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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

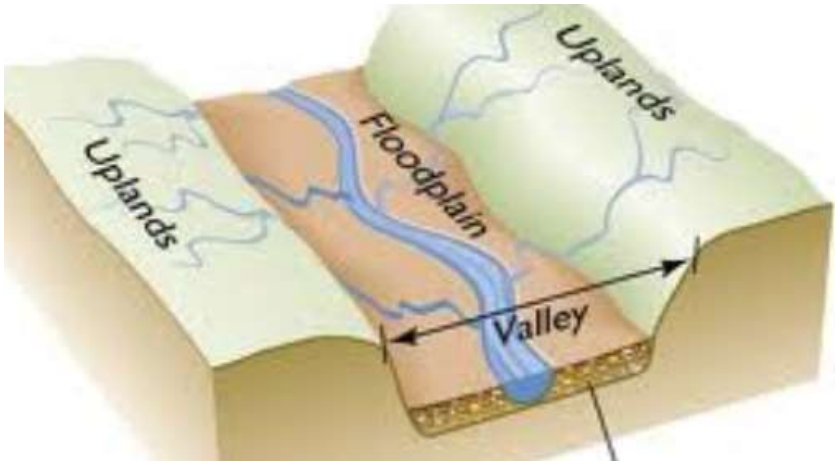
- Speaker Resume – Verde River
  - Flood History
    - Graduate Work 1984-86 – Paleoflood Studies
    - 1993 Flood Report
  - Previous Navigability Studies
    - Verde & Major/Minor Tributaries
  - Engineering Studies
    - Main stem – 404 permitting, floodplain, erosion
    - Tributaries – master plans, 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 **watercourse** 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

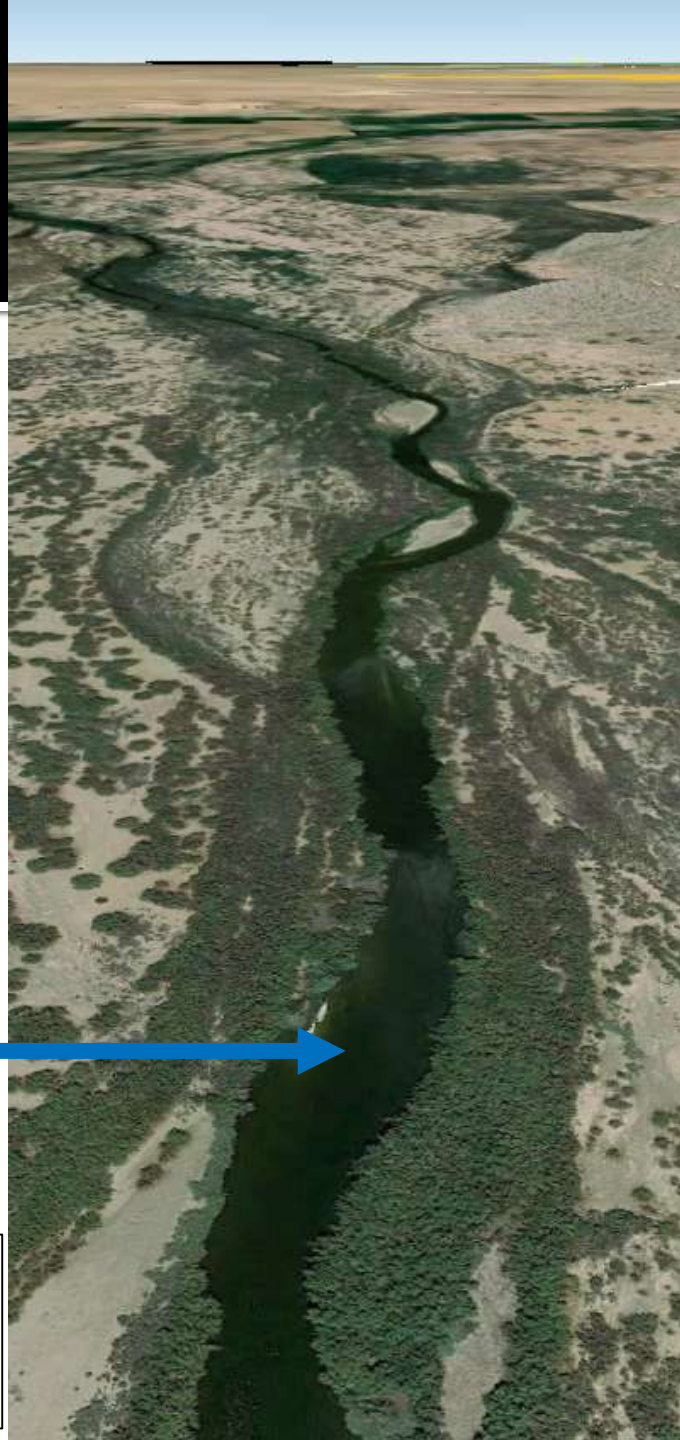
- Channel
  - Flood Channel. The portion of the floodplain that carries floods that exceed the main channel capacity.
  - Compound Channel. A stream type that has both a low flow channel and a flood channel(s). Each may have a different stream pattern.

