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BEFORE THE
ARIZONA NAVIGABLE STREAM ADJUDICATION COMMISSION

IN THE MATTER OF THE NAVIGABILITY OF THE VERDE RIVER FROM ITS HEADWATERS AT SULLIVAN LAKE TO THE CONFLUENCE WITH THE SALT RIVER, YAVAPAI, GILA AND MARICOPA COUNTIES, ARIZONA.

No. 04-009-NAV

ARIZONA STATE LAND DEPARTMENT'S NOTICE OF SUBMISSION OF FIRST SUPPLEMENTAL EVIDENCE REGARDING THE VERDE RIVER

The Arizona State Land Department ("ASLD" or the "Department") hereby submits the following first supplemental evidence in the above-referenced matter. ASLD reserves the right to supplement its evidence through the close of evidence.

No.	Description
49	Davis, Jr. Goode Paschall *Man and Wildlife in Arizona: The Pre-Settlement Era, 1823-1864* Master of Science Thesis,1973
50	Schreier, Jim "Born a Cavalryman" *The Journal of Arizona History,* Summer, 1999. 143-164
51	Weedman, David *Salt and Verde River Fisheries Survey Trips and related River Flows*
52	Oregon Historical Society, ohs.org: *Beaver Trap, 2002*
53	Photo of Canoe on Verde

No.	DESCRIPTION
54	Photo of Canoe on Verde (2)
55	Photo of Canoes on Verde
56	Dodge, Bertha S. *The Road West; Saga of the 35th Parallel,* University of New Mexico Press, 1980.
57	Trimble, Marshall. "Ewing Young: The Southwest's Premier Mountain Man" *Arizona Adventure,* 27-37, 1982.
58	Medina, Alvin and Neary Daniel G. *Historical and Pictorial Perspective of the Upper Verde River,* USDA Forest Service, 2012.
59	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Anglo Penetration, 1979.
60	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Colorado River Ports 1852-1909, 1979.
61	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Main Stagecoach Lines, 1979.
62	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Major Trails, 1979.
63	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Military Posts 1865-1920, 1979.
64	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Railroads, 1979.
65	Walker, Henry P. and Bufkin, Don, Excerpt of *Historical Atlas of Arizona*, Routes of American Explorers and Surveyors, 1979.
66	Trimble, Marshall. "James Ohio Pattie: Arizona's First Storyteller" *In Old Arizona Adventure,* 33-36, 1982..
67	Mearns, Edgar Alexander *Mammals of the Mexican Boundary of the United States,* 1907. (Excerpts)
68	Mussetter Engineering, Inc. *Inundation and Substrate Stability Study to Support Verde River Vegetation Analysis,* 2004.
69	ASLD *Presentation to ANSAC: Verde River Navigability* 2014.
70	Carrillo, Christopher, et al, *An Overview of Historical Beaver Management in Arizona*, 2009.
71	McPhee, John, Excerpts of *The Survival of the Bark Canoe, 1982.*
72	Weber, David, Excerpts of *The Taos Trappers; The Fur Trade in the Far Southwest, 1540-1846,* 1968.

DATED: October 6, 2014.

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ORIGINAL AND SEVEN COPIES of the foregoing hand-delivered for filing this 6th day of October, 2014, to:

Arizona Navigable Stream Adjudication Commission
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COPY of this document, with enclosures, sent October 6th, 2014, via e-mail to each party on the mailing list (*see* http://www.ansac.az.gov/parties.asp) for *In re Determination of Navigability of the Verde River*

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MAN AND WILDLIFE IN ARIZONA:

THE PRE-SETTLEMENT ERA, 1823-1864

by

Goode Paschall Davis, Jr.

A Thesis Submitted to the Faculty of the

DEPARTMENT OF BIOLOGICAL SCIENCES

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE
WITH A MAJOR IN WILDLIFE BIOLOGY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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STATEMENT BY AUTHOR

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APPROVAL BY PROJECT SUPERVISOR

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11-30-73
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ABSTRACT

A sufficient number of historical records survives to provide a description of Arizona's wildlife, from the viewpoint of abundance and distribution, as it appeared to American explorers and travelers before settlement began in earnest during the Civil War.

Until the outbreak of the Mexican War in 1846, American beaver trappers operated illegally in Arizona, which was Mexican territory after 1821. Written accounts of this period are rare; the few available indicate that wildlife was sometimes locally abundant but could not be depended on by mountain men as a regular source of meat.

Beginning with the Mexican War, a number of well-equipped U.S. government expeditions crossed Arizona, adding immensely to the scientific knowledge of a wilderness inhabited almost entirely by Indian tribes. Army surgeons, doubling as naturalists, left accounts of species like the grizzly bear, now extinct in Arizona, occupying much of the state in a wide variety of habitats. At the same time, Gold Rush emigrants and other prospectors, some staying on in Arizona, added vivid descriptions of the wildlife.

Many accounts of the landscapes indicate that Arizona had more water and more extensive grasslands before 1864 than she does today.

CHAPTER 1

INTRODUCTION

This thesis is an attempt to provide, through old newspaper articles and the journals of Americans present at the time, a general sketch of Arizona's fauna and landscapes before its widely scattered settlements received central government dispensed by a territorial legislature in Prescott. Before the late 1850's Arizona was still for the most part an unknown region, though it was exploited by self-reliant beaver trappers whose knowledge of woodcraft fully equalled that of the Indians, investigated by well-equipped government expeditions, or crossed by wagon trains of emigrants whose only desire was to reach California.

Most of these people passed like the wind in the grass, leaving the wilderness as they found it. (One exception would be the mountain men, who had a temporarily depressing effect on the beaver population.) All of this began to change with the establishment of mining communities, first in the southeastern part of the state and later at several points to the north and west. But before 1864 each community of ranchers or miners was largely a self-contained unit. Charles D. Poston, a pioneer mining executive, had this to say about the rabble of prospectors that settled at Tubac in 1856: "We had no law but love, and no occupation but labor. No government, no taxes, no public debt, no politics. It was a community in a perfect state of nature."

When the first Territorial Legislature met at Prescott on September 26, 1864, a new era began. Four counties were set up, a board of regents for a proposed university was established, road companies were incorporated and railroads chartered. Fifteen hundred dollars were appropriated for public education. Most significant of all, a code of laws was compiled, and with it a court system.

In other words, by the end of 1864 Arizona had a government. The period of pure exploration was over. This did not mean that Arizona did not continue to be a raw frontier region for many years, with large blank spots persisting on the map. But 1864 is as logical a time as any to use as a cutoff point, calling everything before that the pre-settlement era.

What kind of land was Arizona between the 1820's and the mid-1860's to the pioneer or explorer with a yen for natural history? Elliott Coues, the ornithologist, who first saw it in 1864, wrote thus:

> The wild and primitive region which constitutes the Territory of Arizona exhibits a remarkable diversity of surface in its mountain ranges, grassy plains, and desert wastes; and its Fauna and Flora are varied in a corresponding degree. The traveller meets, at each successive day's journey, new and strange objects, which must interest him, if only through the wonder and astonishment they excite.[1]

This diversity of ecological niches is illustrated by the fact that Arizona has plants and animals characteristic of the Rockies, the Chihuahuan Desert, and the Great Plains to the east, the Great Basin to the north, the Sierra Madre to the south, and the Sonoran and Mohave Deserts to the west.[2] In mammals alone, Arizona can claim 290 species

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1. Elliott Coues, "The Quadrupeds of Arizona," Amer. Nat., i, (1867), p. 281.

2. Charles H. Lowe, The Vertebrates of Arizona (Tucson, 1964), pp. 15-83. Also, D.F. Hoffmeister and W.W. Goodpaster, "The Mammals of the Huachuca Mountains, Southeastern Arizona," Illinois Biological Monographs, v. 24 (Champagne, 1954), p. 25.

and subspecies, 23 families, and seven orders. This is exceeded only by California.[3]

Considering the broad spectrum of travelers who saw Arizona within the 40 years between the coming of the beaver trappers and the institution of a territorial government, it is not surprising that the attitude toward wildlife ranged from complete indifference to the high degree of perception typical of many 19th century naturalists. Most pioneers at least noticed game animals as a welcome source of fresh meat. But even skilled hunters could be sloppy observers; for instance, there was a prevalent belief that Arizona had three species of bear: the "black," the "cinnamon," and the "grizzly." Most records indicate that "cinnamon" bears usually turned out to be grizzlies. Being largely restricted to coniferous forests (although there were some interesting sightings in riparian growth along the lower Gila River), the shy black bear was not often seen by emigrants, who generally stayed on the plains or deserts, negotiating the mountains only when they had to.

There was also an exasperating tendency to lump all quail as simply "quail," mule deer and whitetails as just "deer," while coyotes and lobos were often categorized as "wolves." Sometimes the correct species could be ascertained by considering the geographical location and habitat described in an anecdote. But where two species overlapped, there was often no way to do this.

Will C. Barnes, an early Arizona rancher and forester, summed up the problems of assessing reports for their reliability in the following

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3. E. Lendell Cockrum, The Recent Mammals of Arizona: Their Taxonomy and Distribution (Tucson, 1960), p. 2.

letter to Aldo Leopold: "I am sorry I cannot give you any information about the rest of the subjects you mention. The fact is that like most men at that time (Barnes saw much of Arizona as a soldier and rancher in the 1870's and 1880's) I was not a close observer and took no notes of the habits of game animals, as so many men have."[4]

Yet, while sifting the research chaff, I found enough in the way of well-written and plausible information to compensate for the many periods of frustration.

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4. Will C. Barnes, letter to Aldo Leopold, October 7, 1924 (Box 4, Barnes Collection), Arizona Historical Society, Tucson.

CHAPTER II

THE LURE OF THE RIVERS, 1823-1846

The commercial enticement of the beaver attracted the first Americans to Mexico's southwestern holdings, including what is now Arizona. Before Mexico gained her independence from Spain in 1821, attempts by foreign trappers and traders to penetrate the region were generally thwarted. Unlike the British, who sought to discourage the northward expansion of the mountain men by trapping the beaver out of Oregon, the Spaniards - in historian William Goetzmann's words - "chose to leave the beaver in the streams and instead embarked on a plan to sweep the country of American adventurers."[1]

The publication of Zebulon Pike's Journals in 1810 helped spread the word of the trading potential of the New Mexico market. The depression of 1819 left the Missouri frontier with a critical shortage of specie which forced many merchants out into Indian country where they could trade for furs those goods that no longer brought much cash in the settlements. When the Mexican War of Independence opened Santa Fe

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1. William H. Goetzmann, Exploration and Empire (New York, 1966), p. 55. The first foreigner to reach Santa Fe was Baptiste La Lande, a French Creole who crossed the plains from Illinois in 1804. He had trade goods and was well treated (Ibid., p. 40). Americans who came after him were not so fortunate. James Purcell, a Kentuckian, was detained in Santa Fe in 1805. Others, intending to trap the upper Rio Grande, were imprisoned by Spanish authorities in 1812 and 1817. On the latter occasion, 30,000 dollars' worth of fur and supplies was confiscated from the trappers (Paul Horgan, The Heroic Triad, New York, 1954, p. 159). As Paul C. Phillips pointed out in The Fur Trade (Norman, 1961, 2 vols.), v. 2, p. 493, the unpleasant Spanish reaction to French and American intruders reflected a desire to protect the local fur trade, and took form as official adherence to mercantilism within the confines of the empire. Trappers soon learned that it was dangerous and unprofitable to poach on Spanish territory.

to American trade in 1821 the price of furs was already rising. Hatters in London and Paris, New York, Boston and Philadelphia still demanded immense cargoes of beaver pelts.

Meanwhile, news of virgin beaver streams in New Mexico spread rapidly, and about 120 Americans took the trail to Santa Fe in 1822 and 1823.[2] As a trapper named William Parker reported, one group that reached Taos in 1823 decided immediately to head about four hundred miles to the west to trapping grounds "which lay in that wild Mountainous tract of country that interrupts the Most westerly Spanish Settlements, and the Gulph of California."[3] These Americans were stopped by a force of Mexican soldiers who probably encountered them while in pursuit of raiding Navahos somewhere along the San Juan River near the Chuska Mountains. The trappers were then taken back to Taos under arrest.

In 1823 there was still only a handful of mountain men operating in New Mexico. They concentrated on the Pecos and Rio Grande Rivers with such thoroughness, however, that within a year these streams were already depleted, and the Americans began to look west. A considerable movement toward the Colorado River began in the autumn of 1824. This followed a pioneer movement into the area the previous spring, when William Wolfskill, Ewing Young, and Isaac Slover outfitted in Taos in February, then trapped west along the San Juan.[4]

To a substantial degree, trapping conditions to the north were responsible for the rapidly developing encroachment on Mexican territory. General William H. Ashley, one of the giants of the fur trade,

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2. David J. Weber, The Taos Trappers (Norman, 1971), p. 58.
3. Ibid., p. 61.
4. Ibid., p. 70.

had established a mobile rendezvous system as a substitute for the fixed trading post. This tended to discourage trappers wanting to work the southern Rockies from Taos on an independent basis. They were ultimately forced to trap on the Gila and Colorado drainages. In the northern Rockies, the American Fur Company and other large organizations made it difficult for free trappers to prosper. Stiff losses in the face of price-rigging tactics threatened small groups, many of which gave up and moved to the Southwest, where no one ever obtained a monopoly. Another aspect which induced many mountain men to look south was the fact that by 1826 beaver in commercially exploitable populations were gone from large areas of the Rocky Mountains.[5]

Many of these trappers, who included a considerable number of French Canadians, came across the Great Plains from the east, after first stopping to outfit in St. Louis, the springboard of the fur trade. After arriving in Taos, the seat of the northernmost government station in Mexico, they gathered further supplies for the trapping seasons on the Gila and Colorado Rivers and their tributaries. What might have been an easier and more direct route down the Green and Colorado Rivers from the north was ruled out by the treachery of navigation in the vicinity of the Grand Canyon.[6]

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5. Forbes Parkhill, The Blazed Trail of Antoine Leroux (Los Angeles, 1965), p. 56.

6. F.S. Dellenbaugh, A Canyon Voyage (New York, 1908), p. 2. William H. Ashley, as described here, concluded that the deep river canyons of the Southwest had no beaver to speak of, besides being dangerous to negotiate. Thus, the Grand Canyon and much of the Colorado River remained virtually unknown until the Powell era.

After 1821, the people of Santa Fe gave a warm welcome to the Missouri pack trains and caravans, which came in ever-increasing numbers. However, the Americans quickly discovered that although trade was legal the authorities generally frowned on trapping. A Mexican decree of 1824 prohibited all trapping by foreigners, with a few exceptions. Sometimes the mountain men were asked to take along New Mexico natives on excursions after beaver in order to teach them the business. In rare instances, a friendly governor would furnish a special dispensation for a particular American who had gained his favor, such as the chronicler James Ohio Pattie, but most of the time the trappers waged a continuous war of wits with the Mexican government.

Permanent residents of New Mexico were allowed to trap and hunt, but licenses were required, and the number in a party was carefully fixed and recorded. Some Americans took out Mexican citizenship, but the licenses thus legally obtained exposed them to the heavy tax imposed on all beaver pelts brought to Santa Fe and Taos. To circumvent the system, many Frenchmen and Americans operated by subterfuge under passports secured from the Governor at Santa Fe for "trading" purposes. A few trappers risked arrest by buying licenses from local citizens, when concealed pelts would then be produced for sale on the open market. Bribing public officials was frequently attempted and was often successful, especially in Taos.

Of all the approaches used to enable a trapper to get his furs to market, smuggling was the most widespread. Many Americans stored caches in Jemez and other towns by working out arrangements with local residents for storage space on private premises. One smuggler in Taos operated under cover of a still, which, as recounted by mountain man George C. Yount, had "an under ground passage, led to the grand subterranean cache, where goods, to an enormous number, were being secretly deposited."[7] At the height of the fur trade, smuggling operations in New Mexico involved hundreds of thousands of dollars' worth of beaver pelts, and very little of the immense profit made by traders filtered into the hands of actual trappers.

There were exceptions. In 1830 a party of mountain men under Ewing Young (which also included young Kit Carson) buried their pelts in a deep mine shaft at the Santa Rita copper mines in southwestern New Mexico, then retrieved them for sale in Santa Fe. On this occasion the trappers sold two thousand pounds of beaver skins from the Gila River drainage. Since the market price for beaver was twelve dollars a pound, Young's men made 24,000 dollars from the expedition.[8]

Employing another artifice, a trapper might pretend to have purchased furs from Indians or native New Mexicans. These could be exported with an appearance of legality to a merchant who would take them on to the St. Louis market. Trappers and traders not only bootlegged furs out of New Mexico, but also profited by illegally importing trade goods without paying duty on them. They felt justified since they were competing under a handicap with fur traders who avoided duty payments entirely by entering the Rockies to the north of the Mexican settlements.

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7. George C. Yount, George C. Yount and His Chronicles of the West, ed. Charles L. Camp (Denver, 1966), p. 64.

8. Dewitt C. Peters, Kit Carson's Life and Adventures from Facts Narrated by Himself (Hartford, 1873), p. 55.

During the 1820's Santa Fe and Taos were the headquarters of trading and trapping expeditions that covered the whole West south of what is now Wyoming. Taos alone became the most important market and supply depot for trappers between Fort Vancouver on the Pacific and St. Louis on the Mississippi.[9] Here, a mountain man could sell beaver, obtain supplies, or pass a winter or summer in a relative state of civilization. More and more, former Ashley men from the Rockies drifted in, liked what they saw, and stayed. Furs could be taken out of Taos, or supplies smuggled in over the Santa Fe Trail without attracting the attention of authorities. And there was no longer any need to make the long trip back to the Missouri settlements for pleasures or necessities.

Between 1824 and 1826 the drainage of the Colorado River was thoroughly explored by the mountain men. Parties under such leaders as Sylvester Pattie, Ewing Young, Michel Robideau, and George Yount traversed the course of the Gila to its junction with the Colorado. They discovered and trapped all the tributaries of the latter river as well as the southern tributaries of the Green.[10] By 1832 hundreds of trappers had dispersed to reach every stream in Arizona that contained beaver.[11]

Typical of these trailblazers was Antoine Leroux, who first reached Taos as a young trapper about 1824. In later years he became a celebrated scout, guiding the Mormon Battalion across Arizona in 1846,

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9. Weber, p. vii.

10. Robert L. Blomstrom, Fur Trading: Forerunner of Industry in Arizona (Tempe, 1963), p. 26.

11. Parkhill, p. 58.

and the surveying expeditions under Bartlett and Sitgreaves in the 1850's. In his own account, "I carried on the business of a beaver trapper for about fifteen years, generally on the waters of the Great Colorado of the West; and have trapped the whole country, every river, creek, and branch from the Gila to the head of the Grand River fork of the Upper Colorado."[12]

Leroux had little else to say about his career in Arizona. Most mountain men were taciturn at best; in the Southwest, where their activity was largely illegal, they were more close-mouthed than ever. Records are understandably scant, and most groups left no written accounts of their expeditions.

The free trappers, who characterized the fur trade in the Southwest, often functioned on an individual basis. They furnished their own equipment, trapped where they pleased, sold their furs to the highest bidder, and felt bound to no company or person. Payment for furs was received in the form of liquor, tobacco, and articles required for new outfits.

Sometimes a number of free trappers formed a band which, though much looser in organization than a company expedition, customarily elected a leader, drafted a set of regulations governing the conduct of the expedition, and provided stringent penalties for the violation of the rules. In the interests of self-protection, this type of group was a feature of the long journeys into Arizona. Each man's equipment under these conditions generally included a gun with two locks, a

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12. Grant Foreman, "Antoine Leroux, New Mexico Guide," New Mexico Historical Review, XVI (October, 1941), pp. 367-377.

hundred flints, twenty-five pounds of powder, a hundred pounds of lead, a good powder horn, a double shot bag, a butcher or skinning knife, a tomahawk or shingling hatchet, and from four to six traps.[13]

The standard rifle, on which a man's life depended more than on any other piece of equipment, was a 40-60 caliber plains rifle often handmade in the renowned gun works of two brothers, Jacob and Samuel Hawken, of St. Louis.[14] From 30 to 36 inches long, the barrel, of soft iron instead of steel, fired a long, heavy lead bullet. This firearm used from two to four times as much powder as the Kentucky rifle of Daniel Boone's heyday. The plains rifle could deal with grizzlies, elk, or mounted Indians and had an effective range of 200 yards.[15]

Because of the lack of navigable rivers in much of the Southwest, trappers had to use pack trains for transportation. These consisted of one or more riding animals equipped with saddles of Mexican design, and two pack mules or horses. Packed in the Mexican fashion, each animal carried from 200 to 250 pounds of supplies.

The livestock foraged for themselves, and when grass failed the inner bark of cottonwood trees served as an emergency food substitute.

There were a few occasions when the mountain men found boats useful. In 1827 an expedition that included George Yount reached the

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13. Robert G. Cleland, <u>This Reckless Breed of Men</u> (New York, 1950), pp. 16-17.

14. <u>Ibid</u>., p. 29.

15. <u>Ibid</u>., p. 28.

Colorado River and built dugouts by scooping out cottonwood logs. With these they trapped upstream to the country of the Mohave Indians.[16]

Another party working the lower Gila in the same year found the current too broad and deep to ford with a horse. Therefore, they built makeshift canoes described by James Ohio Pattie, one of the members of the group: "A canoe is a great advantage, where the beavers are wild; as the trapper can thus set his traps along the shore without leaving his scent upon the ground about it."[17]

On reaching promising beaver country a trapping expedition usually established a base camp from which small parties or single trappers radiated out for many miles to carry on their operations. There was little ice or snow over large areas of the Southwest, so trapping continued through the winter.[18] Trapping parties in Arizona consisted typically of old Rocky Mountain hands from Missouri and novices from the Southern states.[19]

The mountain man soon learned that Arizona beaver, the object of all his endeavors, possessed fall and winter pelts only slightly inferior to the northern variety. Since the trapping season was longer than in the Rockies, he could make up in quantity what might be lacking in quality.

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16. Yount, p. 32.

17. James Ohio Pattie, _The Personal Narrative of James O. Pattie_, ed. William H. Goetzmann (Philadelphia, 1962), p. 124.

18. As Horgan states (p. 163), trappers in the northern Rockies went out in large parties: 50 to 100 men. Base personnel maintained camp for trappers and hunters who fanned out into the surrounding wilds. These trappers were contract employees for the big fur companies.

19. Phillips, v. 2, p. 516.

In the early 1820's beaver were common throughout the drainage systems of both the Colorado and Gila Rivers.[20] One group of seven trappers, working the San Francisco River in the fall of 1825, took 250 beaver in a matter of days.[21] Two years later, on the lower Colorado, a party under Sylvester Pattie put out 40 traps and caught 36 beaver in one night.[22]

In Arizona, beavers built lodges in suitable areas, but most records indicate that burrows tunneled into the banks of rivers were the most frequently encountered form of shelter.[23] The entrance to a burrow was a considerable distance below the water line, and the passage penetrated from five to 20 feet back, terminating in a home chamber several feet in diameter and above the water level. On the Colorado, beaver constructed piles of branches and poles above the chambers to prevent coyotes from digging away the roofs.[24] Back entrances on land, concealed in brush and weeds, were sometimes dug.[25]

Where streams were shallow and flowed gently, or formed stagnant sloughs, lodges were built. The Colorado River is an example. Out on

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20. E. Lendell Cockrum, The Recent Mammals of Arizona: Their Taxonomy and Distribution (Tucson, 1960), pp. 155-156.

21. Pattie, p. 51.

22. Ibid., p. 129

23. Cleland, p. 12.

24. A. Starker Leopold, Wildlife of Mexico (Berkeley, 1959), p. 381.

25. Edgar A. Mearns, Mammals of the Mexican Boundary of the United States (Washington, D.C., 1907), p. 359.

the main channel beaver tunneled into the soft alluvial soil of the banks, but in the backwaters away from the river lodges were fashioned from broken saplings and river driftwood.[26] Mountain streams feeding the headwaters of the San Pedro had beaver in abundance,[27] and this population tended to build lodges.[28] James O. Pattie also reports having seen lodges on shallow lakes south of the Gila River, probably in the San Simon Valley.[29]

On the Verde River, where bank burrows predominated, one beaver nest was found in the decayed bole of a tree. The nest, made of the stalks and leaves of sedge, tule, and herbaceous plants, interwoven with dry leaves and fine rootlets washed bare by the stream, was in an area where a pool had undermined trees along a jutting bank.[30]

Beavers characteristically built dams across small rivers, forming a series of deep pools. On streams in southeastern Arizona, such as the San Pedro River, these pools often spread out to help maintain extensive grassy marshes.[31] Over part of its course the San

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26. Joseph Grinnell, An Account of the Mammals and Birds of the Lower Colorado River Valley with Special Reference to the Distributional Problems Presented (vol. XII of Univ. of Calif. Publ. Zool.), Berkeley, 1914, p. 227.

27. Sarah G. Bakarich, Gun Smoke (Privately Printed, Tombstone, 1947), p. 126.

28. J.A. Allen, "On a Collection of Mammals from Arizona and Mexico Made by Mr. W.W. Price" (vol. VII of the Bull. Amer. Mus. Nat. Hist.), New York, 1895, p. 256.

29. Pattie, p. 59.

30. Mearns, p. 356.

31. Della Bohn Etz, Reminiscences, unpublished manuscript (Arizona Historical Society, 1939), 4 pp.

Pedro meandered through the marshes in a network of narrow, well-concealed channels.[32]

However, beaver did not limit their activities to narrow streams. There are records of dams on good-sized rivers like the Verde,[33] the Virgin,[34] and the Little Colorado.[35] Because of its depth and the strength of its current, the Colorado River may well have been the only watercourse in Arizona that was beyond the engineering capabilities of the beaver.

Typical beaver habitat on streams in Arizona consisted of sloughs and stretches of quiet water densely fringed with tule (_Scirpus_ sp.), backed in turn by a riparian growth of trees and shrubs. Of the latter, willows and cottonwoods were staple food items. Ash and oak were also eaten.[36]

Although Beaver were abundant in the depths of the Grand Canyon (contrary to General Ashley's opinion), fur trappers found the gorge too inaccessible to make the effort to work it profitable. Cottonwood grew rapidly enough in the canyon to support a permanent beaver population. On the Colorado River, which is rapid and muddy, beaver found shelter on

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32. James R. Hastings and Raymond M. Turner, _The Changing Mile_ (Tucson, 1965), p. 3.

33. Mearns, p. 356.

34. Byrd H. Granger, _Will C. Barnes' Arizona Place Names_ (Tucson, 1960), p. 214.

35. C. Hart Merriam, "Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona" (_N.A. Fauna No. 3, Division of Ornithology and Mammalogy, U.S.D.A._), Washington, D.C., 1890, p. 59.

36. Leopold, p. 381.

the rocky shores, since there was no place to burrow. Here, they feed extensively on arrowweed, Berthelotia sericea.[37] Beaver have also been observed crossing the hot sand at the bottom of the Grand Canyon to feed on mesquite bark.[38]

On some streams, the Little Colorado being a notable example, water dried up for long distances during drought periods, leaving only isolated chains of stagnant pools. Yet beaver continued to prosper where cottonwood was abundant along with banks suitable for burrows.[39] The opposite extreme presented a problem of a different nature; floods often flushed beaver out of their tunnels.[40] But high water on the lower Colorado River sometimes brought a boon with it. Beaver did not need to fell their own trees because the constant undercutting of the banks dumped green trees into the water where they were easily salvaged for food.[41]

When trapping expeditions set out for Arizona from the New Mexico settlements, they generally followed two routes. One led north from Taos for about 50 miles, where, in order to throw off the Mexican authorities, a party would change direction abruptly to the southwest. The rest of the journey moved west across a series of watersheds: the Zuni, the Salt,

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37. Russell K. Grater, "An Unusual Beaver Habitat," Jour. Mammalogy, XVII, 1936, p. 66.

38. Donald F. Hoffmeister, Mammals of Grand Canyon (Urbana, 1971), p. 123.

39. Will C. Barnes, "The American Beaver," Barnes Collection Box 13 (Arizona Historical Society), p. 7.

40. Mearns, p. 357.

41. Joseph Grinnell, Joseph S. Dixon and Jean M. Linsdale, Fur-Bearing Mammals of California (2 vols., Berkeley, 1937), v. 2, p. 726.

the Verde, the Gila, and the Colorado. Other groups moved down the Rio Grande from Santa Fe, then struck southwest for the Santa Rita copper mines. From there it was a short distance to the headwaters of the Gila, which was followed downstream, with side excursions up its various tributaries. Here again the Colorado was often the ultimate objective.

These parties usually headed for beaver country in autumn, ever on the alert for Indians, grizzlies, and other trappers, with whom they might be competing. This state of awareness was well described by the English adventurer George Frederick Ruxton: "A turned leaf, a blade of grass pressed down, the uneasiness of the wild animals, the flight of birds, are all paragraphs to him written in Nature's legible hand and plainest language."[42] Nevertheless, because of Indians and grizzlies, James Ohio Pattie estimated that on one expedition only sixteen men out of 116 survived their first year's trapping in the Southwest.[43]

Once on his own, away from camp, the trapper lived mainly off the land. He traveled lightly, carrying scant provisions of salt, flour, tea and coffee. Deer, antelope, elk and bear kept him supplied with meat. Beaver tail was relished, but the rest of the animal figured only in times of want.

The mountain man in the wilderness was a self-contained figure, and the merchant trapper Rufus Sage has left a classic word picture of him:

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42. George F. Ruxton, Adventures in Mexico and the Rocky Mountains (New York, 1848), p. 235.

43. Cleland, p. 31.

> His skin, from constant exposure, assumes a hue almost as dark as that of the Aborigine, and his features and physical structure attain a rough and hardy cast. His hair, through inattention, becomes long, coarse, and bushy, and loosely dangles upon his shoulders. His head is surmounted by a low-crowned wool hat, or a rude substitute of his own manufacture. His clothes are of buckskin, gaily fringed at the seams with strings of the same material, cut and made in a fashion peculiar to himself and associates. The deer...furnish him the required covering for his feet which he fabricates at the impulse of want. His waist is encircled with a belt of leather, holding encased his butcher-knife and pistols--while from his neck is suspended a bullet-pouch securely fastened to the belt in front, and beneath the right arm hangs a powder-horn traversely from his shoulder, behind which, upon the strap attached to it, are affixed his bullet-mould, ball screw, wiper, awl & c. With a gun-stick made of some hard wood, and a good rifle placed in his hands, carrying from thirty-five balls to the pound, the reader will have before him a correct likeness of a genuine mountaineer when fully equipped.
>
> The mountaineer is his own manufacturer, tailor, shoe-maker, and butcher--and, fully accoutred and supplied with ammunition in good game country, he can always feed and clothe himself and enjoy all the comforts his situation affords.[44]

Sometimes working in pairs, but often alone, mountain men usually carried six traps while searching for fresh beaver sign. Each trap weighed about five pounds as a rule and was worth from 12 to 16 dollars.[45] At a promising site, the trapper waded into the stream to hide his set traps. A trap was planted in three or four inches of water a short distance from the bank. It was attached by its chain to a strong stick, which the trapper drove into the bed of the stream a full chain's length

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44. Rufus Sage, Scenes in the Rocky Mountains (Philadelphia, 1846), p. 18.

45. Hiram M. Chittenden, A History of the American Fur Trade of the Far West (Stanford, 1954, 2 vols.), v. 2, p. 820.
The Los Angeles County Museum has a trap used on the Gila and Colorado Rivers in 1827-1828 by a trapper named N.M. Pryor. It is considerably smaller and lighter than the average trap used in the West, but otherwise typical. Without a chain it weighs one and three-quarters pounds (Carl P. Russell, Firearms, Traps, & Tools of the Mountain Men, New York, 1967, p. 117).

from the trap. The chain was about five feet long, with a swivel near the end to keep it from kinking.

Immediately over the trap, a twig was positioned so that one end was some four inches above the surface of the water. The twig was smeared with a pungent musk from the beaver's castors, a pair of anal scent glands found in both sexes, but larger in the male.[46] Attracted by the musk, the beaver raised its nose to the twig, placing its feet so that one of them entered the trap, springing it.

Once caught, the frightened animal tended to rush for deep water, only to find itself held by the chain, which could not be gnawed through. The exhausted beaver eventually sank to the bottom and drowned. Sometimes it would rip the chain from the stake and drag the trap into deep water. Or it would head for the shore and become entangled in the undergrowth.[47]

When the trapper recovered the carcass, the skinning was normally done on the bank nearby, although large expeditions sometimes hired men whose primary job was performing this chore in base camp.

The hide was first slit along the belly and along the inside surfaces of the four legs. Then it was carefully removed, dried on a

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46. Ernest P. Walker, Mammals of the World (Baltimore, 1964, 2 vols.), v. 2, p. 748.

Musk from the castors is deposited by beavers at spots regularly visited by others of the species. The animals add mud, sand, dead leaves and other materials to form scent mounds. These hillocks, some a foot high, served the trappers as markers for beaver trails or runways (Cleland, p. 14).

The castor glands, used as trap bait, sold on the average for three dollars a pound (Chittenden, v. 2, p. 821).

47. Chittenden, v. 2, p. 820-821.

willow hoop, and scraped or grained to get rid of adhering flesh particles.[48]

It generally took a full day for a trapper to find suitable areas in which to place his sets, make the rounds of the traps, skin the animals, and flesh the pelts. Besides the skins, the castor glands, tails, and sometimes all the meat were saved.[49]

In the next phase of the operation, the hides were smoked on a framework of sticks planted around the edge of a hole containing a fire of rotten wood or punk. This procedure required ten to 12 hours. The skins were then folded with the fur inside and packed in bundles by means of a crude press. Each bundle was tied with green buckskin thongs, which contracted while drying and finally became almost as hard and inelastic as iron bands.[50]

On long expeditions it was often to the advantage of the trapper to cache his food or pelts. In time of need he thus knew where to find a concealed stockpile of provisions, as well as sparing his pack animals the ordeal of carrying heavy burdens unnecessarily over considerable distances.

The method described by the veteran trapper George Yount was commonly used in Arizona. Outward bound from New Mexico, the mountain man selected a place near a river and unlikely to be visited. He marked

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48. Cleland, p. 14.

49. Russell, p. 150.

50. Chittenden, v. 2, pp. 820-821. On the average, 80 skins comprised a pack weighing 100 pounds. The value of a pack varied from 300 to 500 dollars in the Rocky Mountains.

the site by making note of trees at random, in various directions and at measured distances, of which he kept a careful record. At the selected location on the ground he dug deep into the earth, enlarging the hole as he descended. Excavated soil was piled on blankets spread nearby, with superfluous amounts dumped into the river.

The supplies or skins to be cached were deposited at the bottom of the completed shaft and the soil replaced. Finally, the original patch of turf was put back in such a way that "every spire of Grass" was in its proper place.[51] The trapper took lengthy pains to try to erase every bit of evidence that man had recently passed by. But despite these precautions, Indians sometimes discovered and uncovered the caches, and the most skillful concealment could not offset the disastrous effects of seeping water or floods.

Of the many hundreds of trappers who worked Arizona's streams before 1846, three men left more than the most cursory accounts of the flora and fauna. Two of these, George C. Yount and Job Francis Dye, made their primary impact on history as prominent California pioneers.[52] Only James Ohio Pattie, whose Personal Narrative is one of the few detailed memoirs of trapper life, limited his career almost entirely to Arizona.[53] The young Kentuckian, accompanied by his father Sylvester Pattie, joined a party of 116 men under Sylvestre Pratt at Council Bluffs

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51. Yount, pp. 63-64.

52. Like many mountain men who settled in California, Yount became a sea otter hunter. He invented a hunting boat made of elephant seal skins and modeled after the famous bull boats of the Missouri River drainage, fashioned from bison hides (Yount, p. xi).

53. Both Jedediah Smith and Thomas L. ("Peg-leg") Smith left memoirs, but neither one referred in any detail to Arizona.

in 1825. The objective: Taos. Over the next two years Pattie explored all of the Southwest from the Rio Grande to the Colorado, went on three expeditions into Arizona, and may have been the first American to see the Grand Canyon.

Pattie has been taken to task by historians because his chronology was sometimes questionable. But Reuben Thwaites, who interpreted and edited one widely read version of the Personal Narrative, was more responsible than Pattie for incorporating geographical inaccuracies. With matters of geography straightened out, much of Pattie becomes "straightforward and plausible," in the opinion of anthropologist Alfred L. Kroeber.[54] Another summing up comes from historian Robert G. Cleland, who felt that Pattie's diary gives an "authentic, overall picture of the early days of the fur trade in the extreme Southwest and a true account of some of its dramatic incidents....His descriptions of the country... are also too accurate and detailed (as the author can attest from personal observation in many instances) to be based on borrowed accounts of spurious experience."[55]

Operating in all likelihood under a license obtained by Sylvestre Pratt, an expedition led by Sylvester Pattie left Santa Fe in November, 1825, and started south down the Rio Grande (see Fig. 1, p. 222). The group of seven men had agreed to head for the unknown wilderness of the Gila drainage rather than follow more familiar routes north out of Taos or on south into the mountainous country of northern Sonora and Chihuahua.

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54. Clifton B. Kroeber, "The Route of James O. Pattie on the Colorado in 1826: A Reappraisal by A.L. Kroeber," Arizona and the West, VI (Summer, 1964), 122.

55. Cleland, p. 161.

Somewhere along the Rio Grande several more trappers doubled the size of the party, and at a point four days below Socorro they all struck west for the Santa Rita copper mines, leaving behind the thin band of riverbank settlements that comprised Mexican civilization in the Southwest. At the copper mines, which had been first worked by the Spaniards around the turn of the century, the expedition hired two Mexican guides and pushed on northwest to the headwaters of the Gila River, in what is now Gila National Forest. This was probably the first group of Americans to reach the Gila,[56] but James Ohio Pattie mistakenly believed that no other white men had ever visited the region. The Spaniards had known the area for a long time, and in 1757 one Jesuit missionary made note of "beavers which gnaw and throw to the ground the alder-trees and cotton woods."[57] However, the Spaniards did leave the Gila drainage as they found it--the same wilderness that the Patties observed.

The expedition soon fell into a pattern that was to hold on all future journeys: the two Patties always stuck to large permanent streams in their search for beaver (on their first night trapping the Gila the party caught 30 of the animals). James Ohio Pattie remarked on the beauty of the river near its head, where it ran swiftly between banks covered with tall cottonwoods and willows. Grass grew luxuriantly over

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56. Dale Morgan believes that Jedediah Smith may have been the second American to lead an expedition into Arizona (Jedediah Smith and the Opening of the West, Indianapolis, 1953, pp. 193-200). While looking for the legendary Buenaventura River, alleged to lead to the Pacific, Smith descended the Virgin River to the Colorado early in 1826. He did not find many beaver, but he did pioneer a new route across the Mohave Desert to the California missions.

57. Weber, p. 112.

the timbered bottoms. On the adjacent mesas Pattie noticed an open woodland of scattered oaks, juniper and pinyon pines.

Along one stretch of the upper Gila, the mountain men passed a number of grizzlies, but left them strictly alone, since the bears also seemed willing to mind their own affairs. However, there were places where bluffs came to the river's edge, and the men often had to scramble through dense underbrush and grapevines. "Added to the unpleasantness of getting along in itself," commented Pattie, "we did not know, but the next moment would bring us face to face with a bear, which might accost us suddenly."[58] This fear stayed with the expedition while they pushed through the tangled bottomlands, but no dangerous encounters occurred.

One evening, while scouting the lower reaches of a small tributary, James Ohio Pattie was overtaken by darkness and had to make camp alone in a region where grizzly sign continued to be abundant. The night's events formed part of his diary:

> I placed a spit, with a turkey I had killed upon it, before the fire to roast. After I had eaten my supper I laid down by the side of a log with my gun by my side. I did not fall asleep for some time. I was aroused from slumber by a noise in the leaves, and raising my head saw a panther stretched on the log by which I was lying, within six feet of me. I raised my gun gently to my face, and shot it in the head. Then springing to my feet, I ran about ten steps, and stopped to reload my gun, not knowing if I had killed the panther or not.[59]

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58. On the way to New Mexico with Pratt's expedition, James Ohio Pattie wounded a grizzly that had attacked the company's livestock one night outside camp. The bear mauled one of the trappers to death before Pattie killed it with a second shot. Grizzlies were so abundant on the Arkansas River that Pratt's men counted over 200 in one day (Cleland, p. 164).

59. Pattie, p. 49.

This incident, the first on record involving a mountain lion in Arizona, describes its characteristic curiosity and set the tone for man's future relations with the species.

As the trappers worked their way down the Gila they shot a few deer (species undetermined), but in general they seemed scarce. The season of the year was at fault, in Pattie's speculation.

Near disaster now occurred. Owing in part to a lack of coherence and discipline within the company, seven men deserted and trapped ahead on the river. They operated with such thoroughness that they virtually exterminated the beaver on a considerable stretch of the upper Gila in a few weeks.[60] By January 1, 1826, the remaining members of the party were close to starvation. Beaver meat sustained them for a while, but soon it became as unavailable as the larger game. For four and a half days, before the group reached the mouth of the San Francisco River, they had nothing to eat but part of a rabbit caught by the dogs.

At the San Francisco their luck changed. The river flowed southwest through an open forest of ponderosa pine interspersed with meadows. Wildlife appeared in abundance: waterfowl on quiet beaver ponds, wild turkeys, white-tailed and mule deer, Merriam elk, and bear of both species.[61] There was mountain lion sign, and on the rugged cliffs that came down to the river Pattie saw "multitudes" of bighorn. "These animals are not found on level ground," he said, "being there

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60. Cleland, p. 173. While skillful trappers, the mountain men were often ruthless and short-sighted. It was usual to aim for the maximum number of pelts in the shortest time possible.

61. Cleland, p. 174.

slow of foot, but on these cliffs and rocks they are so nimble and expert in jumping from point to point, that no dog or wolf can overtake them....Their meat tastes like our mutton."[62]

Because the deserters had trapped out the Gila ahead of them, the Pattie company turned northeast up the San Francisco. They took 37 beaver the first night, an omen of good fortune that held true where trapping was concerned all the way to the river's headwaters in the Mogollon Mountains. Wild turkeys were particularly numerous on these upper stretches of the San Francisco, and several were shot by the party.

Near the source of this river the seven men in the company cached some 250 beaver pelts taken in the two weeks or so since they left the Gila. It was the middle of January, 1826, when they struck overland to the southeast and once more came to the Gila River. At one point, after the mountain men had started downstream, several horses disappeared in a snowstorm, and Pattie joined a search party that tracked them after the storm subsided. They followed the trail up a creek that emptied south into the Gila somewhere east of modern Clifton. Pattie spotted bear sign at a cave at the base of a cliff near the creek. Holding a pine torch, he entered the cave and shot a grizzly that was bedded down for the winter dormant period. It took several men to drag the bear out. In Pattie's words, "It was both the largest and whitest bear I ever saw. The best proof, I can give, of the size and fatness is, that we extracted ten gallons of oil from it. The meat we dried, and put the oil in a trough, which we secured in a deep crevice of a cliff,

62. Pattie, p. 51.

beyond the reach of animals of prey. We were sensible that it would prove a treasure to us on our return."[63]

A few days later, farther along the river, Pattie noted tersely that the company "killed a bear, that attacked us." The animal was undoubtedly a grizzly.

In March the trappers worked their way up a semi-permanent stream joining the Gila from the south. They called it Beaver Creek because in a short time they took 200 pelts and loaded the pack horses to their limit. Pattie noticed this stream valley near its confluence with the Gila as being covered with cottonwoods and willows. Flanking the flood plain was a foothill region containing a strange plant which he described in some detail: "A species of tree, which I had never seen before, here arrested my attention. It grows to the height of forty or fifty feet. The top is cone-shaped, and almost without foliage. The bark resembles that of the prickly pear; and the body is covered with thorns. I have seen some three feet in diameter at the root, and throwing up twelve distinct shafts."[64] Pattie, unmistakably, is discussing the saguaro cactus. He later referred to lofty, snow-capped mountains rising beyond the valley.

This account of what is now known as the San Pedro Valley vindicates James Ohio Pattie as a basically accurate chronicler. No other stream flowed north to the Gila with the following combination of features: (1) it was semi-permanent, with a dependable flow of water all

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63. Pattie, p. 54.

64. Ibid., pp. 62.

the way to the Gila for a good part of the year, (2) a Sonoran Desert community exists parallel to the river near its mouth, with saguaro cactus a dominant, (3) an abundance of beaver, (4) high mountains overlooking the valley. Both the Santa Catalinas and the Galiuros rise steeply from the lower San Pedro, and each range could have a noticeable snow cover in March.

Writing again within the realm of natural history, Pattie made another observation of the lower San Pedro Valley:

> In these bottoms are great numbers of wild hogs, of a species entirely different from our domestic swine. They are fox-colored, with their navel on their back, towards the back part of their bodies. The hoof of their hind feet has but one dew-claw, and they yield an odor not less offensive than our polecat. Their figure and head are not unlike our swine, except that their tail resembles that of a bear...We killed a great many, but could never bring ourselves to eat them.[65]

Probably to help sell the first edition of the Personal Narrative, Pattie overdramatized the javelina, or collared peccary, by describing its "enormous" tusks, and the animal's tendency to charge and tree people without provocation.

The expedition soon returned to the Gila and proceeded west. But a decision was made to backtrack to the San Pedro and try their luck farther up that stream. Late in March, somewhere on the lower San Pedro River, Apaches stole most of the company's horses, leaving the trappers with no choice but to start home largely on foot.[66] Pattie says they immediately had to ascend a range of "icy mountains" walling in the valley

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65. Pattie, pp. 61-62.

66. The Patties had previously turned over some of the horses and supplies to some of the deserters, who had returned in a chastened state after being ambushed by Apaches. These men had since returned to New Mexico.

on the east. These must have been the Galiuros, which would have been anything but balmy in March. Since the party complained of the lack of water, the crossing was probably made well south of Aravaipa Creek.

The trappers descended the eastern slope of the Galiuros and came out onto a broad, grassy plain. This, in all likelihood, was the northern end of the Sulphur Springs Valley, which is dry today, although Pattie made a vague reference to the presence of water at that time. The company stopped for a while, and Pattie shot a pronghorn. His entry reads as follows:

> Here we encamped the remainder of the day, to rest, and refresh ourselves. The signs of antelopes were abundant, and the appearances were, that they came to the water to drink; from which we inferred, that there was no other drinking place in the vicinity. Some of our hunters went out in pursuit of the antelopes. From the numbers of these animals, we called the place Antelope Plain. The land lies very handsomely, and is a rich, black soil, with heavily timbered groves in the vicinity.[67]

Continuing eastward, the party crossed another high range, which, if Pattie's itinerary remains accurate, would have to be the Grahams. The mountain men then halted briefly to trap a shallow lake for beaver, to which they were attracted by the gabbling of ducks and geese. The exact location of this lake is difficult to ascertain, but the north end of the marshy San Simon Valley would be a logical area, assuming that the expedition had not yet reached the Gila River.

Having regained the Gila, probably near the site of modern Safford, the Pattie expedition headed straight for the Santa Rita copper mines. The journey was a difficult one, and the trappers once again came close to starvation; at one period they were reduced to eating

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67. Pattie, p. 63.

ravens and turkey vultures. James Ohio Pattie left his father at the mines in April and returned to Santa Fe to requisition horses and supplies for another trip to the Gila, this time to reclaim the pelts buried at two caches. The expedition reached its objectives, but only a few furs were recovered from the cache on the San Francisco River, and the larger cache on the Gila had been broken into and stolen, presumably by Indians. Financially broken, the Patties settled for the next few months at Santa Rita, where they attempted to work the mines.

During the summer of 1826, the influx of trappers and traders into New Mexico continued undiminished. However, business in Santa Fe was at a standstill owing to an excess of foreign goods and a lack of capital among local merchants. William Becknell's great caravan of 1824 had drained the hard cash out of New Mexico.[68] Consequently, many traders could not sell their goods, and some of them joined trapping expeditions to recoup their fortunes.

That autumn, at least four groups of trappers--some 90 men all told--headed into the Gila River country, carrying passports issued by Governor Narbona, who was lenient about enforcing the decree of 1824. One of these was a party of French Canadians led by a seasoned mountain man named Michel Robidoux. In or about September, 1826, James Ohio Pattie joined this assemblage at the Santa Rita copper mines and accompanied them on a trapping venture down the Gila all the way to the mouth of the Salt River. Here, despite Pattie's remonstrances, Robidoux

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68. Becknell's caravan to Santa Fe in 1824 consisted of the following: 83 men, 156 horses and mules, 35 wagons, and 30,000 dollars' worth of merchandise (Yount, p. 7).

camped at a Papago village whose inhabitants showed more evidence of treachery than the hospitality they at first professed. Pattie and one other trapper withdrew for the night some distance away. Their fears were realized; the Papagos massacred the entire party except for Robidoux himself, who escaped, badly injured, into the darkness. He eventually stumbled into the hiding place that concealed Pattie and his companion, and the three men successfully evaded the Indians.

An incredible piece of good fortune now befell them. The next night the three fugitives spotted the campfires of an expedition of thirty trappers under Ewing Young. They were made welcome and accepted the chance to continue trapping as part of the company.

Young's party had descended the Gila just behind Robidoux, and George Yount, one of its members, remembered at least two anecdotes involving wildlife. At some point in the gorge country of the upper Gila, probably just east of the Peloncillo Range, Yount referred to a stream named Hog Creek for its abundance of javelina. This may have been what is now called Apache Creek, but the location could just as well have been farther east into New Mexico. One evening, an apparently rabid wolf entered Young's camp on this creek and bit several dogs before being shot.[69]

After reaching the Salt and picking up the massacre survivors, Ewing Young exacted a successful revenge on the Papagos: his company killed most of the warriors in an ambush, then burned the village. They now settled down to the routine of trapping beaver, working their way up

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69. Yount, p. 28.

the Salt and Black Rivers to the head of the drainage in the Blue Range. Pattie found the whole region "to abound with beavers." His associates agreed; in fact, for the period between the 1820's and the 1840's, the mountain men regarded the Salt River as the most consistently productive beaver stream in Arizona.[70]

Reunited once again at the confluence of the Salt and the Verde, Young's company descended to the Gila, which they trapped all the way to its mouth. They were probably the first Americans to reach the Colorado River by this route. As a good-will gesture, the mountain men gave beaver meat to the Halchadom Indians, who farmed corn between the Yuma and Mohave tribes.

It was now sometime in the spring of 1827, and the expedition turned north up the Colorado. On the stretch of the river below Black Canyon, the lagoons that flooded the bottomlands supported a high population of beaver. But the Mohave Indians resented the Americans trapping in their territory, and they had to weather a series of bloody skirmishes before escaping upriver. With a lull in the fighting, there was time for hunting, and in Pattie's words, "We killed plenty of mountain sheep and deer, though no bears."[71] This occurred in the vicinity of Black Canyon, where the mule deer was the only representative of its family.

After passing the Mohave villages, the company stopped in the area of what is now Lake Mead. The trappers investigated the washes and

70. Cleland, p. 172.

71. Pattie, p. 87.

canyons leading up to the Grand Wash Cliffs, but they found little bottomland and few beavers. According to Thomas ("Peg-leg") Smith, the expedition separated near the mouth of the Virgin River. A small group that included George Yount had a falling-out with Ewing Young and turned directly east for New Mexico. Those loyal to Young, Pattie among them, continued up the Colorado.

Yount tells us that his party nearly starved before reaching Zuni. Even in pre-settlement times, there were periods and regions noted for the lack of enough game to support expeditions. One bright spot in the journey occurred while Yount and his companions were passing San Francisco Mountain. Here the chronicler shot a "large brown bear of more than four hundred pounds weight, and very fat--it afforded a rich repast."[72] From this description there is no clue as to whether the animal in question was a black or grizzly bear. Both species were found in the area. Yount may have exaggerated somewhat when he referred to a bear killed in April as being "very fat." But the meat was certainly welcome, since lean times were to lie ahead for a considerable distance.

Meanwhile, hard times also awaited Young's group. Three trappers were killed by Havasupai Indians while reconnoitering either Havasu or Cataract Creeks, where there was sufficient cottonwood growth to sustain beaver in abundance.[73] Ill-clad and hungry, the survivors followed the edge of the Grand Canyon, probably along the north rim.[74] The mountain

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72. Yount, p. 54.

73. Clifton B. Kroeber, Arizona and the West, vol. 6 (summer, 1964), p. 130.

74. Weber, p. 126.

men did not descend to the Colorado River until, in all probability, they reached the present site of Lee's Ferry. Both Robert Glass Cleland and Alfred L. Kroeber place Pattie on this section of the river when he made the following statement: "We likewise killed plenty of elk, and dressed their skins for clothing."[75] Olaus Murie indicates the mouth of the Little Colorado as being the proper location,[76] but if David J. Weber's exhaustive analysis of Pattie's route is correct the trappers passed well to the north of the confluence on the other side of the Colorado River.

The Paria River (Paria means "elk water" in Paiute) flows into the Colorado from the north at Lee's Ferry, and early records state that elk were common on this stream and on the adjacent Paria Plateau until the mid-1850's.[77] Why they disappeared so early is problematical, but, assuming that this was a marginal population, these elk might have been vulnerable to heavy hunting pressures from both Indians and trappers.[78]

After leaving the general region of the Grand Canyon, Ewing Young's party took a brief side trip up the San Juan, returned to ascend the Colorado, and eventually turned east into the Rockies in some region as yet undetermined. The Personal Narrative is hopelessly vague in its geography from here on, but the trappers came down to Taos from the north

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75. Pattie, p. 89.

76. Olaus J. Murie, The Elk of North America (Harrisburg, 1951), p. 21.

77. Granger, p. 81.

78. According to G.S. Miller, Jr., and R. Kellogg ("List of North American Recent Mammals," U.S. Nat. Mus. Bull., 205: 796-797, 1955), the Paria Plateau would have been well north of the range of *Cervus merriami*. There is a strong likelihood that the population Pattie referred to consisted of *Cervus canadensis nelsoni* near the extreme southwestern limit of its normal distribution.

sometime in the summer of 1827. They soon shared the same fate as Yount's group, which had reached Santa Fe in May: all pelts were confiscated by Mexican officials. Together, the two halves of the expedition amassed about 20,000 dollars' worth of beaver skins. Despite the probable keeping of accurate account books, the furs were seized on the disputed grounds that the trappers had no proper licenses.[79]

Temporary bankruptcy did not deter the Patties. By September, 1827, they were ready to take the field again, this time leading a group of 24 men south out of Taos. This would be the most ambitious undertaking yet, with Mexican California the probable goal, right from the beginning. Rumors had been circulating among the mountain men that American traders, operating from offshore vessels, were offering higher prices for furs than the merchants of Santa Fe.

Following the established route to the copper mines and beyond, the trappers began working the upper Gila again. "But our stay on this stream was short," recalled Pattie, "for it had been trapped so often, that there were but few beavers remaining, and those few were exceedingly shy."[80] With local exceptions, the Gila probably had been excessively exploited, especially during the season of 1826-1827. After that, there

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79. Account books were probably kept in the self-interest of each party, to keep a record of skins taken or contributed by themselves as credits, or of company supplies charged to them. Lacking such a record, the mountain men would be unprotected at the final settlement of accounts. A mere tally score would be vague and unverifiable months later, so presumably there would be a date entered with each batch of skins.

80. Pattie, p. 121.

were only a few records of mountain men working in the area except for those who used it as a road to California.[81]

The luck of the expedition turned when it reached that old reliable, the San Pedro River. Beaver still survived there in "considerable number," according to Pattie. But the familiar specter of starvation awaited the trappers; with a scarcity of game to contend with, they had to eat six horses and all the dogs during October. Conditions were better back on the Gila, and trapping became lucrative again in the vicinity of the Maricopa villages. George C. Yount, who was once again part of the company, made reference to a small slough on the south side of the river where the beaver produced dark pelts of an unusually "splendid lustre."[82] Downstream, the party continued to take beaver, especially when they approached the confluence of the Gila and Colorado Rivers.

At about this time, all but six of the trappers revolted against the authority of Sylvester Pattie, and the highly individualistic mountain men once again broke up into separate detachments. George Yount joined the larger group, which ascended the Colorado a short distance, then journeyed overland to Taos by way of the Hopi villages, Zuni, and Laguna. They cached their furs on the Jemez River before entering Taos. Afterwards, they safely smuggled the pelts in.

Below the mouth of the Gila, misfortune again plagued the eight men of the Pattie company (six, plus the two Patties). Yuma Indians

81. Weber, p. 220.

82. Yount, p. 33.

stole all their horses, and the mountain men had to compensate by hollowing out two cottonwood logs to serve as canoes. All the pelts and supplies were loaded into the dugouts, and the expedition proceeded downriver. They hoped ultimately to find a Mexican settlement in the delta of the Colorado, but meantime they worked energetically "to trap the river clear," as Pattie phrased it. Sometimes the trappers brought in as many as 60 beaver in a morning.[83] The river became circuitous, with many islands on which they set beaver traps with consistent success. Southward, the gallery forest on the banks comprised larger timber than farther upstream, being less of a jungle. And Pattie remained alert to the fauna around them:

> There are but few wild animals that belong to the country farther up, but some deer, panthers, foxes and wildcats. Of birds there are great numbers, and many varieties, most of which I have never before seen. We killed some wild geese and pelicans, and likewise an animal not unlike the African leopard, which came into our camp, while we were at work upon the canoe. It was the first we had ever seen.[84]

The last animal described probably represents the first mention in literature by an American of a jaguar in the Southwest. It is unlikely that ocelots were ever recorded this far west, but the possibility cannot be ruled out.[85] The "panthers" Pattie mentions refer to

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83. Pattie, p. 130.

84. _Ibid._, p. 131.

85. As late as 1922, Aldo Leopold in _Sand County Almanac_ (New York, 1966), p. 143, states that the jaguar still prowled the dense tangle of mesquite and willow that separated the delta channels from the thorny desert beyond.

a well-marked desert form, the Yuma mountain lion, Felis concolor browni.[86]

One morning, as the party was paddling south in the two canoes, some trappers detected two Yuma bowmen waiting to ambush them from the tops of cottonwoods overlooking the river. The mountain men sat, rifles primed, until they were within 100 yards of the ambuscade, then, in Pattie's words, "brought them both tumbling down the branches, reminding us exactly of the fall of a bear or a turkey. They made the earth sound when they struck it."

As the trappers approached the delta country the landscape became flat and waterlogged. Beaver remained abundant until the expedition reached tidewater, below which point they soon disappeared.[87] Pattie reported: "The land is exceedingly marshy, and is the resort of numerous flocks of swans, and blue cranes. The rackoons are in such numbers, that they cause us to lose a great many beavers, by getting into our traps and being taken instead of the true game. They annoy us too with their squalling when they are taken."[88]

After it became evident that there were no Mexicans in the inundated wilderness of the Colorado delta, the mountain men considered

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86. In 1910, according to Joseph Grinnell, lions were fairly common in the bottomland thickets along the lower Colorado. They apparently swam at will back and forth across the river (Grinnell, Lower Colorado, p. 252). C. Hart Merriam suggested that the Yuma mountain lion, being quite small, with small teeth, may "indicate that he preys on smaller animals than the deer-killing Cougar of the uplands" (Grinnell, Dixon and Linsdale, Fur-Bearing Mammals, v. 2, p. 587).

87. Daily Alta California, July 2, 1865.

88. Pattie, p. 136.

retracing their steps upriver. But winter floods had so swollen the current that it was impossible to pole or paddle against it. One day a huge tidebore from the Gulf of California submerged the camp, nearly drowning the whole party. The trappers now had no choice but to cache their furs and start walking directly for the Pacific. Miraculously, they survived the desert only to be arrested and imprisoned by the Mexican authorities in Baja California. After a period of hardship in which Sylvester Pattie died, the men were finally released. James Ohio Pattie returned to Kentucky by way of Vera Cruz and New Orleans, after which he vanished from history.

For another year, George C. Yount trapped out of New Mexico, but excited by the prospects of mule trading in California, he headed west. He was never to see Arizona again.[89] Over the years, Yount dictated his memoirs to various friends, primarily the Reverend Orange Clark. He spent the last years of his life as a respected rancher in the Napa Valley.

Kit Carson, who is perhaps best remembered as a guide and Indian fighter, was an experienced mountain man by the age of twenty. His dictated reminiscences are detailed, but include mostly sketchy information about the fauna of Arizona during his trapper days. Reaching Taos in 1826, he spent his apprenticeship as a cook and teamster before joining one of Ewing Young's expeditions in 1829 as a full-fledged trapper. This party swung southwest to the upper Salt River, which they trapped down to

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89. In California alone, and particularly in the Napa Valley, George Yount gained a reputation as a celebrated grizzly bear hunter. He claims to have killed hundreds (Yount, p. xvi).

the mouth of the Verde. From here, they ascended the Verde to its headwaters, where the company divided. One group returned to Taos with pelts and to replace traps stolen by Indians, while Young led 17 men due west, pioneering a difficult new route to California. Before setting out, the latter contingent killed three deer, jerked the venison, and converted the skins into "tanks" or water bags by casing them with tallow.[90] The venison had to go a long way, Carson remarking that game was generally scarce between the Verde and the Grand Canyon.

Young's company trapped the San Joaquin Valley in 1830 before returning to New Mexico. On the way back, they worked the Colorado River down to tide water, then ascended the Gila and proceeded to the copper mines, where they cached their furs. A number of trappers went on to Santa Fe to inform the Mexican officials that they wished to purchase licenses to trade with the Indians. When the furs hidden at Santa Rita were smuggled into Santa Fe, the authorities assumed they had been taken in legal trade.

Meanwhile, at least along certain stretches of the river, the beaver population on the upper Gila was showing signs of recovery by 1830. In August of that year four veteran trappers went south from Santa Fe to try their luck in Sonora. They did poorly on the Yaqui River, so headed northwest until they reached the San Pedro, which they followed to the Gila. An attempt to head downstream was thwarted by the hostility of the Papagos and Maricopas, so the party turned east again. In the words

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90. Cleland, p. 229.

of Robert Isaacs, one of the trappers, "Beaver sign...was abundant. The banks of the river were literally smooth from the small trees and timber which had been slid down them, for the construction of their dams."[91] The four men stopped and put out sets, but on the first night Indians stole their horses and traps, and for the next two days the little company was fighting for its life in a running battle. However, they not only managed to get back to the copper mines with their lives, but with most of their furs as well. A year later, the trader William Sublette paid Isaacs 2,260 dollars, which probably represented payment for beaver pelts.

In 1869, the Sentinel of Santa Cruz, California, printed the memoirs of an old trapper named Job Francis Dye. It was entitled "Recollections of a Pioneer, 1830-1852," and among the reminiscences of early California, it described a trapping expedition across Arizona in 1831. A latecomer to the fur trade in the Southwest, Dye joined a company of aspiring mountain men assembling at Fort Smith, Arkansas, in 1830. Some 43 men strong, this group ascended the Arkansas River to the Rockies, had most of their provisions stolen by Indians, but managed to push south through deep snow to Taos in the late autumn. Within a year, Dye enlisted for a venture to California led by the perennial Ewing Young. Trapping beaver on the way, the 36-man expedition probably spent some time on the headwaters of the San Francisco River after

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91. Weber, p. 221.

leaving Taos in the fall of 1831.[92] Dye recalled that the mountain men found "beaver plenty and caught a great number of them."[93]

Like so many predecessors, Dye also remembered a scarcity of game. The upper San Francisco flows through rugged country, and the trappers were hard put to live off the land. On one occasion a dozen wild turkeys were shot (Pattie had recalled them as being common in this region in 182~~5~~6). Deer sign was encountered, and several herds were seen at a distance, but no one was able to bring in venison. One large bear (probably a grizzly) charged the party after she and her two cubs were wounded. She veered off and escaped after being missed by a second fusillade.

On a subsequent hunt, Dye and Ewing Young spotted a large grizzly climbing a ridge. They circled around on horseback and worked to within rifle range. After Young wounded the bear in the neck, it stopped, turned and stood up. Dye's shot then struck the animal in the forehead, the ball glancing off. The bear ran off down the mountainside, and Dye tracked it to a patch of scrub oak. This time it charged furiously, but Dye kept his horse safely beyond reach until the wounded grizzly turned off and started up the mountain again. Following closely, Dye got off

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92. Although Dye speaks of trapping on the Black and Salt Rivers after passing through Zuni, the expedition's geography becomes hopelessly confused if he is accepted at face value. Young's men may well have worked these rivers, but not in the sequence suggested by Dye. It would have been impossible to descend the Salt to the Gila, then follow the Gila downstream through a "horrid canyon" to the mouth of the San Carlos. Assuming that the expedition did descend a river to the gorge of the Gila, which is upstream from the San Carlos, the only possible choice is the San Francisco. See Job Francis Dye, Recollections of a Pioneer, 1830-1852 (Los Angeles, 1951), pp. 19-27.

93. Ibid., p. 19.

three more shots, the last one killing the bear. In Dye's words, the bear, dressed, weighed "five or six hundred pounds, which was highly prized, in our camp, and was really worth more, in our famished condition, than its weight in silver, as it was the only meat we had tasted for several weeks, except beaver--a very poor substitute for hungry trappers."[94]

The bear hide was cut into two sacks, each holding about 300 pounds of meat, which were carried several miles to camp. Dye also used the hide to make temporary moccasins to replace the ones that had been worn out in the chase.

When the trappers descended the Gila to its confluence with the San Carlos, Apaches stole a number of traps and pack mules. However, the company was able to replace the provisions at the Pima villages near the mouth of the Salt River. With what traps remained, the mountain men worked the Gila all the way down to the Colorado. They then crossed the Mohave Desert without serious mishap, arriving in Los Angeles in March, 1832. For Dye this was a one-way journey. His first experience with the Arizona wilderness was never to be repeated.

Up until about 1832, fur trapping in the Southwest continued to be a highly profitable enterprise. One Mexican legislator estimated that at its height trappers shipped about 200,000 dollars' worth of beaver pelts annually from Abiquiu and Taos.[95] In 1828 beaver fur brought $3.50 a pound at New Mexico prices. This was slightly more than the

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94. Dye, p. 23.

95. Cleland, p. 153.

"mountain" price of three dollars, which remained constant between 1823 and 1833. Meanwhile, trade in horses, equipment, and provisions at Taos alone amounted to some 50 or 60 thousand dollars a year. When the authorities attempted to interfere with this trade by confiscating furs and merchandise, American traders retired to the interior beyond the reach of Mexican law and established fortified posts like Bent's Fort on the Arkansas River. Trapping and trading operations, largely geared to exploiting one natural resource--the beaver--diverted so much potential revenue from Mexico that to a degree the Southwest became an American economic colony long before the Mexican War.

With the growth of the China trade out of England and New England, the world market in beaver began to break. The early 1830's witnessed the clipper ships bring silk in great quantities to manufacturing cities everywhere. Fashion changed, and silk was now offered for hats instead of beaver. After 1831, as trappers began to rely on intermontane trading posts as markets for beaver, and as the fur trade itself showed the first indications of decline, there was a slight advantage in an American becoming a Mexican citizen in order to trap legally. This trend changed even more drastically within the decade. With beaver fading out of the economic picture, many former trappers took up trading entirely.

As the era of the Taos trappers waned in the 1830's, two events came to dominate mercantilism in the Far West. One was the preeminence of the stationary trading post, and the other was a correlative rise in the demand for bison hides. For three decades after 1832 buffalo became the most sought after animals in North America. Few Indians had ever trapped for beaver pelts, but buffalo robes were readily available through trade with the plains tribes. This made it possible for the fur trade to be carried out at strategically located fixed posts.

Economic decline was not the only reason that trappers were beginning to disappear from the Gila and Colorado drainages. As early as the period between 1829 and 1831, problems with hostile Indians had become so acute that mountain men on their way to California were already circumventing Arizona by following the Old Spanish Trail through Utah.

Parts of the upper Gila were an exception to the general situation. Some Apache bands in that region actually extended protection to beaver trappers, in part because the Americans brought trade goods in the form of arms and ammunition. But all this changed during the season of 1836-1837, when the bottom had nearly dropped out of the market anyway. American bounty hunters, seeking Apache scalps to turn in to the Mexican authorities, killed a number of friendly Indians, including a chief. From then on, no trapper was safe on the Gila.

Until the outbreak of the Mexican War, a few hardy adventurers continued to trap beaver in Arizona. The market price for pelts was low, but beaver had made a good recovery from the peak trapping years, and this handful of romantics had the field to themselves. In the season of 1840-1841, for example, mountain men found the trapping particularly good on the upper Gila. Game was abundant; bear meat and venison were dependable staples.[96]

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96. Vincent Colyer, Peace with the Apaches of New Mexico and Arizona (Washington, D.C., 1872), p. 5.

In 1846, when George Frederick Ruxton passed through New Mexico, he noted that "beaver has so depreciated in value within the last few years that trapping has been almost abandoned."[97] Beaver were then commanding 90 cents a pound in the southern Rockies.

The trappers who worked the rivers of Arizona left little impact on the land. But their mark on history is impressive. In the process of harvesting the beaver, they blazed a system of trails that linked New Mexico with the missions of San Gabriel and San Diego. A vast, unsettled region was opened to trade and enterprise. The basin of the lower Colorado was explored and a way prepared for its occupation by American forces. They showed, above all, that southern California was accessible to overland pack trains and that it need not remain isolated behind mountains and deserts.

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97. George F. Ruxton, Ruxton of the Rockies, ed. LeRoy R. Hafen (Norman, 1950), p. 225.

CHAPTER III

PATHFINDERS IN BLUE, 1846-1864

When the Mexican War broke out in April, 1846, Arizona in itself was of little strategic value. However, by providing access to the Pacific Ocean it was vitally important. Beaver trappers had shown that it could be crossed in a direct line to the west coast, and the American appetite to possess California was thereby whetted. United States military leaders realized that a fixed route across southern Arizona was crucial for maintaining any future supply line to California and for protecting the southwestern border from Indian and Mexican attacks. Accordingly, a force of 1700 men with the grandiloquent title of the "Army of the West" was organized at Independence, Missouri, under the command of Colonel Stephen Watts Kearny. Kearny's immediate objective was the occupation of New Mexico, and after an uneventful march Santa Fe fell without bloodshed.

Following the surrender of Governor Manuel Armijo, Kearny divided his army into four separate commands. One stayed on in Santa Fe as an occupation force. Another under Colonel Alexander Doniphan was to march south, seize Chihuahua City, then turn east to link up with Zachary Taylor. A third, consisting of 300 dragoons under Kearny himself, would push west to occupy California, while the fourth, led by Captain Philip St. George Cooke, was to open a wagon road from New Mexico to California.

One of the primary missions of the California column was to create the first accurate map of the vast region lying between the Rio Grande and the Pacific Ocean. To realize this need, a unit of well-trained topographical engineers was essential. These men were provided, and their commander, a first lieutenant, was an aristocratic Marylander with flaming red whiskers named William Hemsley Emory. More than a competent engineer, Emory showed evidence of being an advanced scientific thinker. On the way out from Fort Leavenworth, where his unit joined Kearny's army, he concluded that continuous erosion had shaped the landscape. A "denuding process," in his perceptive interpretation, had left only the hard volcanic rock unworn.

On September 25, 1846, Kearny led his dragoons down the Rio Grande with the eventual intention of turning toward the Gila River. At Valverde he met the seasoned mountain man and explorer Kit Carson, riding east with dispatches stating that American forces had already gained control of key areas in California. Kearny was able to persuade Carson to wheel about and guide his column west, and the troopers set out along one of the traditional routes used so often by mountain men in the 1820's and 1830's (see Fig. 2, p. 223). Honed down to 100 men, plus Emory's 14-man contingent of topographical engineers (the other 200 dragoons were sent back to Santa Fe), the Army of the West marched first to the Santa Rita copper mines, now the site of a ghost town under the dominion of the Apache chief Mangas Coloradas. Kearny declined Mangas' offer to help against the Mexicans and moved on to the upper Gila. It was October when the Americans began descending the ever-deepening gorge cut by the river in its westward passage. Many men in the dusty, noisy column saw no wildlife at all, though Emory commented on the abundance of deer and beaver sign. Wolves were also spotted on several occasions.[1]

Emory was not the only literate observer on this expedition. James M. Cutts recorded seeing immense numbers of Gambel's quail on the bottoms of the upper Gila.[2] Of the river itself, Abraham Johnston, a member of the First Dragoons, had this to say: It was "a beautiful mountain stream about thirty feet wide and one foot deep on the shallows, with clear water and pebbly bed fringed with trees and hemmed in by mountains, the bottom not more than a mile wide. The signs of beaver, the bear, the deer, and the turkey, besides the tracks of herds of Indian horses, were plain to be seen on the sand."[3] An army surgeon, John S. Griffin, commented on the abundance of deer and turkey tracks and the elusiveness of the animals themselves. He quoted Kit Carson as saying that he never knew a party not to leave the Gila in a starving condition.[4] A few days later Griffin did see some ducks and geese on the river and heard that the artist John M. Stanley had shot two turkeys.

One member of the column who kept a particularly detailed journal was Henry Smith Turner. He was impressed by the continuous cover of good grass along the river, plenty to sustain the mules. Turner also found

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1. William H. Emory, Notes of a Military Reconnaissance (Washington, 1848), p. 64.

2. James M. Cutts, The Conquest of California and New Mexico (Albuquerque, 1965), p. 186.

3. Abraham R. Johnston, Journal of A.R. Johnston, First Dragoons, 25 September to December, 1846 (Washington, 1848), p. 579.

4. John S. Griffin, A Doctor Comes to California (San Francisco, 1943), p. 25.

much evidence of wildlife along the upper Gila: not only Gambel's quail and turkey, but signs of deer, beaver, and bear.[5] Nevertheless, the expedition's hunters did not bring in much game.

Farther downriver, as the canyon deepened, Dr. Griffin continued to notice deer and turkey tracks, but saw no game except Gambel's quail. Abraham Johnston got a look at the lower stretch of the San Francisco River when the Army of the West reached its confluence with the Gila. He reported a large number of beaver dams on this mountain tributary, with "flags and willows along the borders very thick," and majestic cottonwoods on the banks.[6]

Just past the mouth of Eagle Creek on the Gila, Turner entered in his journal some facts about the Gambel's quail: "A portion of our route today abounded with the partridges peculiar to this country--never were partridges so numerous as in this--in the distance of half a mile we must have seen today from 800 to 1,000."[7]

At some point beyond the junction of the Gila and the San Carlos, Lt. Emory made note of the presence of javelina. He remembered that the Graham Mountains were distinct against the sky to the southeast. "Last evening about dusk (Oct. 29)," the entry reads, "one of my men discovered a drove of wild hogs....The average weight of these animals is about 100 pounds, and their color invariably light pepper and salt. Their

5. Henry Smith Turner, The Original Journals of Henry Smith Turner, ed. Dwight L. Clarke (Norman, 1966), p. 90.

6. Johnston, p. 587.

7. Turner, p. 91.

flesh is said to be palatable, if the musk which lies near the back part of the spine is carefully removed."[8]

For a short distance early in November Kearny struck southwest away from the Gila and came to the lower San Pedro, which the dragoons followed to its mouth. Dr. Griffin recalled that another name for the San Pedro was Hog River, because of the abundance of javelina on its well-wooded flood plain. In Emory's journal the valley of the lower San Pedro is described as being wide, with a dense growth of mesquite, cottonwood, and willow, "through which it is hard to move without being unhorsed."[9]

Back on the Gila, just west of the mouth of the San Pedro, Johnston also saw javelina in the dense riparian thickets.[10] Lt. Emory jotted down his impressions of this part of the Gila, the date being November 7. The expedition observed "Flights of geese, and myriads of the blue quail, and flocks of turkies, from which we got one....The river bed, at the junction of the San Pedro, was seamed with tracks of deer and turkey; some signs of beaver and one trail of wild hogs."[11]

For Lt. Emory, one of the most absorbing aspects of the journey was an opportunity to study the ruins of twelve ancient Indian towns, as well as abandoned irrigation systems. These investigations convinced him that no direct connection existed between the Pueblo cultures and the Aztecs and Mayas to the south.

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8. Emory, p. 69.

9. *Ibid.*, p. 75.

10. Johnston, p. 593.

11. Emory, p. 78.

Near the mouth of the Salt River, the expedition rested and traded among the Maricopas and Pimas, now peaceful farmers who grew crops of corn and cotton, planted to exploit seasonal overflows on the river bottoms. In the middle of November Kearny resumed the march down the Gila. Dr. Griffin observed that below the Salt the Gila River was about 80 yards wide, three feet deep, and rapid. Waterfowl teemed: ducks and geese of several species, and whistling swans.[12] Beyond the great bend, Lt. Emory referred to the river bottoms being "wide, rich, and thickly overgrown with willow and a tall aromatic weed." The Gila was covered in places with waterfowl, particularly snow geese, which Emory called "white brant," with black-tipped wings. Signs of mule deer and beaver were everywhere, and one member of the party shot a buck in the stream-side thickets.[13]

In what is now western Maricopa County, Turner noticed that the Gila was becoming much more like a real river. The width varied from 100 to 150 yards wide, with an average depth of four feet--"quite deep enough to float a steamboat." It flowed gently over a sandy bottom, while the banks, in Emory's terminology, were fringed with cane, willow, and myrtle. Farther on, at Painted Rocks, in modern Yuma County, Kit Carson shot a bighorn ram. Johnston remembered that the face of the mountain came close to the river bottoms, and that a flock composed entirely of males clambered with great facility up the cliff. Emory's notes state that the column named the site "Goat's Spur," after the

12. Griffin, p. 25.

13. Emory, p. 91.

bighorn. Near there, on November 19, "We encamped on an island where the valley is contracted by sand buttes in what had been very recently the bed of the river. It was overgrown with willow, cane, Gila grass, flag grass, etc. The pools in the old bed of the river were full of ducks, and all night the swan, brant, and geese, were passing, but they were as shy as if they had received their tuition on the Chesapeake Bay, where they are continually chased by sportsmen."[14]

Five days later the Army of the West came out on the banks of the Colorado River. Turner remarked on the good cover of grass under the woody growth along the shore, but the expedition feared losing the pack animals in the almost impenetrable riparian thickets of "mesquite and other thorny bushes." There were a few cottonwood trees at this point, but generally there was an absence of heavy timber. The Colorado reminded Turner of the Arkansas, being a little larger, but with the same "dingy red water."[15]

Near the mouth of the Gila a detachment under Lt. Emory captured an enemy courier with the news that much of southern California had been recaptured by Mexican forces. Kearny immediately crossed the Colorado and drove his army over the Mohave Desert in a series of forced marches. At San Pascual, outside San Diego, the exhausted and disorganized Army of the West suffered a sharp defeat at the hands of a unit of California lancers. A relief column from the coast eventually forced the Mexicans back, and in the end California was annexed by the United States. But in the main, Kearny's march down the Gila is remembered for the

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14. Ibid., p. 92.

15. Turner, p. 119

achievements of Lt. William H. Emory. He drew the first accurate map of the region, a map that was not only the geographical base of the official report on the expedition, but was to prove invaluable to Gold Rush emigrants in 1849. In addition, Emory made detailed notes of the topography, geology (including fossils), plants and animals seen along the route. John Torrey studied the plants collected and described 18 new species. George Engelmann of St. Louis wrote the first scientific description of the sahuaro, Cereus giganteus. And a common evergreen oak of southern Arizona was named Quercus Emoryi.[16]

When Kearny marched out of Santa Fe, he left orders for Captain Philip St. George Cooke to form an adjunct to his column by blazing a wagon road connecting New Mexico with San Diego. Cooke's force--not a combat unit--consisted of 500 volunteers of the Mormon Battalion, whose pay was being used to finance the Mormon settlement of Utah. They were to act as shepherds for a wagon train to be used to test the feasibility of the route.

After leaving Santa Fe on October 21, the Mormon Battalion descended the Rio Grande, averaging some ten miles a day. On November 10 they left the river and set a course that would take them south around the Mimbres Range after first stopping at the copper mines (see Fig. 2, p. 223). The column kept to this route, came to the road from Janos, Chihuahua, and marched west past Playas Lake (in modern Hidalgo County, New Mexico). The next objective was a large ranch said to lie on the far side of a pass that the guides felt could be negotiated. Meantime,

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16. William H. Goetzmann, Army Exploration in the American West, 1803-1863 (New Haven, 1959), p. 142.

the volunteers marveled at an abundance of game, especially mule deer and herds of pronghorn. One of the guides shot a grizzly bear, bringing in the meat to vary the camp fare.[17]

Cooke's contingent was assisted by an impressive assemblage of guides, all former beaver trappers. One was the inimitable Antoine Leroux. The others were Pauline Weaver, half English, half Cherokee, and Baptiste Charbonneau, son of Toussaint Charbonneau and Sacajawea, who played such notable roles in the Lewis and Clark expedition. There were also several Apaches assigned to the column by Mangas Coloradas, who had promised Kearny he would see Cooke through.

After crossing the Animas Valley, the Americans neared a steep jumble of hills said to conceal Guadalupe Pass, the gateway to what is now Cochise County, Arizona. Leroux convinced Cooke that a narrow horse trail would take them over the proper route. This turned out to be a mistake, and a Dr. Foster finally happened on the real pass. It turned out to be no bargain. In fact, an anonymous traveler called this passage "the worst place for wagons to travel over I ever saw." Nevertheless, the Mormon Battalion hacked a crude trail down the defile called today Guadalupe Canyon, hauling the wagons piece by piece with ropes, losing both wagons and mules in the process. Guadalupe Pass was no true wagon road, though Cooke retained the composure to stop and admire the scenery. Here too, in his official report, Cooke referred to a phenomenon that was to occupy the battalion's attention for days to come: "It was in the mountain pass that we first saw the wild bulls, from which the command

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17. H.W. Bigler, "Extracts from the Journal of Henry W. Bigler," Utah Historical Quarterly, V (1932), 35-64, 87-112, 134-160.

obtained their exclusive supply of meat for about two weeks. They are the increase from the abandoned, when the two ranches of San Bernardino and San Pedro (on the river of the same name) were broken up, in consequence of incessant Indian attacks. They have spread and increased, so as to cover the country; they were as wild and more dangerous than buffalo."[18]

On December 2, the Mormon Battalion emerged from the Guadalupe Mountains and camped at the ruins of San Bernardino Ranch, the site of which is now just below the Arizona-Sonora border.[19] Wild cattle were everywhere, and the guides shot three or four while the column was still filing out of Guadalupe Canyon. The San Bernardino land grant, which according to Cooke once extended to the Gila River, was deserted in the 1830's when constant Apache raids became intolerable. Possibly as many as 100,000 head of Andalusian cattle were left behind.[20] When the Mormon Battalion arrived most of the herds had been scattered or thinned by the Indians. The survivors were almost all bulls, usually running together.

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18. A.W. Gressinger, Charles D. Poston, Sunland Seer (Globe, 1961), p. 45.

19. As early as 1694, 100,000 head of stock ranged northern Sonora. Within three years cattle were introduced at San Xavier del Bac. The heyday of economic success for the Spaniards in cattle raising was reached about 1751, when the mission period had ended.

Around the end of the 18th century, a number of Spanish ranches were operating in the valleys of the Santa Cruz, San Pedro, and San Simon. They included the following: San Bernardino, Babocomari, San Pedro, Arivaca, Calabasas, Sapori, Raventon, San Rafael de la Zanje, Sonoita and Tubac. There were also the Agua Prieta, Pueblo Viejo, and largest of all, the Sierra Bonita.

By 1811 the Apache terror had begun again, and this pastoral era began to come to an end. See J.J. Wagoner, History of the Cattle Industry in Southern Arizona, 1540-1940 (Tucson, 1949), pp. 14,27,36.

20. Ibid., p. 42.

The cows, which were more easily killed, had been largely culled from the population. The Americans noticed that these remaining bulls sported a variety of colors: black, brown, blue, or red, with black predominating. Their horns were trim and white, and their faces were covered with coarse hair.

One of the volunteers, Robert Whitworth, who kept a diary, remarked on the beauty of the San Bernardino Valley, which stretched away from the ranch on all sides. There was plenty of water, and the grass was "two feet high as far as the eye can reach." Mesquite was the only woody cover. Whitworth also noticed numerous herds of pronghorn.[21]

After the battalion had stopped to rest in the valley, preparations were made to bring in a supply of beef. One of the men participating was Sergeant Daniel Tyler, who has left a vivid account of hunting a species that qualified as big game in every sporting sense of the word.

> One of the guides killed a wild bull and was found drying his meat on our arrival. A few hunters were immediately sent out, and more went out on their own responsibility, the author among the latter. Every now and then a bull bounded past him, having been routed by the hunters.
>
> After following one and another, in the hope of getting a shot, he discovered one standing under a lone tree, at a distance of, perhaps, a mile. He crouched and sneaked along from bunch to bunch of the Mezquite until one half the distance was made, when the crack of a musket and a rather sharp screech or lowing of the animal proved that another hunter had discovered his quiet resting place. His thigh bone was broken. Another shot succeeded in bringing him to the ground. By this time I had approached within a few rods, when the well-known voice of Walter Barney, one of my messmates, directed me to stop until he fired again.

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21. David B. Gracy II and Helen J.H. Rugeley, "From the Mississippi to the Pacific: An Englishman in the Mormon Battalion," Arizona and the West, VII (summer, 1965), p. 149.

Much of the San Bernardino Valley today is dominated by a Chihuahuan Desert plant community. Mesquite is still abundant, but open grasslands exist only in scattered mosaics.

> I insisted, however, on going up and cutting the animal's throat to save the waste of ammunition, but as he claimed that there might be danger of the animal rising and goring me, I picked up a rock about the size of a man's fist and threw it a distance of, perhaps, ten feet, against the horn of the animal. Quick as thought he bounded to his feet, and, with a wild, shrill bellow, hobbled after me on three legs. I fired and he fell again, only to arise and pursue his intended victim with the more fury. I was below him on a hill-side; as he neared me I dodged him, and while he was turning round gained a few feet up the hill. My comrade fired again, and the animal once more fell to the ground. This time a bullet from my musket, a little below the curl in the pate, ended the battle. Six bullet holes, all in fatal places, showed that these cattle could endure as much lead as a buffalo. He had a very large body, with horns about two yards from tip to tip, and he was round and fat.[22]

Tyler remained with the carcass until well after dark, when his companions returned with a pack mule. As he maintained, he "had but little fear of other wild beasts or Indians, although the country abounded with both."

The battalion remained at the abandoned hacienda for nearly two days, and Tyler's report states that the hunters brought in five days' allowance of wild beef as rations. While the volunteers spent the time constructing scaffolds on which to dry the meat, Cooke traded with the Apaches for mules. He also issued an order prohibiting the firing of guns after the resumption of the westward march, the idea being that wounding a bull was more dangerous than ignoring it. The men became uneasy, since in Tyler's words they were about to go among "thousands of wild cattle, ten-fold more dangerous than the buffalo." Consequently, a few volunteers, fearing unprovoked attacks, took matters into their own hands and shot some bulls in the vicinity of present-day Douglas. Only a few choice cuts were taken from these animals.

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22. Sgt. Daniel Tyler, A Concise History of the Mormon Battalion in the Mexican War (Chicago, 1964), pp. 211-213.

On December 5 the Mormon Battalion probably camped on Whitewater Draw (the Americans called it Ash Creek from the predominance of ash, walnut and oak), at the south end of the Sulphur Springs Valley. Tall grass and mesquite dominated the adjacent flats. That night a teamster died, and as Tyler recalled: "The large wolves, probably scenting the corpse, made the night hideous with their howls. Their grum voices almost rent the air only a few feet from our camp."[23]

Four days later, after passing the Mule Mountains, the battalion debouched once more into open country. Cooke describes the march to the west: "A vast unbroken slope of prairie was before us....After ascending somewhat, saw a valley indeed, but no other appearance of a stream other than a few ash trees in the midst; but they, with numerous cattle paths, gave every promise of water. On we pushed, and finally, but not until within twenty paces, I saw a fine bold stream! There was the San Pedro, so long and anxiously sought."[24] Everywhere, the volunteers saw herds of wild horses, cattle, and pronghorn.[25] Deer (species undetermined) were also abundant. As the column turned north down the river, near the site of Lewis Springs, dry wallows made by the wild bulls appeared on all sides. They reminded Cooke of buffalo wallows on the Great Plains. Henry Standage, another of the literary soldiers with this expedition,

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23. Tyler, p. 216.

24. Philip St. George Cooke, The Conquest of New Mexico and California (Albuquerque, 1964), p. 144.

25. Robert S. Bliss, "The Journal of Robert S. Bliss, with the Mormon Battalion," Utah Historical Quarterly, LV (1931), p. 80.

observed many signs of grizzlies under the walnut trees that grew in places along the stream.[26]

The Mormon Battalion was still marching north on December 11 when an encounter took place with bulls close to the future location of the mining town of Charleston. The events are related by a member of the contingent named Keysor:

> The land on each side of the Pedro River bottom is a dense thicket of bramble bush, mostly muskeet, with which millions of acres are covered. Those in the Mormon Battalion who had yaugers (jaegers?) were permitted to go a hunting this morning. Shortly after we started, two wounded bulls came jumping into our marching column. One of them knocked down and run over Sergeant Albert Smith, bruising him severely; as soon as they passed the column, they received a volley which brought them to the ground. The Sergeant was put into a wagon and the command marched on; soon descending to the river bottom we halted to water our teams, where another couple of bulls raging and foaming with madness, charged upon us. One of them tossed Amos Cox of Company D into the air, and knocked down a span of mules, goring one of them till his entrails hung out, which soon died; Cox's wound was four inches long and three deep. While these two bulls were performing thus, others stood a few rods off seemingly unable to determine whether they should charge or await the issue; they chose the latter course; meantime, the two bulls retreated, closely pursued. Then our attention was turned to the bulls that were looking on. Some officers yelled "shoot them," others cried, "let them alone;" amid this confusion the wagons and part of the command moved on. The battle was renewed on our side and in a few minutes the enemy lay weltering in their blood. After advancing about half a mile another bull came rushing out of the muskeet thicket, and charged upon the hind end of a wagon, lifting it partly around, and knocking down a mule, but his career was short for all the command now had their muskets loaded, and soon greeted our fierce opponent with a shower of bullets. These bulls were very hard to kill; they would run off with half a dozen balls in them unless they were shot in the heart.[27]

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26. Henry Standage, The March of the Mormon Battalion, ed. Frank A. Golder (New York, 1928), p. 192.

27. Standage, pp. 193-194.

Tyler estimated that between 20 and 81 bulls were killed in the "battle." The element of surprise was with the animals, since they charged from the close-in cover of tall grass.

After leaving the San Pedro, the Mormon Battalion marched straight for Tucson, which it occupied without firing a shot, the Mexican garrison having evacuated the town before the forces sighted one another. The next phase of the journey took the Americans to the Gila, where they found the trail left by Kearny. The column reached San Diego on January 29, 1847, in a routine march, and nothing of significance was added to what was already known of the natural history of southern Arizona.

Cooke summed up what he considered the accomplishments of the expedition: "Marching half naked and half fed, and living upon wild animals, we have discovered and made a road of great value to our country."

During the summer of 1848, a final detachment of American troops crossed Arizona to carry out duties imposed by the Mexican War. Some 500 men of the Second Dragoons, commanded by Major Lawrence P. Graham, set out from Monterrey, Mexico, on a march to San Diego. Major Graham and many of the troopers were drunk much of the time after the column passed Janos, which explains in part why a flash flood near San Bernardino Ranch carried off wagons and mules. This event, probably occurring in either the Animas or Guadalupe Mountains, evoked a comment from Lt. Cave J. Couts, a young West Pointer with the expedition: "We also see a little game occasionally, and his good spirit (the commander of the expedition) moved him through the influence of whiskey, to leave the harmless deer, antelope, turkeys, etc. unmolested."[28]

The dragoons somehow retained their coherence for the rest of the journey, but not without some difficult periods. On the Gila River, about 100 miles above its junction with the Colorado, Couts made the following entry in his journal: "If the game and fishing on the Rio Gila abounded as represented by the pop-gun stump speakers and demagogues of our fair and glorious Republic, the scarcity of provisions would not alarm us but every man who can hunt or fish, and I flatter myself as good if not the best in the command, is constantly out, and enough for one meal is doing remarkably well."[29] Couts went on to observe that the Gila was running like a "wild torrent" over its extensive sand bottom and had overflowed to form "a great number of lakes, ponds, lagoons & c. and nothing else." Although this was written on November 8, no mention is made of the abundant waterfowl reported two years earlier by members of the Kearny expedition.

The Mexican War, which ended with the Treaty of Guadalupe Hidalgo, provided for the cession of Mexico's northern holdings to the United States for 15,000,000 dollars. All of Arizona north of the Gila River was included in the terms. Ratified on July 4, 1848, the Treaty necessitated a long and difficult boundary survey project, initiated a year later.

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28. Cave J. Couts, Hepah, California! The Journal of Cave Johnson Couts, ed. Henry F. Dobyns (Tucson, 1961), p. 50.

29. Couts, p. 72.

In the fall of 1849 the first members of the U.S. Boundary Commission reached Arizona after a march eastward from San Diego. The officer in charge, Lt. Amiel Weeks Whipple, was a topographical engineer with orders to survey and map the confluence of the Gila and Colorado Rivers. With him as an escort was Lt. Couts, now in charge of a company of the First Dragoons. Whipple, whose contributions to science in Arizona were just beginning, aroused Couts' scorn by using an ambulance as a base of operations and working in the field under an umbrella.

On October 2, the First Dragoons began construction of Camp Calhoun, a forerunner of Fort Yuma. The fort was intended to protect and assist soldiers and scientists of the Boundary Commission, keep an eye on the Indians, and help Gold Rush emigrants crossing the Colorado River on their way to California. Lt. Couts provides an interesting picture of the terrain near the site of the new fort: "I was endeavoring to reach the bank of the Colorado, and see where the mouth of the Gila was, and previously to reaching this large lagoon, which puts in here, passed through the dry bed of an immense slough, through which most of the water of Colorado must pass when high, and where I also saw cottonwoods not less than a foot in diameter, recently cut down by beaver."[30]

Since the cost of supplying the new outpost by wagon from San Diego was prohibitive--amounting to 500-800 dollars per ton of provisions--the government decided to investigate the possibility of ships ascending the Colorado as far as the mouth of the Gila. Major General Persifor F. Smith, commanding the Division of the Pacific, in the fall

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30. William McPherson, From San Diego to the Colorado in 1849, the Journal and Maps of Cave J. Couts (Los Angeles, 1932), p. 31.

of 1850 ordered Lt. George H. Derby to determine if this could be done. Derby sailed from San Francisco in the 120-ton schooner Invincible on November 1 and rounded Cape San Lucas, Baja California, on the 28th. On Christmas day the ship dropped anchor at Montague Island, off the delta of the Colorado. Sounding and survey operations were begun, and by December 27 the ship was edging upstream along meandering channels until it reached the head of navigation for ocean-going vessels at Howard's Point. Between January 2-11, the crew made short sallies upriver in a longboat, spending some time observing the peaceful Cocopa Indians.

At some point near the tide line, Derby took down some notes on the natural history of the region: "The banks are lined with rushes, cane, small willows and acacia, and occasionally we observed small cotton woods or poplars; the river was full of geese and ducks, and on the banks we observed many deer tracks of unusual size."[31] A day or so later, a bit upstream, Derby found the banks increasingly more wooded, though with no large trees. Wildlife spoor continued to be abundant, with signs of black bear being particularly conspicuous.[32]

On January 13, 1851, Lt. Derby, in charge of a party in a longboat, met Major Samuel P. Heintzelman, commander of Camp Independence,

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31. George H. Derby, Derby's Report on the Opening of the Colorado, 1850-1851, ed. Odie B. Faulk (Albuquerque, 1969), p. 46.

32. Ibid., p. 46. Along much of the lower Colorado the dense riparian woodland was often miles in width, and it extended for over 100 miles between the mouth of the Gila and the tidewater region of the delta. Before this gallery forest was largely cleared out, it offered good bear habitat. Forty-niners saw black bears in similar vegetation along the lower Gila in 1849. See: Robert Eccleston, Overland to California on the Southwestern Trail (Berkeley, 1950), p. 227.

a new post across the river from Camp Calhoun. The rendezvous took place 80 miles downstream from the encampment. By February 1, the job of unloading 10,000 rations for the garrison was completed, and Derby started for home. His mission had been a success. In addition to completing accurate soundings and compiling data on winds and weather, he had redrawn an inaccurate map made in 1826 by Lt. Hardy of the Royal Navy. Derby's concluding statement about the Colorado River was to have particular significance for the forthcoming expedition under Joseph C. Ives in 1857-1858: "I have no hesitation in saying that it may be navigated at any season of the year by a steamboat of 18 or 20 ft. beam drawing 2-1/2 to 3 feet of water."

Despite being severely hindered by political infighting in Washington, the work of the Boundary Commission went on. William H. Emory and A.B. Gray, the commission surveyor, overcame desertion, lack of funds, and Indian hostilities to complete the job of running and marking the boundary across southern California in 1849. A year later a scholarly Rhode Islander, John R. Bartlett, was placed in charge of the entire Commission, with orders to proceed to El Paso as a first step. He sailed from New York for Texas in August, 1850, with a retinue that included a detachment of topographical engineers, a group of civilian surveyors, a contingent of mechanics, a collection of field scientists sponsored by learned societies, and an assortment of personal friends and relatives.

Bartlett's caravan crossed Texas at a leisurely pace, with the Commissioner reaching El Paso on December 3 to confer with his Mexican counterpart, General Pedro Garcia Conde, on the joint commission set up by the two countries. Conde was unhappy about the treaty provision concerning the southern boundary of New Mexico, but Bartlett was conciliatory and willing to compromise. Both men took to the field with their respective parties and began surveying westward after Bartlett agreed to leave Mexico with a more northerly boundary than many Americans would have been willing to settle for (see Fig. 3, p. 224).

The Bartlett party established headquarters at the old Santa Rita copper mines and made progress despite a steady drain of horses and mules to Apache thievery. On the way across Texas, Bartlett had hunted from a four-horse rockaway carriage that he had virtually converted to an arsenal. He observed large numbers of white-tailed deer grazing on the treeless coastal prairies with cattle, and in April, 1851, mule deer appeared well out on the open flats of the Mimbres River valley of southwestern New Mexico. In Bartlett's account: "As we rode rapidly forward, we noticed a herd of about twenty black-tailed deer quietly grazing on the luxuriant grass of the valley. Disturbed...they dashed away over the plain in single file, led by a large buck....Nearer the river, other deer of the same species were seen browsing upon the willows."[33]

In the area of the copper mines, grizzlies were numerous, and what Bartlett said about them there applied equally to adjacent eastern Arizona. Some of the bears shot in the Mimbres Range by members of the boundary commission weighed up to 800 pounds. Bartlett remarked that grizzlies were usually dangerous to approach, unless there were several well-armed men in a group. Even then, a safe place to retreat to should be picked out, if available. He also knew of several grizzlies that

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33. John R. Bartlett, Personal Narrative of Explorations and Incidents, 2 vols. (New York, 1854), v. 1, p. 221.

received 12 or more rifle or pistol balls before falling, but one particularly large bear was brought down by a single shot from a well-aimed rifle, the ball passing the length of the animal, killing it instantly.

During a crossing of Guadalupe Pass that spring, the party sighted two bears on a hillside above Cooke's 1846 "wagon road." Several horsemen gave chase, but the grizzlies--"so large as to be taken at first for mules"--soon outdistanced their pursuers and escaped. Bartlett made note of the fact that this event took place in a region dotted with evergreen oaks and juniper, with a good cover of grass on the open patches.[34]

Toward the end of the summer, Bartlett was leading a surveying expedition to the upper Gila, when another grizzly encounter took place, probably just east of the Peloncillo Mountains and close to the present Arizona-New Mexico state line. The group was resting on a dry hillside covered with small oaks, when, in Bartlett's words:

> While seated on a rock...we were startled by the appearance of a huge grizzly bear, about fifteen rods distant, advancing in our direction. He discovered us at the same moment we did him, and seemed quite as much alarmed, for he suddenly sheered and made his escape at full speed along the base of the hill. We ran for our arms, which we had left with our horses a few yards below; but before we could get them he was too far off for a shot. He crossed directly in the rear of the train, when he made for the hills, followed by several of the party. Coming to a steep ascent, he ran up it with as much ease apparently as he did over level ground, and soon disappeared. The bear has a great advantage over his pursuers in this respect, as his large and pliable feet, and huge claws, enable him to climb up the steepest acclivity with the same facility as a cat. The color of this animal was of a silvery gray, with a darker or a black stripe down his back.[35]

34. Ibid., v. 1, p. 252.

35. Ibid., p. 363.

On the first expedition out from Santa Rita del Cobre in the spring of 1851, Bartlett headed southwest, in part along the route of Cooke's wagon road. The vast grasslands of southwestern New Mexico and northern Sonora seemed largely devoid of game animals except for an occasional herd of pronghorn, "unapproachable by the hunter for the want of a tree or shrub behind which he may advance," in Bartlett's words. He was impressed by the beauty of the Animas Valley, a treeless plain separated from the San Bernardino Valley (now in Cochise County, Arizona) by the rugged Guadalupe Range: "So level was this valley, and so luxuriant the grass, that it resembled a vast meadow; yet all its rich verdure seemed wasted, for no animals appeared, except a few antelopes and several dog towns."[36]

After emerging from Guadalupe Canyon, the party crossed a stretch of desert plateau before reaching the area of San Bernardino Ranch. Bartlett described the open country encompassing the ranch as a lush prairie some eight or ten miles long and a mile wide. However, on the west side of the San Bernardino Valley the expedition found mesquite thickets and extensive stands of ocotillo.[37] Like the Mormon Battalion five years earlier, Bartlett's contingent saw large numbers of wild cattle, usually in small herds of half a dozen or so. Bartlett hesitated to try a shot, since he seemed to be carrying only a double-barreled shotgun and some revolvers whenever he came across them.

The surveying party pushed on to Black Water Creek, at the southern end of the Sulphur Springs Valley and near the site of Douglas.

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36. _Ibid._, v. 1, p. 248.

37. _Ibid._, p. 256.

Here, pronghorn reappeared in abundance on the grassy plains.[38] Bartlett shot a wolf from his carriage door and reports seeing a grave that had been excavated by "wolves" and the clothing scattered (see page 60). He complained about their "incessant yelping" at night, which, in combination with the bellowing of wild bulls, made sleep hard to come by. In 1851 Bartlett found what he called wolves consistently abundant on the plains and valleys of southern New Mexico, southeastern Arizona, and northern Mexico.[39] Many of the animals referred to were undoubtedly coyotes, but the presence of *Canis lupus* is indisputable from a number of 19th century accounts of this general region. Between 1849 and 1853 border survey parties in what is now southeastern Arizona and northern Sonora found Mexican ranchers using strychnine in fresh livestock kills. Many wolves were disposed of this way, and on occasion mountain lions were poisoned when they returned a second time to visit a carcass.[40]

On July 19, A.B. Gray, the official American surveyor, arrived at the copper mines and immediately condemned the boundary arrangement that Conde and Bartlett had worked out. Convinced that the United States had been duped in that Bartlett had surrendered the right of way for a southern transcontinental railroad line, Gray halted all surveying until a new conference could be arranged with Conde. Gray was backed up in his objections by Colonel James D. Graham of the Topographical Engineers, who

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38. *Ibid.*, v. 1, p. 248.

39. *Ibid.*, v. 2, pp. 199, 322, 555.

40. A.S. Leopold, *Wildlife of Mexico*, p. 480.

had arrived at El Paso to begin work as "chief astronomer and head of the scientific corps" of the Boundary Commission.

Commissioner Bartlett started once again from the Santa Rita copper mines in late August for an area south of the Gila River where another meeting with Conde could be worked out. Among the 57 men in the column were Lt. Whipple and A.B. Gray, both watching Bartlett with suspicion. Colonel Graham followed the main party with a separate contingent of 13 men.

Early in September, Bartlett's group entered what is now Arizona after passing the Stein's Peak area. They camped in the San Simon Valley, at a cienega called Sauz, "the willow marsh." Speaking of the valley, Bartlett wrote: "Here was a great abundance of water, which from the rushes that grew on its margin, I suppose to be permanent. Grass was also plenty here." He referred to the general aspect of the valley as being "unbroken by a hill or a tree."[41]

The expedition then crossed the Chiricahua Range and descended into the Sulphur Springs Valley, which was also treeless, "extending in both directions from sixty to eighty miles." Colonel Graham, who was close behind with his small command, rounded the Chiricahuas on the north, reaching the valley on the same day, September 5. He describes the event: "We descended into a most beautiful level plain, abounding with delicious green grass as far as the eye could reach, without any

41. Bartlett, v. 1, pp. 255-256. Today, the San Simon Valley is dry, being covered to a considerable degree with vegetation typical of the Chihuahuan Desert.

stinted shrubbery, as is generally the case on these plains, but interspersed with the magay."[42]

Meantime, Bartlett had discovered Conde's camp near Willcox Playa and had a conference with him on September 8. After the two parties separated, the Americans continued to the west, crossing the Dragoon Mountains into the San Pedro Valley, probably following Dragoon Wash. "On emerging from the arroyo," Bartlett said, "we entered a plain, thickly overgrown with large mezquit bushes, but destitute of grass.[43] We looked in vain for a line of trees, or of luxuriant vegetation to mark the course of the San Pedro--when all of a sudden we found ourselves upon its banks. The stream...was here about twenty feet across, about two feet deep, and quite rapid. The water, though muddy, was pleasant to the taste."[44] Bartlett felt that irrigation would be impracticable in the San Pedro Valley because the banks, at least on some stretches, were from eight to ten feet high.

In order to cross the river, the party had to level the banks on both sides and let the wagons down by hand. While this was going on, the whole surface of the valley became deluged in a torrential rain. Colonel Graham's surveying contingent came up from behind, and his

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42. J.D. Graham, _The Report of Lieutenant Colonel Graham on the Subject of the Boundary Line Between the United States and Mexico_ (Washington, 1852), p. 30. In speaking of _magay_, Graham was probably referring to soaptree yucca, _Yucca elata_, a conspicuous dominant on the desert grassland of southeastern Arizona.

43. Bartlett, v. 1, p. 377. Bartlett's comment about the lack of grass is interesting, in view of the fact that the summer rainy season had just ended, and chroniclers were commenting on the dense growth of grasses in adjacent valleys.

44. _Ibid._, p. 377.

observations of the San Pedro agreed with those of Bartlett. In Graham's words, "The San Pedro runs here through a soft, alluvial soil, and its rapid current has worn a deep bed for it, leaving steep banks on either side."[45]

Bartlett's train left the San Pedro to ascend an undulating plateau, similar, as he put it, to the "western prairies." It was covered with short grass, and in the depressions, sometimes 50 or even 100 feet below the plain, were ponds, luxuriant grasses, and groves of evergreen oaks. The Americans spotted herds of wild horses, and deer and pronghorn were frequently seen.[46]

Turning south, the column moved up the San Pedro to a point opposite the south end of the Whetstones, when it turned west again. Since he makes no mention of finding water, it seems likely that Bartlett missed Babocomari Creek, passing instead between the Whetstones and the Mustang Mountains, using the corridor known today as Rain Valley. His immediate goal was to return a Mexican girl kidnaped by Indians to her home village of Santa Cruz, Sonora, an adobe hamlet on the Santa Cruz River at the south end of the San Rafael Valley.

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45. Graham, p. 36. As early as the 1850's, the channeling process was thus evident on the San Pedro River. Where there was no trench, the water table remained high and the bottoms marshy. The soil was waterlogged and too poorly aerated to support anything most of the time but marsh vegetation dominated by grass. The presence of an arroyo on the river meant that the bottom of the trench fixed the elevation of the water table. Between the surface of the water and the top of the bank there was a soil layer sufficiently well drained to support mesquite and other plants whose roots require aeration and cannot tolerate waterlogging. See: Hastings and Turner, <u>The Changing Mile</u>, p. 36.

46. Bartlett, v. 1, pp. 383-384.

Colonel Graham, meanwhile, continued farther up the San Pedro, finally heading west on a course that probably skirted the north end of the Huachucas. While still near the river, Graham and two other men spurred their horses in pursuit of some "fine, large, wild cattle." One of them, a jet black bull, wheeled about as if to charge, then changed its mind and fled. The horses were unable to catch up with the cattle. As compensation, somewhere in the foothills of the Huachucas, a member of the surveying party shot a large black bear, "which was a very welcome addition to our rations."[47]

Graham's party was now searching for Cooke's old trail leading to Santa Cruz. Northwest of the Huachucas they came out onto another treeless grassland on which Graham reported seeing a "great many antelope" grazing.[48] His comments on this plain, bordered by the Whetstones on the east and the Santa Ritas on the west, bear repeating: "This whole valley was covered with the most luxuriant grass we had anywhere seen. Our mules fed upon it as they traveled, for it was from three to four feet high in many places....We encamped in the valley, without water. The grass was, however, so green and fresh that our mules did not appear to suffer....We were obliged to keep close to the western margin of the valley, because it began to be quite boggy in the middle."[49]

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47. Graham, p. 36.

48. Ibid., p. 37.

49. Ibid., p. 38. The valley has no official name, though local residents sometimes refer to it as the "Sonoita Valley."

Farther ahead, the Bartlett group had crossed the valley passing close to the modern site of Sonoita, Santa Cruz County. Near the southeastern foothills of the Santa Rita Range, they picked up the headwaters of Sonoita Creek. Bartlett speaks of reaching the stream through a marsh with grass growing head high, of an abundance of grass along its banks, and of a gallery forest of giant cottonwoods. Sonoita Creek was closely hemmed in by an understory of willows, making it difficult to reach water. Large mesquites and oaks were also present. Where the pass between the Santa Ritas and the Patagonia Range becomes a defile, there were "gigantic cotton-woods, with an undergrowth of rank grass, weeds, and jungle, rising above our heads even when on horseback. Among them grew a vine, binding all together; so that it was impossible to force a passage through."[50] The only way to negotiate the swampy tangle was to use axes. It was hard work, but somewhere near Calabasas, Bartlett took the time to measure the girth of a cottonwood in a grove of the largest trees of the species he had ever seen. Its circumference five feet above the ground was 28 feet, and its limbs spread "full forty feet on every side." Bartlett found turkey sign along the creek here and shot a bird in one of the draws leading down from the Santa Ritas.[51]

Unable to find any trace of a wagon road to Santa Cruz, Bartlett decided to return to the San Pedro Valley and try again. This time he stayed south of the Mustangs and came upon Babocomari Creek, which flows east into the San Pedro. Bartlett wrote: "The valley of the Babocomari, is here from a quarter to half a mile in breadth, and covered with a

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50. Bartlett, v. 1, pp. 384-389.

51. Ibid., pp. 390-391.

luxuriant growth of grass. The stream, which is about twenty feet wide, and in some places two feet deep, winds through this valley, with willows, and large cotton-wood trees growing along its margin."[52] Bartlett stated that there were about 40,000 head of cattle on the ranch called San Ignacio del Babocomari when it was abandoned to the Apaches in the 1840's. At one time it embraced 200,000 acres of the grasslands west of the Whetstones and Huachucas.[53] As the party proceeded eastward, John C. Cremony, a member of the contingent, shot a young mountain lion out of a cottonwood tree growing on the bank of the stream.[54]

Graham continued to shadow Bartlett's train, and on September 18 he reached the headwaters of Babocomari Creek. Wild horses and herds of pronghorn were seen several times during the day.[55] Two days later the Graham Party met a group of Mexicans hunting wild cattle as a beef supply for the garrison at Santa Cruz. The animals were roped by the horns, fastened to the heads of tame livestock, then driven into a corral to be sold to the government.

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52. Bartlett, v. 1, p. 396.

53. Ibid., p. 397. A column in the Arizona Citizen (Tucson) for June 21, 1873, consists of an interview with one Mariana Diaz, reputed to be over a hundred years old. In reminiscing about rangelands near Tucson in the early 19th century, she said: "The country was covered with horses and cattle and on many of the trails they were so plenty that it was quite inconvenient to get through the immense herds. They were only valuable for the hides and tallow, and a good sized steer was only worth $3."

Before 1848 no cattle at all came from the east. Herds were driven to California after the Gold Rush, but many were seized by the Apaches, who treated cattle as legal tender. Grass near the Santa Cruz River was excellent, but cattle were exhausted and skeletonized before they reached the Gila River. See Wagoner, p. 51.

54. Bartlett, v. 1, p. 393.

55. Graham, p. 37.

Bartlett had better luck on his second attempt to find a route to Santa Cruz, and from the descriptions of the terrain it seems likely that he led his men down the west side of the Huachucas and over the Canelo Hills to the San Rafael Valley. What follows probably refers to the view of this valley from Canelo Pass:

> A few miles brought us to the puerta, or gate in the mountain; passing which, we emerged into a very broad and open plain of remarkable beauty. From the elevation where we first saw this valley, the prospect was exceedingly picturesque. Around us grew the maguey, the yucca, and various kinds of cacti, together with small oaks; while beneath us, the valley spread out from six to eight miles in width, and some twelve or fifteen in length. Unlike the desolate and barren plains between the mountain ridges, which we had crossed between the Rio Grande and the San Pedro, this valley was covered with the most luxuriant herbage, and thickly studded with live-oaks; not like a forest, but rather resembling a cultivated park. While the train was passing down the mountain, I stopped with Mr. Pratt to enjoy the scene, which he hastily transferred to his sketch book.[56]

After leaving Santa Cruz, his humanitarian mission accomplished, Bartlett decided to push on deep into Mexico in search of mules and provisions. He found no supplies and came down with typhoid fever. His loyal friend Dr. Webb, an expedition member, nursed him back to health, whereupon he continued south to Acapulco, where he caught the steamer Oregon, bound for San Diego. His field party followed on foot, suffering considerable hardship while crossing the deserts of Sonora and southern California. They arrived in San Diego on February 11, 1852, three days after Bartlett.

Before organizing the return trip to El Paso, Bartlett took time off to explore California, making notes on the Indians, gold prospectors, and geysers. By the end of May he was ready to move. The old beaver

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56. Bartlett, v. 1, p. 401.

trapper Antoine Leroux acted as guide for the expedition, and Colonel Lewis S. Craig, who was to be murdered by deserters in the Mohave Desert, commanded the military escort.

The Commission reached the Colorado River in June, and Lt. Whipple was detached to complete a survey of the Gila River, begun a year earlier but left incomplete because of a shortage of funds. Near Pilot Knob, which is just below the confluence of the two rivers, Bartlett recorded his impressions of the vast riparian jungle, which was about two to four miles wide on the Colorado and slightly wider on the lower Gila. The gallery forest on the Gila consisted of cottonwoods and willows near the river, with a mesquite bosque behind them. These three species formed the almost impenetrable forest on the Colorado.[57] Bartlett noticed that the Gila itself was diminutive and unnavigable except at its mouth.[58]

The main expedition, including Bartlett and the escort, left Fort Yuma and worked its way up the Gila toward the Pima villages. In the vicinity of Painted Rocks (where Kearny's little army saw a flock of bighorn in 1846) Antoine Leroux shot a buck mule deer in the dense thickets along the river. Deer and pronghorn were often seen on the

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57. Bartlett, v. 2, p. 160.

58. Ibid. A year earlier, in June, 1851, Lt. Thomas W. Sweeny and nine men established Camp Independence, on the east bank of the Colorado. Travelers told him at the time that the Gila River had completely dried up in the area of the Pima Indian villages, where extensive irrigation was practiced. See: Thomas W. Sweeny, *Journal of Lt. Thomas W. Sweeny*, 1849-1853, ed. Arthur Woodward (Los Angeles, 1956), p. 120.

Gila, but, as Bartlett tells us, the wagons alarmed them, and the hunters had to go out well in advance of the train in order to succeed.[59]

At the Pima villages the Commission turned south and headed for Tucson and the Santa Cruz River. An eastward route then took them through Guadalupe Pass. Here, Bartlett recorded a conversation with some members of an emigrant train who had weathered a recent brush with a grizzly. Either in the Guadalupe Range or just to the east in the Animas Mountains, the bear was sighted and wounded by hunters sent out from the main column. The bear limped off and vanished into a thicket. One of the men followed too closely, blundered into the enraged animal, and was severely bitten in the leg. The man stabbed the grizzly, and both antagonists rolled off a nearby ledge. The fall separated them, with the bear once more attempting to escape. Though bleeding heavily, the injured hunter joined his companions in tracking their quarry, which was eventually overtaken and shot to death.[60]

The Commission expedition reached El Paso on August 17, 1852, after crossing northern Mexico. Bartlett was jubilant and lost little time in spreading the news that he had traveled 1100 miles, as if this in itself were an accomplishment. Actually, there was very little to show for the 200,000 dollars the Commission had spent other than Lt. Whipple's survey of the Gila River.

Since the Commission's field trips were not accompanied by a competent naturalist whose primary duty was to observe and collect the fauna of the region, the only written account of wildlife in what is now

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59. Bartlett, v. 2, p. 197.

60. Ibid., pp. 335-336.

Arizona is Bartlett's. His concluding summary: "In a region as barren as the greater portion of that traversed, animal life would hardly be expected to abound. Nevertheless, there was no spot, however barren, or however distant from water, where rabbits and wolves were not seen. (Here again, Bartlett, like so many of his contemporaries, seldom bothered to distinguish between the coyote and the gray wolf.)[61] Bartlett goes on to list a number of large mammals found in the mountains and in the riparian growth along rivers and creeks. Included were: jaguar, mountain lion, ocelot, black and grizzly bear, pronghorn, coyote, and "the large wolf" _Canis lupus_.[62]

Bighorn were also seen, and Bartlett makes the erroneous observation that "the elk is not found south of the Gila." Beaver were numerous on the Gila and its northern tributaries, having made a good recovery from the onslaught of the mountain men some 20 to 25 years earlier. Both species of deer were abundant, especially in mountainous regions and along the Gila, "but nowhere as common as in Texas."[63]

Finally: "On the whole, game, both animals and birds, was scarce throughout the broad regions traversed by us, except in the mountain districts, where it was abundant."[64]

Once in El Paso, Bartlett learned that A.B. Gray had been dismissed as Commission Surveyor and replaced by William H. Emory, since promoted to Major. Emory had taken his new post in November, 1851, to

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61. Bartlett, v. 2, p. 555.

62. _Ibid_.

63. _Ibid_., p. 562.

64. _Ibid_.

find half the Commission, under Colonel Graham (who had returned to El Paso when Bartlett undertook his jaunt into Mexico) sitting tight, with the rest somewhere in the field with Bartlett. He described the general condition of the Commission thus: "no money, no credit, subdivided amongst themselves and the bitterest feeling between the different parties."

Bartlett soon found the following charges arraigned against him: mismanagement of public funds, disregard for the health, comfort, and safety of those under him, and general negligence. Above all, there was clamor in Washington for his political head as a result of the Bartlett-Conde agreement, in which 6000 square miles of land needed for the proposed railroad were given over to Mexico. Finding that future appropriations for the Commission had been halted, Bartlett had no choice but to sell the field equipment and the animals, disband the crews, and retire from the field.

The Boundary Commission was disbanded on December 22, 1852, and Bartlett and Emory returned to Washington, the former never to be a public figure again. But the controversies he aroused led directly to the Gadsden Purchase of 1853. The Bartlett-Conde agreement planted the seeds of a bitter fight in Congress between Whigs and Democrats, or, in other words, between factions advocating conciliation and aggressive expansionism at Mexico's expense. There was also danger that a new boundary dispute involving the two countries might grow out of control. Consequently, in March, 1853, President Franklin Pierce sent James Gadsden of South Carolina to Mexico to settle all areas of disagreement. On December 30 a treaty known to history as the Gadsden Purchase was signed. The United

States paid Mexico ten million dollars for the area that includes most of Arizona south of the Gila River, giving final delineation to the present international boundary.

With the expansionists in Washington satisfied, the next step was to survey the best route for the proposed new railroad. Lieutenants John G. Parke and George Stoneman received this assignment, with orders to run the 32nd parallel across southern Arizona. In January, 1854, they started, working from California to Fort Yuma, then east up the Gila to the Pima villages. The surveyors followed a cut-off version of the emigrant trail called Nugent's wagon road, which led to Tucson, angled southeastward to the Chiricahuas, crossed the salt playas of New Mexico, finally linking up with Cooke's old wagon road as it led south after leaving the Rio Grande (see Fig. 4, p. 225).

In the spring of 1855 Lt. Parke again surveyed the 32nd parallel between the Pima villages and the Rio Grande. This time he located a new pass between the base of Mount Graham and the Chiricahuas. He was accompanied by a naturalist, A.L. Heermann, who had also gone along on the first expedition. However, Heermann's observations were largely limited to a cataloguing of specimens. He did make note--like so many before him--of the incredible abundance of Gambel's quail along the Gila and in the Sonoran Desert. The birds seemed to actually prefer the haunts of man, being common along roads and in cultivated fields, particularly around Tucson.[65] He also observed that the scaled quail was not seen west of the mouth of the San Pedro. On the grasslands of

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65. A.L. Heermann, "Zoological Report," Reports of Explorations and Surveys, X (Washington, 1859), p. 19.

southeastern Arizona the species preferred the vicinity of prairie dog towns, where the vegetation was thinned out, perhaps, in his words, offering "the attraction of some favorite insect."[66]

Lieutenant Parke made some observations of the Gila River as it appeared in 1855. Near the Pima villages it formed a broad plain, much of which was covered with dense groves of mesquite. Upstream, at a point just west of its confluence with the San Pedro, the Gila occupied the entire bottom of its gorge, spreading out in places to a width of 50-100 yards. There was ordinarily a single channel, but side drains created sloughs in seasons of rain or snow melt. The water was clear and palatable, flowing with a moderate current over an alternating bed of sand, pebbles, and rock. In July, the stream was 20 feet wide and 12 inches deep near the mouth of the San Pedro. As on the lower Gila, the banks here were fringed with cottonwood and willow, with mesquite at the base of the terraces.[67]

The surveyors moved up the San Pedro Valley and found the terrain and the river anything but uniform. In places the valley was grassy and open, with inviting meadows. The bed of the river curved through these open bottoms, sometimes a few inches below the level of the meadow, at other places much deeper. At Tres Alamos Parke found the stream 15 inches deep and 12 feet wide, flowing rapidly over a light, sandy bed beneath nearly vertical banks some 15 feet high.[68] In most

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66. A.L. Heermann, v. X, pp. 19-20.

67. John G. Parke, Reports of Explorations and Surveys, VII (Washington, 1857), pp. 23-25.

68. Ibid.

areas, timber did not mark the course of the San Pedro, and the stream tended to spread out over a considerable expanse where the bed was nearly flush with the banks. There were a few places where the banks supported a dense growth of cottonwood, willow and underbrush. The flow of water was not continuous, sometimes disappearing completely, to rise a few miles farther as a limpid stream.[69]

When the surveying party crossed the Galiuro Mountains, Parke commented that they resembled the Coast Range of California. The slopes were open and covered with a vigorous growth of grama grasses, while the ravines contained oak, ash and walnut. The party often saw herds of pronghorn and mule deer in the foothill region.[70]

In August, 1854, Major William H. Emory was appointed Commissioner and Chief Astronomer of a new Commission set up to survey the Gadsden Purchase boundary. One of his primary goals was to produce the first scientific description of the entire Southwest as a physical region. He planned to start with an outline map, adding the findings of scientists in all disciplines.

Emory divided the survey into two parties, one under himself to work west from the Rio Grande, while the other, commanded by Lt. Nathaniel Michler, would start east from San Diego. The two halves would meet at the 111th meridian, approximately where Nogales stands today (see Fig. 4, p. 225). Accompanying Lt. Michler was the artist, surveyor and collector Arthur Schott. Emory's contingent included two

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69. Ibid.

70. Ibid.

naturalists, J.H. Clark and Dr. C.B.R. Kennerly, a member of the Whipple expedition of 1853-1854 across northern Arizona.

The survey went smoothly, with no dissension or Indian troubles. On October 14, 1855, it was officially concluded.

Emory's journal lacks the literary flair shown by Bartlett, and there are few detailed accounts of wildlife. However, he did have an eye for landscapes and plant communities, his impressions beginning at the San Bernardino Valley when the surveying party negotiated Guadalupe Pass in the spring of 1855. Near the abandoned San Bernardino hacienda Emory commented on the numerous springs, spreading out into "rushy ponds."[71] He added: "The valley is thickly covered with a growth of coarse grass, showing in places a saline character of soil. The timber growth is confined to a few lone cotton-wood trees scattered here and there."[72] Some 30 miles to the west, right on the international border where Agua Prieta, Sonora, is today, Emory noticed that the land was low and marshy, with no constant stream, but a considerable expanse of saline flats and pools of rain water. As a further observation: "Extensive lagoons are said to occur in this valley a short distance south of where the road crosses."[73]

Near the head of the San Pedro River, on the boundary, Emory remarked that the valley "is everywhere carpeted with fine grama grass,

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71. William H. Emory, _Report on the United States and Mexican Boundary Survey_, 2 vols. (Washington, 1857), v. I, p. 17.

72. _Ibid_.

73. _Ibid_.

the nutritious quality of which is exhibited in the well-conditioned character of the numerous wild horses and cattle that luxuriate over this favored region."[74] Close to the river he saw "a close sward of grama grass, giving a peculiarly smooth shorn look to the general face of the country."[75] He also had this to say about the approaches to the upper San Pedro:

> At this point (on the international boundary), approaching from the east, the traveller comes within a mile of the river before any indications of a stream are apparent. Its bed is marked by trees and bushes, but it is some sixty or one hundred feet below the prairie, and the descent is made by a succession of terraces. Though affording no very great quantity of water, this river is backed up into a series of large pools by beaver-dams, and is full of fishes. West of the river there are no steep banks or terraces, the prairie presenting a gentle ascent.[76]

The notes on the fauna of Arizona, primarily from Dr. Kennerly's journal, are best presented by species, since the day-to-day chronology of the expedition is too uneven in its details to permit a sequential narrative approach.

Gambel's Quail: Kennerly reports this species as being extremely abundant in the Rio Grande Valley. Interestingly, he says that these quail were seen only occasionally in Arizona, with no sightings at all by the time the surveyors had reached the Colorado River.[77]

Turkey: No reference to the natural history of wild turkeys is made by any member of the Boundary Commission. It is interesting to note

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74. William H. Emory, v. I, p. 17.

75. Ibid., p. 18.

76. Ibid., p. 99ff.

77. C.B.R. Kennerly, "Zoological Report," Reports on Explorations and Surveys, 1853-1854, IV (Washington, 1856), p. 33.

that a year later, in 1856, Captain Richard S. Ewell reported seeing turkeys on the Santa Cruz River within sight of San Xavier Mission.[78]

Beaver: The particular naturalist who took notes on this species was not identified. He refers to the abundance of beaver on the Gila and, especially, the Colorado Rivers in 1855. "On a reconnoisance down the latter river to its mouth, we passed miles and miles of river banks which are inhabited, fortified, and covered over by the labor of this singular animal." The beaver's lodge formed a "chaotic heap of drift wood, rush, and mud." No observations were made of construction activities.

Beaver were observed at an elevation of 5000 feet in Guadalupe Canyon. The lowest point was "about 30 miles above the mouth of the Colorado, where the last timber gives way to those unbounded canebrakes and salt marshes which border the head of the Californian Gulf."[79]

Gray Wolf: This species is described in Dr. Kennerly's notes: "Near Santa Cruz (in Sonora on the Santa Cruz River, about seven miles south of the border station of Lochiel, Arizona), we found this animal more common than we had observed it elsewhere on our route. It, as well as the coyote, were often destructive to the flocks around the village. It often, too, attacks the young cattle, both domestic and wild of this region, which are forced to succumb to its great strength."[80]

Grizzly Bear: The Boundary Survey party found grizzlies abundant in all the mountainous regions west of the Rio Grande. Dr. Kennerly

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78. Arizoniana, v. 7, p. 25.

79. Emory, Boundary Survey, v. 2, Part II, p. 41.

80. Ibid., p. 15.

collected one at Nogales. Frontiersmen told the naturalists that these bears often left the mountains in late summer to search on the open plains for a plant that ripens at that time. J.H. Clark was unable to find out what the plant was, but he noticed that Southwestern grizzlies did move down from the foothills in the fall when acorns, juniper berries and pinyon nuts were no longer available.[81]

Overturned rocks and loose soil torn from the roots of junipers in search of insects and small animals was characteristic grizzly sign in the mountains. Clark made note of the fact that a grizzly easily outdistanced a mule in rough country. The species usually tried to avoid man, but grizzlies often came into the Commission camp after dark to smell out discarded food scraps.

Dr. Kennerly felt that the animal commonly called "brown bear" by frontiersmen on the boundary was really the grizzly. He found grizzlies particularly numerous in the San Luis Range (near Guadalupe Canyon), the Guadalupe Mountains (part of what he called the "Sierra Madre") and around Nogales. These bears subsisted largely on acorns, walnuts, pinyon nuts, "the fruit of an ericaceous shrub" (probably manzanita), and such animals as they could capture. The following anecdote, related by Dr. Kennerly, took place when the survey team had crossed the Guadalupe Range and had descended into the Animas Valley, heading east:

> Near the highest crest of the Sierra Madre, called 'San Luis' mountains, I had an opportunity to witness a rare butchery, by which, in less than one hour, a whole family of grizzlies was killed, without one offering the slightest resistance. It was about noon on the 11th of October, 1855, when our long trains, coming from the Guadaloupe Pass, in the Sierra Madre, towards the San Luis springs, met on the plains these

81. Emory, Boundary Survey, v. 2, Part II, p. 28

> unexpected mountaineers. When surprised, they were lying on the ground not far from each other digging roots. The position in which they performed this work naturally caused long narrow strips of grassy lands to be turned up and searched as if it had been done by a bad plough. I could not learn what kind of roots they had been looking for. After taking off the thick skin of these root-diggers, we found them all in a very poor condition, and this may account for the want of that resistance which they failed to offer. The ungrizzly-like behavior of these poor brutes induced the majority of our party to doubt their being grizzlies at all. They evidently had descended from the surrounding mountains, where they have their stronghold in the rough trachytic recesses of this part of the Sierra Madre, the highest crest of which is densely crowned by a dark growth of pines. There their fruit stores had probably given out in the late season, and they were obliged to resort to roots to satisfy their hunger.[82]

The grizzlies of the border country were mainly inhabitants of the oak woodland, ranging as high as the xeric fringe of the pine belt.[83] This brushy foothill region was developed early for livestock, a fact that hastened the extermination of these bears.

Jaguar: In 1855 Dr. Kennerly noted that only one jaguar was seen west of El Paso by the Boundary Commission. This was at Guadalupe Canyon, the gateway to the San Bernardino Valley. He continues thus: "However, we were assured by many persons at Santa Cruz that it was very common near that village, in the valley of the river of the same name." Kennerly remarked that jaguars preferred the impenetrable

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82. Emory, Boundary Survey, v. 2, Part II, p. 29. Kennerly is referring to the San Luis Range, which straddles the Chihuahua-New Mexico border to tie in with the south end of the Animas Mountains. In 1892 Edgar A. Mearns reported grizzlies still present in the San Luis Range. An American living in Mexico found grizzly tracks there in 1948, and as of 1959 A. Starker Leopold believed that it was "barely possible" that the species hung on in these mountains. See: A.S. Leopold, p. 420.

83. A.S. Leopold, p. 422.

thickets of river bottoms, where they preyed on deer, mustangs, and wild cattle as they came to water.[84]

Mountain Lion: Lions were seen by Emory's party as far west as Nogales. "Those panthers that we have observed," says Kennerly, "were always found in the most solitary places, generally where there were thick bushes, and in the vicinity of rocky spots, affording canyons for secure concealment, and in which to bring forth their young. They always manifested great shyness, and fled rapidly at the sight of us, rendering it difficult to get within gun shot of them."[85]

Kennerly's reports indicate that mountain lions not only inhabited rimrock country, but also suitable areas in river valleys--wherever deer were abundant. Like the jaguar, lions found a liking for dense cover along streams. In 1855 ranching was not extensive enough to eliminate the mountain lion from flood plain woodlands.

Members of the Boundary Commission noticed that Mexican ranchers sometimes suffered heavy losses from lion predation on colts and calves. The usual retaliation was to poison the carcasses with strychnine, but wolves and coyotes were generally the victims in this case.[86]

Arthur Schott, who accompanied Lt. Michler's group on the journey east from San Diego, commented on the presence of the mountain lion in the Sonoran Desert: "The habits of the puma seem to be nocturnal, and it is during the hours after dark that his mournful note is heard

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84. Emory, Boundary Survey, v. 2, Part II, p. 7.

85. Ibid., p. 6.

86. Ibid.

resounding through the solitude of the deserts. The note listened to once attentively is apt to make a deep lasting impression.

"The note itself is often several times repeated, with intervals of from two to four minutes. As night time advances, the cry is heard but rarely."[87]

Javelina: Kennerly's journal elaborates on the abundance of javelina in Texas, but apparently the species evaded detection most of the time in Arizona. Dr. Kennerly states that javelina were seen near the ruins of San Bernardino Ranch, just west of Guadalupe Canyon.[88]

Mule Deer: Naturalists with Emory's party did not find the mule deer very common along the border, except in the San Luis and adjacent ranges. Dr. Kennerly remarked on the fact that this species was quickly thinned out by hunting, whereas the whitetails in a given area continued to hold their own. In his words: "In a few weeks, although at first equally as numerous, if not more so, than the latter, it disappeared almost entirely, while the red white-tailed deer became only a little more shy, but its numbers did not seem to diminish."[89] Between the "Sierra Madre" (Kennerly probably means the Guadalupe Range) and the area of Nogales, a region of mesquite-grassland and evergreen oak savanna, the surveyors did not see any mule deer, although Kennerly refers to large numbers of white-tailed deer and pronghorn.[90]

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87. Emory, Boundary Survey, v. 2, Part II, p. 6

88. Ibid., p. 50.

89. Ibid., p. 51.

90. Ibid.

White-tailed Deer: The boundary surveyors under Major Emory observed white-tailed deer in all the mountains between El Paso and Nogales. They were particularly common in the San Luis and Guadalupe Ranges, the two areas where Dr. Kennerly also saw mule deer in considerable numbers.[91]

Whitetails were abundant in all the stream valleys along the route as well. Dr. Kennerly again:

> In the valley of the Santa Cruz river and the adjacent country we found them in such numbers as to influence the belief that a few skilful hunters might have supplied our entire party with fresh meat. The Mexicans of this region, having but few firearms, and being very much afraid of the Indians, do not often hunt them. Indeed, thirty miles west of the village of Santa Cruz, these animals seem to be so unaccustomed to the sound of a gun that we have known them, when the hunter was concealed, to be fired at several times before becoming sufficiently alarmed to take flight.[92]

Near the present site of Nogales, Kennerly recorded the fact that whitetails fed on the hillsides in the early morning in June, withdrawing to dense shrubbery along streams about ten o'clock, when the sun became hot. At this time "they could be killed as easily as rabbits, by the hunter passing through the undergrowth with a gun charged with buck-shot. They would rarely spring from their concealment until approached within twenty paces."[93]

Pronghorn: West of the Pecos, Kennerly found pronghorn common on "open and naked prairies" in 1855. It was also "no rare occurrence," in his words, to come across them in mountain valleys. Where pronghorn were most numerous Kennerly noticed an almost complete absence of deer, which he attributed to a lack of water and lush grasses.

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91. Emory, Boundary Survey, v. 2, Part II, p. 50

92. Ibid., p. 51.

93. Ibid.

On the plains along the border Kennerly reported that pronghorn gathered in herds varying in size from eight or 10 animals to 300 or more. The species was just as abundant west of the Rio Grande as east of it, being especially common in northern Sonora, where pronghorn seemed less shy and "more easily captured" than elsewhere.[94]

Lt. Michler, who had come up the Gila to the Pima villages, then south up the Santa Cruz River, met Emory's party in the summer of 1855 near Nogales. Michler's next assignment was to follow an azimuth line west on the border to Sonoyta. On the way, his contingent skirted the south end of the Baboquivari Mountains, proceeding to the next range west: the Sierra del Pozo Verde. "Many antelope were seen about this place," reports Michler. He was camped near the modern Sonoran border village of Pozo Verde, in an environment that was typically lower Sonoran, with ocotillo, sahuaro, and many other cacti. Michler describes good grass on the mountainsides; it was August, and the rains were on the land.[95]

The animals Michler observed were probably Sonoran Pronghorn, _Antilocapra americana sonoriensis_, which at that time were plentiful on the Sonoran Desert.

Bighorn: On the same surveying expedition west from Nogales, Lt. Michler placed markers at Quitobaquito (now within Organ Pipe Cactus National Monument), Agua Dulce, Tule, and Tinajas Altas. He comments: "The bighorn mountain goats frequent this region, and the noise of their horns as they butt them together in fights is often heard among the

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94. Emory, _Boundary Survey_, v. 1, p. 121.

95. _Ibid_.

rocks."[96] Arthur Schott backs up Michler on this point; he often heard these "butting contests" between rams in the area from Quitobaquito west. Schott regarded the rocky desert ranges along the border as the optimum habitat for the species. He continues: "On the whole of these mountain tops there was not a single horizontal or gently inclined spot where the round footprints of this animal could not be observed. In some places well-beaten pathways lead up to the most rugged portions of the rocky sierras."[97]

Schott felt that the big rams were invulnerable to predation by mountain lions or wolves in the open country of the desert ranges.

Within a year, 10,000 copies of the narrative, or first, volume of Report of the Mexican Boundary Survey had been ordered for printing. Three large quarto volumes were to be published as an Executive Document of the thirty-fourth Congress. When the second and third volumes were ready for publication, Congress expressed alarm over expenditures on illustrated scientific books and authorized publication of only 3000 copies of the botanical and zoological reports for distribution among centers of learning. In these books, Schott and Parry made substantial contributions to geology, while James Hall approached geology from a paleontologist's viewpoint.

Spencer Baird and Charles Girard of the Smithsonian Institution classified the birds, mammals, and fishes collected by the Boundary Commission. Baird himself classified 311 species. His report was purely

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96. Emory, Boundary Survey, v. 1, p. 124

97. Ibid., v. 2, Part II, p. 52.

descriptive, with no attempt to correlate specimens with plant communities or geographical areas in general.

Northern Arizona was not affected by the boundary controversies that followed the Mexican War, but the U.S. government took an immediate interest in the region, and the first exploratory expedition was organized in 1849. Lt. James H. Simpson, the only topographical engineer in New Mexico at the time, went along as a surveyor, but the column that marched west from Santa Fe on August 15 was punitive in nature. Simpson was part of Colonel John Washington's command, sent out to intimidate the Navajos, who had been raiding settlements in northwestern New Mexico. The force consisted of four companies of infantry and two of artillery, plus a detachment of mounted Mexican and Indian volunteers. Lt. Simpson had three assistants to help make sketches and lend a hand in the topographic work (see Fig. 2, p. 223).

Although his primary interest was archeology (he was the first American to write about the ruins of Chaco Canyon), Simpson took notes on what wildlife a noisy military column was likely to see. The expedition skirmished briefly with the Navajos in the foothills of the Chuska Range, then marched over the mountains, in what is now extreme northeastern Arizona. To Simpson, this was a beautiful parklike country of Douglas firs, good grass, and sparkling mountain streams. Near the head of Crystal Wash, members of the column saw a grizzly bear, probably the first record for this part of the state.[98]

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98. James H. Simpson, Navaho Expedition: Journal of a Military Reconnaissance from Santa Fe, New Mexico, to the Navaho Country, Made in 1849 by Lieutenant James H. Simpson, ed. Frank McNitt (Norman, 1964), p. 77.

Colonel Washington's reconnaissance force descended the Chuskas and swept the Navajos out of Canyon de Chelly, another archeological treasure-trove for Simpson to mull over. The Americans then turned south, marching through eroded pinyon-juniper country. Somewhere on Black Creek, between the modern sites of Window Rock and Lupton, Simpson had an experience which he describes in his journal under September 13, 1849:

> A deer was killed by a soldier this morning, after running the gauntlet of numerous shots from the command--myself, among the number, throwing away a pistol shot. This is the first deer which has been killed by any of the party. The scarcity of this kind of game may therefore readily be inferred. Indeed, a more wretched country for game of every kind I have never seen that we have been traversing since we left Santa Fe.[99]

The animal referred to was most likely a mule deer. There are no whitetails in this part of Arizona today.

Simpson apparently saw no elk on the expedition, although the species was present, at least in the Carrizo Mountains (a northern spur of the Chuskas), until about 1850.[100]

Swinging past the future site of Fort Defiance, the column returned to Santa Fe by way of Canyon Bonito and Zuni. The information gathered on the reconnaissance was later used in charting military expeditions, directing emigrant trains, aiding the selection of Indian reservations, and determining the route of a transcontinental railroad. In addition, Simpson made a treaty with the Navajos, which though never ratified, provided a basis for future agreements.

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99. Simpson, p. 108.

100. W.W. Hill, The Agricultural and Hunting Methods of the Navajo Indians (Yale University Publications in Anthropology No. 18), New Haven, 1938, p. 167. A Navajo informant told ethnologist W.W. Hill that after 1850 the nearest region where elk might be found was the La Plata Range of southwestern Colorado.

In August, 1851, another expedition left Santa Fe for the uncharted wilderness that lay toward the Colorado River. Captain Lorenzo Sitgreaves, the topographical engineer in charge of the column, was told, in part, to search for a wagon route described by Lt. Simpson after the reconnaissance of 1849. But he was also an element in another diversion against the Navajos, and Colonel Edwin Sumner provided him with an escort of fifty infantrymen. Lt. John G. Parke (later to lead his own expedition in southern Arizona) was Sitgreaves' assistant, while Antoine Leroux served as the expedition guide. Dr. S.W. Woodhouse, the naturalist, began his journey in Philadelphia and collected his way across Texas before joining the expedition to Arizona.

For about a month Sitgreaves' party remained in the vicinity of Zuni. In September they started west down an intermittent stream, the Zuni River, which empties into the Little Colorado (see Fig. 3, p. 235). Dr. Woodhouse saw a few cottonwoods along the Zuni, and at one point he found a beaver dam on which cattails grew.[101] Near the stream was a good growth of grama grasses and juniper.

The column continued westward down the Little Colorado after reaching the mouth of the Zuni. The river flowed across a rolling, grassy plateau devoid of trees. Willow thickets grew along the banks, and Woodhouse reported beaver lodges shortly after leaving the Zuni.[102] Farther downstream, in the direction of the San Francisco peaks, cottonwoods and willows became more abundant. In places, deep bayous, overgrown with

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101. Lorenzo Sitgreaves, Report of an Expedition Down the Zuni and Colorado Rivers (Washington, 1853), p. 36.

102. Ibid.

rushes, formed alongside the main bed of the river.[103] The nearby mesas, covered with a thick growth of "unnutritious" grasses, reminded Sitgreaves of the high plains adjacent to the northern Rockies.

Where the river entered the Painted Desert, both mule deer and pronghorn appeared, the deer mainly limited to the bottoms.[104] The Little Colorado soon made a bend to the north, winding over a wide, muddy plain in a system of channels. Because of an increasing shortage of grass and wood for fuel, the expedition struck west for the San Francisco peaks, traversing lava fields and an expanse of undulating plains with some juniper and a fine cover of grama grasses. Mule deer were seen again, and Sitgreaves comments on the presence of pronghorn: "Herds of antelope were seen in all directions, but they kept to the open country, and were shy and difficult to approach."[105] As the Sitgreaves party approached the San Francisco peaks, weathering several skirmishes with Yavapai Indians, hunters attempted unsuccessfully to shoot some pronghorn for the camp mess.[106] In some area, between the mountains and the Little Colorado, Woodhouse saw fresh grizzly tracks several times, and later he verified the presence of the species on San Francisco Mountain itself.[107] He regarded grizzlies as generally common in the mountains of Arizona.

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103. Sitgreaves, p. 8.

104. Ibid., p. 36.

105. Ibid., p. 11.

106. Ibid., p. 13.

107. Ibid., p. 37.

It was now October as the expedition ascended the lower slopes of San Francisco Mountain, passing through the pinyon-juniper belt to a forest of ponderosa pines interspersed with aspen. Grass was thick in the mountain glades, but water was limited to occasional springs. Off to the southwest was a vista of grassy plains dotted with parklike stands of ponderosa pine and some oaks. Mule deer and pronghorn continued to be abundant.

Dr. Woodhouse saw no sign of elk while crossing Arizona, although he recollected seeing the animals in Indian Territory while on his way west. He did not refer specifically to seeing bighorn, but he stated that they were found in mountainous districts. Likewise, Woodhouse considered black bears abundant in timbered regions of Arizona, although he did not describe any incidents involving them.

Sitgreaves remarks in his journal that the cry of a mountain lion stampeded the expedition's mules while the party was camped one night on the slopes of San Francisco Mountain.[108] Woodhouse also heard lions after dark while the column was in the mountain forests, but he added the opinion that lions were not plentiful in the Southwest.

Moving down off San Francisco Mountain, the Sitgreaves party negotiated the open, grassy parkland of tall pines. Waterfowl were flushed from pools hidden in the deep grasses. The rich grassland persisted as the men headed west. On the flanks of Bill Williams Mountain it flourished amid open forests of juniper, pines, and oaks. The expedition proceeded directly toward the Colorado River, the terrain alternating between open grassland and patches of pinyon-juniper woodland.

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108. Sitgreaves, p. 12.

This was the only region in which Woodhouse reported wild turkey,[109] but Sitgreaves considered them abundant along the route from the San Francisco peaks to the Big Sandy drainage.[110]

Dr. Woodhouse stated that wolves were common on open, thin grasslands west of San Francisco Mountain.[111] He recognized three species in Arizona: *Canis nubilis*, the "dusky wolf;" *Canis latrans*, the coyote; and *Canis frustror*, the "American jackal." The dusky wolf was modern *Canis lupus*, the gray wolf, and Woodhouse found it abundant east of the Mojave Desert. *C. Latrans* and *C. frustror* were both coyotes, of which Woodhouse believed there were several species in North America.

Mule deer remained plentiful until the expedition crossed the drainage of the Big Sandy River,[112] while the open valleys of sparse grass lying west of the river abounded in pronghorn.[113] Woodhouse makes one of the first references in Arizona to hunters luring the species within range by creeping through the grass waving a stick with a handkerchief attached to it.

Water was now becoming increasingly scarce, being limited to an occasional small spring, and more rarely, to a running stream. Grass remained ample to feed the expedition's stock until the area of the Colorado River was reached. Meanwhile, a series of Indian ambushes was testing the nerves of Sitgreaves' party, and Leroux the guide was wounded.

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109. Sitgreaves, p. 94.

110. *Ibid.*, p. 38

111. *Ibid.*,

112. *Ibid.*,

113. *Ibid.*

On November 5, the column came within sight of the Colorado River, only to run into a hostile reception from the Mohave Indians. This time Dr. Woodhouse was wounded, but this did not divert his mind entirely from natural history. He observed that beaver were very abundant on the Colorado, far more common here than anywhere else in northern Arizona.[114]

Sitgreaves' half-starved men moved down the Colorado in the face of repeated attacks by Mohave and Yuma Indians. Fresh meat from mules that had died from exhaustion sustained the party until it reached Camp Yuma on November 30. Here, the expedition rested and stocked up on fresh supplies. Eventually, Sitgreaves got his contingent across the Mojave Desert to San Diego.

The Sitgreaves expedition did not produce any scientific generalizations about the region covered. There was merely a catalogue of plant and animal specimens collected by Dr. Woodhouse, and only a few of these were new. The route of the party traversed some relatively unknown terrain, but it did not follow the direct line necessary for a transcontinental railroad. Nevertheless, Sitgreaves' effort was an epic of exploration since it was a painstaking reconnaissance of forbidding and little-known territory. His map of the area was a standard reference for those who came after him.

Nearly two years passed before the next major expedition was ready to take to the field. Organized at Fort Smith, Arkansas, in July, 1853, it was placed under the command of Lt. Amiel Weeks Whipple, the highly capable assistant astronomer on the Mexican Boundary Survey. Whipple's

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114. Sitgreaves, p. 47.

party was well staffed with scientists, including Dr. Jules Marcou, a Swiss geologist, and Heinrich Baldwin Mollhausen, a German artist-naturalist who was sent to America by Baron Alexander von Humboldt. One of the Americans was Dr. C.B.R. Kennerly, later to distinguish himself on Major William H. Emory's boundary survey expedition. Guiding the group was to be the irrepressible Antoine Leroux.

Whipple's instructions were to explore the 35th parallel and determine the practicability of this route for a railroad. He was to proceed west by way of Albuquerque and Zuni, making a careful survey of all the territory lying between the Zuni villages and the Colorado River. To a considerable degree the expedition would follow in the footsteps of Captain Sitgreaves (see Fig. 3, p. 235)

At Albuquerque, Whipple's party was joined by an auxiliary force under Lt. Joseph C. Ives, providing added insurance against damaging Indian attacks. The expedition then moved on to Zuni, where it set up camp close to the present Arizona-New Mexico state line. A period of planning and preparation lay ahead before Whipple felt ready to negotiate the Arizona wilderness.

Dr. Kennerly, the party's physician as well as a naturalist, lost little time in exploring the broken mesa country around Zuni. Grizzlies were common, and he remarked that they often came down from the mountainous areas to raid the flocks of sheep kept by the Indians in the grassy valleys.[115] On one occasion, Kennerly and Heinrich Mollhausen were taken

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115. C.B.R. Kennerly, "Report on the Zoology of the Expedition," <u>Reports of Explorations and Surveys</u>, 1853-4 (Washington, 1856), v. IV, p. 6.

by a Zuni guide to a spring where the Indians had erected a blind from which to shoot grizzlies in ambush. This was in a rocky terrain covered with pinyon-juniper forest. The two men saw no "grey bears" on this excursion, but Mollhausen describes a trail used by the grizzlies for such a long time that they had "fairly polished the rocky steps with their heavy clumsy paws."[116]

In the immediate area of Zuni, Kennerly noticed numerous herds of mule deer feeding in the little valleys between the mesas.[117] Pronghorn were also present, but they were very shy and kept their distance far off on the plains.[118] He also wrote an account of natural history after dark:

> At night the prairie jackal, or coyote (Canis latrans) rarely failed to approach our camp, and serenade us with his loud and varied notes. The long and dismal howl of the larger species (Canis gigas) was occasionally heard in the distance (he is referring to the gray wolf, Canis lupus); but the latter is much less numerous than the former, and was not often seen. It, too, prefers the wooded regions, and depends mainly upon the deer for a subsistence, which it hunts, and rarely fails, after a long pursuit, in overtaking and conquering.[119]

One evening in November, the Whipple party stopped to set up camp near a small saline pond a few miles west of Zuni. This was in rough terrain, with small valleys interspersed with ridges covered with pinyons and junipers. In Mollhausen's account: "Herds of black-tailed

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116. H.B. Mollhausen, Diary of a Journey from the Mississippi to the Coasts of the Pacific with a United States Government Expedition (London, 1858), v. 2, p. 92.

117. Kennerly, v. IV, part VI, p. 5.

118. Ibid.

119. Ibid., p. 6.

deer and antelopes showed themselves in the twilight and alarmed our people, who took them for a troop of Navahoe Indians."[120] When the expedition finally got under way, it followed the Zuni River westward, passing through the same type of country. Dr. Kennerly was also impressed by the prevalence of deer and pronghorn, stating that this region of "Cedar groves and grassy valleys" abounded with the two species. He also observed mountain lions in the area, saying that they hid during the day on "hillsides or ravines, where the bushes are the thickest and most impenetrable."[121] The overall sweep of terrain embracing the Zuni River and the upper Little Colorado prompted this observation by Kennerly: "Grass throughout this whole country is very abundant, and of a most excellent quality, especially around the mountain bases, and on the more elevated plateaus. Large herds of cattle and sheep might be reared and sustained here, were it not for the depredations of the Indians."[122]

West of the Zuni River, the Whipple party entered the Painted Desert, a region which Mollhausen considered sandy and bleak. Members of the expedition were surprised to observe a herd of pronghorn scramble down the rocky sides of a steep wash that emptied into the Puerco River. This was close to the present boundaries of Petrified Forest National Park, just north of the Little Colorado.[123]

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120. Mollhausen, v. 2, p. 114.

121. Kennerly, v. IV, part VI, p. 6.

122. *Ibid*.

123. Mollhausen, v. 2, p. 118.

On the Little Colorado, Mollhausen saw beaver dams, and Dr. Kennerly's notes tell us that both beaver and porcupine were very common in places along the stream. They subsisted mainly on an abundance of bark and tender twigs and buds of young cottonwoods growing in the sandy soil of the river bottom.[124] Between the Puerco River and Chevelon Creek, Mollhausen exulted over the fine hunting furnished by an abundance of mule deer in the riparian growth along the Little Colorado.[125]

The expedition camped for several days in the bottoms near the mouth of Chevelon Creek. Mollhausen says that the men entertained themselves by laying trap lines for wolves and hunting deer. Beaver continued abundant on the Little Colorado, but on the adjacent grassy uplands only jack rabbits and rodents were much in evidence. One night a pack of wolves came in close to camp, started howling, and stampeded the entire herd of tethered mules.[126]

Although it was early winter, Dr. Kennerly saw few ducks and geese on the Little Colorado, with the exception of occasional flocks of mallards and teal. He speculated that this was due to the absence of marshy areas, with emergent or aquatic plants.[127]

It was December when Whipple left the Little Colorado, turning west toward San Francisco Mountain, probably where Diablo Canyon comes in. The column followed Sitgreaves' route, past cinder cones and a sweep of plains covered even at that time of the year with an excellent growth of

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124. Kennerly, v. IV, part VI, p. 6.

125. Mollhausen, v. 2, p. 124.

126. Ibid., p. 127.

127. Kennerly, v. IV, part VI, p. 6.

grama grass.[128] Hundreds of pronghorn thronged the sheltered valleys at the eastern base of the Mountain. In places progress was difficult through the lava fields, especially in the face of snowstorms. Mollhausen also saw pronghorn: "We met herds of forked antelopes, who appeared to be hastening away from the snowy regions towards the plains, and with every mile some change took place in the scenery."[129]

Whipple's party now began climbing, through the pinyon-juniper belt and into the grassy parkland covered by ponderosa pine. Still, pronghorn were everywhere, and Whipple reported that he followed the trail of "at least one hundred." Well up on the mountainside, he made the following entry in his journal: "Thus far, since leaving the Navajo country, we have not seen the fresh track of a wild Indian. The snow is untrodden, except by birds and beasts, which afford plenty of game. Antelope, deer, hares, and turkeys are abundant." Dr. Kennerly also saw large flocks of turkeys in the pine forests,[130] but his colleague Mollhausen was disappointed that the pronghorn and mule deer were so shy that few members of the party ever got a shot at them. He also recalled that, during the expedition's passage through the pine forests, "the wolves, lurking here and there in the woods, indulged us only now and then with a broken howl."[131]

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128. A.W. Whipple, A Pathfinder in the Southwest, ed. Grant Foreman (Norman, 1941), p. 165.

129. Mollhausen, v. 2, p. 146.

130. Kennerly, v. IV, part VI, p. 6

131. Mollhausen, v. 2, p. 147.

As the expedition continued to ascend, Dr. Kennerly noticed many tracks of bighorn. All efforts to secure a specimen were unsuccessful, however, except for a skull and several sets of horns. Kennerly believed that bighorn were numerous on San Francisco Mountain, but that their timidity and preference for inaccessible areas kept them out of reach.[132] He also took notes on the abundance of Abert squirrels, which were everywhere in the pine belt. In his opinion, they were limited to the San Francisco massif, since he saw none west of Mount Sitgreaves. Mollhausen added that a number of men went squirrel hunting under conditions of bitter cold and deep snow. The animals were secretive and had to be shot from the very tops of the pines.[133] However, though few were obtained, they were considered a welcome addition to the camp fare.

Whipple managed to lead the expedition around the south face of San Francisco Mountain, then on to the west. Some 20 miles ahead rose another prominent peak, described by Kennerly:

> A few short marches through dense pine forests and the deep snow brought us near Mount Sitgreaves, from the base of which stretched beautiful valleys, covered with grass, and dotted by clumps of cedars. This mountain had been, apparently, before the falling of the snow, the peculiar home of grizzly bears; but the cold and want of food had caused them all to go in search of other quarters. The number of trails of this animal that we found here, all leading towards the south, is almost incredible.[134]

Mollhausen also elaborated on this phenomenon:

> The numerous footprints of the grey bear, which traversed the forest in all directions, tempted us to follow them. We examined

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132. Kennerly, v. IV, part VI, p. 6.

133. Mollhausen, p. 156.

134. Kennerly, v. IV, part VI, p. 7.

> the forest that lay to the south of us, as well as that at the foot of Mount Sitgreaves and the neighboring hills, and we found dens in such numbers that if they had been tenanted we should have had a bear to every acre of land. The declivities and ravines of Mount Sitgreaves, are, it seems, a particularly favourite residence with them, and even Leroux, old trapper and hunter as he was, did not remember to have ever met with signs of such numbers living together on so small a space; but, unfortunately, the whole company had emigrated but a few days before our arrival. Probably the freezing of the water had occasioned this move, for we found on the ice marks of their having tried to break it. They seemed to have made their journey to the south in troops of eight or more, and their path was plainly recognisable on the glittering snow. They walk one behind another, each stepping in the footprints of his front rank man, and in this way broad trampled impressions had been made, in which the snow, melted by the heat of the fleshy foot-soles, had afterwards frozen again to smooth ice. They had probably left with reluctance a region that had afforded them in superfluity their favourite food, the sweet nuts of the cedar (he probably means pinyon); but the want of water had driven them all away, and our bear hunt consisted in nothing more than running about looking for the prints of their huge paws, and then, from their breadth, estimating the size of the individuals who had made them. Every day, as long as we remained at this spot, we searched the woods, climbed the neighbouring hills, and scrambled down into the ravines, but no creature but the grey squirrel enlivened the solitude, and it fled at our approach to the tops of the highest trees.[135]

West of Mt. Sitgreaves, the Whipple party once again negotiated a region of lava fields and volcanic hills. In the pinyon-juniper country ten miles north of Bill Williams Mountain, Mollhausen made the following observation: "Here and there we saw solitary specimens of the black-tailed deer and the antelope, and more frequently wolves and cayotas announced their presence by howling and chattering as they prowled around us in the scanty cedar woods."[136] Kennerly concluded that over most of the dwarf evergreen forest on the plateau west of the San Francisco peaks there were no pronghorn at all. But he regarded mule deer as

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135. Mollhausen, v. 2, p. 165.

136. *Ibid.*, p. 171.

"quite common," and not very shy, being "unaccustomed to the sight of man" (contrast this to observations of game behavior on the east side of San Francisco Mountain).[137]

In January, 1854, the expedition moved down an intermittent stream given the name of Partridge Creek, probably in the drainage of Big Chino Wash near modern Ash Fork, Yavapai County. Mollhausen tells us how the creek got its name: "Hundreds of pretty little partridges (Gambel's Quail) kept flying about us, but flew far off when a charge of murderous shot was sent among them....We found them in such masses in Partridge Creek, that very few shots served to supply us all with an abundant dish."[138] Mollhausen made an additional note on the wildlife of Partridge Creek: "We also saw the large gray wolf....crossing along the edge of the ravine, but he was very shy, and knew exactly how to keep out of the reach of our rifles."[139] (Later that month a reconnaissance group that included Mollhausen returned to the Chino Valley after pushing a short distance to the west. They camped one night among the junipers in the eastern foothills of the Juniper Mountains, where they could hear "the howlings of the wolves prowling in the ravines.")

Whipple also commented on the abundance of game on Partridge Creek. In addition to Gambel's quail, a mule deer was shot, and he observed innumerable tracks of deer, pronghorn, bear, and wild turkeys.[140]

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137. Kennerly, v. IV, part VI, p. 6.

138. Mollhausen, v. 2, pp. 174-175.

139. Ibid., p. 175

140. Whipple, p. 185.

After coming down off Black Mesa, the party camped along a stream on the east side of Chino Valley. Willows and cottonwoods grew beside large pools, and the nearby flats were covered with fine grama grass. The dwarf evergreen forest on the hills yielded an excellent crop of pinyon nuts. Whipple commented on the quantity of wildlife; he saw mule deer, many rabbits and quail, and also the tracks of pronghorn and bear.

Breaking camp and proceeding west again, the expedition came out on a magnificent treeless plain, "so densely covered with the best grama grass," in Kennerly's words, "that we named it 'Val de China!'."[141] Dr. Kennerly also noticed the abundance of pronghorn here: "This species prefers the open valley, or wide and unbroken plain. Descending into the Chino valley, we found this animal in large herds, sometimes of hundreds. Occasionally, impelled by curiosity, they would approach quite near, and for a time gaze upon the train, then circling round, would hurry off and disappear in the distance."[142] Whipple added that some of the men took shots at "the antelopes that came trooping around us." He relates another anecdote involving stormy weather in the valley: "The wind blew furiously over the plain, so that the antelopes, who here began to show themselves again, played about us undisturbed, for it was quite impossible to take aim in such a gale."[143]

Whipple's train now crossed the northern end of Chino Valley, passing Picacho Butte (between the sites of Ash Fork and Seligman). Pronghorn continued to be seen on every hand, and near the butte Whipple

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141. Kennerly, v. IV, part VI, p. 8.

142. Ibid., p. 7.

143. Whipple, p. 179.

reports finding "the magnificent antlers of a mountain sheep."[144] He reflected on the fact that the valley, now sustaining only deer and pronghorn, might someday furnish pasturage for thousands of cattle and sheep.

Turning south from Picacho Butte, Whipple headed down the Chino Valley. He observed that deer and wild turkeys were numerous, as well as the ubiquitous pronghorn. Turkeys became even more in evidence when the expedition changed course to the west again, entering the pinyon-juniper forest in the foothills of the Juniper Range. Kennerly found turkeys particularly common near streams, where he saw them feeding on juniper berries. Mollhausen now relates what happened when some of the party approached a grove of cottonwoods and willows where a ravine emptied into Chino Valley from the mountains:

> As we rode through the long withered grass that covered an opening in the wood, we suddenly came in sight of a numerous flock of wild turkeys, which, startled at our approach, were running at a great rate towards a hiding-place. The shots fired among them were eminently successful; but when several of them fell, the rest spread their wings and flew away as fast as they could.[145]

The birds killed fell in a marshy area formed by a spring that was later called Turkey spring.

A short time afterwards some members of the expedition found turkeys on the west slope of the mountains. A period of bitter cold had just followed a snowstorm. As Mollhausen says: "The very turkeys seemed to be suffering from cold, and cowering between the rocks and bushes

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144. Whipple, p. 189.

145. Mollhausen, v. 2, p. 192.

took little notice of the shots with which they were saluted as the hunters came up."[146]

Meanwhile, the main expedition ascended Walnut Creek, between the Juniper and Santa Maria Mountains. Coming down over Aztec Pass, Whipple's train reached a grassy plain, described by Kennerly as "a beautiful valley, where we found both the black-tailed deer and antelope quite numerous."[147] The party headed northwest, following Muddy Creek past the Mohon Mountains. Probably at a point south of Cross Mountain, Whipple turned west into the Aquarius Range. In all likelihood, he continued to ascend Muddy Creek until he picked up the headwaters of Trout Creek. His entry for January 26 states that he found a new Indian arrow lying on the ground, causing him to speculate that it had been shot at one of the mule deer with which the region abounded. On this point Dr. Kennerly had a comment: "The distance from Pueblo Walnut Creek to Williams' River is probably much less than the distance embraced between any other divisions that we have assumed but it was a country throughout particularly rich in deer."[148]

The party proceeded once more to the northwest, setting up camp on January 30 at Cactus Pass in the Cottonwood Mountains, near the head of the Big Sandy River, which drains south into the Bill Williams. Whipple's diary continues: "As coyotes stole the remnant of our mutton last night from the camp-fires, we have lived today on game--partridges, rabbits, and black-tailed deer."

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146. Mollhausen, v. 2, p. 201.

147. Kennerly, v. IV, part VI, p. 6.

148. *Ibid.*, p. 7.

Whipple now came to a major decision. Until now, the expedition had followed the route established by Sitgreaves in 1851. At the Big Sandy, however, Whipple resolved not to continue due west, but to descend that river to its confluence with the Bill Williams, then follow the latter stream out to the Colorado. This change of course pleased Dr. Kennerly, who made the following observations of natural history along the Big Sandy River: "On the wide mesas that stretched out on either side of us herds of antelope continually sported, and in the valley black-tailed deer were not uncommon. In the precipitous and rugged mountains that we encountered we found the big-horn more numerous than in any other locality that we passed."[149] Mollhausen added the fact that the bighorn, although abundant, were too shy to approach closely. Consequently, no member of the party ever got within rifle range of the animals.[150]

As the expedition moved downstream, Whipple noticed that Gambel's quail were once more incredibly numerous. He grasped the rudiments of the food-chain concept with his statement that deer, pronghorn, and rabbits fed on the rich grama grass and other plants. These animals in turn were preyed on by the wolves and coyotes that were seen and heard on the Big Sandy.[151]

Somewhere near the point where Trout Creek joined the Big Sandy, the party met a Yavapai Indian wearing leggings made of bighorn skin.

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149. Kennerly, v. IV, part VI, p. 7.

150. Mollhausen, v. 2, p. 222.

151. Whipple, p. 213. The wolves referred to by Whipple, if actually Canis lupus, may be the westernmost account of the species on record for Arizona.

This may have been close to the place where several members of the expedition made a side excursion to the east into the Aquarius Mountains (about 12 miles north of the mouth of Trout Creek). At the foot of a "white feldspar cliff" Whipple found a spring shaded by willows, acacias, and cottonwoods. A band of bighorn was frightened away from the spring as the men approached. Whipple wrote: "They were magnificent animals, with skin of silky hair like an antelope, and horns of remarkable size, curled like those of a ram....Those that we had started disappeared among the mountains; and as a prize had been offered for a specimen, some of the men followed with perseverance, which, however, was not rewarded."[152]

In early February the expedition reached a section of the Big Sandy near the present site of Wikieup, Mohave County. Whipple describes it: "A few miles below our last camp the stream changed its character, from alternate fertilizing rills and beds of sand, to a continuous rivulet, clear, rapid, and several feet in depth. Many fresh beaver dams existed upon this portion of the river, enlarging it so as to make the crossing difficult."[153]

Just above its confluence with the Bill Williams River, the valley of the Big Sandy became choked with dense willow brush, making progress extremely difficult for Whipple's wagon train. There were also places where beaver dams had inundated the whole valley. Mollhausen recorded seeing lodges built in the ponds formed by these dams.[154]

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152. Whipple, p. 212.

153. _Ibid._, p. 214.

154. Mollhausen, v. 2, p. 224.

On February 9, after the expedition reached the Bill Williams River, a group under Whipple set out to explore one of the mountain ranges lying just to the north. This side excursion took place some two miles below the mouth of the Big Sandy, so the mountains investigated were probably an eastern spur of the Rawhides. Once again, several bighorns were flushed from the vicinity of a spring. They had been concealed in a cave containing Indian petroglyphs.[155] Mollhausen found bighorn horns scattered around the spring and assumed that Indians came here to ambush the animals when they came for water.

Dr. Kennerly observed bighorn sign all the way down the Bill Williams and concluded that the species was common in the ranges that flanked the river. There was a good growth of grass in the upper valley, more than enough to support the mules and other livestock while passing through. But farther down, closer to the Colorado River, grass became scarce, and the pack animals had to depend on willow twigs and on the twigs and bark of cottonwoods. Kennerly also had a comment about the Bill Williams River: "The water of Bill Williams fork, in many places, flows in a bold current; but, like the Mimbres, and other streams in this country, it sinks again in the sand, sometimes within a very short distance of its head. It rises and sinks this way, alternately, until it reaches the Rio Colorado."[156]

To Dr. Kennerly, the waterfowl on Bill Williams River in midwinter were particularly interesting. Great numbers of ducks and geese were continually frightened from the stream or nearby lagoons, and many

155. Whipple, p. 220.

156. Kennerly, v. IV, part VI, p. 11.

specimens were added to the expedition's collection. Pintails were most abundant in the marshes, along with large congregations of ducks of other species. Both green-winged and cinnamon teal were everywhere, and small flocks of buffleheads were seen on both the Bill Williams and Colorado Rivers.[157]

Heinrich Mollhausen, the avid hunter, spent a good deal of time with his shotgun on the Bill Williams marshes:

> The shallow water was covered by thousands of birds, who usually sported on its surface undisturbed, but at the approach of our procession they fled; and shot after shot was heard in all directions, echoing among the rocks and hills. I happened to be one of the foremost of our party, and had thus an opportunity of obtaining a fine harvest of various kinds of ducks, many of them with splendid plumage, that would be an ornament to our collection.[158]

The ducks were considered a "savoury dish" by Mollhausen, but not enough to satisfy the hunger of the whole party. Game, in fact, was lacking on the Bill Williams except for the inaccessible bighorn. Even together, waterfowl and Gambel's quail could not make up for the inability of the hunters to bring in venison or pronghorn. And the flock of domestic sheep that had been driven all this distance was by now nearly gone. Still, the expedition pressed on, and the problems of contending with the lower valley of the Bill Williams were recorded by Mollhausen:

> Sometimes we were stopped by the windings of the now deep and full river, sometimes by the marshy grounds formed by its overflow; here the thick wood and tangled bushes stopped the way, and there an almost impenetrable growth of canes, and other obstacles, requiring time and toil to overcome....Slowly we made our way over the marshy ground covered with innumerable

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157. Kennerly, v. IV, part VI, p. 11.

158. Mollhausen, v. 2, p. 236.

> water-fowl, and more slowly still past places where every foot of our way had to be cleared with the axe."[159]

A few miles short of the Colorado, the scene took this form. Mollhausen again: "The Bill Williams fork waters a beautiful valley varied by meadow, woods, and ponds or small lakes, and the clear waters of the stream, passing the rugged mountains, take their way to join the flood of the Colorado."[160]

The expedition finally reached the Colorado without serious mishap and turned upriver to the vicinity of the Needles. This time the previously warlike Mohaves assisted the tired travelers, even helping Dr. Kennerly collect birds and fish. But the larger game animals, as Kennerly observed, had been heavily hunted by the Indians and were scarce along the Colorado.[161]

Once over the Colorado, Whipple headed due west to the Mojave River. From there the expedition found the Mormon wagon road to San Bernardino, before moving on to Los Angeles. Lt. Whipple considered the long reconnaissance a successful one and felt that the 35th parallel was, indeed, a practicable route for a railroad.

The next expedition to follow the 35th parallel was easily the most exotic of them all. It had its origins in an idea conceived by a lieutenant in the Navy, Edward Fitzgerald Beale, who believed that camel caravans would be the most effective way of moving supplies across the American deserts. When the concept was supported by Jefferson Davis,

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159. Mollhausen, v. 2, p. 238.

160. *Ibid.*, p. 239.

161. Kennerly, v. IV, part VI, p. 7.

Secretary of War under Franklin Pierce, Congress appropriated 30,000 dollars to import the animals.

With Lt. Beale in charge, thirty-three Bactrian camels were shipped from the Middle East to Indianola, Texas, in 1856. Another forty-four camels arrived a year later, and all were concentrated at Camp Verde, Texas, some 60 miles northwest of San Antonio.

Lt. Beale received orders from the Secretary of War to start west in the summer of 1857 to survey a wagon route from Fort Defiance, a six-year old post some 30 miles southeast of Canyon de Chelly, to the Colorado River. He left Camp Verde on June 25, 1857, with each camel carrying between six and eight hundred pounds and traveling 25 to 30 miles a day. Beale was particularly impressed with the fact that the camels thrived on creosote bush, Larrea divaricata, which no other ruminants would touch.[162]

By August, Beale's caravan had reached the Zuni villages, after which he headed due north to Fort Defiance. His survey route into Arizona therefore started considerably farther north than the course followed by Sitgreaves and Whipple, who both descended the Zuni River (see Fig. 3, p. 224).

Lt. Beale pushed southwest from Fort Defiance, crossing the open plateau country of what is now the Navajo Reservation, Apache County. His first reference to wildlife, which later went into his official report of the expedition, is dated September 1 and refers to sighting "a fine band of antelope" on an expanse of rolling plains covered with a

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162. Odie B. Faulk, Arizona: a Short History (Norman, 1970), p. 82.

good growth of grama grasses.[163] This incident took place near the present site of Wide Ruin. A day later Beale described a high table land covered with "beautiful grass" close to the head of Leroux Wash, just north of the present location of Petrified Forest National Park.

The expedition probably continued south along Leroux Wash, reaching the Little Colorado a few miles west of modern Holbrook. As they moved downstream to the west, members of the party saw numerous signs of beaver, especially where Clear Creek and Jack's Canyon came in from the south. Clear Creek was muddy and lined with cottonwoods, while the stream in Jack's Canyon was clear with no trees on its banks. One beaver was found partly eaten by a coyote.[164]

On September 7 the caravan was moving parallel to the river up on the plateau above the north bank. Beale had this to say about the open terrain near the site of Winslow: "The grass throughout the day has been most abundant, and we have constantly exclaimed, 'what a stock country!' I have never seen anything like it; and I predict for this part of New Mexico a larger population, and a more promising one than any she can now boast."[165] On the same day he commented thus on the natural history: "We have seen indications of the greatest abundance of game for the past three days. Elk, antelope, and deer, besides beaver and coyotes

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163. May H. Stacey, Uncle Sam's Camels, ed. Lewis B. Lesley (Glorieta, 1970), p. 191.

164. Ibid., p. 200.

165. Ibid., p. 202. Today, of course, most of the Navajo Reservation is a sand or red rock desert, devoid of grass for most of the year.

in large numbers."[166] Before sundown, the party having maintained a course to the northwest, Beale again spoke of wildlife. Deer and elk continued to be abundant, and he refers to their tracks near the river as being "innumerable."[167] He closed his journal entry for the day with the observation that cottonwoods grew in profusion along the river, but that there was no woody growth at all on the grassy mesas above the valley.

Another member of the expedition who kept a diary was May Humphreys Stacey. As the caravan moved downstream, now above the left (south) bank of the Little Colorado, he speaks of grass and pronghorn everywhere. "Every now and then herds of antelope would dart across our path," he said. Like Beale, Stacey thought that the beautiful rolling grassland would someday be a paradise for livestock.[168] He was referring specifically to the area near Diablo Canyon, just west of modern Leupp, Coconino County.

Beale now took his column due west, following the trail of Sitgreaves and Whipple toward San Francisco Mountain. He never ceased to marvel at the green expanse of waving grasses, now covering the lava fields between the Little Colorado and the mountains. When the expedition reached the flanks of San Francisco Mountain the grass was knee-high to

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166. Stacey, p. 201. It is a matter of considerable interest that keen observers like Sitgreaves and Whipple, Woodhouse, Kennerly, and Mollhausen made no mention of elk while crossing northern Arizona. It is conceivable that the elk found around the San Francisco Peaks in summer wintered to the north, in the valley of the lower Little Colorado River. If this were the case, Sitgreaves and Whipple passed too far to the south to see the animals.

167. Ibid., p. 202.

168. Ibid., p. 93.

the mules, interspersed with a carpet of wild flowers. And over this parkland towered the widely spaced ponderosa pines. (Beale was the first explorer to write about this country in summer. As it was, the members of the Sitgreaves and Whipple expeditions were impressed with the density of the grass in fall and winter).[169] Beale saw bear, deer, and pronghorn on the mountainside and reported the first Abert's squirrels shot on the expedition. The date was September 11, at Stacey's Spring, on the southeastern slope.

The caravan circled San Francisco Mountain and continued west through the lush park country. At a spring on the north slope of Mount Sitgreaves Beale recorded his impressions of the region:

> The fine spring attracts numerous antelopes, which appear and disappear as they glance rapidly through the fine open forest with which it is surrounded, sometimes stopping to gaze at the strangers, and at others racing past at full speed; and the majestic mountains looking bold and grand, and black with heavy timber, at just a sufficient distance to make the scenery of the amphitheatre in which the springs are one of the loveliest valleys we have seen. This stopping to gaze has been fatal to two of the antelope, which have been killed by our party with muskets, directly in sight of the whole camp.[170]

While the expedition camped on Mount Sitgreaves, hunting parties reported an abundance of both mule deer and pronghorn on the parkland to the northeast, toward Kendrick Peak.

By September 17 Beale's party had reached a place he calls King's Creek, near the present site of Seligman. There was permanent water in the stream, which might actually have been Big Chino Wash, and Beale shot some snipe and blue-winged teal. He also saw flocks of sandhill cranes.

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169. Stacey, p. 210.

170. *Ibid.*, p. 215.

Like Kennerly before him, he commented on the numerous herds of pronghorn that grazed the open plains adjacent to the creek.

The caravan next turned south into the Chino Valley, which it followed as far as Walnut Creek. Beale's men were hardly ever out of sight of pronghorn or deer and their trails.[171] Even in the pinyon-juniper country along Walnut Creek game flourished because water persisted as deep pools on the rocky canyons.[172] Once over the Juniper Range, Beale headed north, apparently keeping to Whipple's route over the Aquarius Mountains. Good grass continued to grow on a rolling plain of clay mixed with gravel. In Beale's words: "Abundance of deer and antelope, constantly in sight render our ride, this morning September 29, a most agreeable one. The deer were of the species known as black-tailed. Bear sign was also frequent, though Cuffee did not show himself in person."[173]

Beale decided to follow the original trail blazed due west by Sitgreaves, rather than attempt the route taken by Whipple down the drainage of the Bill Williams River. Therefore, he crossed the Aquarius Mountains and the Big Sandy River, circled the north end of the Hualpai Range and passed the present site of Kingman, Mohave County. The Black Mountains were thus his last obstacle before reaching the Colorado River near the Needles. Here, to his amazement, Beale encountered, not hostile Indians, but a steamboat expedition under one Captain Alonzo Johnson, who was returning downriver after reaching the head of navigation 34 miles

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171. Stacey, p. 228.

172. Ibid., p. 231.

173. Ibid., p. 236.

above the meeting point. Beale was quite impressed by this chance contact between two of the most innovative expeditions to date: "Here in a wild almost unknown country inhabited only by savages, the great river of the west, hitherto declared unnavigable, had for the first time borne upon its bosom that emblem of civilization, a steamer."

The last leg of the journey to California was less eventful than the drama on the Colorado, and Beale took his caravan back to Texas soon after completing the survey. Only one entry concerning wildlife added information of significance. On January 26, 1858, Beale had reached the south end of the Sacramento Valley (between the Black and Hualpai Ranges) after heading east from the vicinity of the Needles. It was the dead of winter, but the valley was filled with grass. About the Sacramento Valley Beale wrote: "A large number of deer, antelope, and big horn tracks show it to be well supplied with game, which, finding abundant grass, probably seek its warmth in winter, and retreat to the neighboring mountains during the heat of the summer."[174]

In the summer of 1859 Beale led a government road-building crew from Fort Smith, Arkansas, to the Colorado River, constructing a wagon road along the route he had surveyed two years earlier. Besides dromedary camels, he brought greyhounds with which to hunt the deer and pronghorn that were so abundant on the way.[175]

An impending clash between the Mormon settlers in the Great Basin and the Federal Government motivated the last major expedition into the Arizona wilderness before the Civil War. In 1857 an army detachment

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174. Stacey, p. 265.

175. Beale Diorama, Arizona Historical Society, Tucson.

under Colonel Albert S. Johnston was sent to Utah to enforce stricter compliance with U.S. statutes. This force had to be supplied, and the cheapest means would be by water. The Bureau of Western Explorations and Surveys therefore funded an expedition up the Colorado to determine the head of steamboat navigation and to see if Johnston really could be supported by this route.

The man selected to lead a party up the river was Lt. Joseph C. Ives, a product of Yale and West Point who had already gained familiarity with Arizona's interior when he accompanied Whipple along the 35th parallel in 1853-1854. He was enthusiastic about his new assignment, describing it according to one contemporary as an event "destined to make fame for his children."

In October, 1857, the members of the Ives party gathered in San Francisco. They included the eminent geologist John Strong Newberry, who also served as physician and naturalist, and Heinrich Mollhausen, the German who so enlivened the Whipple expedition, now functioning as the official artist. This group was divided into three detachments. One, under Newberry's leadership, was to proceed by coastal steamer to San Diego, then overland to Fort Yuma. Another contingent led by P.H. Taylor, the astronomical assistant, would march from San Pedro to Fort Yuma by way of Fort Tejon. Ives himself commanded the third element, destined to sail from San Francisco on a voyage to the mouth of the Colorado. This party embarked on November 1 on the schooner Monterey. Lashed to the deck were the disassembled parts of a shallow-draft steamboat, the Explorer, built in Philadelphia and tested on the Delaware River the previous August.

The voyage was congested and uncomfortable, involving at one stage a three-week period of "dead calms, of burning tropical days and stifling nights," as Ives phrased it. On November 29 the Monterey reached the delta of the Colorado off Montague's Island, but spent several days maneuvering into position to unload the fragmented steamboat. Wood to construct a derrick for assembling the boat had to be dragged for nearly two miles over the vast mud flats. After back-breaking labor lasting almost a month, the steamboat was back in one piece, with the massive boiler lowered into place amidships. While all this was going on, steamboats from Fort Yuma and curious Cocopa Indians visited the "shipyard."

At high tide on the night of December 30 the Explorer was launched. News had just been received from upriver that the Mormon War, so long expected, had finally broken out. Ives was driven by a sense of urgency as his odd little vessel churned northward. And a spectacle she was: painted bright red, some fifty-four feet long with a stern paddlewheel. The hull was left open, with most of the space occupied by the steam boiler. At the bow a four-pounder howitzer was mounted on a little deck. The stern contained a small cabin eight feet by seven, with a roof that formed an observatory deck for the pilot and the scientists.

On January 9, 1858, the whole party was reunited at Fort Yuma, a rough stockaded encampment built on a gravel spur on the west bank of the river. While Ives was ascending the Colorado, the civilian Alonzo Johnson had already completed his expedition to El Dorado Canyon on the 35th parallel.

Ives started upriver on January 11 (see Fig. 4, p. 225). He immediately struck a sandbar, but pulled free without damage and continued. At Explorer's Pass in the Purple Hills area, he took his first good look at the terrain bordering the river. Here, the banks were largely destitute of vegetation, being limited to occasional growths of mesquite, cottonwood, and willow--just enough to supply fuel. The hills were bare, and the gravelly valleys supported Sonoran Desert plants. Sahuaros were much in evidence.

