

Arizona State Land Department
June 11, 2014

Presentation to ANSAC: Gila 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

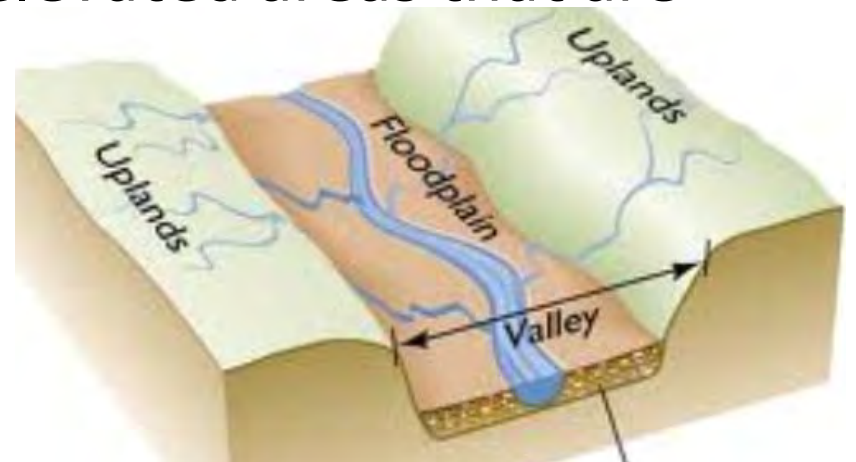
- Note on Evidence
 - Not all evidence submitted by ASLD will be discussed today
 - Incorporate evidence from previous hearings and filings by reference
 - AZAGO Submittals & ASLD Reports (all rivers)

Presentation Overview

- Navigability Studies
 - Arizona: 1992-2014
 - All Major River Systems
 - 30,000+ Small & Minor Watercourses
 - Alaska, Rocky Mountain States, East Coast
- Professional Experience (30 yrs in Arizona)
 - Hydrologist (PH)
 - Civil Engineer (PE)
 - Geomorphologist (RG)
- Boating Experience
 - Canoe, Kayak, Raft
 - AZ (Gila, Salt, Verde, Virgin, San Francisco, Colorado)
 - NM, CO, UT, CA, AK, NC, GA, SC, TN, NY, MI, WI

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

- 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 (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.

Gila River @ Arlington, AZ



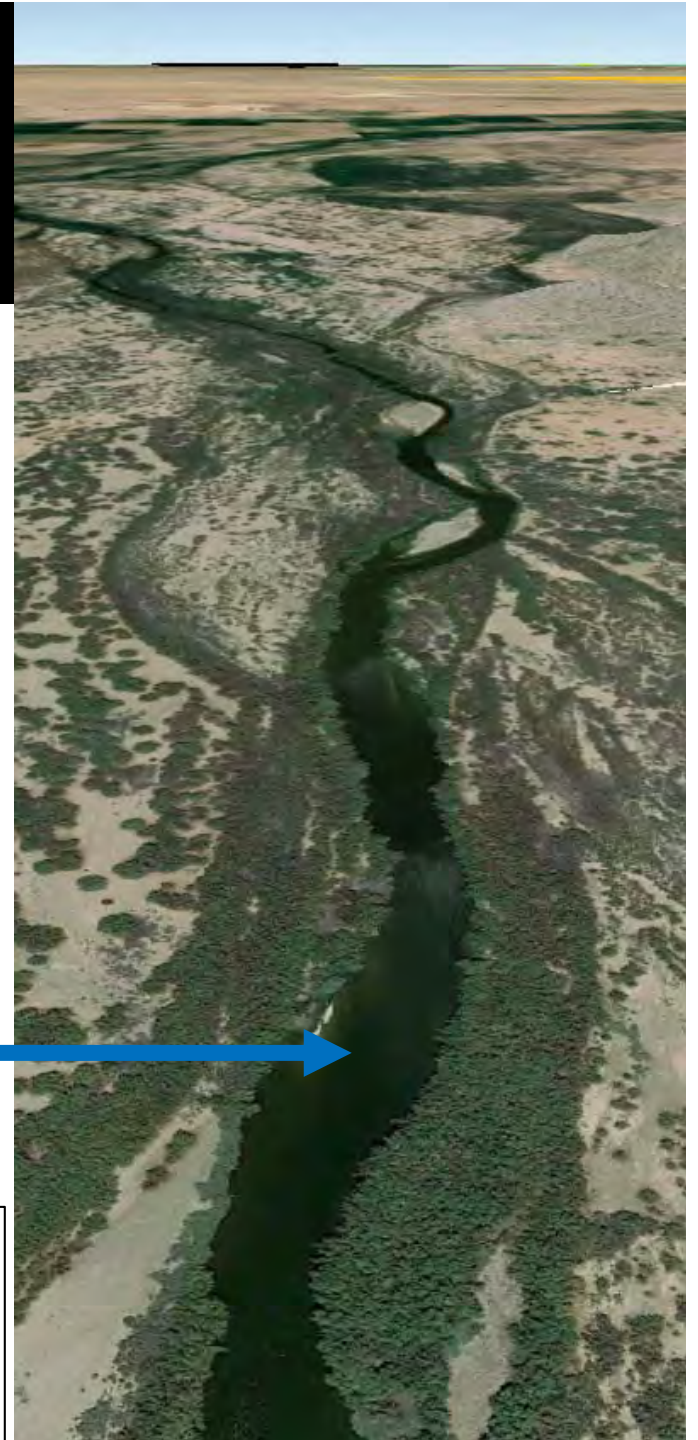
Compound Channels

Gila River @ Arlington, AZ

<< Braided Flood Channel

Non-braided main channel >>

Boating occurs on ordinary flows in the main channel, which is a subset of the flood channel.



Terminology

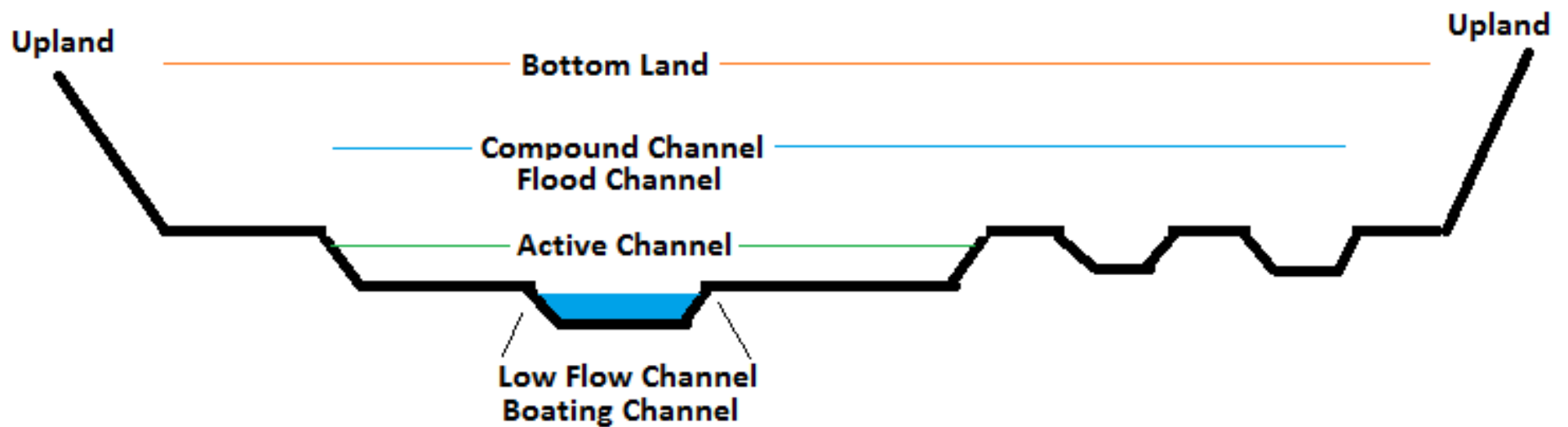
- US Army Corps of Engineers:
“...the most common channel type in dry regions, compound channels are characterized by a single, low-flow meandering channel inserted into a wider braided channel network.”

