the coast and inland to South America. The Seri Indians who lived on the coast about 100 miles south of the Colorado River delta built reed rafts of highly sophisticated design, well suited for open-water travel on the Sea of Cortez. Rafts were propelled by paddles, poles or swimmers.

Wooden rafts were flat, made of stems or trunks attached horizontally. Both were propelled by poles or swimmers. The first Spaniards reported seeing and traveling on rafts of both types. The rafts were highly maneuverable. There is no evidence that either type of raft was used prehistorically in Arizona beyond the Colorado River and lower Gila River, although it seems possible that such rafts were used on the middle Gila and Salt at some times. Because of the perishability of the materials, proof is unlikely to be found, but archaeologist, Frank Cushing, is reported to have found remains of a canoe in a Hohokam site from the Salt River Valley.

Other prehistoric vessels were made of woven twigs (usually willow) in the shape of a basket and made waterproof with what the Spaniards described as "a bitumen-like substance." Similar boats from southern California were made watertight with tar, probably from the tar pits in the area. Sap from agaves was used to waterproof smaller baskets and may also have been used for these larger vessels. Basket-type boats are reported to have been used by Apaches on the Gila River.

The Quechan made ceramic vessels large enough to carry goods, children and even wives. These vessels were propelled by swimmers. One writer described these as nearly flat vessels, while others describe them as "ollas," rounded vessels for carrying water. There is some evidence of the use of dugout canoes, but these were never as popular as they were farther north all the way to what is now British Columbia where plenty of trees of appropriate wood of fir, cedar, or pine could be easily found.

Beaver trapper, George Yount, said that he built a dugout canoe "after the manner of the Mohave Indians" in the 1820s.

The Arrival of the Spaniards - Several groups of Spaniards arrived by sea along the California coast and the Sea of Cortez in large sailing ships. They proceeded up the Colorado River probably not much farther than the mouth of the Gila River in their ships or in smaller ship's boats of various types - rowboats or canoes. The tidal bore "burro" was often a major problem, but they were able to deal with it. The Spaniards are not known to have used boats on other Arizona rivers as their exploration inland was on horseback and on foot. Most of the missions were established and served by routes inland from Mexico and New Mexico. One description has Father Kino felling a large cottonwood tree in Caborca to provide lumber for a boat to explore the coast and to determine whether Baja California was a peninsula or an island, and determine the character of the Colorado River, but the boat was not completed.

Anglo Trappers - Anglo trappers came to Arizona from the north and east. They were traveling on horseback and on foot, but sometimes constructed boats to get across and down rivers. The most common type of boat was the "bullboat" developed by plains Indians. Originally these boats were made of one bull buffalo hide stretched over a framework of willows or similar wood. In Arizona where there were no buffalo, elk or horse hides were stitched together for this purpose. These boats were propelled with paddles or poles were sturdy but were not very maneuverable and were usually abandoned after serving a particular purpose. In one exploration from Idaho to the Sea of Cortez, two of the trappers' horses were killed for their hides on the first Colorado River crossing and another two later for the return journey. Some trappers used these boats for some distance downstream on the Colorado and Gila Rivers. Trappers sometimes built dugout canoes where they could find appropriate wood along the upper Gila and upper Colorado rivers. There are no appropriate trees in Arizona for the kinds of birchbark canoes common in the eastern parts of the continent.

American Exploration and Surveys along the Lower Colorado River - After 1850 the U.S. Government sponsored a number of surveys of the new territory. Most of these were cross-country trips involving crossing the Colorado River by ferry, but some were designed to explore the river itself by boat. Joseph Ives took a steamboat up the river in 1861 as far as Vegas Wash. The Wheeler Expedition used rowboats (with the occasional addition of sails) to explore parts of the lower Colorado River as far as what they considered the limits of practical navigability - somewhere around the present Hoover Dam. Jacob Hamblin explored the lower Colorado River in the vicinity of the mouth of the Virgin River and in the Lee's Ferry region, usually on foot, but also using rafts and rowboats over a period of about twenty years at the end of the nineteenth century. The first inflatable boat was used in Arizona in 1854 to cross the Colorado River somewhere near Needles on the second Ives Expedition. Balduin Mollhausen drew a picture of this boat and humorously described how the Indians on their easily maneuvered rafts laughed at the Anglos trying to get their clumsy raft across the river. A few years later Edward Beale used an inflatable raft with slightly more success. Use of inflatables, however, did not become common until the development of artificial rubber in the 1940s.

Godfrey Sykes spent many summers boating on the Colorado River, exploring the Delta, often with his family. He conducted scientific explorations along the Colorado and to the Salton Sea for the Carnegie Institution's Tumamoc Hill facility in Tucson. He sometimes hauled lumber to the shore and built his boat on the spot. His boats were generally rowboats or a combination of oar and sails.

Ferryboats - The California Gold Rush, California statehood and acquisition of Arizona in the 1840s and 1850s increased the demand for cross-river travel on the Colorado. At first the demand was met by Quechan and Mohave Indians who ferried travelers across the river for a fee. The business became so lucrative that Anglo entrepreneurs soon challenged Indian domination of the river. Several outright battles ensued, especially at the Yuma crossing. For a while Anglos dominated the passenger-freight business while Indians ferried and swam animals across the river. Farther north at the Mohave crossing, Indians bitterly resented Anglos who cut down their sacred and valuable cottonwood trees to build rafts for single crossings. Here, too, Indians crossed travelers for a fee, especially if convinced that the travelers were moving on, not settling nearby. In nearly all cases, wood rafts were used as ferries, though travelers report seeing Indians using reed rafts.

For the most part, cross-country travelers came on horseback, covered wagons, on foot, or, later, stagecoach, fording rivers such as the San Pedro and Gila. Some travelers attempted travel down the Gila by converting their wagons to boats or by building rafts. In several cases, when the river was high, they did travel for some distance along the Gila from Gila Bend to the Colorado. One pioneer designed his wagon to be easily convertible as he crossed the country, but seldom used that feature in the West.