Ives' journal entry for January 17, adjacent to the Chocolate Range, reads thus:

> The scarcity of vegetation has been alluded to: of fish, but a single one--and that a poor variety--has been caught; and game is seldom met with. An occasional flock of ducks or geese is observed flying past, and this morning a dozen mountain sheep ("bighorns") were seen scampering over a gravel hill near Lighthouse Rock, but not within shot from the bank of the river.[176]

Even this far south, Newberry the geologist became excited by the vistas presented where the Colorado had cut through the jagged ranges on each side. When the Explorer passed the mouth of the Bill Williams River, Ives did not recognize it at first. A severe drought had reduced the stream to a trickle, and its mouth became effectively screened by a growth of willows. There was no sign of Whipple's trail. A bit to the north, the expedition went ashore to camp among the peaceful Chemehuevi Indians. They were highly amused by the bearded Mollhausen, who enlisted the children to collect reptiles and small mammals. Said Ives: "They think he eats them and are delighted that his eccentric appetite can be gratified with so much ease and profit to themselves."[177]

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176. Joseph C. Ives, Report Upon the Colorado River of the West (Washington, 1861), p. 52.

177. Ibid., p. 62.

Above the Needles, the Explorer entered Mojave Canyon, "a profound chasm." This walled-in twilight zone provided a vivid contrast with the open Mojave Valley to the north, "clothed in spring attire and bathed in all the splendor of a brilliant morning's sunlight....a scene so lovely that there was a universal expression of admiration and delight." Beale also made note of the fact that there was no game in the valley and that fish were scarce and of "very inferior quality."[178]

The expedition passed the Mojave Indian villages without incident, ascending to the Cottonwood Valley above the point where Alonzo Johnson turned back. At the head of the valley was Paiute country and Black Canyon, the first really awesome gorge of the Colorado. The Explorer entered the canyon and struck a submerged rock; the boat was crippled, but did not sink. Ives sent up signal rockets, and his party settled down to wait for a land supply detachment under Lt. John Tipton.

During the wait, Ives and two companions reconnoitered Black Canyon in a skiff. For several days they paddled laboriously through the gorge, reaching Las Vegas Wash before coasting downstream again. Ives estimated the Mormon Road at 20 miles west from the river and saw no reason why a wagon road could not be connected to it. After returning to the Explorer, Ives extended the camp's hospitality to a young Mormon bishop disguised as a lost emigrant. He was actually one of a party that included the renowned frontiersman Jacob Hamblin, all out to stir up the Paiute Indians against the Federal authorities. Part of Ives' overall expedition was spent in placating the Indians of northwestern Arizona with presents and skillful diplomacy.

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178. Ives, p. 73.

When Tipton finally appeared, Ives sent half of the command back to Fort Yuma on the temporarily repaired Explorer. With the rest, including the scientists and 20 soldiers, he set off eastward to look for another connection with the Mormon Road. Ives looked back and recorded his final impression of the Mojave Valley, "enveloped in a delicate blue haze that imparts to it so softened and charming a glow, while the windings of the Colorado could be traced through the bright fields and groves till the river disappeared in the Mojave Canyon."

The Ives party followed Beale's wagon route for part of the way while pushing eastward, first across the Black Range, then around the Cerbat Mountains to the Hualapai Valley. It was March, but Ives noticed a luxuriant growth of "glue grama and pin grass." He also made an entry regarding the fauna of the Hualapai Valley: "Deer and antelope are now frequently seen, but they are shy and hard to approach. A single antelope one of the Mexicans succeeded in killing; they are just in season, and the flesh was tender and delicately flavored."[179]

The Expedition was now in the territory of the Hualapai Indians, described by Ives as "Squalid, wretched-looking creatures, with splay feet, large joints and diminutive figures." The Americans persuaded two members of a band to guide them, despite Mollhausen's suggestion that one of the ugliest be preserved in a jar of alcohol as a zoological specimen.

On March 31 the party reached Peacock Spring, near the Peacock Mountains, after four days of intense heat in which the mules suffered acutely from thirst. To the northeast stretched a broad plateau described by Ives: "The road became hard and smooth, and the plain was covered with

179. Ives, p. 98.

excellent grass. Herds of antelope and deer were seen bounding over the slopes. Groves of cedar occurred, and with every mile became more frequent and of larger size."[180] After resting at the spring, Ives' train resumed the journey, eventually turning north to follow Diamond Creek down into the depths of the Grand Canyon. Ives finally reached the mouth of the creek, walking out onto the floor of Granite Gorge, beside the Colorado River. Only Cardenas in 1541, Espejo in 1583, Garces in 1776, and perhaps James Ohio Pattie and his companions had even come close to the Grand Canyon. But Ives was the first known white man to descend to the Colorado itself.

Ives and his men climbed back out of the Canyon with great difficulty, since the guides had deserted, and their water was almost gone. They stopped for awhile in the ponderosa pine forest on the South Rim, while some of the soldiers hunted mule deer. After one more unsuccessful attempt to descend to the Colorado from a new point, the expedition headed off to the southeast. The route lay across an extensive pygmy forest of pinyons and junipers, an area lacking in water. Ives found this region--the Coconino Plateau--depressing: "The deer, the antelope, the birds, even the smaller reptiles, all of which frequent the adjacent territory, have deserted this uninhabitable district."[181]

On April 21 the column observed bear tracks near a pool on one of the headwaters of Cataract Creek (now in Coconino County). Ives relates what happened:

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180. Ives, p. 98.

181. Ibid., p. 110.

> A large grizzly bear--the animal whose tracks we had observed--was seen quietly ascending a hill near by, and half of the company rushed after the grim monster. He was unconscious of pursuit till the party was close upon him. Then he commenced to run, but the hill retarded his pace, and a volley of balls made the fur fly in all directions from different parts of his hide. Twice he turned as though meaning to show fight, but the crowd of pursuers was so large, and the firing so hot, that he continued his flight to the top of the hill, where he fell dead, riddled with bullets. His skin was taken off to be preserved, and the flesh divided among the party. It is rather too strong flavored to be palatable when roasted or broiled, but makes capital soup.[182]

Ives and his party reached the north base of Bill Williams Mountain on April 25. Like all previous explorers who passed this way, he was enchanted by the extensive grassland growing beneath widely spaced ponderosa pines. Melted snows had turned the landscape green, and it was covered with spring flowers. One camp site was beside a stream that meandered across a lush meadow. Ives writes: "We found in possession of the spot a herd of antelope that scoured over the mountain like the wind when they saw the train approaching."[183] He continues: "The place is a great resort at this season for grizzly bear, antelope, deer, and wild turkeys, large numbers of whose tracks were seen heading to and from the water holes."[184]

The expedition resumed the journey a few days later, entering the cool pine forest on San Francisco Mountain on April 30. "Antelope and deer were constantly seen bounding by, stopping for a moment to gaze at us, and then darting off into the obscure recesses of the wood," recalls Ives.

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182. Ives, p. 112.

183. Ibid., p. 113.

184. Ibid.

Changing direction to the northeast, Ives apparently passed what is now Wupatki National Monument, reaching the Little Colorado River in the vicinity of Black Falls. One of his entries reads thus: "The bottom is filled with black-tailed deer. A buck was killed today measuring six feet from the nose to the base of the tail. The venison was of delightful flavor, and though not in season, quite tender. Ruins of ancient pueblos have been passed."[185]

Lt. Ives now divided his command once more. Tipton and the supply train followed Whipple's trail back to Fort Defiance, while Ives crossed the Little Colorado in "Buchanan boats," tipsy structures of canvas stretched over wood. He then headed for the Hopi villages. While crossing the Painted Desert, Ives commented on the general bleakness of the region, characterized by an almost total absence of grass, in contrast to the lushness of the open country to the south and east.[186]

From the Hopi villages, where Ives took detailed notes on the ethnology of the area, the party returned in a somewhat disheveled state to Fort Defiance, while mounted Navajos dogged their trail. Shortly after they reached the fort, open war broke out between the Navajos and the U.S. Government.

Ives took the Butterfield Stage back to California, after which he sailed from San Francisco on a ship bound for Washington, D.C. He could look back on an expedition that had tested the navigability of the Colorado and made a connection with the Mormon Road into the Great Basin.

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185. Ives, p. 117.

186. Ibid.

In addition, Newberry's geological report revealed the Grand Canyon and the Plateau Province to the scientific world for the first time.

Following the outbreak of the Civil War, American troops of both sides marched and countermarched across Arizona, but matters concerned with natural history were not uppermost in the minds of most participants. A small Confederate force occupied Tucson and the Pima villages in the spring of 1862, but logistical problems were insurmountable, and it soon withdrew to New Mexico. Its place was taken by a Union column of 1500 California volunteers that marched east from Fort Yuma in June. By the end of the year there were no Confederates west of Texas, and the Californians were occupied with the elusive Apaches instead. Routine garrison duty in scattered outposts across Arizona and New Mexico was to be the fate of most of these men for the war's duration.

One colorful visitor to Arizona was a soldier named George O. Hand, Company "G," First Infantry, California Volunteers, who marched up the Gila River in the summer of 1862. As Marshall points out in The Birds of Arizona, Hand's main interests were "whiskey, women, and whiskey" so that any comments he made about the natural history of the region must have indicated something extraordinary.

Before starting east, Hand did take a little time to explore the banks of the Colorado. Local informants told him of the incredible numbers of waterfowl on the river during the winter, and Hand himself came to the opinion that beavers were "very thick."

At Mohawk Station, 66 miles up the Gila River from Fort Yuma, Hand and some companions packed a mule deer they had shot through two miles of "brush and high grass." The troops saw wildlife again on the river four miles east of Burke's Station (near present Agua Caliente, Maricopa County). Hand speaks of bighorn in the area and "great droves of antelope," adding that there was no time to go hunting.[187] More pronghorn were encountered in the desert ten miles farther on, at Oatmans, where one was shot and prepared for dinner.[188]

Hand made his final--and most dramatic--observation of the fauna on the lower Gila River with this entry:

> July 30,--Left Kinnion's Station on or near the Gila River just east of Oatmans at twenty five minutes till two and travelled eight miles. Struck a bend in the river at 4 a.m., had a bath, filled our canteens, and started again. All along this day's march the quail were astonishing; big flocks of them two hundred yards long. I really think there were millions of them in each flock. If I were to tell my old friends in California that, they would say that I had lost my senses, and would not believe me. Came to camp, Gila Bend, about eight in the morning.[189]

Hand, of course, was describing the Gambel's quail.

In the fall of 1863 a detachment of the California Column was sent west from Fort Craig, New Mexico, to help establish a new post, Fort Whipple, in the mountains of central Arizona. Some of these men were diverted northward to the area around San Francisco Mountain to keep an eye on roving Navajos. One of these troopers, Frederick G. Hughes, kept a diary, as follows:

> By the time we reached the base of the San Francisco Mountains our cattle were giving out and dying to such an extent that it became necessary to either destroy part of our stores, or cache them until the command could go on to its destination....In the

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187. George O. Hand, Diary, typescript, Arizona Historical Society, Tucson, p. 17.

188. Ibid.

189. Ibid., p. 18

> interim we enjoyed ourselves hunting to our hearts' content, for our camp was a veritable hunters' paradise. It was at a point then called Snider's Water Hole. Bear, elk, deer, antelope and turkey abounded in greater numbers than I have ever seen either before or since. While hunting we would see Indians almost daily and being as we now were in Tonto or Hualapai Apache country we knew them to be Apaches, and really expected each day that our camp would be attacked.[190]

On February 24, 1863, Abraham Lincoln signed into law a bill making Arizona a territory, separating it from New Mexico along a north-south line at approximately 109 degrees west longitude. However, members of the provisional government did not reach Arizona from the east until late in the year (another contingent headed for Fort Whipple from California). James D. Houck, a member of the expedition that left Santa Fe under army escort, reported that Governor John Goodwin and his party reached Navajo Springs (now Navajo, Apache County) on the cold, raw day of December 29. Six inches of snow covered the ground, and the camp was muddy and uncomfortable. The party was completely out of meat, so Houck and a couple of Mexicans went out to kill pronghorn, since several herds had been seen near the camp. The hunters were successful, and a number of animals was brought in. After a flag-raising ceremony officially establishing the Territory of Arizona, the entire command feasted on pronghorn steak and drank champagne to commemorate the occasion.[191]

Six months later, on June 12, 1864, a company of infantry and a troop of California and New Mexico cavalry gathered at Los Pinos, New Mexico, to escort a wagon train of provisions to the new palisade of unbarked pine logs known as Fort Whipple. Along with the wagons was a

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190. Arizona Daily Star, 5-23-09.

191. Will C. Barnes Collection, Arizona Historical Society, Tucson.

herd of cattle and sheep to be driven through 500 miles of wilderness, much of which was the domain of Apache and Navajo raiding parties.

One of the members of the column was the 21-year old surgeon in charge, Dr. Elliott Coues. His medical background belied the fact that his primary interest was natural history, especially ornithology. At the request of the Smithsonian Institution, he had received his present assignment, in his words, to "shoot up the country between the Rio Grande and the Rio Colorado." Free transportation had been assured for all his collections, and to preserve specimens he brought along a five-gallon keg of alcohol.

Between June 16 and July 29 Dr. Coues made many excursions along the flanks of the column collecting a wide assortment of vertebrates. He rode out each day on a buckskin-colored mule named Jenny Lind, in recognition of her vocal qualities, his uniform consisting of a corduroy suit containing many large pockets. On the saddle was an additional array of sacks and pouches. Generally, Coues would be gone until the detachment had camped and been settled in for several hours. Sometimes the troops heard the far-off discharge of his double-barreled shotgun. On his return to camp, he would empty his pockets of specimens and make up study skins of birds and mammals while officers and men flocked around to watch. Coues would eagerly instruct anyone interested in making up a skin.

Unfortunately, the keg of alcohol did not last long. It was emptied by soldiers who felt the need of a libation following a dusty day on the trail or in the saddle, and apparently the mass of well-soaked reptiles did not detract from the flavor. In any event, the collection was ruined.

During a tense period on the march, when Apaches were making frequent attempts to stampede the livestock, Coues tended to remain closer to the escort, but an interesting bird never failed to lure him away despite the danger of ambush. At one point all firing of weapons was forbidden, orders being issued to rally in the direction from which any shot came from. One day the bluecoats swung hastily about and gathered to the rear, only to find Elliott Coues holding up a bird. As he explained the situation, "I really could not allow this bird to escape without causing a serious loss to science."

The colonel in command of the column responded thus: "Well, I shall deprive science of any further collections for a week by placing you in arrest and taking possession of your gun and ammunition."

The arrest only lasted a few hours. Relenting, the colonel merely gave Coues a lecture, making it clear what the young surgeon might expect if he fired his shotgun again or left the escort before it was out of hostile country.[192]

Stationed for a year at Fort Whipple, Coues earned a creditable reputation as a surgeon. When he was ordered to Washington, D.C., in November, 1865, he took with him the skins of 250 species of birds, including six unknown to science. His paper, "The Quadrupeds of Arizona," published by the American Museum of Natural History in 1867, was based on his observations during his tour of duty in central Arizona.

While at Fort Whipple, in what is now Prescott National Forest, Coues took to the field at every opportunity. His apparent recklessness

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192. C.A. Curtis, "Coues at His First Army Post," Bird-Lore, IV (1902), pp. 5-9.

was tempered in the following comment, prompted by the frustration of not always being at complete liberty to perform as he pleased: "My operations were conducted at the most imminent personal hazard from the continual presence of hostile Indians--the wily and vindictive Apaches--which always cramped, and at times necessitated entire cessation of investigations."[193]

The following species accounts are taken from Coues' notes and recollections stemming from the period 1864-1865, when he was stationed at Fort Whipple, close to the new territorial capital of Prescott.

Merriam's Turkey: The wild turkey was a permanent resident of the mountains around Fort Whipple (the Sierra Prieta, Granite Mountain, the Bradshaws, etc.). However, as early as the middle 1860's turkeys were, in Coues' opinion, "quite rare, so much so that I procured no specimens."[194]

Abert Squirrel: Coues considered this species shy and hard to shoot. Fort Whipple was probably on the extreme western edge of the range of the Abert squirrel, though Coues does not cite the localities where he saw it.[195]

Beaver: Beavers were found in "great abundance" on all the streams of interior Arizona, according to Coues. They were particularly numerous in the 1860's on the Salt and San Francisco Rivers. Beaver dams

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193. Elliott Coues, "List of the Birds of Fort Whipple, Arizona," Proc. Acad. Nat. Sci. of Philadelphia, v. XVIII (1866), p. 42.

194. Coues, "Birds of Fort Whipple," p. 94.

195. Elliott Coues, "The Quadrupeds of Arizona," Amer. Nat., v. i (1867), p. 356.

were found every few hundred yards on some streams. Old trappers attributed the increase to Indian depredations as well as the demise of the fur market. It simply was not safe for trappers to operate because of hostile Apaches.[196]

Gray Wolf: This species was common around Fort Whipple, although it was secretive and rarely seen during the day. A number of specimens were taken in winter, all being grizzled white;[197] Coues heard of no black or tawny individuals from the mountains of central Arizona.[198] Many of the wolves killed had been poisoned for their furs, which made fine robes. Wolves were generally distributed over the Territory, although not so common as the coyote.[199]

On one occasion Dr. Coues took detailed notes on a mixed chorus of wolf and coyote howls heard one night in central Arizona:

> A short, sharp bark (Coues is speaking of the coyote) is sounded, followed by several more in quick succession, the time growing faster and the pitch higher, till they run together into a long-drawn lugubrious howl in the highest possible key. The same strain is taken up again and again by different members of the pack, while from a greater distance the deep melancholy baying of the more wary Lobo breaks in, to add to the discord, till the very leaves of the trees seem quivering to the inharmonious sounds.[200]

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196. Elliott Coues, "The Quadrupeds of Arizona," pp. 362-363.

197. Ibid., p. 289.

198. Elliott Coues, "Notes on a Collection of Mammals from Arizona," p. 134.

199. Ibid.

200. George M. Wheeler, Report upon Geographical and Geological Explorations and Surveys West of the One Hundredth Meridian, v. V, (Washington, 1875), p. 45.

Grizzly Bear: Grizzlies were still common in wooded and mountainous areas of central Arizona in the 1860's. They had been especially numerous on San Francisco Mountain and Bill Williams Mountain, "though they appear to have somewhat decreased of late," Coues said.[201] He was with a party that killed several grizzly bears on the slopes of the latter peak in 1864.[202]

Like Kennerly, Dr. Coues observed that grizzlies extended south into the Sierra Madre of Mexico. He also brought out the important point--when one examines old records--that frontiersmen of the period often called the lighter or browner grizzlies "cinnamon" bears.[203]

Jaguar: Elliott Coues suspected that jaguars might be found in Arizona, but he never saw any, or knew of anyone who had.[204]

Mountain Lion: While generally distributed, the mountain lion was seldom seen, and Coues never met with one or heard its cry. He did see the skins of lions killed by Indian arrows.[205] His opinion that mountain lions were rare in the Arizona of the 1860's is probably based on the fact that few, if any, frontiersmen owned well-trained hunting dogs at that time, especially in the face of Apache hostility. Therefore, not many situations would have arisen in which one might expect to see lions or their sign.

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201. Coues, "Quadrupeds of Arizona," p. 354.

202. Wheeler, v. V, pp. 65-66.

203. Ibid.

204. Coues, "Quadrupeds of Arizona," p. 286.

205. Ibid.

Mule Deer: Dr. Coues found mule deer still very abundant around Fort Whipple in 1864-1865, although they had decreased from the numbers in evidence when the first white prospectors entered the region in 1863. The species was enduring heavy hunting pressure from both Indians and white settlers during Coues' tour of duty, and it contributed substantially to the food and clothing needs of both ethnic groups.[206] Mule deer were economically far more important than the white-tailed deer, which was rare near Fort Whipple.

Coues usually saw mule deer singly, except in autumn, when the species tended to form herds. Once, in October, he observed between 20 and 30 deer feeding in a little glade in thick pine woods. Mule deer were not, in Coues' opinion, inhabitants of open grasslands, preferring thinly wooded tracts comprising oaks or junipers, or mountainsides covered with pines. They were also common in chaparral.[207]

Pronghorn: Coues had little to say about pronghorn except that in the middle 1860's they were common on the open grasslands of central and northern Arizona.[208]

Bighorn: In central Arizona the bighorn had been considerably reduced by 1864-1865. It inhabited only the most rugged mountain regions, and Coues found a number of horns lying at the bases of cliffs near Fort Whipple.[209]

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206. Coues, "Quadrupeds of Arizona," p. 535.

207. Ibid., p. 536.

208. Coues, "Notes on a Collection of Mammals," p. 136.

209. Ibid.

CHAPTER IV

PASSAGE TO CALIFORNIA, 1849-1850

For three years following the military expeditions of Kearny and Cooke, only a handful of the hardiest Americans braved the harsh and little-known region called Arizona. An occasional detachment of dragoons passed through on its way to a new post in California. Here and there, a few beaver trappers hung on, unable to change to a new life despite the absurdly low price of pelts that prevailed. There were also outlaws and other social castoffs, including gangs who hunted Mexicans and Indians for their scalps, then turned them in to the authorities of Chihuahua and Sonora for bounty money, claiming that their victims were Apaches.

Once, in 1848, a group of scalp hunters based in Fronteras, Mexico, ranged all the way to the Grand Canyon country while practicing their nefarious trade. Somewhere on the Little Colorado River they killed a "large brown bear," according to one of the men, and its meat was eagerly consumed.[1] This bear could have been of either species, but in that semi-arid region of open, grassy mesas the chances are particularly good that it was a grizzly. _Ursus horribilis_ was common then in the San Francisco peaks to the west, in the Chuskas and other ranges to the northeast, and almost certainly it wandered to the South Rim of the Grand

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1. Samuel E. Chamberlain, _My Confession_ (New York, 1956) p. 277.

Canyon.[2] There is also a strong possibility that grizzlies existed on the North Rim and in the Kaibab region generally, since they inhabited the Pine Valley Mountains just to the north in southern Utah.[3]

The discovery of gold at Sutter's Mill, also in 1848, was to lead to a new phenomenon in Arizona: the emigrant wagon train on its way to California. Roughly two dozen forty-niners described their journeys in diaries (as compared to hundreds who took the Great Plains route), and some of them were interested in the fauna and flora along the Gila Trail.

When gold fever swept the United States early in 1849, many newspapers, especially in Texas, made much of Cooke's wagon road as the best way to the new El Dorado. The Houston Democratic Telegraph and Texas Register, for instance, on January 25, 1849, described it as being "so well furnished with good pasturage and water that mules or horses could travel the whole distance without interruption, and the journey could be made in about two months with pack mules and in about three months with wagons."

Texans were on the way to California by January. From Brownsville, Corpus Christi, and San Antonio, the gold trails headed west into Mexico, taking in a chain of villages where food and other supplies could be bought. At Parral the emigrants could either turn toward the Gulf of California to board ships for San Francisco, or they could head northwest to Janos, Guadalupe Pass, and Cooke's route. There were other trails as well: one to Altar, then north to the Pima villages, another straight

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2. Vernon Bailey, Mammals of the Grand Canyon Region (Nat. His. Bull. no. 1, Grand Canyon Nat. His. Assoc., 1935), p. 35.

3. Donald F. Hoffmeister, Mammals of Grand Canyon (Urbana, 1971), p. 66.

west from New Mexico to Tucson by way of Apache Pass, and a third from Albuquerque to Zuni, continuing southwest across the Mogollon Plateau to the Gila River.

Fewer people took the Gila Trail than the Platte-Humboldt route across the Great Plains, perhaps due, in part, to the reputation of the Apaches. Yet the southern course had advantages. There were not as many mountains to cross, and although the weather was hot in summer there were no winter blizzards to contend with. In 1849 alone more than 9,000 Americans followed Cooke's route, and according to one record, about 60,000 emigrants crossed southern Arizona in the years 1849-1851 (see Fig. 5, p. 226).

Most emigrant parties were large; therefore there were few brushes with Indians. But families and small groups were often attacked. Herds of cattle, gathered in south Texas, were driven with some of the wagon trains, and despite the rigors of the journey surviving animals bought 100 dollars a head on the hoof in California.

Like Cooke before them, the first forty-niners to cross Guadalupe Pass found wild cattle still abundant. Owen Coy, an emigrant in one of these early parties, wrote that the beef provided by the wild bulls was as important to travelers on the southern route as buffalo were to the wagon trains crossing the Great Plains.[4] Forty-niners often stopped for several days in the San Bernardino Valley in order to replenish their larders with fresh meat. The bulls were as dangerous as Cooke's men found them, especially to hunters on foot, but they were far more conspicuous and easy to hunt than the numerous deer and pronghorn. Possibly for this

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4. Owen C. Coy, The Great Trek (Los Angeles, 1931), p. 243.

reason, few journals of the Gold-Rush emigrants refer to wildlife in the extreme southeastern corner of Arizona.

On May 19, 1849, an emigrant train passed through Guadalupe Pass and stayed overnight in the San Bernardino Valley. One of the travelers, John E. Durivage, an outstanding reporter for the New Orleans Daily Picayune, recalled an abundance of water but complained about the all-night bellowing of wild cattle near the camp. The next day the forty-niners moved on across open country covered with excellent grass, although there was no water until they reached the vicinity of Agua Prieta. On the way, according to Durivage, "guns were popping off in all directions" at the cattle.

Durivage and his party continued west to the village of Santa Cruz, where they began to follow the Santa Cruz River downstream. On May 27 the emigrants camped about eight miles north of Tumacacori Mission. "Just below this point," relates Durivage, "the river sinks into the sand and appears again only at intervals for many miles. Here the river is crossed for the last time for fifteen leagues, although the cottonwoods marking its course are frequently in sight. The grass for several days past has been coarse and innutritious."[5]

In contrast, another group passed down the river in August, presumably at the height of the summer rains. In the words of an emigrant, "The valley is covered with mesquite timber and is the finest grazing country (except California) I ever saw."[6]

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5. Ralph P. Bieber, "Southern Trails to California in 1849," The Southwest Historical Series, V (Glendale, 1937), p. 209.

6. Ibid.

Durivage nearly died of thirst and exhaustion crossing the desert between Tucson and the Pima villages. After recovering among the Indians, he started down the Gila River with his party of forty-niners in early June. He describes the river in the area of Gila Bend: "We found excellent grass along the river bottom--a species of coco grass and timothy. Whole acres of Mexican sunflowers covered the entire bottom. Quail and a species of dove were in the greatest abundance. The river at this point branches and flows with much less rapidity than above, over a broad, sandy bed--perfect quicksand."[7] Grass was spotty, being good in some areas, totally absent along other stretches of river.

Somewhere between the present sites of Yuma and Dateland, on the lower Gila, Durivage reported that "The whole bottom abounded in deer."[8] These were probably desert mule deer, since it seems unlikely that whitetails would have been found this far west.

Durivage made his final observation on the fauna of Arizona at the crossing of the Colorado River near its confluence with the Gila. "There is no game in the vicinity of the Colorado--at all events (none) at the present season."[9]

On the same day that Durivage crossed Guadalupe Pass, an emigrant train originating in Missouri also negotiated the defile. Their chronicler was a New Englander named A.B. Clarke, who had become separated by

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7. Bieber, "Southern Trails," p. 221.

8. Ibid., p. 223.

9. Ibid., p. 227.

illness from a Massachusetts company that had gone on ahead. Clarke was impressed by the lush appearance of the San Bernardino Valley, considering it "one of the prettiest valleys" he had ever seen, although on the higher tablelands to the west desert shrubbery took the place of grassland. Excellent pasturage for the train's livestock persisted all the way to the Sulphur Springs Valley. Clarke was another traveler to regard the wild cattle as more dangerous than buffalo, adding that many of them had escaped from herds driven north from Mexico by Apaches returning from raids. One member of the company was tossed in the air by a charging bull, but escaped with only slight injuries when another member of his hunting party quickly brought the animal down with one well-aimed shot.

On May 23, while the emigrants were crossing the treeless grassland of the Sulphur Springs Valley, Clarke was intrigued by a lone pronghorn standing on the plain with no others of his kind within sight. It was his only reference to pronghorn, in a region where other travelers were to report them abundant.

The next day Clarke's party entered the valley of the San Pedro River, which they followed for several days. Since the emigrants later passed through Santa Cruz, Sonora, on their way to Tucson and the Pima villages, the train must have headed south up the river at the point where the Mormon Battalion crossed on its northwesterly course in 1846.

Clarke found indications that the valley had been intensively farmed by Mexican settlers before the Apaches drove them out. The forty-niners replenished their water supply from abandoned irrigation ditches. In Clarke's mind, the fine expanse of grassland must once have supported large herds of cattle. As he concluded, "The Indians, now, have undisputed possession. It must be a miserable race that could deliver up such a valley, with its delightful climate."

There were places on the upper San Pedro that supported a good stand of riparian growth. Cottonwoods predominated in the gallery forest, indicating the direction of the river for a long distance, but there were also sycamores, willows, and mesquites.[10] This part of the valley varied in width from one to four miles, with "stunted oaks" growing in the foothills of the nearby mountains.

On May 27 Clarke made the following entry in his journal, after a day following the upper San Pedro:

> Three of the men attacked a grizzly bear last night on the other side of the river. They felled him three times, but their ammunition gave out. He was running towards one of the men, whose gun was yet loaded with buck shot, when coming very near, he let it blaze into his face, when they all ran, the men in one direction and the bear in another; this was the last that they saw of him. In the morning, they went out again, and tracked him by his blood some distance.[11]

Following the established route down the Santa Cruz River, Clarke and his companions reached Tucson, then braved the heat of the Sonoran Desert in early June to drive their wagons to the Pima villages. He made the following observation of the Pima and Maricopa communities along the Gila River: "Nearly the whole of the Gila is drawn off by zequias for irrigating the land, which is laid out in little squares, with sluices between, to admit the water from the zequias."[12]

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10. A.B. Clarke, Travels in Mexico and California (Boston, 1852) pp. 82-83.

11. Ibid.

12. Ibid., p. 92.

To save time, the company crossed a stretch of waterless desert at the base of the big bend of the Gila, arriving back on the river at noon on June 9. On the way, Clarke saw the weathered horns of a bighorn lying on the slope of a hill, probably in the Maricopa Mountains.[13]

The wagon train cleared the bend country two days later, heading downstream somewhere near the present boundary between Maricopa and Yuma Counties. Clarke made this observation of the river: "The river was at this place a quarter of a mile wide. The volume of water at times must be immense, as there is brush and other substances lodged in the mesquites from ten to twenty feet high, through the adjoining plain, over which we have been traveling."[14] He also noticed that the river on June 12 did not occupy more than a quarter of its bottom, the remainder consisting of a deep bed of sand, baked so hard and cracked so deep that it was difficult to estimate the depth of the fissures. The river banks were generally low along this stretch, the bottom being covered with alluvial soil from the periodic overflows. There were scattered heaps of driftwood and a dense growth of weeds, but no grass.[15]

In places, sunflowers from eight to 10 feet high grew in extensive clumps, giving the appearance of cultivated fields. Other flowers, of various colors, grew in profusion, and a narrow line of cottonwoods marked both sides of the river. Gambel's quail were everywhere, running in large flocks through the weeds or under the heaps of driftwood.[16]

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13. Clarke, p. 95.

14. Ibid., p. 96.

15. Ibid.

16. Ibid., p. 99.

The emigrants had a hard time clearing a way for their wagons through the dense riparian growth on the Colorado River a mile and a half below its junction with the Gila. This jungle consisted of willows and cottonwoods shading an almost impenetrable wall of "canes, vines, and weeds." Farther back from the river were extensive mesquite bosques. The river itself was about 350 yards wide, with a deep, strong current. Clarke commented on the contrast in the color of the water in the two rivers. The Gila was "clear and sea-green," while the Colorado was a deep yellow, from the "clay and mud" it carried.[17]

In late June an expedition of 52 men mounted on saddle horses, with all their supplies on pack mules, entered Guadalupe Pass. They had no wagons, so made good time. One of these "Texas Argonauts," who had just weathered a brisk skirmish with Apaches under Mangas Coloradas, was a literate Tennessean named Benjamin B. Harris. Near the summit of the pass, in a mixed woodland of evergreen oaks, junipers, and Chihuahua pines, Harris stopped to watch a flock of wild turkeys, including some young birds.[18]

Like most emigrants who had just come through Guadalupe Canyon, Harris' party camped near the ruins of Rancho San Bernardino, in an area of abundant water. He observed that the wild cattle remained out of sight in the hills during the day, coming down into the valley after dark for water and grazing. On the way to Agua Prieta, somewhere south of the Perilla Mountains, the emigrants saw a herd of feral cattle estimated at between five and fifteen thousand head.

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17. Clarke, p. 105.

18. Benjamin B. Harris, The Gila Trail, ed. Richard H. Dillon (Norman, 1960), p. 71.

A routine journey took the Harris party to Santa Cruz, on the Santa Cruz River, then down the river to the abandoned ruins of Tubac. Here, Harris wrote that thousands of turkeys came down to the Santa Cruz to drink. "Their fresh tracks were visible everywhere about the water," he said.[19]

When the column resumed its northward journey, Harris commented on the abundance of mesquite in the valley, observing that the horses and mules seemed very fond of the pods that grew on the trees at that time of year. He also marveled at the structure of a sahuaro cactus growing near Tubac. (Today, Tubac is in mesquite-grassland country. Ocotillo and small cacti are found nearby, but no sahuaros.)

The emigrants continued downriver, camping at one point half a mile north of Tucson. It was late in the dry season, but there was still water in pools in the bed of the Santa Cruz.[20]

After an uneventful crossing of the desert, the forty-niners followed the rich Gila bottom through a dense mesquite bosque to reach the Pima villages.[21] The next leg of the journey took them due west to the area of modern Gila Bend, where they picked up the river again. Harris' journal reads thus: "Two or three mornings after, while breakfasting in the Gila bottom, a herd of deer--the largest I ever saw, being as big as common burros--came to view forty yards away. One, struck with a ball, made for the <u>mesa</u>. With another party, I tracked him by his blood along

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19. Harris, p. 77.

20. <u>Ibid</u>., p. 79.

21. <u>Ibid</u>., p. 80.

the course of a dry arroyo about three miles."[22] The mule deer escaped, in part because Harris discovered some Indian pottery shards protruding from the earth, the archeologist in him taking precedence over the hunter.

Downstream, the Gila continued broad and shallow until it passed the northern end of the Gila Mountains. Here, the emigrants went swimming, since the water was waist-deep.[23] Harris took the time to notice that "millions of blue quail inhabited near the water."

Harris' company crossed the Colorado without difficulty, being towed on rafts by swimming Yuma Indians. The river in early summer was swollen with snow water, deep and cold, and about 500 yards wide.

Back up the Gila, near its headwaters in what is now Gila National Forest, another party of forty-niners was just getting under way in July on the trail taken by Stephen Watts Kearny and the Army of the West. Like many mountain men twenty years earlier in this region, these emigrants did not have much luck on hunting excursions. Diarist Robert B. Green, a Pennsylvanian, reported talking to one of the company on his return to camp: "Capt Dixon just shot a wolf & says 'Green I shot the wolf but by God I could not get the deer,' game is very scarce no ingins today but lots of mockasin tracks."[24]

Near the junction of the Gila and San Pedro Rivers, Green expressed his discontent thus: "There is no game worth mentioning along

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22. Harris, p. 84. The old mesquite bosques no longer exist along this stretch of the Gila. The sandy bed of the stream is indicated by a few cottonwoods.

23. Ibid., p. 85.

24. J. Orrin Oliphant, On the Arkansas Route to California in 1849 (Lewisburg, 1955), p. 59.

this river, no country, no people, no timber, no fresh water no grass, & no comfort."[25] On the lower Gila, beyond the big bend, things began to look up. "Saw 3 old fashioned deer today the 1st in a great while." Once again, if the point needs to be made, it is apparent that on the Gila River the larger game animals were spotty in their distribution and not a dependable source of food for large parties.

Another chronicler of the Gold Rush, George W.B. Evans, seemed particularly interested in landscapes. When the Defiance Gold Hunter's Expedition, of Defiance, Ohio, reached the middle Santa Cruz River in modern Santa Cruz County, Evans thought they were in the most beautiful valley he had ever seen. "All kinds of wood grows on the hillsides," he wrote, "and fine towering cottonwoods mark the course of this river."[26]

When Evans' party reached the Pima villages on August 22 he recorded his impressions of the adjacent stream: "The Gila River opposite our present camp is a deep, narrow, and rapid stream of warm, muddy water, the banks covered with a dense growth of wild willows and weeds, tall cottonwoods, and the low willow tree, known as the water willow."[27] It was late in the summer rainy season, and Evans may have been observing the Gila just below the point where the Salt River comes in from the east. He goes on to comment on the fact that grass was found on the high benches several miles to each side of the river, but none down in the bottoms

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25. Oliphant, p. 66.

26. G.W.B. Evans, Mexican Gold Trail, ed. Glenn S. Dumke (San Marino, 1945), pp. 149-150.

27. Ibid., p. 153.

themselves. Like Clarke, he saw large stands of a tall, sunflower-like composite.

Farther downstream, in what is now Yuma or western Maricopa County, Evans saw "indisputable evidence of the presence of the beaver, deer, and wolves (coyotes)."[28] He did not elaborate on this "evidence," but he must have been referring to dams and tracks.

At the Colorado River in early September Evans wrote a detailed account of the water flow:

> The river here is about two hundred yards, with a five-mile current, good sloping banks on this side but very bluff and about twelve feet high on the other (California). The waters from the melting of the snows above are now receding, but have for weeks past been very high. The rise of the water in this river and tributaries north commences about the middle of June, and about the last of July or first of August, the snows being melted, the water recedes and a stream of two miles in width is at this time within banks, and about the distance across above spoken of.[29]

In the middle of September a wagon train of emigrants calling themselves the Illinois Company reached the treeless grassland just east of the Guadalupe Range called today the Animas Valley. A party of hunters sent out to scour the plain had poor luck. H.M.T. Powell, one of the forty-niners, believed that Indians had chased away the game. However, a scouting party that probed the foothills of the nearby Animas Mountains

28. Evans, p. 158.

29. Ibid., p. 160.

reported "plenty of deer, herds of Antelope, and some bear tracks near the Sierra," in Powell's words.[30]

Despite the loss of several wagons during the ordeal of crossing Guadalupe Pass, Powell's keen eye catalogued the beauty of the land. In the bottom of Guadalupe Canyon, on the west side of the Guadalupe Mountains, Powell described the plant community: "Walnut, sycamore, cedar, blue ash, scrubby oak, small white mulberry and willow and a scrubby tree with red, smooth bark; the South Carolinans call it Red Skunk; I suppose it is a kind of laurel."[31] The last-named plant was obviously the manzanita, *Arctostaphylos sp*.

That night Powell relaxed in camp after sketching the scenery. He enjoyed a strip of fresh venison broiled over mesquite, and his journal entry for September 20 states: "Deer are plentiful here, but very small; venison plenty in camp."[32] The deer he reported were whitetails; he emphasized the small size characteristic of the Coues subspecies, *Odocoileus virginianus couesi*, which is common there today.

While crossing the San Bernardino Valley, Powell mentions an abundance of grass, but he also speaks of the widespread presence of

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30. H.M.T. Powell, *The Santa Fe Trail to California, 1849-1852*, ed. Douglas S. Watson (San Francisco, 1931), p. 122. The bears referred to were probably grizzlies, since the Animas Range ties in with the San Luis Mountains in Mexico, where the species was common. There are also grizzly records from the Guadalupe Range to the west, and from other mountains in southwestern New Mexico.

31. *Ibid*., p. 124.

32. *Ibid*.

mesquite, covering the plateau in places.[33] Farther west, at the south end of the Sulphur Springs Valley (near the site of Douglas), Powell entered this comment in his journal: "hunters killed 3 wild cows. On arriving at Camp, saw to the North what we supposed to be a herd of wild cattle. Men turned out quick to follow them, but they proved to be a herd of Antelope."[34] Again, on the Santa Cruz River, probably on the international boundary near the Buena Vista land grant: "On our road over the low hills we saw a herd of about 20 Antelope some 3000 yards from us; pretty creatures, they bounded away as fleet as the wind."[35]

The Illinois Company kept to the Santa Cruz Valley while working its way northward, and Powell reported that deer and pronghorn were "very plentiful" in an area of "bunchy swamp grass" near Quebabi Mission, about ten miles south of Tumacacori.[36] It was October when the company camped near the latter mission, on the Santa Cruz River. Powell remarked that sleep was difficult because of the constant howling of wolves. He could, of course, have been referring to coyotes, but the gray wolf was native to this area and might well have been what he was listening to.

Powell's group followed the trail left by earlier emigrants to the Pima villages and down the Gila. At a point about 30 miles from the

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33. Powell, pp. 126-127. This report is at odds with a widely held belief that mesquite was always restricted to washes and flood plains before the era of American cattle grazing. Mosaics of Chihuahuan desert were apparently present in 1849 and were not a more recent development following the period of settlement and ranching.

34. Ibid., p. 129.

35. Ibid., p. 138.

36. Ibid., p. 139.

Colorado he mentioned the fact that someone shot a bighorn in the hills across the river to the north (he probably means the Muggins Mountains, Yuma County). On the next day (it was now November) the hunter came into camp with his report, as jotted down by Powell:

> Dr. Snelling killed four sheep in the range of hills across the river, just north of us. Brought one in, a young one; tan color, black streak along his back and black tail. He says they are all of the same colour; the rams with very large, heavy horns reaching behind their shoulders. He thought the head, neck and horns of one he killed weighed as much as the rest of the carcass. He suffered so severely from thirst whilst among the hills that he drank 3 or 4 double handfulls of the blood of one of the sheep he killed.
>
> Dr. Snelling tells me the sheep before they lie down scratch away the loose stones to make it smooth. He says he saw a number of places thus cleaned off for their own comfort. He also says that when a rock falls from above they are much more alarmed than at the crack of a rifle; at the sight or sound of the former they bound madly away as if aware of the danger, but at the sound of the latter, they stop to look to see what it means. I have an idea that they will soon learn from the Emigrants that a rifle is as much to be dreaded as a rock.
>
> Jones tells me that some of his party killed wild sheep (or goats) as far back as the mountains between Tucson and the Pima villages.[37]

When the Illinois Company reached the Colorado River, Dr. Snelling informed Powell that beaver sign was abundant everywhere; slides, dams, and lodges. He also saw large numbers of waterfowl.[38]

A group of forty-niners who headed straight west in the fall of 1849 from Socorro, New Mexico, to contact Cooke's wagon route included another chronicler, Judge Benjamin Hayes. He makes frequent references to the great abundance of pronghorn on the plains of southwestern New

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37. Powell, pp. 169-171. The ranges referred to could have been any of the following: Sierra Estrella, Sacaton, and Picacho. Neither can the Tucson Mountains be ruled out.

38. *Ibid.*, p. 174.

Mexico, from the Mimbres Valley on west, as well as on the open grasslands on the western side of the Guadalupe Range. The latter region would include the San Bernardino and Sulphur Springs Valleys, and Hayes also refers to a "large gang of antelope" on the upper San Pedro River, right on the present Mexican border.[39] All along the international boundary, between the San Bernardino and San Pedro Valleys, wolves howled at night, and wild horses, wild cattle, and deer (species not differentiated) were abundant on the upper San Pedro.[40]

Judge Hayes makes the additional observation that wolves were frequently heard or seen along the entire wagon route between southwestern New Mexico and Tucson. They were particularly noticeable in the mesquite bosque near San Xavier Mission, as this statement brings out: "They are howling around us, and one of very large size, was seen an hour or two since."[41]

Near the end of the journey, on the lower Gila, close to its confluence with the Colorado, Judge Hayes mentions beaver slides and speaks of seeing the animals playing in the water at a point where the Gila River was about half a mile wide.[42] Charles Pancoast, another emigrant, referred to a considerable growth of flags and reeds above the

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39. Benjamin Hayes, Diary of Judge Benjamin Hayes, October 31, 1849 to January 14, 1850, Ms in Arizona Historical Society, Tucson, p. 24.

40. Ibid., p. 25.

41. Ibid., pp. 35-36.

42. Ibid., p. 58.

mouth of the Gila, and "much evidence of beaver."[43] On the same stretch of the river, Judge Hayes comments on an "immense number" of Gambel's Quail, saying that the mesquite bosque was swarming with them.[44]

Early in October a party of forty-niners came through Guadalupe Pass and followed the tracks left by other groups on Cooke's wagon trail. One of the emigrants, Lorenzo Aldrich, made an observation that symbolized nature's resurgence over the fleeting traces of Spanish civilization: he spotted a large grizzly bear prowling through the ruins of San Bernardino Hacienda.[45]

In the same month, 1849, an emigrant train crossing western New Mexico decided to try a new cutoff. Instead of heading southwest to Guadalupe Pass, it continued on past the Burro Mountains to Apache Pass in the Chiricahuas. Robert Eccleston, one of the company, recalled that a companion shot the first mule deer taken on the expedition at a range of 150 yards on the west side of the pass. Eccleston also admired the landscape; the nearby mountain slopes were "beautifully studded with scrub oaks." He was likewise impressed by the numerous stands of large junipers.

Eccleston's party proceeded to Tres Alamos crossing on the San Pedro River, passing Willcox Playa on the way. Somewhere in the Little Dragoon Mountains, near Nugent's Pass, one of the emigrants encountered

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43. Charles E. Pancoast, _A Quaker Forty-Niner_, ed. Anna P. Hannum (Philadelphia, 1930), p. 252.

44. Hayes, p. 60.

45. Lorenzo D. Aldrich, _A Journal of the Overland Route to California and the Gold Mines_ (Los Angeles, 1950), p. 47.

two grizzlies. He shot one, but the other bear charged, forcing him to flee on his horse. The hunter then rode to the San Pedro River for help, the company having stopped there to water the livestock. With two friends he returned to the mountains, but they were unable to find the site of the confrontation, and the trophy was not recovered.[46]

Maintaining their westward course, the forty-niners crossed Pantano Wash and a wide expanse of creosote-bush flats, approaching San Xavier Mission from the east. The company then threaded its way through a large mesquite bosque to reach an abundant flow of water in the Santa Cruz River. There was a good grass cover on the adjacent flood plain, and two pronghorn were shot near the mission.[47]

It was December when Eccleston descended the Gila to a point within 40 miles of the Colorado River. He has this to say about the fauna of the region:

> We were in the bottom all day and touched near the river at several points (roughly, between the Mohawk and Copper Mountains to the south). We have seen some deer tracks but not a single hoof since we have been on the river. Ducks, geese, brant, & crane are tolerably plenty, but keep close to the other shore generally, & therefor out of reach. The poor quail is our only victim, but even he is extremely shy. Mr. Adams saw a bear last Saturday, on a cottonwood tree a short distance from camp, & panther & wildcat track may be found occasionally.[48]

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46. Robert Eccleston, Overland to California on the Southwestern Trail, 1849, ed. G.P. Hammond and E.H. Howes (Berkeley, 1950), p. 192.

47. Ibid., p. 199. Mammal taxonomists might ponder the fact that these pronghorn might have been from one of two subspecies: the Sonoran pronghorn, *Antilocapra americana sonoriensis*, or the Mexican pronghorn, *A. a. mexicana*.

48. Ibid., p. 227.

Some time before news of the gold strike reached the east, the famous wildlife artist John James Audubon gave the following advice to his son John Woodhouse Audubon: "Push on, to the West, even to California: you will find new animals at every change in the formation of the country, and new birds from Central America will delight you."[49]

When family friends formed a "California Company" to head for the gold fields in early 1849, John W. Audubon joined the group as second in command. He was not interested in gold, but in natural history and adventure. On February 8 the company of 80 men sailed on the steamship Transport from New York, with ports of call at Philadelphia, Brazo Santiago, Texas, and Brownsville. From Brownsville, the emigrants boarded a steamer for a trip up the Rio Grande. They disembarked at Rio Grande City, Texas, and while preparing for the trek across northern Mexico were shattered by a cholera epidemic. Eight men died on the river, with more deaths to follow as the demoralized company decided to continue the journey.

At Parras Audubon and some 40 die-hards elected not to take the popular route to Janos and the Gila Trail, but struck due west across the Sierra Madre to Ures and the Sonoran Desert. Enduring the intense heat of late spring, the survivors of the California Company moved on to Altar, then northwards across what is now the Papago Indian Reservation.

Audubon was disappointed at the paucity of visible wildlife. He reported that the horns and antlers of bighorn and mule deer had been

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49. John W. Audubon, "Illustrated Notes of an Expedition Through Mexico and California, 1849-50," Magazine of History, XI, Extra Number 41 (1936), p. 7.

seen, but no live animals. The Papagos "live on turtles," wrote Audubon, "and what game they can get, I have seen some elk and antelope skins dressed and terrapin shells are everywhere."[50] Near the site of modern Sells, Audubon again reported finding the horns of bighorn and was told by Papagos that the species was common in the surrounding mountains.[51]

Audubon and his party probably followed the Santa Rosa Valley north to the Gila River, which they reached in an exhausted state. Nevertheless, Audubon had time for zoological pursuits. In the area of modern Gila Bend he shot five Gambel's quail in ten minutes and noticed that they were feeding on pigweed, which was very abundant. Members of the company saw numerous flocks, each with hundreds of birds, while following the trail along the lower Gila.[52] Audubon also succeeded in shooting two blue-winged teal, but at this time of year waterfowl was scarce on the river.[53]

A year later, in October, a party of settlers following in the backwash of the forty-niners, camped on the Santa Cruz River just south

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50. John W. Audubon, Audubon's Western Journal: 1849-1850, ed. Frank H. Hodder (Cleveland, 1906), p. 148. The "turtles" and "terrapins" are the desert tortoise, *Gopherus agassizi*. The elk skins might have been obtained by trade with Indians east of the desert, but it is just as likely that Papago hunters killed Merriam elk in the forested ranges that lie to the east. For instance, the species was recorded from the Santa Catalinas, which are on the edge of the Sonoran Desert. See: William T. Hornaday, Our Vanishing Wildlife (New York, 1913), p. 35.

51. Audubon, p. 149. Farther west, at the Cabeza Prieta tanks, there is a large pile of ancient, weathered bighorn horns. Some of these were several hundred years old and had been piled up by Indians, possibly Sand Papagos. They threw the horns into a pile as a good luck omen. See: Arizona Daily Star, May 18, 1964, "Stark Game Refuge Landscape Reveals Relics of Indian Era."

52. Audubon, p. 159.

53. *Ibid.*, p. 160.

of Tubac. William Miles, an emigrant, reports: "Saw twenty black-tailed deer, a herd of wild horses and a flock of wild turkeys; killed none."[54] The party continued on through the deserted town of Tubac and followed an Indian trail nine miles to the west, away from the river. After finding water they kept moving until dusk, when they came on a camp of Pima Indians. The Indians sold them some bighorn meat, described by Miles as "very palatable and delicious."[55]

The company maintained a northwesterly direction, toward the route taken by Audubon in 1849. Bypassing Tucson they reached a Papago Indian village which Miles called "Santa Rose." The site may have been near the Santa Rosa Mountains in the valley of the same name, but this cannot be ascertained. Miles' succinct reference to wildlife reads thus: "Here we had fine sport after mountain goats on the prairie, but killed none."[56] Conceivably, the hunters caught a flock of bighorn crossing the desert on their way from one mountain range to another, but on a level stretch horses should have been able to close the distance, enabling the hunters to get in some good shots. It is also possible that inexperienced easterners would mistake pronghorn for a type of "goat," considering the backward curve of the horns. Pronghorn, unlike bighorn, could easily outdistance horses, providing "fine sport," though unsuccessful. It can only be conjectural; both species were found in this general region.

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54. William Miles, Journal of the Sufferings and Hardships of Capt. Parker H. French's Overland Expedition to California (Austin, 1965), p. 22.

55. Ibid.

56. Ibid.

CHAPTER V

THE SETTLERS, 1849-1864

The movement of the emigrant trains across Arizona in 1849 made little impact on the land other than leaving wagon wheel ruts, and for nearly a decade the scattered bands of Indians retained control of their wilderness. A trickle of settlers began to come in during the late 1850's but for some time outlaws, both Mexican and American, combined with hostile Indians to bring ranching and farming efforts to a virtual halt, particularly in the southeastern part of Arizona. Even by the end of the Civil War white settlement was largely confined to a few isolated enclaves near areas of dependable water: Tucson, Tubac, Prescott, and Yuma.

It was against this background that several settlers and travelers wrote about the land and its wildlife as they saw it in the 1850's. One of these was Sylvester Mowry, a territorial delegate and successful miner, who published his impressions and those of contemporaries in 1864 under the title _Arizona and Sonora_. The book mentions the fact that in 1851 the San Simon Valley (Cochise and Graham Counties) was treeless and marshy, a basin where water collected from the surrounding slopes.[1] The Sulphur Springs Valley lacked woody growth, as did much of the middle course of the San Pedro River.[2]

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1. Sylvester Mowry, _Arizona and Sonora_ (New York, 1864), p. 183.
2. _Ibid._, p. 184.

A delightful eccentric of the period, John C. Reid, left Alabama in 1857, driving a wagon alone across Texas, New Mexico, and Arizona on his way to California. He, like many other travelers, noticed that the water in the San Pedro and Santa Cruz Rivers tended to disappear seasonally from the surface for distances of ten to 20 miles.[3] At the Pima villages, he found the Gila a bold, clear little river of uniform volume, fordable in most places, that likewise tended to vanish underground during dry periods.[4]

Another settler, a Virginian named James H. Tevis, described the San Pedro Valley in 1858 while on patrol with Captain Richard S. Ewell, commander of Fort Buchanan (near present Patagonia). "In those days the grass grew very tall in the San Pedro Valley;" he wrote, "in fact, so tall that one could see only the heads of antelopes that roamed over the valley in large herds."[5] Of the river itself he had this to say:

> The San pedro river as they Call it--is a stream one foot deep six feet wide and runs a mile and half an hour and in ten minutes good fishing we Could Catch as many fish as we Could use and about every five miles is a beaver dam this is a great country for them--and we have went to the river and watterd and it was running fine and a half mile below the bed of the river would be as dry as the road--it sinks and rises again.[6]

An official government report, dwelling on the problems of constructing a wagon road across the San Pedro in the late 1850's, describes the river as having a width of 12 feet and a depth of 12 inches. The

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3. John C. Reid, Reid's Tramp (Selma, 1858), p. 186.

4. Ibid., p. 222.

5. James H. Tevis, Arizona in the '50s (Albuquerque, 1954), p. 81.

6. Ibid., p. 55.

current flowed in places between clay banks ten or 12 feet high. But on some stretches "it widens out, and from beaver dams and other obstructions overflows a large extent of bottomland, forming marshes, densely timbered with cottonwood and ash, thus forcing the road over and around the sides of the impinging spurs."[7]

The San Pedro Valley was still a stronghold for wildlife in 1859. In that year a group of settlers followed the San Pedro River north down its valley toward the Gila River. Deer were abundant, and grizzly bears were seen near the San Pedro in an area of good grass and large cottonwoods.[8] During the 1850's, close to the junction of the two rivers, Mowry reported a particularly impressive woodland dominated by ash trees.[9]

After the start of the Civil War, when the Apaches had become implacable enemies of the whites, another evaluation of the San Pedro was made by Captain James M. Box, a soldier of fortune. He commented on the fine soil in the valley and the extensive stands of cottonwood and mesquite. But there were pitfalls to settlement: "As this is on the great trail of the Apaches, who are always on excursions of robbery and murder, to Sonora, very little security could be had by small isolated parties of settlers. The San Pedro is a good mineral country, if not one of the best, and furnishes deer, turkey, and other wild fowl, for game.[10]

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7. U.S. Congress, House Executive Document 108, 35th Congress, 2d Session, House. (Washington, 1859), p. 87.

8. The Weekly Arizonian, June 9, 1859.

9. Mowry, p. 24.

10. James M. Box, Capt. James Box's Adventures and Explorations in New and Old Mexico (New York, 1869), p. 41.

To travelers of the period, the Colorado River, at the beginning of its steamboat era, was both a highway and an obstacle. Francois Aubry, a noted French-Canadian freighter, negotiated it several times on trips between California and Santa Fe (in 1852 he drove thousands of sheep across Arizona to California). On July 22, 1853, Aubry crossed the Colorado just below the site of Hoover Dam. He observed that the river was over 300 yards wide and 25 feet deep. "It is here a grand and magnificent stream," he wrote, "swift like the Mississippi, and apparently as well adapted to navigation." Aubry saw no waterfowl, it being midsummer, but there were a few mule deer and pronghorn near the banks.[11] On rafts the Aubry party made the crossing, but they landed five miles below the launching point. The journal continues: "The driftwood of which we constructed our little raft appeared to have been cut by beavers. These animals must be exceedingly abundant, as they destroyed during the first night the ropes with which our raft was bound together, and carried off the timber."[12]

At some point in the 1850's, a group of beaver trappers (men who refused to recognize the decade-old demise of the Taos fur trade) worked their way down the Colorado to Mohave Indian country. Like the members of the Whipple expedition, their chronicler, one J.S. Campion, pointed out the fact that the region was "almost destitute of game," and that the Indians had to live on maize, beans, fish, pumpkins and other vegetables.[13]

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11. Ralph P. Bieber, "Exploring Southwestern Trails," Southwest Historical Series (Glendale, 1938), pp. 359-360.

12. Ibid.

13. J.S. Campion, On the Frontier (London, 1878), p. 265.

In 1854, following the Gadsden Purchase, the Texas Western Railroad Company, chartered by the state of Texas, commissioned Andrew B. Gray to survey for a railroad route along the 32nd parallel. Gray, who was appointed the first Boundary Commission surveyor in 1849, had been removed from office after a dispute with Bartlett over the terms of the Bartlett-Conde Agreement. Now he was in charge of the first private surveying expedition in Arizona. En route, he met Lt. John G. Parke, surveying the same course for the government. As a result of the two expeditions, the first accurate maps of southern Arizona were created, and much of its geography became known.

After entering Arizona from the east, Gray, whose party consisted mostly of former Texas Rangers, turned north into the San Simon Valley. The expedition members were delighted with the numerous springs of good water, and Gray located the place where San Simon Creek rose in a willow swamp (cienega). In his journal, the stream "ramifies in numerous veins for some miles, until it forms into a regular channel, and although not generally a living stream, has plenty of water for all purposes necessary to make it valuable for grazing."[14] Gray added that the whole valley was covered with grass, "in many places the rich grama, and in others a coarser or less nutritious kind."[15]

Gray passed the Chiricahuas, probably through Apache Pass, and crossed the Sulphur Springs Valley, reaching the San Pedro River somewhere on its middle stretch. As he describes it, the San Pedro was a

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14. Andrew B. Gray, _The A.B. Gray Report_, ed. L.R. Bailey (Los Angeles, 1963), p. 61.

15. _Ibid._, p. 63.

"small stream at this stage, about eight feet wide and shallow; between steep banks 10 feet high and 25 to 50 feet apart. At three points where I have crossed it, it is a living stream, with large fish. At its mouth, where it joins the Gila, it spreads into passes, forming a sort of diminutive delta....Abundant springs and large districts of grama were frequently met with from half a mile to a mile off."[16]

In July, 1854, Charles D. Poston and a small party came up the west coast of Mexico, then down the Gila from Gila Bend to Fort Yuma. As Poston viewed the trip, "The journey down the Gila was monotonous--we killed some buck deer--made seines out of our blankets, and caught some fish, and fed mostly on mesquite beans."[17] James Tevis saw another aspect of the Gila in 1857. In the fall of that year he joined Mose Carson, Kit Carson's brother, on a trapping expedition to the Gila and San Francisco Rivers. Beaver and otter were abundant on both streams.[18]

One night, while Tevis and Carson were camped on the Gila close to the mouth of the San Pedro River, they heard a tree fall, cut down by beavers. Tevis reported that the beavers were building a dam across the Gila a little bit downstream and that the water was backing up and flooding their campsite. When their blankets got wet the two men packed up and went to watch the beavers at work. A large cottonwood was being

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16. Gray, p. 77.

17. Wallace W. Elliott (comp.), History of Arizona Territory (San Francisco, 1884), p. 208.

18. Tevis, p. 25.

cut up for construction material, and mud was also transported to the campsite.[19]

James G. Hamilton, an emigrant on his way to California, stopped to camp near San Xavier Mission on the evening of October 14, 1857. He describes the valley of the Santa Cruz River: "We reached this place night before last some time after dark, and yesterday morning moved camp a mile down the creek, and have now a beautiful camping place in a valley surrounded by mountains and timber and beautiful, level prairie in the center with fine grass knee high and plenty of water and wood."[20] This area is now close to the southwestern edge of Tucson.

A year later, in July, 1858, a party of settlers bound for California set out over Beale's wagon route across the 35th parallel. One of the pioneers, John Udell, left a record of the two attempts necessary before the expedition crossed northern Arizona. On the first journey the settlers saw mule deer in the bottoms of the Little Colorado, shooting one near the site of Leupp. Udell speaks repeatedly of the spectacular cover of grass along the Little Colorado and on the adjacent plateaus.[21]

As the train approached the eastern foothills of San Francisco Mountain, Udell continued to express delight over the blanket of grass, now covering highland valleys with an open forest of ponderosa pines. An added note mentions the fauna: "There is an abundance of wild game, such

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19. Tevis, p. 45.

20. James G. Hamilton, _My Dear Cornelia, Letters by James G. Hamilton During an Overland Trip, 1857-1858_ (Fresno, 1951), p. 6.

21. John Udell, "Journal of John Udell," _Western Historical Series_ (New Haven, 1952), pp. 17-19.

as deer, antelope, bear, turkeys, etc."[22] The party camped at Leroux Springs, and the men took their rifles into the surrounding country. Udell's entry for July 27, 1858, reads thus: "In the evening the hunters came in with deer, antelope and turkeys enough for the whole company, and the mountain-climbers came in with snow enough for all to taste."[23]

The mood of the party became less bucolic as it moved west into the territory of the Mohave Indians. Tantalizingly close to the Colorado River, Udell and his companions reluctantly turned back in the face of incessant ambushes by the Mohaves.

When the pioneers started out again in April, 1859, they accompanied a road-building crew under Lt. Edward Fitzgerald Beale. Near the Little Colorado Udell's notes state that Beale employed two Indians to hunt. Apparently they were so successful that the entire contingent was kept supplied with fresh meat, including many beaver. Unlike James Hamilton, who found beaver meat repugnant when it was served to him on the Gila by Pima Indians,[24] Udell considered the beavers of the Little Colorado a delicacy.[25] In fact, beaver were caught and eaten all the way down the river to Diablo Canyon, where the expedition turned west toward the mountains.

Pronghorn became a staple for the Udell party in the vicinity of San Francisco Mountain. "Fresh antelope meat today" was a news item

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22. Udell, p. 20.

23. Ibid.

24. Hamilton, p. 8.

25. Udell, p. 39.

that the travelers did not tire of when the cooking fires were lit in camp each evening.[26]

In southern Arizona The Weekly Arizonian for May 12, 1859, reported that pronghorn were abundant near Fort Buchanan,[27] but changes were taking place in the open, grassy valley to the east. One traveler in the same year reported that most of the region now comprising Sonoita and the southern part of the Empire Ranch was largely covered with golden fields of grain. A single field contained 150 acres of corn.[28] During this brief period of agricultural prosperity, before the outbreak of the Civil War, a substantial part of the pronghorn habitat between the Santa Ritas and the Mustang Mountains may have been eliminated.

Before the Civil War, pioneers crossing southern Arizona regarded the meat of the bighorn as a delicacy, but few of the species were seen because of the relatively inaccessible habitat, and even fewer were shot. Bighorn were probably found at one time in every mountain range in Arizona that had good visibility and rocky outcrops. In addition to being found in the Sonoran Desert ranges, they extended southward into the Sierra Madre of Chihuahua and Sonora on high peaks and in rocky canyons.[29]

An area of potentially good bighorn habitat that has not had a population of the animals for a long time is the rimrock region near

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26. Udell, p. 40.

27. The Weekly Arizonian, v. 1, no. 11, Tubac, May 12, 1859.

28. Granger, p. 325. Between 1861-1876 the valley was uninhabited by white men because of Apache troubles.

29. Donald R. Brand, "The Natural Landscape of Northeastern Chihuahua," The Univ. of N.M. Bull. (Albuquerque, Nov., 1937), p. 53.

Montezuma Pass in the Huachuca Mountains.[30] A short distance to the east, Samuel Cozzens was on his way in 1859 from Tucson to New Mexico with a group of travelers. He commented on the sighting of several bighorns watching the party from rocky outcrops in the Peloncillo Mountains, across the San Simon Valley from Apache Pass.[31]

Even near the few settled areas an abundance of wildlife withstood heavy hunting pressure before the Apache wars kept American settlers largely confined to the fortified outposts of Tucson and Tubac. In 1854 the pioneer prospector Charles D. Poston arrived in Tubac after an overland trip from Sinaloa, where he had been shipwrecked with a party of 25 men. (In San Francisco he had been persuaded by a French syndicate to lead an expedition to Arizona in search of silver.) There was still a Mexican garrison at Tucson, and Tubac had not yet become a ghost town.

Poston appears to have been something of a gourmet, as his account of life in Tubac attests:

> Wild game in abundance could be procured in the immediate vicinity, and by Christmas we had such a store of bear meat, deer, antelope, and fat wild turkeys, that no apprehension of short rations disturbed our enjoyment. We even essayed to give an entertainment to our neighbors from Sopori, Tucson, and Magdalena, places distant from twelve to eighty miles, these being the nearest settlements....The festivities were continued during Christmas week; and, in order to relieve our guests of any anxiety about the

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30. D.F. Hoffmeister and W.W. Goodpaster, "The Mammals of the Huachuca Mountains, Southeastern Arizona," Illinois Biol. Monographs 24 (Urbana, 1954), p. 138.

31. Samuel W. Cozzens, The Marvellous Country (London, 1873), p. 231. In 1868 an explorer named Stephen Powers climbed outcrops in the Stein's Peak area on the Arizona-New Mexico border, close to the Peloncillos. He found bighorn sign, including fresh bedding areas, but saw no live animals. He reported that they were already becoming rare in the region. (Stephen Powers, Afoot and Alone; A Walk from Sea to Sea, Hartford, 1872, p. 189.)

abundant resources of the larder, a dozen fat turkeys were dressed and hung up on the joist over the table in the spacious dining-hall.[32]

In 1857, after he had returned to renovate Tubac following its abandonment by the Mexican community, Poston continued this gustatory tradition. Again, at Christmas, people were invited from as far as a hundred miles away or more. Quail and waterfowl also garnished the table, and, in Poston's words, "We obtained through Guaymas a reasonable supply of French wines."

Poston's return to Tubac marked the beginning of a new era for the old Spanish presidio. In the three years since his first visit he had helped organize the Sonora Exploring and Mining Company in Cincinnati, Ohio, capitalized at one million dollars. Poston, as general manager, was in charge of recruiting employees and establishing mines in Arizona. Most of the men came from Texas, a crew which, in his words, was "armed with Sharp's rifles, Colt's revolvers, and the recklessness of youth."

At Tubac, in 1857, Poston found that the buildings were still habitable, although the doors and windows had been removed. The recruits were sent into the Santa Ritas for the lumber necessary to restore the buildings, and Poston soon had the town in functioning order again. Several silver mines were developed in the surrounding mountains. Poston's company prospered. In this climate, the first newspaper in Arizona, the Weekly Arizonian, opened in Tubac.

Since the local fauna contributed substantially to the town's provisions, it is not surprising that the Arizonian printed a number of

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32. J. Ross Browne, Adventures in the Apache Country (New York, 1869), p. 254.

columns on the natural history of the Santa Cruz Valley and even farther afield. An entry for March 10, 1859, reads thus: "Quail begin to be very abundant in the wooded valleys and dry beds of streams, and in the Santa Cruz Valley there are plenty of turkeys; it is about time also for grizzly bears and rattlesnakes."[33]

On April 7, the newspaper quotes an unnamed army officer who had just arrived from Fort Yuma. Speaking of the Gila River near its junction with the Colorado, he says: "The river bottoms are wide, rich, and thickly overgrown with willows and a tall aromatic weed, and alive with flights of white brant (wings tipped with black), geese, and ducks, with many signs of beaver and deer."[34]

Two entries for June 2, 1859, are particularly dramatic:

> All the past week great fires have been raging along the western slope of the Santa Rita mountains, extending sometimes to the tallest peaks. At night the scene was grand--a vast illumination of the mighty hills--the fire in circles, in long lines, in scattered patches, and glowing in the distant horizon like the watch-fires of a great army--The entire western slope of the mountains has been burned over, and the fires are now working over and around to the eastern side, making at night a strange and beautiful spectacle.[35]

Events related to the fires now follow:

> Several grizzly bear have been killed by persons working in the timber regions of the Santa Rita mountains, and the fires that are now raging in the canons will have the effect of driving

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33. The Weekly Arizonian, v. 1, no. 2, Tubac, March 10, 1859.

34. Ibid., v. 1, no. 6, April 7, 1859

35. Ibid., v. 1, no. 14, June 2, 1859.

> Mr. Grizzly into the more accessible regions. We should say that it is a good time for a bear hunt in those canons and localities in the mountains where the fires have not burned.[36]

A week later two Mexicans who were hunting lost horses in the Santa Ritas surprised a large bear in a narrow canyon containing a stream. The animal, described in the _Arizonian_ as a "cinnamon" bear, but in all probability a grizzly, charged one of the men, who was on foot, knocking him down and mauling him. His companion, who was mounted, lassoed the bear. After a brief struggle, the bear broke the rope, nearly throwing the horse in the process, and escaped.[37]

On June 23, another Mexican spotted three grizzlies on the banks of the Santa Cruz River near Tubac, giving them a wide berth before returning to the trail to the Santa Ritas.[38]

Early in the summer of 1858, a young prospector named Phocian R. Way reached the San Simon Valley from New Mexico, bound for a silver mining camp at the south end of the Santa Rita Mountains. He reported that San Simon Creek had gone underground where his party crossed the valley. There were pronghorn in sight, but Way could not get close enough for a shot.[39] After crossing the Sulphur Springs Valley, one of the contingent shot at a pronghorn somewhere east of Dragoon Springs (two miles southeast of the Dragoon Post Office) but missed. Way

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36. _The Weekly Arizonian_, v. 1, no. 14, Tubac, June 2, 1859.

37. _Ibid._, no. 15, June 9, 1859.

38. _Ibid._, June 23, 1859.

39. Phocian R. Way, "Overland via Jackass Mail in 1858: The Diary of Phocian R. Way," ed. William A. Duffen, _Arizona and the West_, v. 2 (1960), p. 156.

deplored this failure, for the pioneers had been out of fresh meat for two days.[40]

On the same day (June 10) Way's party picked up the fresh trail of a large grizzly bear in Texas Canyon. They followed it well into the Dragoon Mountains, but eventually lost their nerve and withdrew without ever catching sight of their quarry.[41] Continuing on the journey, Way's party stopped for breakfast on June 11 at Pantano Wash, close to the site of Pantano. Way described the water in the wash as being "clear and beautiful," though somewhat alkaline. The valley delighted him with its cool water and green foliage and he called it "a paradise to the weary traveler over the hot and parched up plain."[42]

By June 20 the emigrants had become settled at the Santa Rita Camp, in the Santa Rita Mountains 22 miles west of Fort Buchanan. That night a mule was frightened by some prowling animal, prompting the following observation by Way:

> I suppose it was a bear as the mountains here are full of them. They are a large brown species and the hunters say they are as fierce as the grizzly (They were, in fact, grizzlies). They will generally attack a man whenever they meet him without waiting to be provoked. I felt more afraid of them than I did of the Indians. They might have been attracted to the camp by the smell of provisions. They are very hard to kill, and a dangerous enemy.[43]

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40. Way, p. 156.

41. *Ibid.*, p. 157.

42. *Ibid.*, p. 158.

43. *Ibid.*, p. 283.

A few days later Way went to Tubac to buy a pack mule and supplies. He got back to the Santa Rita Camp in the evening and discovered that one of his companions had shot a jaguar.[44] A number of miners had also set out in pursuit of a black bear that had ventured near the camp. Way wrote that both species of bear were common in the Santa Ritas, but that the black bear "here as everywhere is cowardly and will run from the hunter, and will not fight unless he is badly wounded or cornered and cannot help it."[45]

On June 26, 1858, Way and two of his friends set out on a hunting trip into the Santa Ritas, where white-tailed deer, the main object of the excursion, were abundant. Way's straightforward writing style preserves a vignette of hunter life in an Arizona that was still essentially unsettled.

> This afternoon Mr. Fuller, Mr. Randall, and myself will start on a bear and deer hunting expedition. We will take a pack mule with us in charge of our Mexicans, to carry our blankets, game, etc. We will sleep in the mountains tonight and return sometime tomorrow. I will have something to say about our trip when we return. We go on this hunt not so much as for sport as to provide ourselves with fresh meat. We have been out of fresh meat for several days and we cannot purchase any without losing so much time and going a long distance, and then we would probably have to pay an exorbitant price. We had better kill our own meat if we can.
>
> (June 27): Returned from our hunt about noon today....When we started we directed our course for the highest peak of the Santa Rita mountains....I was expected to bring up the rear, and, of course, had but little chance to shoot game even if it had been plentiful, but yesterday it was unusually scarce.

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44. Way, p. 287. The animal, called a "tiger" by the hunter who shot it, was known to the Mexicans as _el tigre_. They, in turn, distinguished it from _el leon_, the mountain lion. American frontiersmen called the mountain lion by a number of names, including--in Arizona--"California lion" and "panther," but never by the term "tiger."

45. _Ibid._, p. 287.

> We saw several deer in the distance but could not get within shooting distance, but about dusk Mr. Fuller succeeded in shooting a large fat buck. About dusk we encamped on the border of a deep canon which leads down from the main mountain, it is from 600 to 1000 feet and in some places the sides are almost perpendicular. It was some time before we found a place where we could reach the bottom with safety. When we did so we found a cool, clear stream of running water. There are only a few places where the sun ever reaches the bottom of this grand ravine, and the water in consequence is very cold (probably Temperal Canyon). It was delightful to us after our fatigue. It is said that there are many such canons and hidden streams in these mountains, but the water generally dries up or sinks before it reaches the plains below. We had coffee, bread, and salt with us, and we soon had a portion of our deer meat roasted at the fire. The hunters always cook their meat in the same way. They cut it in small slices, sprinkle salt upon it, string it on a long sharp stick, and hold it over the coals until it is sufficiently done. And it is really delicious cooked in this manner, at least I thought so, and I ate more meat at one meal than I would have eaten at home in two or three days.
>
> It was a beautiful moonlight night and after we had finished our repast we spread our blankets on the ground and slept soundly on the mountains surrounded by bears, wolves, and perhaps by Apache Indians....In the morning at daylight we each took a different direction to hunt an hour or two before breakfast. We all returned at the same time without having seen any game. We saw fresh bear and deer tracks in abundance, but the game was not to be seen. We saw several deer on our way home but did not succeed in killing another. At some future time when I have more leisure, I intend to take a hunt of several days in these mountains.[46]

Within two days after returning, Fuller shot two deer on his way to Tubac, bringing one of them back to camp with him. Way was satisfied that the prospectors now had plenty of venison.

On the night of July 3 the dry grass near Santa Rita Camp caught fire, and in a short time the whole valley was ablaze. Since the grasses were tall and thick, Way had been afraid of this exigency for some time. Apparently, a stray coal from the camp fire caused the conflagration, and everything "flashed up like powder." All attempts to stem the fire

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46. Way, pp. 288-289.

failed, and the wind carried the flames up one side of the valley, leaving the hillsides "black and desolate" in the morning. However, Way was confident that the impending summer rains would soon cover the landscape with green grass.

Grizzlies, rattlesnakes, and poisonous invertebrates were not the only dangers in the Santa Ritas of 1858. Way expressed a particular horror for a phenomenon which the local Mexicans told him prevailed in July and August--the danger of "mad wolves." In Way's words:

> I have always associated everything that is horrible with the disease Hydrophobia and I would run faster from a Mad Dog than I would from a legion of Devils. The wolves are numerous here and in the two above named months they sometimes go mad and in this condition they will enter a camp or town or even a house if the door is left open and bite everything in their course. At this season the Mexicans generally (those that have no doors) sleep on top of their houses out of reach of this danger. This horrible disease is much more common here among the wolves than it is among our dogs in the States. They are a terror to the whole country. One of our men told me of six persons who were bitten in this thinly settled neighborhood last year. One of them was badly mangled by the rabid animal, and in one instance the wolf entered a house and bit two persons. But what appears very singular to me, only one of these persons died. I have always been accustomed to look upon this disease as incurable, but here they have a stone which attracts the poison and when it is applied in time it never fails to cure. This fact is so well established that I cannot reasonably doubt it, and it should be known far and wide that others may profit by it.[47]

When not working a silver mine, Phocian Way indulged what may have been his favorite preoccupation--hunting. His flair for the dramatic comes out in another written anecdote:

> July 8, 1858: Yesterday Mr. Fuller and myself went out with our guns for a short hunt near the mining camp (at the south end of the Santa Rita Mountains). When about a mile from our

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47. Way, p. 291.

> Ranche we saw a large cinnamon (most likely a grizzly bear) walking leisurely along, stopping occasionally to take a bite at the wild cactus. He was distant about 600 yards and had not seen us. We crept softly up toward him in the cover of a canyon until we were within a hundred yards of the spot when we had last seen him. When we clambered up the steep bank under a low scrubby tree, there was the monster in open view. He had evidently got wind of us, for he was snuffing the air and tossing up his head. They are very keen scented and when the wind is in their favour they can scent a man a long distance. We had no time to lose for the bear had already turned to run. We knew our only safety was to keep ourselves hid from his view, for if we wounded him he would be upon us in a moment if he should happen to see where the shot came from. It is true we might climb the (s)crubby tree (which was the only one near); but we could not see that we would get entirely out of his reach, and we would likely have hard fighting to do before we gained the victory.
>
> It was a critical moment and I felt we were standing on dangerous ground. Fuller, being the best shot, levelled his gun and fired. He struck the bear for he gave an awful grunt, reared on his hind legs, and looked around in every direction for his enemies. We were concealed by the rocks and lay still as mice. He did not see us. Becoming frightened at the stillness around him, (he) started to move off. I took courage at this and fired my sharp shooter at him, but this only made him run the faster. He soon disappeared over the mountain. We tracked him by his blood about a mile and then gave up the chase. If we had come upon him suddenly it might have cost us our lives, so we followed him with great caution. If we had captured him we would have taken nothing but his hide, for the bears are all poor at this season and not fit to eat. Bear hunting is a dangerous sport and very few here will engage in it. I have heard old frontier men say that they would rather fight 6 Indians than one Grizzly or Cinnamon bear. The Indians and Mexicans will not kill nor eat them. They have an old superstition which causes them to respect and even venerate this shaggy brute....and to this day they believe a bear will not harm a Mexican or Indian. If they meet one they talk to him and he turns and walks away. I have not heard of one being attacked by a bear.[48]

Way seldom had to go far from camp to find an opportunity for a shot. For instance, on two days in July, he saw deer and pronghorn in the Santa Rita foothills, but did not bring home any game. He was having

48. Way, pp. 356-357.

trouble with his Sharp's rifle, which was designed to overshoot, requiring the hunter to make allowance for a foot every hundred yards. Pronghorn were particularly frustrating to him. Thus: "They are a provoking animal to hunt. They will run off until they get out of gunshot, when they will stop and look at you. If you approach too near they will run off again and in this way they will keep you following them a long distance in hopes of getting a shot."[49]

Toward the end of the month Way began to improve with his Sharp's rifle. He shot two deer at 130 and 150 yards respectively and was pleased that he had supplied the mining camp with meat for several days, although he had to travel 16 miles to get one deer home. "Our large family will consume two deer in a week," he reported. The occasion inspired another anecdote: "I neglected to state that it is customary in this country to set up with a man the night after he has killed his first deer, and make him treat the party present to a gallon of whiskey. I was fortunate enough to escape this ordeal as most of our company were in Tubac and there was no whiskey to be had without traveling 20 miles for it."

On August 5 Way accompanied Charles D. Poston on a hunting trip into the southern upthrust of the Santa Ritas. Somewhere near the upper limits of the mesquite-grassland biome, perhaps within the oak woodland, they shot a large pronghorn. The two men had to carry it a mile on their shoulders to get it back to camp.[50]

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49. Way, p. 359.

50. Ibid., p. 360. In northern Arizona pronghorn often penetrated deep into the ponderosa pine forest. It is not inconceivable that in a southern range like the Santa Ritas they would also leave open country to enter higher wooded areas on occasion.

On the eve of the Civil War, American settlement in Arizona was developing a more complex structure than a few self-reliant outposts of mining and farming. Army posts had been established, and the government was subsidizing mail service. This also led to the establishment of a stagecoach line. On the Colorado River, steamboats were bringing in supplies at a reasonable cost. Tucson was bustling with mercantile activity.

Hilario Gallego, who was born in Tucson in 1850, recalls this period from his own boyhood memories and accounts passed on by relatives. "Years ago there were lots of Indians here," he reminisced. "They lived on mescal, penole, deer, wild sheep...etc. There were lots of game in those days and over in the Santa Rita we had a good many wild turkeys. The little Indians who worked for my father used to trap small game, such as squirrels, rabbits, and quail.[51]

Beginning in 1860 a series of high-handed provocations instigated by white settlers and army personnel ended the tenuous peace between the Americans and the Chiricahua Apaches in Arizona. Nevertheless, mining operations continued on a "business-as-usual" basis. For instance, in February, 1861, a mining engineer named Biertu visited the Mowry lead-silver mine in the Patagonia Mountains, over the road which led south 20 miles from Fort Buchanan. Biertu was obviously interested in the wildlife: "The whole country abounds with rabbits, quails, and wild turkeys. It is not a rare occurrence to meet droves of deer and antelopes numbering

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51. Bernice Cosulich, Tucson (Tucson, 1953), pp. 61-62.

from twenty-five to thirty. The amateur of more intense excitement may also indulge in bear and Apache hunting."[52]

In the early summer of 1861, Raphael Pumpelly, a geologist commissioned in Cincinnati by the Santa Rita Silver Mining Company to appraise Charles Poston's mines, left Tubac to take a look at the Papago country. Accompanied by Poston and a man named Washburn, he inspected the Heintzelman Mine in the Cerro Colorado Mountains, then headed west into the Altar Valley. Pumpelly was most impressed with this sweep of grassland lying just to the east of the Baboquivari Range. His account reads thus:

> As we entered the valley from our position on its eastern border, the broad plain lay before us. Descending in a gentle slope to the center, and thence rising gradually to the same height along the base of the opposite mountain range, it was a wide expanse of grassy steppe, and forests of mesquit and cacti. Detecting us from afar, a drove of wild horses trotted off over the grassy surface, and we watched their graceful course as with streaming tails and flowing manes they disappeared in the distance.
>
> The only other signs of life that break the monotony of these journeys, are given by the herds of bounding antelopes, or by the red or gray wolf as he trots slowly away from the traveler, stopping dog-like ever and anon to turn and watch the intruder.[53] The tracks of the great grizzly bear, the marks of the huge paw of the no less ferocious panther, and the sudden and frequent sound of the rattlesnake, warn the traveller of other dangers than the Apache.[54]

Despite the Indian danger, coupled with the fact that neither Federal nor Confederate troops could provide much security for isolated

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52. Mowry, p. 74.

53. The red wolf, *Canis rufus*, never ranged west of Texas and Oklahoma. Pumpelly may be referring to both coyotes and gray wolves, *Canis lupus baileyi*.

54. Raphael Pumpelly, *Pumpelly's Arizona*, ed. Andrew Wallace (Tucson, 1965), p. 74.

settlements, a varied assortment of pioneers continued to brave Arizona's mountains, deserts, and plains during the Civil War.

In the north, a party of prospectors who had left Nevada in the spring of 1861, stopped to hunt on the flanks of San Francisco Mountain. One of the group, Sam Miller, recalled in a letter to a relative that the man shot all the mule deer they could accommodate, dried the venison, and stayed on the mountain for six to eight weeks.[55] The Mormon missionary, Jacob Hamblin, camped on San Francisco Mountain in 1863. He reported that game was so plentiful his contingent had no trouble killing what was needed. Pronghorn supplied an abundance of dried meat, especially just before the settlers moved on in late April.[56]

Another prospector, and a literate one at that, J. Ross Browne, entered Arizona from Fort Yuma in 1863. This observant traveler left one of the finest accounts of frontier Arizona: Adventures in the Apache Country. His first mention of the fauna was made while starting up the Gila River with the Castle Dome Mountains in the distance to the north. The terse entry in his reminiscences states that bighorn were said to be very abundant in that range.[57]

Browne went on to Tucson, then south up the Santa Cruz River to Tubac. Both game and wild cattle were abundant in the Santa Cruz Valley, but fear of the Apaches prevented many of the remaining settlers from

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55. Robert C. Stephens (ed.), Echoes of the Past: Tales of Old Yavapai, v. 2 (Prescott, 1964), p. 17.

56. James A. Little, Jacob Hamblin, a Narrative of His Personal Experience (Salt Lake City, 1909), p. 91.

57. Browne, p. 72.

going on hunting excursions.[58] Undeterred, Browne spent as much time as possible in the field, inspecting mines and commenting on the countryside. Quail were so plentiful that no man was expected to kill less than five birds with one shot. For one thing, powder cost two dollars a pound and shot, a dollar a pound.[59]

The Santa Cruz Valley in 1864 still abounded with wildlife despite the influx of silver miners that dated from 1856. The presence of Apaches did keep potential hunters at home, but enough settlers went out so that venison, quail, and turkey were basic table items when Browne stopped for meals during his excursions.[60] Once Browne reported several deer killed near the edge of Tubac. "Wild turkeys were also abundant," he wrote, "but our hunters failed to get a shot at them, although their tracks were to be seen within a stone's throw of the Plaza."[61]

On an expedition into the Atascosa Mountains, Browne reported deer as being very abundant in the mesquite-grassland and oak savanna country, but he does not ever distinguish between mule deer and whitetails. The wildlife in the Atascosas seemed tame, as if it had not been hunted much. Wild turkey and quail (species undetermined) were also much in evidence.[62]

Concerning the valley of the Santa Cruz, Browne was unstinting in his admiration. The following account was written in January, 1864:

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58. Frank C. Lockwood, Pioneer Days in Arizona (New York, 1932), p. 136.

59. Browne, p. 76.

60. Lockwood, p. 224.

61. Browne, p. 151.

62. Ibid., p. 244.

> The valley of the Santa Cruz is one of the richest and most beautiful grazing and agricultural regions I have ever seen. Occasionally the river sinks, but even at these points the grass is abundant and luxurious. We travelled, league after league, through waving fields of grass, from two to four feet high, and this at a season when cattle were dying of starvation all over the middle and southern parts of California. Mesquit and cotton-wood are abundant, and there is no lack of water most of the way to Santa Cruz.[63]

The next entry in the diary was written several days later when Browne's party had continued upstream past Calabasas, where Sonoita Creek comes in, to the valley where Nogales now stands. In Browne's words: "Every mile we travelled the country improved in beauty and fertility. Grass up to our horses' shoulders covered the valley, and the hills were dotted with luxuriant groves of oaks. Much of the country reminded me of the coast range in California."[64]

During his trip into Sonora, Browne went as far east as the village of Santa Cruz. He worked his way north again by following the Santa Cruz River downstream. Somewhere near the international boundary, just south of Tubac, he penned a description of the game seen that day: "We saw great quantities of deer (probably whitetails,) for the most part and a few flocks of wild turkeys; but they are unaccountably wild--much more so than in populated countries. We supposed they were not accustomed to the presence of white men."[65]

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63. Browne, p. 144.

64. Ibid., p. 159.

65. Ibid., p. 224. Browne does not take into account the fact that for the previous 20 years or so, a wide assortment of emigrants had been using the Santa Cruz Valley as a highway, and that no traveler would overlook a chance to obtain fresh venison.

A little later in the year Browne accompanied an expedition to the Heintzelman Mine in the Cerro Colorado region west of the Santa Cruz Valley. The hills were covered with mesquite and good grass, with the presence of paloverde indicating an ecotone between the Sonoran Desert and the mesquite-grassland. The party had no difficulty keeping their camps supplied with meat, since deer were common and relatively undisturbed, and turkeys, rabbits, and quail abounded.[66] (In his wanderings it is quite possible that Browne encountered all four species of Arizona quail: Gambel's, scaled, Mearns', and masked bobwhite. But he never differentiated between them; they were all simply "quail" to him.)

After leaving the Cerro Colorado mining district, which consisted of 29 working silver mines, Browne and his group followed a wagon road south along the western foothills of the Pajaritos and then across the Altar Valley to Sasabe. Of the valley he wrote: "Nothing possessed of animal life is to be seen, save at very remote intervals, and then perhaps only a lonely rabbit or a distant herd of antelope."[67]

The expedition moved on from Sasabe to the little Mexican border village of Pozo Verde, some ten miles to the west. Browne went hunting in a small valley at the foot of the Pozo Verde range. Again, he left his impressions in the diary:

> The valley abounds in game. (This was primarily evergreen oak savanna.) In several places near the water-holes the deer tracks were so thick that they reminded me of a sheep corral. Strange to say I saw but one deer during my ramble, yet this is not an uncommon experience in Arizona. We all saw acres of deer tracks and turkey tracks during our journey; but few of

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66. Browne, p. 265.

67. _Ibid._, p. 274.

> us saw the deer or the turkeys that made them. Game is exceedingly wild, and difficult to kill when shot. (Compare with Browne's remarks about the fearlessness of the deer in the Atascosas, just a short distance to the east.)[68]

During the mid 1860's, farming communities as well as mining settlements were initiated, but the successful ones were in areas of minimal Indian danger. One such community was Littlefield, established by Mormon farmers on the Virgin River in the extreme northwest corner of Arizona. From the north flows a stream called Beaver Dam Creek, attesting the problems the farmers had with the abundant beaver in this area. The animals repeatedly dammed both the creek and the Virgin River, making farming a very difficult enterprise.[69]

After going into a decline at the start of the Civil War, mining was revived by the arrival of the California Column in 1862. Many of these volunteers had prospected in California, and their commander, Colonel James H. Carleton, granted permits to look for gold in northern Arizona (with an unwritten stipulation that he would share in what was found).

Strikes, in fact, were made in the north and west--wherever the Apaches were not in control. Gold had been found on the lower Gila River in 1858, leading to the founding of Gila City, while other significant finds were made on the Colorado upriver from Fort Yuma.

Early in 1863, a party of prospectors under the old mountain man Pauline Weaver investigated the Weaver Mountains near the site of modern

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68. Browne, p. 280.

69. Granger, p. 214.

Yarnell. On a stream later named Antelope Creek they flushed a herd of pronghorn that ran up the canyon deeper into the mountains. The expedition later moved into the hills, and a pioneer named Abraham Peeples killed three pronghorn on the side of a mountain now known as Antelope Peak.[70] The meat was jerked, and while it was drying several of the men indulged in sporadic prospecting. Rich deposits of gold were found on the summit of the peak and in an arroyo called Weaver Gulch. The prospectors worked the placers with nothing more than knives, prying nuggets out of the crevices. In less than three months 100,000 dollars in nugget gold were taken out of the ground on nearby Rich Hill. But it only took two years to exhaust the placers in the Weaver Mountains.

On September 26, 1863, the Weekly Alta Californian, a San Francisco newspaper, came out with a description of the country that lies between the sites of Wickenburg and Prescott. This includes roughly the Weaver Mountains and what is now Prescott National Forest. Miners from California were infiltrating the region in fair numbers, and the Alta Californian responded to public interest in this newly discovered wilderness. The column described the mountainous country east of Bill Williams River as being "well watered," with hills covered with pines and oak timber. Grass grew tall and green in the valleys, and a profusion of wildlife included mule deer, Merriam elk, and pronghorn. There were also "immense droves of wild turkeys." The article said that prospectors had encountered grizzly bears and mountain lions as well. The mining camps

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70. Granger, p. 331.

in the area were well supplied with deer, turkey, and elk provided by men who spent most of their time hunting.[71]

The first settlers in the Prescott area were interested only in gold and brought nothing with them but horses and pack mules. For meat these prospectors, who appeared in 1863, depended entirely on game. During a deer hunt to replenish the camp larder Sam Miller (who had hunted on San Francisco Mountain on his way south) discovered gold on Lynx Creek, near modern Walker. Wildlife alone furnished the meat for these early settlers and the additional miners and soldiers that followed.[72]

William Fourr, a prospector, kept a diary of his activities while searching for gold on Lynx Creek (near future Prescott) in 1863. There were many placer mining camps in the region, and deer hunters were constantly combing the mountains in an effort to keep the prospectors supplied with venison. To pick up "a few dollars," in Fourr's words, these market hunters often tried to sell a bear or deer, particularly when a camp was running low on fresh meat.[73]

At Hell Canyon, 45 miles east of the site of Prescott, wild turkeys were extremely abundant in the pinyon-juniper woodland. Hunting was

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71. Daily Alta California, San Francisco, September 26, 1863.

72. John C. McNelty, "History of Game on the Prescott National Forest," Arizona Wildlife and Sportsman (September 20, 1941), pp. 1, 14. Serious inroads were made on game populations in this region by the late 1860's, and by the early 1880's only a remnant survived. Game meat thus supplied the entire community until the early 1880's, when military garrisons controlled Indians to the point where it was safe to raise cattle.

73. William Fourr, "Journal," typed manuscript, Arizona Historical Society, p. 180.

dangerous because gunfire attracted Apaches, but the need for fresh meat superseded caution.[74] On one occasion, while on the way to the Bully Bueno Mine in Black Canyon (35 miles east of present Prescott), Fourr and and several prospectors shot a number of deer and pronghorn. They arrived at the camp near the mine to find, as Fourr expressed it, a "large Juniper tree which was hung full of all kinds of wild meat, bear meat, turkey, deer, antelope and rabbits and we were told to hang our game up there too, so we did."[75]

Starting in 1863, gold led to the ultimate defeat of the Western Apaches in central Arizona. It brought in the population and the army to protect it. Farmers and ranchers followed to feed the soldiers, and communication lines were established. On Lynx Creek alone, prospectors killed off most of the game in a single year--1863.[76]

Shortly after the Civil War began, Joseph Reddeford Walker, the veteran mountain man and pathfinder, then in his sixties, was stricken with gold fever while leading a relatively quiet life in California. He set out with a band of some 40 adventurers, bound for Colorado by way of northern Arizona and New Mexico. After prospecting for a while in the Colorado gold fields, the Walker party decided to move on. These restless men traversed New Mexico from north to south, were present at Fort McLane when California volunteers murdered the captured Apache chief Mangas Coloradas, then turned west into Arizona. Daniel Ellis Conner, the

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74. Fourr, p. 200.

75. Ibid., p. 201.

76. Dan L. Thrapp, The Conquest of Apacheria (Norman, 1964), p. 24.

chronicler of the Walker expedition, commented about the country covered from Apache Pass to Tucson, the Pima villages, and the valley of the Hassayampa River in the late fall of 1862 (see Fig. 5, p. 226). "We would sometimes find game in superabundance, and then perhaps for the next month, do without because we unluckily happened to blunder into a section whose only inhabitants were lizards, rattlesnakes, horned toads, and coyote wolves."[77]

During moments of relaxation, members of the Walker party sometimes sought entertainment that reflected the harshness of their frontier conditioning. While crossing the Peloncillo Mountains on their way to the San Simon Valley and Apache Pass, Walker's men put out steel traps attached to long chains after camp had been made for the night. Captured coyotes were then dragged into camp and forced to fight the numerous dogs that followed the expedition.[78]

The adventurers stopped briefly at Tucson on their way north toward the Gila. Conner's one diary entry concerned with wildlife states that coyotes commonly scavenged in the outlying streets of the town after dark.[79]

After leaving Tucson, the Walker party reached the Gila River at the Pima villages, following it downstream to the mouth of the Hassayampa River, which comes in from the north, opposite the Buckeye Hills. Walker now headed up the Hassayampa toward the Sierra Prieta and other ranges

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77. Daniel Ellis Conner, Joseph Reddeford Walker and the Arizona Adventure (Norman, 1956), p. 25.

78. Ibid., p. 30.

79. Ibid.

now included in Prescott National Forest. The expedition staked claims along the upper river, both because there was gold, and in Conner's words, "plenty deer and other game in the woods." There was some harassment by Indians, but by the summer of 1863 the prospectors were firmly established. "We now devoted our time to hunting and prospecting when not at work upon our claims," added Conner.[80]

As news of the gold strikes spread, more and more prospectors converged on the area where construction was to start within a year on the new town of Prescott. Mining camps sprang up in this mountainous region: watercourses with descriptive names like Lynx Creek, Big Bug Creek, Turkey Creek, and Wolf Creek. To protect the camps in what soon became known as the Walker Mining District, Colonel Carleton created the District of Northern Arizona and ordered Fort Whipple established.

Conner's experiences with the Walker party were largely confined to the mountainous country around the site of Prescott. In the absence of clear-cut chronological events over a large geographical area, his descriptions of wildlife are best presented in separate species accounts.

<u>Merriam's Turkey:</u> In 1863 wild turkeys were common in the Bradshaws, especially along Turkey Creek, a tributary of the Agua Fria River. Conner also saw turkeys along a stream on the edge of chaparral country a few miles to the southwest of present Prescott.[81]

<u>Gray Wolf:</u> Conner reports that in the autumn of 1863 prospectors saw a large pack of wolves on a creek about five miles south of modern

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80. Conner, p. 105.

81. <u>Ibid</u>., p. 108.

Prescott. The stream, now called Wolf Creek, flowed at that point through chaparral.[82] Another time, before setting out on an expedition to the Colorado River, Conner shot a wolf in a brushy hollow just to the west of the Prescott site. He remarked that wolves tended to gather and howl when they spotted men, thus attracting any Indians in the vicinity.[83]

In 1864, while prospecting in the upper Verde River country, Conner was often "annoyed" at night in camp by the howling of wolf packs.[84]

Grizzly Bear: Conner was deer hunting on a chaparral-covered ridge in the Prescott Mountains in 1864 when he heard the roar of a wounded grizzly, following a rifle shot from a companion not far away. The two men trailed the grizzly by its blood spoor but lost the animal with the onset of darkness.[85]

Mountain Lion: One night in 1864 Conner and two friends put up for the night in a deserted miner's cabin on Lynx Creek. While the three men were playing cards a pack burro suddenly burst through the door into the cabin, where it stood perfectly still. The prospectors rose with drawn six-guns, but all was quiet outside. An examination of the burro showed that one of its thighs was badly mangled, and Conner reconstructed

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82. Conner, p. 110.

83. Ibid, p. 118.

84. Ibid., p. 162.

85. Ibid., pp. 202-203. Chaparral is common in the vicinity of Prescott. It is dense shrubby growth dominated by scrub oak, *Quercus turbinella*, and was typical grizzly habitat in parts of central Arizona and in southern California, where the plant community of the California coastal chaparral is similar. In fact, *Quercus turbinella* and *Q. dumosa* of California may be conspecific. See: Charles H. Lowe, *The Vertebrates of Arizona*, (Tucson, 1964), pp. 48-50.

events as follows. A mountain lion had attacked the burro, the burro had rushed for the cabin, and the lion had somehow been shaken off. Conner felt that except for the light in the cabin the lion would have followed the burro right in.[86]

<u>Mule Deer:</u> When the Walker party made its first gold strike in 1863, mule deer (and possibly some whitetails) were extremely common on the headwaters of the Hassayampa River. Conner once found a deer killed by a mountain lion in ponderosa pine forest near the site of Prescott.[87] When the miners first started hunting in the general region deer were not alarmed by rifle shots, but were easily spooked by thunder.[88]

By 1864 deer had been virtually eliminated from the vicinity of gold-mining settlements on the upper Hassayampa generally. Hunters had to go farther afield, well away from any center of human activity, in order to bring in venison.[89]

<u>Pronghorn:</u> When Conner first approached the Prescott area in 1863, several of his comrades shot some pronghorn in a grassy prairie on Weaver's Creek, 25 miles southwest of the site of the future capital.[90] Later, while hunting in chaparral country near the upper Hassayampa, Conner met an Indian (either Apache or Yavapai) on his way to more open country to hunt pronghorn with his bow. The head of a pronghorn was tied

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86. Conner, p. 144.

87. <u>Ibid</u>., pp. 99-100.

88. <u>Ibid</u>.

89. <u>Ibid</u>., p. 202.

90. <u>Ibid</u>., p. 131.

to the small of his back. When the Indian stooped to peer backwards between his legs, the head rose to an upright position. The Indian then shot an arrow through his legs when a pronghorn was lured within range.[91]

Bighorn: In 1864 Conner and some gold miners had just inspected a camp established by Mexican prospectors at the head of Date Creek. All had been killed by Indians. Conner looked up and saw a flock of bighorn on what he described as a "low, rocky ridge overlooking the narrow valley."[92] This was probably on the north flank of the Date Creek Mountains.

In April, 1864, construction began on Prescott, to be the first territorial capital of Arizona. Nearby Fort Whipple would be ready for occupation in a month. But military forces were to prove inadequate to the task of containing Apache raids, and even before the end of 1863 miners, ranchers, and other civilians decided to take matters into their own hands in the Walker Mining District. Up to then, in the words of General William S. Rosecrans, the whites lived on the reservations and the Indians occupied the country.

The leader of these civilian irregulars was a frontiersman from Louisiana named King S. Woolsey, described by historian Bert Fireman as "the most notable, the most enterprising and the most courageous of all the great host of trailblazers who first penetrated Arizona." Early suspected of having Confederate sympathies, Woolsey ended up growing hay for the Union forces on his ranch on the Agua Fria River.

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91. Conner, p. 108.

92. Ibid., p. 217.

In 1864, Woolsey led three punitive expeditions across central Arizona in pursuit of Apaches who had stolen livestock from ranches in the Prescott area. These excursions revealed the agricultural and mineral potential of the mountain valleys that formed the drainage of the Verde and Salt Rivers. The civilian volunteers who went along combined Indian-hunting with exploring and prospecting activities.

Woolsey's second expedition, in March, has been described by a participant, Henry Clifton, in a ten-part serial in the Arizona Miner, published as a semi-monthly in Prescott. One hundred miners left Woolsey's ranch on the Agua Fria and struck off in three parties to raid Apache rancherias. Clifton's contingent headed east, then south, picking up the east branch of Agua Fria. The volunteers found a stream emptying into the Agua Fria which they called Ash Creek, because of "the abundance of fine ash timber that grew on its banks." Clifton went on: "The creek at this place is some ten feet in width and crossed by innumerable beaver dams, making it quite deep."[93]

After a skirmish with Apaches in April, 1864, Woolsey's irregulars were camped on Cane Creek, near its junction with the Ague Fria, while on their way home. Some eight or 10 men left camp, in Clifton's words, "for the purpose of hunting deer and antelope." Even in hostile country, well-armed parties would go hunting, assured that they could handle any Indian attacks.[94]

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93. Clara T. Woody, "The Woolsey Expeditions of 1864," Arizona and the West, v. IV, No. 2 (Summer, 1962), p. 165.

94. Woody, p. 166.

In June the third expedition was heading east through the Pinal Mountains on an exploring foray (see Fig. 5, p. 226). Woolsey commented that the column's hunters kept the volunteers "well supplied with venison and turkey."[95]

On June 14 a party that included a chronicler named F.A. Cook was working its way eastward when it came to the Salt River. Cook says that the men made a seine of willow branches and caught 200 fish. The largest, in his opinion, looked like cod but had no teeth, weighing between ten and 20 pounds. The men worked up to their necks in the warm water.[96]

Cook's diary for June 21 states that his group caught 50 fish, all suckers and "verry sweet." The volunteers were completely out of meat, having been living on fish alone for several days. Some of the fish, estimated to weigh up to 40 pounds, broke every line that could be improvised.[97] On June 25 this party ascended Tonto Creek, then turned east into the mountains. Cook describes what happened next: "After dinner, I with five others...went up the high mount E. of us hunting this was somewhere in the Sierra Ancha, but instead of finding Deer we found 8 or 10 Indians who were watching us and had run off all the deer."[98]

At one point, on the third expedition, Woolsey went all the way to the Black River. His volunteers returned through the Natanes Mountains, then down the San Carlos River through the Antelope Hills.

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95. Woody, p. 173.

96. Frank D. Reeve, "War and Peace: Two Arizona Diaries," New Mexico Historical Review, v. 24 (April, 1949), pp. 103-105.

97. Ibid.

98. Ibid.

According to Henry Clifton, the column passed over "a level country covered with grass and shaded by cedar trees forming a most excellent stock range. Among these cedars we found an abundance of 'bear sign,' and one evening just before camping we had some excellent sport in killing a bear, our second, as we had killed one on the Gila about 15 miles above Fort Goodwin. Both of them were of the species known as the Cinnamon bear."[99]

When Arizona officially became a territory in 1863 there were no schools, churches, or libraries. But by the end of September, 1864, there was a territorial legislature, even if the capitol building had not yet been built. Prescott had a hotel by then, the Juniper House, and the menu was dominated by venison. Near the present location of the Old Governor's Mansion there was a small spring of clear water in 1864. Wild turkeys came here to drink, and where the water flowed over the bank into Granite Creek, clumps of ferns grew.

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99. Woody, p. 174. Clifton may have encountered black bears, but the situation is confused by the fact that Arizona frontiersmen of the time commonly called grizzlies "cinnamon" bears.

CHAPTER VI

SUMMARY: THE LAND AND ITS WILDLIFE

The Grasslands

Before the Civil War, travelers in Arizona spoke often of extensive areas of superb grasslands in the northeast, the southeast, and parts of the northwest. Today, many of these areas have been degraded, with the grasses usually giving way to woody vegetation. The expanses of grassland described in most detail were those lying along the routes followed by military expeditions and emigrant trains.

The San Bernardino Valley: This valley, to the east of Douglas in Cochise County, was crossed by Cooke's wagon road in 1846. At that time the area was largely open grassland with small mosaics of desert scrub. There were also extensive marshes on land now part of the Slaughter Ranch.

Today, the San Bernardino Valley is covered to a considerable extent by Chihuahuan Desert vegetation.

The San Simon Valley: Lying just to the north of the San Bernardino Valley, this region was once a basin collecting water from surrounding mountain slopes. In 1851 it was described as marshy and nearly treeless except for willows growing alongside the many springs and cienegas. The whole valley was covered with a lush growth of grass. In contrast, it is now part of the Chihuahuan Desert.

The San Pedro Valley: Emigrant trains passed this way in 1849-1851. The upper valley (on the present international boundary) was largely an open grassland. Farther north, where Babocomari Creek comes in from the west, the San Pedro River formed extensive grassy marshes. Near the Gila River mesquite covered much of the valley, even in the middle of the 19th century. There were also ponds and areas of good grass.

The Sulphur Springs Valley: In 1851 this valley was largely plains grassland. This is still true in places except where irrigation farming has taken over.

The Santa Cruz Valley: Tall grasses filled much of the flood plain of the Santa Cruz River in the 1850's. Near Tucson, the river was flanked by lush, open plains.

The Sonoita Valley: In the 1850's, as now, a magnificent stretch of plains grassland filled the valley that lies between the Whetstone Mountains on the east and the Santa Ritas on the west. It was much wetter then, and wagons sometimes bogged down in the extensive cienegas that occupied the middle of the valley.

The Navaho Reservation: The northeastern section of Arizona, now composed of parts of Coconino, Navajo, and Apache Counties, once had the most extensive grasslands in the state. This treeless plains region, which extended from New Mexico west to the San Francisco peaks, was approximately bisected east to west by the Little Colorado River. Explorers and emigrants rhapsodized over the beauty of the region and the lush grasses available for their stock. Much of what is now within the Navaho Reservation has since deteriorated into a sandy wasteland.

One area that has changed little since the 1850's is the Painted Desert. Even then, travelers described it as bleak, with very little grass cover.

The Bill Williams River: In the 1850's there was excellent grass cover along the upper stretches of this river. However, the grass disappeared a short distance before the Bill Williams flowed into the Colorado.

The Sacramento Valley: Even in winter (1858) there was a superb cover of grass in this valley, which is close to the Colorado River. Much of the area now supports northern desert scrub.

The River Valleys

The San Pedro River: In 1846 the Mormon Battalion found that a considerable stretch of the San Pedro River was marked by an absence of timber. This was particularly true along its middle course, where it flowed slowly through grassy marshes, flush with its banks, often flooding extensively behind beaver dams. Locally, there were areas of dense cottonwood and ash woodland, with mesquite bosques in the lower valley. As early as 1851 channelization was observed where Benson now stands, with a swift current flowing between clay banks ten or 12 feet high. The water also tended to disappear at seasonal intervals for distances of ten to 20 miles.

Sonoita Creek: This stream, still noted for its magnificent cottonwoods, was flanked by extensive marshy grasslands in 1851. In addition to cottonwoods, there was a screen of large mesquites and a dense jungle of willows and other shrubbery, all bound by grape vines. The marshes and understory are now largely gone.

The Gila River: At the Pima villages and above, the Gila River was a clear, swift little stream in the 1850's. The volume of water tended to be uniform for most of the year, and the river was fordable in most places. During drought periods the river occasionally dried up completely, or was entirely diverted by the Pima Indians for irrigation purposes.

Below the confluence with the Salt River, the Gila widened to about 80 yards, with a depth of three feet (1846). Beyond the great bend the current reached a width of 100-150 yards, with an average depth of four feet. The water flowed gently over a sandy bottom and was occasionally too deep to ford even with a horse. The lower Gila often formed a seasonal chain of lakes, ponds, and lagoons adjacent to the main channel.

In the middle of the 19th century the Gila River supported a dense riparian growth along most of its length. Willows and cottonwoods grew on the banks, backed by terraces of mesquites. The river bottoms were also overgrown with tall herbaceous plants, such as sunflowers. Near this river's junction with the Colorado, the riparian woodland formed a dense jungle two to four miles wide, even more extensive than the similar growth on the larger river. Today, this superb bottomland forest is gone, along with the living Gila River.

The Big Sandy River: In 1853 this stream, in Mohave County, flowed south on its upper reaches as small rills alternating with beds of sand. Farther down, near its confluence with the Bill Williams River, the Big Sandy became a continuous stream of clear water several feet deep. Dense willow brush lined the banks, and in places the river formed swamps caused by beaver dams.

The Bill Williams River: During the same period, the Bill Williams River ran for much of its course as an intermittent stream, periodically disappearing beneath the sand. There were good stretches of water in places. The lower river became deep and full, with thick riparian growth and extensive marshes adjoining the main stream bed.

Fires

The Santa Rita Mountains: In the late 1850's there were several reports of fires burning in the Santa Ritas. One was an extensive grass fire in the foothills at the south end of the range caused by a coal from a prospector's camp fire. Another was a timber fire on the upper slopes, for which no cause was given. No fires were reported as having been started by Indians or lightning.

The Wildlife

The first American explorers and settlers in Arizona found game abundant at certain times, scarce at others. During the 1820's, for instance, several parties of beaver trappers nearly starved on the upper Gila because of an apparent absence of wildlife. Other trappers had trouble sustaining themselves between the upper Verde River and the Grand Canyon, and along the upper San Francisco. However, in the 1840's, when the bottom had fallen out of the fur market, a few die-hard trappers found game once again plentiful, and venison and bear meat were dependable staples. The Kearny expedition found deer and turkey sign everywhere on the upper Gila in 1846.

It is quite probable that game populations were locally reduced along the main beaver streams by hundreds of trappers working Arizona at the height of the fur trade. Additional pressure from the Indians may also have been a factor. Since this was a temporary phenomenon, the wildlife should have made a substantial recovery within a few years. This, in all likelihood, is what happened.

Bartlett in 1851 commented on the scarcity of wildlife on the fine grasslands of southwestern New Mexico and southeastern Arizona. Even pronghorn were not abundant. (Bartlett felt that game was generally scarce in Arizona except in mountainous regions.) Since Bartlett stuck to a fixed route he would have missed seeing pronghorn that had moved away, influenced by a seasonal migration pattern. Again, hunters for the emigrant trains over the previous two years, when 60,000 people passed through this region, could have thinned out the herds along the wagon routes. At any rate, the Emory expedition, coming some four years later, found pronghorn once more abundant.

In the vicinity of some Indian agricultural settlements, large game disappeared. This was true near the Pima villages on the Gila River and along the lower Bill Williams River east of the Mohave Indian communities. No game was observed on the Colorado River in Mohave territory. Exploring parties were often hard pressed to find wildlife in the extensive pinyon-juniper woodlands north of the Mogollon Rim.

In contrast, most Americans were exuberant in describing the abundance of wildlife on the grasslands of northeastern Arizona and in the vicinity of the San Francisco peaks at their western edge. Pronghorn, in particular, may have been present in much larger numbers than on the grasslands of southeastern Arizona in the middle of the 19th century.

As late as 1863, deer and pronghorn furnished meat for parties camped for weeks on end on the slopes of San Francisco Mountain.

Waterfowl: During fall and winter, many observers in the middle of the 19th century saw spectacular numbers of ducks, geese, and whistling swans on Arizona's rivers. On the larger streams like the Gila and the Bill Williams numerous marshes and lagoons formed subsidiary bodies of water alongside the main channels. Aquatic vegetation provided cover for resting flocks. The willow swamps along the lower Bill Williams River attracted immense flocks of wintering ducks, as recorded by members of the Whipple expedition. Other travelers singled out snow geese as being particularly conspicuous and abundant on the Gila River. White pelicans were observed in the 1820's on the Colorado River.

Scaled Quail: In 1855 Heermann reported this species as abundant on the open grasslands of southeastern Arizona. For some reason he did not see scaled quail west of the San Pedro River. He commented that the birds liked the area of prairie dog towns, where the grasses were thinned out.

Gambel's Quail: Arizona's first American explorers marveled at the size of flocks of this species, especially in the river bottoms that lay parallel to wagon routes so much of the time. In 1846, on the upper Gila, Turner saw several flocks estimated to contain between 800 and 1000 birds each. An 1855 report described these quail as teeming in cultivated areas near Tucson. Huge flocks were also reported in central Arizona in the 1850's, along washes and streams west of the San Francisco peaks. Partridge Creek, near the site of Ash Fork, was an especially favorable area, as was the valley of the Big Sandy River.

The largest number of sightings was made along the lower Gila River, with observers all agreeing as to the incredible number of birds in each flock. Gambel's quail were seen both in dense riparian growth and in the adjacent Sonoran Desert.

Wild Turkey: Before the 1860's, Americans encountered wild turkeys in wooded areas everywhere east of the Sonoran and Mohave Deserts and south of the Kaibab Plateau. Some records: 1825, upper San Francisco River; 1846, upper Gila River (west to San Pedro River); 1849, Guadalupe Mountains, Cochise County; 1851, Sonoita Creek, Santa Cruz County; 1851, common between San Francisco Mountain and Big Sandy River; 1856, Santa Cruz River (near San Xavier Mission). In the 1850's turkeys were abundant on San Francisco Mountain and Bill Williams Mountain. They were also frequently seen in the Juniper Range, to the west of Chino Valley. Turkeys were commonly reported on the San Pedro River, in the southeastern corner of the state, and along the full length of the Santa Cruz River. Prospectors hunted them often in the Santa Rita and Patagonia Mountains.

Turkey and venison were staples in the diet of gold miners working the mountains of central Arizona in the 1860's. By 1864 Elliott Coues believed that the wild turkey was already becoming rare in the general region around Fort Whipple.

In southeastern Arizona, turkeys were found in the oak-pine woodlands in the mountains, in riparian woodlands in river valleys, and in mesquite bosques. North of the Mogollon Rim they inhabited such diverse communities as juniper-pinyon woodland, riparian woodland, chaparral, and ponderosa pine forest.

Beaver: At one time probably every permanent and intermittent stream in Arizona with an adequate food supply in the form of willows and cottonwoods supported a population of beaver. Between the 1820's and 1840's the drainage systems of the Gila and Colorado Rivers were intensively trapped by mountain men, and the beaver populations fluctuated drastically. The species was virtually trapped out on the upper Gila in 1825 and was still shy and scarce there two years later. But by 1830 there were already signs of recovery. The Salt River was heavily worked and was considered by many trappers the best beaver stream in Arizona. Other popular areas were the San Francisco, the Verde, the lower Gila, and the San Pedro.

Following the collapse of the fur market in the 1830's, the beaver made a vigorous comeback in Arizona. The species was even abundant on tiny Zuni Creek in 1851, where few cottonwoods grew. In 1853 beaver colonies thrived on the Big Sandy, where there was a good water supply. Beaver were as abundant as ever on the Gila River, on the upper San Pedro, and even at 5000 feet in Guadalupe Canyon, on the Mexican border. On the Colorado River beaver were immensely abundant in the 1850's, extending south to within 30 miles of the delta.

Gray Wolf: The first mountain men saw and heard wolves on the upper Gila, and the presence of the animals was detected at one time or another by emigrants throughout Arizona east of the deserts. In 1846 the Mormon Battalion heard wolves howling on the grasslands near the site of Douglas. During the Gold Rush in 1849 wolves prowled around emigrant camps in the mesquite bosques near San Xavier Mission on the Santa Cruz River. Wolves were common at this period on the grasslands of southeastern Arizona, northern Sonora, and southwestern New Mexico. The first boundary surveyors learned that Mexican ranchers in this general region were poisoning wolves with strychnine in an effort to cut down on livestock predation. In 1855 travelers reported wolf packs as being common near the village of Santa Cruz on the Santa Cruz River, where they preyed heavily on domestic animals. In the late 1850's wolves were frequently encountered by American silver prospectors in the Santa Rita Mountains, where they had a reputation for invading Mexican settlements when rabid.

Above the Mogollon Rim, wolves in the 1850's were common on the open grasslands of the Navaho country, especially near the Little Colorado. They also inhabited juniper-pinyon forest and were found in ponderosa pine forest on the San Francisco peaks. Wolves also ranged well to the west of San Francisco Mountain, as far as the Big Sandy, being found in both open country and wooded areas. They were reported common in Chino Valley. Elliott Coues found wolves abundant in the mountains of central Arizona, around Fort Whipple. In this region they were found in chaparral as well as in the pine forests.

Though generally distributed through a variety of habitats, the gray wolf was less common than the coyote, and, according to most observers, more likely to keep its distance from human campsites and settlements.

Black Bear: Explorers and emigrants did not leave many reports of black bear sightings, probably because travel routes tended to stick to the open plains and river valleys. Black bears were occasionally reported in riparian situations and on lower mountain slopes, but travelers of the period usually had little reason to enter the high coniferous forests, where the species found its optimal habitat. Colonel Graham's party shot a black bear at the north end of the Huachucas, possibly in oak-pine woodland. In the same year Dr. Woodhouse stated that black bears were abundant in timbered regions throughout Arizona. They were certainly common in the Santa Rita Mountains of southeastern Arizona, where prospectors considered them shy and difficult to hunt, in contrast to the easily provoked grizzly.

In northern Arizona black bears were reported from juniper-pinyon woodland as well as ponderosa pine forest.

Forty-niners and other travelers on the lower Gila and Colorado reported bear tracks in the dense riparian "jungles" of willow and cottonwood near the river banks. One observer reported seeing a black bear in a tree on the lower Gila River. No specific reports of grizzlies in this part of Arizona have come to light, though one would assume that the larger bear would be more likely to follow a low-elevation riparian corridor into the Sonoran Desert.

Grizzly Bear: In the 1820's, the first beaver trappers discovered grizzlies, sometimes in a dramatic face-to-face manner, in riparian woodland on the upper Gila River. As in the Rockies, the grizzly became very much a fact of life for the mountain man in the Arizona wilderness.

Grizzlies in southeastern Arizona, like their counterparts in California, were animals of the foothill region. Members of the Mormon Battalion found their sign in riparian growth along the San Pedro River in 1846. In 1849 a grizzly was shot on the headwaters of the same river, and another was observed in the ruins of the San Bernardino Hacienda, in what was probably open grassland country at the time (today this area is Chihuahuan Desert). Grizzly sign was also followed by later emigrants in the Little Dragoon Range, near the middle reaches of the San Pedro. Bartlett, in 1851, saw grizzlies in the Guadalupe Range while negotiating Guadalupe Canyon. He considered them always dangerous to approach except in a well-armed group. A year later other travelers shot a grizzly bear either in the Guadalupe Mountains or just to the east in the Animas Range, New Mexico. The species was common in the southeastern corner of Arizona, where oak woodland was the typical habitat. Along the Mexican boundary grizzlies often left the mountains entirely to forage on the open grasslands. In Dr. Kennerly's opinion, this took place after acorns, pinyon nuts, and other woodland staples had become scarce. Kennerly considered grizzlies abundant in all the mountain ranges west of the Rio Grande and east of the Sonoran Desert. They ranged as high as the ponderosa pine forest. Kennerly collected one grizzly at the present site of Nogales.

In the late 1850's silver prospectors found grizzlies numerous in the bottomlands of the Santa Cruz River and in the adjacent Santa Rita Mountains. They were also reported in grassland in the Altar Valley, to the west. As late as 1859 the species was still abundant in the riparian woodland on the San Pedro River.

In northern Arizona at this time, grizzlies probably ranged as far as the Kaibab Plateau on the north, the Hualapais on the west,[1] and

1. Alfred L. Kroeber, "Walapai Ethnography," Memoirs no. 62, Amer. Anthro. Assoc., Menasha (1935), p. 62.

the Chuskas and other ranges in the northeastern corner of the state. In 1849 Simpson saw a grizzly in the Canadian life zone of the Chuskas. Sitgreaves considered the species common in all the mountains of northern Arizona, and he reported grizzlies on the grassy plains between the Little Colorado River and San Francisco Mountain. They were also encountered in the bottomlands of the Little Colorado. These bears were abundant in juniper-pinyon woodland around Zuni and in the same habitat to the west, on the Coconino Plateau. They seemed particularly numerous along the wagon route that led past San Francisco Mountain, Mt. Sitgreaves, and Bill Williams Mountain.

In 1864 Elliott Coues reported grizzlies as still common in the mountains of central Arizona, though a noticeable decrease had taken place in the few years before that. They still held out in such ranges as the San Francisco Peaks, on Bill Williams Mountain, the Weaver Mountains, and the Natanes Mountains. Grizzlies were also reported in the chaparral in the Prescott Mountains, not far from Fort Whipple.

Jaguar: A jaguar was shot in 1827 by members of the Pattie expedition on the lower Colorado River. The animal was in thick riparian growth close to the bank. Other reports of jaguars are few and scattered. Major Emory's Boundary Commission expedition recorded only one jaguar west of El Paso--at Guadalupe Canyon. Dr. Kennerly learned that jaguars were often reported from the bottomlands of the Santa Cruz River, near Santa Cruz, Sonora, where they preyed on livestock. In general, as he pointed out, they preferred the impenetrable thickets of river bottoms, preying on deer, horses, and cattle as they came to water.

In the late 1850's a jaguar was reported shot in the Santa Ritas. At about this period the Walapai Indians reported them as occasionally being seen in Coconino County.[2] Elliott Coues, on the other hand, never heard of a jaguar from central Arizona, and he never met anyone who had seen or heard of one in that region.

Mountain Lion: The first trappers on the upper Gila saw lions or their sign in the 1820's, and they considered the animal the same "panther" they had known in the east. Because of its secretive habits, the mountain lion was seldom reported by American travelers in the middle of the 19th century. A member of the Bartlett expedition shot what may have been a young mountain lion out of a tree on Babocomari Creek in 1851. Dr. Kennerly considered mountain lions abundant in southern Arizona, not only in the mountains but in bottomland growth along rivers and streams. They were found wherever there were deer, and ranching had not yet eliminated them from valley flood plains.

In 1849 mountain lions were reported in the dense growth of willow and cottonwood on the lower Gila River.

In northern Arizona Dr. Woodhouse found little first hand evidence of mountain lions in 1851 and considered them rare and retiring. Elliott Coues likewise neither saw nor heard one and believed that they were uncommon in the mountains of central Arizona. This, of course, is testimony to the lion's ability to keep out of sight unless flushed by trained dogs.

Javelina: The first Americans on record to encounter javelina, the beaver trappers reported the species in the riparian bottoms along

2. A.L. Kroeber, p. 80.

the upper Gila River and the lower San Pedro in 1826. Members of the Kearny expedition in 1846 also found javelina abundant in the same general area. The favored habitat seemed to be a floodplain with a thick growth of mesquite, cottonwood, and willow.

Subsequent sightings were few and far between. Emory's Boundary Commission in 1855 reported javelina only near the San Bernardino Ranch, just west of Guadalupe Canyon. There were no records of the animals in the Sonoran Desert or oak woodland, communities where they are common today.

Elk: The mountain men in Arizona must have covered the entire range of the Merriam elk in the east-central and southeastern parts of the state, but only one reference to the species has come to light. In 1826 a party of beaver trappers shot a number of elk on the Colorado River just east of the Grand Canyon. This is far enough to the north to consider the possibility that the animals were members of the Rocky Mountain race and not Merriam elk. Until the 1850's elk were present on the Paria Plateau and also in the Carrizo Mountains in extreme northeastern Arizona.

John W. Audubon in 1849 found dressed elk skins among the possessions of the Papago Indians in the Sonoran Desert. They may have been obtained from Indians to the east, though there is the chance that Papago hunters killed the elk in ranges on the eastern edge of the desert, such as the Santa Catalinas. Elsewhere in southern Arizona in the middle of the 19th century Merriam elk were common within the range of the central Chiricahua band of the Apache Indians. This area extended from the

Mexican border north to Parker Canyon, then east to the Willcox area and over the state line into New Mexico.[3]

Strangely enough, the members of the Sitgreaves and Whipple expeditions did not report elk in central Arizona. Conceivably, since Sitgreaves and Whipple crossed Arizona in fall and winter, the bulk of the elk population may have moved to wintering grounds to the north, down the valley of the Little Colorado. In retrospect, the elk shot by Ewing Young's trappers in 1826 were probably taken in early spring, and a likely site was the junction of the Little Colorado and the Colorado. Thus, no elk may have been left as far south as the wagon route used by Sitgreaves and Whipple.

The next expedition to follow the same route set out in the summer of 1857. Its members reported "innumerable" elk sign along the middle stretches of the Little Colorado and on the rolling grasslands to each side of the river. Soldiers and prospectors in the Civil War period found elk abundant in the area of San Francisco Mountain, but Elliott Coues makes no reference at all to elk in the vicinity of Fort Whipple, or anywhere else in central Arizona. Prospectors, however, reported them in the Weaver Mountains in 1863 and considered them initially abundant in that part of the state.

Mule Deer: A vital element in the meat diet of explorers and settlers, the mule deer, like the whitetail, was simply referred to as "deer" in most early records. Where the two species overlapped it was often impossible to determine which one was being referred to in a given report.

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3. Morris E. Opler, An Apache Life-Way (Chicago, 1941), p. 325.

All the emigrants and explorers who crossed Arizona before the Civil War probably saw mule deer at one point or another. The species was not uniformly abundant, but no other game animal occupied such a wide variety of habitats. In southern Arizona mule deer were observed from the Guadalupe range in the east all the way to the Colorado River. Dr. Kennerly, however, did not find them particularly numerous along the border, except in localized areas like the San Luis Mountains, on the Sonora side of the boundary. He observed that they were thinned out quickly by hunting, whereas the whitetails held their own under the same pressure.

Mule deer in central and northern Arizona were seen in riparian woodland, juniper-pinyon forest, chaparral, the Mohave Desert, grassland, and ponderosa pine forest. They were economically important to the gold miners who swarmed into central Arizona in the early 1860's, and Elliott Coues reported that the species had decreased markedly in this region within a year of the mining influx.

White-tailed Deer. Mountain men in Arizona depended on deer of both species for food, and they undoubtedly saw whitetails in many areas along the Gila and San Pedro Rivers and in the adjacent mountains. Like most frontiersmen, they seldom identified a deer by species.

In 1852 Bartlett found deer abundant along the Gila and in all the mountains along his route. Emory reported whitetails specifically as being common between El Paso and Nogales. They were especially abundant in the Guadalupe Range and other nearby mountains. Whitetails also found an optimal habitat in stream valleys, such as that of the Santa Cruz River.

In the late 1850's whitetails furnished venison for silver prospectors in the Santa Rita Mountains, where these deer were very common.

Pronghorn: As early as 1826, James O. Pattie reported an abundance of pronghorn in what was probably the Sulphur Springs Valley. The next references, dating from 1846, refer to the species being numerous in the San Bernardino and San Pedro Valleys. An 1849 report describes the species in spectacular numbers in the valley of the Santa Cruz River. In 1851 Bartlett again found pronghorn abundant in the Sulphur Springs Valley, at the south end (near the present site of Douglas.) He also found them in large numbers west of Dragoon Wash in the San Pedro Valley. Colonel Graham saw many herds on the magnificent treeless grassland that lies between the Whetstone and Santa Rita Mountains.

A year later, Bartlett saw many pronghorn in the Sonoran Desert near the lower Gila River. In 1858 they were abundant in the San Simon Valley, the San Pedro Valley, and near Fort Buchanan on Sonoita Creek. Prospectors observed many of them in the foothills of the Santa Ritas and the Patagonias, right up to the oak woodland. Pronghorn were also reported from the Altar Valley.

In 1853 Dr. Kennerly found pronghorn in considerable numbers on all open, treeless plains west of the Pecos River. They also ranged up into mountain valleys. Where pronghorn were numerous, in Kennerly's opinion, there were usually few deer. On these border plains pronghorn generally numbered small groups of eight or 10, but at times they formed herds of 300 or more. The species was particularly abundant in northern Sonora. Lt. Michler noticed pronghorn in the Sonoran Desert near Pozo Verde and found them common between the Colorado River and Nogales, where he met Emory's party. To the east at this period, Apaches hunted them in the San Simon Valley and other grasslands within the range of the Chiricahua bands.

There were times when the journals of soldiers and emigrants reported that pronghorn nearly disappeared from the great sweep of grasslands that straddled the international boundary between the Rio Grande and Nogales. Even lush valleys like the Animas, just to the east of the Guadalupe Range, were described as being empty of wildlife at certain periods in the 1850's.

Reports from the 1850's indicate that pronghorn were extremely abundant on the grasslands of central and northern Arizona. They were seen everywhere in the Navaho country, ranging up into the ponderosa pines on the San Francisco peaks and Bill Williams Mountain. This abundance continued to the west, and in suitable grassy valleys pronghorn were encountered all the way to the Colorado River. Some areas where large numbers were consistently sighted: Chino Valley (where herds of hundreds were sometimes seen), Big Sandy Valley, Hualapai Valley, and the Sacramento Valley. Occasionally herds were reported within juniper-pinyon woodland.

During the 1850's Indians still hunted pronghorn over the large areas remaining under their control. Some favorite hunting grounds: Monument Valley,[4] Lonesome Valley (below Mingus Mountain),[5] the Harquahala

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4. Byrd H. Granger, Will C. Barnes' Arizona Place Names (Tucson, 1960), p. 233.

5. Edward W. Gifford, "Northeastern and Western Yavapai," Publ. in Amer. Archeo. and Ethnology, v. 34, Berkeley (1936), p. 265.

Plains (Yuma County),[6] head of Agua Fria Creek (between Prescott and Jerome),[7] and Black Canyon (near Phoenix).[8] Large numbers were killed in fire drives between the upper Verde River and the Flagstaff region.[9]

Gold miners in the early 1860's found pronghorn abundant on the slopes of Antelope Peak in the Weaver Mountains. They were also common in grassy areas near Prescott. Elliott Coues, in 1864, considered pronghorn still numerous in open country in central and northern Arizona.

Bighorn: The first known account of bighorn in Arizona originated with James O. Pattie. He observed the animals on cliffs overlooking the lower San Francisco River in southeastern Arizona. A year later he referred to their abundance in Black Canyon, on the Colorado River. The next description of bighorn, dated 1846, states that Kit Carson shot a ram at Painted Rocks on the lower Gila River. The three observations represent three distinct habitats. The first was probably in juniper-pinyon woodland, the other two in the Mohave and Sonoran Deserts, respectively. At one time bighorn probably inhabited all hilly or mountainous areas in Arizona where there was a combination of rocky outcrops and good, open visibility.

In 1849 travelers reported an abundance of bighorn in the following areas: the Muggins Mountains, on the lower Gila; the mountains between Tucson and the Gila River—the Sierra Estrella, Sacaton, Picacho

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6. Samuel W. Cozzens, The Marvellous Country (London, 1873), p. 100.

7. Edward W. Gifford, "The Southeastern Yavapai," Publ. in Amer. Archeo. and Ethnology, v. 34, Berkeley (1936), pp. 215-216.

8. Ibid.

9. Gifford, "Northeastern Yavapai," p. 265.

Peak, and the Tucson Mountains. Bighorn were hunted by the Pima Indians in the vicinity of Casa Blanca, on the Gila River. They were abundant at the northwest end of the Gila Bend Mountains, where they were hunted by the Yavapai Indians.[10] The species was generally common in all the ranges along the lower Gila River. In southeastern Arizona and southwestern New Mexico bighorn inhabited the Peloncillo and adjacent ranges in the 1850's.

The Emory expedition of 1855 reported bighorn as being particularly abundant in the Sonoran Desert ranges along the international border between Nogales and the Colorado River.

In northern Arizona Dr. Woodhouse saw no sign of bighorn in 1851, but he stated that the species was considered abundant in mountainous districts. A short time later other travelers found them numerous on the San Francisco peaks. In 1853 bighorn were observed in considerable numbers in the mountains adjacent to the Big Sandy River. Members of the Whipple expedition considered them much more abundant there than in the ranges lying to the east. The animals remained common in the mountains lying along the Bill Williams River.

The Ives expedition found bighorn common near the Colorado River, especially in the vicinity of the Sacramento Valley in 1858. They were also abundant in the early 1860's along the South Rim of the Grand

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10. Gifford, "Northeastern Yavapai," p. 265.

Canyon.[11] The Yavapai Indians reported many bighorn in the rimrock country adjacent to the Kirkland Valley, southwest of Prescott.[12]

During the gold rush in the Prescott area in 1863, prospectors found bighorn in considerable numbers in the Date Creek Mountains. However, by 1864-1865, Elliott Coues could write that the species was already greatly reduced in central Arizona and could be found only in the most rugged mountain regions.

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11. Leslie Spier, "Havasupai Ethnology," Anthropological Papers, v. 29, New York (1928), p. 11.

12. Gifford, "Northeastern Yavapai," p. 265.

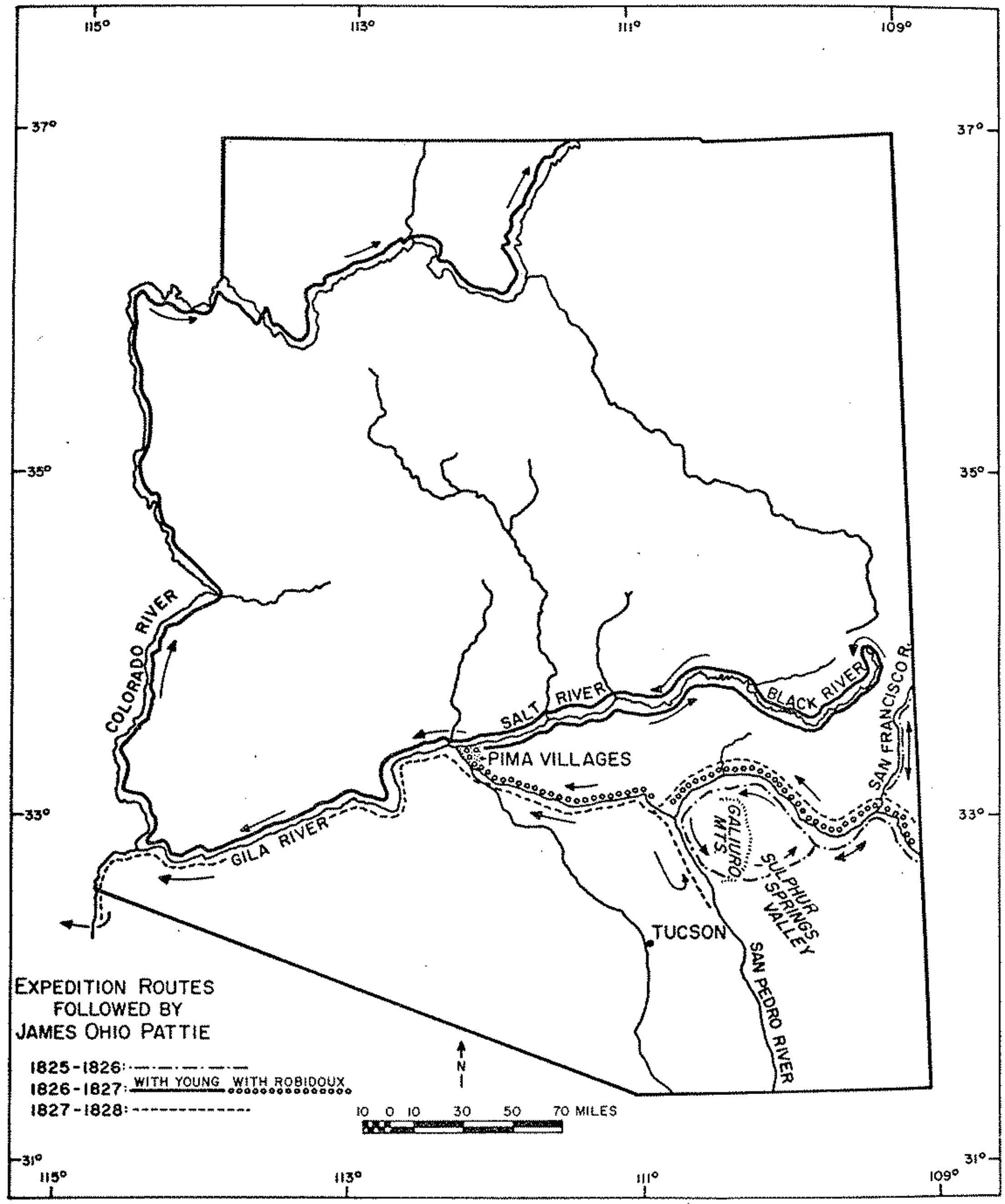

Fig. 1 Trapping Routes Along the Main Beaver Streams of Arizona

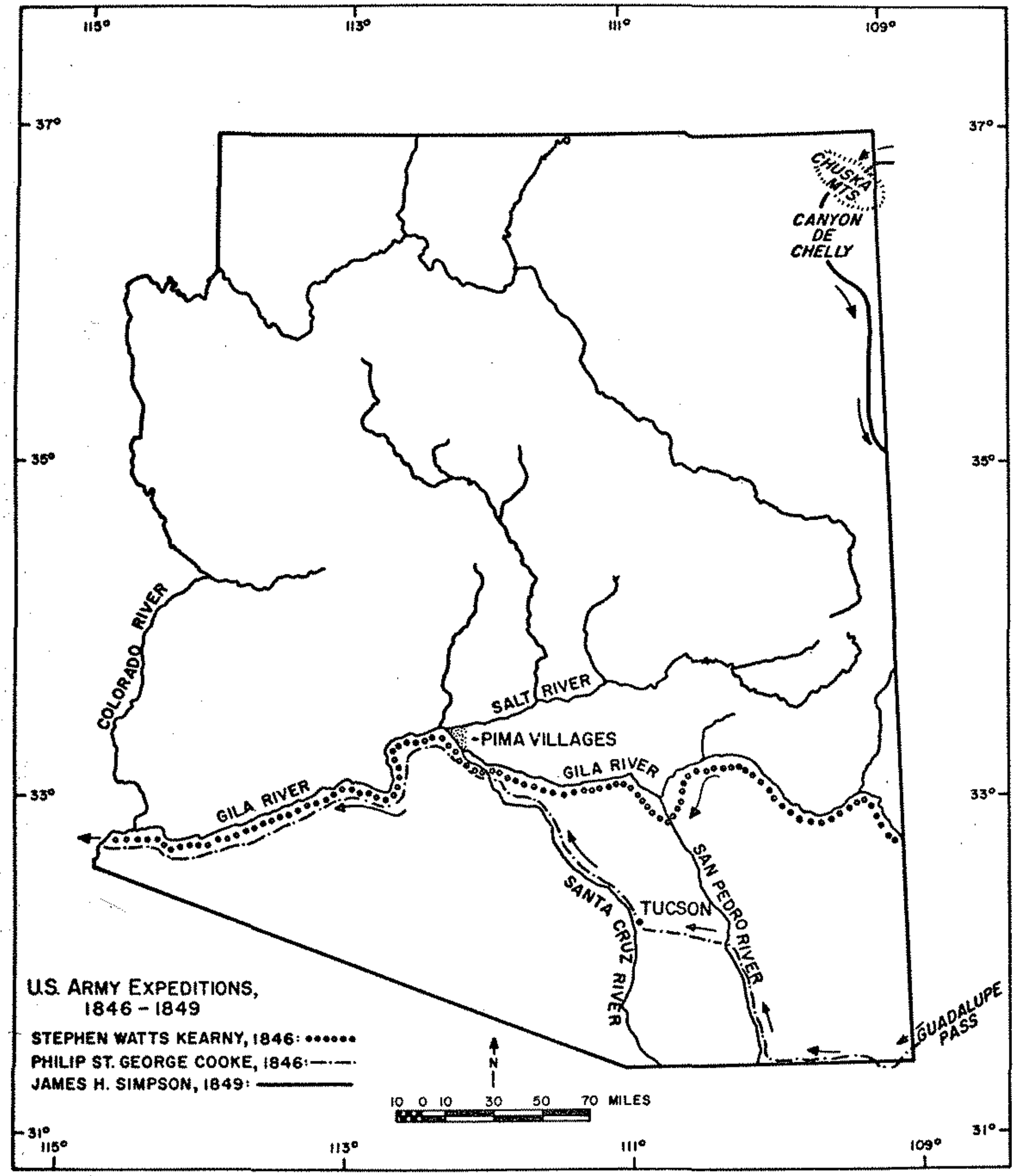

Fig. 2 U.S. Military Expeditions
Against the Mexicans and the Navajos, 1846-1849

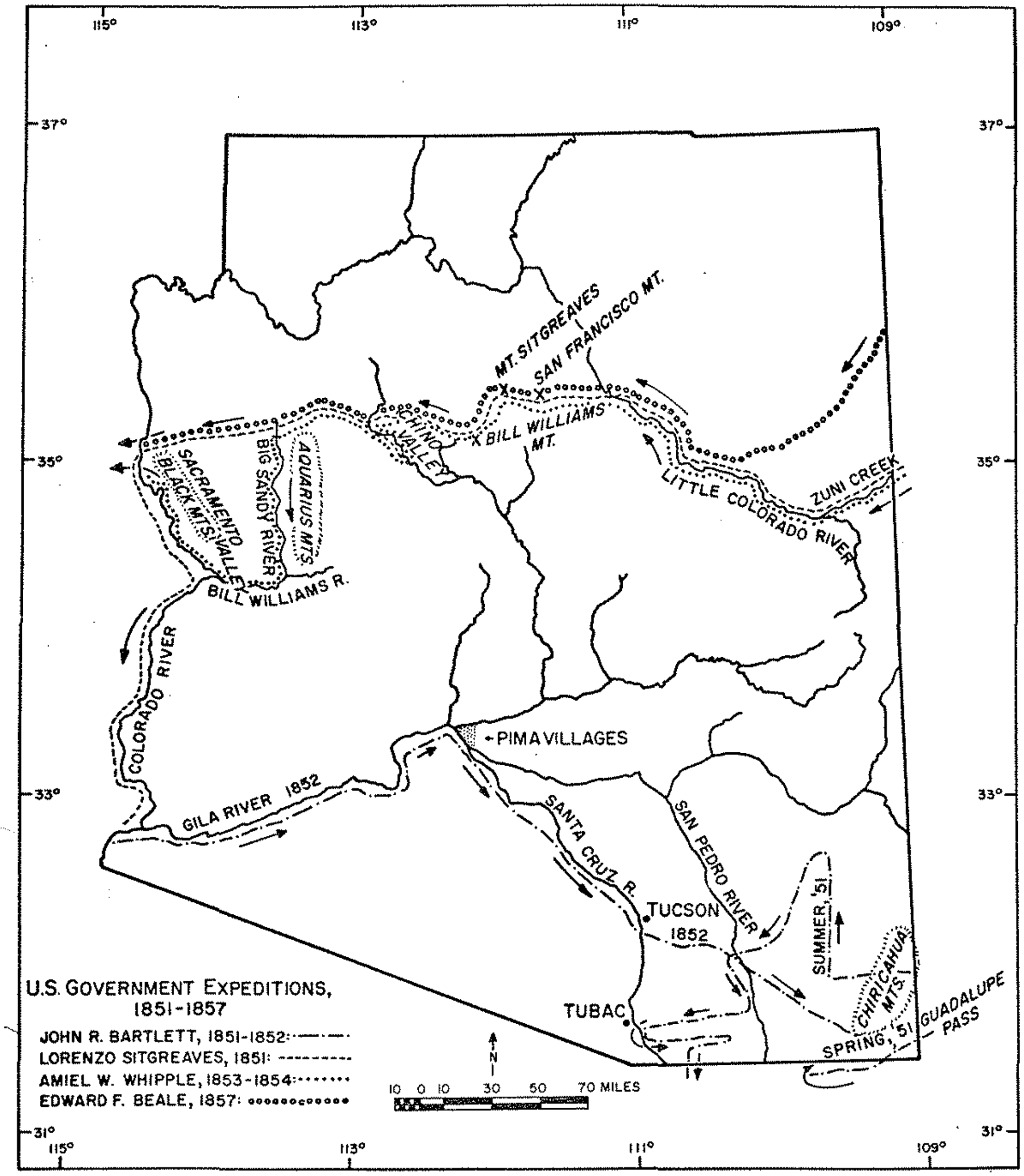

Fig. 3 Federal Surveying Expeditions, 1851-1857

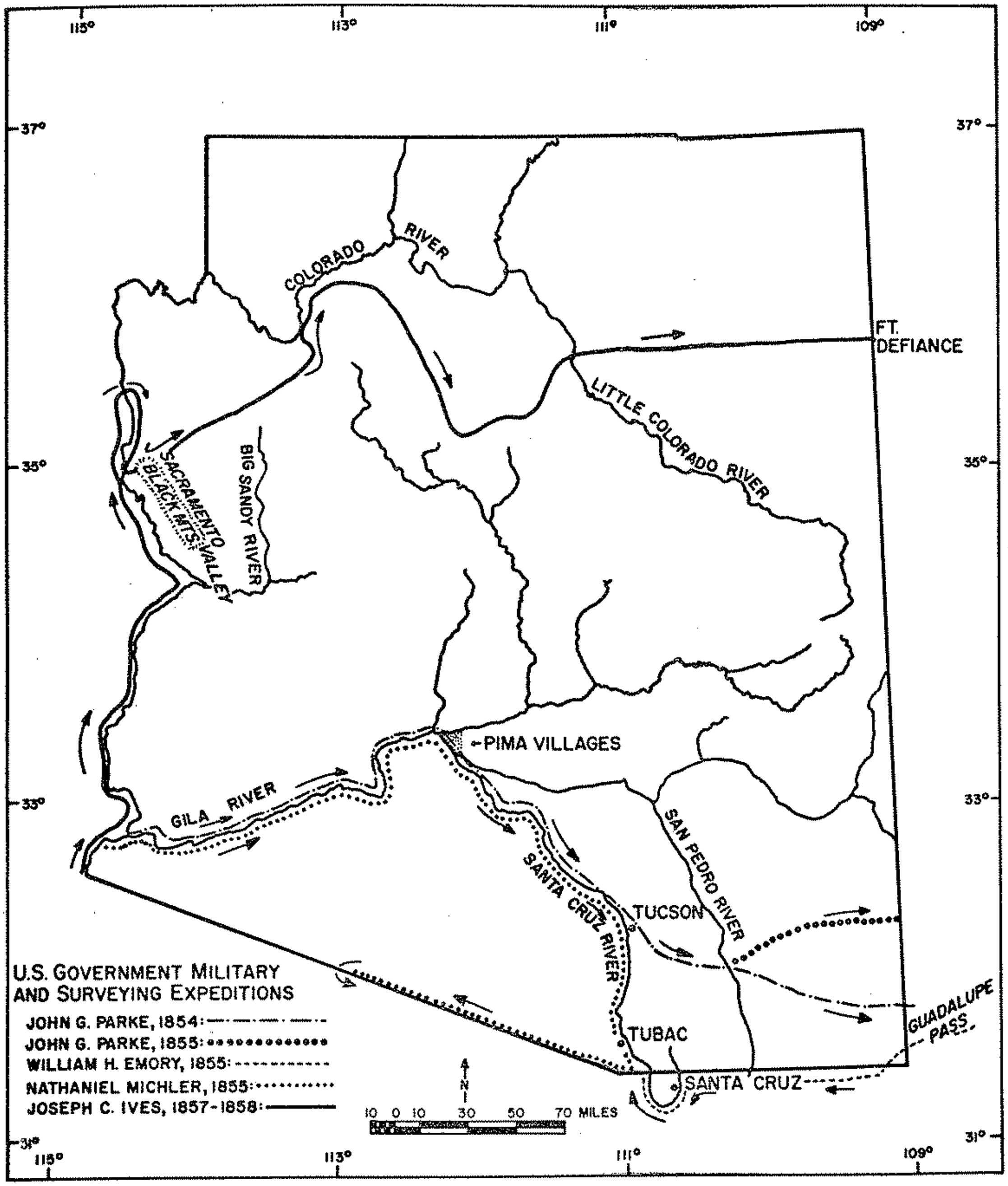

Fig. 4 Federal Expeditions to Survey the Area of the Gadsden Purchase and to Seek a Supply Route for the U.S. Army in Utah, 1854-1858

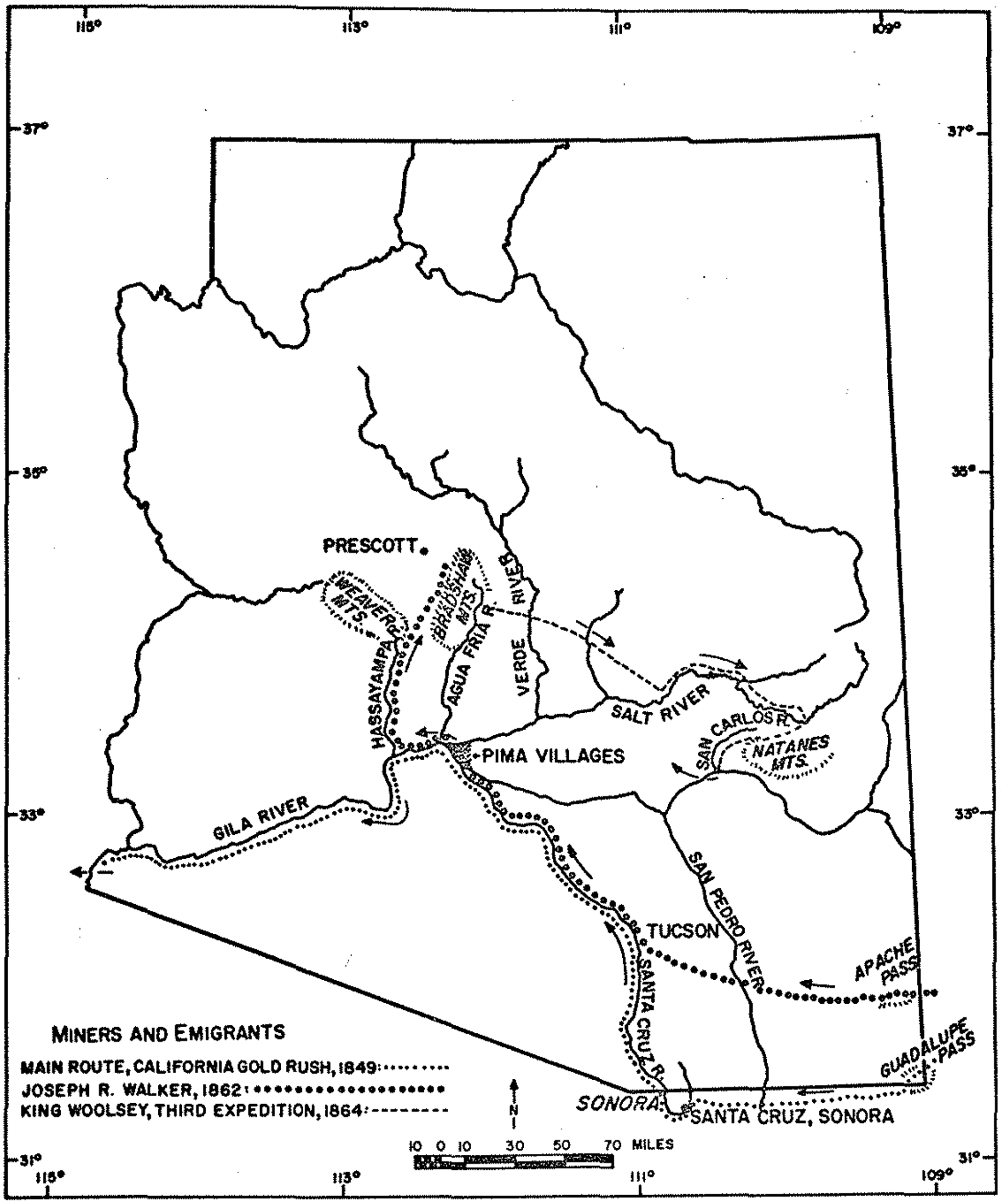

Fig. 5 Major Routes Followed by Gold
Prospectors to California and Central Arizona, 1849-1864

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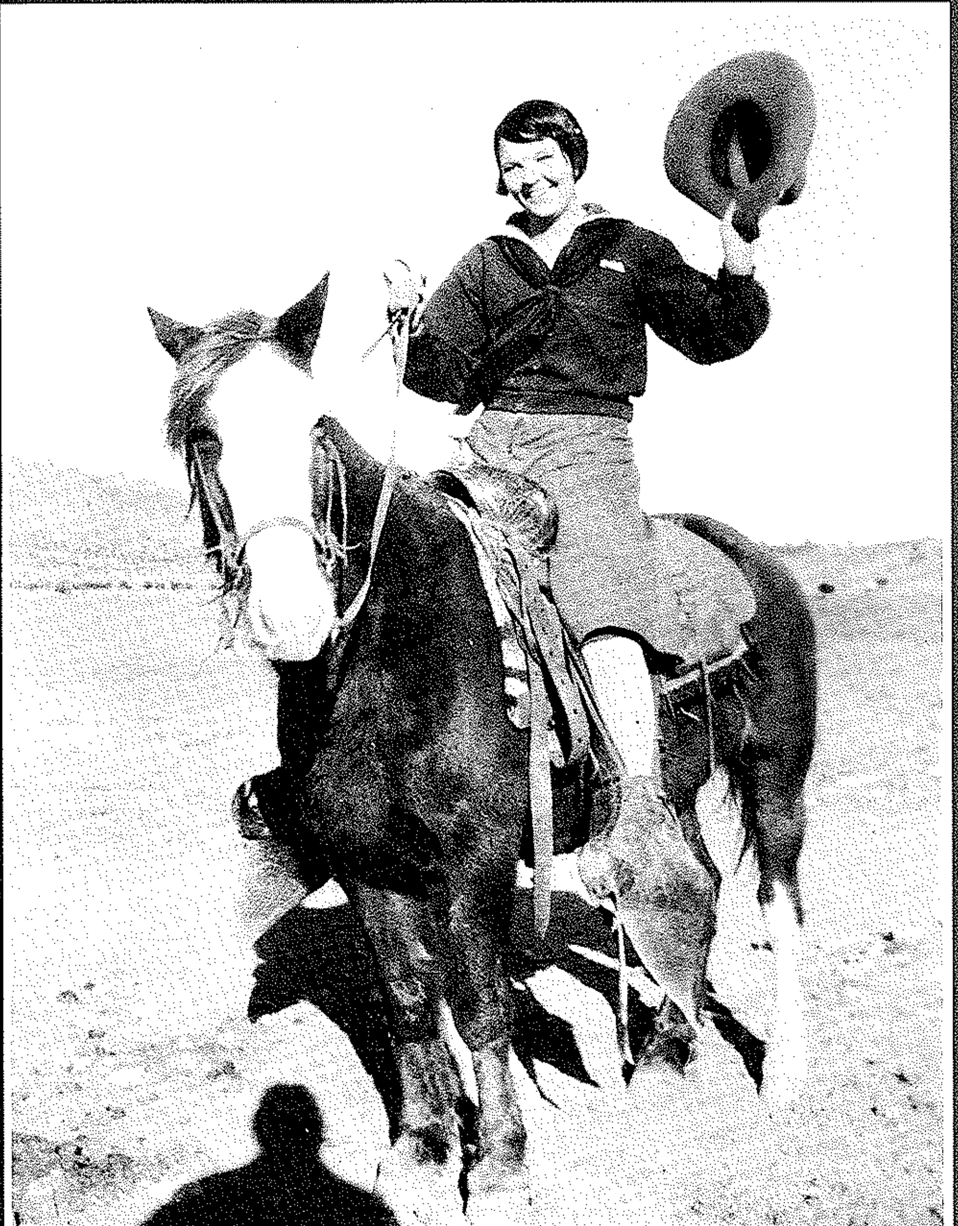

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BORN A CAVALRYMAN
Camillo C. C. Carr in Arizona

by
Jim Schreier

> One must be born a light cavalryman. No other position requires so much natural aptitude, such innate genius for war as that as an officer of that arm.
>
> —Antonie de Brack, 1831.

THE TROOPERS FROM FORT MCDOWELL adjusted to the backs of their saddles and tightened rein. It was 3:30 in the afternoon of October 3, 1866, and below them was a busy Apache rancheria. They had been riding since five that morning. At about two o'clock, they had discovered a fresh trail and followed it to the Indian encampment in the Sierra Anchas of central Arizona. Captain George B. Sanford shouted orders. With whoops and hollers the cavalrymen dug spurs to their mounts and galloped down the brush-covered mountainside, edging near boulders and trees. The surprised Apaches scattered amid a hail of carbine fire. After a running fight that lasted over an hour, the victorious soldiers gathered up the abandoned food, supplies, and equipment and burned them along with the Indian camp. Twenty-four-year-old Camillo C. C. Carr turned in his saddle to watch the fire. He had just experienced his first Indian fight.[1]

Camillo Casatti Cadmus Carr was born in Harrisburg, Virginia, on March 3, 1842, the sixth of eleven children of Wattson and Maria G. Carr. In 1857 the family moved to Chicago, where his

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Jim Schreier of Phoenix is an avid researcher in Arizona military history. He is particularly interested in Fort McDowell and its role in the development of the Salt River Valley.

physician father established the most respected medical practice on the West Side.[2] Camillo completed three years at the "old" University of Chicago. On August 15, 1862, just weeks before the beginning of his senior year, he enlisted as a private in the First U.S. Cavalry, where his older brother, Milton, was a captain.[3] He rose from corporal to sergeant major and was commissioned a second lieutenant with the help of a petition to President Lincoln from some of Chicago's leading citizens. Camillo's mother, Maria, wrote an even more convincing letter:

> I have had four sons in this war the youngest of whom is Camillo C. C. Carr who I am informed has been recommended by the officers of his Regiment . . . to a 2d Lieutenancy. . . . If you would be so very good as to give Camillo a commission you may rest assured that he will never disgrace it.[4]

Two months later, near Culpeper, Virginia, Camillo requested ten days' leave "for the purpose of procuring an outfit suitable for an officer in the U[nited] S[tates] A[rmy]." Brigadier General John Buford, commanding the division, granted him five days.[5]

Carr was twice wounded, most seriously in May of 1864 at Todd's Tavern, Virginia, where his legs were injured. This may be the reason that he was given a staff appointment a few months after rejoining his regiment. The assignment effectively removed him from action. "I was compelled as Regimental Quartermaster, and much to my regret, to remain behind," he later wrote, "so that my field services in the Civil War ended with the close of the campaign in the Shenandoah Valley in 1864."[6]

After Appomattox, Carr accompanied his regiment to New Orleans, San Francisco, and finally to Drum Barracks, near Wilmington, California, the staging point for its move into Arizona. Carr disliked quartermastering, and when Captain Sanford's E Company was ready to march east, Camillo made an impromptu decision. He had served with Sanford at Todd's Tavern, and Sanford now had an opening for a first lieutenant. Although it meant a ten-dollar cut in his monthly pay, he resigned as regimental quartermaster and prepared for the trip to Arizona. Carr later looked back at his decision with wonder, accusing himself of excessive youthful optimism.

Camillo C. C. Carr, around 1869.

Carr was introduced to Arizona by the seat of his pants. He described the scene when the company mounted horses that had formerly belonged to the Second California Volunteer Cavalry:

> The only objection to them was their irresistible propensity for bucking when first mounted, and this they displayed to such an extent that the troop was seldom ordered to mount without the air being filled for a few minutes with flying men, carbines and sabers in inextricable confusion. However, we had no one seriously injured and soon grew accustomed to this exhibition of the "high school" of riding, although not provided for in our drill book.[7]

Plagued by lack of water, intense heat and sandstorms, the march from Drum Barracks to Fort McDowell, via Fort Yuma and the overland route paralleling the Gila River, took the troopers fifty days. Carr was impressed by the vast plain north of the Gila that today is the site of Chandler, Tempe, and Mesa. Yellow and black pottery shards, stone tools, and skeletons of prehistoric irrigation canals—remnants of the vanished Hohokam civilization—littered the ground. A military trail led to the Salt River (the water was brisk and fresh and not at all salty), into McDowell Canyon, then four miles up the Verde River to Fort McDowell.

On May 30 the column approached its destination. From a distance, the post resembled a collection of dirt mounds. Although McDowell was only nine months old, many of its buildings already were in poor shape, having been constructed from insufficiently cured adobe and lacking roofs. Before long they collapsed under desert rains and windstorms. The officers' quarters had roofs, but lacked wood and glass to fill the rough openings for doors and windows. Tents lined the perimeter of the parade ground, which was covered with white granite that blazed so hot in the summer sunlight that it hurt the eyes.[8]

Carr recalled that dogfights erupted nightly outside his doorless quarters and within moments spilled into the middle of his living room. Chew-happy puppies often carried off boots and stockings. Soldiers who entered their quarters after dark lit matches to verify that rattlesnakes had not repossessed the area, and in the morning they gingerly plucked scorpions from wool uniforms.

The ceilings at McDowell were hard to forget because they leaked. A layer of horse manure sealed the roofs, which had then been covered with mud. "The water that poured through . . . was at first of a dark-brown color," Carr discovered, "then shaded off into a light yellow as the mud of the roof dissolved and made its way through the lower stratum. On such occasions the occupants of the quarters covered their bedding and other perishable articles with rubber blankets and passed their time outdoors, where if there was more moisture, it was at least cleaner and less fragrant."[9]

The infantry and cavalry at McDowell were chiefly occupied during the summer of 1866 with the construction of a government farm north of the post, following an ancient Hohokam canal. Because of McDowell's remote location, freight was expensive and delivery undependable. It was hoped that the farm would provide forage and grain and stabilize prices.

Carr described clearing the ground:

> A piece of bottom land lying on the [Verde] river, near the post, containing about half a section, was selected, an irrigating ditch several miles in length, and, in places, ten or twelve feet in depth, was dug; the land cleared of its dense growth of mesquite trees, bull brush and cactus—mainly by the labor of the three companies of the Fourteenth U.S. Infantry, and one troop of the First U.S. Cavalry, constituting the garrison.[10]

Post commander Lieutenant Colonel Clarence E. Bennett of the California Volunteers gave the farm his highest priority. Many overworked soldiers became sick in the intense desert heat. Others contracted scurvy, a vitamin deficiency disorder, caused no doubt when the company gardens, which should have been in production by early summer, were neglected.

Apaches roamed the post at night looking for metal and broken glass to manufacture into arrowheads. Captain Sanford recalled that the soldiers "repell[ed] constant raids not only on our communications with our supply depots, but on our very houses. No man's life was safe five hundred yards from the garrison by day or five feet from his door at night, and many a poor fellow I can remember who received his final discharge from the service and life by the deadly arrow of the Apache." The reason that the post was not properly defended, Carr maintained, was that the extra diversion of energy would hinder development of the farm.[11] What had started out as a cost-control measure was threatening the well-being of the garrison.

As the new post quartermaster and subsistence officer, Carr was responsible for obtaining food and supplies from hundreds of miles away. Fresh produce was scarce and prices were steep:

> For the first half bushel of potatoes I was able to buy in Arizona I gladly paid sixteen dollars, and would have given sixty had it been demanded. For once, money seemed to have lost its power. It could neither be eaten nor exchanged for that which the human system craved. When, at last, scurvy attacked the garrison, and the post surgeon demanded the purchase of anti-scorbutics [lime juice], wagons were sent two hundred and fifty miles and loaded with onions at forty-five dollars per bushel, and potatoes and cucumber pickles at corresponding prices. The remedy was expensive, but it was the natural result of the so-called economical measures originated by those in authority.[12]

While the soldiers performed forced labor, the territorial legislature grumbled that action against the hostile Indians was long past due. The Joint Committee on Military and Indian Affairs of the Third Territorial Assembly complained that the military was "inadequate properly to garrison the different posts and to defend the roads and mails, not to speak of waging an aggressive war upon a barbarous enemy, which war is positively necessary to the successful opening of the country." The Prescott *Arizona Miner* pointed out that it was the army's responsibility to defend civilians, and yet "our citizens are almost daily massacred, our property stolen, and in consequence our business enterprises are at a stand still [*sic*], and all for want of that protection which is due to us from our government, and which is our right to *demand*."[13]

Amid the uproar, the cavalry finally achieved success. The October 3 attack on the Apache rancheria in the Sierra Anchas demonstrated that, even with pressing supply problems, angry territorial politicians could be appeased.

Word of the victory exploded in the media, as newspapers throughout the country, including the New York *Times* and *Herald*, ran the text of the official report. "Such an officer . . . is worth his weight in gold," the ever-vocal *Miner* observed about Sanford, "and must have a warm place in the affections of the people." More importantly, some of the Apaches, under Chief Delchay, approached Fort McDowell requesting peace. As a compliment to the soldiers, the warriors offered to join them in an attack on Fort Grant.[14] Naturally, the post commander declined their generous offer.

Six weeks later Sanford led a second attack on an occupied rancheria, this time east of the Mazatzal Mountains. His Civil War-hardened troops were becoming accustomed to the new techniques of fighting in Arizona, and Sanford was quick to commend Lieutenant Carr in particular:

> To Lieut. *Carr* and the enlisted men . . . I am exceedingly indebted for the activity and energy they displayed. The conduct of one and all was gallant in the extreme. Their success in the previous expedition had given them confidence in themselves, and every man exerted himself to the utmost, to make the campaign a success. The long preserved reputation of the First Cavalry will never suffer in the hands of these men.[15]

In 1867 the Verde River flooded, damaging the intake canal that irrigated the McDowell farm. The summer harvest fell below expectations, and the price of hay skyrocketed to $65.00 per ton.[16] Carr, Sanford, post surgeon Charles Smart, and T. J. Barnes, a post employee, saw the potential for profit and on June 8 took out water rights on the north side of the Salt River. Two weeks later, they incorporated the Salinas Milling, Mining and Irrigation Ditch Company to reactivate an extensive Hohokam canal system for agricultural purposes—the first modern irrigation venture planned for the Salt River.[17] The project apparently never got underway, although in July the fort established a hay and grain camp in the immediate vicinity, suggesting that the enterprise was feasible.[18]

In January of 1868, Carr set out to establish a wagon road connecting McDowell with Camp Lincoln to the north and returning by way of the site for Camp Reno in the Tonto Basin.[19] The route along the Verde River covered some of the most rugged landscape in the territory. The heavy winter rains had turned central Arizona into a mud bog, and the river showed signs of rising forty feet above its normal level. Freezing rain and snow fell almost daily throughout the exploration. The expedition twice narrowly avoided disaster.

The soldiers encountered their first obstacle as they attempted to cross the flooded Verde. At the time, Carr reported the episode in unemotional language:

> . . . the Command proceeded to construct a Raft, a Corporal and six Men swam the River to assist in the Management of it[.] One was made of logs obtained on the bank of the stream and five (5) pack cords were placed upon it, the Raft was carried too far down the stream, . . . struck a Rock, capsized, threw the Raftsmen and Cargo overboard, the Raftsmen was [*sic*] recovered but the Cargo was lost.[20]

Twenty years later, he recalled the incident differently:

> The water was as smooth as glass, not a ripple disturbing its surface, and the current apparently sluggish. When about the middle of the stream there was a cry from the men, an opening in the surface of the water, and the raft went down bow foremost, never to be seen again. The men swam to shore, but neither the freight nor a stick of the raft ever came to the surface, or was seen again, although the stream was carefully examined for some distance below the scene of the wreck. The disappearance of that raft is a mystery for which no rational explanation has ever been offered.[21]

The second phase of the trip was equally harrowing. At Camp Lincoln, Carr rendezvoused with Captain David Krause of the Fourteenth Infantry, and the combined command turned southeast toward Camp Reno. Two guides employed at Lincoln suggested a shortcut, but instead the soldiers became engulfed in steep-walled canyons. As animals wore out and rations neared exhaustion, Carr decided to return to Lincoln. Then it began to rain. The creek rose, and horses sank up to their knees in mud. Pack mules lost their footing on slippery boulders and fell into the turbid water. Rain continued to fall, and the stream grew increasingly treacherous.

Recognizing that the situation was critical, Carr camped on a mesa above the angry creek. Miraculously, during the night the mud froze, and early in the morning the explorers followed the now-solid canyon floor to safety. The expedition had been costly. In addition to washed-away equipment, Carr lost eleven horses and four mules, nearly 25 percent of his livestock.[22]

Carr was overjoyed when he received orders in December to report for recruiting duty at Carlisle Barracks, Pennsylvania. His first tour of duty in Arizona had been arduous. Communication and cooperation between posts were almost nonexistent. Far from direct supervision, some of Camp McDowell's commanders had been difficult to serve. His assignments had been hard and the results meager. Major Roger Jones summarized the situation in his report of his 1867 inspection of Camp McDowell. The troops, he wrote, "have been more in the field than any I visited south of the Gila." But, he added, "their efforts . . . have not been crowned with any success of late."[23]

Without coordination between far-flung garrisons, the army in Arizona accomplished little. "With our one troop of cavalry," Carr noted, "we overran and routed the Apaches, temporarily, at least, from nearly every part of the country bounded by the Mogollon, the Verde, Salt River and the East Fork."[24] Because the War Department did not have an Indian policy, responsibility for various bands of Apaches shifted constantly from one post to another. Military activity in the territory, it seemed, had been in vain.

On April 8, 1869, Carr was promoted to captain of I Troop, First Cavalry, and ordered to Camp Winfield Scott, Nevada, as the post's last commanding officer. After thirteen months, Carr and his troop were sent to Camp McDermitt, Nevada, until November of 1871, when they were ordered to Camp Verde, Arizona, the new name for Camp Lincoln.

In 1870 two companies of Third Cavalry had been assigned to the post. The facilities, however, were too small, and a "cavalry camp" was established on the other side of the river, dividing the post in half. By 1871 a full-time construction program was underway at the cavalry camp, which was to become the new Camp Verde.[25] Carr reported for duty as commanding officer on December 3, 1871.

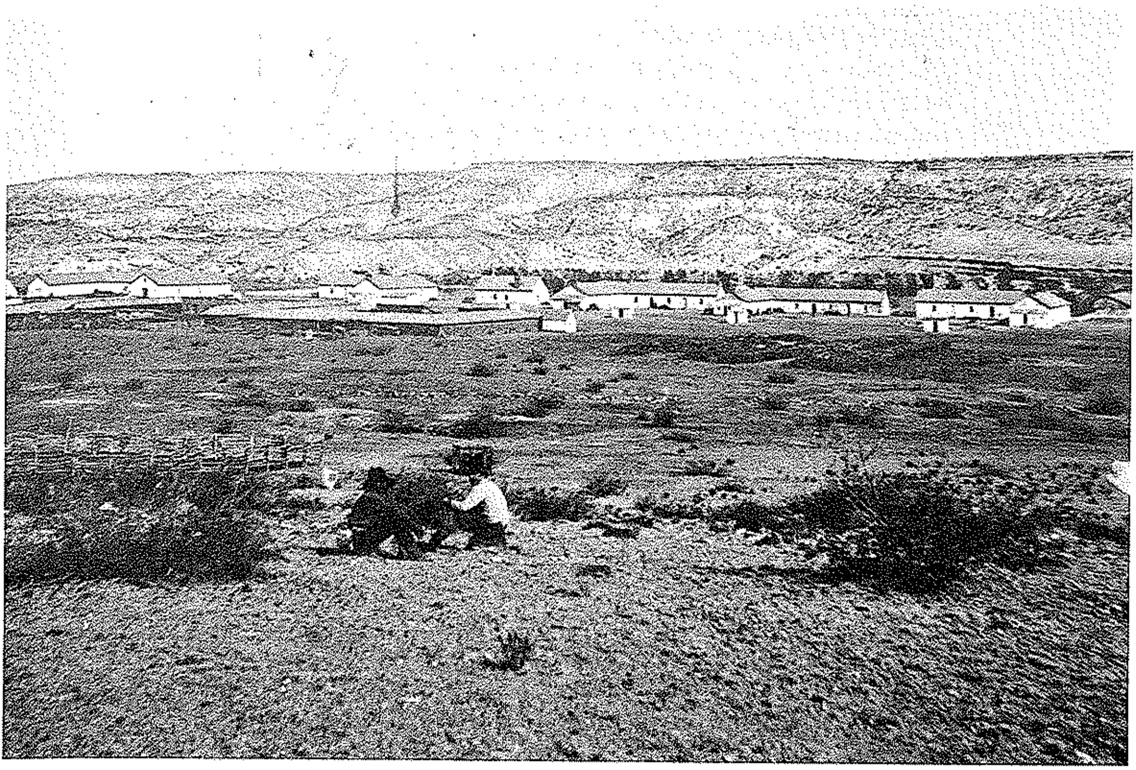
A week later, Lieutenant Colonel George Crook of the Twenty-third Infantry, commanding the Department of Arizona, ordered that all roving bands of Indians would be placed on reservations, one of them located at Camp Verde. The Verde reservation extended along a ten-mile-wide strip on each side of the river for forty-five miles, "to the point where the old wagon road to New Mexico crosses the Verde." If the Apaches did not settle on the authorized reservations by February of 1873, they would be treated as hostile. Carr was responsible for the operation and administration of both the reservation and the post of Camp Verde. As post commander, he was instructed to "prevent as far as possible collision between the troops and Indians." And, Crook added, "it is also your duty to protect as far as possible the settlers in your vicinity."[26]

Carr maintained cordial relations with the settlers. He authorized them to route a canal through the post, and when salt deposits were discovered in Copper Canyon, he permitted work on portions of the claim that overlapped the military reservation.[27]

A number of local contractors supplied Camp Verde, and Carr promoted good relations with his vendors as well. He accepted—over previous refusals by the post quartermaster—hay and firewood of questionable quality. The materials, he explained, were the best the local contractors were able to provide at that time of the year.[28]

The post trader's store served both the military and settlers, and was the commercial center of the Verde Valley. Although built and managed by civilians, the store operated under army regulations. Carr, however, was flexible in administering the rules. When Reverend David White, the post chaplain, complained to General Crook that Carr violated section 29 of the Articles of War by allowing the post trader to remain open on Sunday, Carr responded:

> To keep the trader's store at this post closed to the citizens of the vicinity as requested would only be received by them in the light of an unnecessary and arbitrary exercise of authority, and would not result



Camp Verde circa 1875.

in any benefit to the troops. The post store is the only one within 50 miles of this place at which citizens can make purchases of any kind, and they visit it principally on Sunday, not in order to show their contempt for the observance of that day, but because hostile Indians render travelling unsafe to small parties, and large ones can only be collected when farm labor is suspended.[29]

Crook agreed and the store remained open on Sundays.

When White also objected to Carr's manner of handling troops, Carr labeled the charges "disrespectful and malicious," and suggested that if another post had need of a chaplain, there were officers at Verde who certainly could make use of Reverend White's quarters.[30]

Carr by all accounts was strict but more than fair. For example, about a week after his arrival at Verde he approved excessive rations of flour for the men of the Third Cavalry. Of course, this caught the attention of department headquarters, which requested an explanation. Carr replied that because the garrison was divided by the river, troops were unable to maintain company gardens or build up a company fund. "The flour which has been purchased was considered actually necessary to prevent constant complaints of insufficient food," Carr explained. In addition, he noted that the troops had not been paid in over six months.[31]

Construction at the cavalry camp site progressed sufficiently so that the move to the new location started in March of 1872. Because the garrison was allowed only one horse, eighteen mules, two army wagons, and two carts to relocate 275 tons of equipment and supplies, much of the hauling had to be contracted out.[32] The army, however, refused permission to move 270 tons of hay stored at the old site, so operation of the post continued to be divided. "The necessity for speedily concentrating the stores and men at one post is becoming daily more urgent," Carr warned, "as the garrison is diminishing from sickness and other causes to such an extent, that it is a matter of some difficulty to furnish the necessary guard for public property."[33]

The relocation was anything but smooth. Materials for a new hospital and jail, for example, had been overlooked. The soldiers spent much of the first half of 1872 jockeying back and forth across the river. Camp Verde's resources were tested, but according to Prescott's newspaper, all in all it was "a good move."[34]

At first the Apaches tried to tolerate life on the Camp Verde reservation, but at the end of March, 1872, they began tampering with livestock and attacking settlers. This set off a cycle of depredations that lasted for thirteen months. "You will have to do the best you can with the force you have for the present," Crook's aide A. H. Nickerson instructed Carr, and "you must use your discretion should any emergency arise."[35]

Carr did not have to wait long for trouble to begin. The Indians complained that their tribesmen at the Date Creek reservation received flour, but Verde doled out only corn. Carr finally responded that they either "take corn and beef as rations or nothing."[36]

The situation on the reservation remained fluid. Some Apaches stayed, others left, and still others wished to return. Carr's response to those desiring to return followed Crook's terse instructions: "If they return, they will be treated and fed, but . . . they will be considered prisoners of war, and remain at [Camp Verde] as such for the present."[37]

Friction mounted as random raids continued. "Captain Carr [and] some other officers, and quite a party of enlisted men," the *Miner* reported tongue-in-cheek, "were out, trying to induce the Apaches to lay down their arms and take quarters on the reserve." Military action, however, had little impact. By August of 1872, all but six Indians had left the reservation. The day prior to skipping, the Apaches requested that their confiscated weapons be returned.[38] This time Carr's response was not recorded.

To settle the Indian problem, Crook planned to send out cavalry guided by Apache scouts in a great arc stretching from south of Prescott, past Bill Williams Mountain, through the Black Hills and Red Rock country, and north to the San Francisco Peaks, driving the Indians toward the southeast. Simultaneously, troops from other forts would launch a similar movement in a generally northwest direction. Eventually, the combined troop movements would herd the Indians into the Tonto Basin where, under the pressure of winter, they would be compelled to surrender.[39]

Reuben F. Bernard.

Crook personally directed the southern operation, while Nickerson oversaw the broad northern movements. Carr participated in two campaigns during December of 1872 and one eastern sweep in February of 1873. After most of the Apaches surrendered in April, Crook commended a number of men from Carr's I Troop for their important contributions to the success of the campaign. Carr himself was singled out for his "conspicuous services."[40]

In early May of 1873, troops of the First Cavalry were withdrawn from Arizona for possible action in the Modoc War. Taking only their personal effects, Carr and his troop left Camp Verde on May 13, rendezvoused with Company A at Fort Whipple, and then proceeded to Camp Mohave via Camp Beale Springs. The troopers surrendered their mounts and equipment at the Colorado River and boarded a riverboat for the trip downstream to Yuma. At the mouth of the Colorado, they embarked on a steamer for the ocean voyage to northern California.[41]

Commenting on Carr's departure, the *Miner* noted that he had "a good record of over four years in our territory."[42] The evaluation was as accurate as it was kind. Carr left Arizona knowing that military operations against a guerrilla enemy could not only be waged, but won. Success hinged on planning and cooperation.

Carr and I Troop spent the next eight years at Camp Halleck, Nevada. By August of 1881, however, the Apaches in Arizona had once again become troublesome. Colonel Eugene A. Carr (unrelated to Camillo) of the Sixth Cavalry moved in to arrest the medicine man Noch-ay-del-Klinne near Cibicu Creek, northwest of Camp Apache. In the process, some of Carr's Apache scouts reportedly turned on the soldiers, killing an officer and seven enlisted men. The press turned the initial Cibicu telegraphic reports into another Little Bighorn. Within weeks, troops flooded into southern Arizona over the new Southern Pacific Railroad.

On September 6, George Sanford (now a major) was ordered from Camp Halleck to Willcox station, the staging area for the military buildup in Arizona. Accompanying him were Camillo Carr's I Troop and G Troop under Captain Reuben F. Bernard. The trip, complete with arms, ammunition, mounts, and horse equipment, involved six commissioned officers and 122 enlisted men. The cavalrymen detrained at Willcox on September 10 and proceeded at once to San Carlos, then on toward Camp Apache. Near Black River on the nineteenth, they attacked and defeated a small body of White Mountain Apaches who appeared to have escaped from the San Carlos reservation. Afterward, the troopers returned to San Carlos.

During the night of September 30, Juh, Nachez, and seventy-four Chiricahua men, women, and children fled the reservation, killing the chief of Indian police. The next morning, Carr and Bernard set out with Major Sanford for Willcox. With them were forty-seven Apache scouts accused of participating in the Cibicu attack. North of Cedar Springs, a messenger from Colonel Orlando B. Willcox, the department commander, notified the soldiers that the fleeing Chiricahuas had attacked a wagon train, killing the owner and all the teamsters.

While Sanford halted, Lieutenants Gilbert Overton and John Glass happened along with a detachment of Sixth Cavalry and reported that the Indians had also massacred a military-telegraph repair party. Even though Sanford was ill (probably from recurring malaria), Willcox directed that he and Bernard proceed together with the Sixth Cavalry troops against the Chiricahuas. Carr and I Troop, meanwhile, would promptly conduct the Cibicu prisoners to Fort Grant. Taking an alternate route, Carr also was fired upon by the renegade Apaches.[43]

Once they had delivered their captives safely to Fort Grant, Carr had twenty men of I Troop ride out to reinforce Sanford. They caught up with him at about nine o'clock in the evening, just as Sanford emerged from a skirmish with the Chiricahuas. One sergeant had been killed, three privates wounded, and fifteen head of horses lost in the engagement. Stymied for the moment, the Indians pressed on south toward the Mexican border.[44]

News of the Chiricahuas' escape turned southeastern Arizona into a camp of tense soldiers and civilians. Tombstone prepared for the worst while the army quartermaster provided arms to Willcox residents. Southern Pacific Railroad section hands were warned to head into towns for safety. On October 3, Carr transferred the Cibicu prisoners to the Willcox depot without incident.[45]

At ten o'clock the next morning, Captains Carr and Bernard, along with Lieutenants Overton and Glass, loaded men, horses, and pack mules onto an empty Southern Pacific freight train and moved eastward until they spotted the Chiricahuas. Unloading their mounts from the boxcars, the troopers, with additional support from men of the Ninth Cavalry, commenced the chase in earnest.[46]

Carr and Bernard caught up with the Indians and chased them into the Dragoon Mountains. A telegram from Tombstone described the action:

> An attack was made at once, and while the Indians engaged the troops the women and children drove the stock over the other side of the mountains after which the Indians followed them. The troops pursued them to the south pass, but darkness made it impossible to go further.[47]

On October 5, two mountain howitzers arrived at Willcox, but they were too little, too late. Carr and Bernard closed to within

Camillo Carr, middle of front row, and First Cavalry officers at Helena, Montana, June of 1884.

five miles of the Indians when fatigue and thirst forced them to stop at Soldier's Hole and unsaddle their horses for the first time in twenty-four hours.