Source: Waters & Ravesloot, p. 293, as cited in Gookin, 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



Terminology



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



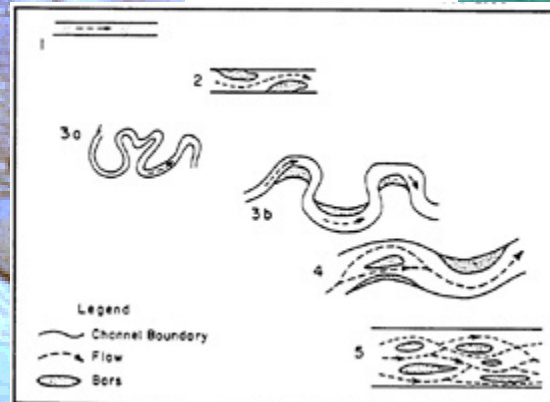
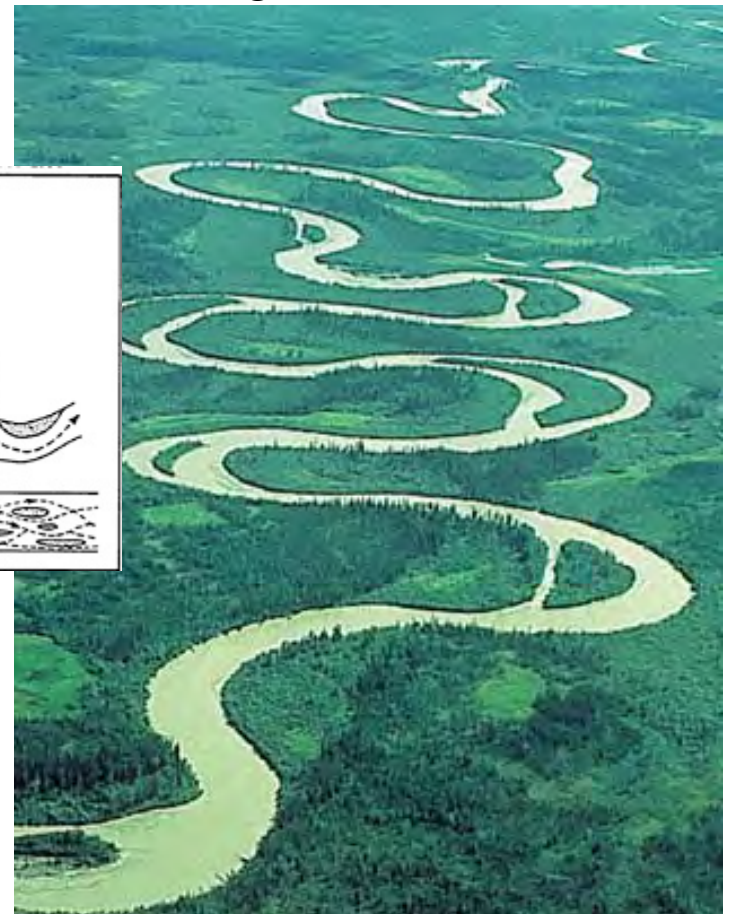
Terminology

- Common Channel Patterns

Braided



Meandering



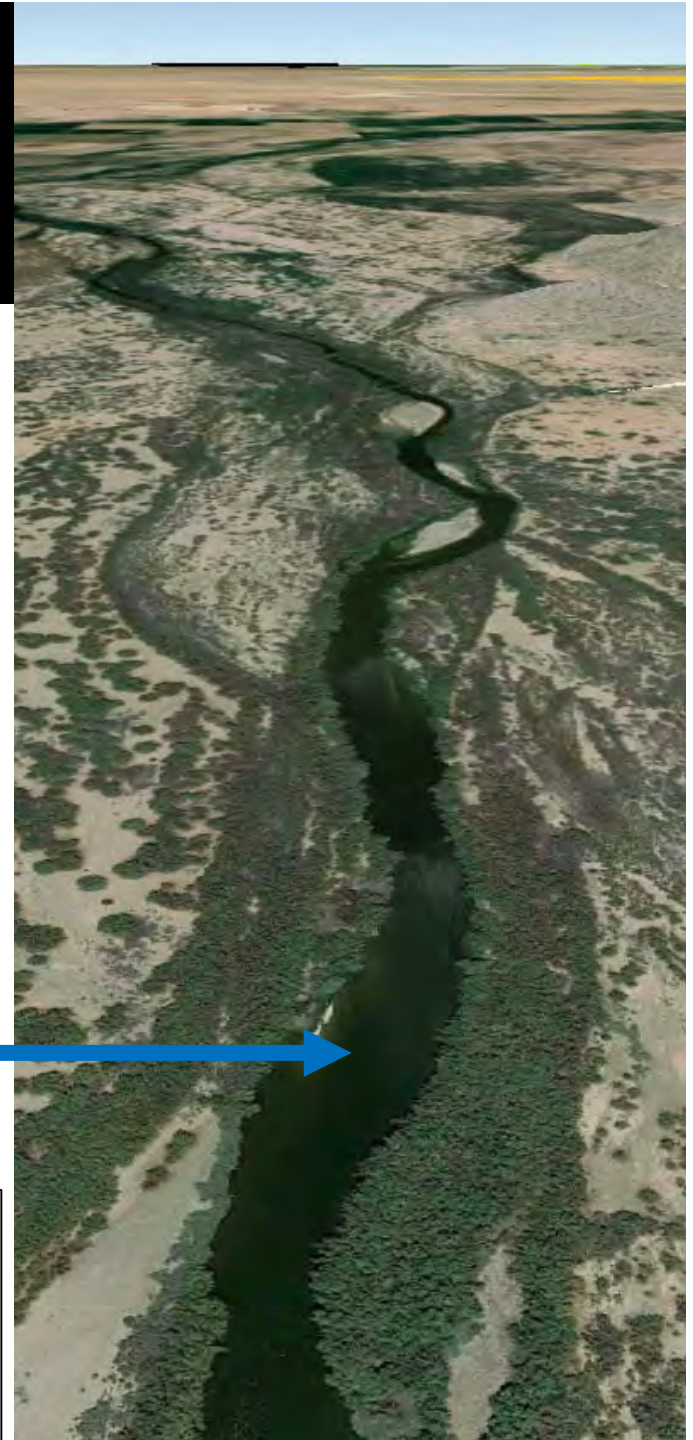
Braided or Meandering

Gila River @ Arlington, AZ

<< Braided Flood Channel

Non-braided main channel >>

Boating occurs on ordinary flows in the single thread main channel, not on the braided 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

- 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

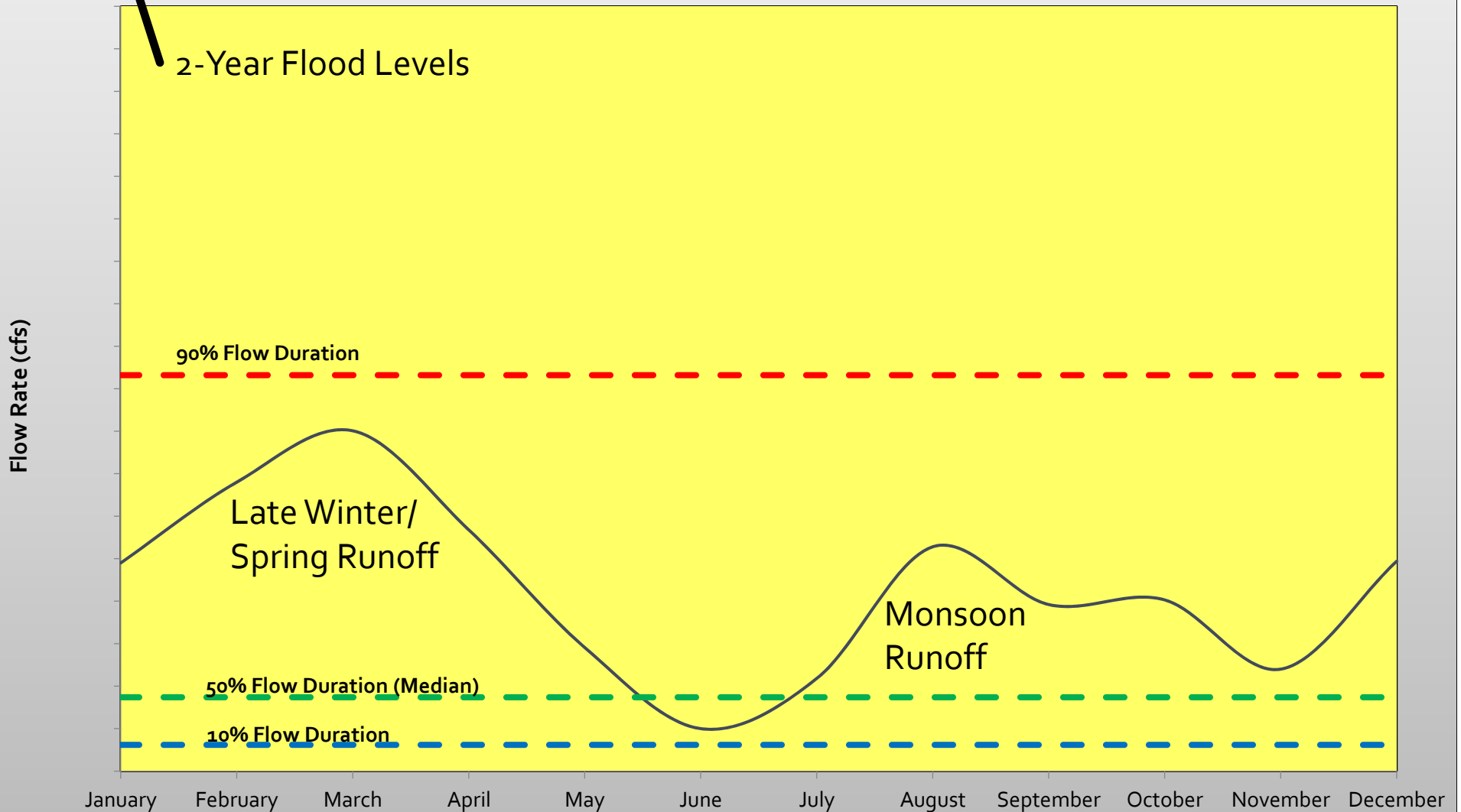
- Erratic
 - Not defined in ARS or ANSAC's statutes
 - Webster's Dictionary:
 - Acting, moving, or changing in ways that are not expected or usual : not consistent or regular
 - Meaning depends on perspective
 - Irrigator vs. Boater
 - Crops & diversion dams vs. boatability
 - Does NOT mean:
 - Ordinary 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."