Anglo ferries originally were rowboats or flatboats, but later often developed into more complex structures. By the early twentieth century, boats were large enough to carry six or more automobiles. Many of the early ferries were operated by cables for stability in crossing changeable rivers. Some of these were propelled by people on the ferry pulling the cable while others were operated from the shore. In most cases the boat was in the water, but some ferries were suspended above the river. Many of the ferries were operated by Mormons to facilitate travel by Mormons between Salt Lake City and the Arizona communities. The Mormon ferries at the mouth of the Virgin River and Lee's Ferry were the most long-lived as they were major points along the Mormon Trail. The ferries at Yuma were used more than any others because of the many people wanting to cross to the gold fields. Hayden's ferry was an important crossing of the Salt River in Tempe. There were other ferries in the Phoenix area as far downstream as Maricopa. One ferry operated across Roosevelt Lake to connect with the road to Young. A suspended cable ferry crossed the Little Colorado River, serving Mormon settlers.

The arrival of the railroad and highway bridges led to the demise of the ferry business. With the development of gas engines, ferries in areas without railroads or bridges became larger and much easier to maneuver than the old ones powered by oars. In more recent times, gas-powered ferries have taken gamblers and tourists across the Colorado River to Nevada casinos.

Figure 3.1 shows a map of the major ferryboat stations in Arizona.

"The watercraft most commonly used in commercial navigation have been row boats of 16-18' in length, drawing 6-12"; row boats 18-22' long, drawing 14-18"; steel rowboats 18' long, drawing 7-19"; motor boats of 20-27' length drawing 10" - 2'; rowboats 16-18' length, propelled by outboard motors drawing 15-18"; scows 32'-8', and 24'-6', drawing 8"; and rafts."

Summary from the Utah Riverbed Case (1931).

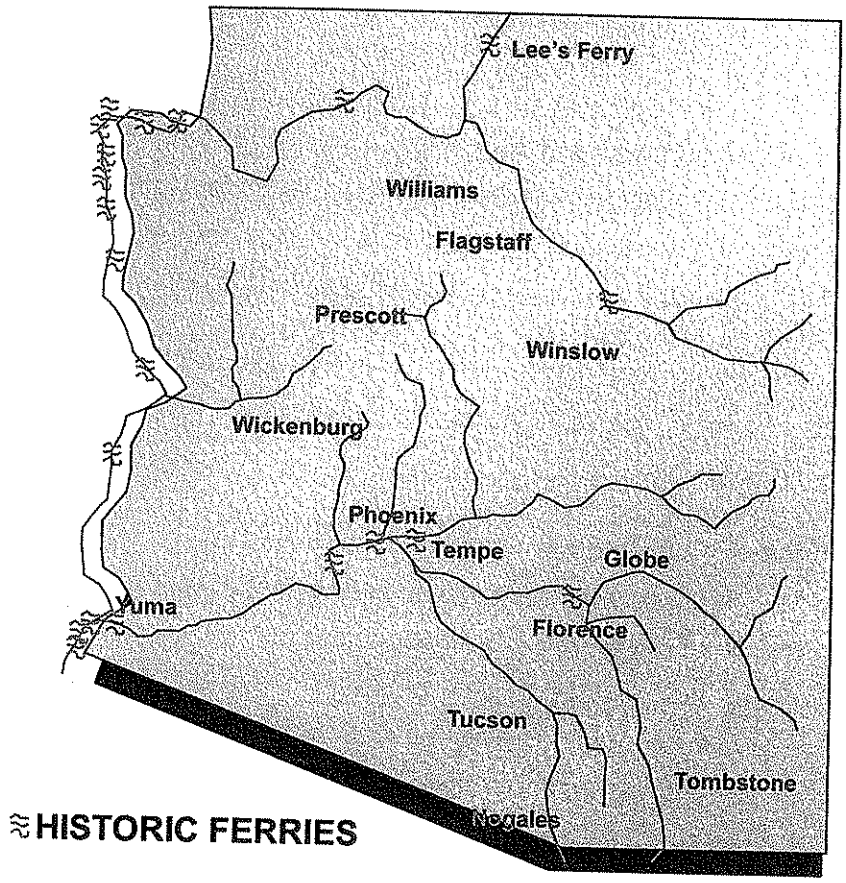

Figure 3.1 map of major ferryboat stations

The Steamboat Era - After the end of the California Gold Rush, many miners sought and found treasure along the Colorado River. After the Civil War, several forts were established along the river. Getting supplies in and ore out and supplying the forts offered new opportunities for boating entrepreneurs. Surveyors were needed to establish boundaries and explore the new territory. The history of steamboats on the Colorado is thoroughly described in Lingenfelter's *Steamboats on the Colorado*. The first steamboats were only partially successful, but were followed by a series of commercial steamboats which could travel during the high water months of spring and early summer. Captains developed techniques for getting their boats off the sandbars so common along parts of the river.

Before the arrival of the railroad, most commercial freight along the Colorado River was transported by steamboat. The limit of navigation was considered to be in the vicinity of the present day location of Lake Mead, as far upstream as the mouth of the

Virgin River (Callville and Rioville) in many years. The Mormons were interested in developing a network of communities, roads, and ferries all the way from Salt Lake City to the coast. At one time they had great hope for a steamboat-land route to carry freight from California or the East to Salt Lake City, along the Virgin River alignment.

One steamboat operated for a while in the Lee's Ferry area and others in the Upper Basin of the Colorado, but steamboats are not known to have been used on other Arizona rivers.