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

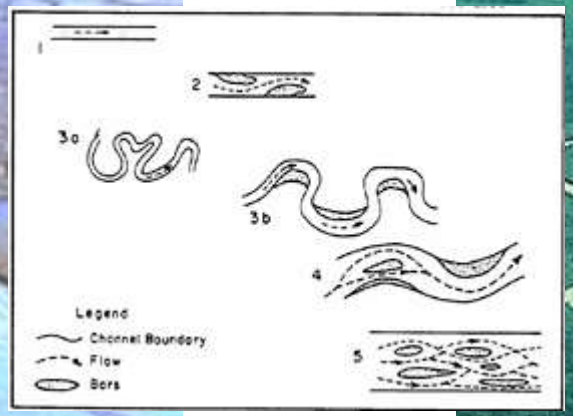
Terminology

- 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

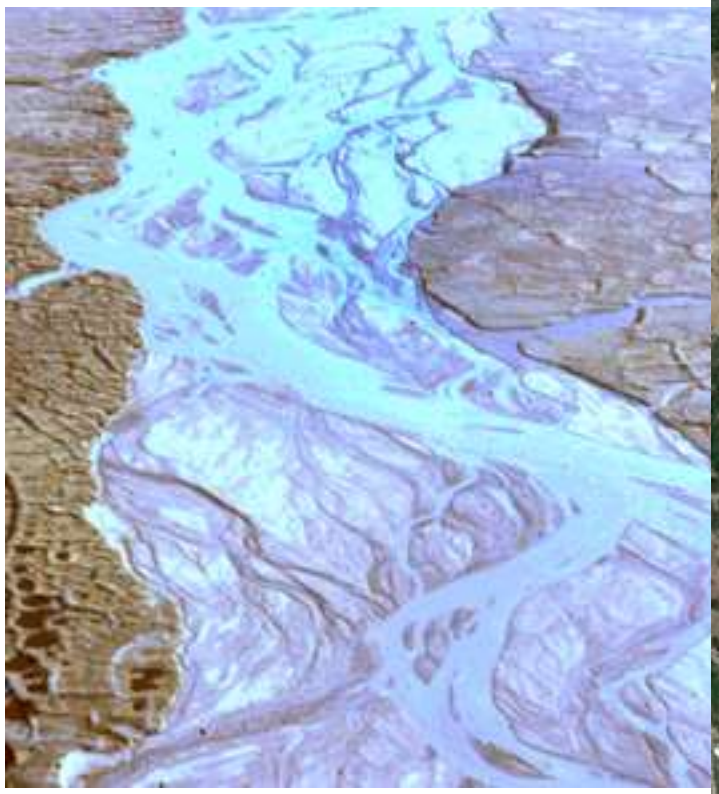


Meandering

Terminology

- Common Channel Patterns

Braided



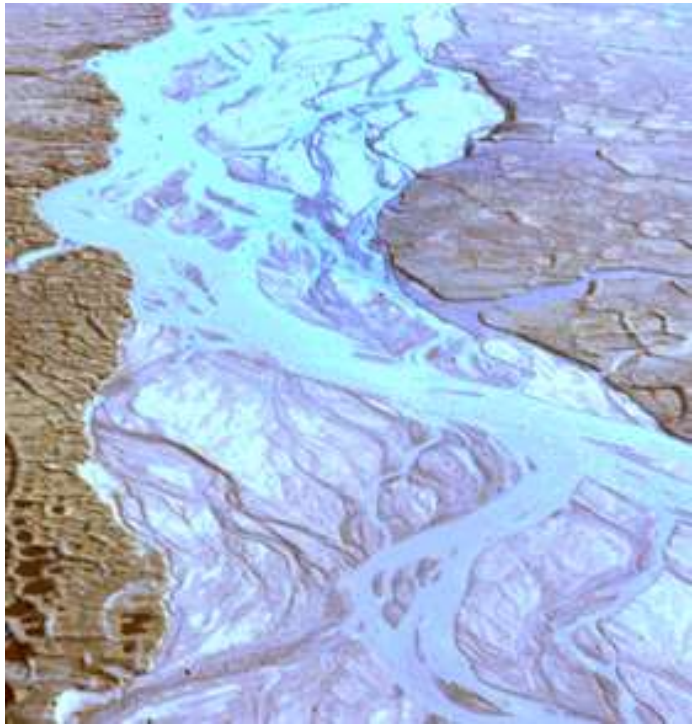
Verde River Near Clarkdale

Meandering

Terminology

- Common Channel Patterns

Braided



Verde River
Near
Ft. McDowell

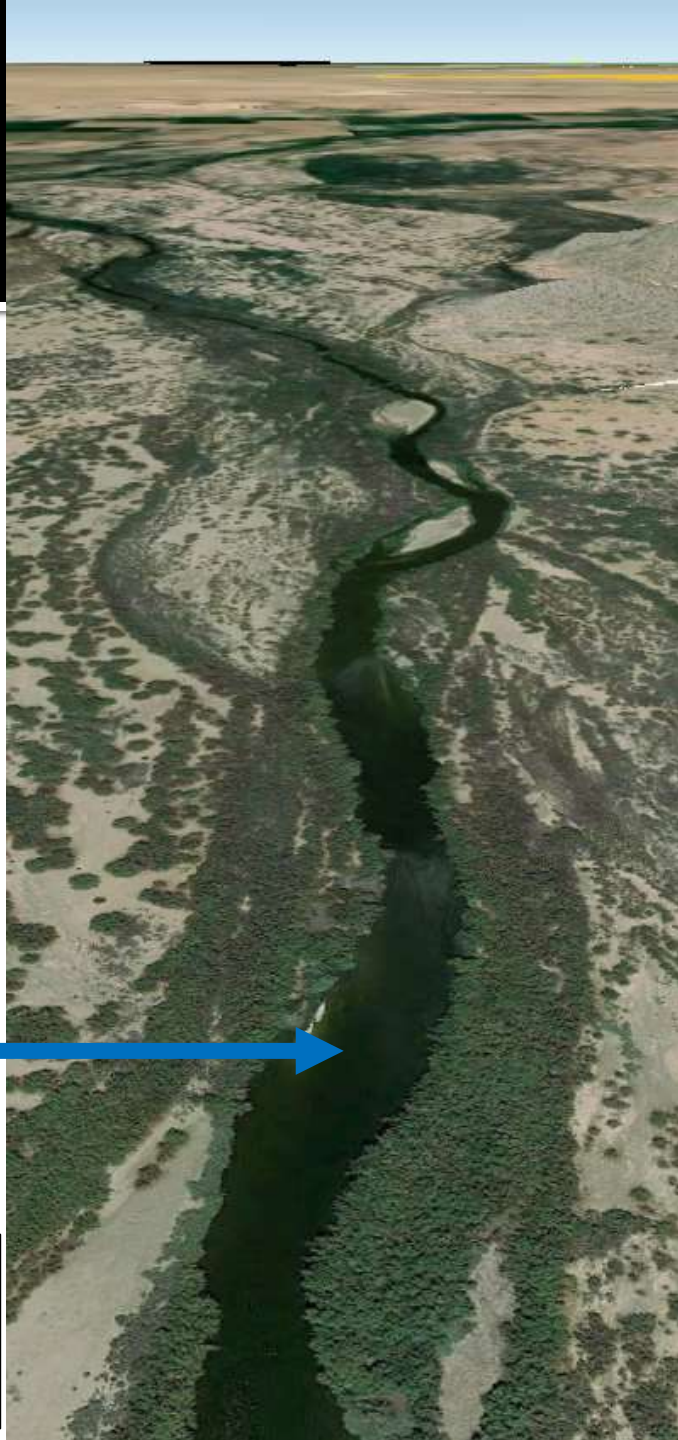
Meandering

Braided or Meandering

Gila River @ Arlington, AZ

< < Braided Flood Channel

Non-braided main channel > >



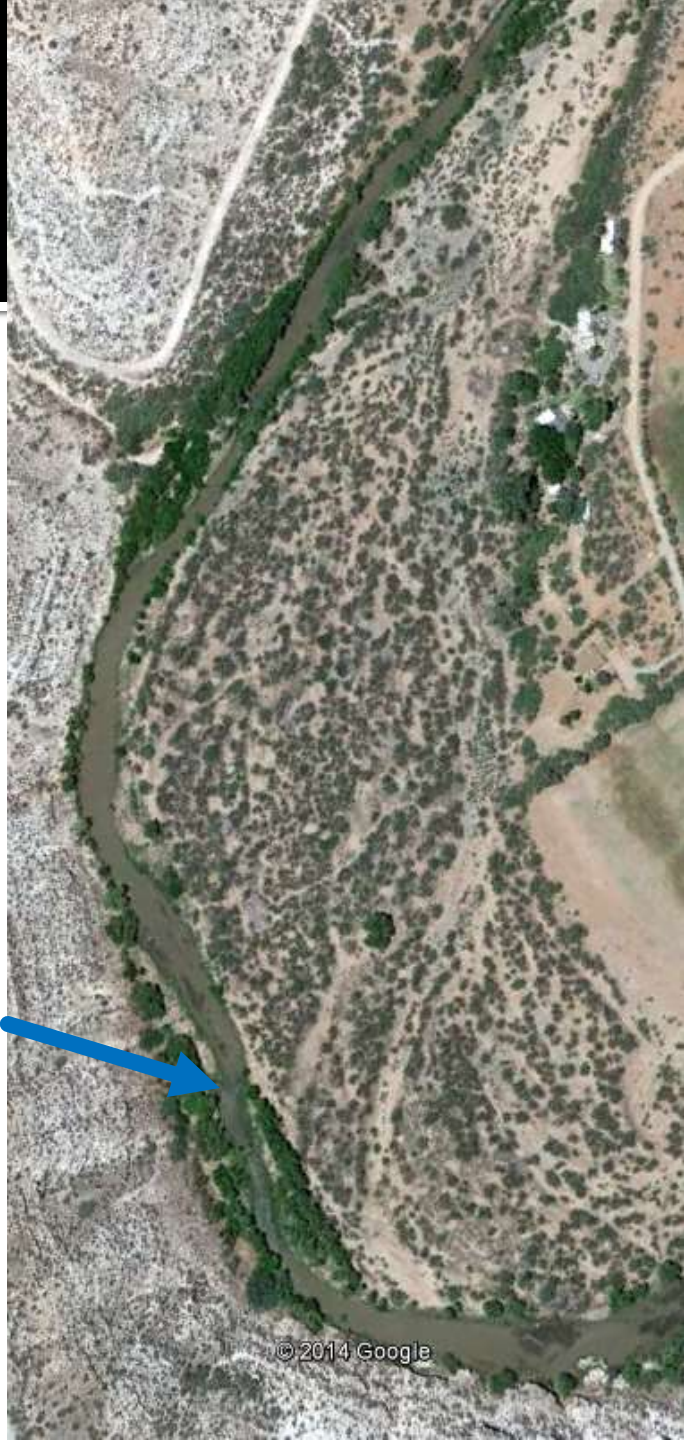
Boating occurs on ordinary flows in the main channel, not on the flood channel.

Braided or Meandering

Verde River in Verde Valley

< < Braided Flood Channel

Non-braided main channel > >



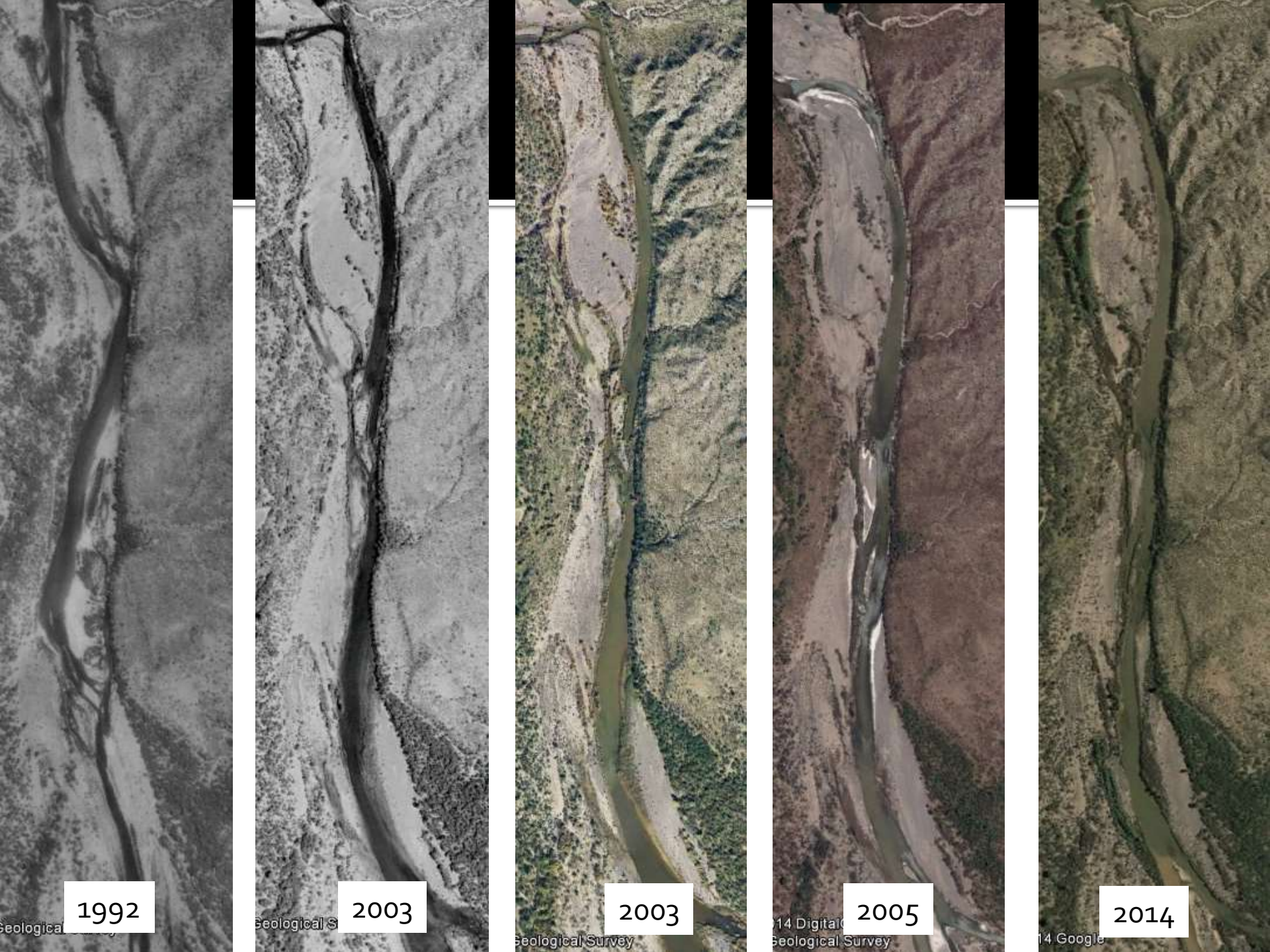
Boating occurs on ordinary flows in the main channel, not on the flood channel.

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
2005
2014

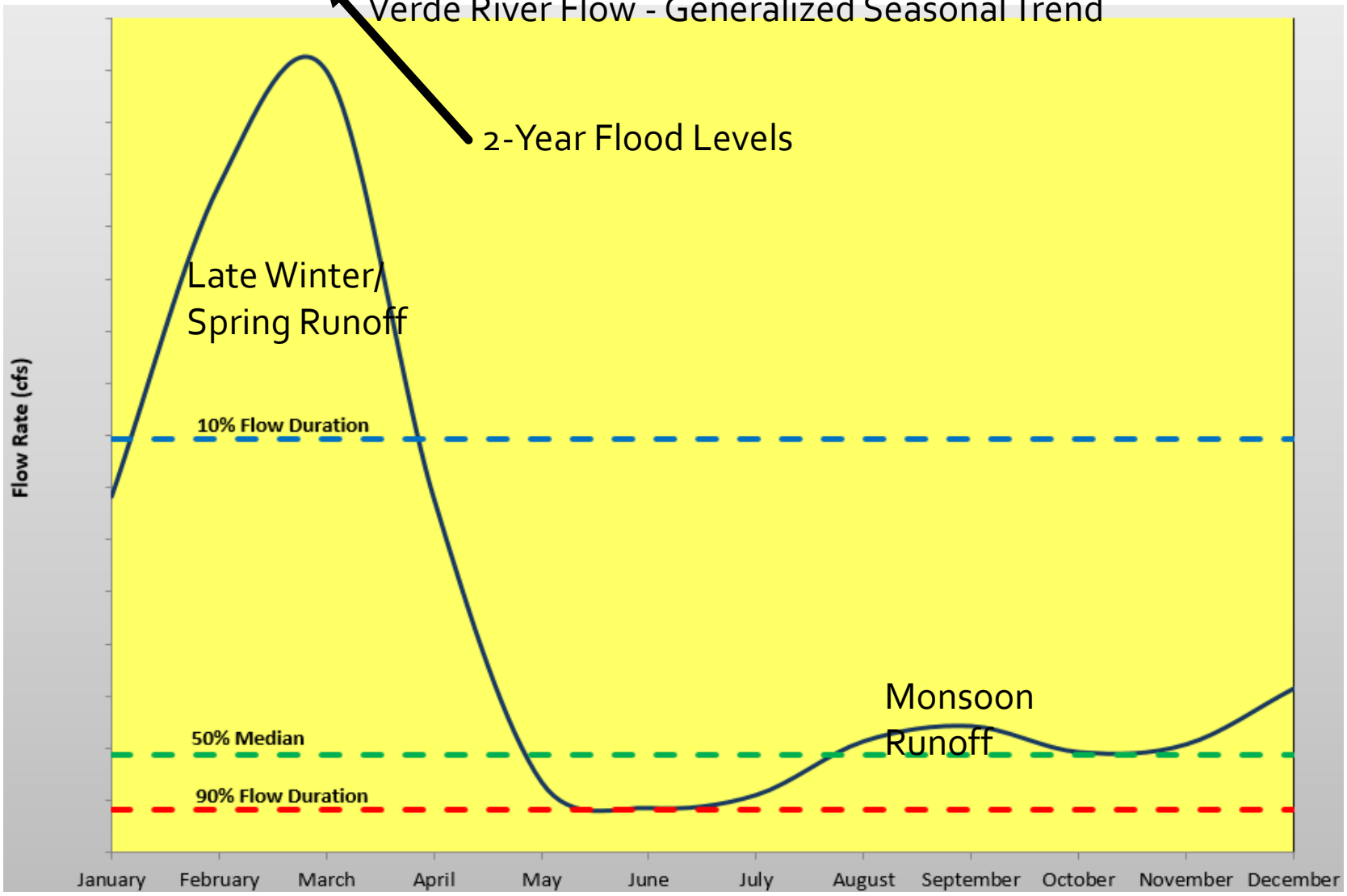
Terminology

- 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"


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 #o

Verde River Segment #0

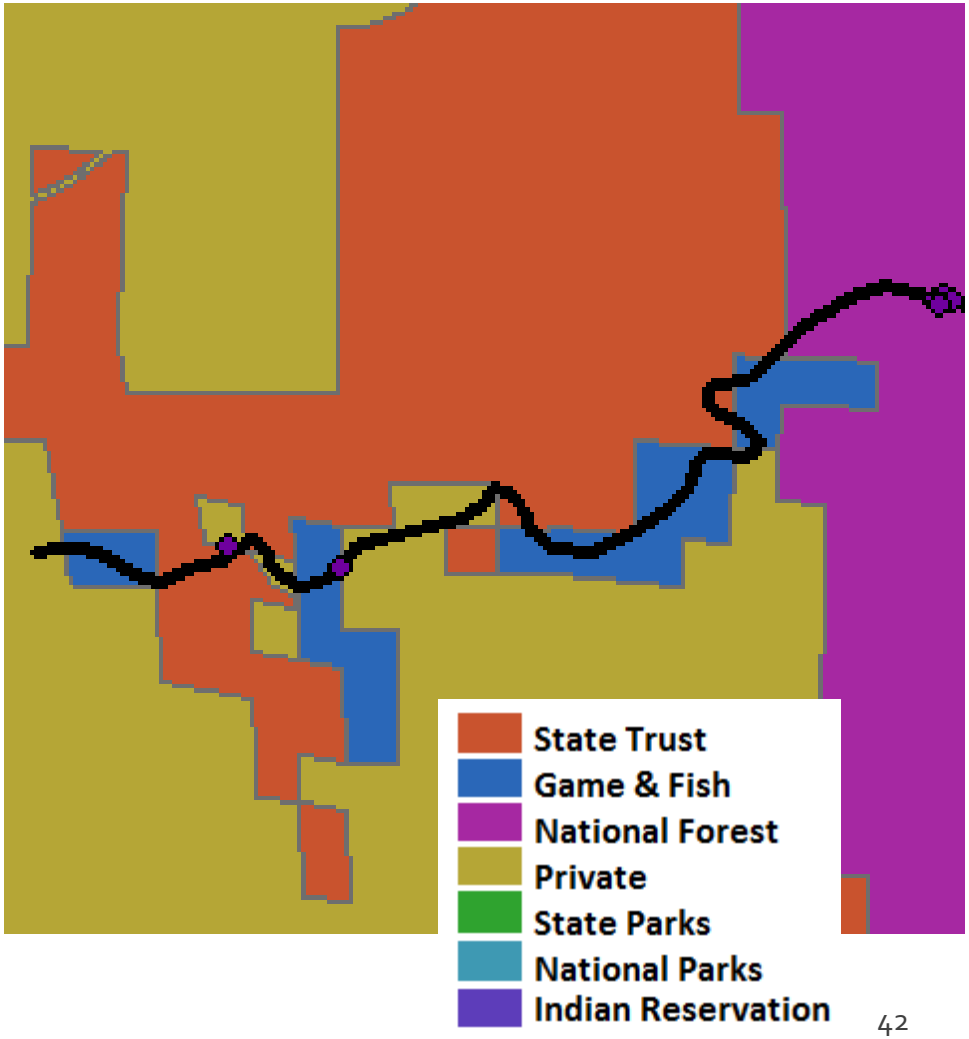
- Verde River Segment #0
  - Sullivan Lake to Forest Road 638
  - Perennial below Granite Creek
  - Channel Characteristics
    - Pool-Drop/Pool & Riffle Pattern
    - Bedrock Canyon
  - Depleted Base Flow Since & Prior to 1912
    - Minimal Other Human Impact
    - Flow Depletions from Ground Water 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 #o