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 (e.g., "Ordinary High Water")
 - Winter freeze
 - Summer low flow

Terminology: Non-Erratic Seasonal, Ordinary Flow Fluctuation

Gila River Flow - Generalized Seasonal Trend



Terminology

- Unstable
 - Not defined in ARS or ANSAC's statutes
 - Unstable w.r.t. some intended human activity
 - Webster's Dictionary
 - Likely to change, not firm or fixed, not constant
 - Meaning depends on perspective
 - Irrigation vs. boating
 - Building bridges vs. boating rivers
 - **All** natural rivers change with time
 - Meandering, sand bars, flood erosion
 - Irrelevant to navigability in ordinary & natural conditions

Ordinary & Natural Condition

- Natural
 - The condition without human impact
 - Not possible to determine condition with zero human impact
 - Is possible to determine condition with no human impacts that significantly reduce or enhance navigability
 - Natural means: without damming & diversion

Ordinary & Natural Condition

- For the Gila River
 - Identify the major changes to the river system
 - #1: Diminished flow due to dams & irrigation diversions
 - 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 the Hydrologic Data Provided:
 - Gage record underestimates natural flow rates
 - Pre-State flows were higher than values reported
 - Streams were more navigable than indicated by flow post-statehood data
- Therefore...
 - Because the Gila River is susceptible to navigation based on modern flow records, it is even more susceptible in its ordinary & natural condition which would have had even higher flow rates.
 - The restoration of ordinary & natural flow does not significantly increase flow velocities or hazard levels of restored river flow.

Navigability of the Gila River

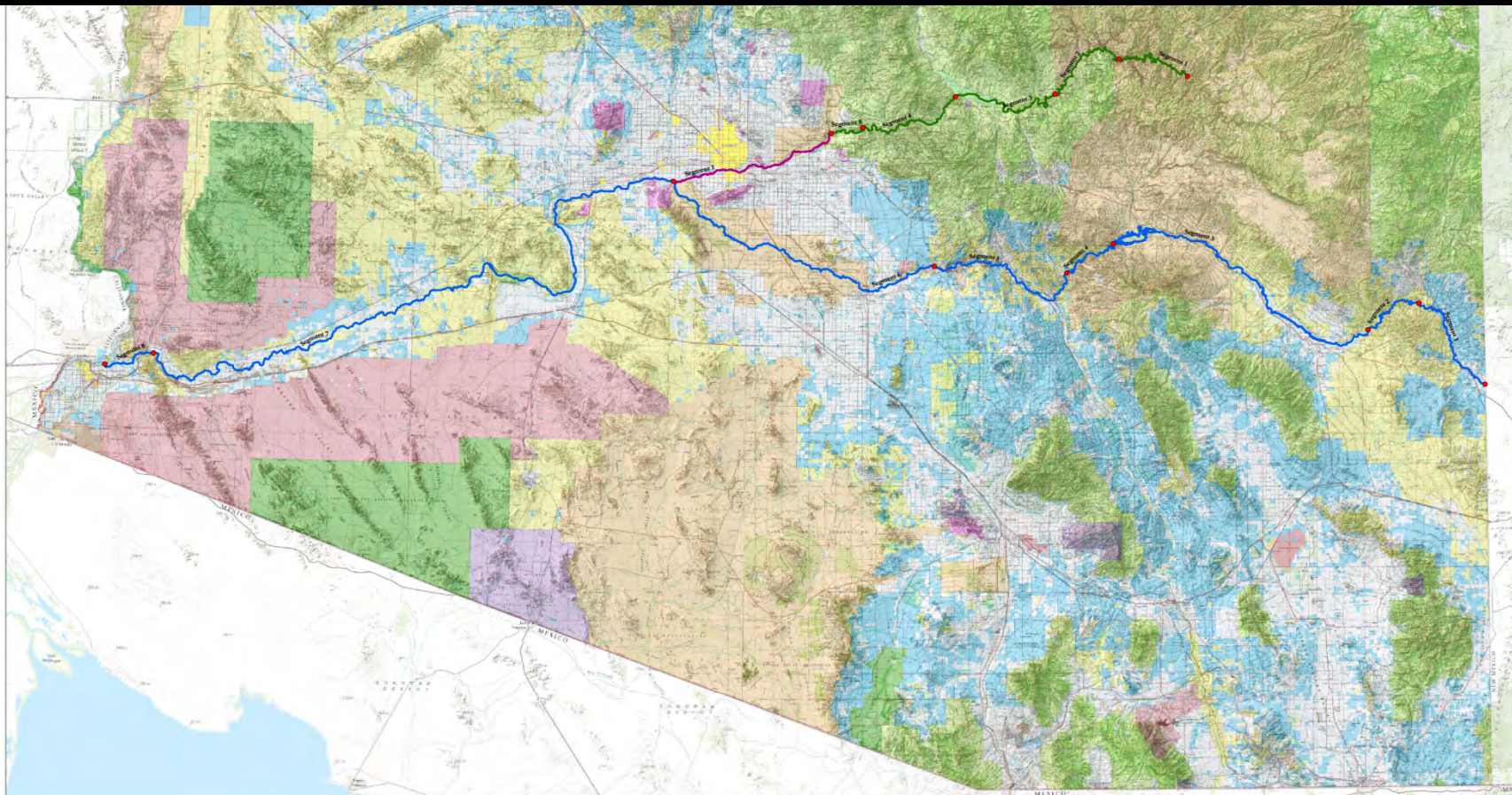
Arizona/New Mexico Border to Colorado River



Presentation Overview

- Preview of State's Findings & Conclusions:
- Gila River:
 - Was navigable in its ordinary & natural condition.
 - Has a history of navigation
 - Is still used for navigation
 - Is susceptible to navigation
 - Was more susceptible to navigation before it was dammed, diverted, and altered.

Segmentation



Gila and Salt Rivers

Legend		
Gila River	Public Land Ownership	Military
Lower Salt River	Private	City or County Parks
Upper Salt River	State Trust	State Parks
Reach Boundary	BLM	Wildlife Refuge
	Forest Service	Other
	Indian Reservation	Natl. Parks



The Arizona State Land Department makes no warranties, expressed or implied with respect to the information shown on this map.



Gila River Segmentation

- Gila River is Variable Over its Course in AZ
 - Changes in Geology
 - Alluvial Valleys
 - Bedrock Canyons
 - Changes in Channel Characteristics
 - Depth/width/pattern
 - Changes in Hydrology
 - Flow Rate
- Justification for Considering River in Segments

Gila River Segmentation

- Basis: Navigability Characteristics
 - Susceptibility to Navigation
 - Flow Depth
 - Rapids or Obstacles (if any)
 - Physical Characteristics
 - River Morphology
 - River Valley Terrain/Geography
 - Flow Rate
 - Magnitude
 - Major Tributaries
 - Reaches in ASLD Reports were more geographical