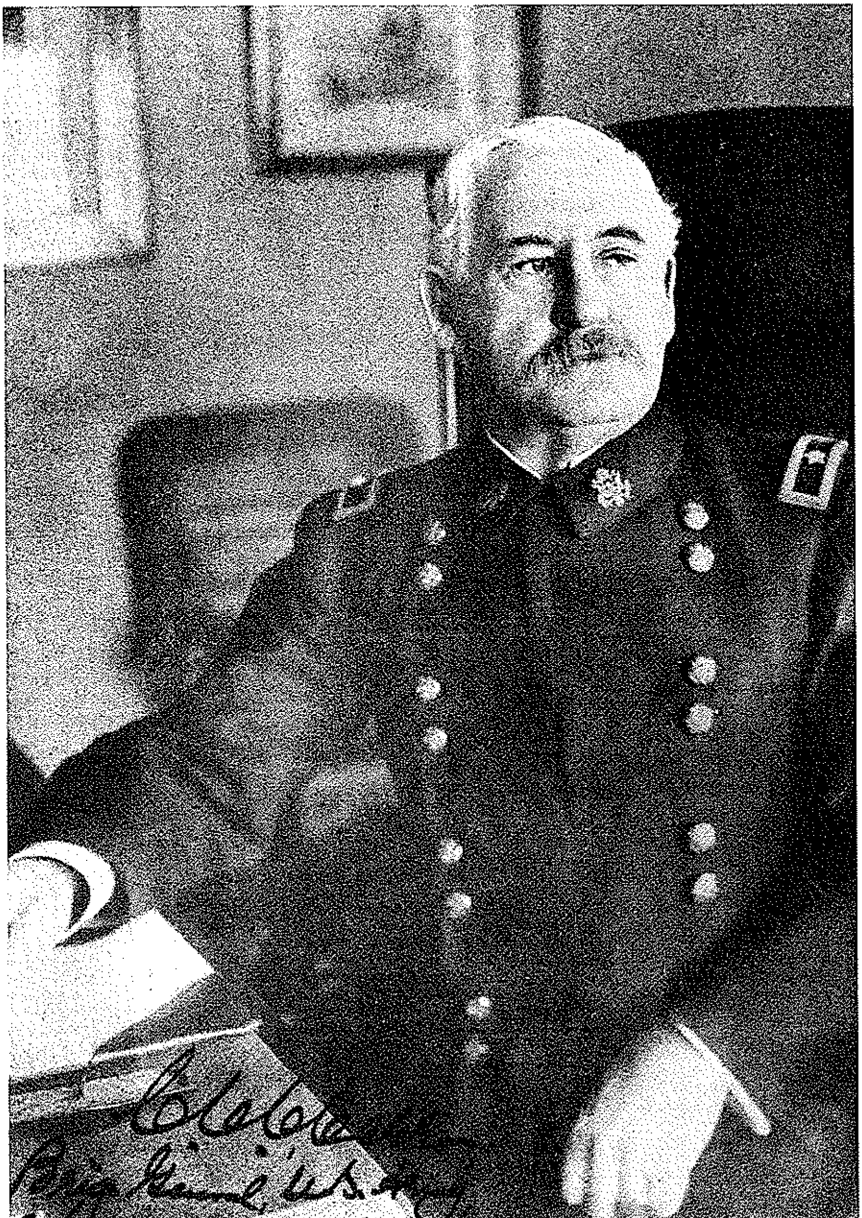
Tombstone mayor John Clum and two of the Earp brothers packed a wagon with supplies and, like a number of other Tombstonites, took off to "help" the cavalry. Their assistance, however, consisted only of that which "was given around their camp fires and coffee pots," punctuated by boastful conversations about capturing and scalping one of the Chiricahuas.[48]

While the cavalry rested, the Apaches pushed forward, gaining a full day's lead over the troops and passing within eight miles of Tombstone. After two nights and one day, the troopers resumed their pursuit in the rugged mountains along the border. Horses became disabled after losing shoes or falling among the rocks. Mexican authorities objected when Carr and Bernard crossed the international boundary, and Sanford was given the job of coming up with an official explanation and apology. By October 11 the Chiricahuas were safe in Mexico, and the campaign was terminated.[49]

The First Cavalry troops lingered in Arizona for the next two months, while General Willcox argued for their retention to guard against renewed Indian troubles in the spring. His requests, however, were denied, and on December 20, 1881, Carr and I Troop left Fort Bowie to return to Camp Halleck. It was Carr's last tour of duty in the territory.

Camillo C. C. Carr was one of the few army officers who served in Arizona during all phases of the Apache wars. He observed firsthand the limitations of cavalry, as well as what it was capable of achieving. The lessons he learned served him well in his subsequent career in the field, and as a writer and educator.

In May of 1885, Carr commenced teaching cavalry tactics, hippology (the study of the horse), and equitation (riding) at the School of Infantry and Cavalry Application at Fort Leavenworth, Kansas. He was instrumental in founding the United States Cavalry Association, the army's first professional organization, and both wrote for and later edited its *Journal*. In 1893 Carr published his translation from the French of Antonie de



Brigadier General Carr in 1903.

Brack's *Cavalry Outpost Duties*, a handbook written by one of Napoleon's generals, which considered, as did Carr, the cavalry as an assertive, pragmatic military force.

In the meantime, Carr experienced happiness and tragedy in his personal life. On November 27, 1878, he had married Mrs. Marie C. Camp, a well-known Washington, D.C., socialite. Marie died suddenly at Fort Leavenworth in April of 1893. The couple had no children, and Camillo never remarried. He remained active in the cavalry, participating in the late Sioux campaigns, the Puerto Rican occupation, and the Philippine insurrection. Carr was promoted to brigadier general in 1903 and retired three years later. He died in Chicago on July 24, 1914.

Captain John G. Bourke listed Carr prominently among nearly 100 army officers, Indian scouts, and civilians who made exemplary contributions to the pacification and development of Arizona Territory.[50] Like Bourke, Carr made valuable use of his Arizona experiences. Bourke saw his service as a means to advance scholarship; Carr employed the lessons he learned in Arizona to improve technical proficiency of the cavalry. For over two decades he had helped sustain the tenuous existence of early Arizona, and the vivid experiences never left him.

NOTES

[1]"Report of Scouts," pp. 1-6, manuscript, in Folder 1, Box 1, George B. Sanford Papers, Arizona Collection, Hayden Library, Arizona State University, Tempe. Sanford counted fifteen dead Indians. The Apaches later admitted that they lost some forty men in the fight.

[2]The family does not agree on the number of children born to Wattson and Maria Carr. Camillo maintains that there were twelve children but provides only eight names. See "Proof of Heirships for the Estate of Wattson Carr," December 13, 1889, Cook County Probate Court, Chicago, Illinois. His younger sister, Venitia, testified that there were eleven children. See "Proof of Heirships for the Estate of Maria G. Carr," December 16, 1896; and "Proof of Heirships for the Estate of Camillo C. C. Carr," July 31, 1914, both in ibid. Venitia Carr supplies the most detailed information. See also Chicago *Tribune*, December 2, 1889.

[3]The "old" University of Chicago existed from 1859 to 1886 and was unrelated to the current University of Chicago, founded in 1890. Milton Carr preceded Camillo to Arizona, having been stationed at Fort Buchanan in 1856-57. He must have influenced his younger brother to join the regular cavalry rather than the volunteers, as Camillo held the rank of lieutenant in both the Thirteenth Illinois Volunteer Cavalry (Bell's Division) and the Fifty-first Illinois Volunteer Infantry in 1861. Camillo maintained the highest regard for Milton throughout his life. See the Carr Collection, Chicago Historical Society; and Administrative Files on Civil War Companies and Regiments, R. S. 301-18, field and staff papers, Illinois State Archives, Springfield.

[4]Maria G. Carr to Abraham Lincoln, June 16, 1863, in Camillo C. C. Carr Appointment, Commission and Personal (ACP) File 2468/1871, Records of the Adjutant General's Office (RAGO), Record Group (RG) 94, National Archives (NA). Another brother, John D. M. Carr, served as assistant surgeon for the First West Virginia Infantry in 1861. *Official Register of the Volunteer Force of the U.S. Army* (Washington, D.C.: Government Printing Office, 1865), vol. 4, p. 1123. The fourth son has yet to be identified as an officer or enlisted man in the Union army.

[5]Camillo C. C. Carr to Assistant Adjutant General (AAG), November 14, 1863, Carr Collection.

[6]Carr's injuries, which he never mentions, are identified in [I. R. Dunkenberger?], "History of the First United States Cavalry," Wilmington (California) *Journal*, March 10, 1866; and Carr to Adjutant General (AG), January 16, 1903, Carr ACP File.

[7]C. C. C. Carr, " 'The Days of the Empire'—Arizona, 1866-1869," *Journal of the United States Cavalry Association*, vol. 2 (March, 1889), p. 5. This trip was also used to escort Maricopa chief Juan Chivaria back home after a tour of San Francisco. See Constance Wynn Altshuler, "Men and Brothers," *Journal of Arizona History*, vol. 19 (Autumn, 1978), pp. 315-22.

[8]Carr, " 'Days of the Empire,' " p. 9.

[9]Ibid., p. 10.

[10]Ibid., p. 12.

[11]George B. Sanford, *Fighting Rebels and Redskins: Experiences in the Army Life of Colonel George B. Sanford, 1861-1892*, edited by E. R. Hagemann (Norman: University of Oklahoma Press, 1969), p. 11; Carr, " 'Days of the Empire,' " p. 12.

[12]Carr, " 'Days of the Empire,' " pp. 13-14.

[13]*Arizona Miner* (Prescott), November 10, 1866; September 21, 1867.

[14]New York *Times*, December 10, 1866; New York *Herald*, December 13, 1866; *Connecticut Herald and Weekly Journal* (New Haven), January 18, 1867; and the *Arizona Miner*, November 30, 1866. Carr, " 'Days of the Empire,' " p. 18.

[15]"Report of Scouts," p. 9, Sanford Papers.

[16]Roger Jones, "Inspection Report of Fort McDowell," June 8, 1867, p. 7, in Records of the Inspector General, RG 159, NA.

[17]Yavapai County Promiscuous Records; and Arizona Dead Corporation Commission Files, Arizona Department of Library, Archives and Public Records, Phoenix.

[18]Post Returns, Camp McDowell, Arizona, July, 1867, Returns from U.S. Military Posts, 1800-1916 (RMP), M-617, Roll 668, RAGO.

[19]Special Orders 1, 2, and 3, January, 1868, in "Troops Operating in Northern and Central Arizona," Records of the U.S. Army Continental Commands, RG 393, NA.

[20]Carr to ________ , District of Arizona, January 28, 1868, in Records of U.S. Army Commands (RUSAC), RG 98, NA.

[21]Carr, " 'Days of the Empire,' " p. 21.

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[25]Constance Wynn Altshuler, *Starting with Defiance: Nineteenth-Century Arizona Military Posts* (Tucson: Arizona Historical Society, 1983), pp. 59-62.

[26]A. H. Nickerson endorsement of Carr's report of March 24, 1872, Letters Sent, Department of Arizona (LSDA), RUSAC.

[27]Carr to AAG, February 9, 1872, ibid.

[28]Carr endorsements, March 3 and 15, 1872, ibid.

[29]Crook and Carr endorsements to Reverend White's letter, April 25, 1872, ibid.

[30]White was relieved as chaplain at Camp Verde on April 10, 1873, and transferred to the Department of the Platte. Post Returns, Camp Verde, Arizona, April, 1873, RMP, Roll 1325.

[31]Carr endorsement, February 18, 1872, LSDA.

[32]*Arizona Miner*, March 2, 1872.

[33]Alexander Grant endorsement to Quartermaster General's letter, March 13, 1872; and Carr's second endorsement to ibid., both in LSDA.

[34]*Arizona Miner*, March 2, 1872.

[35]Nickerson to Commanding Officer, Camp Verde, December 29, 1871, LSDA.

[36]*Arizona Miner*, February 10, 1872.

[37]Nickerson to Carr, February 20, 1872, LSDA.

[38]*Arizona Miner*, July 27, August 17, 1872.

[39]For more information on Crook's 1872-73 operations, see Constance Wynn Altshuler, *Chains of Command: Arizona and the Army, 1856-1875* (Tucson: Arizona Historical Society, 1981), pp. 197-226; and Dan L. Thrapp, *The Conquest of Apacheria* (Norman: University of Oklahoma Press, 1967), chapters 8 through 11.

[40]General Order 13, Department of Arizona, April 8, 1873, LSDA.

[41]Post Returns, Camp Verde, May, 1873. *Arizona Miner*, May 17, 1873.

[42]*Arizona Miner*, April 12, 1873.

[43]Tucson *Weekly Citizen*, September 25, October 9, 1881. Sanford report, in *Secretary of War Annual Report, 1881-1882* (Washington, D.C.: Government Printing Office, 1882), pp. 146-47. John Bigelow, Jr., *On the Bloody Trail of Geronimo* (reprint, Tucson: Westernlore Press, 1986), pp. 18-19.

[44]Sanford report, in *Secretary of War Annual Report, 1881-1882*, pp. 146-47.

[45]*Weekly Citizen*, October 9, 1881.

[46]Don Russell, *One Hundred and Three Fights and Scrimmages: The Story of General Reuben F. Bernard* (Washington, D.C.: United States Cavalry Association, 1936), p. 163. Contemporary newspaper accounts refer to the train at Willcox, but do not verify the unusual (but ingenious) method of chasing the Chiricahuas by rail.

[47]*Weekly Citizen*, October 9, 1881.

[48]Ibid., and October 30, 1881.

[49]Telegram, Orlando Willcox to AG, Division of the Pacific, December 12, 1881, LSDA.

[50]John G. Bourke, *On the Border with Crook* (New York: Charles Scribner's Sons, 1891), pp. 209-11.

CREDITS—The photos on pp. 145, 153, and 159 are courtesy of Fort Verde State Historical Park; on p. 161 courtesy of the author.

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Arizona Game and Fish Department

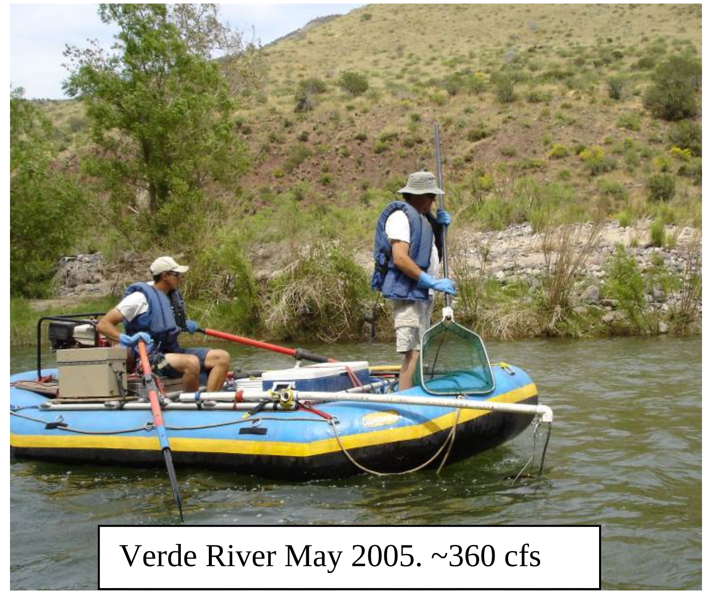
Salt and Verde River Fisheries Survey Trips and related River Flows

Prepared by David A. Weedman, Aquatic Habitat Program Supervisor

Date	River Reach	Discharge[1]	Measured at	Watercraft Used
June 19-21, 2001	Salt-Horseshoe Bend to Hwy 288	137-122 cfs	Roosevelt	Canoe electrofisher/Puma raft
Oct. 15-18, 2001	Verde Childs to Sheep Bridge	233-213 cfs	Tangle Creek	Canoe electrofisher/Puma raft
Apr 8-12, 2002	Salt-Gleason to Hwy 288	186-233 cfs	Roosevelt	Canoe electrofisher/Puma raft
May 14-17, 2002	Verde-Childs to Sheep Bridge	101-87 cfs	Tangle Creek	Canoe electrofisher/Puma raft
May 12-16, 2003	Verde-Childs to Sheep Bridge	160-150 cfs	Tangle Creek	Canoe electrofisher/Puma raft
Jun 9-13, 2003	Salt-Gleason to Hwy 288	175-135 cfs	Roosevelt	Raft electrofisher
Jul 31, 2003	Salt-Diversion Dam to Schoolhouse	500-700 cfs	Roosevelt	Raft electrofisher
May 17-21, 2004	Salt-Gleason to Hwy 288	310-280 cfs	Roosevelt	Raft electrofisher
June 14-17, 2004	Verde-Childs to Sheep Bridge	60-64 cfs	Tangle Creek	Canoe electrofisher/Puma raft
May 16-20, 2005	Verde-Childs to Horseshoe Lake	373-360	Tangle Creek	Raft electrofisher
July 13-14, 1995	Gila-Coolidge Dam to Winkleman	~1000cfs	Coolidge Dam	Raft electrofisher

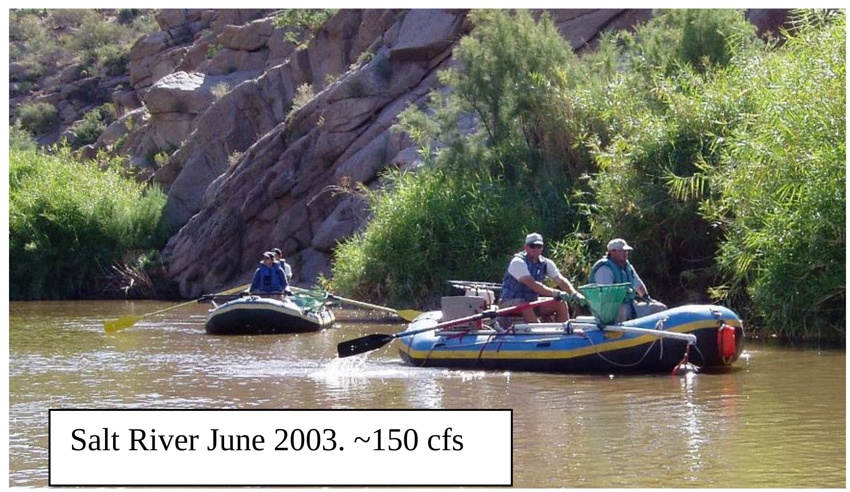
[1] Flows reported for first day of survey to last day of survey

Verde May 2002. 100 cfs



Verde River May 2005. ~360 cfs

Verde River May 2002. Canoe walked to avoid swamping generator. Other canoes ran this rapid. 100 cfs



Salt River June 2003. ~150 cfs

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Beaver Trap

Catalog Number: OHS Museum 218
Date: early 19th century
Era: (1754-1850) Age of Exploration / Cultural Encounters
Type: artifact
Author: Unknown
Themes: People and the Environment, Economics
Credits: Oregon Historical Society

Regions:
• Southwestern Oregon

Related Documents:
• Lithograph of Fort Vancouver
• Fort Nez Perce
• Trade Beads
• Hudson's Bay Company Blanket
• Men's Stovepipe Hat

Beaver Trap // OHS Museum 218

• enlarge this image

This beaver trap, from the early nineteenth century, was found by William Deveny in the Rogue River of southern Oregon.

From the mid-sixteenth century through the mid-nineteenth century, consumer demand for hats made from the fur of beaver fueled far-flung efforts to hunt and trap beaver across Europe and the Americas. Prices were sustained at such high levels throughout the period of the beaver hat's popularity that beaver pelts were themselves referred to as "soft gold" by some.

Although many scholars of the fur trade era have romanticized the lives of free-roaming trappers, the actual act of trapping beaver was arduous and sometimes dangerous work. To obtain quality pelts, most trapping was carried out during winter months, when the animals' fur grew thickest. Trappers had to frequently wade thigh-deep into frigid water near beaver dams. They set their traps under water, anchoring the trap's short chain in place with a stake long enough to be seen above the water line. For bait, trappers used castoreum oil, taken from the musk glands of beaver already unlucky enough to lose their hides.

The musk oil of the beaver, used by the nocturnal rodents to attract each other for mating proved itself to be an effectively lethal attractant when rubbed onto the top of the anchoring stake or suspended from a tree branch in a small bag above the trap. At night, an unsuspecting beaver would swim toward the scent, stand up to get a good whiff, and step on the trap's trigger, located at the center of the trap. Once the trigger was activated, the jaws of the trap would slam shut onto the beavers leg. Frightened and in pain, the beavers would swim toward the deepest water available—a flight response that evolved over millenia to help them escape dangers originating from land. However, once in deep water, with an anchor firmly attached to its foot, the trapped beaver would eventually tire and drown. Trappers preferred drowning beaver so that their catch would be preserved from scavengers as long as needed, under water, until they could empty their trap. Most often, trappers would "clean" their trap and reset it until they had caught all of the beaver in the area, then move on, leaving nothing for their competitors to capitalize.

Further Reading:

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Vaughan, Thomas and Bill Holm. *Soft Gold: The Fur Trade and Cultural Exchange on the Northwest Coast of America*. Portland, Oreg.: 1982.

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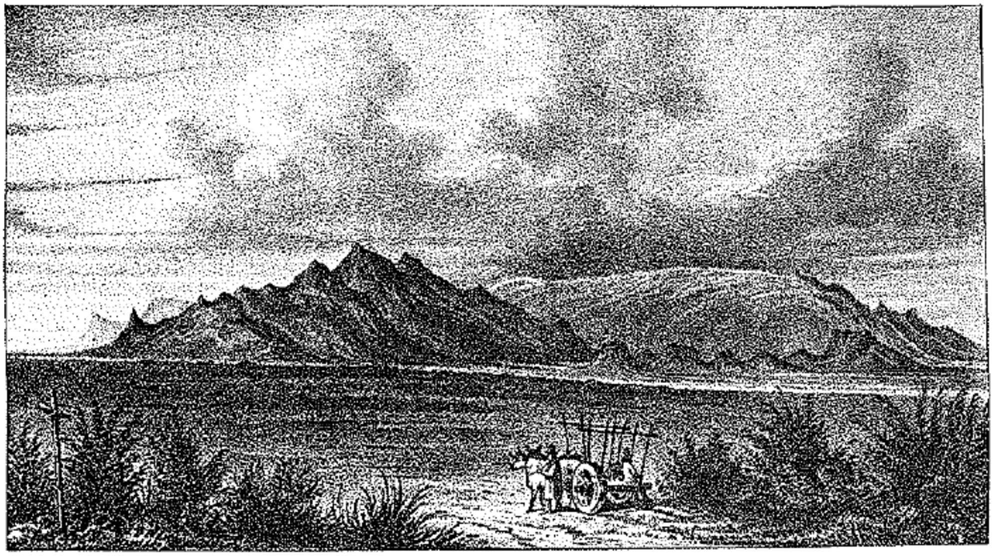
The Road West

Saga of the 35th Parallel



Bertha S. Dodge

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2

The Making of a Mountain Man

By the end of the eighteenth century, Imperial Spain was not only losing her preeminence as a world power but at home the stronger powers in Europe had come to look upon her as decadent and a fair spoil. Though the Treaty of Paris (February 10, 1763), which ended the Seven Years War (French and Indian War to Americans), transferred the Louisiana Territory from France to Spain, her grip on it was feeble. By the turn of the century, a world-conquering Bonaparte was forcing return of sovereignty over Louisiana to the French under the Second Treaty of Ildefonso. France, in turn, agreed that should she ever be moved to divest herself again of the Territory, it should be to no other power but Spain. Within three years of that agreement, a financially stripped and forsworn Bonaparte was selling Louisiana to the United States.

Naturally, Spaniards, those overseas even more than those at home, were infuriated by the bad faith this sale demonstrated—the fury being directed especially toward the purchasers. But what had they purchased? No one knew precisely what that Louisiana Territory included. No one had surveyed it and drawn lines on a map indicating where it ended and New Mexico Territory began.

So exploring parties went forth to find the answers. There was the U.S. government-sponsored expedition of 1804–6, directed to locate the source of the Missouri River. There was also an expedition, sent out in 1806 by General Wilkinson of dubious fame, under Lieutenant Zebulon Montgomery Pike, to search out the sources of the Red and Arkansas rivers. This latter exploration of the more southerly areas ended in Pike's running afoul of Spanish authorities in Santa Fe, New Mexico. Of course those authorities knew no better than their United States counterparts just where the line of demarcation should run. They were, in any case, growing suspicious of the motives of any U.S. explorer and, more particularly, of the sponsors of this one, who, they feared, might be scheming toward a takeover of all Mexico. Thus when forced by the bitter cold of winter in the Sangre de Cristo mountains to seek refuge in Santa Fe, Lt. Pike was immediately seized, though politely so, marched south into Mexico, then forced to abandon his expedition altogether and return to the United States. Two nations, which miles of separation had previously kept in reasonably friendly attitudes, now were looking at one another across the vague borders of the Louisiana Territory with suspicions that were not completely unjustified.

By 1821, Mexico, without the U.S. aid that authorities in Spain had long been anticipating, broke away from Spain and declared her independence, thereby assuming formal control of New Mexico, which she intended to hold inviolate from the grasp of ambitious adventurers from the east and north. So far these adventurers had, for all practical purposes, been confined to two classes—traders and mountain men. Traders were bound to be the least menacing to authorities in Santa Fe since they could not conduct much profitable trade in secret. Beside, the wares they brought at their own risk to such isolated communities must have been something of a compensation for their unwanted presence. A mountain man, on the other hand, killed fur-bearing animals, took the furs, and offered little in return save the reckless spending of wages in the night spots of towns like Santa Fe. And always there was the menace of an attempt at takeover by the government in Washington.

For twenty-five years, the Mexican government tried to enforce strict rules against the infiltration of her remote northernmost province by adventurers from the United States who, if encountered, could count upon less friendly treatment than Lt. Pike had received. So it is small wonder that for this period, El Morro shows only a single, now nearly effaced inscription—"O.R. 1836."

Who was O.R.? A trader? A mountain man? What nationality and where from? Surely, while New Mexico remained a territorial possession of old Mexico, no non-Mexican mountain man who knew what was good for him—and only a mountain man who knew what was good for him could long survive—would have left his name on El Morro, thereby announcing to the world he was a trespasser. The trapping and hunting on which he depended for food, clothes, excitement, and income was strictly illegal for any United States citizen. Even had he been one of the rare mountain men who were literate, he must have known better than to defy the authorities by leaving a damning confession upon a rock to which Mexican officials had access.

This is not to suggest that mountain men did not continue to take the thirty-fifth parallel route if they thought there might be some profit in it for them. Having explored the unexplored western wildernesses, they felt them to be theirs to use as they saw fit. The spoils should come to the men who took the risks and defied death there in any number of forms. Only an unusually intelligent, brave, cautious, self-reliant man could hope to survive long at their trade. Such a man cared little about restraints imposed from the outside, whatever the government imposing them. Living from one day to the next, mountain men concerned themselves very little with what another month or year might bring. Immortality of any kind, notably that to be achieved by a few scratches on soft sandstone, would look to them as silly as it must be valueless.

Though most mountain men seem to have gotten along quite well in their particular limited world without reading or writing skills, their lack is our real loss. If only some of them had sent letters to distant friends telling of their unique kind of life and if only a few such letters might have survived! If only, like Juan de Oñate, they had recorded their passing on Inscription Rock—"Christopher Carson passed this way bearing dispatches from California to Washington"—but such "if only's" are of small use now. Today we must rely upon legends or upon the comments of more literate friends and admirers to picture the kind of life that was theirs.

The name of that most famous of mountain men, "C. Carson 1863," was actually once seen upon the rock, though today it cannot be found. Who put it there? Who later removed it? And when, and why? And why that special year when Kit must have passed that way numberless times both earlier and later, including those many dispatch-bearing missions? Perhaps his first visit to the rock was in 1829 when the twenty-five-year-old Kit left Taos with a group of men, mostly traders, headed for California on an expedition that the Mexican authorities, had it been brought to their attention, would have sternly forbidden.

It might be that Kit himself made that inscription on the rock, for by 1863 he had learned to write his name at least, as it is known that he did before his death in 1868. Or perhaps his name was placed there by one of the soldiers serving under Kit during his years of army service when he finally attained the rank of brigadier general. Perhaps it was cut by a friend who thought that among the names of so many brave and adventurous men, Kit Carson's should not be lacking.

Kit had a host of such admirers that included both his illiterate one-time mountain-men companions and highly literate officers like the Lt. Beale, whose name, undated and in modest script, still survives on a protected area of the rock. In 1863, however, Lt. Beale could have cut no inscription there for at that date he was, by President Lincoln's special request, acting as surveyor-general for California and Nevada.

Always, since chance had first thrown him into Kit's company, Beale had cherished the deepest admiration and the warmest affections for this man, "who had not the advantage of an education but was wise as a beaver." It would be Ned Beale who would rise swiftly and indignantly in Kit's defense when, in 1871, with Kit no longer able to defend himself (had he been of a kind to think it worth the trouble), Joaquin Miller published a smart-alecky poem that Beale felt depicted Kit Carson as a coarse border ruffian.

"Dear old Kit," Beale wrote:

> Looking back through the misty years, I see a man calm, serious, and sweet of temper; a man of very moderate stature, but broad-fronted and elastic, yet by no means robust of frame though gifted with immense endurance and nerves of steel. A head quite remarkable for its full size and very noble forehead, quiet, thoughtful blue eyes, and yellow hair, and very strong jaw. . . . This was the outward shape which enclosed a spirit as high and daring and as noble as ever tenanted the body of man . . .
>
> Oh, Kit, my heart beats quicker even now, when I think of the time twenty-five years ago, when I lay on the burning sands of the great desert, when you had, tenderly as a woman would put her firstborn, laid me, sore from wounds and fever,

> on your only blanket. I see the dim lake of waterless mirage. I see waving sands ripple with the faint hot breeze around us, and break upon our scattered saddles. I see the poor mules famishing of thirst, with their tucked flanks, and dim eyes, and hear their plaintive cry go out to the wilderness for help. . . .
>
> Without a thought of ever seeing water again, you poured upon my fevered lips the last drop in camp from your canteen . . . afterwards, on the bloody Gila, where we fought all day and travelled all night, with each man his bit of mule meat and no other food, and when worn from a hurt I could go no further, I begged you to leave me and save yourself. I see you leaning on that long Hawkins gun of yours (mine now) and looking out of those clear blue eyes at me with surprised reproach as one who takes an insult from a friend. And I remember when we lay side by side in the midst of the enemy's camp when discovery was death and you would not take a mean advantage of a sleeping foe. [16]

The "twenty-five years ago" was in 1846, during the Mexican War, when Edward Fitzgerald Beale, twenty-four-year-old alumnus of the United States Naval Institute, came to know Christopher Carson, thirty-seven-year-old graduate of innumerable hunting-trapping expeditions into remote western wilderness. In war, as well as on such expeditions, nerves of steel and inexhaustible endurance counted most and the wisdom of a beaver could far outweigh the knowledge of a genius. Gallantry, of a kind that refused to take advantage of a sleeping foe, which Ned Beale described in Kit and which Kit, though he was unable to record it, sensed in Ned—this was something extra, something upon which the friendship of a lifetime could be based.

In 1810, Christopher Carson's frontier parents had moved from Kentucky to Franklin, Missouri, half way up the Missouri River from the city of St. Louis to the very little town that was to become Independence. In Franklin, one-year-old Christopher, as well as all his brothers and sisters, would grow up without a chance to master the three R's, without even becoming more than vaguely aware of a need for learning. In any case, for such youngsters no printed tale could possibly have rivaled the excitement of word-of-mouth accounts that passing adventurers from far western mountains told to the young and old alike.

Those fur-laden trappers and hunters, fresh from expeditions to remote areas known to few but themselves, would pass a few days, maybe, in Franklin before moving on downriver to St. Louis. In that Mississippi River metropolis, they'd sell their furs and have themselves a wild and wonderful time with the proceeds. Then they'd start upriver again to head for the mountains, supplied with equipment for the new expedition, purchased, usually, against the income from the next year's furs. It was a life of adventure and freedom and danger.

Kit's father could not have failed to read in his son's eyes the lad's hero worship for these passing mountain men and, fatherlike, he must have become alarmed. No such wild risky life for a son of his! The boy should settle down and learn a steady trade that could support him, and help his family, of course. In a community dependent on horses and mules for any transport away from the river thoroughfare, saddlery was as safe a bet for the future as a filling station or garage now might be. The local saddler, David Workman, was willing to receive Kit as an apprentice, so an agreement was soon drawn up and Kit found himself bound to a trade "that did not suit me."

"Having heard tales of life in the mountains of the West," he later confessed, "I concluded to leave him. He was a good man, and I often recall to mind the kind treatment I received from his hands, but taking into consideration that if I remained with him and served my apprenticeship, I would have to pass my life in labor that was distasteful to me, and being anxious to travel for the purpose of seeing different countries, I concluded to join the first party for the Rocky Mountains." [48]

The first party for the mountains to which Kit, after reaching the decision, could attach himself left the river in early September. Kit was along, though, by the rules of the game, he was legally bound to serve out the apprenticeship in which his father had placed him. His master was equally bound to watch over and provide for the youth entrusted to his care.

The kindness that Kit so long remembered was shown in the advertisement placed by his master in an 1826 issue of *The Missouri Intelligencer:*

> Notice: To whom it may concern. That Christopher Carson, a boy about sixteen years old, small of his age, but thickset, light hair, ran away from the subscriber, living in Franklin,

> Howard County, Missouri, to whom he had been bound to learn the saddler's trade, on or about the first day of September last. He is supposed to have made his way toward the upper part of the State. All persons are notified not to harbor, support, or subsist said boy, under penalty of law. One cent reward will be given to any person who will bring back said boy. (Signed) David Workman, Franklin, October 6, 1826. [16]

One cent could hardly have been David Workman's estimate of Kit's worth. Nor could it have taken him six weeks to become aware that the lad had left Franklin. Least of all could he have expected that any boy bound for "the upper part of the State" had not in six weeks managed to get himself well beyond the reach of Missouri law. By thus advertising, the master was fulfilling his legal obligations and could smile his kindliest smile at the thought of the restless boy happily headed for the land of his dreams.

Three years later, in Mexican Santa Fe and after some kinds of employment that could not have been much more to his taste than saddlery, Kit managed to approach his dreamed-of goal by joining a California-bound expedition under the direction of an experienced fur trapper named Ewing Young. "In those days," Kit later recounted, "licenses were not granted to citizens of the United States to trap within the limits of Mexican territory . . . We travelled in a northerly direction for fifty miles then changed our course to the southwest." [33, 48]

This was typical strategy for the times. During the California-bound trip, which ended with the band's return to Taos in 1830, they crossed through Zuñi and Navajo country. Since Zuñi lies not many miles west of El Morro, it is a safe bet that they paused by the tank to water both horses and mules, not to mention themselves. Without a license for exploration and trapping, even the most literate member of the band would not then have dreamed of adding a damning personal inscription to the roster already on the rock.

"In April, 1830," Kit told of that trip, "we had all safely arrived at Taos. The amount due us was paid, and each of us having several hundred dollars, we passed the time gloriously, spending our money freely, never thinking that our lives were risked in gaining it." Kit was learning that it was routine for most mountain men to risk their lives in gaining money which they would spend riotously.

During the following decade, Kit, now a full-fledged mountain man, built himself a formidable reputation both as a hunter (notably to supply meat to Bent's Fort, a private establishment on the Arkansas River) and as a trader (notably for the Bents of Bent's Fort and of St. Louis, Missouri). He also managed to fall in love, twice. The first time was with a girl of a proud St. Louis French family, which sternly forbade marriage with a man who not only had taken a now deceased Indian squaw to wife, but who published his unfortunate union through a half-breed daughter he would not dream of disowning.

The second time, deeply in love with the aristocratic Mexican belle María Josefa Jaramillo, Kit was determined not to let the child stand permanently in the way of his own romance. She was not, however, to be denied loving care or the best upbringing and education available. Certainly she was not to grow up among her mother's people to become the squaw of some wild Indian. The way out would be to persuade one of his Missouri relatives to take the child into her home and keep her there until she was old enough to be received into a proper St. Louis convent school. A niece in Howard County, Missouri, agreed to this and Kit heaved a sigh of relief that his little Adaline would now have a far better chance of growing up happily than in a community like Taos that already had no real place for its too many half-breeds.

In 1842, when Kit had made that return journey to Franklin and completed the family arrangement, he decided to go on downriver to visit St. Louis, center of the fur trade and of fur traders. Ten days of that metropolis, which seemed overcrowded and too noisy, sufficed for the mountain man. He was soon again bound upriver on a boat headed for Westport Landing, just beyond the western extremity of the state.

As fate would have it, a fellow passenger on that same boat was John Charles Frémont, planning the first of his several western exploring expeditions, one of the earliest government-subsidized explorations of the country lying between the Missouri River and the Rocky Mountains. To an ambitious twenty-nine-year-old army man hoping to make a name for himself in the strange wild land ahead, the thirty-three-year-old mountain man must have seemed like the answer to a prayer. As homesick Kit spoke knowledgeably about the mountain land toward which Frémont was headed, Frémont listened delightedly. By the time the boat reached Westport, in May 1842, Kit had been persuaded to serve Frémont for $100 a month, just about three times the amount the Bents had been paying him.

Perhaps the respectable government employment helped convince María Josefa's critical parents that the now Catholic Kit Carson might not be an unacceptable husband for their daughter. Early in 1843, Kit and Josefa were married. They would establish a good home and raise eight children—but Kit's growing reputation made it difficult for him to settle down near Taos to the uninterrupted life of a family man and rancher.

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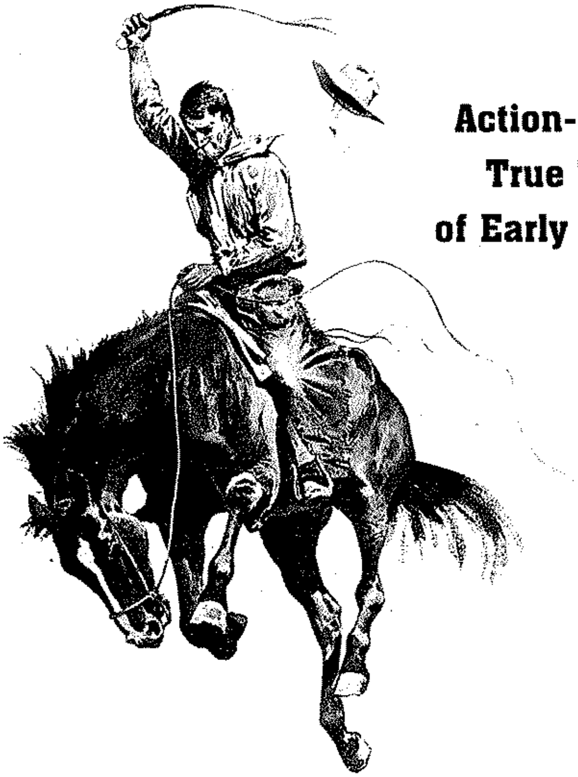
Official Arizona State Historian

Marshall Trimble's

ARIZONA ADVENTURE



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DEDICATION

To my son, Roger Frederick Trimble,
born April 18, 1979
No honor or event could ever match the total joy
and happiness you have given.

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Ewing Young:
The Southwest's Premier Mountain Man

Mountain men . . .They've been called a peculiar product of the American frontier, a reckless breed of adventurers to whom danger was a daily commonplace; explorers who took tribute of the wilderness and wandered the outerwest with all the freedom of the lonely wind.

These fur trappers and traders, during their brief but exciting heyday between the 1820s and 1840s, explored the vast reaches of terra incognita, including the Colorado Basin and Gila River watershed, establishing routes that would eventually become highways for cities and commerce.

The demand for beaver pelts provided the inspiration that made these restless adventurers brave the unknown wilderness in a quest for crafty, fur-bearing critters that provided a world market with hats and other apparel. They alternately traded, lived among and fought with native tribes inhabiting the regions, had deadly encounters with savage grizzly bears who attacked without provocation and faced thirst and starvation in desolate deserts and sometimes left their bleached and forgotten bones in obscure places.

By the time the exuberant cry "Manifest Destiny" caught the imagination of impetuous, but less adventuresome Americans, an advance guard of mountain men had explored every nook and cranny of the far western mountains, rivers and valleys.

Roughhewn mountain men such as Kit Carson and Tom Fitzpatrick skillfully guided U.S. soldiers across the rugged unknown terrain during the War with Mexico in the 1840s to capture New Mexico and California. Had these armies relied upon their own limited knowledge of the country, the results might have been costly, altering the course of "Manifest Destiny" and history. Agents representing the aggressive British Empire had aspired to seize California during the interim between the declaration of war between the U. S. and Mexico and the arrival of American troops on the Pacific Coast.

Others, like Jim Bridger and Joe Walker, led wagon trains of immigrants to California and Oregon after their trapping days were over. In the 1860s, the ubiquitous Walker would lead a party of gold prospectors up the Hassayampa River finding rich placer strikes in the Bradshaw Mountains.

By and large, the history of the fur trade in the Southwest regions has been left out of the mainstream of American history. Trappers like Walker, Bridger, Fitzpatrick and especially Carson have become American legends and folk heroes, their fame coming primarily from exploits in the northern Rockies and Sierra Nevada. Contrary to popular myth, the Mexican border-lands had a great impact on industry. During the early 1830s, the heyday of the business, a third of the total furs shipped east came from the Southwest. And when discussing the Southwest fur trade, an obscure individual stands out above the rest. His name was Ewing Young.

He was a tall, strapping carpenter from Tennessee. Like many restive souls of his time, Ewing Young wested to the Missouri frontier and, after an unsuccessful attempt at farming, he formed a partnership with a trader named William Becknell, who would become known as the "Father of the Santa Fe Trail."

In 1822, they led the first wagons west across the plains of New Mexico. Santa Fe at the time was a remote adobe village lined with dirt streets, nestled against the towering Sangre de Cristo Mountains. During more than two centuries of Spanish rule, trade restrictions against foreigners had prevented commerce between the enterprising Americans and the citizens of New Mexico. Following the Mexican Revolution in 1821, Americans like Becknell, who had been out on the Plains trading with Indians, were invited to sell their wares in New Mexico. Thus began the long and mutually profitable Santa Fe Trade.

Like others of his genre, Ewing Young had no aspirations of leading the course of empire, but saw, instead, a business opportunity in the raw, untamed land. Before he quit the region in 1831, he was a central figure in the fur trade in the Southwest. He led one of the first American expeditions into what was to become Arizona, was the first to trap the Salt and Verde Rivers and was the first American to explore the Gila River to its mouth.

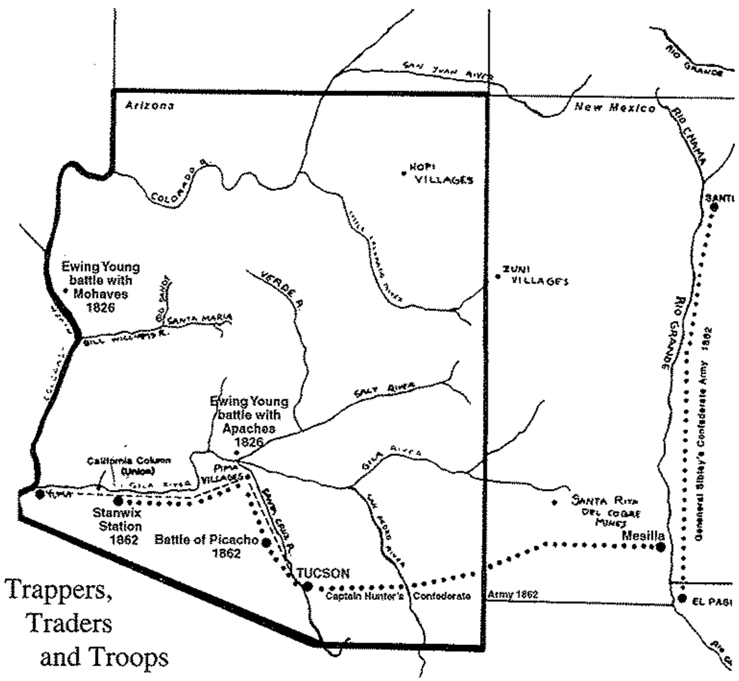
Ewing Young is one of the most elusive figures in Southwest history. This quiet Tennessean, who played such an important role in the fur trade, might have gone unknown had it not been for a few letters, documents and journals written by his contemporaries. No photographs or composite drawings exist, and he kept no journal. The uncharted region that some 40 years later was to be called Arizona, was then a part of the Republic of Mexico and only Mexican citizens could trap legally. Therefore, Young's entrepreneuring was shrouded in mystery and remains so today. While many Americans gave up their citizenship to obtain the licenses, Young remained staunchly proud of his and refused to compromise.

Ewing Young began his great adventure on the morning of May 25, 1822, at Boonslick, a rude frontier town near Franklin, Missouri. There, several wagons laden with trade goods, he embarked on an historic journey to Santa Fe in the Mexican Republic.

"Mexico." There was magic in the word, conjuring up visions of breathtaking scenery, romantic pueblos and beautiful, dark-eyed women. And, there was a spectacular profit to be made in the trade. Interest was sparked the previous year when Becknell returned to Franklin and dumped several rawhide bags full of Mexican silver on the street. Keep in mind, at

this time the U. S. had not located any of those fabulous gold and silver mines in the Far West.

The thousand-mile journey to Santa Fe was fraught with danger. Most of the travelers were merchants, ill-prepared for the vicissitudes of the trail. One stretch required crossing 60 miles of desert void of watering holes. Rattlesnakes were a constant menace, as were the warlike Plains tribes along the way. Certain necessities, such as water, wood and native range grasses,



Trappers, Traders and Troops

were vital. Further west, the wood gave way to ever-present buffalo chips, which were used as fuel for cooking.

After completing the journey, which took about ten weeks, the heavy wagons rumbled into the pueblo of Santa Fe to be greeted enthusiastically by the Mexicans with cries of "Los Carros" or "Los Americanos." Since the arrival in late June or early July coincided with the welcome arrival of the summer rains, a myth grew among the simple natives that the Americans were responsible for the rain as well as providing much-needed trade goods.

The picturesque village, located on the slopes of the steep, dark Sangre de Cristo Mountains, was in a delicate enclave of scenic beauty, picture perfect, as if the setting had been placed in position by an artist.

The dusty plaza that marked the "End of the Trail" was the traditional gathering place in the Hispanic Southwest. On the north side stood the ancient Palace of the Governors, a rectangular, flat-roofed adobe structure with a ramada in front and a courtyard in the rear. The rest of the square plaza was lined with characteristic low, adobe buildings consisting of *tiendas* (shops), *cantinas* (saloons) and private dwellings. Bright red strings of chili peppers hung from the cedar *vigas* (beams) to dry in the warm sun. In the evening, the air was filled with the rich, aromatic smell of scented smoke from the pinon wood of the cooking fires.

After going through Mexican customs, the traders sold their goods to eager consumers, packed the Mexican silver coin in wet rawhide bags, then hung them over hot coals to dry. The packs were then slung across pack mules and made ready for the long journey to Missouri.

A few enterprising Americans chose to remain in New Mexico, went into business, married and eventually integrated into the culture. Others saw a lucrative profit in trapping, a business that did not require much capital to start, and headed into the vast wilderness north and west of Santa Fe.

For the next nine years, Ewing Young maintained a base of operations in both New Mexico and St. Louis. He operated a trading post in the slumbering Mexican community of Taos, establishing that region as one of the great staging areas for trappers in the Far West, and himself as a central figure in American trapping, and the fur trade as an important adjunct of the Santa Fe Trade. In Taos, Young also took a common-law wife, who bore him a son.

From Taos, Young's trappers blazed trails into the Colorado Basin and the Gila watershed, traversing vast regions never before "en by white men, opening important avenues to California. It is worth noting that Young was the first American to cross both of today's transcontinental routes across Arizona.

Young continued to import from St. Louis essential items ranging from razors and looking-glasses to bright-colored silks and cooking utensils. With profits earned from these, he purchased horses, mules and mule stock (jackasses and jennies) and drove them to the States. There was a "horse famine" on the American frontier at the time, and Young found an eager market for his livestock. Contrary to popular belief, the sturdy, dependable Mexican mules imported to Missouri marked the beginning of the great mule business for which that state was noted on the American frontier.

Following this first venture over the Santa Fe Trail, Young spent the Fall of 1822 trapping beaver around the headwaters of the Pecos River in the Sangre de Cristo Mountains.

The next year he headed west, away from well-established trapping grounds. "I want to get outside of where trappers have ever been," he told a friend. That year he trapped the headwaters of the Colorado River on the rugged western slope of the Rockies, returning with his pack mules loaded with thousands of dollars worth of prime beaver pelts.

A pelt weighed at least 1 1/2 lbs. and sold for an average of four to six dollars each. These "hairy banknotes" were shipped east, some going to American hatters, who removed the fur from the skin and felted it into beaver hats. Other pelts were sent to European fur auctions. The fur business was comparable to giant industries of our time. The only thing that saved the beaver's hide for posterity was the advent of the silk hat in the early 1800s.

The streams of Arizona were an ideal location for finding beaver. In the high country, abundant stands of quaking aspens were a gourmet's delight for the wily, paddle-tailed critters. Further downstream, cottonwood and willows lined the banks of rivers and streams. During this pristine period, prior to giant irrigation projects, tree-cutting and overgrazing, the verdant land was a veritable paradise. With the exception of the hot summer months when the pelts were too thin, beaver could be trapped year around.

Trapping the Arizona wilderness had its grim side. Hostile natives were a constant menace. One trapper recorded only sixteen out of 160 trappers survived a single year in the Gila watershed.

The Southwest never held the annual rendezvous, as was common further north. This trade fair was a peculiar American institution whereby merchants hauled their goods by wagon, at considerable profit margin, to the mountains each summer. There, in some pre-designated setting, trappers sold their furs and purchased what they needed for the next year, and spent the rest on fun and frolic. This barbaric, medieval fair has provided the background for much of the lore and legends of the mountain men. For upwards of a week, they haggled, traded, quarreled, gambled, wenched, drank and fought before returning to the wilderness once more to face another year's toil, danger and hardship.

Although the Southwest had no rendezvous, trappers still found plenty of opportunity for devilment at fortified trading posts such as Bent's Fort along the Arkansas River. At Taos, Ewing Young's post was a permanent "rendezvous" for trappers to trade and indulge themselves. Nearby, some enterprising Americans built a whiskey mill which turned out a concoction called "Taos Lightning," guaranteed to peel the hide off a Gila Monster. Taos, because of its proximity to the American border and remoteness—it was some 70 rugged miles north of Sante Fe—became the center of foreign-born residents of New Mexico. These Americans, engaged in smuggling trade goods, could operate freely in the isolated village because there was no customs house and Mexican officials were seldom seen.

In the Spring of 1826, Young sent his partner, William Wolfskill, and a small party of trappers into the Gila watershed, while he went to the states on a trading expedition. Wolfskill's party met with disastrous results. Coyotero Apaches ambushed the group and forced them to return to Taos empty-handed.

About that same time, another party was trapping along the San Francisco, Gila and San Pedro rivers. This band included James Ohio Pattie, whose now-famous *Narrative* provides a written account of the first American expeditions into Arizona. Although Pattie's thrilling adventure story reads something like a Western pulp novel, many of the incidents, times and places have been authenticated by other sources. Pattie's group struck paydirt, taking a large number of pelts. After a band of Apaches raided their horse herd, the trappers cached the furs, being careful to conceal all the evidence, and went after more pack animals. In Santa Fe, Pattie re-outfitted and returned to the Gila, only to find that Apaches had found their cache. Once again, a party of American trappers saw an entire season of hard, dangerous work in the Arizona wilderness go for naught!

During the fall season of 1826, Young was among several Americans licensed to trap the Gila River country. The expedition headed down the Rio Grande River to Socorro, then turned west into the Mogollon Mountains to the legendary Santa Rita del Cobre mines, near today's Silver City. The mine was operated by an American who allowed the trappers use of the facility as a convenient haven before launching off into the Gila wilderness.

Before settling down to trap the Gila watershed, Young's first order of business was to even the score with the Apaches who had routed his expedition the previous spring.

Young was, by this time, a hard-bitten bourgeois ("Captain of Trappers") committed to the trapper's code that the only way white men could go about their work without fear of attack was to take direct and decisive action. The first lesson one learned on the frontier was to never show weakness to the warrior tribes. He led his party of 16 trappers into the lair of the fierce Coyoteros, routing them and inflicting heavy casualties.

Meantime, James Ohio Pattie was back in the Gila county again, this time with a party of French trappers, led by Michel Robidoux. They arrived at a large Indian village at the junction of the Salt and Gila rivers (on the west end of the Salt River Valley).

Pattie maintained it was a "Papago" village, but later-day anthropologists have suggested the Indians were actually Apache or Yavapai. The natives invited the trappers to spend the night in the village, and all but Pattie and a companion accepted the generous offer. Our suspicious hero found a secluded spot a safe distance from the village and made camp. Some time during the night, they were awakened by the sound of bloodletting from the village. The Indians had waited until Robidoux's men were asleep, then launched a bloody massacre. When the dust had settled, all the trappers were dead except Robidoux. He sneaked off into the darkness and joined Pattie, perhaps somewhere around the center of today's Phoenix. The three survivors remained hidden until the next day. That evening they moved through

the darkness until they encountered what they took to be an Indian camp. As they crept closer, they heard a couple of men talking in English. Fortunately, the three had stumbled into the camp of Ewing Young. Once again, Captain Young sought vengeance against those who would murder trappers. He led some 30 trappers up a dry arroyo on the outskirts of the village, then had two men act as decoys to lure the warriors into an ambush. The ruse worked perfectly as about 200 warriors took off in pursuit of the two white men. When the Indians were some 20 yards from the arroyo, Young and his men rose and fired their high-caliber rifles killing, according to Pattie, 110 warriors. The rest of the people headed for the nearby hills, except for an elderly, blind and deaf man the trappers left unharmed. Then they set fire to the village and began the unpleasant task of burying the mutilated bodies of the French trappers. The next day, the village headman called for a parley with the resolute Captain Young and his 33 buckskin-clad mountain men, and in the ensuing discussion, agreed to stop molesting trappers.

From there, Young led his men up the Salt, past today's Scottsdale, to the junction of the Verde, then worked his way up the Verde and back again down the Salt and Gila, trapping sometimes as many as 30 beavers a night, all the way to today's Yuma. This was the first American expedition to follow that river to its mouth and the first American encounter with the Yuma Indians. The meeting seems to have been friendly. Pattie described them as "the stoutest men with the finest forms I ever saw, well proportioned—as straight as an arrow" and "as naked as Adam and Eve in their birthday suits."

Young then led the party up the Colorado River where they had another encounter with natives, this time Mohaves, and it wasn't so cordial. A belligerent headman demanded a horse, and when refused, speared the animal, causing an angry trapper to shoot him dead in his tracks.

The Mohaves backed off and disappeared into the brush, but Young knew their habits and when the natives launched a pre-dawn attack, the trappers were ready. The Mohave weapons were no match for the trapper's guns and 16 warriors were killed in the melee. The fierce Mohaves bided their time, quietly stalking the trappers until the right moment. One evening several days later, they showered Young's camp with poison arrows, killing two and wounding two more. Pattie claimed his blanket alone was pierced by sixteen arrows.

Swearing trapper vengeance, Young pursued the war party and killed several. The bodies of the slain warriors were hung from the limbs of a cottonwood tree as a stern warning to others.

As an added precaution, Young divided his expedition into two groups—one to trap, the other to stand guard. The persistent Mohaves attacked again, this time killing three trappers on the Bill Williams River. When Young found the men, their bodies had been hacked to pieces and were being roasted over a campfire.

Young decided it was time to leave the Colorado River and head to Taos. The 1,000-mile expedition had been profitable, taking some $20,000 in pelts, but he had lost a third of his men to hostile Indians.

Young's penchant for wandering had taken him over some of the wildest country in America on this, one of the Southwest's greatest overland expeditions. In spite of the trials and tribulations of the wilderness, Young's troubles weren't over. There had been a changing of the guard in Santa Fe and the friendly governor, Antonio Narbona, had been replaced by an "ambitious and turbulent demagogue" named Manuel Armijo.

Once the bureaucratic confusion following the Mexican revolution subsided, the old Spanish policy of strict rules concerning commerce with outsiders was reinstituted. Also, there was the natural suspicion of Norte Americanos, and for good reason. Since the opening of the Santa Fe Trade, Americans had gone to great lengths to avoid paying customs. It was estimated that hundreds of thousands of dollars in contraband furs were being smuggled out of New Mexico each year.

In 1824, Mexico passed a law allowing only Mexican citizens a license or "guia" to trap. However, by some quirk in the law, beaver pelts brought into Mexico were heavily taxed while those taken out were not. Obviously, this only encouraged evasion. Some Americans got around the law by becoming Mexican citizens or secured a proxy permit through one of the locals. Others simply ignored the law because to apply for a license meant exposing oneself to the import tax.

In Taos, American trappers found a friend in the local priest, Father Antonio Jose Martinez. Martinez, for a small fee, arranged things like baptisms and marriages so citizenship could be obtained more easily.

Many Americans entering Mexico from the States had avoided customs by hiding their merchandise in the Sangre de Cristo Mountains, then smuggling the goods in after dark. Trappers returning from the wilderness to Santa Fe were doing the same with beaver pelts.

Enforcement of the new law began while Young was still trapping in Arizona. Unsuspecting, he returned to Santa Fe in the spring of 1827 to find his license was void and the season's catch, worth $20,000, was impounded.

One rambunctious member of Young's party, Milton Sublette, grabbed his furs and ran inside a friendly house occupied by trappers. By the time authorities were able to force their way in, Sublette and his furs had disappeared. The story of Sublette's daring escapade spread and was told and retold around trappers' campfires for years afterwards.

An angry Governor Armijo held Young personally responsible for Sublette's brash action and charges were pressed. He was released from custody a few days later when Armijo could not locate a copy of the Law of

1824. Young's fortune in furs was not returned, however.

Young's 1827-28 expedition into the Gila country was again routed by Apaches. Somewhere near the junction of the Salt and Verde rivers, Apaches ambushed the party, killing 18 of Young's 24 trappers. Despite these occupational trepidations, Young resolved to equip another expedition the following year. This 1828-29 expedition is remembered for the presence of Young's best known protege, a diminutive, bright young man named Christopher "Kit" Carson.

The Mexican authorities had been keeping a careful watch on Young since the 1827 smuggling incident, so he headed north out of Taos some 50 miles towards U.S. Territories, then doubled back across the Jemez Mountains to the pueblo of Zuni. From there he went into the White Mountains to the headwaters of the Salt River. With a vengeance, Young sought out the Apaches that had routed his expedition the previous year, whipped them soundly, then trapped his way up the Verde to its headwaters in Chino Valley. On the western slope of Bill Williams Mountain, near today's Ashfork, he divided his party, sending one group laden with furs, back to Taos. Young took 17 men, including Carson, and headed west to California. He had heard much talk about California from other trappers and he wanted a first-hand look. In early 1830, after a near disastrous journey across the trackless wastes of the Mohave Desert, the expedition reached the Mission San Gabriel.

Ewing Young liked what he saw in California. Beaver were plentiful in the San Joaquin Valley and horses and mules superior to those in New Mexico ran by the thousands in the Central Valley. Young trapped his way into northern California. To avoid carrying the pelts over the dangerous overland trip to New Mexico, he sold them to a Yankee sea captain. At San Jose he purchased a large herd of horses and mules to drive to the States. On their way back, the trappers stopped in Los Angeles where they indulged in a glorious drunken spree. The mannerly *Californios* were not exactly overjoyed with the increasing number of incorrigible, hairy-faced, buckskin-clad *Americanos* in their midst. But the winsome young women of Los Angeles, dressed in traditional short skirts, loosefitting, low-cut blouses, displaying firm un-corseted bosoms, captured the heart of many a lonely American trapper, at least temporarily. The Americans were shocked upon first meeting these liberated Hispanic ladies in the Southwest, but they quickly adjusted. The small-waisted, olive-skinned beauties whirled around the dance floor with great abandon at frequent fandangos. In between dances, they puffed uninhibitedly on *cigarillos*, just like the men. One observer with Young noted admiringly that the ladies put on "a prodigal display of their charms" for one and all.

The Hispanic men, especially the *caballeros* (gentlemen horsemen) were even more dazzling in appearance with their traditional low-crowned, flat-brimmed sombreros, banded with oil cloths or tinsel cords, tight-fitting *chaquetas*, or jackets decorated with elaborate needlework and fancy conchos, and bright-colored sashes wrapped around tight silver-studded *calgoneras*, or pantaloons. The outer part of the legs were slit up to the knees and decorated with colorful gussets. Embossed leather *botas* or leggings were worn to protect their ankles. Their spurs were characterized by huge five-inch rowels. A serape *saltillero* (fancy blanket) usually hung across the pommel of the saddle and was thrown over the shoulders during inclement weather. The rider stuck his head through a slit in the middle of the blanket and the garment hung loosely from the neck. Their elegant style matched the fine-bred horses they rode with considerable pride.

The California militia kept a watchful eye on the trappers and perhaps harbored some scheme to place them in custody. Those plans ended abruptly when two of the trappers, an Irishman and an Englishman, exchanged unpleasantries over some frivolous matter and the Irishman nonchalantly stepped down off his mule and shot the Englishman dead. The authorities wisely decided that if the crazy Americanos would shoot each other without provocation, what would they do if somebody outside the group were the antagonist?

Young's party returned to Arizona, trapped up the Gila River, then cached their furs at the friendly Santa Rita Cobre Mine. Young and Carson rode on to Santa Fe where the bourgeois secured a license "to trade with Indians on the Gila." They returned to Santa Rita, picked up some 2,000 pounds in beaver pelts and sold them in Santa Fe. The authorities were, no doubt, surprised at the trappers' uncanny good fortune to have gathered so many pelts in such a short time—*quien sabe?*

The expedition earned a small fortune for Young, and the word quickly spread about wondrous opportunities in California.

Increasing troubles with Comanches along the Santa Fe Trail, Apaches and Mohaves in Arizona, inspired Young to move his base of operations to California. In the Fall of 1831, he left New Mexico for good.

It has been said that Young's decision to move his operations to the Pacific Coast might have been principally because of mounting problems with authorities in New Mexico who considered him a troublemaker. And there is little doubt those officials were glad to see him leave.

Whichever, Ewing Young's (or "Joaquin Yong" as he was referred to on Mexican records) great Arizona adventure was over. He eventually settled in the Oregon Territory, where he became one of that region's outstanding citizens. Young died prematurely in 1841, years before the "Course of Empire" changed the complexion of the entire Far West region.

As for rugged Arizona, continuing trouble with hostile tribes encouraged trappers to seek safer pastures in California, circumventing the area entirely by using the Old Spanish Trail from Santa Fe across Utah to California.

These trappers and their contemporaries were the embodiment of free spirit and independence. They were rebels against the restraints of society and chose to live their lives in the vast unknown where death could come at any moment in a variety of ways. Many returned to society, only partially, to serve as guides for the immigrant trains that came West in the 1840s and 1850s. Today's super-highways cross deserts and mountains over their trails. It seems ironic that men who sought sanctuary in the West would, in the final analysis, be the ones to lead the society they despised into their final refuge.

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Chapter 2

Historical and Pictorial Perspective of the Upper Verde River

Alvin L. Medina, Daniel G. Neary

Introduction

The UVR corridor is a diverse riverine ecosystem in central Arizona (see Chapter 1). Since European settlement, it has witnessed many events such as droughts, floods, construction of Sullivan Dam, groundwater withdrawals, cattle grazing, mining, nonnative fish introductions, native fish extinctions, and urbanization that are not fully understood. Geologically, the UVR displays a wide array of formations of spectacular color and variety; the landscapes vary from open valleys to narrow and deep canyons. Several publications have described the Verde River (Wirt and Hjalmarson 2000; Blasch and others 2006), yet few provide pictorial descriptions of historical and existing conditions. Oral accounts offer different glimpses of purported historic conditions (Byrkit 1978). For the most part, descriptions of the Verde River are largely limited to the Middle Verde River and the Lower Verde River. The UVR is distinct from the former sections due to the smaller character of the landscapes, yet it is unique in many attributes.

In this chapter, repeat photography is used to display the vivid texture of the river vegetation, channel, and valley landscapes and to contrast the historic with current conditions. These contrasts are interpreted within the context of plant ecology and hydrogeomorphology to provide a comprehensive understanding of the changes that have occurred in the past century. In some cases, additional photographs provide a larger perspective of the area and its habitats. A principal objective is to provide a broad understanding of historic influences that is necessary to comprehend the physical and biological processes that govern present-day conditions on the UVR. Climate and land uses undoubtedly have affected the flow and sediment regimes, which, in turn, have influenced such factors as riparian vegetation and aquatic life. Paleo-reconstruction studies of historic environmental conditions are utilized to put forward alternative descriptions of the Verde River for the period of record (1890 to present). These paleoecological data are useful for discriminating between natural and cultural influences on observed environmental changes (Swetnam and others 1999). The most significant period regarding vegetation and hydrologic changes may be the last 400 to 500 years (the time of European influence in the area. The introduction of livestock circa 1890 is an important event that is often cited as crucially influential on present-day conditions. However, many past descriptions of the UVR that have been extrapolated from general sources do not recognize climatic conditions during this period. These changes in climate may have misunderstood and long-lasting consequences on the future evolution of riparian and aquatic habitats.

Credits

Several people and organizations contributed photographs to this effort. Mr. James Cowlin (Cowlin 2008) is a freelance photographer who captured many views of the UVR in 1979. Some photographs are courtesy of and used with permission from Sharlot Hall Museum, Prescott, Arizona. Many photographs are courtesy of Mr. Thomas Perkins, a descendant of the original settlers on the UVR. Mr. Perkins shared photographs that are now archived at Sharlot Hall Museum. Dr. and Mrs. George and Sharon Yard of the Y-D Ranch in Perkinsville provided photographs of their private lands and the Horseshoe Allotment. Mr. and Mrs. David and JoAnn Gipe of the Verde River Ranch provided historical photos of ranching activities. Some photographs of the 1920s were taken by Mr. Matt Cully while working for Southwestern Forest and Range Experiment Station on the Santa Rita Experimental Range in southern Arizona. A special thanks is extended to Mr. James Steed who assisted in the collection and archival of repeat photographs. Photographs are also provided from the author's private collections.

Methods

Layout

A spatial sequence is used to reference locations of historic photos, starting at the headwaters on the west of the UVR and proceeding easterly downstream. Photographs were selected that depict significant changes in the vegetation and channel conditions for the period of record. Repeat photographs were utilized to provide a temporal aspect and spatial contrast through the riverine corridor, as well as extended areas above the headwaters. Relative changes that are observed in the photographs are described and discussed in order to provide differing perspectives of riparian conditions using background studies of the hydrology and vegetation of the UVR.

The Verde River and its watershed have been studied extensively since the early Twentieth Century. More than 2000 science and popular articles have been written on diverse aspects of the river, including many on historical, ecological, and socio-economic issues. It was impractical to review all of the collective works, so only those with original context relevant to the objectives of this Report were selected. Considerable works on watershed management of all of the principal vegetation types of the Southwest, compiled by Dr. Malchus B. Baker, Jr. are available online (http://ag.arizona.edu/OALS/watershed/). In addition, selected scientific works on the UVR are available at the RMRS, Flagstaff, Arizona web site: http://www.rmrs.nau.edu/lab/4302/4302VerdeRiverBibliography.htm.

Terminology

The following definitions are provided to assist the reader. The UVR study area is defined as the section of river starting at the Prescott National Forest boundary to the east near Tapco, Arizona, to the headwaters at Sullivan Dam to the west (fig. 1.1). This designation is consistent with the Arizona Department of Water Resources watershed area, which drains to the Clarkdale USDI Geological Survey gauge (#0904000). The Middle Verde River study area is defined as the section of river starting at the Prescott National Forest boundary to the west near Tapco, inclusive of the Verde Valley, to the eastern boundary of the Prescott National Forest. This Report deals only with the UVR, but references to or examples from the Middle Verde River (Camp Verde area) are utilized. The Lower Verde River extends from the Middle Verde River section south to the river's confluence with the Salt River.

The Verde River was historically referred to as "El Rio de Los Reyes" by Antonio de Espejo in 1583, "Sacramento River" and "El Rio Azul" in Seventeenth and Eighteenth Century Spanish maps, and "San Francisco River" and "Granite Creek" by Nineteenth Century Anglo-American pioneers (Byrkit 2001). In this chapter, the term "historical" refers to time of recorded history since Antonio de Espejo's travel in the Southwest. The word "paleo" refers to time before recorded history. The Pecos Classification refers to a period sequence used to describe paleo and historic settlements of Southwestern Native Americans (Morrow and Price 1997). The classification is as follows:

Paleo-Indian (unknown dates to 8500 before present [B.P.])

Basketmaker I (6700 B.P. to A.D. 1) (Archaic)

Basketmaker II (A.D. 1 to 500)

Basketmaker III (A.D. 500 to 700)

Pueblo I (A.D. 700 to 900)

Pueblo II (A.D. 900 to 1100)

Pueblo III (A.D. 1100 to 1300)

Pueblo IV (A.D. 1300 to 1600)

Pueblo V (A.D. 1600 to 2000)

Common geomorphic and hydrologic terms used in this Report can be found in the Glossary (Appendix 1). "Floodplain" refers to "the area along the river that has been subject to erosion and deposition by the Verde River in the past few thousand years" (Pearthree 1996). This geomorphic feature and the river itself are the foci of this report, but the surrounding landscape is considered in this and other chapters.

Study Area

The Verde River is centrally located within Arizona, flowing about 350 km (220 mi) southward to its confluence with the Salt River (fig. 1.1). The watershed area, elevations, and other features are discussed in Chapter 1. Landownership is mostly public lands, with private ownerships centered about the river and transportation corridors (fig. 1.5).

Major vegetation types of the Verde Valley range from mixed conifer on peaks of the Mogollon Rim to Sonoran Desert Scrub at the confluence with the Salt River. (see Chapter 1). Original riparian woody vegetation was largely coincident with valley form, with large cottonwoods scattered in the wide open valleys, and Arizona ash on terrace slopes of canyon bound reaches. Since 1993, an expansion of many obligate species has occurred owing to such factors as floods, land use changes, and general climate changes. Invasive plants such as saltcedar have been a developing component since about the 1950s (see Chapter 6).

Several scientists have recently provided characterizations of the geohydrology of the UVR (Wirt and Hjalmarson 2000; Blasch and others 2006), owing to public demand for estimates of the water resources and locations. Perennial flow in the UVR watershed is limited from the confluence of Granite Creek easterly. The Del

Rio Springs in the Chino Valley supplied perennial flow above the Granite Creek confluence prior to the construction of Sullivan Dam in 1938. Principal intermittent and ephemeral streams above Sullivan Dam are Big Chino Wash, Little Chino Wash, Williamson Valley Wash, Walnut Creek, Granite Creek, Pine Creek, and Partridge Creek (Blasch and others 2006). Other major tributaries that contribute significant flow and bedload from the Rim to the north include Hells Canyon, Grindstone Wash, MC Canyon, Bear Canyon, Government Canyon, Railroad Wash, and Sycamore Creek. The southern tributaries from the south are Muldoon Canyon, Bull Basin, Wildcat Draw, Munds Draw, Orchard Draw, and SOB Canyon.

Paleo-Historic Description

Many authors have provided insight into paleoecological conditions of local and regional riverine and upland environments of the UVR (Gladwin and Gladwin 1930; Fish 1967, 1974; Hevly 1974; Fish and Fish 1977; Hevly and others 1979; Smith and Stockton 1981; Ely and Baker 1985; Hevly 1985; Anderson 1993; Pearthree 1993, 1996; Ely and others 1993; Ely 1997; House and Hirschboeck 1997; Allen and others 1998; Swetnam and Betancourt 1998; Blasch and others 2006). This analysis mainly addresses scholarly works that pertain to the river within the context of human influences and land uses, vegetation changes, and hydrology and geomorphology, but it also includes relevant works of upland influences. There are many descriptions of the Verde River with often conflicting accounts of historic and current conditions. The purpose of this analysis is to establish an understanding of paleohistoric conditions using reconstruction studies from the Verde River and the region. The paleohistoric events, especially climate (Ni and others 2002), and human influences, of the late Nineteenth Century have had strong influences on the current and potential ecological states of the habitats of the UVR.

Geologic History

The Verde River and the Mogollon Rim are believed to have established during the Oligocene epoch of the Paleogene period, 27.4 to 37.2 million years ago (Ma) (Pierce and others 1979). During the following Miocene epoch (7.4 to 27.4 Ma), the Verde River was interrupted by tectonic and volcanic events in the Hackberry Mountain–Thirteen-Mile Rock volcanic center a few miles southeast of Fort Verde (Elston and others 1974; McKee and Elston 1980; Menges and Pearthree 1989; Nealy and Sheridan 1989; Elston and Young 1991). This resulted in a closed basin, during which Miocene volcaniclastic, clastic, and evaporite sedimentation occurred to form the Verde Formation (Nations and others 1981). Between the Miocene and Pliocene, extensive sedimentation occurred within the Verde Basin until the breaching of the volcanic-tectonic dam during the Quaternary period (<3.6 Ma), which eroded much of the Verde Formation (Nations and others 1981). The depth of the Verde Formation is unknown but is estimated near 960 m (3,150 ft) or roughly a top elevation near 2,000 m (6,560 ft) (Nations and others 1981).

The UVR is largely situated within the Chino Basin and the Verde Basin (fig. 2.1). One can surmise that the extensive sedimentation that occurred during the Miocene epoch within the Verde Basin likely reached elevations upstream to include the Chino Basin. Sullivan Dam lies within the Chino Basin at an elevation of about 1,325 m (4,350 ft). Some sediments reside as terraces or mesas (see

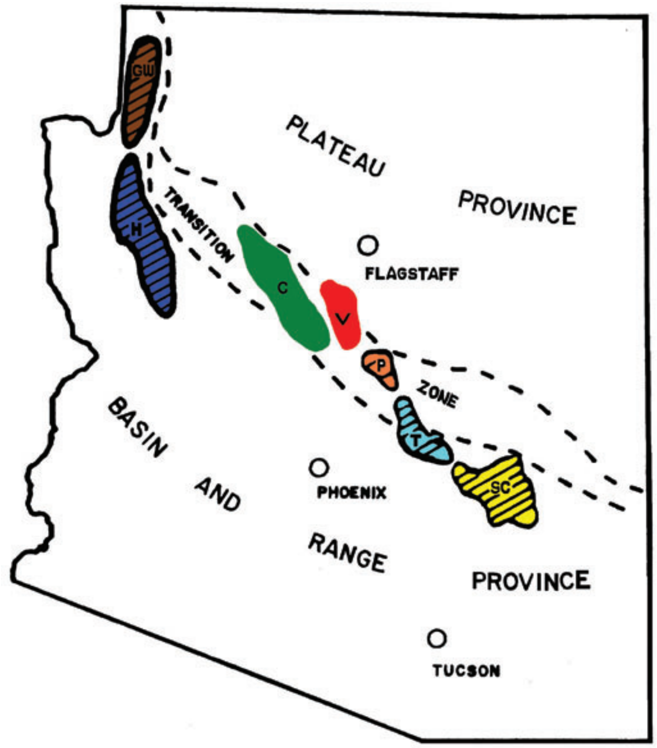


Figure 2.1—The Cenozoic basins of the Transition Zone between the Colorado Plateau province and the Basin and Range province. The basins are identified by color and letters: brown (GW) = Grand Wash Basin, dark blue (H) = Hualapai Basin, green (C) = Chino Basin, red (V) = Verde Basin, orange (P) = Payson Basin, light blue (T) = Tonto Basin, and yellow (SC) = San Carlos Basin (adapted from Nations and others 1981).

Chapters 3 and 4). Hence, the paleogeology of the UVR suggests that the basin sediments are different from those of the Middle or Lower reaches of the Verde River, as well as from other streams and rivers of Arizona.

The paleogeology and local physiography have influenced the current character of the Verde River (Twenter and Metzger 1963; House and Pearthree 1993). The depositional history is important for understanding the current and changing conditions of the watershed and riparian corridor. Hydrologic processes, such as flooding and channel incision, have been occurring over several million years and are witnessed by the 90 to 150 m (300 to 500 ft) of incised tributaries and the Verde River canyon below Perkinsville. Pleistocene floodplain terraces are evident at various locations about 45 m (150 ft) above the present-day valley floor. Open valley forms account for about 75% of the landscape types, with the remaining 25% classified as confined reaches with high canyon walls and limited floodplain.

Climate, Floods, and Drought

The climate in central Arizona is undoubtedly influenced by the varied mountainous topography and the formidable Mogollon Rim. Precipitation in the region is bimodal, with intense monsoonal storms in the summer that are linked to tropical Pacific events and cooler winter storms linked to northern Pacific Ocean events (Philander 1990; see Chapters 1 and 3). The climate varied substantially during the Twentieth Century (Hereford and others 2002), but more so during the paleo period (Swetnam and Betancourt 1998).

Grissino-Mayer (1996) reconstructed more than 2,100 years of precipitation in the Southwest from tree-ring records (fig. 2.2). His climate reconstruction is well corroborated with other studies (Swetnam and Betancourt 1990, 1998) that link the three- to five-year Southern Oscillation to the regional climate (Philander 1990). Essentially, greater rainfall occurs during El Niño years, with somewhat lesser rainfall in summer, and La Niña years produce an opposite consequence. These

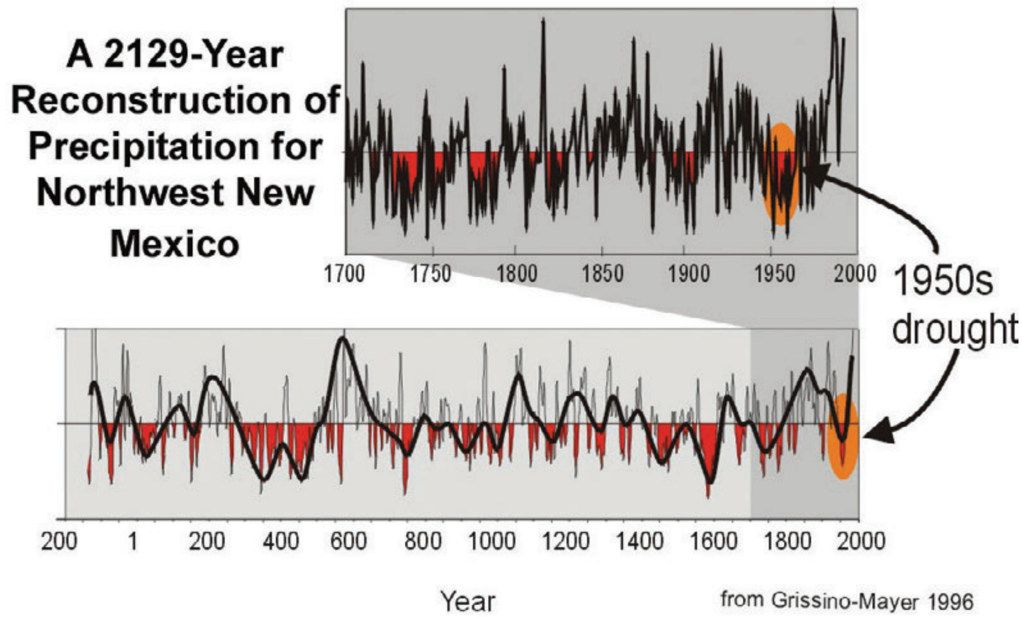


Figure 2.2—This graph is a reconstruction of precipitation for northwestern New Mexico. The units are of standard deviation, with red color indicating drought periods. This graph was developed by the National Oceanographic and Atmospheric Administration's Paleoclimatology Center (http://www.ncdc.noaa.gov/paleo/drought/drght_grissno.html; adapted from Grissino-Mayer 1996).

fluctuations are linked to floods (Webb and Betancourt 1992; Ely 1997), drought cycles (Grissino-Mayer 1996), fire frequencies (Swetnam and Betancourt 1990; Grissino-Mayer and Swetnam 2000; Gray and others 2003), and periods of high reproduction of woody plants (Swetnam and Betancourt 1998).

Ely and Baker (1985) performed the first paleoflood reconstruction study on the Verde River and provided an in-depth inventory of paleoflood frequencies and magnitudes. By 1997, Ely and other scientists (Smith and Stockton 1981; Ely and others 1993; O'Connor and others 1994; House and others 1995; Ely 1997) produced a 5,000-year paleoflood chronology linking the occurrence of similar floods in other regional river systems of the Southwest in a pattern similar to the Verde River.

Ely (1997) noted three types of storms that generated large floods: North Pacific winter frontal storms, late summer and fall storms, and convective summer thunderstorms. The largest historic floods have been from winter storms (Smith and Stockton 1981; Ely 1997). High- magnitude floods coincided with periods of cool, wet climate such as those witnessed in the last 200 years (fig. 2.3). Ely (1997) further noted the occurrence of 15 large-magnitude floods on the Verde River within the past 200 years. This is a frequency much greater than that reported in the historic record, and it ranks third highest of 19 Southwestern rivers. Evidence from tree-ring records (Webb 1985; Ely 1992; Grissino-Mayer 1996) corroborate that the historical period between 1905 and 1941 (early 1900s) and in the latter half of the Nineteenth Century experienced a high frequency of high-magnitude floods (Ely and others 1993; Ely 1997). Ely (1997) and Baldys (1990) noted that the largest historic flood peakflow of 4,248 $m^3\ s^{-1}$ (150,017 $ft^3\ s^{-1}$) at the Tangle Creek Gauge (#09508500) on the Verde River that occurred February 24, 1891 (fig. 2.4). This flood was slightly larger than the January 8, 1993, flood peakflow of 4,106 $m^3\ s^{-1}$ (145,002 $ft^3\ s^{-1}$) at the same site. This would explain the scoured and eroded conditions seen in photographs from the early 1900s on the Verde and other regional rivers (e.g., Little Colorado, Salt, Bill Williams, and Agua Fria).

Examination of reconstructed paleoflood studies (Smith and Stockton 1981; Ely and Baker 1985; Ely and others 1993; Ely 1997; Klawon 1998; House and others 2001) and paleoclimate studies (Grissino-Mayer 1996) reveals high agreement (Figures 2.2, 2.3, and 2.4). There is also high agreement between historical floods

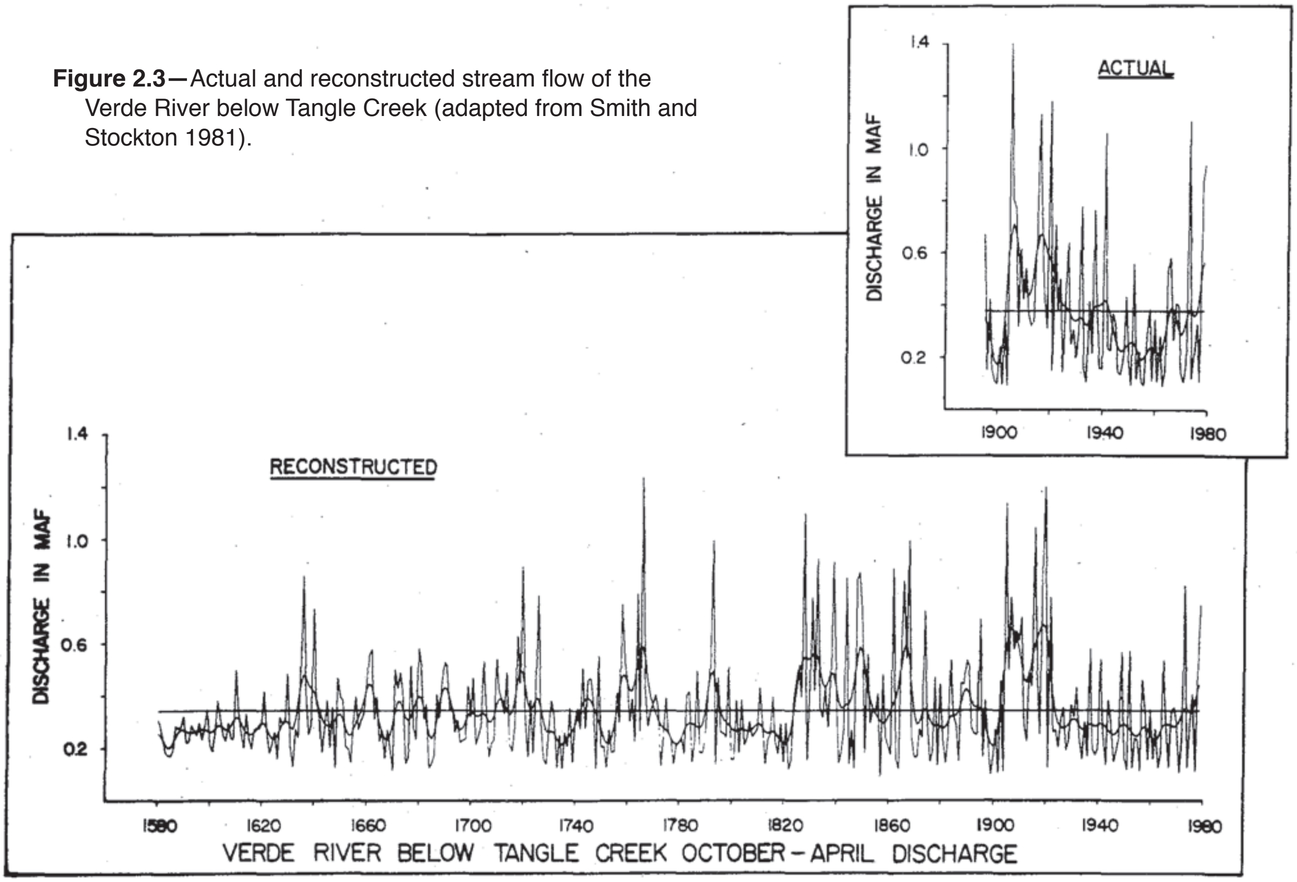


Figure 2.3—Actual and reconstructed stream flow of the Verde River below Tangle Creek (adapted from Smith and Stockton 1981).

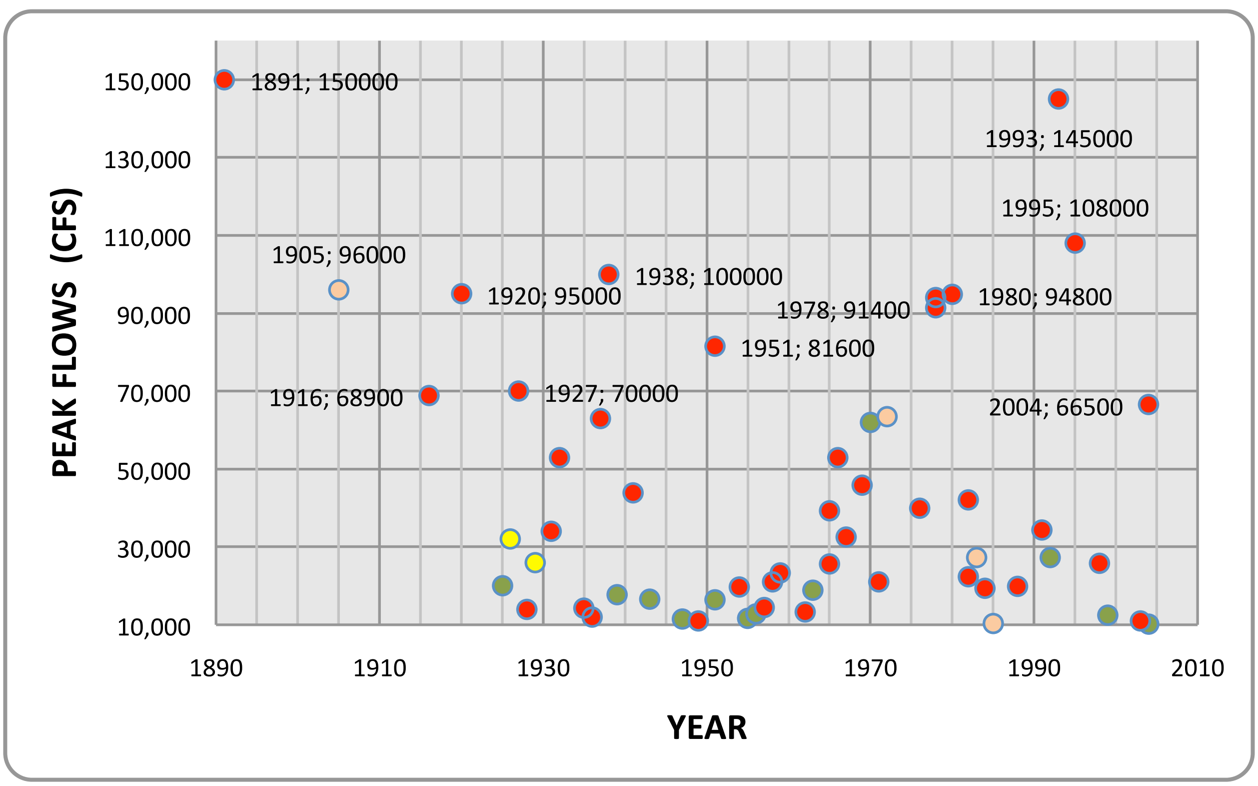


Figure 2.4—Peak flow events greater than 10,000 $ft^3\ s^{-1}$ (283 m^3) at Verde River-Tangle Creek Gauge #09508500. Winter storms are depicted in red, spring in yellow, summer in green, and fall in orange. Data points between 1891 and 1932 are estimates (USDI Geological Survey 2005).

(Smith and Stockton 1981) and the regional climate (Blasch and others 2006) for the Twentieth Century. In addition, the paleoflood history of the Verde River is coincident with the other western streams of Arizona, (e.g., Bill Willams Basin; Enzel and others 1993; House and Baker 2001). This provides greater assurance that early photographs depicting highly eroded and barren conditions were likely due to floods and drought episodes.

Aside from winter floods, summer monsoon storms are an important source of moisture in the Southwest (Poore and others 2005), and they promote a unique climatic regime where summer floods are annual occurrences. Tropical-derived thunderstorms of the monsoon, as well as decaying tropical storms and hurricanes, may be intense enough to cause widespread flooding and erosion in desert rivers (House and Hirschboeck 1997). As with many Southwest rivers and streams, flow varies considerably from season to season, year to year, decade to decade, and century to century.

Robert Webb and colleagues also published studies of paleofloods on other Southwest rivers (Webb 1985; Webb and others 1988, 1991; Webb and Betancourt 1992). The paleo studies by Webb and his colleagues provided the best explanation to date about likely evolutionary conditions of Southwestern rivers and associated vegetation in the late Holocene (Webb and others 2007). More important, Webb and others (2007) provided a rationale for understanding long-term relationships among climate, hydrology, and riparian vegetation. Their extensive treatise renewed debate about the role of riparian gallery forests in Southwestern rivers.

Examination of paleodroughts (figs. 2.2 and 2.3) revealed that droughts within the Twentieth Century were relatively mild compared to droughts within the two millennia of paleoprecipitation described by Grissino-Mayer (1996). The 1950s drought, noted as the most severe within the region in modern time, was mild compared to droughts dating back to 2148 years B.P. In contrast, the duration of paleodroughts was several decades compared to one decade now, and their magnitude in terms of reduced precipitation and streamflow was two to three times that experienced in 1950 (figs. 2.2 and 2.3). The significance of the 1950s drought on the Verde River cannot be quantified in terms of biological changes, but the resulting intermittent flows in the headwater sections of the Verde River in 1954 certainly would have influenced riparian conditions (Wagner 1954). The period from the early 1960s to early 1990s is noted with significant departure from normal in winter flows and the recent wetter period from 1993 to present (see fig. 3.5). Smith and Stockton (1981) remarked that several periods of extended low flow have occurred during the past 400 years and appeared to have a recurrence interval of 22 years (fig. 2.3). The current floodplain and terrace vegetation community of the UVR is comprised of many mesic species (e.g., juniper, oaks, acacias, and other upland plants) indicative of prolonged dry periods and comparatively mild floods witnessed during this century as the plants are age-correct for the time period (see Chapter 6).

Concomitant with drought and flood studies are investigations that address the period of arroyo cutting in the Southwest. The arroyo development periods are important because many past and present-day environmental assessments have used channel erosion as a determinant of historic land degradation by humans in the Verde River watershed. Many assessments attributed overgrazing by cattle and other human activities to arroyo cutting (Antevs 1952; Cooke and Reeves 1976; Graf 1983; Bull 1997). However, recent examination of Quaternary geologic records by Waters and Haynes (2001) linked arroyo formation to the Holocene epoch of the late Quaternary (<11,700 years B.P.) and to changing post-glacial climate, vegetation, groundwater conditions, and human land use. Specifically, the authors identified arroyo-forming episodes around 8,000 and 4,000 years B.P. Waters and Haynes (2001) further noted that arroyo formation appears to be linked to repeated wet-dry cycles, similar to other studies linked to the Southern Oscillation (El Niño-La Niña). The authors described the processes as dropping of water tables and reduced vegetation cover during dry periods (fig. 2.2), making sites susceptible to erosion. Subsequent wet periods induced flooding and initiated arroyo formation. Mann and Meltzer (2007) noted that incision occurred early in the Medieval Warm Period (1000 to 1300 A.D.) and aggradation ensued during the Little Ice Age (1350 to 1900 A.D.), followed by another incision cycle during this past century. Hereford (1993) also suggested that arroyo formation was related to periods of large floods. In the early Twentieth Century, Dellenbaugh (1912) cautioned that grazing wasn't the only probable cause of arroyo formation, but his interpretation was not widely accepted.

Today, the physical evidence identifying climate change as the principal factor inducing channel erosion is revealed in the works of several scientists (Webb and others 1991; Hereford 2002; Reheis and others 2005; Mann and Meltzer 2007; Chapin 2008) and are consistent with paleoclimate interpretations of pollen and packrat middens of the region (Reheis and others 2005). These processes have likely been operative on the Verde River Watershed and would explain historic sediment pulses from tributaries into the main channel, as well as recent erosion of terraces. In short, these sediment-channel dynamics are linked to the paleo-hydrology of the watershed, as previously discussed. Further examination of climate-sediment relationships could explain some residual effects on flora and fauna changes that have occurred on the UVR.

Vegetation

The biota of the Colorado Plateau during the middle (50,000 to 27,500 years B.P.) and late (27,500 to 14,000 years B.P.) Wisconsin time periods were very different from present day. Anderson (1993) attributes the differences to major climate changes associated with the last major glacial period. Areas once dominated by mixed conifers (late Wisconsin period 21,000 to 10,400 B.P.) are largely occupied today by ponderosa pine (*Pinus ponderosa*), a newcomer (<10,000 years B.P.). As the cold climate of the last glaciations ended, there was a shift toward warmer and wetter conditions (3550 to 2480 years B.P.), resulting in major shifts in vegetation upslope. Mixed conifer species and all lower-elevation woodlands and scrublands similarly retreated upslope to present-day elevations.

Oral accounts of UVR vegetation available from Nineteenth Century pioneers and settlers are insightful but not completely reliable. Brykit (1978, 2001) cites Spanish accounts that the Verde River was more "marsh-cienega"-like than typical stream conditions. Trees were scant and grass-like vegetation prevailed. Such references are most likely of the Middle Verde Valley where the landscape was most suitable for wetland conditions. Perkinsville, Bear Siding, Duff Springs, Bull Basin, Verde River Ranch, and a few other open valley areas upstream are sites that could have retained substantial wetlands. The presence of wetland vegetation and soil conditions at Duff Springs, Verde River Ranch, Al's Spring, and the Prescott National Forest "wetland" (fig. 2.5) have been verified by on-the-ground examinations.

Early accounts of Espejo's visit in 1583 to the mines at present-day Jerome noted the presence of "great groves of walnut trees" along the banks of the Verde River and most likely the confluence of either Sycamore Creek or Oak Creek (Farish 1915). Whipple and others (1856) quoted Antoine Leroux's description of

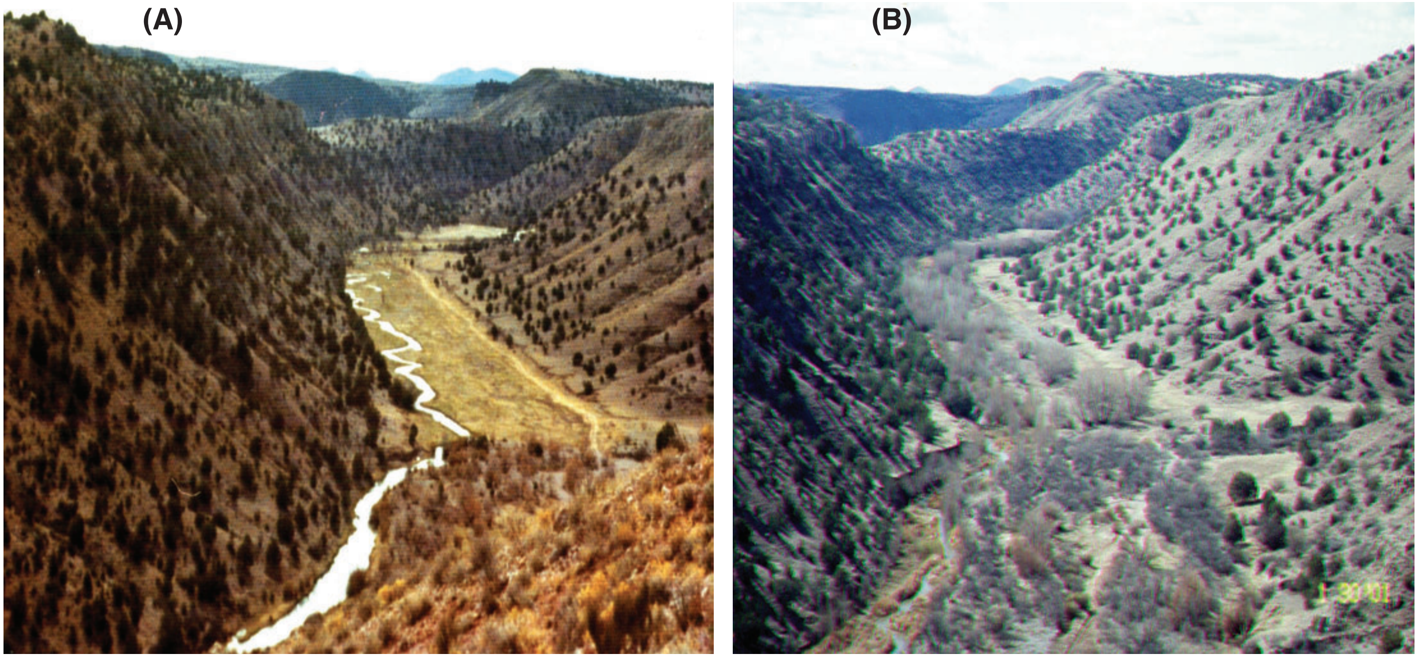


Figure 2.5—The 1979 photo (A) shows a stable wetland sedge meadow, while the 2001 photo (B) shows an invasion of woody species, e.g., tamarisk, and deeply incised channel. Woody vegetation on the floodplain is dated to 1993 flood. (Photo A by Prescott National Forest staff; Photo B by Alvin L. Medina.)

the Verde Valley accordingly: "The river banks were covered with ruins of stone houses and regular fortifications; which, he [Leroux] says, appeared to have been the work of civilized men, but had not been occupied for centuries. They were built upon the most fertile tracts of the valley, where there were signs of acequias and of cultivation." Accounts of cottonwoods and willows occur in archeological studies (Fewkes 1896, 1898, 1912; Mindeleff 1896) and in Hinton's (1878) travelogue. These accounts are limited to the Middle Verde and the tree stands are described as "scattered" and "confined to the immediate vicinity of the river" (Mindeleff 1896). This is surprising, considering the Verde Valley is several miles wide, and one would expect evidence of old groves around old channels. No mention of cottonwoods and other groves of riparian trees were found in historical records beyond Perkinsville. Walnut groves are likely, since they are facultative species that can occupy mesic habitats away from the river's edge. Photographic evidence from the turn of the century in the Perkinsville valley shows an absence of cottonwoods and other obligate riparian woody plants (figs. 2.6, 2.7, and 2.8). These photos show the presence of a few and scattered large cottonwoods perched on the first terrace. Most cottonwoods evident today established along irrigation ditches on the south side of the river (fig. 2.8). The floodplain was devoid of obligate woody plants, except for a few facultative species (e.g., mesquite). These same photos illustrate the eroded channel conditions and terraces likely caused by the 1891 paleoflood noted by Ely (1992, 1997) and Ely and others (1993). It is implausible that livestock ate, or otherwise affected mature stands of cottonwoods and willows between the period 1890 to 1925, since no evidence of stands of trees was found in any historical photos for of the Perkinsville area or other locations. The small grove of cottonwoods in Perkinsville appear to be remnant survivors of floods, with an approximate age greater than 40 to 50 years based on their girth and height (fig. 2.7). Hence, the presence of extensive riparian gallery habitats or stands of cottonwoods, willows or other obligate trees is highly questionable over the last century for the UVR. This situation has been suggested for several Southwestern

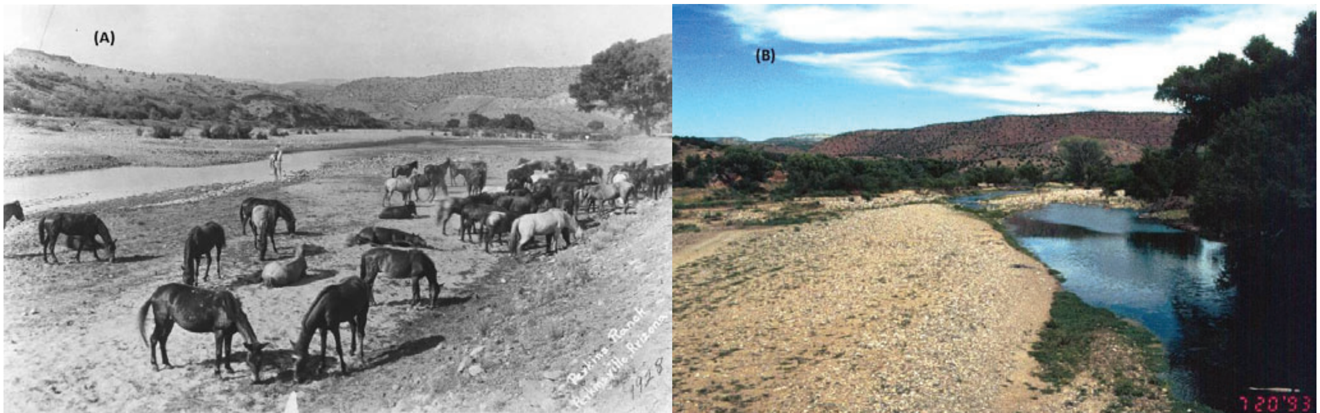


Figure 2.6—Photo (A) taken in 1928 on the Perkins 76 Ranch in Perkinsville, depicts the riparian conditions of the time, with an absence of mature cottonwoods and other obligate trees and shrubs. Large cottonwoods are found on the second terrace. It also shows the channel substrates and geomorphology, those being favorable native warm water fish habitat. The terrace (right bank) is stable as evidenced from its low bank angle and shows no evidence of recent erosion. Photo (B) taken in 1993 shows the continued absence of woody plants. Spikedace were abundant in the immediate reach. Photo (C) taken after a flood in 2004 shows encroachment of woody plants and other invasive plants, as well as major changes in fish habitat. Spikedace have not been sampled since 1997, despite removal of livestock grazing. (Photo A courtesy of the Sharlot Hall Museum, Prescott, Arizona; Photos B and C by Alvin L. Medina.)

rivers (Webb and others 2007), and in recent quantitative descriptions of riparian vegetation by Medina (see Chapter 6). This is not to say that cottonwoods (*Populus*), willows (*Salix*), and other obligate riparian woody species were absent from the basins. Pollen studies by Nations and others (1981) noted the presence of various genera from Miocene to Pleistocene. The most likely explanation for the general absence of gallery vegetation in the UVR prior to recorded history is severe paleoflooding and drought as evidenced by the paleoflood records and climate over the past 2,500 to 5,000 years (Smith and Stockton 1981; Ely and Baker 1985; Webb 1985; O'Connor and others 1986; Ely 1992, 1997; Ely and others 1993; O'Connor and others 1994; House and others 1995; Grissino-Mayer 1996).

In summary, major climatic changes are attributed to the last major glacial period (Anderson 1993). The paleoclimate before 8,000 B.P. was relatively cold and moderately wet with mixed conifer species dominant on present-day ponderosa pine areas. Climatic shifts also produced high variability in drought and flood frequencies and in magnitude. The period of early European occupation and settlement (1600s to 1900 A.D.) of the Southwest was marked with droughts and floods of high magnitudes. Essentially, conditions were harsh and chaotic. The largest recorded flood on the Verde River occurred in 1891 A.D., though many more paleofloods are apt to be discerned using modern technology (e.g., Lidar and HEC-RAS). Regionally, many rivers were subject to the same extremes, thereby setting the stage for a new climatically and hydrologically quasi-stable era where the growth of woody plants was favored across many rivers of the Southwest. Riparian vegetation as evidenced today was largely absent in the late 1800s and early 1900s on the UVR and attributable to large floods.

Figure 2.7—Photo looking south across the Perkinsville valley depicting the condition of the UVR circa 1920s. The river runs amidst a valley devoid woody plants and irrigated bottomland (ditches in foreground) where horses are seen grazing. Streamside vegetation was largely herbaceous and lacking woody plants. The floodplain morphology is a gentle "C" type channel with ample freeboard for flood waters to spread. A small grove of cottonwoods resided atop an older terrace. (Photo A courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.8—This photo was taken from the Perkinsville Road looking east and shows the homestead on the south side of the river. A stand of young cottonwoods, likely less than 10 years old, can be seen growing along the irrigation ditch. These same cottonwoods are seen in figs. 2.36 to 2.42. (Photo A courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Human Influences

Paleo-Indians—The UVR watershed and riparian corridor have been influenced by man for centuries. Archeological studies (Pilles 1981; Elias 1997) suggest the Colorado plateau and the Verde River Valley were likely occupied by paleo-Indians since around 14,000 B.P. Archeological studies of the Perkinsville sites confirm the UVR was occupied by paleo-Indians from Pueblo I thru Pueblo IV periods (Fish 1967, Fish and Fish 1977). The influence of hunter-gather nomadic groups was likely small. On the other hand, paleo-Indians of the Pueblo periods inhabited the river valleys (e.g., Verde Valley and Perkinsville Valley), building abodes, harvesting fish and game, and farming using extensive irrigation canals (Kayser and Whiffen 1966; Minckley and Alger 1968). Gladwin and Gladwin (1930) suggested that various paleo-Indians from the south and east (Salado), north (Tusayan and Hopi), and west (Havasupai, Yavapai, and Hualapai) also visited and inhabited the UVR valleys, as evidenced by lithic materials. The valleys of the Lower Verde River experienced agriculture as early as 750 A.D. and probably remained until 1450 A.D. (Van West and Altschul 1997). Pierson (1957) concluded that the Hohokam settled the southern reaches of Verde Valley prior to 1100 A.D., but then the valley was resettled during the drought of 1276 to 1299 A.D. (fig. 2.2) by the Sinaguans, who built the elaborate structures known as Tuzigoot and Montezuma Castle (Wormington 1977). These settlers farmed the Middle Verde Valley using extensive irrigation canals. Likewise, the Perkinsville Valley was also farmed, and several irrigation canals have been discovered (Kayser and Whiffen 1966; Fish 1974). The Sinaguans abandoned the Verde Valley in the early 1400s for unknown reasons (Pierson 1957).

As Fewkes (1896, 1898) suggested, it is reasonable to expect that the valleys of the UVR were occupied and farmed by paleo-Indians. In 1896, Fewkes noted pueblo ruins in Sycamore Canyon, Perkinsville (Baker's Ranch House), Hell Canyon, Granite Creek confluence, and Del Rio Springs. Kayser and Whiffen (1966) confirmed farming and extensive irrigation canals in Perkinsville. Extensive pueblo ruins can be observed at Bear Siding, Duff Springs, Prospect Point area, Bull Basin, Verde River Ranch area, 638 Road areas, the Prescott National Forest wetland area, and the Arizona Game and Fish Department property. All of these areas have open valleys with moderate to extensive floodplain terraces that could have easily accommodated farming. In addition, Fewkes (1896, 1912) noted several defensive structures (i.e., forts) and many cave dwellings (fig. 2.9) throughout the UVR. Mearns (1890) noted locations of several habitations as far west as Sycamore Canyon and many throughout the Middle Verde River area, but he did

Figure 2.9—Cliff dwelling located about 61 m (200 ft) above the UVR overlooking the Duff Springs area to the east. (Photo by Alvin L. Medina.)

not visit the upper reaches. Hence, considerable evidence exists that the UVR was largely occupied by paleo-Indians. It is also reasonable to expect their agricultural activities would have affected riparian conditions, including the exploitation of fish and wildlife for domestic uses.

Europeans—The Spanish explorer Antonio de Espejo was the first European to visit the Camp Verde area of the Valley during an expedition in May 1583 (Hammond and Rey 1966; Mecham 1930). Espejo's visit was brief—he was in search of mineral wealth at the location where the mines were established near Jerome. In 1598 A.D., Don Juan de Oñate sent his lieutenant, Marcos Farfán de los Godos, to further investigate the ore mines at Jerome (Pierson 1957). Munson (1981) reported that "Oñate crossed the Verde River in 1604 en route to the Colorado." For about another 220 years, the Verde Valley remained unnoticed, except for the paleo-Indians of the area, until the arrival of French trappers to the Arizona Territory.

Historical accounts of European trappers in the Verde River are scant. Cleland (1963) noted that various trappers visited the Verde Valley, including Ewing Young, James Pattie, Pegleg Smith, George Yount, Milton Sublette, Kit Carson, Bill Williams, and Antoine Leroux. In 1826, Ewing Young was reported to have led a trapping expedition up the tributaries of the Salt River. Pattie encountered Young at the Salt River after coming down the Gila River and losing most of his party to Indian skirmishes. He joined Young on the Salt River while a separate party ascended the Verde River to its source (Pattie 1831; Cleland 1963; Hafen 1982, 1983). Three years later in 1829, Ewing Young and 40 men, including Kit Carson, ventured on another trapping expedition down the Salt River to the confluence with the Verde River, then up the Verde to the headwaters and onto the Colorado (Cleland 1963; Byrkit 1978). In 1854, Leroux is said to have discovered the paleo-Indian ruins of the Verde Valley in passing through the area but he made no mention of trapping (Fewkes 1898).

Considering the many miles of streams and rivers in Arizona that were supposedly traversed in search of beaver pelts, relatively small quantities of beaver pelts were reported in historical accounts (Hafen 1982, 1983; Despain 1997). Hamilton (1881) noted that beaver were found throughout the Sub-Mogollon region, including the Verde River and its tributaries. Coues (1867) reported that beaver were abundant in the Verde River, as well as in the many other waterways of Arizona. However, others (DeBuys 1985; Hoffmeister 1986) reported that streams were over-trapped from the headwaters to their confluences. Such exploitations led to trapping moratoriums in 1838 by Mexican authorities (DeBuys 1985) who detested trappers in Southwestern territories (Hafen 1983). Apparently, the Southwestern river otter (*Lontra canadensis sonora*) may have been similarly over-exploited (Huey 1956). The UVR, not unlike many other streams of the Southwest, was likely exploited for beaver from the mid-1820s through to settlement in mid-1860s (Pierson 1957). Leroux was part of other trapping expeditions in Arizona throughout the period from the mid-1820s through mid-1850s, when he visited Montezuma Castle. Likewise, Pauline Weaver, a noted mountain man, trapper, rancher, guide, prospector, and pioneer, was part of several expeditions in the Southwest (Pierson 1957). Weaver first visited the Verde Valley in 1829/1830 A.D. (Munson 1981), although others placed him in the Verde Valley in 1832 (Pierson 1957). He finally settled in the UVR valley, where he scouted at Fort Whipple in 1864. He was later assigned to Fort Lincoln where he died in 1867 (Despain 1997). Bill Williams was another trapper who lived in the area and was noted for his expeditions across the Southwest with other trappers (Favour 1962). Trapping by "foreigners" in Mexican Territory was eventually banned and limited to Mexican citizens. Thereafter, illegal trapping and defrauding was common by trappers who commonly had their pelts confiscated (Weber 1971). It's highly likely that beaver were trapped thereafter as part of settlement activities during the late 1800s (Pierson 1957) and early to mid-1900s, as trapping was a common secondary source of income. In short, trapping in the UVR appears to have been limited as reported, probably to the general absence of beaver. This is consistent with the general absence of woody vegetation noted in previous sections.

Sand and Gravel Mining—Undoubtedly, the period from the 1880s to the present marked a period on the Verde River where a variety of human influences consistent with settlement activities occurred. Extraction of river products, e.g., sand and gravel, for construction of towns and businesses was in place since the mining industry in Jerome began expansion in the late 1800s. Extensive gravel mining of Verde River reaches near Tapco, Cottonwood, and the Camp Verde area was reported as early as 1910 (Simons, Li, and Associates, Incorporated 1985). Similarly, sand and gravel mining occurred on private lands in Perkinsville from the 1960s to 1970s. Remnant piles of rock and boulders traceable to sand and gravel extraction still remain on the Y-D Ranch. By 1989, sand and gravel mining was curtailed under order from the Environmental Protection Agency for violations of the Clean Water Act (Arizona Floodplain Management Association 1989). These actions resulted in limiting sand and gravel extraction activities on the Verde River.

Diversions—The settlement period of the late 1800s to early 1900s also initiated new water diversions throughout the Verde Valley and Perkinsville (Turney 1901, 1929; Alam 1997; NRCD Verde 2000). These diversions were, and continue to be, used for agriculture (Owen-Joyce and Bell 1983). As noted before, these same areas were extensively farmed by paleo-Indians. Arizona Department of Water Resources (1994) estimated that about 90% of summer flow in the Middle Verde River between Clarkdale and Camp Verde was diverted at one time for agricultural use. Some of these diversions are still in place today. One of the most notable diversions was the Peck's Lake diversion in 1920, which created a barrier and tunnel to provide water from the Verde River to the estuary/marsh. The barrier of Peck's Lake diversion dam has functioned much like a fish barrier, limiting upstream movement of fish to the UVR study area for decades. Alam (1997) reported 11 other diversions in the Verde Valley. These diversions have been implicated as threats to native fish habitats and populations (Girmendonk and Young 1997; USDI Fish and Wildlife Service 2005, 2007a, 2009). However, no scientific evidence exists yet linking significant decreases in native fish or habitats to diversions or determing whether diversions affect stream flow or hydrologic conditions (Moyle and Israel 2005; Industrial Economics Incorporated 2006). Roy (1989) documented entrainment of fish in two irrigation ditches of the Verde Valley, noting that exotic species, i.e., red shiners (*Cyprinella lutrensis*), smallmouth bass (*Micropterus dolomieui*), and rainbow trout (*Oncorhynchus mykiss*), were the most abundant fish found in the diversions. However, Ziebell and Roy (1989) noted that some fish, like the roundtail chub (*Gila robusta*), rarely used irrigation diversions on the Verde River. Reliable estimates of entrainment losses are lacking, despite observations of entrainment. Studies of trout suggest entrainment rates are relatively small (0.4 to 3.3%) at the basin level and constitute a relatively small loss compared to the total annual mortality (Carlson and Rahel 2007). Nonetheless, some entrainment losses are apt to occur wherever irrigation diversions exist, but their extent is debatable.

Impoundments—The UVR ecosystem has been impacted by indirect and direct effects of impoundments. Two large reservoirs—Bartlett and Horseshoe—constructed in 1939 and 1949 (USDI Bureau of Reclamation 2009a, 2009b), respectively, have regulated flows and impeded aquatic wildlife (e.g., fish movements) from the Lower Verde River corridor to the UVR. In addition, these impoundments became regionally important for sport fishing, recreation, flood control, and water storage for agriculture and production of electricity for the Phoenix metropolitan areas (Arizona Department of Water Resources 2009). The impoundments have excluded fish movements across the Salt River and Gila River Basins.

On the UVR, King (2007b) reported that as early as 1884, a dam was built on Miller Creek to store water for the city of Prescott. Granite Dam was completed in 1899 on Granite Creek (King 2007b). Several other impoundments (e.g., Goldwater Lake, Lynx Lake, Watson Lake, and Willow Lake) were also constructed in headwater tributaries of the Prescott area. Other impoundments with 616,800 m^3 (500 ac-ft) capacity (e.g., Hell's Canyon Tank) are located on tributaries north of the Verde River. Arizona Department of Water Resources (2007) listed several registered impoundments, including six impoundments of greater than 20 ha (50 ac) in surface area. Another 27 impoundments have storage volumes of 18,500 m^3 (greater than 15 ac-ft). About 32 reservoirs have storage capacities rated between 2 and 20 ha (5 and 50 ac) of surface area, and another 2,328 stock ponds with up to 18,500 m^3 (15 ac-ft) capacity are scattered across the UVR landscape. It's reasonable to assume that these impoundments have altered flow and bedload contributions to the Verde River over their years of service. Sullivan Dam, constructed in 1939, has probably most directly affected the hydrology and overall ecology of the UVR. Originally intended as another regional recreational lake with inflows from the Del Rio Springs, it quickly filled up with alluvium within three to four years of construction and currently remains a largely seasonal water impoundment. Sullivan Dam cut off access to headwater flows, and blocked natural bedload movement to the UVR perennial flow riverine system. The effects of 70 years of bedload-sediment deprivation can be viewed in deeply incised channels and eroded terraces throughout the UVR corridor. The cumulative effects of the Sullivan Dam and other impoundments on the hydrology and native fishery have yet to be assessed, but there is considerable evidence that impoundment disturbances have altered the UVR ecosystem considerably. Other efforts to harness the tranquil baseflows near the headwaters are yet evident at the Verde River Ranch, where a dam was constructed across the river sometime in the 1960s, only to be washed away or demolished. Several authors have referred to the Verde River as "the last free-flowing river" in Arizona (Beyer 2006; Marder 2009). However, this limited definition applies only to the segment between the confluence of Granite Creek and Horseshoe Dam, an approximately 160-km (100-mi) segment of the river. The designation of "the last free-flowing river" applies only if the many smaller diversions noted above are discounted. Today, perennial flow starts at springs near the Granite Creek confluence, rather than from the historical Del Rio Springs a short distance upstream. In short, the Verde River is not free flowing but rather limited to only segments, owing to its variety of channel diversions and impoundments.

Ranching and Grazing—The first permanent settlers to the Verde Valley arrived in January 1865 (Pierson 1957; Munson 1981). This event marked the beginning of cattle ranching in the Verde Valley. Livestock were produced to meet local needs of Army personnel at Fort Lincoln (name changed in 1868 to Camp Verde and later in 1879 to Fort Verde) and the settlers. The valley floodplain and terraces were suited for agricultural production of foods and forage for settlers and Army personnel at Fort Whipple in Chino valley (Pierson 1957) despite very marshy conditions. Outbreaks of malaria were attributed to wet conditions, typical of wetland environments (Munson 1981).

Livestock grazing of the UVR area began after the establishment of Fort Whipple in 1864. Ludington (2002) provides a historical account of this period:

> "In 1864, President Abraham Lincoln sent an official party with military escort to establish the capital of the new Arizona Territory. Their first camp was at Del Rio Springs north of present site of the town of Chino Valley. A few months later the party moved to the forested area of present-day Prescott, where logs were readily available to build a fort, houses, and businesses. While at the original site, army doctor James Baker traded his horse and saddle to a squatter for his land claims along the Verde River. Baker and his partner James Campbell were soon running one of the largest cattle/horse operations in Arizona. They called it the Verde Ranch. The severe drought years of the 1890s, however, brought financial setbacks that forced the partners to sell."

Early attempts to establish cattle ranches in the Williamson Valley were made by Stevens in 1864 (40 head) and H.C. Hooker in 1868, but these efforts were unsuccessful owing to Indian conflicts (McClintock 1916). Sheep were introduced into the watershed in 1876 by John Clark on Bill Williams Mountain (McClintock 1916). Bronson (1978) provided cattle numbers for various ranches in the upper Chino Basin during the 1870s, further suggesting that large herds were being sent to Arizona. However, most of the livestock were used to meet local needs. The presence of Fort Whipple would have increased the chances of establishment, despite frequent raids by Native American tribes, but little evidence exists to infer that the range was heavily stocked at that time (Bronson 1978). Brown (2007a) reported from oral accounts that James Baker's 76 Ranch in Perkinsville was stocked with 10,000 head of cattle circa 1882, making the operation the largest cattle and horse operation in northern Arizona. This number of cattle was widely distributed in the watershed and not solely in Perkinsville, as range capacity was limited (see discussion below). However, troubled years lay ahead with prolonged droughts that saw many cattle perish, especially in 1891/1892, for lack of forage and water. Poor financial markets for livestock (1895), as well as personal problems left the 76 Ranch with relatively little stock, thereby forcing Baker to sell in 1898.

In 1900, Marion Perkins purchased the Verde Ranch from Baker and Campbell and arrived on the UVR at Perkinsville November 1, 1900, with his cattle herd (Ludington 2002). The expanse of the cattle operation was reported to extend from Granite Mountain to the west, to Ash Fork and Williams to the north, to Dugas to the east, and to Mayer to the south (Ludington 2002). This approximated about 91 km^2 (35 mi^2) of open rangeland, inclusive of summer and winter range. The number of livestock of this operation is unreported for this period, although numbers were probably relatively low owing to the scarcity of precipitation as well as the relative poor distribution of water throughout the area at the time.

Talbot (1919) noted that range examiners performed a range survey of the present-day Limestone and Del Rio Allotments on the UVR encompassing 34,978 ha (86,433 ac). These rangelands were part of the southern portion of what was then the Tusayan National Forest, which was established July 1, 1910. Encompassing just over 569,635 ha (1,407,600 ac), it was later transferred to the Prescott National Forest October 22, 1934 (Davis 1983). Approximately 16.4% (5,765 ha or 14,245 ac) were classified as forage acres, with an estimated carrying capacity for these lands based on year-long use of 3.2 ha cow^{-1} (8 ac cow^{-1}). Total annual carrying capacity for all Forest lands combined was estimated at about 12.6 ha (31.1 acres cow^{-1}). Non-forage acres were mixed pinyon-juniper woodland range with browse and annual forage. Cattle and sheep were grazed year-long on the UVR portion of the Prescott National Forest with an average stocking rate of 380 cattle and 1,730 sheep. These numbers were noted as being under the protective limits for the local District. Limiting factors to management included water, fencing, and range pests (e.g., prairie dogs). Most range improvements were constructed during the 1930s. Contrary to popular belief for the times, Talbot's (1919) assessment indicated that range conditions were relatively fair, despite the drought conditions and poor animal distribution. The examiners noted that trend conditions were declining, but estimates for stocking capacity suggested that range conditions were not "highly degraded or devastated," as is often advocated in some literature. Declining range conditions during this time (1900 to 1920) were exacerbated by severe droughts and floods, poor livestock management practices, and lack of range improvements. Cattle stocking was fueled by demands for meat products to meet the nation's World War I (1914 to 1918) needs, mining industry requirements throughout the West, and new human population center expansions.

Today, stocking of the same range that was examined by Talbot (1919) approximates a small fraction of the estimates of 1919. Miller (1921) attributed the conversion of 4,050 to 6,070 ha (10,000 to 15,000 ac) of tobosa grassland to Utah juniper (*Juniperus utahensis*) to sheep grazing. Miller (1921) further noted that the average age of 20% of Utah juniper stands was fewer than 35 years; the remaining 80% was 13 years or less. He also noted the same phenomena for one-seed juniper (*J. monosperma*), citing seed size and lessened herbivory.

Despite the lack of stocking data, the period of the late 1880s through the early 1940s was marked with severe droughts (Webb 1985; Ely 1992; Grissino-Mayer 1996) and very intense floods (Ely and others 1993; Ely 1997) that contributed to overuse of rangelands. These climatic events were coincident with the influx of cattle and sheep and establishment of the ranching industry in the region. Early range scientists recorded the general overgrazing that was obvious in the region (Griffiths 1901, 1904, 1910). These assessments brought about major changes in land management and the start of range research in the West. Also coincident with range overgrazing during the same period was the exploitation of neighboring forests and woodlands for development (King 2007a). Forest products were in demand for the mining industry, railroads, and settlements within the watershed. These activities undoubtedly worsened the deterioration of the rangelands, as noted by range examiners (Talbot 1919).

Indirectly, trends in range conditions could be partially explained by economic factors. During poor markets, livestock operators were more likely to retain annual crops, thereby placing additional stress on overstocked rangelands. Local livestock production during the period of 1890 to 1910 was initially determined by the ability to successfully stock the range and maintain numbers in the face of adversities (e.g., Native American skirmishes, livestock thefts and depredations, and droughts). Some stock was produced for local needs, such as military fort and mining camp meat supplies, but stock that was produced for regional and national markets became susceptible to national economic recessions. The link between stocking strategies, climatic conditions, and national markets remains today. Another factor that likely affected range trends between the turn of the century and circa 1950 was the national policy of Congress and land management agencies to encourage settlement and development of States with public land (Nielsen 1972). This policy made it more difficult for land managers to administer grazing lands in accordance with carrying capacity principles.

Grazing Litigation—Litigation over livestock grazing in riparian habitats and federally listed fish and wildlife species in Region 3 has played a major role in the management of the riparian habitats and listed fish species in the UVR. The results of litigation have great potential to affect ecosystems and their components long term. Although well intended and supposedly based on best science available, litigation may not always yield the best of intended results. Despite numerous appeals and lawsuits, native fish, such as the spikedace on the UVR, continue to disappear.

Livestock have grazed portions of the UVR since about the 1860s. Large numbers were introduced when cattle were imported from Texas to the Perkinsville area in 1895. Large-scale reductions in cattle numbers using the river occurred in the early 1900s (see previous discussion on ranching and grazing), and was accompanied by long-term monitoring of the uplands. Yearlong grazing use of the river continued until the 1980s. At that time the Prescott National Forest changed grazing use to seasonal or rotational, releasing yearlong grazing pressure on riparian plant communities in the river corridor. With the wholesale reduction in cattle numbers in the early 1900s, cattle numbers have declined considerably to the present (Rinne and Medina 2000).

In 1993, the Horseshoe Allotment (Y-D Ranch) voluntarily removed cattle from the river after a cooperative effort with Prescott National Forest to improve riparian conditions from the historic 1993 winter flood. Prescott National Forest surveys suggested that riparian conditions would likely improve within five years and the area could be restocked. Grazing on the Horseshoe Allotment had also been under contention by Forest Guardians for years prior to the voluntary temporary removal. Although National Environmental Policy Act (NEPA) analyses has since been completed for grazing on the allotment, grazing on the river was not considered at that time, and is not precluded pending approval of the NEPA analysis. In continuing efforts (1993 to 2010) to get research performed on grazing- fish relationships, Y-D Ranch and Verde River Ranch invited RMRS and Prescott National Forest to engaged in a collaborative group (UVR Adaptive Management Partnership [UVRAMP]), which became the conduit for communication and development of research plans. The hope was to provide management science-based guidelines for grazing the UVR. However, appeals to grazing riparian areas were impending and discouraged plan implementation.

In 1997, Forest Guardians (Forest Guardians v. U.S. Forest Service 1997) and the Center for Biological Diversity (Southwest Center for Biological Diversity v. U.S. Forest Service 1997) filed complaints against the U.S. Forest Service, Region 3, seeking an injunction and cessation of grazing on multiple allotments in Region 3, including four of the seven grazing allotments, Antelope Hills, Perkinsville, China Dam, and Sand Flat, in the UVR. Three grazing allotments, Horseshoe, West Bear-Del Rio, and Muldoon were not included in the litigation because the permittees had previously agreed with the Prescott National Forest to remove livestock from the river. Forest Guardians and the Center alleged failure by the U.S. Forest Service to comply with the Endangered Species Act (ESA) by failing to have completed ESA Sec. 7 consultation for livestock grazing effects on watersheds and riparian habitat affecting four listed species, loachminnow, spikedace, spotted owl, and southwestern willow flycatcher. These lawsuits placed livestock grazing of riparian areas in Region 3 at risk. Subsequently, the Arizona Cattle Growers Association (ACGA) and the New Mexico Cattle Growers Association (NMCGA) joined the lawsuit as interveners (CV-97-2562 PHX-SMM, CV-97-0666-TUC-IMR).

On April 16, 1998, Region 3 entered into a stipulated agreement with Forest Guardians and the Center (Southwest Center for Biological Diversity v. U.S. Forest Service, Forest Guardians v. U.S. Forest Service, ACGA, and NMCGA interveners 1998). The agreement required the U.S. Forest Service to exclude livestock from at least 99 percent of occupied, suitable but unoccupied, and potential habitat of the species identified in the Motion for Preliminary Injunction, “so long as the U.S. Forest Service complies with the terms of this stipulation for the duration of the ongoing grazing consultation.” The ongoing grazing consultation was completed on February 2, 1999. The consultation period essentially avoided a region-wide injunction over livestock grazing and gave the U.S. Forest Service time to come into compliance with the requirements of the ESA Section 7. At the time of the stipulated agreement, the West Bear-Del Rio allotment was the only allotment of the seven that had completed a NEPA assessment and Sec. 7 ESA consultation. Since then the remaining six allotments have completed NEPA assessments and ESA Sec. 7 consultation. However, none of the assessments included grazing of the river, thus effectively limiting livestock grazing, but not precluding if supported by future NEPA analyses.

The USDI Fish and Wildlife Service proposed designation of critical habitat for the spikedace several times (Federal Register 2000, 2010). The first proposal was on March 8, 1994 (Federal Register 1994) which was set aside by court order for failure by USDI Fish and Wildlife Service to analyze the effects of critical habitat designation under NEPA (Catron County Board of Commissioners, New Mexico v. USDI Fish and Wildlife Service, CIV No. 93-730 HB DNM 1994). On September 20, 1999 the Southwest Center for Biological Diversity filed suit against the USDI Fish and Wildlife Service for failure to propose a rule (Southwest Center for Biological Diversity v. Clark, CIV 98-0769) and the court ordered USDI Fish and Wildlife Service to finalize designation of critical habitat. The proposed rule was promulgated December 10, 1999, and a final rule was submitted April 25, 2000 (Federal Register 2000). It was subsequently challenged in court (NMCGA and Coalition of Arizona/New Mexico Counties for Stable Economic Growth v. United States Fish and Wildlife Service, CIV 02-0199 JB/LCS–D.N.M.) because the USDI Fish and Wildlife Service used a method for economic analysis deemed invalid by the U.S. Tenth Circuit Court. The proposed rule was rescinded on August 31, 2004. The USDI Fish and Wildlife Service re-proposed rules December 20, 2005 (Federal Register 2005), again in 2006 (Federal Register 2006), and a Final rule in 2007 (Federal Register 2007). The 2007 final rule was challenged on the basis that USDI Fish and Wildlife Service designated critical habitat without adequate delineation or justification (Coalition of Arizona/New Mexico Counties for Stable Economic Growth, and others v. Salazar and others–D.N.M.). The proposal was voluntary remanded on May 4, 2009. Each proposal from 2000 to 2007 met and failed legal challenges, mostly on economic and science based issues. For example, the 2007 proposal excluded segments of the Verde River below the UVR study area "due to potential economic impacts," still noting grazing as a threat but recognized nonnative fish as a threat for the first time (Federal Register 2007).

The 2010 proposed rule (Federal Register 2010) takes into consideration new information on distribution, e.g., Mangas Creek in southern New Mexico, and addressed flaws in previous proposals. However, livestock grazing is still cited as a major threat (Federal Register 2010, p-66489) because of adverse effects that may occur from watershed alteration and "subsequent changes in the natural flow regime, sediment production, and stream channel morphology." This Report presents alternative views of watershed responses to other factors other than grazing, and that have similar consequences as those noted in the 2010 proposal.

Despite various litigation efforts on the UVR to protect listed fish, native fish populations continue to decline. Spikedace have not been found for over 10 years (see Chapter 9). Other minnows that were once common, such as speckled dace and longfin dace, also have become infrequent in fish surveys (see Chapter 9). Depressed populations of the latter are attributed to direct effects of nonnative fish (Desert Fishes Team 2004, 2006). The future of native fishes in the UVR and the Southwest has been well expounded by many fishery experts (Rinne and Minckley 1991; Rinne 1991a, 1999a, 2001a; Olden and Poff 2005; Rinne and others 2005a), all of which note that native fish populations are down trending despite various legal and resource protection measures, and pleas for exclusion of livestock grazing of riparian areas (Desert Fishes Team 2004). On the UVR, the threat of litigation looms even across research efforts to understand fish-grazing-riparian relationships. To date, there have been no studies that addressed direct effects of livestock grazing on native fishes despite the continued urgency to resolve the controversies. However, many have recognized that nonnative fish in the UVR are the principal cause of depressed native fish populations (see Chapter 9; Desert Fishes Team 2004, 2006). In addition, litigation may force managers to employ conservative protection measures, such as livestock exclusion, that could cause unforeseen changes to the aquatic and riparian habitats over time and ultimately further limit opportunities to manage the UVR habitats for listed species.

Railroads—In 1912, the Santa Fe Railroad brought a spur line through the Perkins family ranch, creating Perkinsville Station and a siding for loading cattle (fig. 2.7). The United Verde and Pacific Railway originated in 1894 when United Verde Copper Company owner, Senator William A. Clark, constructed a narrow-gauge railroad from Jerome to Jerome Junction, which became Chino Valley in 1920 when the railroad ended service (McClintock 1916). The spur line was later decommissioned and became a roadway from Jerome to Perkinsville and Chino Valley. Much wood product was reportedly harvested from the vicinity of the spur to meet mining and community needs.

Mining and Power Development—The first mining camps in the Verde Valley were established in 1876 and were greatly facilitated by the introduction of railroads into the territory in 1882. Railroads were used to import coal to the region from New Mexico, providing coke to the mines and exporting ore (Munson 1981). The United Verde Copper Company was founded in 1883 (Munson 1981) and so began the industrialization of the area. A smelter was built in Jerome to process ore, thus marking another landmark of what was to be a significant change to the local environment of the Valley. Another narrow gauge railroad between Ash Fork and Prescott, known as "United Verde and Pacific Railroad" was constructed in 1894. By 1900 Jerome had become the fifth largest city in Arizona (Munson 1981).

The mining boom during the early 1900s created additional needs for electricity to power equipment and the new settlements. Originally, an oil fired plant provided power to the mines; but by June 18, 1909, electricity that was generated at the Fossil Creek Power Plant was being used to power mining operations at the United Verde Mine in Clarkdale (Munson 1981). By 1917, the need for an additional smelter warranted construction of another steam powered plant, built on a terrace of the Verde River upstream from Clarkdale, to provide power to other mining customers (Munson 1981). The power plants supplied electricity to the surrounding towns of Prescott, Mayer, Poland Junction, and Crown King, and they met 70% of the Phoenix power needs (Munderloh 2007). Brown (2007b) reported that smoke from the smelters in Clarkdale clouded the Camp Verde Valley, resulting in a decline of range plants. As early as the 1920s and 1930s, Verde Valley farmers organized to protest, document, and seek compensation from the effects of smelter emissions on crops (Verde Valley Protective Association, no date). The sulfur dioxide rained on the valley for several years until the smelters shut down in the 1950s (Byrkit 2001). Smelter slag deposited on an 18-ha (45-ac) site amounted to 18.1 million Mg (20 million tons) from the years 1912 to 1950. The slag still resides adjacent to the Verde River, although efforts are underway to reclaim precious metals from the slag material (Searchlight Minerals Corp. 2008). The off-site atmospheric deposition of heavy metals and metallic oxides on watershed rangelands is another unknown variable that complicates our understanding of present-day environmental conditions for plants and animals. Byrkit (2001) noted that by 1910, Woodchute Mountain had been denuded by woodcutting and the effects of acidic sulfurous smelter smoke.

Fish Species History

Native Species Decline—The Verde River historically was home to many native fish species. Minckley and Alger (1968) identified paleo remains of five species of fishes on an archeological site in Perkinsville: *Pantosteus clarki* (Gila sucker), *Castostomus insignis* (Sonora sucker), *Gila robusta robusta* (roundtail chub), *Xyrauchen texanus* (humpback sucker), and *Ptychocheilus lucius* (squawfish). Some of these fish are present still, although in low numbers, while others were extirpated and some were repatriated (see table 2.1). Spikedace have not been confirmed on the Verde since 1997 (Rinne 1999a; see also Chapter 9). A single spikedace was reported in a 1999 fish survey but was unconfirmed and questionable. As of 2009/2010, no fish surveys have found spikedace, yet the species status is reported as extant (Robinson and Crowder 2009; Chmiel 2010a, 2010b, 2010c).

The native fish fauna (table 2.1) of the entire Verde River markedly changed with the introduction of 22 species of sport and forage fishes (Rinne 2005; Pringle 2009; see also Chapter 9). Stocking of Arizona's waterways began as early as 1880/1881 with the passage of an Act by the Arizona Legislature "for stocking the rivers and lakes of the Territory with carp and other varieties suited to the climate" (Hamilton 1881). The earliest recorded stocking of nonnative fish in the Verde River system occurred in 1938 (Pringle 2009). Upon the completion of Sullivan Dam at the headwaters, 10,000 blue gill (*Lepomis macrochirus*) were stocked in 1938 (Arizona Game and Fish Department 1938). An additional 2,500 bass (*Micropterus dolomieui* and *Micropterus salmoides*), 4,000 blue gill, and 15,500 channel catfish (*Ictalurus punctatus*) were stocked above Clarkdale and Peck's Lake. Rinne and others (1998) reported that more than a dozen nonnative species and more than 15 million individuals were stocked in virtually every tributary, stock tank, reservoir, and water body capable of sustaining fish on both public and non-public lands. From 1920 to 1995, nearly 560,000 nonnative fish comprising 14 species were planted in stock tanks within the Verde watershed (Pringle 2009). Sponholtz and others (1997) speculated that stock tanks might also contribute to introductions of nonnative fish during high rainfall events that cause overflow into the Verde River. Rinne (2005) further noted that by 1950, five records of nonnative fishes were noted for Oak Creek and Wet Beaver Creek (tributaries of the Middle Verde). By 1964, records doubled with 6 of 11 records from the main stem Verde and the number increased four-fold from 1965 to 1979. Since the 1970s, more intensive surveys revealed that the UVR was exceptional in retaining proportional abundance of native fishes compared with the Middle and Lower Verde River. The UVR harbored about a 4:1 ratio native to nonnative, while the lower reaches ranged from about 1:3 to 1:9 ratios (Rinne 2005; see also Chapter 9). Stocking of rainbow trout (*Oncorhynchus mykiss*) is a continued practice today in the middle Verde Valley in response to angler pressure (Pringle 1996). The Peck's Lake diversion barrier is an apparently effective obstruction to the upstream movement of trout, as trout were not found in the upper reaches.

Interest in the status of native fishes of the UVR did not peak until the early 1990s concomitant with regional implications of effects of livestock grazing and regional trends in native fish populations (Rinne 1999b, 2000, 2005). Land managers sought information about management of riparian areas and native fishes, while others (USDI Fish and Wildlife Service 1999) sought protection status citing grazing, introduced fishes, and water diversions. Long-term studies were

Table 2.1—List of native and introduced aquatic fauna on the Verde River over the last 75 years. Species identified with "*" are reintroduced and experimental. Spikedace were last evidenced in 1997 by Rinne (1999a). Speckled dace have become uncommon in recent years (Rinne and Miller 2006). Roundtail chub were proposed for review in 2009 (USDI Fish and Wildlife Service 2009). (Adapted from Rinne 2005.)

Status	Common name	Scientific name
Extirpated	Gila trout	*Oncorhynchus gilae*
Extirpated	Colorado Pikeminnow	*Ptychocheilus lucius**
Extirpated	Razorback sucker	*Xyrauchen texanus**
Extirpated	Flannelmouth sucker	*Catostomus latipinnis*
Extirpated	Loach minnow	*Rhinichtyhs cobitis*
Extirpated	Gila chub	*Gila intermedia*
Unknown	Spikedace	*Meda fulgida*
Present	Desert sucker	*Catostomus clarki*
Present	Sonora sucker	*Catostomus insignis*
Present	Roundtail chub	*Gila robusta*
Present	Speckled dace	*Rhinichthys osculus*
Present	Longfin dace	*Agosia chrysogaster*
Introduced	Rainbow trout	*Oncorhynchus mykiss*
Introduced	Brown trout	*Salmo trutta*
Introduced	Brook trout	*Salvelinus fontinalis*
Introduced	Goldfish	*Carassius auratus*
Introduced	Common carp	*Cyprinus carpio*
Introduced	Threadfin shad	*Dorosoma petenense*
Introduced	Fathead minnow	*Pimephales promelas*
Introduced	Red shiner	*Cyprinella lutrensis*
Introduced	Golden shiner	*Notemigonus crysoleucas*
Introduced	Tilapia	*Oreochromis mossambicus*
Introduced	Northern pike	*Esox lucius*
Introduced	Smallmouth bass	*Micropterus dolomieni*
Introduced	Striped bass	*Morone saxatilis*
Introduced	White crappie	*Pomoxis annularis*
Introduced	Black crappie	*Pomaxis nigromaculatus*
Introduced	Green sunfish	*Chaenobryttus cyanellus*
Introduced	Bluegill sunfish	*Lepomis macrachirus*
Introduced	Mosquitofish	*Gambusia affinis*
Introduced	Channel catfish	*Ictalurus punctatus*
Introduced	Flathead catfish	*Pilodictus olivaris*
Introduced	Yellow bullhead	*Ameiurus natalis*
Other introduced fauna	Otter	*Lontra canadensis*
Other introduced fauna	Bull frog	*Rana catesbeiana*
Other introduced fauna	Crayfish	*Procambarus clarkii*
Other introduced fauna	Asiatic clam	*Corbicula fluminea*

initiated by Rinne (2001a) and the Arizona Game and Fish Department (2000, 2002). Since 1994, fish surveys have been conducted on an annual basis jointly by the Prescott National Forest and RMRS, as well as Arizona Game and Fish Department. Specific surveys to locate spikedace were jointly performed in 2005 by USDI Fish and Wildlife Service, Arizona Game and Fish Department, and U.S. Forest Service (USDI Fish and Wildlife Service 2005), with no positive results of the presence of spikedace. Similar studies were performed in New Mexico, where spikedace were noted to decline over 18 years in the absence of livestock grazing on the Gila National Forest and Wilderness Area (Paroz and others 2006, Paroz and Probst 2007). These contradictive studies have not abated the controversy over grazing and native fishes.

The cumulative effects of nonnative fishes on native fish and ecosystem processes of the UVR are highly significant. Rinne (1999b, 2005; see also Chapter 9) documented the gradual disappearance of spikedace and present rarity (see Chapter 9) of native fishes on the UVR. A principal hypothesis that has been promoted universally in the Southwest is that livestock grazing is a major causative factor in the demise of native fishes and all fishes in general. However, Rinne (2005) and Rinne and Miller (2006) found no evidence to justify the hypothesis for the Verde River. Others have similarly tried to link grazing effects to native fish sustainability in Arizona and have obtained conflicting results (Robinson and others 2004). Rinne (1999b) examined the grazing-fish controversy and found little evidence in support of the hypothesis, noting that over 80% of the literature was not peer reviewed and the rest of the studies were fraught with design issues. The overwhelming evidence of 15 years of study on the UVR strongly suggests that other factors, such as predation by nonnative fish and other aquatic invasive species (e.g., bullfrogs and crayfish) and hydrogeomorphic changes in habitat conditions are operative in the decline (see Chapter 9). In addition, Rinne and Miller (2006) suggested that factors related to changes in hydrology and geomorphology in the UVR could be principal factors that caused habitat changes favoring nonnative fishes, thereby placing additional survival stress on native fish populations. Propst and others (2008) later identified similar factors for the Gila River watershed. Schade and Bonar (2004, 2005) noted that nonnative fishes have profound effects on native fish populations in the Southwest and note largemouth bass as the principal predator on the Verde River (Bonar and others 2004). Efforts to mechanically reduce populations of nonnative fishes have shown positive results (Rinne 2001b; see Chapter 9). However several other factors have to be addressed before any success can be declared (Rinne 2003a, 2003b; see also Chapter 9).

Repatriation of Native Fish—Various efforts to repatriate native fishes in Arizona have yielded poor results (Desert Fishes Team 2004) and have largely been a learning process, especially with razorback sucker and pikeminnow. Hendrickson (1993) reported that approximately 12 million fingerling razorback suckers (*Xyrauchen texanus*) were stocked into the Verde River between 1981 and 1991 with little or no success. Losses were assumed to be due to predation by nonnative fishes. Since 1991, 22,869 razorback suckers have been released into the Verde River by the USDI Fish and Wildlife Service (Hyatt 2004). In 1992, 11,231 Colorado pikeminnow (*Ptychcheilus lucius*) stocking-fry and fingerlings were stocked (table 2.2) in the UVR and Lower Verde River (Hendrickson 1993; Hyatt 2004). Hendrickson (1993) noted that after several years of failure to detect recruitment, stocking sites were relocated to sections of the UVR, including Perkinsville. These attempts were made to reduce predation on stocked fishes. Subsequent surveys failed to locate the stocked fish, which had likely moved or were transported downstream, where predation may have again become a factor

Table 2.2—Razorback sucker (XYTE: *Xyrauchen texanus*) and pikeminnow (PTLU: *Ptychocheilus lucius*) stocking from 1991 to 2003 by the USDI Fish and Wildlife Service on the Verde River. (Adapted from Hyatt 2004.)

Year	Species	Location	Number stocked	Mean total length mm
1991	XYTE	Upper Verde River	128	356
1992	PTLU, XYTE	Upper Verde River	222	330-406
1993	XYTE	Upper & Lower Verde River	1120	76-356
1994	XYTE	Lower Verde River	2204	324-386
1995	PTLU, XYTE	Lower Verde River	5837	305-432
1996	PTLU, XYTE	Lower Verde River	5961	254-362
1997	PTLU, XYTE	Lower Verde River	3818	287-477
1998	PTLU, XYTE	Lower Verde River	4036	305-330
1999	PTLU, XYTE	Lower Verde River	2364	381-406
2000	XYTE	Lower Verde River	2131	305-580
2001	XYTE	Lower Verde River	1574	300-440
2002	PTLU, XYTE	Lower Verde River	2248	300-350
2003	PTLU, XYTE	Lower Verde River	2427	330-400

(Jahrke and Clark 1999). Eventually, larger fish (12+ in) were stocked to overcome predation factors, but mostly in the Lower Verde River (table 2.2; Hyatt 2004).

Hyatt (2004) noted key observations about restocking razorbacks and pikeminnow:

- Since 1991, larger fish produced better results with recaptures, but introduction has been limited to 87 Colorado pikeminnow and 283 razorback suckers in the UVR.
- Recaptures were found near their original stocking areas on the Salt River, suggesting a high site fidelity relative to site introduction, but only one PIT-tagged razorback has been recaptured on the middle Verde River near Childs.
- Adult survival is at the low end and of short duration, with no recruitment.
- Continued failures to repatriate native fishes in the Verde River prevail owing to inadequate identification of causal factors such as predation (Marsh and Brooks 1989; Mueller 2003).

Rinne (Chapter 9) pioneered efforts to physically remove nonnative fish in the UVR. Physical removal may be the only reasonable choice to repatriate native fishes, as chemical treatments are currently controversial owing to their cumulative effects on aquatic organisms (Hubbs 1963; Minckley and Mihalick 1981; Magnum and Madrigal 1999; Dinger and Marks 2007; Hamilton and others 2009; Vinson and others 2010), human health risks (Tanner and others 2011), and general lack of success (Dawson and Kolar 2003). Successful reintroduction of native fishes is dependent on many factors that could have contributed to their current status. Mueller (2003) acknowledged that more than three decades of stocking endangered fishes in the Verde River has shown that unless limiting factors are accurately identified and adequately addressed, recruitment failure will continue to occur. Efforts are underway to repatriate native minnows, e.g., spikedace and loach minnow, on a segment of the UVR (USDI Bureau of Reclamation 2010). Dawson and Kolar (2003) assessed the utility of using chemical control in Arizona streams and concluded "chemical reclamations have not always been successful as indicated by reviews of hundreds of fish control projects with reported successes ranking from 43% to 82%." Dawson and Kolar (2003) further noted that the present arsenal of pisicides is not likely to be effective for controlling nonnative fishes in the southwestern United States, and that reclamation of habitats is required. This may be another controversial point since aquatic and riparian habitats have changed considerably in the last century in the UVR.

Exotic Aquatic Species—In addition to nonnative fish, other exotic aquatic fauna were also introduced by the State of Arizona (Arizona Game and Fish Department 2006), including crayfish (1940s) (*Orconectes virilis*, *Procambarus clarkii*), bullfrogs (*Rana catesbeiana*), otter (*Lutra canadensis lataxina*) (1981 to 1983), and Asiatic clam (*Corbicula fluminea*). The first three have turned out to be significant predators of native fish. Crayfish and bullfrogs were likely introduced as bait, sport, and food (Arizona Invasive Species Advisory Council 2008). Asiatic clams are filter feeders and generally abundant, but their role in the aquatic ecology of native fishes is unknown. Because of their relative abundance, they can affect stream nutrient dynamics through their effects on organic matter processing in streambed sediments (Hakenkamp and Palmer 1999) and consumption of phytoplankton (Phelps 1994). The clams are also known as bio-indicators of organic pollutants because they siphon large volumes of water on a daily basis, thereby concentrating dissolved or suspended contaminant that may be present in low concentrations in the water column (Doherty 1990).

Crayfish are omnivores (Dean 1969), and recent studies demonstrated that they are opportunistic, eating both plants and animals, including young snakes (Fernandez and Rosen 1996), lily pads, iris, insects, snails, tadpoles, frogs, baby turtles, fish eggs small fish, and other crayfish. They also are able to successfully compete with native fishes for food and cover (Carpenter 2005; Arizona Game and Fish Department 2006; USDI Geological Survey 2006).

It is unknown when or how bullfrogs were introduced into the Verde River but it was most likely during the turn of the century as a food item or as bait. Nonetheless, bullfrogs are abundant in the Verde River and have been attributed as a principal predator of sensitive species in Arizona (Rorabaugh 2008), leopard frogs (Sredl and others 1997; USDI Fish and Wildlife Service 2007b), garter snakes, endangered fish eggs and larvae (Mueller and others 2006; Witte and others 2008), and endangered fishes such as Yaqui chub and Yaqui topminnow (Schwalbe and Rosen 1988). In a study of southeastern Arizona herpetofauna, Schwalbe and Rosen (1988) commented that bullfrogs "eat anything they can get into their mouth."

The Arizona river otter (*Lutra canadensis sonora*) type locality was from Montezuma Well (Rhoads 1898) and these otters are recognized as a distinct subspecies (Wilson and Reeder 2005; ITIS 2009). The Arizona otter were extirpated and replaced with a surrogate species—the North American river otter (*L. canadensis*) from Louisiana. The Arizona Game and Fish Department introduced the Louisiana otter into the UVR during 1981 to 1983 (Arizona Game and Fish Department 1995). An assessment in the past decade indicated that the otter are doing well (Raesly 2001). However, their food habits may stress the food web dynamics of the UVR, as they relate to native fish populations. Tesky (1993) reported collectively that their fish diets include "suckers (*Catostomus* spp.), redhorses (*Moxostoma* spp.), carp (*Cyprinus* spp.), chubs (*Semotilus* spp.), daces (*Phinichthys* spp.), shiners (*Notropis* spp.), squawfish (*Ptychocheilus* spp.), bullheads and catfish (*Ictalurus* spp.), sunfish (*Lepomis* spp.), darters (*Etheostoma* spp.), and perch (*Perca* spp.)." Crayfish are also a mainstay food item when in abundance (Toweill and Tabor 1982). In general, otter are known to prefer slow-moving nongame fish, but they will eat other mammals, amphibians, insects, birds, and plants (Melquist and Dronkert 1987; Tesky 1993). As such, they pose a potential threat to other sensitive wildlife, aside from native fish, of the UVR (Toweill 1974; Melquist and

Hornocker 1983). However, otters are opportunistic and, by shifting their diets relative to abundance and availability, they could prey upon undesirable nonnative aquatic species such as crayfish, bullfrogs, and nonnative fish (Melquist and Hornocker 1983).

Pictorial Guide

The following section provides a visual montage of the UVR as well as some insights to changes in the river over the past 100 years. Figure 2.10 shows the photo locations as well as other features like main springs and tributaries.

Headwaters

Perennial flow of the Verde River originated from the Del Rio Springs at one time and flowed north along Del Rio Creek (Krieger 1965). The springs are located about 1.6 km (1 mi) south of Sullivan Dam, near the town of Paulden, Arizona. Flow from the springs has varied for the period of record from about 3.42

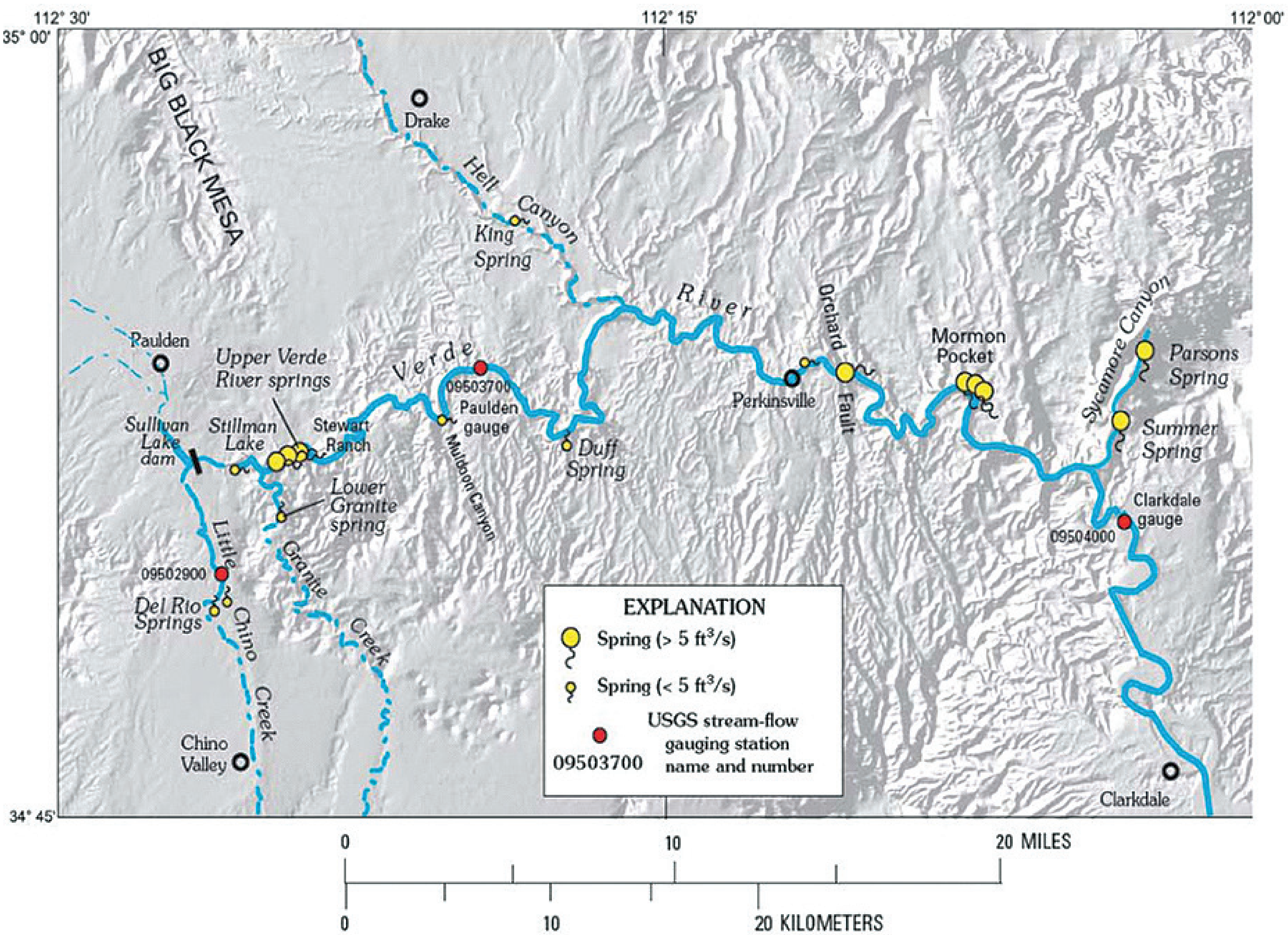


Figure 2.10—Location of known springs and photo points (numbers correspond to figure numbers; e.g., 6 = fig. 2.6 and 11 = fig. 2.11) along the UVR from Del Rio Springs and Granite Wash to Sullivan Lake to the Clarkdale gauge below Sycamore Creek (from Wirt and others 2005).

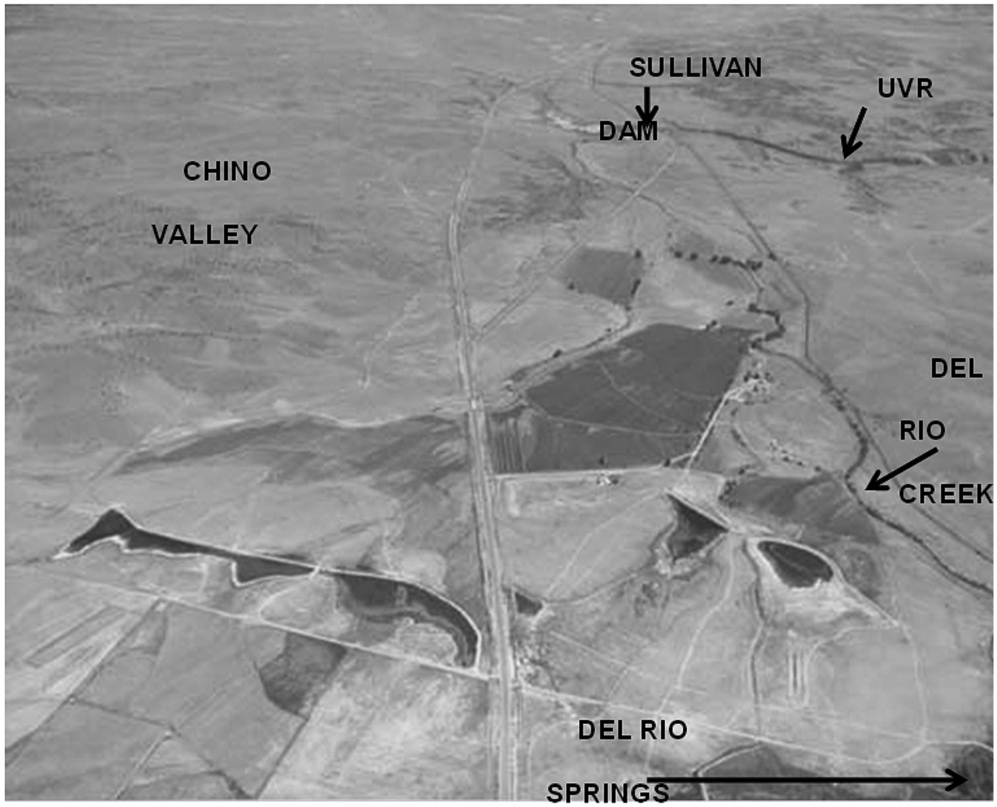
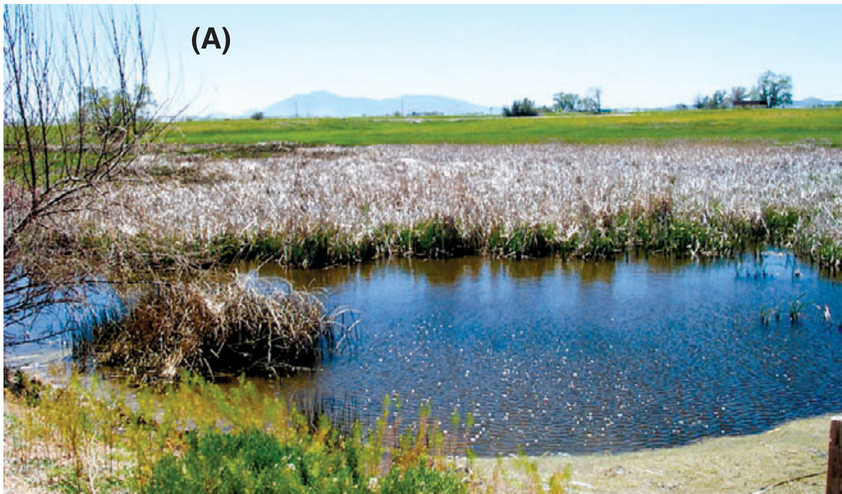


Figure 2.11—Aerial photo taken May 21, 1969, looking north from Del Rio Springs toward Sullivan Dam and the UVR (Sharlot Hall Museum call no. pb167f3i11).

x 10^6 m^3 (2,773 ac-ft) in 1939/1940 to 1.74 x 10^6 m^3 (1,410 ac-ft) in 1999 (Wirt and Hjalmarson 2000). Blasch and others (2006) reported that flow declined from the approximate 3.45 x 10^6 m^3 (2,800 ac-ft) in the early 1940s to near 1.23 x 10^6 m^3 (1,000 ac-ft) in 2003. The Del Rio Springs flow is artesian, seemingly a product of the greater artesian basin extending upstream for several miles (Remick 1983). Henson (1965) referred to this meadow-like drainage as “Cienega Creek.” Remnant wetland species still remain in localized areas.

Figure 2.11 is an aerial photo from 1969 that shows the general appearance of the landscape looking north of Del Rio Springs. The cienega habitat surrounding the springs is evident in the lower right corner of the photo. A dark line formed by cottonwood trees on the right side of the photo running to the top third of the photo marks the location of Del Rio Creek. Sullivan Dam is visible as a white and dark patch in the uppermost area, and the Verde River is the dark line running to the east. A few young cottonwoods dot the area and are still present but in poor condition (fig. 2.12). Evidence of old cottonwoods is lacking for the area.

A primary source of seasonal overland flow to Sullivan Dam and the Verde River is from the Williamson Valley and the Big Chino Wash tributaries. These tributaries are located a few miles upstream to the west. The area is known for the large Big Chino aquifer that provides spring-fed sources to the Verde River (Wirt and Hjalmarson 2000; Blasch and others 2006). The valley is extensively farmed (fig. 2.13) with irrigation water originating subsurface from artesian water sources or pumped and distributed on the surface from shallow wells. Many locations retain a variety of sedges, rushes, and spikerushes.



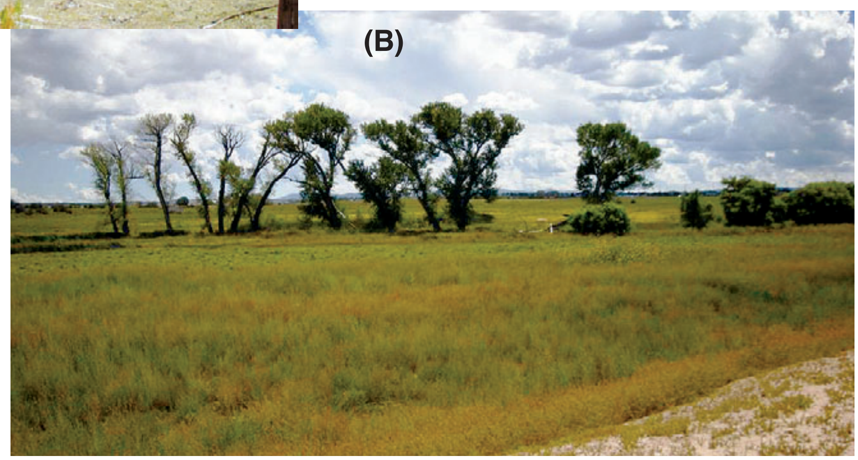


Figure 2.12—Ground view of Del Rio Springs showing riparian vegetation and the current condition of the cottonwoods seen in the aerial photo of fig. 2.10. The photos, taken on September 9, 2008, illustrate (A) the lack of woody plants around the wetland site of the springs, and (B) the condition of the cottonwoods. (Photos by Alvin L. Medina.)

Figure 2.13—Aerial views of the Williamson Valley to the west of Sullivan Dam showing the agricultural area (Upper photo courtesy of the USDI Geological Survey; bottom photo by Michael Collier.)

Sullivan Dam—The City of Prescott acquired the land for the development of Sullivan Lake from the Santa Fe Railroad in 1935. Shortly thereafter, construction of the dam ensued and was completed in 1939 (figs. 2.14, 2.15, and 2.16). By 1942, the lake had become significantly filled in with fine-textured alluvial sediments, and its capacity to store water was minimal. Sullivan Lake still served as a recreational area and was apparently stocked with fish as late as 1950s (Wagner 1954). Sullivan Lake was described by Wagner (1954) as "a shallow muddy water body that, from a fisheries point of view, could best be described as nondescript bullhead hole." With a maximum depth of 2.4 m (8 ft), the lake lacked any productivity for fish and was recommended to be managed for waterfowl (Wagner 1954). Woody vegetation was lacking about Del Rio Creek despite perennial flow as evidenced in fig. 2.15. The dam is presently private owned.

Flood flows in 1993 completely overtopped the Sullivan Dam and nearly filled the gorge downstream (fig. 2.17). The concrete seal around the wall and boulders from the wall was eroded by flood overwash from this event and several subsequent flood flows (fig. 2.18). Trees have sprouted within the exposed boulders of the wall, further compromising the structure. Future floods could breach Sullivan Dam and restore the natural stream gradient in the now intermittent portion of the UVR. This process would initiate downstream movement of sediments that have been trapped above the dam since 1939.

Figure 2.14—A 1936 photo showing the early construction phase of excavating basalt rock for the base of Sullivan Dam. Perennial flow from Del Rio Springs was routed through a sluice box visible on the right side of the rock cut. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.15—Photo from 1937 showing the building of the Sullivan Dam wall. Note the scarcity of woody plants and the additional seasonal flow—probably runoff from Big Chino Wash and baseflow from Del Rio Springs. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.16—A 1939 photo of Sullivan Dam taken shortly after the completion of the dam wall. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.17—Flood runoff from the February 1993 storms going over Sullivan Dam. The reddish, sediment-laden water is characteristic of the soils from the Big Chino Wash high in the watershed. (Photo by Alvin L. Medina.)

Figure 2.18—This 2011 photo illustrates the current condition of the Sullivan Dam wall and minimal water storage in the remnants of Sullivan Lake. (Photo by Alvin L. Medina.)

Granite Creek—A major tributary that affects the headwaters of the UVR is Granite Creek. The creek originates in the Bradshaw Mountains southwest of Prescott and flows north toward its confluence with the UVR east of Sullivan Lake. It is intermittent over much of its reach, and the braided channel system is the major source of bedload for the UVR headwaters during infrequent storm events (Wirt and Hjalmarson 2000; fig. 2.19). Sand and gravel mining occurs in several locations in the Granite Creek channel about 5 km (3 mi) downstream from the location shown in fig. 2.19 and within 3 km (2 mi) of Granite Creek's confluence with the UVR.

Figure 2.19—(A) aerial view of Granite Creek drainage in July 1997, looking north (downstream) towards the Verde River and (B) ground view of the confluence of Granite Creek (upper drainage) with the Verde River (flows right to left). The pool-like water feature in the lower right is referred to as Stillman Lake. The "lake" is formed by the sediment deposits at the confluence and the inflow from groundwater upstream. (Photos by Alvin L. Medina.)

Prescott National Forest Wetland—The boundary of the Prescott National Forest on the west is noted for the presence of a large historical wetland (fig. 2.5). The wetland was first confirmed in 1994 by the presence of hydric soil indicators (USDA Natural Resources Conservation Service 2006), and obligate wetland vegetation (i.e., sedges and rushes). The wetland was first photographed by Prescott National Forest staff in February 1979 (fig. 2.5A). The photo is notable because of the absence of woody plants along the channel. A photo from February 2001 (fig. 2.5B) shows the development of woody vegetation along the UVR due to stream incision that occurred during the 1993 flood. A June 1981 aerial photo (fig. 2.20) also shows the paucity of woody vegetation in contrast with the 2008 photo (fig. 2.21), which shows marked differences in woody plants and channel position.

In May 1979, Mr. James Cowlin provided ground views of the wetland (fig. 2.22A). The large tree on the upper left is a velvet ash with an understory of hackberry. Other important channel features in the 1979 photo are depth to water from the first terrace (right bank, 30 to 60 cm or 1 to 2 ft), channel width of about 3 m (9.8 ft), sand and gravel substrates, a gradient of <.01%, and pool-riffle sequences. A repeat photograph of same location in May of 2008 shows development of much different habitat conditions, with extensive growth of woody plants and cattails (fig. 2.22B). These vegetation changes have encouraged beaver to build dams on the floodplain (fig. 2.23) that have induced hydrologic and vegetation changes and created much different wetland habitats.

Figure 2.20—1981 aerial photo of the Prescott National Forest wetland showing locations of aquatic sites as dark blotches. The view is northerly with flow from bottom left to upper right. (Photo courtesy of the U.S. Geological Survey, Photo #503-30 6-6-1981.)

Figure 2.21—2008 aerial photo of the Prescott National Forest wetland contrasting woody vegetation and channel position changes since 1981 (Google, October 2008).

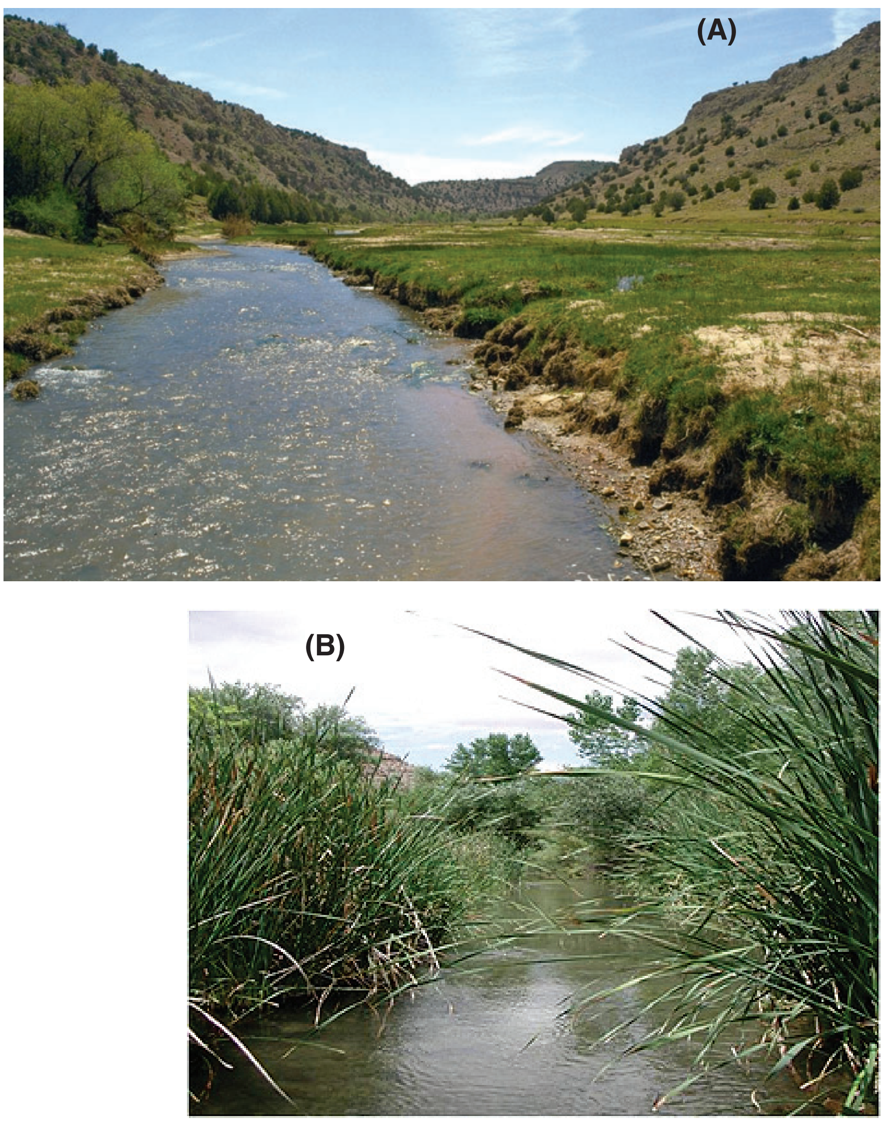


Figure 2.22—A May 1979 photo (A) showing the upstream view of the UVR wetland. (Photo by James Cowlin.) A May 2008 repeat photo (B) near the location of the 1979 photo showing occupation of mixed stands of the first terrace by cattails, cottonwoods, and willows. (Photo by Alvin L. Medina.)

Figure 2.23—Lodge in a pool formed by beaver dam construction along the UVR near the Prescott National Forest wetland. (Photo by Daniel G. Neary.)

Channel Incisions—Concomitant with these changes are evidences of erosion of paleo and historical terraces as well as the modern floodplain (figs. 2.24 and 2.25). Eroded sediments wash downstream, spiraling through the aquatic system, causing a gray-green color of the water and impairing water quality for turbidity. This process is common throughout the length of the UVR.

Terraces located above the wetland provide dramatic documentation of channel downcutting. The terrace in fig. 2.24 is about 5 m (16.4 ft) in height from the terrace level to the channel bottom. It is one of the paleoterraces documented by Cook and others (2010a, 2010b, 2010c) that date from A.D. 440 to 1650 and are composed of fairly uniform fine sediments (fine sands and silts). These terraces are major point sources of fine sediment for the UVR. Sediments are dropped into the river periodically during baseflows by bank sloughing (see fig. 2.24 center and fig. 2.25 lower left). During high flow events, large pieces of the terrace are frequently eroded. Most first terraces along the UVR are much lower in height (figs. 2.22 and 2.26). These terraces still contribute to the load of fine sediment in the UVR by bank collapse, but they do not match the magnitude of inputs from the large paleoterraces. Likewise, many small tributaries also contribute large amounts of bedload and fine sediments as they continue to headcut upstream as part of the adjustment to incision of the river (fig. 2.26).

Field documentation dates nearly all of the terrace erosions to 1993. The 1993 floods initiated the erosion of several paleoterraces throughout the length of the UVR. These terraces are a principal source of continued fine-grained sediment inputs and stream turbidity. The 1993 flood also caused the main channel to drop, thereby setting in motion the degradation of tributaries. An assessment conducted by Prescott National Forest and RMRS staff of post-flood conditions in spring and summer of 1993 identified countless tributaries in a "hanging" condition. Since 1993, these tributaries continue to adjust to the grade of the main stem by sloughing fine sediments. Grade adjustments up the UVR channel system are not yet complete on many tributaries and draws (fig. 2.25). Channel incisions of tributaries are another principal source of fine sediments to the UVR, and are commonly attributed erroneously to other land uses, e.g., grazing.

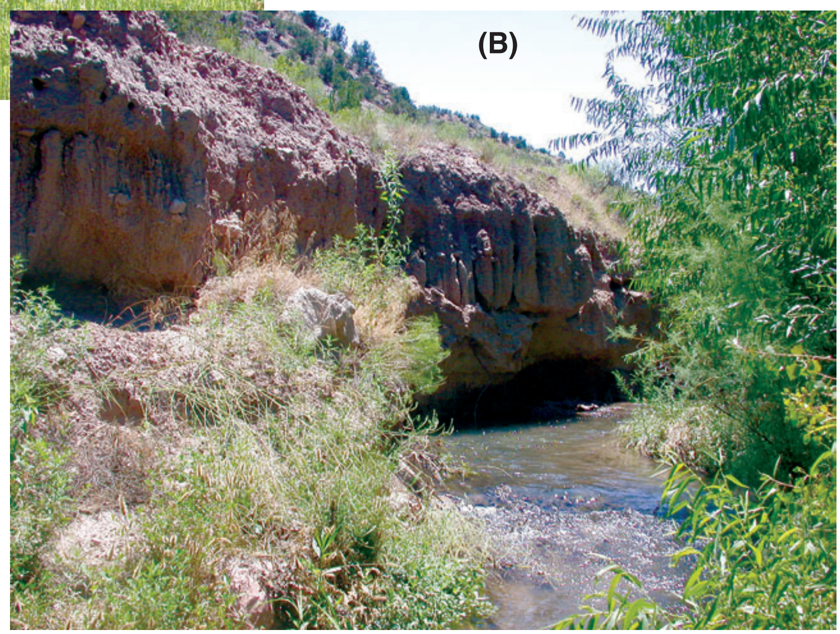


Figure 2.24—Photos A and B show typical paleoterraces located slightly upstream of the Prescott National Forest wetland. Rapid terrace erosion was initiated in 1993 and is now a major source of fine sediment. B is located downstream of the paleoterrace in A, showing active erosion of the terrace and the presence of tamarisk, Gooding willow, and assorted herbaceous weeds. (Photo by Alvin L. Medina.)

Figure 2.25—This tributary, located near Al's Spring, depicts the typical case of headcutting for many tributaries. (Photo by Alvin L. Medina.)

Figure 2.26—Example of smaller first terraces resulting from channel incision on the UVR. (Photo by Alvin L. Medina.)

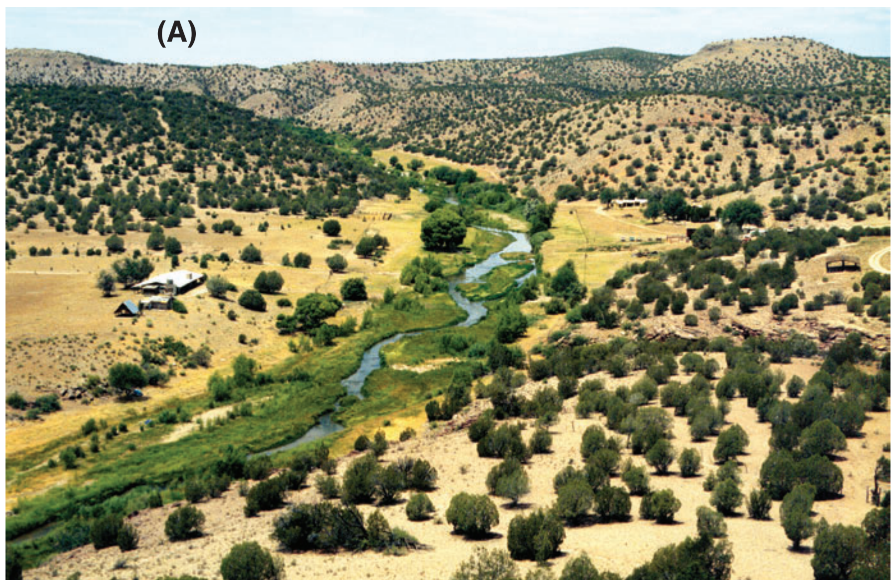
Verde Ranch

A number of photos and other records exist from the Verde River Ranch below the USDI Geological Survey Paulden stream gauge. The UVR has been important for the cattle raising operation at the ranch because it supplies water and supports forage growth during dry periods. Cattle grazing was certainly heavier in the 1950s (fig. 2.27), but vegetation was very sparse on steeper slopes that would not be grazed at all. The dark trees are juniper and lighter colored woody plants are upland shrubs. Other light colored shrubs on the floodplain, aligned linearly, are most likely seepwillow. Figure 2.28 shows the Ranch headquarters at the present time with a clearly defined riparian zone. The area shown in this figure contains some of the rarer E-type channels (Rosgen 1996).

Figure 2.29 is an example of one of the few remaining historic wetland habitats in excellent condition. Where woody plants have encroached on streambanks, erosion around their trunks has created stream nick points and has generally destabilized the site. The streambanks shown in fig. 2.30 are occupied primarily by bulrushes, sedges, and rushes. These plant species are superior for stabilizing streambanks and dealing with the brutal impacts of episodic flood events. Woody species in close proximity to channels are often damaged or ripped out by episodic flood flows of the magnitudes experienced on the UVR. Figure 2.31 illustrates post-flood recovery by herbaceous plants adjacent to the stream channel. Herbaceous species have recovered well. The tree visible in the left side (fig. 2.31A) is the sprouting stump on the left side of fig. 2.31B. Note that no woody species recruits are visible in the 2003 photo. A similar trend is visible at another location on the Verde River Ranch (fig. 2.32). Recovery by herbaceous vegetation at an additional site was fairly swift two years after the 1993 flood (fig. 2.33A), and the site was still dominated by herbaceous vegetation on the 10th anniversary of the flood (fig. 2.33B).

Figure 2.27—Cattle drive in 1946 on the Verde River Ranch and an illustration of the riparian vegetation and geomorphological conditions at the time. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

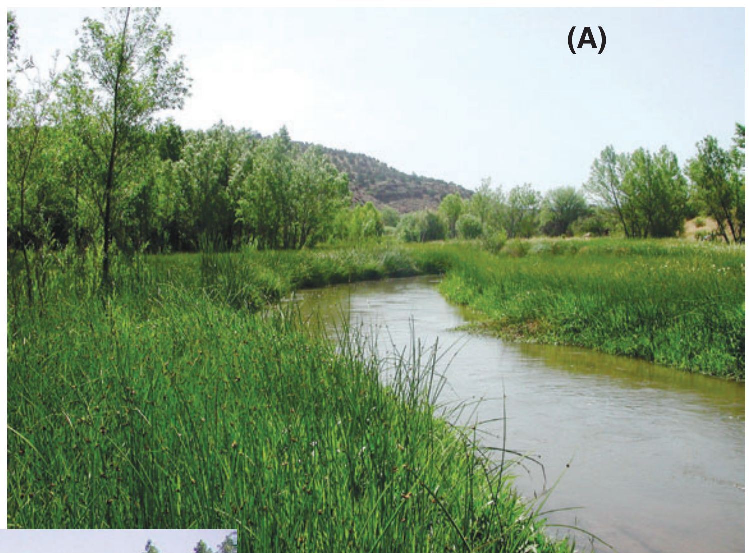
(A)



(B)

Figure 2.28—Photo A is an aerial view of the Verde River Ranch headquarters below the U.S. Geological Survey's Paulden gauge in March 1997. The wetlands, intact for many decades, provide a valuable reference of wetland habitats of time past. These wetlands have recently been at risk of channel erosion from encroachment of woody plants. Photo B, taken in July 2011, shows some changes in woody vegetation after selective removal of several cottonwoods from the active floodplain. Removal of cottonwoods restored the freeboard needed by flood waters to flow without inducing erosion of the wetland. (Photos by Alvin L. Medina.)