- Land Ownership
  - State Trust, Game & Fish
  - Prescott National Forest
  - Private



Google Earth Flyover

- Verde River, Segment o

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

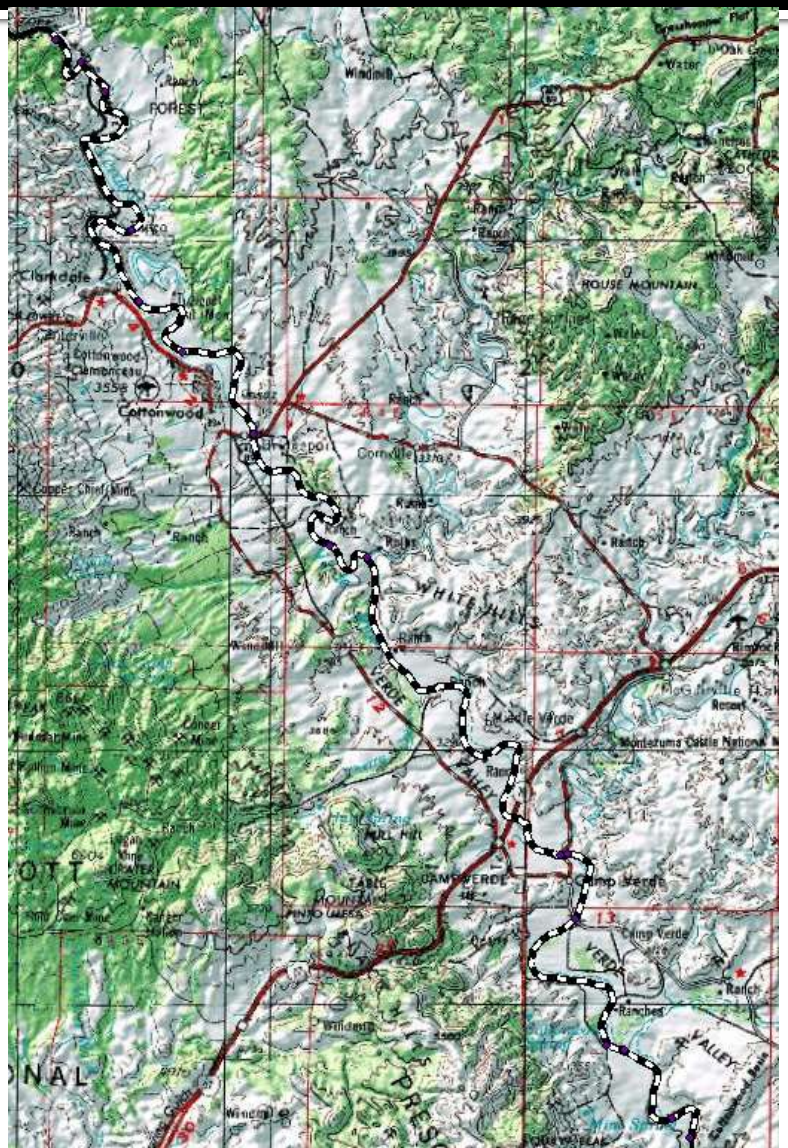
- Land Ownership
  - Prescott National Forest
  - Several Private Inholdings
- Major Tributaries
  - Sycamore Canyon
- Minor Diversions