Boat Use by Settlers and Prospectors - People who traveled through Arizona on their way to someplace else used ferries, but were not usually involved in travel up and down rivers. Settlers sometimes used boats, especially during spring snowmelt periods or other flood times. People in rural areas depended on horses to a large extent and seldom needed boats as their horses or wagons could easily ford the rivers. In more urban areas along the Gila and Salt rivers, especially the Florence-Kelvin and Phoenix-Tempe areas, boats were slightly more common. While boats are seldom mentioned either in journals or newspapers, they were clearly available for use when needed in situations such as flood rescue, suggesting they may have been used at other times for uses such as hunting or fishing.

The Colorado River and some of its tributaries were used by prospectors in the late 19th and early 20th centuries. Various kinds of rowboats are reported traveling extensively in the Lee's Ferry area and surrounding areas, but most of the prospecting activity was in the lower Colorado from somewhere around present day Needles to Yuma. Marshall Bond, a gold prospector, was one of the few prospectors who described his travels on the Colorado River in the early years of the twentieth century. In 1912, he took his wife and children down the river from Needles to Yuma in a canoe and a 20-foot scow which he described as a "luxury." He also described travels by boat in the delta region and up the Alamo River to Imperial Valley.

Flood Rescue and Travel at Flood Time - Water flowed in the Salt and Gila rivers in urban areas almost every year until the construction of upstream dams. Regular ferry service operated during several high-water months of the year in Tempe, Phoenix on the Salt River, and Maricopa, Kelvin, Florence, Dome and other places on the Gila River. At low-water times the river could be forded. At some times, however, the rivers flowed too strongly for even the ferries to operate. At one point, cross country

train travelers headed for Phoenix had to embark at Casa Grande, take the stage to Florence where they were ferried across and from then one went by stage.

During the winter and spring of 1905, heavy flooding occurred along the Gila River. Bridges went out at several places and the ferry business thrived at Florence and Kelvin. Each issue of the weekly paper described the lengths people went to transport passengers and freight and keep the Ray Mine at Kelvin supplied. Extracts from Editor Tom Weedin's humorous descriptions of the competition, and the trials and tribulations experienced are briefly excerpted in Appendix B-4. Two "navigation companies" were in fierce competition for three months until the completion of cable "cages" and subsidence of the flood waters in May. These rescue boats are seldom well described except as "rowboats" or "flatboats" sometimes large enough to transport a horse and buggy. The editor, tongue-in-cheek, spoke of the "Gila Fleet" and of an important person he called "Admiral of the fleet" that operated near Florence, but it seems probable that the fleet was much less grandiose than described. But it is clear that a number of boats, some of which were large enough to haul tons of freight were in use there.

Exploring the Grand Canyon - The history of river running in the Grand Canyon and the development of boat types and boat skills are discussed in great detail in Lavendar's River Runners of the Grand Canyon. John Wesley Powell was undoubtedly the first American to travel from the Green River through the Grand Canyon, although there are unproven reports of an earlier traveler through the Grand Canyon. Powell's first boats were made of sturdy oak of a typical rowboat design of the period. His boats were propelled by an oarsman facing backward in the traditional rowing fashion, providing power as the oars were pulled forward. Nathan Galloway changed this traditional method to one in which the oarsman faced forward going through the rapids, making it possible to clearly see exactly what the obstructions were and how the rapids were behaving. This revolutionized Grand Canyon travel at least as much as the new boat design, also developed by Galloway. He was a trapper who traveled alone in the Grand Canyon in the late 1800s and early 1900s for months at a time. His boat was lightweight and easily maneuverable - ideal for one man. Airtight compartments were built into the boat fore and aft, allowing both for waterproof storage areas and increased buoyancy.

Later explorers, especially those doing official surveys for the railroad and the government used variants on Galloway's design. In 1909 Julius Stone brought

Galloway to Ohio to design boats for a trip on the Colorado. These boats had to be larger than the traditional Galloway design to hold several men and heavy supplies, including survey and photographic equipment. Because they were much larger and heavier they were much less maneuverable in the rapids, but were adequate for the purpose as long as they were built of sturdy materials. One explorer ordered boats built in the Galloway-Stone pattern, but they were constructed of lightweight cedar which was far too fragile for the Grand Canyon and some were even broken in transit before they reached the river. From then on until the development of modern materials, Grand Canyon boats were built of oak or pine, not cedar. While later explorers modified the designs, the most successful boats were the Galloway-Stone type made of sturdy wood until the development of modern materials after World War II.

In 1938 Buzz Holmstrom took the first modern-type inflatable raft (provided by Goodyear) through the Grand Canyon with mixed results. In the 1940s the development of artificial rubber made it possible to design durable, maneuverable rafts which did well in the Grand Canyon, due largely to experiments with war surplus rafts, conducted on the river by Georgie White. It was not until after construction of Glen Canyon Dam that rafting the Grand Canyon became relatively safe and popular for tourists. Today boats of many kinds are used in the Canyon, including kayaks, canoes, inflatable rafts, and rowboats made of various materials from wood to fiberglass.

Boats in the Dam-Building Era - Boats were used in the process of building dams, first for exploring for appropriate dam sites and later for moving people and material to the sites. Such boats ranged from rowboats to barges. Dignitaries were taken to the dams by boat. Once the reservoirs were in place, the lakes became popular boating areas. Photos of boats on reservoirs are available from the 1880s and later. After construction of Roosevelt Dam, boating was a popular pastime. One photo shows a tour boat at a boat landing there, while another shows people in a tourboat on the lake. Murl Emery and others operated tunnel-stern motorized boats in the Needles/Hoover Dam area both before and after dam construction, serving both dam workers and tourists.