Gila River Segment #1



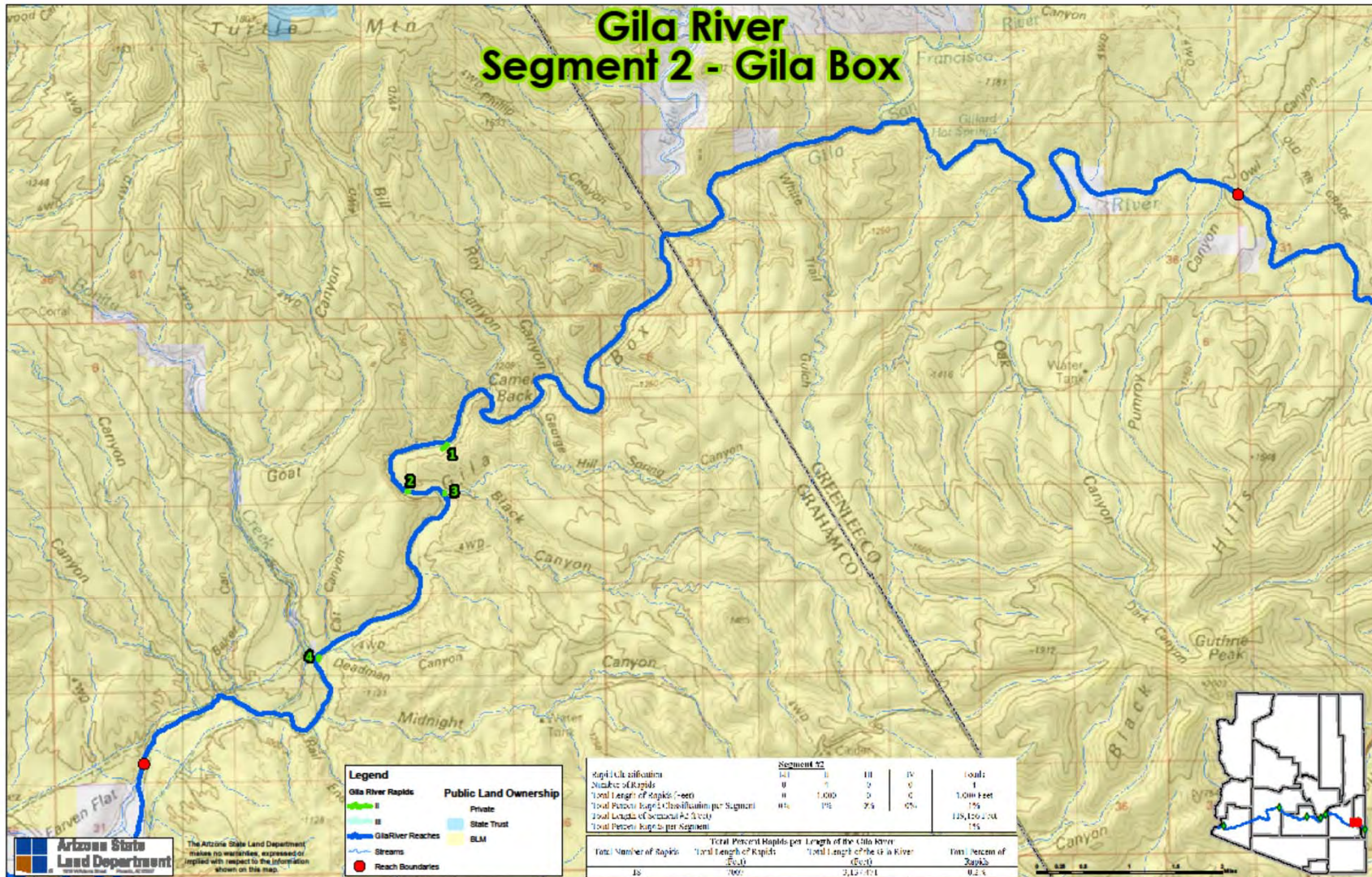
Gila River Segment #1

- Gila River Segment #1
 - New Mexico Border to Gila Box
 - Perennial
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel
 - Sinuous to straight
 - Broad alluvial valley
 - No Rapids or Natural Obstructions
 - Major Tributaries: None

Google Earth Flyover

- Gila River, Segment 1

Gila River Segment #2



Gila River Segment #2

- Gila River Segment #2
 - Gila Box
 - Perennial
 - Sinuous Channel Pattern
 - Pool & riffle, sand-gravel, cobbles
 - Sinuous to straight channel
 - Bedrock canyon
 - Several Minor Rapids (Class I-II)
 - Major Tributaries:
 - San Francisco River, Eagle Creek, Bonita Creek

Google Earth Flyover

- Gila River, Segment 2

Gila River Segment #3



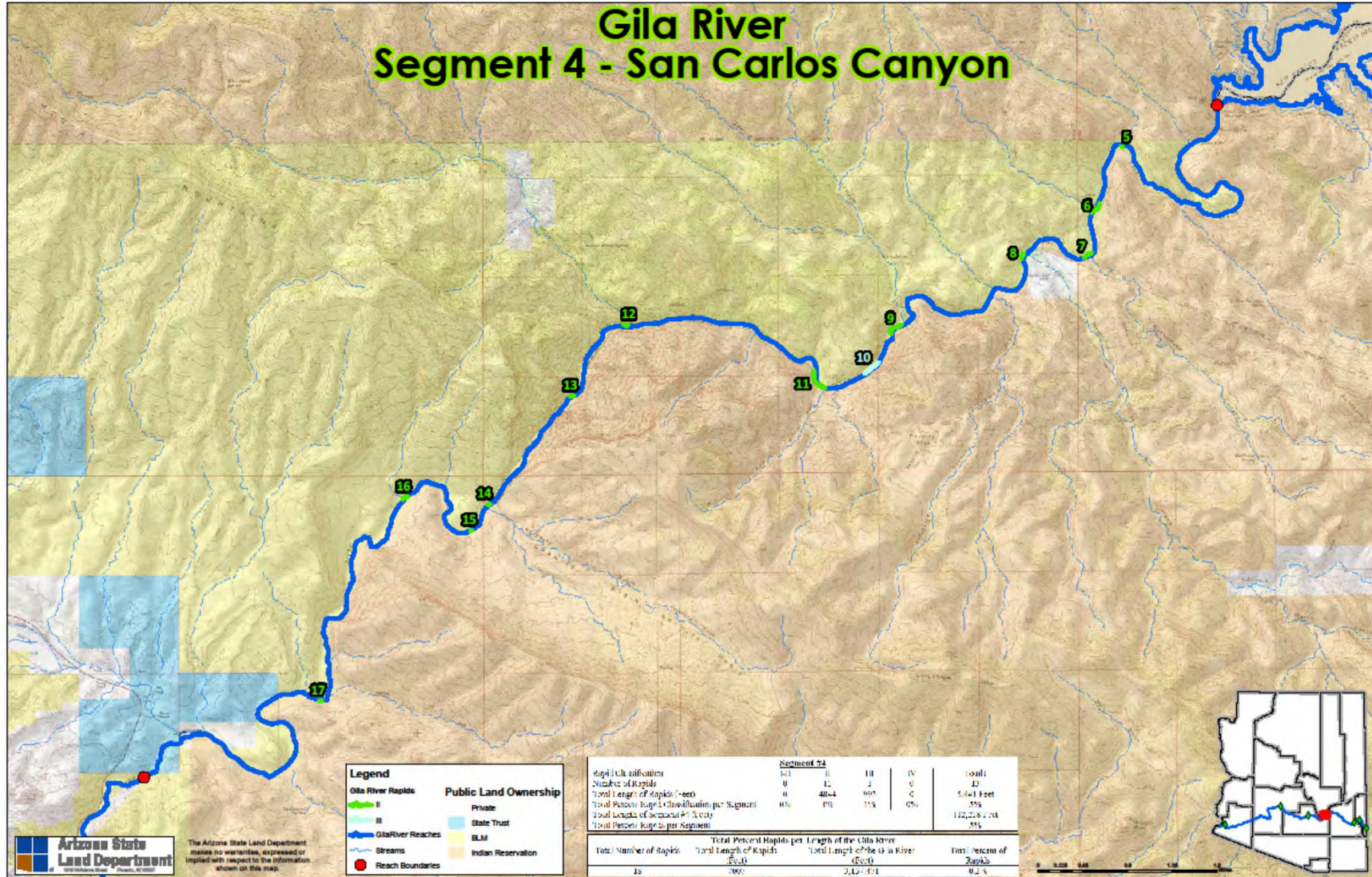
Gila River Segment #3

- Gila River Segment #3
 - Gila Box to San Carlos Reservoir/Coolidge Dam
 - Perennial
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel bed
 - Sinuous main channel
 - Broad alluvial valley
 - No Rapids or Natural Obstructions
 - Major Tributaries: San Carlos River