Google Earth Flyover

- Verde River, Segment 1

Field Photos

Verde River Segment #2

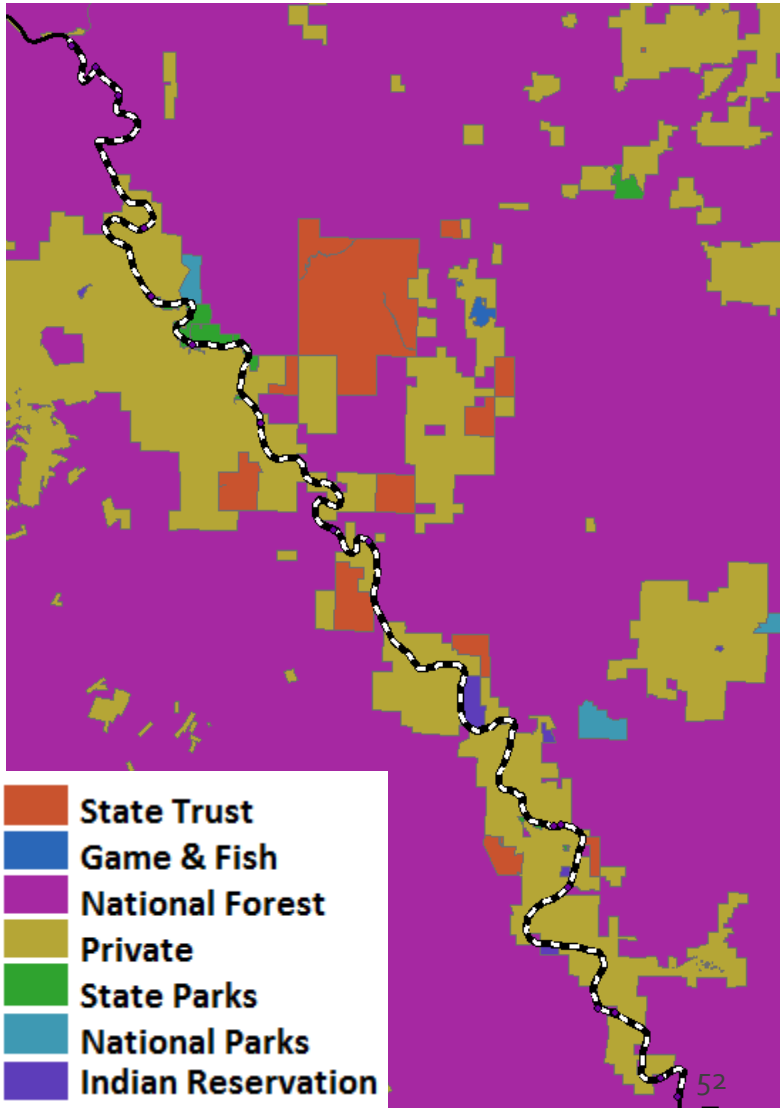


Verde River Segment #2

- 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

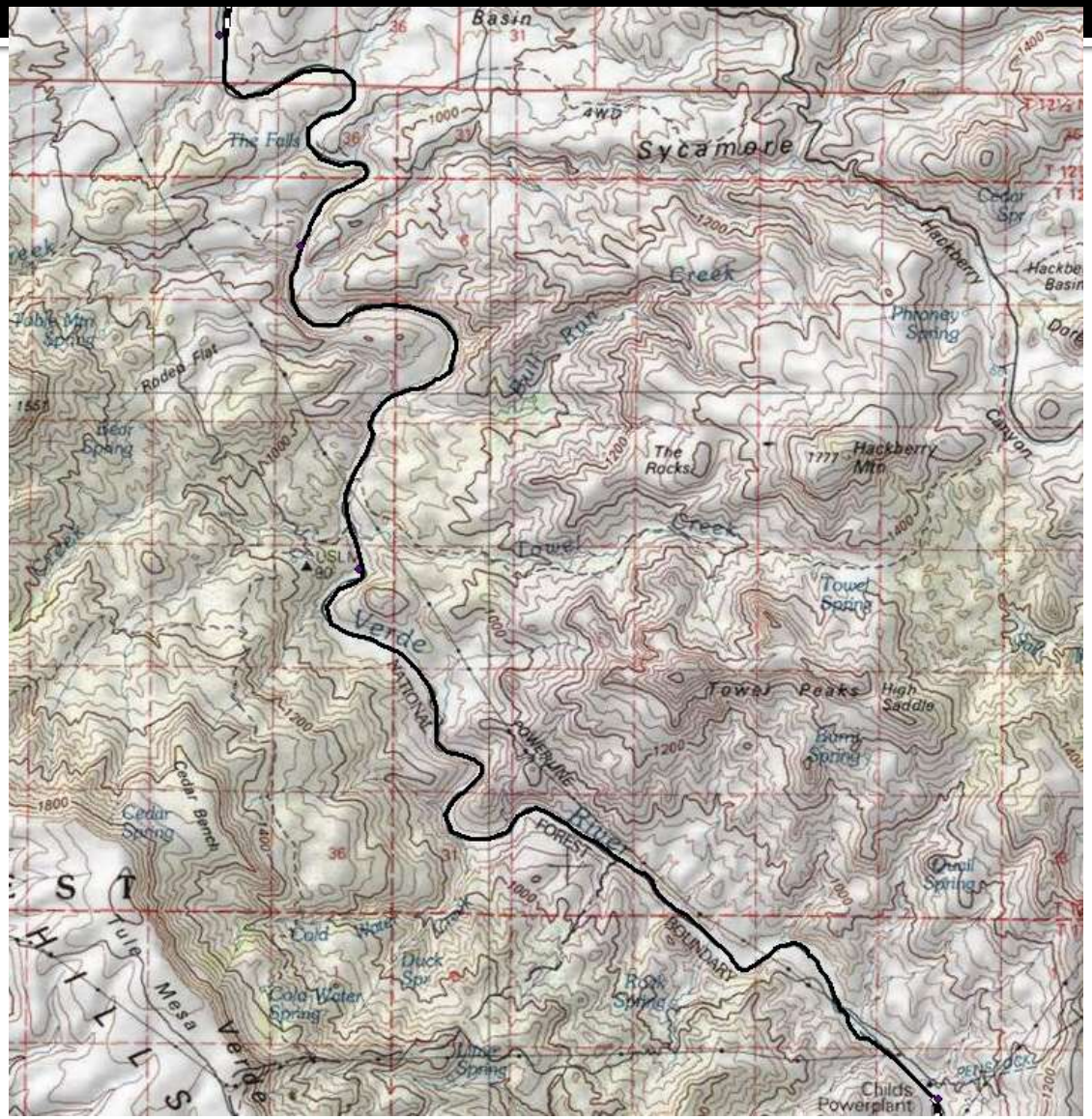


Google Earth Flyover

- Verde River, Segment 2

Field Photos

Verde River Segment #3

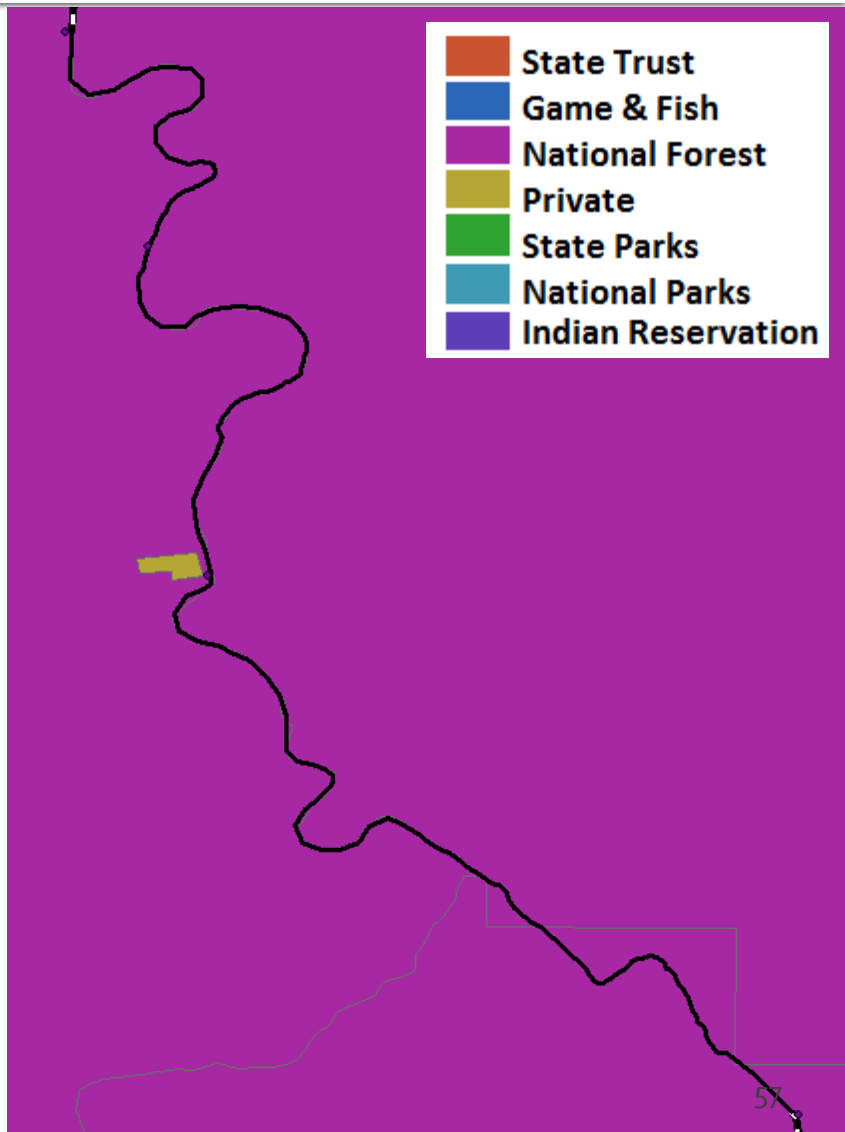


Verde River Segment #3

- 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

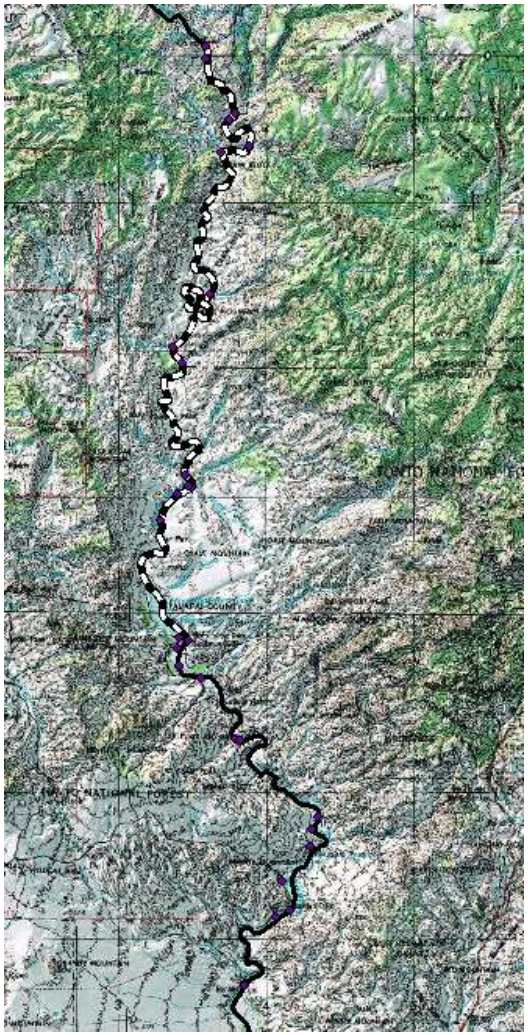


Google Earth Flyover

- Verde River, Segment 3

Field Photos

Verde River Segment #4

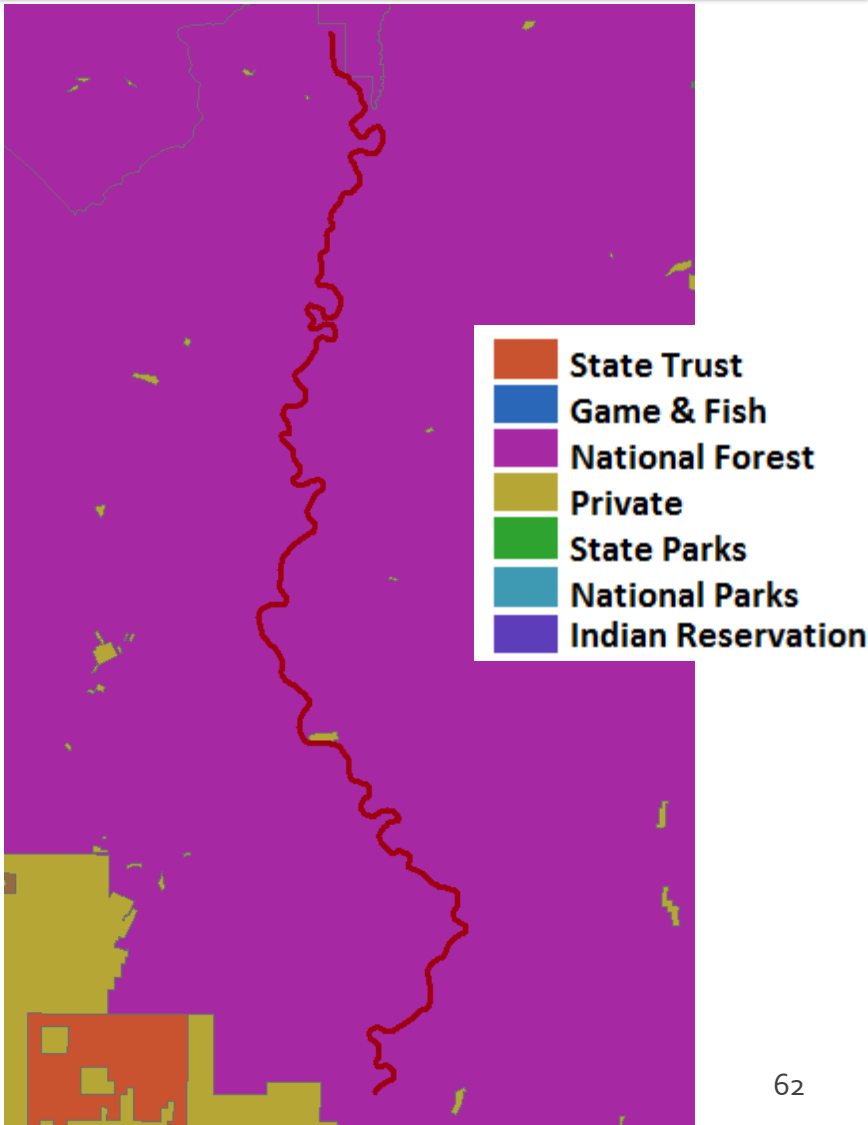


Verde River Segment #4

- 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

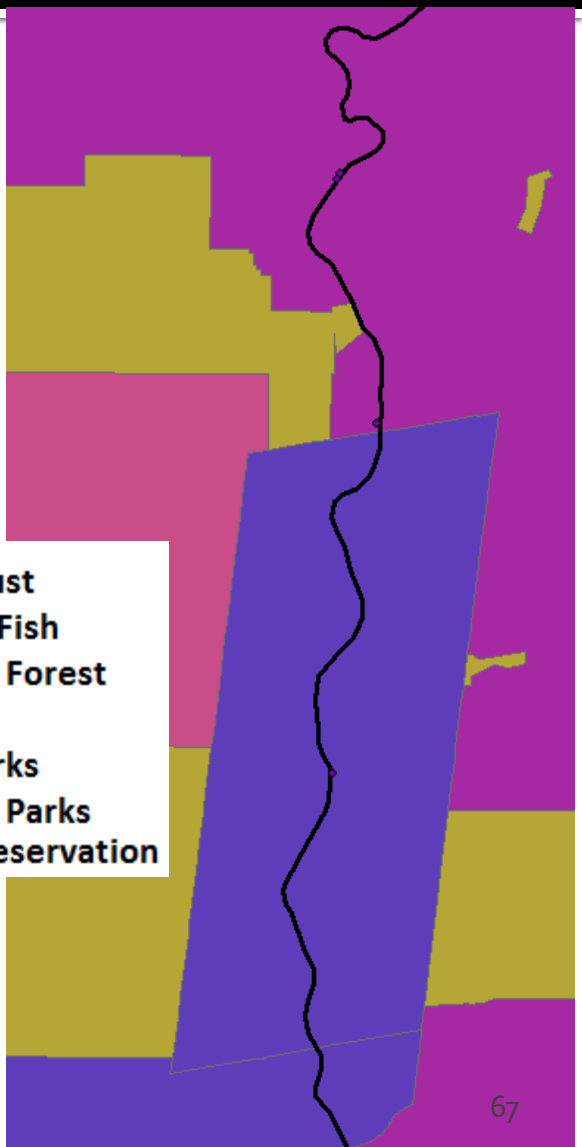
Verde River Segment #5

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

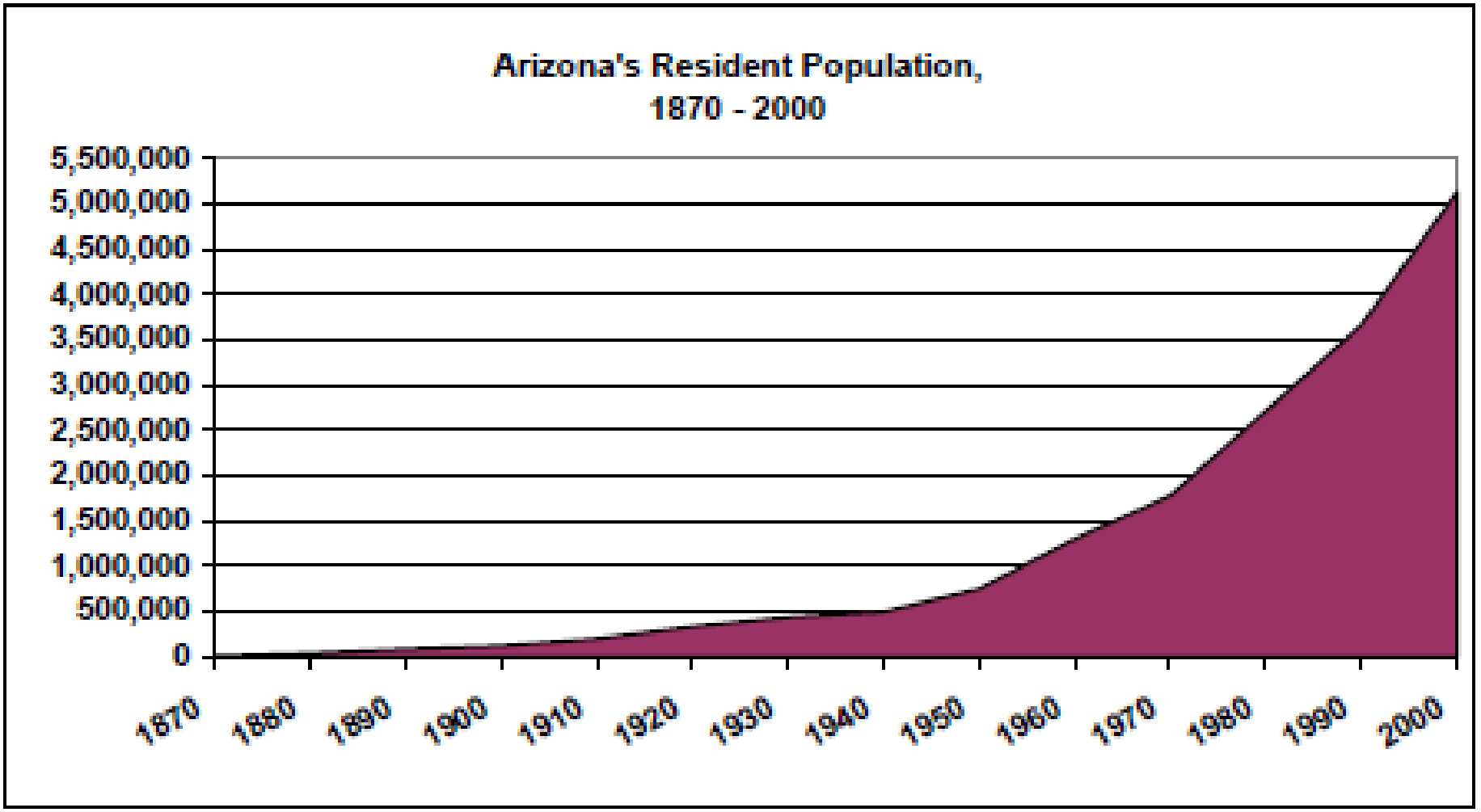
History: Key Findings

- 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)

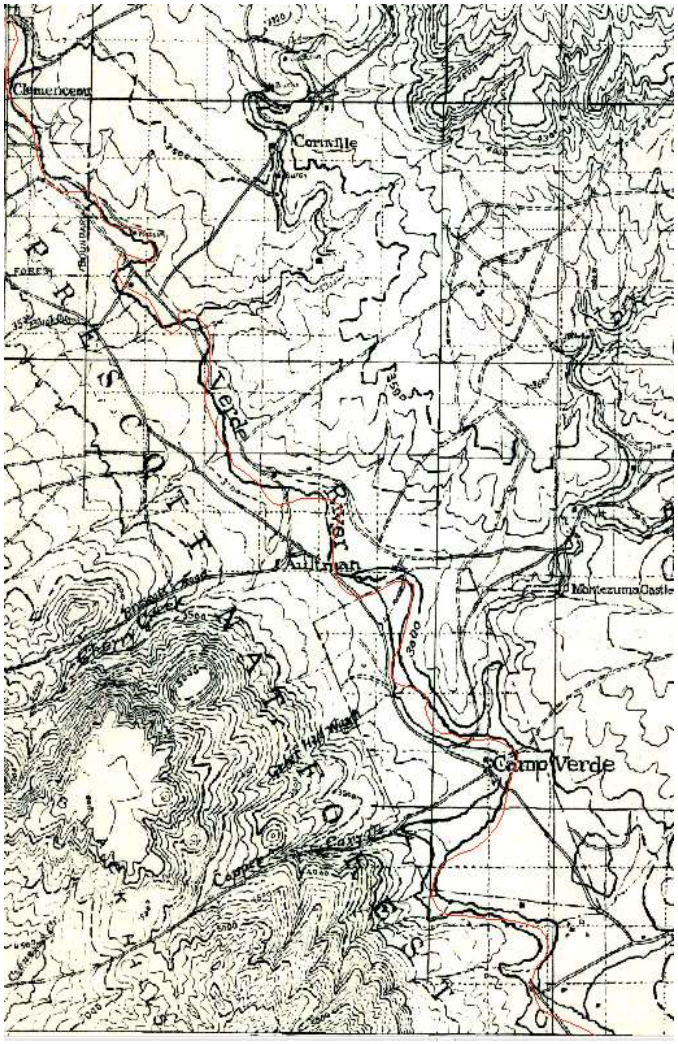
*Ralph Palmer: Verde River … **50 feet wide** and no more than waist deep, with banks two to three feet high* (Palmer, 1979)