Recreational Boat Use - Recreational boating was popular in Arizona as early as the 1880s. The first man-made lakes made the use of boats for hunting, fishing, or daily adventures common. A picture of the lake formed by the Walnut Grove Dam near Wickenburg shows a number of boats under full sail in the late 1880s. Other photos

show boats on lakes Mary and Rogers near Flagstaff in the late 1800s. The Granite Dells Lake near Prescott opened in 1907 offering both boating and swimming. A 1900 promotional pamphlet by the Phoenix Chamber of Commerce talks about opportunities for boating "nearby." One photo shows eight men in a rowboat on the San Francisco River at Clifton, while another shows men in a rowboat traveling down a Salt River canal and a third shows people in a boat on Clear Creek near Winslow in the late 1800s.

Newspapers describe several adventuresome trips down the Salt and Gila Rivers in the 1880s and 1890s. In some cases, the adventurers sent a letter to a newspaper part way through a journey reporting progress, but there is no record of whether the journey was completed. Godfrey Skyes' brother Sydney built a canvas boat around 1910 which he used for an only moderately successful winter low-water trip down the Gila from somewhere downstream of Phoenix to the Colorado, having to tow the boat much of the way.

Even in the early 1900s, people took boats down to Mexico for fishing and recreation. One description in the Florence Blade Tribune describes some men from Florence taking a "yacht" to the gulf in 1905 and not finding good hunting and fishing proceeded 500 miles to Tiburon Island.

In the 1930s Bus Hatch and Norman Nevill began commercial river trips on the San Juan and upper Colorado rivers, using wooden boats and charging $65 per trip. After World War II, inflatable rafts made of the new artificial rubber (neoprene) developed during that war, became popular on Arizona rivers. The development of fiberglass in the 1950s led to the popularity of river recreation on rivers such as the Verde, Gila, Salt and Colorado, although wooden canoes and rowboats continue to be used. More recently the development of one-person lightweight kayaks and "rubber duckies" has made it possible to boat shallow rivers previously thought unboatable.

Lake recreation also increased about the same time with the increase in large man-made reservoirs throughout the state. Today more than 150,000 boats are registered in Arizona, almost all for recreational use on lakes, for uses such as fishing and water skiing. Small "personal watercraft" have become popular on dammed rivers such as the Colorado. It is often stated that Arizona has more boats registered per capita than any other state. While Arizonans do own a large number of boats, this statistic is somewhat misleading since Arizona requires registration of all boats no matter how

small, while other states such as Michigan only require registration above a minimum size, skewing the comparison. Watercraft registration increased from 20,866 in 1959, the first year registration was required, to 241,280 in 1997 (of which 161,061 are "active" registrations.) See Table 3.1 for a breakdown of registered watercraft in Arizona by boat type in 1998.

TYPE OF BOAT	ACTIVE	INACTIVE	TOTAL
Runabout	66,413	30,817	97,230
Day Cruiser	9,039	3,899	12,938
Cabin Cruiser	4453	2505	6955
Houseboat	991	433	1,424
Pontoon Boat - Cabin	8073	2141	10224
Sailboat	2,857	2,174	5,031
Catamaran	788	828	1,616
Sailboard	538	1,159	1,697
Utility	26,542	14,864	41,406
Canoe	9,154	5,460	14,614
Inflatable	3,118	3,430	6,548
Kayak	1,899	981	2,880
Personal Watercraft	26,268	10,314	36,582
Airboat	35	14	49
Hovercraft	18	30	48
Amphibious	7	2	9
Other	848	1,171	2,019
Total	161,061	80,219	241,280

Table 3.1 - Arizona boat registration in 1998

"Runabout" includes fishing and ski boats, usually motorized.
"Utility" includes rowboats and small outboard motor boats.
"Inactive" means that the boat was registered at one time, but the registration was not kept up. AGF does not know whether the boat is still in use in Arizona.

"... A desert, yes. But Arizonans own and use twice as many boats per capita as Californians. Our waterways offer exciting variety and adventure, the dramatic complement of water to an already majestic land. We're proud of our remarkable variety which ranges from quiet coves on calm lakes to the pounding excitement of white water; from the thundering might of unlimited hydroplane races to the pastoral relaxation of a solitary canoe resting in a tree-shaded lagoon. ..." Gov. Raul Castro, 1976. Introductory letter in McDannel's Guide to Arizona's Waterways.

Summary of the Availability of Boats in the First Decades of the 20th Century - Table 3.2 provides a summary of boat types in Arizona before 1913. Prior to about 1900, most small boats were homemade from lumber or driftwood and of many shapes and sizes. Boat-building manuals gave detailed plans for making canoes, row boats, hunting boats and small sailboats. There are no commercial boat builders listed in the census for river towns such as Yuma or Phoenix but there are several examples of private boatbuilding.

Boat Type	Size Range (Length)	Materials	Primary Historic Uses in and Near Arizona	Known Areas of Use by 1912
Reed Raft	4' - 15'	Reeds, Agave, Willow	Fishing, open sea, cross and up/down river travel	Pacific coast, Baja, Colorado River, lakes, etc.
Olla Raft	3' - 5'	Ceramic	Transport goods, children across river	Colorado River
Basket Boat	3' - 5'	Willows, etc.	Transport goods, children across river	Colorado, Gila Rivers
Wooden Raft	5' - 25'	Logs	Travel across and up/down river travel	Colorado, Gila Rivers
Bullboat	6' - 25'	Hides	Cross and down river travel	Colorado River
Canoe	8' - 25'	Wood	Lakes and calm rivers for fishing, recreation, travel	Many rivers, canals, lakes.
Rowboat	6' - 22'	Wood, Steel	Lakes and calm rivers for fishing, recreation, travel up/down rivers- also ferrying	Many rivers, canals, lakes.
Canvas Boat	5' - 12'	Canvas/framework	Hunting, recreation	Many rivers, canals, lakes.
Scow	8' - 32'	wood, metal	Transport goods up/down rivers, also ferrying.	Colorado, Gila and Salt Rivers
Duckboat	4' - 6'	steel, canvas, wood	Hunting	Lakes, marshes
Flatboat	8' - 30'	wood, steel	Ferrying, transport goods up/down rivers	Colorado, Gila and Salt Rivers
Sailboat	6' - 35'	wood	Exploration, recreation	Colorado River, lakes
Dory	8' - 22'	wood	Fishing, adapted for whitewater boating	Colorado River
Aerial Ferry	6' - 35'	wood, steel	Cross-river travel	Colorado, Gila, Little Colorado Rivers
Ferry Boat	6' - 35'	wood, steel	Cross-river travel	Colorado, Gila Rivers
Steamboat	25' and up	wood, steel	Transport good and people up/down river	Colorado River
Galloway Boat	8' - 12'	wood	Whitewater travel	Colorado River
Galloway-Stone Boat	16' - 22'	wood	Whitewater travel	Colorado River
Gas-powered	10' - 27'	wood, steel	Travel up/down rivers, recreation, fishing ferrying.	Colorado River, lakes