Google Earth Flyover

- Gila River, Segment 3

Gila River Segment #4



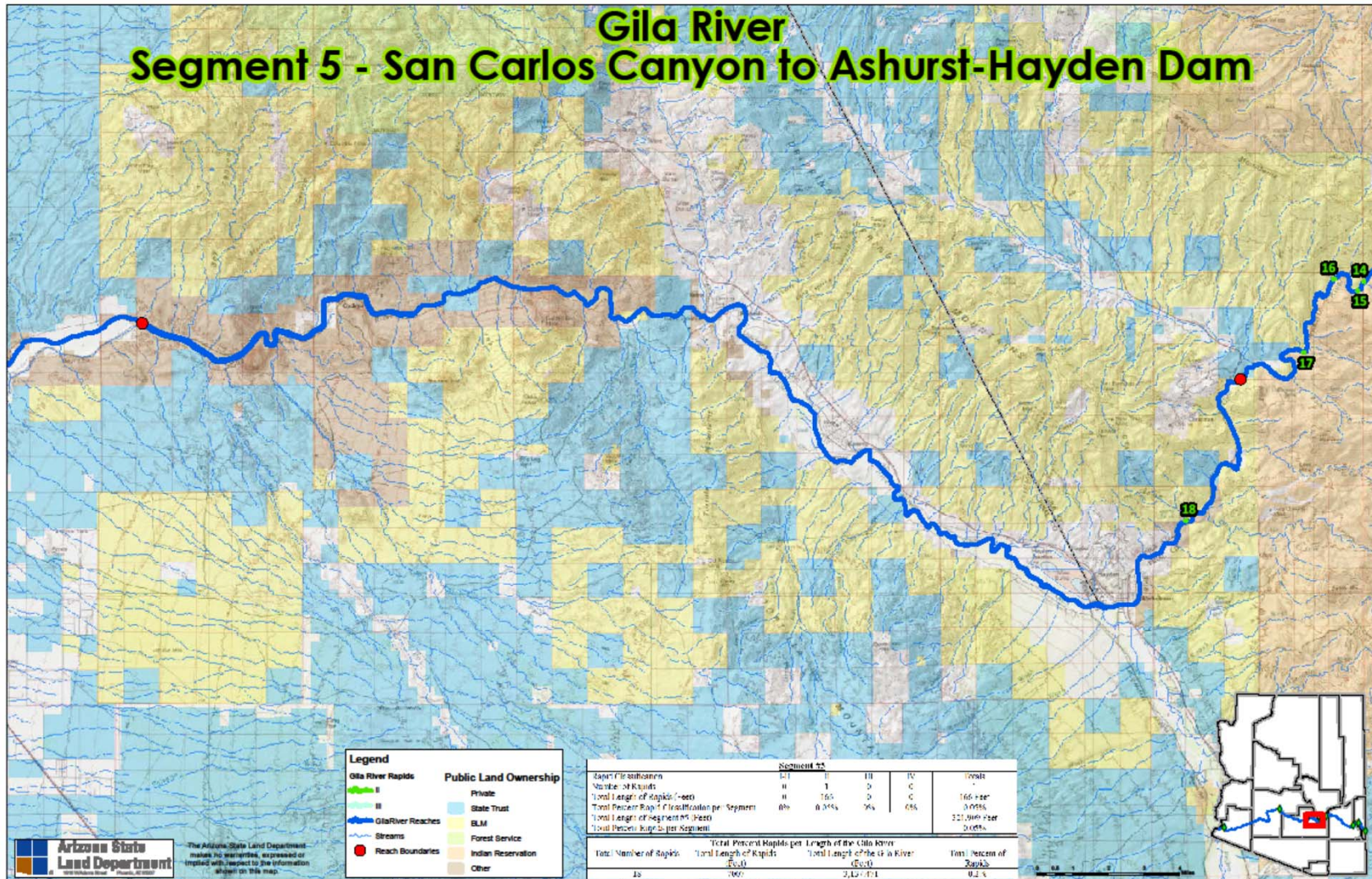
Gila River Segment #4

- Gila River Segment #4
 - San Carlos Reservoir to SR 77 above Winkelman
 - Perennial
 - Sinuous Channel Pattern
 - Pool & riffle, sand-gravel, cobbles
 - Sinuous to straight
 - Bedrock Canyon
 - Several Rapids (Class I-II, one III*)
 - Major Tributaries: None

Google Earth Flyover

- Gila River, Segment 4

Gila River Segment #5



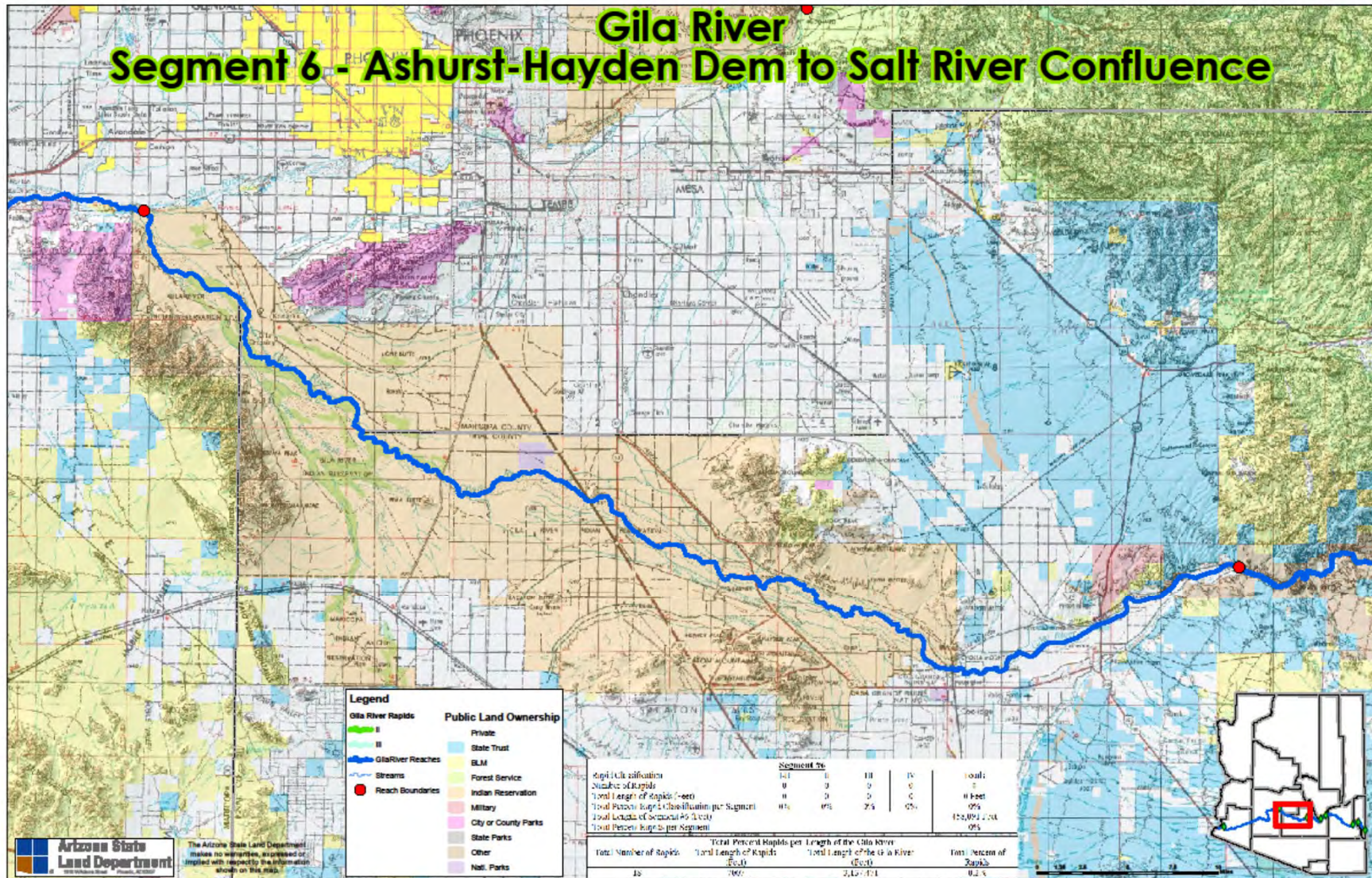
Gila River Segment #5

- Gila River Segment #5
 - San Carlos Canyon to Ashurst-Hayden Dam
 - Perennial
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel, some cobbles
 - Sinuous to straight
 - Alluvial valley to Riverside
 - Shallow bedrock Canyon below Kelvin
 - Alluvial valley near Ashurst-Hayden Dam
 - One Class II Rapid
 - Major Tributaries: San Pedro River