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

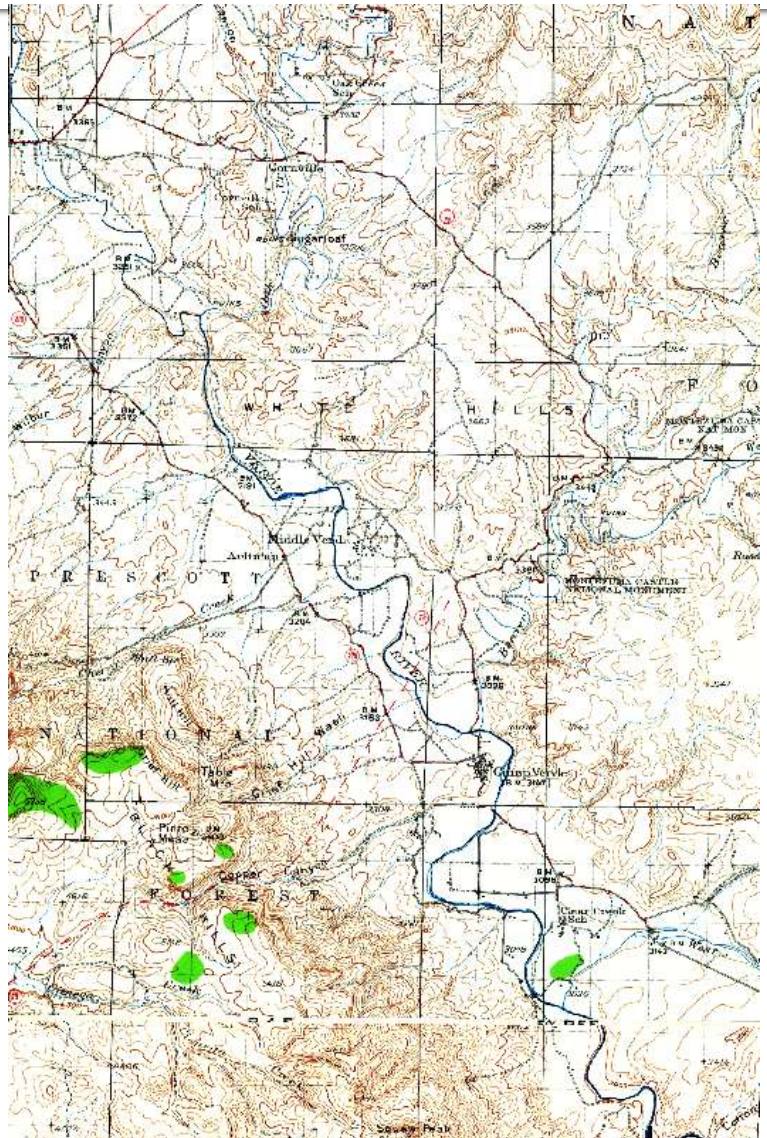
Historical Maps: Segment 2



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

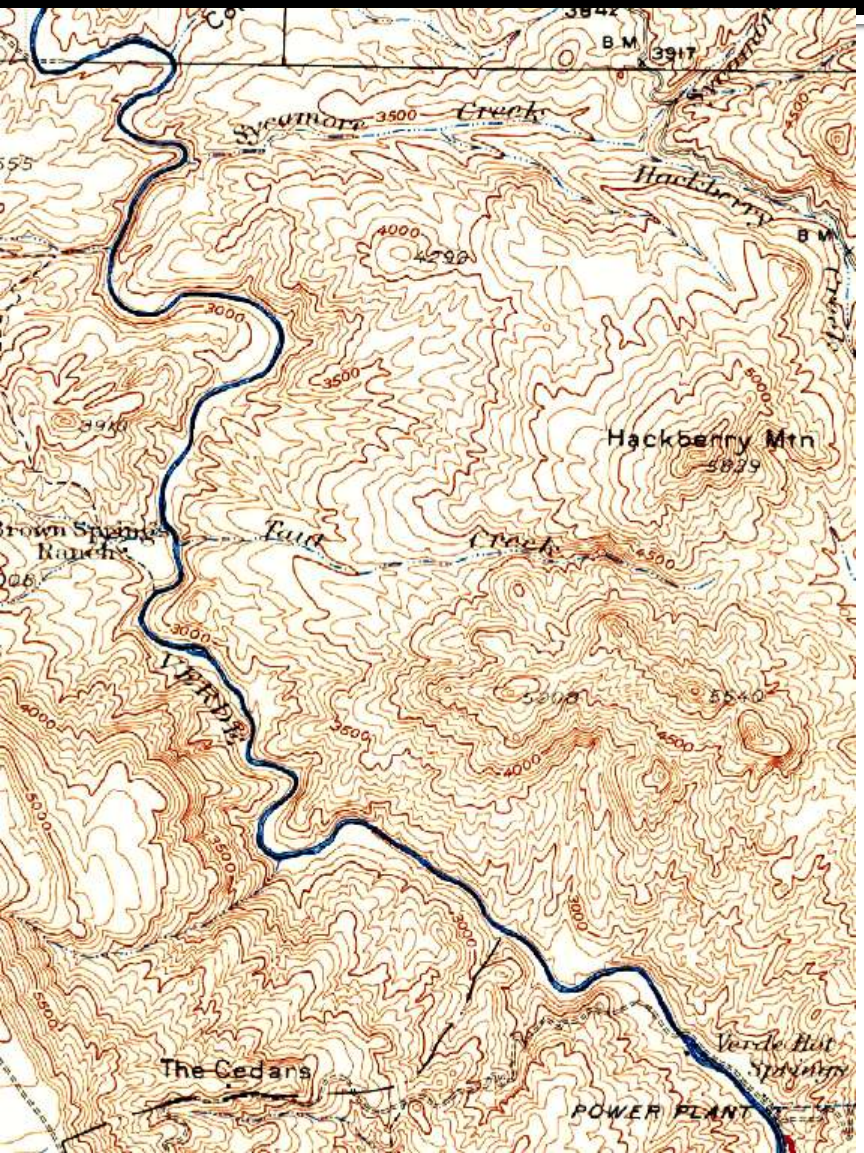
Historical Maps: Segment 2



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

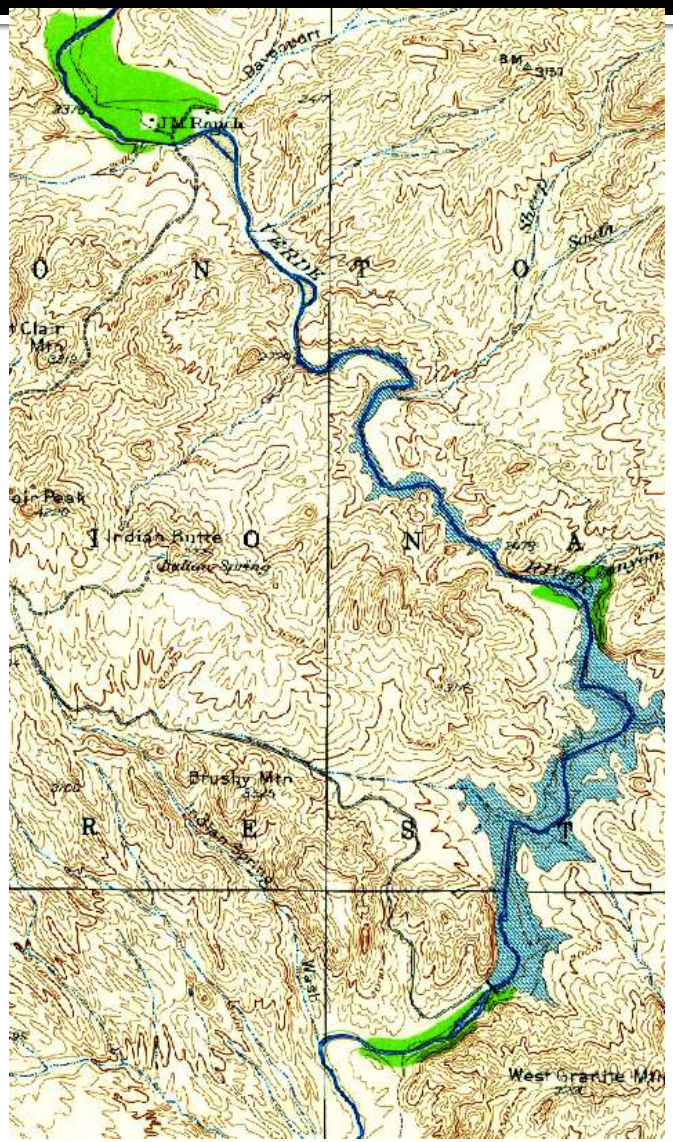
- Verde River shown as single channel
- Solid line
- Channel in same location as 2014
- No rapids listed on map
- No marked crossings
- Communities:
  - Verde Hot Springs

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)

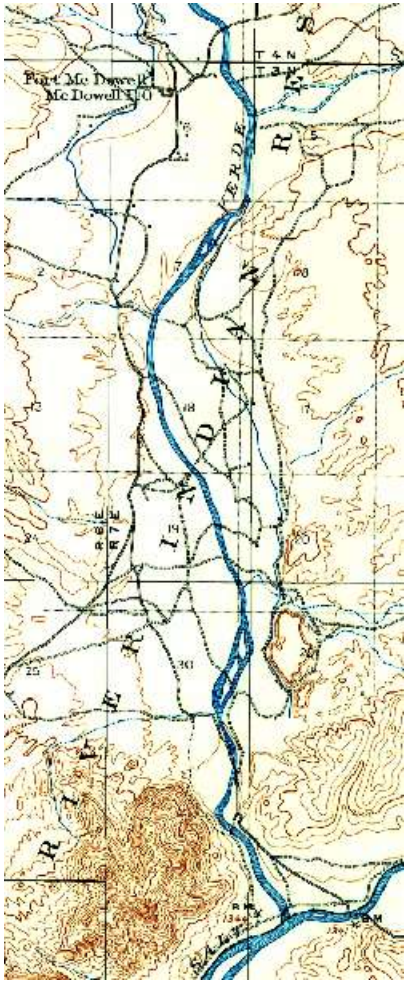
Historical Maps: Segment 4



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.