Table 3.2 - Boat types in Arizona before 1913

By 1900 it was possible to order boats from the Sears and Wards catalogs. Rowboats, canoes, and duckboats for hunting (along with oars and other equipment) were offered at low prices for many years. These were available in wood, canvas and steel. The rowboat is the most common small boat seen in historic photos, sometimes with provisions for sails.

Kayaks, although common in the arctic regions for thousands of years, were apparently not used in Arizona until after World War II. Inflatable boats were available as early as the 1850s, but these boats were awkward, difficult to maneuver, and not very durable and it was not until artificial rubber was developed during World War II that inflatables became feasible.

Gas-powered boats were available as early as 1900, but were not very powerful or reliable until the 1920s. A major problem with gas power in sandy rivers, such as the Colorado River near Needles, was solved by the invention of the "tunnel-stern boat" which filtered the sand out so it didn't clog the motor.

By 1910 the U.S. Rescue Service (later the Coast Guard) was using gas–powered engines in its sea-going rescue boats and soon after in its inland boats. By the 1920s gasoline engines had developed so that there were choices of inboard and outboard motors and engines developed that could power larger and larger boats.

Recreational Boating after World Water II - Commercial recreational rafting started in the 1930s, but developed in the 1970s, on the Colorado River (especially upstream in Utah) and later on the Salt, Gila, and Verde Rivers. The development of durable small boats - plastic, fiberglass and other modern types of canoes and kayaks, inflatable boats for single paddlers and for groups - all contributed to the rising popularity of river running in Arizona especially on rivers not previously considered boatable, or boatable only very rarely because of low water.

Twenty rivers are reported to be used frequently in the spring high water season by boaters and a few more are boated occasionally. Use of boats on reservoirs is especially popular for speedboating, water skiing, fishing and other recreation. Boats became popular and boat registration climbed rapidly. Arizona is reported to have more boats per capita than any other state, but this statistic is misleading since Arizona requires registration of smaller boats than many other states, skewing the statistics.

In 1994, Arizona State Parks surveyed the popularity of various recreational activities by residents and found that boating was practiced at least occasionally by more than

25% of the population, with rafting and motorboating being the most popular. They also found that out-of-state tourists boated in Arizona in significant numbers, especially on the lower Colorado River and through the Grand Canyon. More than 15,000 people raft the Grand Canyon annually and more would undoubtedly participate if the numbers were not limited by the Park Service to protect the Park.

3.2.3 Conclusions

Arizona has a long tradition of boating, despite its desert environment. Prehistoric peoples used boats to cross and travel along the lower Colorado and lower Gila rivers. Ferryboats were used on the Colorado, Gila, Salt, and Little Colorado rivers in historic times, especially in flood situations. Steamboats transported people and goods up and down the Colorado River until the arrival of the railroad. Recreational boating became popular on man-made lakes starting in the 1880s, and accelerated with the construction of large dams such as Roosevelt. Some daring adventurers traveled on the Gila and other rivers throughout the historic period, but rivers were not generally used for recreational travel until the development of new materials such as fiberglass and artificial rubber after World War II. The construction of Glen Canyon Dam increased the feasibility of commercial recreational rafting, boating, and kayaking through the Grand Canyon by reducing very high flood flows downstream of the dams. The sequence of man-made lakes along the lower Colorado has increased recreational use of that area by motorboats, canoes and personal watercraft.

3.3 WHEN IS A STREAM BOATABLE?

Historically, people have used boats in Arizona for many purposes, such as exploration, transport of goods, travel, fishing and trapping. Today, however, the primary reasons for boating in Arizona are recreation-related. Whitewater boating was practiced only by a small number of explorers and adventurers before 1912, but is commercially important today in some areas, such as the Grand Canyon and Salt River Canyon. Canoeing and kayaking on rivers have gained in popularity in the past ten to twenty years, but many people canoed even before 1912. Lakes are used for motorboating, water skiing, fishing and other recreational purposes today as they were in 1912.

When determining boatability, the intended kind of boat and purpose need to be considered. A river that is boatable by a neoprene raft or fiberglass canoe may not be boatable by wooden rowboats, for example. Man-made lakes in Arizona are boatable

by sailboats, but small streams are not. Table 3.3 shows the range of boatability of streams in terms of their suitability for different kinds of boating.

It is difficult to develop hard and fast rules for boatability of streams in the Arizona context. Water supply varies dramatically throughout the year, but even with adequate water, a stream may not be boatable. Boatability depends on a number of factors - water supply, slope of the stream, obstacles such as boulders or sand bars, and width and depth of the channel. The draw of a boat varies with the amount of load, so that a boat used for a single run on the river carrying few supplies draws less than one loaded for a long journey. Rapids are classified on a scale of 1-6, with 6 being unrunnable. A stream with Class 6 rapids or obstacles may be boatable if it is possible to portage around the rapids. (Figure 3.2.) There is no simple formula which applies automatically to all streams.