Figure 2.29—Wetland site with an E-type channel on the UVR located on the Verde River Ranch headquarters, downstream of the Paulden gauge. These sedge meadows were prevalent throughout the UVR corridor prior to woody plant encroachment. (Photo by Alvin L. Medina.)



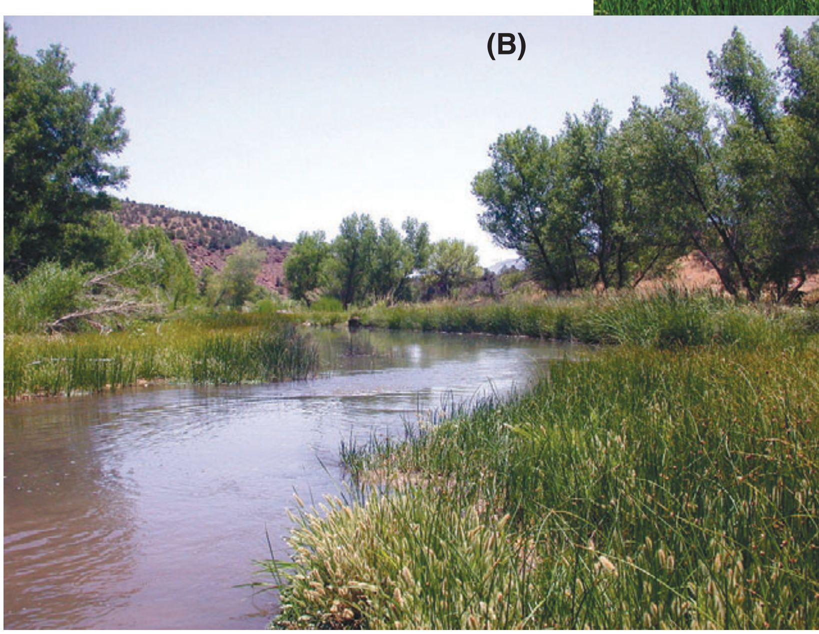


Figure 2.30—This wetland site on the Verde River Ranch referred to as "Little Slice of Heaven" because of its excellent wetland habitat condition. Several species of sedges, rushes, and spikerushes inhabit the streambanks and floodplain. (Photo by Alvin L. Medina.)

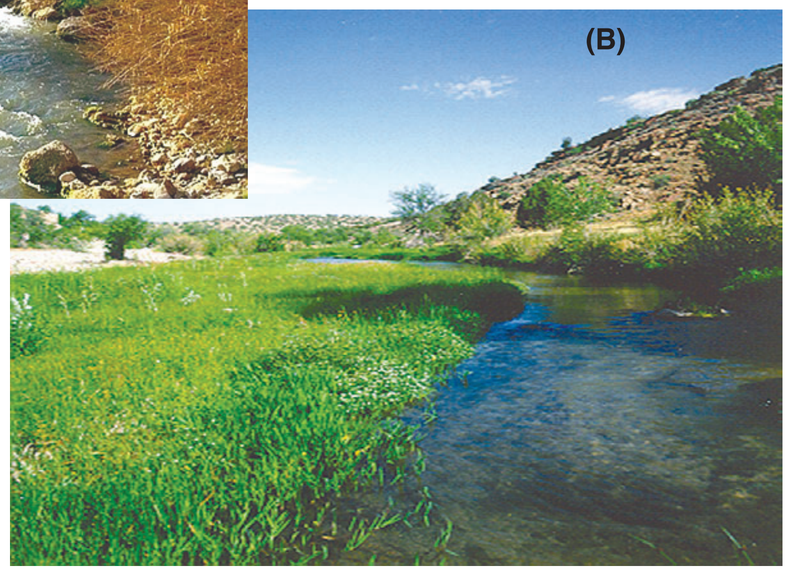


Figure 2.31—Comparison of UVR vegetation next to the channel a decade before (A: 1979) and after (B: 2003) the 1993 floods, Verde River Ranch. (Photo A by James Cowlin and photo B by Alvin L. Medina.)

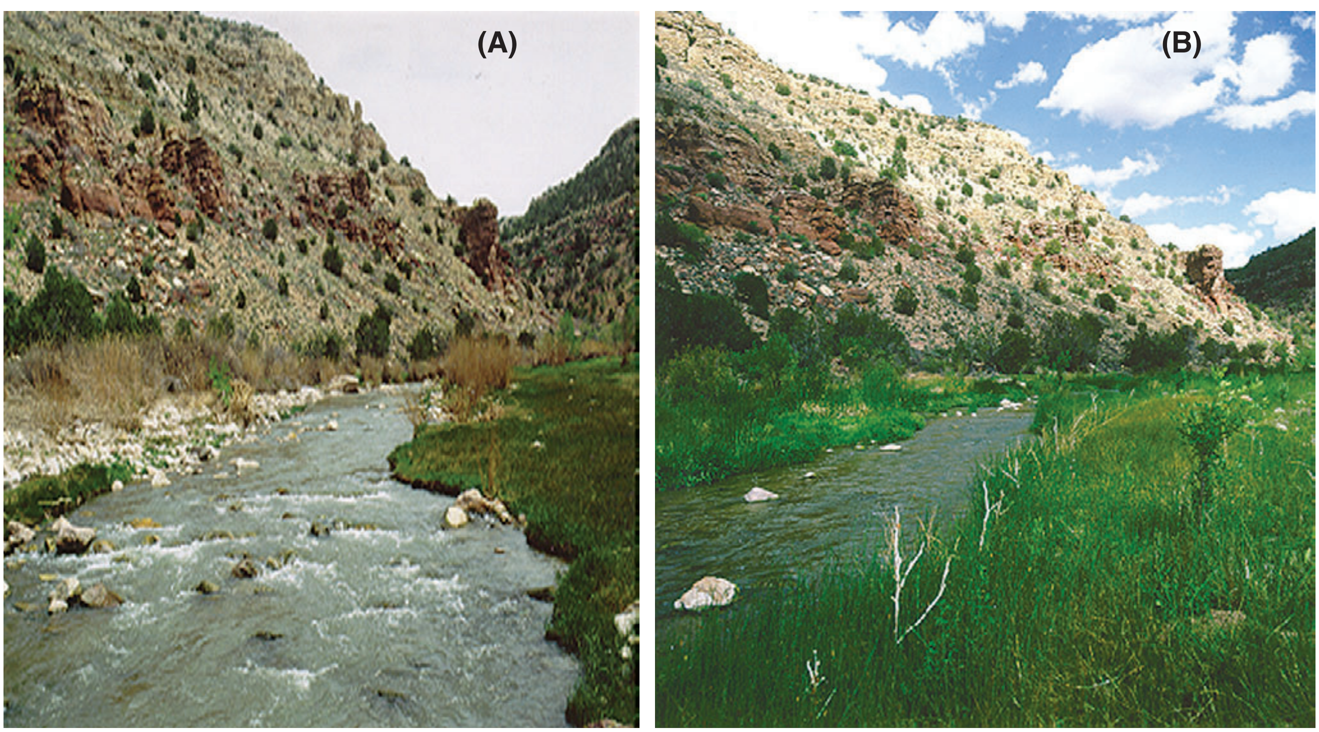


Figure 2.32—UVR vegetation recovery and channel narrowing and deepening at a second site a decade before (A: 1979) and after (B: 2003) the 1993 floods, Verde River Ranch. (Photos by James Cowlin and Alvin L. Medina.)

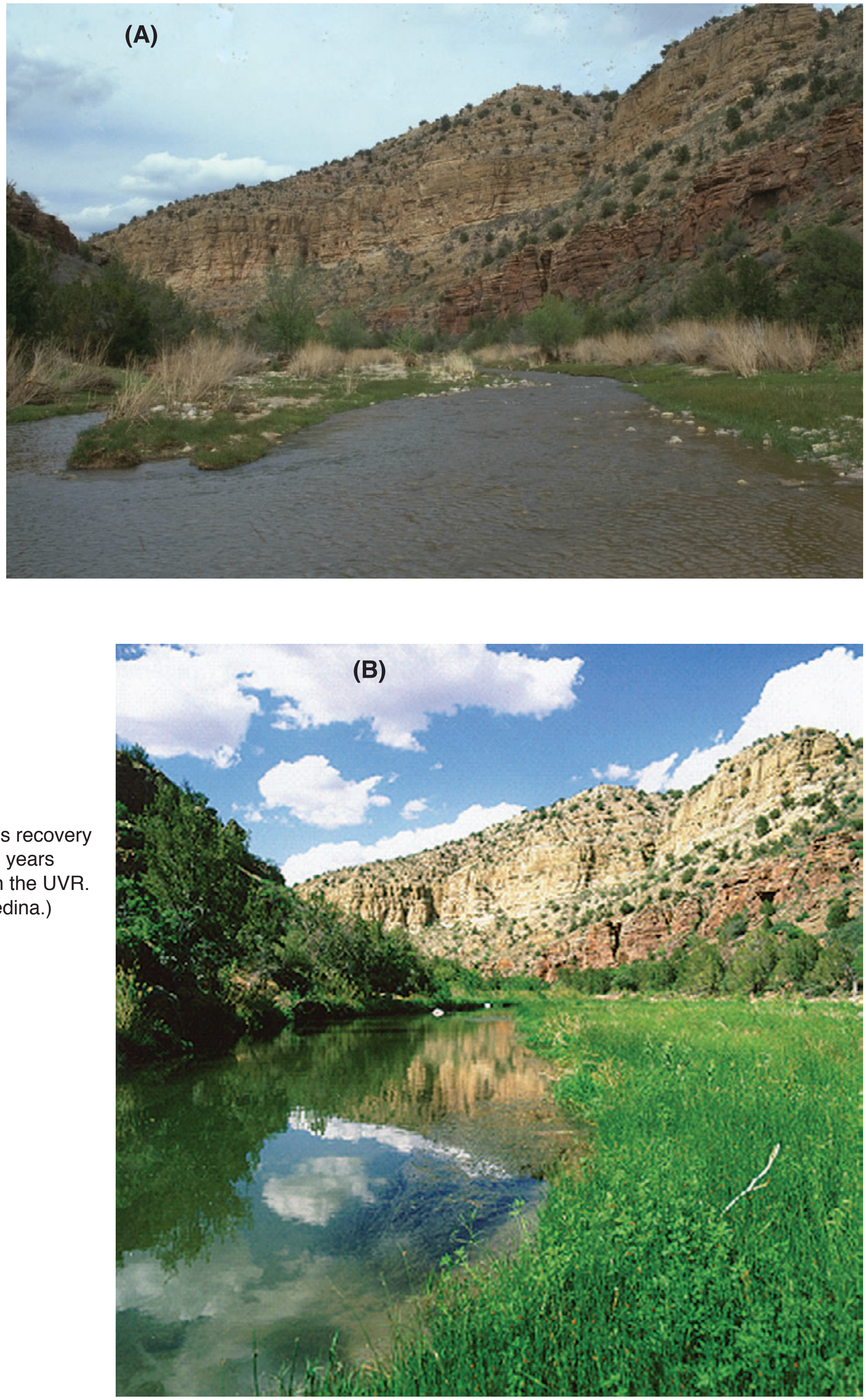


Figure 2.33—Herbaceous recovery (A) 2 years and (B) 10 years after the 1993 flood on the UVR. (Photos by Alvin L. Medina.)

Bear Siding

Bear Siding has one of the long-term fish sampling locations discussed in Chapter 9. The photo from 1979 (fig. 2.34) shows a fairly sparse riparian vegetation community even before the 1993 flood. The flood of that year scoured the riparian zone even more. By 1998, in the absence of any large floods and shortly after grazing removal in 1997, a more substantial riparian flora had re-established itself (fig. 2.35).

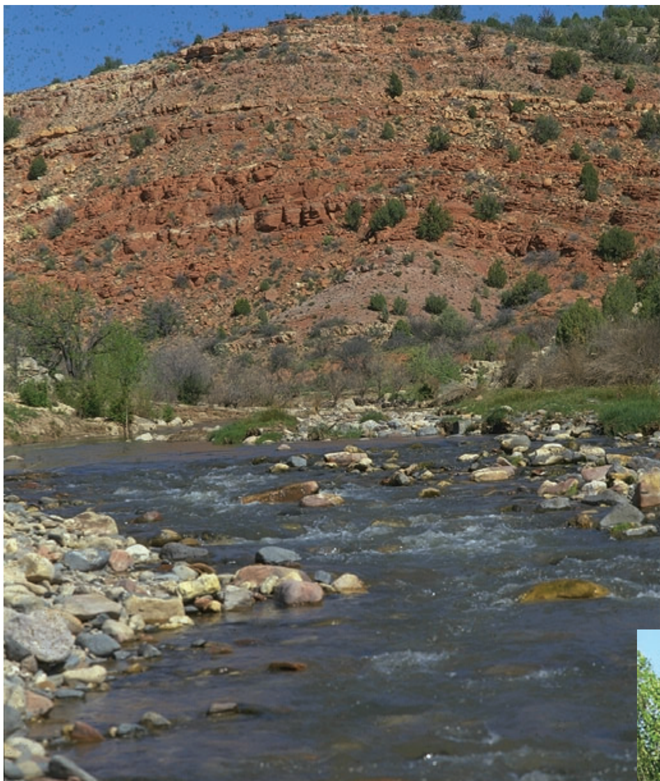


Figure 2.34—Photo of a fish study site at Bear Siding in May 1979. Note the vegetation, water color, channel substrates, and streambank conditions. The aquatic habitat is characterized as a typical C-3 type channel with interspersed riffles throughout the reach. (Photo by James Cowlin.)

Figure 2.35—Repeat photography of fig. 2.34 taken in February 1998. The exact location is inaccessible due to trees and deep water that obscure the view. Note the vegetative growth of nonnative plants, cattails, and tamarisk (right bank) on the active floodplain. The water is notably turbid, a gray-green color, and much different from the 1979 photo. The aquatic habitat consists of turbid, deep pools flanked by woody vegetation. The channel type is a C-6 with submerged riffles forming a glide-pool habitat. (Photo by Alvin L. Medina.)

Perkinsville

Perkinsville is one of the open valley bottoms in the UVR with bedrock constrained canyon sections above and below it. This area was a site of an early settlement with the establishment of the Perkins Ranch in 1900 and the construction of the Santa Fe Railways's Clarkdale to Drake spur line. This railway line is still operated by the Verde River Railroad. Note in the 1925 photo (fig. 2.36) the pinyon and juniper trees in the area are not very tall or vigorous. The riparian area is mostly free of vegetation except for the band of cottonwoods on the inside of the bend in the UVR at mid-photo. These most likely survived the paleofloods of 1891 and early 1900s and some may have been planted by the Perkins family or allowed to establish along newly constructed irrigation ditches (fig. 2.36) at the beginning of the Twentieth Century. Twenty-two years later, fig. 2.37 shows evidence of better plant growth due to wetter conditions in the latter part of the Century. By 1995, woody vegetation had expanded considerably on slopes adjacent to the UVR as well as along the channel (fig. 2.38). Another photo from 1925 shows the generally dry conditions and the sparseness of vegetation (fig. 2.39). Episodic floods kept the riverbanks scoured of vegetation (fig. 2.40). The trees that were present then were located back on second and third terraces, indicating the powerful effects of floods on woody vegetation (fig. 2.41). A repeat photograph of fig. 2.41 from 2003 shows that 78 years has resulted in a much expanded woody vegetation complex along the UVR channel, a narrower channel system, and greatly enhanced pinyon pine and juniper vegetation on the uplands (fig. 2.42). Most of the sediments in the channel are coarse gravels, cobbles, and boulders. There is no evidence of large amounts of fine sediments, which would be indicative of wide-scale and intensive erosion in the uplands.

At the downstream edge of the Perkinsville valley area is the "Black Bridge" on the Verde River Railroad (fig. 2.43) where the UVR goes into another canyon-bound reach. The channel appears to be in the same position in 2003 (fig. 2.43B) as it was in 1910 due to the influence of the solid rock wall which causes flow to divert toward the bridge. The point bar on the left seems to have the same coarse sediment composition although there is much more evidence of woody species recruitment on the bar and channel edges. The 2003 photograph indicates a greater clearance beneath the bridge than the photograph taken just after construction of the railroad in 1910. This could be evidence of channel downcutting in the interim or movement of large amounts of channel sediments. The photo from 1910 shows that there was virtually no riparian gallery forest or other woody species before the railroad arrived (fig. 2.43A). The lack of trees could be due to a variety of causes, including scouring floods; drought; long-term use by Native Americans; or early European settler use of wood for buildings, fences, and firewood. Grazing was probably not the cause or there would be larger trees evident on the landscape. Grazing animals introduced into an area usually affect only seedlings or saplings.

Figure 2.36—A 1925 photo illustrating UVR riverine and upland conditions in the Perkinsville area. (Photo by Matt Tully.)

Figure 2.37—A 1947 photograph that depicts major changes in vegetation density and composition at Perkinsville since 1925. (Photo by R. King, U.S. Forest Service, Prescott National Forest, Photo #446116.)

Figure 2.38—This is a 2008 repeat photo of fig. 2.37. Cottonwoods established along old channels, but the floodplain is generally devoid of woody species, which are washed away by recurring floods. (Photo by Alvin L. Medina.)

Figure 2.39—A 1925 photo of the Perkinsville area illustrating the drought conditions of the time. Of special significance is the absence of obligate riparian trees and shrubs. Two clusters of very large cottonwoods are evident survivors of paleofloods. Other woody vegetation are facultaive upland species, e.g., mesquite. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.40—A 1925 photo showing the magnitude of seasonal floods on the UVR at Perkinsville. (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.41—A 1925 photograph of the Perkinsville area looking northwest along the Santa Fe Railroad (Verde River Railroad) toward the Station (light colored buildings in the upper right quadrant). (Photo courtesy of the Sharlot Hall Museum, Prescott, Arizona.)

Figure 2.42—A 2003 repeat photograph of the 1925 photograph (fig 2.41) of the Perkinsville area looking northwest along the Santa Fe Railroad (Verde River Railroad) toward the Station (light colored buildings in the upper right quadrant). Cottonwoods have established along old channels. This river segment of private land still remains a refuge for native minnows. (Photo by Alvin L. Medina.)

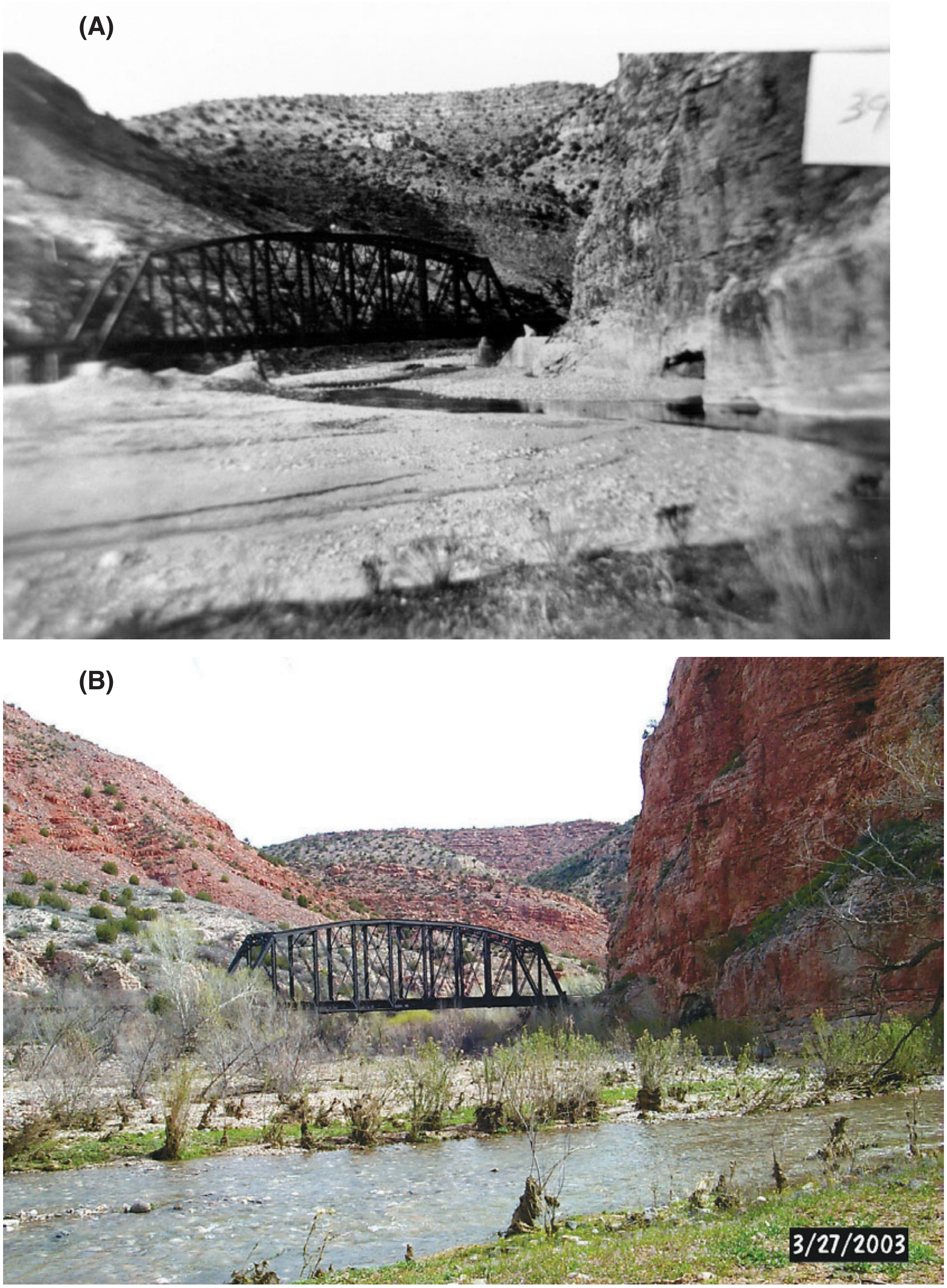


Figure 2.43—The "Black Bridge" on the Verde River Railroad downstream of Perkinsville. The photographs are from (A) 1910 and (B) 2003. (Photo A courtesy of the Sharlot Hall Museum, Prescott, Arizona; photo B by Alvin. L. Medina.)

Horseshoe Allotment

The Horseshoe Allotment is the grazing allotment that includes the Black Bridge and the south side of the downstream reach of the UVR for several kilometers. Figure 2.44A shows the condition of the UVR below the “Black Bridge” in 1925. The railroad runs along the right bank towards its terminus at Clarkdale. The repeat photo from 2003 highlights the stands of cottonwoods and willows, which have developed since the 1993 flood (fig. 2.44B). It also shows more extensive juniper growth along the UVR riparian margins and on adjacent slopes.

Figures 2.45 and 2.46 show a section of UVR channel in the Horseshoe Allotment demonstrating the scoured condition of the river bed after the 1993 flood. The subsequent photograph in 1999 shows the dense vegetation that developed in the years after the significant 1993 flood. That part of the UVR is now difficult to negotiate because of the woody and herbaceous plant growth. An additional series of photographs (figs. 2.47 to 2.49) documents vegetation changes in the UVR channel in the Horseshoe Allotment from 1994 to 1998. The distinctive mid-channel rock was

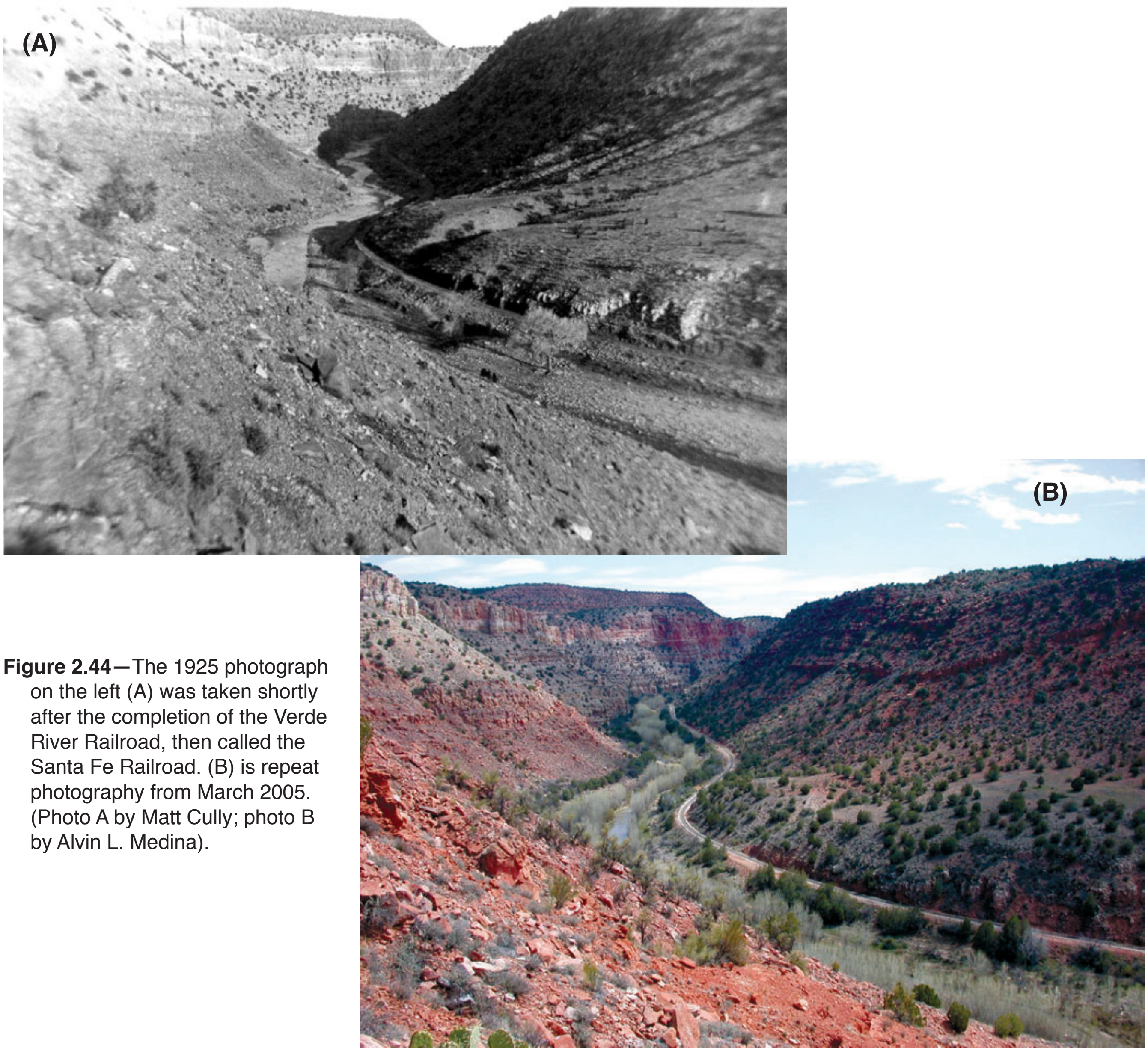


Figure 2.44—The 1925 photograph on the left (A) was taken shortly after the completion of the Verde River Railroad, then called the Santa Fe Railroad. (B) is repeat photography from March 2005. (Photo A by Matt Cully; photo B by Alvin L. Medina).

used as a reference point. The photo-series also shows how the UVR channel has narrowed and deepened.

One of the consequences of woody vegetation encroachment on the UVR channel is the formation of woody debris dams. Figure 2.50 shows young sycamore trees that were uprooted by a minor flood in 2005. These stems can be easily piled up by subsequent flood flows, creating a debris jam in the river. This process creates a risk of a debris dam backing up streamflow and then breaching during a flood event, creating a much elevated peakflow. Debris dam breach flows have a much greater impact on channel morphology and downstream structures like irrigation diversions, bridges, and residences (Cenderelli 2000; Ice and others 2004).

Figure 2.45—UVR channel in the Horseshoe Allotment after the 1993 flood. (Photo by Sharon and George Yard.)

Figure 2.46—UVR channel conditions near the area shown in fig. 2.44 in the Horseshoe Allotment in 1999, six years after the 1993 flood. (Photo by Sharon and George Yard.)

Figure 2.47—The "Otter Rock" in the UVR channel in the Horseshoe Allotment in 1994, one year after the large 1993 flood. (Photo by Sharon and George Yard.)

Figure 2.48—The "Otter Rock" in the UVR channel in the Horseshoe Allotment in 1996, three years after the large 1993 flood. (Photo by Sharon and George Yard.)

Figure 2.49—The "Otter Rock" in the UVR channel in the Horseshoe Allotment in 1998, five years after the large 1993 flood. (Photo by Alvin L. Medina).

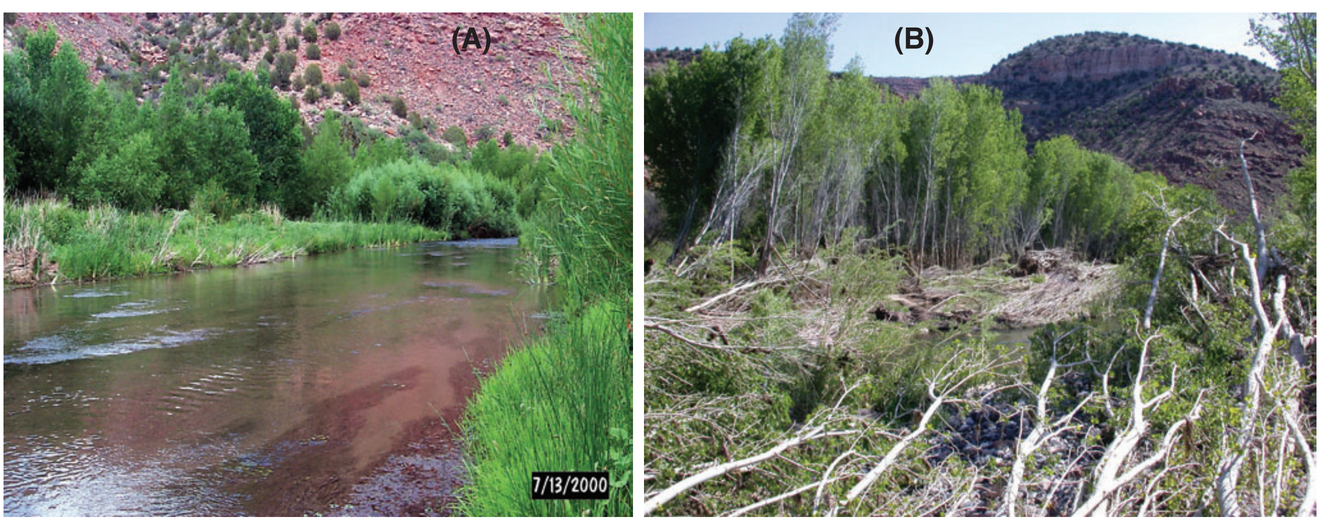


Figure 2.50—Photo A taken in July 2000 upstream of the otter rock site shows an established grove of cottonwoods and coyote willows, which were planted by the Y-D Ranch in 1994. Photo B, taken in July 2005 after a major flood, shows uprooted trees throughout the reach. Willows were also up-rooted and washed away into debris piles. (Photos by Alvin L. Medina.)

Antelope Hills Allotment and Sycamore Canyon

A set of photographs from the Antelope Hills Allotment further down the UVR demonstrates the changes that occur in river sediments and geomorphology with flood events. Figure 2.51A shows a straight reach of the UVR in 1979 that was characterized by shallow water and gravel and cobble bedload materials. It was a very long riffle reach. During the 1993 flood, this reach was scoured out and deepened. Now it is a deepened pool dominated by fine-textured sediments (fig. 2.51B). In addition, the riparian vegetation has changed completely in the 27 years separating the photos. These photographs indicate the high degree of dynamics of the river in changing both aquatic habitats and riparian vegetation.

A section of the UVR just above the confluence with Sycamore Creek also demonstrates the dynamic nature of the UVR. The reach in fig. 2.51A in 1979 was dominated by gravel and cobble bars. The river meandered through these deposits in a series of glides, runs, and riffles. During the 1993 flood, this reach was scoured out into a big, deep (2 to 3 m or 6 to 10 ft) pool, but it still contained a substantial amount of gravel-sized particles. By 1996, this section was completely filled in with sand-sized and finer sediments (fig. 2.51B). Figures 2.52 and 2.53 show the type of gravel bars and channel substrates that are left in the channel after flood events. In the absence of floods, these coarse sediments become embedded in fine-textured sediments and lose their habitat value to native fishes.

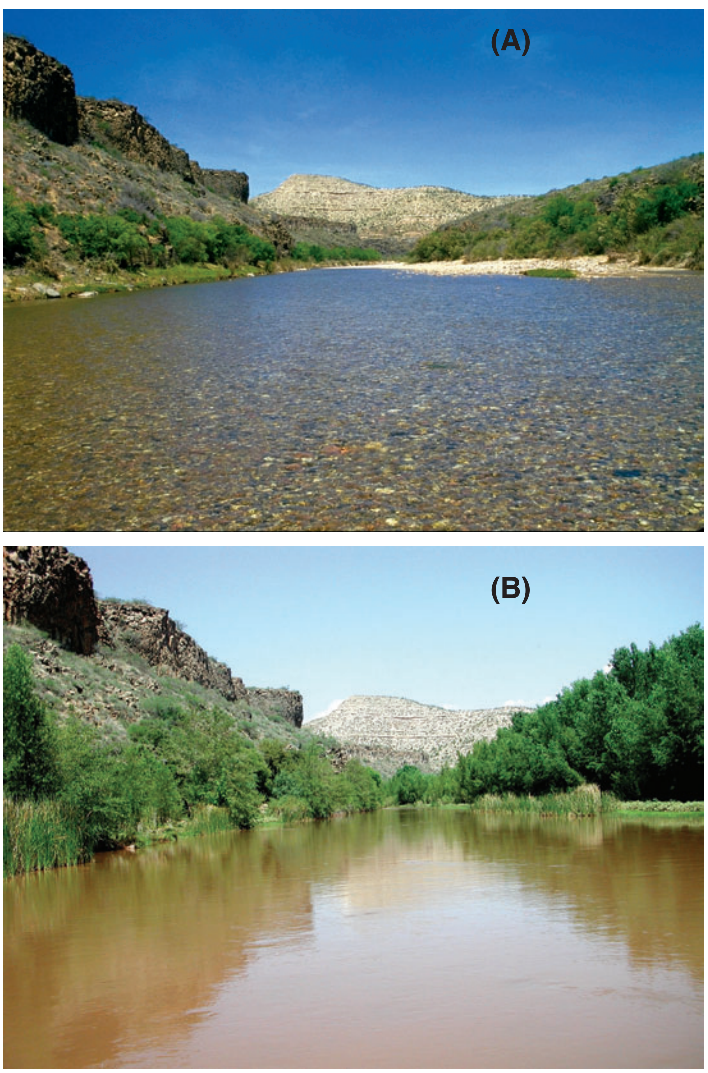


Figure 2.51—(A) 1979 photo of the UVR in the Antelope Hills Allotment, and (B) the same site in 2009. (Photo A by James Cowlin; photo B by Alvin L. Medina.)

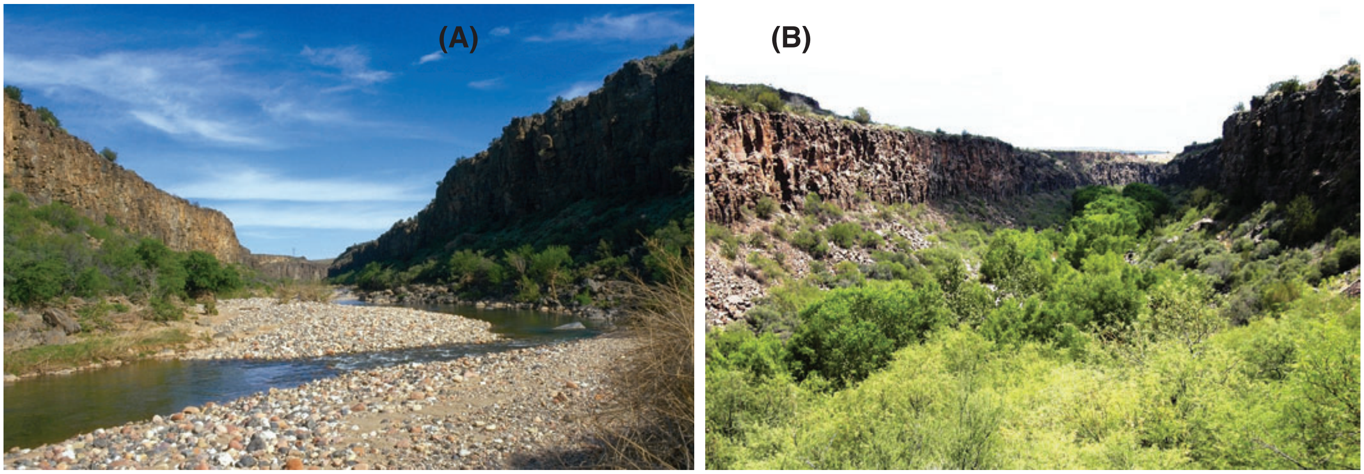


Figure 2.52—UVR below Sycamore Canyon at the Clarkdale gauging station in (A) 1979 and (B) 2005. The exact photo location in B is obscured by woody vegetation requiring an oblique aerial view of the canyon. The channel conditions are much different from the pool-riffle habitats shown in A. These have been replaced by deep glides, with submerged riffles and the channel winds about the maze of trees. (Photo A by James Cowlin; photo B by Alvin L. Medina).

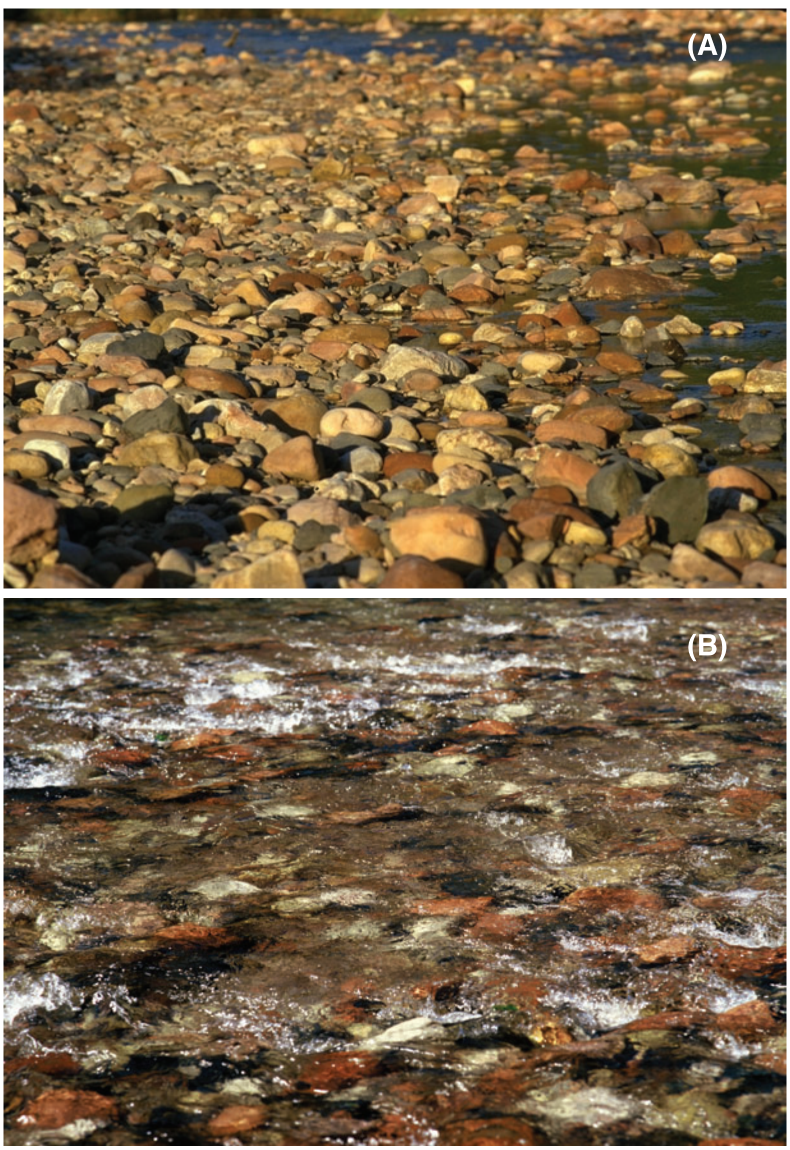


Figure 2.53—Photos of coarse cobble substrates (A) near Sycamore Canyon. These stream habitat conditions are favored by native fishes. Photo B is a reference condition for the reach in 1979, which is much different from the present. (Photos by James Cowlin).

Discussion

Vegetation Changes

Vegetation in the riparian zone of the UVR has gone through considerable change since the earliest photos from 1910. The riparian habitats are dynamic and will continue to change with future disturbances. Photographs highlight the cycle of scour and revegetation going on in the UVR's riparian zones. It is evident that climate-related events are the main drivers of vegetation dynamics, but human activities have also contributed to the changes that have been observed in the river over the past century. Cumulative and sequential effects of Sullivan Dam since 1939 on the channel dynamics that subsequently changed channel conditions, which led to changes in vegetation communities. Patterns of grazing, largely unknown, over 100+ years and recent changes to zero grazing have affected the sustainability, composition, and succession of plant communities. Major changes in recreation, e.g., from open access throughout the corridor to limited access, have further affected how the river functions and changes. Lack of information about how to manage riparian vegetation has largely resulted in a conservative approach to historical uses. In short, the vegetation of the Verde River is much different in composition, structure, and diversity than it was 100, 50 and 25 years ago, as evidenced on other Southwestern streams (Webb and others 2007). Chapters 6 and 7 of this volume present assessments of the current status of UVR riparian vegetation and will facilitate future research efforts. Of significance is how vegetation has changed over time and spatially in response to disturbance from hydrologic factors, such as Sullivan Dam. These hydrologic changes undoubtedly had direct and indirect effects on aquatic habitats and fish. The exact processes remain to be defined.

UVR Hydrologic Changes

The wet and dry cycles of the Southwest have strong influences on the geomorphology, hydrology, and ecology of the region's rivers (Grissino-Mayer 1996). Past climates have been dominated by these oscillations and future climates certainly will be affected as well (Ely 1997). There is evidence that the Holocene epoch prior to European settlement was marked by a larger quantity and intensity of flood events than has been observed in the UVR in recent years. These events significantly affected the geomorphology and vegetation conditions of the UVR. As noted above, the effects of Sullivan Dam have cumulatively affected many other physical and biological components of the UVR ecosystem.

Ecological Changes and the UVR

Numerous hypotheses have been proposed about the relationships among UVR hydrological and ecological processes, current watershed condition, land management practices, and aquatic fauna (Haney and others 2008). Understanding these processes in their paleo, historic, and modern time frames is important for determining their impact on the UVR biological system. An intellectual evolution is required to avoid assigning cause-and-effect relations to only currently visible land management activities. Some processes that have been going on for thousands of years are still affecting the UVR (flooding, drought, arroyo cutting, vegetation changes, landscape-level erosion, etc.) and others are not. Human activities such as exotic species introductions, groundwater pumping, irrigation diversions, livestock management, and mining can produce effects as profound as, greater than, or much less than natural processes.

The following chapters deal with the topics of hydrology, channel morphology, watershed condition, woody vegetation, herbaceous vegetation, water quality, and fish fauna. Some of the questions that should be considered when reading through this report are:

- Is the current watershed condition of the UVR the result of Twentieth Century land management or long-term geologic processes?
- Is arroyo and gully cutting a modern problem or one that goes back well into the Pleistocene epoch?
- What is the role of paleofloods in channel geomorphic evolution and erosion processes?
- Are gallery woody forests in the riparian zone the natural vegetation form or just an artifact between destructive floods?
- Is there evidence of landscape-scale erosion that affects the productivity and sustainability of the native UVR ecosystems?
- What roles do invasive plants and aquatic fauna play in the ecology of the UVR?
- How have changes in the hydrologic equilibrium affected channel stability, vegetation, and aquatic habitats?

Management Implications

This chapter provided historical and geophysical perspectives on the UVR. The current vegetation conditions on the river are the result of pre-European streamflows, past and present climate, a century of cattle grazing, and current land management activities. Paleofloods and droughts had far greater impacts on the riparian vegetation and channel geomorphology, as noted in other rivers of the Southwest (Webb and others 2007). Without the context of pre-Twentieth Century impacts on the river, it is too easy to attribute the currently visible conditions of the UVR to modern activities. All of the natural processes and management activities need to be considered holistically before making conclusions about current and future land uses and management activities. From the historical analysis presented here, it is apparent that the UVR has been impacted to a larger extent and intensity by hydrologic and erosion events that pre-dated modern land management. The interactions of the UVR and its surrounding landscape are far more complex than they appear at first glance. Simple cause-and-effect assumptions by land managers and technical staff should be avoided. Likewise, extrapolation of research or management results from other ecosystems or regions should be done with caution and knowledge of the risks of unintended consequences. However, Best Management Practices should always be employed to ensure the sustainability of both the river and upland ecosystems.

Summary and Conclusions

Repeat photography was used to display the vivid texture of the UVR's vegetation, channel, and valley landscapes and to contrast the historical and current conditions. These contrasts are interpreted within the context of plant ecology and hydrogeomorphology to provide a comprehensive understanding of the changes that have occurred in the past century. In some cases, additional photographs provide greater breadth for understanding the larger perspective of the area and its habitats. A principal objective is to provide a broad understanding of historical influences that is necessary to comprehend the various physical and biological processes that govern present-day conditions on the UVR. Climate and land uses undoubtedly have affected the streamflow and sediment regimes, which, in turn, influence such factors as riparian vegetation and aquatic wildlife. Paleo-reconstruction studies of historical environmental conditions are utilized to put forward alternative descriptions of the Verde River for the period of record (1890 to present). Paleoecological data are useful for discriminating environmental changes between natural and cultural influences (Swetnam and others 1999). The introduction of livestock circa 1890 is an important event that is often cited as crucially influential on present-day conditions. However, many descriptions have been extrapolated from general sources that did not recognize climatic conditions during this period that may have long-lasting consequences on the evolution of riparian and aquatic habitats in the UVR. Vegetation descriptions are consistent with Webb and others (2007) with respect to historical changes and current dominance by woody vegetation.

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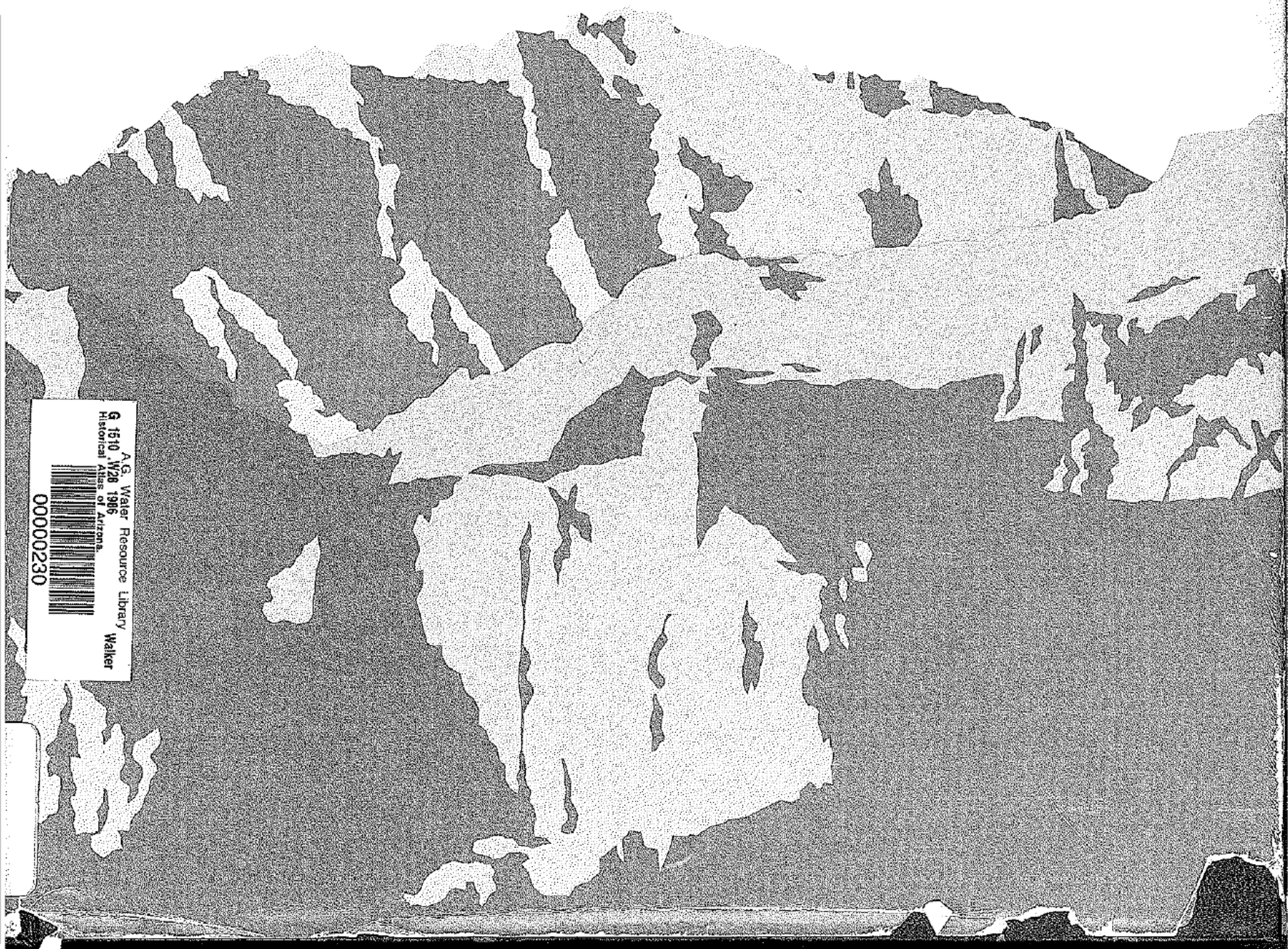

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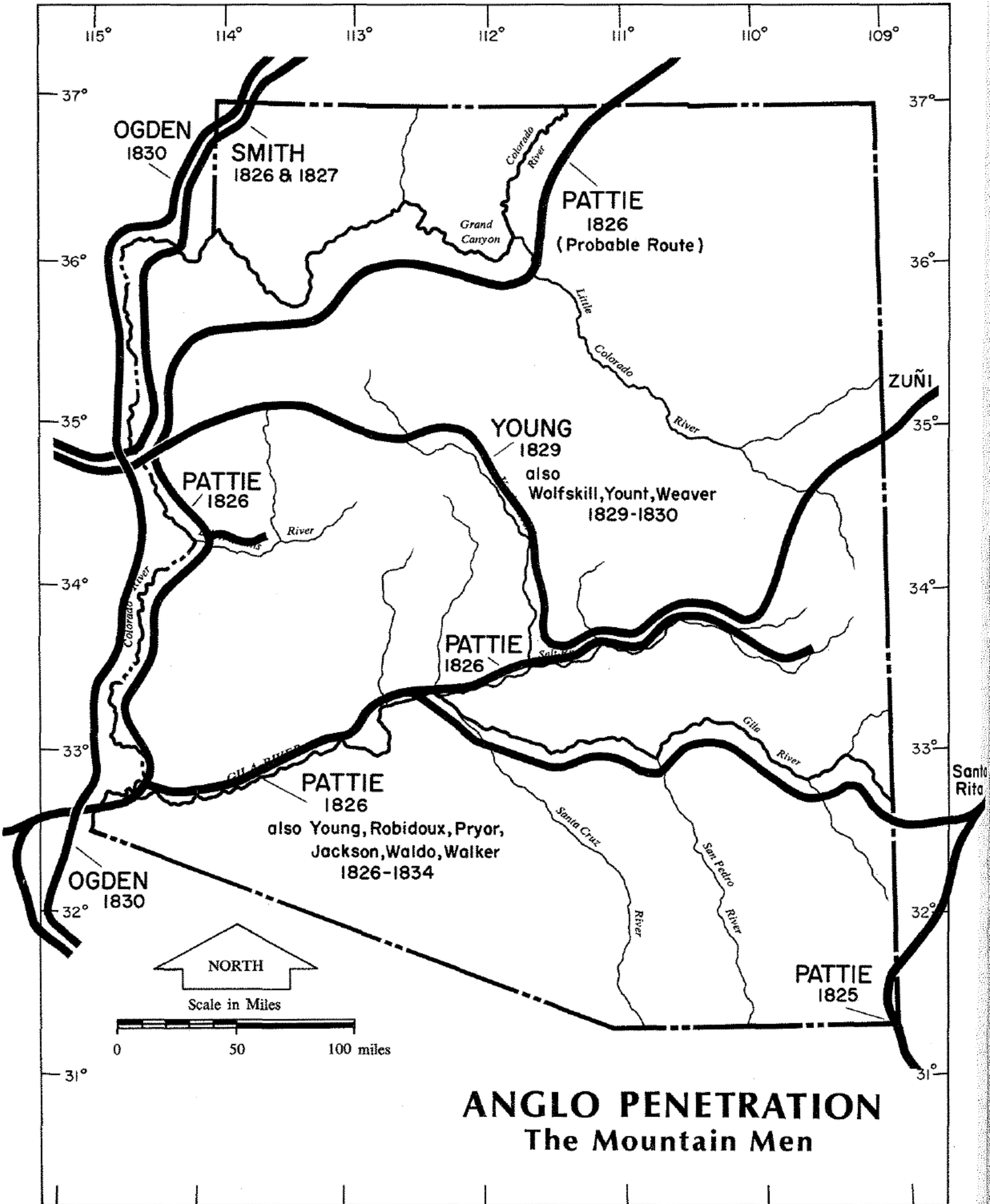

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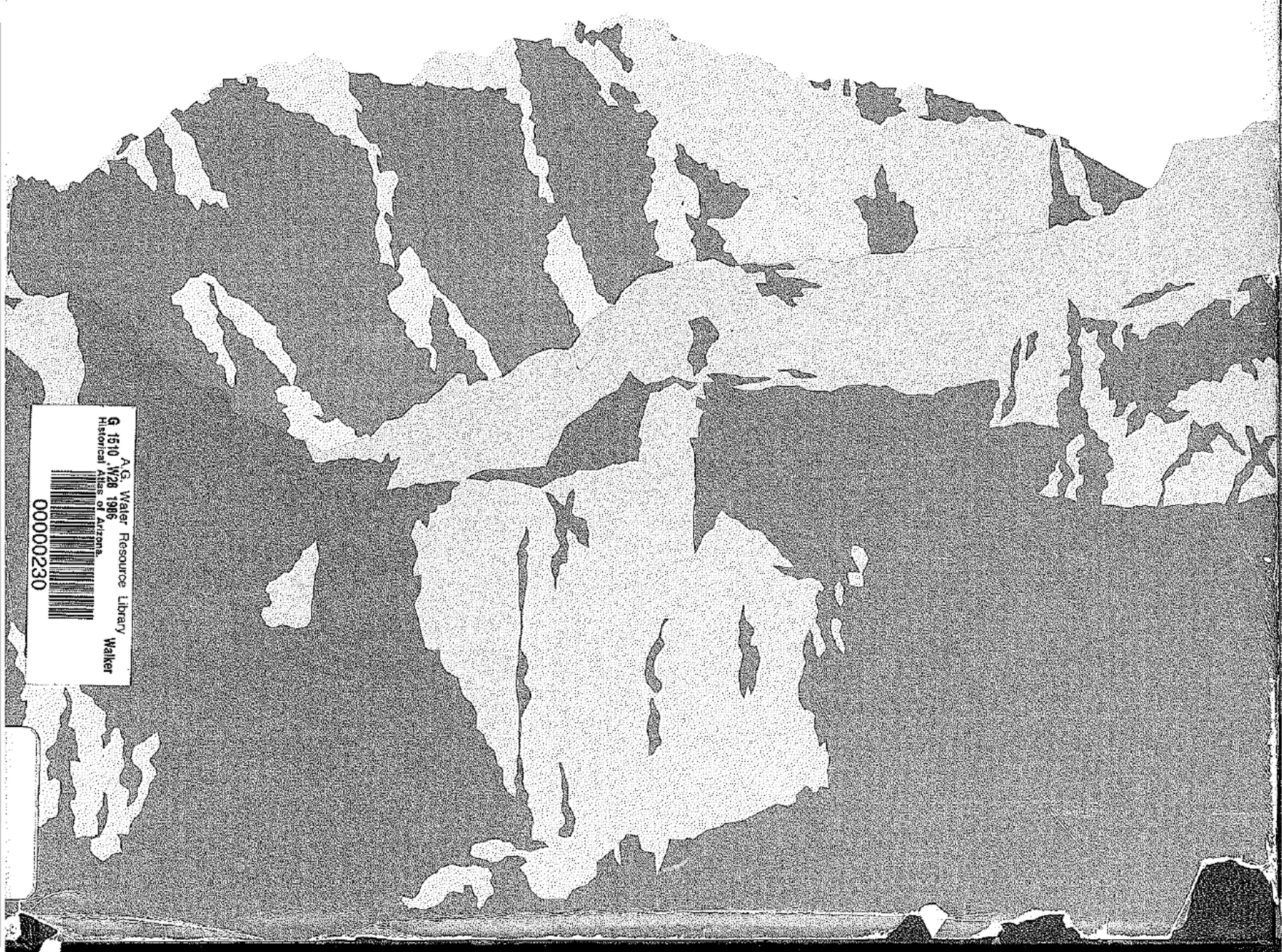

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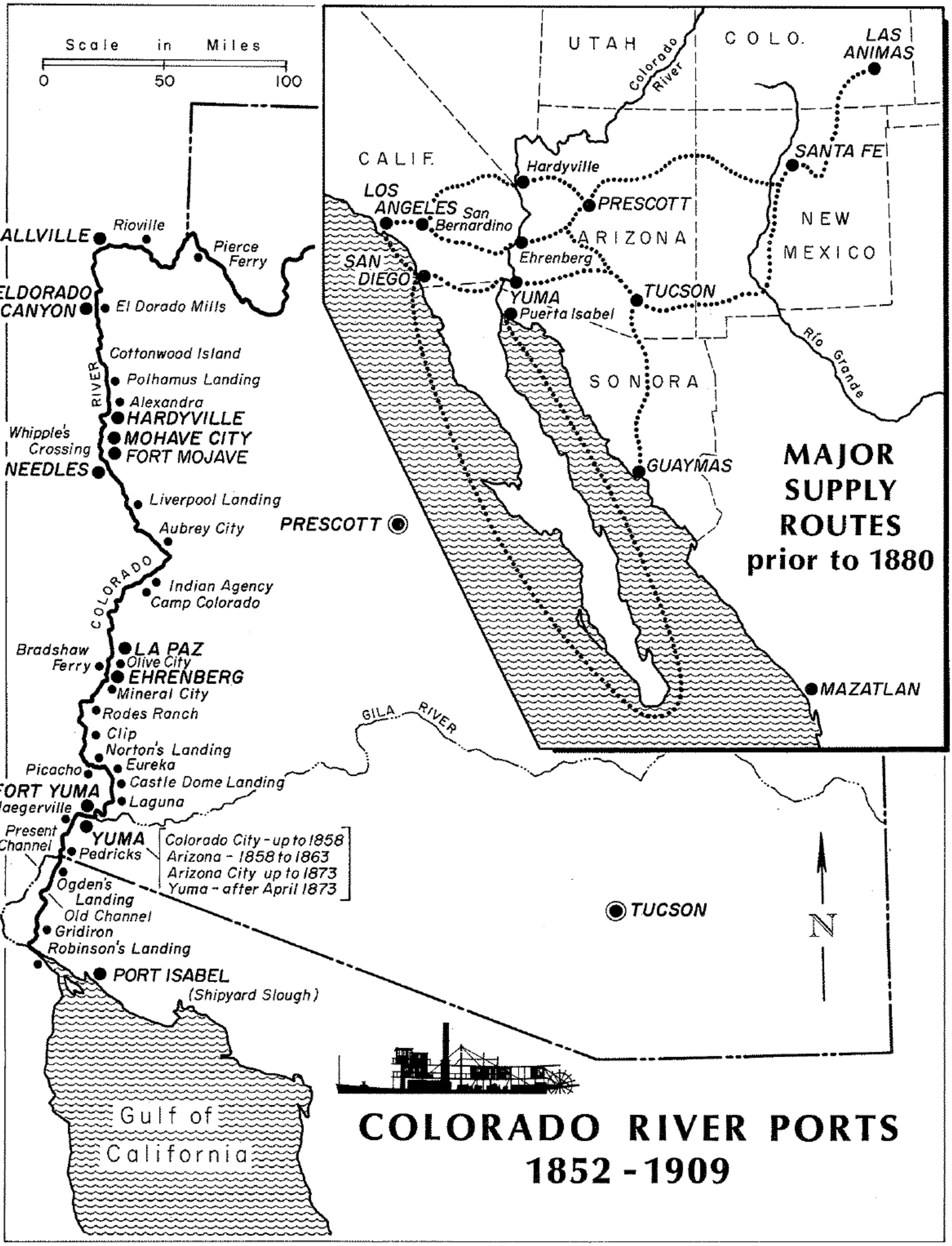

COLORADO RIVER PORTS 1852 - 1909

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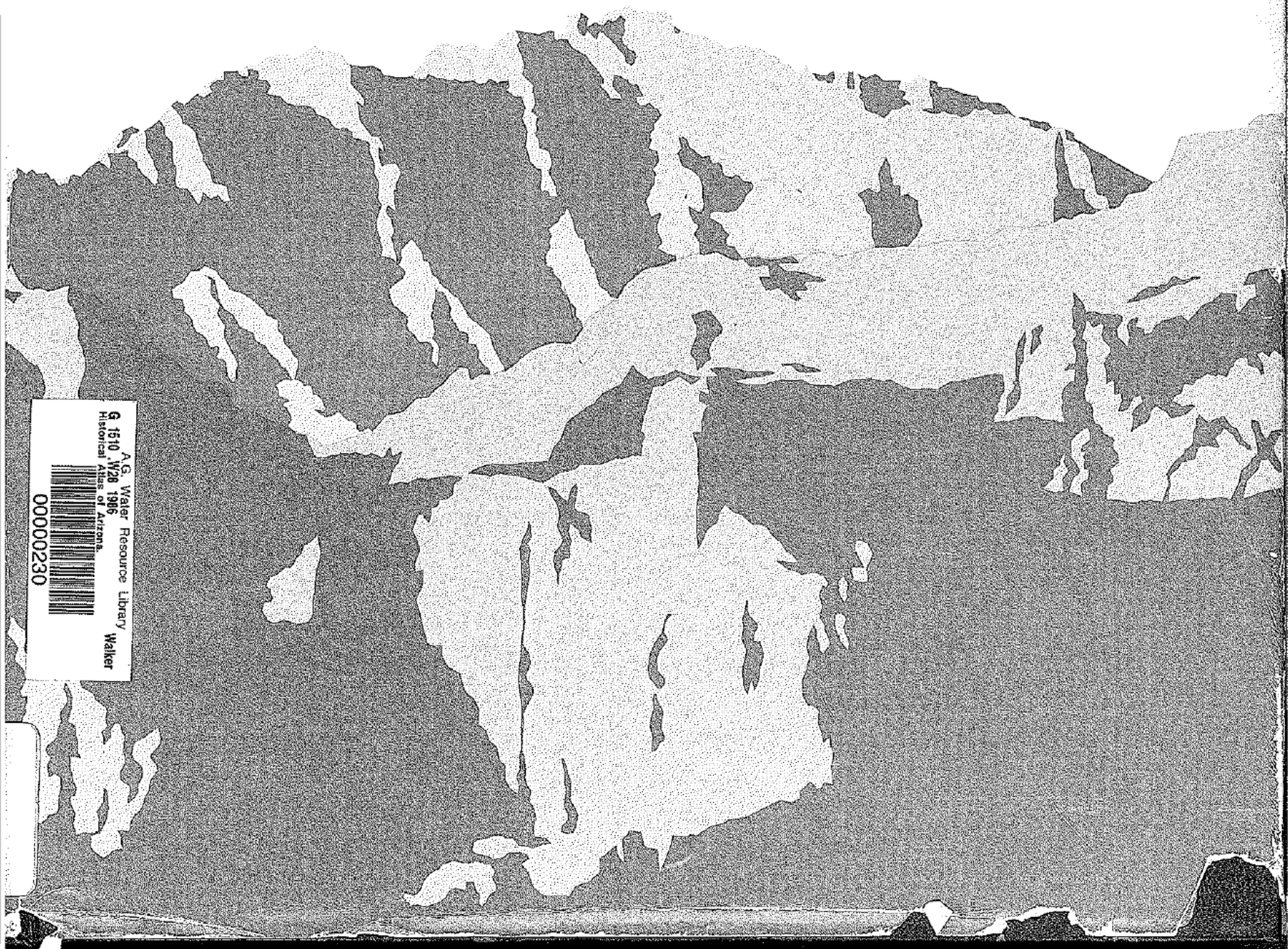

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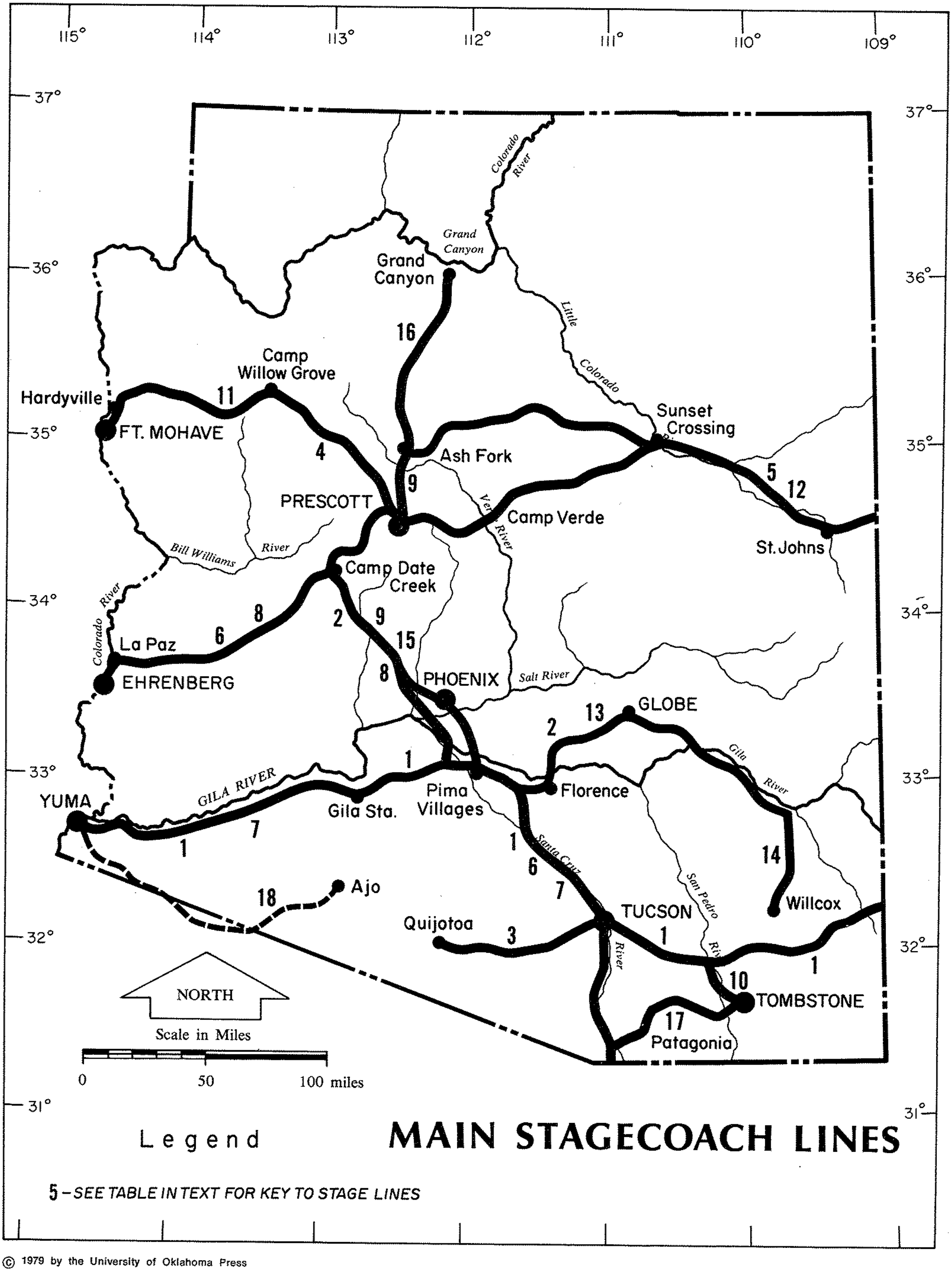

MAIN STAGECOACH LINES

5 – *SEE TABLE IN TEXT FOR KEY TO STAGE LINES*

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41. MAIN STAGECOACH LINES

IN 1853 TUCSON and the area southward along the Santa Cruz River were isolated from California by some 350 miles and from New Mexico by at least 250 miles. Under these conditions, communications were vital to the development of the territory. The first line with the outer world was the San Antonio & San Diego Mail Line, which began operating a semimonthly service in mid-1857. The line has been described as running from nowhere, through nothing, to no place, and it was nicknamed "the Jackass Mail."

The Butterfield Overland Mail began semiweekly service from Missouri via El Paso, Tucson, and Los Angeles to San Francisco in 1858. Operation continued until March, 1861, when the equipment was transferred to the route through Nebraska, Wyoming, and Utah.

Until 1864 Arizona had to rely on military couriers for mail service. In that year Dukes & Company started a line from Prescott to Fort Mohave connecting with their line to Los Angeles. The Santa Fe Stage Company provided service, in 1866, from Prescott to Denver and Kansas City and connections between Prescott and Tucson. The Arizona Stage Company in 1868 ran from Prescott and Tucson and connected at La Paz with the Noble & Winters line to San Francisco.

Stage companies went out of business or changed names with exasperating frequency. A very important element in the financial health of a stage line was the contract to carry the United States mail. The loss of this contract, or a successful bid that was too low, might ruin a company. Carrying the Wells-Fargo treasure box was an additional source of income, if somewhat risky.

The Tucson, Arizona City [Yuma] & San Diego Stage Company started operations in 1870 with triweekly service. The business was sold to James A. Moore and L. W. Carr in February, 1872. Connections to the east were offered by J. F. Bennett & Company running from Tucson to Mesilla, where the connections were made. In 1872 the Tucson, Prescott & San Bernardino Line left Tucson weekly for Wickenberg, where connections were made with the semiweekly stage from Prescott to San Bernardino. The fare from Prescott to San Bernardino was about forty dollars.

Kerens & Mitchell, proprietors of the Southern Pacific Mail Stage Lines, offering triweekly service from San Diego to Mesilla in 1874, claimed to have the longest stage line in the country. After April, 1877, daily service was offered, and the fare from Phoenix to San Francisco was quoted at ninety-three dollars.

In 1878 Gilmer, Salisbury & Co's Stage Lines took over the two-year-old California & Arizona Stage Company and later offered service from Prescott to Ash Fork on the Atlantic and Pacific Railroad and from Dos Palmas, California, on the Southern Pacific to Prescott. Early the next year the Tucson & Tombstone Stage Line offered four trips per week, but increased this schedule to daily service later in the year. The fare was ten dollars, and the running time was seventeen hours.

With the completion of the two major railroads across the territory in 1881 and 1883, short lines proliferated, connecting the larger settlements with the rails and to each other. As the railroads developed branch lines, the stages disappeared.

Number on Map	Major Stage Lines
1.	San Antonio and San Diego Mail Line, 1857–58
	Butterfield Overland Mail, 1858–61
	Texas and California Stage Line, 1878
	Southern Pacific Mail Line, 1874–78
	National Mail & Transportation Co., 1878
2.	Southern Pacific Mail
3.	Pedro Aguirre & Co.
4.	Duke's Express, 1864
5.	Santa Fe Stage Co., 1866
6.	Arizona Stage Co., 1868
7.	Tucson, Arizona City & San Diego Stage Co., 1870
8.	California & Arizona Stage Co., 1875
9.	Gilmer, Salisbury & Co. Stage Lines, 1878
10.	Tucson & Tombstone Stage Lines, 1879
11.	Hugh White & Co., 1879
12.	Prescott–Santa Fe Stage Line
13.	Arizona Stage Co., 1881
14.	Norton & Stewart, 1881
15.	Prescott & Phoenix, 1886
16.	Grand Canyon Stage Line, 1895
17.	Tombstone & Patagonia Express, 1880
18.	Jaeggers Pack Trail, 1854

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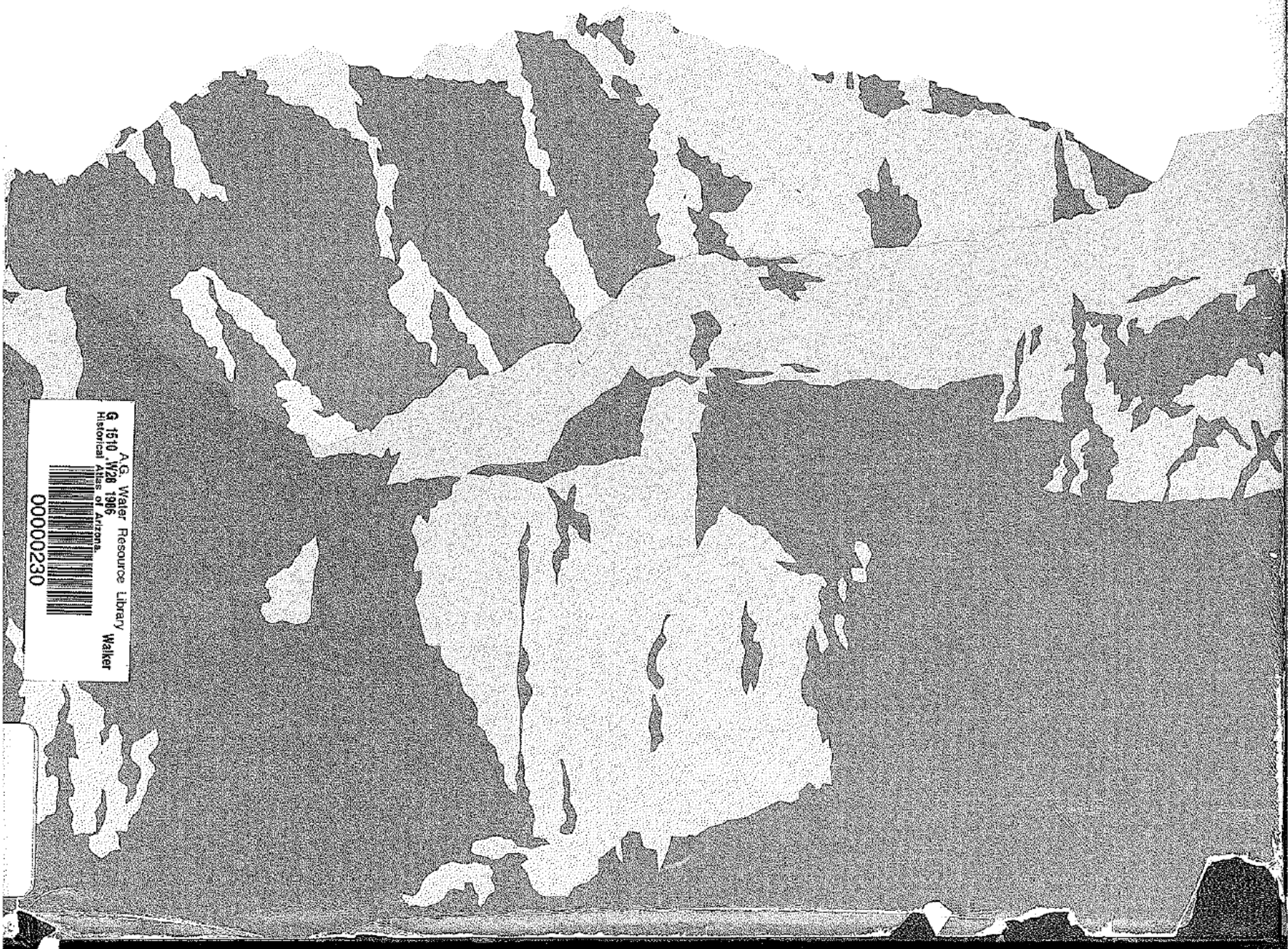

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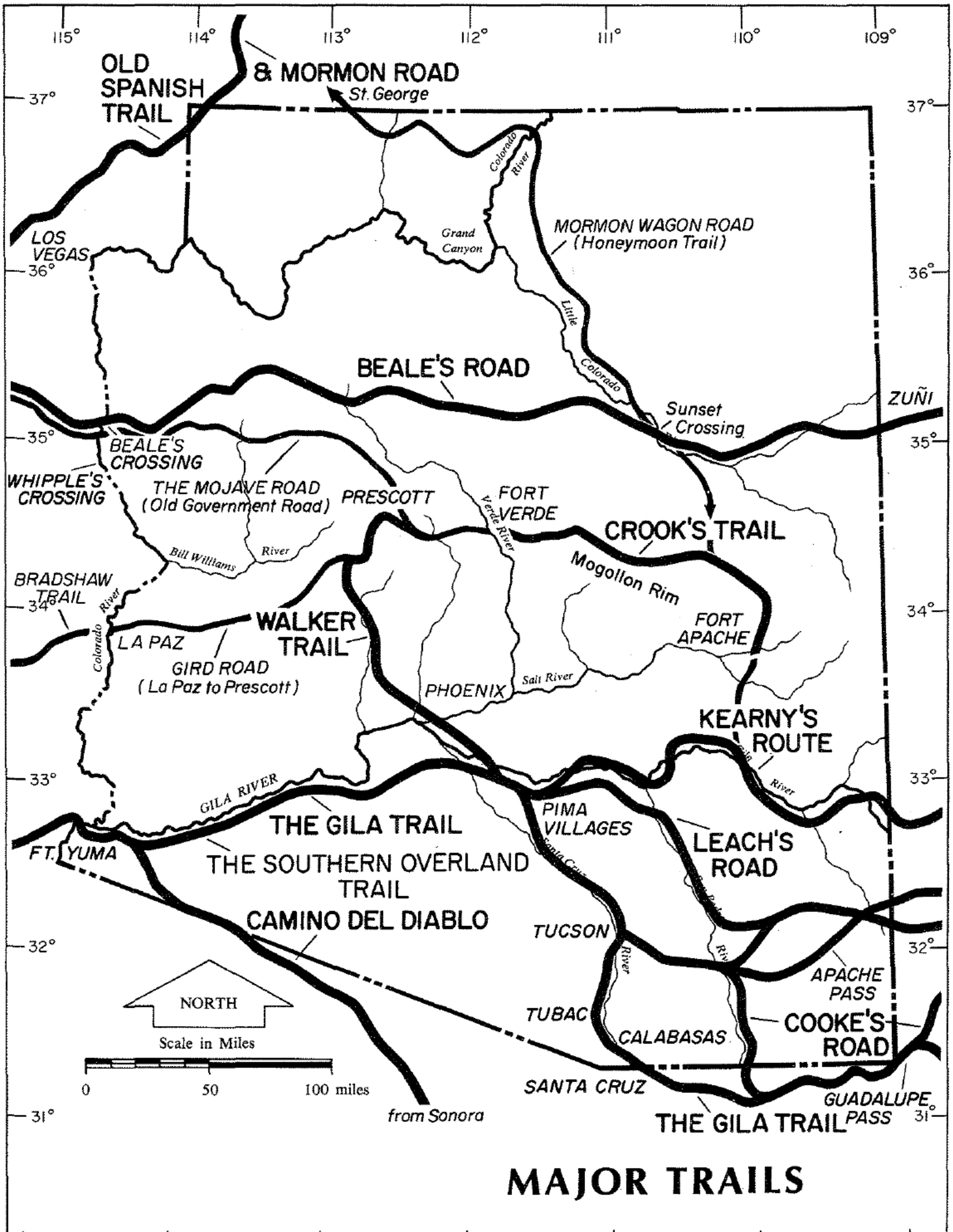

MAJOR TRAILS

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40. MAJOR TRAILS

THROUGHOUT THE HISTORY of the westward movement in the United States the lines of travel followed, for the most part, trails already established by the Indians. West of the one hundredth meridian these trails followed rivers such as the Platte or marched from one water hole to the next.

The Southern Overland Trail, with its many variants, was one of those that ran between reliable sources of water. Portions of this trail were known to the Spaniards as early as the 1700's, when Apache Pass was known as Puerto del Dado, the Gate of the Die, undoubtedly reflecting the gamble one took in passing through this stronghold of the Chiricahua Apaches.

During the Mexican War, Colonel Stephen W. Kearny led the Army of the West over a trail, well known to the mountain men (Map 17), along the Gila River all the way across Arizona. This trail was known to be unsuited for wagons, so Brevet Lieutenant Colonel Philip St. George Cooke, who had orders to build a wagon road from the Río Grande to California, blazed a new trail farther to the south (Map 18).

During the Gold Rush of 1849 many parties of emigrants used various branches of the southern trail—through Janos and Fronteras in northern Mexico or through Apache Pass, as well as Cooke's Wagon Road.

To make travel easier, the federal government appropriated money for the surveying, marking, and improvement of wagon roads. In 1857–59 James B. Leach supervised the work on the El Paso and Fort Yuma Wagon Road—generally referred to as Leach's Wagon Road. This road followed the line of Parke's railroad survey (Map 23), with one notable exception. On reaching the San Pedro River from the east, the road turned north, striking the Gila River about fifteen miles below the junction of the San Pedro and the Gila. While this line saved some thirty miles, it bypassed Tucson, much to the disgust of the residents. Local newspapers commented that many of the water tanks on the road were so constructed that water could not possibly flow into them. This section of the road was little used by travelers, who preferred to stop in Tucson.

Another thought behind the wagon roads was that the route of a wagon road might be converted into a railroad line. Edward F. Beale was sent out to build a road generally along the line surveyed by Captain Amiel W. Whipple in 1853–54 (Map 23). As Beale approached the Colorado River he deviated from Whipple's line by holding directly west instead of swinging south and west along Bill Williams River. This road was followed by a few California-bound parties, most notably the Rose party (Map 38).

A north-south trail was pioneered by James R. Walker and his party of prospectors in 1863. Leaving the Pima Villages, the trail struck out northwesterly to the Hassayampa River, followed that stream to its headwaters, and crossed the Bradshaw Mountains to Prescott. This trail was followed by freighters and stagecoaches.

To shorten the line of communications between Fort Apache and Fort Verde (Map 37), General George Crook had a rough wagon road cut up and along the Mogollon Rim in 1874. This trail, rough as it was, reduced the distance between the two posts by about 50 per cent.

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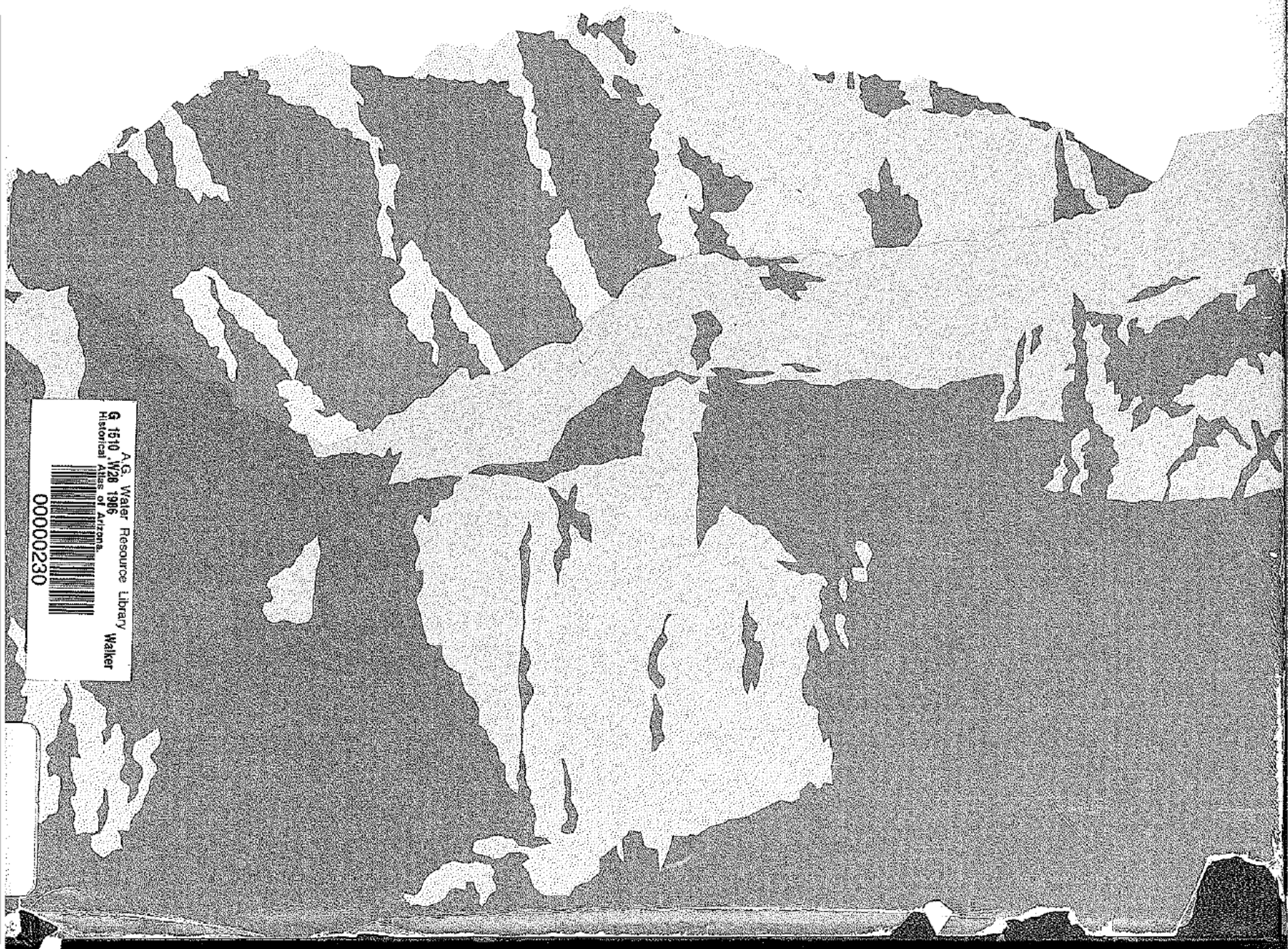

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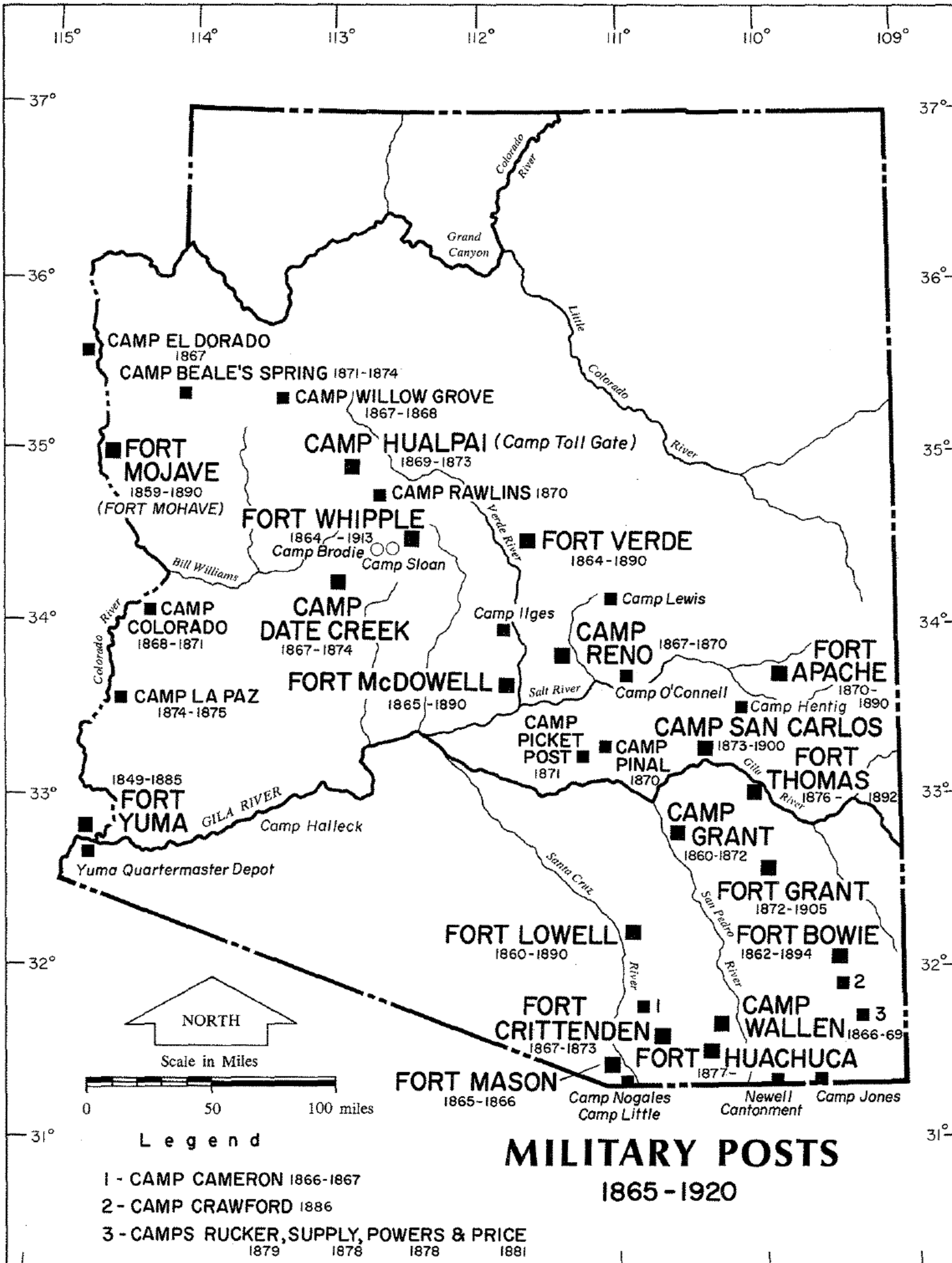

MILITARY POSTS 1865-1920

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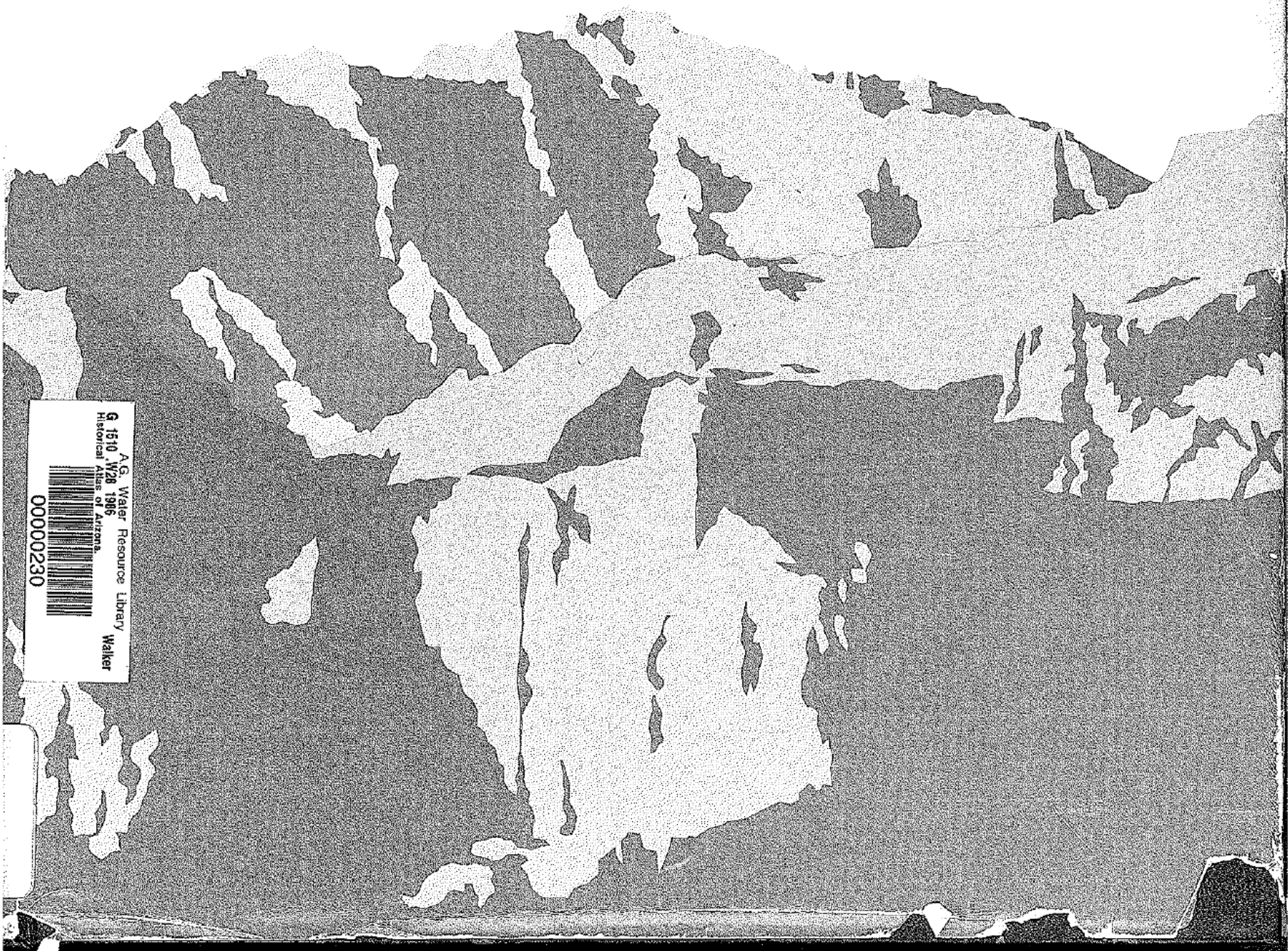
Second Edition

Historical Atlas of Arizona

By Henry P. Walker and Don Bufkin



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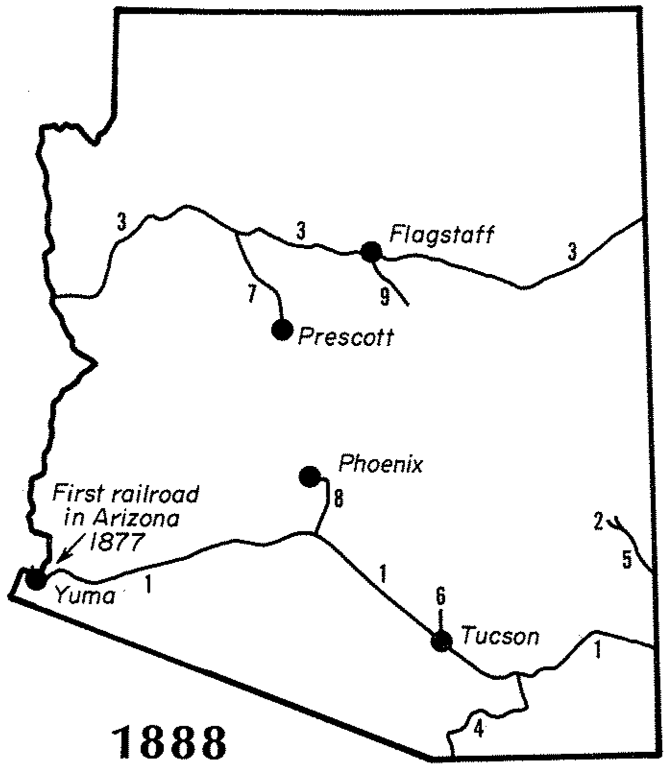
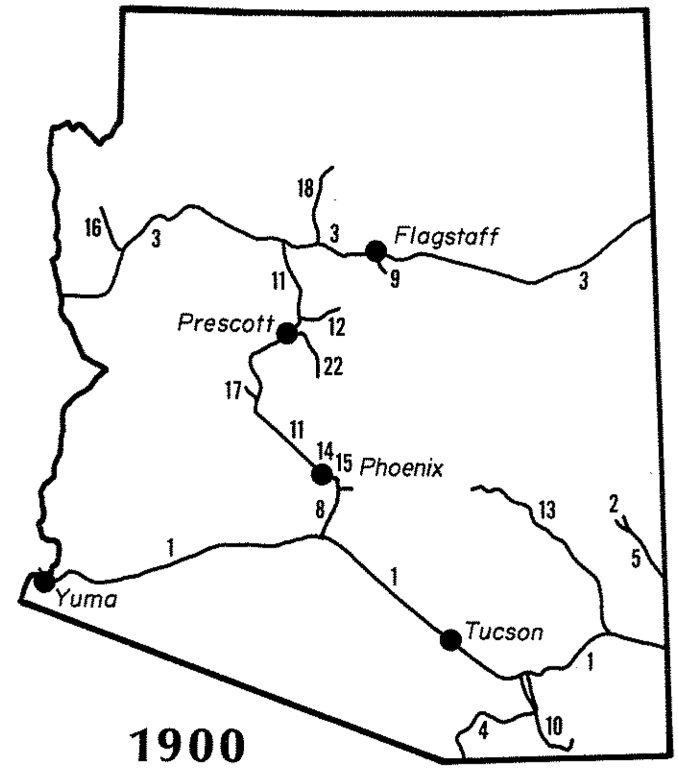
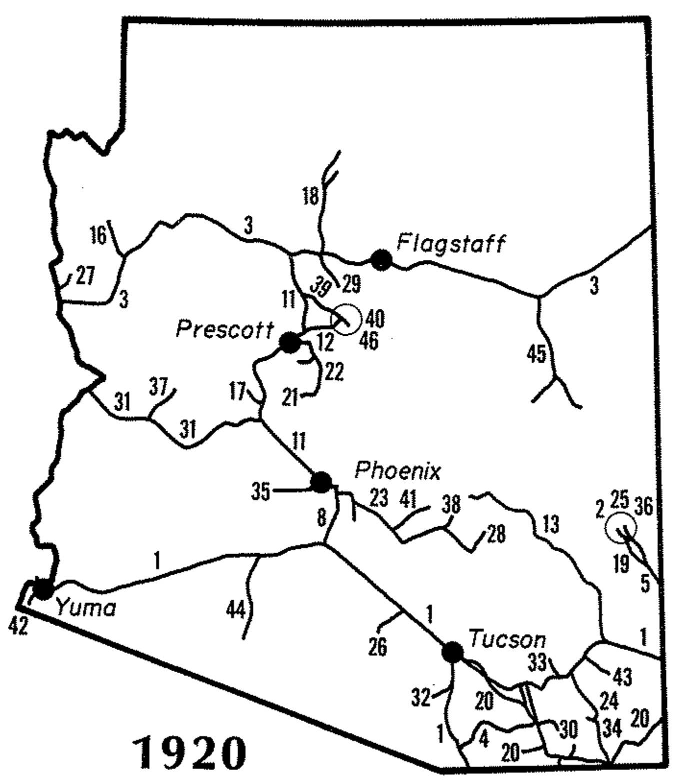
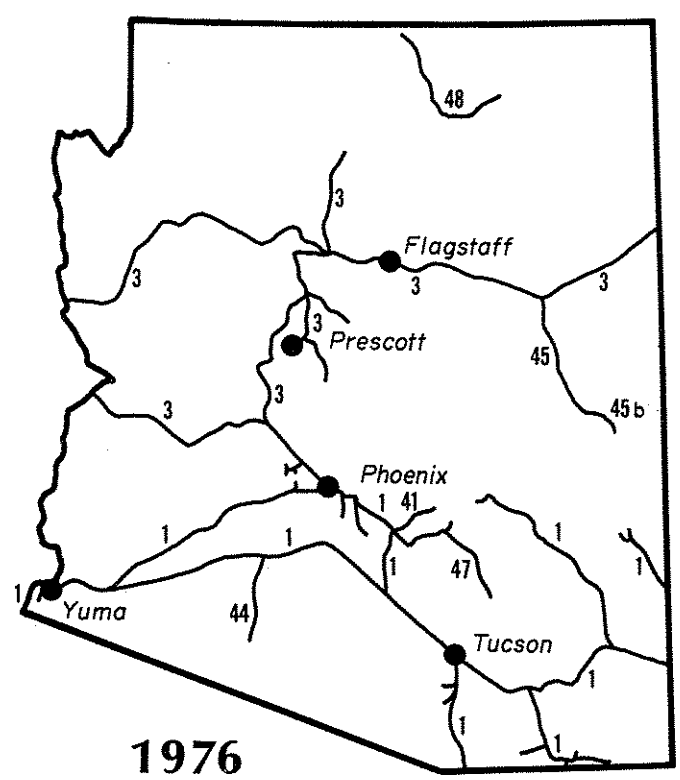




Refer to numbered table for key to maps

1888, 1900 & 1920 maps show existence of railroads by their initial corporate names. The 1972 map indicates current operating company.





RAILROAD DEVELOPMENT

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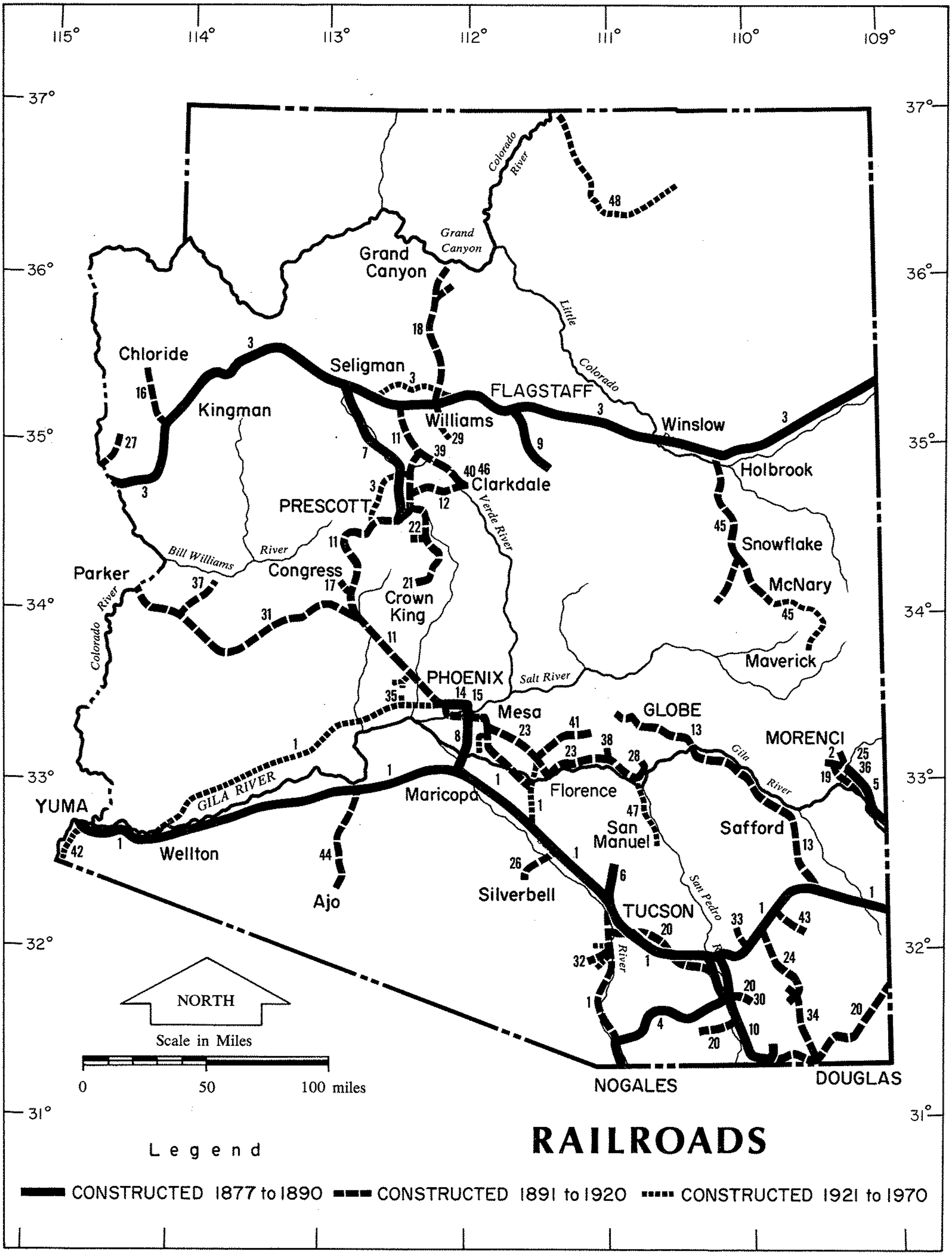
46. RAILROAD DEVELOPMENT

Much of the early exploration and mapping of Arizona was done in anticipation of building a railroad from the Mississippi River to California (Map 23). However, it was not until 1877 that the Southern Pacific Railroad reached the western border at Yuma and four years later that it connected with the Texas Pacific east of El Paso. The second line to cross the territory was the Atlantic & Pacific (later the Atchison, Topeka & Santa Fe), which built west from Albuquerque in 1880 and reached the Colorado in 1883.

The four decades between 1880 and 1920 was a period of great activity in railroad building. Lines were projected, and some were built to provide north-south links between the two major lines, but most of the new roads were designed to serve the mining industry.

Number on Map	Company Name	Year of First Service to Any Part of Arizona
1	Southern Pacific	1877
2	Coronado	1879–80
3	Atlantic & Pacific	1881–83
	3a Santa Fe Pacific	1897
	3b Atchison, Topeka & Santa Fe	1902
4	New Mexico & Arizona	1881–82
5	Arizona and New Mexico	1883–84
	5a Clifton & Southern Pacific (New Mexico)	
	5b Clifton & Lordsburg (Arizona)	
6	Arizona Narrow Gauge	1886
	6a Tucson, Globe & Northern	
7	Prescott & Arizona Central	1886
8	Maricopa & Phoenix	1887
9	Arizona Mineral Belt	1887
	9a Central Arizona	
10	Arizona Southeastern	1888–89
11	Santa Fe, Prescott & Phoenix	1893
12	United Verde & Pacific	1894
13	Gila Valley, Globe & Northern	1894–98
14	Maricopa and Phoenix and Salt River Valley	1895
15	Phoenix, Tempe and Mesa	1895
16	Arizona and Utah	1899
17	Congress Consolidated	1899
18	Santa Fe & Grand Canyon	1901
	18a Grand Canyon Railway	
19	Morenci Southern	1901
20	El Paso & Southwestern	1901
21	Bradshaw Mountain	1902–1904
22	Prescott & Eastern	1898
23	Phoenix and Eastern	1903
24	Arizona & Colorado	1903–1909
25	Clifton & Northern Railroad	1903
26	Arizona Southern	1904
27	Mohave & Milltown	1904
28	Arizona Eastern	1910
29	Saginaw Southern	1904
30	Tombstone & Southern	1905
31	Arizona & California	1905
32	Twin Buttes	1906
33	Johnson, Dragoon & Northern	1908
34	Mexico & Colorado	1909
35	Phoenix and Buckeye	1910
36	Shannon-Arizona	1909
37	Arizona & Swansea	1910
38	Ray & Gila Valley	1900, 1910
39	Verde Valley	1913
40	Verde Tunnel & Smelter	1914
41	Magma Arizona	1915
42	Yuma Valley	1914
43	Mascot & Western	1915
44	Tucson Cornelia & Gila Bend	1916
45	Apache Railway	1918–1919
	45a Southwest Forest Industries	
	45b White Mountain Scenic (operated on lumber railroad connecting with the Apache Railway)	
46	Arizona Extension	1918
47	San Manuel & Arizona	1955
48	Black Mesa & Lake Powell	1971–72

NOTE: The complete story of railroads in Arizona is quite complex. The purpose of this listing is to provide a chronology of railroads based on their original corporate names. The date given is for the year of first service in Arizona. No attempt has been made to indicate acquisition and consolidation of the initial lines into the larger roads, nor has any attempt been made to provide dates of abandonment for those routes no longer in existence.



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47. RAILROADS

Following the completion of the two transcontinental railroads, several connecting links were built by local businessmen. The Maricopa & Phoenix was built in 1887 to connect Phoenix to the Southern Pacific. In the preceding year Prescott was tied in to the Atlantic & Pacific at Seligman by the Prescott & Arizona Central Railway.

An attempt was made to connect Flagstaff on the Atlantic & Pacific with the mineral district around Globe. The Arizona Mineral Belt laid about thirty-six miles of track and started a tunnel through the Mogollon Rim, but then funds ran out. Another attempt to reach Globe was the Arizona Narrow Gauge, which laid about ten miles of track out of Tucson before the company went bankrupt. Changing the name to the Tucson, Globe & Northern Railroad did not help.

Possibly the most interesting railroad in Arizona was the Coronado, a twenty-inch narrow-gauge line built in 1879 from the Longfellow Mine to the smelter at Clifton. The empty cars were hauled up to the mine by mules and were run down to the smelter by gravity with the mules riding on platforms on the cars. Then a steam locomotive was built in Baltimore, shipped by rail to Las Animas, Colorado, and thence by ox-wagon to Clifton. A second locomotive made the trip around the Horn to San Francisco, thence in another ship to the mouth of the Colorado River, up to Yuma by river steamer, and finally to Clifton by wagon.

Most of the trackage in the complexes east of Prescott, east of Phoenix, and southeast of Tucson was laid to provide cheap transportation for the big mining districts. In fact, the real development of Arizona's mining industry had to await the arrival of the railroads.

There were some exceptions. The Apache Railroad was designed primarily to haul lumber out of the forests of the Mogollon Rim country. The Santa Fe & Grand Canyon provided transportation for tourists visiting the Grand Canyon. The newest line in the state is the Black Mesa & Lake Powell, which carries coal from the Black Mesa coal fields to an electric power generated plant.

In 1881–82 the Atchison, Topeka & Santa Fe built the New Mexico & Arizona from Benson to Nogales, connecting with the Sonora Railway to Guaymas on the Gulf of California.

The Southern Pacific laid a new line from Wellton to Phoenix in 1926, thus finally putting the state capitol on a main line. A few short spurs have been built in recent years to provide access to new mines such as the Twin Buttes Mine some twenty-five miles south of Tucson.

When Arizona became a state in 1912 it had 1,678 miles of railroad track, and by 1930 the total had grown to 2,524 miles. Since then there has been a steady decline as a result of the development of the automobile and truck as well as the closing of a number of mines because the ore had been mined out. A number of short-line railroads have been closed down as common carriers but continue to operate as "factory facilities" to move ore from mine to concentrator or smelter.

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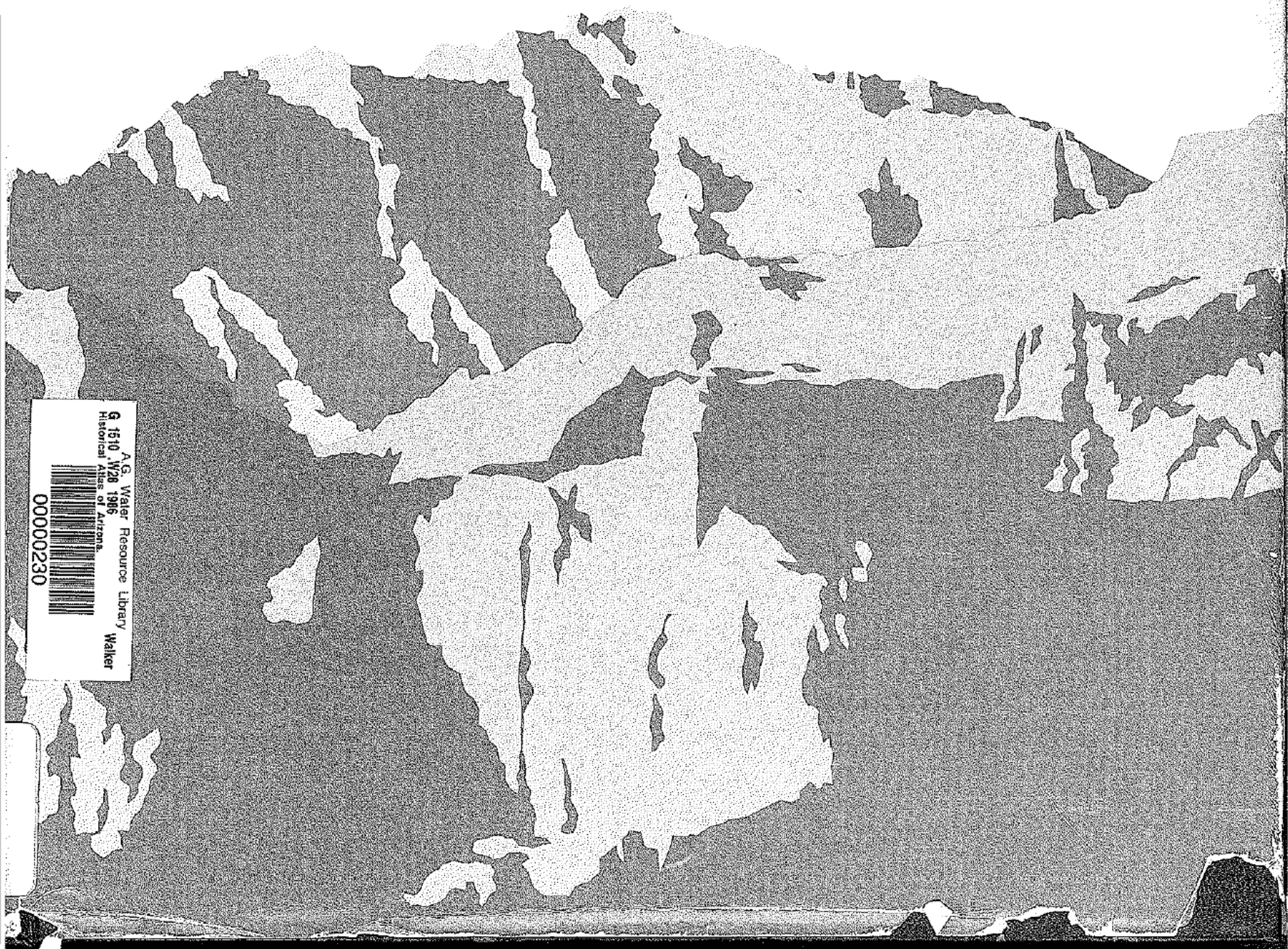
Second Edition

Historical Atlas of Arizona

By Henry P. Walker and Don Bufkin



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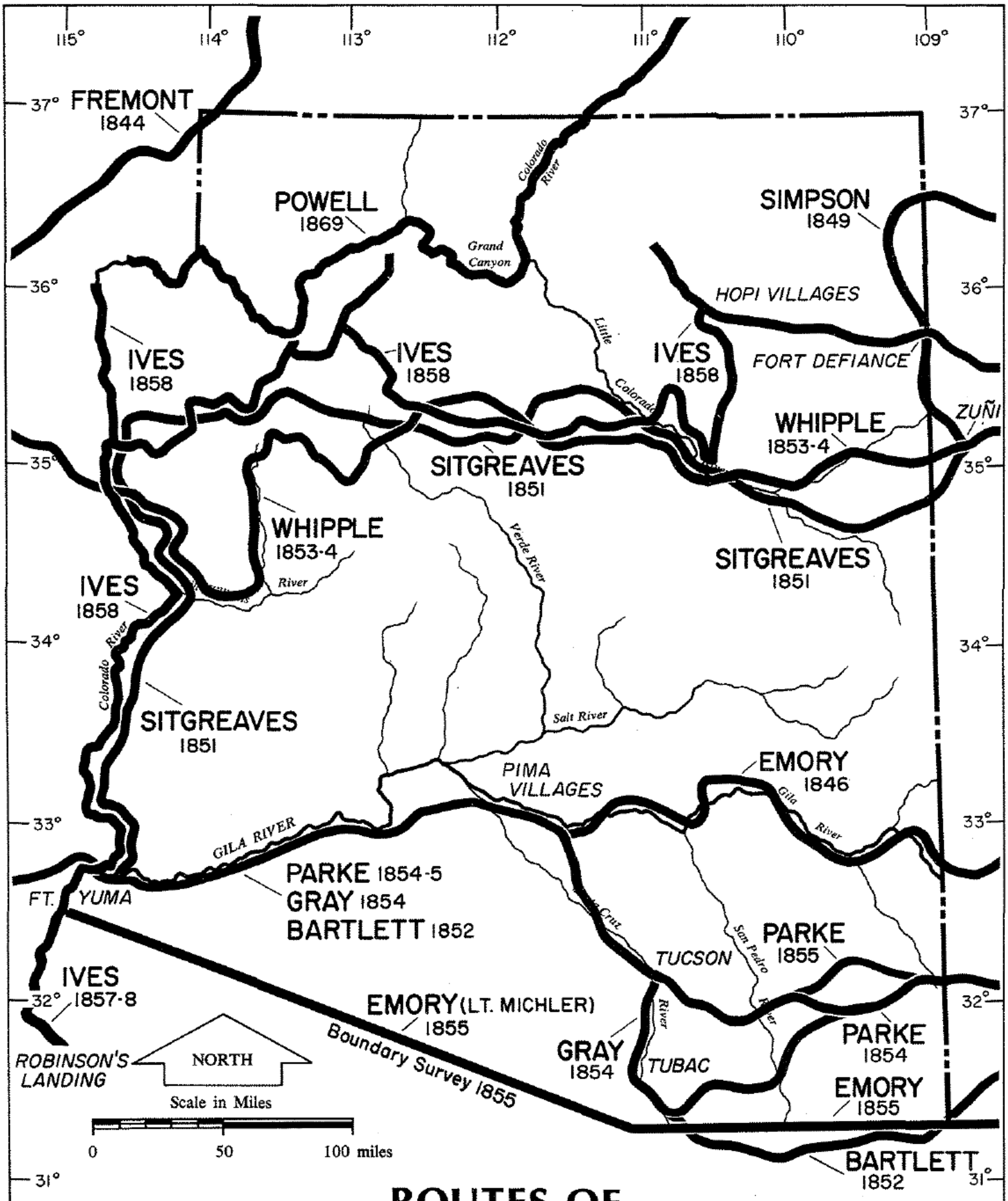

ROUTES OF AMERICAN EXPLORERS and SURVEYORS

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Official Arizona State Historian

Marshall Trimble's

IN OLD ARIZONA

True Tales of the Wild Frontier

The Arizona Trilogy — Volume 2

Front cover art: *Old Reynal* by Frederic Remington

About the Illustrator

Jack Graham's black-and-white illustrations lend a distinctive note to this collection. Having an interest in art from his earliest recollection, Jack has long worked toward a career as an illustrator. His formal art training includes studies at Arizona State University and a Bachelor of Fine Arts degree in illustration from Utah State University. Jack now makes his home in Scottsdale, Arizona.

Oher books by Marshall Trimble:
Arizona Adventure
Arizoniana
Marshall Trimble's Official Arizona Trivia

Many of the stories in this book were published previously in *Phoenix Magazine*, *Arizona* (the Sunday magazine in the *Arizona Republic*) and *Saturday* (the magazine supplement of the *Scottsdale Progress*).

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James Ohio Pattie:

Arizona's First Storyteller

Ain't that something . . . I told mom and pop I was going to the Rocky Mountains to trap and be a mountain man . . .
They acted like they was gut shot! Says, "Son, take your life here, here's where the people is . . . them mountains is full of animals and savages!"
I said, "Mama Gue, them Rocky Mountains are the marrow of the world"— and by God I was right!
I ain't never seen them, but the Andes is foot hills and the Alps are for children to climb . . . and these here are God's finest sculpturings.
Ain't no law for the brave ones, ain't no asylums for the crazy ones, ain't no church, 'cepting right here! Ain't no preachers, 'cepting the birds.
By God, I am a mountain man, and I will be here until bullet or arrow finds me; then I'll leave my bones to weather white on these here stones.

Del Gue, Rocky Mountain Fur Trapper

The first Anglo-Americans to penetrate the wilderness regions of Arizona were that reckless breed known as Mountain Men. Prior to their arrival in the 1820s, few people east of "the Wide Missouri" were even aware of the vast, uncharted lands that would, some forty years later, be called Arizona.

The earliest written account was the narrative of James Ohio Pattie of Kentucky. Pattie's bigger than life adventure reads like a cross between dime novel fiction and a stage play melodrama. He braved Comanche lances to rescue naked women, fought grizzlies, mountain lions, Apaches, survived a harrowing desert ordeal and vaccinated thousands from the scourge of smallpox during his five-year Southwest odyssey.

Grieving over the loss of James' mother in 1824, he and his father Sylvestre, left the family farm in Kentucky and headed for St. Louis, where they outfitted themselves for a fur-trapping expedition. It was the heyday of the fur trade and soon they were bound for the pristine hunting grounds of New Mexico. They arrived in Taos in the fall of 1825. Taos in those days was the favorite rendezvous for American and French trapping parties in the Southwest. It was also the launching pad for expeditions into Arizona. The Gila watershed was an untapped resource of beaver pelts or "hairy bank notes" back in the days when beaver hats were the fashion and the fur trade was one of America's greatest economic enterprises. The area was still part of the Republic of Mexico and the Mexicans weren't eager to see the increasing number of rough-hewn, buckskin-clad Americans setting up business in Taos and Santa Fe.

The Patties were delayed in Santa Fe while trying to secure a Mexican license by Governor Antonio Narbona. The governor was reluctant and might not have granted permission had fate not intervened in a most dramatic way. A Comanche war party swooped down on Santa Fe and carried off some young women, including Governor Narbona's beautiful daughter, Jacova. The Patties, outraged at such barbaric behavior, organized a party of trappers and went off in hot pursuit. Since the Comanches weren't accustomed to being followed, it wasn't hard for the rescuers to circle around and set up an ambush. The unwary war party was emerging from a narrow gap when the trappers struck. The captive women had been stripped of their clothing and were forced to walk in advance of the main group. When the shooting began, the warriors momentarily forgot about their captives and braced for battle. This gave young James and a couple of friends time to ride in and make the heroic rescue. "The gratitude of such captives," he wrote, "so delivered, may be imagined. Fears, thanks and exclamations in Spanish were the natural expression of feeling in such a position." He removed his buckskin jacket and gallantly placed it on Jacova's bare shoulders, then returned her safely to her father in Santa Fe. Needless to say, the grateful governor had a change of heart and issued the Patties and their friends a license to trapping the "Helay" or Gila country.

The remote city of Santa Fe, resting on the gentle, pinon-studded slopes at the foot of the towering Sangre de Cristo Mountains, had a population of 5,000 in 1825. The fabled Santa Fe Trail had recently opened a flourishing trade between the Mexicans and Americans and the Southwest would never be the same with the arrival of merchants, trappers and opportunists. The Mexican officials at first welcomed the interlopers, but soon began to realize the trappers would exploit the beaver-laden streams. Soon after Governor Narbona issued licenses to the Pattie party, the Mexicans toughened their laws, placing heavy restrictions on American fur trappers.

Meanwhile, the Patties and their friends were following the Rio Grande south to Socorro, then headed west to the Santa Rita del Cobre mines, (near today's Silver City, New Mexico), before going into the rugged Gila wilderness.

After a brief rest at Santa Rita, they went up to the headwaters of the Gila and found a wealth of beaver sign. The first night out they caught thirty wily but unwary critters in their steel traps.

Next, the trappers headed north, up the San Francisco River, passing today's Clifton. In two weeks their packs contained the pelts of 250 beaver. They had even better luck further down the Gila country. The San Pedro River was so plentiful, they named it "Beaver River."

One morning while James was scouting the area, he chanced upon a bear's den. Endowed with the recklessness of youth, he rigged a pine torch to the end of his rifle and foolishly entered the cave and came face to face with a huge grizzly. In the confusion of the dark, narrow confines of the cave, Pattie aimed his rifle at the shadowy figure and fired. Without waiting to see if the shot was on target, he ran towards the entrance, dropping his rifle somewhere along the way. Moments later, his courage regained, Pattie borrowed a rifle and re-entered the cave. The critter was dead and it took four men to haul the carcass out. The fat, according to Pattie, yielded ten pounds of valuable grease. A few nights earlier, he'd had a similar encounter with a mountain lion. The beast had sprung out of the darkness and landed on a log less than six feet from his bedroll. Our hero grabbed his rifle and fired point blank, killing the animal with a head shot.

In April 1826, they cached several thousand dollars worth of pelts near the San Pedro River and returned to Santa Rita while James went on to Santa Fe to get more pack animals to haul out the unexpected treasure.

While in Santa Fe, James had another friendly meeting with the beautiful, dark-eyed Jacova where she again openly expressed gratitude for his heroic rescue. But, the call of the wild got the best of him and back he went to recover the cache of furs. At the San Pedro River, Pattie's luck ran out. The clever Apaches had located the pelts and made off with the year's efforts.

Despite the loss, the news started a rush of trappers to the Gila country. In the fall of 1826 Pattie joined a party of French trappers led by Michel Robidoux and journeyed down the Gila to the junction of the Salt and Gila rivers (near today's Cashion). They stopped at a village, according to Pattie, of Papagos. It's more likely they were Yavapais or Tonto Apaches. With a grand display of hospitality, the natives invited the trappers to spend the night. All agreed, with the exception of the suspicious James Pattie, who camped some distance away. During the night, he was awakened by the sounds of violence and was soon joined by Robidoux and an unidentified Frenchman. The others were all killed by their hosts. The three survivors traveled up either the Salt or Gila and chanced upon another party of trappers led by Ewing Young.

Young, a hardbitten mountain man of renown, took his group, along with the three survivors and returned to the site of the massacre where they trounced the natives and burned the village.

Pattie remained with Young's outfit the rest of the season. They trapped up and down the Salt and Verde rivers, then followed the Gila to the Yuma crossing, becoming the first Americans to make the trek. Next, they went up the Colorado and past the Bill Williams Fork to the Mojave villages where a fight erupted between the natives and the trappers. The big guns of the trappers carried the day, but the cunning Mojaves stalked them along the trail. One night, a war party launched a barrage of arrows into the camp. Pattie counted 16 arrows embedded in his bedroll, but somehow he was unscathed. After losing a few men in skirmishes, the trappers split up and returned by separate paths to Santa Fe. Pattie took the scenic route—traveling by way of the North Rim of the Grand Canyon, across to the San Juan River, then overland to Taos.

Once again, bad luck plagued James Pattie. This time his furs were taken by Mexican officials who claimed, under a new policy, the bundles were illegal contraband. Undaunted, Pattie tried again in the fall of 1827. This time his father, Sylvestre, joined the expedition. They trapped the Gila all the way to the Yuma crossing where the local natives proved inhospitable and stole their horses. Assuming the Mexicans would have a port city at the mouth of the Colorado, they loaded their furs in canoes and headed downstream. At the mouth of the Colorado, they found more Indians who were not inclined to be friendly. Their last desperate hope was to turn west and try to reach the California coast. They made it to the coast and were immediately arrested as trespassers and taken to jail in San Diego. Sylvestre Pattie, weak from the desert ordeal, died in his cell but dame fortune was with young James. He negotiated his release by promising to vaccinate "thousands" of locals from smallpox.

In mid-1830, an older and wiser James Ohio Pattie returned to his old Kentucky home. Discouraged, weary and broke, he lamented, "the freshness, the visions, the hopes of my youthful days are all vanished, and can never return."

Pattie didn't keep a journal on his Arizona adventure but told his story to Timothy Flint, who edited it for publication.

It was customary for the buckskin men to stretch their tales a bit and Pattie was no exception. However, there was basis for fact in much of what he recalled and his journal provides an important piece of history of the fur trade in Arizona.

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Mammals of the Mexican boundary of the United States

Edgar Alexander Mearns

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
Bulletin 56

MAMMALS OF THE MEXICAN BOUNDARY OF THE UNITED STATES

A DESCRIPTIVE CATALOGUE OF THE SPECIES OF MAMMALS OCCURRING IN THAT REGION; WITH A GENERAL SUMMARY OF THE NATURAL HISTORY, AND A LIST OF TREES

BY
EDGAR ALEXANDER MEARNS, M. D.
Major and Surgeon, U. S. Army

PART I

Families Didelphiidæ to Muridæ

WASHINGTON
GOVERNMENT PRINTING OFFICE
1907

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Published April 13, 1907.

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Genus CASTOR Linnæus (1766).

Castor LINNÆUS, Syst. Nat., 12th ed., 1766, I, p. 78.

The upper molar teeth are subequal, each with one internal and two external enamel-folds; the stomach has a large glandular mass situated to the right of the œsophageal orifice; the anal and urethro-genital orifices open within a common cloaca; the tail is broad, horizontally flattened, and naked; and the hind feet are webbed. (*Flower and Lydekker.*)

CASTOR CANADENSIS FRONDATOR Mearns.

BROAD-TAILED BEAVER; SONORAN BEAVER.

Castor canadensis frondator MEARNS, Proc. U. S. Nat. Mus., XX, p. 503, Jan. 19, 1898, (advance sheet issued Mar. 5, 1897; original description.—MILLER and REHN, Proc. Bost. Soc. Nat. Hist., XXX, No. 1, Dec. 27, 1901, p. 63 (Syst. Results Study N. Am. Mam. to close of 1900).

[*Castor canadensis*] *frondator*, ELLIOT, Field Col. Mus., Zool. Ser., II, 1901, p. 116 (Synop. Mam. N. Am.).

Castor c[*anadensis*] *frondator*, ELLIOT, Field Col. Mus., Zool. Ser., IV, 1904, pp. 159 to 161, fig. 30 (skull of type); fig. 34 (animal). (Mam. Mid. Am.).

Päh-höné-äh of the Hopi Indians.

Ap-é'-nä of the Hualapai Indians.

Type-locality.—San Pedro River, Sonora, Mexico, near Monument No. 98.—(Type, skin and skull, No. $\frac{20760}{35883}$, U. S. National Museum.)

Geographical range.—This form occupies the southern interior area of North America, ranging north from Mexico to Wyoming and Montana, its habitat being, of course, restricted to the vicinity of wooded streams, which it follows through the Austral and Transition zones.

Description.—Larger than the beaver of Canada, paler and different in coloration, with a much broader tail. Above russet, changing to chocolate on the caudal peduncle above, and to burnt sienna on the feet; toes reddish chocolate. Below grayish cinnamon, brightening to ferruginous on the under side of the caudal peduncle. Sides wood-brown, enlivened by the tawny olive color of the overhair. Length, 1,070 mm.; length of tail, measured from anus, 360; length of bare portion of tail, 125; height of ear from crown, 31; height of ear from anterior base, 35; distance from tip of nose to eye, 68; from tip of nose to ear, 125; nose to occiput, 165; length of manus, with claw, 82; length of pes, with claw, 185. Skull, 133 mm. by 99. Weight, 62 pounds avoirdupois.

Cranial characters.—The skull of the European beaver (*Castor fiber*), which is readily distinguishable from that of the Canadian beaver (*Castor canadensis*) by its slender build, lengthened nasal bones, and elongated rostral portion, presents still greater differences

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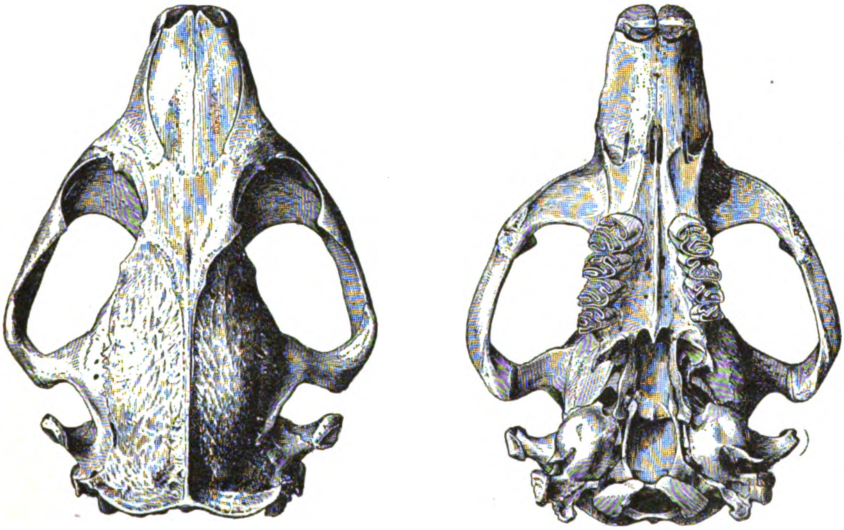
when compared with the beaver of Arizona and Sonora. There being at present no forest connection between the habitats of *Castor fiber* and *C. canadensis* in their respective geographic ranges, and consequently no continuity of habitat, there can be no question as to their specific distinctness. The skull of *C. canadensis frondator* (fig. 57) differs from that of typical *C. canadensis* in being much larger, with more spreading zygomata.



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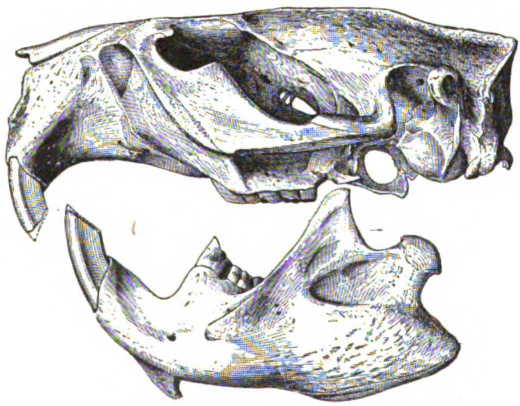

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FIG. 57.—CASTOR CANADENSIS FRONDATOR. (TYPE, CAT. NO. 35883, U.S.N.M.) *a*, DORSAL VIEW; *b*, VENTRAL VIEW; *c*, LATERAL VIEW.

Variations.—In the year 1885 I purchased from a professional trapper 17 beaver skins, taken on the Verde River during the winter of 1884–85. These skins were dried in oval shapes on looped sticks in

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the usual way and weighed 29 pounds avoidupois, costing $1 a pound. The fur was quite heavy, and was made into capes, muffs, and a coat, which are still serviceable. The adult skins measured as follows: 1,090 by 700 mm., 1,060 by 720, 1,010 by 840, 970 by 780, 950 by 650, 940 by 770, 930 by 800, 930 by 700, 920 by 750, 900 by 770. Four young of the year measured 760 by 600, 710 by 600, 670 by 580, 695 by 620. One in the second year measured 720 by 610. Two in the third year measured 820 by 680, 810 by 720. As in all Arizona beavers, the hides are thick and indurated, especially those of old males that have many scars from fighting; and the coat is poorer in quality and less dense than in northern skins. The fur, however, is quite full and handsome. Ten of these skins are of adults, taken between December and March, and stretched to a nearly perfect ellipse. Of these, No. 168 (original number) is the largest, darkest, and handsomest, being in perfect winter pelage. The skin measures 930 by 800 mm., and weighs 2¼ pounds. There is an area of dark, reddish brown extending from the forehead to the root of the tail, where the color changes to a darker hue of shining vinaceous-chestnut, a lighter shade of which extends to the under surface of the caudal peduncle and inner surface of the thighs. The sides are rather uniform (slightly reddish) fulvous. The underfur is of about the same color terminally but grayish at the base of the hairs; that upon the dorsum is rich brown. There is no ventral chestnut stripe in this specimen.

The remaining nine adult winter specimens exhibit certain color differences amounting to a considerable variation. No. 169 has the dorsum paler and less reddish; the sides and belly are uniformly brownish gray, with no tinge of red or fulvous, while the rump is paler than the back, and more yellowish than in the above specimen, this shading into dark vinaceous posteriorly and beneath. The skin measures 1,090 by 700 mm.

Between the extremes above described are various gradations in color. In some skins there is a distinctly darker ventral stripe, and occasionally the sides are of a brighter yellowish fulvous. In some the top of the head is darker, in others lighter, than the rest of the dorsum; but in all the muzzle, sides, and under surface of the head and neck are pale, so that the skin exhibits a triangular dark patch above, corresponding to the crown of the head.

Young of the year (from four skins taken in midwinter).—These are strikingly paler than adults at the same season. They present a central area of reddish brown and two broad, lateral bands of nearly uniform brownish gray, faintly washed with fulvous. The ventral surface is appreciably darkest in the median line. The sides of the head are washed with fulvous. The rump and base of tail are pale chestnut-fulvous, with less of the vinaceous tint than in adults.

Three immature skins, presumably in their second and third years,

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respectively, present color characters intermediate between those of the young of the year and the adult.

Summer pelage of adult (adult male No. $\frac{3336}{1854}$, coll. Amer. Mus. Nat. Hist., New York, taken at Fort Verde, Arizona, August 16, 1884).—Upper parts pale reddish fulvous, much paler and more uniform than in any winter specimen. A darker vertebral area is indicated. The rump and upper side of the tail are considerably paler and more yellowish than in winter. The long hairs of the sides, giving the general body color, are paler yellowish fulvous; and the same shade prevails on the under parts, where the overhair is very scanty. Along the middle of the belly is a band of dark, shining chestnut, a paler, barely apparent shade of which extends forward to between the fore legs and more distinctly backward to the vent. The under side of the tail, posterior to the anal orifice, is reddish chestnut, paler than the dark area of the middle of the belly. The bare sole of the hind foot is fringed behind the heel with a band of long, chestnut-red hairs. The upper surface of the hind feet is covered with coarse hairs of a dark vinaceous color, with a few markings of fulvous, especially upon the terminal portion of the toes. The front, sides, and under surface of the head and the fore legs and feet are a paler shade of fulvous than the rest of the body; and the feet are marked above with a few irregular vinaceous blotches (mixed with brown) similar to, but paler than, those of the hind feet. The soft underfur is dark, grayish brown on the upper parts, becoming pale grayish on the under parts.

Very young specimens, taken in June, have a drabish coloration.

Remarks.—The beaver of Canada and the northeastern United States (*Castor canadensis canadensis*) is of a beautiful glossy bay on the upper surface, paling to chestnut on the head and rump. The under surface is seal brown. Sometimes the color is still darker, the back being blackish brown, the caudal peduncle burnt umber, and the under side of head vandyke brown. The feet are seal brown. I have examined thirty-three skulls and a large number of skins of *C. canadensis frondator*, from Arizona and Sonora. In old males the total length reaches 1,130 mm., and the bare and scaly portion of the tail measures 285 by 155. Adult males weigh 60 pounds and upward; females 40 to 50 pounds.

Beavers are found throughout the Rio Grande Valley, except where civilization has caused their disappearance. At El Paso I bought some beaver traps from a trapper, but was unable to catch any beavers. Some were living on Las Moras Creek, near Fort Clark, Texas, but they also eluded me. Not having obtained a specimen, I can not say whether the Texas beaver is most like *Castor canadensis carolinensis* Rhoads or the present subspecies. Skins of the Arizona beaver make elegant rugs, robes, and even fur trimmings when the long over-

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hair has been plucked out; but the price at which they were sold shows that beaver trapping was not a remunerative occupation in Arizona, which is further attested by the great abundance of these animals along the rivers of the Territory during the early eighties. I have had large skins offered me, prepared with less skill and pains than those above described for 50 cents apiece; but the value has risen so that a trapper named Milligan, who obtained more than 100 skins on the Gila and Verde rivers during the winter of 1886–87, selling them by the pound, received an average price of $5 apiece. The largest beaver taken by Mr. Milligan weighed 73 pounds.

Habits and local distribution.—Signs of the beaver were evident on nearly all of the streams of the Colorado Basin visited by me from March, 1884, to May, 1888. I always found this animal to be excessively shy, secretive, and difficult of observation, in these respects quite different from the half-tame beavers of the Yellowstone National Park. The slight amount of information respecting them that I was able to obtain while in Arizona can be best presented in the form of extracts from my diary of those years, as follows:

July 18, 1884, Fort Verde, Arizona.—Beavers are abundant in pools of Beaver Creek from above Montezuma Well to the Verde River. Mr. Henry Mehrens, a settler living just below Montezuma Well, says he frequently sees them in pools of Beaver Creek, which are there densely bordered by tule (*Scirpus*) and surrounded by willow and cottonwood trees, upon which they feed. He informed me that beaver frequent the irrigation ditches of the ranches along the stream, doing some damage to the ditches and shade trees planted along them.

August 16, 1884, Fort Verde, Arizona.—I killed an old male beaver about 3 miles above the post of Fort Verde, in the Verde River. I first saw it in the river a good way above me, floating like a piece of driftwood, low in the water. For some time I was unable to make out whether it was an animal or not; but I soon saw it move its head up and down slightly, and then I felt sure that it was a beaver—the first one I ever saw. Every walk I had taken along the banks of the Verde River had revealed to me evidences of the abundance and industry of this singular beast. Large cottonwood trees were to be seen with trunks gnawed half through, which, on the next occasion that I visited the spot, were lying prostrate, felled by the beaver. Numbers of cottonwood trees had been cut down by them during the preceding two months, and in some places every tree near the water and some good-sized ones at quite a distance from the stream had been cut, until the spot resembled a clearing made by the woodman's ax. The saplings and limbs were frequently dragged to form a large windrow beside the river bank, in doing which well-made paths had been swept in the sand and loam by the industrious beavers. I had not seen any typical or recently occupied beaver dams, although there were re-

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mains of several old ones near the post of Fort Verde. But notwithstanding the plentitude of beavers not one had before been seen, although the streams had been forded at night and in the evening many times. This one was seen on a cloudy day, after a shower, and was shot from an ambush as it swam slowly down the river channel, with only its head visible above the surface of the water most of the time, although it sometimes floated higher and drifted like a board. It was so large and heavy that it was with difficulty removed to a small tree and hung up in the shade.

August 11, 1884, Fort Verde, Arizona.—Visited a spot two miles above the post where beavers had been hard at work cutting cottonwood trees and lopping off the branches close to the trunk. Well-worn paths had been made by them when carrying the branches to the river. I was walking silently and cautiously in the shade of the cottonwoods at a place where the bluff bank was about 10 feet high, when I noticed a ripple proceeding from the nearer shore beneath some jutting roots and brushwood, and crept stealthily to the shore and saw that there was a great commotion in the water. In fact, the whole stream was quaking from the rapid movements of some animal beneath the surface. Soon the head of a large beaver emerged from the shallow water on the opposite side, and in a moment another and another. It proved to be a beaver mother giving instructions to her kittens in the art of swimming. I quickly pulled both triggers of my shotgun. Then there was a splash, and for a moment the water and sand fairly boiled, after which there was only the spasmodic kicking and flapping of a wounded beaver, which was secured, not however without difficulty, from a dangerous quicksand among some stranded snags of trees about which the beavers had been trying to build a dam. On this account the beaver colony was not subsequently molested by me, as I was desirous of observing their method of work on the attempted dam.

August 21, 1884, Fort Verde, Arizona.—This evening I repaired to the spot where I shot the beaver and watched for these animals until it was pitch dark. I saw a large beaver at work on the dam, but it flapped its tail on the water and dived upstream, and I did not see it again. As the darkness increased I could hear them splashing in the water and flapping their tails on the ground with a sharp thud from time to time, but I could see nothing, as the night was dark save when a distant flash of lightning illumined the water for a second.

August 22, 1884, Fort Verde, Arizona.—The beavers are putting forth strenuous efforts to cut down all the timber near their dam. I am interested to see whether they will actually succeed in cutting off some large trees from which they have stripped the bark and on

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which they have commenced to chisel the wood. Some of these trees are cottonwoods, two feet or more in diameter. Beavers have already felled some of the largest trees in the vicinity, and it is probable that others will soon follow. The limbs have been cut from the felled trees at the trunk and carried off. To cut some of them the animals had to climb along the trunk to a position 10 to 15 feet above the ground. There are numerous beaver slides in the vicinity of the dam, and these are well worn and cleanly brushed by the leafy boughs that have been dragged down them.

September 4, 1884, Fort Verde, Arizona.—To-day I shot a young male beaver. Its stomach was nearly filled with the bark of the cottonwood. We had this young beaver served on our table, and all who partook of it pronounced it to be excellent meat.

September 12, 1884, Fort Verde, Arizona.—One young beaver was seen swimming in the Verde River with only the nose and fore part of the head out of water. It climbed out upon the opposite river bank, where I obtained a good view of it.

October 17, 1884, Gila River at the San Carlos Indian Agency.—Beavers are abundant. I saw many cottonwoods cut down or gnawed by them.

October 25, 1884, Fossil Creek, Arizona.—Beavers are numerous on this stream. While on this expedition (with General Crook) I saw fresh signs of the beaver on White River, the Gila, Salt River, and Tonto Creek, and old signs on Pine Creek, all in Arizona.

January 17, 1885, Indian Garden, Oak Creek, Arizona.—Beavers have cut many small saplings, but no large trees, along this stream.

May 13, 1885, Gila and Salt rivers, near Phoenix, Arizona.—Tracks and cuttings of the beaver were seen.

June, 1885, Fort Verde, Arizona.—Early in June, when fishing for bonytail (*Gila*) on a sluice of the Verde River, I accidentally stumbled upon a nest containing three young beavers, two of which I took for specimens on another occasion (June 13). The nest was contained in a hollow of the large decayed bole of ash trees that grew out of a common base, and was composed of stalks and leaves of sedge, tule, and herbs, together with some dry leaves and fine rootlets that had been washed bare by the stream. On this neat and soft bed were the three little ones. The mother dived into the pool which had undermined the trees along the jutting bank, but soon came back to look after her progeny and was quite bold. On subsequent visits to this nest I heard the splash of the parent when I approached the spot, and the progeny followed her example as soon as I reached them. The mother did not appear, but the young ones swam freely around the pool in my presence.

June 19, 1885, Fossil Creek, Arizona.—Beavers were seen in Fossil Creek, central Arizona.

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October 1, 1885, Fort Verde, Arizona.—Being desirous of obtaining a handsome section of a cottonwood tree bearing the marks of the beaver's teeth, I selected an immense one which the beavers had cut two-thirds through, and which exhibited well the marks of their teeth and their apparent intention and ability to fell a tree in a particular direction. Colonel Clendennin, commanding the post, kindly allowed me to take a large crosscut, double-handed saw and the provost sergeant with two men. The tree proved to be larger than I had supposed, and we were unable to saw it down. As a good deal of heavy cottonwood timber had been cut by beavers in that vicinity, I measured the circumference of the trunks of six of the larger trees. The measurements, taken above the cutting, were as follows: 31½ inches, 21½, 55½, 36, 87½, and 89. One or two of the trees measured were still standing nearly cut through, but these were felled by the beavers soon after and carried away by them, with the exception of the heaviest trunks from which all the branches were gnawed.

November 7, 1885.—A prospector related a story of a fight between a beaver and mountain lion. The miner, encamped on the Colorado River at a point where there was a broad sand flat, saw a beaver in the early morning crossing the sand flat to a strip of cottonwood timber, whence it was afterwards seen dragging a stick of wood back toward the water. A mountain lion was then seen crouched in the trail watching, ready to intercept the beaver. As the latter approached the lion sprang upon it, and the two animals closed in a desperate conflict. The fortunes of war wavered, now on the side of the lion, anon on that of the beaver. The miner, taking his rifle in hand, cautiously approached the combatants and watched them from a place of concealment. After fighting a long time the beaver was left dead on the field and the lion attempted to crawl from the spot, followed by the prospector, who found it unnecessary to kill the lion with his rifle, as it soon lay down upon the sand and died from exhaustion and loss of blood.

January 22, 1886, Fort Verde, Arizona.—During the past week there have been long heavy rains. The rainfall in the valley amounted to several inches, while upon Grief Hill, 1,500 feet higher (altitude about 5,000 feet), the precipitation amounted to 5 inches. The Verde River overflowed its banks and flooded the beavers out from their burrows in the river banks. For a night or two they were seen all along the river, showing great excitement, and several of them were shot.

March 26, 1886, Fort Verde, Arizona.—A few days ago a female mallard flew from a beaver-felled cottonwood whose branches drooped into the water beyond a pile of driftwood. As I had been within a few feet of the spot for a quarter of an hour without noticing the duck, I suspected that it had a nest among the driftage. To-day,

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with a view to discovering the mallard's nest, I stopped and scrutinized the spot with particular care from the opposite bank of the stream, and descried a huge beaver seated upon the tree trunk beneath the débris. It had evidently been driven from its home by the very high water of the rising stream, and had sought concealment in this shady spot. When I revisited the place later in the day the beaver had returned, but only its head was out of water, and that so nearly concealed by brushwood that I caught sight of it too late for a shot. When first seen I could easily have obtained the specimen had my gun been loaded for such tough game; but it had gone before exchange of cartridges could be effected.

May 28, 1886, Fort Verde, Arizona.—Hoy, the driver of the post water wagon, brought me a large female beaver that he killed with a stone under the bank of Beaver Creek. The soldier's dog caught one of this beaver's young, which Hoy also brought to me (Nos. 6785 and 2339, coll. Amer. Mus. Nat. Hist.).

June 11, 1886, Fort Verde, Arizona.—To-day I saw a place where the beavers' castoreum had been deposited. The ground was stained blackish, and the odor was so strong as to attract my attention when riding near.

February 10, 1887, Fort Verde, Arizona.—A beaver was caught in a steel trap eight days ago, and left one fore foot in the trap. To-day it was found stranded upon a low sand island, having but recently died. The uterus contained three fetuses about 25 mm. in length. They were contained in spherical sacs as large as a hen's egg. The placenta was four times larger than the embryo, which latter had developed largely to head and hind extremities. The weight of the other was 46 pounds; eye 9.5 mm. in diameter.

March 15, 1887, Verde River, Arizona.—I saw a beaver come out of its burrow in the bank and drag a cottonwood branch into its home in broad daylight.

March 27, 1887, Fort Verde, Arizona.—I have noticed that beavers have been working on ash trees in several localities in this region of late.

April 3, 1887, Box Canyon of the Verde River.—Beavers are numerous, and have cut much of the timber along the river bank. Mr. J. P. Milligan took 120 beavers on the Gila and Verde rivers during the winter of 1886–87, and sold the skins at $2.50 a pound (about $5 apiece).

November 22 to 24, 1887.—On the East Verde River are several fine beaver dams. One of them is 4 feet high, and could not have been better built by man. This dam is superior to any other that I have seen in the region. Beavers are very plentiful on the East Verde.

I found bones of the beaver in many cliff and cave dwellings of the extinct race of man known as cliff dwellers in the Verde Valley, Arizona, from 1884 to 1888.

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The dens of beavers are usually dug in the bluff banks of streams, and have the entrance at a considerable depth below the surface of the water. At the back part are usually one or more openings, probably for the purpose of admitting the air, which are concealed by brush and weeds. At Fort Verde a beaver den was partially opened, and a bull-dog that had earned the reputation of being a hard fighter was admitted. In the fight that ensued the dog was badly beaten, and could not again be induced to attack a beaver.

Mr. Stuart Daniels found beavers on the Sonora River, Mexico. He also found them in abundance on the Gila River, Arizona. On the Boundary Survey they were found on the San Pedro River and on Babocomeri Creek, one of its tributaries in Arizona. Two trappers whom we met at Yuma, Arizona, in March, 1894, had recently arrived from a 200-mile trapping expedition down the Gila River. They had shipped a number of beaver and raccoon skins taken during this trip, but found no beavers on the lower portion of the Gila. I saw old beaver cuttings on the Gila in the vicinity of Adonde Siding, Arizona, in February, 1894. Residents said that there had been scarcely any beavers on the lower Gila since the flood of February, 1891, which washed them all out. One man told me that beavers were then (February, 1894) working extensively at Mohawk, on the Gila. Beavers were formerly found at Gila City, but had been driven out by previous floods. In the years 1893 and 1894 a colony of beavers was located about 12 miles below Yuma, on a lagoon of the Colorado River. Seven of them were trapped by Mr. Smart, of our party. Beavers are common on the Colorado, and doubtless sometimes ascend the Salton and New river lagoons of the Colorado Desert during seasons of overflowing; but we saw no signs of them at the time of our visit away from the Colorado River in that region.

No signs of beavers were seen by us on Cajon Bonito Creek or the San Bernardino River, terminals of the Yaqui River; but Mr. Hall, who resided in the Guadalupe Canyon, informed me in 1892 that he had seen their cuttings lower down on Cajon Creek; but I failed to discover them there.

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Comparative cranial measurements of 27 specimens of beavers.

Museum number of skull.	Locality.	Sex and age.	Condylo-basal length.	Basilar length.	Length of nasals.	Greatest width of nasals.	Interorbital breadth.	Greatest width of skull.	From front of intermaxillaries to lateral teeth.	Palitar length.	From posterior border of palate to foramen magnum.	Maxillary tooth row.	Greatest length of mandible.	Height of mandible from angle to apex of coronoid process.
			mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
2045[a]	Verde River, Arizona	♂ ad.	138	122	47	25	23	102	57.0	79.0	43	30.0	115	61.0
2029[a]	....do	♂ ad.	140	125	48	26	26	100	58.0	90.0	44	32.0	116	59.3
5131[a]	....do	♂ ad.	141	123	53	27	24	101	59.0	92.0	43	32.0	120	60.6
2047[a]	....do	♂ ad.	139	122	50	25	23	97	56.0	86.0	45	31.4	114	63.0
2028[a]	....do	♂ ad.	135	119	46	24	25	97	56.0	87.0	41	31.0	112	59.0
2052[a]	....do	♂ ad.	138	122	50	27	24	97	55.0	86.0	44	31.2	112	56.0
35883	San Pedro River, Sonora, Mexico[b]	♂ ad.	133	117	47	25	23	99	55.1	84.6	40	31.0	108	54.5
60354	Colorado River, Arizona	♂ ad.	134	119	48	25	23	97	54.4	81.0	40	32.2		
2033[a]	Verde River, Arizona	♀ ad.	135	119	47	25	22	95	54.2	85.0	42	30.5	109	56.0
2035[a]	....do	♀ ad.	127	111	44	23	22	92	51.0	80.0	38	29.0	104	54.0
2046[a]	....do	♀ ad.	131	115	48	25	22	94	54.0	83.0	41	29.0	107	55.0
2030[a]	....do	♀ ad.	128	112	48	24	23	92	53.0	82.0	41	29.0	106	54.0
2031[a]	....do	♀ ad.	137	123	49	24	22	100	57.0	79.0	44	31.0	113	59.0
2043[a]	....do	♀ ad.	136	120	50	25	24	101	55.0	72.0	43	31.0	112	57.0
2032[a]	....do	♀ ad.	133	116	46	24	24	96	54.0	75.0	40	30.2	107	54.0
35946	San Pedro River, Sonora, Mexico	♀ ad.	126	111	45	22	22	94	51.2	80.2	39	29.2	104	56.0
4347	Fort Simpson, Hudsons Bay territory		120	105	42	22	23	86	49.0	71.0	35	28.0	99	50.0
4292	....do	♂ ad.	120	106	41	21	22	84	47.0	70.0	36	28.0	95	50.0
4204	....do		116	102	40	20	22	81	45.0	66.0	34	28.0	92	47.0
3280	Nelson River, Hudsons Bay territory		116	102	40	23	22	87	46.0	66.0	34	27.5	97	51.0

7194	Fort Good Hope, Hudsons Bay territory	♂ ad.	120	106	41	21	21	85	47.0	68.0	38	28.0	98	51.0
7195	....do	♂ ad.	122	108	43	22	21	85	51.0	71.0	37	28.0	96	48.0
7392	Lake Superior	....	123	107	43	22	24	88	50.0	71.0	35	29.0	101	54.0
7389	....do	....	126	111	44	21	23	89	53.0	76.0	39	29.0	102	55.0
20894	Genito, Virginia	....	133	117	47	23	26	94	55.0	78.0	40	32.0	107	57.0
3772	Franklin County, Mississippi	....	134	118	48	24	24	99	54.0	76.0	43	32.0	110	58.0
6564	River Elbe, Germany	....	125	105	51	23	25	83	50.0	70.0	35	30.0	97	51.0
Average of 8 males from Arizona and Sonora			137	121	49	26	24	99	56.3	85.7	42	31.4	114	59.1
Average of 8 females from Arizona and Sonora			132	116	47	24	23	96	53.7	80.0	41	29.9	108	55.6
Total average of 16 from Arizona and Sonora			134	119	48	25	24	98	55.0	82.9	42	30.7	111	57.4
Average of 10 adults from Canada and the eastern United States			123	108	43	22	23	88	49.7	71.3	37	29.0	100	52.4

[a] American Museum of Natural History.

[b] Type of *C. c. frondator*.

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Measurements of 13 specimens of Castor canadensis frondator.[a]

Museum number. Skin.	Museum number. Skull.	Collector's number.	Locality.	Date.	Sex and age.	Total length.	Length of tail, measured from anus.	Greatest width.	Ear, height above crown.	Length of manus and claw.	Length of pes with claw.	Weight, pounds avoirdupois.
				1884.		*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*
3336	1854	120	Verde River, at Fort Verde, Arizona.	Aug. 16	♂ ad.	1,120	360	125	40	73	143	61
	2055?	122	....do................	Aug. 19	♀ juv.	630	224	63	30	52	99	....
3337	2054?	123	....do................	Sept. 10	♂ juv.	750	253	77	32	57	99	....
				1885.								
3338	....	198	....do................	June 13	♀ juv.	387	122	36	17	41	81	....
(?)	2038	199	....do................	....do...	♂ juv.	390	127	32	17	41	78	....
	5131	262	....do................	Oct. 14	♂ ad.	1,130	365	150	27	83	182	64
	2037	265	....do................	Oct. 17	♂ juv.	800	280	88	29	68	150	....
				1886.								
6785?	5394?	406	Beaver Creek, near Fort Verde, Arizona.	May 28	♀ ad.	1,080	365	155	35	85	185	42
2339	....	407	....do................	....do...	♂ juv.	340	97	.....	.....	.....	.....	.....
				1887.								
	2057	515	Verde River, at Fort Verde, Arizona.	Feb. 10	♀ ad.	1,132	385	153	35	85	182	46
	2036?	522	....do................	Feb. 21	♂ juv.	963	318	114	34	76	168	....
20751	35946	2118	San Pedro River, Sonora, Mexico.	1892.....	♀ ad.	950	334	127	25	84	176	32
20750	35883	2151	....do.[b].............	1892.....	♂ ad.	1,070	360	125	31	82	185	62

[a] All but the last two specimens are in the collection of the American Museum of Natural History.
[b] Type.

Family MURIDÆ.

RATS AND MICE.

Dentition.—I. $\frac{1-1}{1-1}$; C. $\frac{0-0}{0-0}$; P. $\frac{0-0}{0-0}$; M. $\frac{3-3}{3-3}=16$.

Skull with contracted frontals; a short and slender jugal, generally reduced to a splint between the zygomatic processes of the maxilla and squamosal; the lower root of the former process more or less flattened into a perpendicular plate; typically, the infraobital vacuity tall, and wide above and narrow below. Lower incisors compressed; no premolars; molars rooted, or rootless, tuberculate, or with angular enamel-folds. Pollex rudimental; tail generally nearly naked and scaly. (*Flower and Lydekker.*)

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INUNDATION AND SUBSTRATE STABILITY STUDY TO SUPPORT VERDE RIVER VEGETATION ANALYSIS

Prepared for:

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1. INTRODUCTION

1.1. Background

The Salt River Project (SRP) operates two dams on the Verde River (Horseshoe Dam and Bartlett Dam) to provide water to municipal and agricultural users in the area of metropolitan Phoenix (**Figure 1.1**). The effects of these dams on cottonwood-willow habitat for bald eagles, southwestern willow flycatchers, and yellow-billed cuckoos along the lower Verde River were discussed during approval of the Roosevelt Habitat Conservation Plan (RHCP), which is part of SRP's Incidental Take Permit (ITP) under Section 10 of the Endangered Species Act (ESA). More recently, SRP has initiated preparation of an ITP application for continued operation of Horseshoe and Bartlett Dams, and is evaluating several alternatives to modify the operation of the dams in order to create and maintain habitat for bald eagles, flycatchers and cuckoos. In addition, the indirect effects of alternative dam operations on Verde River reservoir levels and releases would be evaluated in the Environmental Impact Statement (EIS) that would be issued by the U.S. Fish and Wildlife Service (USFWS) on consideration of a Section 10 permit for Horseshoe and Bartlett Dams.

In order to evaluate the effects of the dams on woody riparian vegetation such as cottonwood-willow habitat, it is first necessary to quantify the effects of various dam operations on the frequency and duration of inundation of likely areas for the establishment and maintenance of the vegetation, and to determine the flows necessary to mobilize the channel bed and bar sediments that form the substrate for the vegetation. This information can then be used by plant ecologists to evaluate the likely effects of various dam operations on the establishment and maintenance of the vegetation.

1.2. Study Objectives and Scope of Work

Mussetter Engineering, Inc. (MEI) was retained by SRP to assist plant ecologists from ERO Resources Corporation (ERO) in addressing the issue of whether re-operation of the dams on the Verde River could significantly improve downstream conditions for establishment and maintenance of woody riparian vegetation. MEI's work involved assistance to ERO in selecting study sites for the analysis, preparation of one-dimensional (1-D) hydraulic models each of the three selected sites (Figure 1.1), and use of the models to evaluate the extent and frequency at which various geomorphic surfaces are inundated and the range of flows that are required to mobilize the sediment that makes up the in-channel bars and channel margins within the riparian zone. This information was then provided to ERO for use in their analysis of the vegetation.

Specific tasks that were carried out to meet the objectives of the study included the following:

1. An aerial reconnaissance of Verde River from the confluence with the Salt River to near the Verde River near Tangle Creek gage, upstream from Horseshoe Reservoir, was conducted on November 11, 2002, to observe the characteristics of the study reach and to select sites for more detailed study. Participants in the aerial reconnaissance included Craig Sommers and Liz Payson (ERO) and Bob Mussetter and Stuart Trabant (MEI).

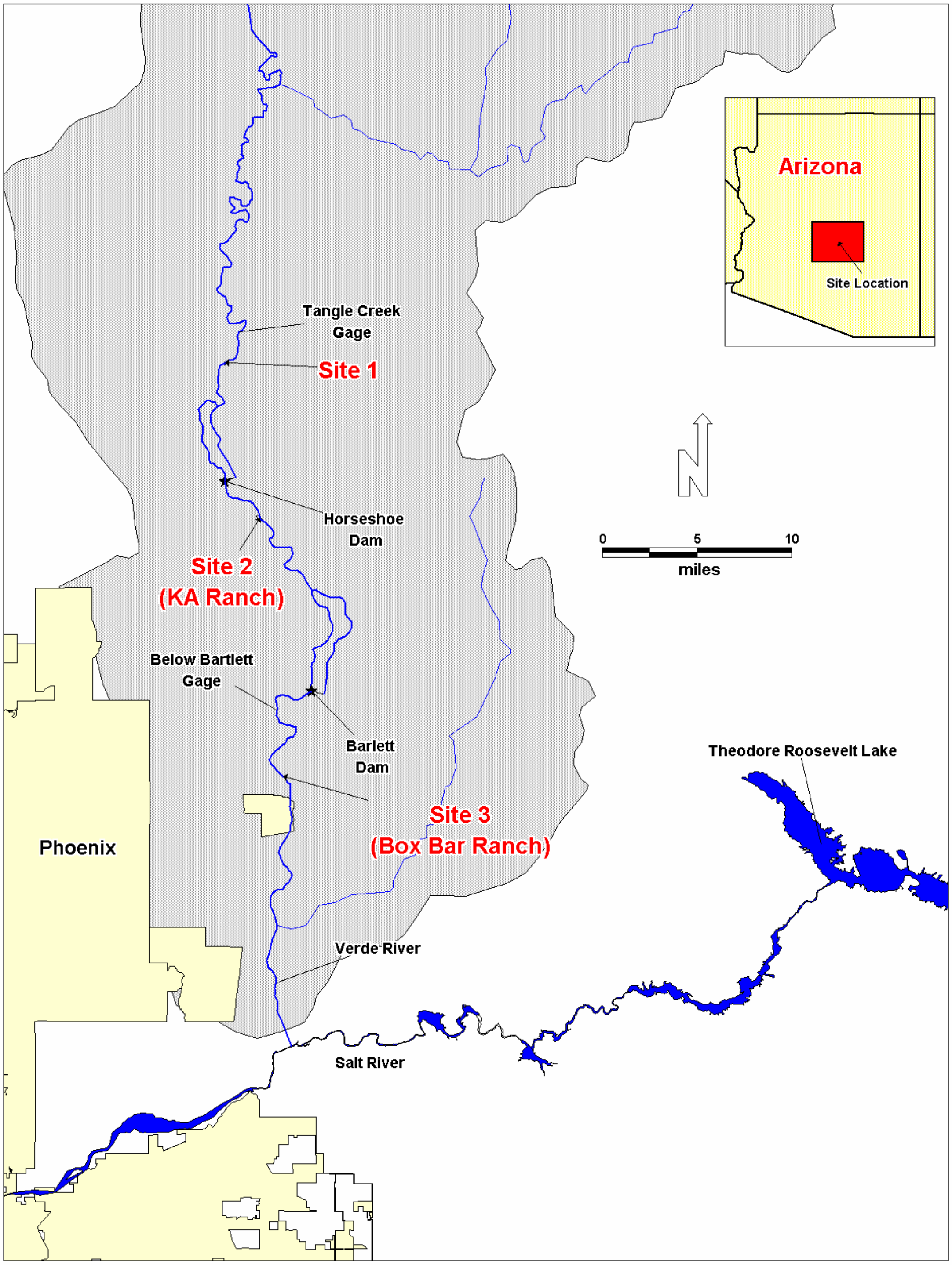


Figure 1.1. Location map.

2. A field visit to each of the three selected study sites was conducted on November 5 through 7, 2002, to lay out cross sections to be surveyed by SRP for use in the hydraulic modeling, to collect sediment samples of the channel bed and the various geomorphic surfaces at each site, and to make other general observations about the physical characteristics of the sites. The cross-section layouts and sediment sampling were performed by Bob Mussetter and Stuart Trabant.

3. Available hydrologic data for the study reach were obtained and reviewed.

4. Recorded hydrographs that could be used to evaluate the effects of operational changes on flood flows at each of the study sites were identified. These hydrographs were provided to SRP, who then used the RiverSim model to develop hydrographs that reflect the effects of the proposed operational changes.

5. One-dimensional (1-D) hydraulic models were developed for each of the study sites using cross-sectional data and aerial mapping that was provided to MEI by SRP, and the models were applied for the range of flows that occur in the observed and routed hydrographs.

6. Results from the hydraulic models were used to evaluate the:

   a. frequency and duration of inundation of various geomorphic surfaces along the river at each site, for each of the hydrographs, and

   b. range of flows necessary to mobilize the sediment that makes up the in-channel bars and channel margins within the riparian zone.

1.3. Authorization and Study Team

This work was performed by MEI under a contract with the Salt River Project Agricultural Improvement and Power District and Salt River Valley Water User's Association (referred to jointly as the SRP). SRP's Authorized Representative responsible for administration of the contract was Mr. Steve Doncaster, Senior Attorney. The Technical Coordinator for SRP was Craig Sommers of ERO. MEI's project manager was Dr. Bob Mussetter, P.E., and the following MEI staff contributed to the work:

- Dr. Mike Harvey, P.G., Principal Geomorphologist
- Mr. Gary Wolff, P.E. (CO), Senior Engineer
- Mr. Stuart Trabant, P.E. (CO), Project Engineer
- Ms. Jesa Lunger, E.I.T, Project Engineer
- Mr. Matt Iman, Graphics and GIS
- Ms. Bonnie Vail, Word Processing

2. PHYSICAL CHARACTERISTICS OF THE STUDY REACH AND STUDY SITES

2.1. General Characteristics of the Verde River

The Verde River heads in, and flows through, the highlands and valleys of central Arizona, and the physiography and geology of the region are transitional between the high elevation, relatively flat Colorado Plateau and the lower elevation Basin and Range province (Pearthree, 1996). Downstream of Big Chino Valley, in the reach of interest to this investigation, the Verde River is entrenched into a relatively narrow, deep canyon from upstream of Horseshoe Reservoir to just downstream of Bartlett Reservoir, where the valley bottom widens, and the river is less confined. The entrenchment of the Verde River through the project reach is due to downcutting through blocked basin outlets that commenced about 2 to 2.5 million years ago and has continued through the Quaternary (Pope and Péwé, 1973; Pope, 1974; Péwé, 1978, Pearthree, 1993; House and Pearthree, 1993).

The long period of downcutting by the Verde River has created a series of terraces that flank the river ranging in age from early-Pleistocene to late Holocene. In general, the older terraces are more erosion-resistant than the younger terraces (Pearthree, 1996). Long-term downcutting and the relative erodibility of pre-Quaternary bedrock and basin-fill units effectively control the extent and character of the Quaternary alluvial deposits and floodplain along the Verde River. Where the lithologies are more erosion-resistant, the river valley is steep and narrow with relatively limited amounts of alluvial storage in the valley bottom. In contrast, where the bounding lithologies are more erodible, the valley width is greater, the slope is flatter, and there is considerably more alluvial storage in the valley bottom (Pearthree, 1996). In common with most canyon-bound rivers, local constrictions and expansions in the valley cause localized accumulations of alluvial sediments (Graf, 1980; Webb et al., 1988; Lisle, 1986; O'Connor et al., 1986; Harvey et al., 1993).

The relative widths of the valley floor determine the geomorphic effectiveness of the large infrequent floods (>10-year recurrence interval) that tend to control channel form in arid regions (Baker, 1977; Wolman and Gerson, 1978; Graf, 1988). In confined reaches of the valley, there is little potential for lateral migration of the river; whereas, the lateral migration potential increases markedly where the valley is wider. In general, where the valleys are narrow and confined the large infrequent flood events tend to disturb most of the valley floor sediments, thereby eliminating, or significantly modifying, any vegetation that may have become established in the interflood period. In contrast, wider reaches tend to be depositional during infrequent flood events, and there is more of a tendency for the channels to relocate, in turn, causing disturbance to established plant communities.

2.2. Characteristics of Detailed Study Sites

During the field reconnaissance, three detailed study sites were selected from an approximately 15-mile long reach of the river that extended from about four miles downstream from Bartlett Dam to about three miles upstream from the head of Horseshoe Reservoir, with one site located upstream from Horseshoe Reservoir, one site between Horseshoe Dam and the head of Bartlett Reservoir, and the third site located downstream from Bartlett Dam (Figure 1.1). The sites were selected in relatively wide segments of the valley where the river is bounded by alluvium on at least one side, because the riparian zone in these areas is more likely to respond to changes in flow regime than in the more confined reaches. The study sites were selected to have similar geomorphic characteristics, to the extent possible, to provide a basis for evaluating effects of changes in flow regime resulting from the operation of the dams.

The upstream study site (Site 1), is located between the head of Horseshoe Reservoir and the USGS Verde River below Tangle Creek gage (USGS Gage 09508500). The middle site (Site 2), which is also referred to as the KA Ranch site, is located 1.7 miles downstream from Horseshoe Dam and a short just downstream from the mouth of Davenport Wash. The most downstream site (Site 3) is located about 2.3 miles downstream from Bartlett Dam and about 0.6 miles upstream from Box Bar Ranch. Aerial photographs at each site showing model cross sections and sediment sample locations are presented in **Figures 2.1 through 2.3**, respectively. Sites 1 and 2 are located in narrow reaches of the valley, and they have average slopes of 0.0027 (14 feet per mile) and 0.0041 (22 feet per mile), respectively, based on a longitudinal profile of the river that was developed from the USGS 7½" quadrangle maps (**Figure 2.4**). Site 3 is located in a wider reach of the valley and it has a slope of 0.0023 (12 feet per mile).

The following sections provide descriptions of the specific geologic, geomorphic and sedimentologic characteristics of the three sites.

2.2.1. Site 1: Upstream of Horseshoe Reservoir near Tangle Creek Gage

The width of the valley bottom at Site 1 is about 600 feet, and the site is bounded along the left side of the valley by a number of Holocene age terraces. In common with most dryland rivers, there is no defined floodplain between the terraces, and the area between the terraces is occupied by braided channels (Graf, 1988). Several older late- to mid-Pleistocene-age terraces are located father back from the river. The upstream portion of the right side of the valley is composed of pre-Quaternary basin-fill sediments, but the remainder of the right side of the valley is composed of coalesced late- to mid-Pleistocene age terraces and alluvial fans, and late-Holocene-age terraces (Pearthree, 1993). The active channel at this site is about 200 feet wide and flanked by narrow bands of riparian vegetation. In the lower two-thirds of the site, the active channel is flanked along the left bank by a very sparsely vegetated gravel-cobble bar that represents a high-flow chute-channel that is confined on its left margin by a Holocene-age terrace. In the upper third of the site, the chute channel is separated from the main channel by a relatively high-elevation vegetated bar (**Plate 1**). The downstream hydraulic control for the site is created by a constriction caused by the presence of erosion-resistant late- to mid-Pleistocene-age coalesced fans on the right bank, and a late-Holocene-age terrace on the left bank. Plots of the surveyed cross sections that were used in the hydraulic modeling, showing the geometry of the channel are included in **Appendix A**. (The locations of the cross sections are shown in Figure 2.1.)

Pebble counts (Wolman, 1954) were conducted at four locations within the site (Figure 2.1). Riffles in the main channel (WC7, WC9), a low-elevation, bank-attached bar (WC6) within the active channel and a higher-elevation braid bar (WC8) were sampled to characterize the surficial sediments at the site. The median sizes (D_{50}) in the riffles range from 124 to 81 mm, and the D_{84} (size for which 84 percent of the sample is finer) range from 123 to 196 mm (**Figure 2.5**). The low bar sample has a D_{50} of 49 mm, and the D_{50} of the high bar is 73 mm. The corresponding D_{84} values are 83 and 113 mm, respectively. The gradations shown in Figure 2.5 were used to identify the critical discharges (discharges at which the surface sediments are mobilized) for the identified surfaces throughout the site (refer to Chapter 5).

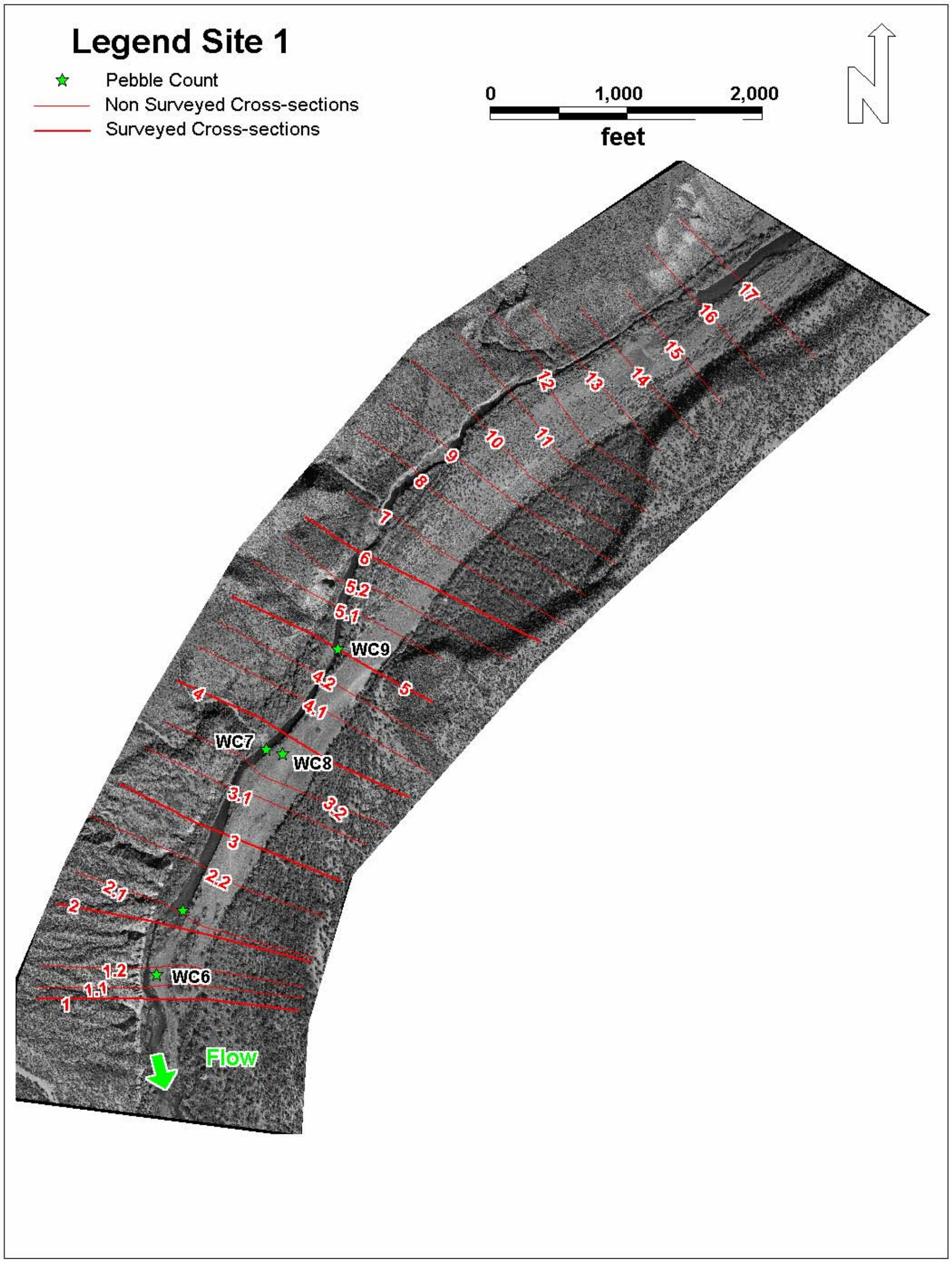


Figure 2.1. Aerial photograph of Site 1 showing the locations of surveyed cross sections and sediment samples.

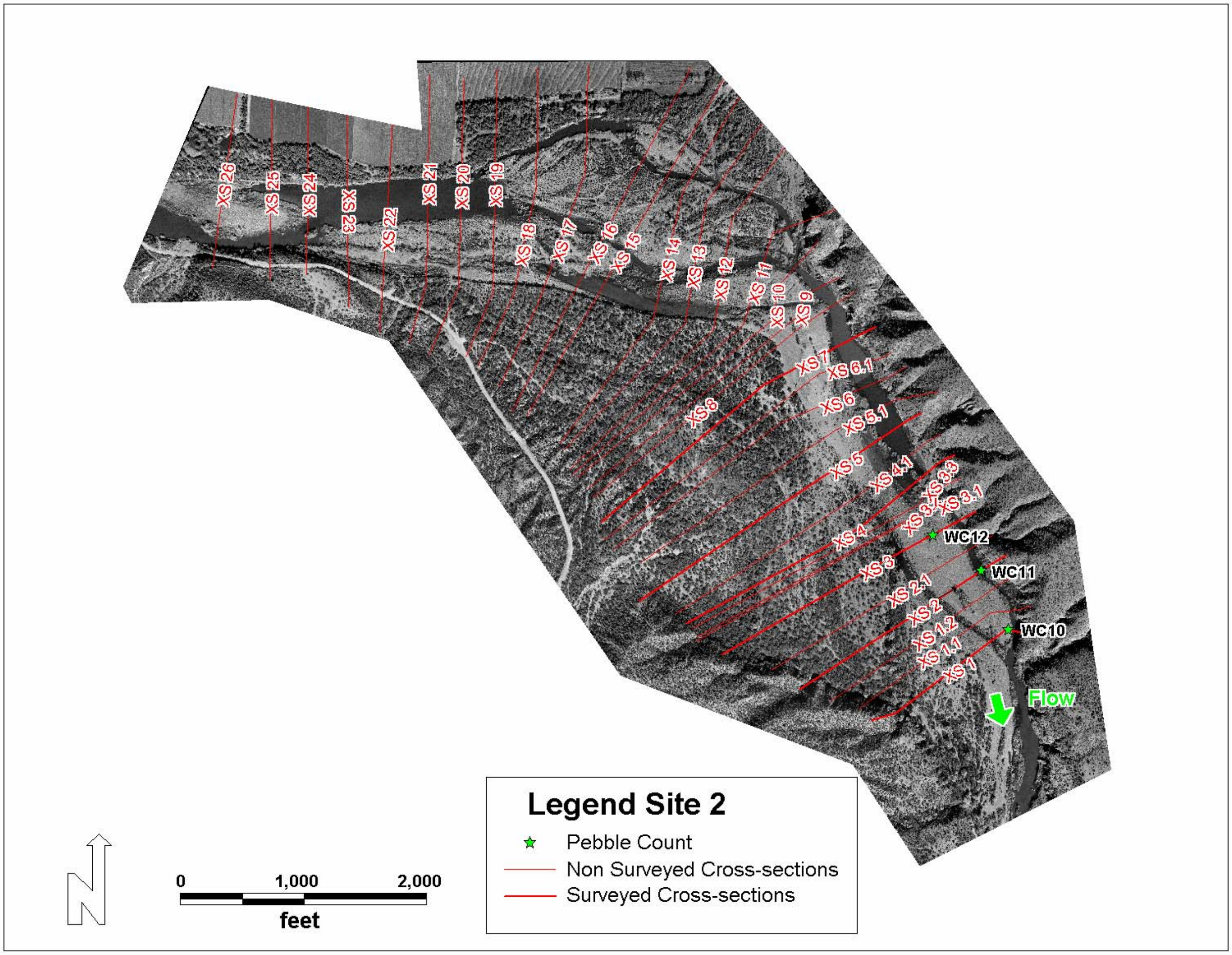


Figure 2.2. Aerial photograph of Site 2 showing the locations of surveyed cross sections and sediment samples.