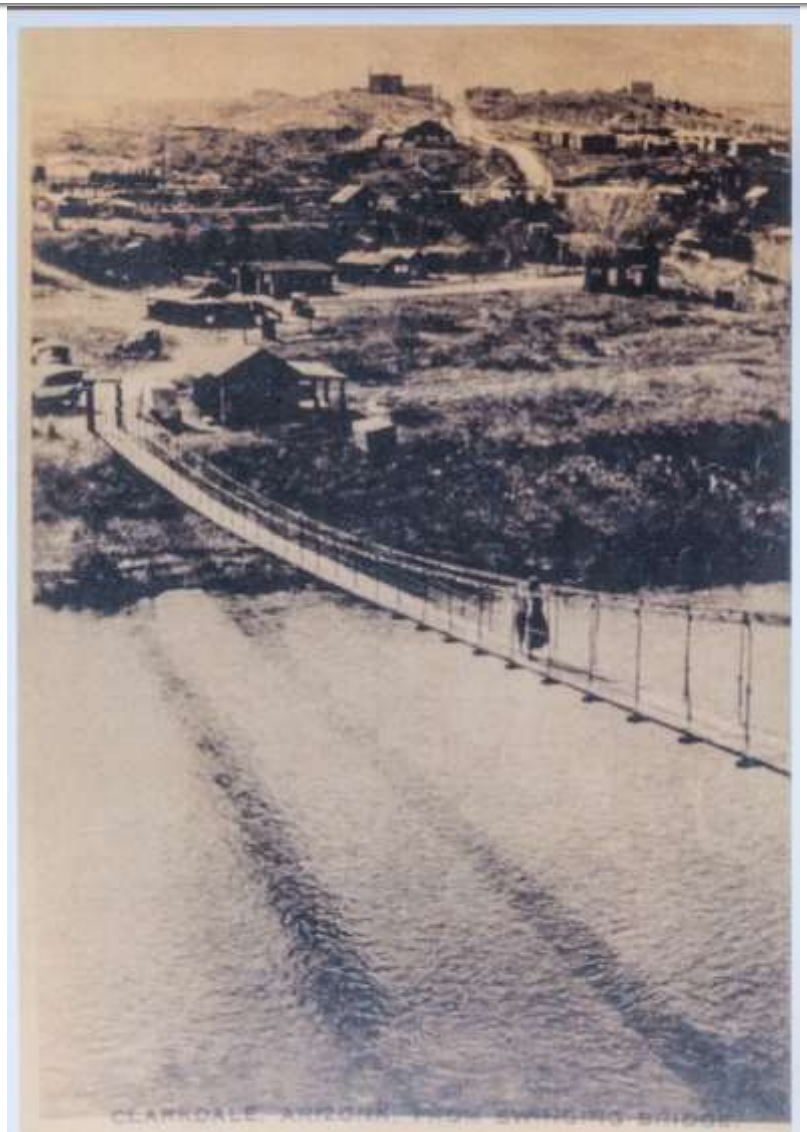
Historical Photographs

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

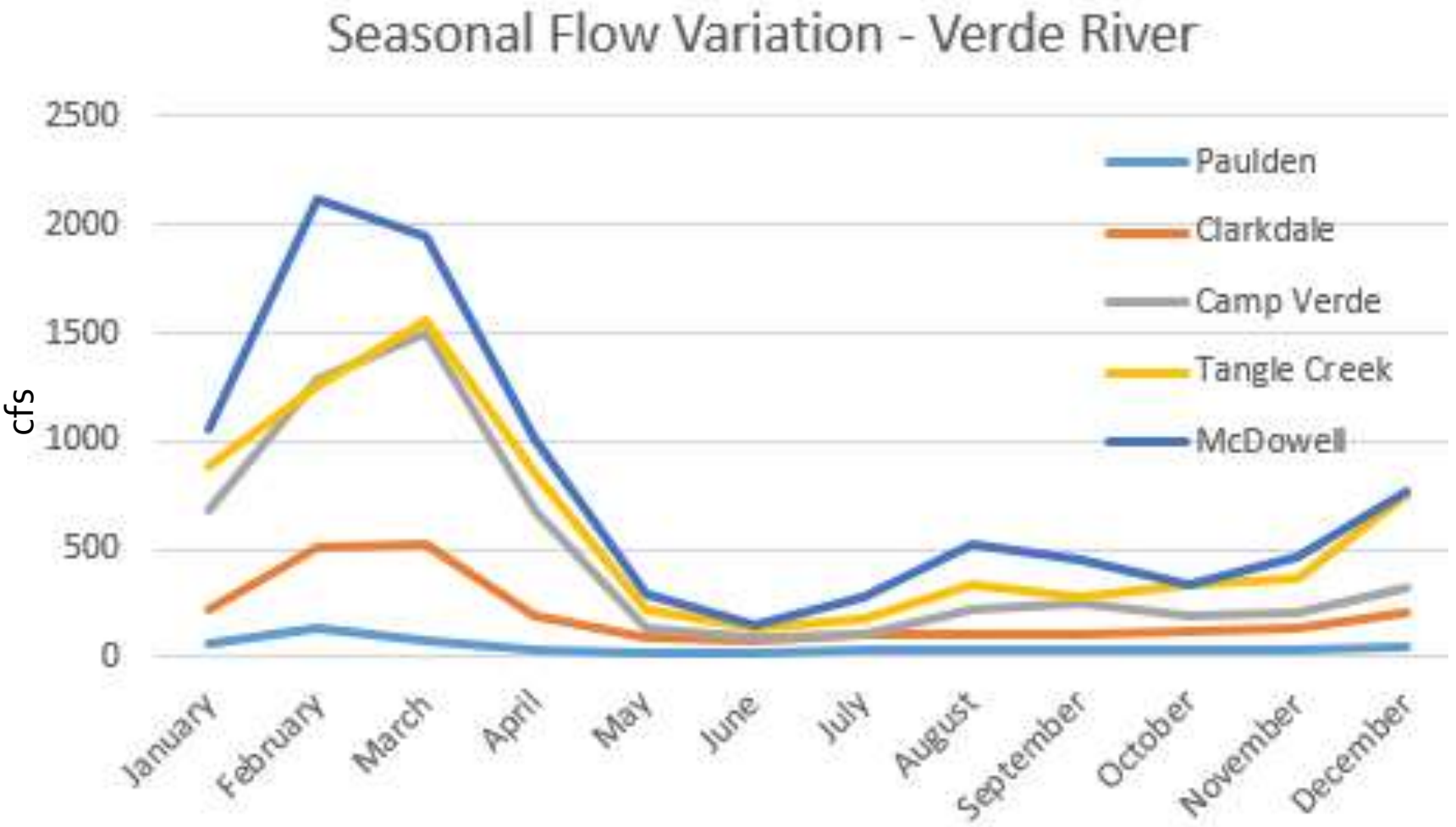
Verde River Hydrology

- 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.					

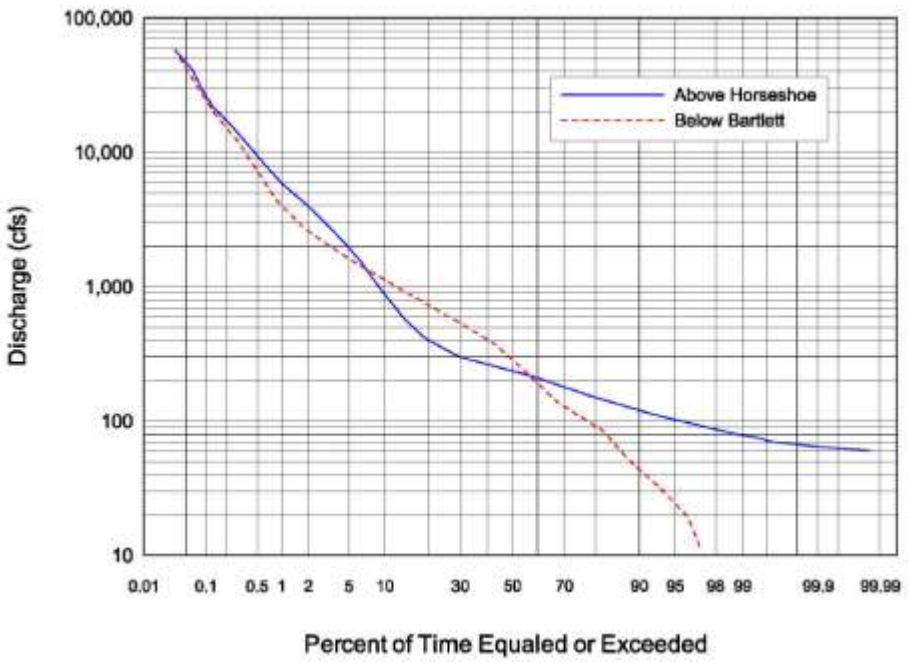
Verde River Hydrology



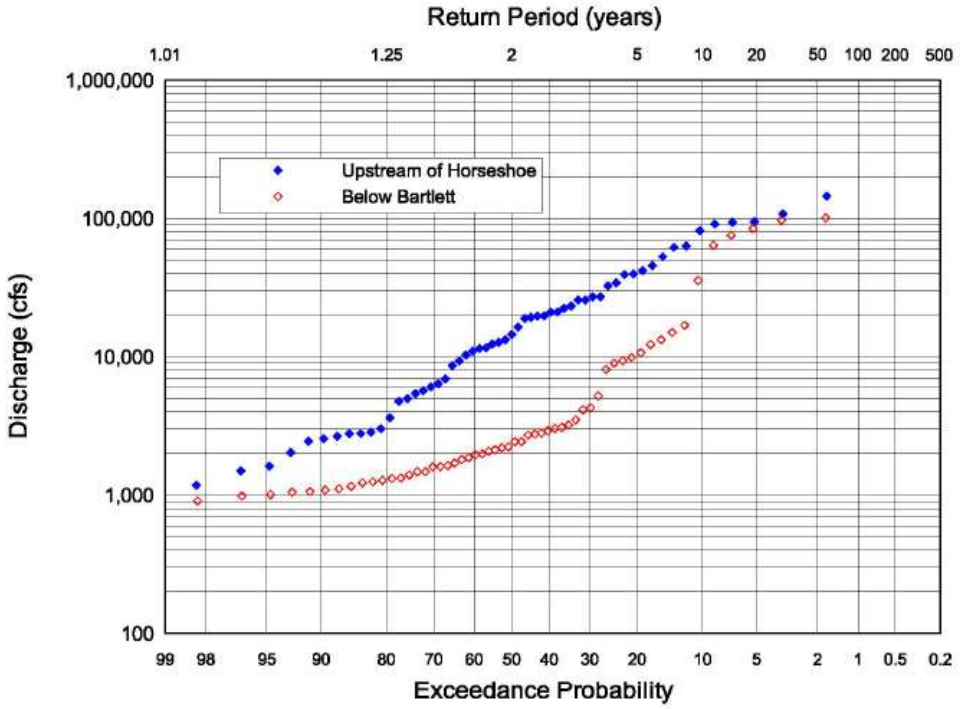
Verde River Hydrology

- 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



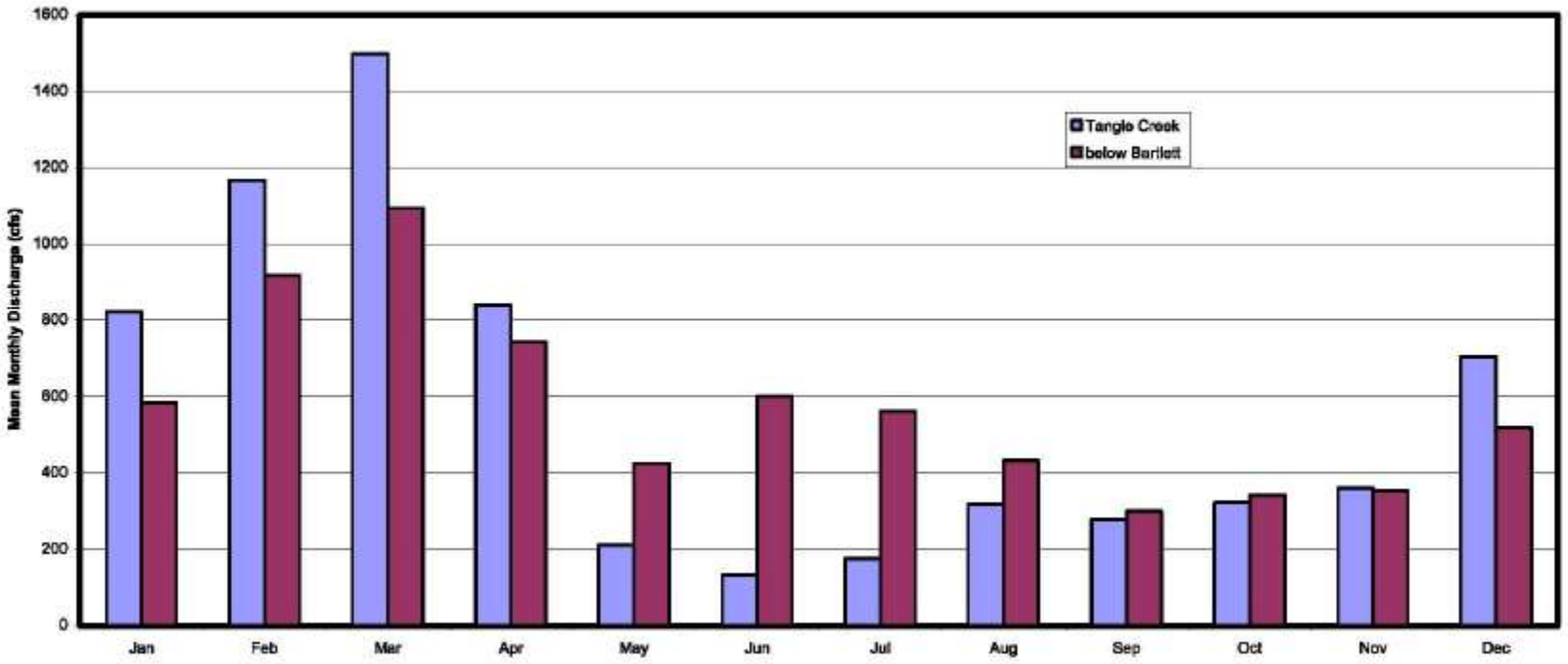
Change in Flow Duration Due to Dams



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 o

- Not Boatable by 1912-Era Watercraft
  - Insufficient Flow
  - Non-Conducive Channel Conditions
    - Extremely bouldery