3.3.1 Water Supply

Water supply varies greatly by season, usually being highest in the spring when snow melts in the mountains. Some rivers are only boatable for a few weeks a year while others may be boatable for several months. Amounts also vary from year to year. Estimates vary on the amount of water needed for boating. The usual measure of water supply is in cubic feet per second (cfs). The amount of water needed depends primarily on the width and depth of the channel and danger from obstacles such as rocks. For example, BLM estimates that the Virgin River is runnable by rafts in some segments with 1,000 cfs, but in another segment, 2,000 - 3,000 cfs is required. In one segment BLM considers 400 cfs minimal for kayaks, while 500 cfs is needed in the rest of the river. Having enough water, however, is not the entire picture. Too much water can also cause problems. Generally above certain flow levels, rivers can become hazardous, although that too is not the entire picture. At low water, a rock may be clearly seen and avoided; at somewhat higher levels it may be possible to float over the rock; at really high levels the rock may create a reversal (hole) that must be avoided; and at maximum levels, the rock may again become insignificant as a barrier.

3.3.2 Channel Configuration

All natural rivers curve and twist to some extent, but some are so contorted as to make river running very difficult if not impossible. A narrow winding stream , especially if strewn with boulders, may be boatable by personal inflatable watercraft but nothing larger, for example, or it may be completely unboatable.

Stream description	Example	Boatability
Not Boatable		
In high mountain regions, small watershed, less than 5' wide in many places, very steep slope, major rapids, major obstacles, rocky bottom.	Minor creeks high in the White Mountains.	Not boatable and not boated historically.
In low desert regions, small low elevation watershed, usually dry except in rare flood events, sandy or rocky bottom, very shallow, low slope, possible sand bars.	Washes in the Cabeza Prieta.	Not boatable except possibly briefly with inflatables or kayaks during very rare and unpredictable flash floods. Probably never boated historically.
Boatable Occasionally Under Highly Unusual Circumstances		
In mid-to-high mountain regions with moderate watershed, steep slope in places, major rapids, no more than 6' wide in most places, adequate water during snowmelt periods.	Clear Creek	Not boatable except very rarely for brief stretches during rare flood events with very skilled paddlers in 1-person boats such as modern inflatable kayaks or plastic canoes. Probably never boated historically.
Boatable Seasonally		
Mountain stream, mid elevation, more than 6' wide in most places, moderate rapids (Class 1-3), few major obstacles, rocky or gravelly bottom, at least 6" of water most places for at least 1 month of the year.	San Francisco River	Boatable for several weeks most years, with some possible portages in kayaks, canoes, inflatables by skilled boaters. Probably never boated historically.
Mid to low elevation stream, more than 10' feet wide, no major rapids, at least 12" of water for at least one month of the year.	Gila River below Coolidge Dam	Easily boatable in wooden rowboat, skiff, flatboat, canoe. Probably boated historically.
Mid to low elevation stream, more than 8' wide in most places, occasional Class 1-3 rapids, sandy or gravelly bottom, only occasional obstacles, at least 5" of water most places for at least one month of the year.	Verde River below Camp Verde	Easily boatable for at least one month of the year with canoes, kayaks, inflatables, rowboats. Possibly boated historically in rare situations
Mountain stream, mid elevation, more than 8' wide in most places, major rapids (Class 3-5), rocky or gravelly bottom, few major obstacles, at least 3" of water most places for at least 1 month of the year.	Burro Creek	Boatable for several weeks possible some years, with portages in 1 person inflatable kayaks or canoes, by highly skilled boaters. Probably never boated historically.
Boatable Most or All of the Time		
Mid to low elevation stream or lake, more than 10' wide, low slope, at least 24" of water most of the year, no rapids, no major obstacles, sandy or gravelly bottom	Lower Colorado River from Needles to Yuma	Easily boatable by rowboats, motorboats, sailboats, canoes, kayaks, inflatables year round.

Table 3.3 – Range of boatability of streams

Class I Still or moving water with few (if any) riffles or obstructions

Class II Small rapids with waves up to 3 feet high and obvious clear channels not requiring scouting.

Class III Powerful rapids with waves up to 5 feet high. Some maneuvering required to miss obstacles. Generally speaking Class II is the upper limit for open canoes.

Class IV Long difficult rapids requiring intricate maneuvering in turbulent waters. Scouting often necessary. Rescue difficult.

Class V. Extremely difficult, extremely violent rapids, requiring difficult and precise maneuvering to avoid numerous serious obstacles. Rescue difficult at best, impossible at worst.

Class VI The most extreme whitewater, generally synonymous with unrunnable. It is a common practice to upgrade to Class V if someone succeeds in running it.

All classes can change depending on season.

Figure 3.2 – The international whitewater rating scale

"There is a bit of revolution in river running going on in the state that makes it hard to give definitive information.. Boaters who aren't content to resign themselves to a few days of fun per year on most of the state's rivers have started using durable plastic canoes and single person inflatables to run them at levels well below what in the past has been considered boatable. These seemingly stubborn individuals may end up dragging their boats over a riffle too shallow to float once in a while but to pay that small inconvenience for the reward of a day in the river is well worth it in their eyes." Arizona State Parks (1989)

3.3.3 Width and Depth

Charts are available which indicate minimum width and depth for various kinds of boats, but there is little agreement on the actual figures. Arizona State Parks, for example, considers that a canoe or kayak needs 6" in depth and 4' in width, while Jim Slingluff, of the Central Arizona Paddler's Club, claims that 2-3" in depth is adequate. Professional river guides with High Desert Adventures, St. George Utah, say they would not choose to take a canoe very far in less than one foot of depth because of the need to control the boat by dipping the paddles deeply into the water without obstructions. They also point out that depth needed depends on how heavily the boat

is loaded. With two paddlers and some goods, a canoe can sink 6" deeper than with one paddler and few supplies. See Table 3.4 for some claims on width and depth. See the Appendix B-4 for quotes from the Utah Riverbed Case and other sources on how much "draw" various kinds of boats had (i.e., how far they sank when fully loaded). Draw is a good indication of required depth, but not equivalent to it, as the needs of the paddler must be considered as well as the ability to avoid rocks on the bottom.