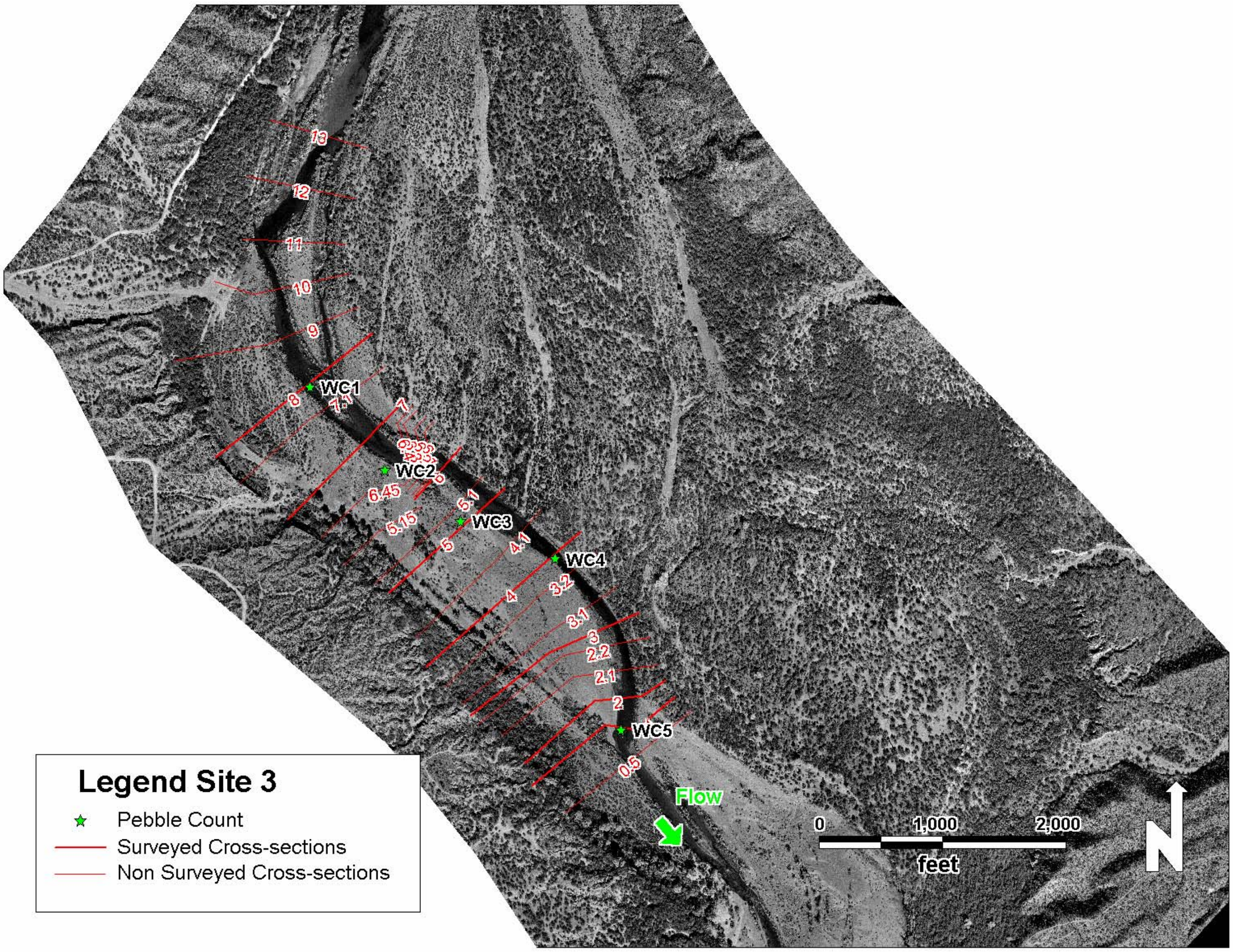


Figure 2.3. Aerial photograph of Site 3 showing the locations of surveyed cross sections and sediment samples.

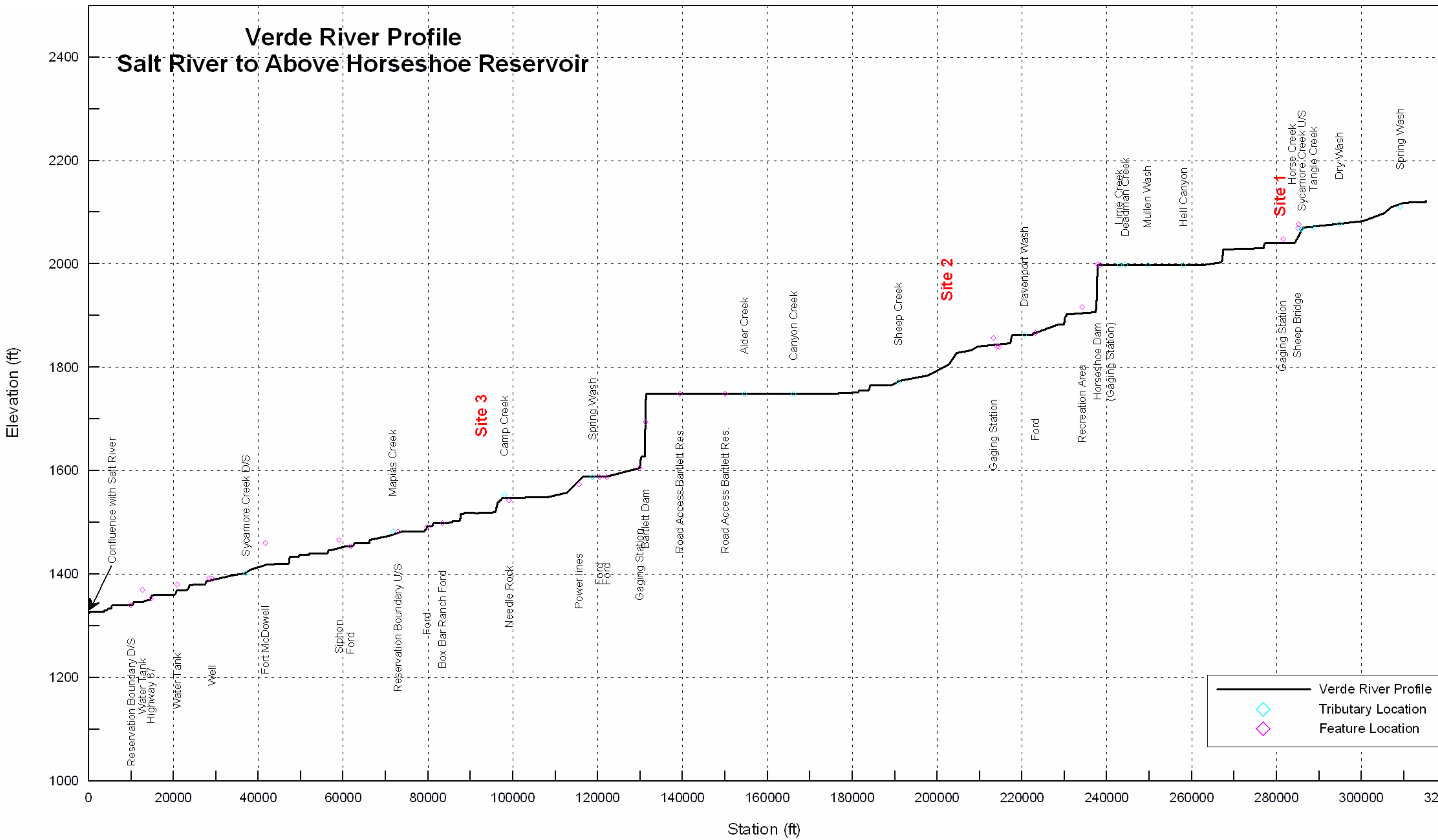
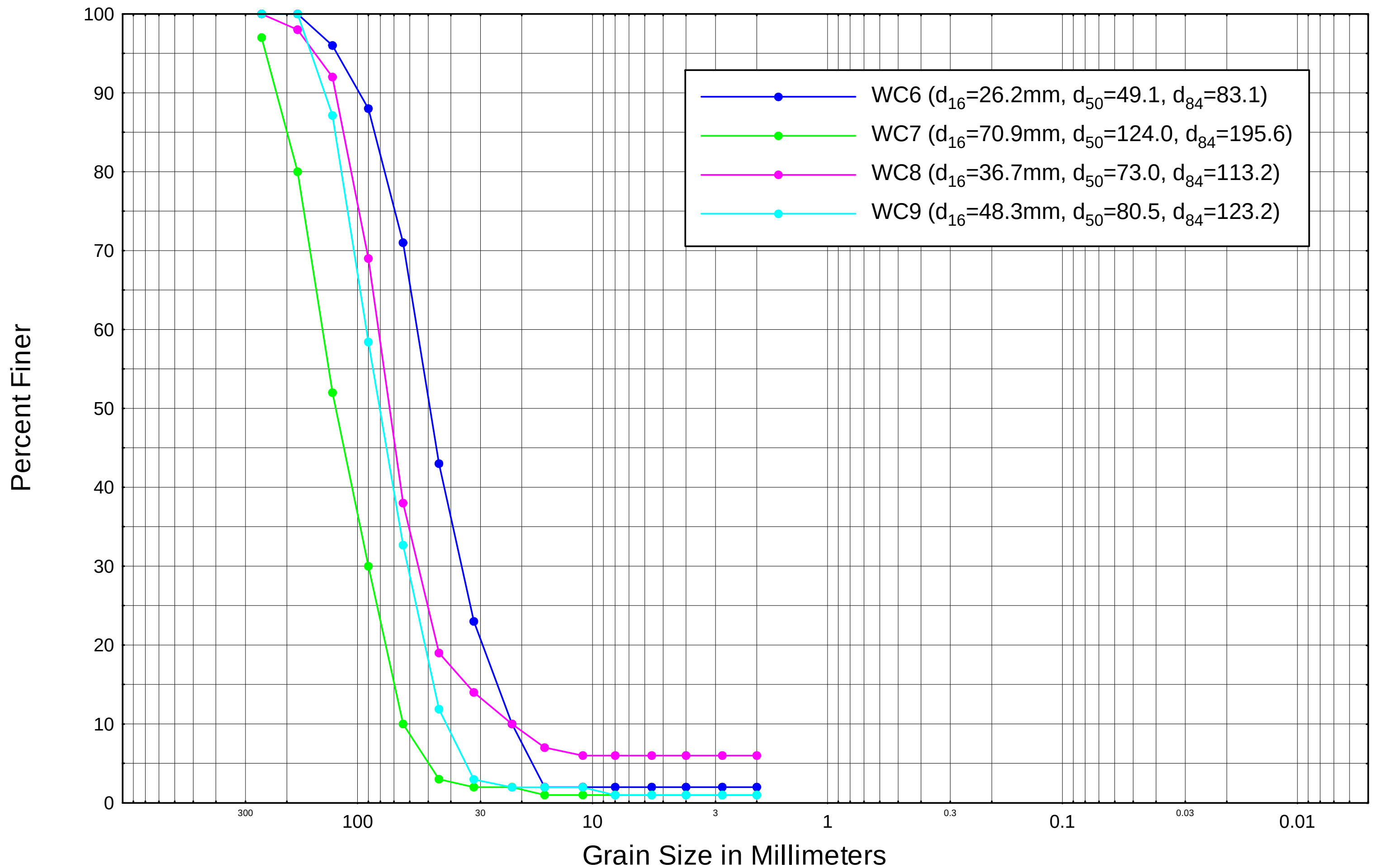


Figure 2.4. Longitudinal profile of Verde River from Salt River confluence to Tangle Creek gage showing the locations of the three studied sites.

Plate 1. View upstream of Site 1 located upstream of Horseshoe Reservoir. The chute channel that extends the length of the site during flood flows is clearly visible, as is the downstream hydraulic control for the site that is formed by old alluvial fans on the right bank and a Holocene terrace on the left bank.

Plate 2. View downstream of Site 2 located downstream of Horseshoe Dam. The left valley wall is composed of basin-fill sediments and the right valley wall is composed of alluvial fan and terraces sediments. The new chute channel, formed in the 1993-1995 floods and that is now flanked by riparian vegetation, can be seen in the lower left portion of the photograph.



BOULDERS	COBBLES	GRAVEL					SAND					SILT or CLAY
		VC	C	M	F	VF	VC	C	M	F	VF	

Figure 2.5. Grain-size distribution curves for four pebble counts that were conducted at Site 1.

2.2.2. Site 2: Downstream from Horseshoe Dam near the KA Ranch

Site 2 is located within a section of the Verde River valley that is about 2,000 feet wide (Figure 2.2**, Plate 2**). Within the site, the active channel width is about 450 feet. The site is located in a depositional zone upstream from a valley constriction, located about one mile downstream, that is caused by the presence of more erosion-resistant basin-fill outcrop on the right bank and older alluvial terraces and tributary fan sediments on the left bank. As is common in arid zone rivers, the braided channel occupies the active valley floor between the terraces and the fan, and therefore, there is no floodplain in the classic sense (Graf, 1988). Further enhancing the depositional nature of the site is the presence of two large tributaries that episodically deliver significant quantities of sediment to the river. Davenport Wash is located on the left bank at the upstream end of the site, and an unnamed arroyo is located on the right bank at the site. Sediments delivered by the right bank arroyo have formed a large alluvial fan that has prograded out onto the valley floor. The left valley wall throughout the site is composed of basin-fill sediments that also crop out on the right valley wall immediately downstream of the site. The right valley wall along most of the site is composed of old alluvial and fan sediments into which the present arroyo is inset. Morphologically, the site is characterized by an approximately 200-foot-wide low-flow channel that is fringed by riparian vegetation. A large, sparsely vegetated cobble-gravel bar separates the main channel from a chute channel that is located on the margin of the valley floor and runs along the base of the bounding alluvial fan and terraces for much of the length of the site. The active and chute channels are flanked by thin strands of riparian vegetation. The downstream hydraulic control for the site is created by a constriction caused by the presence of erosion-resistant late- to mid-Pleistocene-age, coalesced fans on the right bank, and an early Holocene-age terrace on the left bank. Plots of the surveyed cross sections that were used in the hydraulic modeling, showing the geometry of the channel are included in Appendix A. (The locations of the cross sections are shown in Figure 2.2.)

Pebble counts (Wolman, 1954) were conducted at three locations within the site (Figure 2.2). A riffle in the main channel (WC11), a low-elevation, bank-attached bar within the active channel (WC10) and a higher-elevation braid bar (WC12) were sampled to characterize the surficial sediments at the site (refer to Figure 5.2 for typical locations of bars). The median (D_{50}) and D_{84} sizes of the riffle sediments were146 and 231 mm, respectively (**Figure 2.6**). The low bar sample had a D_{50} of 73 mm, and the D50 of the high bar was 105 mm. The corresponding D_{84} sizes were 118 and 207 mm, respectively. The sediments that compose the riffle, low bar and high bar surfaces at this site are somewhat coarser than those on the corresponding surfaces at Site 1, but this is probably due to the steeper slope at Site 2, as well as the proximity of the two tributaries that are steeper than the mainstem.

2.2.3. Site 3: Downstream of Bartlett Dam near the Box Bar Ranch

Site 3 is located about 6.5 miles downstream from Bartlett Dam in a section of the Verde River valley that is about 4,000 feet wide (Figure 2.3, **Plate 3**). The active braided channel at the site is about 600 feet wide, and is flanked on the left side by the younger Lehi (Holocene) terrace that was overtopped by the large floods that occurred in the early part of the 20th century. The upper portion of the site is flanked by the older Lehi terrace, but the remainder of the site is flanked by both late- and early-Pleistocene age alluvial sediments that are dissected by a number of relatively small active arroyos. In common with most arid zone rivers, there is no floodplain in the classical sense (Graf, 1988). The older Lehi terrace was not overtopped by the large floods of the early part of the 20th century. The site is located in a depositional zone

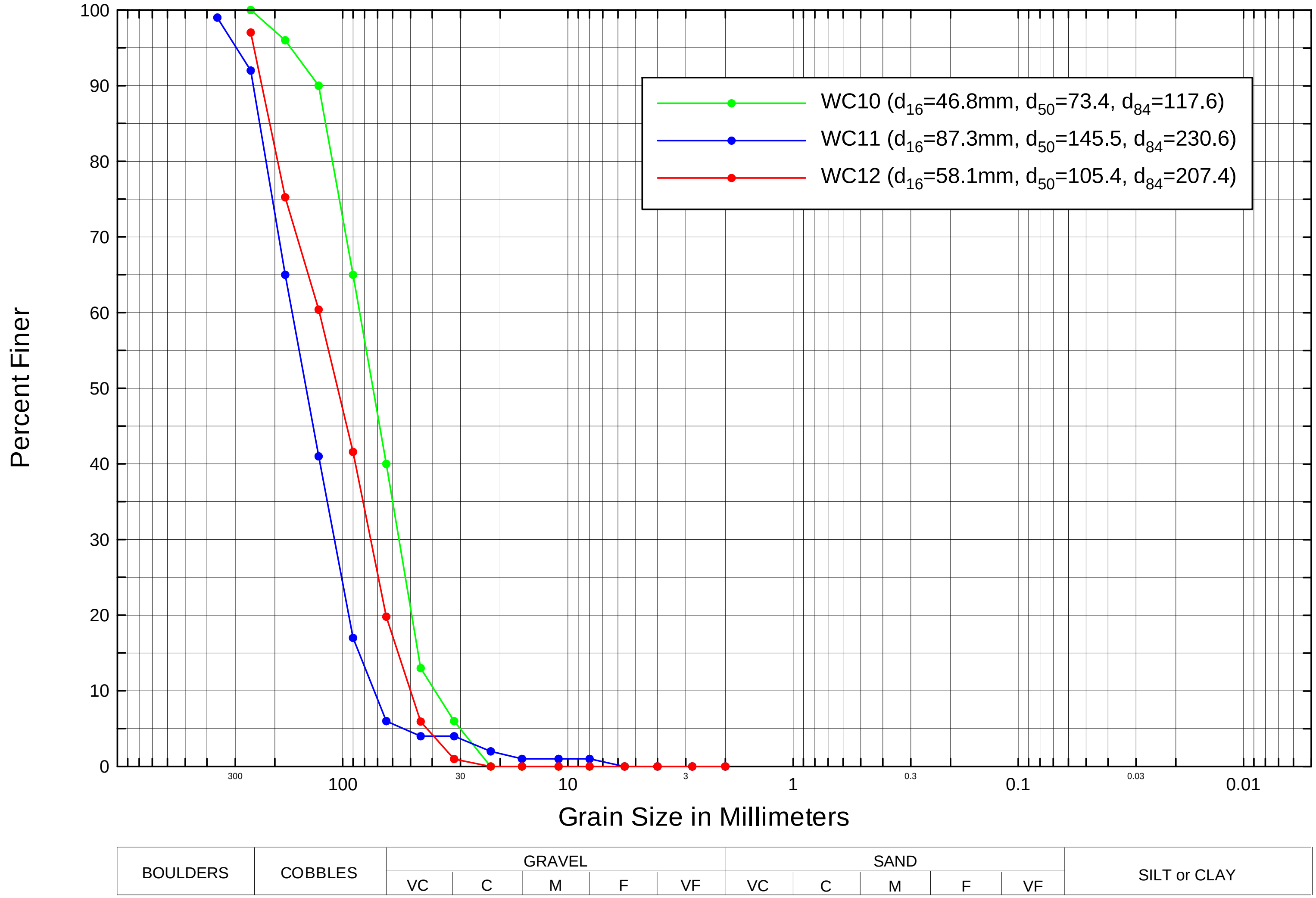


Figure 2.6. Grain-size distribution curves for three pebble counts that were conducted at Site 2.

Plate 3. View upstream of Site 3 in the upper part of the picture. The right valley wall is composed of old alluvial and fan sediments, and the left valley wall is comprised of the older and younger Lehi terraces. The larger cottonwoods are growing on the Lehi terraces. Younger riparian vegetation is located on the margins of the active and chute channels.

upstream of a valley constriction located about one mile downstream that is caused by the presence of more erosion resistant older alluvial deposits on the right bank and outcrop of the Needle Rock Formation on the left bank (Skotnicki, 1996). Morphologically, the site is characterized by an approximately 500-foot-wide active channel that that is separated from a chute channel that runs along the left side of the site for most of its length by a sparsely vegetated gravel-cobble bar. The active and chute channels are flanked by thin strands of riparian vegetation. Plots of the surveyed cross sections that were used in the hydraulic modeling, showing the geometry of the channel are included in Appendix A. (The locations of the cross sections are shown in Figure 2.3.)

Pebble counts (Wolman, 1954) were conducted at five locations within the site (Figure 2.3). Riffles in the main channel (WC1, WC4, WC5), a low-elevation bar (WC3) and a higher-elevation bar (WC2) were sampled to characterize the surficial sediments at the site. The median sizes (D_{50}) of the riffles ranged from 61 to 98 mm, and the D_{84} sizes range from 121 to 164 mm (**Figure 2.7**). The low bar sample has a D_{50} of 54 mm, and the high bar value is 67 mm. The corresponding D_{84} values are 107 and 121 mm, respectively.

2.3. Historical Changes

In arid climates and canyon-bound rivers, most change in river characteristics is driven by relatively infrequent floods (>10-year recurrence interval, Baker, 1977; Wolman and Gerson, 1978). Paleoflood studies of the Verde River (Ely and Baker, 1985; O'Connor et al., 1986) have identified a number of very large floods within the last 1,000 years, the largest of which may have been on the order of 195,000 cfs (House et al., 1995). In more recent times, the largest flood appears to have been that of 1891 (about 150,000 cfs), but the floods of 1993 were comparable in size (House et al., 1995). Other large floods that have occurred on the Verde River include a number in the early part of the 20th century before Bartlett Dam was constructed in 1939 (1906—96,000 cfs, 1920—95,000 cfs, 1927—70,000 cfs, and 1938—100,000 cfs. The next large flood occurred in 1952 (81,600 cfs) after the construction of Horseshoe Dam in 1946, and then there was a period of relatively low flood peaks until 1978 (91,400 cfs), 1979 (94,000 cfs) and 1980 (94,800 cfs). Large floods again occurred in 1993 (145,000 cfs) and 1995 (108,000 cfs). The presence of the dams had relatively little effect on the magnitude of these very large flood flows (refer to Figure 5.3).

Flood-driven changes at the three sites can be evaluated by examining a series of aerial photographs. Photography was available for 1934, 1953, 1967, 1976, 1980, 1988, 1992, 1997, and 2002. A discussion of changes at each of the sites follows.

2.3.1. Site 1: Upstream of Horseshoe Reservoir near Tangle Creek Gage

Although the quality and resolution of the aerial photographs is variable, it appears that the major change that has taken place episodically between 1934 and 2002 has been in the density of the vegetation in the upper portions of the chute channel that extends the length of the site (Figure 2.2 and Plate 1). Following the floods of 1906, 1920 and 1927 [recurrence intervals (RI) ranged from 10 to 18 years]; the 1934 photographs indicate there was very little vegetation growing in the active portion of the channel between the heavily vegetated bounding terraces. By 1953, following the 1952 flood (15-year RI), there appears to have been some vegetation establishment at the downstream end of the high bar surface that separates the main channel from the chute channel (Cross Sections 5 and 6, Appendix A). The 1968 photograph shows a significant increase in vegetation on the bar surfaces, which can probably be attributed to the

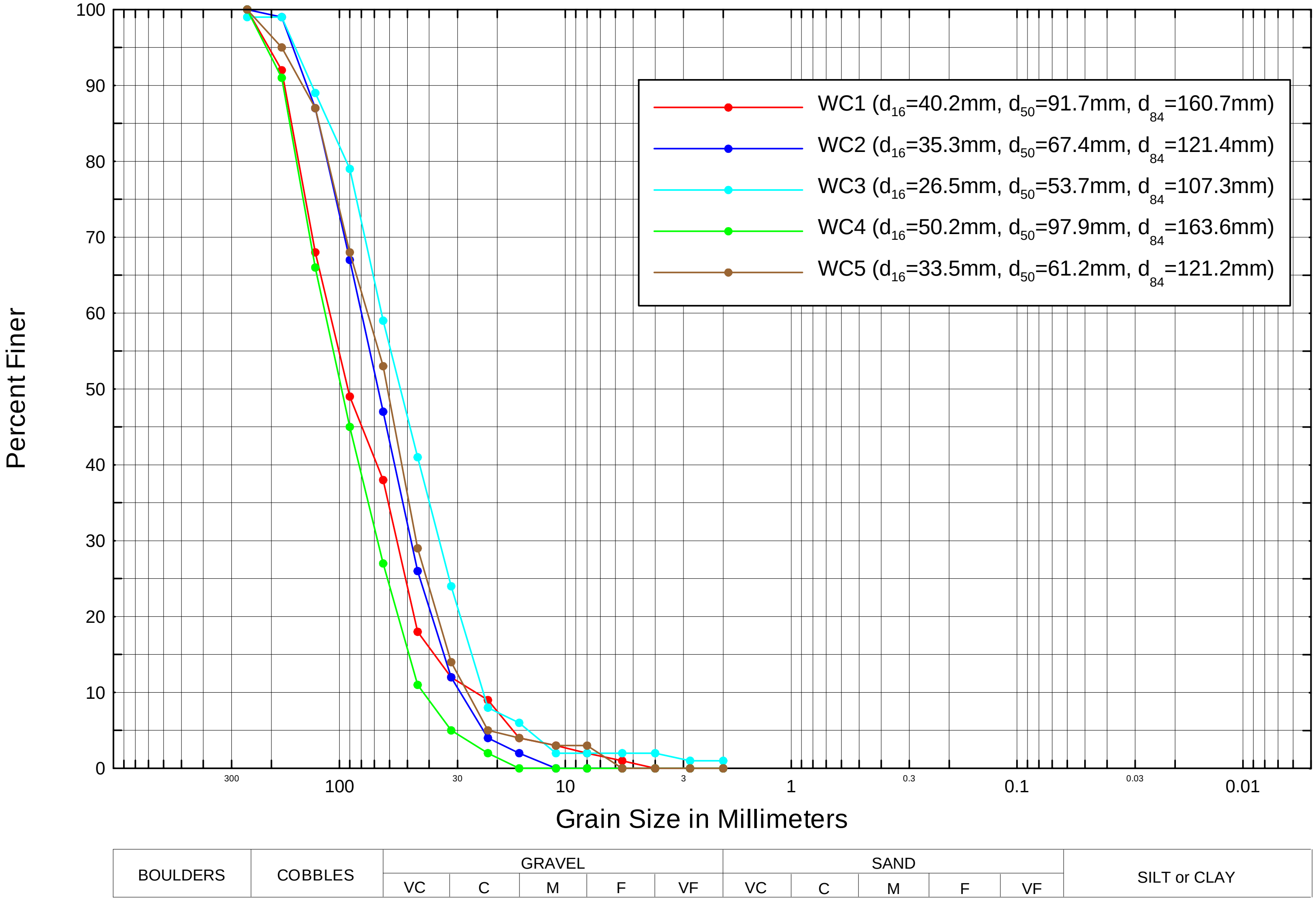


Figure 2.7. Grain-size distribution curves for five pebble counts that were conducted at Site 3.

absence of significant floods since 1952. Following the floods of 1978, 1979 and 1980 (RI 16 through 18 years), the 1980 photograph shows very little vegetation in the active channel. Between 1980 and 1992, there were no significant floods and the amount of vegetation increased. Following the floods of 1993 (>50-year RI) and 1995 (25-year RI), the vegetation in the chute channel and the upstream portion of the bar was stripped, but the vegetation on the high-bar surface separating the main channel and the chute channel persisted, which suggests that even a 50-year flood has little impact on the higher elevation portions of the active channel. The 2002 photographs indicate that the vegetation is returning to the bar surfaces. The general pattern of vegetation encroachment between large flood events and removal during floods is most likely attributable to the relatively confined nature of the site and the resulting high energy during large flood events (Friedman and Auble, 1999).

2.3.2. Site 2: Downstream of Horseshoe Dam near the KA Ranch

The 1934 photographs show sparse vegetation cover within the margins of the active channel. The channel appears to have been modified by the floods of 1906, 1920 and 1927. A large chute channel formed on the right side of the active channel near the middle of the site where a large mid-channel bar formed in the main channel, and this chute channel persisted through the period of record. Some vegetation survived the floods on the margins of the right bank arroyo fan. The 1953 photographs show that there was a general increase in vegetation over the entire site, but the highest density of vegetation was located along the chute channel. By 1967, vegetation cover had further increased across the site, especially in the chute channel. The chute channel is the location of the highest density of large cottonwoods in the 1976 photographs. The sequence of floods in 1978, 1979 and 1980 removed the large, vegetated mid-channel bar at the head of the chute channel, and also removed most of the riparian vegetation along the channel margin, but the heavily vegetated chute channel persisted. The floods of 1993 and 1995 caused a shift in the location of the main channel at the head of the site and created a new chute channel on the right side of the main channel towards the downstream end of the site. The 2002 photography shows that riparian vegetation has become established along the margins of the new chute channel. The abandoned portion of the channel at the mouth of Davenport Wash is a likely site for new vegetation to establish during the post-1993 through 1995 flood period. The general patterns of vegetation encroachment between floods and vegetation removal along the channel margins during the floods is very similar to that observed at the above-Horseshoe Dam site, and probably reflects the relatively minor effect of Horseshoe Reservoir on flood-flow magnitudes.

2.3.3. Site 3: Downstream of Bartlett Dam near the Box Bar Ranch

The 1934 photography shows that there had been significant disturbance of the site, most probably as a result of the large floods in the early part of the 20th century. Areas mapped as the older Lehi terrace (Skotnicki, 1996) do not appear to have been overtopped, but the younger Lehi terrace was overtopped and is devoid of vegetation. Large chute channels were present on the east side of the upper portion of the site, and around the higher Lehi terrace towards the bottom of the site. The main channel was located along the west side of the site. By 1953, vegetation had reestablished on the younger Lehi terrace and in the chute channels around both the younger and older Lehi terraces. The 1967 and 1976 photographs show a progressive increase in vegetation at the site. Following the floods of 1978, 1979 and 1980, the chute channels around the younger Lehi terrace on the east side of the river were reactivated, and the vegetation was stripped from them and on parts of the terrace surface, as well. Although flow entered the chute channel to the east of the higher Lehi terrace, it did not appear to remove any vegetation, and in fact this old flow path appears to be the location of the most vigorous vegetation growth. The apex of the bend on the west side of the site chute cut-off, and displaced the main channel farther to the east. The 1988 and 1992 photographs show that vegetation density increased throughout the site. The 1997 photographs show that, following the large floods of 1993 and 1995, the chute channels on the east side of the younger Lehi terrace were reactivated in the floods, but very little other change took place within the site. The 2002 photographs show recolonization of the site by vegetation. The cutoff bar apex along the western margin of the site has been vegetated and stabilized.

The vegetation and morphological changes through time at the site may be related to the effects of the upstream dam on the frequency of morphogenetically significant events (**Figure 2. 8**), as well as by the fact that the earlier part of the 20th century was wetter than the latter part. Prior to construction of Bartlett Dam, inundation of portions of the younger Lehi terrace probably occurred with a frequency of about 2.5 to 3 years at a discharge of about 20,000 cfs. In the post-Bartlett period, the same flow has a recurrence interval of about 7 years. Review of the flow records at the Bartlett gage indicates that, between 1942 and 1965, the largest peak flow was less than 10,000 cfs. The aerial photography demonstrates that during this 23-year period, vegetation became well established in areas of the site that were obviously disturbed in the 1934 photographs of the site. In contrast, at the Tangle Creek gage, there were six floods in excess of 20,000 cfs in the same time period. Between 1965 and 1977, there were no flows in excess of 15,000 cfs below Bartlett Dam. Cumulatively, the three floods of 1978, 1979 and 1980 caused significant morphological and vegetation changes at the site, but these flood magnitudes ranged between 75,800 and 101,000 cfs (15- to 50-year RI). Hydraulic modeling of the site indicates that, at a discharge of 100,000 cfs about 20 percent of the total flow is being conveyed in the left overbank and flows in this range are, therefore, capable of effecting change. In contrast, at a discharge of 50,000 cfs, less than 10 percent of the total flow is being conveyed in the left overbank, and hence, there is a much lower potential for change. The large floods of the late 1970s were again followed by a period of 12 years (1981 through 1992) when the maximum flow was less than 17,000 cfs below Bartlett Dam, but 6 events exceeded 20,000 cfs at the upstream gage in the same time period. The 1993 (84,700 cfs) and 1995 (64,100 cfs) floods, with recurrence intervals of 11 and 18 years, respectively, caused very little change at the site, probably because of the extent of the vegetation that has become established since the dam was constructed, due to the infrequent disturbance of the site in the post-dam period.

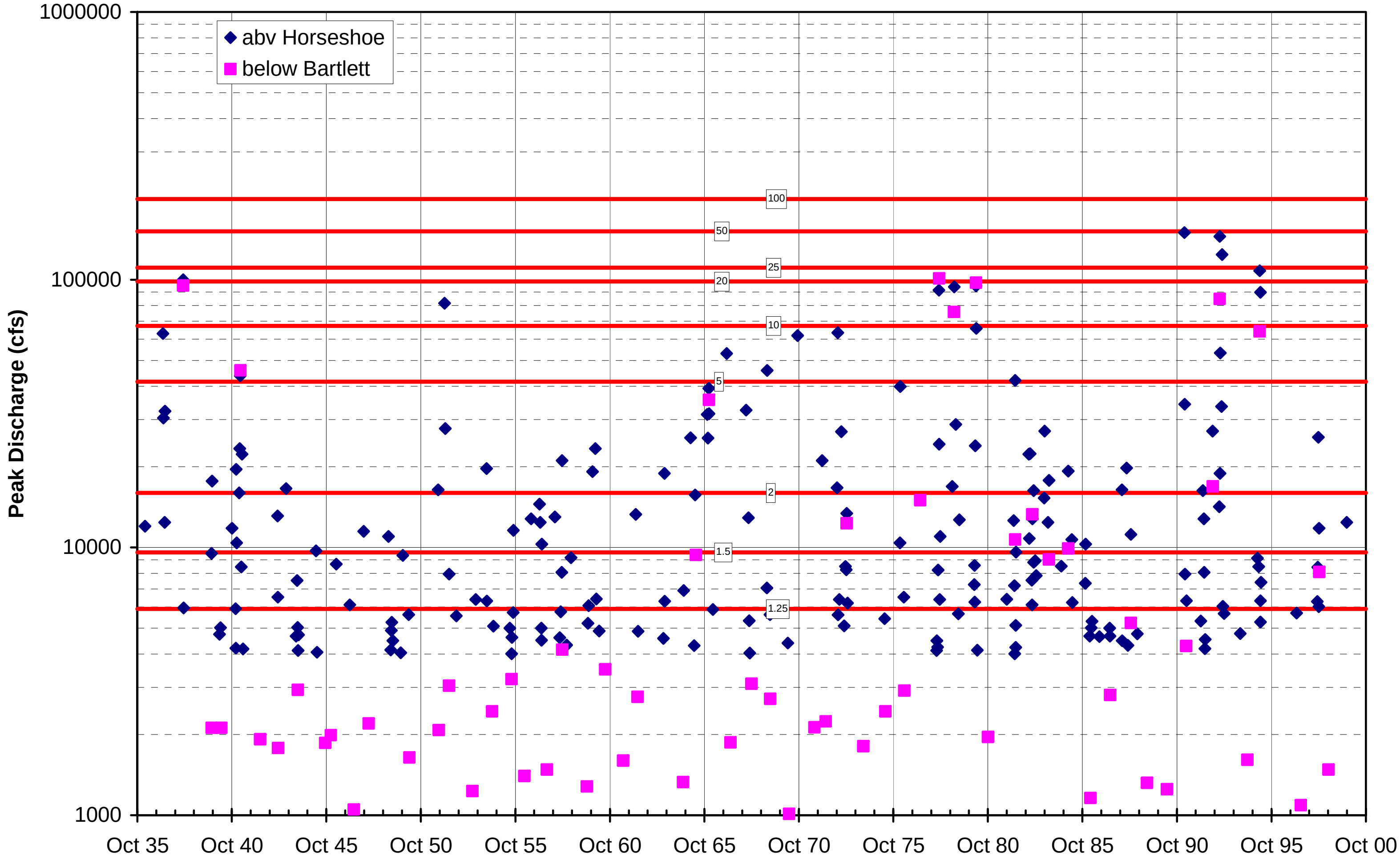


Figure 2.8. Annual flood peaks for above Horseshoe (Gage No. 0908500) and below Bartlett (Gage No. 09510000) gages. Also shown are the above Horseshoe gage flood frequencies.

3. HYDROLOGY

3.1. Descriptive Hydrology

The Verde River is a perennial stream that drains an approximately 6,600-square-mile area of north-central Arizona, joining the Salt River just east of Phoenix (**Figure 3.1**). Elevations within the drainage basin range from over 7,000 feet in the high country near the headwaters to about 1,300 feet at the confluence. Due to its large size, the drainage basin encompasses several different climatic regimes which vary with elevation. The lower portion of the basin, including the study sites, lies in the semi-arid Sonoran Desert. Flows in the river are affected by two periods of moderately heavy precipitation that typically occur during winter and in late summer. Winter precipitation generally results from large-scale cyclonic storms that originate in the Pacific Ocean. Long, steady rains resulting from these storms produce the largest floods on the Verde River because they are sufficiently wide-spread to cover significant portions of the drainage basin, including both low- and high-elevation areas (Graf, 1983). In fact, the largest floods of record (greater than 80,000 cfs) have all occurred in the November through March time-period (**Figure 3.2**). The intense summer thunderstorms are more localized and do not generally result in significant flooding in basins as large as the Verde River (Ely and Baker, 1985).

Flow regulation by Horseshoe and Bartlett Dams alters the flow regime of the lower Verde River. These dams are part of the SRP and are operated to provide water to municipal and agricultural users in the metropolitan Phoenix area. Bartlett Dam began regulating flows in February 1939 and Horseshoe Dam was closed in November 1945. Recent modifications to both dams have been made to address dam-safety issues. The total storage capacity behind Horseshoe Dam is currently about 109,000 ac-ft and the total storage capacity behind Bartlett Dam is currently about 178,000 ac-ft. The combined capacity of the two dams represents about two-thirds of the average annual flow in the Verde River.

3.2. Analysis of Gage Records

Two U.S. Geological Survey (USGS) stream gages are present in the project reach. The Verde River below Tangle Creek above Horseshoe Dam gage (USGS Gage 0908500) is located above both reservoirs, and immediately upstream from Site 1, the most upstream study site (Figure 1.1). Although flows at the this gage are altered somewhat by upstream irrigation and a power plant that is located about 32 miles upstream, the effects are relatively minor, particularly during high flows that are important to channel morphology. The gage, therefore, provides a good representation of natural flow conditions in the project reach. Mean daily flow records for the Tangle Creek gage extend from 1945 to the present, and a record of peak flows is available for 1891, 1906, 1916, 1920, and 1925 to the present.

The Verde River below Bartlett Dam gage (USGS Gage 09510000,) is located about 1.8 miles upstream from Site 3 (Figure 1.1). The mean daily flow record at this gage extends from 1904 to the present, and the peak discharge records include the post Bartlett Dam period (1938-present). The portion of the record after closure of Horseshoe Dam in November 1945, therefore, represents the altered flow regime at the downstream study site resulting from the operation of both dams.

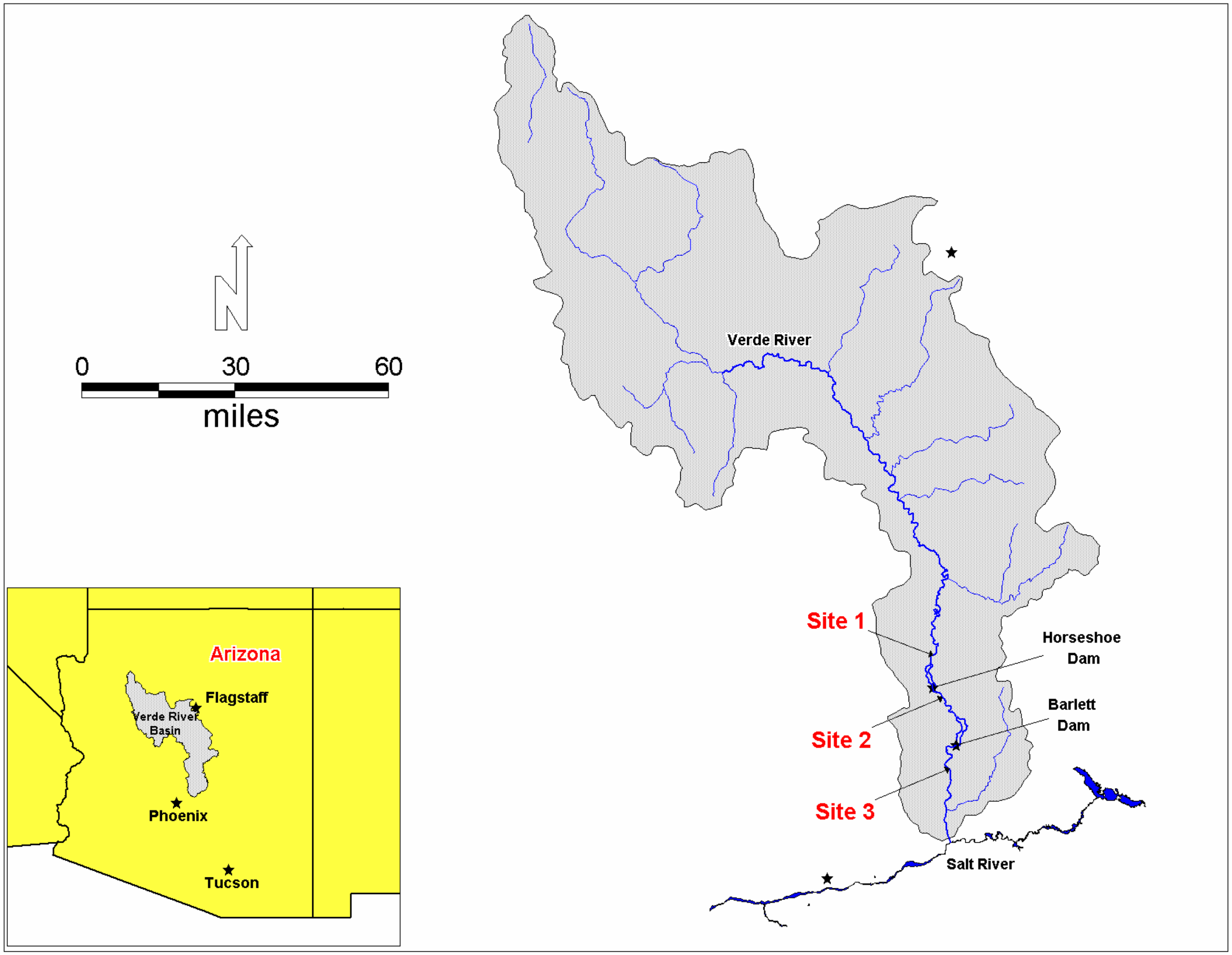


Figure 3.1. Map showing the Verde River drainage basin.

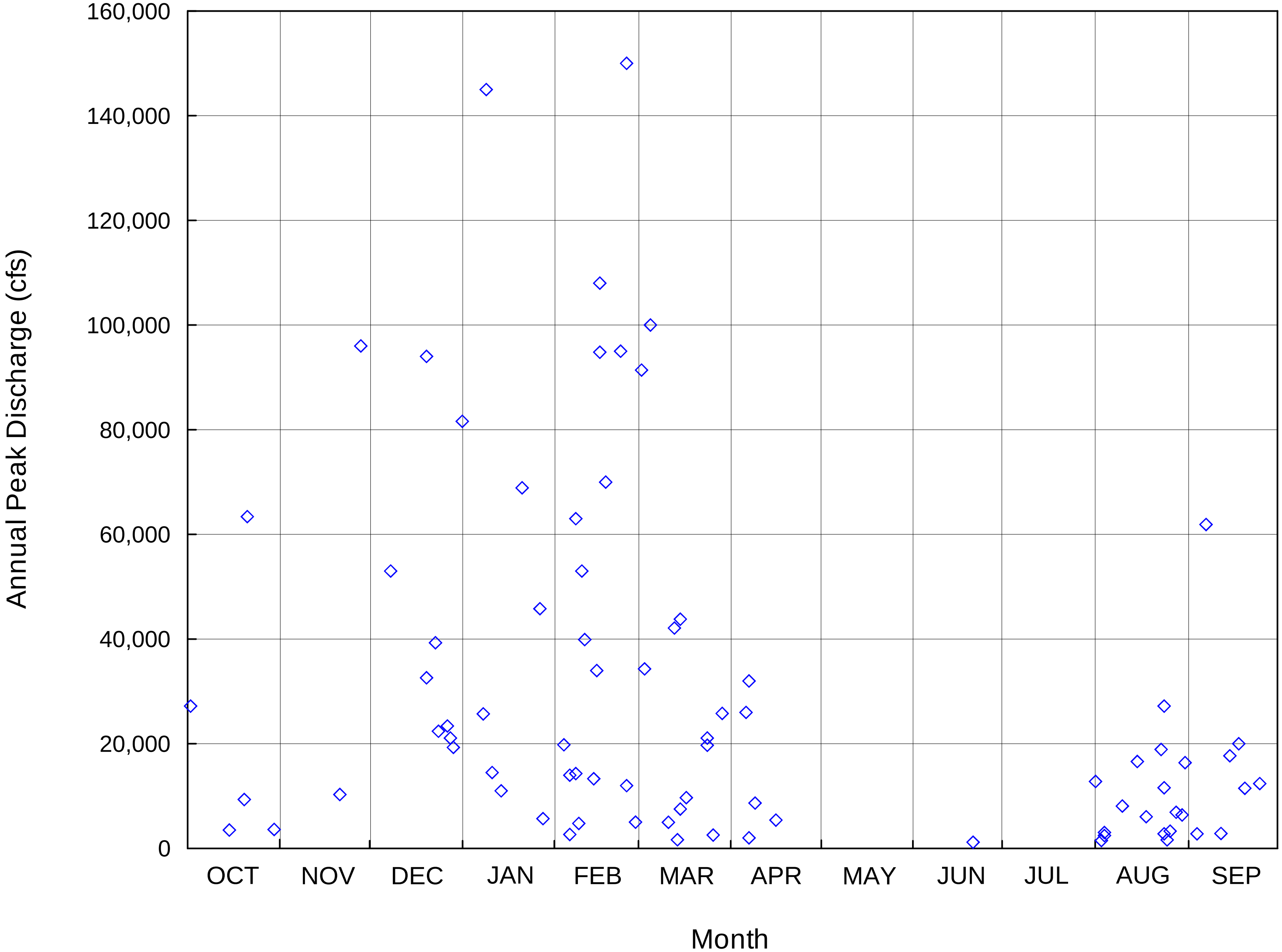


Figure 3.2. Magnitude and day-of-the-year of recorded annual peak flows at the Verde River below Tangle Creek above Horseshoe Dam stream gage (USGS Gage 0908500).

The records at both gages show significant variability in annual peak flows, with peaks ranging from 1,500 cfs (August 1974) to 150,000 cfs (February 1891, estimated value; 145,000 cfs in January 1995 is largest recorded value) at the Tangle Creek gage, and from 905 cfs (December 1995) to 101,000 cfs (March 1978) at the "below Bartlett" gage (**Figure 3.3**). Peak flood-frequency estimates made by the USGS (1998), and confirmed by MEI for this study using the procedures outlined in Water Resource Council (WRC) Bulletin 17B (WRC, 1981) indicate that the 2-, 10- and 100-year peak discharges are about 16,000, 67,300, and 200,300 cfs, respectively (**Figure 3.4**). It should be noted that the data used by both the USGS (1998) and by MEI for this study to confirm the USGS results included estimated historical flood peaks from the paleoflood study of Ely and Baker (1985).

Although the post-dam annual peak flow record (1946 through 2002) at the "below Bartlett" gage does not fit the standard Log-Pearson Type III frequency distribution on which the Tangle Creek frequency curve is based, comparison of the relationships indicated by the relative plotting position of the individual data points shows that the magnitude of the more frequent flood events (i.e., less than about the 10-year flood) has decreased significantly since construction of the dams (**Figure 3.5**). The 2-year flood, for example, decreased from 16,000 cfs to about 2,500 cfs and the 5-year flood decreased from 41,600 cfs to about 11,000 cfs.

Mean daily flow-duration curves were developed for the post-dam period for both gages to assist in evaluating the effects of the dams on the non-flood flow regime at the sites (**Figure 3.6**). These curves indicate that the dams tend to decrease the duration of flows in the range above about 1,400 cfs and below about 210 cfs. Conversely, the duration of flows between 210 and 1,400 cfs is significantly increased. It is interesting to note that the average annual flow volume past these gages during the 57-year period from 1946 through 2002 period was nearly the same (about 410,000 ac-ft at Tangle Creek versus 413,000 ac-ft below Bartlett). On a year-by-year basis, however, the annual flows at the two gages varied significantly with a 56-percent decrease from the Tangle Creek gage to the below Bartlett gage in 1970 to a 76-percent increase between the two gages in 2002. The largest difference, on a percent basis, tends to occur during low-flow years. On a seasonal basis, flows downstream from the dams tend to be lower during winter and early spring (December through April), higher during late-spring and summer (May through August), and about the same during the fall months, compared to the flows upstream from the reservoirs (**Figure 3.7**).

3.3. Operational Scenarios

To assist in evaluating whether or not reservoir operations could be modified in a way that would potentially increase the amount of woody riparian vegetation that provides suitable habitat for the bald eagles, southwestern willow flycatchers, and yellow-billed cuckoos, hydrographs for a range of historic floods were evaluated for three basic reservoir-operational scenarios, as follows:

Alternative 1 - Historical Operation,
Alternative 2 - No Permit alternative, and
Alternative 5 - Mimic Natural Hydrograph alternative.

*The alternative numbers correspond to a numbering system that has been used by SRP and ERO to evaluate a broader range of alternatives than were specifically considered in this analysis.

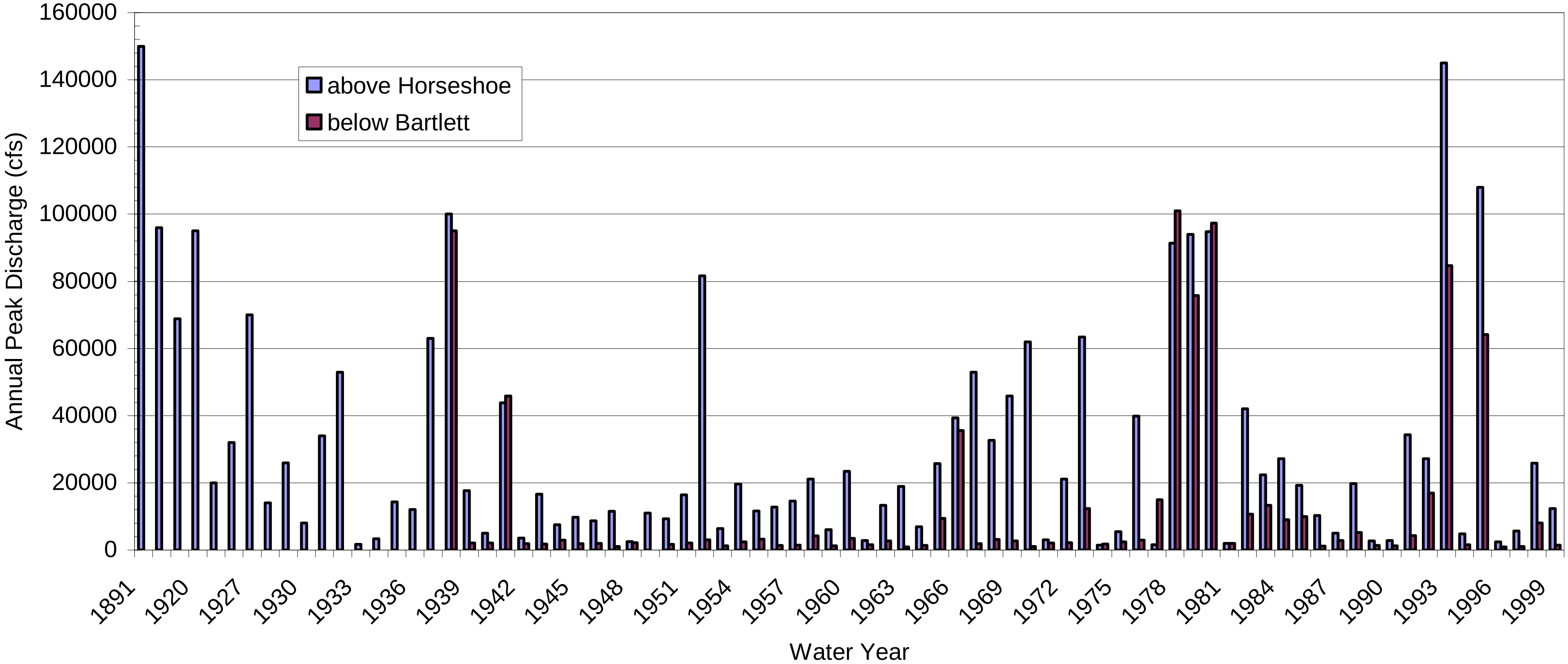


Figure 3.3. Recorded annual peak flows at the Verde River below Tangle Creek above Horseshoe Dam stream gage (USGS Gage 0908500) and the Verde River below Bartlett Dam gage (USGS Gage 09510000). The four historical peaks prior to 1925 at the Tangle Creek gage are estimated values (Ely and Baker, 1985).

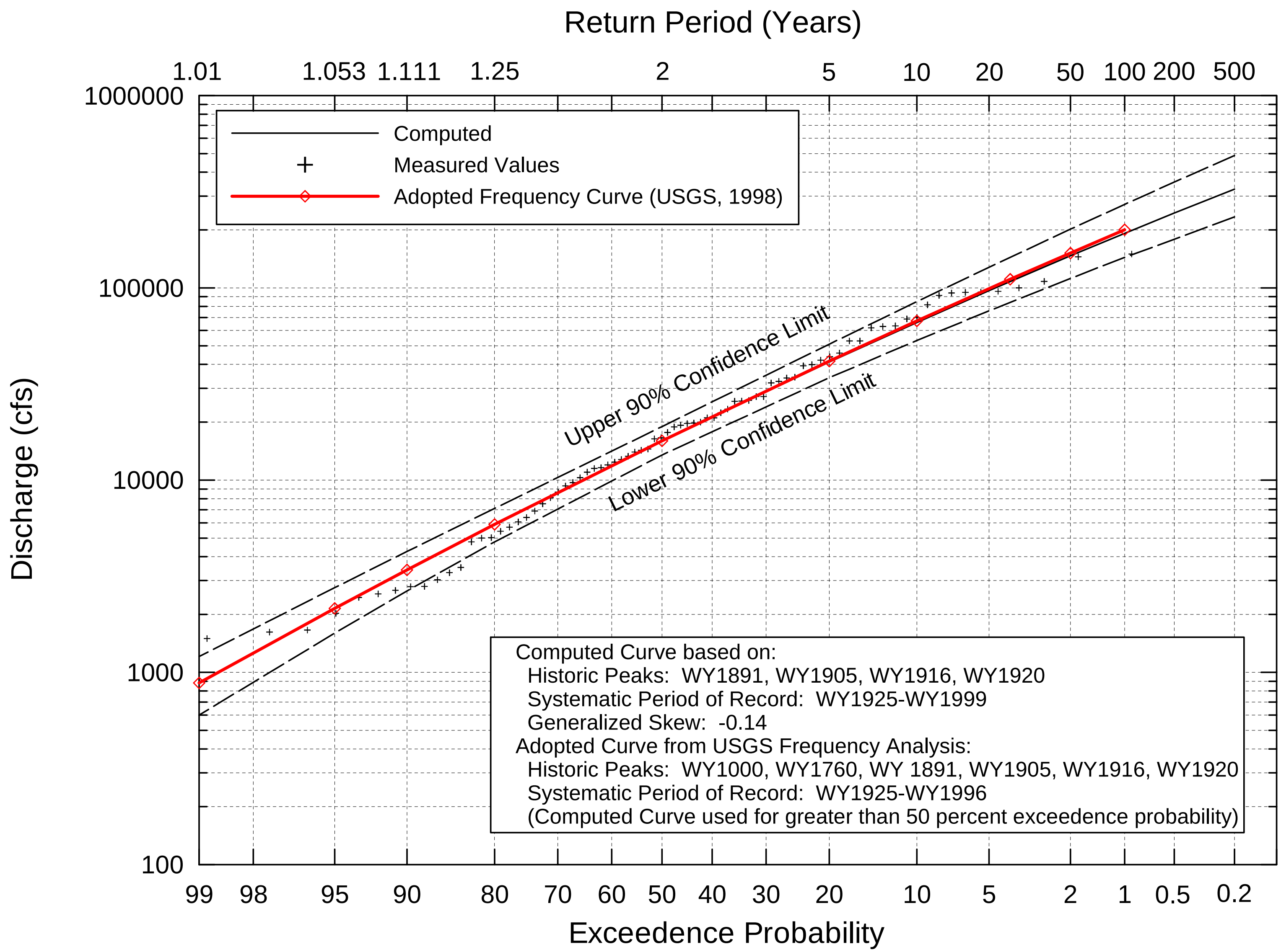


Figure 3.4. Recorded peak flows and estimated flood frequency curves for the period of record at the Verde River below Tangle Creek above Horseshoe Dam stream gage (USGS Gage 0908500).

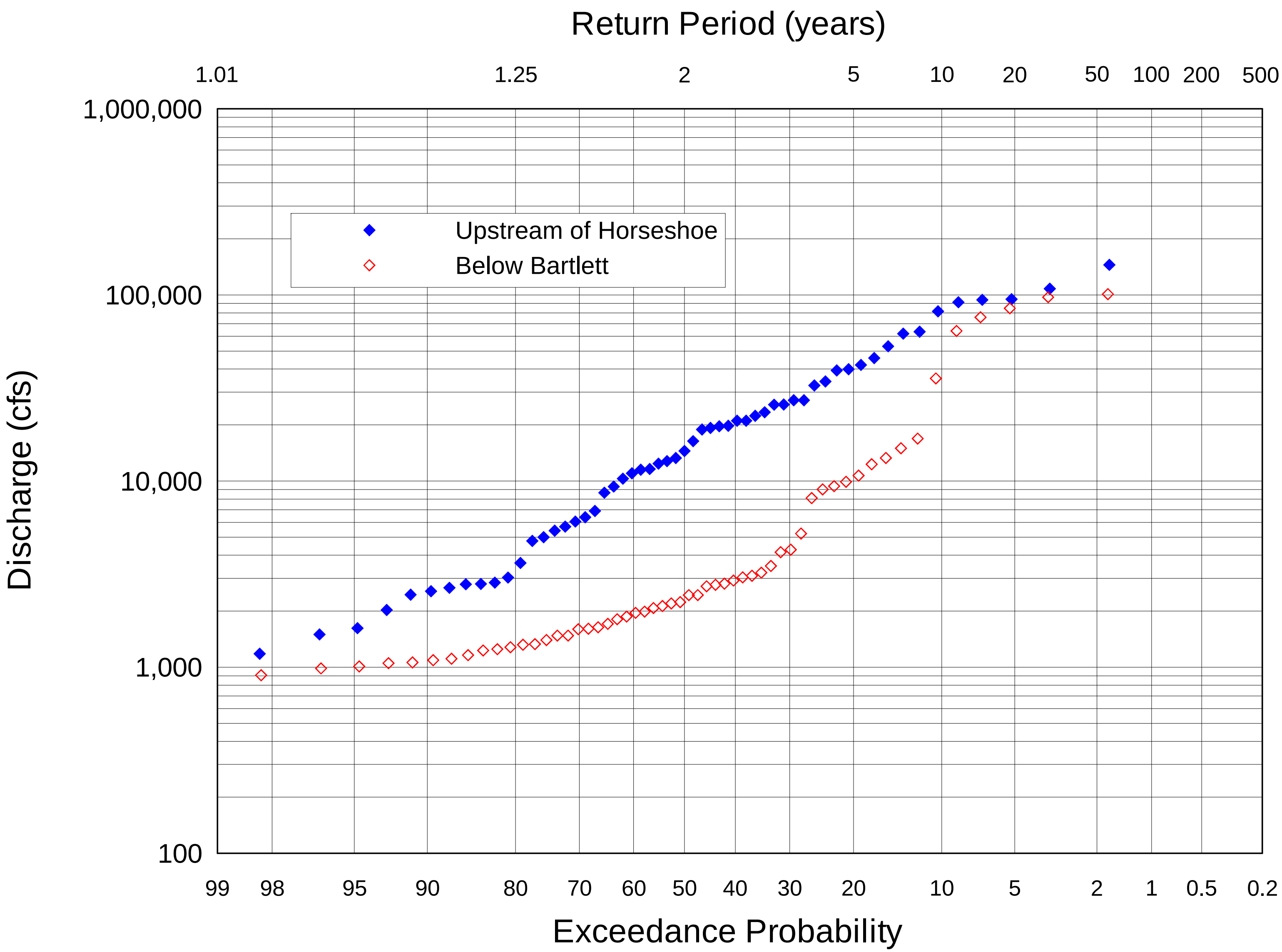


Figure 3.5. Comparison of flood-frequency curves for the Tangle Creek and below Bartlett gages for the post-dam period (1946—2002).

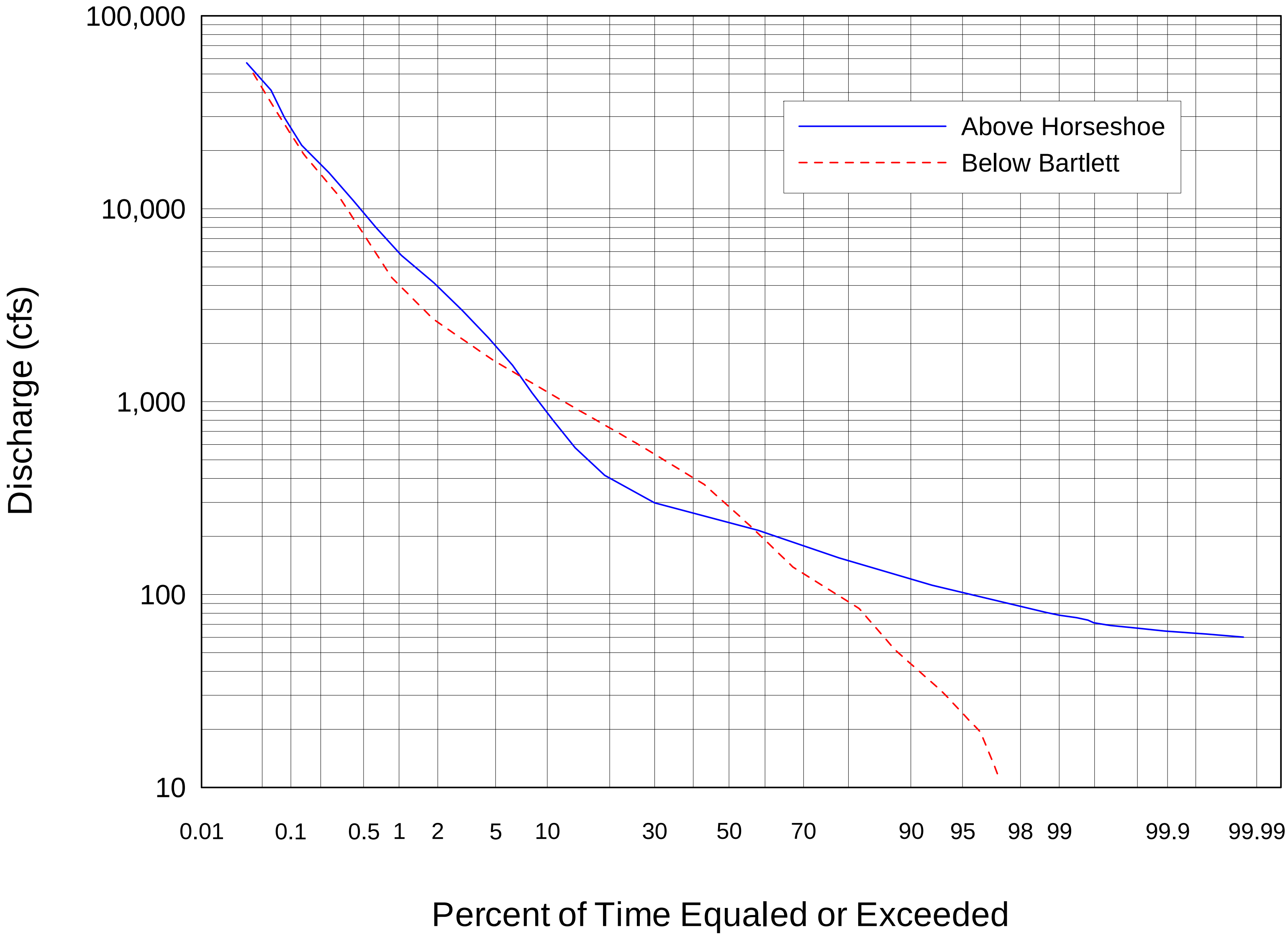


Figure 3.6. Comparison of mean-daily flow duration curves for the above Horseshoe and below Bartlett gages for the post-dam period (1946—2002).

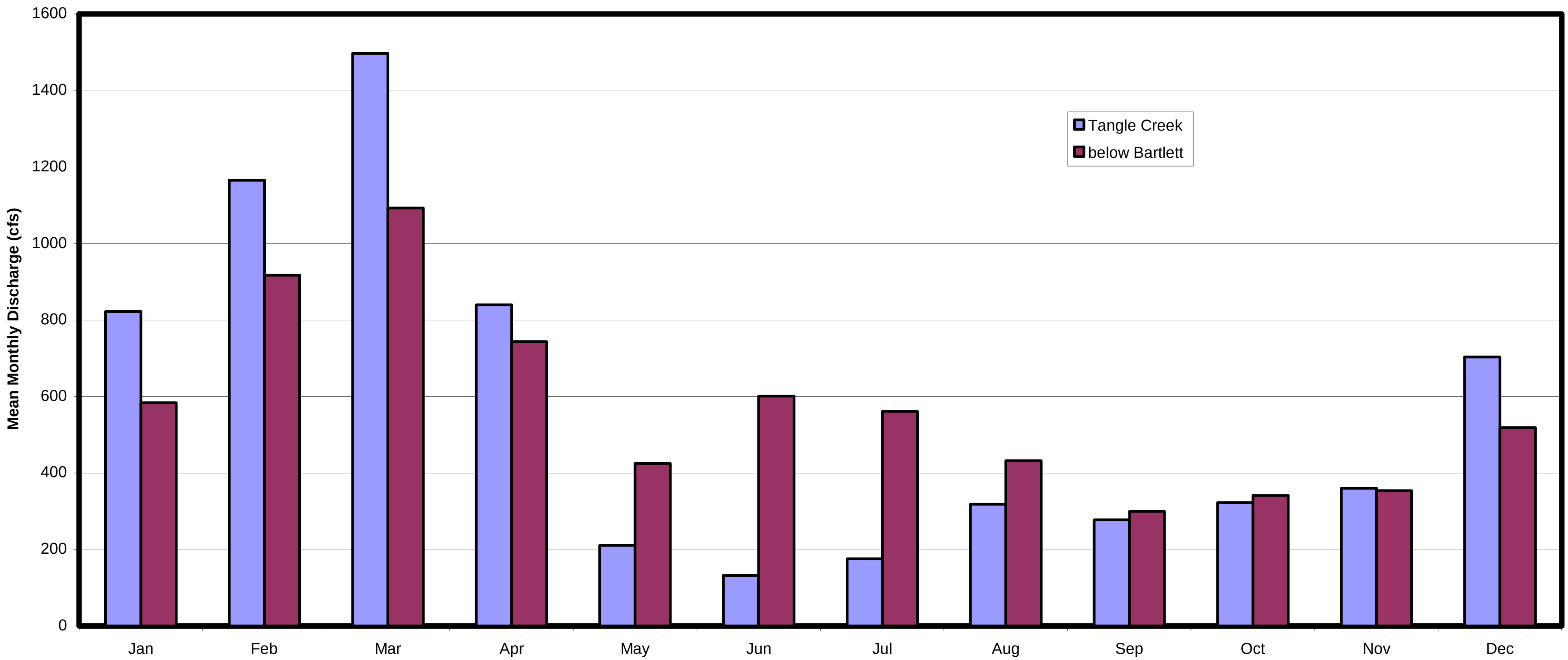


Figure 3.7. Comparison of mean monthly discharges at Tangle Creek and below Bartlett gages for the post-dam period (1946—2002).

The specific hydrographs that were analyzed were selected through joint consultations between MEI, ERO, and SRP. The potential effects of each of the three alternatives on the flood hydrographs at study Sites 2 and 3, which are located between the two dams and downstream from both dams, respectively, were assessed by routing the recorded flows at the Tangle Creek gage through the reservoirs using the RiverSim model, a river-basin model that allows the user to simulate reservoir operations for a given upstream input hydrograph and pre-defined reservoir-operational rules, constraints, and demands (see www.watersteward.com). The RiverSim routings were carried out by SRP, and the results were provided to MEI for use in this analysis. The following paragraphs, taken from information that was provided to MEI by ERO and SRP, describe the basic objectives and constraints that would control operations under each of the three scenarios.

Alternative 1 (Historical Operations) refers to the current and historical operational regime for Horseshoe and Bartlett Reservoirs. This scenario serves as a baseline with which to compare changes that would result from the modified operations associated with Alternatives 2 and 5. Under existing operations, during the winter and spring months (October 1 through April 30), water is typically delivered to meet SRP demands from the Verde River reservoirs to keep storage levels low, thereby maximizing the ability to capture runoff and minimizing the risk of spilling water from Bartlett Dam. These months have the lowest demand and the highest potential to produce the greatest amounts of runoff. Because the storage capacity of the Salt River reservoirs is relatively large in comparison to the Verde River reservoirs, there is usually sufficient space available to store runoff in the Salt River side of the water-supply system during winter and spring, and to provide releases during the summer when water demand is the greatest. In addition, due to the lack of power generation on the Verde River, water is stored during the winter on the Salt River for release during the summer when demand for electricity is the greatest. For these reasons, water releases to meet orders are progressively shifted from the Verde River reservoirs to the Salt River reservoirs in late-April or early-May.

Under **Alternative 2 (No Permit)**, the U.S. Fish & Wildlife Service (USFWS) would not issue an Incidental Take Permit (ITP) to SRP for continued operation of Horseshoe or Bartlett Reservoirs. Without the ITP, SRP would be expected to do everything within its control to avoid take of federally-listed species associated with the continued operation of the reservoirs. To avoid the risk of potential take of SWWFC, it would be necessary to operate Horseshoe Reservoir in a manner that would reduce the water level below the elevation at which SWWFC nested in the previous year (determined to be 1,985 feet in 2002 and 2003). Based on this requirement, the reservoir elevation would be lowered in April to reach a target elevation of 1,985 feet in late-April to early-May to expose the vegetation used for flycatcher nesting (uncontrolled high runoff during late spring could delay meeting the target elevation). Horseshoe Reservoir would be held at or below elevation 1985 feet through August.

Under **Alternative 5 (Mimic Natural Hydrograph),** alternative floods would be passed through Horseshoe and Bartlett Reservoirs from February through May in order to mimic the natural hydrograph, to the extent possible, to benefit downstream riparian areas.

These scenarios were modeled by selecting representative hydrographs from the historical record that cover a range of flood magnitudes. Because the RiverSim simulations are based on a time-step length of one hour, the mean daily flows in the published USGS record could not be used, and a special data request was made to the USGS for detailed flow data with shorter time-steps. The more detailed data were only available for WY1991 and later; thus the six hydrographs that were analyzed were selected from the post-WY1990 time-frame **(Table 3.1).**

Table 3.1. Summary of recorded peak hourly flows for the hydrographs selected for use in the reservoir operation simulations.

Year	Date of Peak	Above Horseshoe Dam		Below Bartlett Dam	
		Peak Hourly Flow (cfs)	Approximate Recurrence Interval (years)*	Peak Hourly Flow (cfs)	Approximate Recurrence Interval (years)**
1991	27 March	34,180	4.0	4,320	3.2
1993	8 January	135,170	44	114,300	61
1995	15 February	107,720	19	40,620	10
1995 (March)	6 March	87,760	14	40,620	10
1997	27 January	5,660	1.2	1,280	1.2
1998	29 March	25,450	3.0	8,820	3.9

* Based on recorded instantaneous flood peaks and the USGS flood-frequency curve for the above Horseshoe gage (Figure 3.4). The value for the March 1995 flood is based on the peak hourly flow.
**Based on the plotting positions of the individual events (Figure 3.5).

These hydrographs had peak hourly discharges at the Tangle Creek gage ranging from 5,660 to 135,170 cfs (recurrence intervals ranging from about 1.2 to 44 years). Peak hourly flows below Bartlett Dam for the hydrographs ranged from 1,280 to 114,300 cfs (approximate recurrence intervals ranging from about 1.2 to about 61 years).

With the exception of the 1993 and 1997 hydrographs, for which the peak discharge occurred in January, the simulations used a constant hydrograph start-date of February 1. The simulations for 1993 and 1997 used start-dates of January 1 and January 10, respectively. Because the bulk of the runoff for each simulation occurs in one to two months, the effect of the reservoirs on floods primarily occurs before April, the time at which Horseshoe Reservoir would need to be drawn down in order to avoid take of flycatchers under the No Permit Alternative. For the purposes of this analysis, there is, therefore, no difference between Alternatives 1 and 2 (Historical Operation and No Permit). As a result, only two operational scenarios remain for the comparative analysis presented in this report: (1) the Historical Operation/No Permit Alternative, referred to henceforth as the Full Operation scenario, and (2) the Mimic Natural Hydrograph Alternative, referred to henceforth as the Full Release scenario.

The effects of the reservoirs on the downstream hydrographs under either scenario are strongly impacted by the reservoir storage at the beginning of the hydrograph. In addition, the reservoir storage during the winter months when the selected floods occurred can vary significantly from year to year, and cannot be predicted with certainty for future operations. For this reason, the simulations for each of the two scenarios were performed with two different starting reservoir levels to provide a sensitivity analysis on the effects on starting reservoir storage. A statistical analysis of the historic February 1 reservoir storages performed by ERO indicated a bi-modal distribution, with a lower mode at about 50,000 ac-ft and a higher mode at about 290,000 ac-ft (i.e., both reservoirs full). Based on ERO's results, a low initial starting reservoir-storage condition was modeled for each scenario with no storage in Horseshoe Reservoir and 50,000 ac-ft of storage in Bartlett Reservoir. For the Full Operational scenario, a high initial starting reservoir-storage condition, with both reservoirs full (109,217 ac-ft in Horseshoe and 178,186 ac-ft in Bartlett) was modeled. Due to the release criteria under the Full Release scenario, the high initial reservoir condition was modeled with both reservoirs at the top of the spillways (50,389 ac-ft in Horseshoe and 72,073 ac-ft in Bartlett). Starting with the reservoirs full under this scenario would result in large releases at the beginning of the simulation which would not be in accord with the manner in which the reservoirs would actually be operated.

The assumed average monthly demand on the Verde River reservoirs that was used in the simulations ranged from 277 cfs in January to 1,514 cfs in May (**Table 3.2)**. The simulations also assumed that demand releases from Bartlett would be met as long as sufficient water is available in the reservoir. If sufficient water is not available, releases would be made from Horseshoe Reservoir. Storage-guide curves for the two alternatives considered in the analysis are provided in **Tables 3.3 and 3.4**.

Table 3.2. Demand on Verde River Reservoirs.

Month	Demand	
	Acre-feet	Average Discharge (cfs)
January	17,000	277
February	32,100	578
March	81,100	1,319
April	90,000	1,514
May	49,500	805
June	32,000	538
July	9,000	146
August	8,000	130
September	8,000	134
October	8,000	130
November	27,120	456
December	8,000	130

A summary of computed peak flows for the different simulations is provided in **Figures 3.8 and 3.9** for the reaches below Horseshoe Dam and Bartlett Dam, respectively, and plots of the routed hydrographs are provided in **Appendix B**. Examination of the routing results leads to the following general observations:

- The initial reservoir storage has a more significant effect on downstream flood peaks than changes associated with the proposed operational rules,
- The reservoirs significantly affect downstream floods during the smaller events, but the effect is less significant during the larger events,
- Timing of storms can also be important, as floods with peaks later in the year are less affected by the initial storage because of the effects of water that is stored before the flood occurs, and

Table 3.3. No Permit Alternative reservoir-storage guide.							
Month	Horseshoe Reservoir			Bartlett Reservoir			Verde System
	Maximum Elevation (ft)	Maximum Storage (ac-ft)	Comments	Maximum Elevation (ft)	Maximum Storage (ac-ft)	Comments	Maximum Storage (ac-ft)
October	2,026	109,217		1,798	178,186	No limitations on Bartlett	287,403
November	2,026	109,217		1,798	178,186		287,403
December	2,026	109,217		1,798	178,186		287,403
January	2,026	109,217		1,798	178,186		287,403
February	2,026	109,217		1,798	178,186		287,403
March	2,026	109,217		1,798	178,186		287,403
April	1,985	25,651	Start drawdown for nesting	1,798	178,186		203,837
May	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
June	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
July	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
August	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
September	2,026	109,217	Flycatcher leaves for Costa Rica	1,798	178,186		287,403

Table 3.4. Mimic Natural Hydrograph Alternative reservoir-storage guide.							
Month	Horseshoe Reservoir			Bartlett Reservoir			Verde System
	Maximum Elevation (ft)	Maximum Storage (ac-ft)	Comments	Maximum Elevation (ft)	Maximum Storage (ac-ft)	Comments	Maximum Storage (ac-ft)
October	2,026	109,217		1,798	178,186	No limitations on Bartlett	287,403
November	2,026	109,217		1,798	178,186		287,403
December	2,026	109,217		1,798	178,186		287,403
January	2,026	109,217		1,798	178,186		287,403
February	2,000	50,389	Gates fully open	1,748	72,073	Gates fully open	122,462
March	2,000	50,389	Gates fully open	1,748	72,073	Gates fully open	122,462
April	2,000	50,389	Gates fully open	1,748	72,073	Gates fully open	122,462
May	2,000	50,389	Gates fully open	1,798	178,186		228,575
June	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
July	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
August	1,985	25,651	Nesting season SWWFC	1,798	178,186		203,837
September	2,026	109,217	Flycatcher leaves for Costa Rica	1,798	178,186		287,403

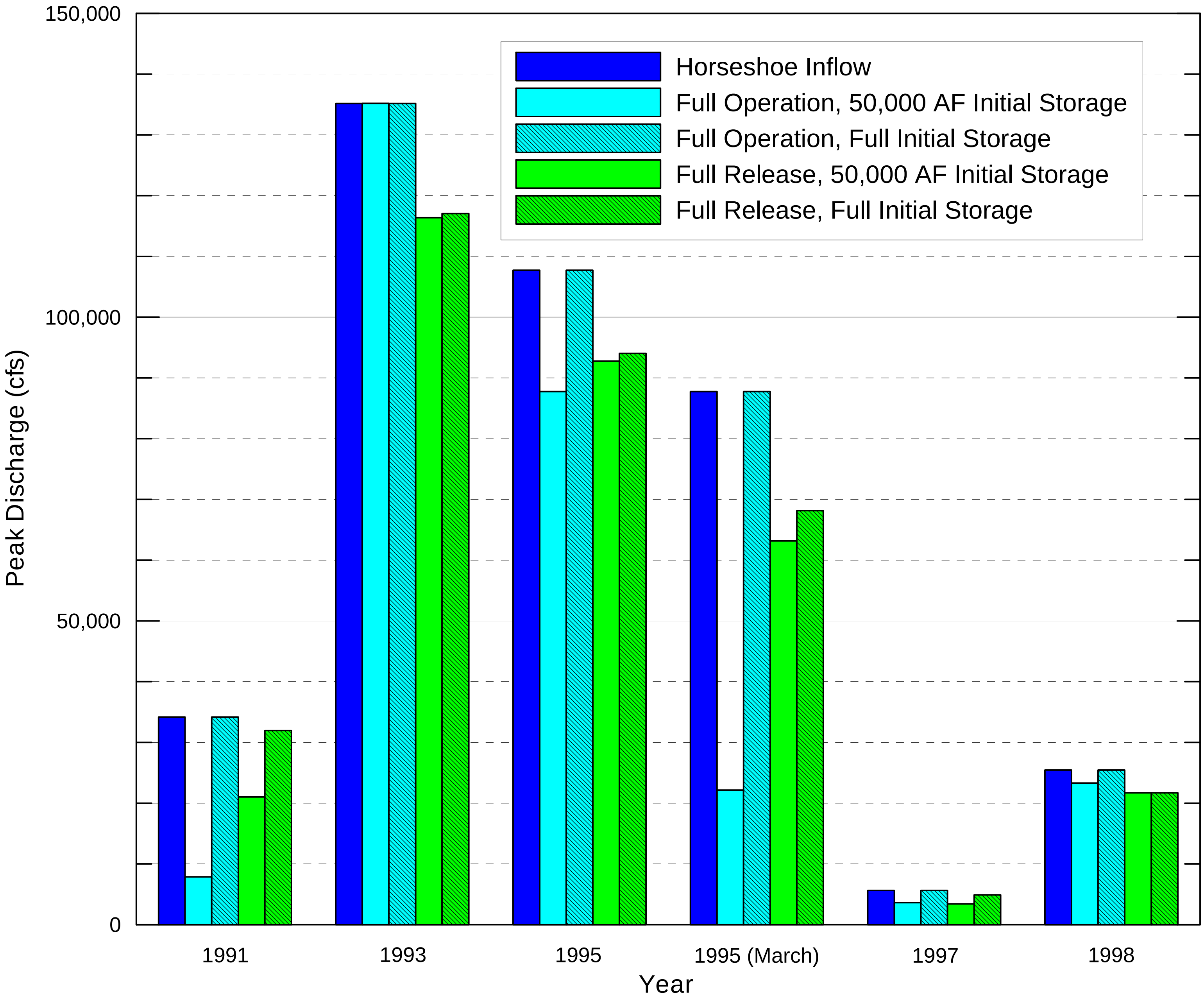


Figure 3.8. Bar graph summarizing computed flood peaks below Horseshoe Dam for the various reservoir operational scenarios.

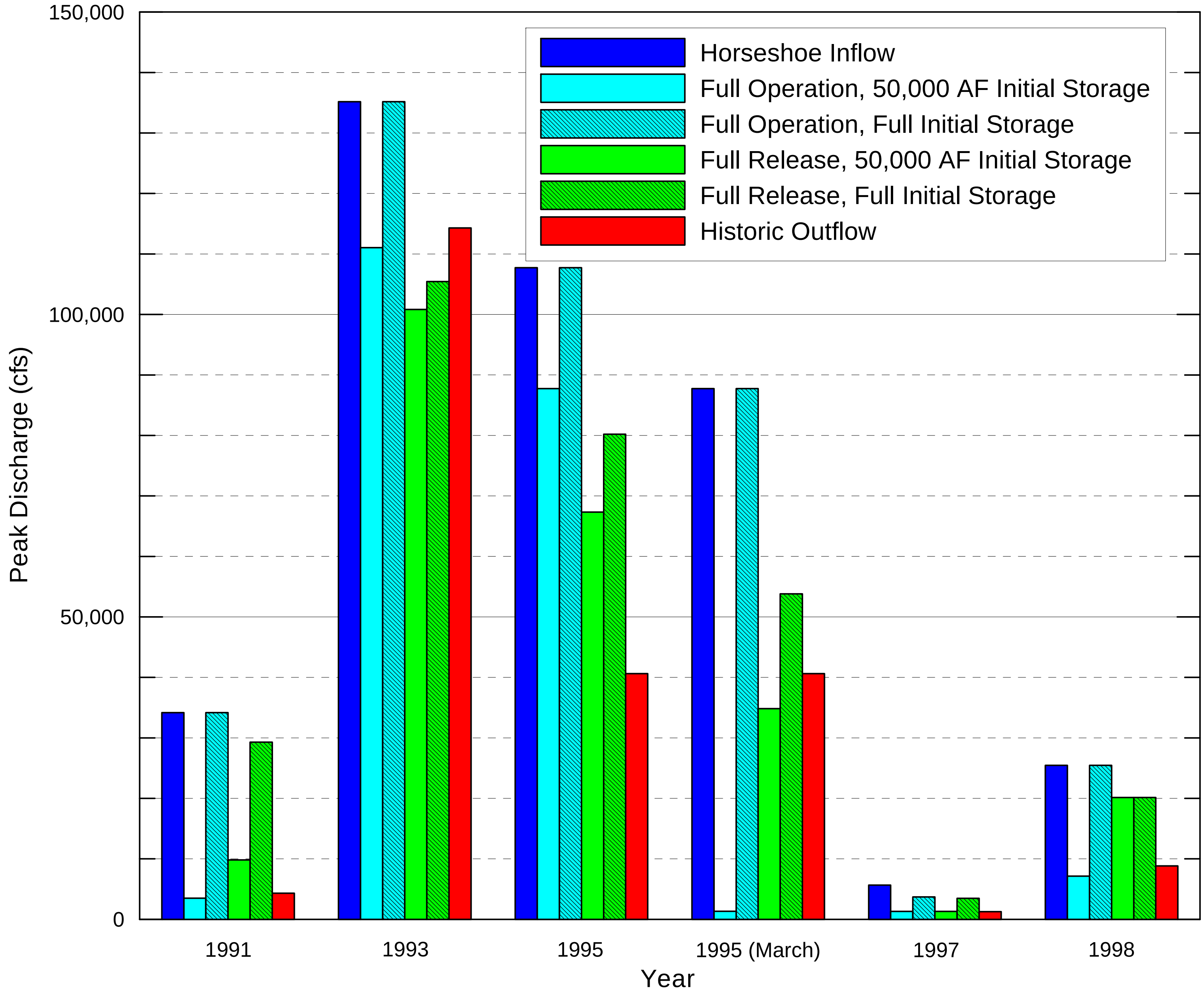


Figure 3.9. Bar graph summarizing computed flood peaks below Bartlett Dam for the various reservoir operational scenarios.

- Because of the above, no general trends with respect to the effects on peak discharges downstream from the dams are evident between the Full Operation and Full Release scenarios.

A detailed examination of the results below Horseshoe Dam (Figure 3.8) illustrates the above points. Under the Full Operation scenario with full initial storage, flood peaks are not attenuated in any of the simulated hydrographs. Because the maximum initial storage under the Full Release scenario is limited to the top of the spillway, there is some storage available, which results in a modest amount of flood-peak attenuation. With no initial storage in Horseshoe Reservoir (simulations with 50,000 ac-ft of system storage), the Full Operation scenario generally results in more flood-peak attenuation than the Full Release scenario. The attenuation is greatest for the 1991 and 1995 (March) events, which had small to moderate-sized flood peaks and small runoff volumes. In 1993, the largest flood examined both in terms of peak-flow and runoff volume, even with no initial storage in Horseshoe, there is no attenuation under the Full Operation scenario, but there is some attenuation under the Full Release scenario. In this case, the reservoir fills under the Full Operation scenario before the flood peak occurs, while earlier releases under the Full Release scenario result in more available storage when the flood peak occurs. In 1998, the peak inflow to Horseshoe occurs late in the simulation, and the results are less affected by the initial storage because the reservoir has time to fill before the flood occurs.

Examination of the results below Bartlett Dam (Figure 3.9) shows trends that are similar to those below Horseshoe Dam. With Bartlett Reservoir full under the Full Operation scenario, there is generally little or no flood-peak attenuation. With the maximum initial storage limited to the top of the spillway under the Full Release scenario, the additional available storage results in a modest amount of flood-peak attenuation. For simulations with only 50,000 ac-ft of initial storage in Bartlett Reservoir, the additional available storage results in more flood-peak attenuation for both scenarios. Under the Full Operation scenario, the additional available storage can result in significant attenuation for floods with small runoff volumes [e.g., 1991 and 1995 (March)].

4. HYDRAULIC ANALYSIS

One-dimensional (1-D) hydraulic models were developed for each of the three study sites to assist in evaluating the amount of inundation and substrate mobilization that would occur over the range of flows encompassed by the routed hydrographs. Model output provides estimates of the water-surface elevation, flow velocities, flow depths and bed shear stresses throughout each of the sites.

4.1. Model Development

The hydraulic analysis was carried out using the Corps of Engineers HEC-RAS computer software (USACOE, 2002). Topographic data for each of the models were developed from surveyed cross-section and aerial mapping that were provided to MEI by SRP. As previously described, the field-surveyed cross sections were laid out by MEI during the November 2002 site visits, and the actual surveys were performed by SRP. Additional topographic information was obtained from 2-foot contour interval mapping of the sites that was developed using aerial photogrammetric mapping techniques by SRP specifically for this project. The mapping was provided to MEI in digital terrain model (DTM) format for use with Bentley Systems InRoads Site, Version 8.04, with MicroStation, Version 8.01. Vertical control for the mapping and hydraulic models is based on the North American Vertical Datum of 1988 (NAVD), and horizontal control is based on the U.S. State Plane Coordinate System of 1983, Arizona Central Zone.

In developing the hydraulic models, the field-surveyed data were used directly in the input files, to the extent possible, because it provides the most accurate data at the survey locations. Where additional topographic data were required to extend cross sections beyond the limits of the field surveys or to add additional cross sections to improve the resolution of the models, this information was taken directly from the DTM using the InRoads and MicroStation software. At the cross sections that were added from the mapping, the below-water profile was estimated based on the typical shape of the surveyed cross sections at geomorphically similar locations. At each of the sites, the mapping and hydraulic models extended sufficiently far upstream from the most upstream surveyed cross section to include flow breakouts that affect the amount of flow that would actually pass through the primary study site over the range of modeled flows. The cross-section layouts for each model are shown in Figures 2.1 through 2.3.

Flow conditions at each of the study sites are very complex, with flow breakouts at high flows, multiple flow paths, and low areas in the overbanks that are not connected to the main channel. To account for this complexity in a manner consistent with the 1-D modeling approach used for this study, each continuous well-defined flow path was analyzed using a separate reach in the hydraulic model. The discharge in each reach was determined automatically using the split-flow routine in HEC-RAS that balances the computed energy grade-line elevation at the upstream end of each branch. Less well-defined flow paths were accounted for using the HEC-RAS ineffective flow-area options to ensure that low areas not connected to the main channel do not flow until the intervening high ground is overtopped, and to ensure reasonable flow continuity in the overbanks from cross section to cross section. Because the nature of the flow paths change with discharge (areas with well-defined separate flow paths at low flows become connected at high flows), different model configurations were used at each site for specific ranges of discharge. The model configurations are illustrated in the georeferenced geometry files included in the HEC-RAS project files set up for each site.

The roughness and energy-loss characteristics of the river channel and overbank areas are accounted for in the HEC-RAS software through the use of Manning's *n* roughness coefficients, and expansion and contraction loss coefficients. Manning's *n*-values for the overbank areas were estimated from aerial photographs and field observations. Horizontal variations in overbank *n*-values were included in the models to account for different zones of vegetation as identified on the aerial photographs. Overbank *n*-values used in the models ranged from 0.035 for bare ground to 0.08 for dense riparian vegetation (**Table 4.1**). A constant main-channel *n*-value of 0.035 was used at each site based on the roughness characteristics of the channel as observed in the field and previous experience with similar rivers, and the selected *n*-values were verified by comparing computed water-surface elevations with field-surveyed water-surface elevations and high-water marks.

Table 4.1. Summary of Manning's *n* roughness values used in the hydraulic models.

Roughness Description	Manning's *n*
Channel bed / bare ground	0.035
Light brush	0.04-0.045
Medium density brush / trees	0.06
Dense brush / trees	0.08

The 1-D hydraulic models require specification of either the water-surface elevation or energy gradient at the downstream cross section. For this project, the water-surface elevation was specified for each modeled flow based on a rating curve that was developed using measured data, where available (i.e., surveyed water-surface elevations at low flows at each site and surveyed high-water marks from recent floods at Sites 1 and 2), and normal depth calculations for flows other than at the measured values. Energy slopes used in the normal depth calculations were estimated so that the computed water-surface elevations would match the measured values as close as possible. At Site 1, the assumed energy slopes ranged from 0.0005 at very low flows to 0.005 at the highest flows. A constant energy slope of 0.004 was used at Site 2 and a constant energy slope of 0.0015 was used at Site 3. At both Sites 2 and 3, the assumed energy slope used in the model is approximately the same as the average bed slope at the respective site.

4.2. Model Verification

The hydraulic models at each site were verified, to the extent possible, using available data. These data included water-surface elevations measured at the time of the cross-section surveys and surveyed high-water marks from recent floods (February and March 2003) at Sites 1 and 2 (data on high-water marks were not available at Site 3). Discharges at the times of the elevation measurements were provided to MEI by SRP (**Table 4.2**).

At Site 1, the computed and measured water-surface elevations are in good agreement at low flows in the 260 to 300 cfs range (**Figures 4.1**). Agreement between the computed water-surface elevations and high-water marks associated with maximum discharges of 7,530 and 13,700 cfs is also very reasonable, although there is more scatter in the surveyed high-water marks than occurs with the measured water-surface profiles (**Figures 4.2 and 4.3**). This is typical because of the difficulty in determining precise flood elevations from debris and other

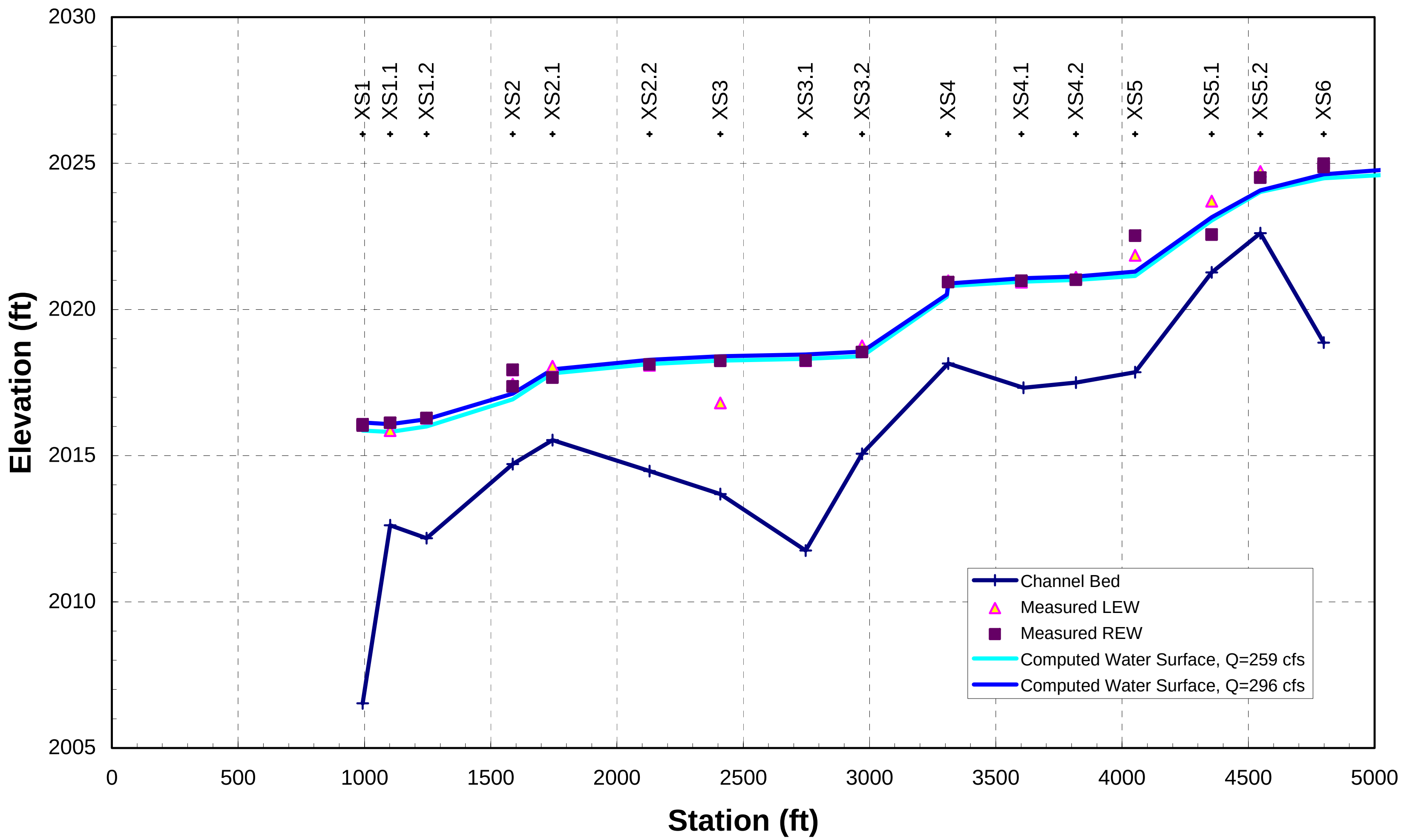


Figure 4.1. Site 1 surveyed water-surface elevations and computed water-surface profiles for the discharges at the time of the survey (259 to 296 cfs).

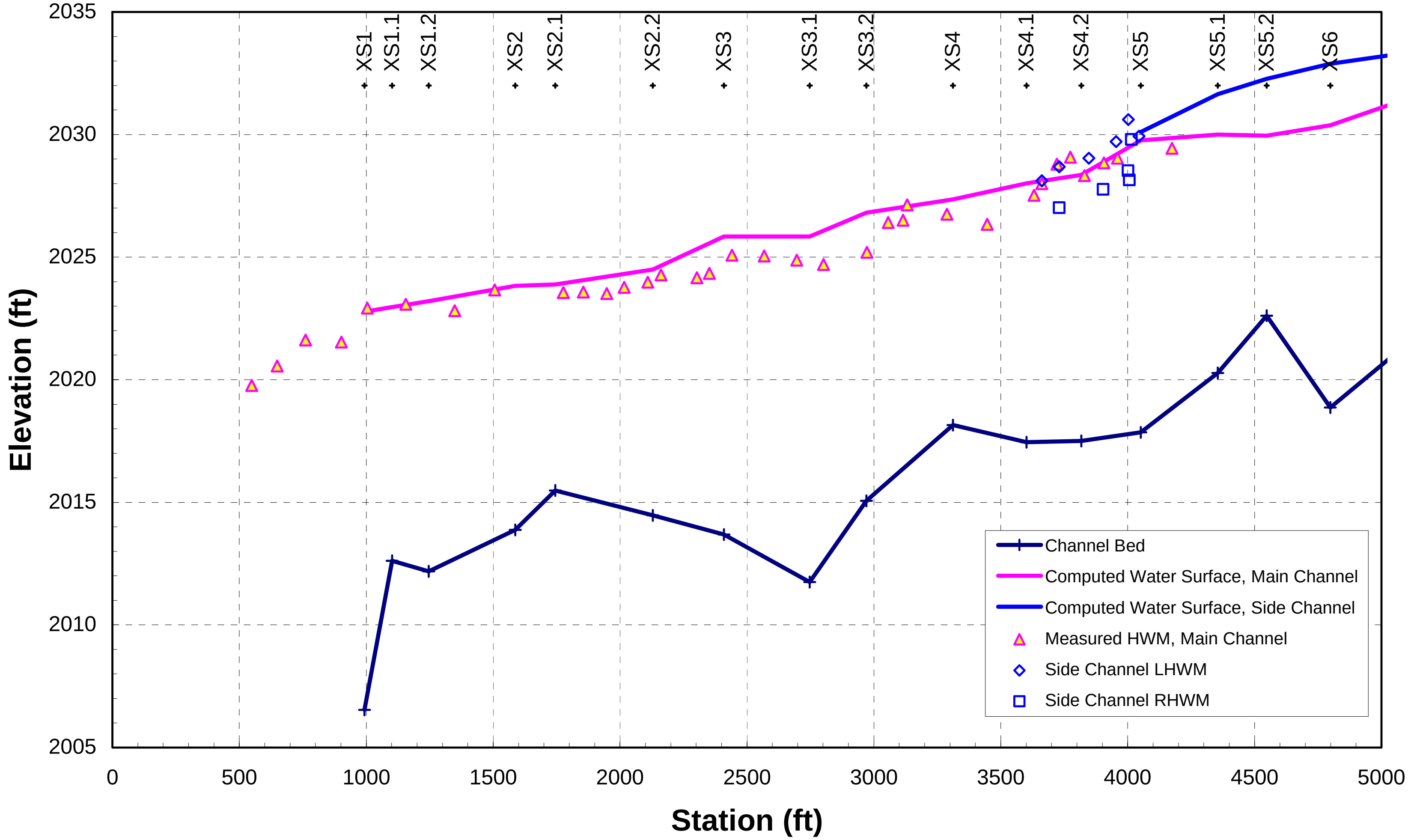


Figure 4.2. Site 1 surveyed high-water marks corresponding to the first 2003 flood peak (February 14) and the computed water-surface profile for the peak discharge (7,530 cfs).

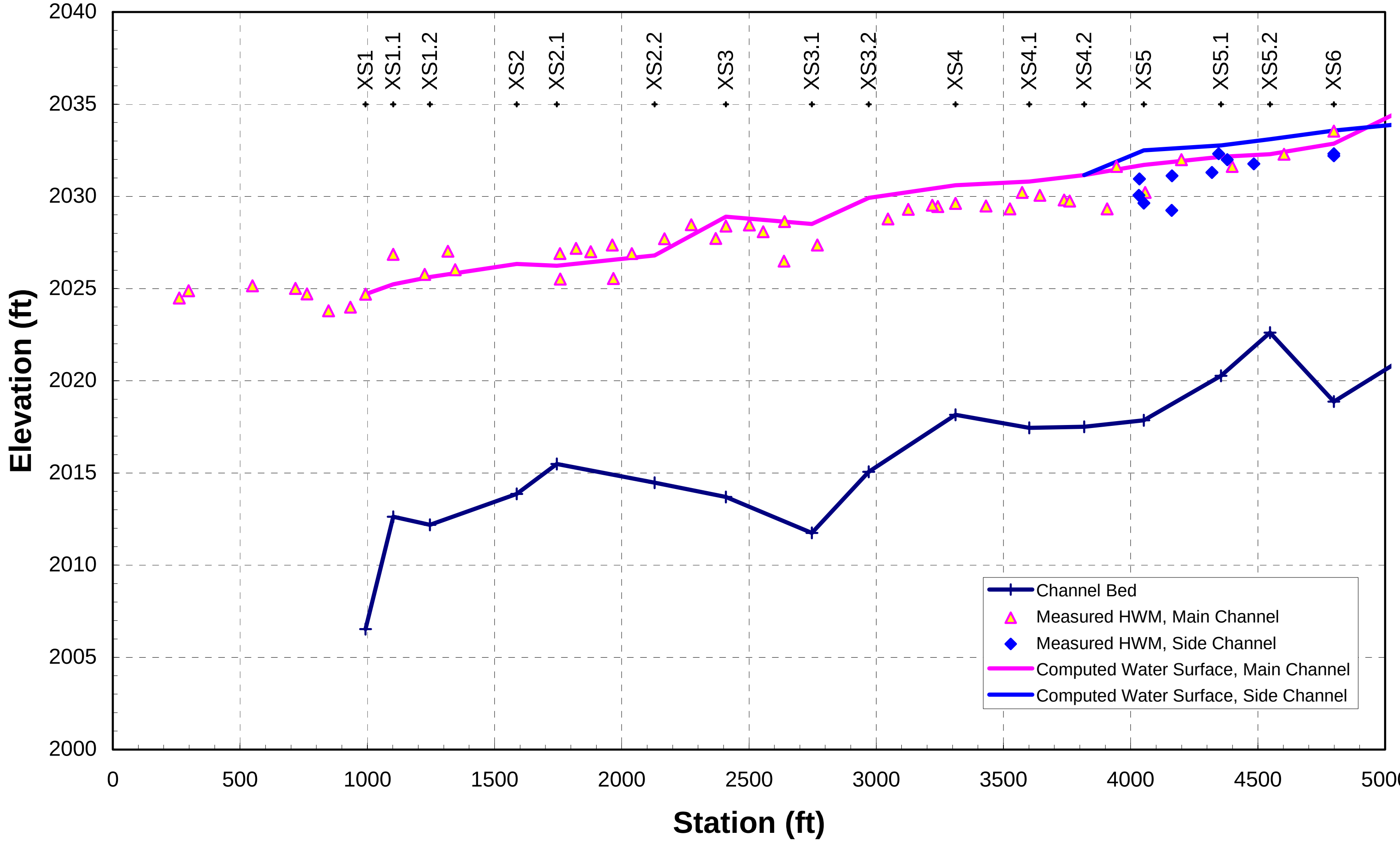


Figure 4.3. Site 1 surveyed high-water marks corresponding to the second 2003 flood peak (March 17) and the computed water-surface profile for the peak discharge (13,700 cfs).

marks left by the flood. In some cases, the surveyed elevations may over-represent flood elevations due to such factors as wind, wave action, and debris piled up on obstructions (representing elevations closer to the energy grade line than the water surface). In other cases, the surveyed elevations may be lower than peak-flood elevations because the actual high-water mark may be obscured and/or the identified mark may be associated with debris lines associated with flows on the recession limb of the hydrograph.

Table 4.2. Summary of data used for model verification.

Location	Description	Discharge (cfs)
Site 1	Surveyed water surface	259—296
	2003 high-water marks, 1st flood peak (February 14)	7,530
	2003 high-water marks, 2nd flood peak (March 17)	13,700
Site 2	Surveyed water surface	225—250
	2003 high-water marks, 1st flood peak (February 28)	1,425
	2003 high-water marks, 2nd flood peak (March 19)	7,100
Site 3	Surveyed water surface	300—500

Similar agreement is obtained at Site 2 for the low-flow water-surface elevations that were measured at discharges ranging from of 225 to 250 cfs (**Figure 4.4**). For the surveyed high-water marks corresponding to a maximum discharge of about 1,425 cfs, the agreement is also very good along the main channel, but the model appears to slightly under-predict water-surface elevations in the overbank area between about XS2 and XS3.1 (**Figure 4.5**). The scatter in the second set of surveyed high-water marks is greater in the downstream portion of the reach, and the modeled water-surface elevation generally passes through the data (**Figure 4.6**).

At Site 3, the agreement between the computed and measured water-surface elevations at discharges of 300 to 500 cfs is also reasonable, although the model slightly under-predicts elevations in the vicinity of the riffles at XS4 and upstream of XS6 (**Figure 4.7**). No surveyed high-water marks were available for this site; however, the model was developed in the same manner as the models at Sites 1 and 2 and should provide similar accuracy.

4.3. Model Results

The hydraulic models for the three sites were run for a range of discharges from very low flows up through the estimated 100-year flood peak (200,300 cfs). HEC-RAS input and output files are included on the CD that accompanies this report. Tables listing the values of important hydraulic variables used in the inundation and incipient-motion analyses are included in **Appendix C**. Water-surface profiles for the main flow path at each site and covering a wide range of flows are shown in **Figures 4.8 through 4.10**.

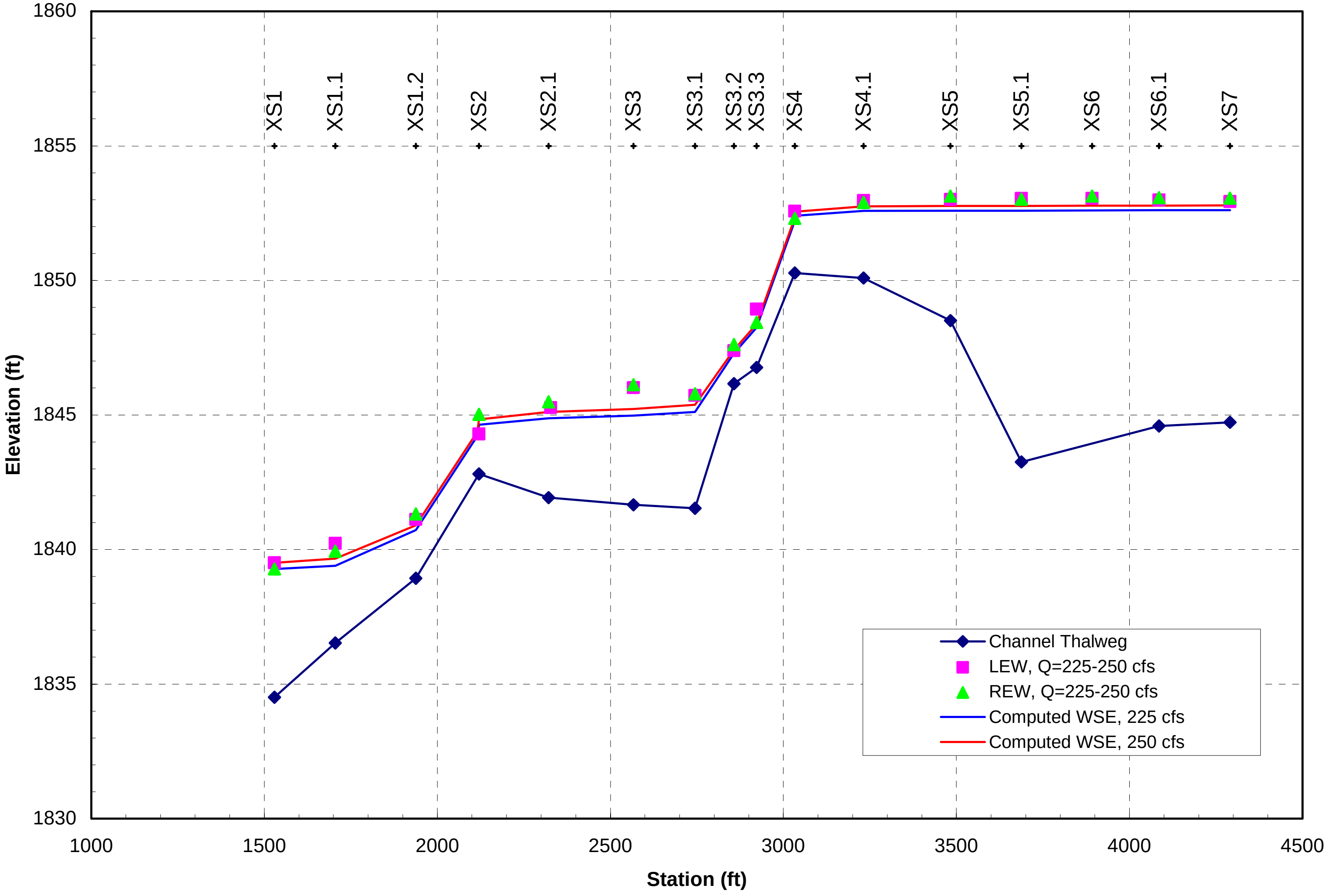


Figure 4.4. Site 2 surveyed water-surface elevations and computed water-surface profiles for the discharges at the time of the survey (225 to 250 cfs).

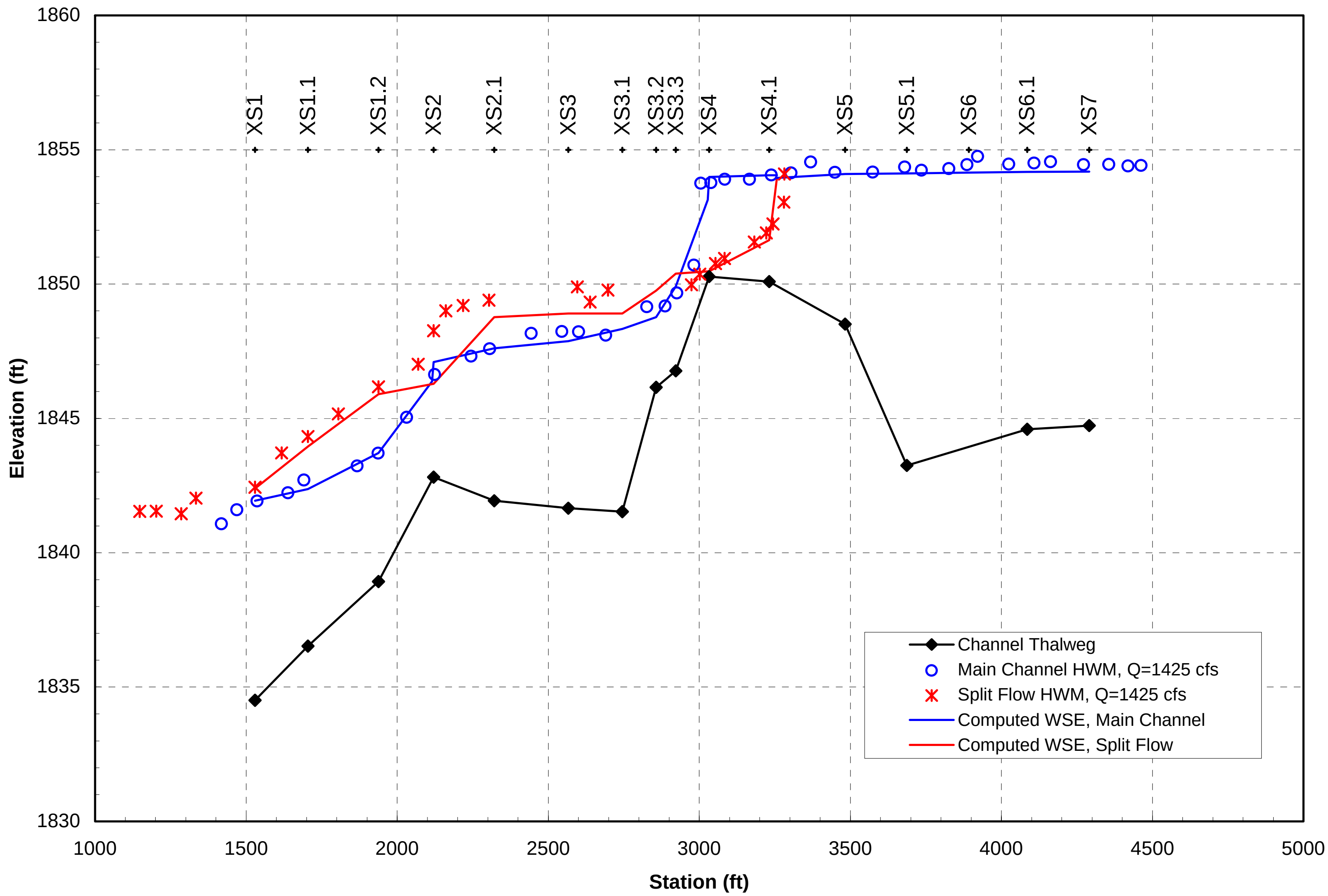


Figure 4.5. Site 2 surveyed high-water marks corresponding to the first 2003 flood peak (February 28) and the computed water-surface profile for the peak discharge (1,425 cfs).

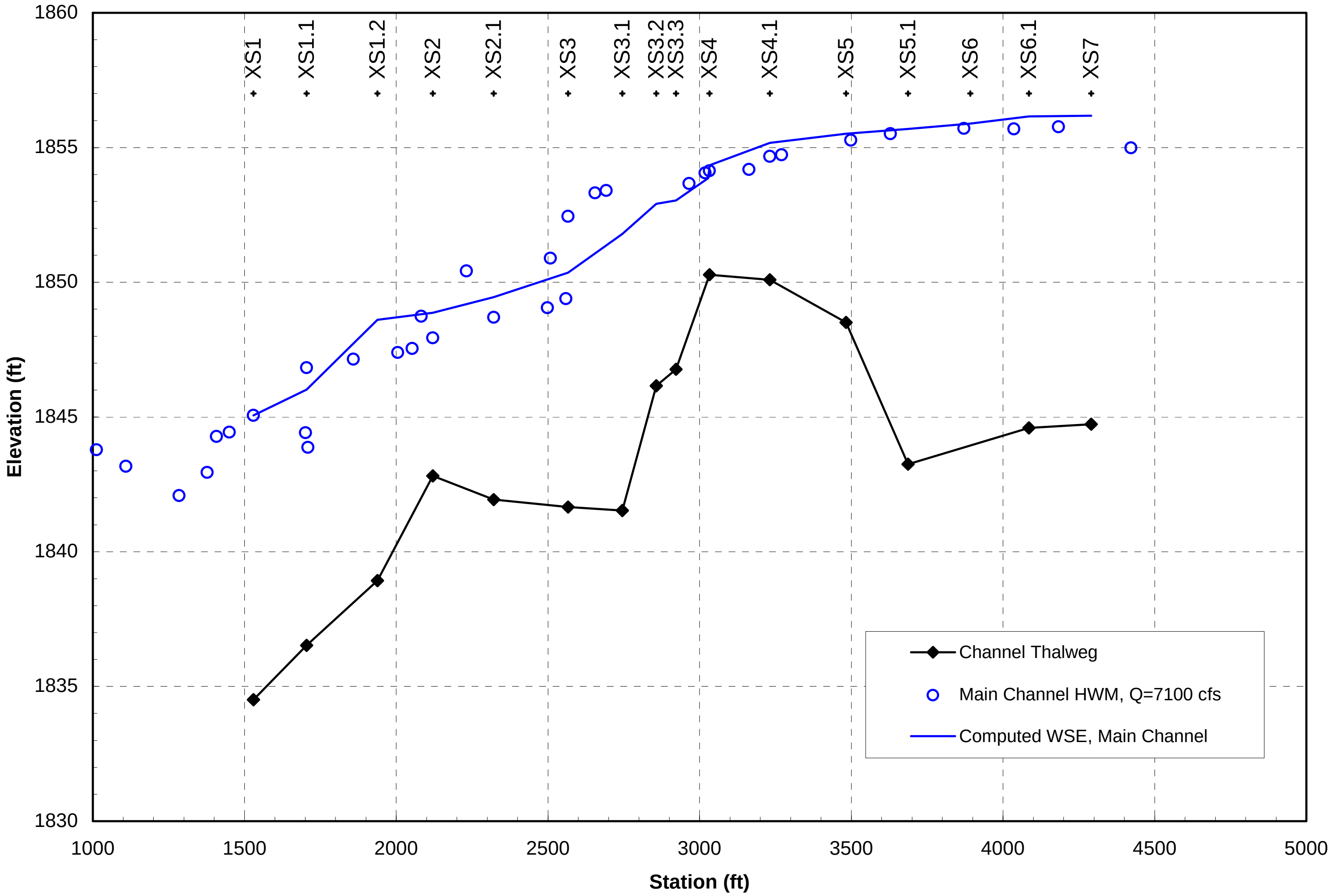


Figure 4.6. Site 2 surveyed high-water marks corresponding to the second 2003 flood peak (March 19) and the computed water-surface profile for the peak discharge (7,100 cfs).

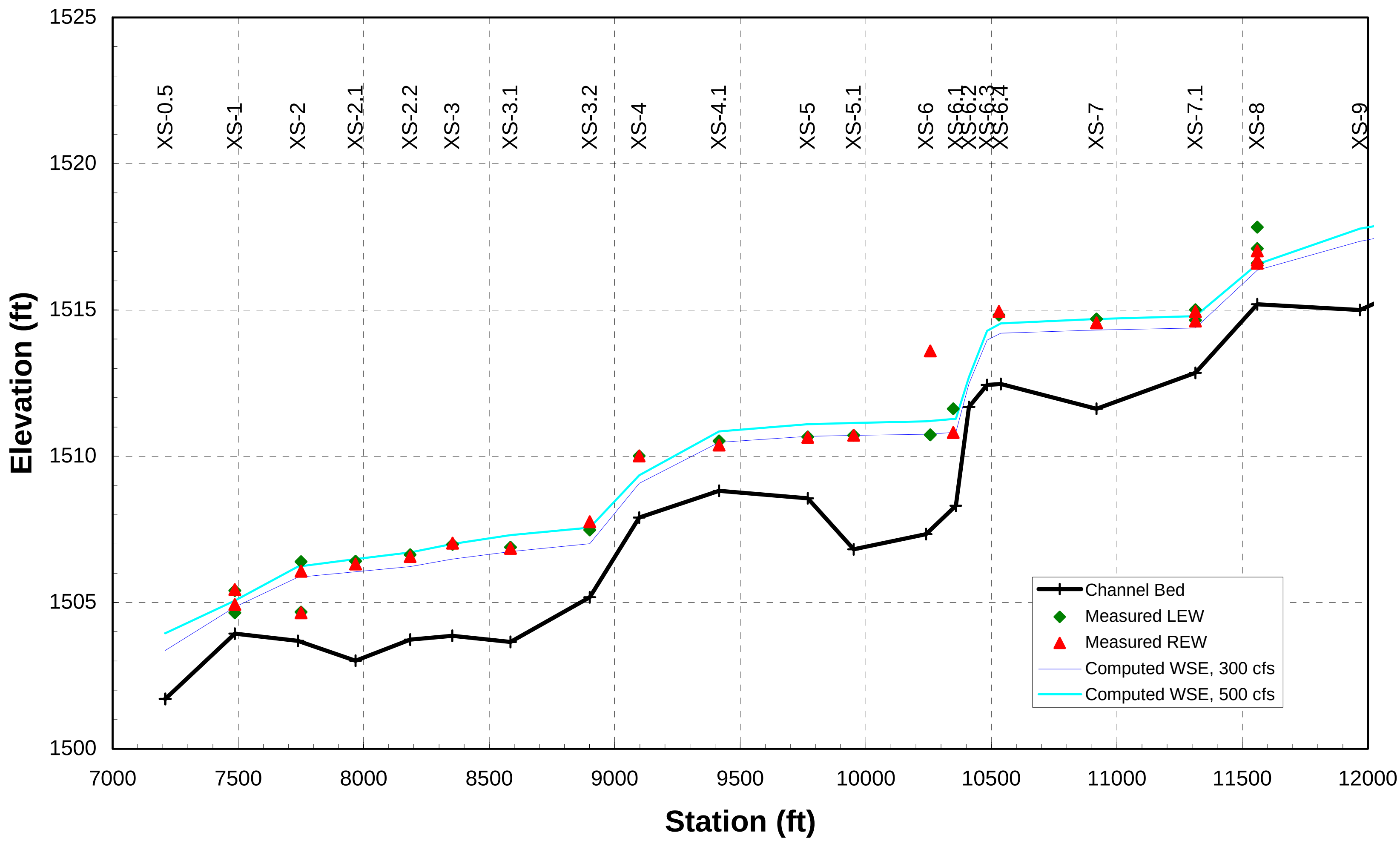


Figure 4.7. Site 3 surveyed water-surface elevations and computed water-surface profiles for the discharges at the time of the survey (300 to 500 cfs).

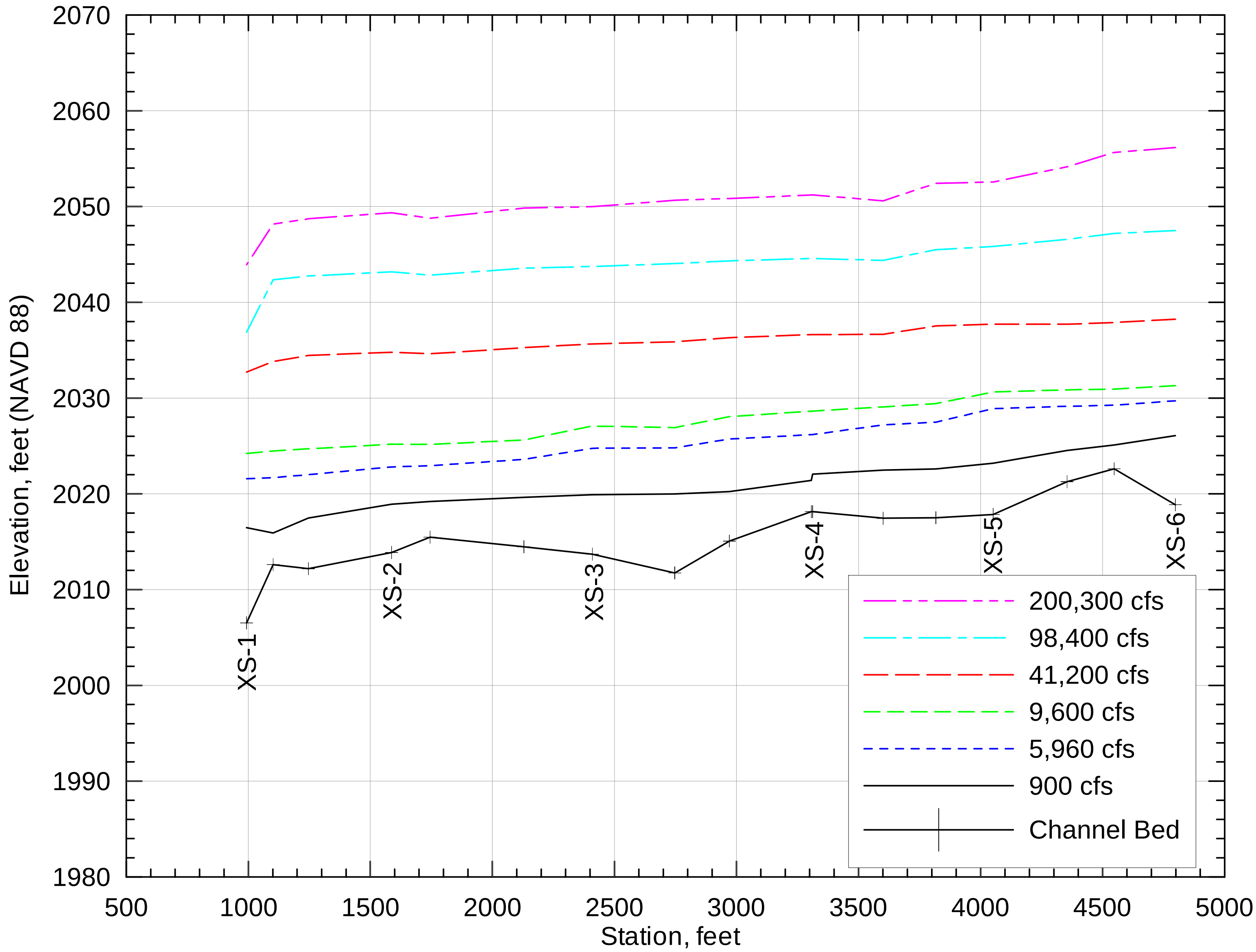


Figure 4.8. Computed water-surface profiles at Site 1 for discharges ranging from 150 to 200,300 cfs.

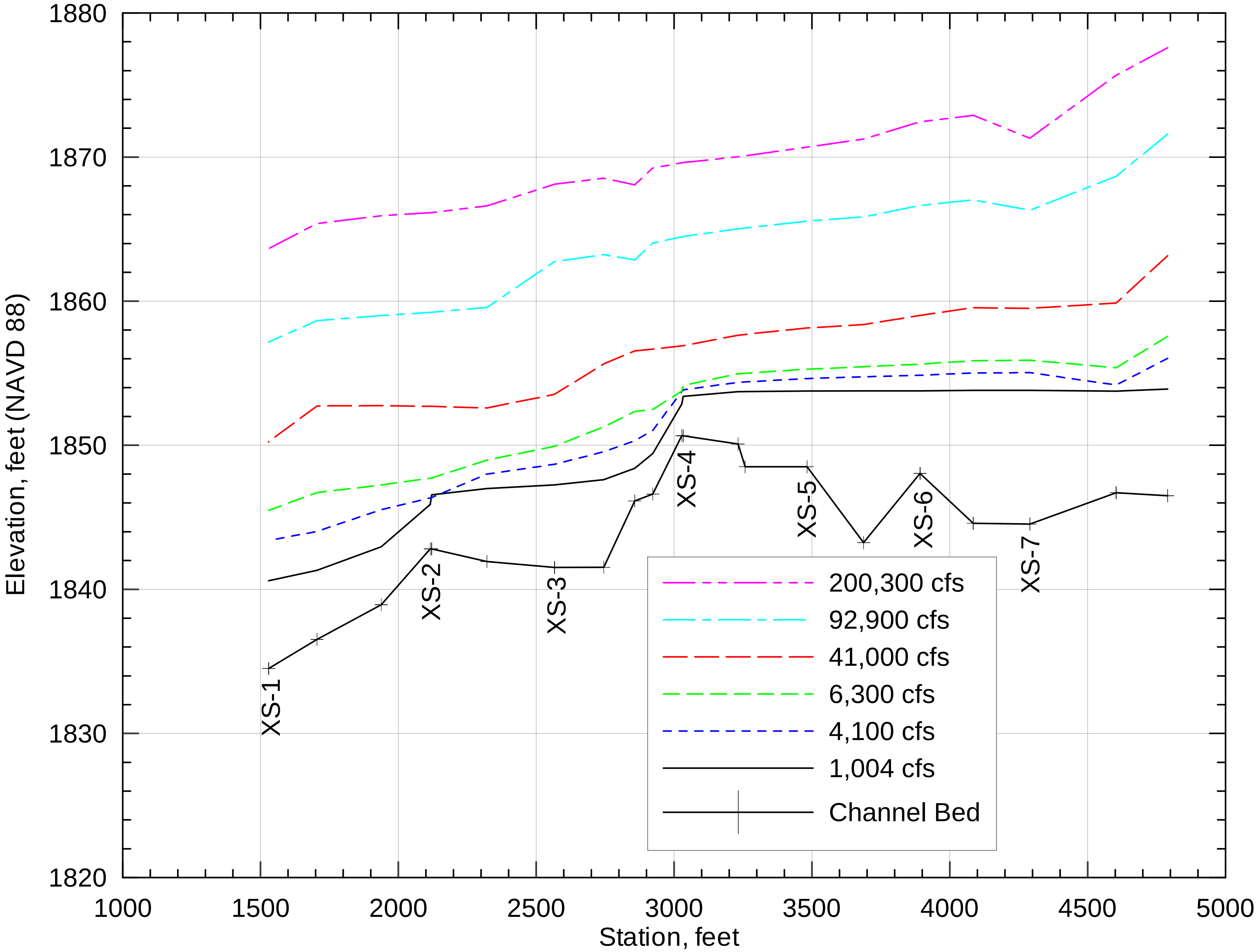


Figure 4.9. Computed water-surface profiles at Site 2 for discharges ranging from 117 to 200,300 cfs.

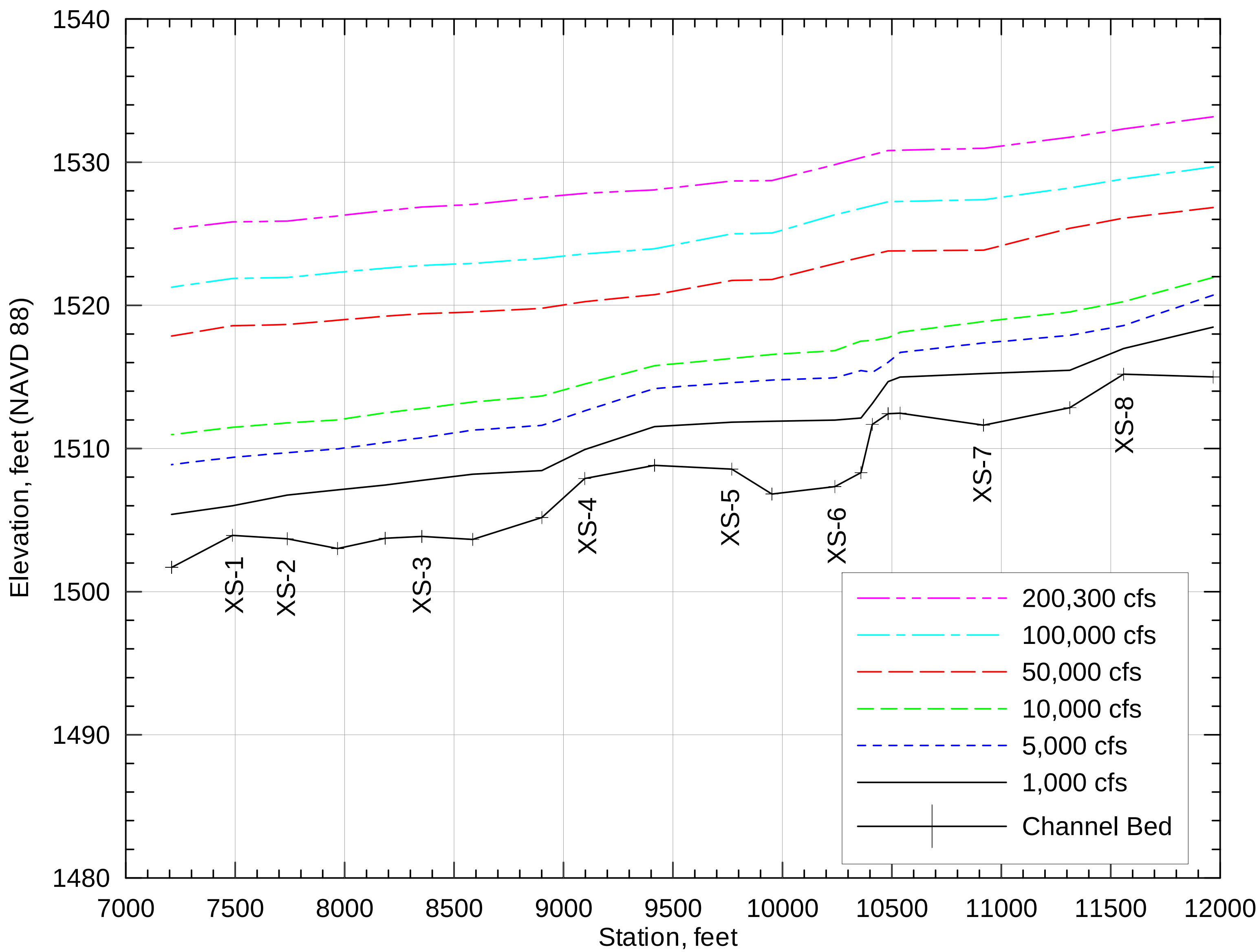


Figure 4.10. Computed water-surface profiles at Site 3 for discharges ranging from 300 to 200,300 cfs.

4.4. Inundation and Incipient-Motion Analyses

The output from the hydraulic modeling was used to conduct incipient-motion and inundation analyses. The inundation analysis quantifies the effects of the different dam operational scenarios on the extent and frequency of inundation of the various geomorphic surfaces along the river at each study site. The incipient-motion analysis determines the flows necessary to mobilize the bed and bar sediments that form the substrate for the riparian vegetation.

For the inundation analysis, the hydraulic models were run for a range of flows from very low flows up through the 100-year event. Results from the models were then used to develop water-surface elevation versus discharge rating curves for each of the surveyed cross sections. Where multiple flow paths exist at a particular cross section (see discussion in Section 4.1), separate rating curves were developed for different portions of the cross section. Modeled water-surface elevations for select discharges covering the range of modeled flows were then plotted on the cross sections to show the extent of inundation that would occur at different flow levels. The cross-section plots are color-coded to show the existing vegetation types on each of the surfaces (Appendix A). Comparison of the water-surface elevations with the color-coded cross-section plots shows the amount and type of vegetation that is inundated for each scenario.

The incipient-motion analysis was carried out by evaluating the effective shear stress on the channel bed in relation to the amount of shear stress that is required to move the sediment sizes that are present. The shear stress required for bed mobilization was estimated using the Shields (1936) relation, given by:

$$\tau_c = \tau_{*c}(\gamma_s - \gamma)D_{50} \tag{4.1}$$

where τ_c = critical shear stress for particle motion,
τ_{*c} = dimensionless critical shear stress (often referred to as the Shields parameter),
γ_s = unit weight of sediment (~165 lb/ft$_3$),
γ = unit weight of water (62.4 lb/ft$_3$), and
D_{50} = median particle size of the bed material.

In gravel- and cobble-bed streams, when the critical shear stress for the median particle size is exceeded, the bed is mobilized and all sizes up to about five times the median size are capable of being transported by the flow (Parker et al., 1982; Andrews, 1984). Reported values for the Shields parameter range from 0.03 (Neill, 1968; Andrews, 1984) to 0.06 (Shields, 1936). A value of 0.047 is commonly used in engineering practice, based on the point at which the Meyer-Peter, Müller bed-load equation indicates no transport (Meyer-Peter, Müller, 1948). Detailed evaluation of Meyer-Peter and Müller's data and more recent data (Parker et al., 1982, Andrews, 1984) indicates that a value of 0.03 may be more reasonable for true incipient motion in gravel- and cobble-bed streams. In fact, Neill (1968) concluded that a dimensionless shear value of 0.03 corresponds to true incipient motion of the bed-material matrix while 0.047 corresponds to a low, but measurable, transport rate.

In performing the incipient-motion and bed-material transport analysis, the bed shear stress due to grain resistance (τ') is used rather than the total shear stress, because it is a better descriptor of the near-bed hydraulic conditions that are responsible for sediment movement. The grain shear stress is computed from the following relation:

$$\tau' = \lambda Y' S \tag{4.2}$$

where Y' = the portion of the total hydraulic depth associated with grain resistance (Einstein, 1950), and

S = the energy slope.

The value of Y' is computed iteratively by solving the semilogarithmic velocity profile equation:

$$\frac{V}{V_*'} = 5.75 + 6.25 \log\left(\frac{Y'}{k_s}\right) \tag{4.3}$$

where V = mean velocity,

k_s = characteristic grain roughness of the bed, and

V_*' = shear velocity due to grain resistance given by:

$$V_*' = \sqrt{gY'S} \tag{4.4}$$

The characteristic roughness height of the bed (k_s) was assumed to be 3.5 D_{84} (Hey, 1979).

To evaluate the flow necessary to mobilize the sediment on the various surfaces across channel and floodplain it was necessary to estimate the distribution of the grain shear along each cross section. Consistent with the 1-D modeling approach used in this study, the lateral flow distribution was estimated by assuming that the flow varies with the distribution of conveyance across the section. The conveyance for a particular subsection of the cross section is given by:

$$K_i = \frac{1.486}{n_i} A_i R_i^{2/3} \tag{4.5}$$

where K_i = conveyance for subsection i,

n_i = Manning's *n*-value for subsection i,

A_i = area for subsection i, and

R_i = hydraulic radius for subsection i.

The discharge in subsection i is then computed as:

$$Q_i = Q_T \frac{K_i}{K_T} \tag{4.6}$$

where Q_i = discharge in subsection i,

Q_T = total discharge, and

K_T = total conveyance determined by summing the subsection conveyances.

With the flow distribution known, the other hydraulic variables necessary to determine the grain-shear distribution can be computed.

Results from the inundation and incipient-motion analyses are discussed in the next chapter.

5. ANALYSIS OF DAM IMPACTS

Changes in the distribution and composition of riparian vegetation downstream of dams can be due to either changes in the magnitude, frequency or duration of the flows (Rood and Mahoney, 1990; Scott, Wondzell and Auble, 1993; Scott, Auble and Friedman, 1997; Friedman and Auble, 1999: Shafroth et al., 1998); changes in channel morphology or sedimentology (Williams and Wolman, 1984; Harvey and Schumm, 1987; Elliott and Parker, 1997; Elliott and Hammack, 2000); or some combination of hydrologic, morphologic or sedimentologic changes that affect the hydrogeomorphic–botanical relationships (Osterkamp and Hupp, 1984; Hupp and Osterkamp, 1985). To evaluate the hydrogeomorphic relationships, and to identify dam-induced changes in the channel morphology or sedimentology, three evaluations were conducted: (1) an evaluation of the discharges and associated recurrence intervals and durations required to inundate various common geomorphic surfaces identified at the three sites, (2) an evaluation of the discharges and associated recurrence intervals and durations required to initiate motion of the surface sediments comprising the identified geomorphic features at each site, and (3) an evaluation of the discharges and associated recurrence intervals required for significant sediment transport on each of the identified surfaces.

5.1. Inundation, Incipient Motion, and Sediment Transport

At each of the three sites, an analysis of the site morphology was undertaken using the topographic mapping and surveyed cross sections to establish the range of geomorphic surfaces that were present. Based on the analyses, four general geomorphic features were identified: (1) main channel, (2) low bars, (3) high bars, and (4) chute channels. The output from the hydraulic modeling of the sites was used to determine the range of discharges that inundated each of the identified surfaces at each site. The range of discharges that were required to initiate motion of the surface sediments on each of the surfaces, and the range of discharges required to cause significant bed-material transport on each surface were also estimated. Typical cross sections showing the geomorphic surfaces and their associated ranges of discharges for each of the sites are presented in **Figures 5.1 through 5.3.** The distribution of the various vegetation types mapped by ERO across the sections is also shown on the figures. **Table 5.1** provides a description of the vegetation types that are shown on the cross sections. Similar plots of all the surveyed cross sections for the individual sites are presented in Appendix A.

Table 5.1. Description of riparian vegetation stand types (ERO, 2003).	
Type	Definition
Tall Woody Vegetation	
Cottonwood (CW)	More than 80%* cottonwood
Mixed riparian (MR) >15 feet	No single species (cottonwood/willow/tamarisk) comprises more than 80%*, trees generally more than 15 feet in height
Mixed riparian (MR) >15 feet, low density	No single species (cottonwood/willow/tamarisk) comprises more than 80%*, trees generally more than 15 feet in height, but noticeably more open with more spacing between trees
Mixed riparian (MR) <15 feet	No single species (cottonwood/willow/tamarisk) comprises more than 80%*, trees generally less than 15 feet in height
Mixed riparian (MR) <15 feet, low density	No single species (cottonwood/willow/tamarisk) comprises more than 80%*, trees generally less than 15 feet in height, but noticeably more open with more spacing between trees
Other Vegetation	
Mesquite (M)	More than 80%* mesquite
Strand (S)	Areas with dense or sparse vegetation including woody and non-woody plants directly adjacent to stream channels and in gravel bars
Shrub (SH)	Densely vegetated but few woody plants; mostly burro bush less than about 10 feet in height
Sparsely vegetated (SV)	Areas with less than 30%* vegetative cover, including bare sandbars
Tamarisk (T) <15 feet	More than 80%* tamarisk, trees generally less than 15 feet in height

*Relative Cover

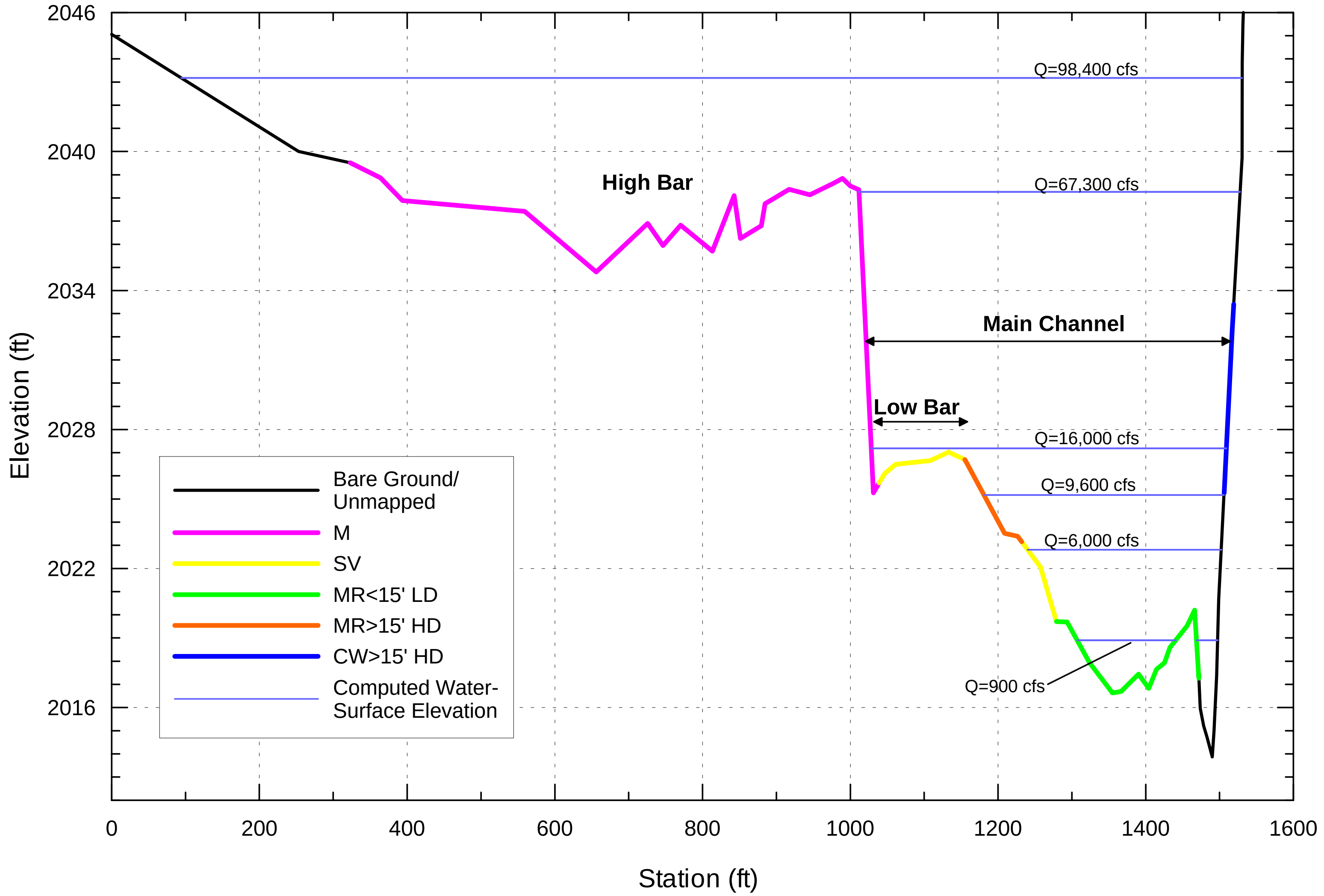


Figure 5.1. Typical cross section at Site 1 (XS2, above Horseshoe Reservoir) showing the geomorphic surfaces and associated inundation discharges.

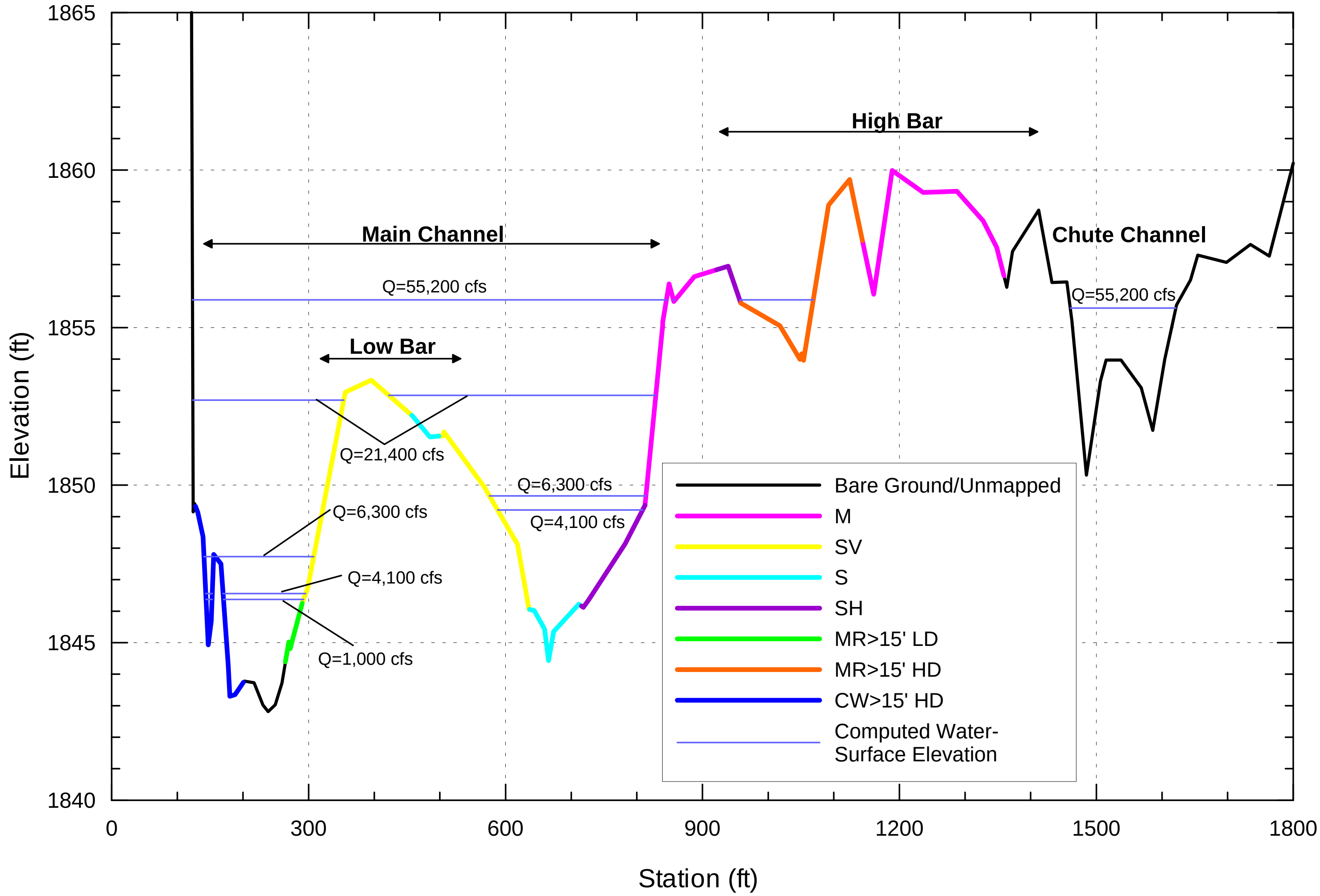


Figure 5.2. Typical cross section at Site 2 (XS2, KA Ranch) showing the geomorphic surfaces and associated inundation discharges.

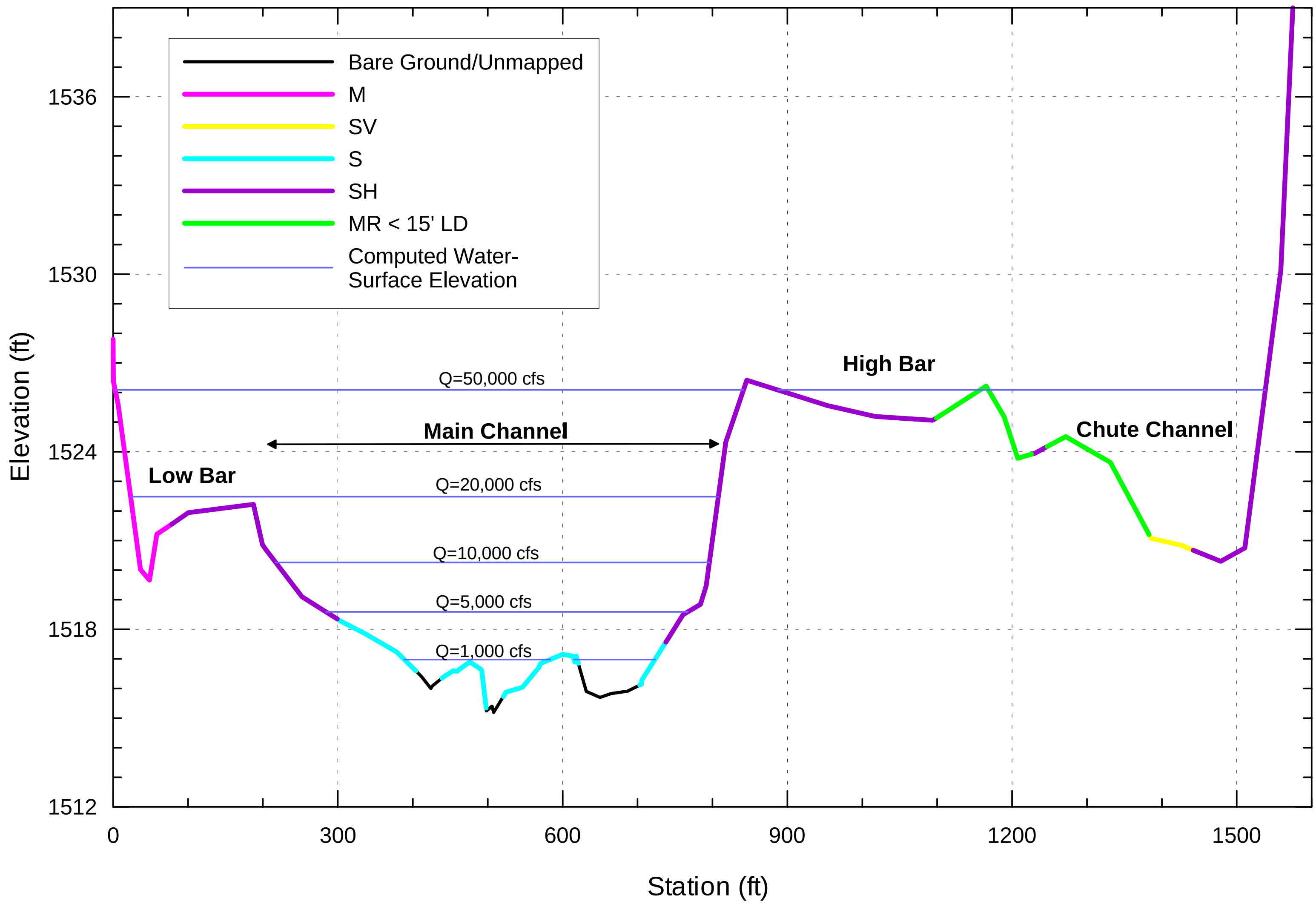


Figure 5.3. Typical cross section at Site 3 (XS8, Box Bar Ranch) showing the geomorphic surfaces and associated inundation discharges.

Table 5.2 provides a summary of the typical main channel characteristics for each of the sites.

Table 5.2. Summary of main channel characteristics for the three sites.			
Characteristic	Site 1	Site 2	Site 3
Slope (ft/ft)	0.0027	0.0041	0.0023
Bed Material D_{50} (mm)	80.5	146	95
Main Channel Capacity (cfs)	16,000	20,000	20,000
Recurrence Interval (yrs)*	2.1	4	8.4
Critical Discharge (cfs)	4,600—28,000	2,400—55,000	2,200—16,000
Recurrence Interval (yrs)*	1.3—3.5	1.1—10	1.9—7.7
Discharge for Measurable Sediment Transport (cfs)	10,000—60,000	3,200—120,000	5,000—90,000
Recurrence Interval (yrs)	1.6—7.1	1.3—>57	3.5—>22.6

*Recurrence intervals for Sites 1 and 2 are based on the records at the Tangle Creek and Bartlett gages, respectively, and for Site 3 they are based on a logarithmic interpolation between the upstream and downstream gages.

The bed-material data in Table 5.2 indicate that Site 2 has the steepest slope and coarsest bed material of the three sites. Although the amount of data for each site are somewhat limited, it does not appear that there has been channel armoring below the dams, and this can probably be attributed to the high frequency of tributaries in each of the below-dam reaches that periodically deliver both fine and coarse sediment to the Verde River downstream of the dams. As expected, the main channel capacity increases in the downstream direction (Leopold and Maddock, 1953), however, under existing conditions with the reservoirs in place, the recurrence intervals for the main channel capacity flows increase significantly, clearly indicating the role of the dams in regulating flows in the low to moderate range. If, however, the Tangle Creek frequencies are applied to the channel capacities at Sites 2 and 3, the recurrence intervals for the main channel capacity flow at these sites are 2.5 years, which is very similar to that at Site 1. This suggests that there has been little or no adjustment of the main channel dimensions downstream of the dams. Again, this lack of adjustment is probably related to the tributary sediment supply downstream of the dams, or the flood-driven channel morphology may be relatively insensitive to the sediment supply (Graf, 1988).

Table 5.3 summarizes the reservoir sedimentation data for Horseshoe Reservoir which has an upstream contributing drainage area of about 6,000 square miles.

Table 5.3. Summary of reservoir sedimentation data for Horseshoe Reservoir, 1945-2001.				
Survey Years	Volume of Stored Sediment (ac-ft)	Average Annual Sediment Yield (ac-ft/year)	Av. Annual Unit Sediment Yield (ac-ft/sq. mi/yr)	Significant Flood Years (> 5-yr RI)
1945-1950	1,200	240	0.05	None
1950-1963	3,592	276	0.05	1952
1963-1978	7,811	520	0.09	1966, 1967, 1969, 1970, 1973, 1978
1978-2001	22,210	965	0.16	1979, 1980, 1982, 1993, 1995

The unit sediment yield data in Table 5.3 indicate that the sediment yields from the basin upstream of the reservoir are strongly influenced by the occurrence of less frequent flood events, which is typical of rivers in arid and semi-arid regions (Schumm, 1977; Baker, 1977; Graf, 1988). However, regardless of the periods of record being considered these yields are low in comparison with those from other southwestern watersheds (Strand, 1975). Strand's sediment yield—drainage area relationship ($Q_s = 2.4A^{-0.229}$) indicates unit sediment yields on the order of 0.4 ac-ft/ sq. mile/year, which is at least twice as much as the unit yield for the Verde River in the period with the greatest number of large floods, and an order of magnitude higher than the values for periods with less floods. Review of sediment yields to Roosevelt Reservoir on the Salt River indicate that unit sediment yields range from 0.1 to 0.4 ac-ft/mi^2/yr in the 1980 to late 1990 period. The relatively low sediment yield for the Verde River basin may, therefore, explain why there has been little if any morphological adjustment of the channel below the dams.

The wide range of critical discharges within each of the sites reflects the morphological variability of the channel. The recurrence intervals for the range of critical discharges reflect both the hydrologic effects of the dams as well as the grain size. At Site 1, the recurrence interval of the critical discharge ranges from 1.3 to 3.5 years. At Sites 2 and 3, the recurrence intervals range from 1.1 to 10 years under the current hydrologic regime. However, if the Tangle Creek frequency curve, which is representative of the pre-dam hydrology of all three sites, is used, the RI values for Site 2 range from 1.1 to 7 years, and at Site 3 they range from 1.1 to 2.1, which are much closer to the range of values at Site 1.

The discharge range for measurable sediment transport at Site 1 is 10,000 to 60,000 cfs, with corresponding frequencies of 1.6 to 7.1 years (Table 5.2). At Site 2, the discharges range from 3,200 to 120,000 cfs, with corresponding frequencies of 1.3 to more than 57 years, and at Site 3, the discharges range from 5,000 to 90,000 cfs, with corresponding frequencies of 3.5 to 22.6 years. However, if the Tangle Creek frequency curve is used, the frequency values for Site 2 range from 1.1 to 20 years, and at Site 3, they range from 1.2 to 15 years, which are much closer to the range of values at Site 1. The pre-dam (i.e. Tangle Creek) frequencies for incipient motion and substantial transport suggest that the dams have not caused significant morphological or sedimentological changes at Sites 2 and 3.

Table 5.4 summarizes the typical low bar characteristics for each of the sites.

Table 5.4. Summary of low bar characteristics for the three sites.

Characteristic	Site 1	Site 2	Site 3
Bar Material D_{50} (mm)	73	73	61
Inundation (cfs)	10,000—16,000	10,000—20,000	10,000—20,000
Recurrence Interval (yrs)*	1.6—2.1	2.5—4	4.8—8.4
Critical Discharge Range (cfs)	35,000—60,000	32,000—50,000	20,000—100,000
Recurrence Interval (yrs)*	4.2—7.1	6—8	8.4—>50
Discharge Range for Sediment Transport (cfs)	50,000—110,000	42,000—170,000	40,000—190,000
Recurrence Interval (yrs)	6.2—>30	7—>57	9—>57

*Recurrence intervals for Sites 1 and 2 are based on the records at the Tangle Creek and Bartlett gages, respectively, and for Site 3 they are based on a logarithmic interpolation between the upstream and downstream gages.

The data in Table 5.4 indicate that there is little difference between sites in the sizes of the materials that make up the low bank-attached bars. Although the data are somewhat limited, it does not appear that there has been bar armoring below the dams, and this can probably be attributed to the high frequency of tributaries in each of the below-dam reaches that periodically deliver sediment to the Verde River. The magnitude of the flows that inundate the low bars is similar at all of the sites (10,000—20,000 cfs), but because of the reservoirs, the frequencies of inundation decrease in the downstream direction. If the Tangle Creek frequencies are applied to the low bar inundation flows in Sites 2 and 3, the recurrence intervals for the sites are the same as at Site 1. This suggests that there has been little or no adjustment of the low bars within the active channel below the dams, and therefore, any differences in colonization by riparian vegetation are most likely due to the changes in hydrology.

Similar to the main channel, the range of critical discharges for the low bars is also wide within each of the sites, again reflecting the morphological variability of the channel within the individual sites, but the ranges are somewhat similar between sites. The recurrence intervals for the range of critical discharges reflect primarily the hydrologic effects of the dams because the grain sizes are quite similar. At Site 1, the critical discharge has a range of recurrence intervals between 4.2 and 7 years which indicates that the bar materials are mobilized very infrequently. At Sites 2 and 3, the critical discharge recurrence intervals range from 6 to more than 50 years under the current hydrologic regime. However, if the Tangle Creek frequency curve is used, the frequency values for Site 2 range from 4 to 6 years, and at Site 3, they range from 2.5 to 20 years, which are much closer to the range of values at Site 1. Since removal of riparian vegetation by floods is closely tied to mobilization of the substrate (Friedman and Auble, 1999), the persistence of the vegetation downstream of the dams is primarily related to changes in hydrology.

The discharge range for measurable sediment transport on the low bars at Site 1 is 50,000 to 110,000 cfs, with corresponding frequencies of 6.2 to more than 30 years (Table 5.4). At Site 2, the discharges range from 42,000 to 170,000 cfs, with corresponding frequencies of 7 to more than 50 years, and at Site 3, the discharges range from 40,000 to 190,000 cfs with corresponding frequencies of 9 to more than 50 years. However, if the Tangle Creek frequency curve is used, the frequency values for Sites 2 and 3 range from 5 to 50 years, and are much closer to the range of values at Site 1. The data, therefore, indicate that significant transport of sediment and destabilization of the low bars occurs relatively infrequently at all of the sites, but the dams have reduced the frequency at Sites 2 and 3 This suggests that the frequency of vegetation removal from the bars by flood events has been reduced in the post-dam era. Since the ability of flows to remove vegetation is reduced by the increased age of the vegetation (Friedman and Auble, 1999; McBain and Trush, 1997), the net effect of the dams may be to significantly increase the stability of vegetated surfaces.

Table 5.5 provides a summary of the typical high bar characteristics for each of the sites.

The data in Table 5.5 indicate that the high bar surface sediments at Site 2 are much coarser than at Sites 1 and 3, and the magnitude of the flows that inundate the high bars decreases in the downstream direction. At Site 1, high bar inundation occurs throughout the site at a discharge of about 67,000 cfs, whereas at Sites 2 and 3, the high bars are inundated by flows of 55,000 cfs and 50,000 cfs, respectively. Although the discharge required to inundate these surfaces decreases in the downstream direction, the recurrence interval between inundation discharges increases from about 9 years at Site 1 to 12 years at Site 3 due to the influence of the reservoirs (Figure 3.5). If the Tangle Creek frequencies are applied to the high bar inundation flows in Sites 2 and 3, the recurrence intervals for the sites are essentially the same as at Site 1. This further suggests that there has been little or no adjustment of the high bars within the active channel below the dams, and therefore, any differences in colonization by riparian vegetation on these surfaces are due to the changes in hydrology. Table 5.5 also shows that the critical discharge for the high bar surface at all of the sites exceeds 160,000 cfs (> 50-year RI) and measurable transport of the bar sediments occurs at flows in excess of 200,000 cfs (>100-year RI). Therefore, mobilization of the upper bar surfaces occurs very infrequently at all of the sites, and the dams have had little effect on the dynamics of this surface (Figure 3.5).

Table 5.5. Summary of high bar characteristics for the three sites.

Characteristic	Site 1	Site 2	Site 3
Bar Material D_{50} (mm)	73	105	61
Inundation (cfs)	67,000	55,000	50,000
Recurrence Interval (yrs)*	8.6	10	12
Critical Discharge Range (cfs)	170,000	> 200,000	160,000
Recurrence Interval (yrs)*	>50	—	>50
Discharge Range for Sediment Transport (cfs)	>200,000	>200,000	>200,000
Recurrence Interval (yrs)	—	—	—

*Recurrence intervals for Sites 1 and 2 are based on the records at the Tangle Creek and Bartlett gages, respectively, and for Site 3 they are based on a logarithmic interpolation between the upstream and downstream gages.

Table 5.6 summarizes the typical chute channel characteristics for each of the sites.

Table 5.6. Summary of chute channel characteristics for the three sites.

Characteristic	Site 1	Site 2	Site 3
Bar Material D_{50} (mm)	73	105	61
Inundation (cfs)	16,000	30,000--55,000	10,000--50,000
Recurrence Interval (yrs)*	2.1	6—10	4.8—12
Critical Discharge Range (cfs)	>200,000	120,000—170,000	40,000—180,000
Recurrence Interval (yrs) *	—	>50	9—>50
Discharge Range for Sediment Transport (cfs)	>200,000	>200,000	55,000—150,000
Recurrence Interval (yrs)	—	—-	13—>50

*Recurrence intervals for Sites 1 and 2 are based on the records at the Tangle Creek and Bartlett gages, respectively, and for Site 3 they are based on a logarithmic interpolation between the upstream and downstream gages.

No sediment measurements were made in the chute channels during the field visit, so for the purposes of the sediment mobilization analyses, the high bar surface sediment gradations were assumed to apply (Table 5.6). The magnitude of the flow that inundates the chute channel that occupies a significant part of the upper reaches of Site 1 is about 16,000 cfs, and this has a frequency of 2.1 years. Because of the high frequency of inundation, there is a general absence of vegetation in the chute channel over time (refer to Chapter 2). Inundation of the chute channel at Site 2 occurs at a range of discharges between 30,000 cfs and 55,000 cfs, and the corresponding frequencies are from 6 to 10 years. At Site 3, inundation of the chute channels occurs at flows between 10,000 cfs and 50,000 cfs, and the corresponding frequencies are 4.8 to 12 years. The critical discharge and sediment transport data for the three sites indicate that sediment mobilization in the chute channels is an infrequent event at all of the sites. The low frequency of sediment mobilization explains why chute channels at all of the sites have persisted over time, and also why riparian vegetation persists at these sites.

5.2. Flow-Duration Analysis

To evaluate whether modification of reservoir operations could be used to increase the amount of woody riparian vegetation and SWWFC habitat, hydrographs for the 1991, 1993, 1995 (2), 1997 and 1998 floods were routed through the reservoirs under the Full Operation and Full Release alternatives for two reservoir storage conditions (low pool and high pool elevations, refer to Chapter 3 for details). Water-surface elevations for each of the sites were determined at each cross section for the individual floods for the various alternatives with the HEC-RAS models. Typical examples of the model output for the three sites are presented in **Figures 5.4 through 5.6**. The bar charts show the elevations of the peak discharges for the various floods for the modeled scenarios next to the plotted cross section that has been color-coded to show the vegetation types at each of the sites (Table 5.1). On Figure 5.4, the only scenario shown is the natural hydrograph since Site 1 is located upstream of the reservoirs. Figures 5.5 and 5.6 show the water-surface elevations for the routed floods for each of the scenarios. Similar plots for all of the cross sections at the three sites are provided in **Appendix D.**

For each of the geomorphic surfaces identified at the three sites (Table 5.2—main channel, Table 5.4—low bar, Table 5.5—high bar; and Table 5.6—chute channel) an analysis of the duration of the discharge(s) that inundated the surfaces, mobilized the sediment and transported the sediment, for each of the scenarios was conducted to determine whether modification of the reservoir operations would to able to cause an increase in the amount of woody riparian habitat. Bar graphs showing the number of days that the discharges were equaled or exceeded for each of the simulated hydrographs generated for the various scenarios are presented in **Appendix E**.

At Site 1, the discharge associated with the main channel capacity (16,000 cfs), low bar inundation (16,000 cfs), high bar inundation (67,000 cfs) and chute channel inundation (16,000 cfs) was equaled or exceeded for about 9.5 days in 1993, but during the other evaluated floods, it was equaled or exceeded for less than 3 days. The critical discharge for the bed material in the main channel was equaled or exceeded for about 10 days in the 1991 flood, for up to 27 days in 1993, for 10 days in the 1995 flood, and for about 11 days in the 1978 flood. With the exception of 1993, where measurable transport of the bed material in the main channel occurred for about 16 days, the remainder of the floods would have transported sediment in the main channel for between 1 and 4 days. From a morphological perspective, the 1993 and 1995 floods were the most effective in the main channel, and would be expected to cause the most change at the site. The critical discharge for the low bar surfaces (35,000—60,000 cfs) would only have been exceeded in the 1993 and 1995 floods, and then only for between 1 and 3.5 days. Sediment transport on the low bar surfaces (50,000 to 110,000 cfs) would have occurred for between 1 and 2 days in 1993 and 1995. Neither incipient motion nor measurable transport would have occurred on the high bar surfaces during any of the floods.

At Sites 2 and 3, the same general patterns were observed for the durations of inundation, exceedence of the critical discharge and measurable sediment transport for each of the routed floods. However, as can be seen in **Figures 5.7 and 5.8** which are typical examples for Sites 2 and 3, respectively, the various operational scenarios have very little, if any, influence on the flow durations for any of the surfaces. Therefore, it is unlikely that they will have significant effect on the amount of woody riparian vegetation at the sites.

Site 1, Cross Section 1

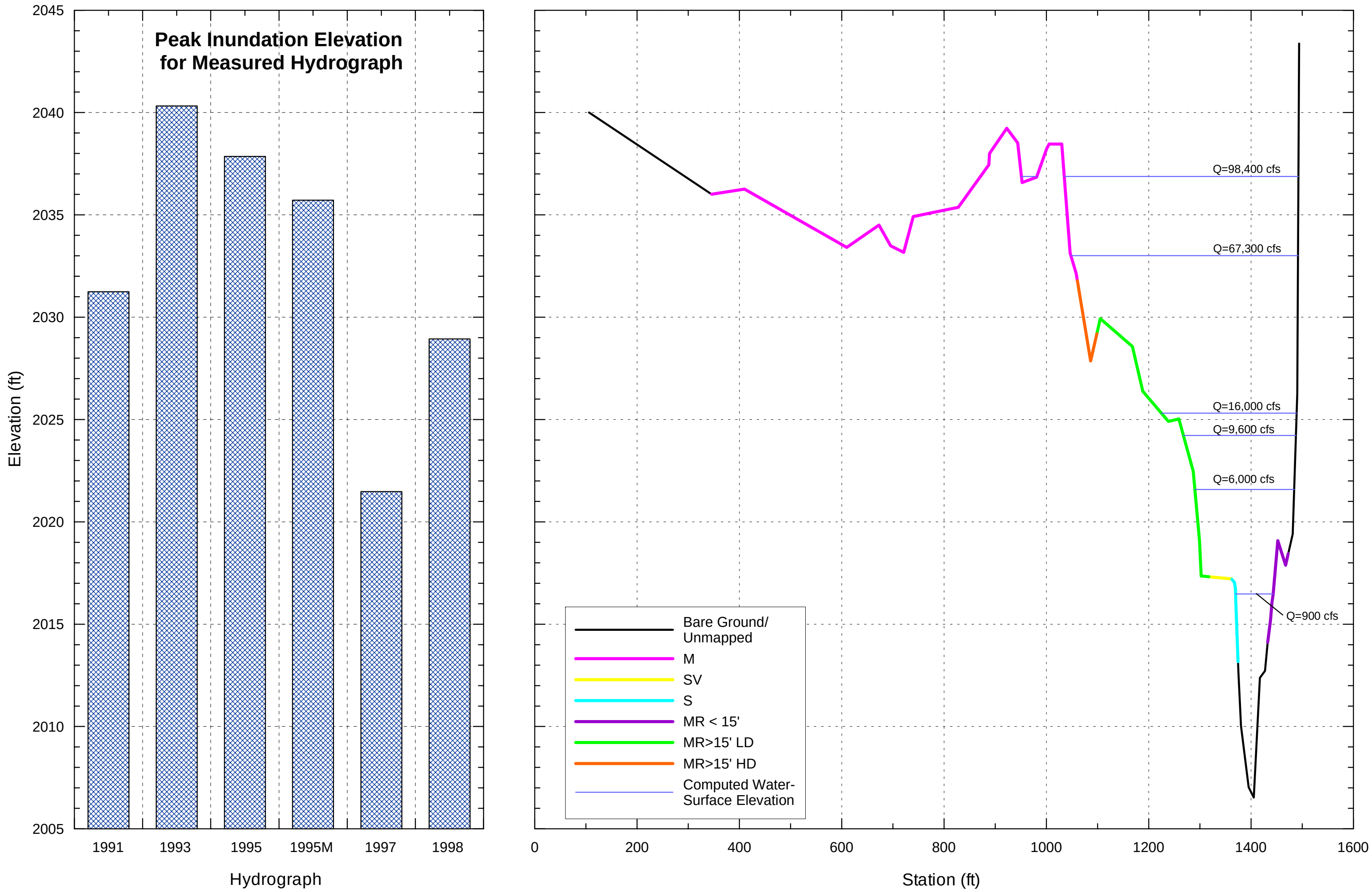


Figure 5.4. Peak discharge elevations for the 1991, 1993, 1995, 1995M, 1997 and 1998 floods plotted with the cross section profile for Cross Section 1 at Site 1. The cross section is color coded to show the distribution of the various types of vegetation at the site (refer to Table 5.1 for full descriptions of the vegetation codes).

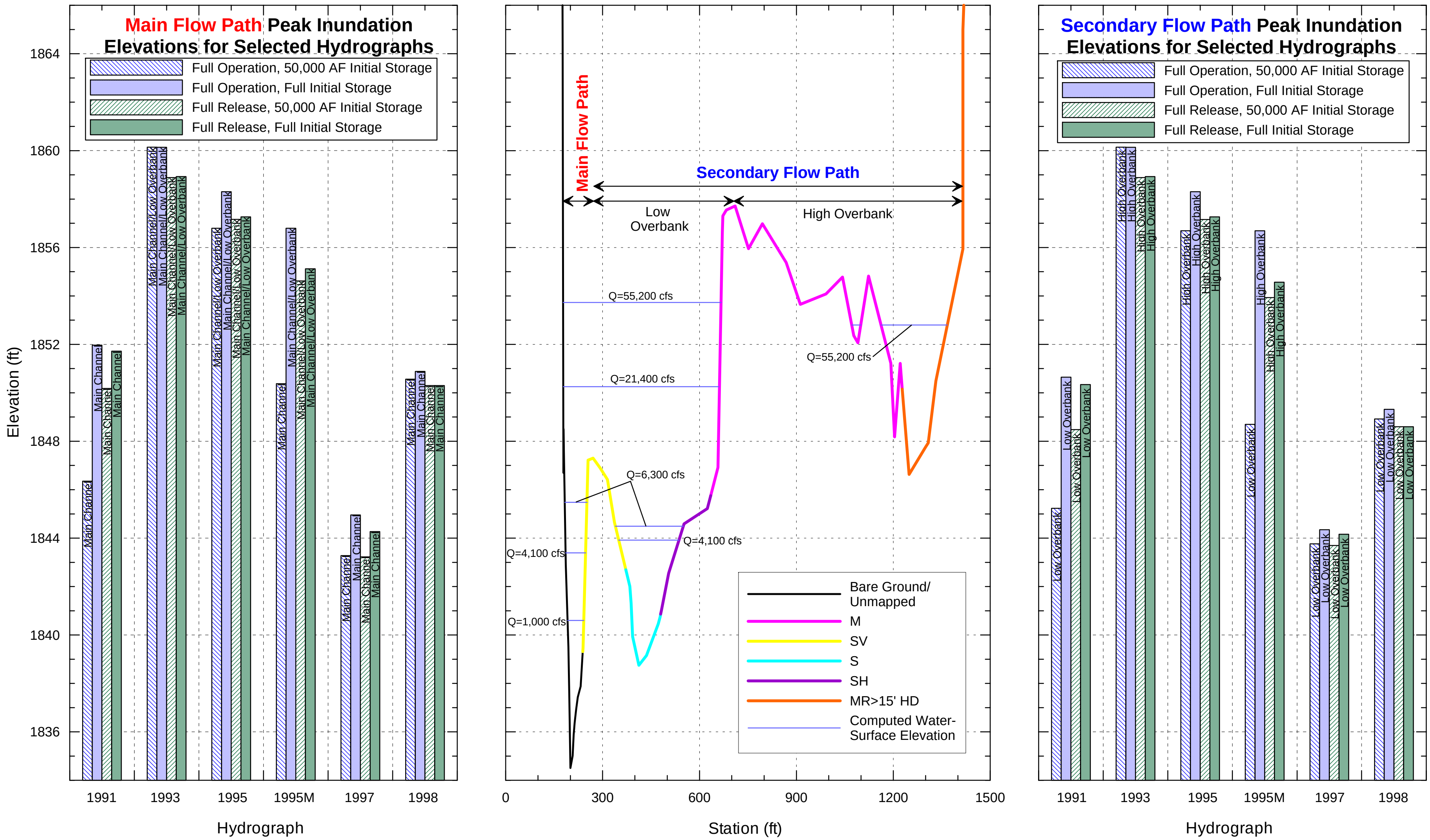


Figure 5.5. Peak discharge elevations for the 1991, 1993, 1995, 1995M, 1997 and 1998 floods for the various scenarios plotted with the cross section profile for Cross Section 1 at Site 2. The cross section is color coded to show the distribution of the various types of vegetation at the site (refer to Table 5.1 for full descriptions of the vegetation codes).

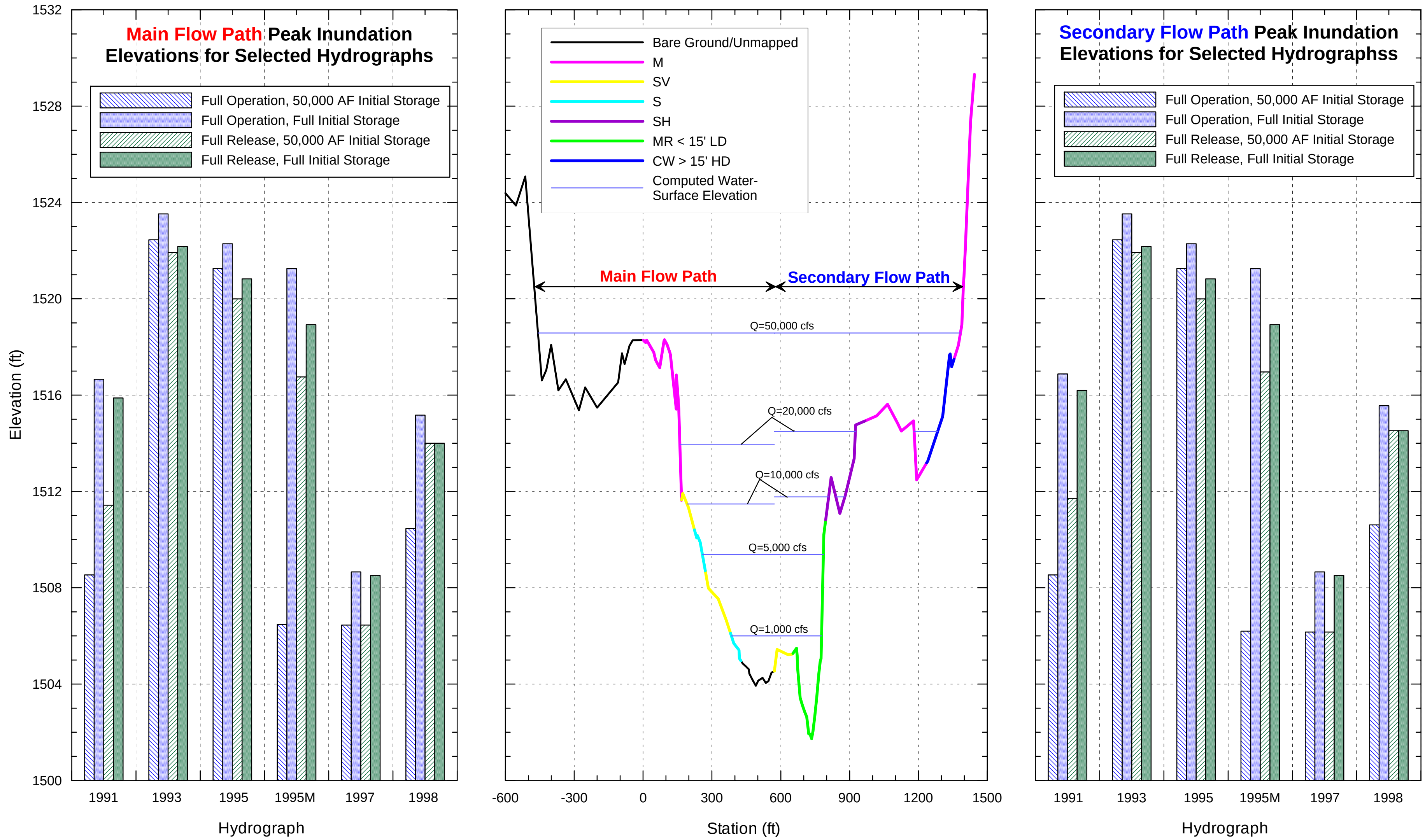


Figure 5.6. Peak discharge elevations for the 1991, 1993, 1995, 1995M, 1997 and 1998 floods for the various scenarios plotted with the cross section profile for Cross Section 1 at Site 1. The cross section is color coded to show the distribution of the various types of vegetation at the site (refer to Table 5.1 for full descriptions of the vegetation codes).

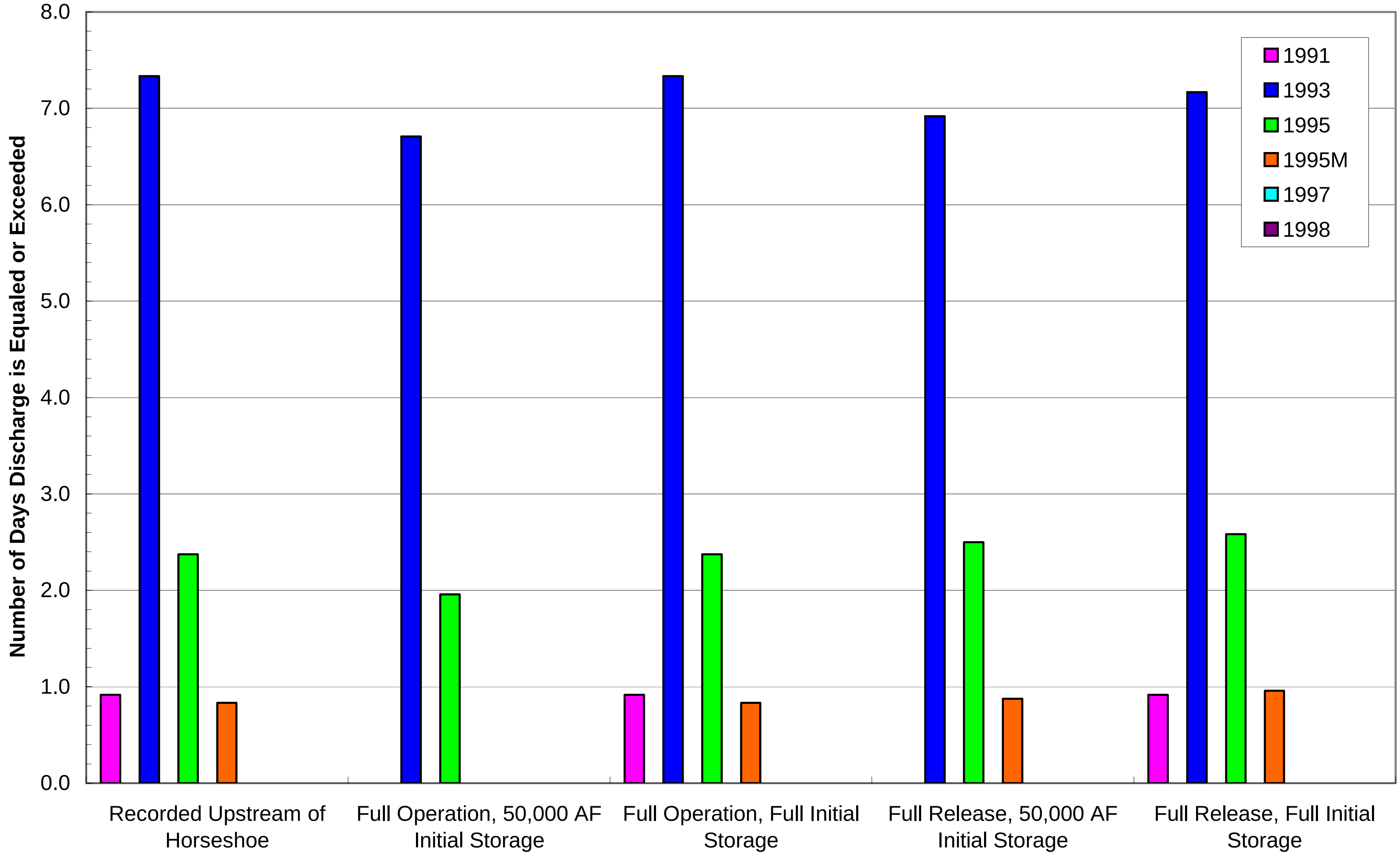


Figure 5.7. Durations that main channel capacity is equaled or exceeded for the various scenarios during the simulated flood hydrographs at Site 2.