Google Earth Flyover

- Gila River, Segment 5

Gila River Segment #6



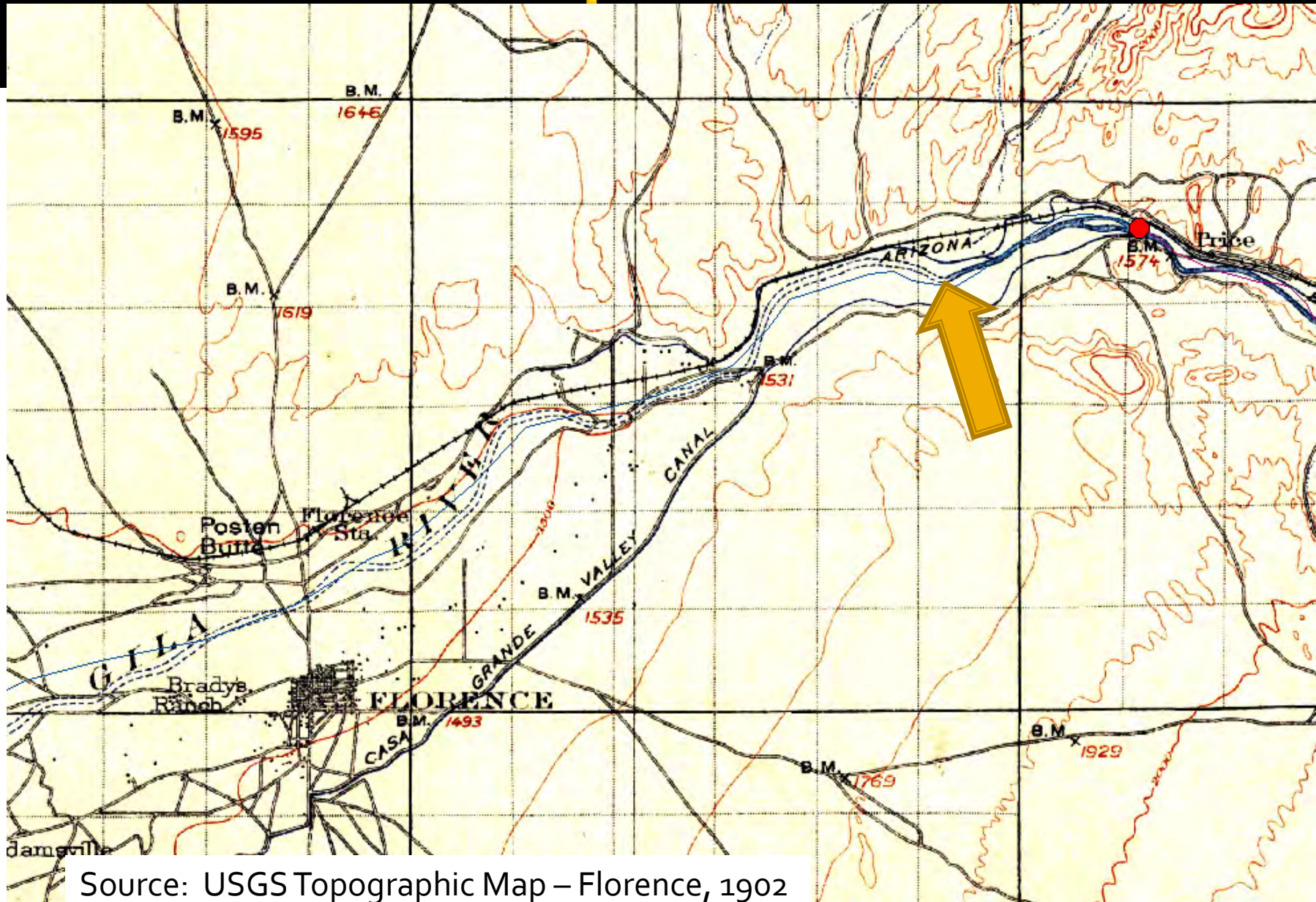
Gila River Segment #6

- Gila River Segment #6
 - Ashurst-Hayden Dam to Salt River Confluence
 - Perennial
 - Losing stream, declining flow
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel
 - Sinuous to straight
 - Broad alluvial valley
 - No Rapids
 - Major Tributaries: Santa Cruz River