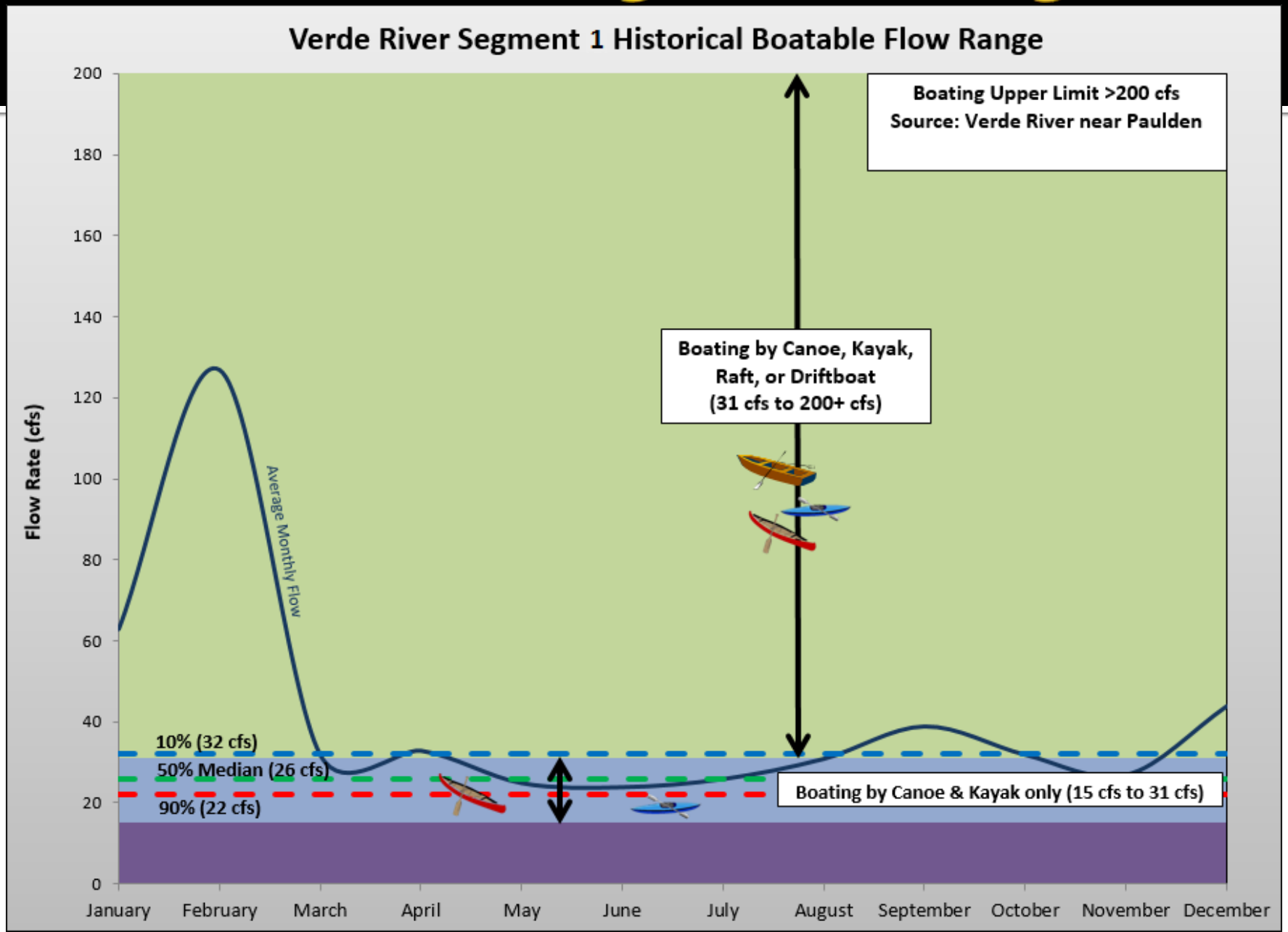
Verde River Segment #o

- 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



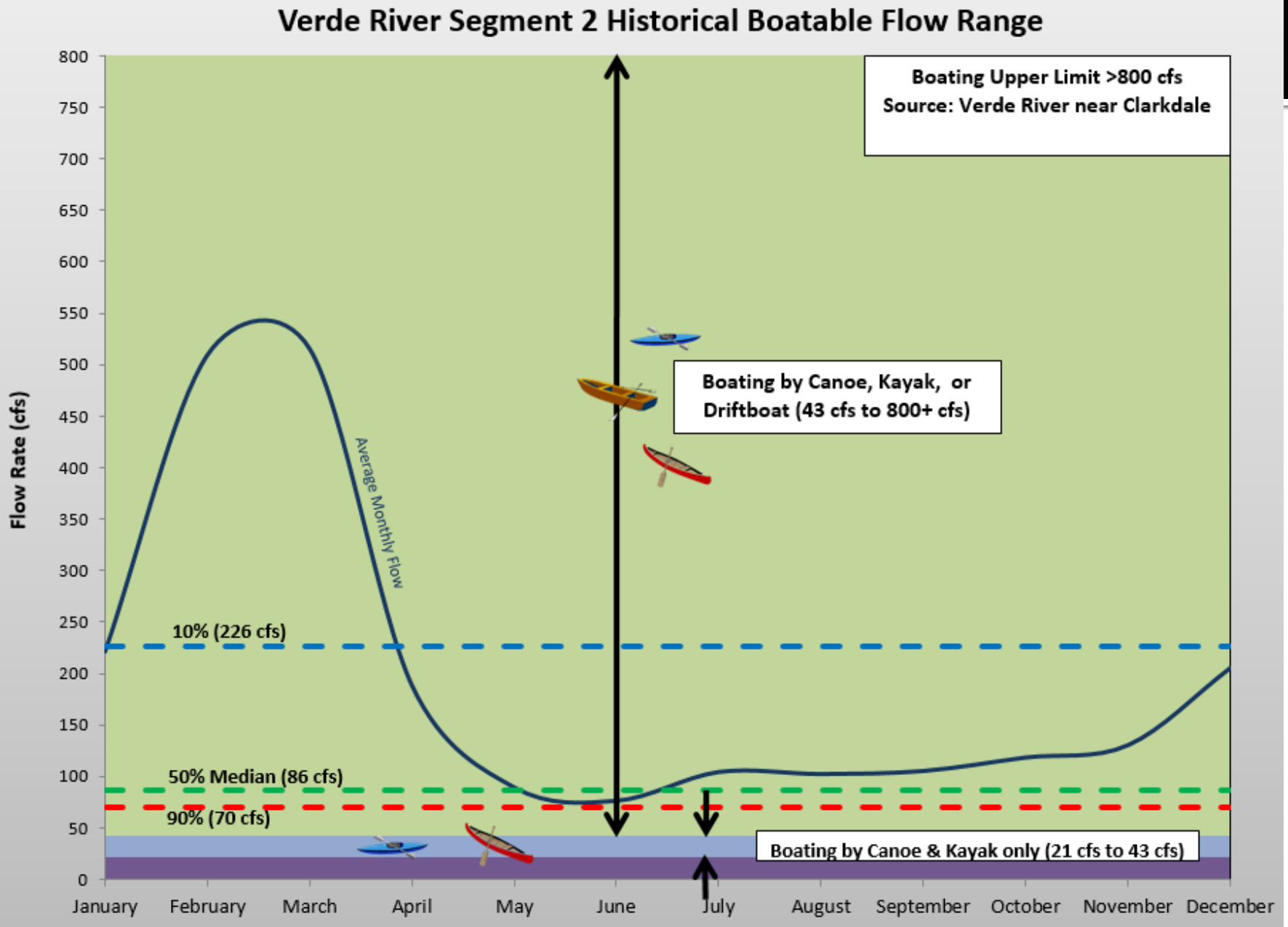
Verde River Segment #1

- 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



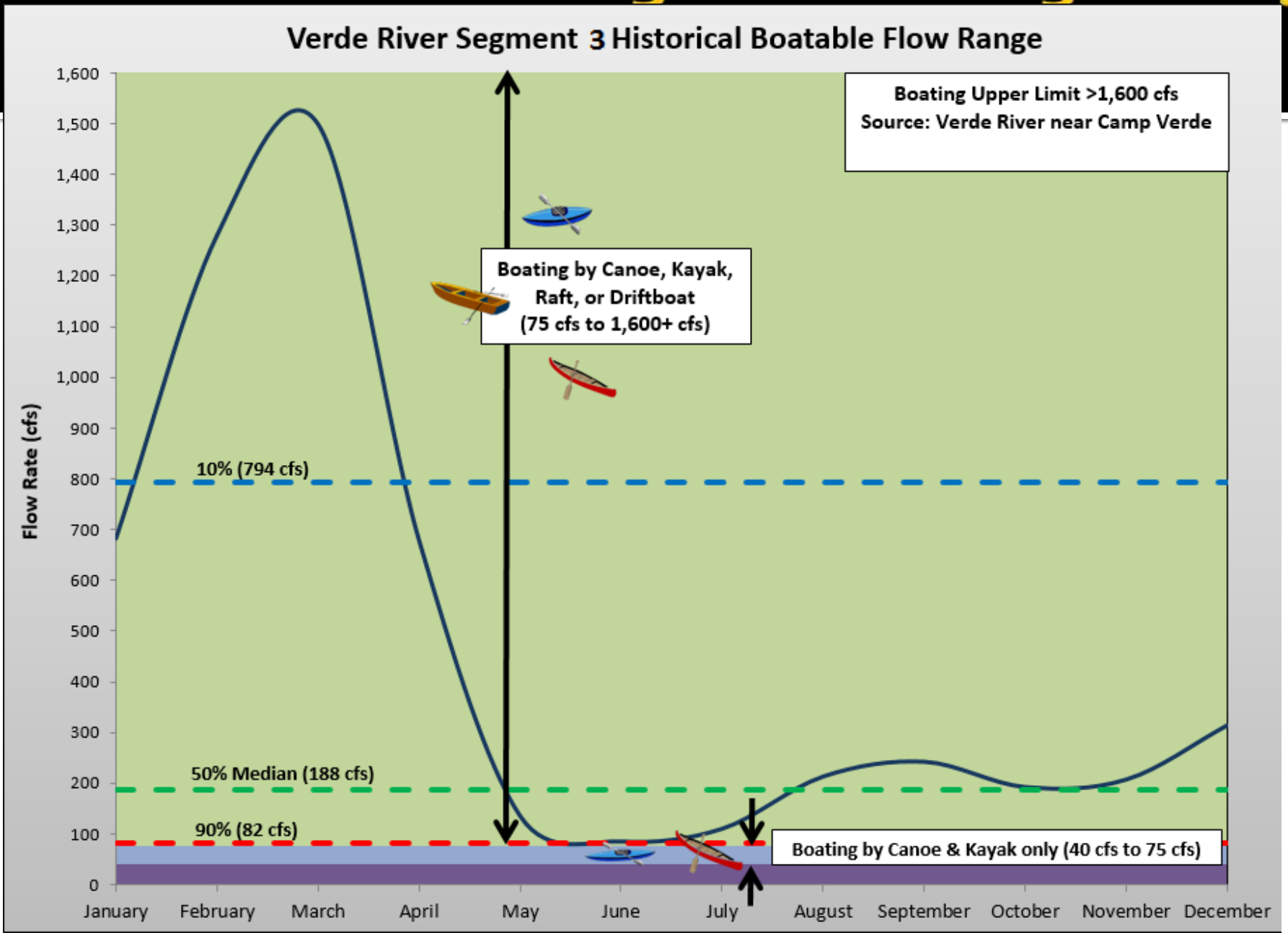
Verde River Segment #2

- 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



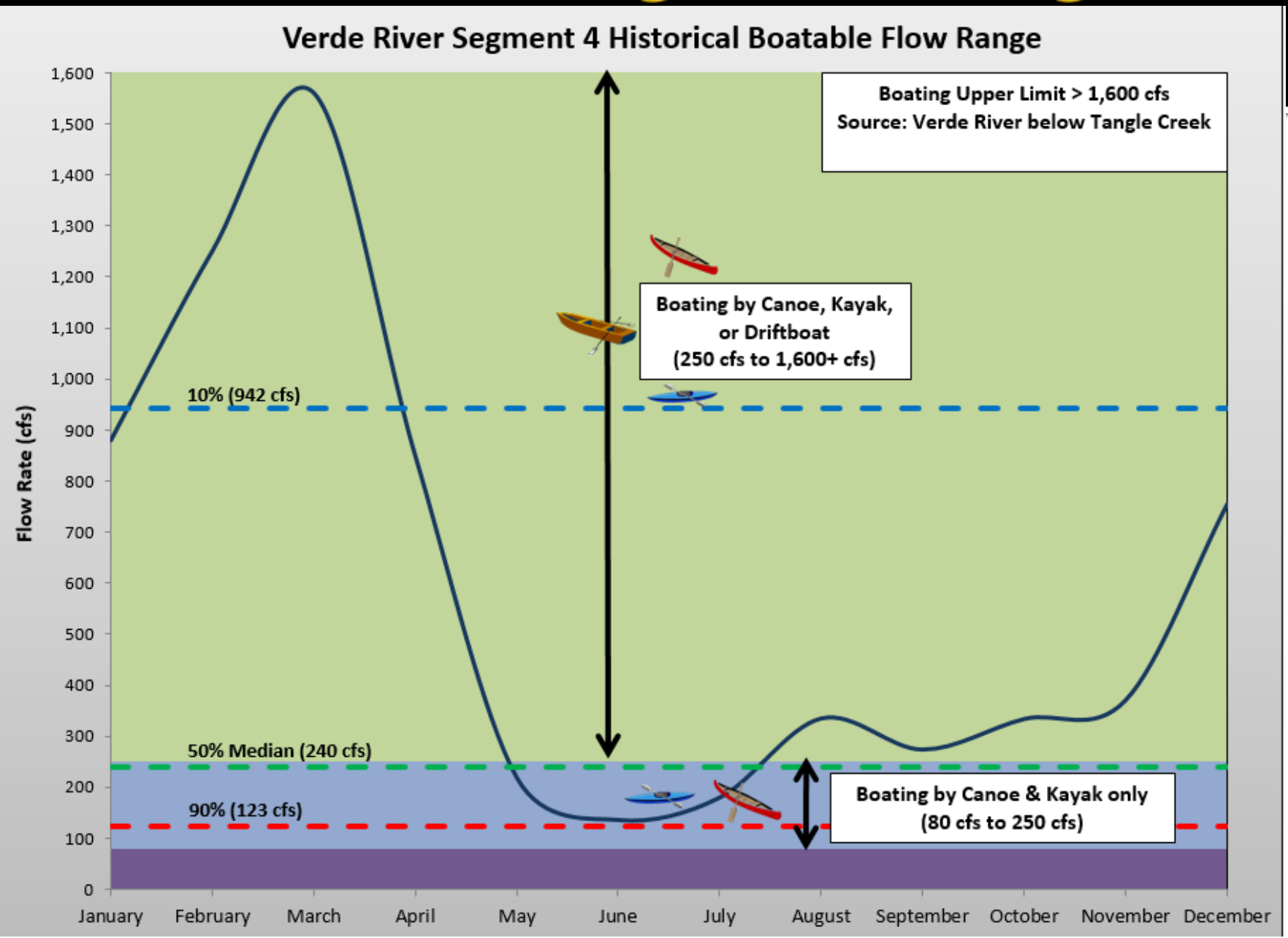
Verde River Segment #3

- 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



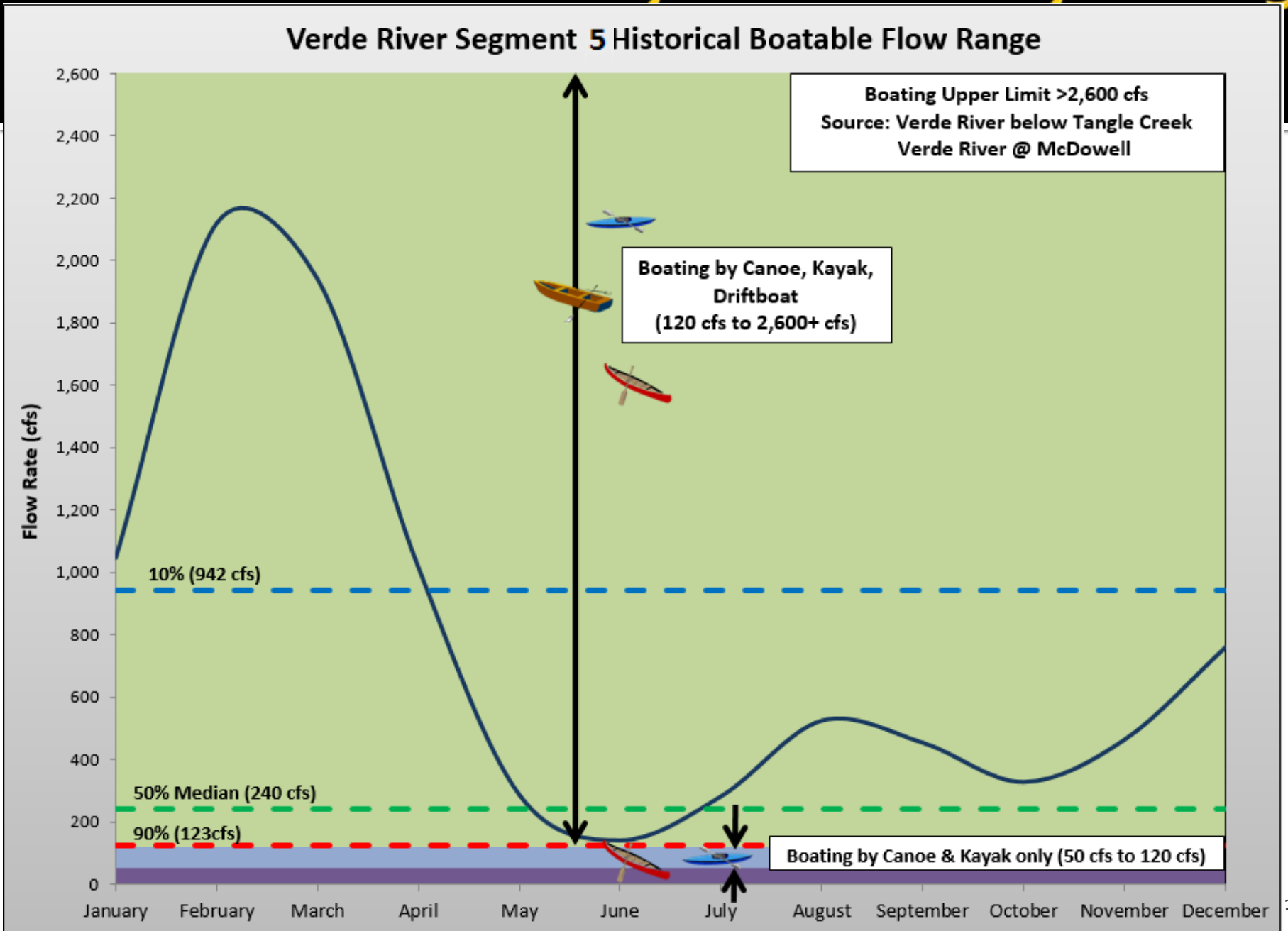
Verde River Segment #4

- 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

VERDE RIVER
CANOE CHALLENGE

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 2008 in the Cascade. — with Sam Fuller.

Share

Kerry Elizabeth Williams likes this.

Marilyn Copeland Love that truck-driver tan you're sporting. Or are you wearing a short sleeve white t-shirt?
June 16, 2009 at 12:25pm

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Hey, shoe lovers! Snag your fave styles for just $29.99-$69.99—only at Macy's! Code: BTS

Jon Fuller
October 31, 2008

Sam & me in the Verde River Race 2007 (Rogue)

Share

2 people like this.

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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

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Jay Bouwkamp likes this.