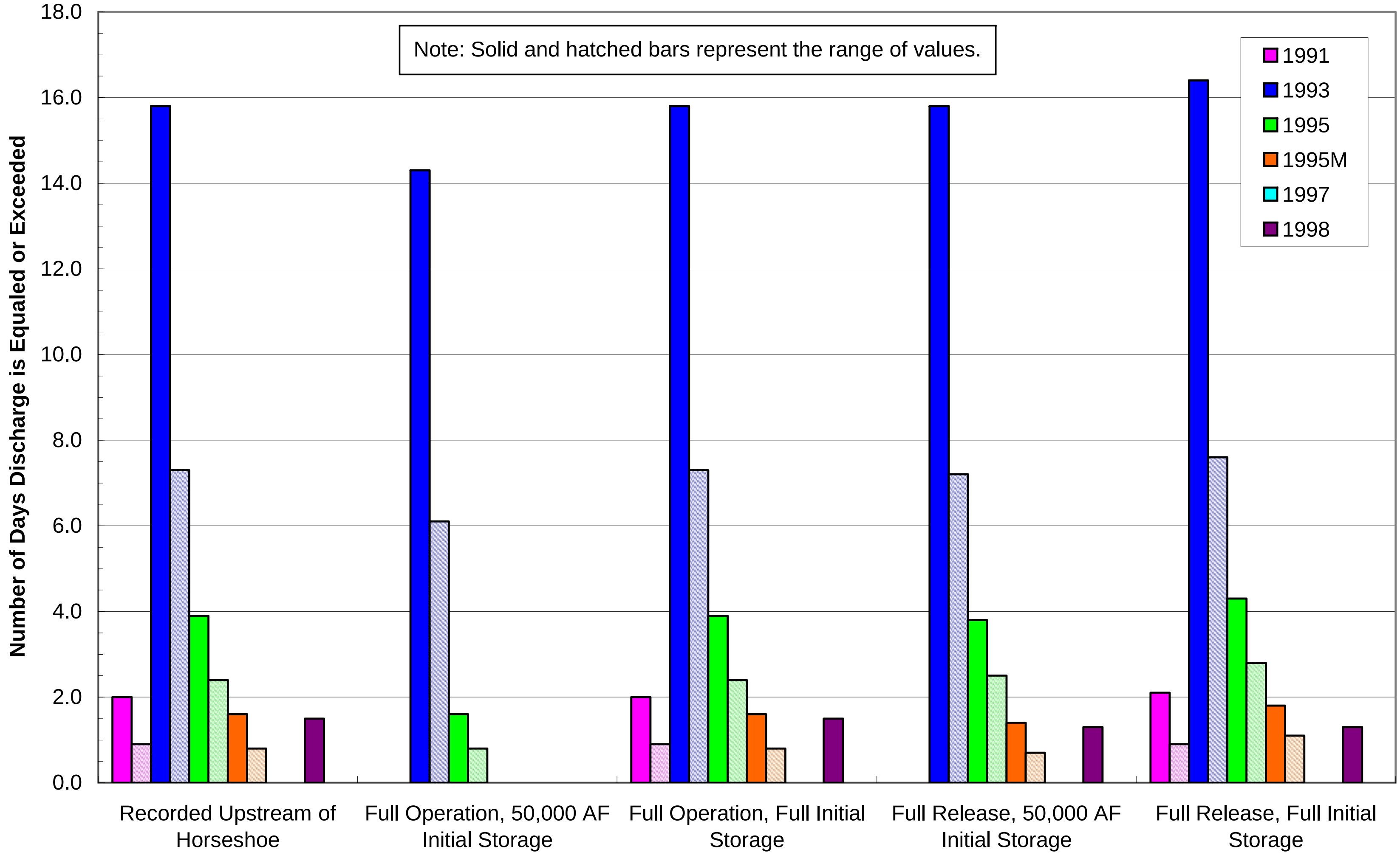


Figure 5.8. Durations of the flows at which the low bars are inundated for the various scenarios during the simulated flood hydrographs at Site 3.

6. SUMMARY AND CONCLUSIONS

In order to evaluate the effects of Horseshoe and Bartlett Dams on the Verde River on the distribution of woody riparian vegetation, it is necessary to quantify the effects of various dam operations on the frequency and duration of inundation of likely areas for the establishment and maintenance of the vegetation, and to determine the flows necessary to mobilize the channel bed and bar sediments that form the substrate for the vegetation. This information can then be used by plant ecologists to evaluate the likely effects of various dam operations on the establishment and maintenance of the vegetation.

Mussetter Engineering, Inc. (MEI) was retained by the Salt River Project (SRP) to assist plant ecologists from ERO Resources Corporation (ERO) to address the issue of whether re-operation of the dams on the Verde River could significantly improve downstream conditions for establishment and maintenance of woody riparian vegetation. MEI assisted ERO in selecting study sites (Figure 1.1) for the analysis; sampled the bed and bar sediments, developed one-dimensional (1-D) hydraulic models, and used the models to evaluate the extent and frequency at which various geomorphic surfaces are inundated and the range of flows that are required to mobilize the sediment that makes up the in-channel bars and channel margins within the riparian zone at each of the sites.

6.1. Summary

The geomorphic surfaces within each of the sites were identified from field inspections and analysis of aerial photographs and topographic maps prepared for each of the sites. Time-sequential aerial photography between 1934 and 2002 was reviewed to identify changes in channel morphology and vegetation cover, particularly as related to the occurrence of large floods. At the Tangle Creek gage, floods with recurrence intervals in excess of five years (40,000 cfs) occurred in 1891, 1906, 1916, 1920, 1927, 1932, 1937, 1938, 1941, 1952, 1967, 1969, 1970, 1973, 1978, 1979, 1980, 1982, 1993 and 1995. Following construction of the dams in 1939 (Bartlett) and 1946 (Horseshoe), floods of a similar magnitude occurred much less frequently at the Bartlett gage (1941, 1978, 1979, 1980, 1993 and 1995). Because of the relatively small capacity of the reservoirs, the effects of the dams on the flood-frequency relationships are most pronounced for events less than about the 10-year event (Figure 3.5). At larger flows, the above- and below-dam frequencies are similar. Analysis of the effects of various operational scenarios for the reservoirs for a range of simulated flood hydrographs that were based on the 1991, 1993, 1995 (2), 1997 and 1998 floods, demonstrated that the durations of inundation of the identified geomorphic surfaces would be very similar for all of the modeled scenarios. Therefore, modification of reservoir operations is unlikely to increase the amount of woody riparian vegetation.

6.1.1. Site 1: Upstream of Horseshoe Reservoir near Tangle Creek Gage

Site 1 is located upstream of Horseshoe Dam and just downstream of the Tangle Creek gage (Figure 1.1). The braided channel of the Verde River at this site is confined between alluvial terraces and Tertiary-age basin-fill sediments in a relatively narrow valley, and there is no well-developed floodplain. Within the site, the following geomorphic surfaces were identified: (1) main channel with a capacity of about 16,000 cfs [2.1–year recurrence interval (RI)], (2) low bar surfaces inundated at about 16,000 cfs, (3) high bar surfaces inundated at about 67,000 cfs

(8.6–year RI), and (4) chute channels that are inundated at about 16,000 cfs. The slope of the river at the site is 0.0027, and the median (D_{50}) sizes of the sediments that comprise the main channel, low bars, high bars, and chute channels are 81, 73, 73, and 73 mm, respectively. The critical discharge (discharge at which sediment begins to be mobilized) in the main channel, the edges of which support a fringe of riparian vegetation, ranges from 4,600 to 28,000 cfs, which has corresponding RI of 1.3 to 3.5 years. Significant bed mobilization occurs at a range of discharges between 10,000 and 60,000 cfs (1.6 to 7-year RI). The critical discharge range for the low bar surfaces that tend to be associated with the riparian vegetation is 35,000 to 60,000 cfs (4 to 7-year RI), and significant sediment mobilization occurs at a range of discharges between 50,000 and 110,000 cfs (6 to >30-year RI). The critical discharge range for the high bar surfaces that tend to be associated with mesquite and other non-riparian vegetation species, is about 170,000 cfs (>50-year RI), and significant sediment mobilization occurs at discharges of >200,000 cfs (>100-year RI). The chute channel that extends for much of the length of the site is inundated at about 16,000 cfs, but because of the presence of very coarse bed material, the critical discharge and significant sediment mobilization occur at flows in excess of 200,000 cfs. Frequent flows within the chute channel remove any fine sediment.

Review of the time-sequential aerial photographs of the site confirms the findings of the hydraulic and sediment-transport analyses. Between large floods, vegetation tends to establish on the lower bar surfaces, but the vegetation is stripped off during large floods. The high bar surfaces tend to remain vegetated even when there have been large floods because the flow depths, and therefore, shear stresses are low.

6.1.2. Site 2: Downstream of Horseshoe Dam Near the KA Ranch

Site 2 is located about two miles downstream of Horseshoe Dam near the KA Ranch (Figure 1.1). The site is located within a wider reach of the Verde River valley that is controlled at the downstream end by a narrower valley constriction. The downstream constriction, and the locally wider reach of the valley that is confined between old alluvial fans to the west and Tertiary-age basin-fill sediments to the east, has created a net depositional reach of the river that has a braided planform. Davenport Wash on the east, and a large unnamed arroyo on the west, episodically deliver sediment to the reach, and this sediment at least partially compensates for the loss of the upstream sediment supply. Sedimentation rates in Horseshoe Reservoir (Table 5.2) suggest that the Verde River transports significantly less sediment than many other rivers in the southwestern US, and this may explain why there have been few reservoir-related morphological changes to the river below the dam.

Within the site, the following geomorphic surfaces were identified: (1) main channel with a capacity of about 20,000 cfs (4-year RI), (2) low bar surfaces inundated at flows between 10,000 and 20,000 cfs (2.5- to 4-year RI), (3) high bar surfaces inundated at about 55,000 cfs (10-year RI), and (4) chute channels that are inundated at flows between 30,000 and 55,000 cfs (6 to 10-year RI). If the Tangle Creek gage flood frequencies, which are representative of the pre-dam hydrology at all three study sites, are applied to the discharges that are associated with the geomorphic surfaces at Site 2, they are very similar to those at Site 1, which indicates that there has been little, if any, morphological adjustment of the Horseshoe and Bartlett Dams. The differences in the associated flow frequencies are due to the changes in hydrology.

The slope of the river at the site is 0.0047, and the median (D_{50}) sizes of the sediments that comprise the main channel, low bars, high bars, and chute channels are 146, 73, 105 and 105 mm, respectively, which are somewhat coarser than those at Site 1, probably because of the steeper slope and local delivery of sediment by both Davenport Wash and the unnamed arroyo.

The critical discharge in the main channel, the edges of which support a fringe of riparian vegetation, ranges from 2,400 to 55,000 cfs which have corresponding RI's of 1.1 to 10 years. Significant bed mobilization occurs at a range of discharges between 3,200 and 120,000 cfs (1.3 to >57-year RI). The critical discharge range for the low bar surfaces that tend to be associated with the riparian vegetation is 32,000 to 50,000 cfs (6- to 8-year RI), and significant sediment mobilization occurs at a range of discharges between 42,000 and 170,000 cfs (7 to >57-year RI). The RI's of the critical discharges and discharges for substantial sediment transport in the main channel and low bars from the Tangle Creek (i.e., pre-dam) flood-frequency curve are similar to those at Site 1, further indicating that there has been little, if any, morphologic adjustment of the channel between Horseshoe and Bartlett Dams. The critical discharge range for the high bar surfaces that tend to be associated with mesquite and other non-riparian vegetation species is above 200,000 cfs. The critical discharges for the chute channels that are located primarily in the downstream portions of the site, are between 120,000 and 170,000 cfs (>50-year RI), and significant sediment transport occurs at flows in excess of 200,000 cfs.

Review of the time-sequential aerial photographs of the site confirms the findings of the hydraulic and sediment-transport analyses. Between large floods, vegetation tends to establish on the lower bar surfaces, but the vegetation is stripped off during large floods. The high bar surfaces tend to remain vegetated even when there have been large floods because the flow depths, and therefore, shear stresses are low. Chute channels are formed during the infrequent large floods and remain stable for long periods of time. They appear to be the preferred sites for cottonwood establishment following the large infrequent floods.

6.1.3. Site 3: Downstream of Bartlett Dam near the Box Bar Ranch

Site 3 is located about 6.5 miles downstream of Bartlett Dam near the Box Bar Ranch (Figure 1.1). The site is located within a much wider reach of the Verde River valley that is located upstream of a narrower valley constriction that makes Site 3 a net depositional area. The braided river is confined between heavily vegetated alluvial terraces to the east and alluvial terraces and old, relatively erosion-resistant, alluvial deposits to the west, and there is no well-developed floodplain. The younger flanking terraces are inundated by large infrequent flows (Skotnicki, 1996).

Within the site, the following geomorphic surfaces were identified: (1) main channel with a capacity of about 20,000 cfs (8.4-year RI), (2) low bar surfaces inundated at flows between 10,000 and 20,000 cfs (4.8 to 8.4-year RI), (3) high bar surfaces inundated at about 50,000 cfs (12-year RI), and 4) chute channels that are inundated at flows between 10,000 and 50,000 cfs (4.8 to 12-year RI). If the Tangle Creek (i.e., pre-dam) flood frequencies are applied to the discharges that are associated with the geomorphic surfaces at Site 3, they are very similar to those at Site 1, which indicates that there has been little, if any, morphological adjustment of the channel downstream of both dams. The differences in the associated flow frequencies are due to the changes in hydrology.

The slope of the river at the site is 0.0023, and the median (D_{50}) sizes of the sediments that comprise the main channel, low bars, high bars, and chute channels are 95, 61, 61 and 61 mm, respectively, which are somewhat finer than those at Site 2, probably because of the flatter slope. The critical discharge in the main channel, the edges of which support a fringe of riparian vegetation, ranges from 2,200 to 16,000 cfs, which have corresponding RI's of 1.9 to 7.7 years. Significant bed mobilization occurs at a range of discharges between 5,000 and 90,000 cfs (3.5 to 22-year RI). The critical discharge range for the low bar surfaces that tend to be associated with the riparian vegetation is 20,000 to 100,000 cfs (8.4 to >50-year RI), and significant sediment mobilization occurs at a range of discharges between 40,000 and 190,000 cfs (9 to >57-year RI). The RI's of the critical discharge and discharge for substantial sediment transport in the main channel and low bars from the Tangle Creek (i.e., pre-dam) flood-frequency curves are similar to those at Site 1, further indicating that there has been little, if ay, morphologic adjustment of the channel downstream from both dams. The critical discharge range for the high bar surfaces that tend to be associated with mesquite and other non-riparian vegetation species, is about 160,000 cfs, but significant sediment transport does not occur at flows under 200,000 cfs. The critical discharges for the chute channels that are located primarily in the downstream portions of the site, are between 40,000 and 180,000 cfs (9 to >50-year RI), and significant sediment transport occurs at flows between 55,000 and 150,000 cfs (13 to >50-year RI).

The vegetation and morphological changes that were observed on the time-sequential aerial photography may be related to the effects of the upstream dam on the frequency of morphogenetically significant events (Figure 2. 7), as well as by the fact that the earlier part of the 20th century was wetter than the later part. Prior to construction of Bartlett Dam, inundation of portions of the younger Lehi terrace probably occurred with a frequency of about 2.5 to 3 years at a discharge of about 20,000 cfs. In the post-Bartlett period, the same flow has a recurrence interval of about 7 years. Review of the flow records at the Bartlett gage indicates that between 1942 and 1965 the largest peak flow was less than 10,000 cfs. The aerial photography shows that vegetation became well established during this 23-year period in areas of the site that were obviously disturbed in the 1934 photographs. In contrast, at the Tangle Creek gage, there were six floods in excess of 20,000 cfs in the same time period. Between 1965 and 1977, there were no flows in excess of 15,000 cfs below Bartlett Dam. Cumulatively, the three floods of 1978, 1979 and 1980 caused significant morphological and vegetation changes at the site, but these flood magnitudes ranged between 75,800 and 101,000 cfs (15 to 50-year RI). Hydraulic modeling of the site indicates that, at a discharge of 100,000 cfs, about 20 percent of the total flow is being conveyed in the left overbank area and this magnitude of flow is, therefore, capable of effecting change. In contrast, at a discharge of 50,000 cfs, less than 10 percent of the total flow is being conveyed in the left overbank area, and hence there is a much lower potential to effect change. The large floods of the late 1970s were again followed by a period of 12 years (1981 through 1992) when the maximum flow was less than 17,000 cfs below Bartlett Dam, but six events exceeded 20,000 cfs at the upstream gage in the same time period. The 1993 (84,700 cfs) and 1995 (64,100 cfs) floods with RI's of 11 and 18 years, respectively, caused very little change in the left overbank area at the site, probably because of the extent of the vegetation that has become established since the dam was constructed due to the infrequent disturbance of the site in the post-dam period.

6.2. Conclusions

This study was conducted to determine whether re-operation of the dams could significantly improve conditions for establishment and maintenance of woody riparian vegetation. The following general conclusions can be drawn from the results of the investigation:

1. The magnitudes of the discharges that inundate the channels and bars, and that mobilize the sediments that comprise these geomorphic features at all of the sites are similar, which indicates that there has been little, if any, morphological or sedimentological adjustment of the Verde River in response to the dams.

2. The reduced frequencies of inundation of the channels and bars, and mobilization of their constituent sediments downstream of the dams are due to the changes in hydrology imposed by the dams. Because of the smaller capacity of Horseshoe Reservoir, the frequency reductions at Site 2 are less than those at Site 3 that is located below Bartlett Reservoir and has a much larger storage capacity.

3. Reduction in the frequency of morphogenetically significant events below Bartlett Dam has enabled primarily mesquite vegetation to become better established in the left overbank area, and this reduces the erodibility of the low terrace during the less frequent, higher magnitude events that are not significantly affected by the upstream dams.

4. The reservoir re-operation scenarios that were considered in this analysis would have an insignificant effect on the frequency and duration at which geomorphic surfaces along the margins of the Verde River are inundated and mobilized. These processes are part of the disturbance regime that is important for establishing and maintaining riparian vegetation; thus, implementation of the scenarios would also have an insignificant effect on the health of the riparian corridor.

5. Comparison of the below Bartlett Dam flow-duration curve with the Tangle Creek gage flow-duration curve (Figure 3.6) shows that the durations of flows in the 200- to 1,400-cfs range have been increased by the dams, and these increased flows occur during the May through October period (Figure 3.7). The increased flows may well be responsible for supporting the relatively low-elevation channel margin riparian vegetation (Appendix A).

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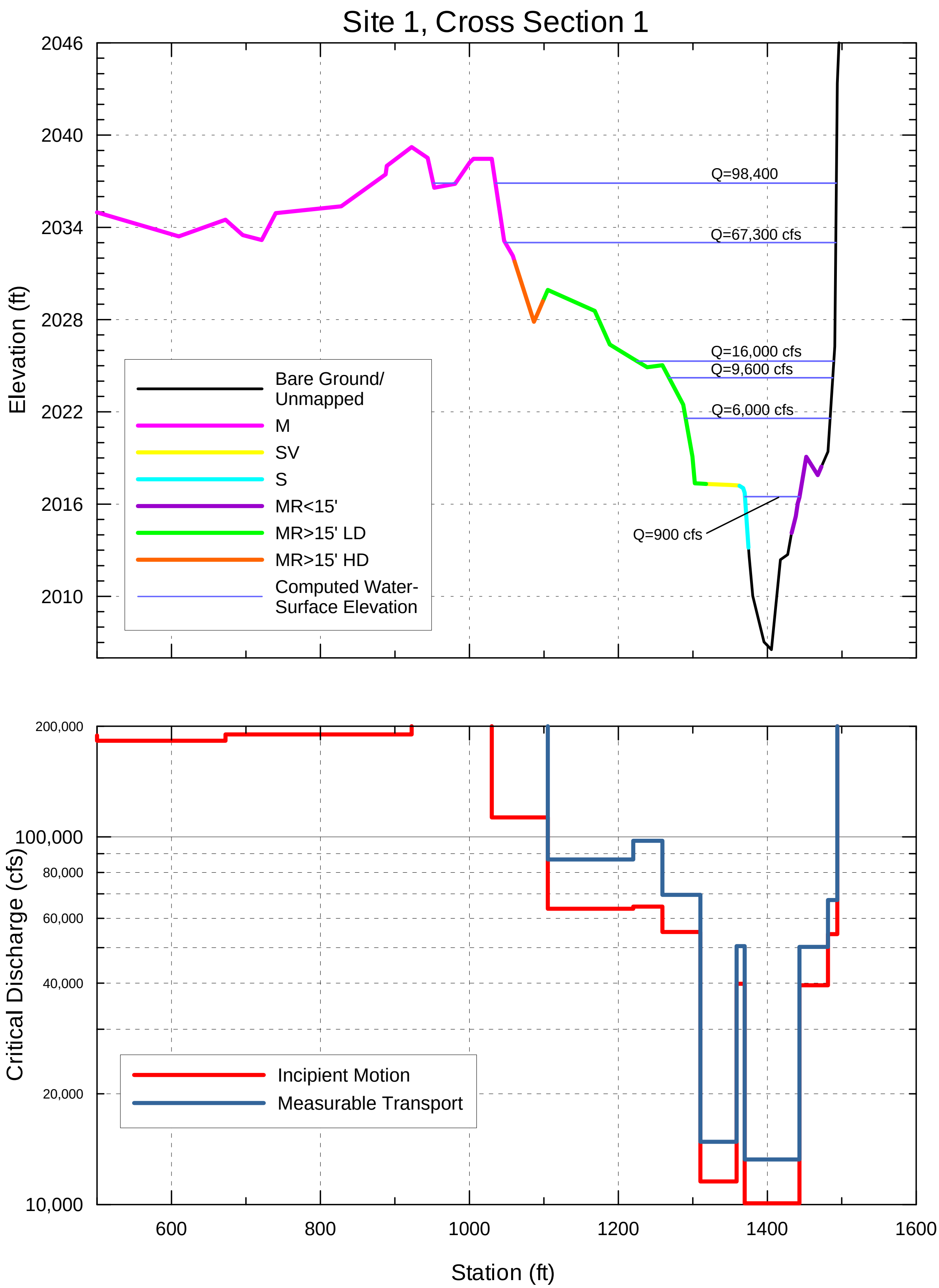
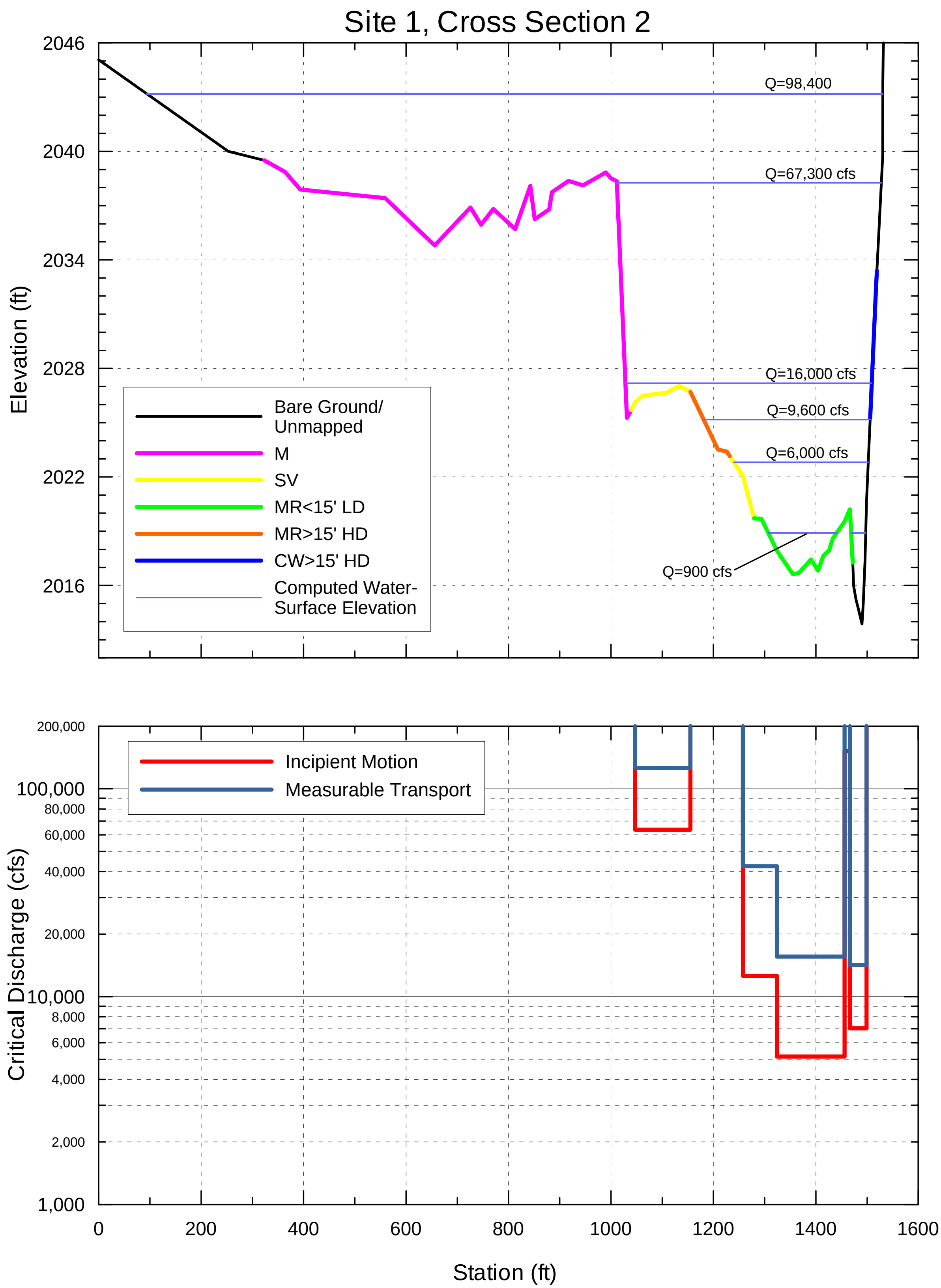
APPENDIX A

Surveyed Cross Sections for Three Sites Showing the Distribution of Vegetation, Water-Surface Elevations and Incipient Motion, and Measurable Sediment-Transport Thresholds

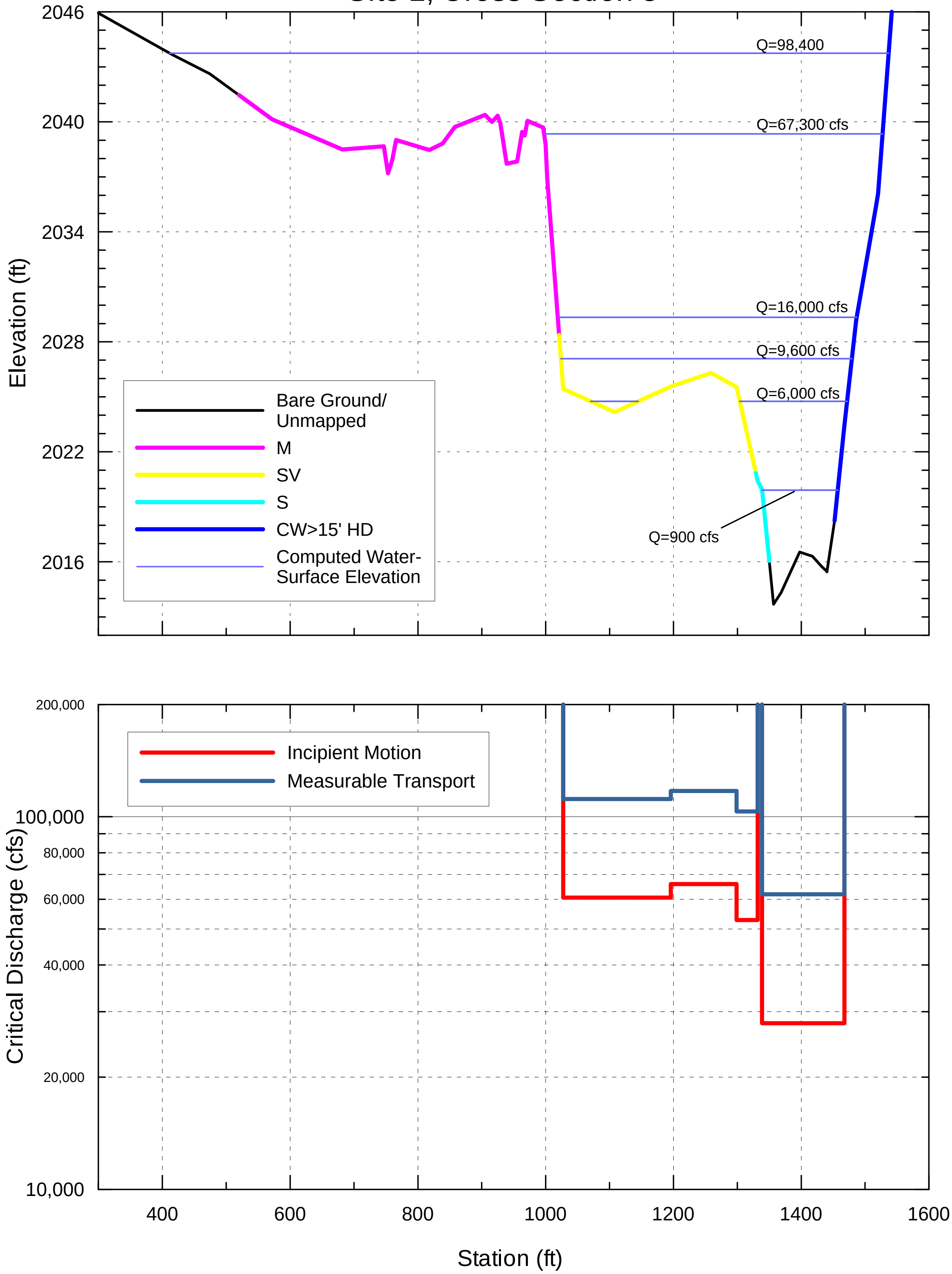


Site 1, Cross Section 1
Elevation (ft)
2046
2040
2034
2028
2022
2016
2010
Q=98,400
Q=67,300 cfs
Q=16,000 cfs
Q=9,600 cfs
Q=6,000 cfs
Q=900 cfs
Bare Ground/ Unmapped
M
SV
S
MR<15'
MR>15' LD
MR>15' HD
Computed Water-Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
Incipient Motion
Measurable Transport
600
800
1000
1200
1400
1600
Station (ft)

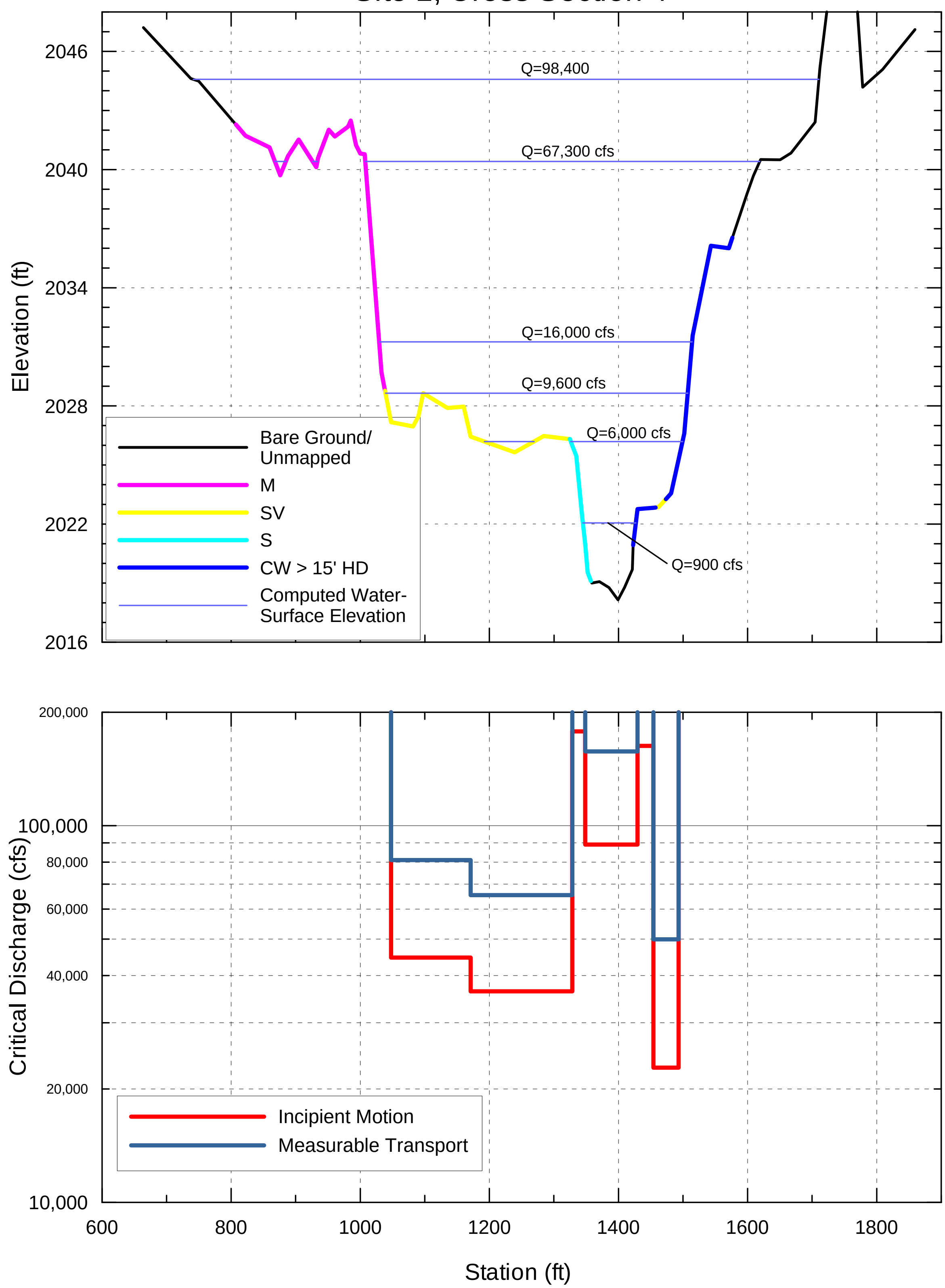


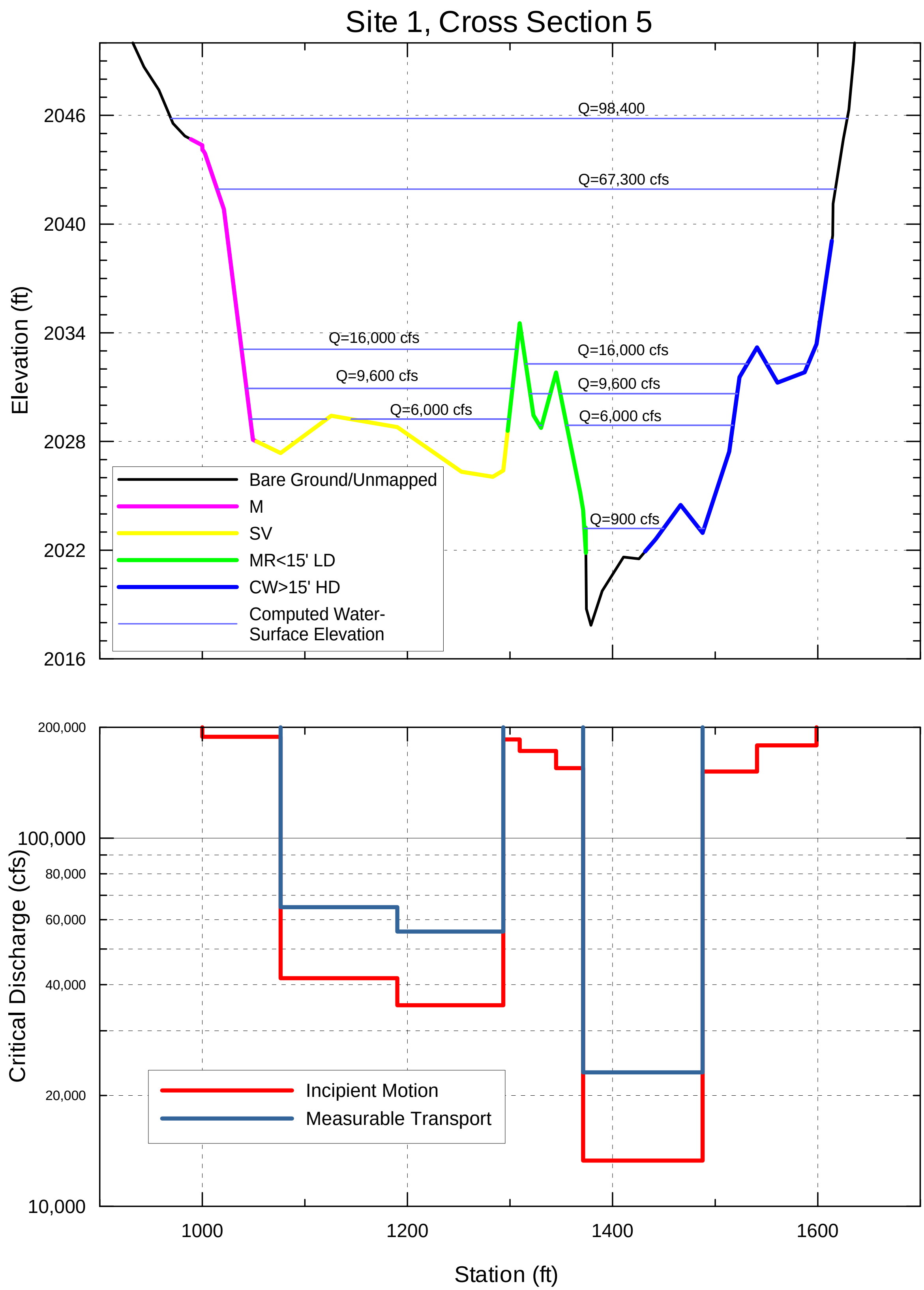
Site 1, Cross Section 2
Elevation (ft)
2046
2040
2034
2028
2022
2016
Q=98,400
Q=67,300 cfs
Q=16,000 cfs
Q=9,600 cfs
Q=6,000 cfs
Q=900 cfs
Bare Ground/
Unmapped
M
SV
MR<15' LD
MR>15' HD
CW>15' HD
Computed Water-
Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
200
400
600
800
1000
1200
1400
1600
Station (ft)

Site 1, Cross Section 3

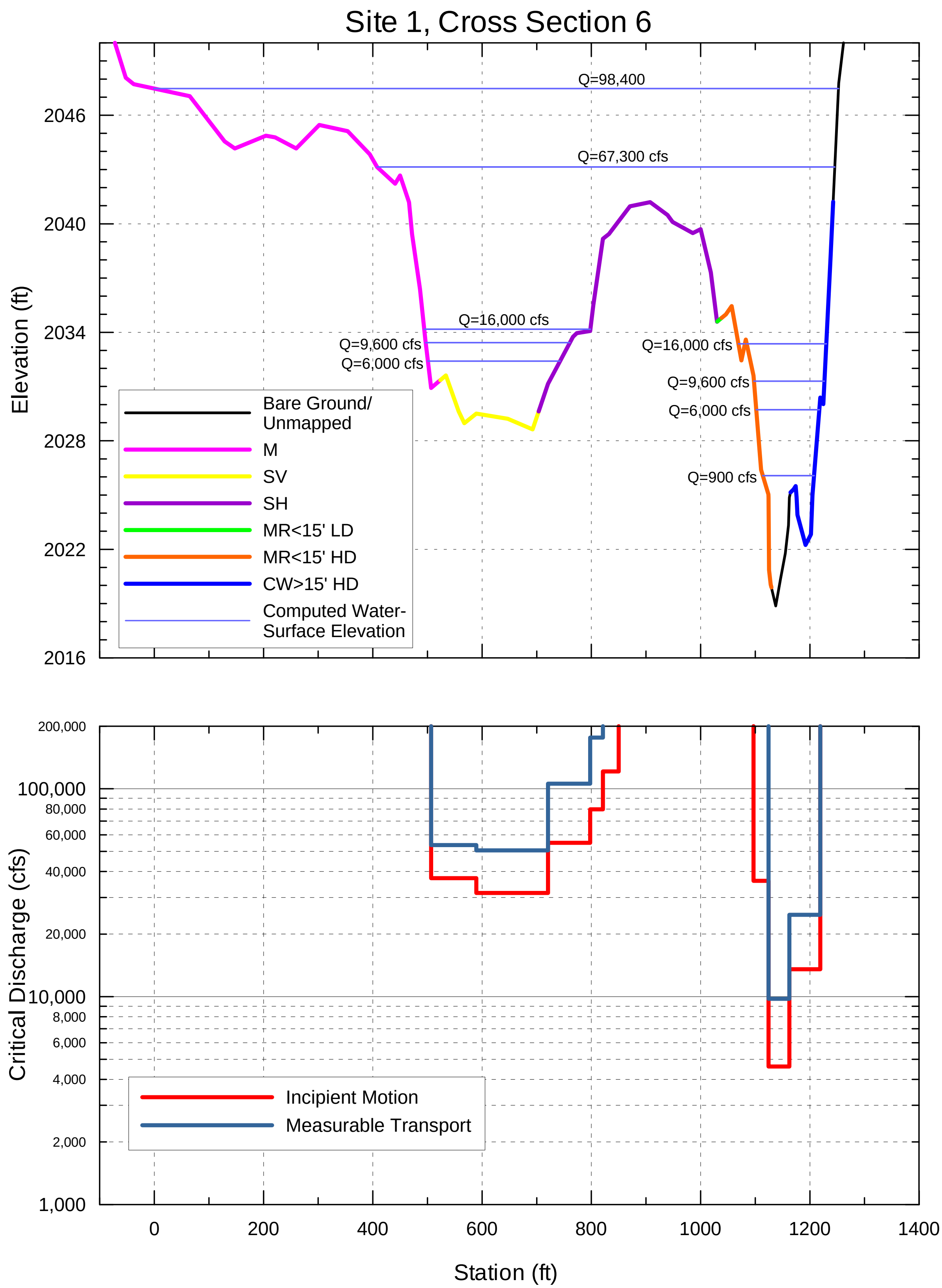


Site 1, Cross Section 4

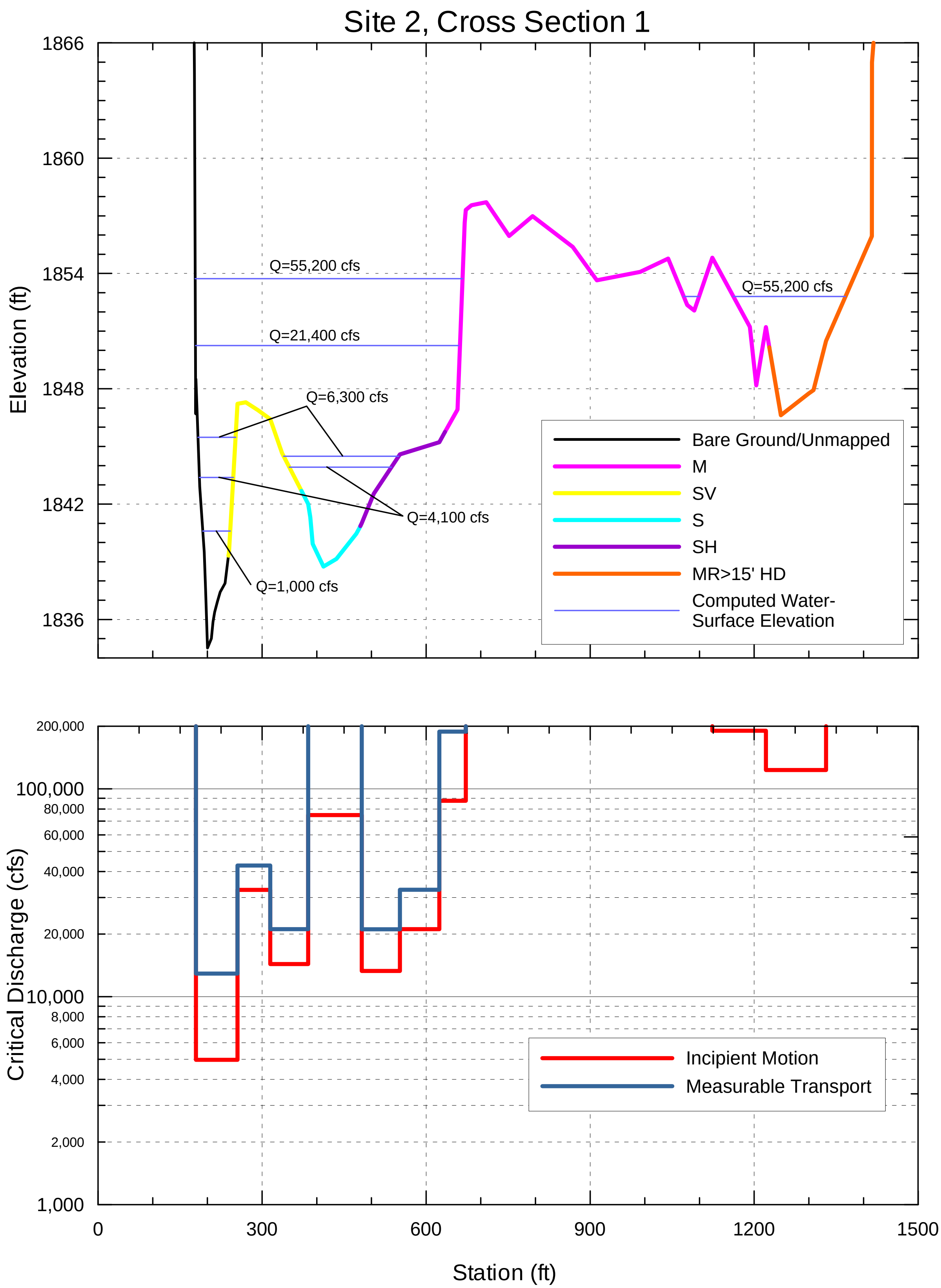


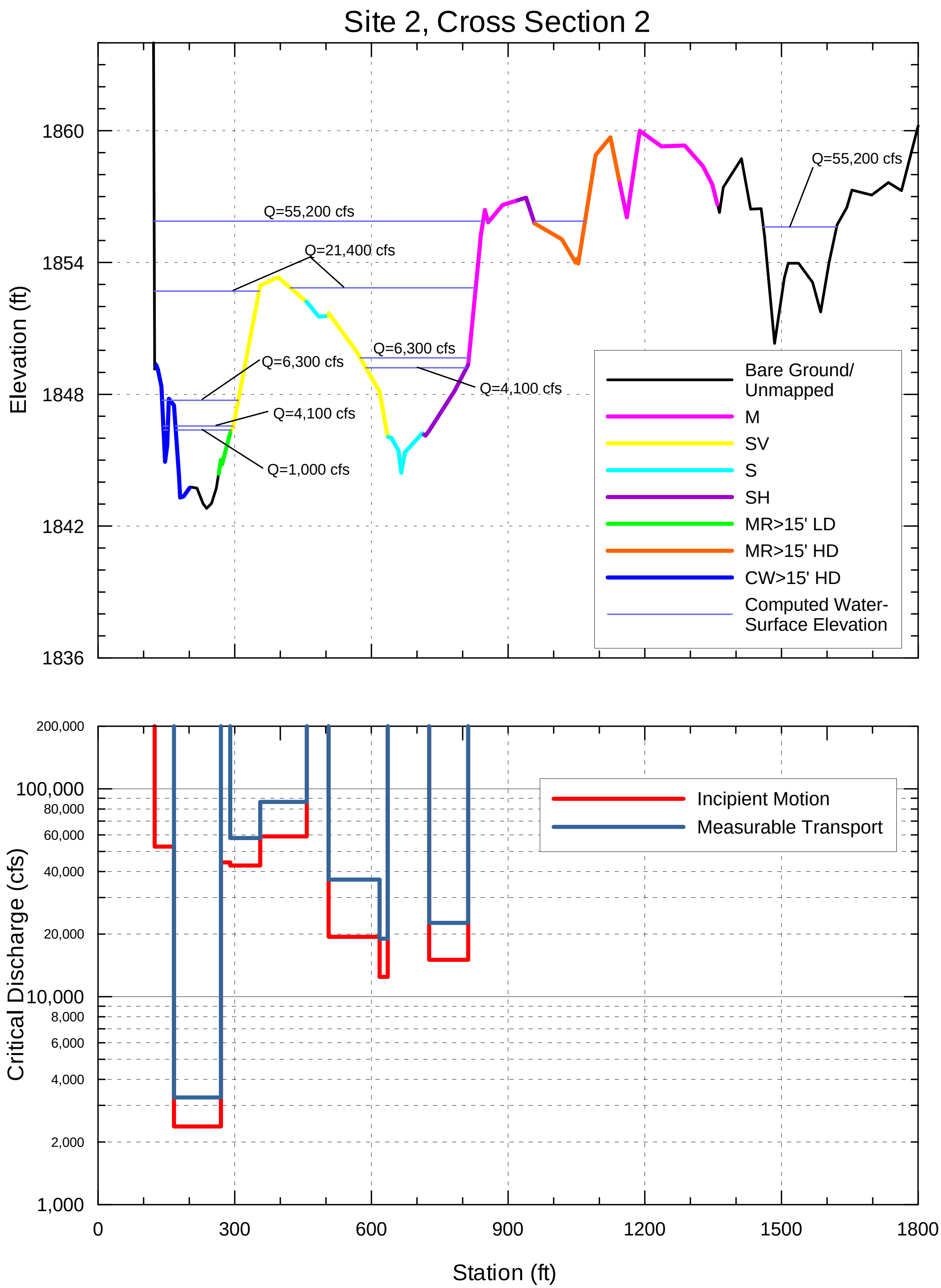


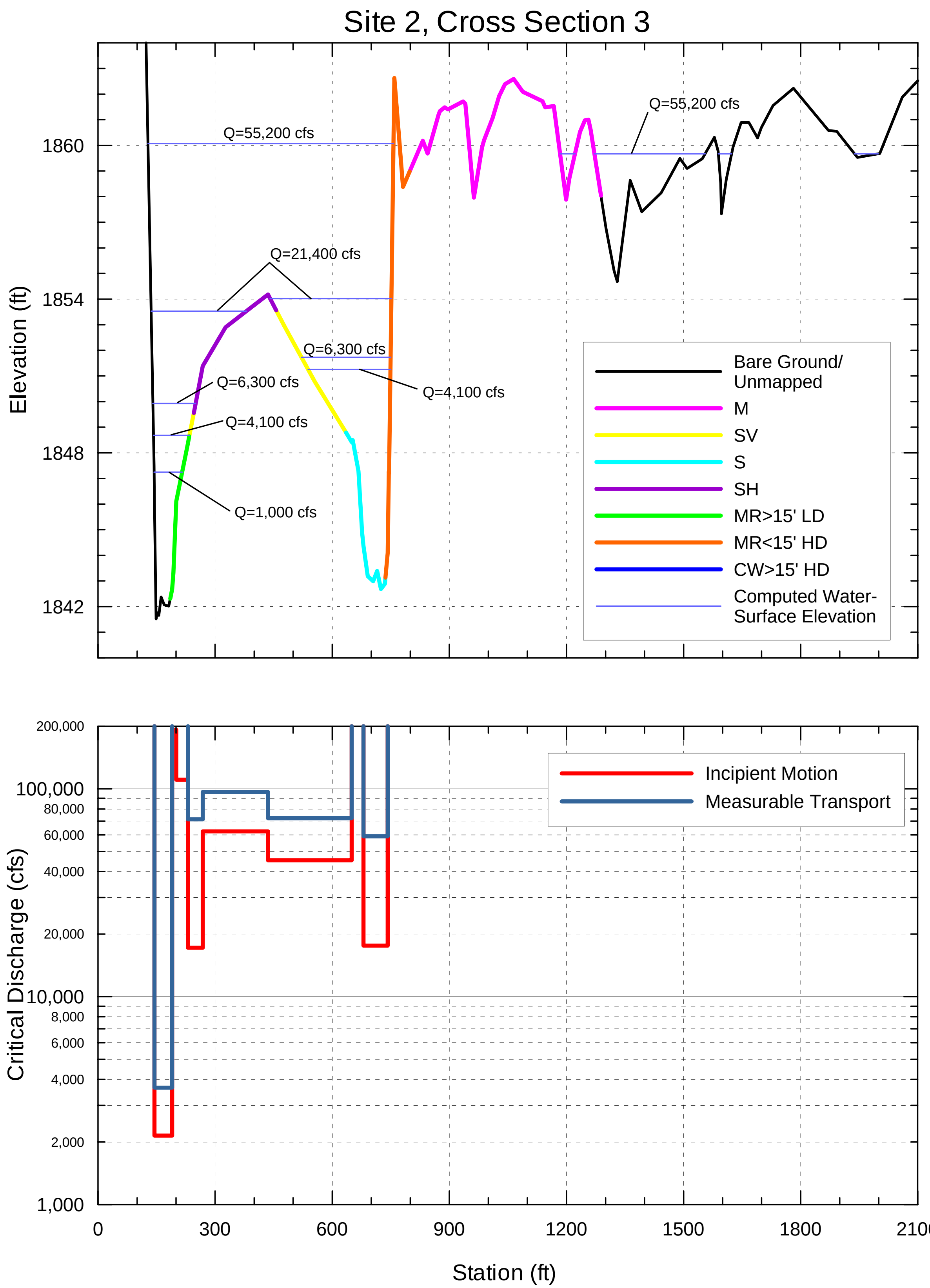
Site 1, Cross Section 5
Elevation (ft)
2046
2040
2034
2028
2022
2016
Q=98,400
Q=67,300 cfs
Q=16,000 cfs
Q=9,600 cfs
Q=6,000 cfs
Q=16,000 cfs
Q=9,600 cfs
Q=6,000 cfs
Q=900 cfs
Bare Ground/Unmapped
M
SV
MR<15' LD
CW>15' HD
Computed Water-Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
Incipient Motion
Measurable Transport
1000
1200
1400
1600
Station (ft)



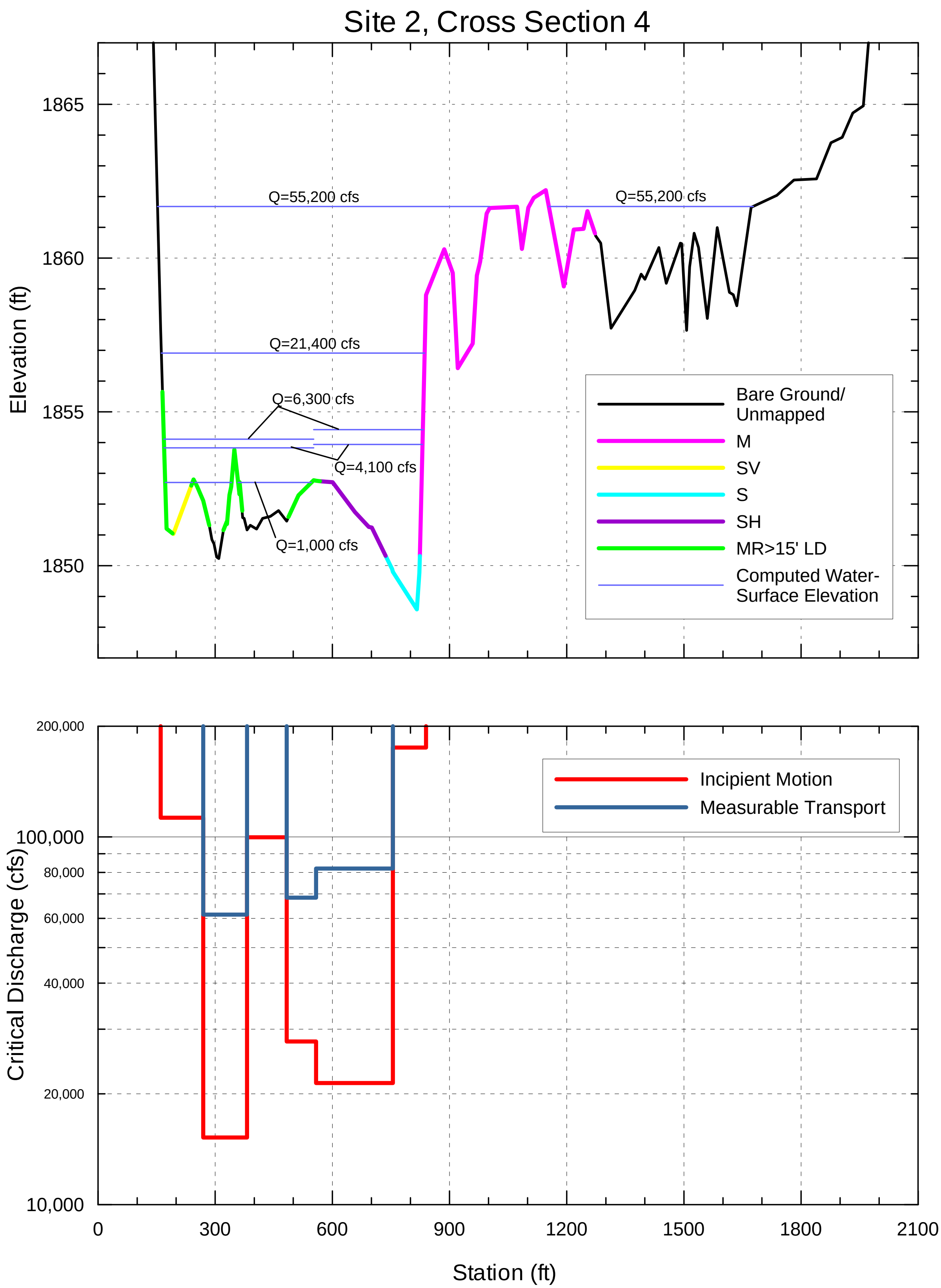
Mussetter Engineering, Inc.


Site 2, Cross Section 1
Elevation (ft)
1866
1860
1854
1848
1842
1836
Q=55,200 cfs
Q=21,400 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=1,000 cfs
Q=55,200 cfs
Bare Ground/Unmapped
M
SV
S
SH
MR>15' HD
Computed Water-Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)


Site 2, Cross Section 2
Elevation (ft)
1860
1854
1848
1842
1836
Q=55,200 cfs
Q=21,400 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=1,000 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=55,200 cfs
Bare Ground/
Unmapped
M
SV
S
SH
MR>15' LD
MR>15' HD
CW>15' HD
Computed Water-
Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
1800
Station (ft)

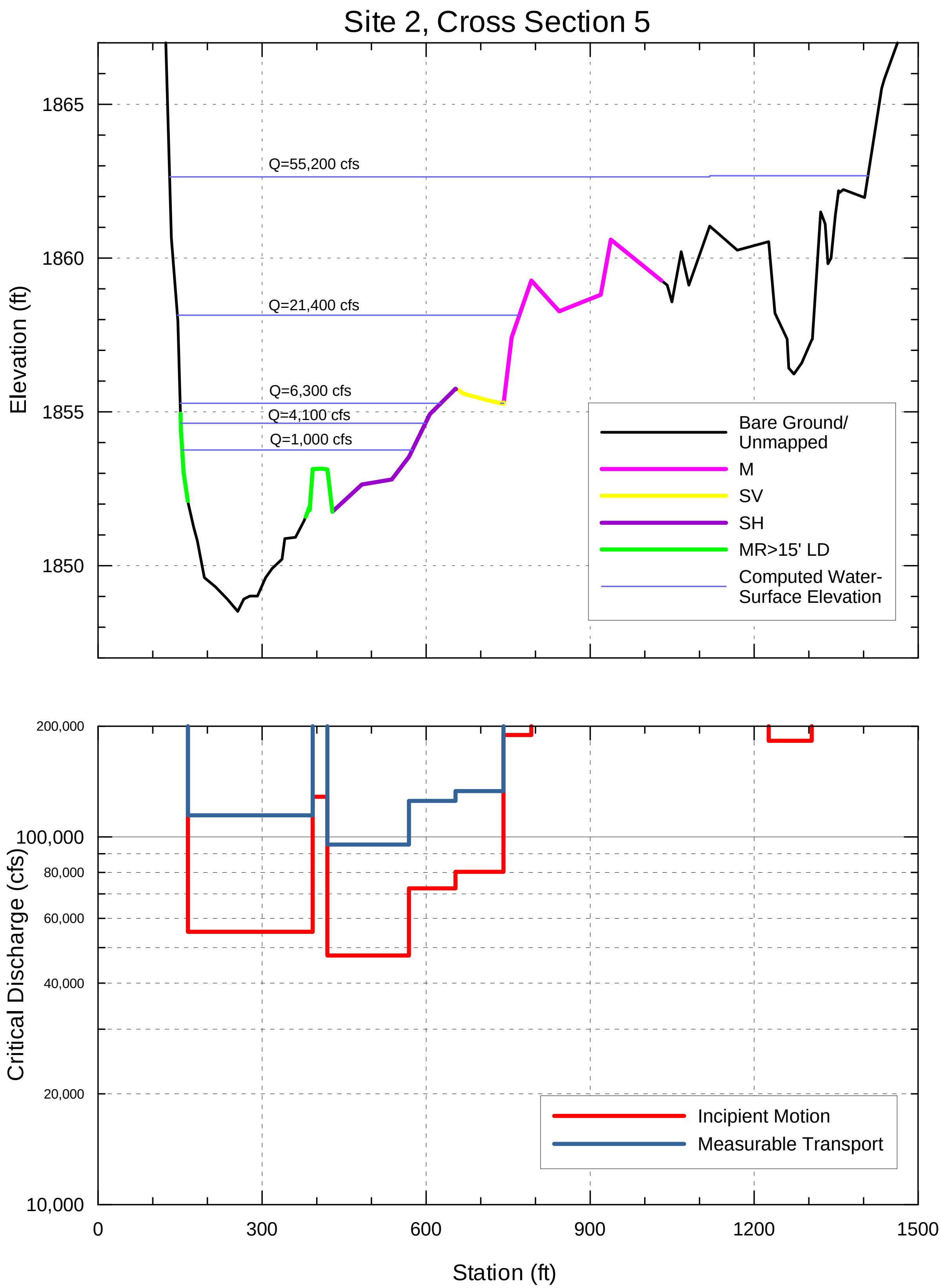


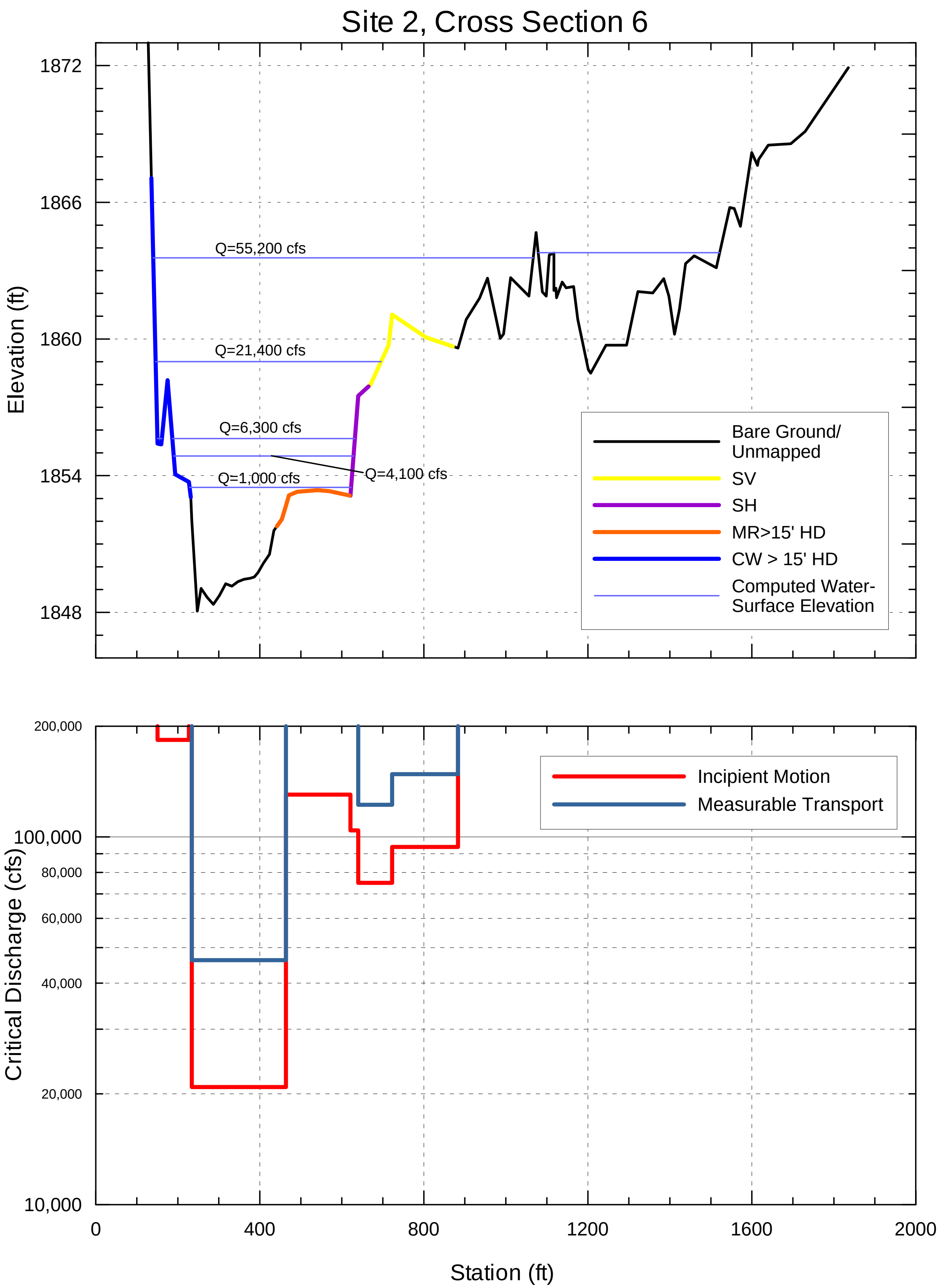
Site 2, Cross Section 3
Elevation (ft)
1860
1854
1848
1842
Q=55,200 cfs
Q=55,200 cfs
Q=21,400 cfs
Q=6,300 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=4,100 cfs
Q=1,000 cfs
Bare Ground/
Unmapped
M
SV
S
SH
MR>15' LD
MR<15' HD
CW>15' HD
Computed Water-
Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
1800
2100
Station (ft)



Site 2, Cross Section 4
Elevation (ft)
1865
1860
1855
1850
Q=55,200 cfs
Q=55,200 cfs
Q=21,400 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=1,000 cfs
Bare Ground/ Unmapped
M
SV
S
SH
MR>15' LD
Computed Water-Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
1800
2100
Station (ft)

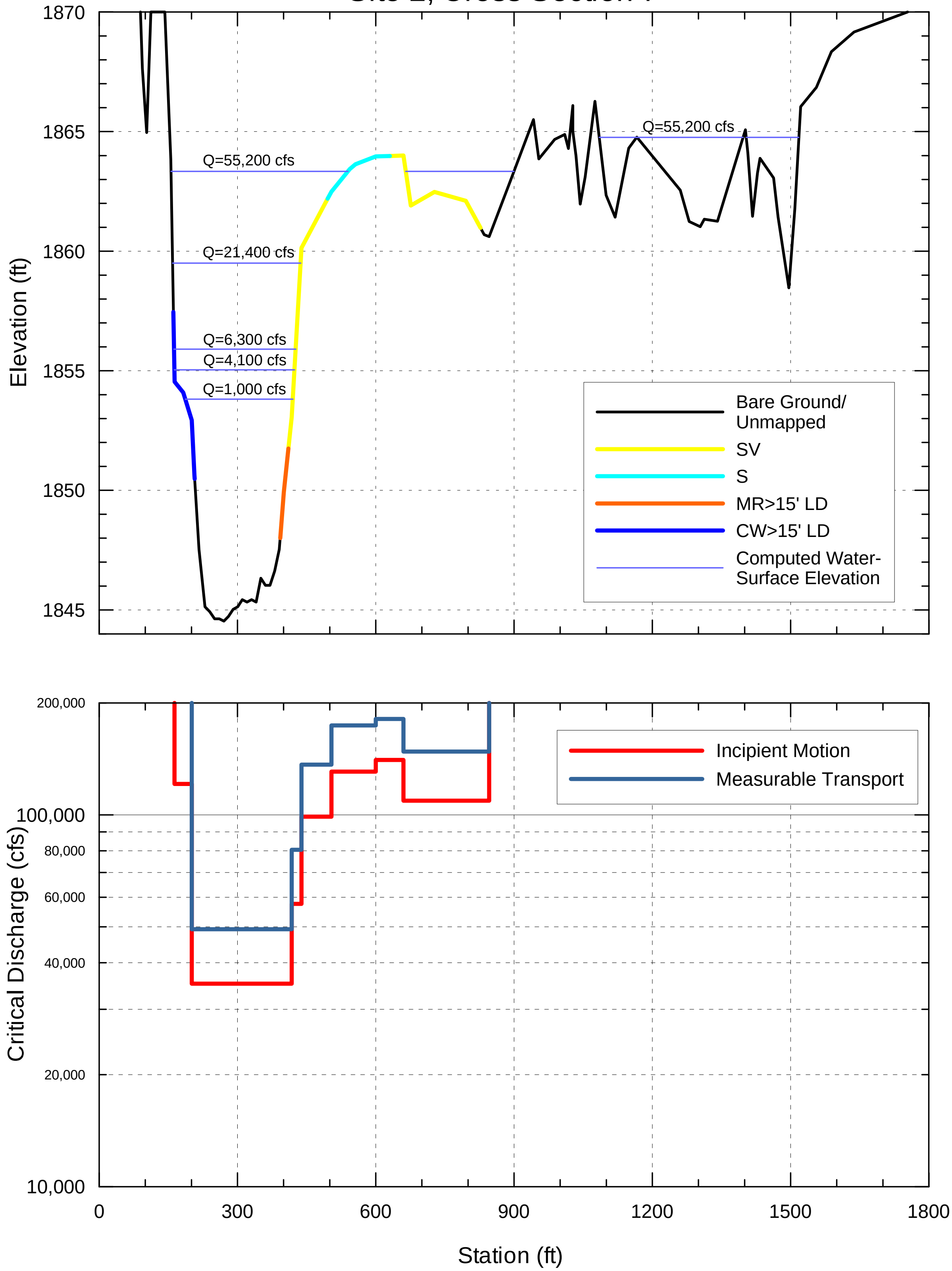
Site 2, Cross Section 5

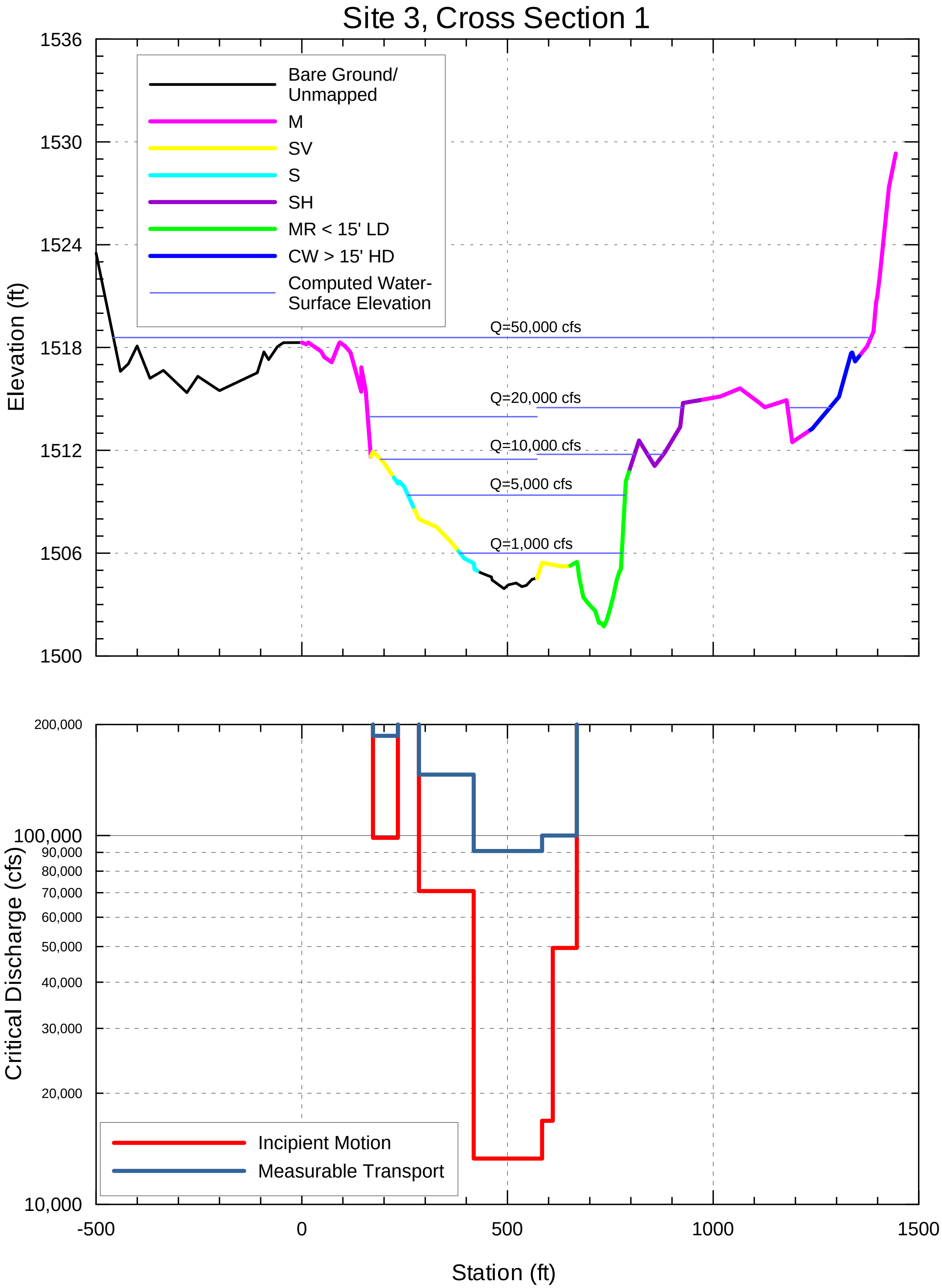




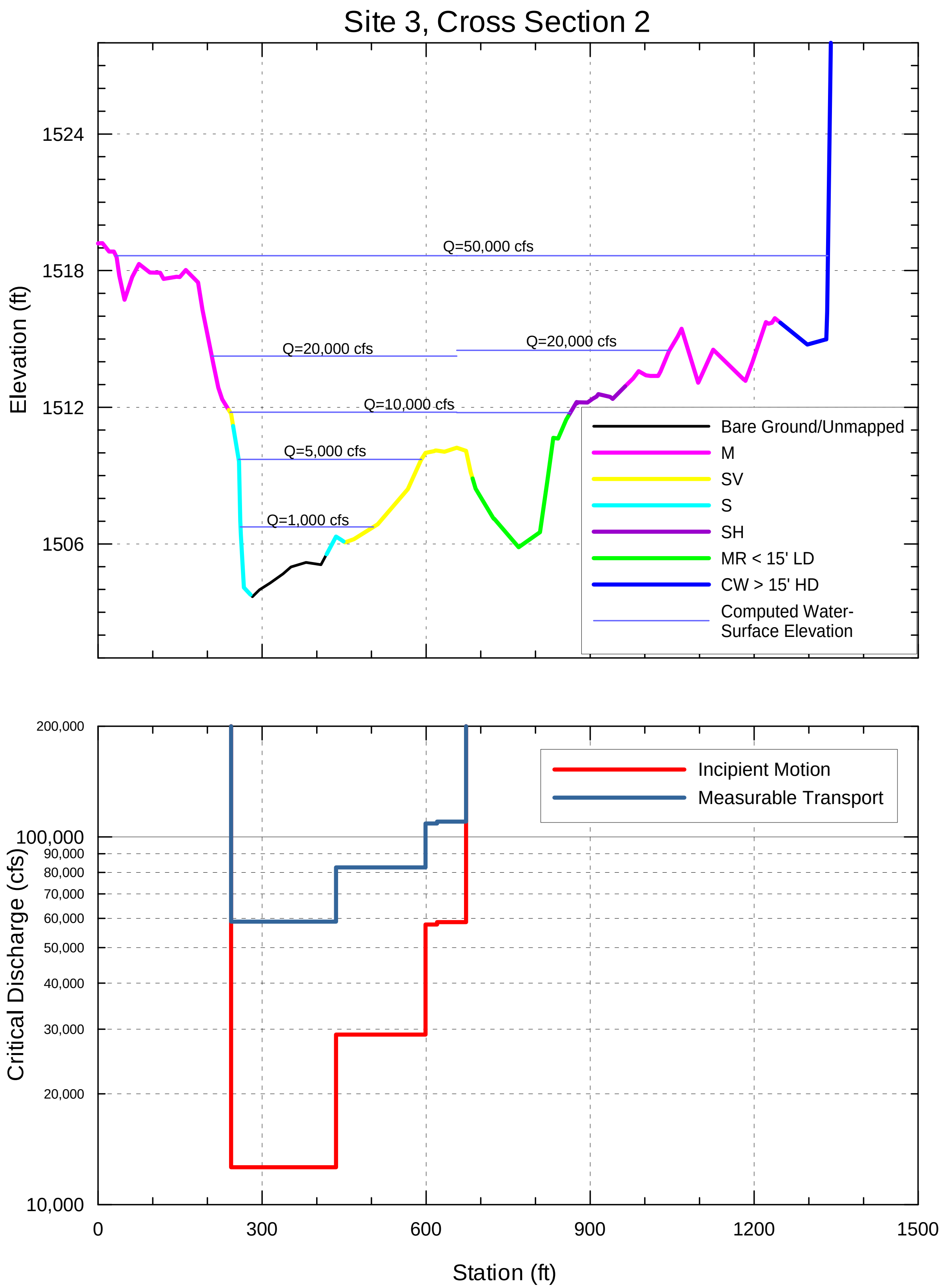
Site 2, Cross Section 6
Elevation (ft)
1872
1866
1860
1854
1848
Q=55,200 cfs
Q=21,400 cfs
Q=6,300 cfs
Q=4,100 cfs
Q=1,000 cfs
Bare Ground/
Unmapped
SV
SH
MR>15' HD
CW > 15' HD
Computed Water-
Surface Elevation
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
Incipient Motion
Measurable Transport
0
400
800
1200
1600
2000
Station (ft)

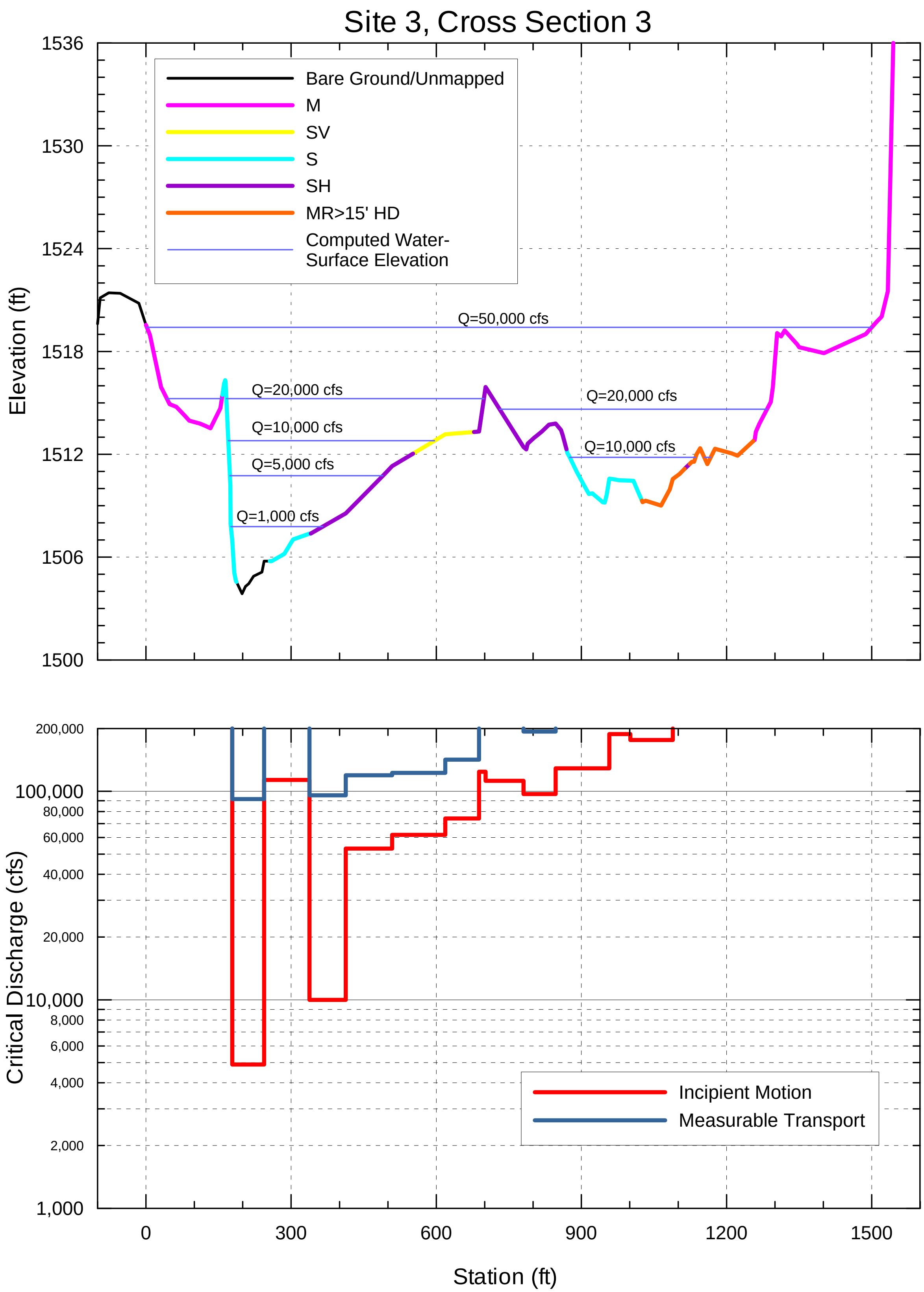
Site 2, Cross Section 7

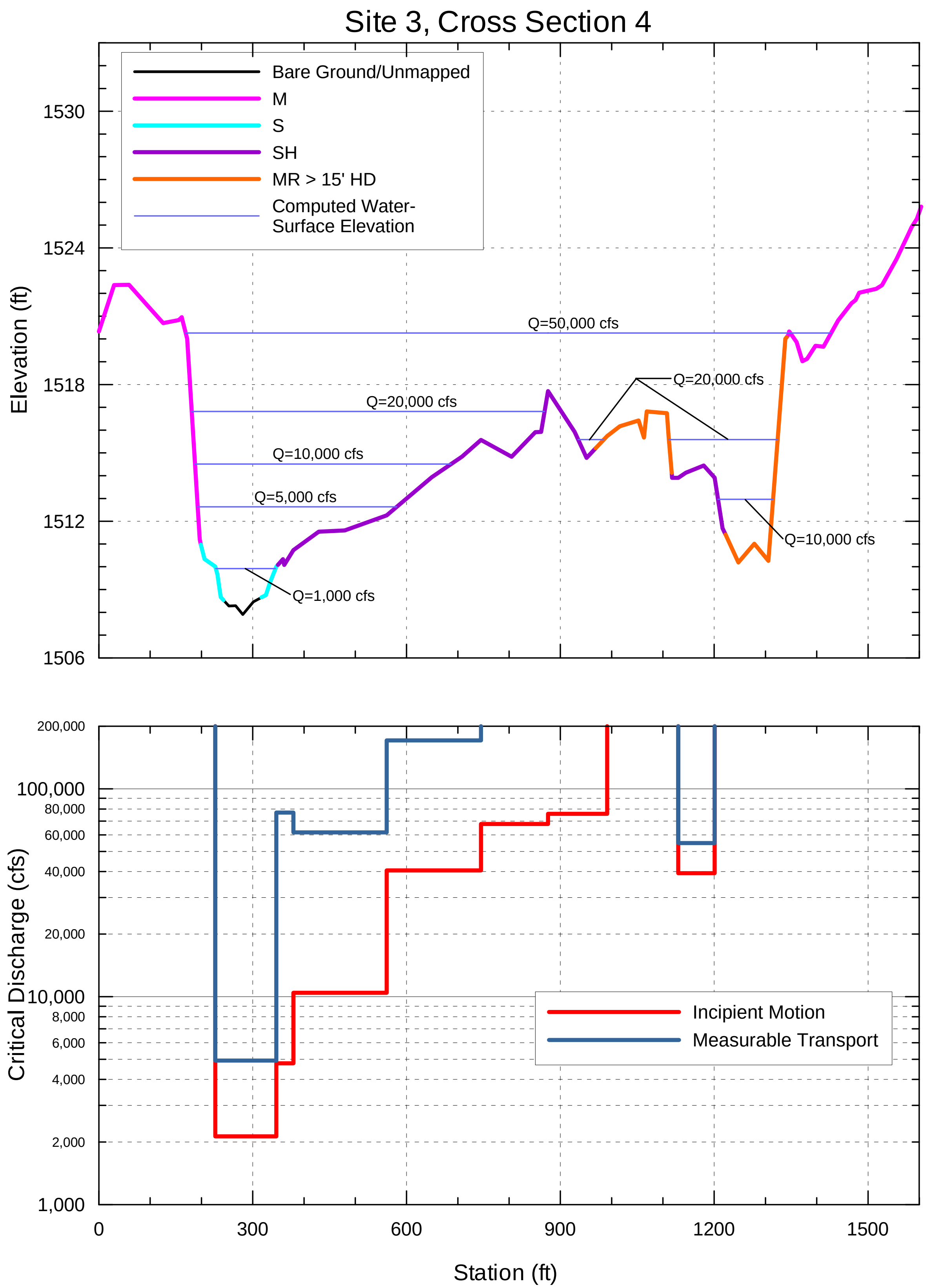




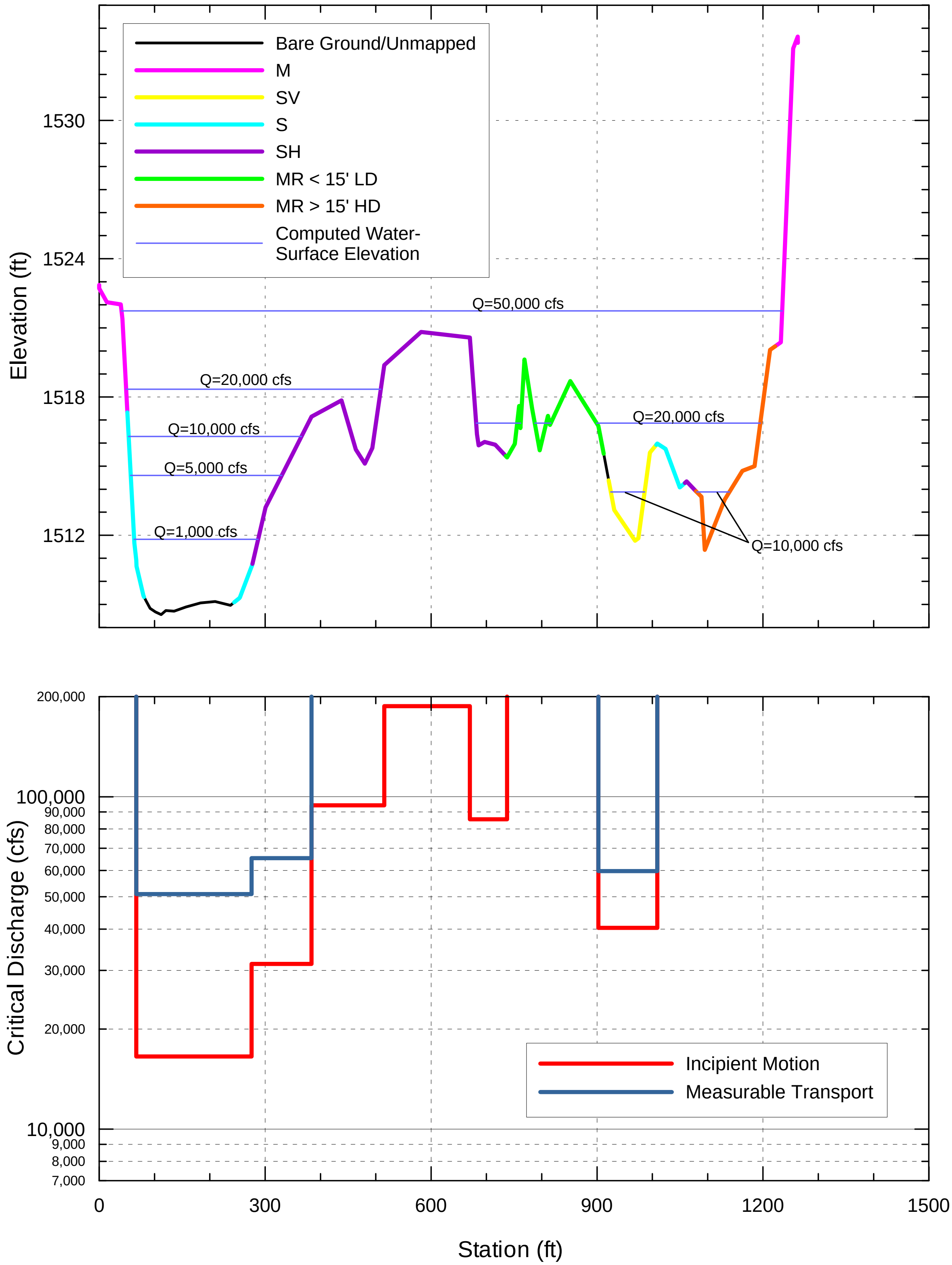
Site 3, Cross Section 1
Elevation (ft)
1536
1530
1524
1518
1512
1506
1500
Bare Ground/ Unmapped
M
SV
S
SH
MR < 15' LD
CW > 15' HD
Computed Water-Surface Elevation
Q=50,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
Critical Discharge (cfs)
200,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
Incipient Motion
Measurable Transport
-500
0
500
1000
1500
Station (ft)

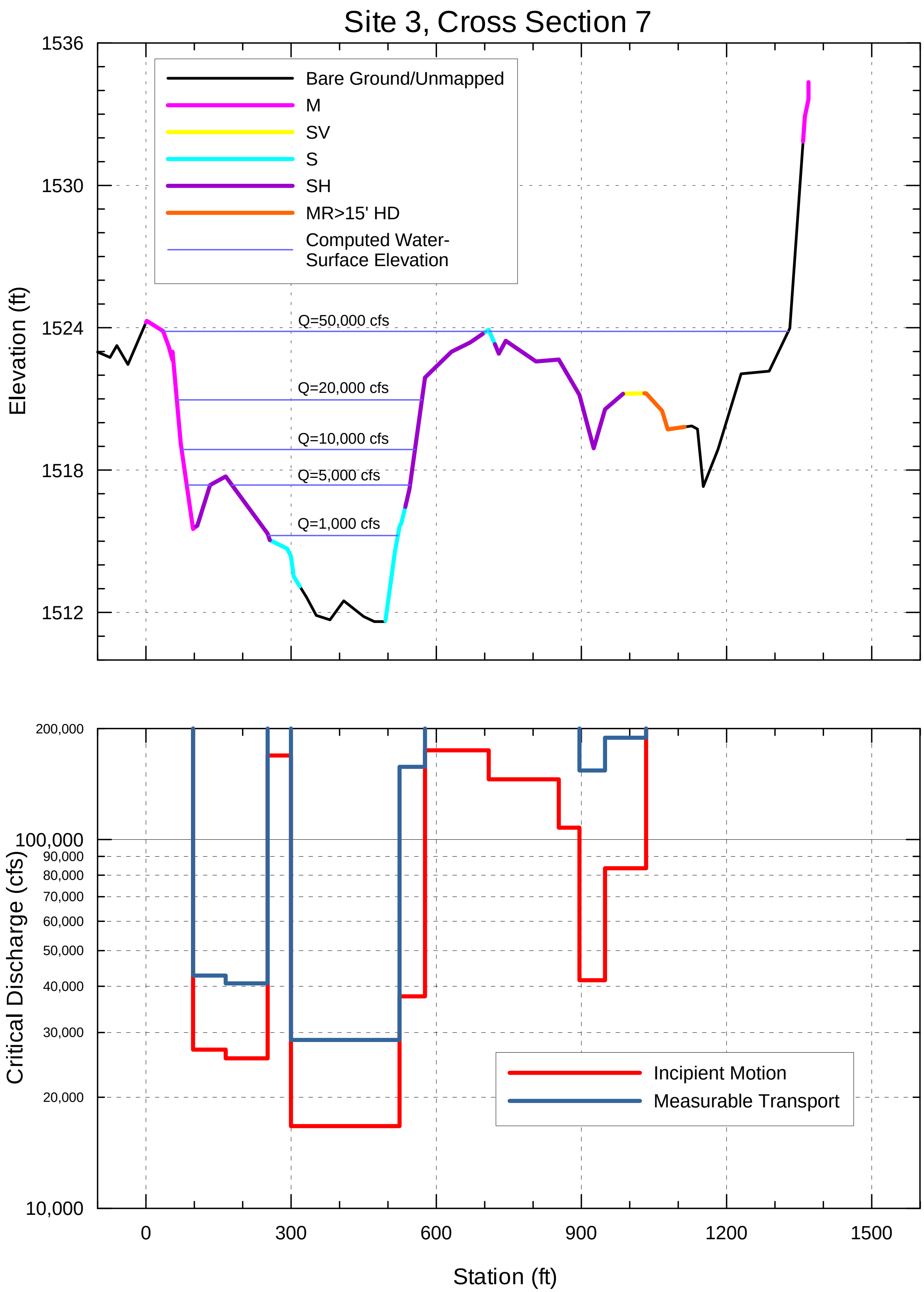

Site 3, Cross Section 2
Elevation (ft)
1524
1518
1512
1506
Q=50,000 cfs
Q=20,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
Bare Ground/Unmapped
M
SV
S
SH
MR < 15' LD
CW > 15' HD
Computed Water-
Surface Elevation
Critical Discharge (cfs)
200,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)


Site 3, Cross Section 3
Elevation (ft)
1536
1530
1524
1518
1512
1506
1500
Bare Ground/Unmapped
M
SV
S
SH
MR>15' HD
Computed Water-
Surface Elevation
Q=50,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)

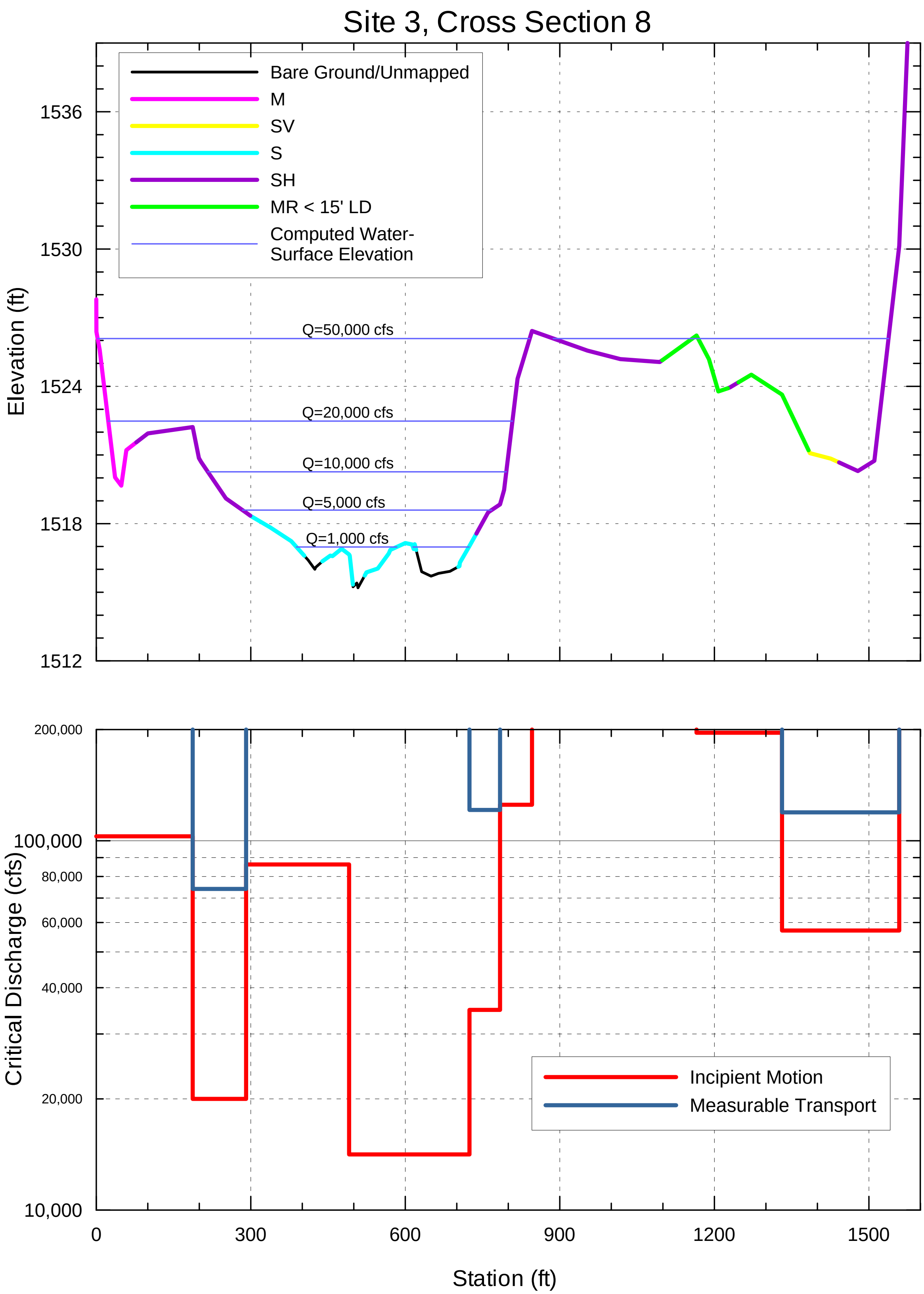

Site 3, Cross Section 4
Bare Ground/Unmapped
M
S
SH
MR > 15' HD
Computed Water-
Surface Elevation
Elevation (ft)
1530
1524
1518
1512
1506
Q=50,000 cfs
Q=20,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
8,000
6,000
4,000
2,000
1,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)

Site 3, Cross Section 5





Site 3, Cross Section 7
1536
1530
1524
1518
1512
Elevation (ft)
Bare Ground/Unmapped
M
SV
S
SH
MR>15' HD
Computed Water-
Surface Elevation
Q=50,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
200,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
Critical Discharge (cfs)
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)


Site 3, Cross Section 8
Bare Ground/Unmapped
M
SV
S
SH
MR < 15' LD
Computed Water-Surface Elevation
Q=50,000 cfs
Q=20,000 cfs
Q=10,000 cfs
Q=5,000 cfs
Q=1,000 cfs
Elevation (ft)
1536
1530
1524
1518
1512
Critical Discharge (cfs)
200,000
100,000
80,000
60,000
40,000
20,000
10,000
Incipient Motion
Measurable Transport
0
300
600
900
1200
1500
Station (ft)

APPENDIX B

Plots of the Hydrographs from the Reservoir Routings Carried Out for the Different Operational Scenarios

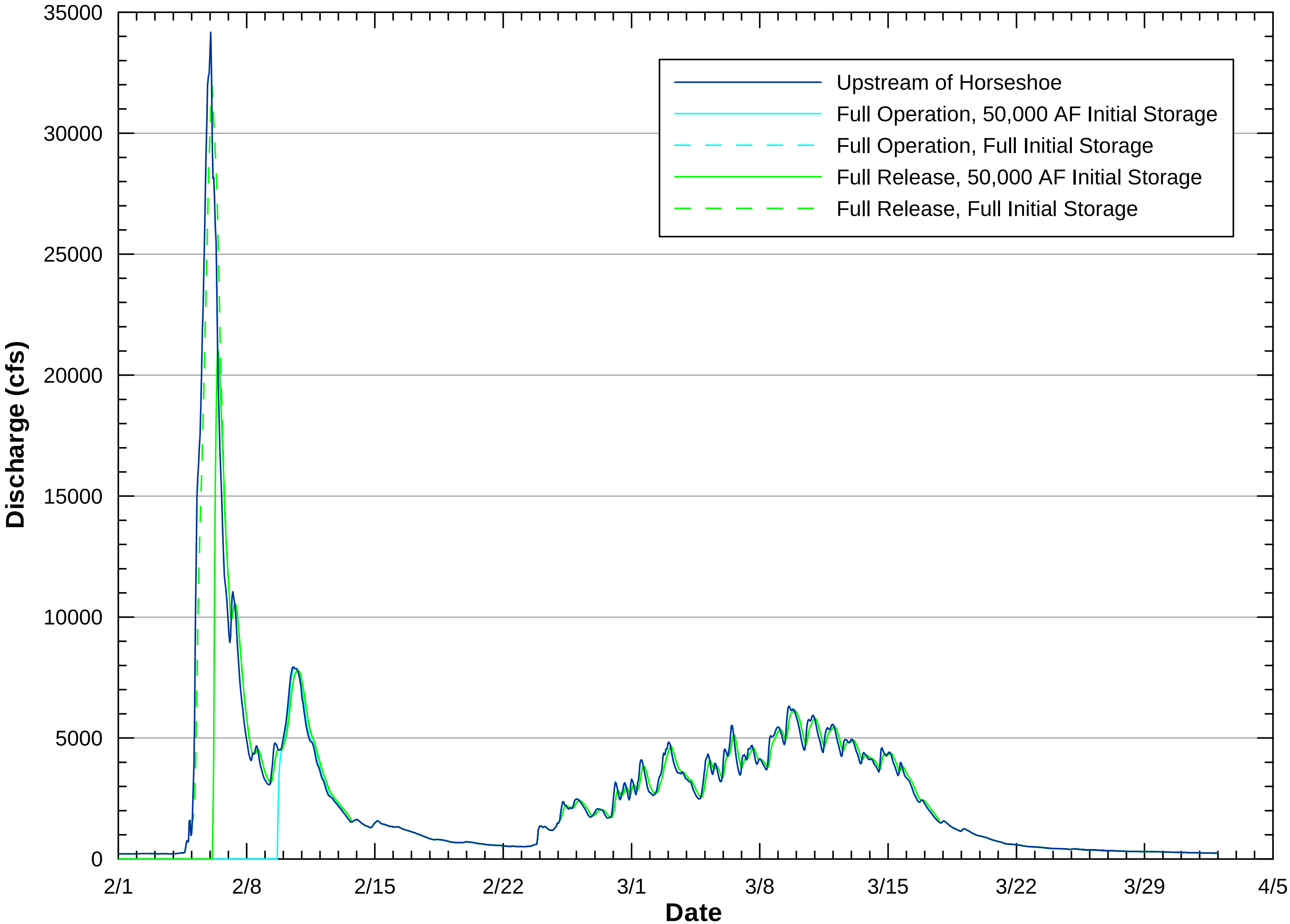


Figure B.1. Simulated hydrographs downstream of Horseshoe Reservoir for the 1991 event.

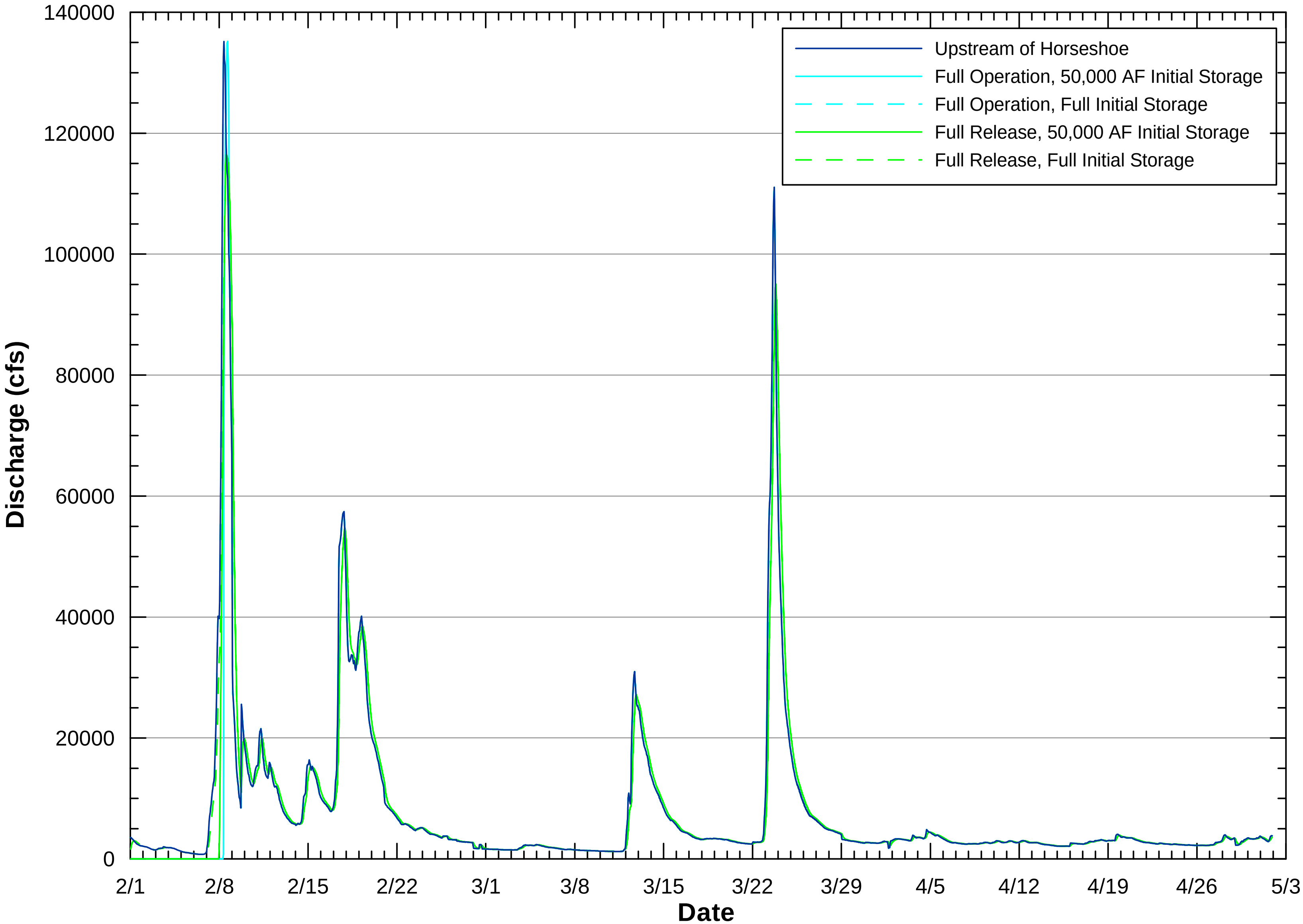


Figure B.2. Simulated hydrographs downstream of Horseshoe Reservoir for the 1993 event.

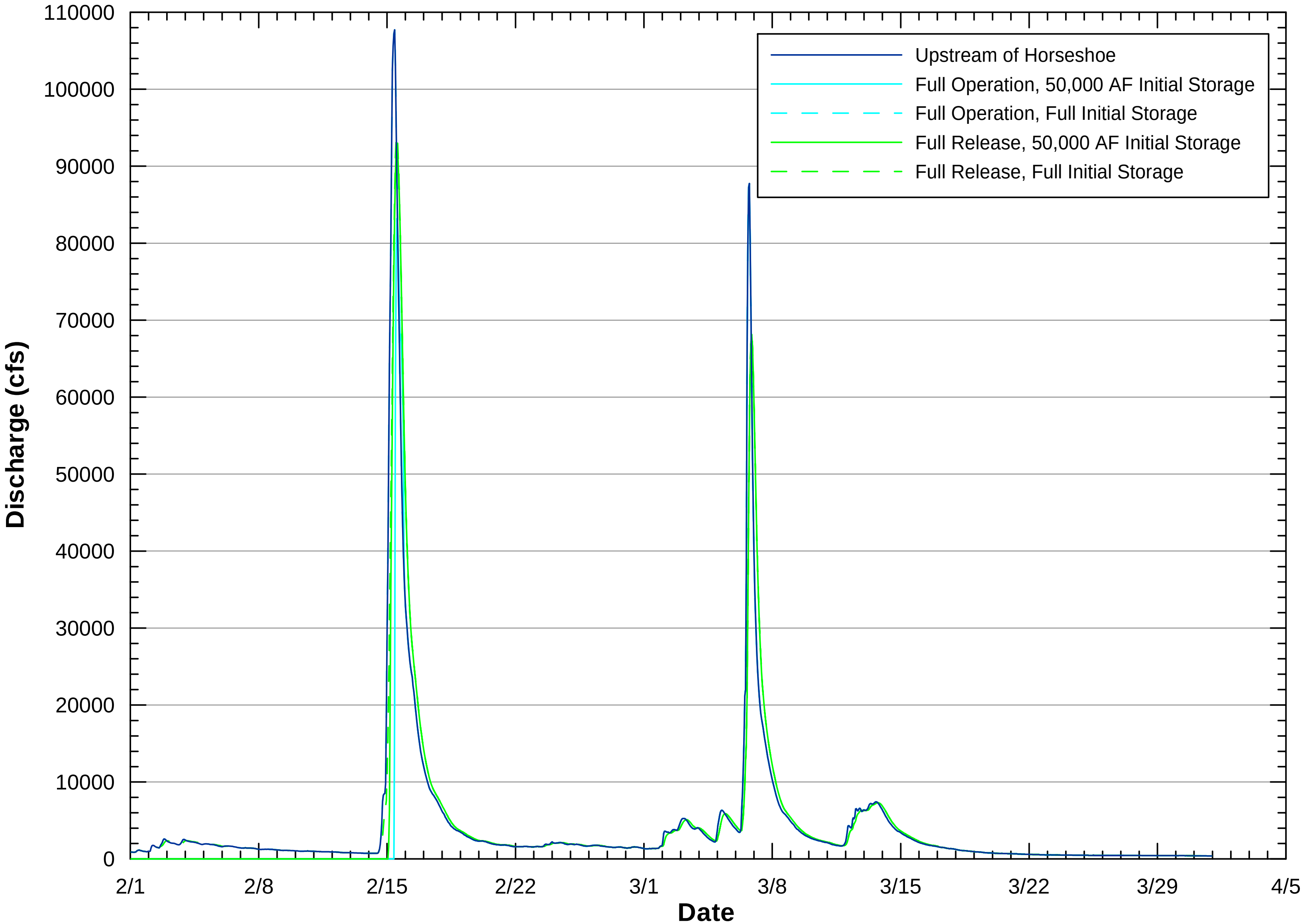


Figure B.3. Simulated hydrographs downstream of Horseshoe Reservoir for the 1995 event.

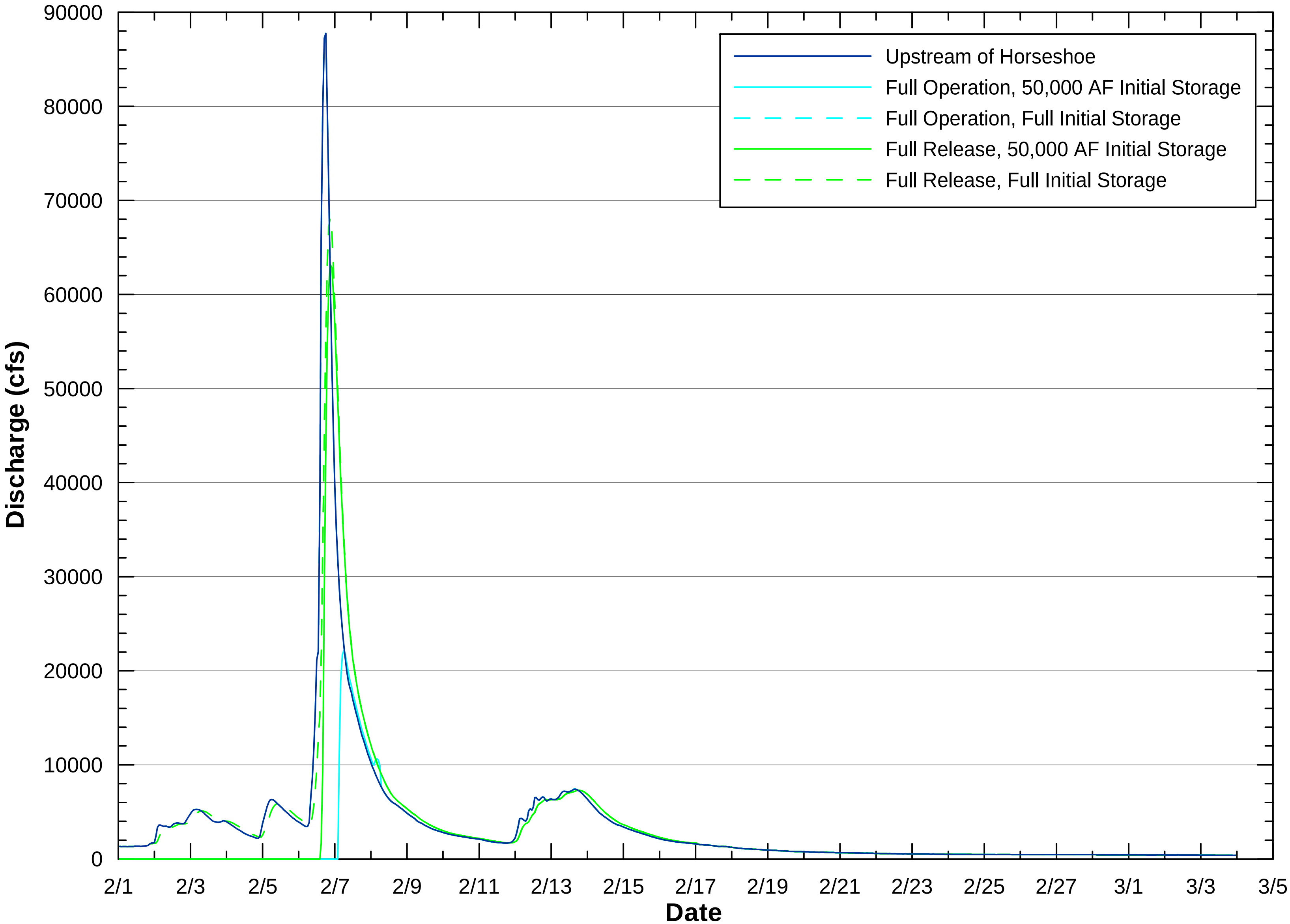


Figure B.4. Simulated hydrographs downstream of Horseshoe Reservoir for the 1995 (March) event.

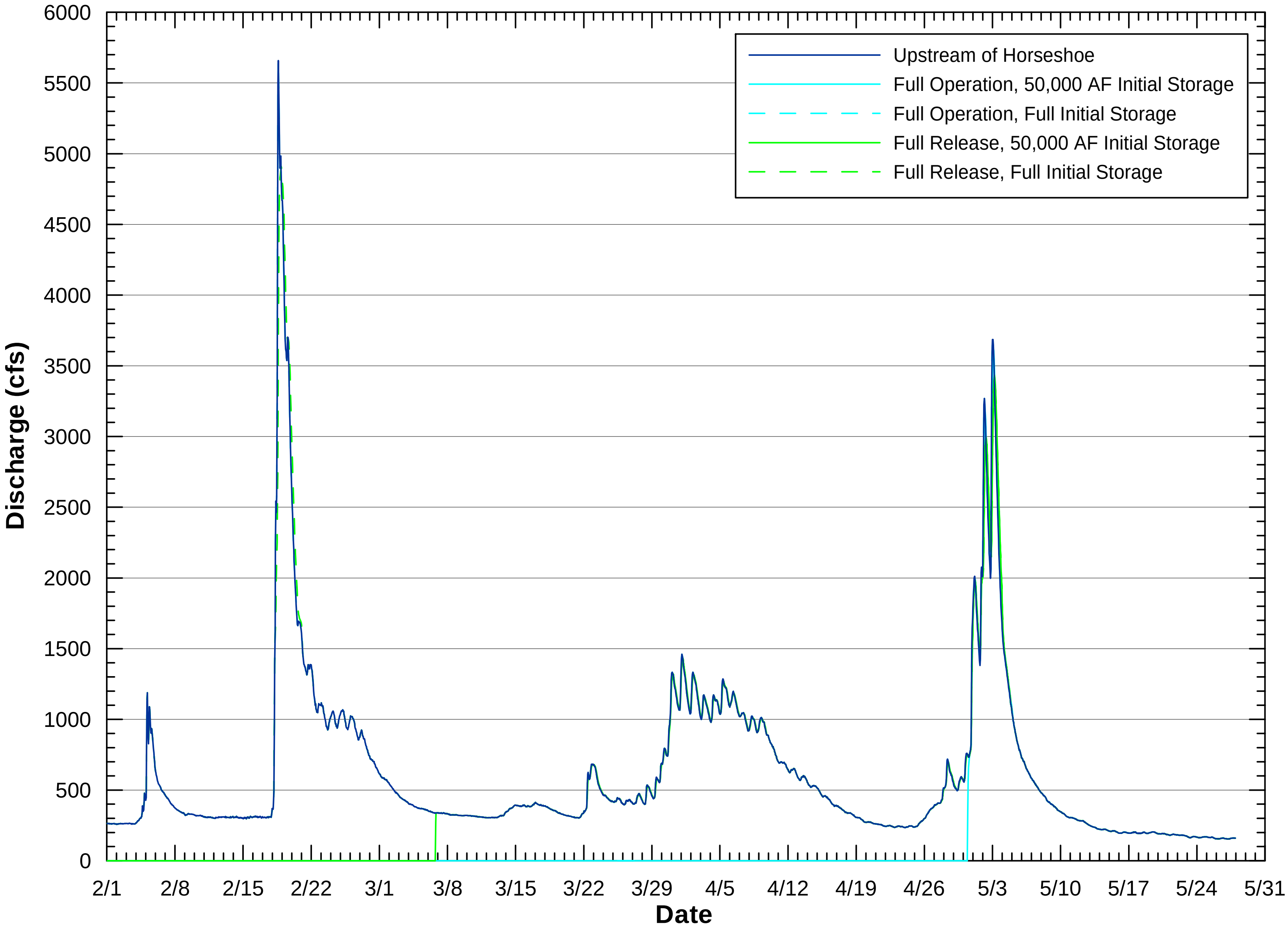


Figure B.5. Simulated hydrographs downstream of Horseshoe Reservoir for the 1997 event.

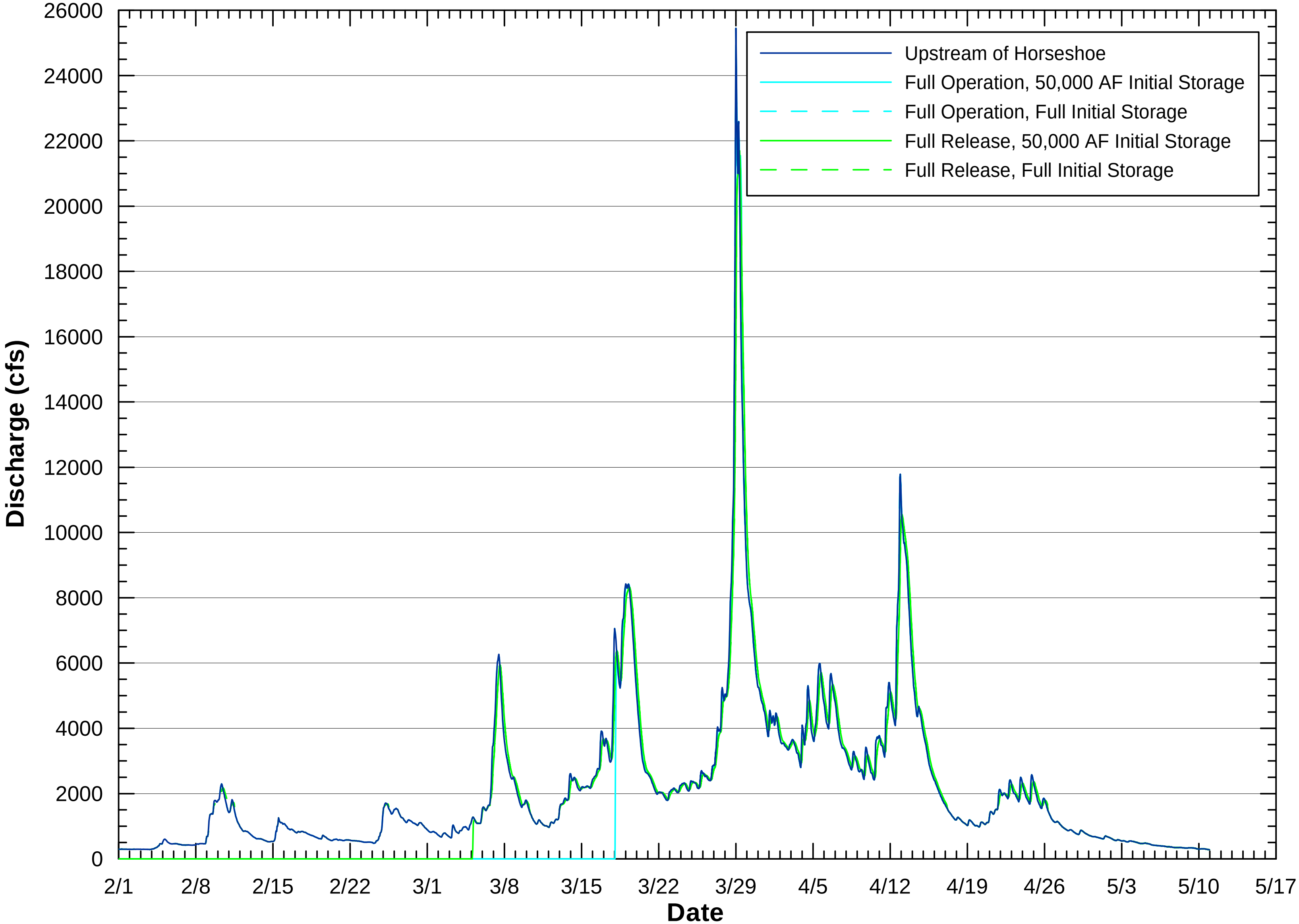


Figure B.6. Simulated hydrographs downstream of Horseshoe Reservoir for the 1998 event.

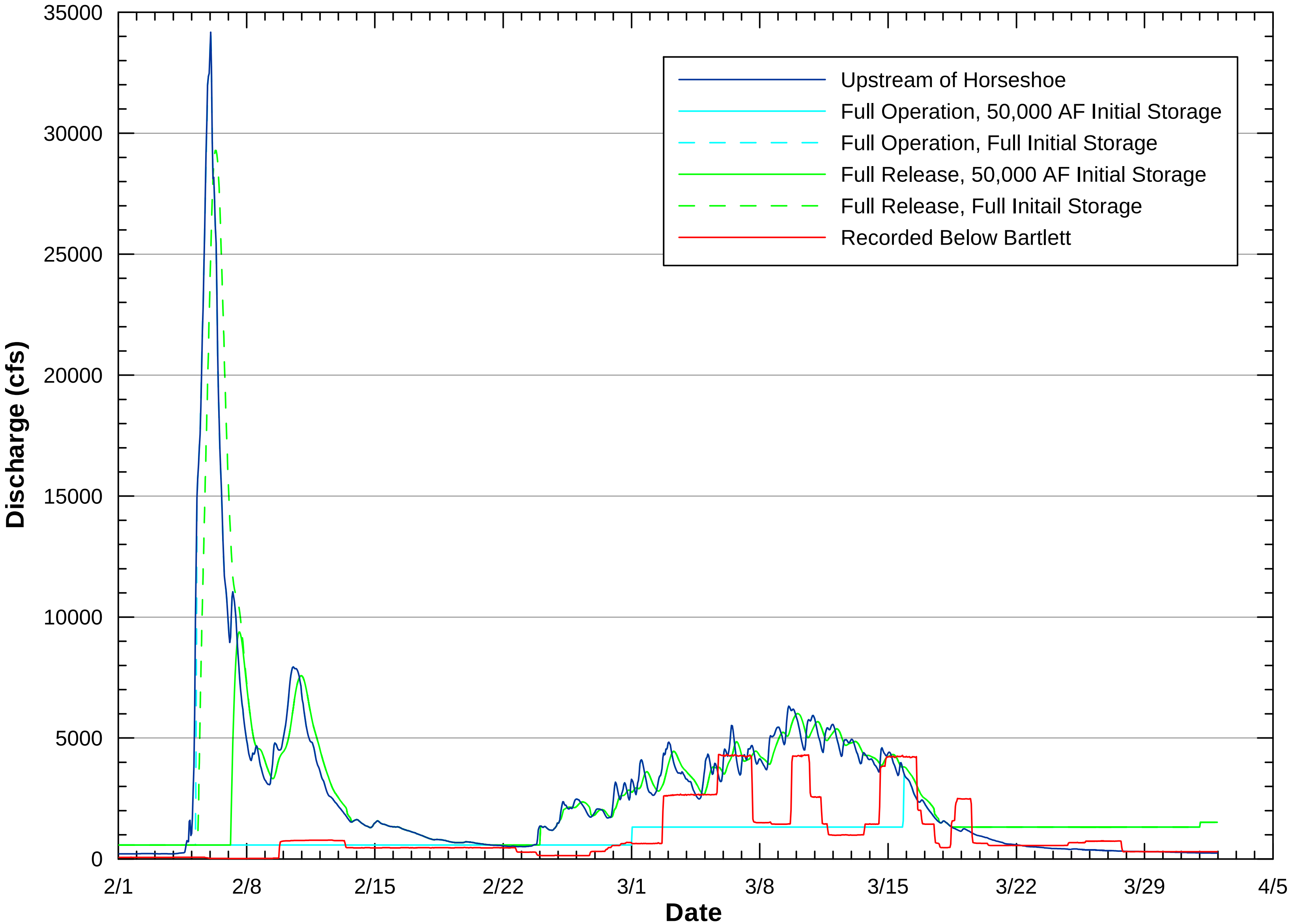


Figure B.7. Simulated hydrographs downstream of Bartlett Reservoir for the 1991 event.

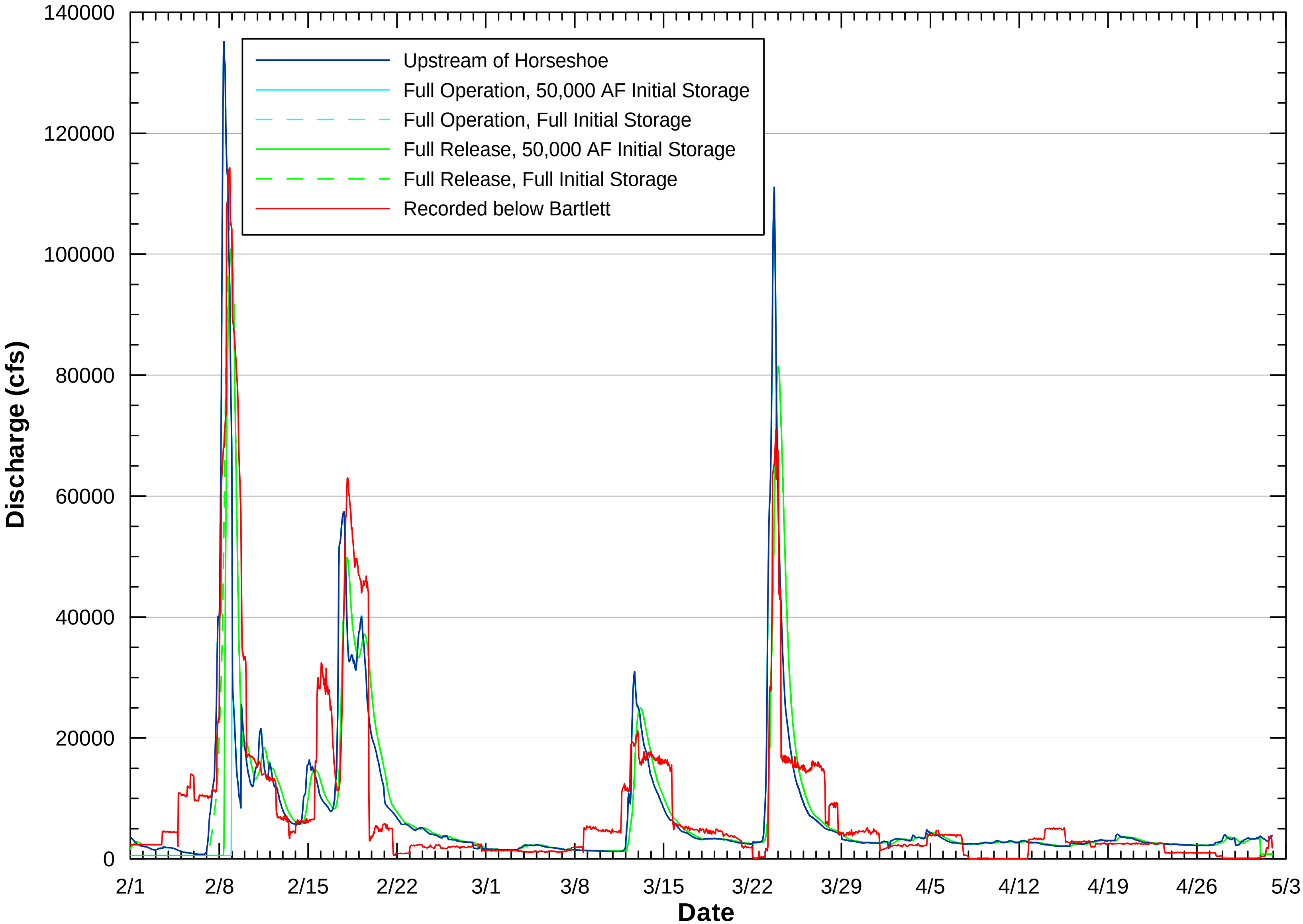


Figure B.8. Simulated hydrographs downstream of Bartlett Reservoir for the 1993 event.

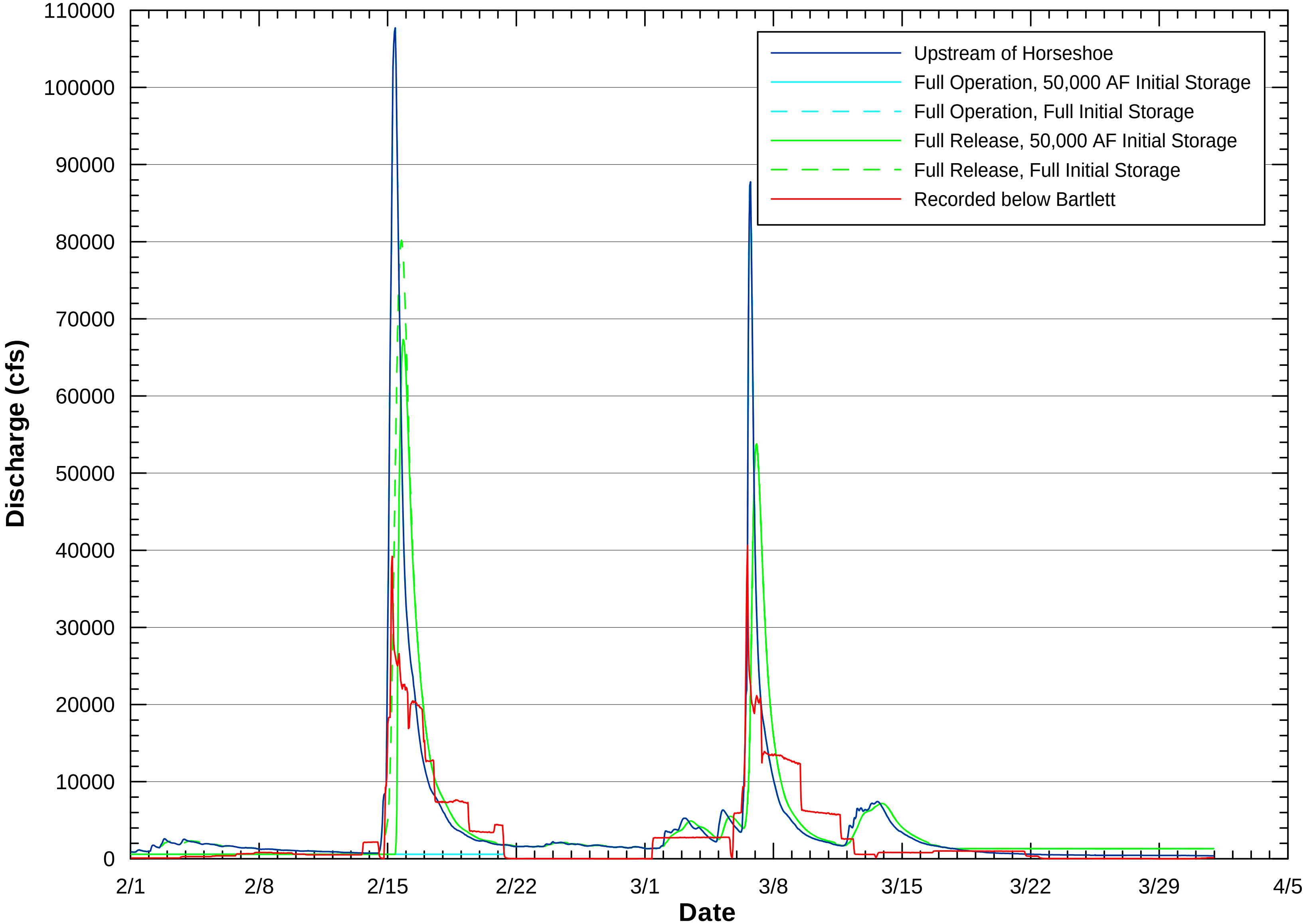


Figure B.9. Simulated hydrographs downstream of Bartlett Reservoir for the 1995 event.

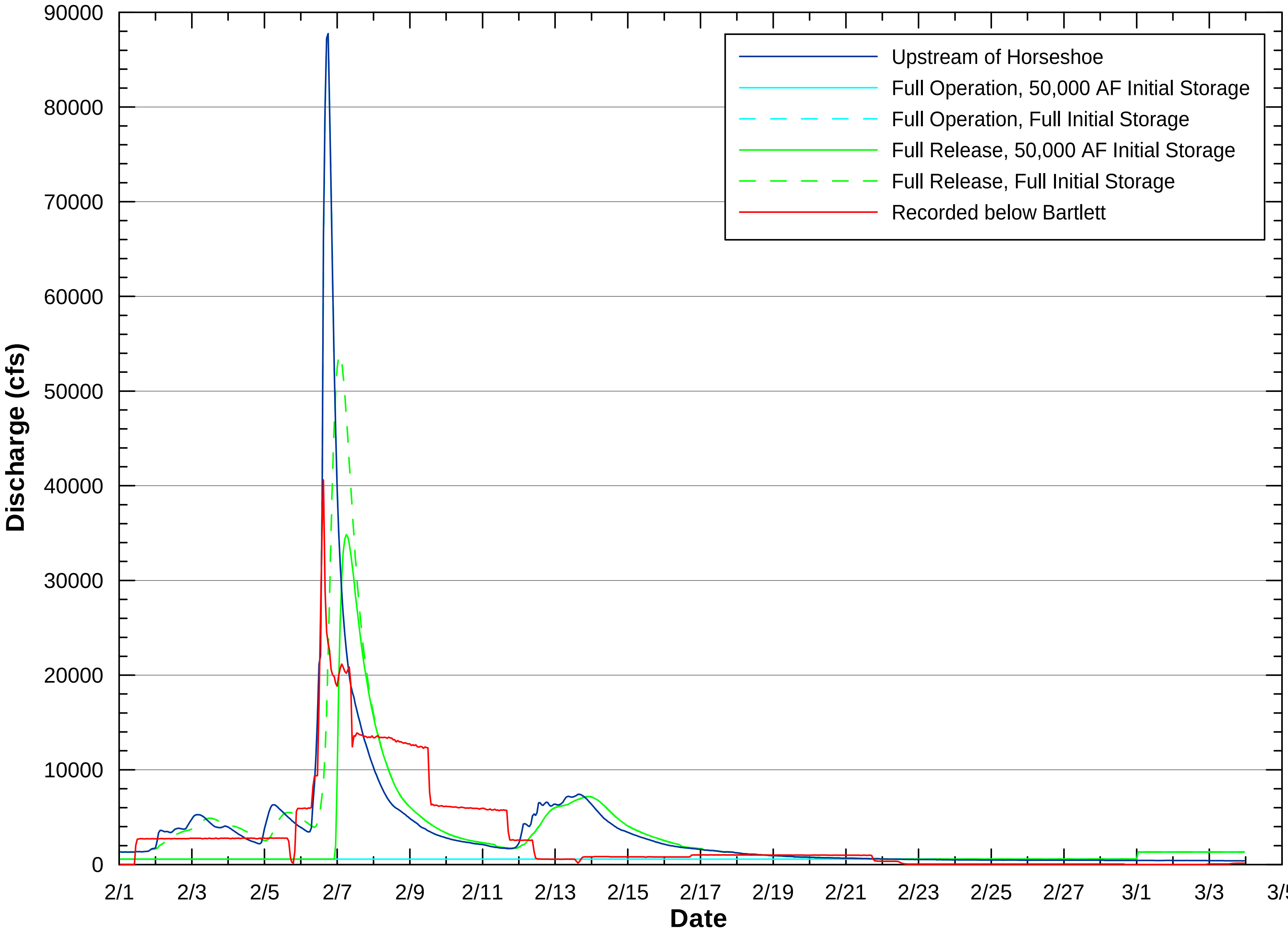


Figure B.10. Simulated hydrographs downstream of Bartlett Reservoir for the 1995 (March) event.

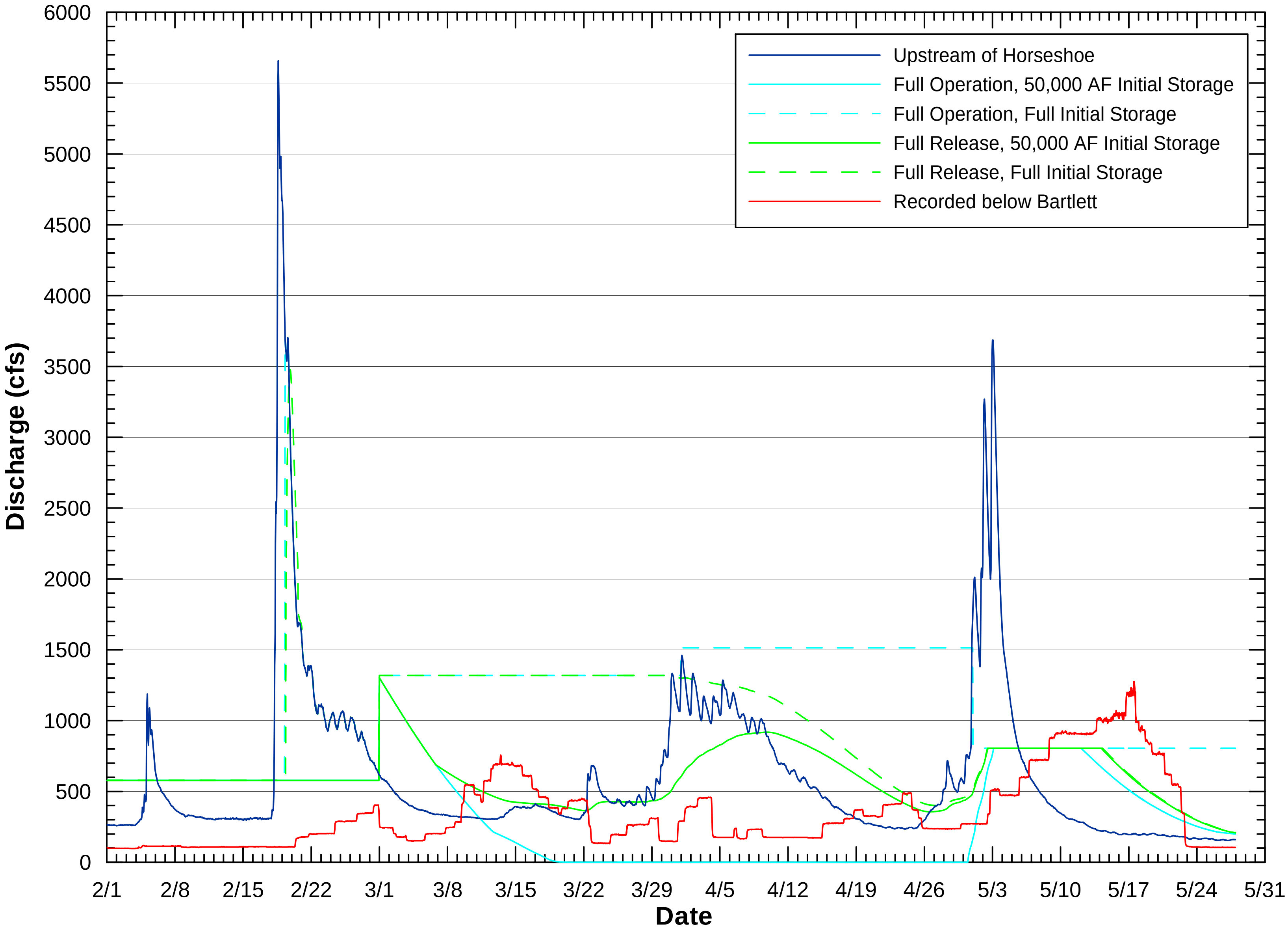


Figure B.11. Simulated hydrographs downstream of Bartlett Reservoir for the 1997 event.

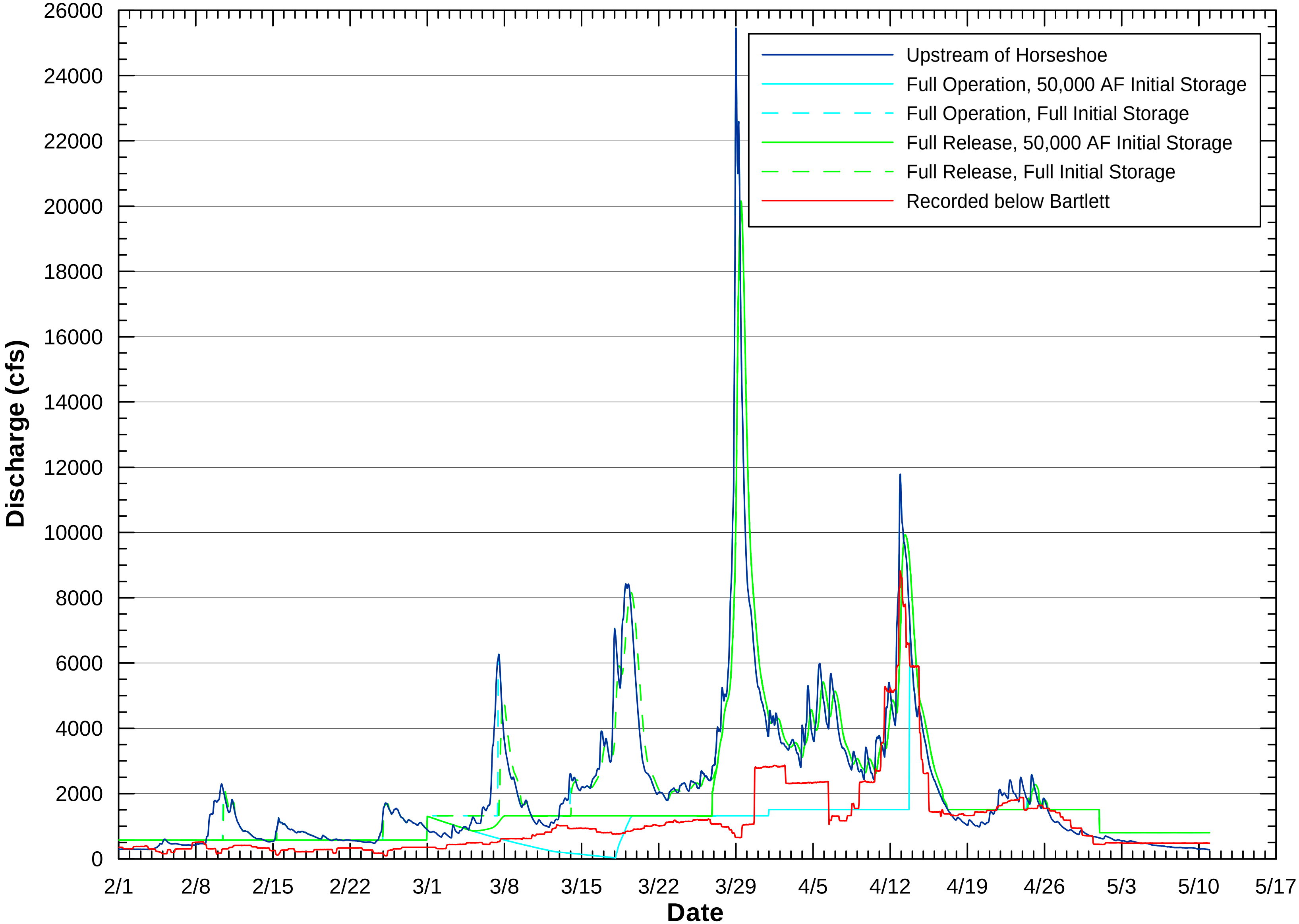


Figure B.12. Simulated hydrographs downstream of Bartlett Reservoir for the 1998 event.

APPENDIX C
Summary of Important Hydraulic Variables Used in the Analysis

Table C.1. Summary of important hydraulic variables for Site 1.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
1	150	2013.50	0.71	3.78	0.000050	n/a	n/a
	240	2014.93	0.81	4.61	0.000050	n/a	n/a
	410	2013.80	1.79	3.98	0.000300	n/a	n/a
	900	2016.48	2.22	5.53	0.000300	n/a	n/a
	1,990	2019.41	2.94	8.44	0.000300	n/a	n/a
	5,960	2021.58	6.25	10.61	0.001001	n/a	n/a
	9,600	2024.22	7.25	13.25	0.001001	n/a	n/a
	16,000	2025.31	10.82	14.34	0.002003	n/a	n/a
	41,200	2032.71	14.27	21.74	0.002002	n/a	n/a
	67,300	2033.01	22.77	22.04	0.005004	n/a	n/a
	98,400	2036.88	25.37	25.91	0.005006	n/a	n/a
	145,000	2041.09	26.02	30.12	0.004305	n/a	n/a
	151,700	2041.44	26.46	30.47	0.004386	n/a	n/a
	200,300	2043.93	28.63	32.96	0.004625	n/a	n/a
2	150	2016.31	5.05	1.41	0.009486	n/a	n/a
	240	2016.90	5.49	1.88	0.007786	n/a	n/a
	410	2017.62	5.24	2.39	0.005249	n/a	n/a
	900	2018.91	4.31	3.30	0.002364	n/a	n/a
	1,990	2020.39	4.42	4.32	0.001779	n/a	n/a
	5,960	2022.81	6.12	6.71	0.001911	n/a	n/a
	9,600	2025.18	6.13	9.07	0.001281	n/a	n/a
	16,000	2027.19	7.56	11.08	0.001493	n/a	n/a
	41,200	2034.79	8.38	18.69	0.000914	n/a	n/a
	67,300	2038.26	10.64	22.15	0.001174	n/a	n/a
	198,400	2043.18	10.77	27.08	0.000920	n/a	n/a
	145,000	2046.18	12.97	30.07	0.001161	n/a	n/a
	51,700	2046.61	13.20	30.51	0.001179	n/a	n/a
	200,300	2049.35	14.76	33.24	0.001315	n/a	n/a
3	150	2017.75	0.70	2.04	0.000106	n/a	n/a
	240	2018.18	0.92	2.41	0.000148	n/a	n/a
	410	2018.77	1.26	2.91	0.000215	n/a	n/a
	900	2019.91	1.97	3.86	0.000364	n/a	n/a
	1,990	2021.53	3.04	5.29	0.000569	n/a	n/a
	5,960	2024.76	5.42	8.24	0.001001	n/a	n/a
	9,600	2027.08	6.01	10.57	0.000886	n/a	n/a
	16,000	2029.35	6.85	12.83	0.000887	n/a	n/a
	41,200	2035.66	8.58	19.15	0.000817	n/a	n/a
	67,300	2039.34	10.56	22.83	0.000978	n/a	n/a
	98,400	2043.74	11.48	27.22	0.000914	n/a	n/a
	145,000	2046.81	13.95	30.30	0.001172	n/a	n/a
	151,700	2047.24	14.23	30.73	0.001196	n/a	n/a
	200,300	2049.98	16.09	33.46	0.001364	n/a	n/a

Table C.1. Summary of important hydraulic variables for Site 1.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-Channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
4	150	2020.47	1.34	1.55	0.000561	n/a	n/a
	240	2020.74	1.82	1.80	0.000853	n/a	n/a
	410	2021.16	2.52	2.17	0.001277	n/a	n/a
	900	2022.06	3.88	2.96	0.002004	n/a	n/a
	1,990	2023.50	5.62	4.29	0.002559	n/a	n/a
	5,960	2026.19	9.08	6.98	0.003488	n/a	n/a
	9,600	2028.64	8.36	9.43	0.001983	n/a	n/a
	16,000	2031.25	8.06	12.04	0.001330	n/a	n/a
	41,200	2036.63	10.23	17.42	0.001309	n/a	n/a
	67,300	2040.41	11.96	21.20	0.001377	n/a	n/a
	98,400	2044.58	13.02	25.37	0.001285	n/a	n/a
	145,000	2047.85	15.61	28.64	0.001571	n/a	n/a
	151,700	2048.29	15.92	29.09	0.001600	n/a	n/a
	200,300	2051.21	17.87	32.01	0.001776	n/a	n/a
5	150	2020.66	4.18	1.39	0.006917	n/a	n/a
	240	2021.07	5.05	1.56	0.008669	n/a	n/a
	410	2021.81	5.30	1.38	0.010892	n/a	n/a
	900	2023.20	5.27	2.12	0.006008	n/a	n/a
	1,990	2025.17	5.22	3.24	0.003311	n/a	n/a
	5,960	2028.90	4.59	6.97	0.000918	2029.23	0.015978
	9,600	2030.64	5.30	8.71	0.000912	2030.93	0.004058
	16,000	2032.28	8.45	10.35	0.001841	2033.09	0.000868
	41,200	2037.71	10.45	15.77	0.001603	2038.31	0.001236
	67,300	2041.93	11.95	19.99	0.001529	2041.93	0.001529
	98,400	2045.83	13.58	23.89	0.001557	2045.83	0.001557
	145,000	2049.25	16.57	27.31	0.001940	2049.25	0.001940
	151,700	2049.69	16.95	27.76	0.001986	2049.69	0.001986
	200,300	2052.56	19.54	30.63	0.002314	2052.56	0.002314
6	150	2024.09	1.16	3.47	0.000160	n/a	n/a
	240	2024.43	1.69	3.77	0.000308	n/a	n/a
	410	2024.98	2.52	4.25	0.000589	n/a	n/a
	900	2026.08	4.29	5.35	0.001258	n/a	n/a
	1,990	2027.55	6.77	6.81	0.002266	n/a	n/a
	5,960	2029.72	8.85	8.99	0.002677	2032.88	0.001860
	9,600	2031.30	10.36	10.56	0.002958	2033.99	0.002190
	16,000	2033.37	15.47	12.63	0.005201	2034.68	0.001940
	41,200	2038.23	19.65	17.49	0.005433	2039.64	0.001570
	67,300	2043.14	14.89	22.41	0.002243	2043.14	0.002243
	98,400	2047.48	14.55	26.74	0.001691	2047.48	0.001691
	145,000	2051.83	15.23	31.10	0.001515	2051.83	0.001515
	151,700	2052.40	15.30	31.67	0.001493	2052.40	0.001493
	200,300	2056.16	15.90	35.42	0.001390	2056.16	0.001390

Table C.2. Summary of important hydraulic variables for Site 2.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
1	117	1837.31	3.28	1.42	0.004001	n/a	n/a
	262	1838.30	3.84	1.78	0.004007	n/a	n/a
	548	1839.39	4.84	2.54	0.004002	n/a	n/a
	1,004	1840.60	5.87	3.41	0.004007	n/a	n/a
	1,425	1841.93	5.81	4.31	0.002882	1842.39	0.000005
	1,790	1842.62	6.10	4.76	0.002794	1842.87	0.000031
	4,100	1843.39	7.82	5.29	0.004003	1843.92	0.004005
	6,300	1845.48	9.14	6.75	0.004001	1844.49	0.004001
	21,400	1850.25	12.37	10.74	0.004002	1848.54	0.004001
	55,200	1853.73	14.91	14.23	0.004000	1852.80	0.004001
	92,900	1857.17	17.23	17.67	0.004001	1857.17	0.004001
	101,100	1857.83	17.66	18.32	0.004007	1857.83	0.004007
	123,200	1859.31	18.59	19.81	0.004002	1859.31	0.004002
	200,300	1863.65	21.22	24.15	0.004003	1863.65	0.004003
2	117	1844.24	2.13	0.98	0.002692	n/a	n/a
	262	1844.89	2.79	1.43	0.002758	n/a	n/a
	548	1845.73	3.44	1.81	0.002794	n/a	n/a
	1,004	1846.56	4.20	2.25	0.003295	n/a	n/a
	1,425	1847.10	4.68	2.57	0.003647	1846.28	0.001227
	1,790	1847.45	5.03	2.79	0.003932	1846.68	0.002168
	4,100	1846.37	8.58	2.28	0.012392	1849.21	0.004893
	6,300	1847.73	8.53	3.02	0.008454	1849.66	0.004803
	21,400	1852.70	6.88	6.56	0.002403	1852.85	0.006889
	55,200	1855.88	12.67	9.67	0.005387	1855.62	0.018876
	92,900	1859.23	13.64	13.02	0.004400	1859.23	0.004400
	101,100	1859.90	13.74	13.69	0.004197	1859.90	0.004197
	123,200	1861.47	13.90	15.26	0.003754	1861.47	0.003754
	200,300	1866.15	14.60	19.94	0.002960	1866.15	0.002960
3	117	1844.50	1.06	2.20	0.000324	n/a	n/a
	262	1845.28	1.74	2.84	0.000677	n/a	n/a
	548	1846.26	2.69	3.65	0.001249	n/a	n/a
	1,004	1847.25	3.86	4.64	0.001874	n/a	n/a
	1,425	1847.88	4.70	5.27	0.002343	1848.90	0.000000
	1,790	1848.30	5.29	5.69	0.002687	1849.14	0.000002
	4,100	1848.68	7.35	6.07	0.004749	1851.26	0.000291
	6,300	1849.93	9.69	7.33	0.006423	1851.73	0.000398
	21,400	1853.53	13.49	10.92	0.007319	1854.02	0.003389
	55,200	1860.07	10.22	17.46	0.002244	1859.67	0.016526
	92,900	1862.75	12.61	20.14	0.002824	1862.75	0.002824
	101,100	1863.27	12.86	20.66	0.002841	1863.27	0.002841
	123,200	1864.23	13.95	21.62	0.003147	1864.23	0.003147
	200,300	1868.12	15.20	25.51	0.002995	1868.12	0.002995

Table C.2. Summary of important hydraulic variables for Site 2.

Cross Section	Discharge (cfs)	Main Flow Path: Water-surface Elevation (ft, NAVD88)	Main Flow Path: Main-Channel Velocity (ft/s)	Main Flow Path: Hydraulic Depth Channel (ft)	Main Flow Path: Energy Slope	Secondary Flow Path: Water-surface Elevation (ft, NAVD88)	Secondary Flow Path: Energy Slope
4	117	1852.09	1.94	0.93	0.002982	n/a	n/a
	262	1852.59	2.67	1.12	0.006164	n/a	n/a
	548	1853.34	1.90	1.69	0.002412	n/a	n/a
	1,004	1853.39	3.38	1.74	0.007314	n/a	n/a
	1,425	1853.99	0.76	2.32	0.001233	1850.53	0.000171
	1,790	1854.30	0.83	2.62	0.001196	1851.00	0.000422
	4,100	1853.83	3.24	2.16	0.005060	1853.94	0.001152
	6,300	1854.11	4.69	2.43	0.009125	1854.42	0.001211
	21,400	1856.91	5.95	5.33	0.004577	n/a	n/a
	55,200	1861.68	7.70	10.05	0.003321	1861.95	0.002482
	92,900	1864.49	9.29	12.86	0.003487	1864.49	0.003487
	101,100	1864.94	9.64	13.32	0.003580	1864.94	0.003580
	123,200	1866.03	10.46	14.40	0.003799	1866.03	0.003799
	200,300	1869.62	12.30	17.99	0.003903	1869.62	0.003903
5	117	1852.23	0.23	2.30	0.000009	n/a	n/a
	262	1852.81	0.40	2.80	0.000022	n/a	n/a
	548	1853.48	0.63	3.41	0.000043	n/a	n/a
	1,004	1853.76	1.05	3.68	0.000105	n/a	n/a
	1,425	1854.09	1.32	3.99	0.000142	n/a	n/a
	1,790	1854.41	1.50	4.29	0.000167	n/a	n/a
	4,100	1854.63	3.22	4.51	0.000760	n/a	n/a
	6,300	1855.28	4.12	5.16	0.001052	n/a	n/a
	21,400	1858.14	6.78	6.93	0.001951	n/a	n/a
	55,200	1862.64	9.05	11.43	0.001860	1862.68	0.000703
	92,900	1865.56	10.70	14.35	0.001940	1865.56	0.001940
	101,100	1866.03	11.11	14.83	0.002005	1866.03	0.002005
	123,200	1867.17	12.17	15.97	0.002187	1867.17	0.002187
	200,300	1870.69	14.97	19.49	0.002552	1870.69	0.002552
6	117	1852.23	0.20	2.58	0.000007	n/a	n/a
	262	1852.81	0.37	3.03	0.000018	n/a	n/a
	548	1853.49	0.61	2.29	0.000120	n/a	n/a
	1,004	1853.78	0.99	2.58	0.000273	n/a	n/a
	1,425	1854.14	1.23	2.93	0.000358	n/a	n/a
	1,790	1854.46	1.39	3.26	0.000396	n/a	n/a
	4,100	1854.86	2.83	3.65	0.001410	n/a	n/a
	6,300	1855.63	3.56	4.43	0.001728	n/a	n/a
	21,400	1859.01	6.63	7.81	0.002812	n/a	n/a
	55,200	1863.56	9.17	12.36	0.002921	1863.79	0.003341
	92,900	1866.64	10.72	15.44	0.002963	1866.64	0.002963
	101,100	1867.19	11.00	15.99	0.002982	1867.19	0.002982
	123,200	1868.50	11.81	17.30	0.003093	1868.50	0.003093
	200,300	1872.45	13.90	21.25	0.003253	1872.45	0.003253

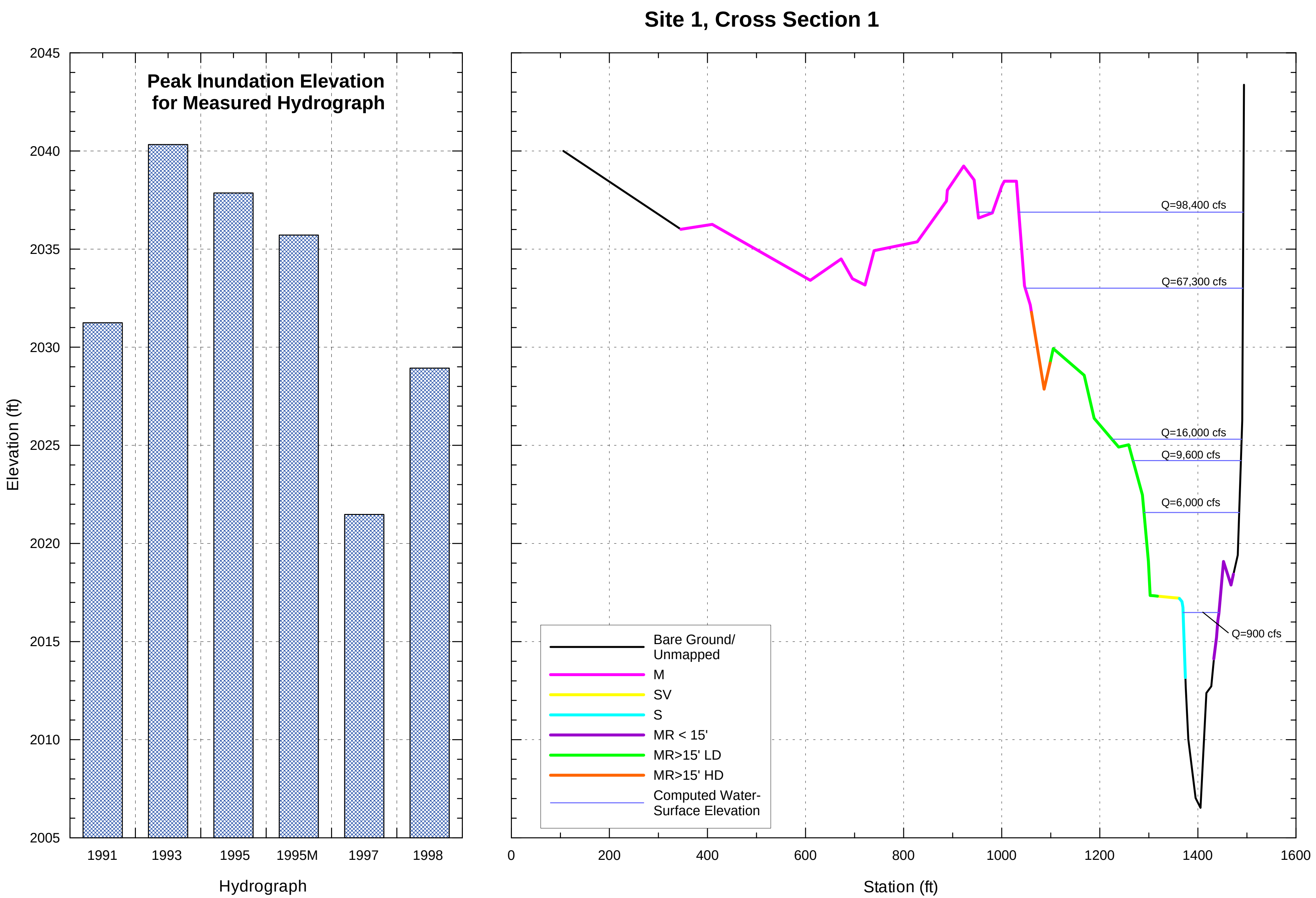
Table C.2. Summary of important hydraulic variables for Site 2.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-Channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
7	117	1852.23	0.09	5.98	0.000000	n/a	n/a
	262	1852.82	0.19	6.43	0.000002	n/a	n/a
	548	1853.50	0.36	7.06	0.000005	n/a	n/a
	1,004	1853.81	0.63	7.38	0.000015	n/a	n/a
	1,425	1854.18	0.85	7.74	0.000026	n/a	n/a
	1,790	1854.51	1.02	8.07	0.000035	n/a	n/a
	4,100	1855.04	2.19	8.61	0.000152	n/a	n/a
	6,300	1855.90	3.05	9.46	0.000260	n/a	n/a
	21,400	1859.50	7.36	13.07	0.000986	n/a	n/a
	55,200	1863.34	13.66	16.91	0.002410	1864.76	0.003819
	92,900	1866.31	17.36	19.87	0.003140	1866.31	0.003140
	101,100	1866.90	17.73	20.46	0.003152	1866.90	0.003152
	123,200	1868.22	18.81	21.79	0.003262	1868.22	0.003262
	200,300	1871.31	23.09	24.88	0.004119	1871.31	0.004119

Table C.3. Summary of important hydraulic variables for Site 3.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
1	300	1504.84	4.12	0.52	0.022432	n/a	n/a
	500	1505.06	4.71	0.67	0.020959	n/a	n/a
	1,000	1506.00	3.68	1.57	0.004107	n/a	n/a
	2,000	1507.19	3.83	2.76	0.002101	n/a	n/a
	5,000	1509.38	4.54	4.95	0.001353	n/a	n/a
	10,000	1511.48	5.54	7.05	0.001260	1511.77	0.000004
	20,000	1513.96	6.90	9.53	0.001309	1514.49	0.000057
	50,000	1518.58	7.13	14.15	0.000824	1518.58	0.000824
	100,000	1521.88	8.92	17.45	0.000975	1521.88	0.000975
	150,000	1524.10	10.18	19.68	0.001083	1524.10	0.001083
	200,300	1525.83	11.15	21.40	0.001163	1525.83	0.001163
2	300	1505.86	1.59	1.16	0.001156	n/a	n/a
	500	1506.23	1.99	1.46	0.001330	n/a	n/a
	1,000	1506.75	2.85	1.95	0.001858	n/a	n/a
	2,000	1507.69	3.57	2.87	0.001747	n/a	n/a
	5,000	1509.71	4.55	4.84	0.001421	n/a	n/a
	10,000	1511.79	5.45	6.51	0.001377	1511.77	0.000027
	20,000	1514.25	6.82	8.96	0.001403	1514.50	0.000169
	50,000	1518.66	7.86	13.38	0.001095	1518.66	0.001095
	100,000	1521.94	9.81	16.65	0.001272	1521.94	0.001272
	150,000	1524.15	11.17	18.87	0.001398	1524.15	0.001398
	200,300	1525.88	12.13	20.60	0.001465	1525.88	0.001465
3	300	1506.48	2.46	1.79	0.001559	n/a	n/a
	500	1507.00	3.01	2.27	0.001706	n/a	n/a
	1,000	1507.78	4.16	3.05	0.002191	n/a	n/a
	2,000	1508.80	5.35	4.07	0.002474	n/a	n/a
	5,000	1510.75	7.10	6.02	0.002581	n/a	n/a
	10,000	1512.79	8.25	8.06	0.002364	1511.82	0.000226
	20,000	1515.25	9.19	10.52	0.002056	1514.63	0.000330
	50,000	1519.41	9.01	14.68	0.001268	1519.41	0.001268
	100,000	1522.79	10.65	18.06	0.001344	1522.79	0.001344
	150,000	1525.09	11.89	20.36	0.001427	1525.09	0.001427
	200,300	1526.86	12.76	22.13	0.001469	1526.86	0.001469

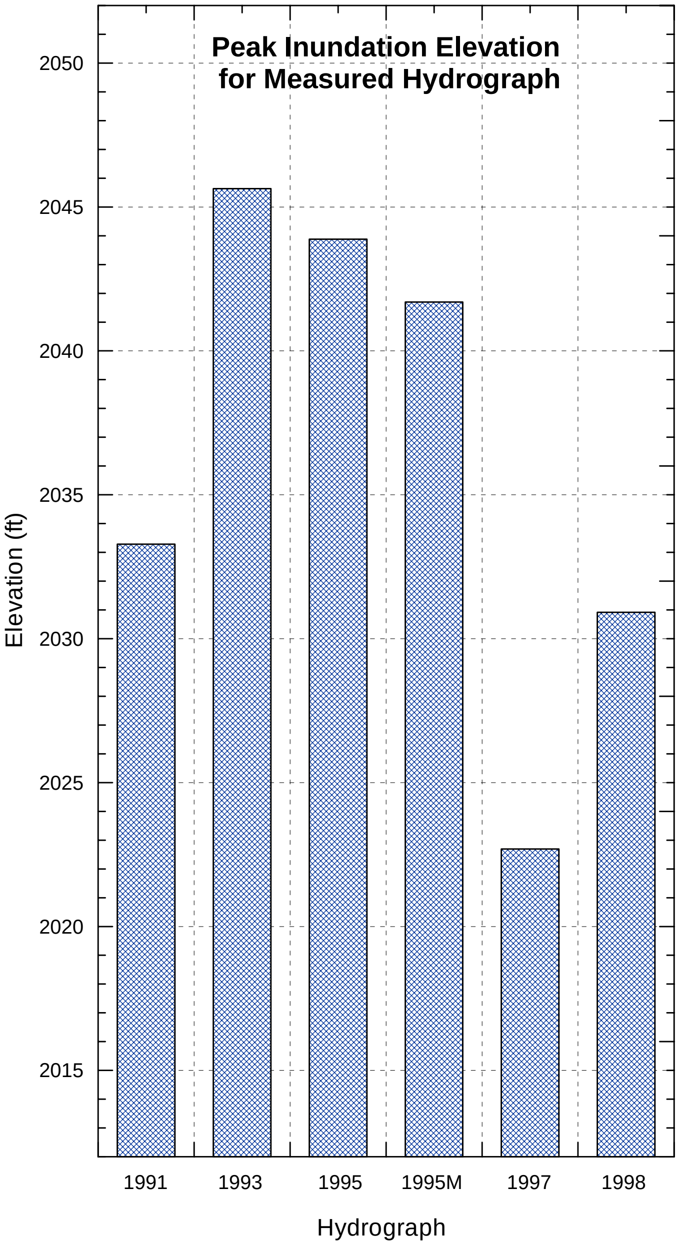
Table C.3. Summary of important hydraulic variables for Site 3.							
Cross Section	Discharge (cfs)	Main Flow Path				Secondary Flow Path	
		Water-surface Elevation (ft, NAVD88)	Main-Channel Velocity (ft/s)	Hydraulic Depth Channel (ft)	Energy Slope	Water-surface Elevation (ft, NAVD88)	Energy Slope
4	300	1509.07	4.68	0.67	0.020597	n/a	n/a
	500	1509.35	5.46	0.90	0.018909	n/a	n/a
	1,000	1509.92	6.54	1.32	0.016482	n/a	n/a
	2,000	1510.75	7.76	2.12	0.012311	n/a	n/a
	5,000	1512.63	8.55	4.00	0.006409	n/a	n/a
	10,000	1514.51	9.06	5.88	0.004298	1512.96	0.001251
	20,000	1516.82	9.70	8.19	0.003168	1515.58	0.002587
	50,000	1520.26	10.73	11.63	0.002428	1520.26	0.002428
	100,000	1523.59	12.37	14.95	0.002310	1523.59	0.002310
	150,000	1525.98	12.25	17.35	0.001857	1525.98	0.001857
	200,300	1527.83	12.60	19.20	0.001715	1527.83	0.001715
7	300	1514.31	0.68	2.08	0.000097	n/a	n/a
	500	1514.69	0.96	2.42	0.000157	n/a	n/a
	1,000	1515.24	1.55	2.91	0.000320	n/a	n/a
	2,000	1515.99	2.42	3.61	0.000590	n/a	n/a
	5,000	1517.37	4.17	4.99	0.001136	n/a	n/a
	10,000	1518.87	5.91	6.49	0.001601	n/a	n/a
	20,000	1520.96	8.08	8.58	0.002065	n/a	n/a
	50,000	1523.85	11.90	11.47	0.003043	1523.85	0.003043
	100,000	1527.38	11.89	15.00	0.002125	1527.38	0.002125
	150,000	1529.38	12.48	17.01	0.001980	1529.38	0.001980
	200,300	1530.97	13.26	18.59	0.001986	1530.97	0.001986
8	300	1516.36	4.01	0.51	0.021802	n/a	n/a
	500	1516.56	4.63	0.66	0.020847	n/a	n/a
	1,000	1516.98	5.25	0.90	0.017645	n/a	n/a
	2,000	1517.45	6.31	1.22	0.016976	n/a	n/a
	5,000	1518.59	7.67	2.36	0.010388	n/a	n/a
	10,000	1520.26	8.04	4.03	0.005605	n/a	n/a
	20,000	1522.48	9.24	6.25	0.004120	n/a	n/a
	50,000	1526.09	10.17	9.86	0.002716	1526.09	0.002716
	100,000	1528.83	12.79	12.60	0.003098	1528.83	0.003098
	150,000	1530.73	13.56	14.50	0.002890	1530.73	0.002890
	200,300	1532.32	14.10	16.09	0.002721	1532.32	0.002721

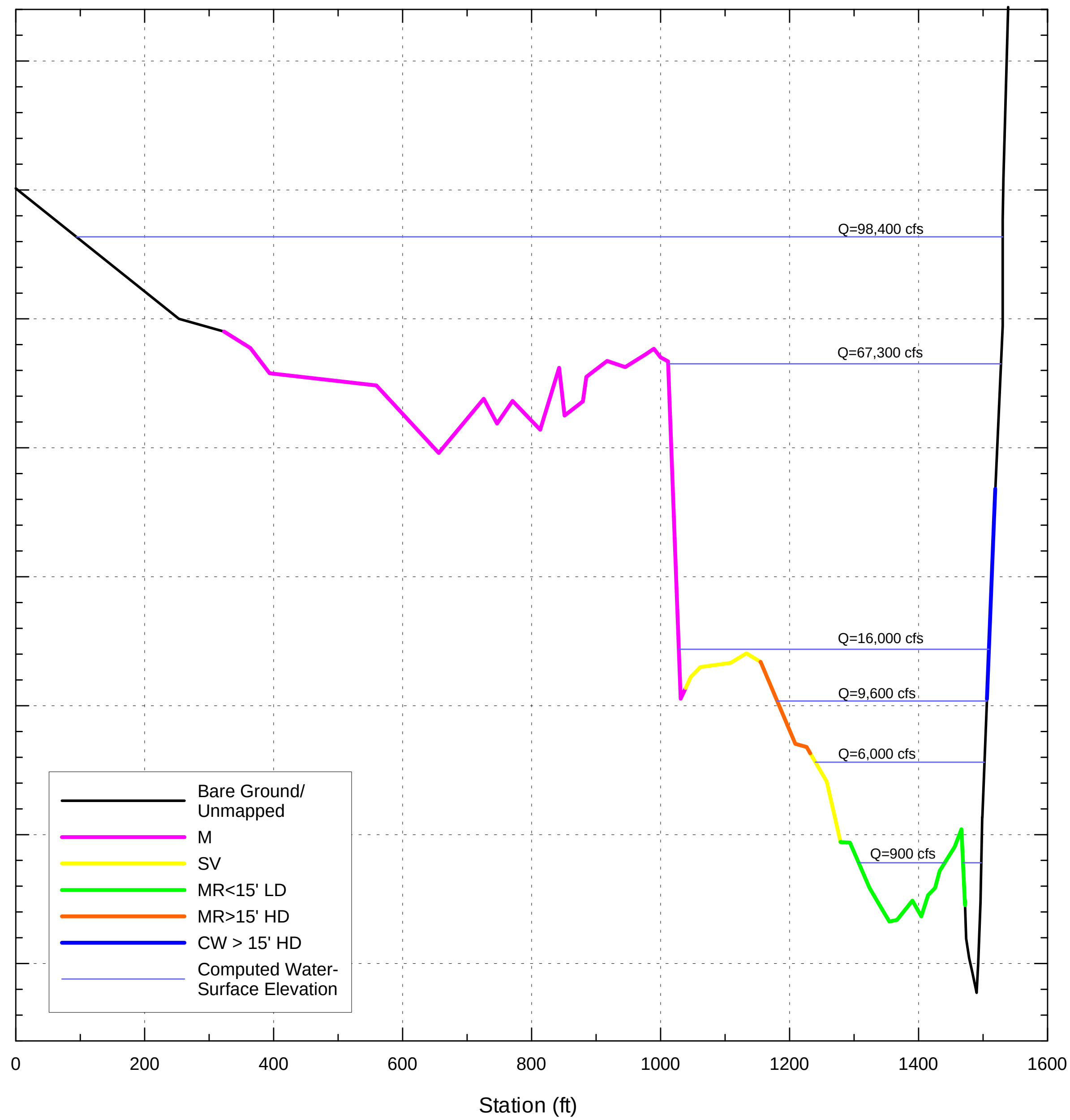
APPENDIX D

Cross-Section Profiles and Water-Surface Elevations for Natural and Routed Flood Peaks for each of the Three Sites

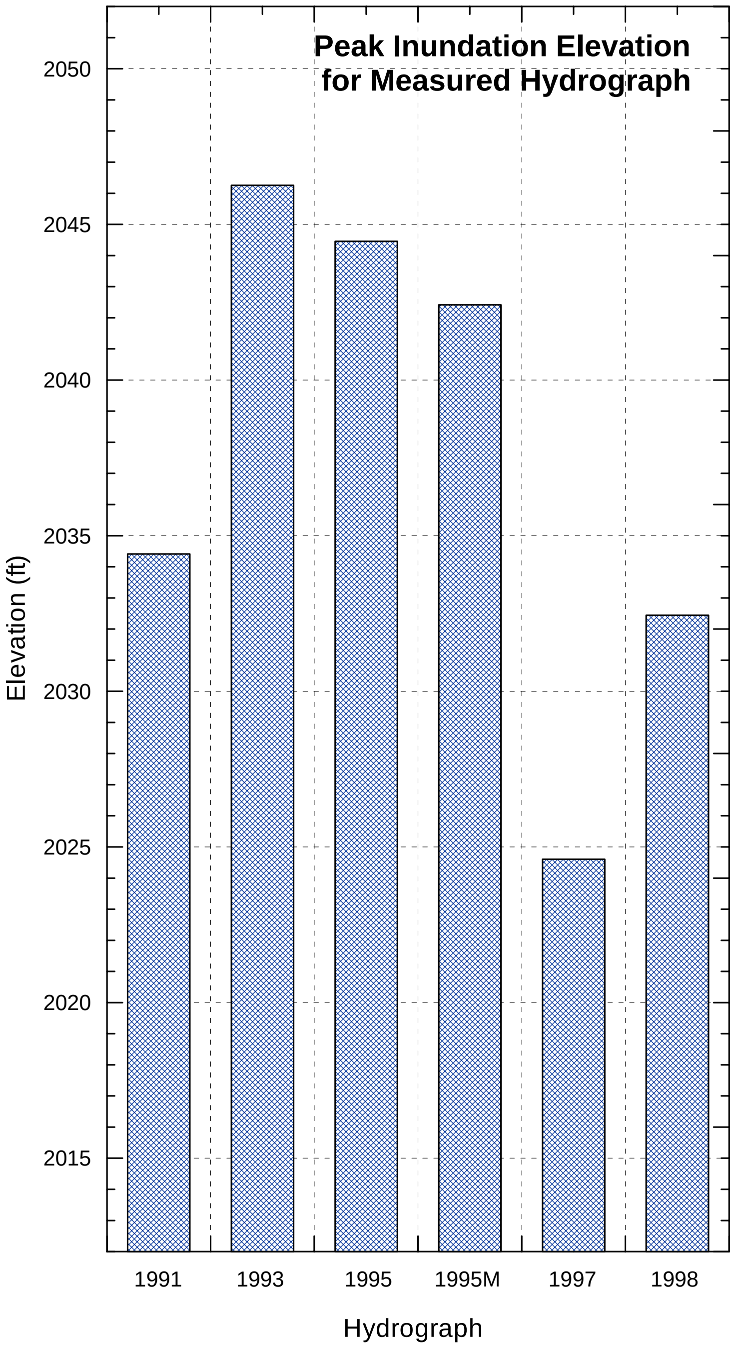

Site 1, Cross Section 1
Peak Inundation Elevation for Measured Hydrograph
Elevation (ft)
Hydrograph
1991
1993
1995
1995M
1997
1998
Station (ft)
Q=98,400 cfs
Q=67,300 cfs
Q=16,000 cfs
Q=9,600 cfs
Q=6,000 cfs
Q=900 cfs
Bare Ground/ Unmapped
M
SV
S
MR < 15'
MR>15' LD
MR>15' HD
Computed Water-Surface Elevation

Site 1, Cross Section 2

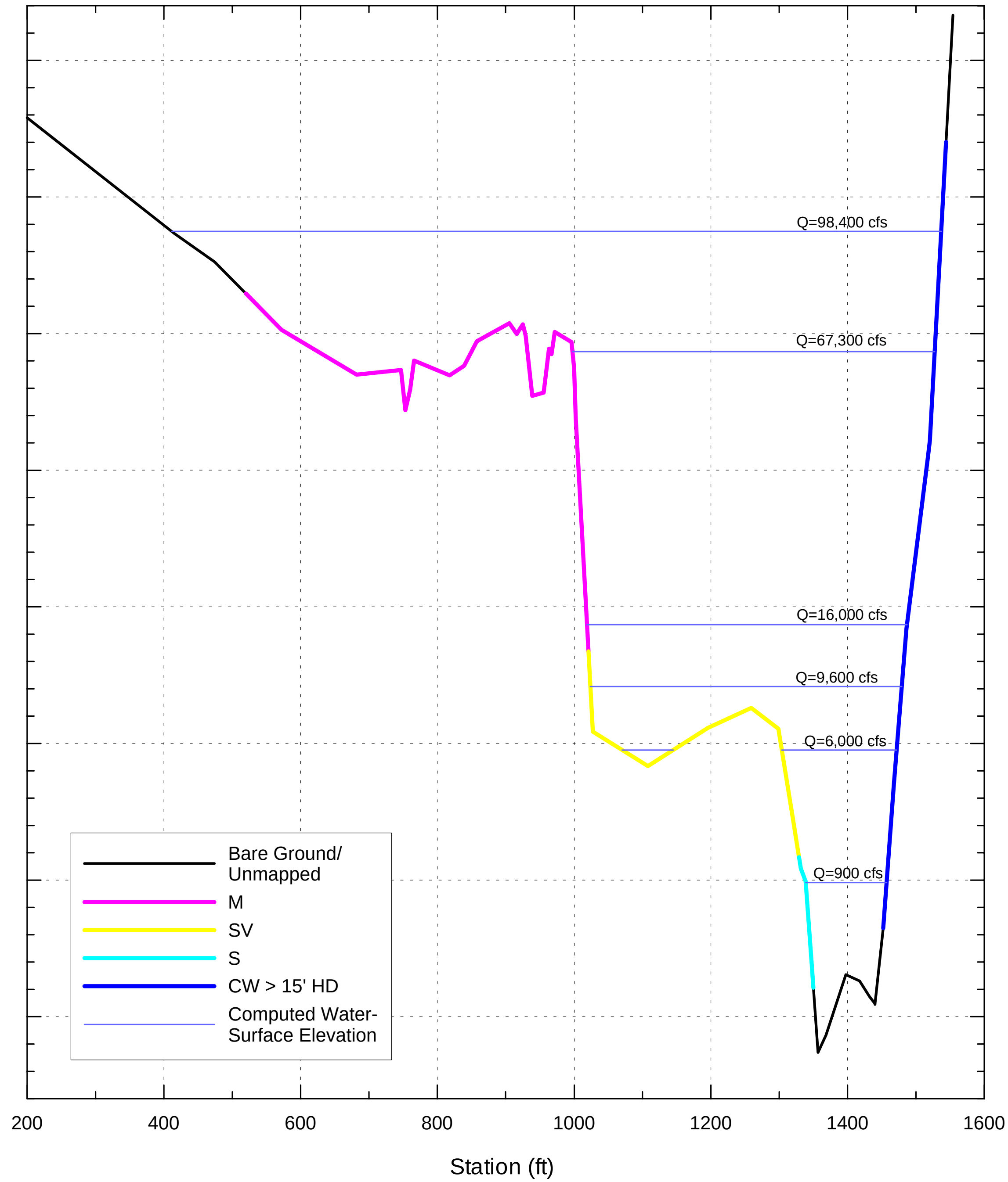




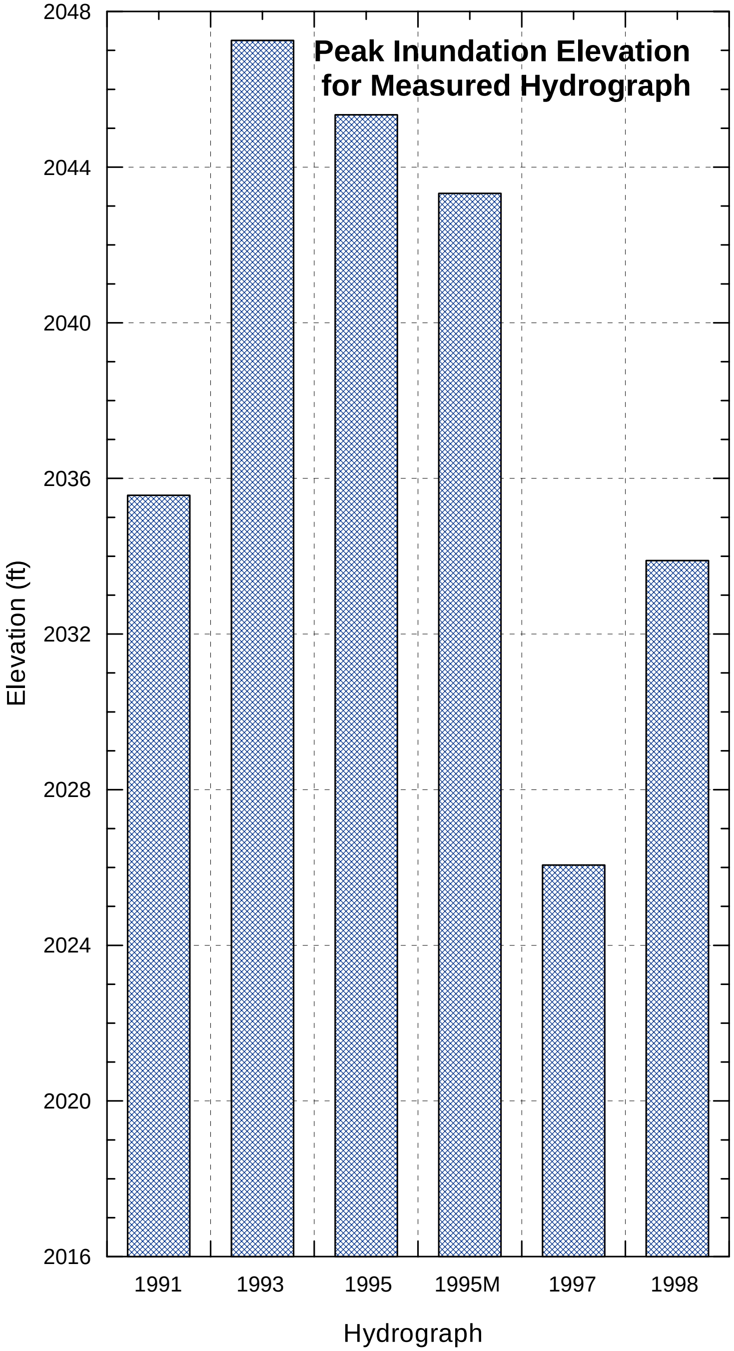
Mussetter Engineering, Inc.