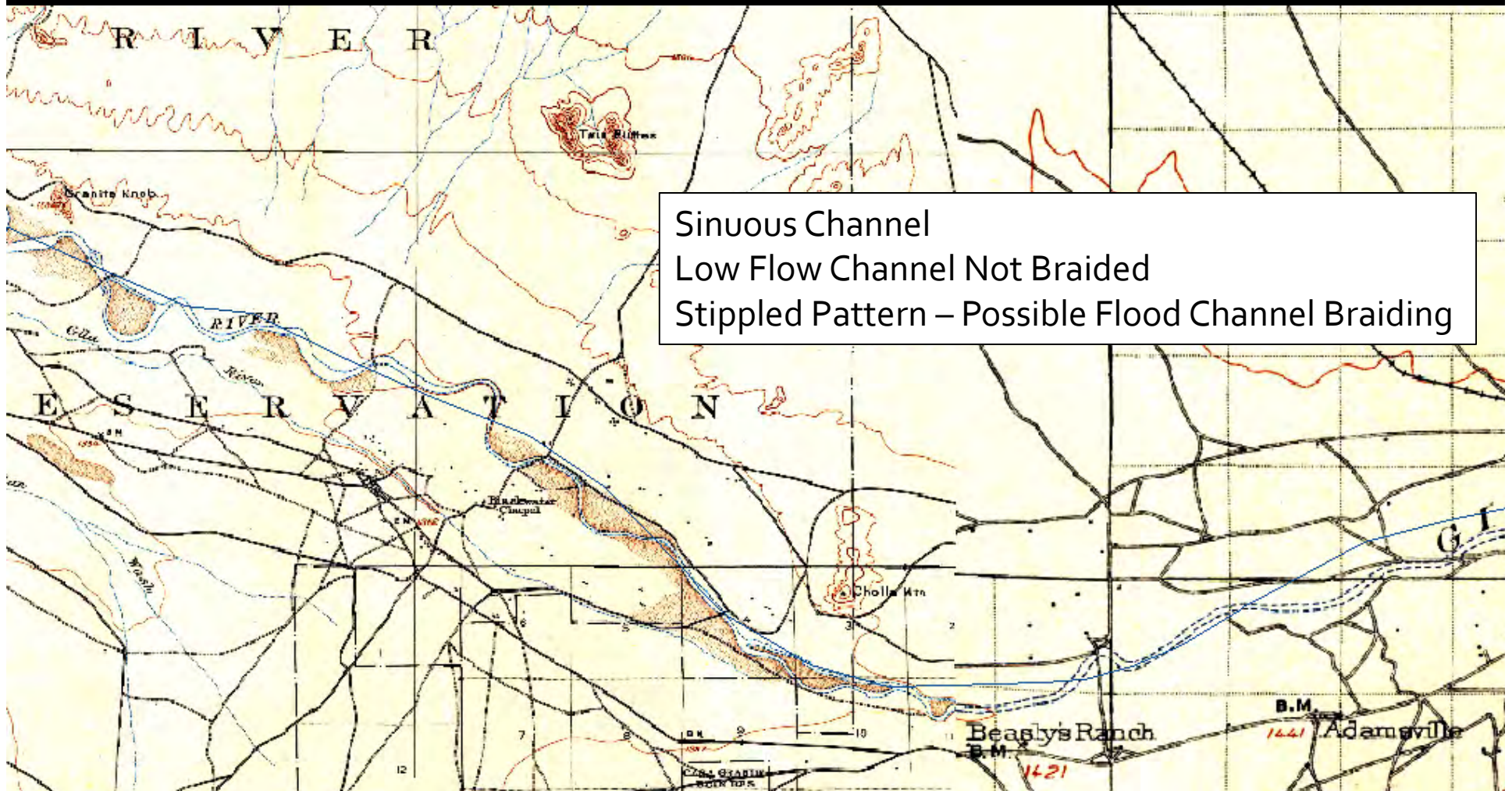
Google Earth Flyover

- Gila River, Segment 6

Historical Maps

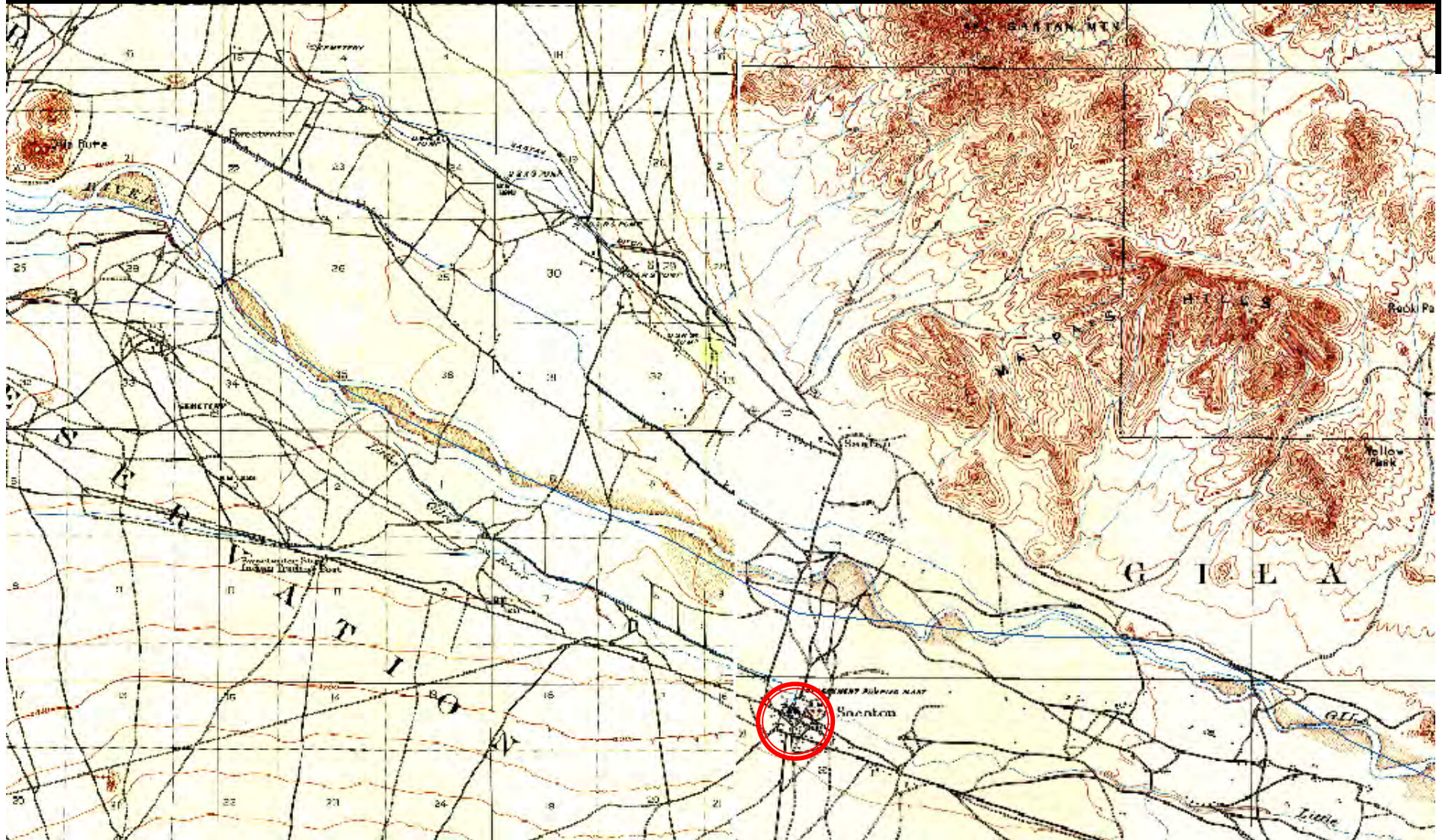


Historical Maps



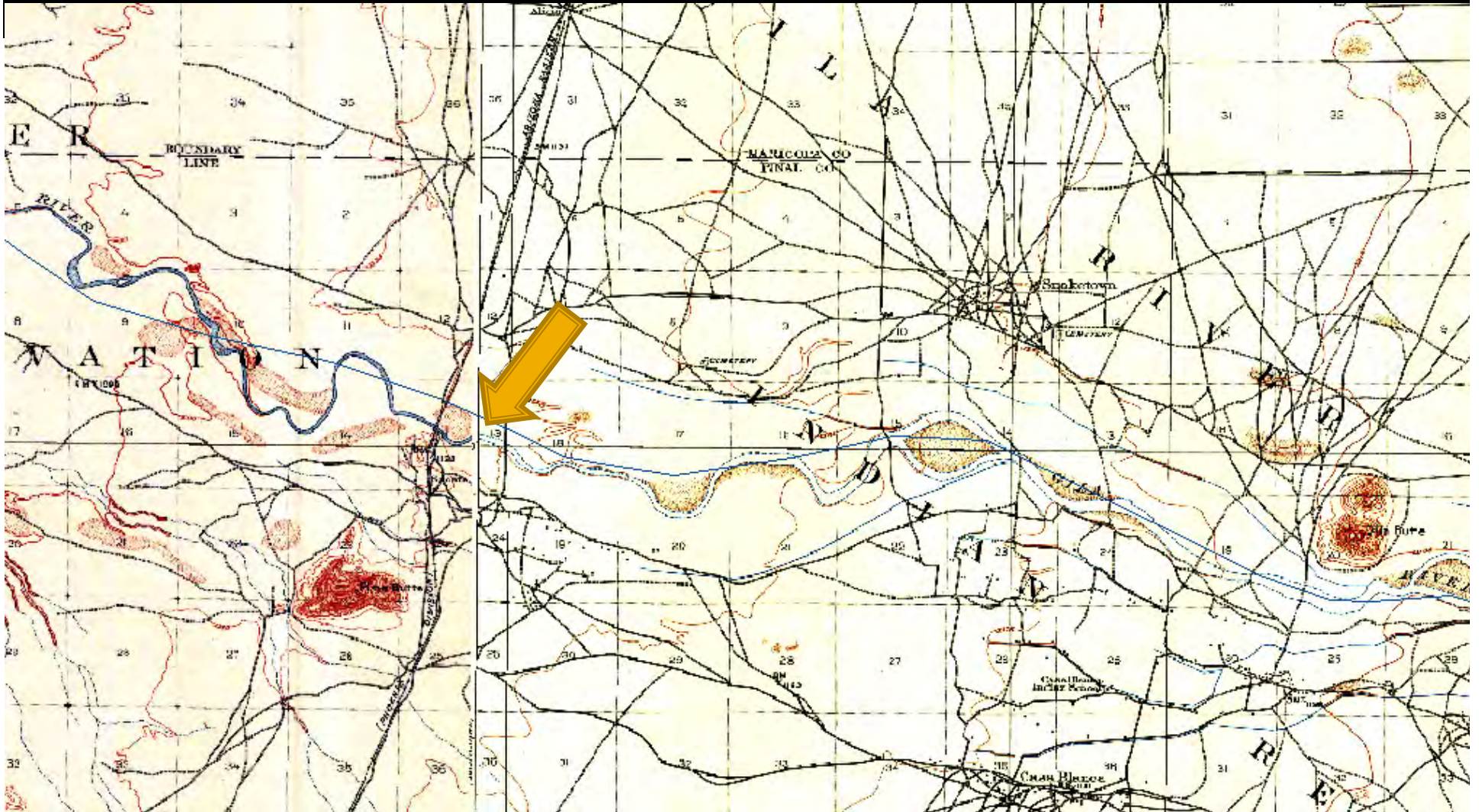
Source: USGS Topographic Map – Florence, 1902; Sacaton, 1907

Historical Maps



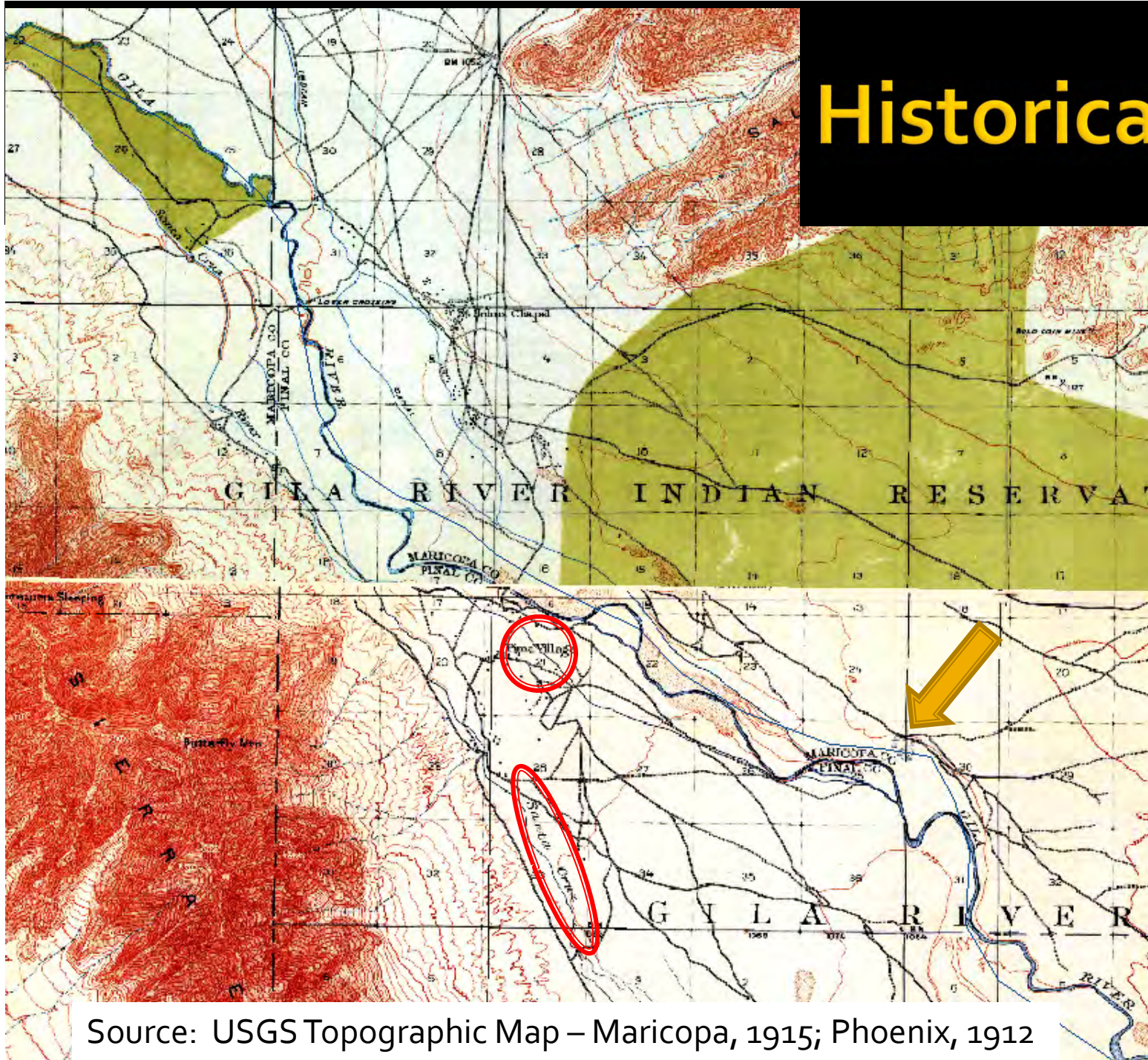
Source: USGS Topographic Map – Sacaton, 1907; Gila Butte, 1914