3.3.4 Slope

The slope (determined by average number of feet per mile the river drops) determines how fast the river flows downstream - the faster the flow, the more difficult rapids are to maneuver. The slope of rivers usually changes throughout the river, with nearly flat calm areas intermixed between moderate or extreme rapids. Where a slope suddenly becomes close to vertical, a waterfall occurs which few would dare to run. While average slope gives quite a bit of information, it does not tell the whole story since sharp drops in a river with low average gradient can make a river hazardous.

3.3.5 Rapids

Rapids occur when the slope of the river suddenly increases, often because of increased slope, decreased width, and/or the presence of rocky areas (sometimes due to landslides). Rapids increase the excitement and thrill of river running, but can be so dangerous as to make a river unrunnable. The International Whitewater Rating Scale in Figure 3.2 was developed to give river runners guidelines for difficulty of various rivers. In Arizona, the amount of water in the stream can vary so greatly throughout the year that the scale is difficult to apply, as a river may be Class I at some times of year and Class II - IV at others, for example, while at some times there is little or no water at all. The scale in Figure 1. is only a general guideline to boatability.

3.3.6 Obstacles

Obstacles include boulders, overhanging branches, beaver dams, sand bars or man-made obstacles such as dams or barbed wire fences. Some of these obstacles are more of a problem at some times of year than others. On the Virgin River, for example, whether or not one large boulder is visible or submerged is considered a test of boatability during spring runoff. Boulders that are fully submerged by plenty of water can be avoided, while boulders emerging from the water can lead to crashes. Sandbars can make the river unrunnable if too extensive. Even a small man-made dam can be a severe hazard to boats.

Boat type	Depth (ft.)	Width (ft.)	Source	Other
Canoe	0.5	4.0	USFWS[1]	
Canoe	0.3 - 0.5		Slingluff[2]	4" for flatbottomed; 6" for round-bottomed
Canoe	3.0 - 6.0	25.0	Cortell[3]	
Canvas Boat	0.2		Sears Catalog 1910	Hunting in calm water
Drift Boat	1.0	50.0	Cortell	
Duck Boat	0.2	3.0	Sears Catalog 1910	
Innertube	1.0	15	Cortell	
Innertube	1.0	4.0	USFWS	
Kayak	0.5	4.0	USFWS	
Kayak	0.15	4.0	Brosius[4]	Can go anywhere there's a little water.
Low-power boat	1.0	25.0	Cortell	
Plastic canoe/ 1-person inflatable	Very shallow		ASP[5]	Can go places previously thought nonboatable.
Neoprene Raft	1.0	6.0	USFWS	
Neoprene Raft	1.0	50.0	Cortell	
Rowboat/Drift Boat	1.0	6.0	USFWS	

Table 3.4 - Some estimates of depth of water and width of stream needed for boating

1. U.S. Fish and Wildlife Service (1978): Methods of Assessing Instream Flow for Recreation. FWS/OBS
2. Slingluff, Jim (1987): Testimony in Maricopa County et al. v State of Arizona et al.
3. Cortell and Associations (1977): Recreation and Instream Flow Vol. 1 Flow Requirements BORD6429
4. Brosius, Jack (1978): Canoes and Kayaks: A Complete Buyer's Guide.
5. Arizona State Parks (1989): Arizona Rivers and Streams Guide. Phoenix.

3.3.7 Portages

Obstacles can be surmounted in many cases by portaging the boat around the obstacle. This is possible where the floodplain is wide enough, and clear enough of vegetation and rocks to make walking possible. If there are only a few portages needed, the river remains boatable. When, however, the canyon walls rise steeply from the river, the area is too rocky or vegetation too dense for long stretches, the river becomes unboatable. "Lining" is similar, except that boatmen attach ropes to the boats and let them float while the people keep hold of it from the shore, walking the boat down the river. Lining can be difficult and dangerous in strong currents.

3.4 SOME PAST SUPREME COURT RULINGS ON NAVIGABILITY

3.4.1 General Rulings

The U.S. Supreme Court has made rulings on navigability in over one hundred cases, but has never set hard and fast rules on what kinds of boats are needed to show navigability, what stream conditions are required or what length of flow season is necessary for a determination. The following are excerpts from U.S. Supreme Court rulings on navigability. Some trends can be determined from rulings in major cases, but any past ruling does not necessarily apply to a particular river.

In U.S. v Utah extensive research was done into past boating on the Colorado River and its Utah tributaries. Many people who had boated the rivers appeared as expert witnesses. Boating history was summarized by Frederick Dellenbaugh who had himself boated the Colorado and had thoroughly researched other boating for his two books on the subject. The range of boats described by witnesses appears as Table 3.5.

U.S. v. Utah - Non-navigability of a river is not established by comparison of conditions with those of other rivers which have been held to be non-navigable, but each determination as to navigability must stand on its own facts.

U.S. v Holt State Bank - Streams and lakes which are navigable in fact must be regarded as navigable in law

U.S. v The Montello - The capability of use by the public for purposes of transportation and commerce affords the true criterion of the navigability of a river, rather than the extent and manner of that use. If it is capable in its natural state, of being used for purposes of commerce, no matter in what mode the commerce may be conducted, it is navigable in fact, and becomes at law, a public river or highway.

U.S. v Appalachian Elec. Power Co. - The navigability of a stream is not depended upon the continuity or extent of its use for navigation, although these factors must be considered in determining, on all the facts, the question of navigability.