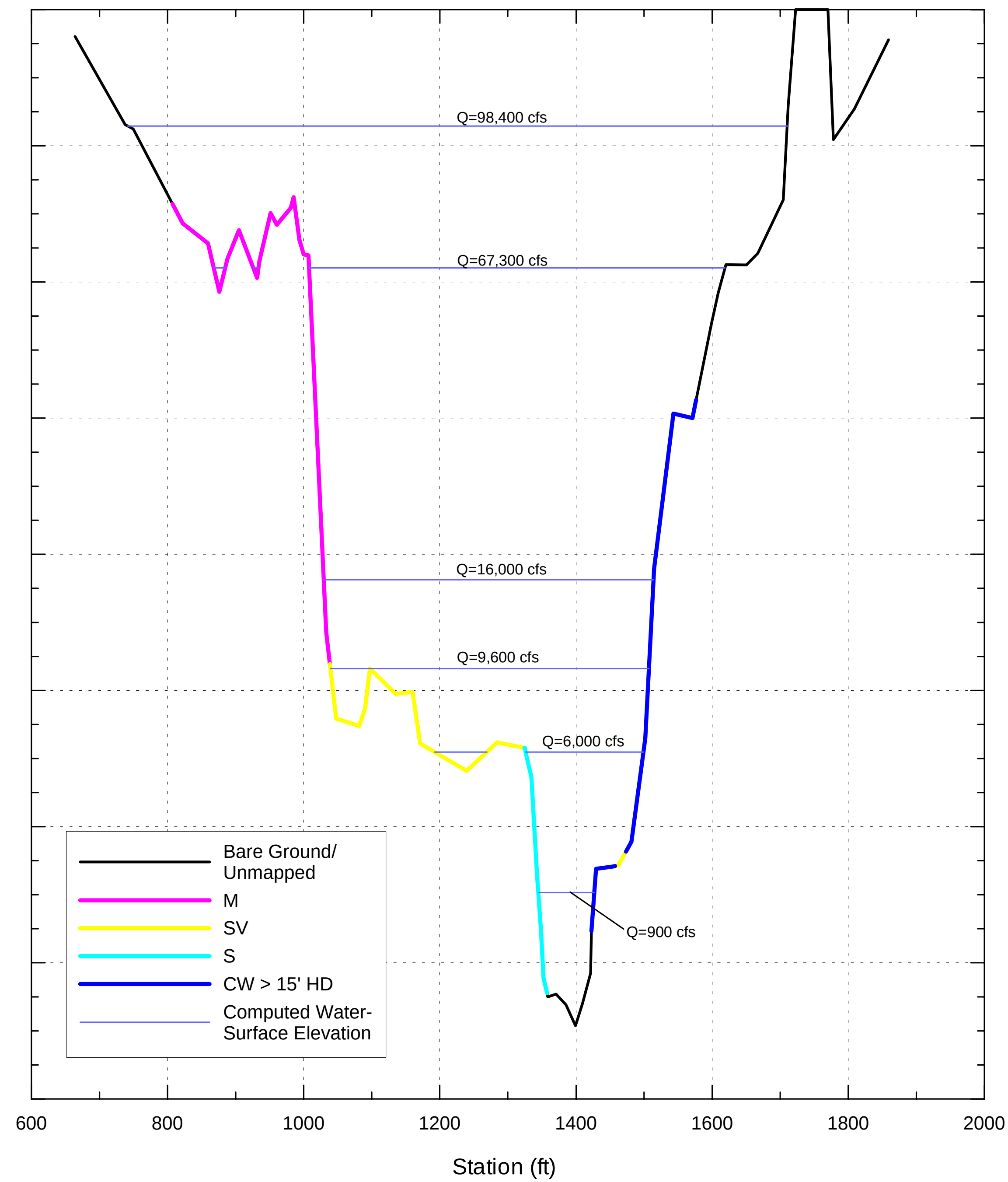
Site 1, Cross Section 3



Mussetter Engineering, Inc.

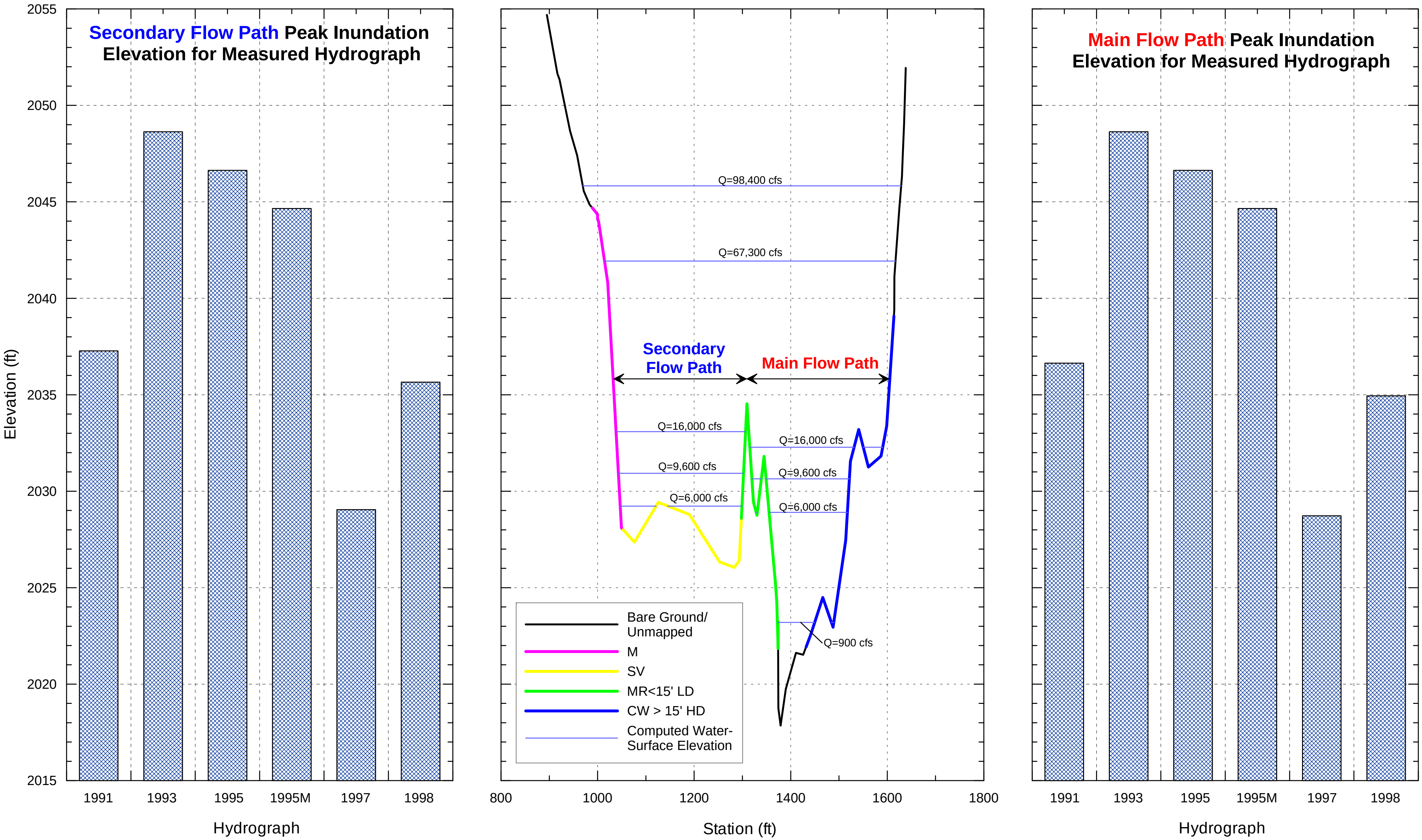


Site 1, Cross Section 4



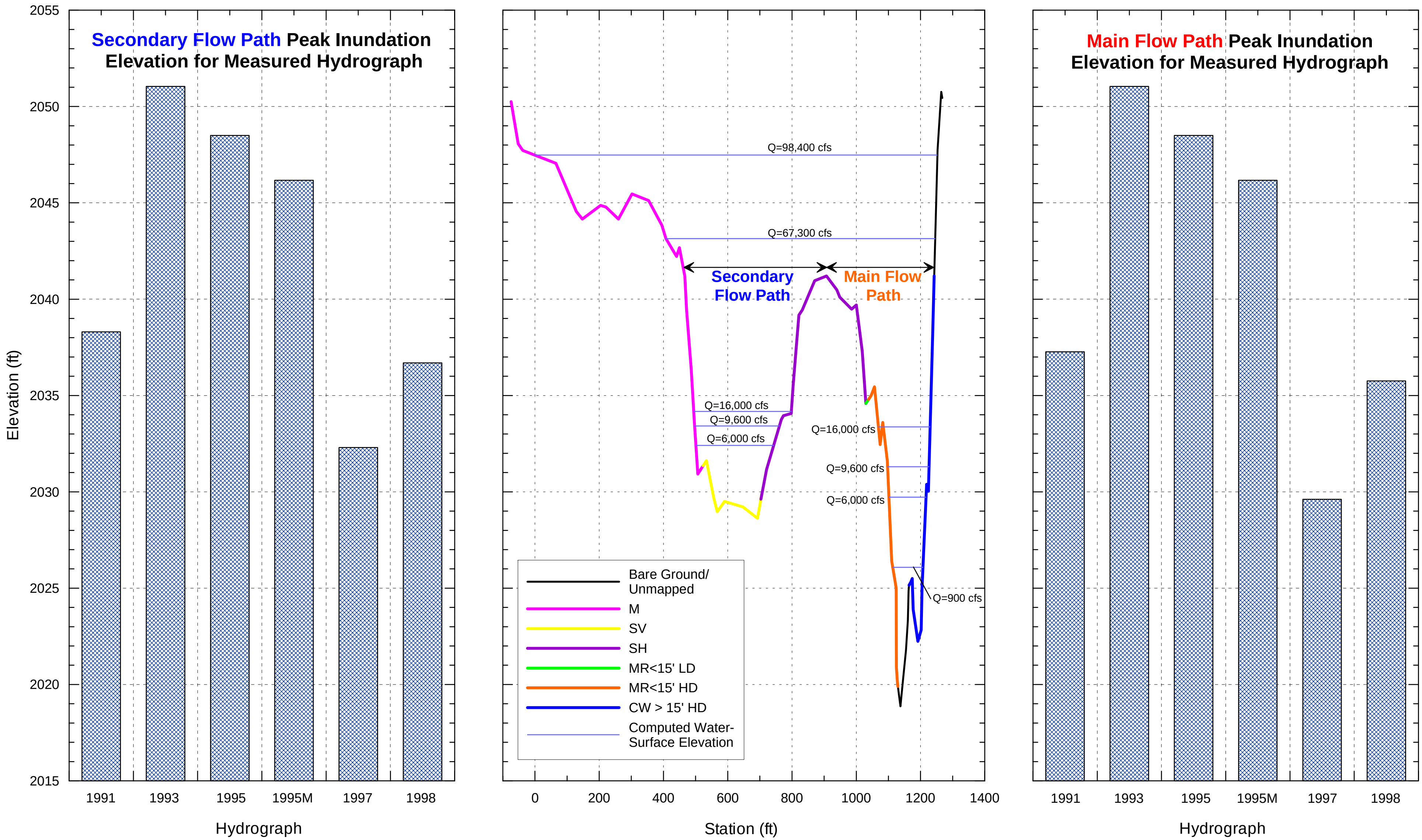
Mussetter Engineering, Inc.

Site 1, Cross Section 5

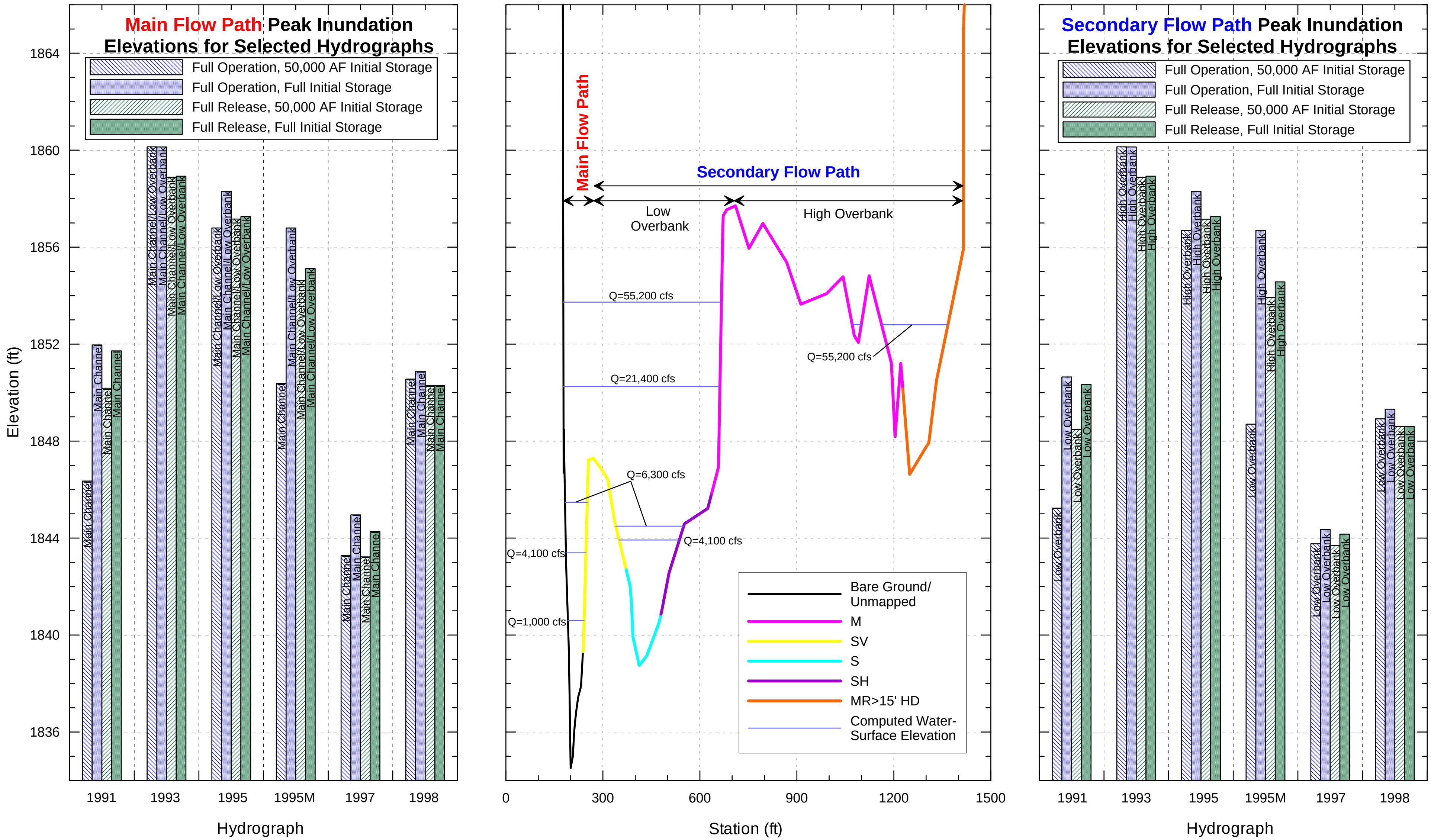


Mussetter Engineering, Inc.

Site 1, Cross Section 6

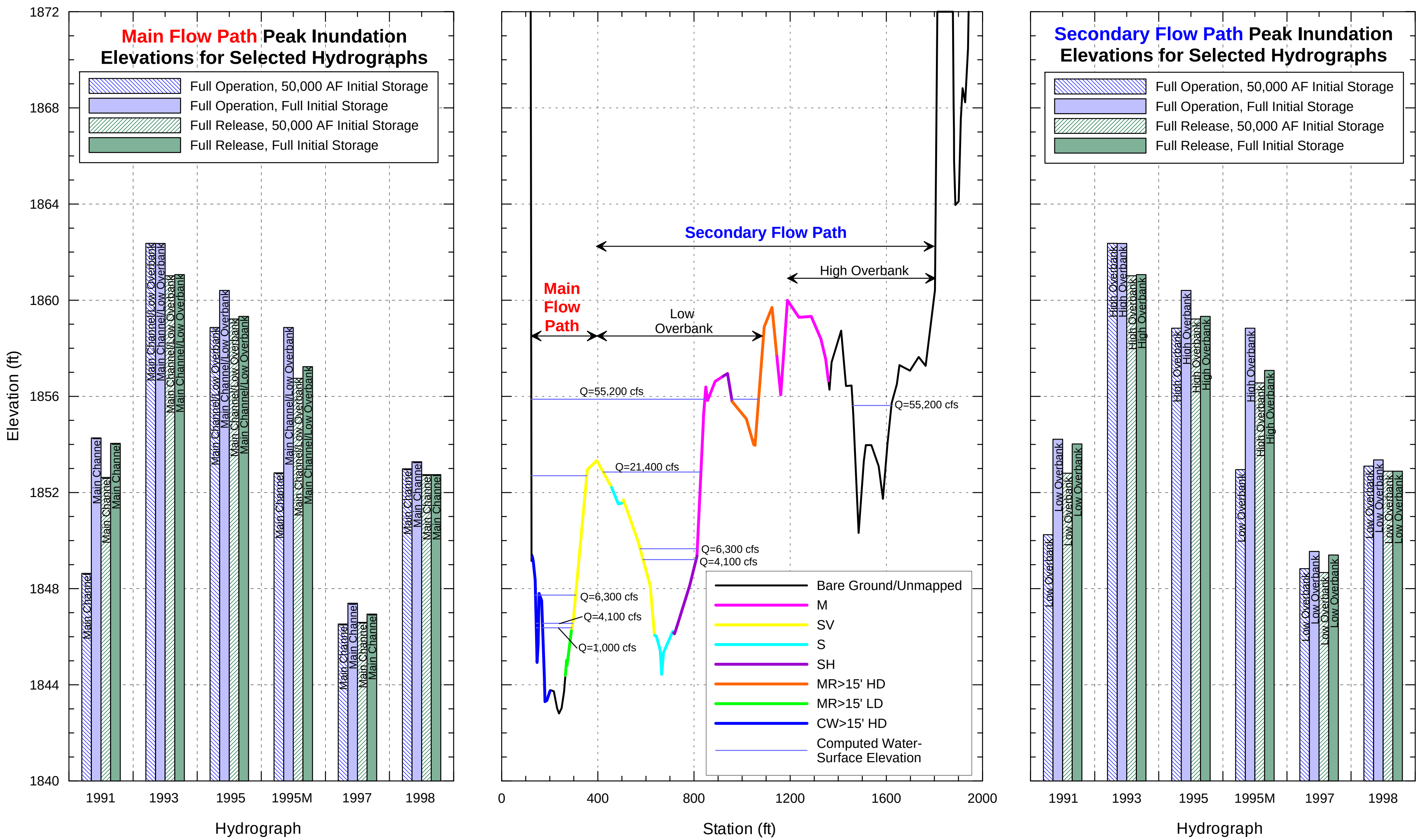


Site 2, Cross Section 1

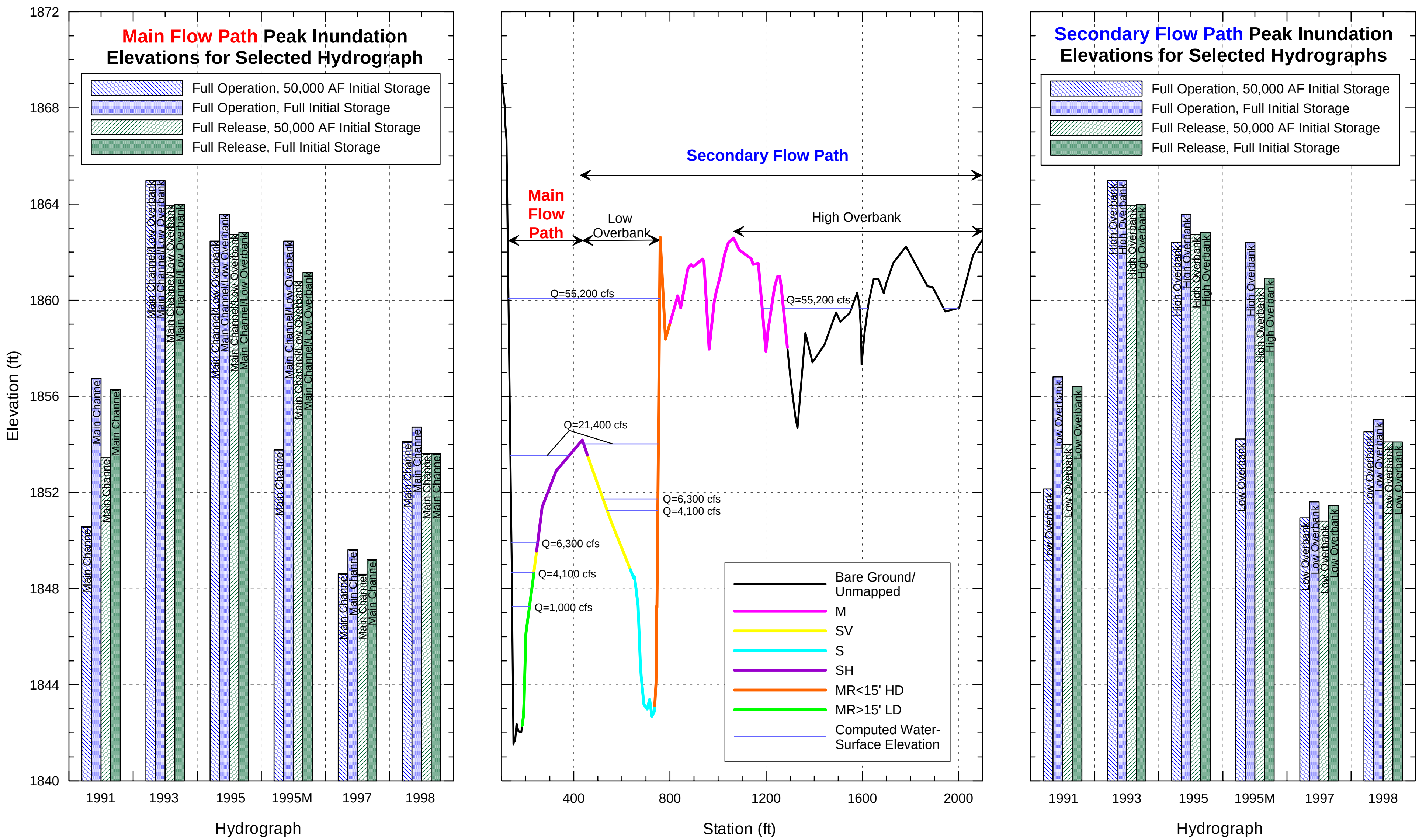


Mussetter Engineering, Inc.

Site 2, Cross Section 2

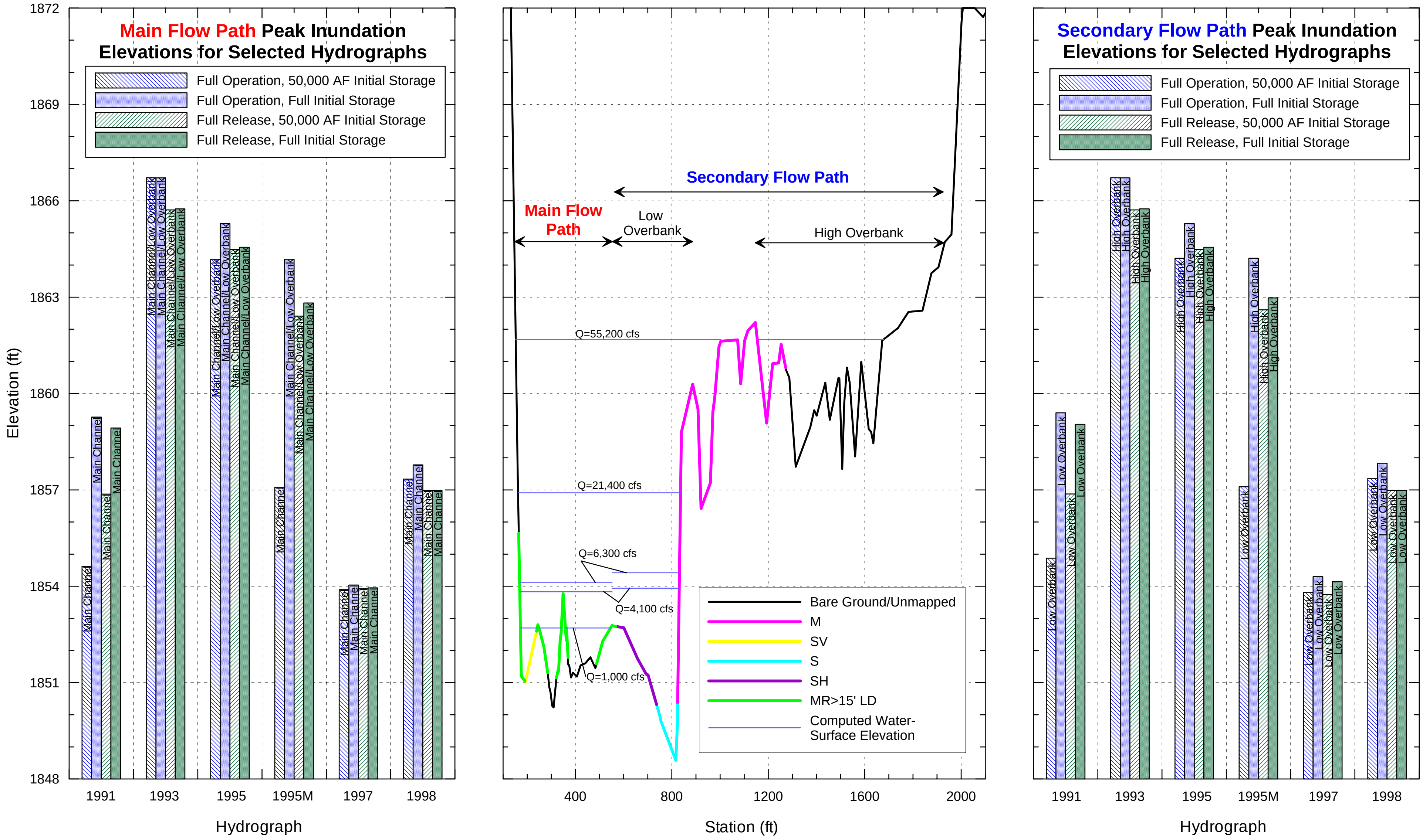


Site 2, Cross Section 3



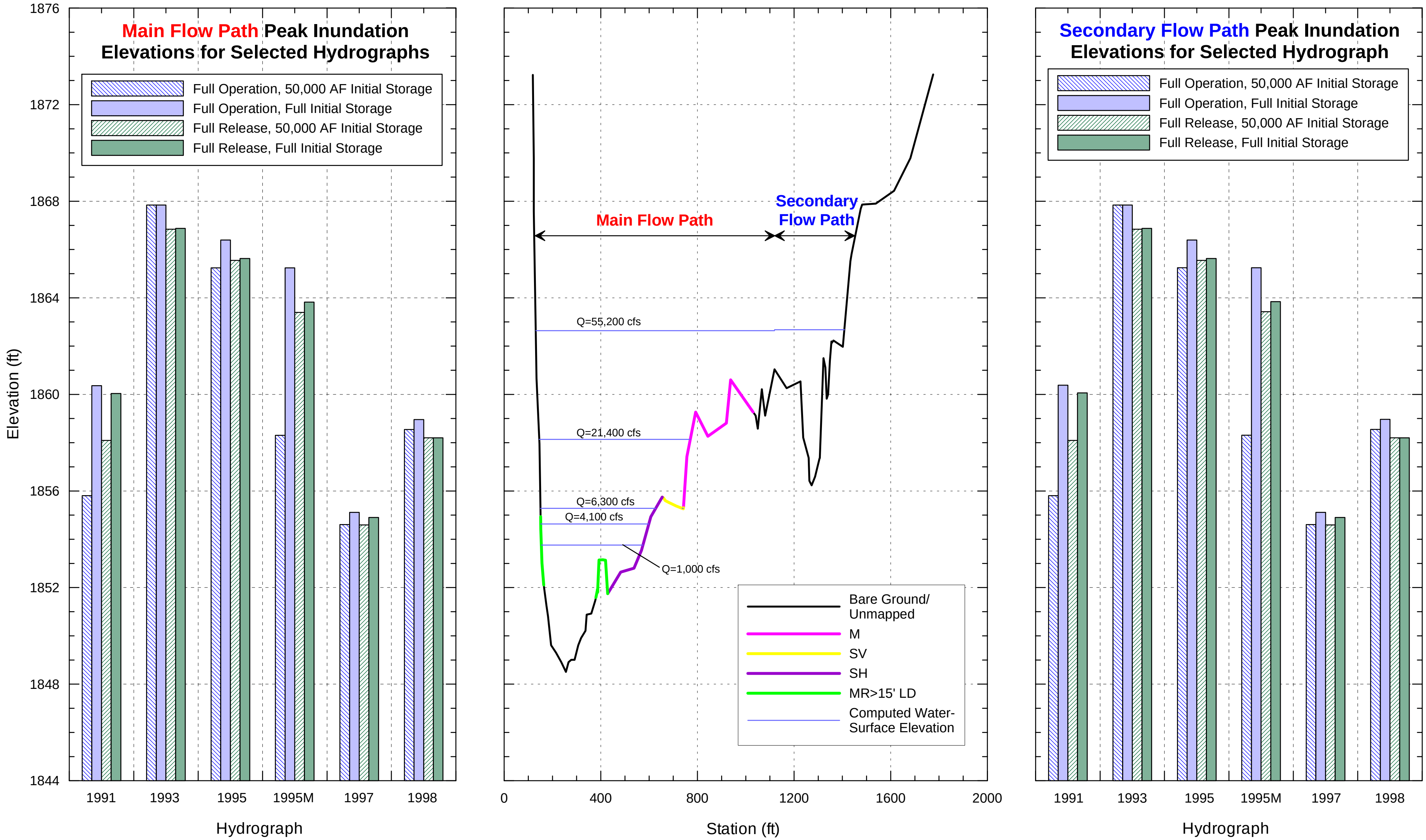
Mussetter Engineering, Inc.

Site 2, Cross Section 4

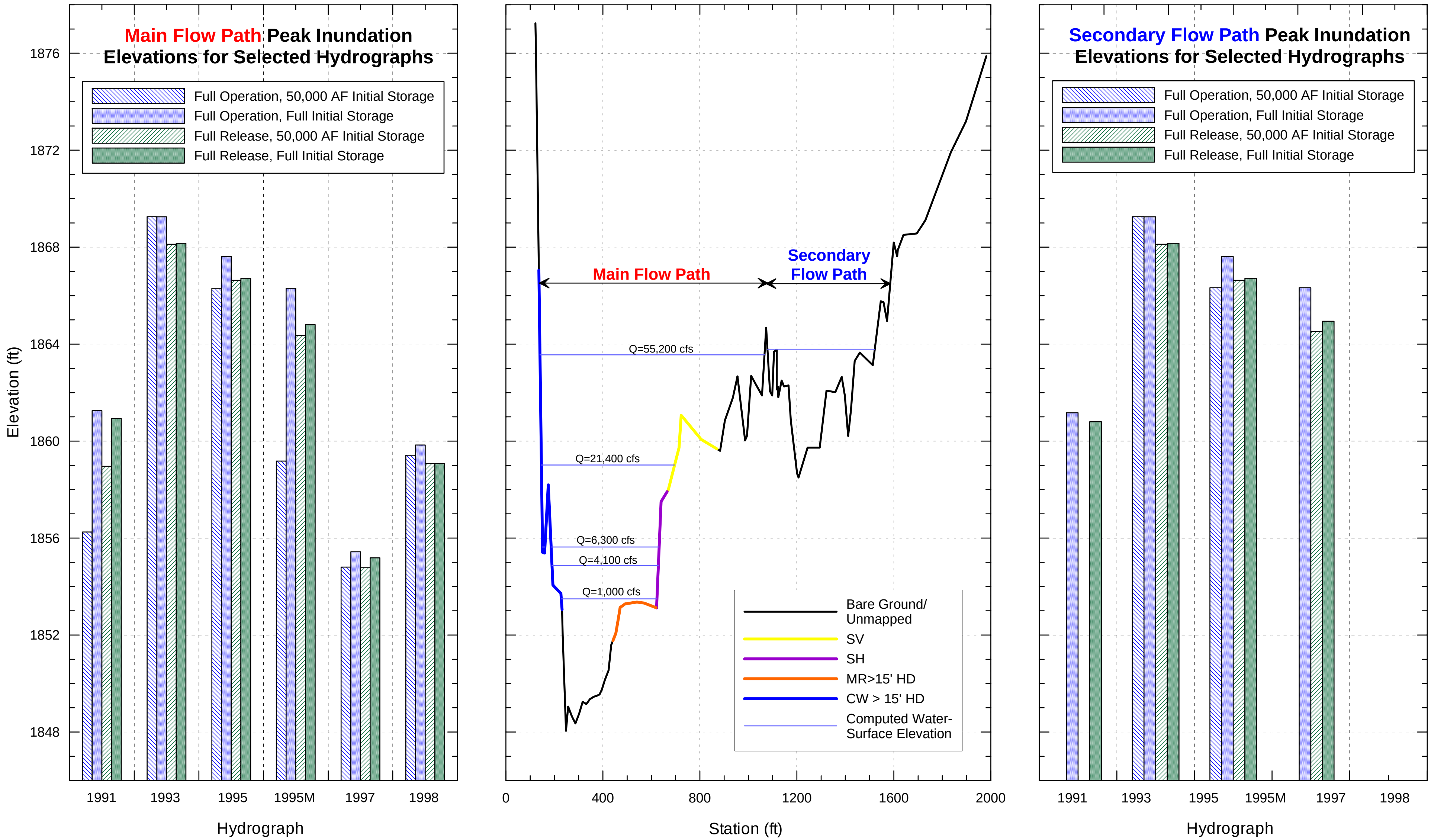


Mussetter Engineering, Inc.

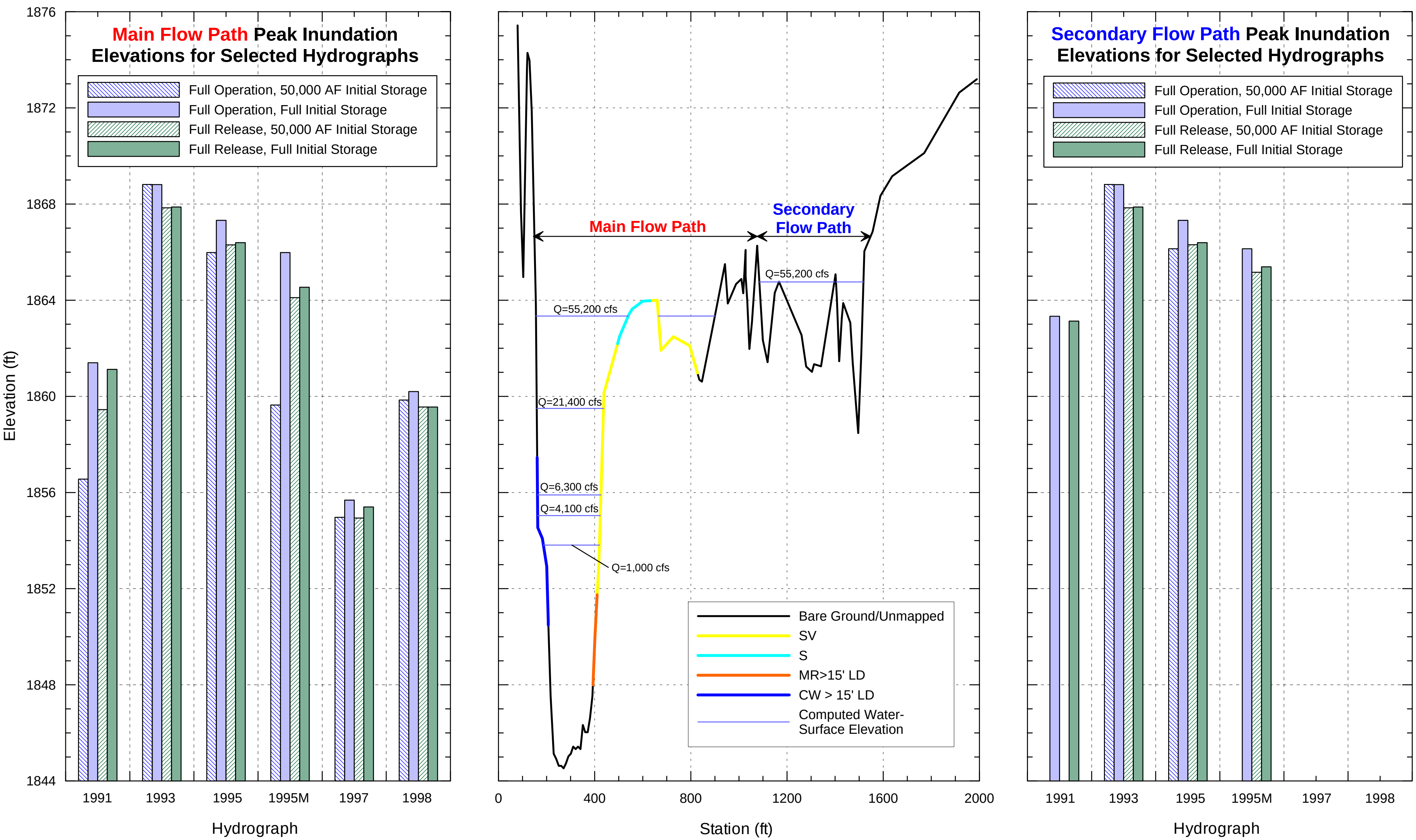
Site 2, Cross Section 5



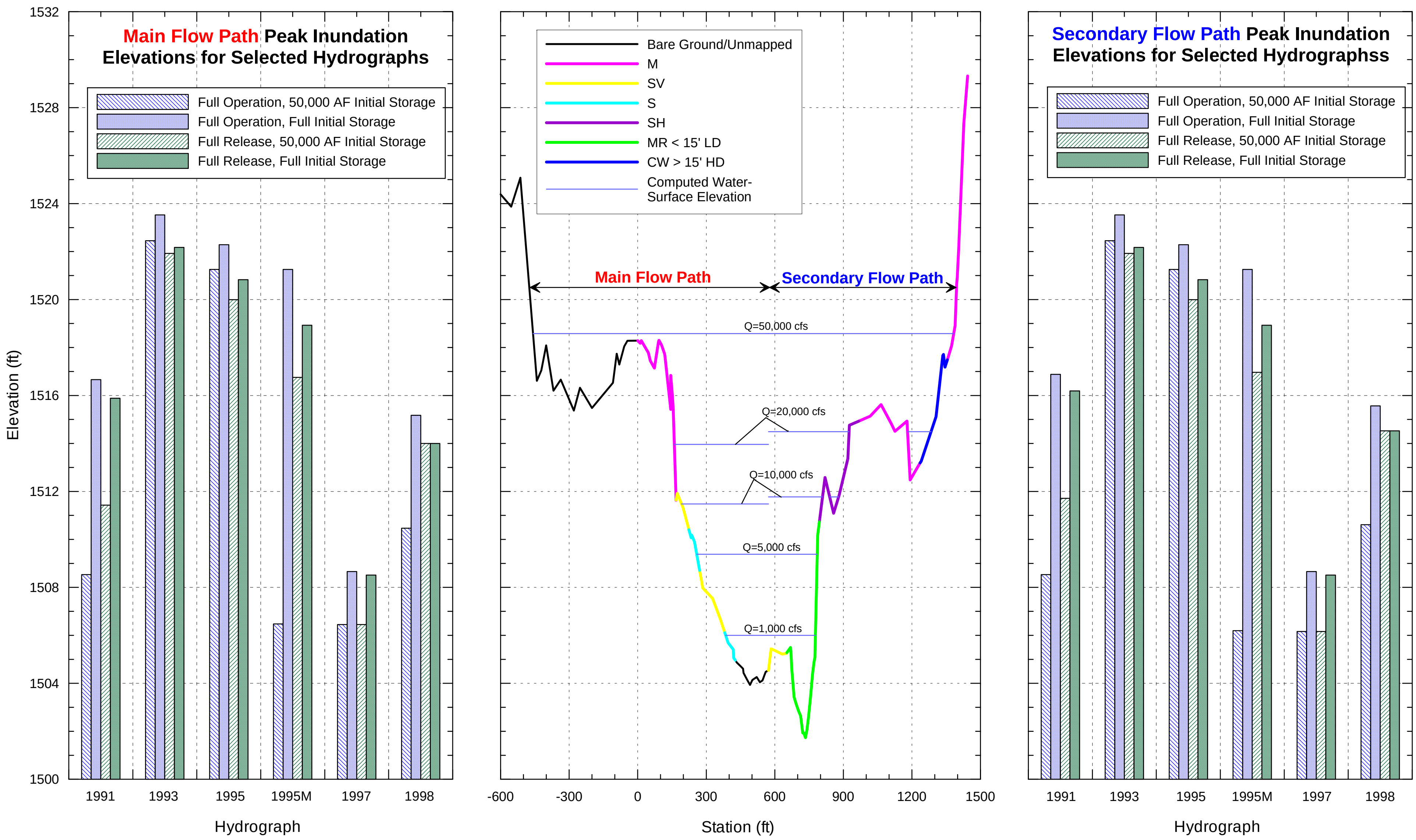
Site 2, Cross Section 6



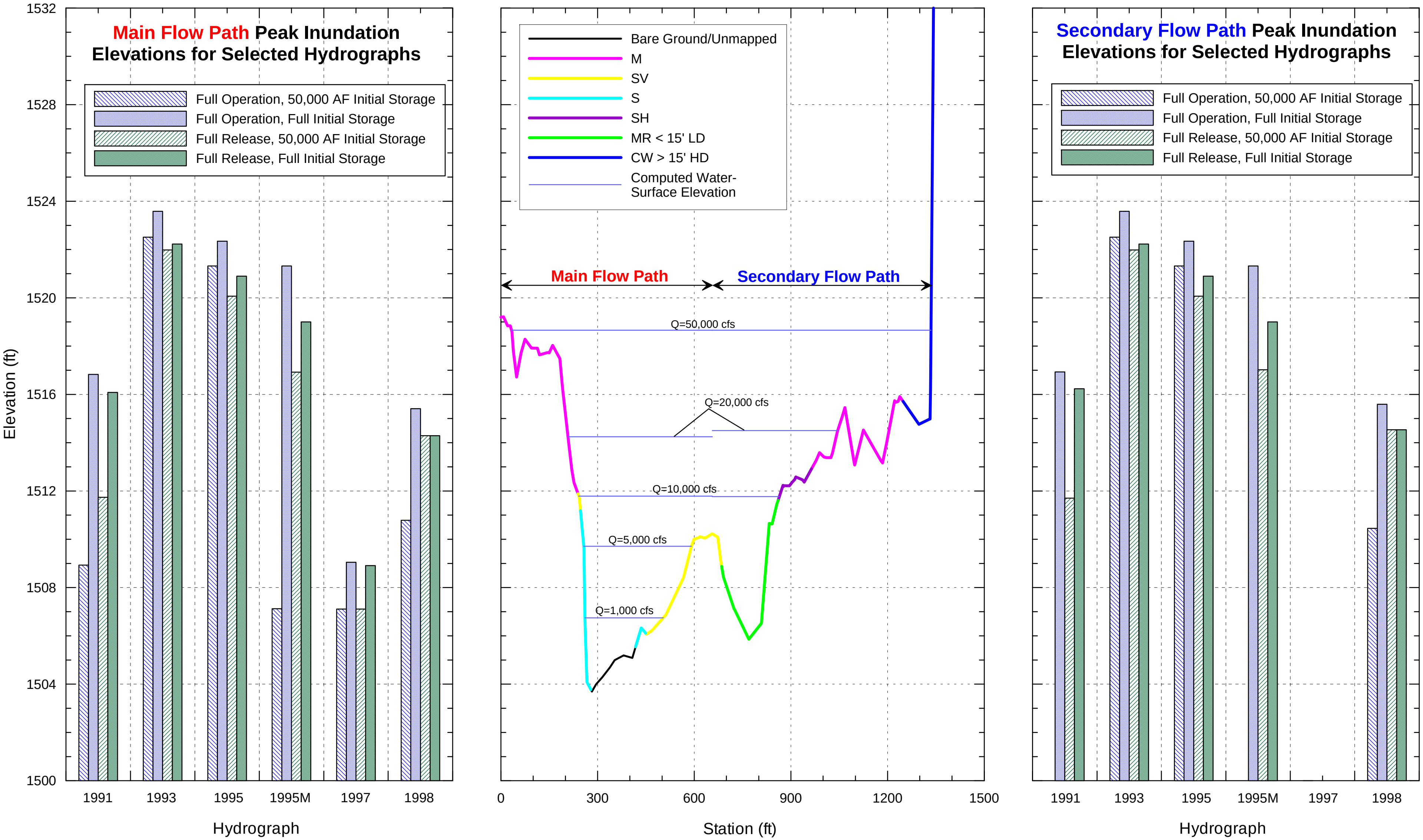
Site 2, Cross Section 7



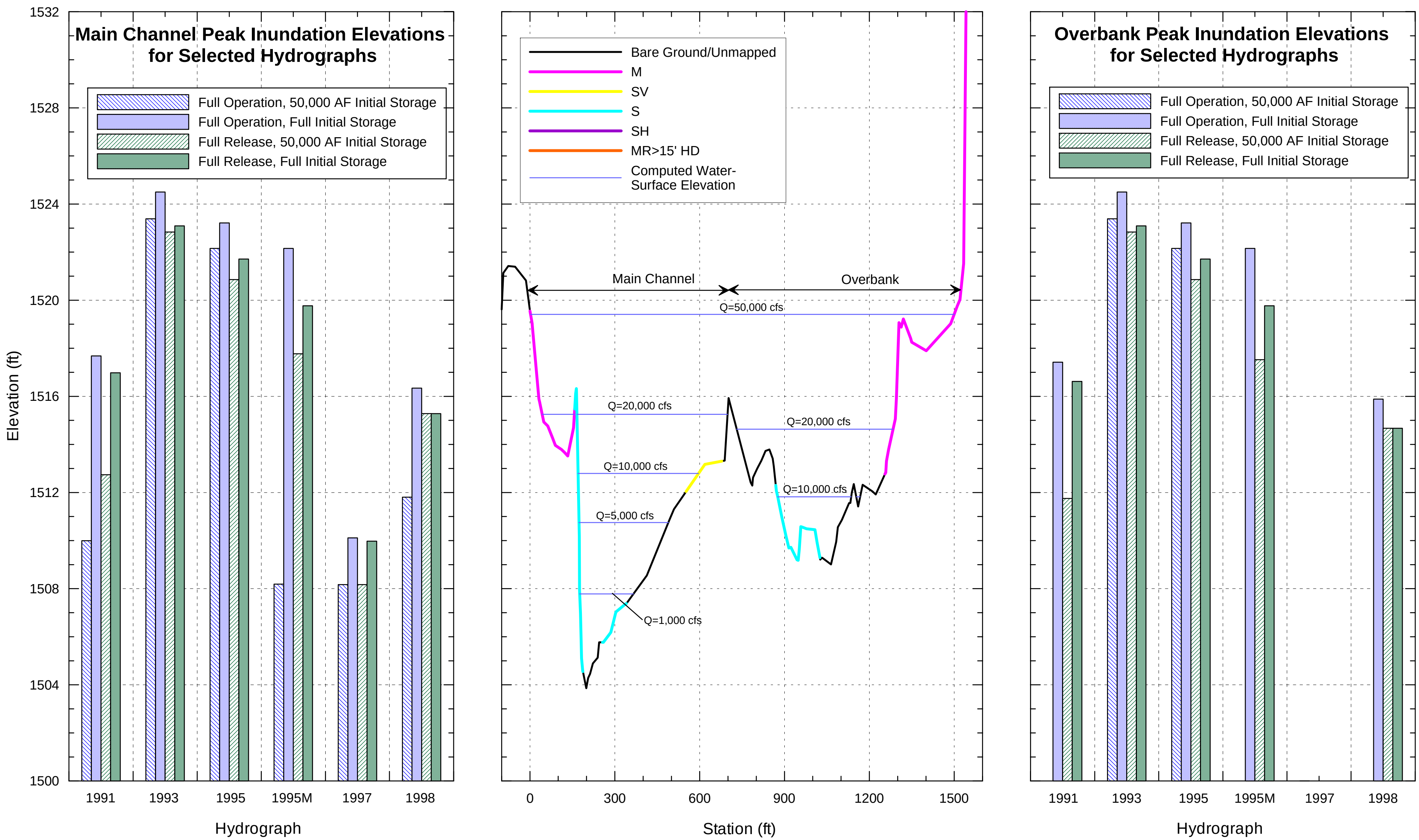
Site 3, Cross Section 1



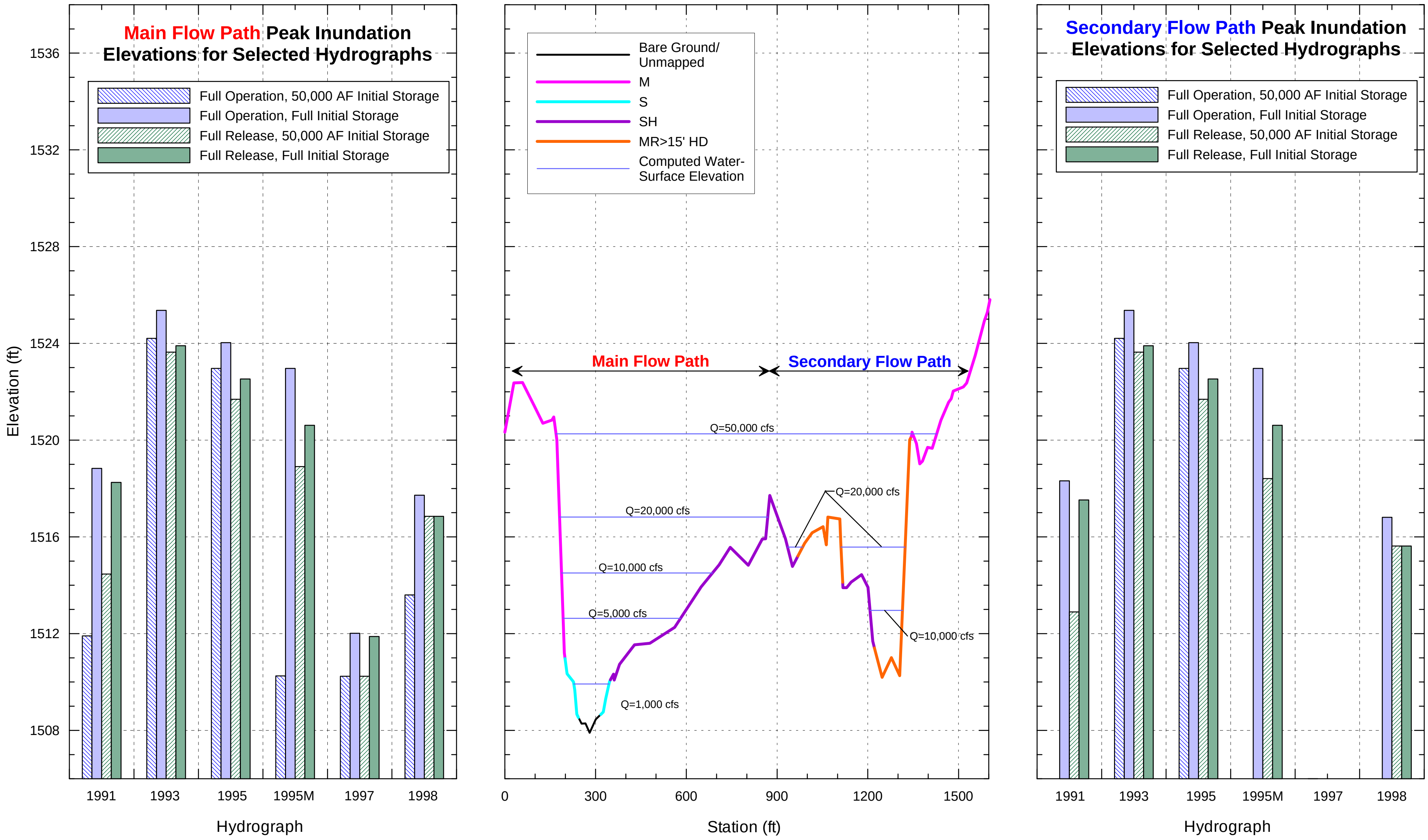
Site 3, Cross Section 2



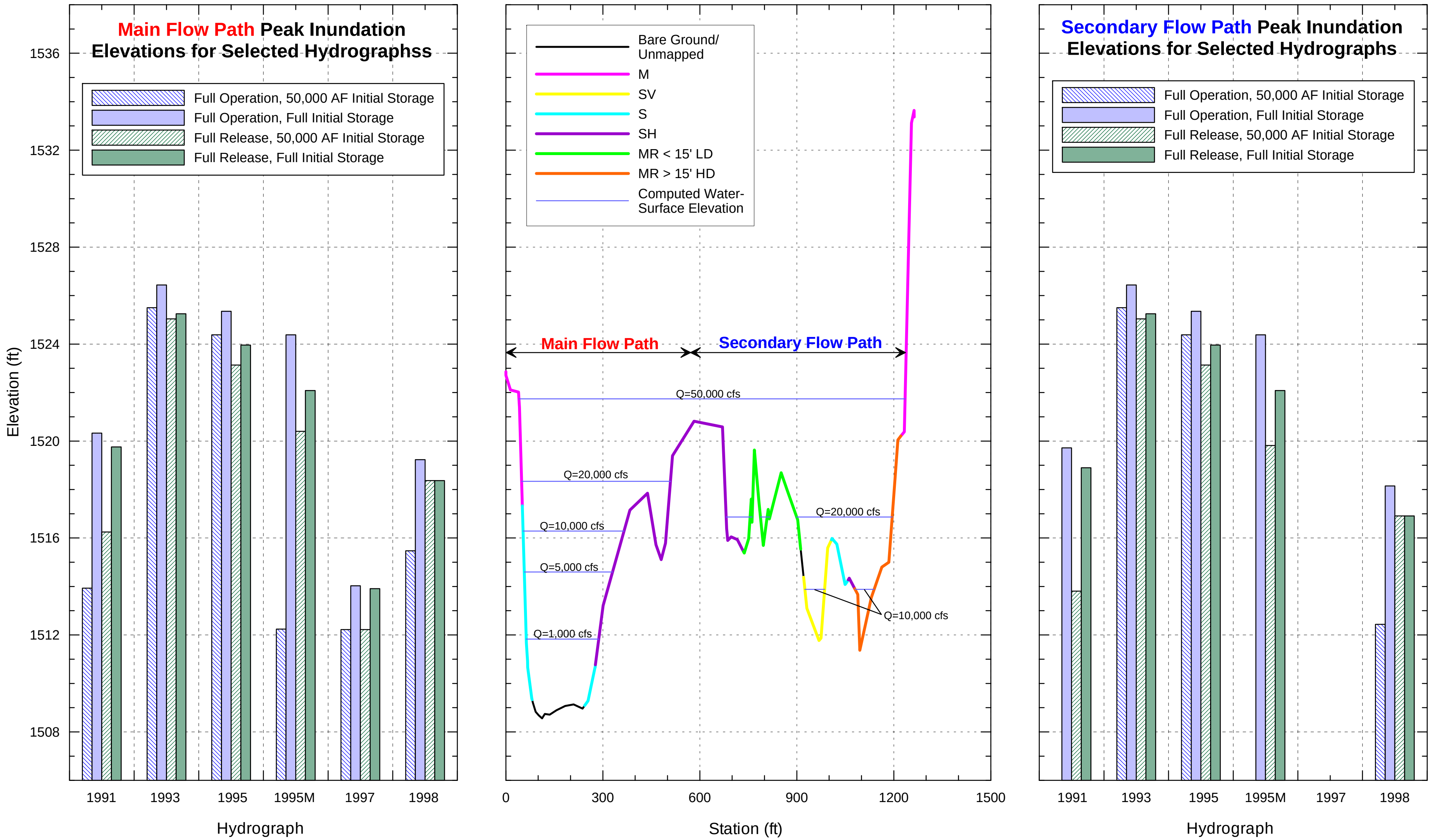
Site 3, Cross Section 3



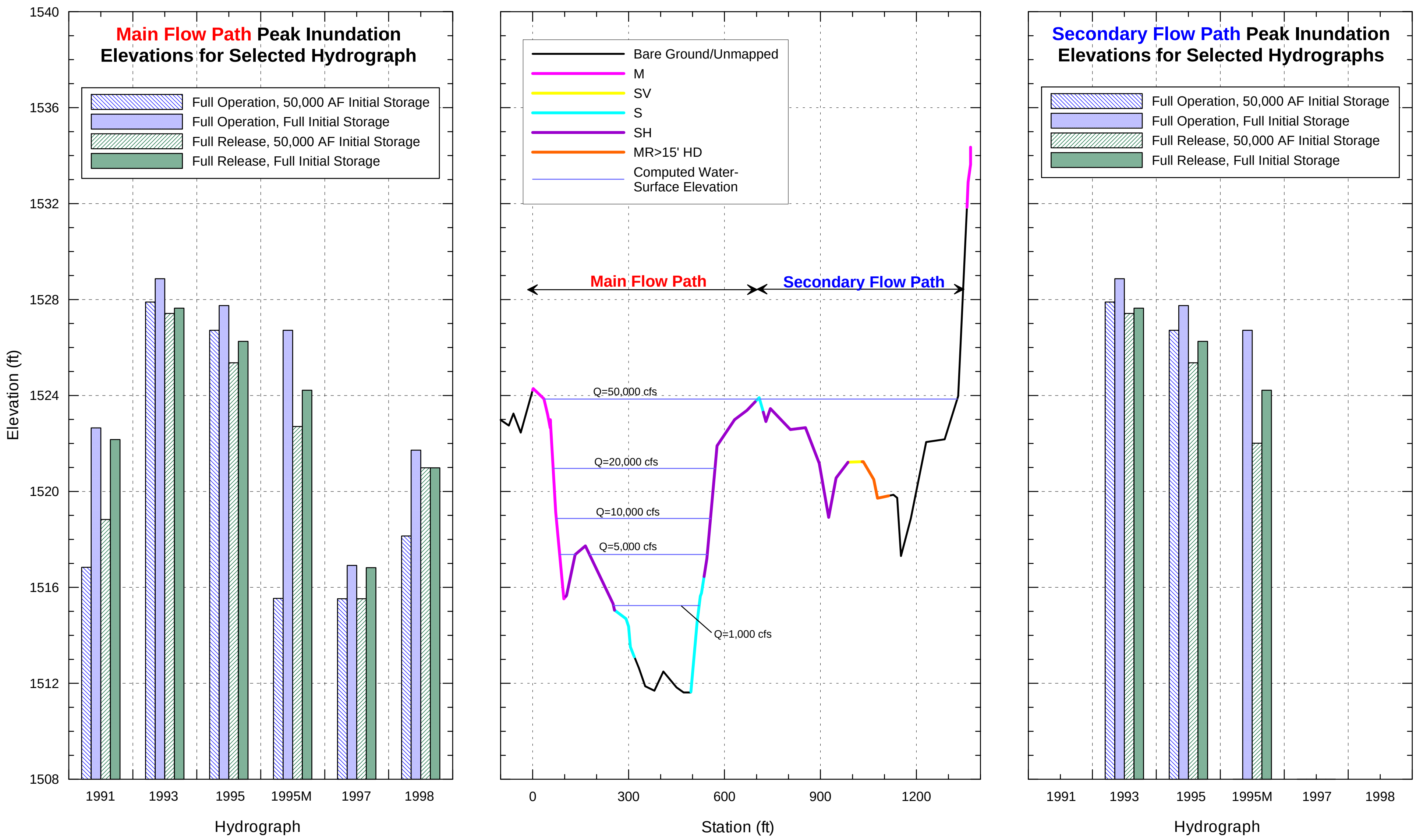
Site 3, Cross Section 4



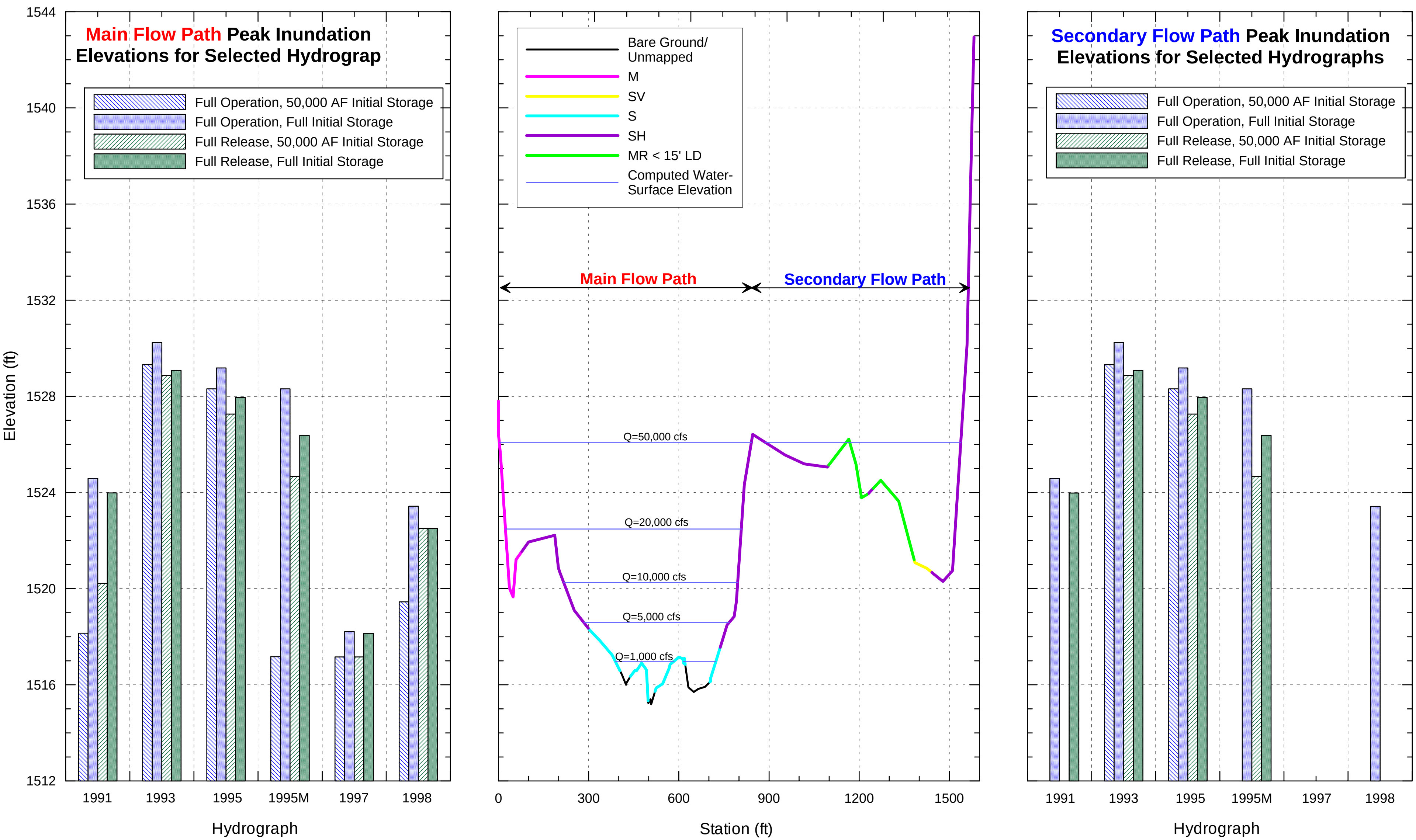
Site 3, Cross Section 5



Site 3, Cross Section 7

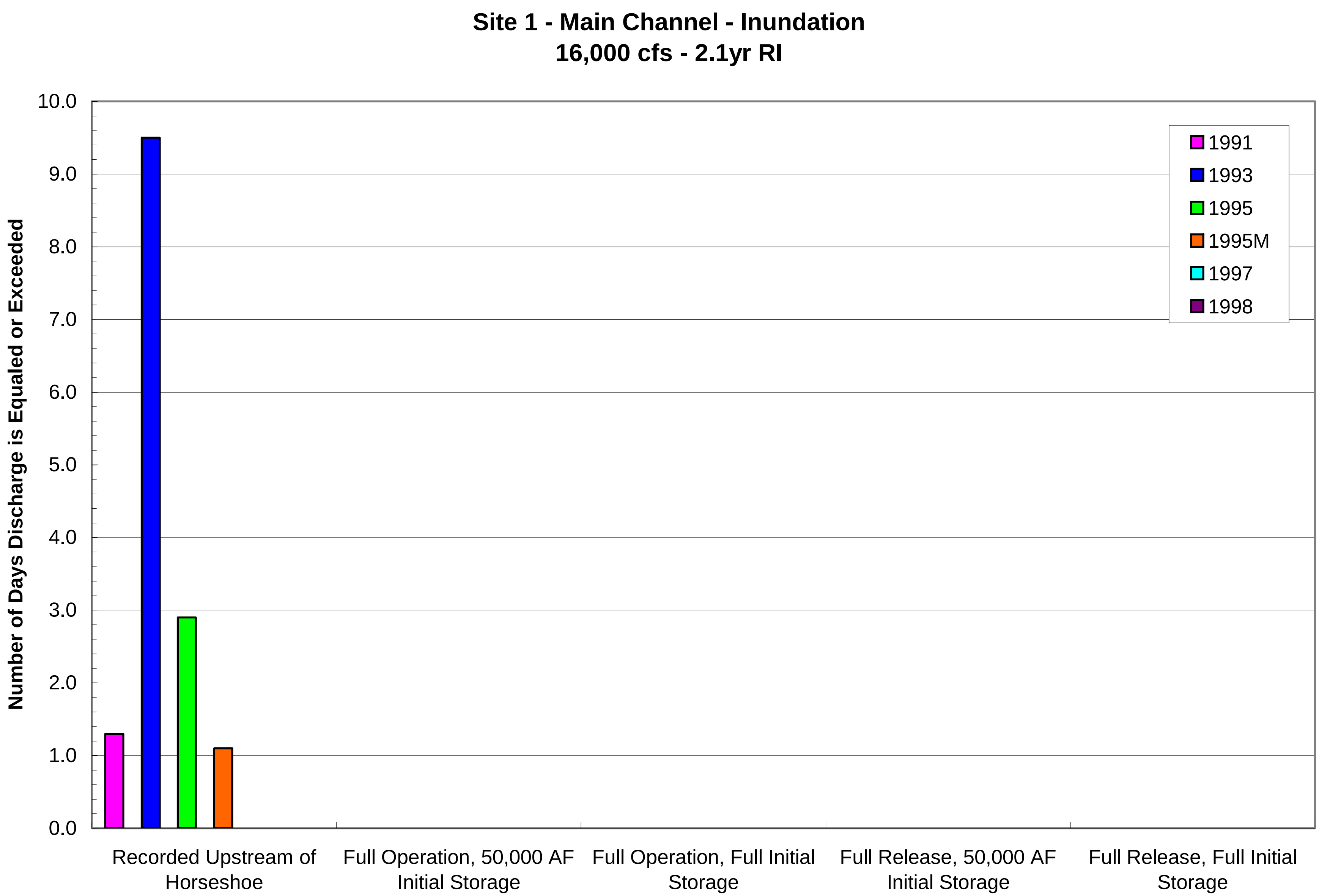


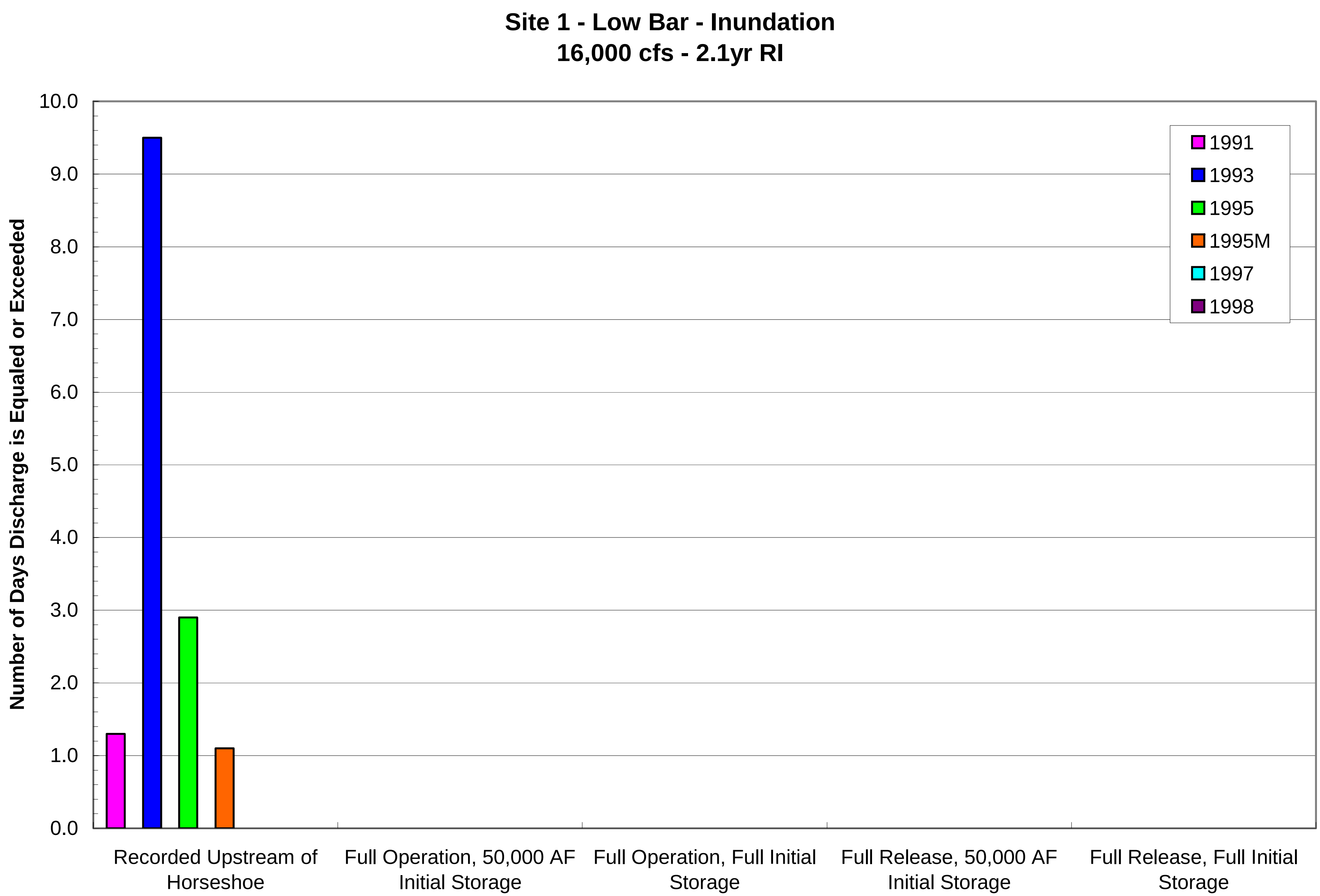
Site 3, Cross Section 8

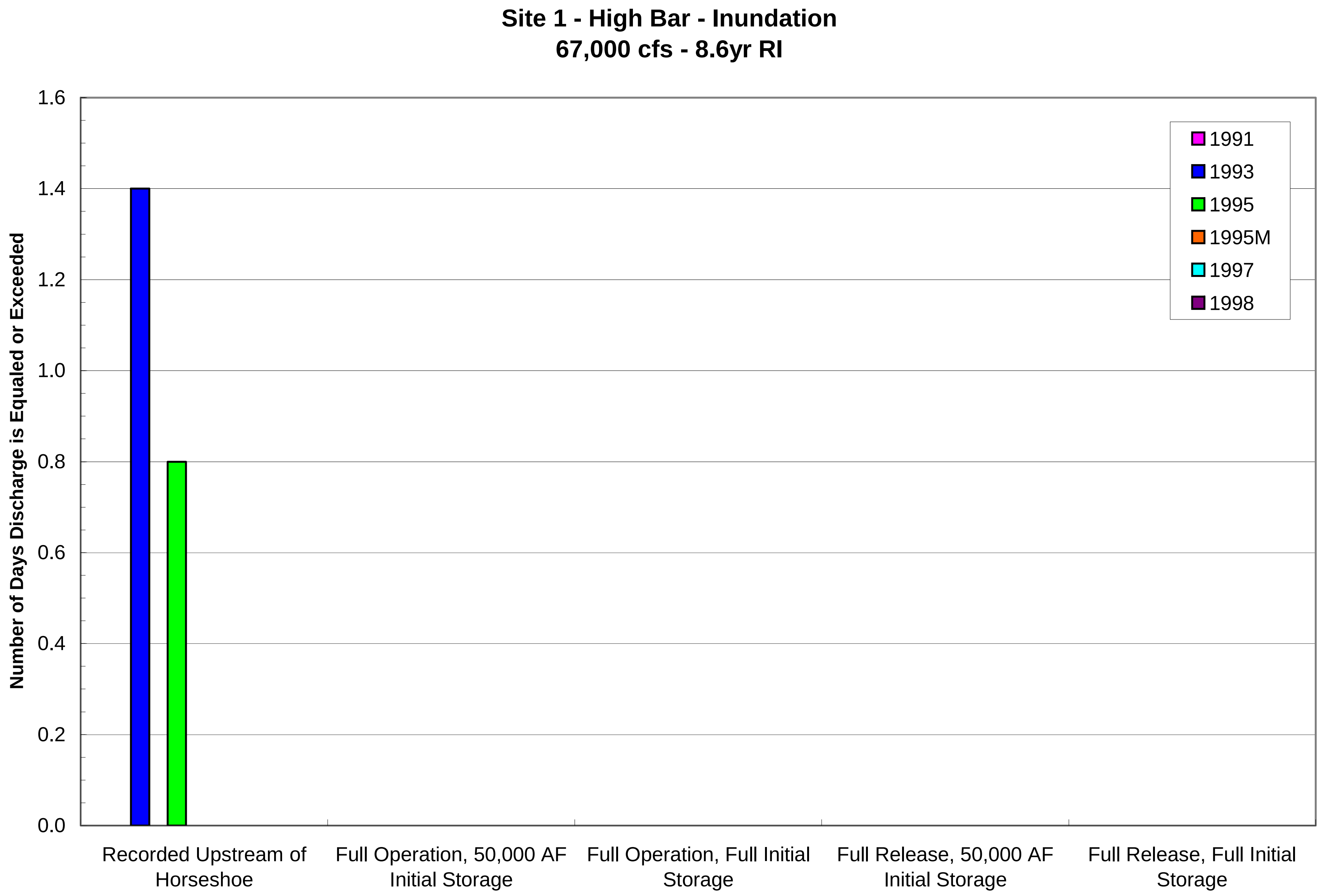


APPENDIX E

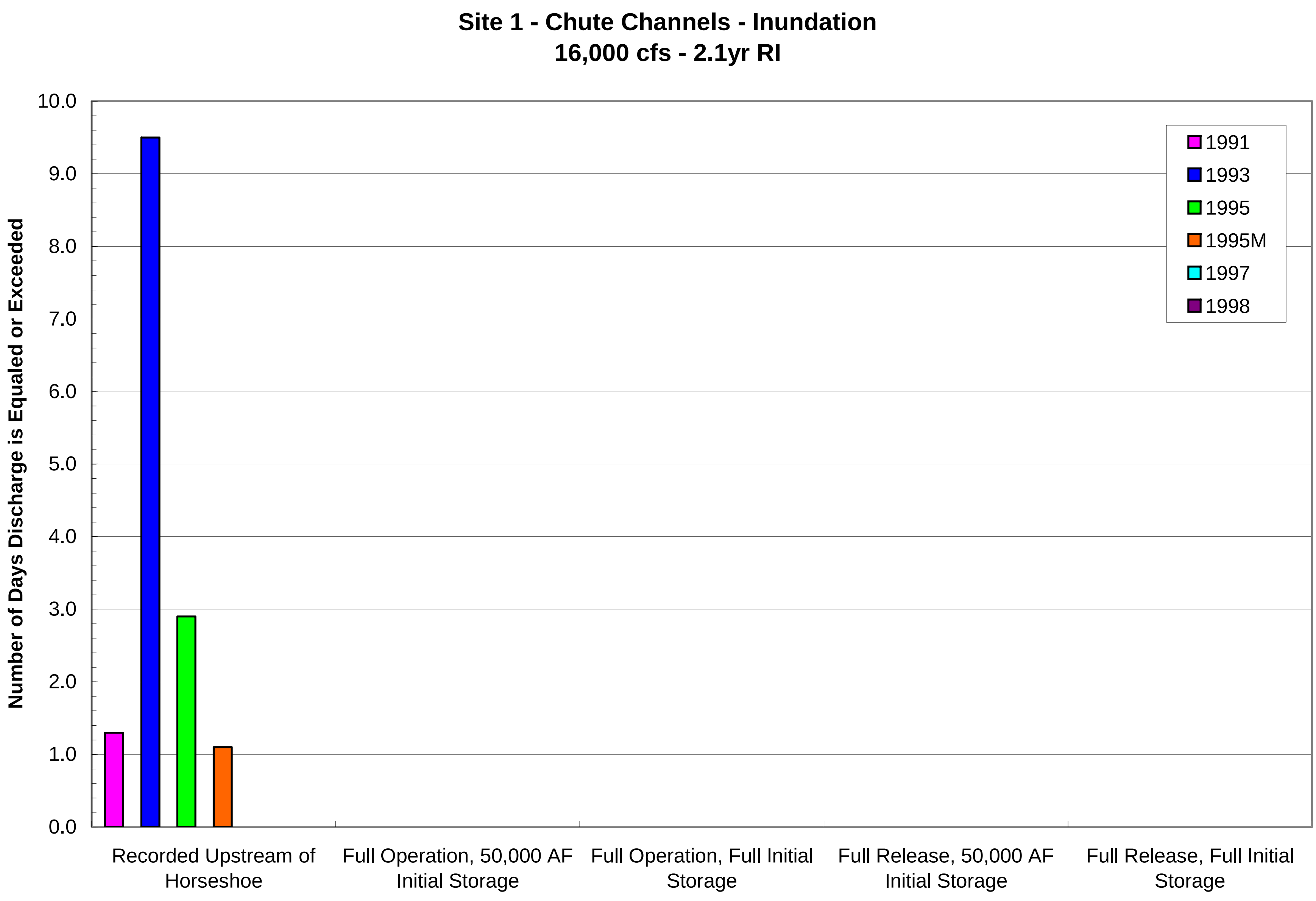
Inundation, Critical Discharge, and Sediment Mobilization Duration Data for Various Geomorphic Surfaces for the Modeled Operational Scenarios


Site 1 - Main Channel - Inundation
16,000 cfs - 2.1yr RI
Number of Days Discharge is Equaled or Exceeded
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

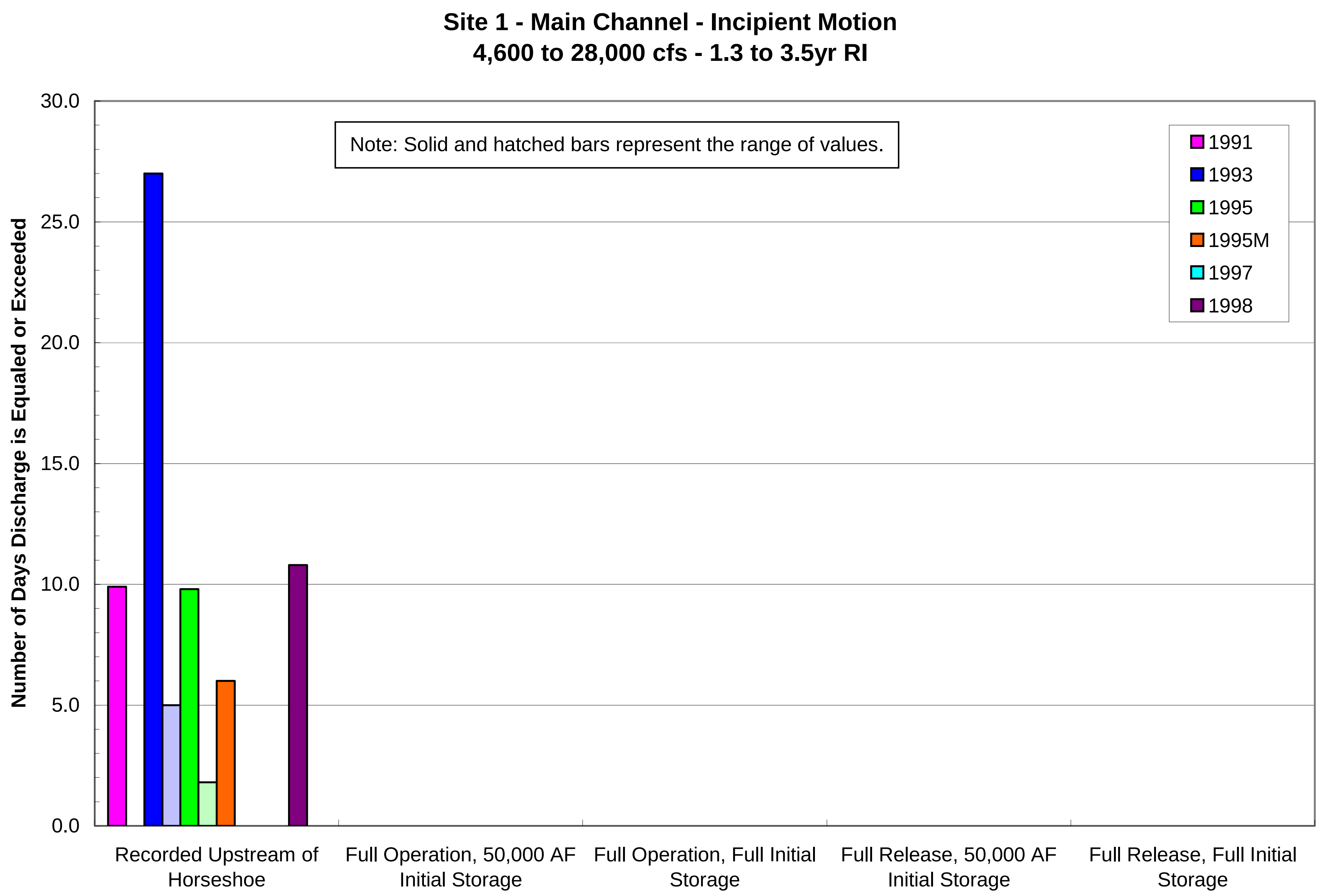

Site 1 - Low Bar - Inundation
16,000 cfs - 2.1yr RI
Number of Days Discharge is Equaled or Exceeded
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



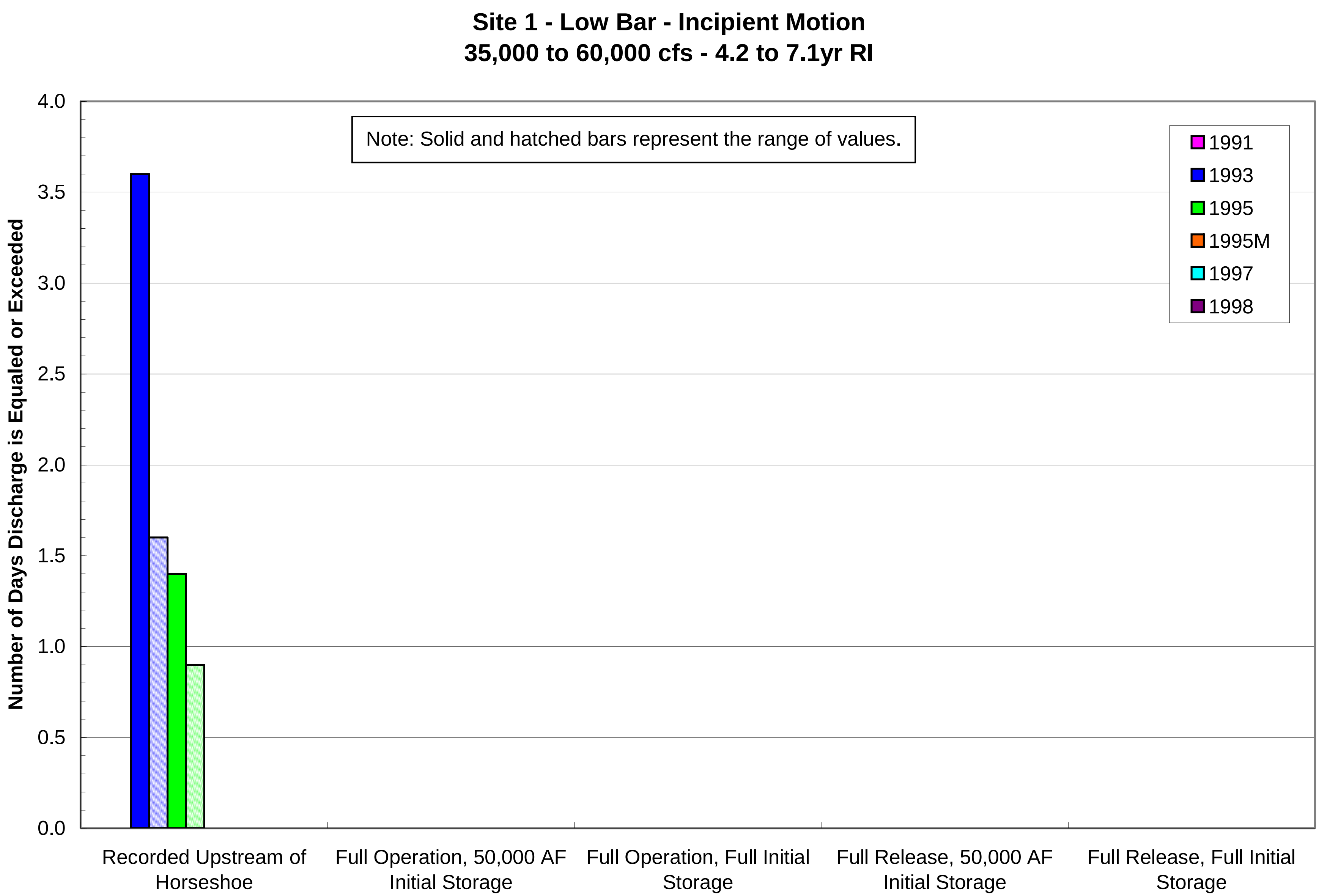
Site 1 - High Bar - Inundation
67,000 cfs - 8.6yr RI
Number of Days Discharge is Equaled or Exceeded
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



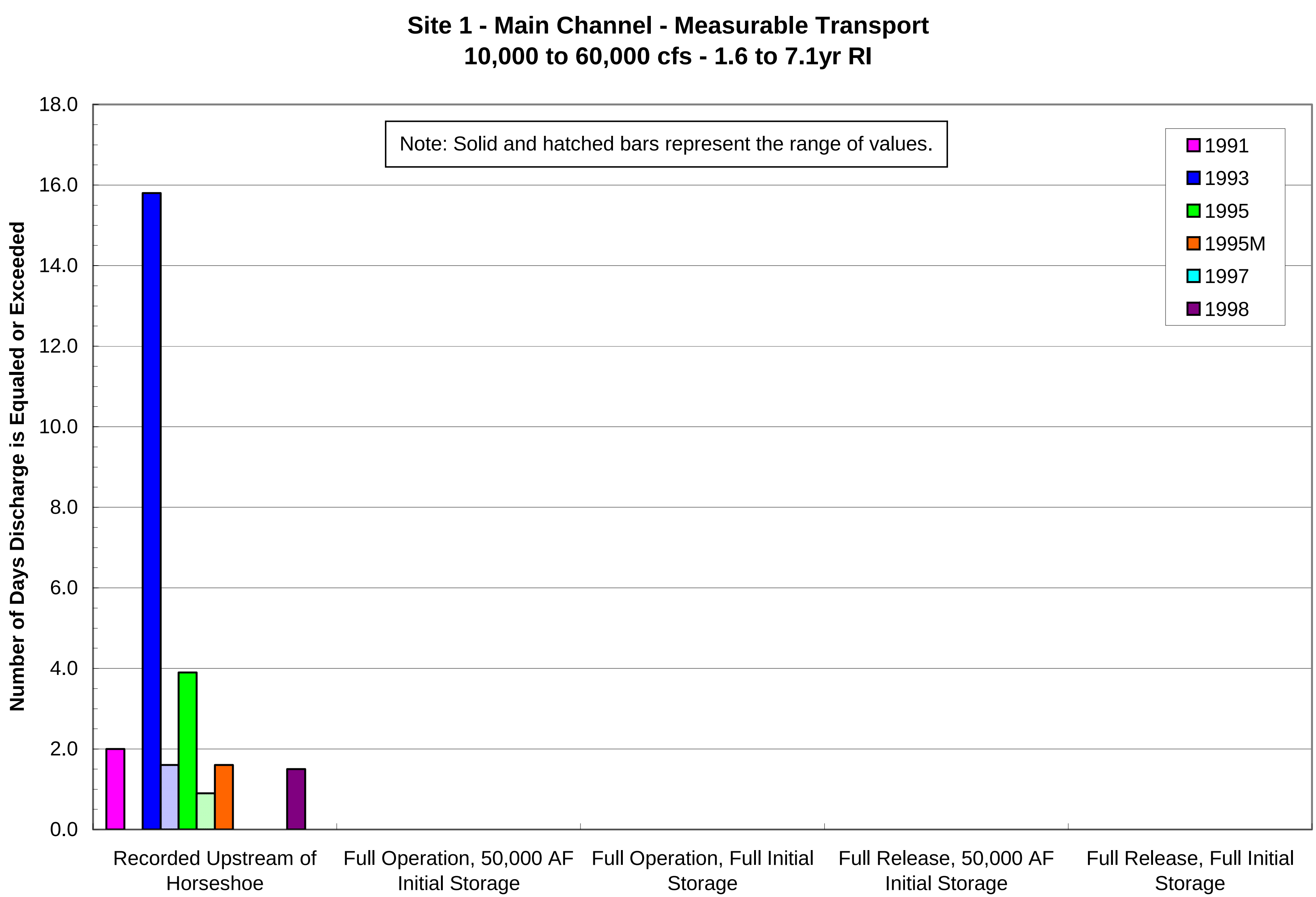
Site 1 - Chute Channels - Inundation
16,000 cfs - 2.1yr RI
Number of Days Discharge is Equaled or Exceeded
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



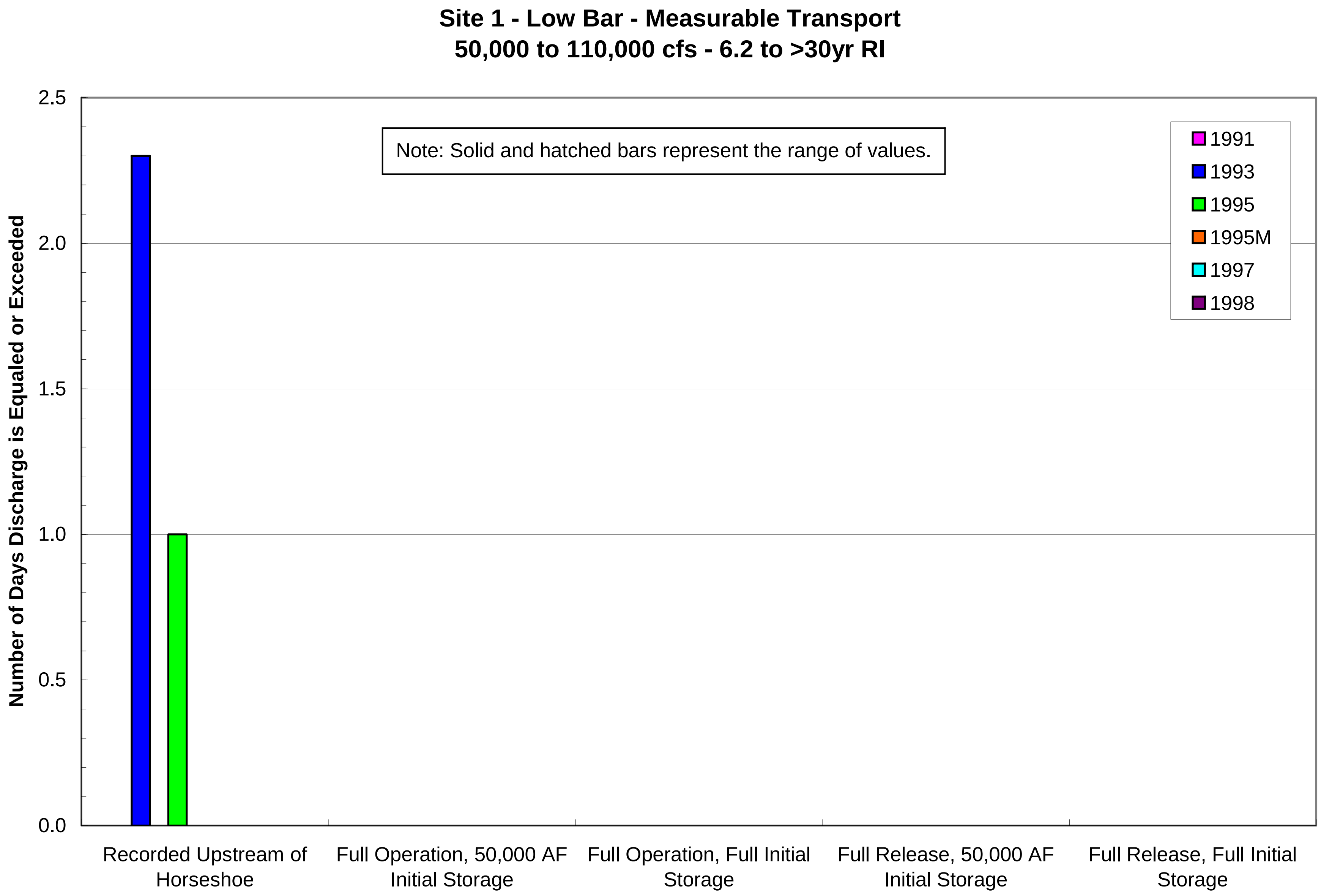
Mussetter Engineering, Inc.



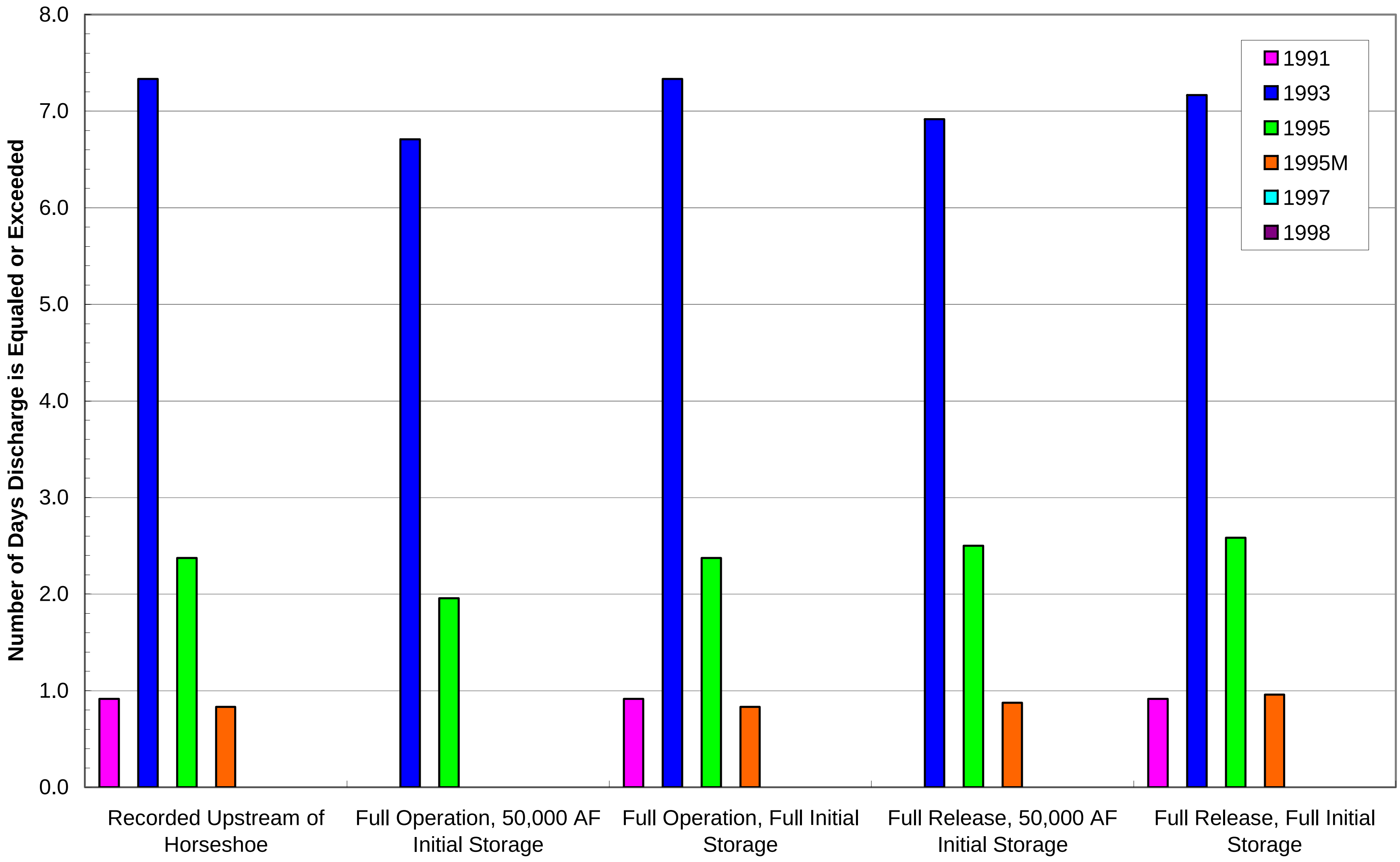
Site 1 - Low Bar - Incipient Motion
35,000 to 60,000 cfs - 4.2 to 7.1yr RI
Number of Days Discharge is Equaled or Exceeded
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

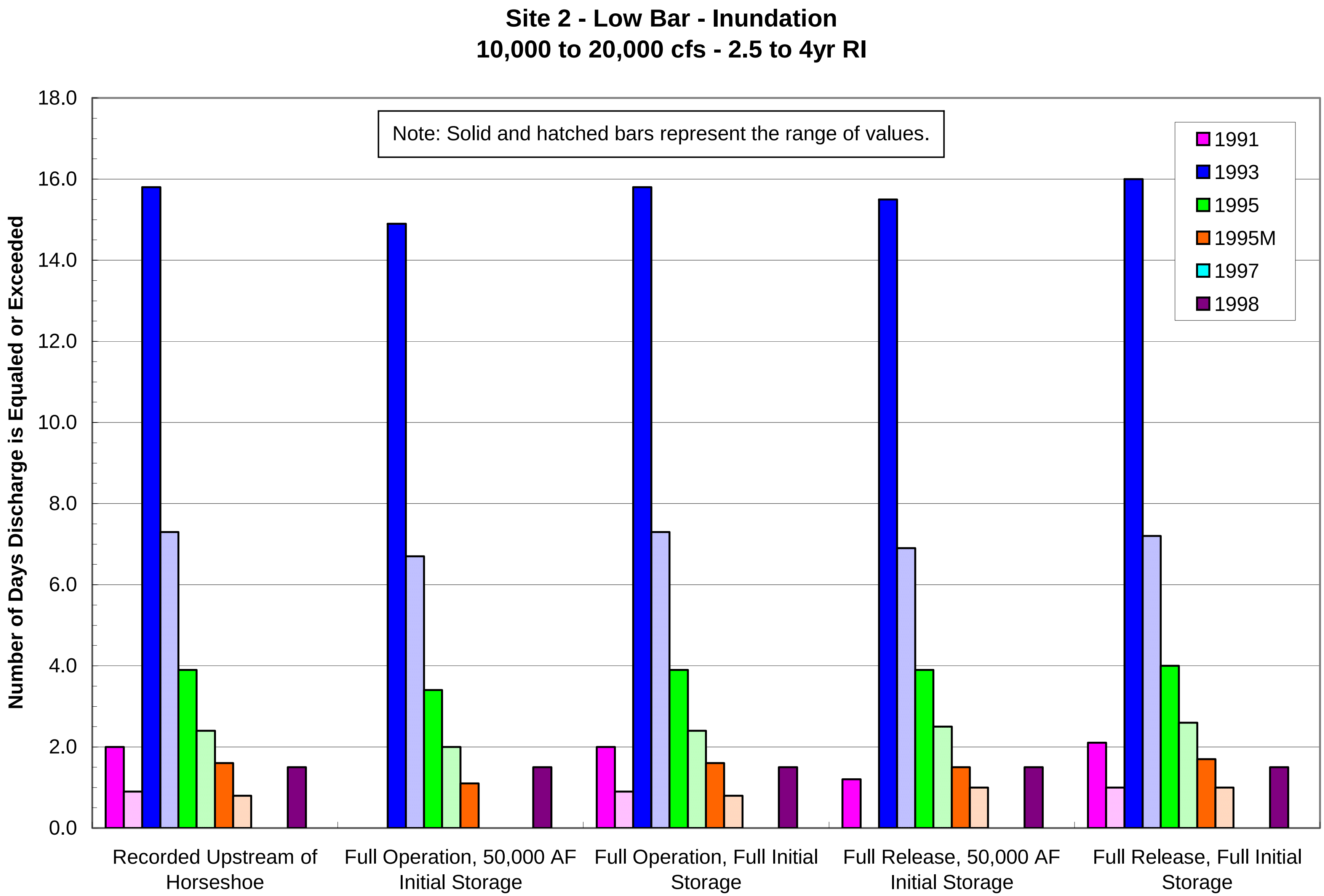


Site 1 - Main Channel - Measurable Transport
10,000 to 60,000 cfs - 1.6 to 7.1yr RI
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Number of Days Discharge is Equaled or Exceeded
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

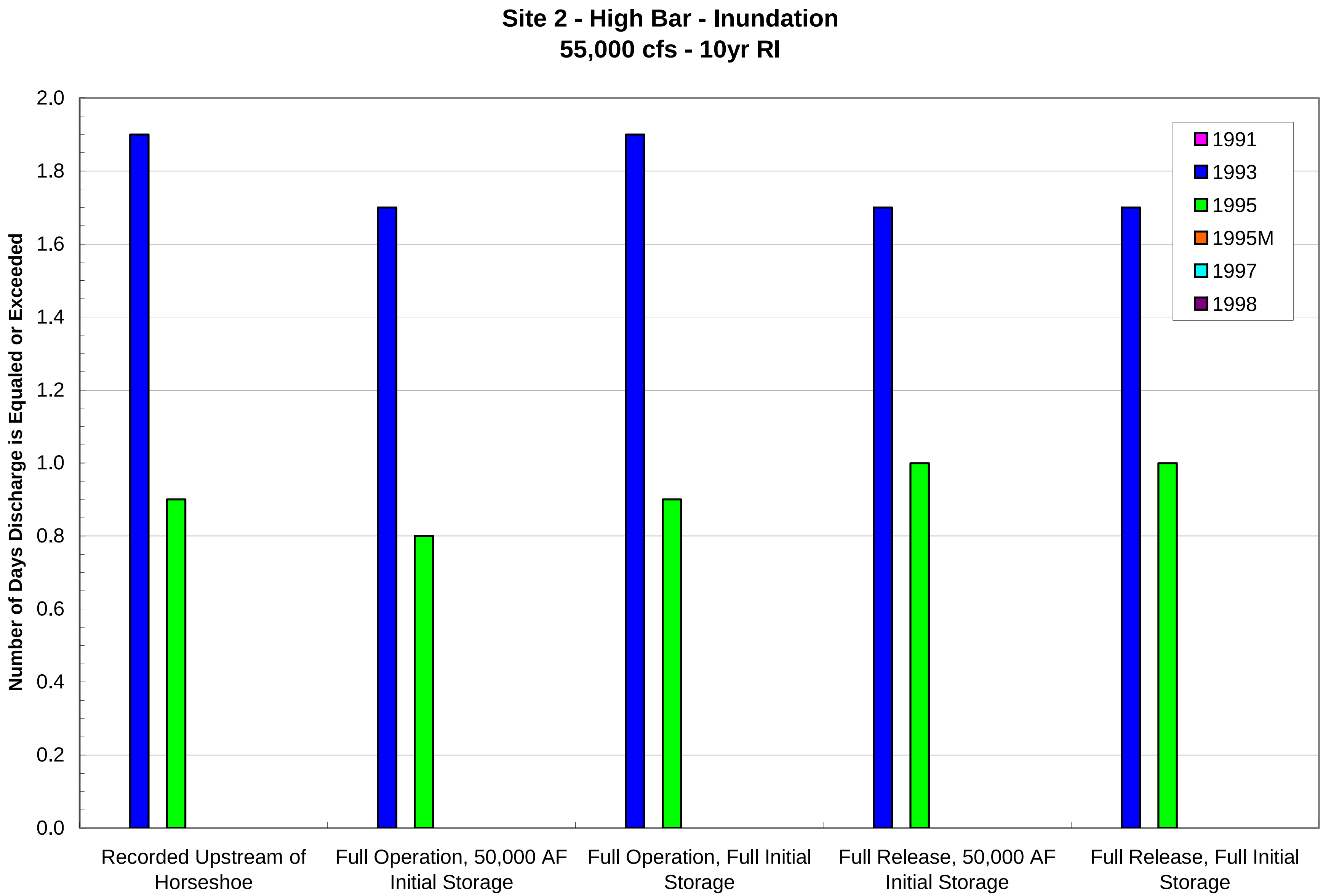

Site 1 - Low Bar - Measurable Transport
50,000 to 110,000 cfs - 6.2 to >30yr RI
Number of Days Discharge is Equaled or Exceeded
0.0
0.5
1.0
1.5
2.0
2.5
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

Site 2 - Main Channel - Inundation
20,000 cfs - 4yr RI

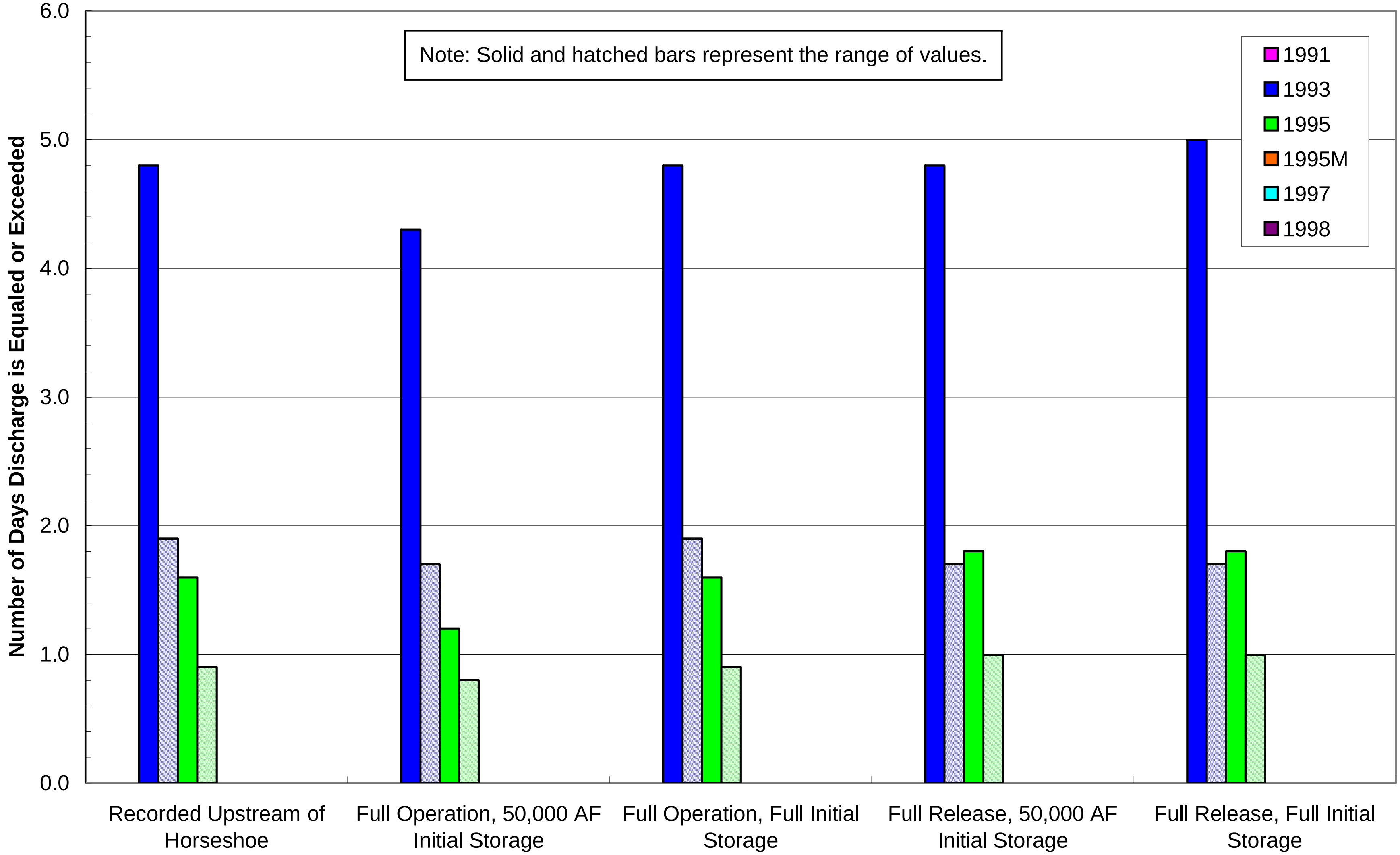


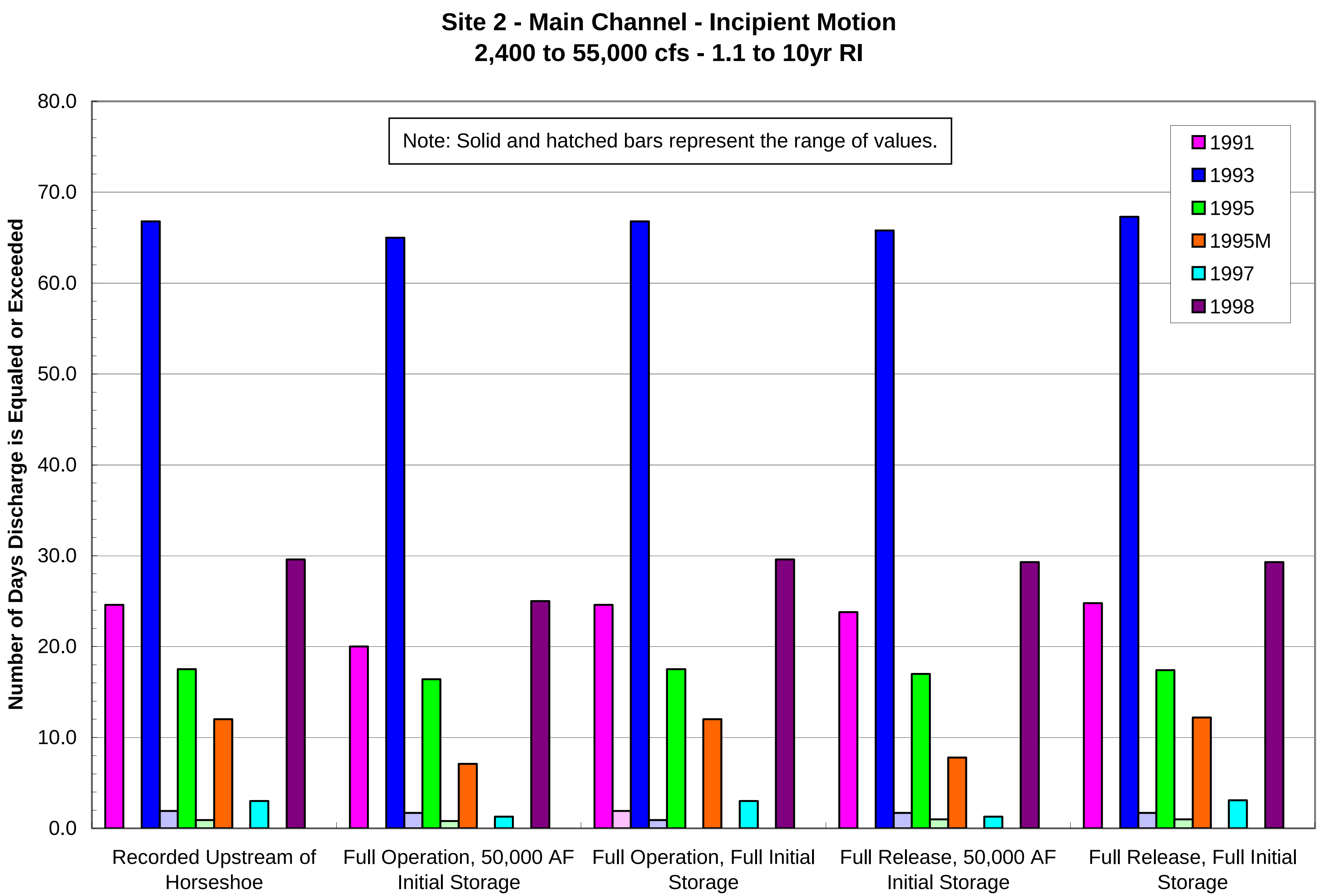


Mussetter Engineering, Inc.

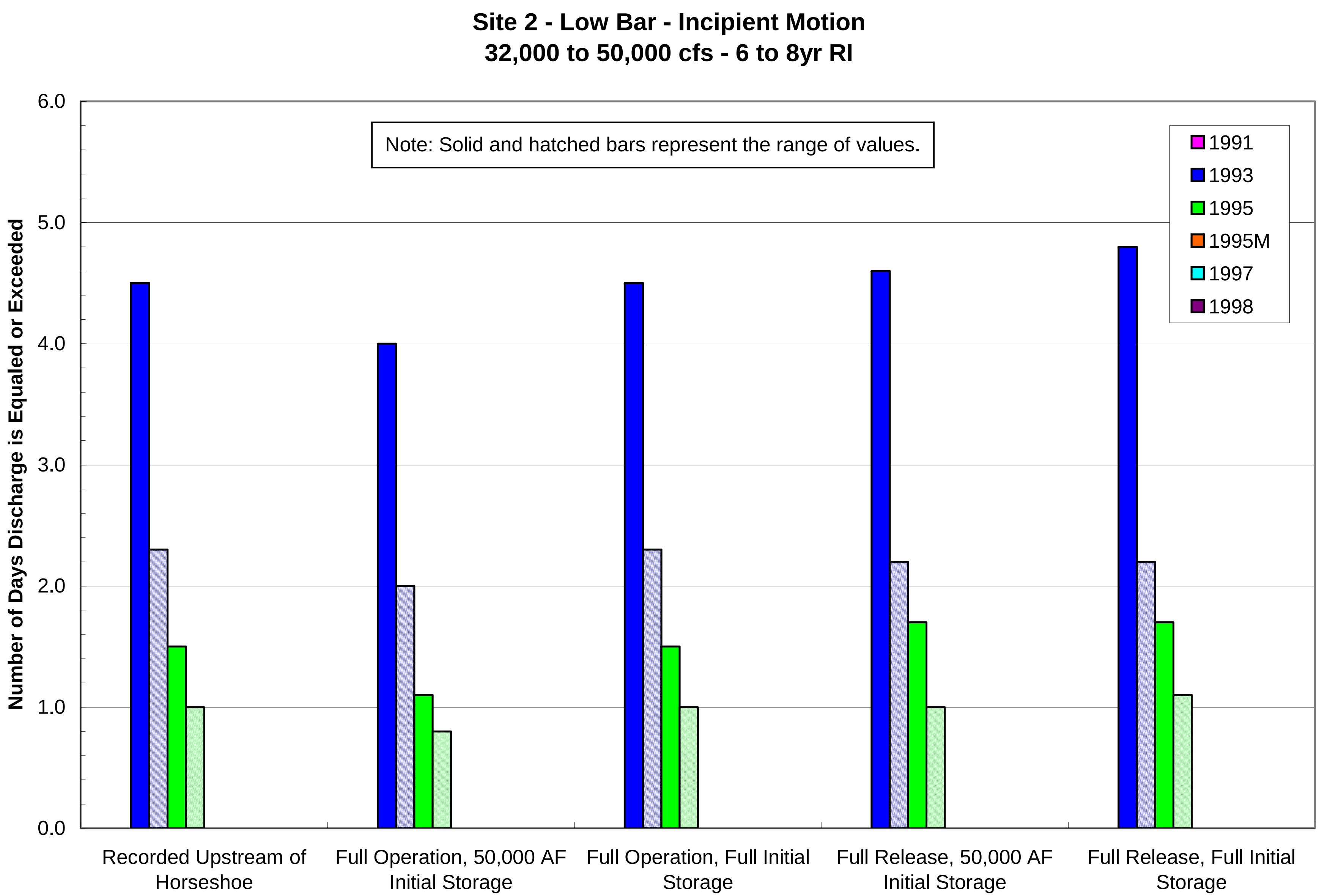

Site 2 - High Bar - Inundation
55,000 cfs - 10yr RI
Number of Days Discharge is Equaled or Exceeded
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

Site 2 - Chute Channels - Inundation
30,000 to 55,000 cfs - 6 to 10yr RI

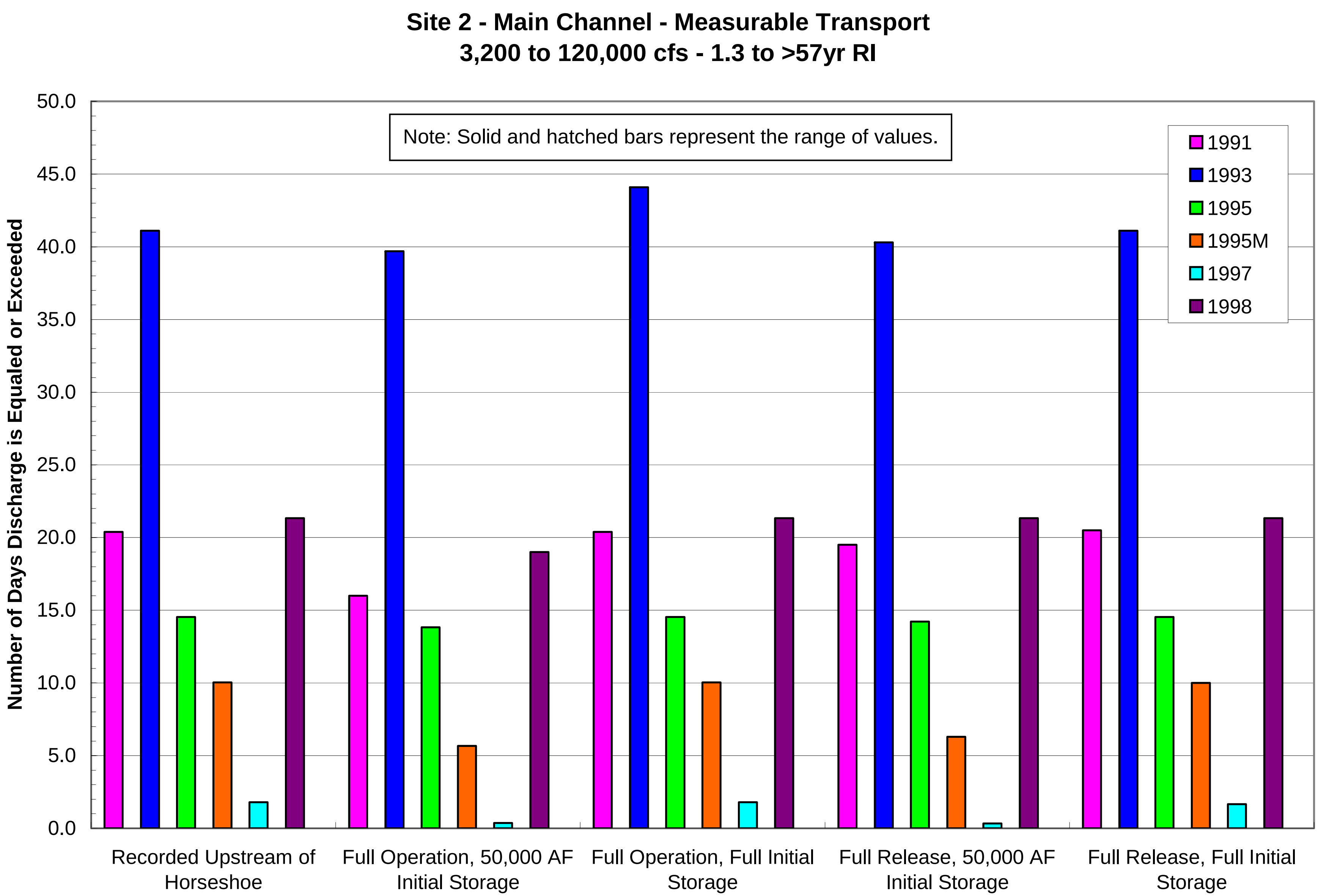


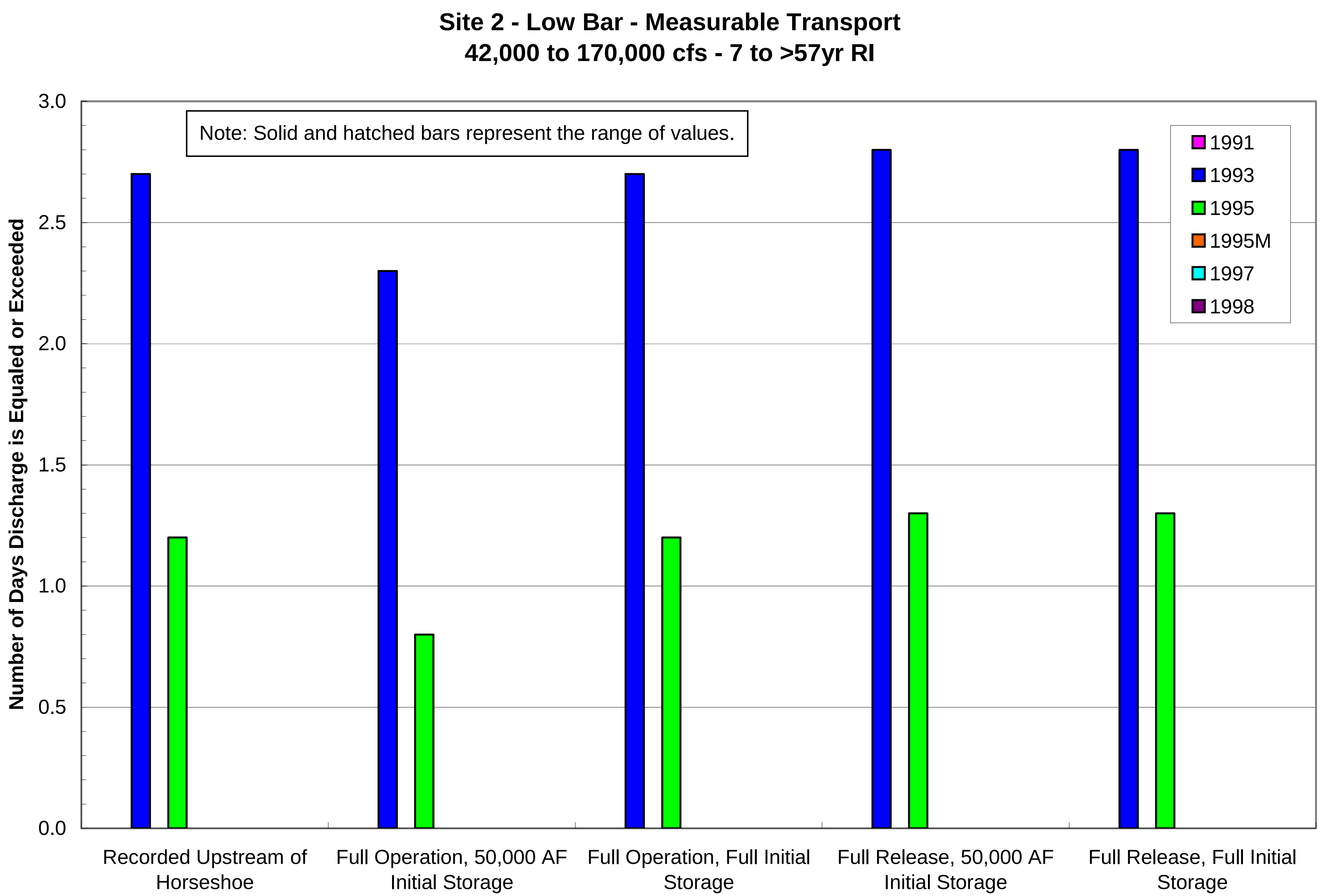


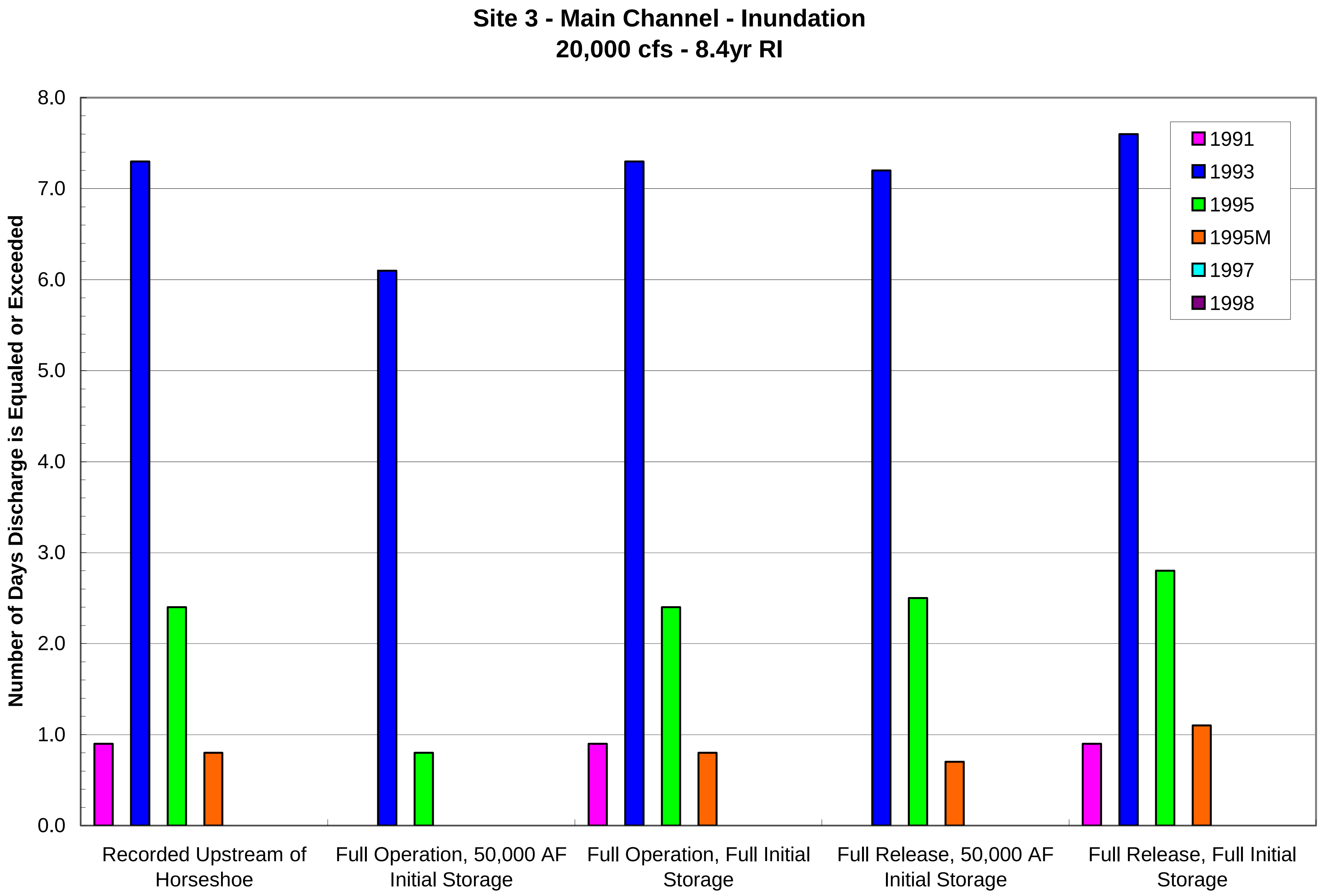
Site 2 - Main Channel - Incipient Motion
2,400 to 55,000 cfs - 1.1 to 10yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

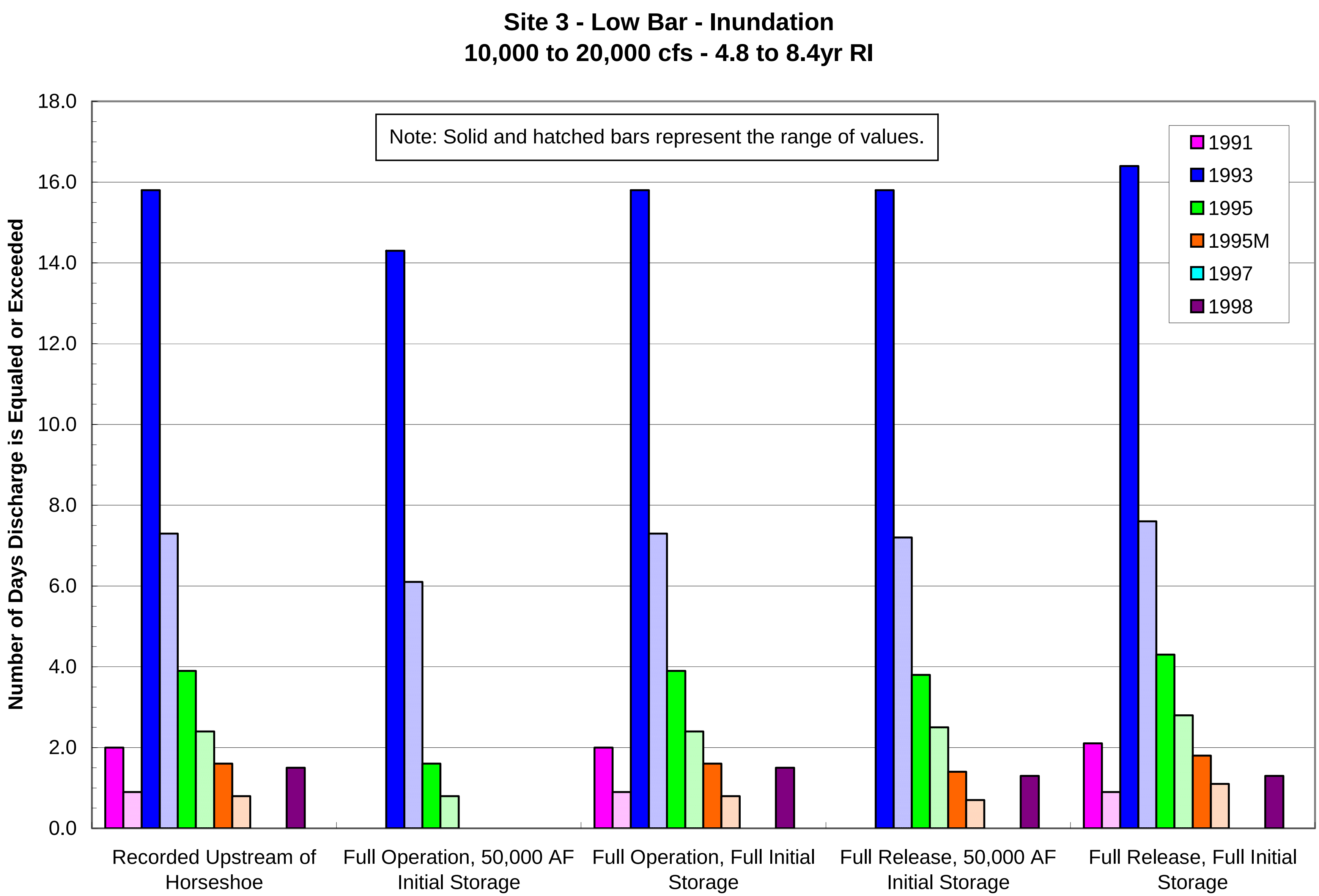


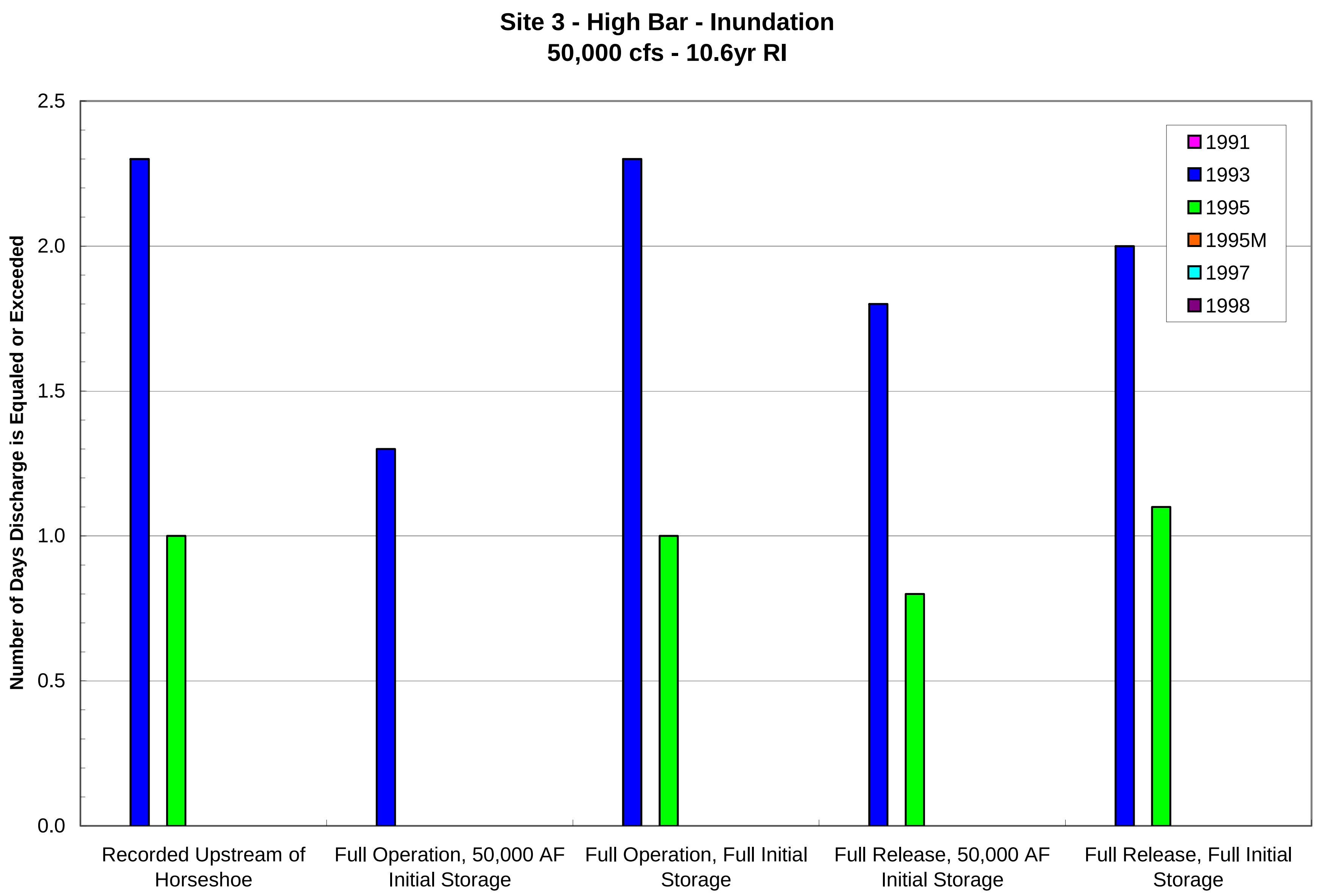
Site 2 - Low Bar - Incipient Motion
32,000 to 50,000 cfs - 6 to 8yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage


Site 2 - Main Channel - Measurable Transport
3,200 to 120,000 cfs - 1.3 to >57yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

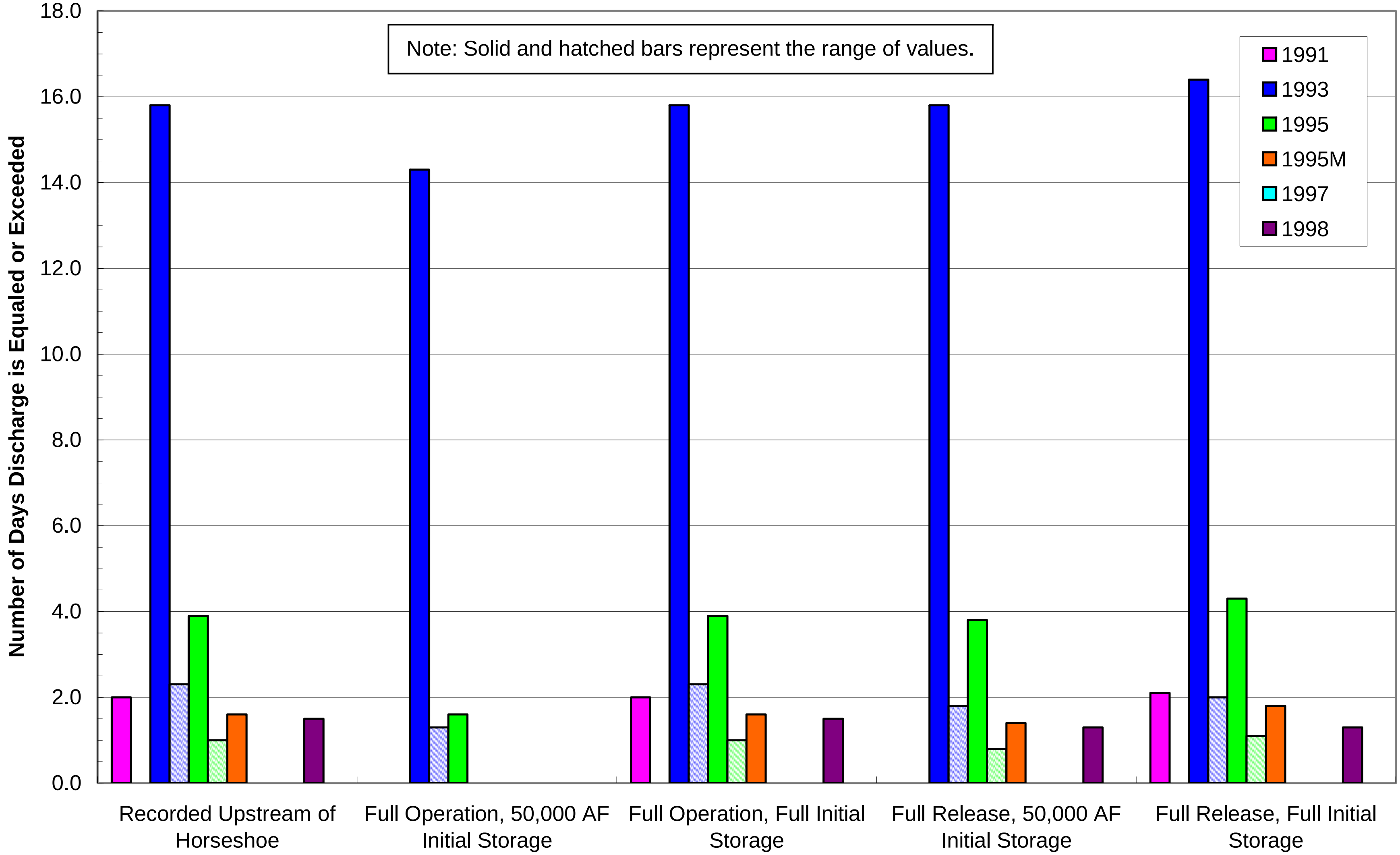

Site 2 - Low Bar - Measurable Transport
42,000 to 170,000 cfs - 7 to >57yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

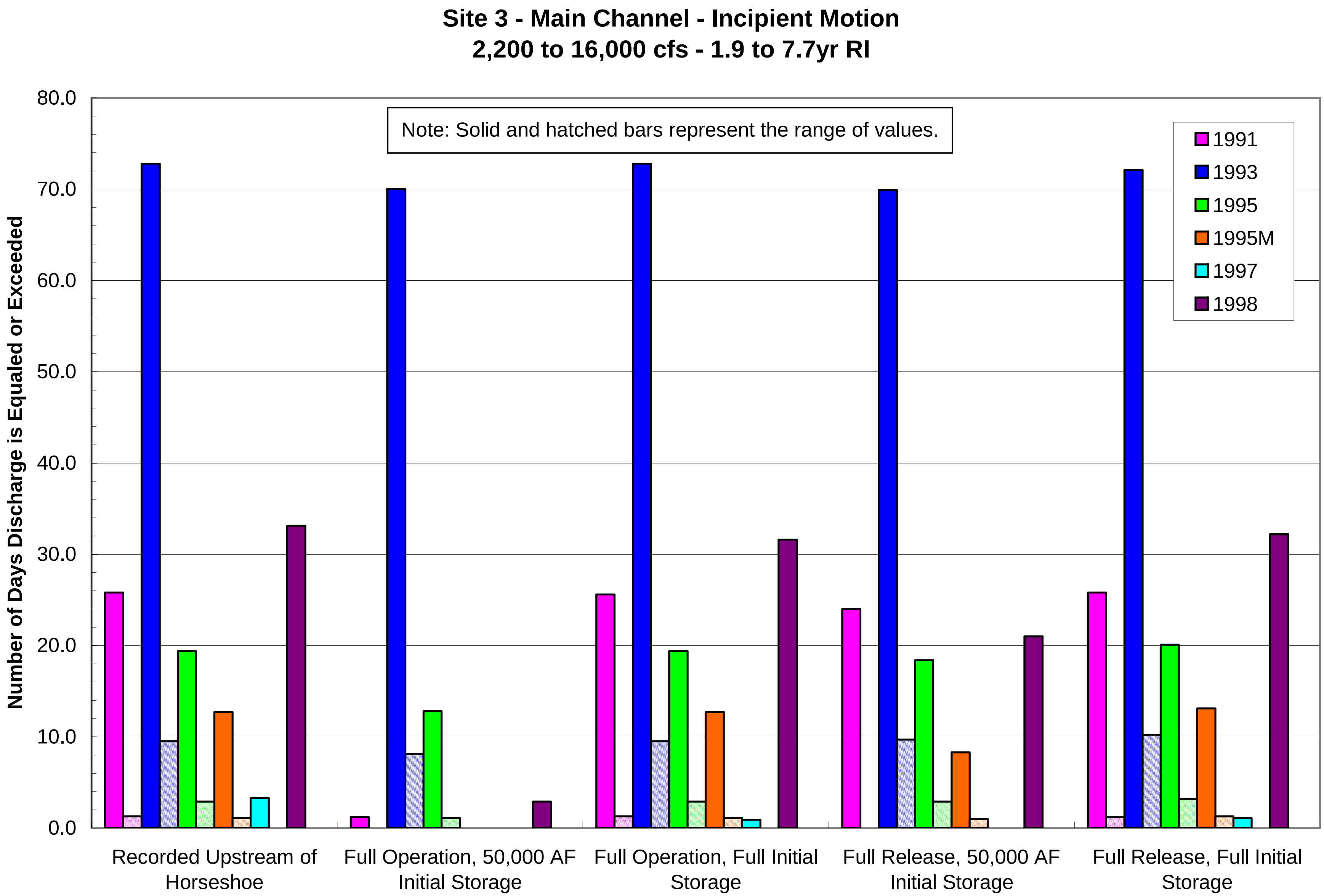

Site 3 - Main Channel - Inundation
20,000 cfs - 8.4yr RI
Number of Days Discharge is Equaled or Exceeded
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

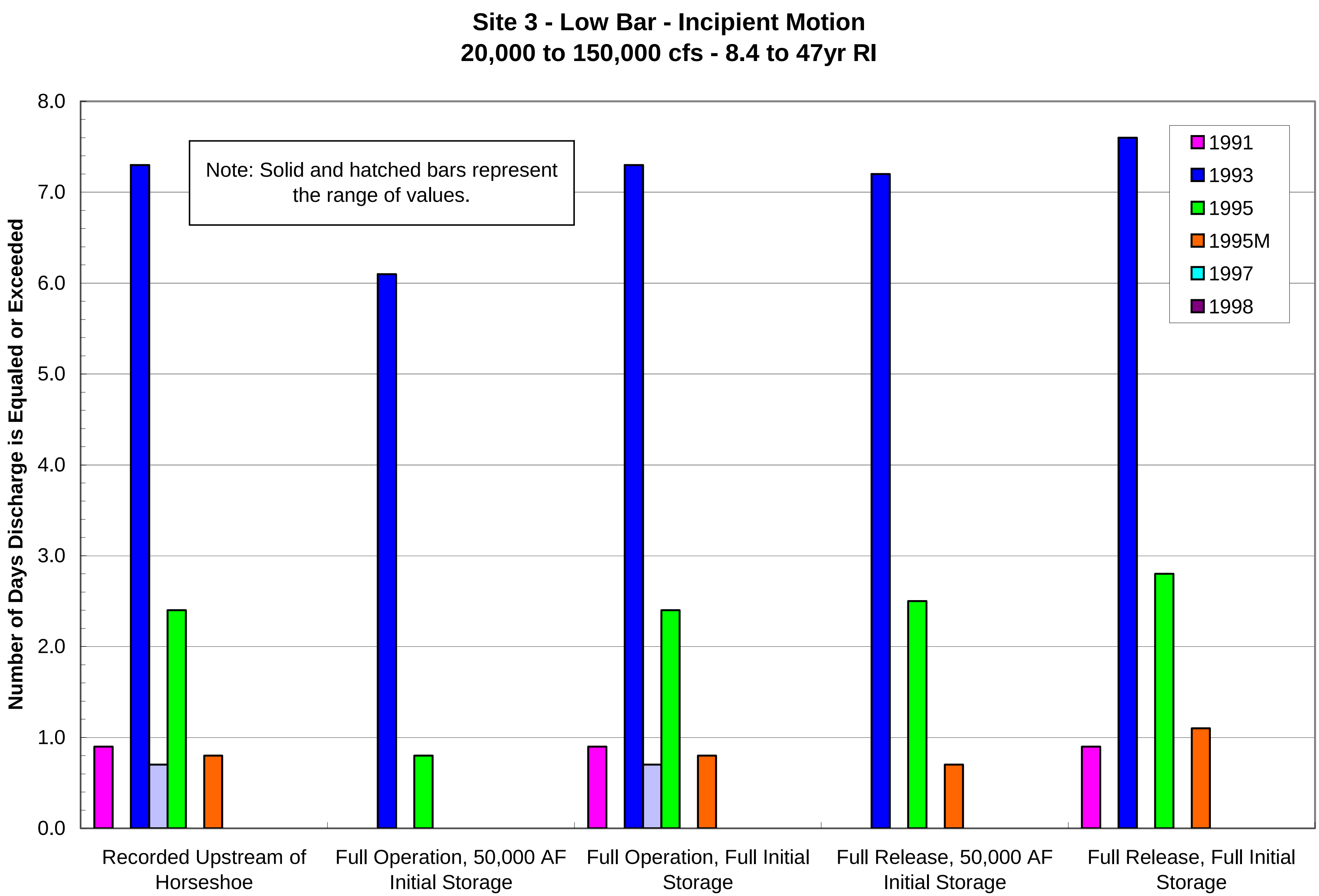

Site 3 - Low Bar - Inundation
10,000 to 20,000 cfs - 4.8 to 8.4yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage


Site 3 - High Bar - Inundation
50,000 cfs - 10.6yr RI
Number of Days Discharge is Equaled or Exceeded
2.5
2.0
1.5
1.0
0.5
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

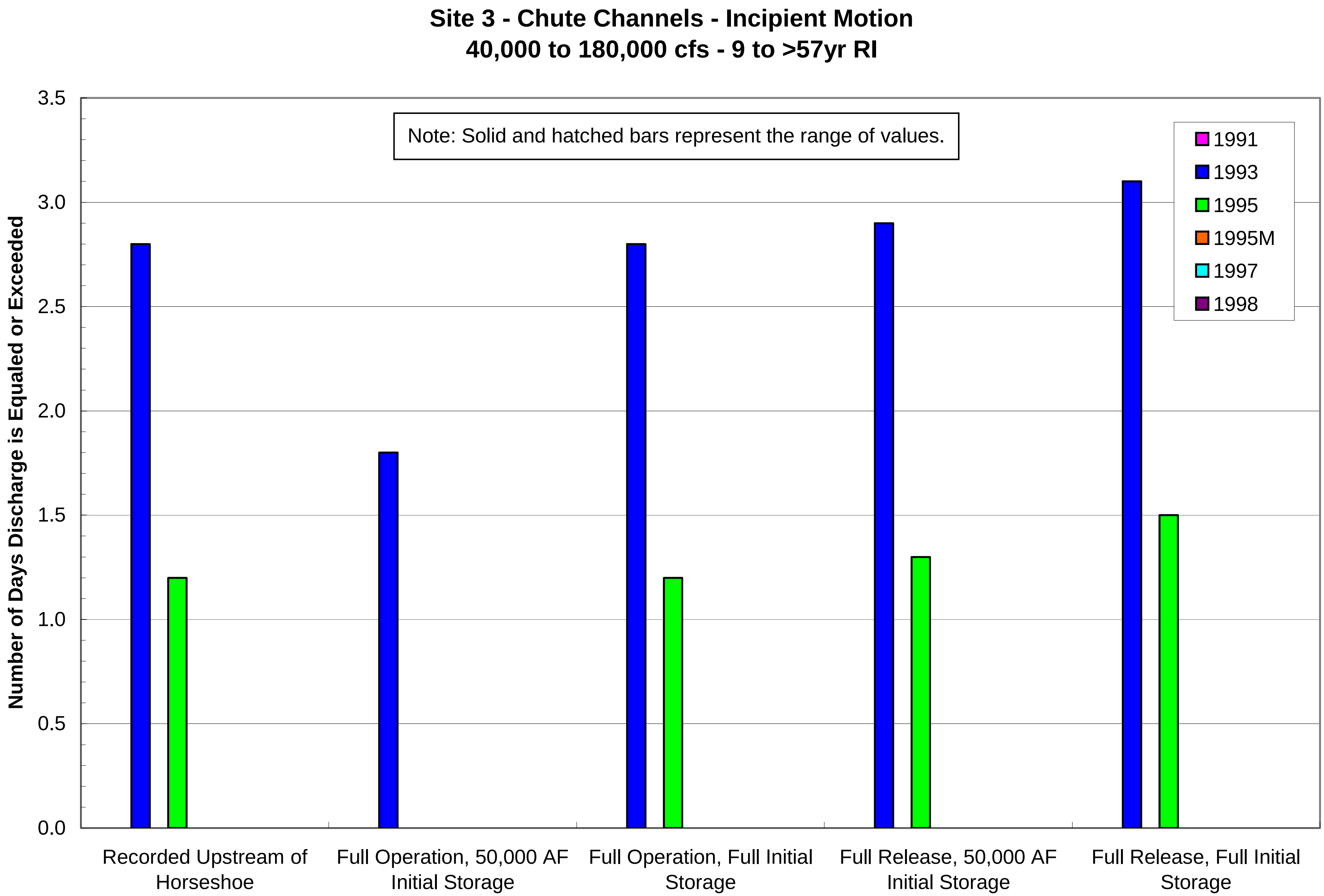
Site 3 - Chute Channels - Inundation
10,000 to 50,000 cfs - 4.8 to 10.6yr RI

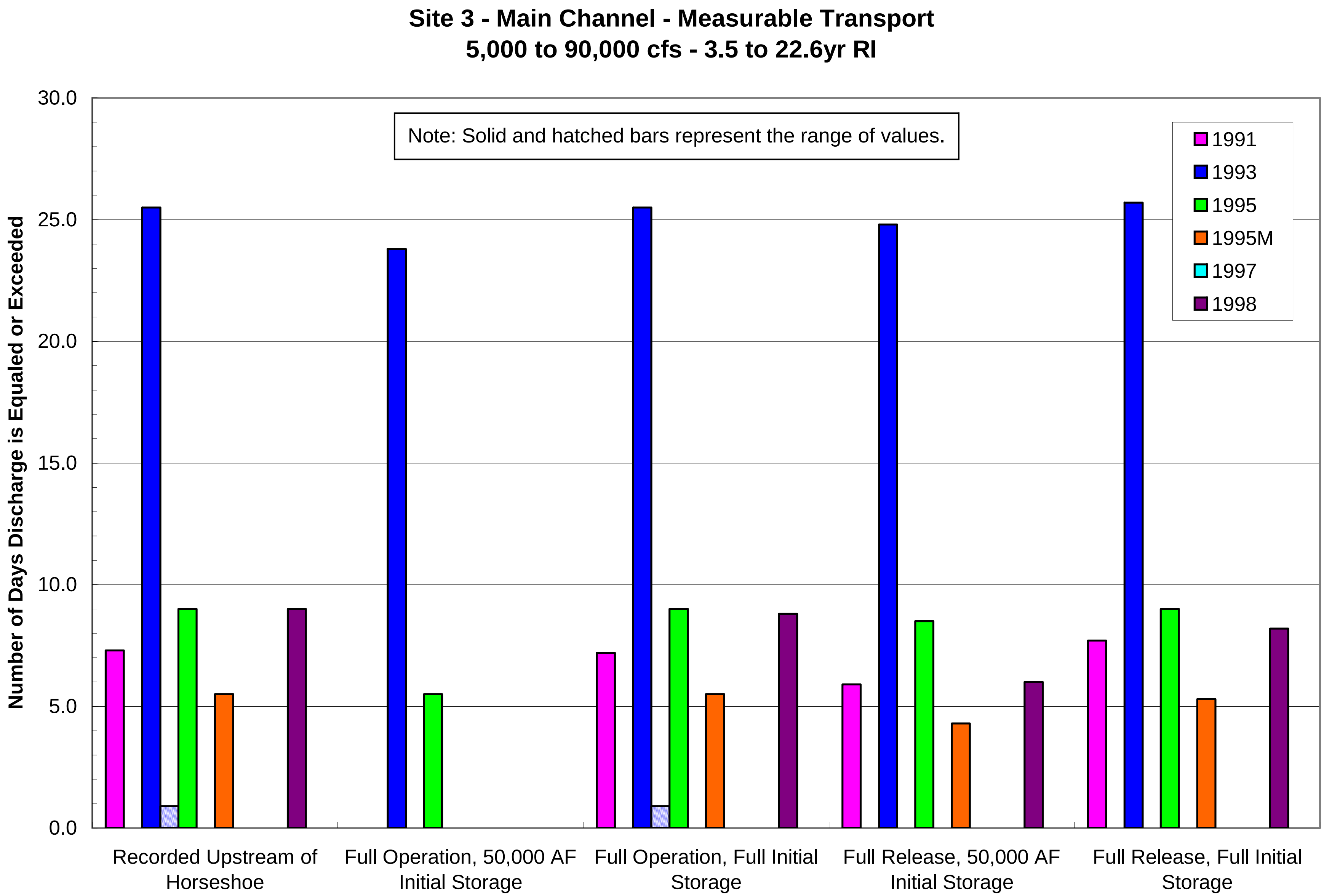


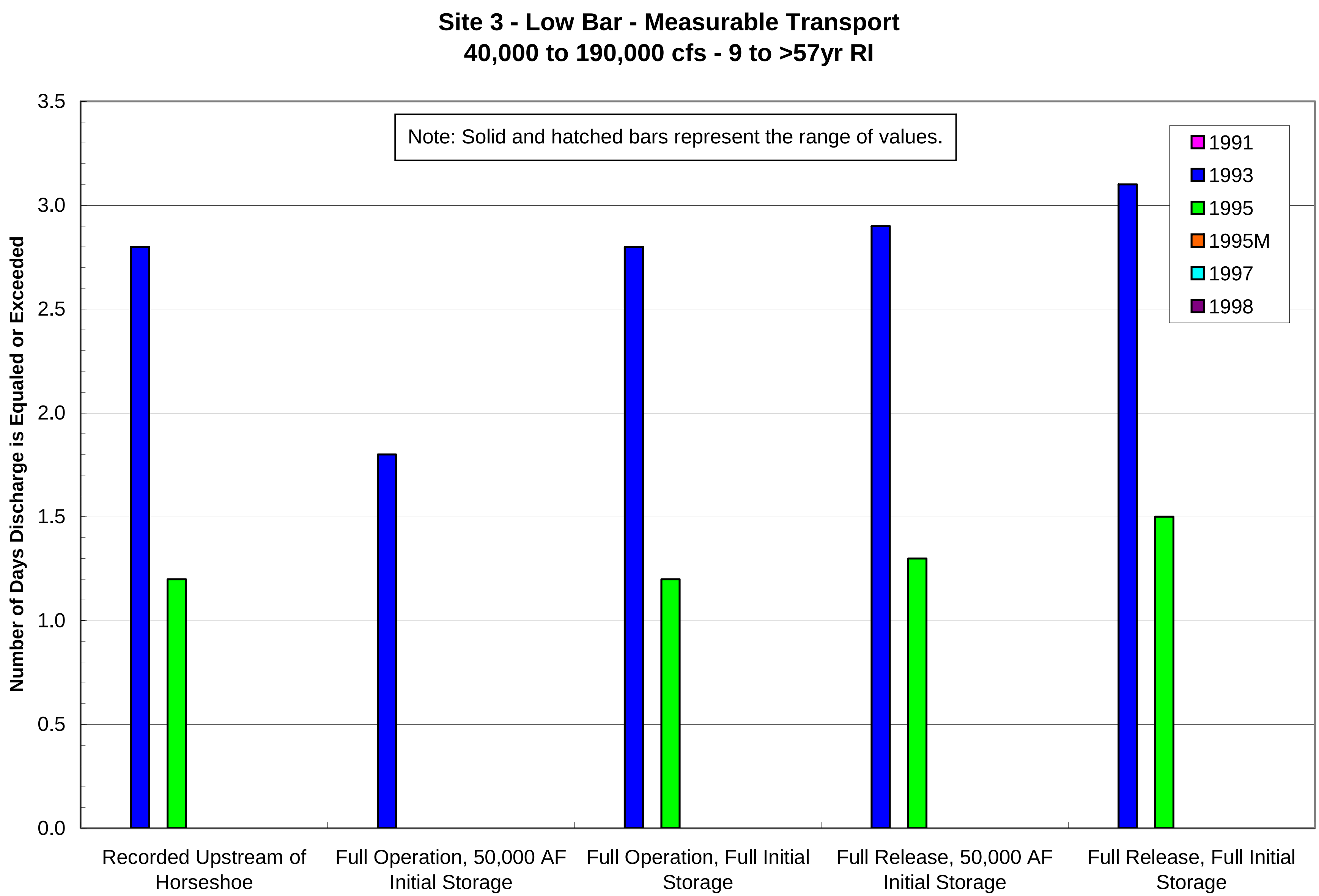

Site 3 - Main Channel - Incipient Motion
2,200 to 16,000 cfs - 1.9 to 7.7yr RI
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Number of Days Discharge is Equaled or Exceeded
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



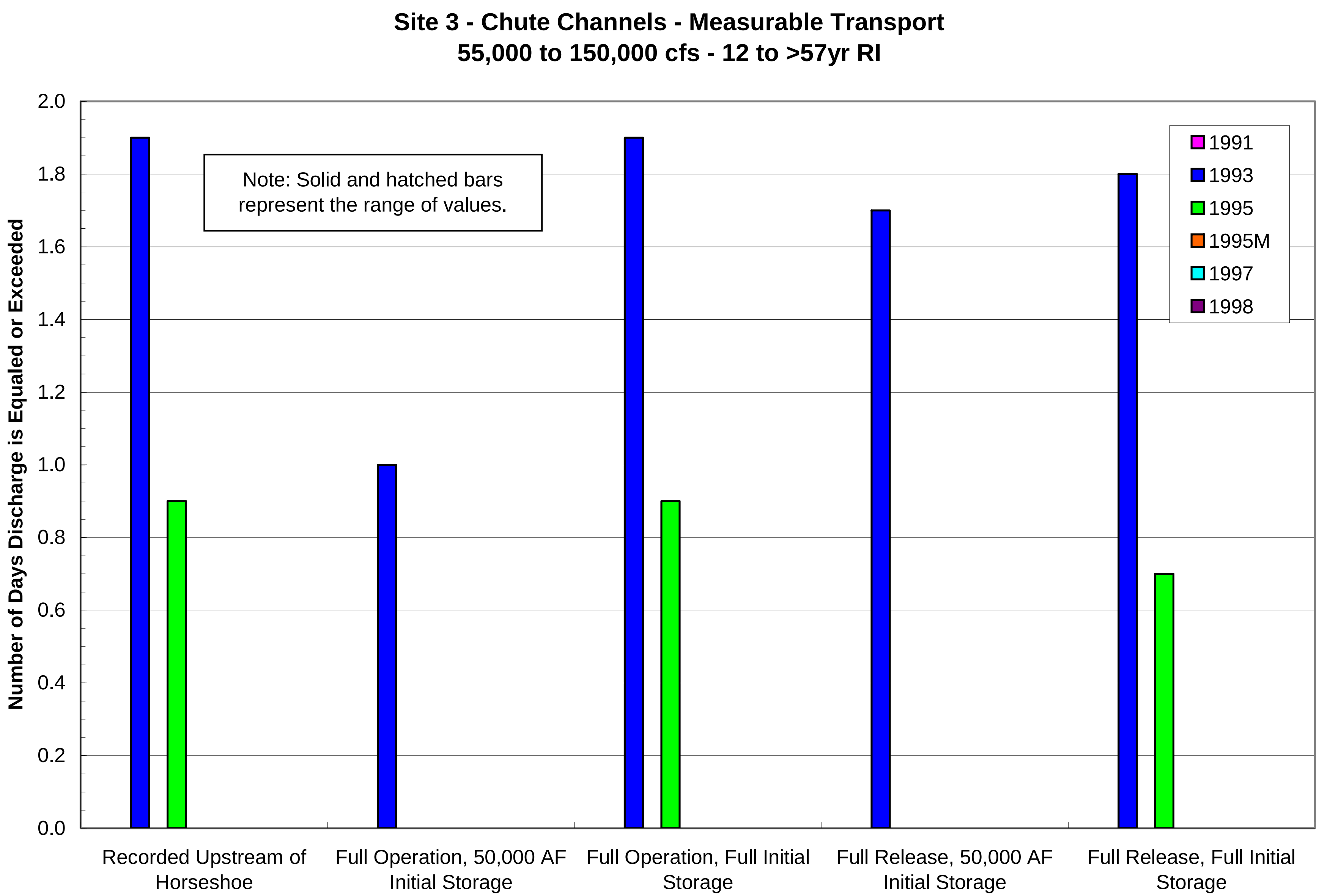
Site 3 - Low Bar - Incipient Motion
20,000 to 150,000 cfs - 8.4 to 47yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage


Site 3 - Chute Channels - Incipient Motion
40,000 to 180,000 cfs - 9 to >57yr RI
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Number of Days Discharge is Equaled or Exceeded
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage


Site 3 - Main Channel - Measurable Transport
5,000 to 90,000 cfs - 3.5 to 22.6yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



Site 3 - Low Bar - Measurable Transport
40,000 to 190,000 cfs - 9 to >57yr RI
Note: Solid and hatched bars represent the range of values.
Number of Days Discharge is Equaled or Exceeded
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage



Site 3 - Chute Channels - Measurable Transport
55,000 to 150,000 cfs - 12 to >57yr RI
Number of Days Discharge is Equaled or Exceeded
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Note: Solid and hatched bars represent the range of values.
1991
1993
1995
1995M
1997
1998
Recorded Upstream of Horseshoe
Full Operation, 50,000 AF Initial Storage
Full Operation, Full Initial Storage
Full Release, 50,000 AF Initial Storage
Full Release, Full Initial Storage

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Arizona State Land Department
September, 2014

Presentation to ANSAC: Verde River Navigability

Introduction

- Federal Standard for Title Navigability (Daniel Ball Test)
  - Ordinary & Natural
  - Used or Susceptible
  - Trade & Travel on Water
- Recent Court Decisions
  - AZ: Prior to dam & diversions
  - US: River Segments

"Navigable" or "navigable watercourse" means a watercourse that was in existence on February 14, 1912, and at that time was used or was susceptible to being used, in its ordinary and natural condition, as a highway for commerce, over which trade and travel were or could have been conducted in the customary modes of trade and travel on water.

A.R.S. § 37-1101(5)

ASLD Reports Background

- Prepared as Directed by AZ Legislature
  - HB 2594 (1992) ➔ A.R.S. §§ 37-1106 -1156
- ASLD provided technical support to ANSAC
  - Collect & present facts re. navigability
- Reports for all watercourses (30,000+) in AZ
  - ASLD Advocated for Navigability on the Salt, Gila, and Verde

ASLD Reports Background

- Reports for the Gila, Salt, and Verde Rivers (and others) were updated after previous legislative changes to A.R.S. § 37-1101-1156
  - Not updated after Montana v. PPL or Winkleman v. ANSAC
  - This presentation provides that update

Presentation Overview

- Note on Evidence
  - Not all evidence submitted by ASLD will be discussed today
  - Incorporate evidence from previous hearings and filings by reference
  - AZAGO Submittals & ASLD Reports (all rivers)

Presentation Overview

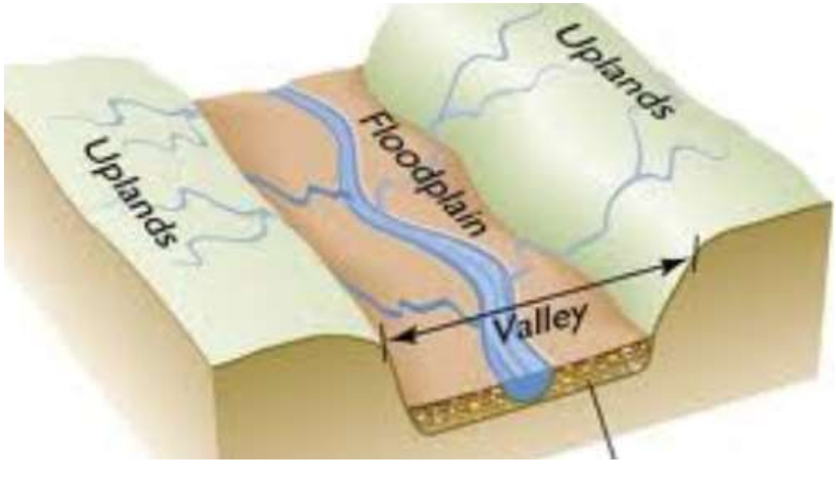
- Speaker Resume – Verde River
  - Flood History
    - Graduate Work 1984-86 – Paleoflood Studies
    - 1993 Flood Report
  - Previous Navigability Studies
    - Verde & Major/Minor Tributaries
  - Engineering Studies
    - Main stem – 404 permitting, floodplain, erosion
    - Tributaries – master plans, hydrology, floodplain

Presentation Overview

- Speaker Resume – Verde River
  - Field Experience
    - Paddled Canoe and/or Kayak
      - FS 638 (mile 7) to Salt River (mile 195), except reservoirs
      - Lowest flow rate: 22 cfs @ Perkinsville, 59 cfs @ Camp Verde
      - Highest flow rate: 2,200 cfs @ Camp Verde
      - Summer, Winter, Spring, Fall trips
    - Every road crossing & river access point

Terminology

- Floodplain *
  - Areas in a **<u>watercourse</u>** which have been or may be covered partially or wholly by flood water (See A.R.S. § 48-3601).
  - Includes a low flow or main channel that is ordinarily inundated, and elevated areas that are less frequently inundated.



* Not defined in ARS § 37-1101

Terminology

- Flood
  - Inundation by water of normally dry land
  - Flow that overtops the ordinary high water mark
  - Not seasonal high flow within normal range
- Drought ("unusual drought")
  - Flow below a normal expected range
  - Term more often associated with precipitation or soil moisture than river flow.

* Not defined in ARS § 37-1101

Terminology

- Channel *
  - An open conveyance of surface water having a bottom and sides in a linear configuration.
  - Low Flow (Main) Channel. A channel within a larger channel which typically carries low and/or normal flows. The area within the ordinary high watermark.
  - Watercourse (ARS A.R.S. § 37-1101.11) – the main body or portion or reach of any lake, river, creek, stream, wash , arroyo, channel or other body of water.

* Not defined in ARS 37-1101

Terminology

- Channel
  - Flood Channel. The portion of the floodplain that carries floods that exceed the main channel capacity.
  - Compound Channel. A stream type that has both a low flow channel and a flood channel(s). Each may have a different stream pattern.

Compound Channels

Gila River @ Arlington, AZ

< < Braided Flood Channel

Non-braided main channel > >

Boating occurs on ordinary flows in the main channel, not on the flood channel.

Terminology

- US Army Corps of Engineers:

  "…the most common channel type in dry regions, compound channels are characterized by a single, low-flow meandering channel inserted into a wider braided channel network."

Source: Waters & Ravesloot, p. 293, as cited in Gookin-Gila River Report, 2014, p. 12

Terminology

- So…What is the “Channel?”
  - It depends – objective, intent, speaker
  - Navigable channel vs. flood channel
  - Characterizing river corridor or low flow conveyance
  - Flood impact study vs. boating guide
  - The terminology is easily confused

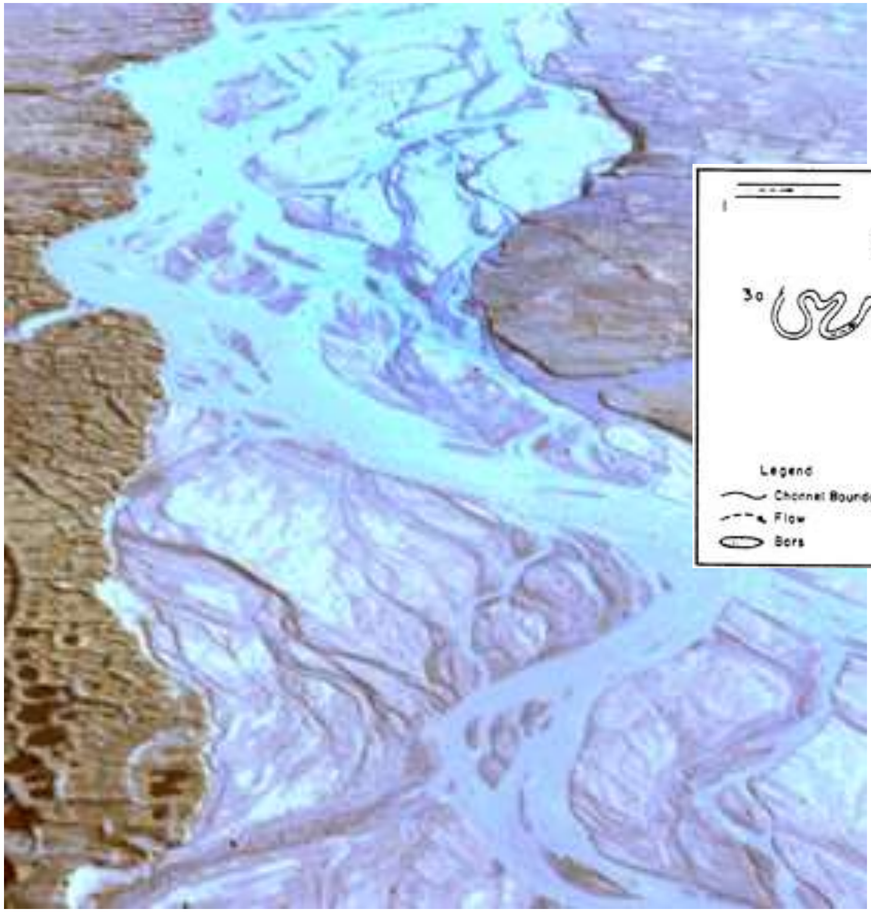
Terminology

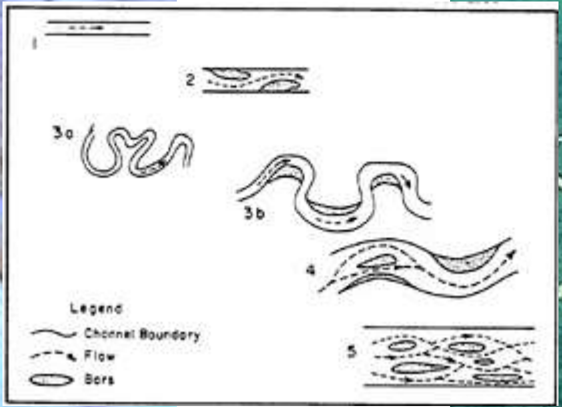
- Example: Burkham, 1972 Study of Gila
  - Phreatophyte study – water use by floodplain vegetation
  - “Stream channel” = area devoid of vegetation
    - Not = boating channel, except in high flow
    - “Active channel” – recent erosion, deposition, water flow
  - “Bottom land” = 1914 flood channel (inclusive)
  - “Flood plain” = outside stream channel, inside bottom land, densely vegetated

Terminology

- Common Channel Patterns

Braided



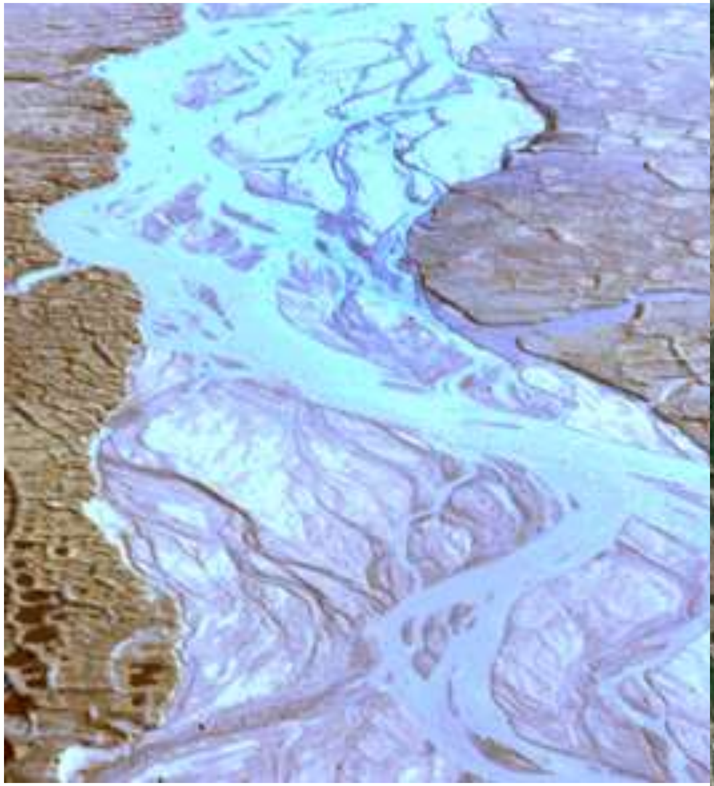


Meandering

Terminology

- Common Channel Patterns

Braided



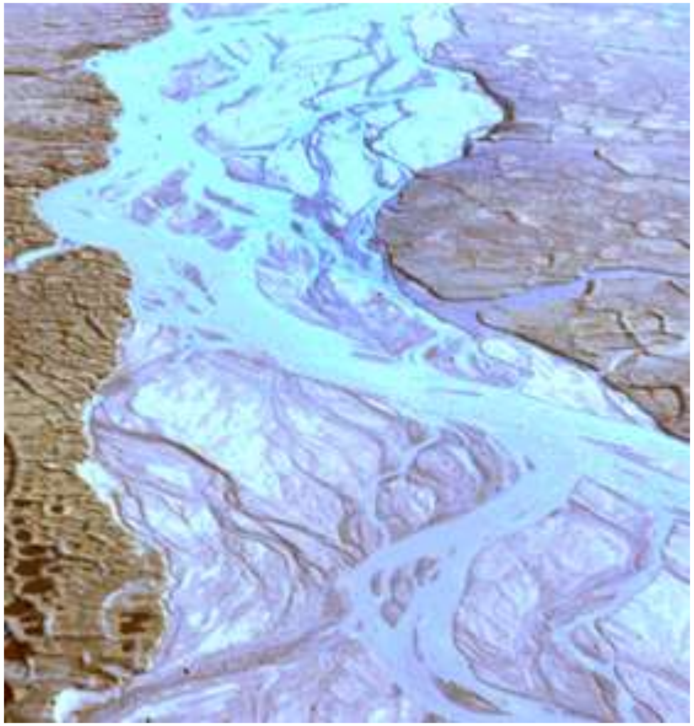
Verde River
Near
Clarkdale

Meandering

Terminology

- Common Channel Patterns

Braided



Verde River
Near
Ft. McDowell

Meandering

Braided or Meandering

Gila River @ Arlington, AZ

< < Braided Flood Channel

Non-braided main channel > >

Boating occurs on ordinary flows in the main channel, not on the flood channel.

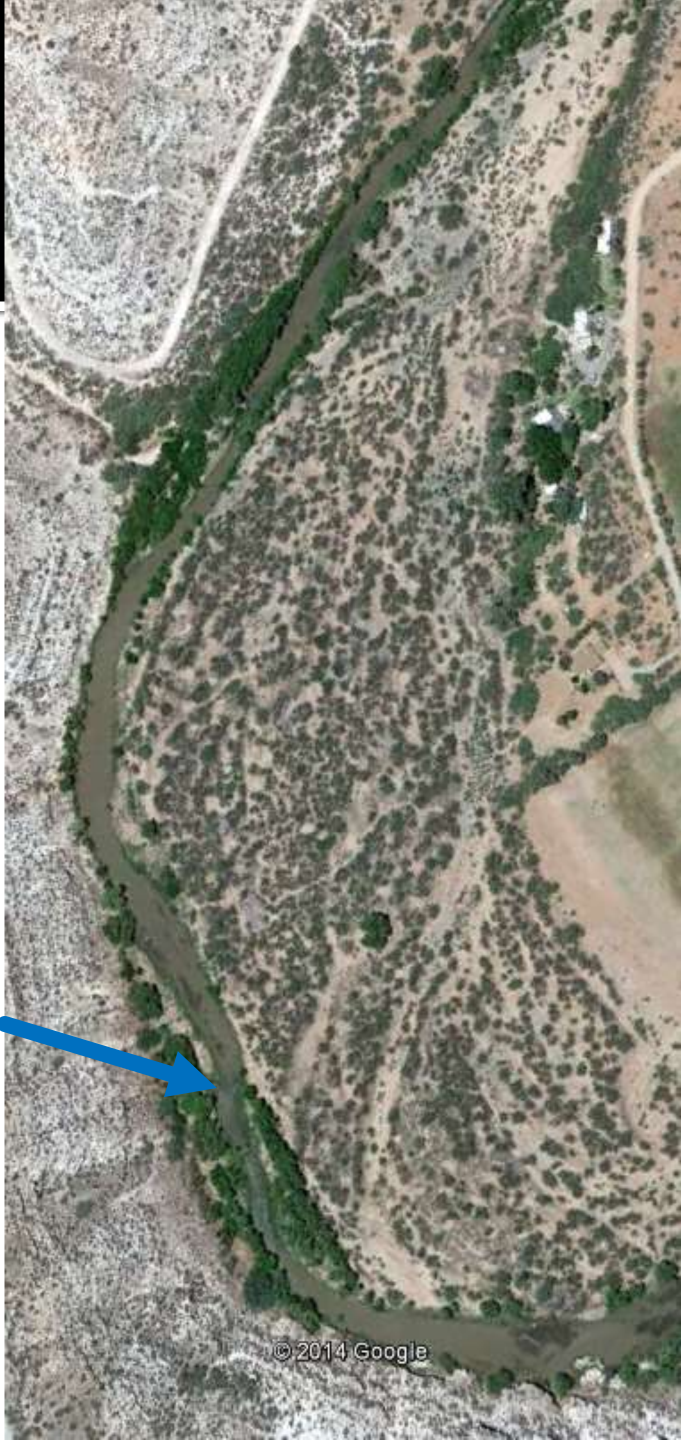
Braided or Meandering

Verde River in Verde Valley

< < Braided Flood Channel

Non-braided main channel > >

Boating occurs on ordinary flows in the main channel, not on the flood channel.