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Modern Boating

- Verde RiverFest
- Verde River Days
- Verde River Runoff

Modern Boating: Guided Trips

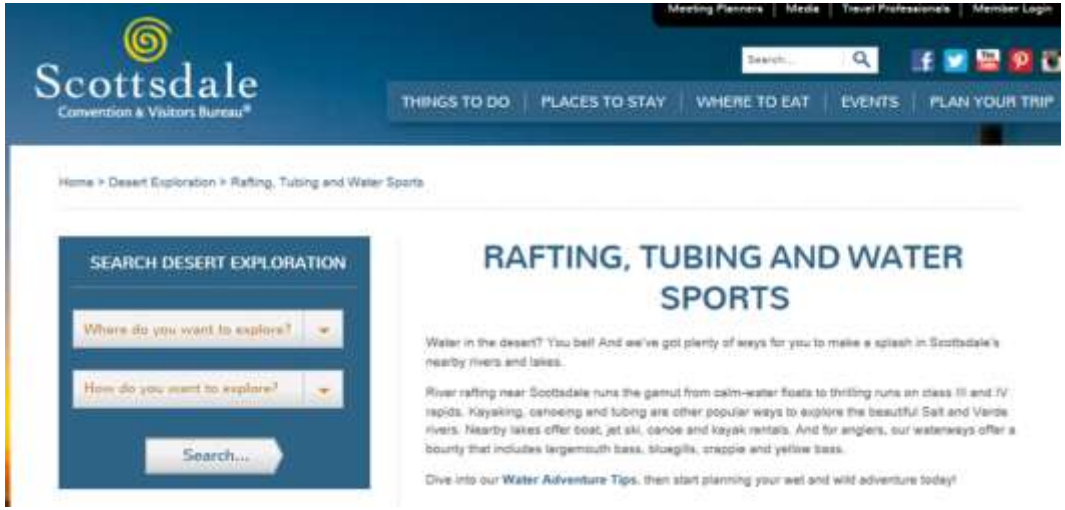
New Guided Trip on the Verde River at Clarkdale

We also offer guided trips on the Lower Verde River.

Sedona Adventure Tours, Arizona Outback Adventures, Verde Valley Kayak Rentals

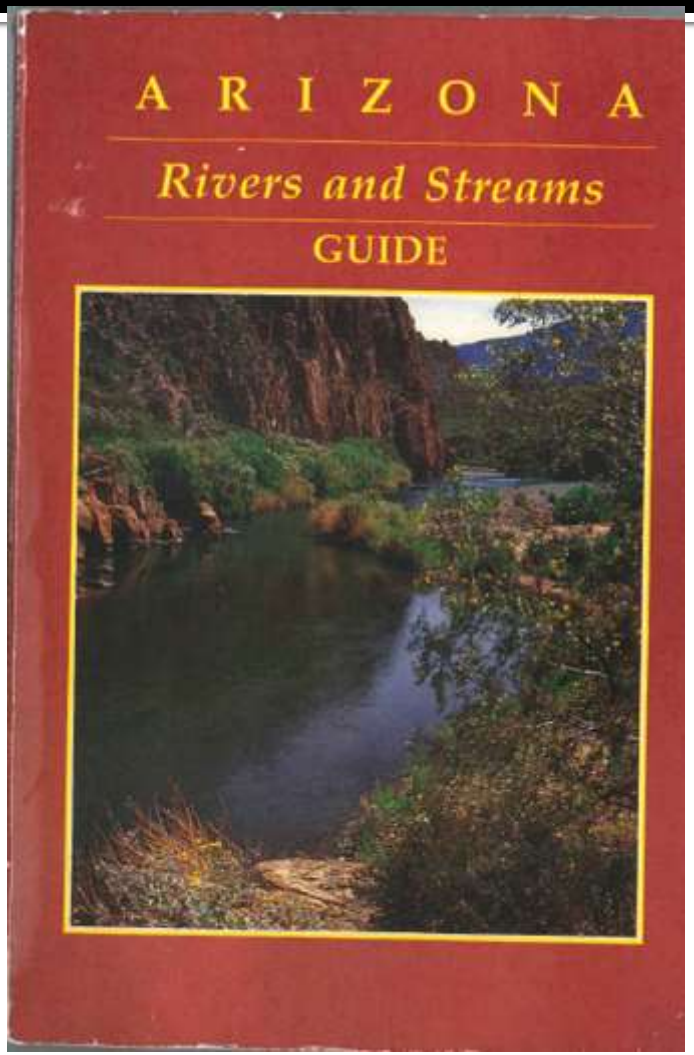
Modern Boating: City Websites

City of Sedona
City of Scottsdale
Town of Camp Verde
Town of Clarkdale
Town of Cottonwood



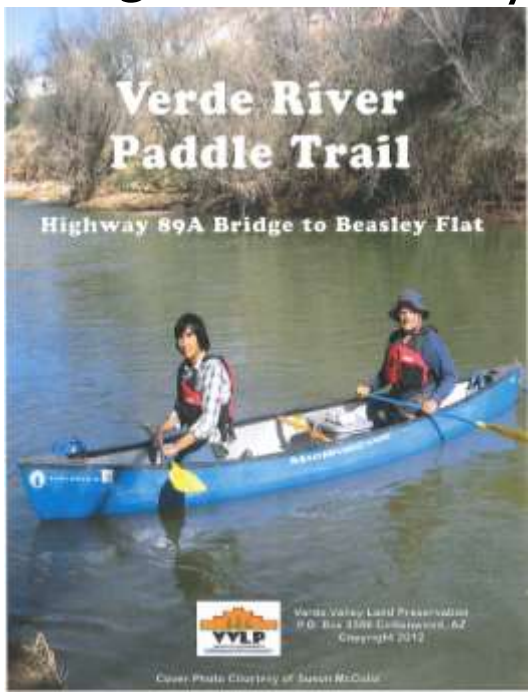
Modern Boating Guides

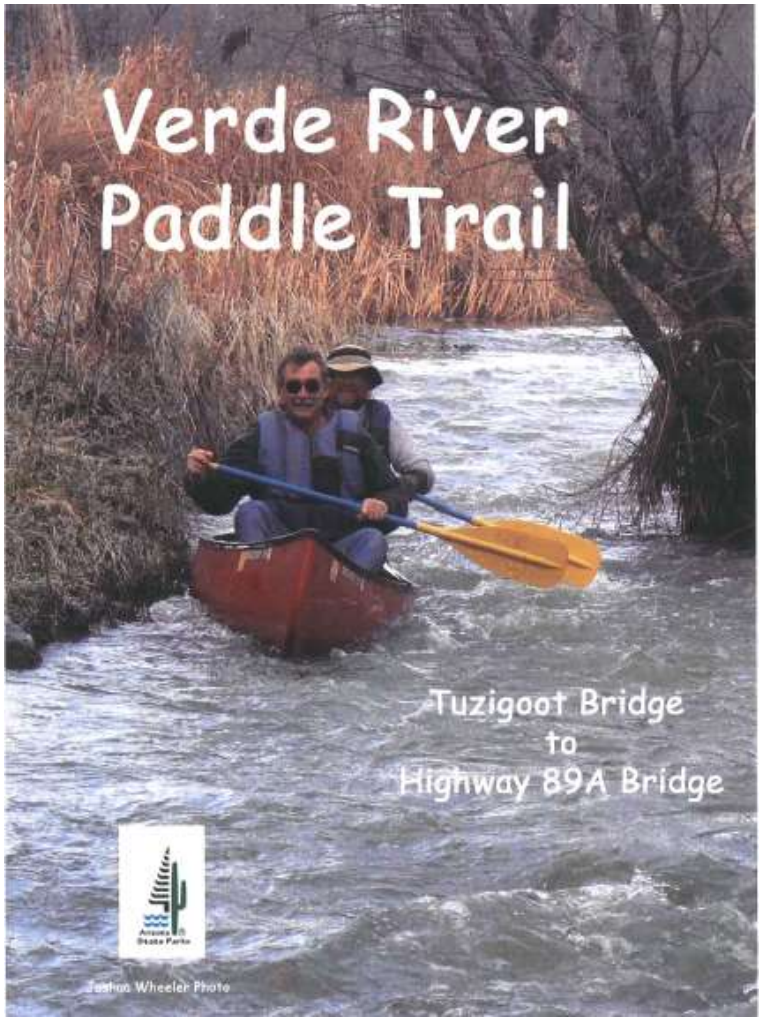
- Arizona State Parks
  - Perkinsville to Salt River
  - Class I-III



Modern Boating Guides

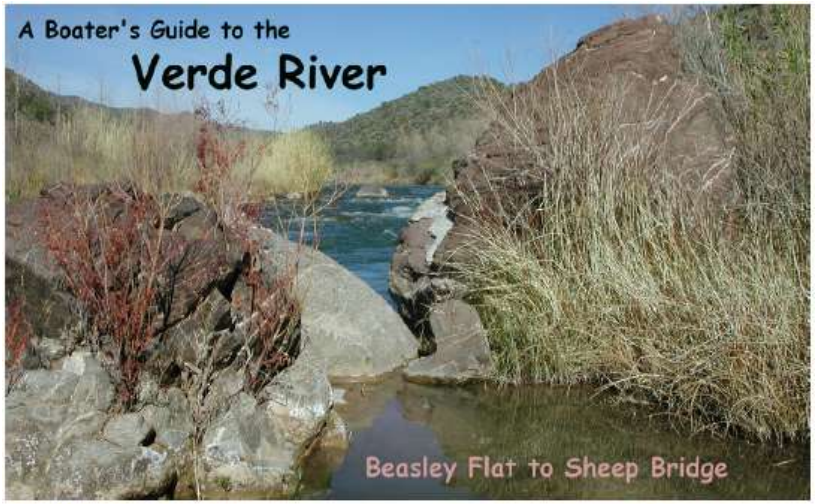
- Arizona State Parks
  - Tuzigoot to SR89A
  - SR89A to Beasley Flat



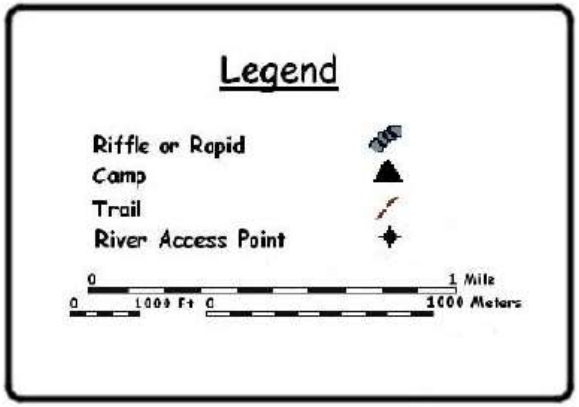


Modern Boating Guides

- 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

Modern Boating

Modern Boating

Modern Boating

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
  - Existed in February 1912
  - Was used as highway of commerce
  - Was susceptible to use as highway of commerce
    - For trade and travel on water
    - By customary modes of 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)**