U.S. v Appalachian Elec. Power Co - .The navigability of a stream is to be determined on the basis, not only of its natural condition, but also of its possible availability for navigation after the making of reasonable improvements, and it is not necessary that such improvements should be actually completed or even authorized.

U.S. v Appalachian Elec. Power Co - Lack of commercial traffic does not negate navigability where personal or private use by boats demonstrates the availability of a stream for the simpler types of commercial navigation.

U.S. v Utah - Absence of existing commerce does not show a river not to be navigable, but its susceptibility in it ordinary condition to use as a highway of commerce, rather than the real manner and extent of actual use if the test. The question remains one of fact as to the capacity of the river to meet the needs of commerce as they may arise in connection with the growth of the population, the multiplication of activities, and the development of natural resources; and this capacity may be shown by physical characteristics and experimentation as well as by the uses to which the stream has been put.

3.4.2 Physical conditions of rivers

U.S. v. Utah - The mere fact of presence of sand bars causing impediments to navigation does not establish the character of a river as non-navigable.

U.S. v Cress - The test of navigability in fact is to be applied to a stream in its natural condition, not as artificially raised by dams or similar structures.

Economy Light & P. Co. v. U.S. - The fact that artificial obstructions in a stream exist, capable of being abated by due exercise of the public authority, does not prevent the stream from being regarded as navigable in law, if, supposing them to be abated, it be navigable in fact in its natural state.

Economy Light & P. Co. v. U.S. - Navigability in the sense of the law is not destroyed because the watercourse is interrupted by occasional natural obstructions or portages, nor need the navigation be open at all seasons of the year or at all stages of water.

U.S. v. Holt State Bank - A lake 3 to 6 feet deep which is an expansion of a river connected with navigable water, and which is used by merchants and settlers in transportation of persons and supplies by boats is navigable, although in times of drought navigation is difficult, and sand bars and vegetation at times interfere with navigation.

U.S. v Utah - A finding that a particular stretch of river is non-navigable is not sustainable where it does not differ in characteristics from the streams which unite to join it, which are found to be navigable above the point of confluence.

U.S. v Appalachian Elec. Power Co. - A stream may be navigable despite the obstruction of falls, rapids, sand bars, carries or shifting currents.

3.4.3 Characteristics of boats

U.S. v The Montello - Vessels of any kind that can float upon the water, whether propelled by animal power, by the wind, or by the agency of steam, may be the instruments of such commerce, although in order to give it the character of a navigable stream, it must be generally and commonly useful for some purpose of trade or agriculture.

U.S. v Rio Grande Dam & Irrig. Co. - The mere fact that logs, poles, and rafts are floated down a stream occasionally and in times of high water does not make it a navigable river.

Leovy v U.S - The mere capacity to pass in a boat of any size, however small, from one stream or rivulet to another, is not sufficient to constitute a navigable water of the United States.

U.S. v Utah - The true test of navigability of a stream does not depend on the mode by which commerce is, or may be, conducted, nor the difficulties attending navigation. It would be a narrow rule to hold that in this country, unless a river was capable of being navigated by steam or sail vessels, it could not be treated as a public highway.

U.S. v Holt State Bank - navigability does not depend on the particular mode in which such use is or may be had - whether by steamboats, sailing vessels, or flatboats.

Year	Person	Boat Type	Length	Width	Draw	Other
1869	John Wesley Powell	rowboat	21'			
1869	John Wesley Powell	rowboat	16'			
1881	Frederick Dellenbaugh	rowboat	22'	18"		
1889	Franklin Nims/Stanton	rowboat	16'	3.5'	keel bottom	
1889	Joseph Ross	skiff	15'16'	6"	flat bottom	
1891	John Best	rowboat	22'	4.5		
1893	Joseph Ross	flatbottom	16'	5-6"		500 lb. load
1893-1895	William Nix	rowboat	22'	3.5'	24"	
1896	George Flavell	flatbottom				
1900	A.V. Stevenson	rowboat	18'	5'	8"	
1900	Edward Wolverton	rowboat			9"	
1901	Edward Wolverton	rowboat	18'	3'	24"	fully loaded
1902	W.F. Reeder	rowboat	16'	4'		
1903	H.T. Yokey	rowboat	15'	3.5'		
1901-1902	A.L. Chaffin	rowboat	28'	8'	2 cylinder auto engine	
1907	Bert Loper	rowboat	16'	4'	7"	steel
1908	M. Oppenheimer	motorboat	30'	5'	18"	gasoline propeller
1908	Albert Anderson	rowboat			10-12"	
1909	Julius Stone	rowboat	16'	4'	6'8"	Galloway
1910	Henry Howland	rowboat	18'		12-14"	
1911	Ellsworth & Emery Kolb	rowboat	16'	4'	8"	Galloway
1914	Bert Loper	rowboat			7"	steel
1921	George Frantz	motorboat	24'	5-6'		6 hp engine
1921	Leigh Lint	rowboat	16'			
1921	Leigh Lint	motorboat	16'	4'	10"	Evinrude motor
1921	Frederick Dellenbaugh	rowboat	22'	5'	14-18"	Galloway type
1921	Frederick Dellenbaugh	rowboat	16'		14-18"	Galloway type
1926	John Galloway	rowboat	16'	5'	4"	
1925-1928	Virgil Baldwin	motorboat	27'	5'	10'	6 cylinder auto engine
1925-1928	Virgil Baldwin	motorboat	20'	4'	6-8"	Ford motor
1925-1928	Virgil Baldwin	rowboat	18'	3.5'	10'	
1926	Carroll Dobbin	motorboat	16'			

*Includes tributaries, mostly in Utah from the Green River many going through the Grand Canyon. where information is not listed, that information was not provided in the evidence.

Table 3.5 Examples of the small boats described as evidence of navigability in U.S. v Utah*