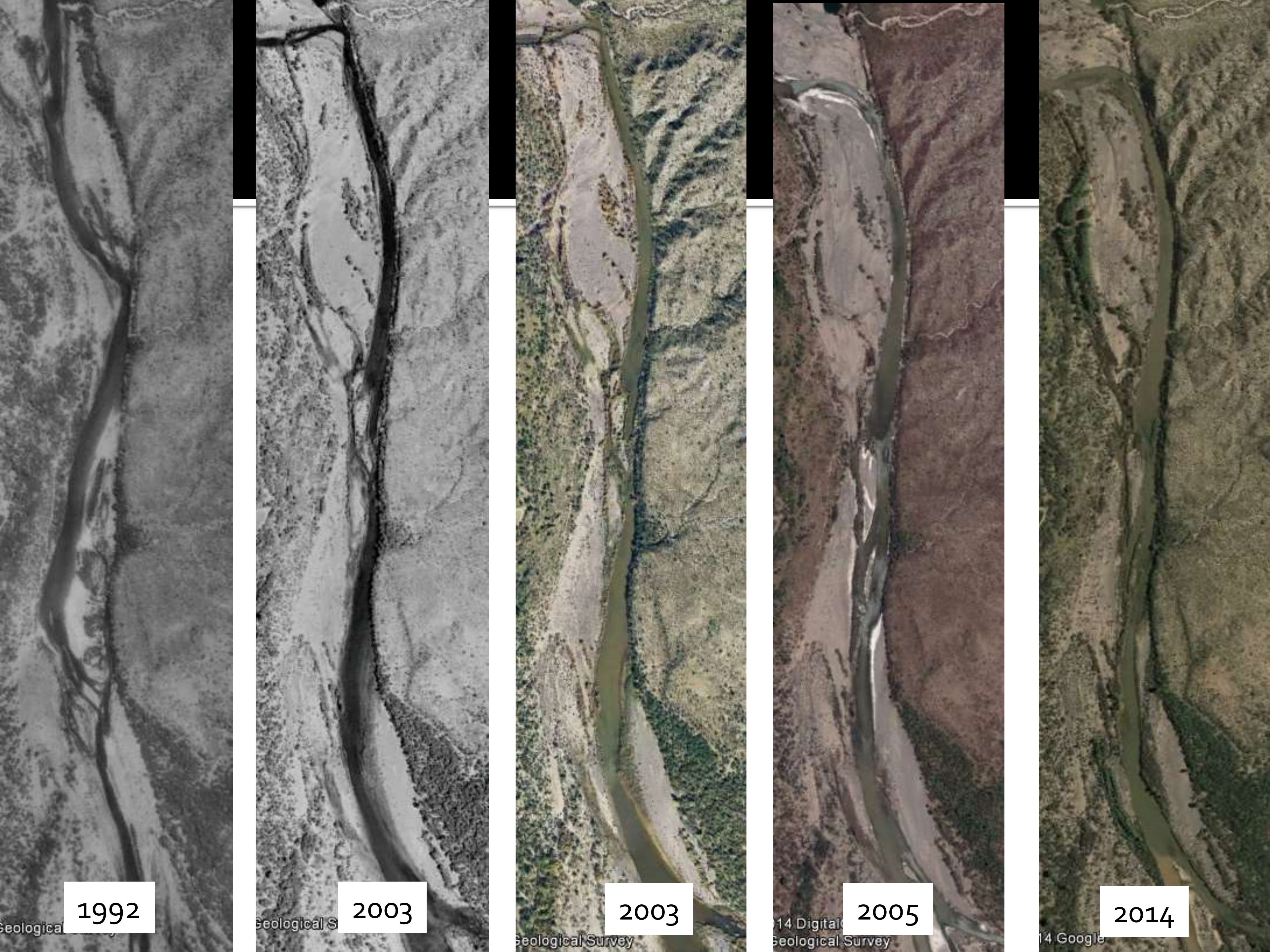


Terminology

- Channel Pattern: Relevance to Navigability
  - Minimal
  - Braided, Meandering, Compound rivers can all be navigated if…
- The Real Question:
  - Is the flowing part of the river deep & wide enough to float boats?

Terminology

- Channel Response to Flooding
  - Flood dominated arid region streams
  - Floods leave a persistent mark on the floodplain
    - Widening
    - Erosion of flood channel
    - Remove vegetation
    - Special case: Geomorphic Thresholds
  - Ordinary flows shape the low flow channel
    - Low flow channel returns after floods recede
    - May be relocated within floodplain


1992
2003
2003
Geological Survey
2005
Geological Survey
2014
14 Google

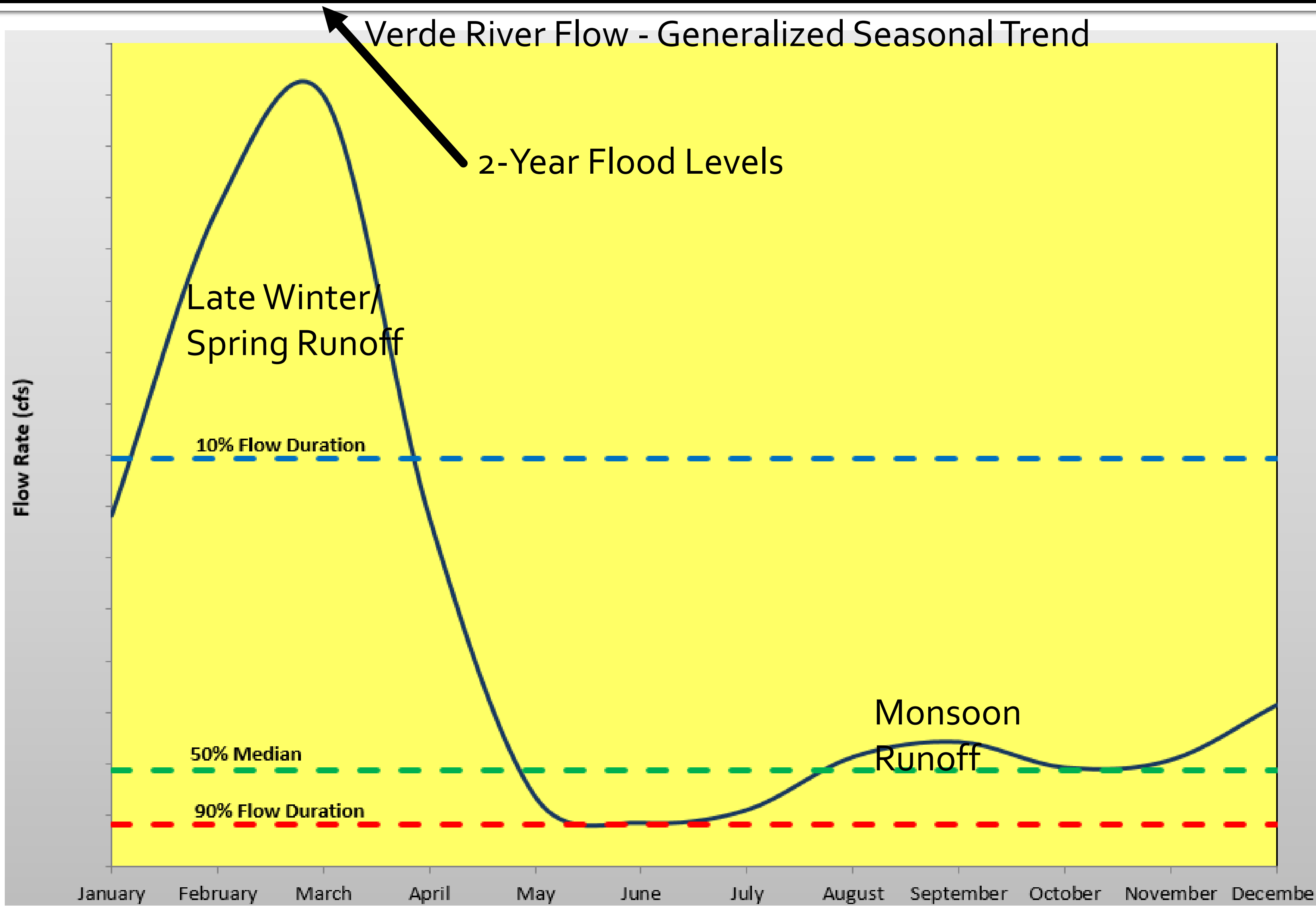
Terminology

- Streambed A.R.S. § 37-1101(2)
  - Bed – the land lying between the ordinary high watermarks of a watercourse.
  - Ordinary high watermark: the line on the banks of a watercourse established by fluctuations of water and indicated by physical characteristics… (topography, vegetation, soils)… Ordinary high watermark does not mean the line reached by unusual floods. (A.R.S. § 37-1101(6))

Terminology

- Erratic
  - Not defined in ARS or ANSAC's statutes
  - Webster's Dictionary:
    - Acting, moving, or changing in ways that are not expected or usual : not consistent or regular
  - Meaning depends on perspective
    - Irrigator vs. Boater
    - Crops & diversion dams vs. Boatability
  - Does NOT mean:
    - Ordinary seasonal changes in flow rates
    - Occasional floods
  - Montana PPL
    - "River need not be susceptible at every point during the year"
    - Not "so brief that is not a commercial reality."

Terminology:
Non-Erratic Seasonal Flow Fluctuation



Terminology

- Unstable
  - Not defined in ARS or ANSAC's statutes
  - Webster's Dictionary
    - Likely to change, not firm or fixed, not constant
  - Meaning depends on perspective
    - Irrigation vs. boating
  - **All** natural rivers change with time
    - Meandering, sand bars, flood erosion
    - Irrelevant to navigability in ordinary & natural conditions

Terminology

- Obstructions (to Navigability)
  - Not Defined in ANSAC statutes
  - Depends on the Type of Boat
    - River Barges vs. Trapper Canoes
  - Depends on Boater's Experience
  - Depends on Flow Rate
  - Obstruction ≠ Obstacle, Challenge

Obstruction?	Barges	Canoes
Sand Bars	Only if river wide	No
Rapids	Yes	No (I-V)
Waterfalls	Yes	Some
Beaver Dams	No	No
Shallow Flow	< 10 ft.	< 0.5 ft.

Terminology

- Sand Bars
  - Raised area of sand at or near the water surface
  - Occupies part of the stream bed channel

Gila River
near Apache Grove

Colorado River
near Bullhead CIty

Cimarron River
Oklahoma

Terminology

- Waterfalls:
  - Definition: River flow over a vertical drop.
  - Not drowned out at high flow
  - Permanent feature
  - Rapids are less steep, may be drown out
  - None on Gila, Salt, or Verde River in AZ
    - Some Rapids are named "falls"


Verde "Falls"


Apache "Falls", Salt River Canyon


Havasu Falls

Ordinary & Natural Condition

- Ordinary
  - Normal, expected flow rate (i.e., median)
    - Median monthly range
  - By Definition
    - Not flood (Also, A.R.S. § 37-1101(6), OHWM)
    - Not drought
  - May Vary Seasonally
    - Spring runoff
    - Winter freeze
    - Summer low flow

Ordinary & Natural Condition

- Natural
  - Absent the effects of civilization
  - Not possible to determine condition with zero human impact
  - Is possible to determine condition with no human impacts that significantly reduce or enhance navigability
  - Only direct impacts to the watercourse

Ordinary & Natural Condition

- For the Verde River
  - Identify the major changes to the river system
    - #1: Diminished flow due to dams, irrigation diversions, and ground water pumping
      - Solution: Add back in the lost flow.
    - #2: Alteration of the river channel due to lack of ordinary flow (only affected some segments)
      - Solution: Identify a natural cross section.
  - Indicates that river was susceptible to navigation.

Ordinary & Natural Condition

- Relevance of Hydrologic Data Provided
  - Modern gage record **underestimates** pre-development natural flow rates because some natural flow has been removed
  - Pre-Statehood flows were **higher** than modern gage averages

- Therefore…
  - Streams were **more navigable** than indicated by flow post-statehood data
  - Because the Verde River is susceptible to navigation based on modern flow records, it is even more susceptible in its ordinary & natural condition when flow rates were higher.

Note: Restoration of ordinary & natural flow would not significantly increase flow velocities or hazard levels of restored river flow.

Presentation Overview: Verde River

- Sullivan Lake to Salt River confluence

Presentation Overview

- Preview of State's Findings & Conclusions:

- The Verde River:
  - Was navigable in its ordinary & natural condition.
  - Has a history of navigation
  - Is still used for navigation, some commercial
  - Was and is susceptible to navigation
  - Was more susceptible to navigation before it was dammed, diverted, and altered.

Segmentation

Verde River Segmentation

- Verde River is Variable Over its Course in AZ
  - Changes in Geology
    - Bedrock Canyons
    - Alluvial Valleys
  - Changes in Channel Characteristics
    - Depth/width/pattern
    - Character of Rapids
  - Changes in Hydrology
    - Flow Rate

- Justification for Considering River in Segments
- Reaches in ASLD Reports were more geographical

Verde River Segment #0

Verde River Segment #0

- Verde River Segment #0
  - Sullivan Lake to Forest Road 638
  - Perennial below Granite Creek
  - Channel Characteristics
    - Pool-Drop/Pool & Riffle Pattern
    - Bedrock Canyon
  - Depleted Base Flow Since & Prior to 1912
    - Minimal Other Human Impact
    - Flow Depletions from Ground Water Pumping
  - Not Normally Boated

Verde River Segment #0

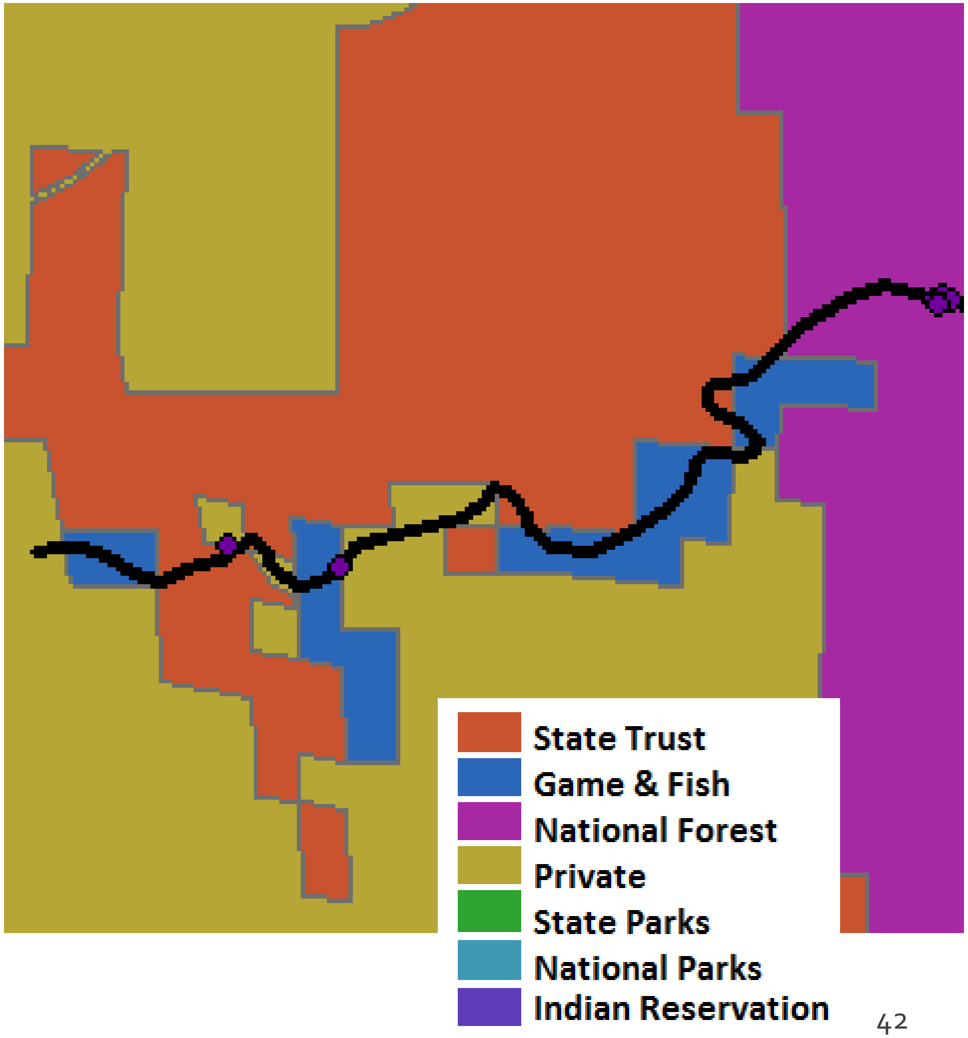
- Segment 0-A: Sullivan Lake to Granite Ck.
  - Ephemeral/Intermittent
  - Bouldery & Steep
  - Difficult Access

- Segment 0-B: Granite Creek to FS 638
  - Perennial
  - Pool & Riffle, Shallow

- Major Tributaries
  - Granite Creek

Verde River Segment #0

- Land Ownership
  - State Trust, Game & Fish
  - Prescott National Forest
  - Private



Google Earth Flyover

- Verde River, Segment 0

Field Photos

Verde River Segment #1

Verde River Segment #1

- Verde River Segment #1
  - Forest Road 638 to Sycamore Canyon
  - Perennial
  - Channel Characteristics
    - Pool & Riffle Pattern
    - Bedrock Canyon
  - Diminished Base Flow Since & Prior to 1912
    - Ground Water Pumping Depleting Natural Flow
    - Minimal Other Direct Human Impact to Channel
  - Boated for Recreation

Verde River Segment #1

- Land Ownership
  - Prescott National Forest
  - Several Private Inholdings

- Major Tributaries
  - Sycamore Canyon

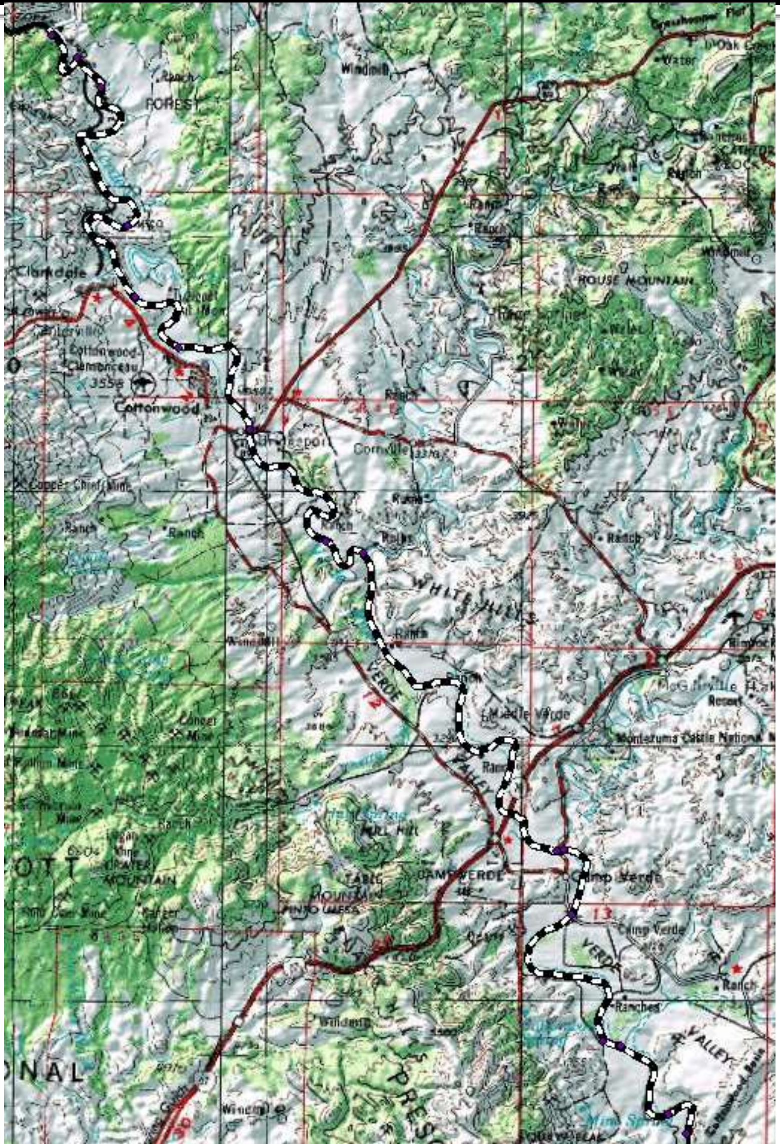
- Minor Diversions

Google Earth Flyover

- Verde River, Segment 1

Field Photos

Verde River Segment #2

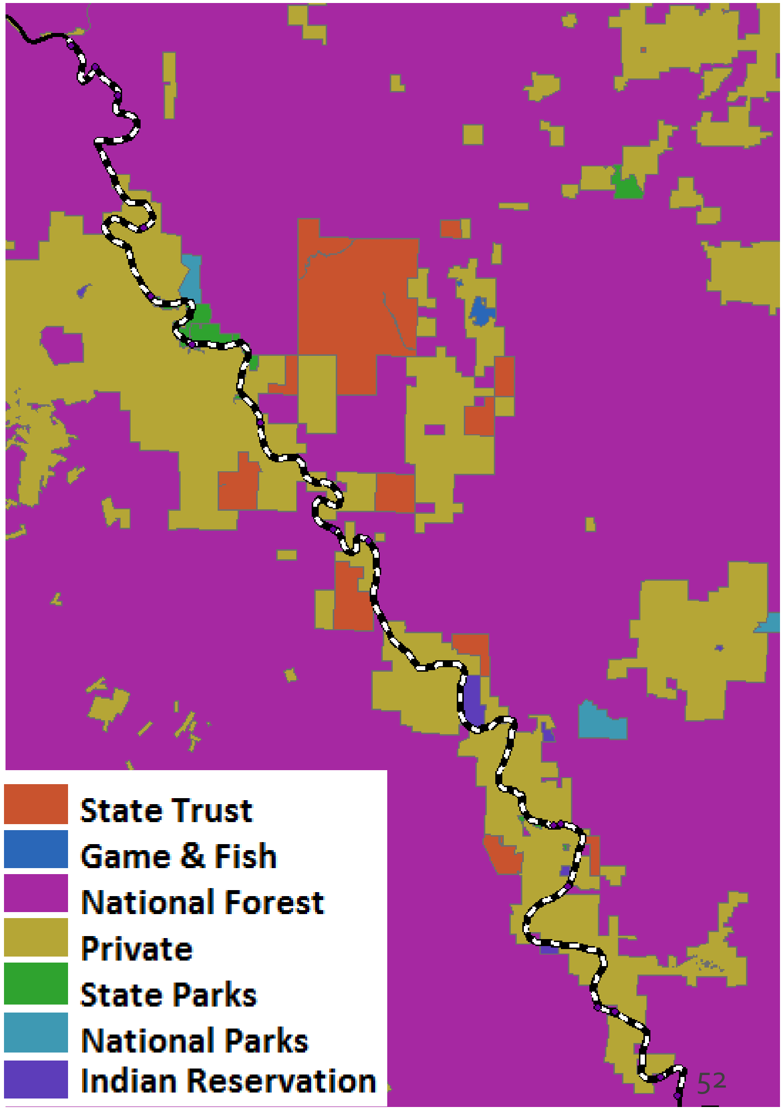


Verde River Segment #2

- Verde River Segment #2
  - Sycamore Canyon to Beasley Flat (Verde Valley)
  - Perennial
  - Channel Characteristics
    - Pool & Riffle Pattern
    - Alluvial Valley
  - Diminished Base Flow Since & Prior to 1912
  - Significant Human Impacts
  - Boated for Recreation
    - Includes commercial boating for recreation

Verde River Segment #2

- Land Ownership
  - Mostly Private Land
  - Prescott & Coconino Forests
  - State Trust Land
  - State & National Parks
  - Yavapai Apache Indian
- Major Tributaries
  - Sycamore Canyon
  - Oak Creek
  - Beaver Creek
  - West Clear Creek
- Major Diversions

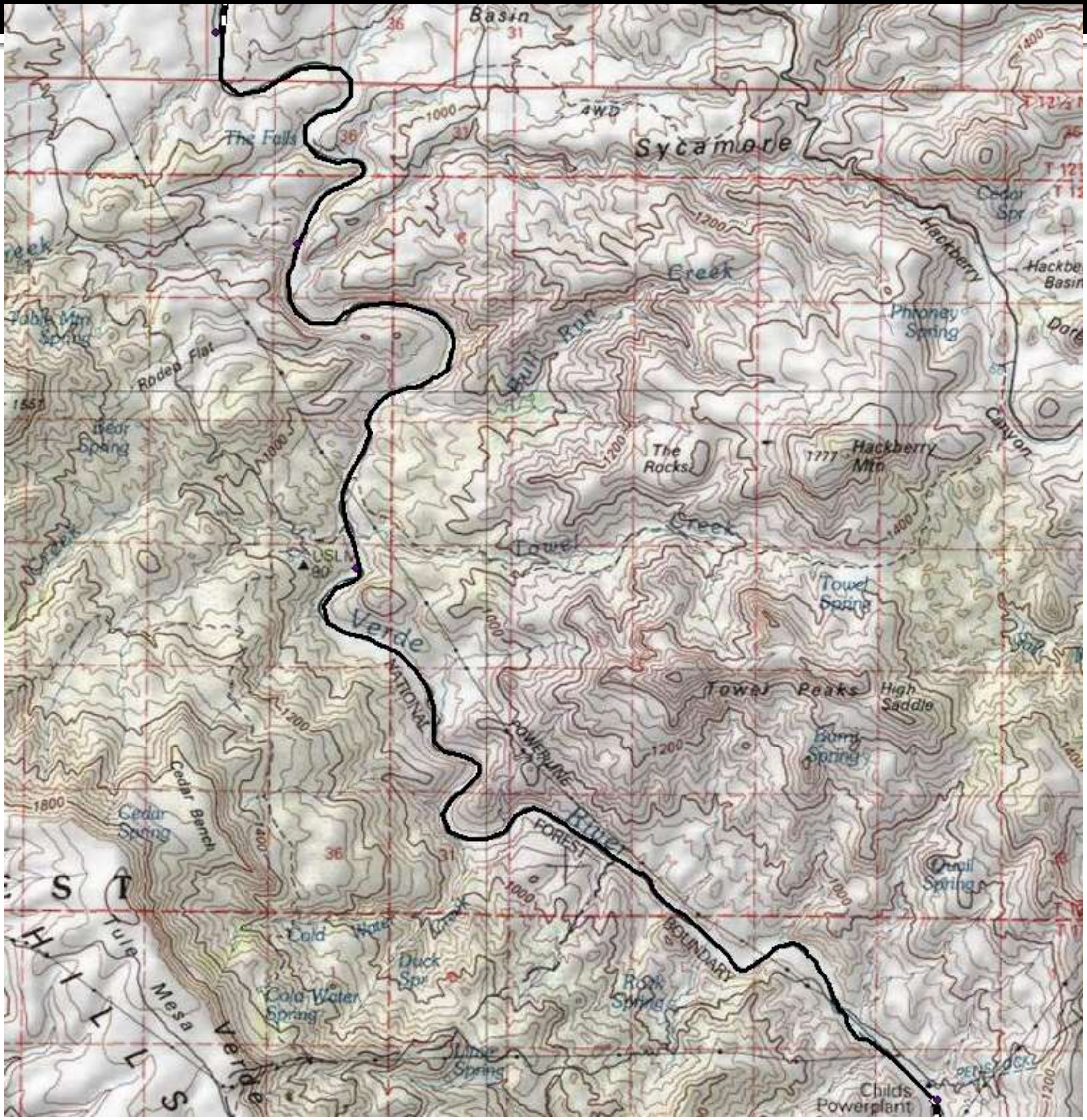


Google Earth Flyover

- Verde River, Segment 2

Field Photos

Verde River Segment #3

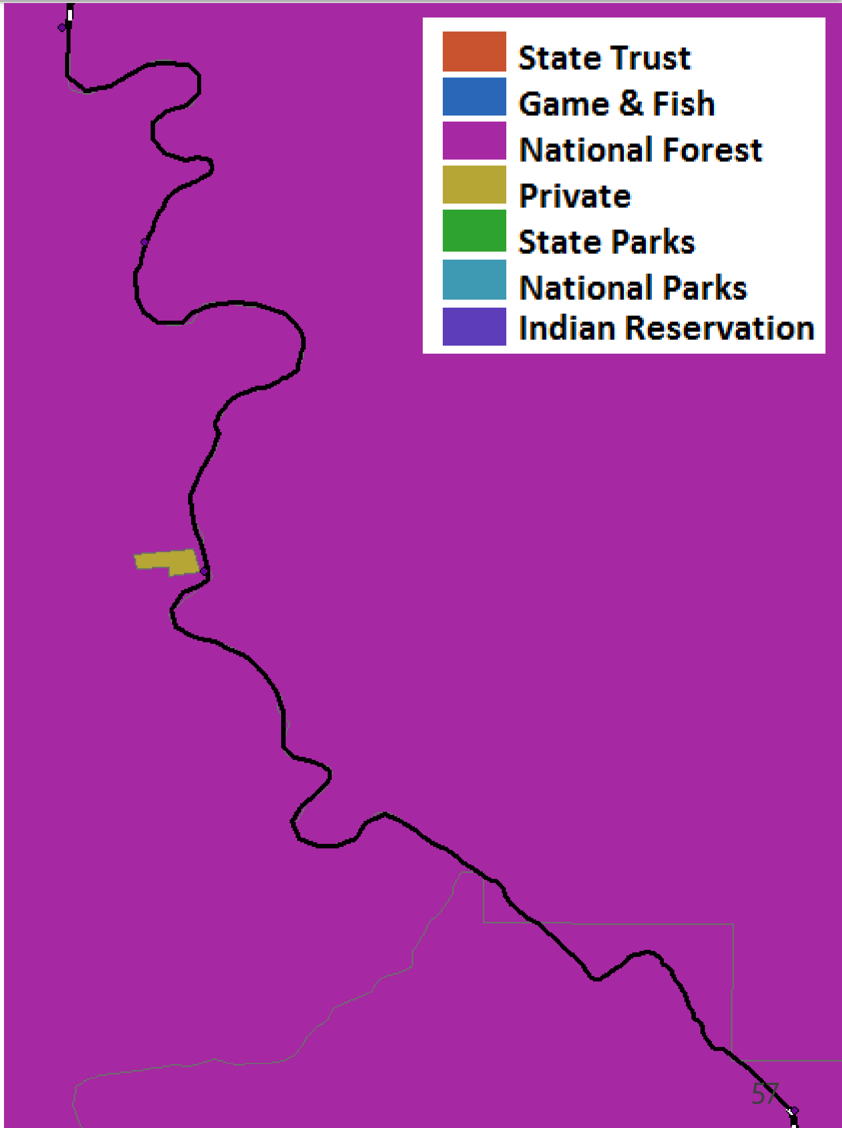


Verde River Segment #3

- Verde River Segment #3
  - Beasley Flat to Childs
  - Perennial
  - Channel Characteristics
    - Pool & Riffle Pattern
    - Bedrock Canyon
  - Depleted Base Flow Since & Prior to 1912
    - Minimal Other Human Impacts
  - Boated for Recreation
    - Whitewater Reach
    - Some commercial recreational trips

Verde River Segment #3

- Land Ownership
  - Prescott, Coconino & Tonto Forests
  - Minor Private
- Major Tributaries
  - Gap Creek
- No Major Diversions at Statehood in Segment

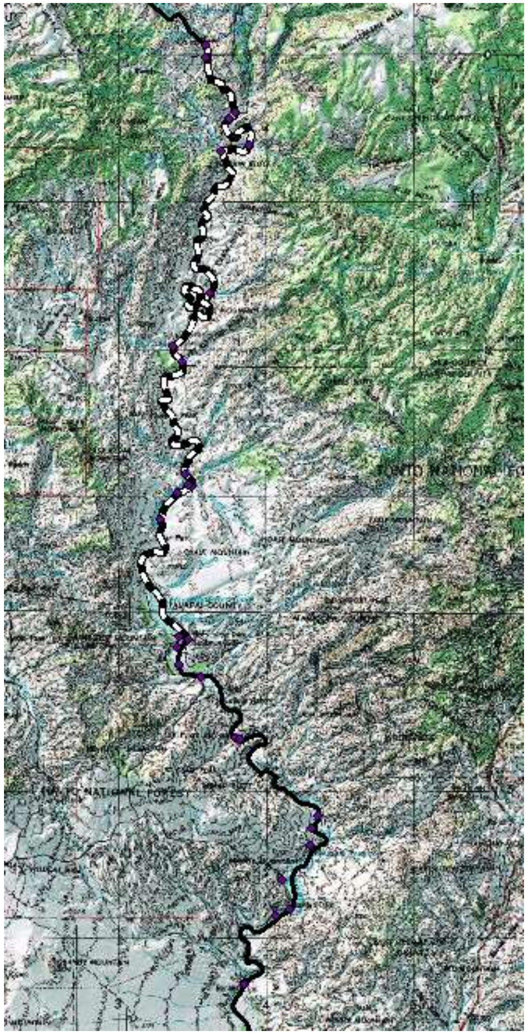


Google Earth Flyover

- Verde River, Segment 3

Field Photos

Verde River Segment #4

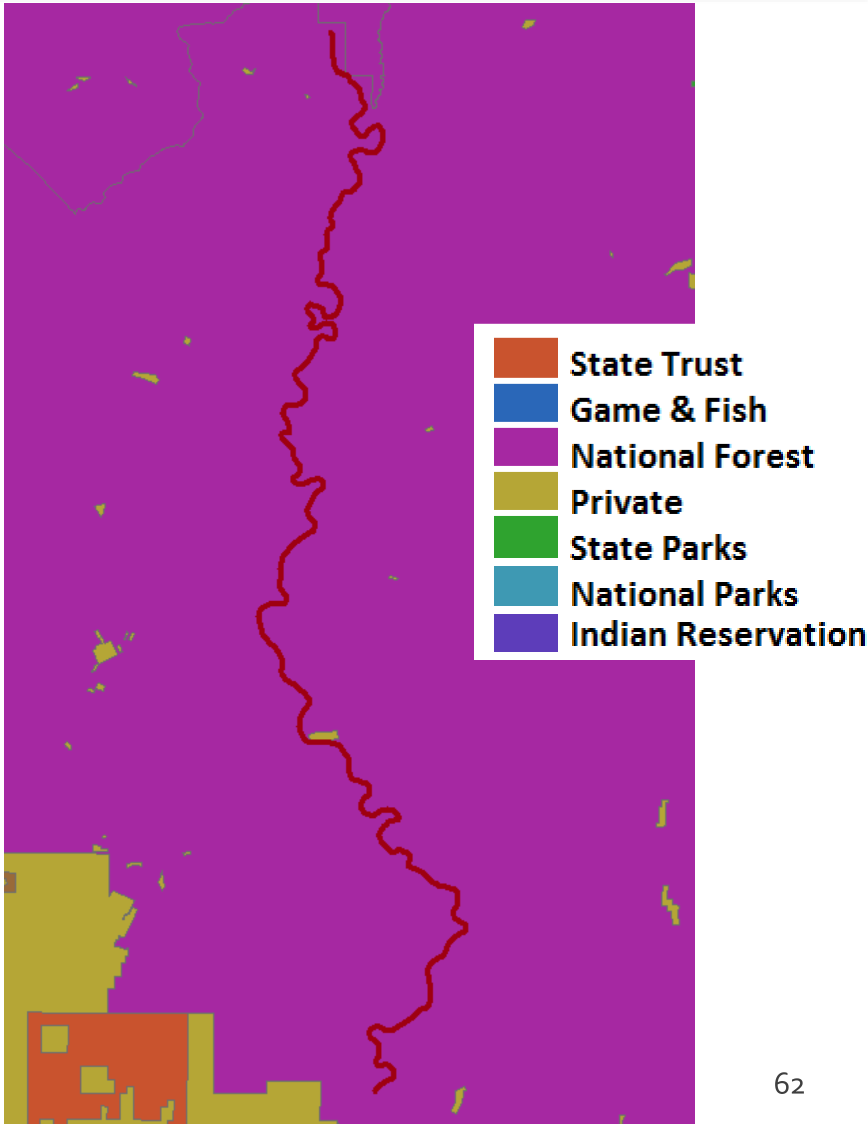


Verde River Segment #4

- Verde River Segment #4
  - Childs to Needle Rock
  - Perennial
  - Channel Characteristics
    - Pool & Riffle Pattern
    - Bedrock Canyon
  - Diminished Base Flow Since & Prior to 1912
    - Two Major Dams (post-Statehood)
  - Boated for Recreation
    - Some commercial recreational trips

Verde River Segment #4

- Land Ownership
  - Tonto National Forests
  - Minor Private Inholding
- Major Tributaries
  - Fossil Creek
  - East Verde River
  - Red, Tangle, Lime Creeks
- No Major Diversions at Statehood in Segment



Google Earth Flyover

- Verde River, Segment 4

Field Photos

Verde River Segment #5

Verde River Segment #5

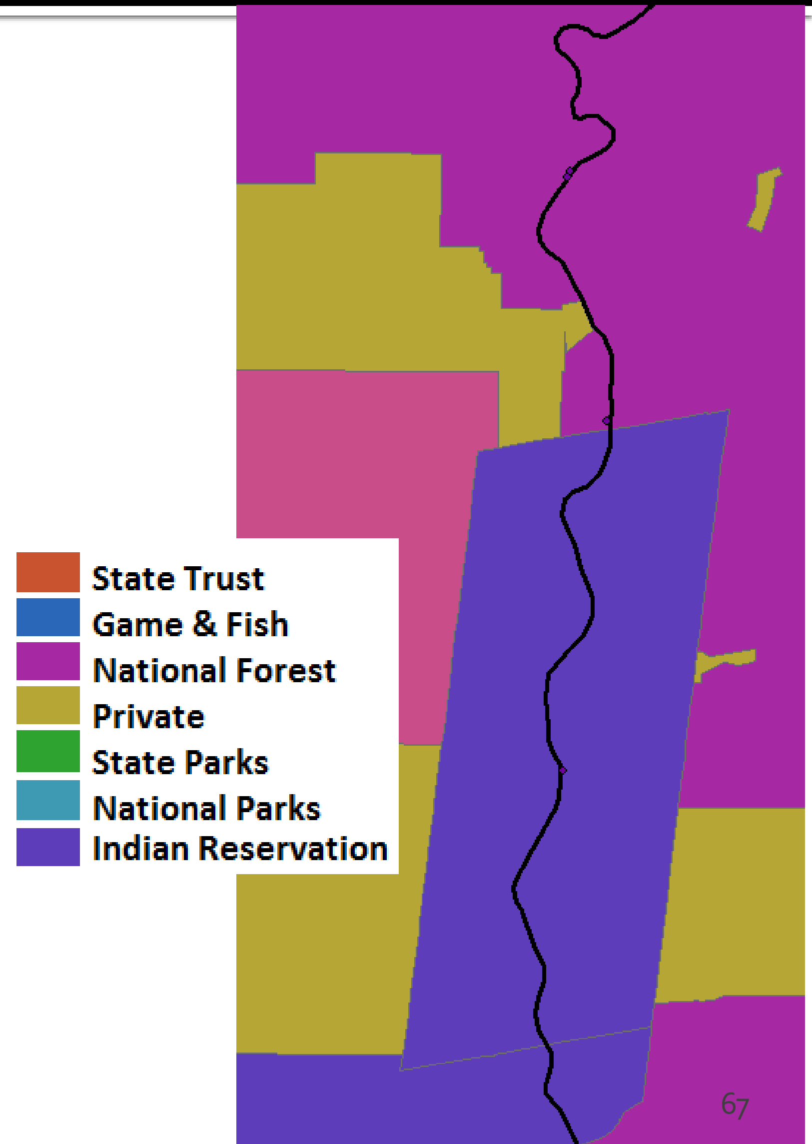
- Verde River Segment #5
  - Needle Rock to Salt River
  - Perennial
  - Channel Characteristics
    - Pool & Riffle Pattern
    - Alluvial Valley
  - Diminished Base Flow Since & Prior to 1912
    - Two Major Dams Upstream (post-Statehood)
  - Boated for Recreation
    - Some commercial recreational trips

Verde River Segment #5

- Land Ownership
  - Tonto National Forests
  - Ft. McDowell Indian Reservation
  - Private Land

- Major Tributaries
  - Camp Creek
  - Sycamore Creek

- Some Irrigation Diversions
- Aggregate Mining



Google Earth Flyover

- Verde River, Segment 5

Field Photos

Navigability of the Verde River

- Information Provided in ASLD Reports
  - Archaeology
  - History
  - River Descriptions
  - Historical Boating Accounts
  - Geology
  - Hydrology
  - Rating Curves (Flow Depths)
  - Modern Boating

Archaeology: Key Findings

- Three Zones
  - Upper (Sullivan Lake to Sycamore Canyon)
    - Segment 1
  - Middle (Sycamore Canyon to Fossil Creek)
    - Segment 2-3
  - Lower (Fossil Creek to Salt River)
    - Segment 4-5

Archaeology: Key Findings

- Accessible Permanent River Flow
- Irrigation Agriculture
- Communication Corridor/Trade Route
- No Known Boats or Boating

History: Key Findings

- Spanish Exploration (1500's)
  - Chamuscado, de Espejo, Farfan, Onate
  - Mineral Exploration
- American Fur Trappers (1820's-30's)
  - Patties, Young, Kit Carson
  - Mode of transportation not known
    - No mention of boats on Verde for earliest trappers
    - Later trapper used boats – Verde Valley to Salt River

History: Key Findings

- Railroad Surveys (1850's)
  - Whipple, Sitgreaves – Headwaters only
- Military Forts (1860's-1890's)
  - Ft. Whipple 1863 @ Del Rio Springs
    - Territorial capital until 1864
  - Camp/Fort Lincoln 1864-90 @ Camp Verde
    - Some known boat use
  - Ft. McDowell 1865-90
    - Some known boat use
  - Camp Ilges 1867 @ Horseshoe Dam site

History: Key Findings

- Mining & Farming (1860's)
  - Began in 1860's in Verde Valley & Jerome
  - Smelter @ Clarkdale (1912)

- Indian Reservations (1870's)
  - Camp Verde 1870-1872; 1914
  - Middle Verde 1914
  - Ft. McDowell 1903

History: Key Findings

- Railroads (1890's)
  - Northern Arizona 1882; Prescott 1886
  - To Jerome 1895
  - Drake to Clarkdale 1911
  - Clarkdale to Hopewell 1915
- Major Dams (Post-Statehood)
  - Bartlett 1939
  - Horseshoe 1946

History: Key Findings

Ditches & Diversions*	Segment
Perkins 1864	1
Eamon (Diamonds) Ditch 1865	2
Woods Ditch 1868	2
Cottonwood Ditch 1869	2
Middle Verde (OK) Ditch 1873	2
Hickey Ditch 1874	2
Asher 1895	5

* A more complete list of diversions is found in Table 7-16 in the ASLD Report

History: Key Findings

- Primary Areas of Settlement Along the Verde
  - Verde Valley (Segment 2)
  - Ft. McDowell (Segment 5)

- Available Modes of Transportation Used ~1912
  - Wagon/Stage
  - Horse
  - Railroad
  - Mule Train
  - Foot
  - Small Boats

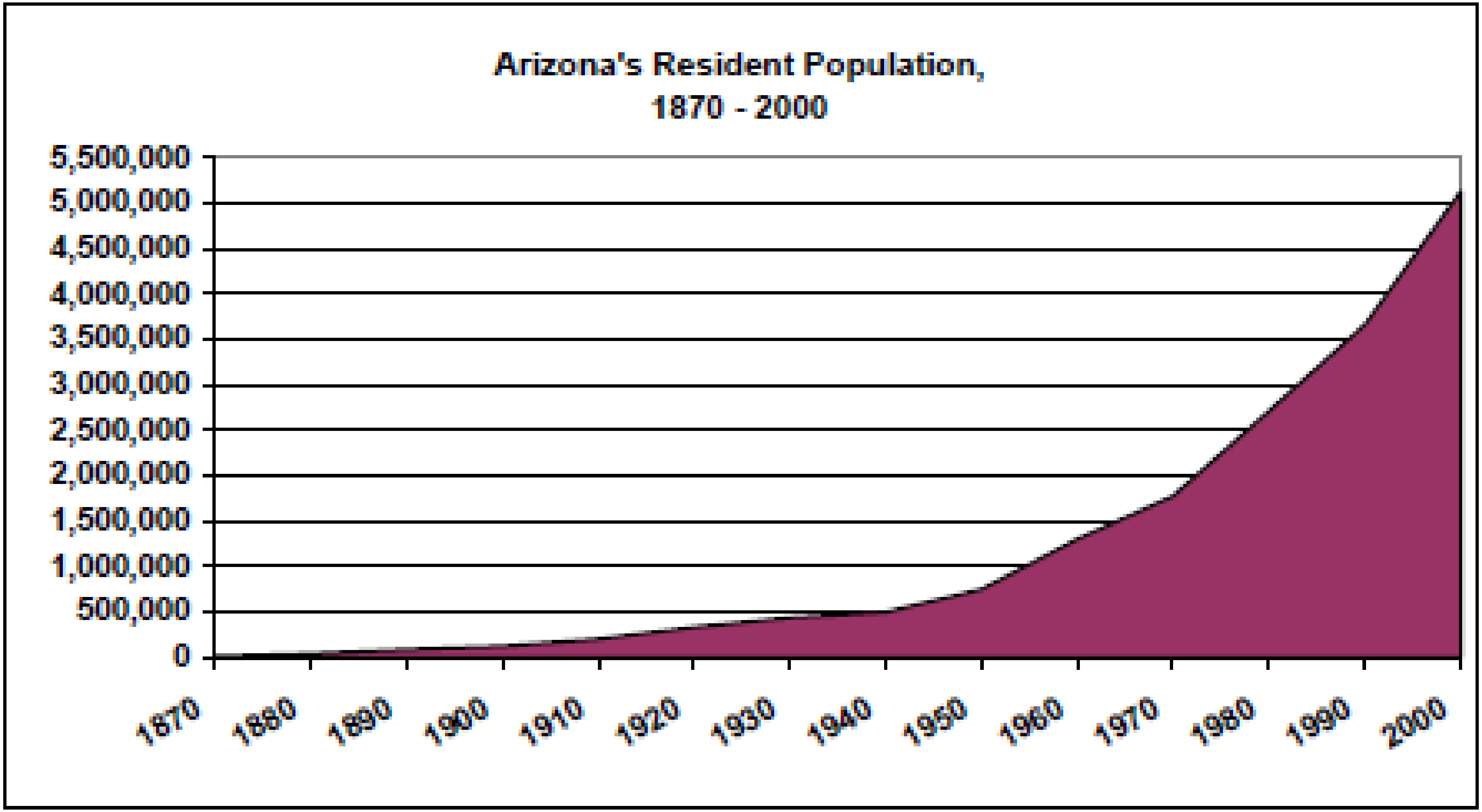
History: Key Findings

- Historical Population

	1910	2010
Camp Verde	269	10,873
Middle Verde	108	-
Fort McDowell	175	600
Cottonwood	91	11,282
Verde Valley *	-	77,000
Yavapai County	15,996	211,015
Jerome	2,803	444
Prescott	5,092	39,828
Phoenix	11,1134	1,447,626
Arizona	204,354	6,392,017

Note: Childs, McGuireville, Bridgeport, Clarkdale, Perkinsville, Del Rio Springs, Paulden not listed in census.

History: Key Findings



Descriptions of the Verde River

- How to Interpret Early River Descriptions
  - What River Segment?
  - What Time of Year?
  - Flood/Drought/Ordinary Condition?
  - When Relative to Man-Caused Depletion?
  - Point of View & Attitude of Observer

River Descriptions

1884 – Entire River

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

(Wallace W. Elliot & Co. 1884:90)

*Waters are "clear and limpid"--river is "**as large as the Gila**"--"well stocked with fish" ....“capable of irrigating vast stretches of land"*

(Hamilton 1884:49, 361).

River Descriptions

Ft. McDowell – Segment 5, 1870

*The **river is thus well confined**, and its bottom lands free from marshes. The strip of easily irrigated bottom land is very narrow, yet much good soil could be reclaimed by irrigation from large acequias" (Surgeon General 1870:459).*

River Descriptions

Yavapai Reservation – Segment 2 (1870's)

*In the 1870's, the **upper Verde River was so marshy** that the Yavapais were able to farm only 20 of the 125 acres available on the floodplain (Fish 1974:5).*

River Descriptions

Middle Verde – Segment 2 (> 1874)

Mrs. Mary Boyer (local resident) "The Verde River at that time was just ***about the size of the Woods ditch*** *of today. Wild mustard and grass grew profusely everywhere and large cottonwood trees could be seen in the distance.*

Verde Valley Pioneers Association 1954:42

Verde (aka Woods) Ditch
Recent photo at www.verdeditch.com

River Descriptions

Cottonwood – Segment 2 (> 1875)

Leonora Lee: In those days malaria was common…There were few, if any, floods, and the Verde River spread out wide, and ***so shallow you could cross it on clumps of grass****. Willow and undergrowth were so heavy all over the river bed that the water was forced into* ***standing pools*** *which bred mosquitoes. Some thought we may have had it when we came, but when the run-off got bigger and the river was cleaned out occasionally with flood, the malaria disappeared.*

Verde Valley Pioneers Association 1954:133

River Descriptions

Clarkdale – Segment 2 (> 1879)

Charles Willard: When I first saw the Verde Valley it was a hunter's and stockman's paradise. Wild game was everywhere and the grass was knee high and plentiful. The land was like a sponge and when it rained the water was absorbed into the ground immediately, so very little ran into the river channel and the small amount that did run into the ***river bed, stood in pools*** *which became stagnant and polluted with malaria germs… Most everybody that came to the Verde Valley brought cattle, horses or sheep with them and the stock soon trampled the spongy land down to solid ground, thus causing the rain water to run into the river channel, which was then only about* ***100 feet wide*** *and the flood waters often rose to six or seven feet high, causing the* ***river to cut into banks****, change the course of the main river channel and the river bed spread to half a mile wide in places.*

(Verde Valley Pioneers Association 1954:150)

River Descriptions

Middle Verde – Segment 2 (> 1879)

*Jessie Shelley: The **Verde River flowed in a definite***

***course** with grass covered banks as those were the days before erosion began too badly in the valley"*

(Verde Valley Pioneers Association 1954:187).

River Descriptions

Fort Verde – Segment 2 (> 1880's)

*Edgar Mearns: River was **deep, flowed slowly**, and was impeded by many **beaver dams**"* (Mearns 1904:354-359).

Ft. McDowell – Segment 2 (1880's)

*Dan Huntington: the river was "**full of beaver dams** with plenty of fish behind these dams"* (Huntington 1957:7)

River Descriptions

Perkinsville – Segment 1 (> 1890's)

Mrs. Nick Perkins: The floodplain of the river was ***quite stable*** *in the 1890s, and Yavapai Indians were using canals to irrigate their crops along the banks of the stream. The river flowed slowly, impeded by many* ***beaver dams****, and extensive* ***marshes*** *occupied the floodplains.* (Minkley & Alger, 1968:95)

River Descriptions

Camp Verde – Segment 2 (1902)

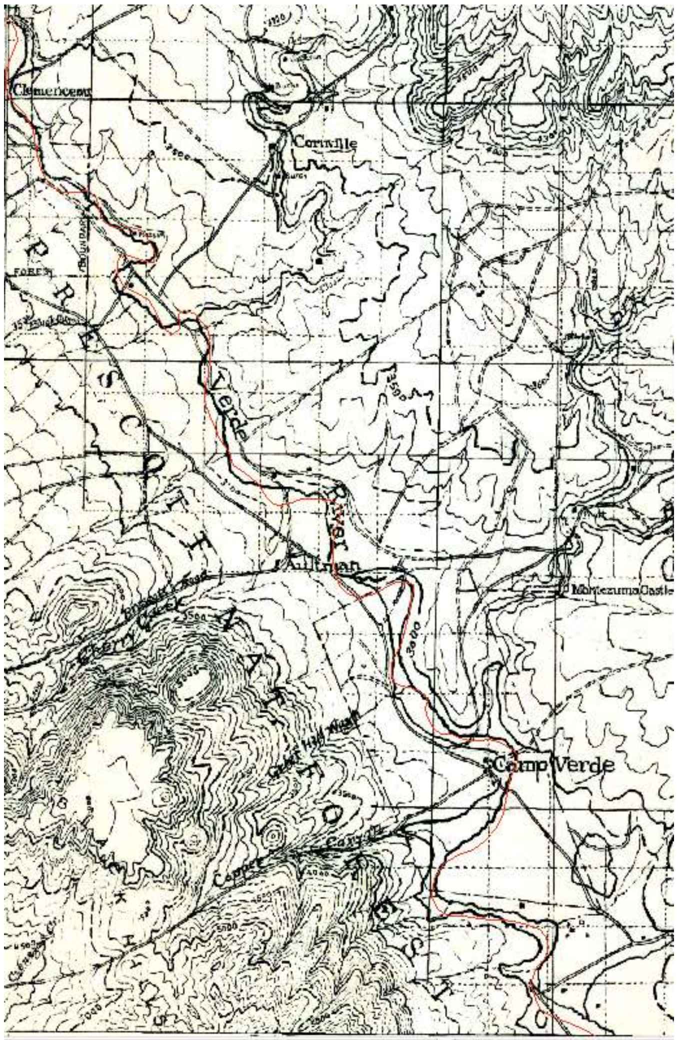
*Ralph Palmer: Verde River … **50 feet wide** and no more than waist deep, with banks two to three feet high* (Palmer, 1979)

River Descriptions

Summary of Historical River Descriptions

- River was not dry
- River channel was narrower …and wider… than today
- Vegetation different – marshy
- Beaver dams
- River channel was shallower … and deeper … than today
- River was erosive …and was stable

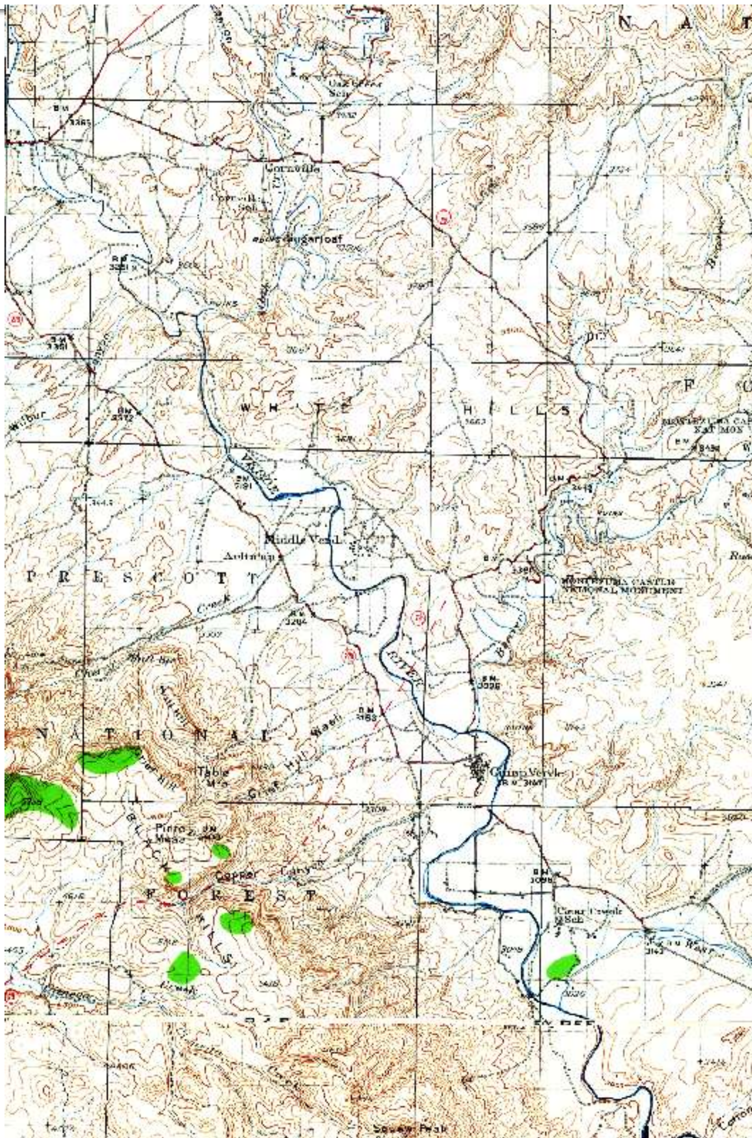
Historical Maps: Segment 2



USGS Topographic Map, 1923
Camp Verde, AZ Quadrangle

- Verde River shown as single channel
- Solid line
- Channel in same location as 2014
- No rapids listed on map
- Several ford crossings
- Communities:
  - Camp Verde
  - Aultman
  - Clemenceau

Historical Maps: Segment 2



USGS Topographic Map, 1932
Camp Verde, AZ Quadrangle

- Verde River shown as single channel
- Solid line, thickens below Oak Creek
- Channel in same location as 2014
- No rapids listed on map
- Several ford crossings
- Communities:
    - Camp Verde
    - Middle Verde
    - Aultman

Historical Maps: Segment 3

USGS Topographic Map, 1929
Turret Peak, AZ Quadrangle

- Verde River shown as single channel
- Solid line
- Channel in same location as 2014
- No rapids listed on map
- No marked crossings
- Communities:
    - Verde Hot Springs

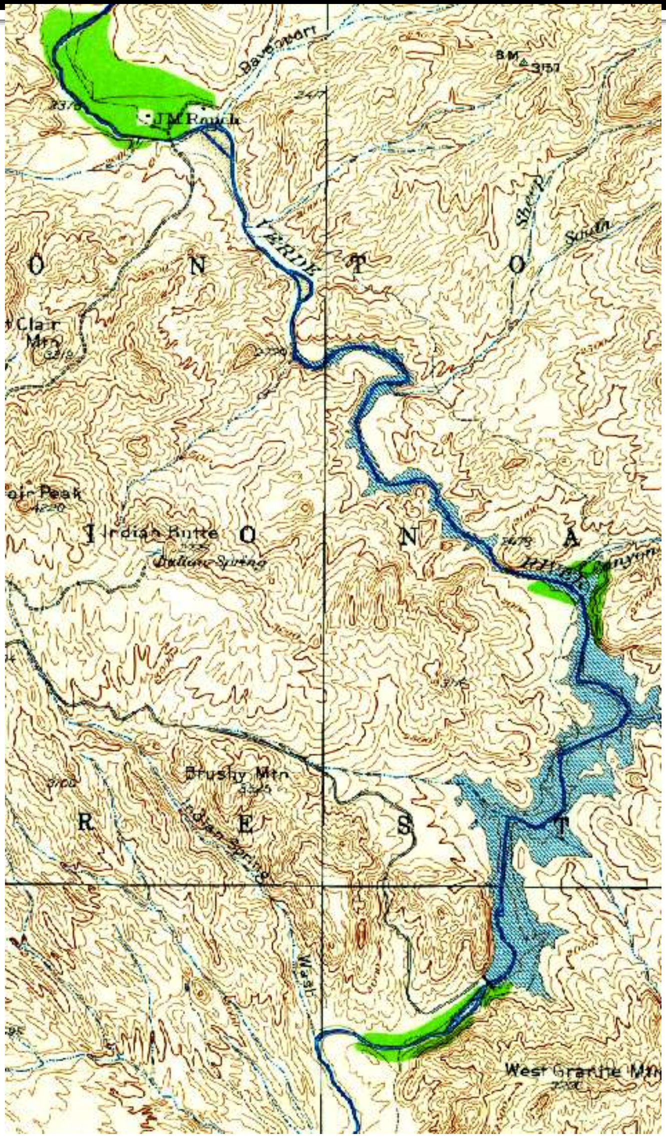
Historical Maps: Segment 4

USGS Topographic Maps

Turret Peak, AZ Quadrangle, 1929

- Verde River mostly shown as single channel
- Solid line
- Channel in same location as 2014
- No rapids listed on map
- Some ford crossings
- Trail along river downstream of Fossil Springs
- Communities:
    - OK Ranch (@ East Verde)
    - JM Ranch (d/s Lime Creek)

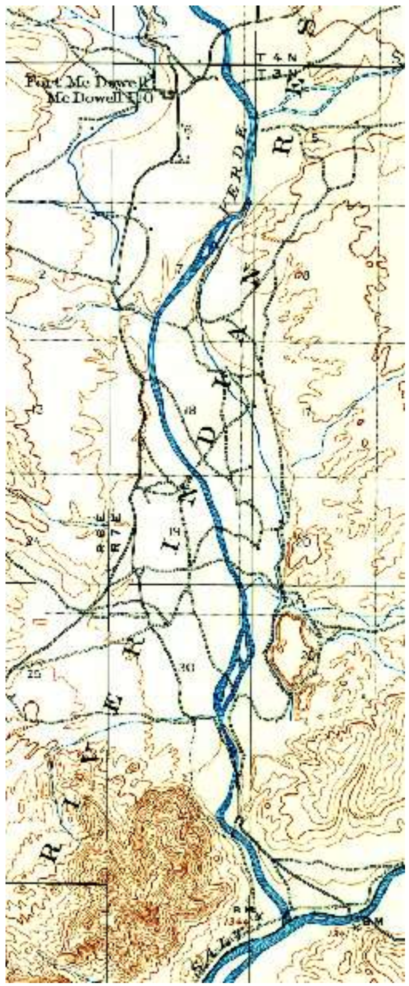
Historical Maps: Segment 4



USGS Topographic Maps
Cave Creek, AZ Quadrangle, 1930

- Verde River mostly shown as single channel
- Solid line
- Channel in same location as 2014
- No rapids listed on map
- Some ford crossings
- Trail along river downstream of Fossil Springs
- Communities:
  - OK Ranch (@ East Verde)
  - JM Ranch (d/s Lime Creek)

Historical Maps: Segment 5



USGS Topographic Maps

Ft. McDowell, AZ Quadrangle, 1904

- Verde River mostly shown as single channel
    - Some double channels
- Irrigation canals
- Main channel shift 1904 to 1930
- Main channel shifts 1904 to 2014
- No rapids listed on map
- Several ford crossings
- Communities:
    - Asher's Ranch
    - Ft. McDowell

Historical Photographs

Historical Photographs

Historical Photographs

Library of Congress: Ruins of Village #20, with Verde River & Fort Verde in Distance
Photo #cph.3c24167. Date: 1884-1887. Photographer: EA Means

Historical Photographs

AZ Memory Project. Verde River in Yavapai County
Photo #4515. Date: 1900 ca. Photographer: TH Bate

Historical Photographs

AZ Memory Project. Verde River – looking upstream at proposed Bartlett Dam site.
Photo #612. Date: 1932. Photographer: Unknown.

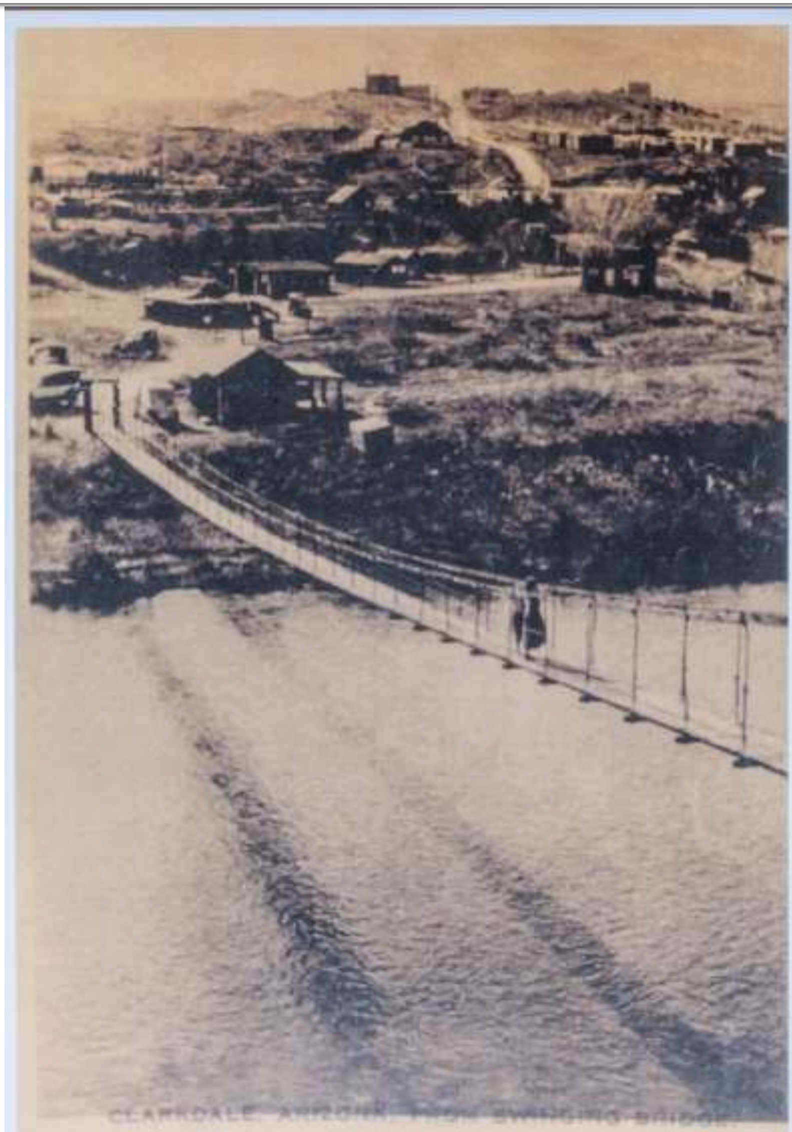
Historical Photographs

Ft. Verde Soldiers in boat on Verde, ca. 1885.
Source: Ft. Verde Historic Park

Historical Photographs

Verde River @ Clarkdale, March 1914
Source: Verde River Institute

Historical Photographs



Footbridge over Verde @ Clarkdale
Source: Verde River Institute

Historical Photographs

Historical Photographs

Historical Photographs

Historical Photographs

Historical Photographs

Historical Photographs

Historical Photographs

Historical Photographs

Historical Boating Accounts

- Cavalry Troops @ Ft. McDowell (1868)
  - Segment 5
  - Raft used as ferry during high flow
  - First raft capsized

Source: Schreier, 1987

- Troops at Ft. Verde (ca. 1878)
  - Segment 2
  - Boat used as ferry during high flow

Source: ASLD, p. 8-3

Historical Boating Accounts

- N. Willcox & Dr. G.E. Andrews, February 1883
  - Segment #5
  - Canvas skiff
  - Pleasant except for rain while camping
  - Fort McDowell to Barnum's Pier (Salt River Canal)

Sources: AZ Gazette, 2-14-1883

Historical Boating Accounts

- Camp Verde: Collapsible US Army Boat ~1887
  - Segment 2
  - Used to take couriers across Verde during high water

- Soldiers in a Boat (1885)
  - Segment 2
  - 10 miles downstream of Camp Verde
  - Row boat – possible canvas

Sources: ASLD Report, 3-20
Ft. Verde Historical Park

Historical Boating Accounts

- Major E.J. Spaulding, December 1888
  - Segment #5
  - Ft. McDowell to Mesa Dam (on Salt River)
  - Canoe – 2 men
  - One boater killed by accidental gun discharge during portage over dam
  - No boating problems reported

Sources: Phoenix Herald, 12-12-1888

Historical Boating Accounts

- T Carrigan (1891, Segment 1)
  - Raft built of railroad ties (“frail craft”)
  - Attempt to repair railroad track & telegraph
  - Raft fell apart trying to cross the river.

Sources: Cited in Littlefield, p. 99; Weekly Journal Miner, 3-4-1891

Historical Boating Accounts

- JK & George Day: Camp Verde to Yuma (1892)
  - Segments 2-5
  - Small boat
  - September to April
  - Trapping – "large quantity of furs"
  - 5th trip
  - Returned to Prescott by railroad
  - Plan to repeat trip next September
  - Verde: "beautiful limpid waters"

Note: Previous trips not in newspapers

Sources: Arizona Sentinel 4-2-1892

Historical Boating Accounts

- Floating Logs, May 1894
  - Lumber from Ft. McDowell post retirement
  - 300 cords of lumber placed in river
  - Scheme abandoned due to threat to Arizona Dam

Sources: The Salt Lake Herald, 5-3-1894

Historical Boating Accounts

- Willard (June 1899)
  - Segment 1
  - Boat used to construct rock dam @ Perkinsville

Source: ASLD Report, p. 8-3 citing Willard (undated)

Historical Boating Accounts

- Ralph Palmer (winter 1903)
  - Segment 2
  - 16 miles on the river
  - Steel boat
  - Duck hunting
  - Hauled boat upstream via wagon
  - Horse trained to return the wagon

Sources: ASLD Report, p. 3-21 citing Palmer, 1979

Historical Boating Accounts

- Hooker, Cox, Smith & Miller (April, 1905)
  - Segments 3-6
  - Two iron boats, Third boat – Mr. Armstrong (alone)
  - Started on May 21, 1905 (Sunday)
  - Planned on 7 day trip, Jerome to Phoenix
    - Fishing & hunting
  - Mentions plan for rapids, portages, "no special danger"
  - Three people gave up
    - Low water downstream of Camp Verde
    - Boat was too heavy

Sources: Arizona Silver Bulletin, 4-27-1905; Bisbee Daily Review, 5-26-1905; Weekly Journal Miner, 5-24-1905

Historical Boating Accounts

- Fogel & Gireaux (February 1931)
  - Clarkdale to Ft. McDowell
  - Five week trapping trip
  - Flat bottomed boat

Source: ASLD Report, p. 3-21 citing Verde Copper News, 2-6 & 2-20-1931

- Segment 3 (1910-1920)
  - "Boats used in the Verde Valley from 1910-1920 needed to be emptied of cargo to pass the rapids downstream of Camp Verde"

ASLD, p. 8-3

Historical Boating Accounts

- Recollections of Boating
  - Jim Byrkit/Historian:
    - Segment 3: Floating logs to build lodge (1958)
  - Bob Munson/Historian:
    - Mountain men may have used canoes on Verde
    - 1880's collapsible boat used at Ft. Verde
  - Betty Tome/Historian:
    - Ft. Verde soldiers used fishing boat

Sources: ASLD Report, Chapter 4

Historical Boating Accounts

- Successful or Failed Boating?
  - Definition of Success:
    - Boat, Passengers, Cargo Arrive
  - Definition of Failure:*
    - Death or Serious Injury
    - Cargo Lost, Not Recovered
    - Boat Destroyed, Not Repairable
    - Trip not Completed

*Note: All of these "failures" can and do occur on navigable rivers like the Mississippi or Colorado.

Historical Boating Accounts

- Successful or Failed Boating?
  - Not Failure:
    - Difficulty or Problem Resolved During Trip
    - Flip in a Small Boat
    - Occasional Lining or Portaging Around an Obstacle
    - Temporarily Stuck on a Sand Bar
    - Modifying the Boat to Fit Conditions
    - Being Described as "Daring" or "Adventurous" or …

Historical Boating Accounts

- Were Historical Boating Episodes Successful?
  - No deaths
  - No injuries
  - Boats reached destination, except 1905
  - Several accounts indicate repeated boating
  - No accounts of actual problems with rapids, portages, beaver dams, etc.
    - Shallow water was problem for 1905 trip in iron boats
- Conclusion: Historical boating was successful.

Historical Boating Accounts

- Typical Trade/Travel Uses ca. 1912
  - Hauling Goods
  - Hauling Passengers
  - Military
  - Ferries
  - Fishing
  - Trapping/Hunting
  - Travel

Boat Types Used		
Steamboat	Flatboat	Canoe
		√
	√	√
	√	
	√	√
	√	√
	√	√
	√	√

Historical Boating Accounts

Segments Boated Historically					
Boat Type	**1**	**2**	**3**	**4**	**5**
Steamboat					
Ferry		X			X
Raft	X				X
Flatboat	X	X	X	X	X
Canoe		X	X	X	X
Floating Logs		X			*

Historical Boating Accounts

- Summary of Historical Boating
  - Flow Rates: Normal, Expected Range
  - Manmade & Natural Obstacles
    - Depleted flows (not actually mentioned in accounts)
    - Irrigation diversions
  - Purpose: Travel, Trapping, Exploration, Hunting
  - Downstream Travel
  - Small, Low-Draft Boats
  - Success v. Failure
    - ~Seven down river accounts
    - All but one trip reached destination

Beaver Dams on the Verde

- Currently:
  - No Beaver Dams Downstream of Perkinsville
- Historical:
  - Accounts of Beaver Dams in Segments 1, 2 & 5
  - Boating Accounts Don't Mention Beaver Dams
  - Trappers & Beaver Dams
- Beavers Dams are Not Obstructions
  - Easily Crossed in Canoe
  - Also Can Be Run or Portaged

Geology: Key Factors

- Channel Pattern
  - Compound Channel
  - "Everywhere along the river, a low-flow channel exists that conveys perennial base-flow discharges. Low-flow channels typically are a few feet deep or less and 50 to 200 ft. wide"   p. 5-6, ASLD Report
  - "Low-flow channels of the Verde River are invariably located within a much larger channel that is shaped by annual and large floods." p. 5-6, ASLD Report
  - Pool/Riffle Pattern
    - Sinuous single channel (> 95%)
    - Local braiding at some riffles

Geology: Key Findings

- Channel Change
  - 1891 Flood – largest in 1,000 years
  - GLO Surveys after 1891 mapped the flood channel
  - Flood Channel had minimal change in character
  - P. 5-16. GLO surveyor notes (1870's)
    - Didn't describe any marshy land along the river corridor
    - No reaches of poorly defined low flow channel
    - Conflicts with historical recollections

Geology: Key Findings

- Channel Conditions
  - Continuous low flow channel (p. 5-15)
  - GLO Survey Notes 1873/1877 (Segment 3)
    - Depth: ~ 2 ft. (average of 3 ft.)
    - Width: 50-100 ft.
  - GLO Survey Notes 1911 (Segment 6)
    - Depth: 1-4 ft.
    - Width: 180-360 ft.

Geology – Other Factors

- Waterfalls: None
- Rapids: Boulder riffles, some bedrock
  - Mostly Class I-II, Some III
- Perennial Stream: Spring fed
- Gaining stream: Segments 1-4
- Losing stream: Segment 5
- Sand Bars: some in Segment 5
  - Most navigable rivers have bars

Hydrology: Key Findings

- Flow Rate Data Provided in ASLD Reports
  - Pre- and Post-Statehood
  - Mean, Monthly, Median, Range
  - Seasonality of Runoff
  - Floods & Droughts (Rare, Not Ordinary)
  - Estimates from Multiple Sources
  - Primary Reliance on Modern USGS Gage Data
    - 1800's-Present

Verde River Hydrology

- Nature of Flow Data Provided
  - Mean vs. Median
    - Both were/are provided
    - Mean is more commonly used
    - Median more reflective of "ordinary" condition on Verde
  - Seasonal Variation
    - Occurs Within Predictable, Ordinary Range
    - 10-90% Range Presented
    - Seasonal Variation Normal on Navigable Rivers
      - Ice, Low/High Flow, Flood Season

Verde River Hydrology

- Nature of Flow Data Provided
  - Floods & Droughts
    - All Rivers Experience Floods & Droughts
    - Floods & Droughts Are Rare
      - i.e., not “Ordinary”
    - Irrelevant to Determination of Navigability

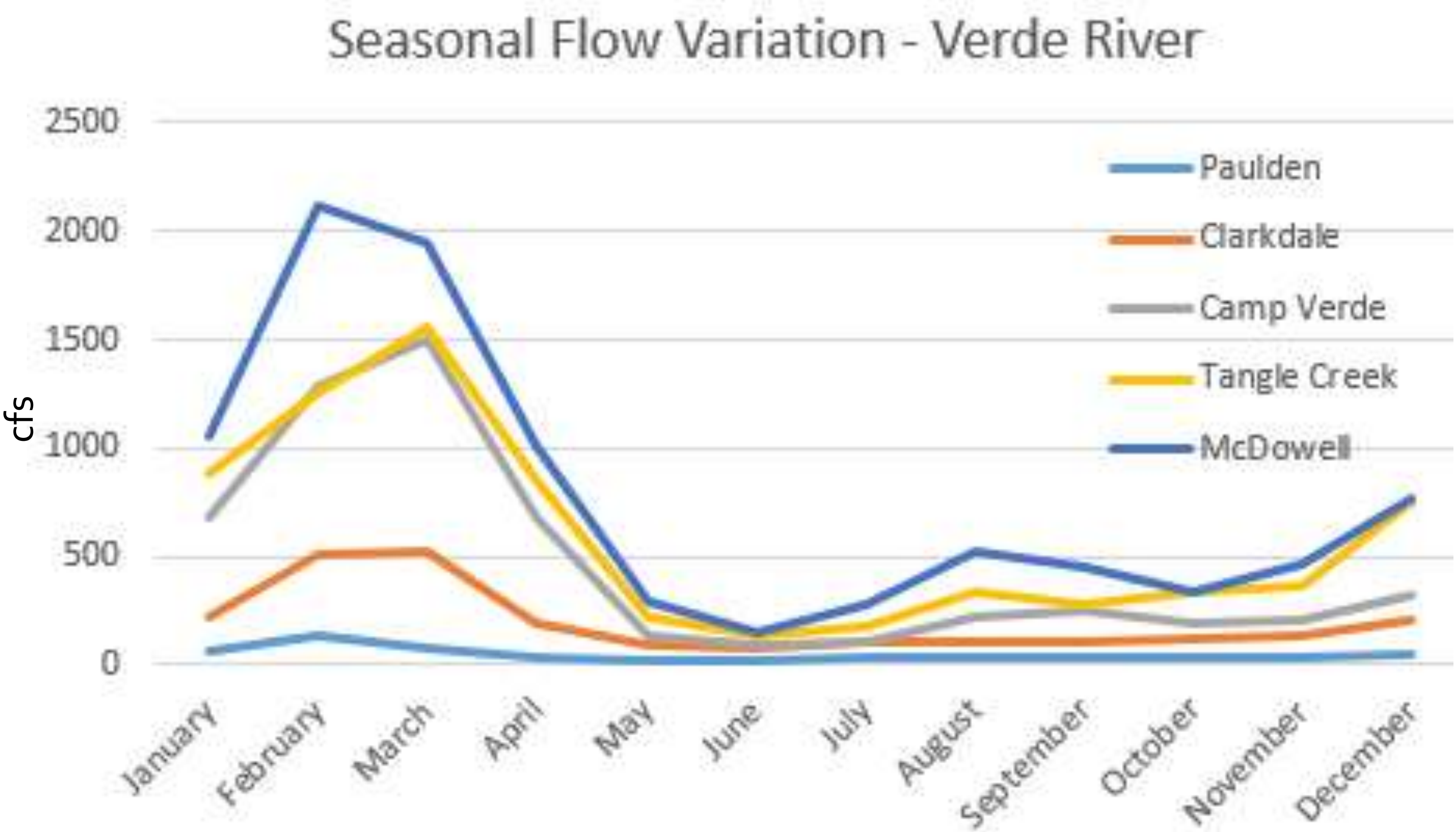
Verde River Hydrology

- Reliability of Flow Data Cited
  - Best available
  - Based on actual measurements
  - Routinely used for court decisions
  - Routinely relied on for:
    - Water Supply
    - Water Rights
    - Recreational Boating Permitting

Hydrology: Key Findings

Long Term Flow Estimates Based on USGS Gauge (Pope et. al., 1998)					
Gage Station	**Segment**	**Flow Rate (cfs) Avg Annual**	**Flow Rate (cfs) Median**	**Flow Rate (cfs) 90%**	**Gage Period**
Paulden	2	42	26	22	1964-1996
Clarkdale	3	197	86	70	1916-1920 1966-1996
Camp Verde	4	465	188	82	1935-1945 1989-1996
Tangle Creek	5	591	240	123	1946-1996
McDowell	6	781	-	-	1889-1939
Note: All flow rates are for post-statehood, depleted flow conditions.					

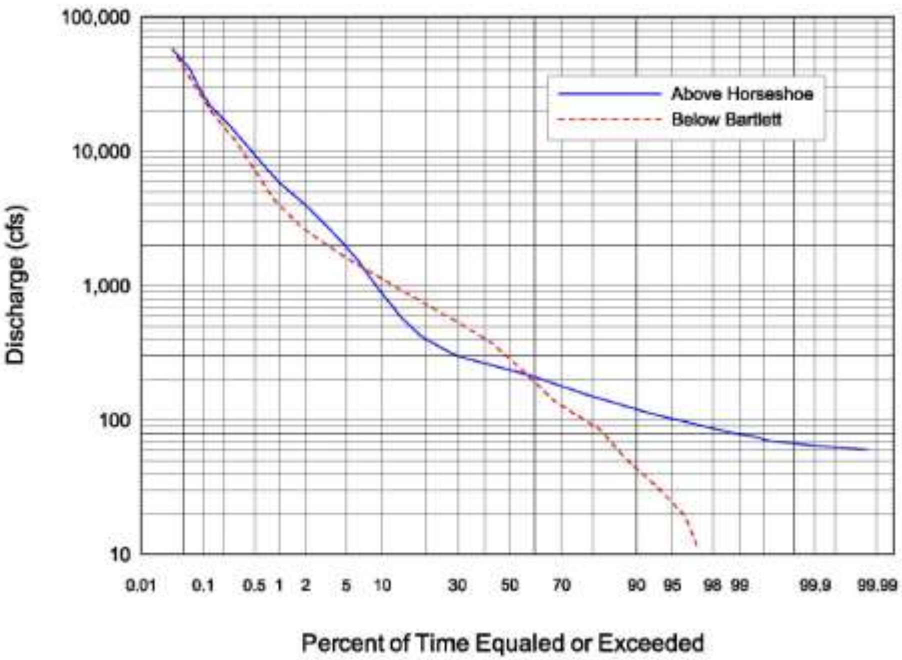
Verde River Hydrology

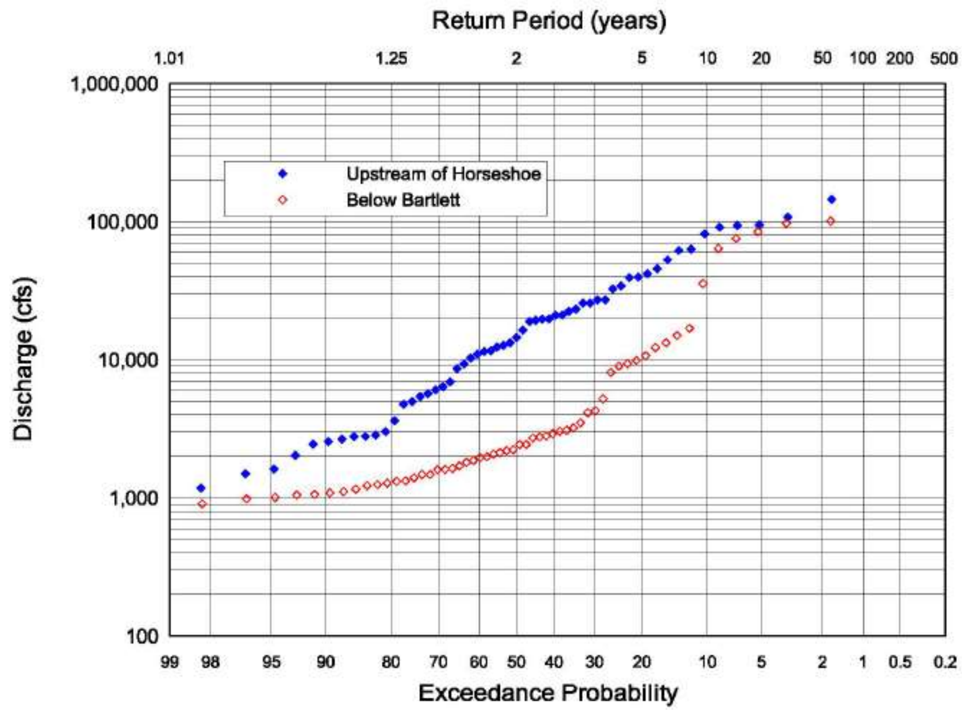


Verde River Hydrology

- Impacts of Dams & Diversions
  - Upstream of Major Reservoirs
    - Irrigation Diversions diminish ordinary low flows
    - Minimal impact on floods
  - Downstream of Major Reservoirs
    - Ordinary Flow Conditions
      - Decrease duration of low flows and high flow, increase mid-flows
      - Lower winter and spring flows (storage in reservoirs)
      - Higher late spring & summer flows (releases for water supply)
      - Minimal change to fall flows
    - Floods:
      - Decrease size of frequent floods (2- to 5-year)
      - Less impact on large floods (> 10-year)

Verde River – Dam Impacts



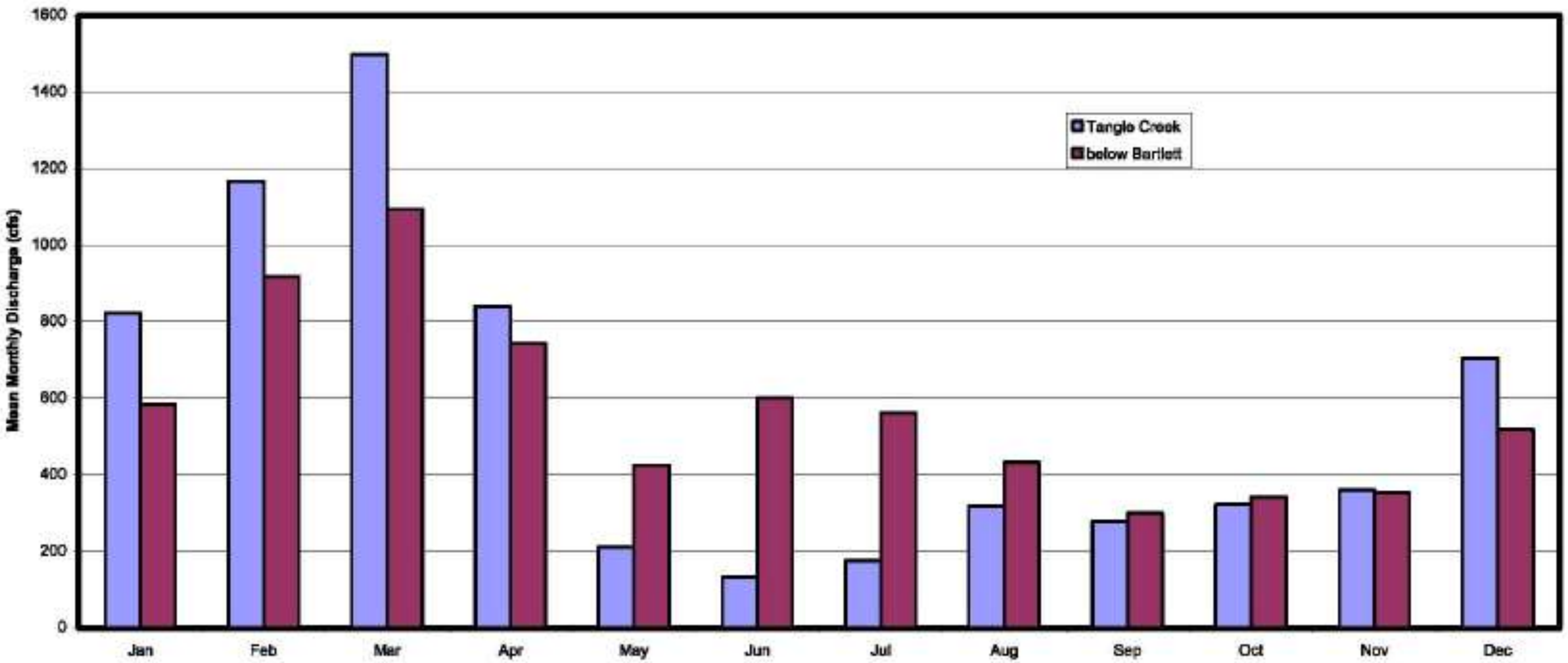


Change in Flow Duration Due to Dams

Change in Flood Magnitude Due to Dams

Source: MEI, 2004

Verde River – Dam Impacts



Change in Average Monthly Flow Rates Due to Dams

Verde River Hydrology

- Summary
  - Best Available Data
  - Flow is Predictable
  - Flow is Reliable
  - Flow is Perennial
  - Flow is Significant
    - Late Winter/Spring Flows Ordinarily Highest

Verde River Rating Curves

- Rating Curves: Flow Depth & Width
  - From USGS Rating Curves & Field Sections
    - Historical & Recent Field Data
  - Representative of Segments
  - Actual Measurements & Observations
  - Consistent with Historical Observations

Verde River Rating Curves

Verde River: Rating Curve – Paulden (Segment 1)				
Flow Frequency	**Flow Rate (cfs)**	**Average Depth (ft)**	**Average Velocity (ft/s)**	**Top Width (ft)**
90%	22	0.8	1.0	25
50% (median)	25	0.9	1.2	25
10%	31	1.0	1.4	25
Mean Annual	42	1.2	1.7	26

Source: Table 7-8b, ASLD Report

Verde River Rating Curves

Verde River: Rating Curve – Clarkdale (Segment 2)				
Flow Frequency	**Flow Rate (cfs)**	**Average Depth (ft)**	**Average Velocity (ft/s)**	**Top Width (ft)**
90%	70	1.4	2.8	19
50% (median)	85	1.5	3.1	19
10%	236	2.5	4.3	22
Mean Annual	192	2.2	4.0	21

Source: Table 7-9b, ASLD Report

Verde River Rating Curves

Verde River: Rating Curve – Near Camp Verde (Segment 3)				
Flow Frequency	Flow Rate (cfs)	Average Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	84	1.2	0.4	120
50% (median)	189	1.5	0.7	145
10%	837	2.6	1.9	170
Mean Annual	439	2.0	1.3	165

Source: Table 7-10b, ASLD Report

Verde River Rating Curves

Verde River: Rating Curve – Tangle Creek (Segment 4)				
Flow Frequency	**Flow Rate (cfs)**	**Average Depth (ft)**	**Average Velocity (ft/s)**	**Top Width (ft)**
90%	120	0.8	1.6	40
50% (median)	238	0.9	2.0	65
10%	917	1.3	2.9	150
Mean Annual	559	1.1	2.5	120

Source: Table 7-12b, ASLD Report

Verde River Rating Curves

Verde River: Rating Curve – McDowell (Segment 5)				
Flow Frequency	**Flow Rate (cfs)**	**Average Depth (ft)**	**Average Velocity (ft/s)**	**Top Width (ft)**
Lowest Month (June)	142	1.7	4.4	19
Highest Month (February)	2121	> 4	> 7	50

Source: Table 7-13, ASLD Report

Verde River Rating Curves: Segment 0

- Not Boatable by 1912-Era Watercraft
  - Insufficient Flow
  - Non-Conducive Channel Conditions
    - Extremely bouldery

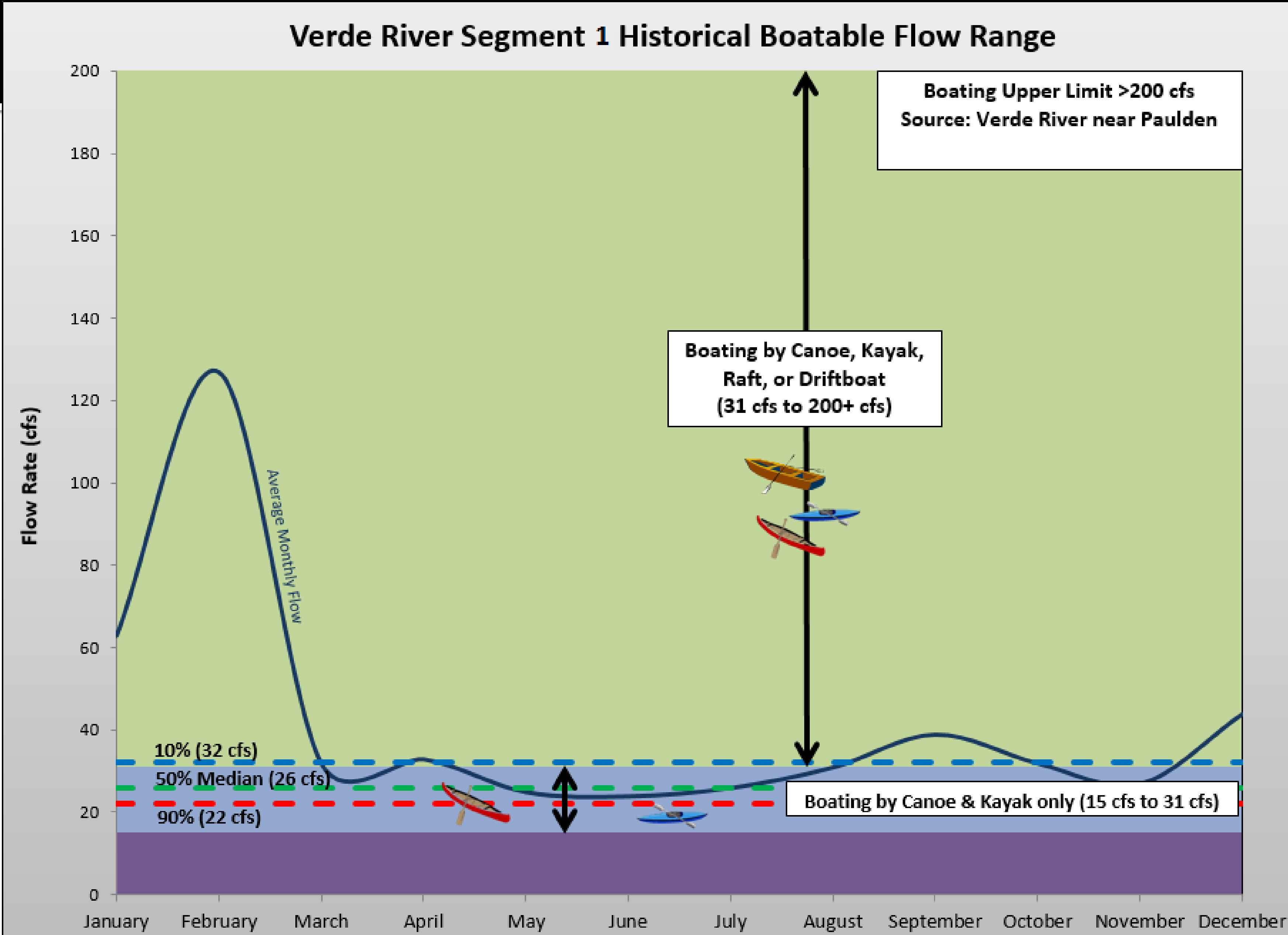
Verde River Segment #0

- Modern Boating
  - Rarely Boated
    - Very difficult access
    - Challenging channel conditions
    - Flows mostly during floods
- Changes Since Statehood
  - Reduced Base Flow

Verde River Segment #0

- Summary
  - Boatable by canoes: ~0% of the time
    - Year Round (0 days/yr)
  - Boatable by flatboats: ~0% of the time
    - Seasonally (Winter, Monsoon) (0 days/yr)
  - Modern Boating
    - Very limited recreational use
    - Significant obstructions
  - Ordinary & Natural Condition
    - Similar to existing condition

Verde River Rating Curves: Segment 1



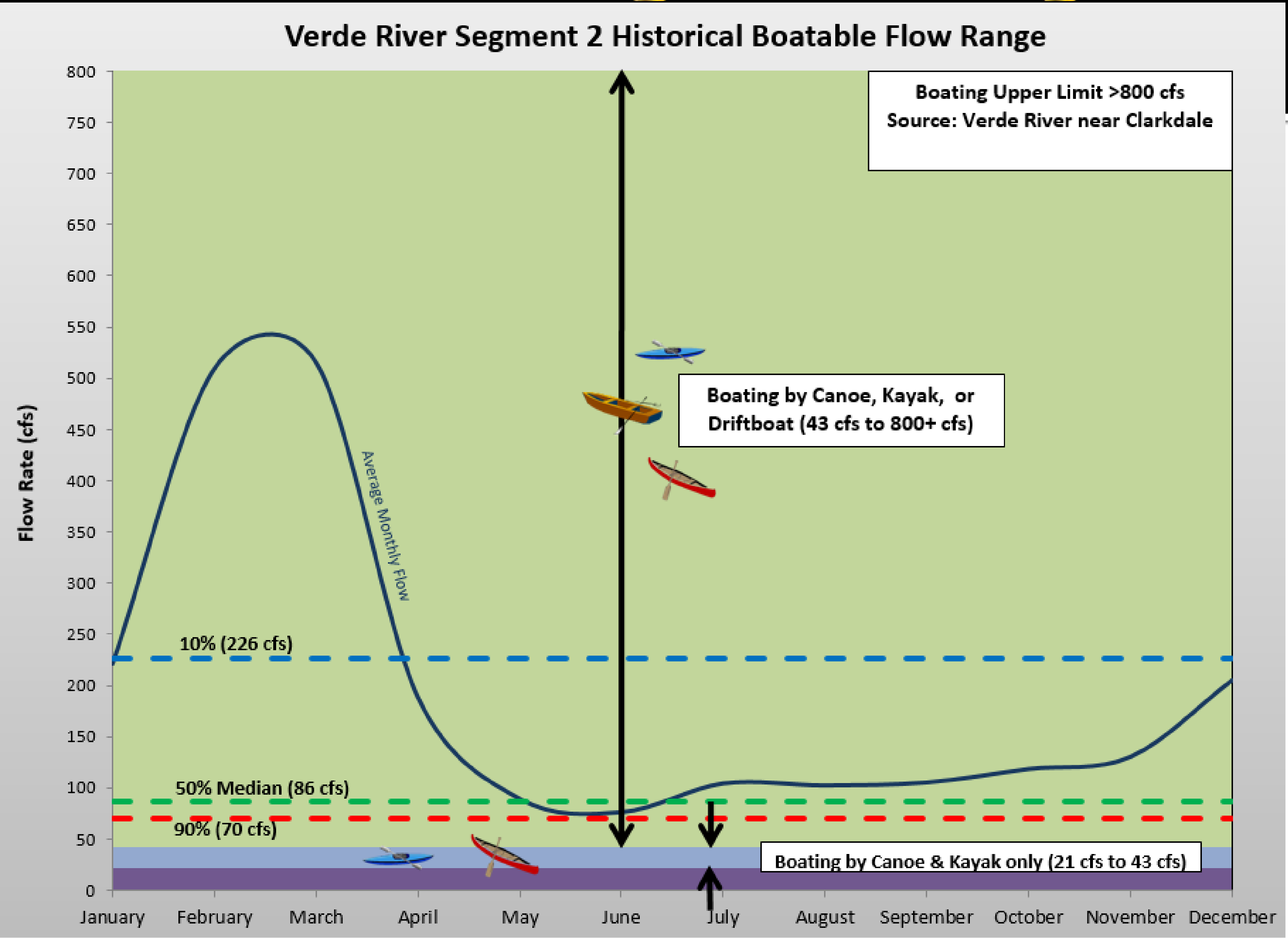
Verde River Segment #1

- Modern Boating
  - Boated for Recreation
    - Access available at FS 638 & downstream
    - Low water boating
    - Reliable flows
- Changes Since Statehood
  - Reduced base flow from ground water pumping

Verde River Segment #1

- Summary
  - Boatable by canoes: ~99% of the time
    - Year Round (360 days/yr)
  - Boatable by flatboats: ~30% of the time
    - Seasonally (Winter, Monsoon) (110 days/yr)
  - Modern Boating
    - Recreational, low water boating
  - Ordinary & Natural Condition
    - Similar to existing condition
    - Minor diversions, fences

Verde River Rating Curves: Segment 2



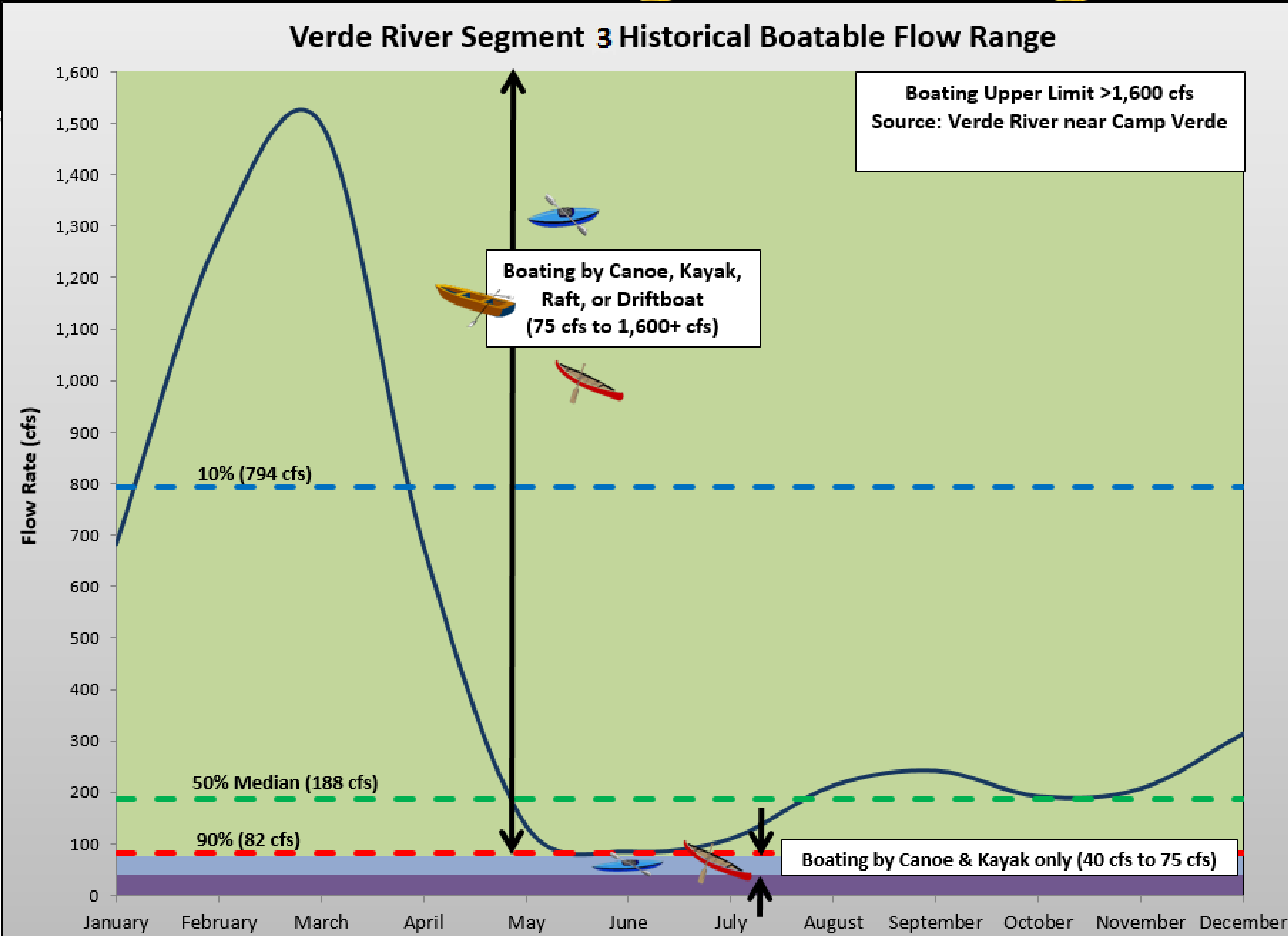
Verde River Segment #2

- Modern Boating
  - Boated for Recreation
    - Verde River Greenway
    - Verde River Canoe Trail
    - Year-round boating
    - Reliable flows
- Changes Since Statehood
  - Reduced base flow
  - Fences, encroachment, mining, roads, diversion dams

Verde River Segment #2

- Summary
  - Boatable by canoes: ~99% of the time
    - Year Round (360 days/yr)
  - Boatable by flatboats: ~85% of the time
    - Seasonally (Winter, Monsoon) (310 days/yr)
  - Modern Boating
    - Very frequent recreational boating
    - Commercial river guiding & rentals
  - Ordinary & Natural Condition
    - Deeper flow, similar channel characteristics
    - Major diversions, fences, encroachment

Verde River Rating Curves: Segment 3



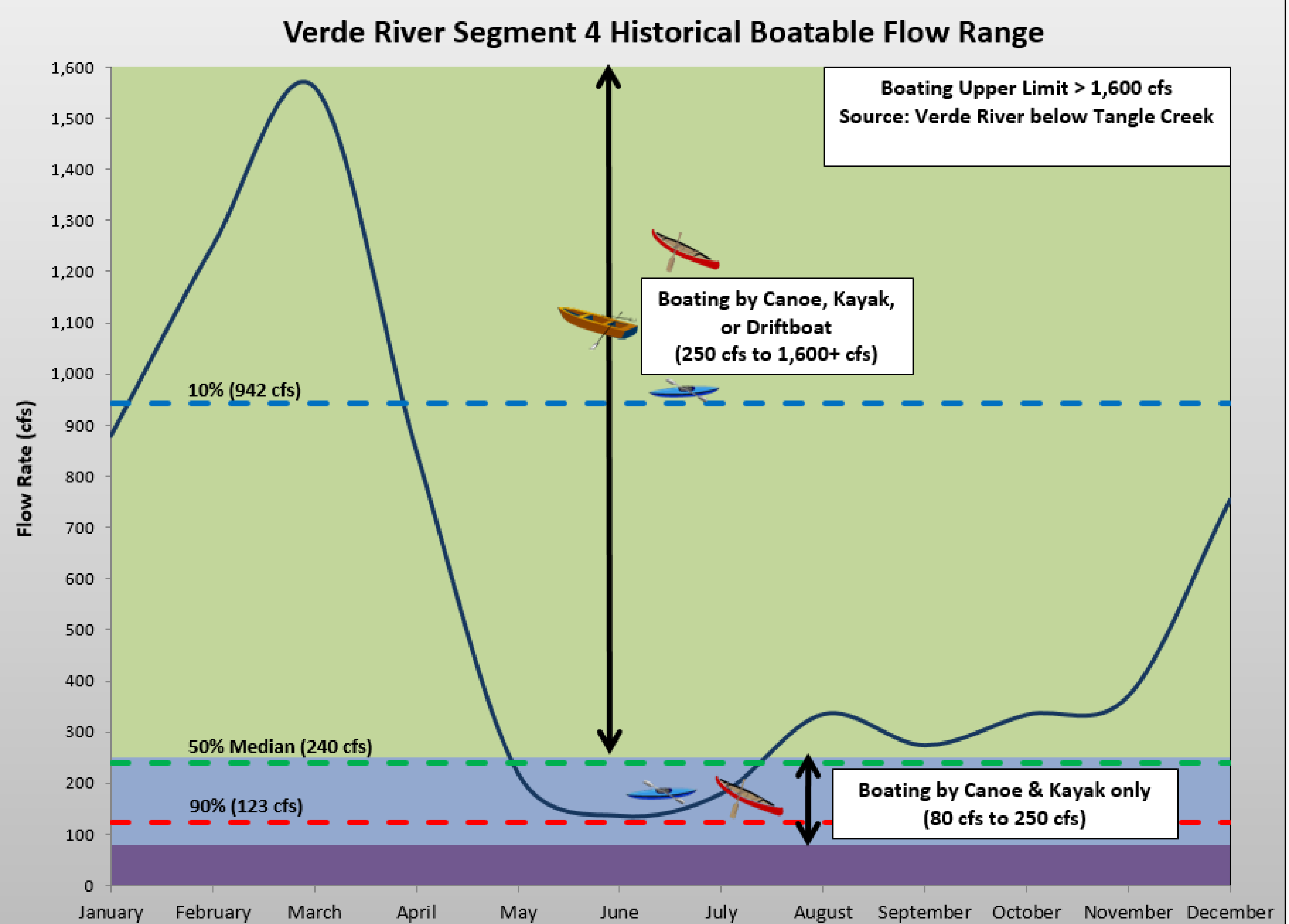
Verde River Segment #3

- Modern Boating
  - Boated for Recreation
    - Wild & Scenic Designation
    - Whitewater Reach
    - Reliable flows
- Changes Since Statehood
  - Reduced base flow

Verde River Segment #3

- Summary
  - Boatable by canoes: ~99% of the time
    - Year Round (360 days/yr)
  - Boatable by flatboats: ~80% of the time
    - Seasonally (Winter, Monsoon) (290 days/yr)
  - Modern Boating
    - Recreational boating
    - Some commercial guiding & rafting
  - Ordinary & Natural Condition
    - Similar to existing condition

Verde River Rating Curves: Segment 4



Verde River Segment #4

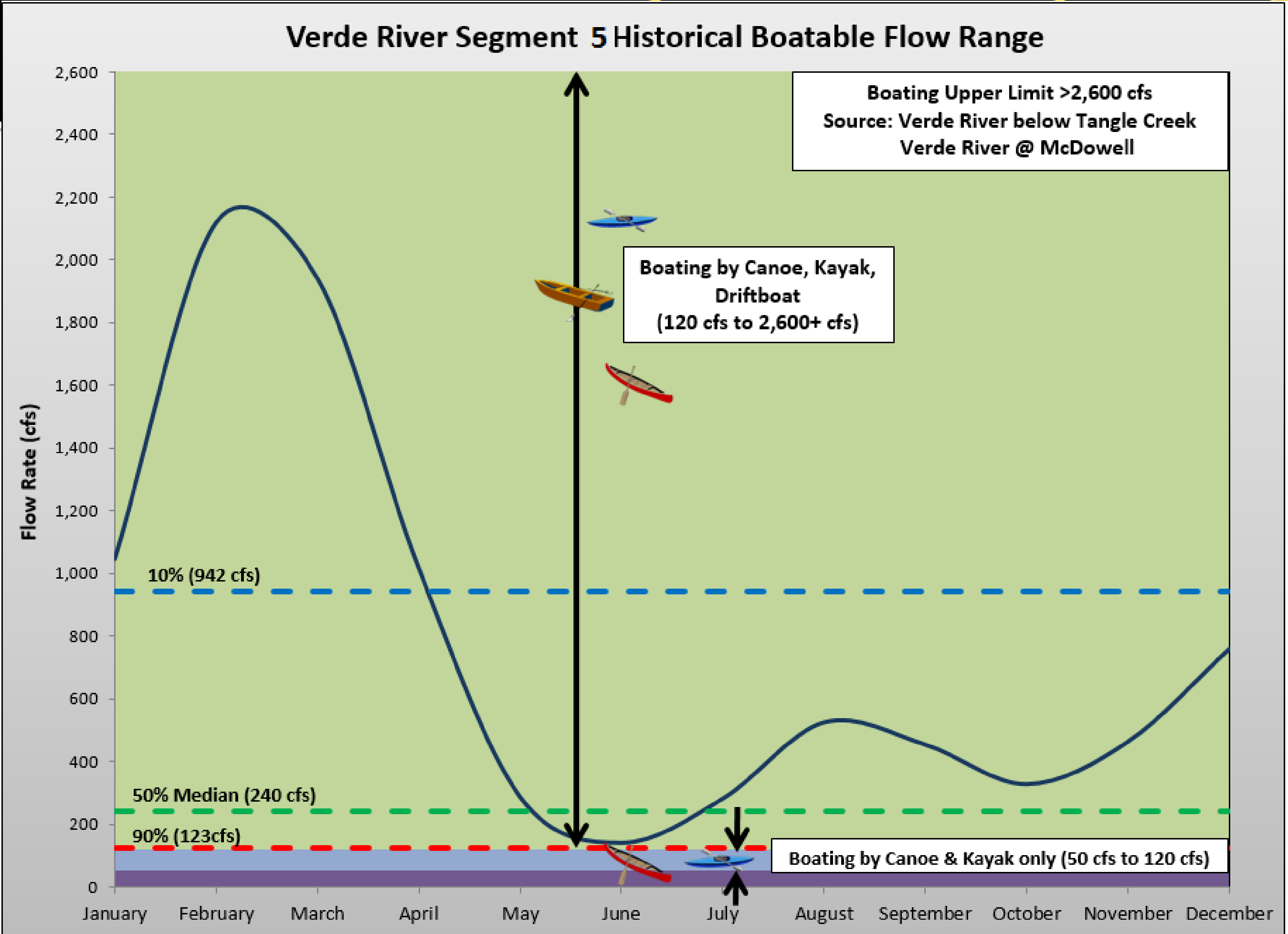
- Modern Boating
  - Boated for Recreation
    - Wild & Scenic Designation
    - Limited Access
    - Reliable flows

- Changes Since Statehood
  - Reduced base flow
  - Altered hydrology below major water supply dams

Verde River Segment #4

- Summary
  - Boatable by canoes: ~99% of the time
    - Year Round (360 days/yr)
  - Boatable by flatboats: ~90% of the time
    - Seasonally (Winter, Monsoon) (330 days/yr)
  - Modern Boating
    - Recreational boating
    - Some commercial guiding & rafting
  - Ordinary & Natural Condition
    - Similar to existing condition to Horseshoe Reservoir
    - Flow altered by dams below Horseshoe Reservoir

Verde River Rating Curves: Segment 5



Verde River Segment #5

- Modern Boating
  - Boated for Recreation
    - Primarily during dam releases

- Changes Since Statehood
  - Reduced base flow (seasonally)
  - Reduction of some flood peaks
  - Altered seasonal hydrograph due to major dams
  - Diversions, mining in floodplain
  - Other human impacts

Verde River Segment #5

- Summary
  - Boatable by canoes: ~99% of the time
    - Year Round (360 days/yr)
  - Boatable by flatboats: ~90% of the time
    - Seasonally (Winter, Monsoon) (330 days/yr)
  - Modern Boating
    - Recreational boating
    - Some commercial guiding & rafting
  - Ordinary & Natural Condition
    - Depleted & regulated flow, man-made obstructions

Modern Boating

- Recreational
  - Segments 1-5
- Commercial Recreation
  - Segments 2-5
  - Guided River Trips (Segments 3-5, Seasonal)
  - Kayak Rental (Segment 2)

Modern Boating

- Paddler Club Survey Results
  - All of Segments 1-5 boated
  - Minimum flows
    - Segment #1: 20 cfs
    - Segments #2-4: 44 cfs
  - "Verde River is navigable"

Modern Boating

- Previous ANSAC Testimony
  - Jim Slingluff, Author
  - John Colby, Professional Boater

Modern Boating

- Commercial Uses
  - Game & Fish Surveys (Segments 1-5)
  - Kayak Rental
  - USFS Permit Commercial Rafting & Boating
  - Shuttle Services
  - Tourism

Modern Boating

April 1, 2000:	450 cfs
March 31, 2001:	204 cfs
March 30, 2002:	148 cfs
March 29, 2003:	346 cfs
March 27, 2004:	145 cfs
April 2, 2005:	451 cfs
April 1, 2006:	179 cfs
March 31, 2007:	144 cfs
March 29, 2008:	550 cfs
March 28, 2009:	162 cfs
March 25, 2010:	1,260 cfs

April 1, 2000:	18 boats & 27 racers;
March 31, 2001:	40 boats & 65 racers
March 30, 2002:	52 boats & 79 racers
March 29, 2003:	88 boats & 124 racers
March 27, 2004:	114 boats & 171 racers
April 2, 2005:	94 boats & 142 racers
April 1, 2006:	88 boats & 118 racers
March 31, 2007:	133 boats & 185 racers
March 29, 2008	147 boats & 210 racers
March 28, 2009:	182 boats & 256 racers
March 27, 2010:	canceled due to high water

2011 Verde River Canoe Challenge Information

**REGISTRATION IS CLOSED FOR THE 2011 VRCC.
WE HAVE REACHED THE 200 PARTICIPANT LIMIT FOR THE EVENT.**

River Difficulty: Novice, Class I, II, & III (depending on water level)

Segment 2 – Verde River Race Pix

Jon Fuller
October 31, 2008

Sam & me in the Verde River Race 2007 (Rogue)

Share

2 people like this.

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Macy's Home Sale
macys.com

Get comfy! Save 20-50% on home goods at Macy's Semi-Annual Home Sale.

Jon Fuller
October 31, 2008

Sam & me in the Rogue at West Clear Creek RAP on the Verde

Share

Jay Bouwkamp likes this.

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The Apple Xchange offers Pre-Owned Apple Computers, Devices, Upgrades and Service.

Modern Boating

- Verde RiverFest
- Verde River Days
- Verde River Runoff

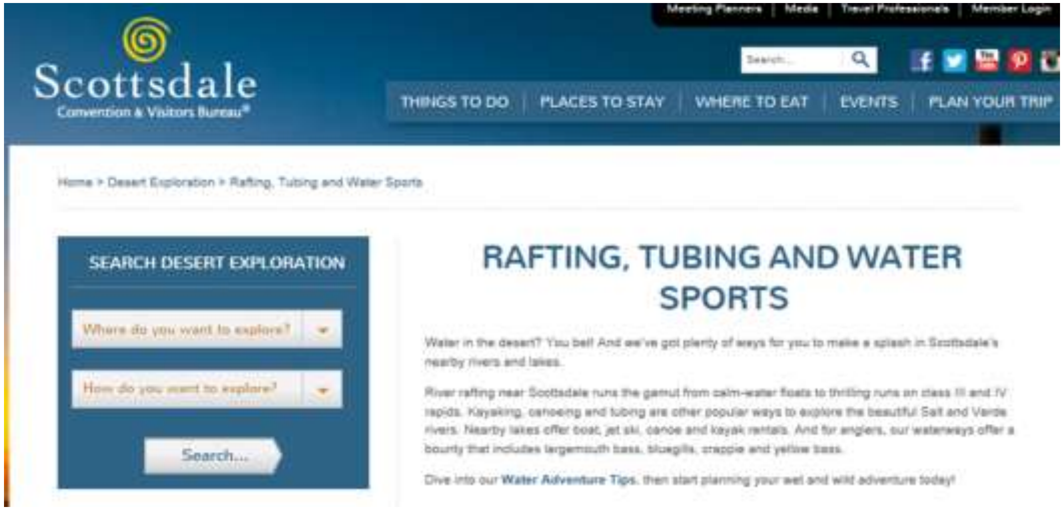
Modern Boating: Guided Trips

New Guided Trip on the Verde River at Clarkdale

We also offer guided trips on the Lower Verde River.

Sedona Adventure Tours, Arizona Outback Adventures, Verde Valley Kayak Rentals

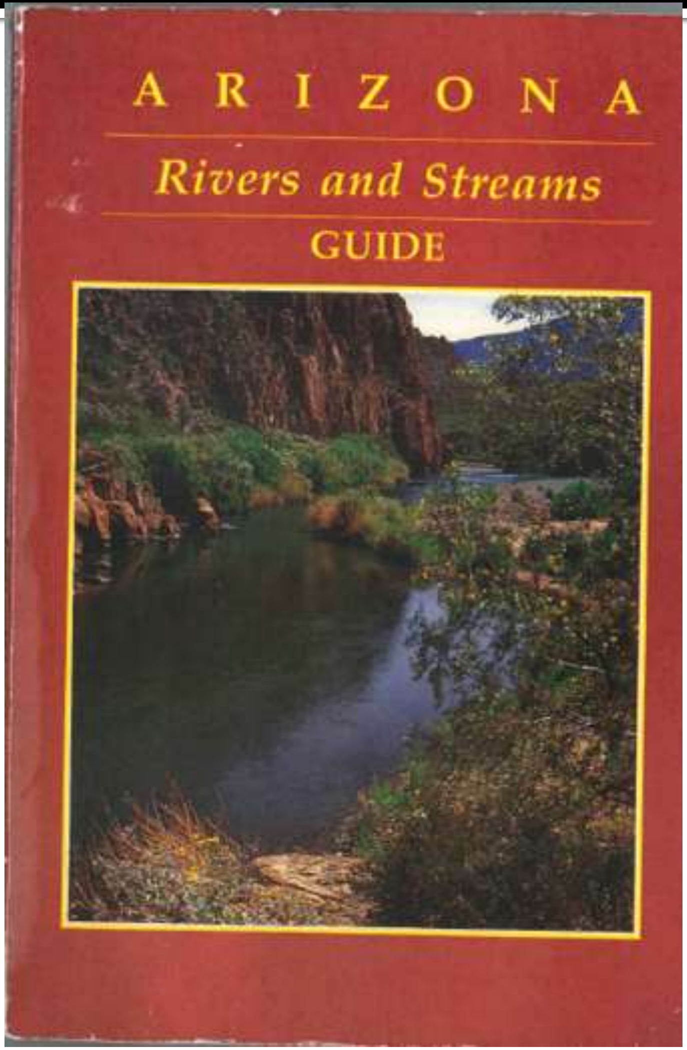
Modern Boating: City Websites



City of Sedona
City of Scottsdale
Town of Camp Verde
Town of Clarkdale
Town of Cottonwood

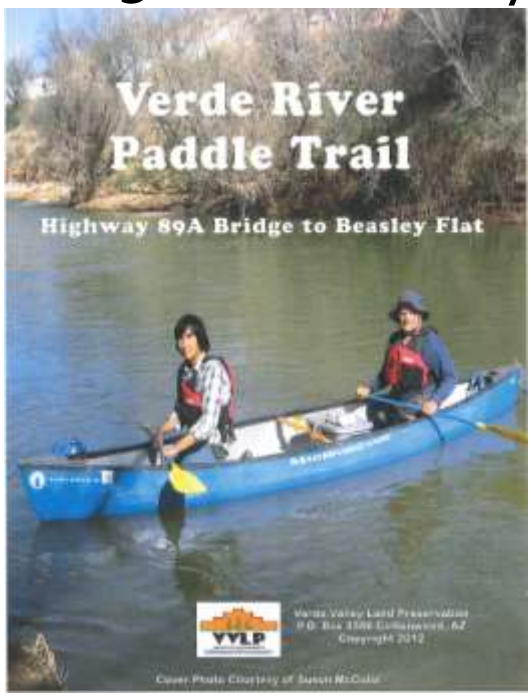
Modern Boating Guides

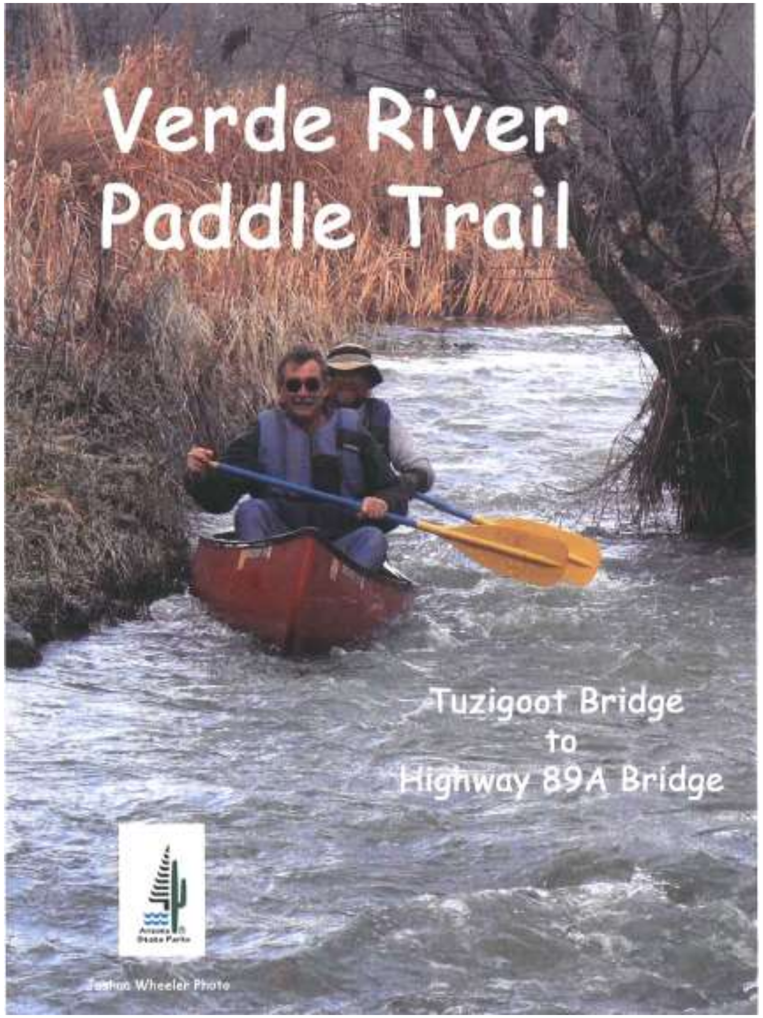
- Arizona State Parks
  - Perkinsville to Salt River
  - Class I-III



Modern Boating Guides

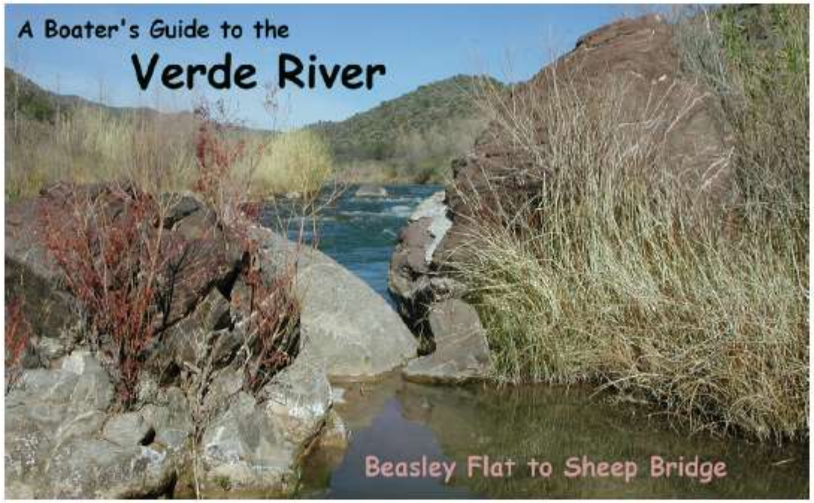
- Arizona State Parks
  - Tuzigoot to SR89A
  - SR89A to Beasley Flat



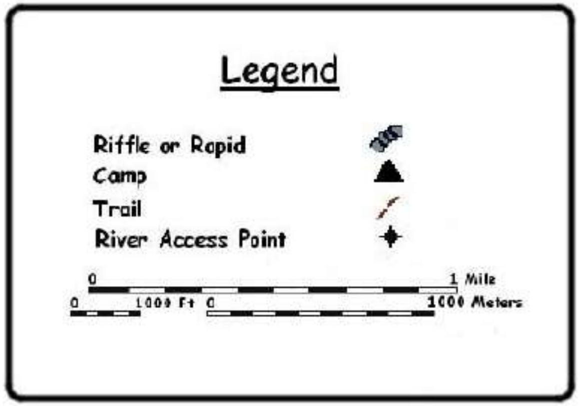


Modern Boating Guides

- US Forest Service
  - Boating Guides
  - River Ranger
  - Sign-In Register Counts



In 1984 the Wild and Scenic Rivers Act established the portion of the Verde River from Beasley Flat downstream to the confluence with Red Creek, as Arizona's only Wild and Scenic River. While it may appear calm at many of the river access points, the large number of wrecked canoes that have been removed from the Verde River testify to the fact that it has its share of hazards. Please plan ahead, be prepared, and practice Leave No Trace ethics to leave the Verde just as you find it for those who come after.



Modern Boating: Websites

- Websites
  - Southwest Paddler.com
  - Rafting-Arizona.net
  - Mild to wild.com

Modern Boating

- Boat Types Typically Used
  - Canoes
  - Kayaks
  - Inflatable Rafts
  - Rowboats
- Comparison to Historical Boats
  - Similar in Draft & Design
  - Improved Durability
  - Meaningfully Similar

Modern Boating

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Conclusion:
Lessons from the Colorado River

- Colorado River is Affirmed to be Navigable
  - A.R.S. §§ 37-1123.A
  - Arizona v. California, 283 U.S. 423 (1931)

Conclusion:
Lessons from the Colorado River

- Characteristics
  - Subject to Flood & Drought
    - Subject to "disastrous floods"
  - Subject to Flash Floods
  - Large Seasonal Flow Variations
    - "widely varying river…fast current in summer and minimal flow in winter"

Conclusion: Lessons from the Colorado River

- Characteristics
  - Many Rapids
  - Compound Channel, some "braiding"
  - Channel Position Changes due to Flood Erosion & Meandering
  - Sand Bars & Islands
    - "ever changing sand bars that hindered navigation"
  - Tidal bores, high tides
- Not Listed in Rivers & Harbors Act of 1899

Conclusion:
Lessons from the Colorado River

- Conclusion:
  - Those characteristics are **NOT** definitive evidence of non-navigability.
- What is evidence of non-navigability?
  - Scientific & Historical Evidence that
    - Not deep enough for boating
    - Not wide enough for boating
    - Natural obstructions prevent boating over long reaches

Conclusion

- Federal Standard for Title Navigability (Daniel Ball Test)
  - Ordinary & Natural
  - Used or Susceptible
  - Trade & Travel on Water

"Navigable" or "navigable watercourse" means a watercourse that was in existence on February 14, 1912, and at that time was used or was susceptible to being used, in its ordinary and natural condition, as a highway for commerce, over which trade and travel were or could have been conducted in the customary modes of trade and travel on water.

A.R.S. § 37-1101(5)

Conclusion

- Verde River can be boated by low draft boats
  - Downstream direction, all year
  - Historical use (limited documentation)
  - Modern use (similar draft to historical boats) demonstrates susceptibility
- Low draft boats were used for trade & travel
- Low draft boats could be used for trade & travel

- Therefore…Verde River meets the federal test for navigability.

Conclusions

- Verde River is a Navigable Watercourse
  - <u>Existed</u> in February 1912
  - <u>Was used</u> as highway of commerce
  - <u>Was susceptible to use</u> as highway of commerce
    - For <u>trade and travel</u> on water
    - By <u>customary modes</u> of travel on water

"Navigable" or "navigable watercourse" means a watercourse that was ***<u>in existence</u>*** on February 14, 1912, and at that time ***<u>was used or was susceptible</u>*** to being used, in its ***<u>ordinary and natural condition</u>***, as a highway for commerce, over which trade and travel were or could have been conducted in the ***<u>customary modes</u>*** of trade and ***<u>travel on water</u>***. **A.R.S. § 37-1101(5)**

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An Overview of Historical Beaver Management in Arizona

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ABSTRACT In the mid-1820s, Anglo-American fur trappers, known as "mountain men," entered Arizona and began trapping beaver (*Castor canadensis*). In Arizona there have been a number of famous mountain men such as Sylvester and James Pattie, Ewing Young, Jededia Smith, and Bill Williams who trapped along the waterways in northern and southern Arizona. Although the heyday of mountain men lasted only a few decades due to a population decline of beaver, management of these animals continues to this day. The purpose of managing beavers shifted from monetary gain to controlling wildlife damage. During the late 1900s, beaver were still widely distributed in limited numbers throughout much of the state. We provide a historical overview of beaver management in Arizona with emphasis on the mountain men, recreational trapping, wildlife damage management, and beaver research in Arizona.

KEY WORDS Arizona, AZGFD, beaver, beaver damage, *Castor canadensis*, fur trappers, wildlife damage management

Historically, Arizona was geographically located within three countries: Spain (1540s to 1821), the Mexican State of Sonora (1821 to 1848) and the United States (1848 to present). In 1848, the entire state north of the Gila River became the Territory of New Mexico, part of the United States. In 1854, the area south of the Gila River was purchased from Mexico in the Gadsden Purchase. It took ten years of political maneuvering before the Arizona Territory was established in 1863. Arizona achieved statehood on 14 February 1912 (Walker 1986).

Beavers (*Castor canadensis*) are the largest rodents in Arizona and are the lightest-colored of any of the North American beaver population (Hoffmeister 1986). Beavers range along most of the major streams and numerous mountain creeks within Arizona. They are also scattered along the Colorado River, especially in those places where there are cottonwoods and tuberous plants near the river (Hoffmeister 1986).

In the 1970s and early 1980s beaver were still widely distributed through much of the state, although not in abundance. They were absent from the western three-fourths of the Gila River, and from the Santa Cruz and San Pedro River. In Arizona there are several factors that affect the abundance of beaver. Limiting factors include lack of water and food (especially cottonwoods) from many streams and encroachment by humans (Hoffmeister 1986).

Spanish Explorers

From the onset of the early exploration of New Mexico, Spaniards had recognized the area's potential fur wealth. In 1540, the first procession of conquistadores to penetrate the southwest was led by Francisco Vasquez de Coronado who came in search of the

"Seven Cities of Cibola." This was a 6-month journey north from New Spain, as Mexico was then called. Coronado's journey brought him to Zuni villages. On this visit the natives presented him with buffalo hides and the skins of deer (*Odocoileus* spp.) and rabbits, long used by native Pueblos for footwear and clothing (Weber 1968).

In addition to the usefulness of furs as clothing, hides and skins were of value to the Plains and Pueblo tribes for trading for corn, cloth, and pottery (Weber 1968). Upon the completion of the first expedition, Coronado found the furs of little value and he felt they would not impress the viceroy or King, thereby halting the exploration of New Mexico for 40 more years.

During the 17th century, coarse furs from deer, elk (*Cervus elaphus*), bison (*Bison bison*), and antelope (*Antilocapra americana*) were among New Mexico's few exportable resources and were of such importance that the governors of the province entered and dominated the trade. Towards the end of the 17th century, trade in animal skins, like nearly all other economic activity in New Mexico, had come to an abrupt halt with the Pueblo Revolt of 1680. When the Spaniards returned in the early 18th century, the Apache were eager to reestablish the coarse-fur trade. The Spaniards also encouraged and traded with the Comanches and Utes. These Shoshonean people were previously unknown and had migrated south from southern Wyoming. With their linguistic cousins, the Utes, they soon displaced the Apaches in trade with the Spaniards. Between 1747 and 1749 the Utes had a falling out with the Comanches and joined the Spaniards against their now common enemy. By 1750, the Utes had become a more dependable source of furs (Weber 1968).

During the first decades of the 19th century, Spanish restrictions against trading to the northwest of New Mexico in Ute territory had loosened and the attitude toward the tribal trade had changed. After the United States acquired Louisiana in 1803, Spanish officials regarded the fur trade as essential to securing friendship of Plains tribes who could serve as a buffer against encroaching Americans.

Anglo-American Fur Trappers

The first Anglo-American trappers to set foot on "Arizona" soil were Sylvester Pattie and his son, James Ohio Pattie in 1825. In the personal narrative of James Ohio Pattie, James describes his first trip with 12 men entering Arizona and trapping a section of the Gila River. On another expedition he describes a trip on the upper branches of the Gila River; Pattie and his men claimed to have caught 250 beavers of which most were used and preserved (Patti 1831).

On 3 March 1825 Pattie described trapping along the San Pedro River, tributary to the Gila River. Due to the large number of beaver, they named it "Beaver River." During the trip from 3–20 March 1825, they collected 200 beavers and turned back to the Gila River with as much fur as their "beast" could carry (Patti 1831). In 1826, the Patties returned to Arizona along the Gila River to resume trapping. However, most of the party was killed by Native Americans. Undaunted, the Patties led another party down the Gila to the Colorado River in 1827. Here the party split up and the Patties continued on to the Pacific Coast (Patti 1831).

In 1826, Ewing Young pioneered trapping the American Southwest, leading many of the first Anglo expeditions into the mountains and watercourses of today's New Mexico, Colorado, Utah, and Arizona. Ewing Young became a successful trapper and businessman, eventually setting up a trading post in Taos, New Mexico in the late 1820s. From 1826 to 1834, Ewing Young spent considerable time trapping and trading in Arizona (Hafen 1997).

In 1826, Ewing Young along with a group of 30 men were working the Gila River and some of its tributaries. The Young party also worked up the Salt River to its junction with the Verde River. Here the party divided, part following the Verde River to its source and the other following the Salt River to its source in the White Mountains. The two groups rejoined and trapped down the Salt and Gila rivers to the Colorado River, where they enjoyed good beaver trapping (Hafen 1997).

In 1829, Young led a group of 40 trappers from New Mexico to the Salt River. They trapped down that stream and up the Verde River with considerable success. Among this group of trappers was a young Kit Carson, who had worked as a cook for Young in Taos, New Mexico, and who was now out on his first trapping expedition (Hafen 1997). After leaving the headwaters of the Verde River, the group separated, half returning to New Mexico and the rest, including Young and Carson, setting out for California.

In 1831, Young along with 36 trappers again set out for California. They stopped at the Zuni Pueblo for supplies and then trapped down the Salt River in Arizona, catching beaver in great numbers (Hafen 1997). During this expedition they had other adventures including a scrape with a grizzly bear and a fight with the Apaches.

Another legendary mountain man to enter Arizona was William Sherley "Old Bill" Williams, also known as an explorer, army scout, and frontiersman. From 1826 to his death in 1849, Williams spent time trapping alone in the "State of Senora" (Arizona). Despite spending a considerable amount of time in Arizona, little is known of Old Bill and his exploits, other than he served America honorably (Favour 1936). In 1837, Williams set out along the Colorado River. He traveled down from what is now Bill Williams Mountain (Williams, Arizona area) through the Santa Maria Country along a stream (Bill Williams River) to the mouth of the Colorado River. During this trip Williams reported that he had "found water all along in holes and some beaver" (Clark 1965).

American Surveyors

In 1867, Dr. Elliott Coues, an American Army surgeon, historian, ornithologist and author, published "The Quadrupeds of Arizona," where he described the presence and abundance of beaver in Arizona (Coues 1867). Coues (1867) reported, "The keen pursuits of the beaver for its money value, and conspicuousness of some of its works, are in the main causes of its unusual notoriety, and of the admiration with which it is always mentioned in trappers' narratives, and naturalists' embellishments of them."

Another notable figure to be stationed with the army in Arizona was Edgar Alexander Mearns, an army surgeon and field naturalist. He developed an early interest in natural history, studying the flora and fauna around his home in Highland Falls, New York. From 1883 to 1888, he was a commissioned assistant surgeon in the medical corps of the army and assigned to duty at Fort Verde, Arizona. While stationed at Fort Verde, Mearns collected beaver specimens from a variety of locations within Arizona. All of the information he gathered while stationed in Arizona was published in the "Mammals of the Mexican Boundary of the United States." Mearns noted in his journals that beaver were evident on nearly all streams of the Colorado Basin visited by him from March 1884 to May 1888 (Mearns 1907). Mearns found the beaver to be excessively shy, secretive, and difficult of observations in contrast to the tame natured beavers he had observed in the Yellowstone

National Park (Mearns 1907). The slight amount of information respecting beavers in Arizona can be presented in the form of extracts from his diary during the years his was stationed in Arizona.

On 3 April 1887, Mearns reported that on the Box Canyon of the Verde River, beaver were numerous and had cut much of the timber along the river bank. On this trip he spoke with 1 trapper who took 120 beaver along the Gila and Verde Rivers during the winter of 1886–87, and sold the skins for $2.50 a pound (about $5 each; Mearns 1907). From 22–24 November 1887, Mearns reported that on the East Verde River beaver were plentiful and that there were several fine dams.

In 1894, while on the Boundary Survey, beaver were seen on the San Pedro River and on the Babocomeri Creek of the tributaries in Arizona. While on this survey, Mearns met two trappers in Yuma, Arizona. The trappers had recently arrived from a 200-mile expedition down the Gila River. They had shipped a number of beaver and raccoons taken during the trip, but found no beavers on the lower portion of the Gila River. In speaking with the residents of Adonde, Arizona, Mearns was told that beaver were scarce since the flood of 1891 (Mearns 1907).

Vernon Orlando Bailey was a field naturalist for the U.S. Department of Agriculture's Division of Economic Ornithology and Mammalogy from 1887 to 1896. In 1897 he became Chief Field Naturalist and Senior Biologist of the Department of Agriculture's Biological Survey Bureau, making many field trips throughout the west and southwest until his retirement in 1933. Bailey's chief biological interest was the study of the life history and distribution of mammals.

During his tenure with the Department he made many field trips into Arizona; most were 2 to 4 months long. In Vernon Bailey's field notes from 1 January to 11 February 1889, he documents his travels into Utah, Nevada, and Arizona. On this trip he mentions that a few beaver were said to be present at Stone's Ferry along the Colorado River, but he only saw tracks. At Fort Mohave, the old holes of beaver lodges were present in the banks of the pond (Hoffmeister 1986). Bailey also reported that a few beaver were said to live along the Colorado River, and he saw some old stumps where they had gnawed down small cottonwoods. One trapper had told Bailey that during the winter of 1888–89 he took 80 beaver along the Colorado River between Needles, California, and Yuma, Arizona, and another 20 below Yuma, Arizona (Hoffmeister 1986).

Arizona Game and Fish Department (AGFD)

In 1917, the Arizona governor appointed the first State Game Warden to manage the wildlife resources of the state (Murphy 2005). By this time wildlife conservation practices were in place, including predator control, limited hunting seasons, establishment of game refuges, and reintroduction of some game species (Murphy 2005).

The State Game Warden published the first AGFD laws for the years 1917 and 1918. Civil penalties were established along with minimum dollar amounts. Hunting seasons were stipulated for most small game animals, but there was no closed season for furbearers, European sparrow (*Passer domesticus*), great horned owl (*Bubo virginianus*), all hawks, prairie dog (*Cynomys* spp.), and porcupine (*Erethizon dorsatum*; Murphy 2005). During this time many farmers, ranchers and homesteaders were experiencing damage from beaver and trapped them to protect their livelihood and to help make ends meet (AGFD 2006). However, in order to trap beaver, a permit must have been secured from the State Game Warden.

One of the earliest letters to the Arizona State Game Warden was from the Salt River Valley Water Users Association on 24 December 1921. In this letter, the association requested a renewal of a permit that was issued on 7 April 1921 to trap beaver along the Arizona Canal, just west of the Granite Reef Dam. The association was again experiencing considerable trouble from this source and was requesting permission to trap beaver on the Salt River above and below Granite Reef. Other instances of beaver damage complaints were subsequently reported in 1923, 1928, and 1929. On 19 March 1929, the president of the Smithville Canal Company wrote a letter to the State Game Warden regarding beavers that were causing considerable damage to the dam at Pima, Arizona, and that they were anxious to have them removed. Moreover, on 10 July, Jesse B. Simms wrote to the State Game Warden describing the damage suffered. Mr. Simms stated "beavers have destroyed about half a crop of lettuce and are now cutting down some trees that I put out for protection of flood water."

In 1927, Governor Hunt passed a law closing the beaver season. However, the decline of beaver had begun. Damming of rivers for developing communities, bank alterations, and channelization combined with depletion of ground water resulting in reduced surface flows, had already contributed to a loss of Arizona's riparian areas (Kennedy 1997).

Beaver Reintroduction

Management practices have helped the beaver to hold its place as a member of Arizona's fauna. Since the early 20th century, AGFD has been experimenting with beaver reintroductions. One of the earliest transplants was completed by the Arizona State Game and Fish Commission, when they introduced 12 beaver into Long Park in the Chiricahua Mountains. The beaver were trapped on the West Fork of the Black River in the White Mountains of Arizona. It was reported that the release was successful (Cahalane 1939).

On 14 January 1940, 3 beaver from Springerville, Arizona, were transplanted to South Fork Cave Creek, in the East Chiricahua Mountains. On 27 February 1940, 2 additional beavers from Pima, Arizona, were transplanted to the same area (Carr 1994). On 24 August 1950, it was reported that "four animals were trapped in the White Mountains and released" in the Graham Mountains by the Arizona Game and Fish Commission (Hoffmeister 1956).

In 1994, AGFD reintroduced beaver to a small desert stream near Wickenburg, Arizona. In 1995, the site was revisited and a recovering robust riparian habitat was found. Four beaver dams and impoundments, a lodge, and many gnawed and downed cottonwoods were located (Welch 1997). Additional beaver relocations occurred on the Bill Williams River, the San Pedro River, and Eagle Creek.

Fur prices bottomed out in the 1950s which caused trapping activities to decline. Fur prices gradually increased in the 1960s along with trapping activities. In 1976–77 there were 1,820 licensed trappers in the state of Arizona; 65 beavers, along with other predators and furbearers were trapped during this time (AGFD 2006). Increased trapping correlated with rising fur prices. However, when the fur prices peaked in the early 1980s there was an additional increase in the number of licensed trappers. In 1981–83 there were 2,219 licensed trappers who trapped 117 beavers, along with other predators and furbearers (AGFD 2006).

In 1994, leghold traps were banned on public lands in Arizona. Following the trap ban and during the trapping year 1995–96, there were only 34 licensed trappers. No beavers were reported trapped that year. Although trapping is still legal on private lands, this event may have reduced the number of licensed trappers in Arizona to 123 during the 2005–06 season for all furbearers combined (AGFD 2006).

Wildlife Services

In 1915, the USDA, APHIS, Wildlife Services (WS) Arizona program was established, under the Bureau of Biological Survey. From the 1920s to the late 1950s, the primary focus was assisting farmers and ranchers with problems from rodents and predators. In Arizona, beaver management has been conducted to protect agriculture, property, human health and safety, and natural resources. Wildlife Services has managed beaver to prevent flooding of pastures and to protect fruit and nut trees. Near airports, beaver have been managed to prevent the creation of ponds which attract waterfowl species that create aviation strike hazards. Beaver have also been managed to prevent damage to trees on golf courses and damming of canals and irrigation devices. In addition to providing direct control, WS has been involved in multiple research projects relevant to managing beaver damage, to include experimental nonlethal techniques, attractants, electronic frightening and detection devices, habitat modification, monitoring techniques, repellents, and DNA analysis (Nolte 2003).

In 2000, the United States Army Corps of Engineers received approval from Congress to construct the Tres Rios Ecosystem Restoration and Flood Control Project in Phoenix, Arizona. In 2000, Tres Rios constructed a demonstration area onsite that used reclaimed wastewater from the 91st Avenue Treatment Plant to establish wetland habitat. Following construction, project staff identified early on that wetland construction created suitable habitat for beaver and connectivity to existing colonies. Consequently, staff noted that excessive beaver activity was negatively impacting project goals (Taylor 2008). In 2002, Tres Rios sought help from WS in defining the extent of beaver damage and developing techniques to reduce that damage on the Tres Rios project site. Along with WS National Wildlife Research Center (NWRC), a series of research projects on the Salt River in the southwestern portion of the Phoenix, Arizona metropolitan area were initiated. The goal of these projects was to determine the possible effects beaver have on riparian and wetland habitats. A brief description of each project is provided below.

To monitor movement of beaver and estimate survival and cause-specific mortality using radio telemetry, more range was needed than internal transmitters could provide. Also, longer retention time of transmitters was needed other that what was documented in published literature. Researchers (Arjo et al. 2008) found that a modified ear-tag transmitter fitted with a plastic sleeve and attached to the tail was efficacious in pen trials. Arjo et al. (2008) also found that incorporating a neoprene washer with this setup in field trials increased retention time to over 3 times that reported previously, giving us an average deployment time of 344 days (SE=44) per tail-mounted transmitter.

Additional pen studies were conducted at the WS Olympia Field Station to develop novel nonlethal techniques for reducing beaver impacts. Harper et al. (2005) conducted pen trials to determine whether beaver could be conditioned to avoid select foods. They concluded that aversion conditioning is probably not a feasible approach to reduce beaver foraging on preferred foods.

Saltcedar (*Tamarisk* spp.) is an invasive woody plant on the Tres Rios Project site. It is rarely consumed by herbivores because it contains high levels of tannin and sodium chloride (NaCl). Cottonwood (*Populus balsamifera*) and willow (*Salix scouleriana*) trees are preferred food sources of beaver and was the object of much damage on Tres Rios. Kimball and Perry (2008) theorized that saltcedar palatability could be improved by topical application of fructose and polyethylene glycol (PEG), and that palatability of cottonwood and willow could be reduced by application of an herbivore repellent. As predicted, they found repellent application to willow and cottonwood cuttings in combination with fructose and PEG treatment of saltcedar altered beaver plant preference. Thus, such applications may promote increased herbivory of alternative plants while reducing loss of desirable ones (Kimball and Perry 2008).

In order to protect wetlands, researchers needed to understand the movements and dispersal that may impact existing populations of beaver. Two fundamental gaps in knowledge of beaver dynamics on Tres Rios were related to their movement and genetic diversity. Beaver were not introduced to Tres Rios when the wastewater treatment project was created, thus they immigrated from populations in adjacent temporally connected wetlands.

An understanding of the origin and diversity of the population allows for improved management decisions (Taylor 2008). Thus, hair or tissue samples were collected from all beaver captured on the Tres Rios Project study area for genetic sampling. Information obtained from this data is being used to determine relatedness among individuals, population genetic structure, and genetic diversity within the population (Pelz-Serrano 2009). Results suggest that the entire Tres Rios beaver population came from a single maternal lineage.

During the Tres Rios Project, 43 adult beavers (31 females and 12 males) were captured and radio-marked along a 8.7-mile (14 km) stretch along the Tres Rios Demonstration Project. To develop strategies to better manage the wetlands and decrease beaver damage, beaver movement was monitored with stationary dataloggers (automated radio telemetry receiving stations) and handheld receivers from 2004–2007. In analyzing data, initial evidence was found that contradicts the classic paradigm that a beaver colony consists of an adult male, an adult female, and 2 sub-adults. To support this assumption, evidence of multiple lactating females using the same den site was collected (Fischer in press).

Conclusion

In Arizona the fur trade has had a long and interesting history. Beginning in 1540 when the first Spanish explorers entered into Northern New Spain (i.e., New Mexico) the fur trade had begun. When the explorers met the tribes, they were presented with coarse furs of bison and deer as gifts. It was during these encounters that the Spaniards realized that the tribes were utilizing the furs for footwear and clothing. As the Spanish explorers learned the value of these course furs they began to trade with the various tribes in the region. From 1540 to the early 1800s the Spanish fur trade continued until the arrival of the Anglo-Americans.

In the mid-1820s, these Anglo-American fur trappers, known as "mountain men," entered “Arizona” from Santa Fe and Taos, New Mexico and began working the flowing waterways in what is now northern and southern Arizona. These men trapped for beaver for a few decades when the fur market and the supply of beaver declined in the 1830s. In order to continue to earn a living, some of the mountain men worked as guides for the United States Army surveyors and engineers. These men had considerable knowledge of Arizona’s geography, however little of this knowledge was recorded.

After the United States acquired what is now Arizona through the war with Mexico in 1848 and the Gadsden Purchase in 1854, Anglo naturalists descended into Arizona to survey the international boundary.

At the turn of the 19th century, commercial trapping for furs and bounties was still being conducted and many ranchers and homesteaders also trapped to protect their livelihood. During the late 1900s, beaver were still widely distributed through much of the state, but management was needed to prevent overharvest. Both the Federal Predatory and Rodent Control branch of the U.S. Biological Survey and the State of Arizona Game and Fish Commission employed professional trappers. Thus, beaver management entered the era of wildlife management.

Present populations of many wildlife species are the result of changes in environmental awareness, followed in many cases by improved legislation, sound stewardship, and successful restoration efforts (Taylor 2008). Moreover, some of the same species are managed as "nuisance" where they cause conflicts with humans. The beaver is one example of a species that was near extirpation in the United States, yet recovered following legislation and regulations (e.g., state harvest laws) and changes in use.

Management for beaver now ranges from lethal control of nuisance individuals to reintroduction of individuals for wetland restoration and to increase wildlife and habitat diversity. In many instances with management of beaver and other species, there are unclear visions of how wildlife populations may exploit resources after successful restoration or with changing landscape conditions (e.g., habitat quality and competition). With increasing anthropogenic changes to the modern-day landscape, natural resource managers must make pragmatic decisions on the potential effects habitat alteration has on system stability. As the human population continues to grow, so will conflicts between humans and wildlife (Taylor 2008).

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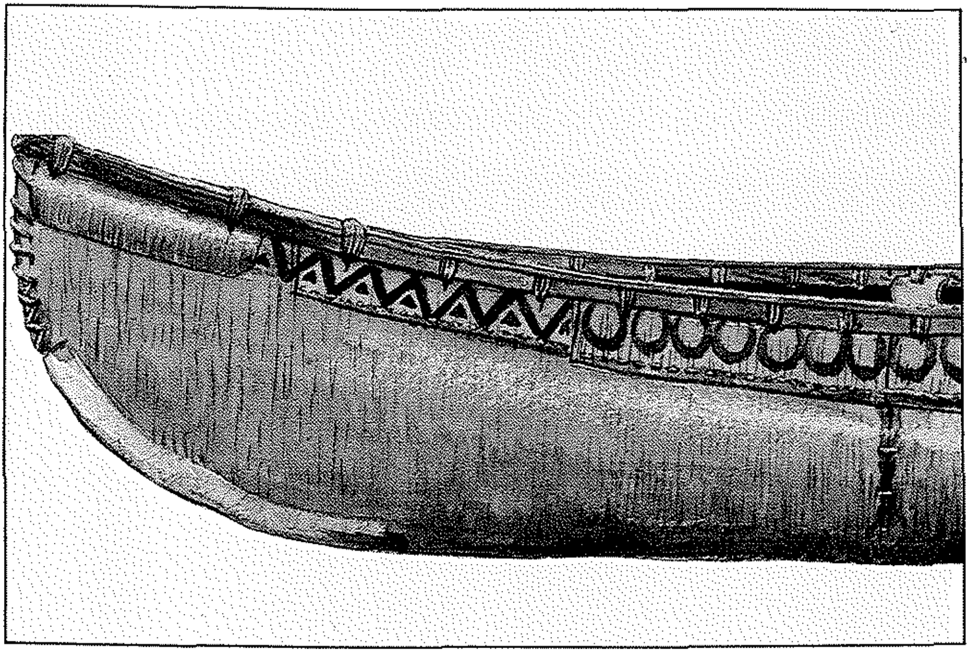

The Survival of the Bark Canoe

JOHN McPHEE

THE SURVIVAL OF THE BARK CANOE

JOHN McPHEE

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taut, was of differing shades of brown, trellised with dark seams. I guess I had expected something a little rough, rippled, crude, asymmetrical. These things, to the eye, were perfect in their symmetry. Their color was pleasing. Turn them over—their ribs, thwarts, and planking suggested cabinetwork. Their authenticity seemed built in, sewed in, lashed in, undeniable. In the sunlight of that cold November morning, they were the two most beautiful canoes I had ever seen. All this—when what I had frankly feared encountering were outsize, erratic souvenirs.

I had spent a good part of my early summers in canoes and on canoe trips, and all the canoes I used in those years were made of wood and canvas. They were Old Towns and E. M. Whites—lake canoes, river canoes, keeled, and keel-less. The bark canoe was gone, but not as long gone as I then—in the nineteen-thirties and forties—imagined. Now, in the nineteen-seventies, wood-and-canvas canoes were gradually becoming extinct, or seemed to be. They were seen about as frequently on canoe trails as bark canoes apparently were fifty years ago. What had replaced the wood and canvas were new generations of aluminum, Fiberglas, and plastic—canoe simulacra that lacked resonance, moved without elegance, fairly lurched through the forest. Some of them—white streaked with black—were designed to suggest birch bark. The sport in white water—where runs are made against a stopwatch—had been taken over by small Fiberglas boats that were called canoes but looked like kayaks. And now here was Henri Vaillancourt, whom I had heard of through a note in a newsletter of the Canoe Cruisers Association, standing in his yard beside bark-covered canoes—in full-time resolve to preserve them in the world—shyly and with what I then took to be modesty answering a most obvious question. Oh, don't worry, they were quite strong, really strong. They could take quite a blow. The ribs and planking were flexible, the bark elastic and durable. All the wood in them had been split, none of it sawn. Split wood had more flexibility and more strength. If you hit a rock with sawn wood in your canoe you were more likely to crack the ribs and the planking. He cocked his arm and drove his fist into the bottom of one of the canoes with a punch that could have damaged a prizefighter. He is six feet tall and weighs a hundred and seventy-five pounds. The bottom of the canoe was unaffected. He remarked that the bark of the white birch was amazing stuff—strong, resinous, and waterproof. He said there was, in fact, virtually nothing the Indian canoe-makers did that was not as good as or better than what could be done with modern tools and materials.

His shyness was in his eyes—looking away, almost always, from the direction in which his voice was travelling—but not in his speech. He talked volubly, with nasal, staccato inflections, and if the subject was bark canoes he seemed in no hurry to stop. I stayed around the yard for a couple of days, and before I left we took one of the canoes and—as Vaillancourt likes to put it—"went for a spin" on a local pond. After paddling half a mile or so over rustling lily pads and open water, we rounded a point at one end of an island and Vaillancourt warned that the pond was shallow there and we might hit a rock. Crunch. We hit one. The canoe glanced off. It was moving fast—slicing, planing the water with much momentum and glide. Crunch. "Look out! There could be more!" Crunch.

The canoe moved on—dry, sound in the ribs. When we landed, we turned it over. On the bark, a couple of marks were visible of the sort that a fingernail might make on a piece of hide. "We hit a stump head on once, in Maine," he said. "And the stump, you know, split in two." He was happy enough, though, to have people go on thinking—as people apparently did—that bark canoes were fragile. Any canoe could be damaged, and the general welfare of bark canoes might be helped by this common misconception. Bark canoes were actually so strong and flexible that Indians had used them not only in heavy rapids but also on the ocean. "But they're so rare today, you know, I wouldn't sell them to people who do white water. It's not the canoes I don't trust. I fully trust the canoes to go down white water. I don't trust the people who are paddling them. Bark canoes are so rare. There's no sense in wrecking even one."

The days are hot, and we often dip our cups in the river. Henri prefers Tang. He has the powder in his pack and a plastic jug by his feet as he paddles. He also has a supply of white bread—several loaves of it—and when he is hungry he pours honey onto the bread. In five minutes, he can prepare and finish a meal. Then he is ready to move on. We are in no hurry, like the shooting stars.

The river has many riffles, too minor to be labelled rapids. Nonetheless, they are stuffed with rock. The angle of the light is not always favorable. The rocks are hidden, and—smash—full tilt we hit them. The rocks make indentations that move along the bottom of the canoe, pressing in several inches and tracing a path toward the stern. It is as if the canoe were a pliant film sliding over the boulders. Still, I feel sorry and guilty when we hit one. I have been in white water and Rick has not, so he has asked me to paddle in the stern—to steer, to pick the route, to read the river—and I reward his confidence by smashing into another rock. Nothing cracks. If this were an aluminum canoe, it would be dented now, and, I must confess, I would not really care. Of all the differences between this canoe and others I have travelled in, the first difference is a matter of care about them. The canoes can take a lot more abuse than we give them, but we all care. Landing, we are out of the canoes and in the water ourselves long before the bark can touch bottom. We load and launch in a foot of water. The Indians did just that, and the inclination to copy them is automatic—is not consciously remembered—with these Indian canoes.

Once, on the upper Delaware, in a fifteen-foot rented Grumman canoe, I ran through a pitch of white water called Skinner's Falls. On a big shelf of rock at the bottom of the rapid, a crowd of people watched. When the canoe came through dry, they gathered around and asked how that was done. They said they were novices—a ski club on a summer outing—and none of them had been able to run the rapid without taking in quantities of water. "Well," said my wife, getting out of our canoe, "if you think you've seen anything yet, just wait until you see what is going to happen now. My husband spent his whole childhood doing this sort of thing—and so did that man up there in the other canoe. The two of them are now going to run the rapid together."

I walked up the riverbank. When I joined my friend and got into his canoe (also a fifteen-foot aluminum), I saw that one of the skiers had set up a tripod on which was mounted a sixteen-millimetre movie camera. My wife later told me she had said to them that it was good that they had the camera, because they would be able to study the film and learn a great deal. Skinner's Falls is easiest on the right. It gets worse and worse the farther to the left you go. So, for the rash hell of it, we dug in hard, got up to high speed, and went into the extreme left side of the rapid. The canoe bucked twice before the bow caught a rock that swung us broadside to the current are making—wandering at will in bark canoes—noting, and marking on inexact maps, the stands of pine. The big trees were there for the taking. They tended to cluster on the shores of the lakes. Loggers and log drivers followed, of course. Indian, hunter, cruiser, lumberer—this progression, in such beautiful country, could not help but lead to the tourist, the canoe-tripping tourist, and among the first of these (in all likelihood, *the* first tourist in the Maine woods) was Henry David Thoreau. He made two bark-canoe trips here, in 1853 and 1857, each time with an Indian guide. He went down this river. He went to the lake where Henri Vaillancourt—a hundred and twenty years later—would hide the felled cedar. Looking for moose in the night, he went up Moosehorn Stream. No moose. He had in his pack some pencils and an oilskin pouch full of scratch paper—actually letters that customers had written to his family's business, ordering plumbago and other printing supplies. On the backs of these discarded letters he made condensed, fragmentary, scarcely legible notes, and weeks later, when he had returned home to Concord, he composed his journal of the trip, slyly using the diary form, and writing at times in the present tense, to gain immediacy, to create the illusion of paragraphs written—as it is generally supposed they were written—virtually in the moments described. With the advantage of retrospect, he reconstructed the story to reveal a kind of significance that the notes do not reveal. Something new in journalism. With the journal as his principal source, he later crafted still another manuscript, in which he further shaped and rearranged the story, all the while adhering to a structure built on calendar dates. The result, published posthumously in hardcover form, was the book he called *The Maine Woods*.

Henri Vaillancourt's familiarity with books appears to be narrow, but he has read Thoreau—from *Walden* to *Cape Cod*, and most notably *The Maine Woods*. Rick Blanchette is saturated in Thoreau. In every segment of the river, they remember things Thoreau did there—places where he camped, where he collected flora, where he searched for moose. "I'm into Thoreau, too," Mike has said. "He writes about pickerel fishing, turtle hunting—the things I know and do."

Vaillancourt is transfixed by the knowledge that Thoreau, at North East Carry, actually watched a group of Indians making bark canoes. "All of them sitting there whittling with crooked knives! What a life! I'd give anything to have been there."

Back and forth between our two canoes, bits of Thoreau fly all day.

"Thoreau said the nose of the moose was the greatest delicacy, and after that the tongue."

"Thoreau said it is a common accident for men camping in the woods to be killed by a falling tree."

"Do you remember during the Allagash and East Branch trip when he said that all heroes and discoverers were insane?"

"No, that was in *Cape Cod*."

"Some people think he was humorless, you know. I disagree."

"Thoreau said . . ."

"Thoreau believed . . ."

"Do you remember the passage where . . ."

When it is not my turn to paddle and I am riding in the center of the canoe, I read to catch up. Thoreau's trips were provisioned with smoked beef, coffee, sugar, tea, plum cake, salt, pepper, and lemons for flavoring the water. His tent was made from cut poles and cotton cloth. He had one blanket. He carried his gear in India-rubber bags, and it included an extra shirt, extra socks, two waistcoats, six dickies, a thick nightcap, a four-quart tin pail, a jackknife, a fishline, hooks, pins, needles, thread, matches, an umbrella, a towel, and soap. For foul weather, he had an India-rubber coat, in which he sweated uncomfortably and got wetter than he would have in the rain. He ate his meals from birch-bark plates, using forks whittled from alder. For relief from mosquitoes, he wore a veil; he also threw damp leaves onto the fire and sat in the smoke. He slept in smoke, too—burning wet rotting logs all night.

Thoreau's guide on the first canoe trip was Joe Aitteon, and, on the second, Joe Polis—both Penobscots from Indian Island in Old Town, Maine. Henri Vaillancourt is at least as interested in these Indians as he is in Thoreau—particularly in Polis, who made his own canoes. Polis and Aitteon travelled light—no changes of clothing. Aitteon was a log driver. Polis was the better woodsman. Polis had represented his tribe in Washington. He had visited New York. He said, "I suppose, I live in New York, I be poorest hunter, I expect." Thoreau hired him for eleven dollars a week, which included the use of his canoe. Some eighteen feet in length, thirty inches wide, and a foot deep in the center, it was a longer, narrower canoe than the Vaillancourt canoes we are using. Thoreau's first canoe—on the 1853 trip with Aitteon—was more than nineteen feet long, and the bark was painted green. Our paddles are made from birch. Thoreau's were made from sugar maple. Thoreau was discomforted by the confinement of the paddling position, and he used the word "torture" to describe it. Sometimes he stood up in the canoe to stretch his legs. He appreciated nonetheless the genius of canoe technology. "The canoe implies a long antiquity in which its manufacture has been gradually perfected," he wrote in his journal. "It will ere long, perhaps, be ranked among the lost arts."

When Thoreau, from Mt. Katahdin, saw neither clearings nor cabins across huge domains of forest, lake, and river, he said, "It did not look as if a solitary traveller had cut so much as a walking-stick there." On closer view, though, from water level, he saw the stumps of timber a great deal larger than he once wrote a letter promoting trade. Her canoe hangs from the shed rafters, on cinches. The canoe Henri is using on this trip was ordered by Idaho State University for a course on Indian canoeing and for the making of an educational film. John Farrell, of Warren, New Jersey, discovered Henri in the "Small Business & Crafts" section of *Yankee* magazine and ordered a fourteen-foot Vaillancourt canoe, which he uses for fishing and duck hunting on the upper Passaic River. Warren Soderberg, who owns a hardware store in Dresser, Wisconsin, bought an eighteen-foot Vaillancourt canoe so that, among other things, he could make fifteen-day canoe trips in Ontario during moose season in the fall. "I'd like to shoot a moose out of my birch-bark canoe with a bow and arrow," he said. "Why? Just to say that I've done it." Henri made a nine-foot hunter canoe for a woman in New Jersey who wanted one that small so she could lift it herself. It weighs twenty pounds.

Then, finally, an order came for a fur-trade canoe. The customer's name was Kent Reeves. He lived in Shokan, New York, and he was a professor of environmental education whose classroom was a forest (called the Ashokan Field Campus). It belonged to a subdivision of the State University. Reeves had conceived, and was in the process of organizing, a graduate course that would be one long field trip on the route of the *voyageurs*, mainly west of Superior. It would be called Frontier Life on the Voyageurs' Trail—six credits toward a master's degree. Beyond Reeves' considerable library on the fur-trade era, what the course needed most was a *canot du nord*. Reeves had sought out the names of people who could make one. He had visited them and had examined their work. He had arrived at an opinion of Henri that exactly coincided with Henri's opinion of himself: Henri was, by a considerable margin, the best. The two main considerations that brought Reeves to this conclusion were, in his words, "quality and authenticity." Henri wanted three thousand dollars. Reeves flinched, but he produced the money. The students who signed up for the course made their own paddles, sawing them out of basswood and finishing them with drawknives. They sewed their own billowy shirts and wove bright-colored sashes. They made *voyageur* hats, and they made moccasins with moose skin from the HBC. Meanwhile, Henri made the *canot du nord*. The bark was all it had appeared to be when it stood in the forest, and the canoe was representative of the best work he could do. He was still tapping in ribs as the course was about to begin, and the day he finished the canoe someone sent by Reeves arrived to take it away. Henri could not stand to see it go, and he was in an ugly mood for the rest of the summer. Finished in the morning, gone in the afternoon—never again would he let that happen, he decided. He was never going to be deadlined by a day, or even a month —the year alone was enough of a promise. He wanted his canoes around for a while when they were done. Wistfully, he wondered if the North Canoe would ever come back to Greenville for a touchup in "the yard." Meanwhile, in the Quetico-Superior, it went up the Pigeon River on the route of the *voyageurs*. It was poled upstream and lined up rapids. It was a dry, sound, stable canoe—beautiful in sheer, smoothly seamed, with high, Christopherson ends. The graduate students sprayed themselves with Off and carried freeze-dried food, but they also learned and sang Loire Valley songs, ate some pork and dried peas, and drank from eight-gallon kegs of brandy. The course, moving northward, was a total success. It established itself in the curriculum. It left nothing in its wake but a lonely master of arts.

Allagash Stream, the highest reach of the river, drops to the head of Chamberlain Lake from the west-northwest. Recrossing the isthmus carry, we go in the morning to the mouth of the stream. By noon, we are literally in the water. As it pours toward us, it is too shallow to be paddled, too shallow to be poled. There is nothing to do but frog it—get out of the canoes and walk them up the current. If it is this shallow here, it is not in all likelihood going to get any deeper as we go along; therefore, as the map informs us, the best we can hope for is a seven-mile walk in the water.

Alternative routes are, for various reasons, less attractive, and do not include Allagash Lake, whose remoteness is written in its approaches: from the east, seven miles' sloshing up a rocky stream; from the west, a portage of three miles, by far the longest in the Allagash woods. So we drag the canoes—in two, three inches of water, jumping, bubbling, rushing at us. We lift them at the gunwales to reduce the draw. Now and again, we slide and fall on rock shelves covered with algae. In pools, we go in to the hips, to the chest, all the way. The cool water feels good coming on. It feels good rushing around the ankles. It feels good closing overhead. I would prefer to frog fifty miles up a forest stream than paddle ten against a big lake head wind.

Often, it is necessary to heave rocks aside to create a channel wide enough for the canoes. On many of the rocks are heavy streaks of paint or aluminum left by hundreds of canoes that have come banging down this river in varying levels of water under the care of people who did not give a damn what they hit. What comes home once more at the sight of those aluminum-covered rocks is the world of difference in the way we feel toward our canoes, and it is the central pleasure of this trip: we care so much about them. We scrape a little, too, and it can't be helped. *Tant pis,* as Henri says. Bark leaves no marks behind. Warren, leading, voraciously sculpts the river —kicking stones aside, lifting rocks so large they appear to be ledges and stuffing them into the banks. Then he hauls the canoe up the freeways he has made. Henri walks behind with a rope in his hand. It is tied to the stern, which he moves from side to side, as if the canoe were a horse on a halter.

The stream is a white-water primer, for it is flowing much like a riverine rapid, which is what it is, scaled down. All in miniature, the haystacks, the standing waves, the souse holes, the eddies, the satin-water pillows are here, and usually there is a place to go—a *fil d'eau*—that is deeper and better than anywhere else. One learns to read the stream. After four hours, we have gone two miles.

Henri remarks that he is now hungry enough to eat a moose, and wouldn't mind trying if one were to appear.

"You have to see one before you can eat one, Henri."

"And how are your wife and your cattle?"

"God bless you, well."

A windfall fir lies across the stream now and stops us altogether, but Henri unsheathes his axe and sends flotillas of chips down the current. The log drops into the water. We

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The Taos Trappers

The Fur Trade in the Far Southwest, 1540-1846

David J. Weber

By David J. Weber

(editor) *Prose Sketches and Poems Written in the Western Country*, by Albert Pike (Albuquerque, 1967)
(editor and translator) *The Extranjeros: Selected Documents from the Mexican Side of the Trail, 1825–1828* (Santa Fe, 1967)
(editor) *The Lost Trappers*, by David H. Coyner (Albuquerque, 1970)
The Taos Trappers: The Fur Trade in the Far Southwest, 1540–1846 (Norman, 1971)
Foreigners in Their Native Land: Historical Roots of the Mexican Americans (Albuquerque, 1973)
(editor) *Northern Mexico on the Eve of the United States Invasion: Rare Imprints Concerning California, Arizona, New Mexico and Texas, 1821–1846* (New York, 1976)
(editor) *El México perdido. Ensayos sobre el antiguo norte de Mexico, 1540–1821* (Mexico, 1976)
(editor, with Duane L. Smith) *Fortunes Are for the Few: Letters of a Forty-niner by Charles William Churchill* (San Diego, 1977)
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it prudent to return." Young then "raised a party of forty men, consisting of Americans, Canadians and Frenchmen," and took command himself, leaving from Taos in August, 1829.[25] Aside from Ewing Young, Carson identifies only James Lawrence and James Higgins (the latter shot the former near Los Angeles) as members of the party. Contemporary documents reveal that three Frenchmen from Taos, François Turcote, Jean Vaillant, and Anastasio Carier, were also along. François Turcote had been one of Sylvestre Pratte's employees on an expedition in 1827–28 and Vaillant, who was born in France and had come to New Mexico in 1824, had been with Pratte in the spring of 1827. Anastasio Carier, a Canadian, had married at Taos in 1824 and had lived there ever since.[26] These three deserted Young's party in California and tried to get passports to return to New Mexico. According to Young, "All the french that I have with me . . . were owing me Large Debts and wishing to not pay them Mutinied they had Concluded to all remain in this Country but the Americans were too strong for them and forced them out much against their wills."[27]

In order to circumvent Mexican authorities, with whom he had been unpopular since they had discovered his scandalous smuggling of contraband beaver in 1827, Young used a tactic that was probably common among the foreign trappers. As Kit Carson explained it, Young led his men north to throw officials off his track. Then, fifty miles above Taos he shifted his course to the southwest, skirting the New Mexico settlements and passing through the Pueblo of Zuñi, on his way to the Salt River.

On the Salt the trappers "routed" the Indians who had bothered Young's earlier party. They continued trapping through the awe-

25 Warner, "Reminiscences," *HSSC*, Vol. VIII (1907–1908), 185; Carter, *'Dear Old Kit,'* 42–44.

26 For Turcote, see the Estate of S. S. Pratte, 1828, Chouteau Collection. For Vaillant, see Report of Manuel Martínez, Taos, April 7, 1827, and papers concerning the naturalization of Juan José Vaillant, February 8, 1831, both in MANM. Carier is "Larié" in Chávez, "New Names," *El Palacio*, Vol. LXIV, Nos. 9–10 (September–October, 1957), 313.

27 Young to John B. R. Cooper, October 10, 1830, in Mariano G. Vallejo, Documentos para la historia de California, Vol. XXX, 1830–32, 135, MS, Bancroft Library; Hill, "Ewing Young," *OHSQ*, Vol. XXIV, No. 1 (March, 1923), 23.

some canyons of the Salt until they reached the Verde River ("San Francisco River"). Again altering their course, they followed the meanderings of the Verde in a northwesterly direction until they reached its headwaters. There the party divided.[28]

Some of Young's men returned to Taos with their catch of furs. Obscure documents in the Mexican archives at Santa Fe mention a group of Americans returning from the Gila in Februray, 1830, going through Cochití on their way to Taos. They were suspected of trapping, but one witness said they were on foot and carrying no equipment. Perhaps they had cached their furs before reaching Cochití. Another document, perhaps referring to this same group, speaks of furs confiscated by the alcalde of Jemez.[29] Collateral documents have not yet appeared.

Meanwhile, Young led seventeen men west from the Verde. Although he pioneered a new route into California, it was a grueling one which he would avoid on later occasions. This route, and Young's subsequent adventures in California, have been well-described elsewhere.[30] It is sufficient to say that they arrived at San Gabriel Mission, probably early in 1830, then spent the remainder of the season trapping the San Joaquin Valley. There they encountered Peter Skene Ogden and some of his Hudson's Bay Company trappers. In late summer, Young sold his furs to the captain of a trading schooner whom they met at San José Mission. By September, Young was on the way back to New Mexico. He retraced his steps to the Colorado, then trapped down that river to the Gila, which he followed to the Santa Rita copper mines. Arriving there, probably in January, 1831, he left his furs hidden at the mines, which were then in the charge of Robert McKnight. Since the furs had been taken without a license, Young could not legally sell them in New Mexico. So Young and Carson traveled to Santa Fe where

[28] Carter, *'Dear Old Kit,'* 44.

[29] Declaration of José Martín, Jemez, March 23, 1830 and José Ignacio Ortiz to the Governor, Santa Fe, March 20, 1830. MANM.

[30] See Hill, "Ewing Young," *OHSQ*, Vol. XXIV, No. 1 (March, 1923), 23–27, and Holmes, *Young*, 46–57. The accuracy of Carson's account is attested to by documents which Hill found in Bancroft's transcripts from California archives. See especially a letter of José Berryeza, July 15, 1830, in Departmental State Papers, II, 135–39, MS, Bancroft Library.

Young obtained "a license to trade with Indians on the Gila." Then he sent some men to bring in the beaver. As Carson later told it, "Everyone considered we had made a fine trade in so short a period." The fur, he said, was "disposed of to advantage at Santa Fe, some two thousand pounds in all."[31]

While Ewing Young found his way to California, his partner, William Wolfskill, kept shop in Taos. Among his customers were William Williams and Thomas Smith, both of whom bought liberal amounts of whisky at seventy-five cents a pint.[32] Some of Wolfskill's customers would soon accompany him to California. Perhaps learning from the trappers who returned from the San Francisco River that Young had pushed on to California, Wolfskill made plans to join his partner there. An important part of his preparation consisted of becoming a Mexican citizen and then obtaining a license to trap in Mexican territory. In early September, 1830, Governor Armijo granted Wolfskill's request to take twenty men on a beaver trapping expedition. By the end of the month they were on their way.

In Wolfskill's employ were many newcomers to the area: John Lewis, Francis "Ziba" Branch, John Rhea, Samuel Shields, David Keller, Love Hardesty, Martin Cooper, and Lewis Burton. Three New Mexicans were taken along, perhaps as cooks or campkeepers: Blas Griego, Manuel Mondragón, and José Archuleta. Traveling along with Wolfskill's contingent were George C. Yount and five veteran free trappers who may have been in his employ: Alexander Branch, whom we have seen on the Gila and the Colorado; Francisco Laforet and Baptiste St. Germain, both former trappers for Sylvestre Pratte; and Zachariah Ham and Bautista Guerra.[33]

Wolfskill's trek to California is best known for inaugurating the route that came to be called the Old Spanish Trail, connecting Los Angeles and Santa Fe. Wolfskill's party was the first to travel the

[31] Carter, *'Dear Old Kit,'* 44–50. Jean Vaillant had returned to Taos by February 8 to apply for naturalization as a Mexican citizen (Vaillant's request of that date is in MANM).

[32] Wolfskill Ledger, 1830–31, photocopy in the Huntington Library, San Marino, California.

[33] Iris Higbie Wilson, *William Wolfskill, 1798–1866: Frontier Trapper to California Ranchero*, 61–66.

for he formed a partnership with Ewing Young and David Waldo, the latter a prominent Santa Fe merchant and old friend. Jackson sold his merchandise for Mexican dollars, loaded these on mules, and on September 6, 1831, set out for California with his Negro slave and nine other men. Among these were one of Jedediah Smith's younger brothers, Peter, and J. J. Warner. According to the latter, they traveled south to the copper mines, followed the Gila west, and reached San Diego in early November.[42]

In October, Ewing Young (who in August had received a passport to go to Chihuahua) followed Jackson to California by a different route.[43] Thirty-six men reportedly comprised his party. Of these, we can identify twenty-nine by name: Pleasant Austin, Powell Weaver, James Wilkinson, James Basey, Hace, James Green, Cambridge Green, James Anderson, Isaac Williams, John Price, Job F. Dye, Sidney Cooper, Moses Carson, Benjamin Day, William Day, Isaac Sparks, Joseph Gale, Joseph Defit, John Higgins, Thomas Low, José Manuel Ortega, Manuel Leal, Julián Vargas, José Teforia, Santiago Cordero, José Manuel Servé, José and Mariano García, and Francisco Argüello. The first eleven of this list had just arrived in New Mexico that previous winter after an abortive attempt at trapping in the southern Rockies. Most of these eleven remained in California. The best account of Young's journey comes from one of these men, Job Francis Dye.[44]

Young waited until reaching Zuñi before picking up food supplies, perhaps, says Dye, to avoid calling attention to his activities. There Young's party paused for two days, stocking up on the "Pinole (roasted corn meal) and pinoche (sugar) and frijoles (beans) required on the route."[45] They continued to the Salt River,

[42] Warner, "Reminiscences," *HSSC*, Vol. VIII (1907–1908), 178–86; William Sublette to William Ashley, Walnut Creek, September 24, 1831, photostat in the Campbell Papers, Missouri Historical Society, St. Louis, Missouri.

[43] The passport of "Joaquin Jon" dated August 21, 1831, in book of passports, 1828–36, Santa Fe, Ritch Papers, No. 185.

[44] William Henry Ellison (ed.), *The Life and Adventures of George Nidever, 1802–83*, 20; Dye, *Recollections*, 18, 20; papers relating to the embargo of the furs of Ewing Young, July 12–July 25, 1832, MANM. A biography of Dye by Gloria Griffen Cline is in Hafen, *Mountain Men*, I, 259–71.

[45] Dye, *Recollections*, 18–19. Pinole was not an uncommon food for trappers

then followed that stream, setting traps as they went. On the Salt, James Anderson and Cambridge Green had a dispute over trapping rights, Green feeling that Anderson had placed his traps in an area which Green had claimed. Green complained to Young about this, and Young, according to Dye, replied, "What makes you let him do it—if I could not prevent him in any other way, I would shoot him." Young's remark, spoken in levity, was taken seriously by Green, who promptly dispatched the hapless Anderson.

Dye recalled that they also trapped for twelve days on the San Carlos River. This would have meant considerable backtracking and would have taken them well off their route. He probably meant the Verde, for Mexican trappers who were along described the route as following the Zuñi River to the Salt and the Verde, and then to the Gila.[46] When they reached the Colorado, thirteen men made the difficult crossing into California while the remainder trapped their way back to New Mexico. J. J. Warner heard that Young's beaver traps, "mostly new ones bought in New Mexico," were defective, allowing many beaver to escape. Dye does not mention this problem, however.[47]

As planned, Young and David Jackson rendezvoused in California. J. J. Warner, who was in Jackson's employ, tells that Jackson had gone as far north as San Francisco to search for mules, but neither he nor Young were as successful as they had hoped. Instead of the fifteen hundred or two thousand mules they had planned on they had only six hundred mules and one hundred horses. Jackson could get the animals back to New Mexico without Young's assistance. Young went as far as the Colorado River to help Jackson make the crossing, then returned to the coast.[48]

When Jackson returned to New Mexico, apparently in July, 1832, it was discovered that he had brought more than mules and

in the Southwest. See Camp, "Journal of a 'Crazy Man,'" *CHSQ*, Vol. XV, No. 2 (June, 1936), 105.

[46] Dye, *Recollections*, 23–24. See the testimony of David E. Jackson in papers regarding the embargo of the furs of Ewing Young, July 12-July 25, 1832, MANM.

[47] Dye, *Recollections*, 24–27; Warner, "Reminiscences," *HSSC*, Vol. VIII (1907–1908), 186.

[48] Warner, "Reminiscences," *HSCC*, Vol. VIII (1907–1908), 179.

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