Historical Maps



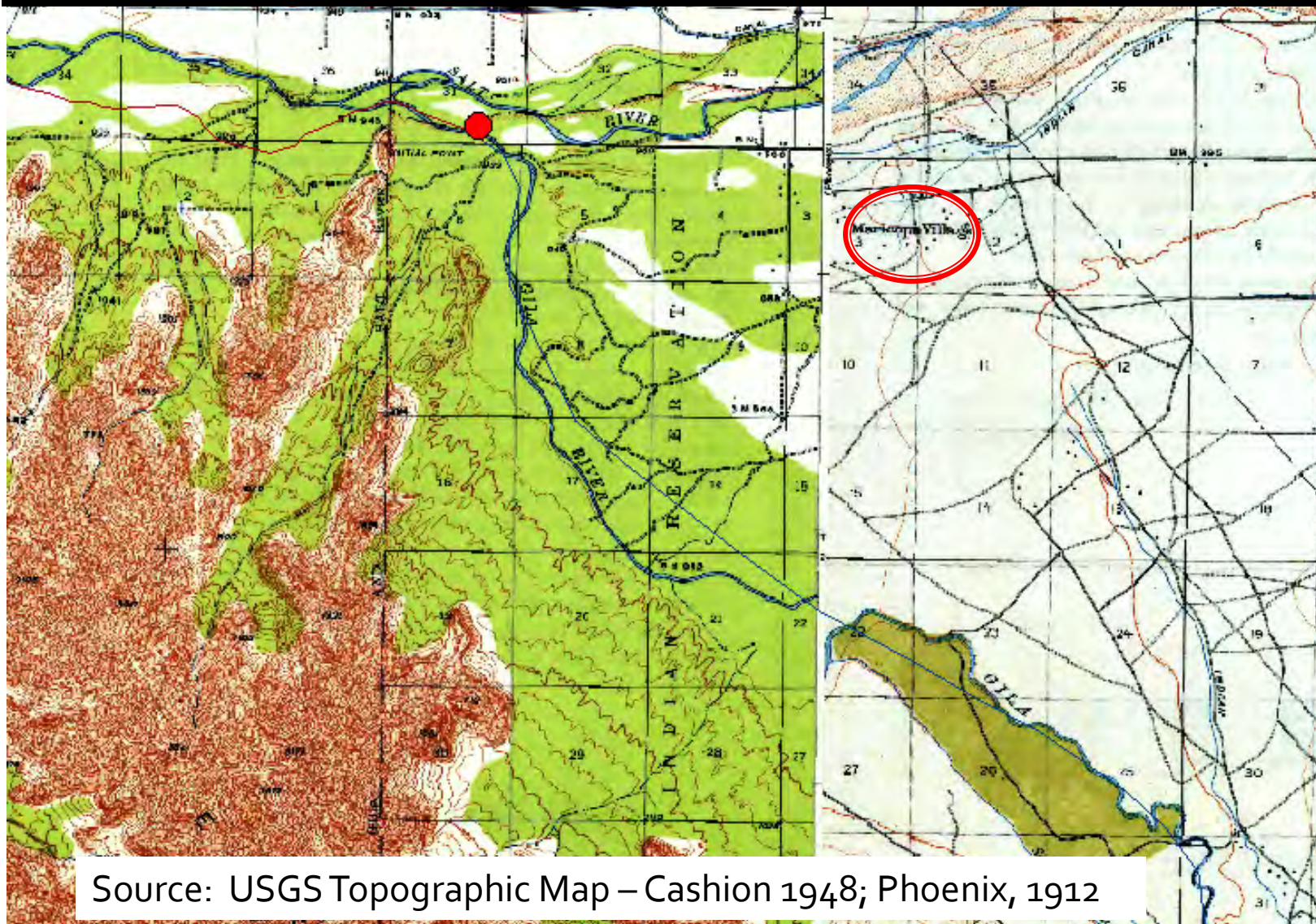
Source: USGS Topographic Map – Maricopa, 1915; Gila Butte, 1914

Historical Maps



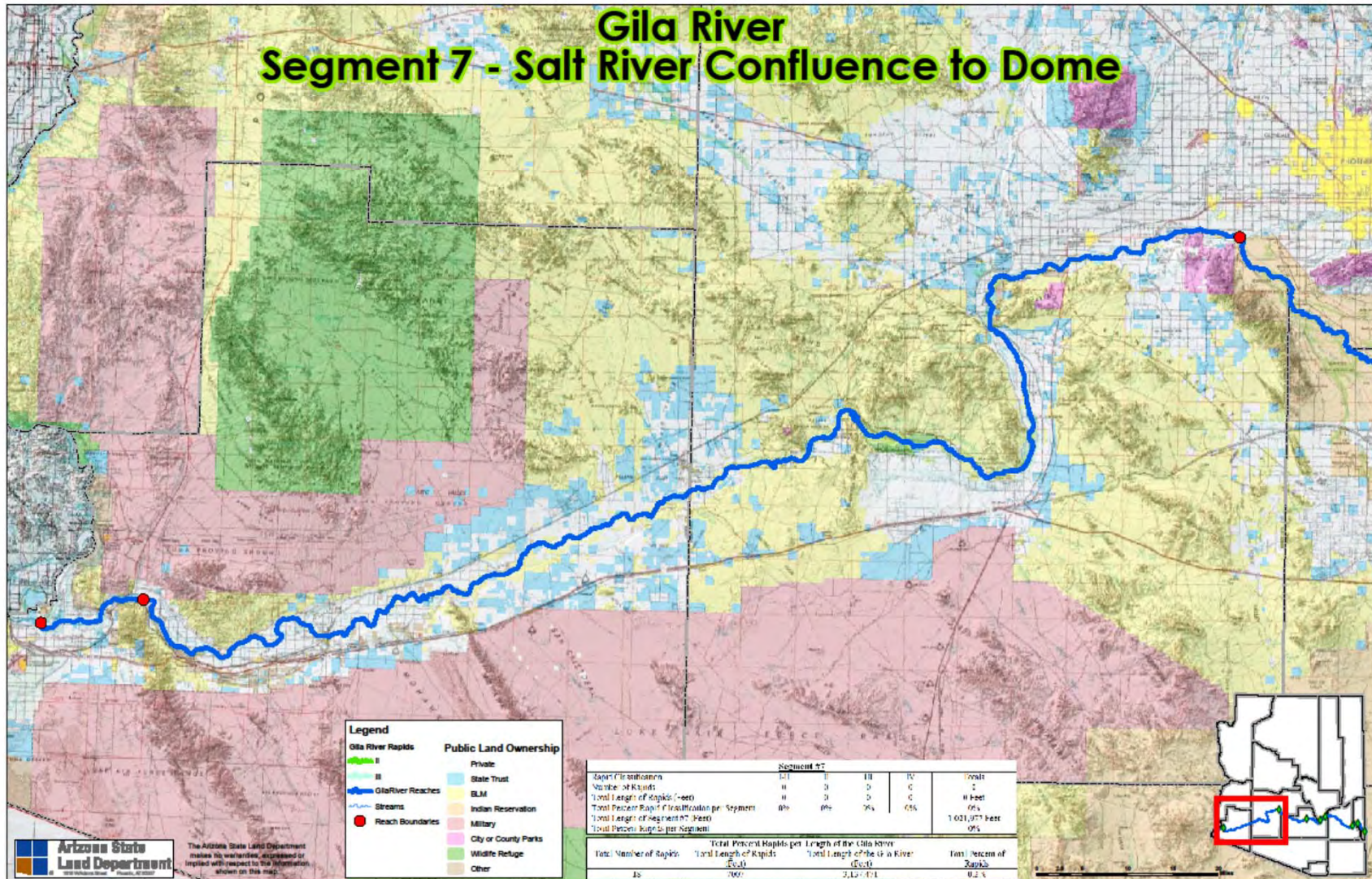
Source: USGS Topographic Map – Maricopa, 1915; Phoenix, 1912

Historical Maps



Source: USGS Topographic Map – Cashion 1948; Phoenix, 1912

Gila River Segment #7



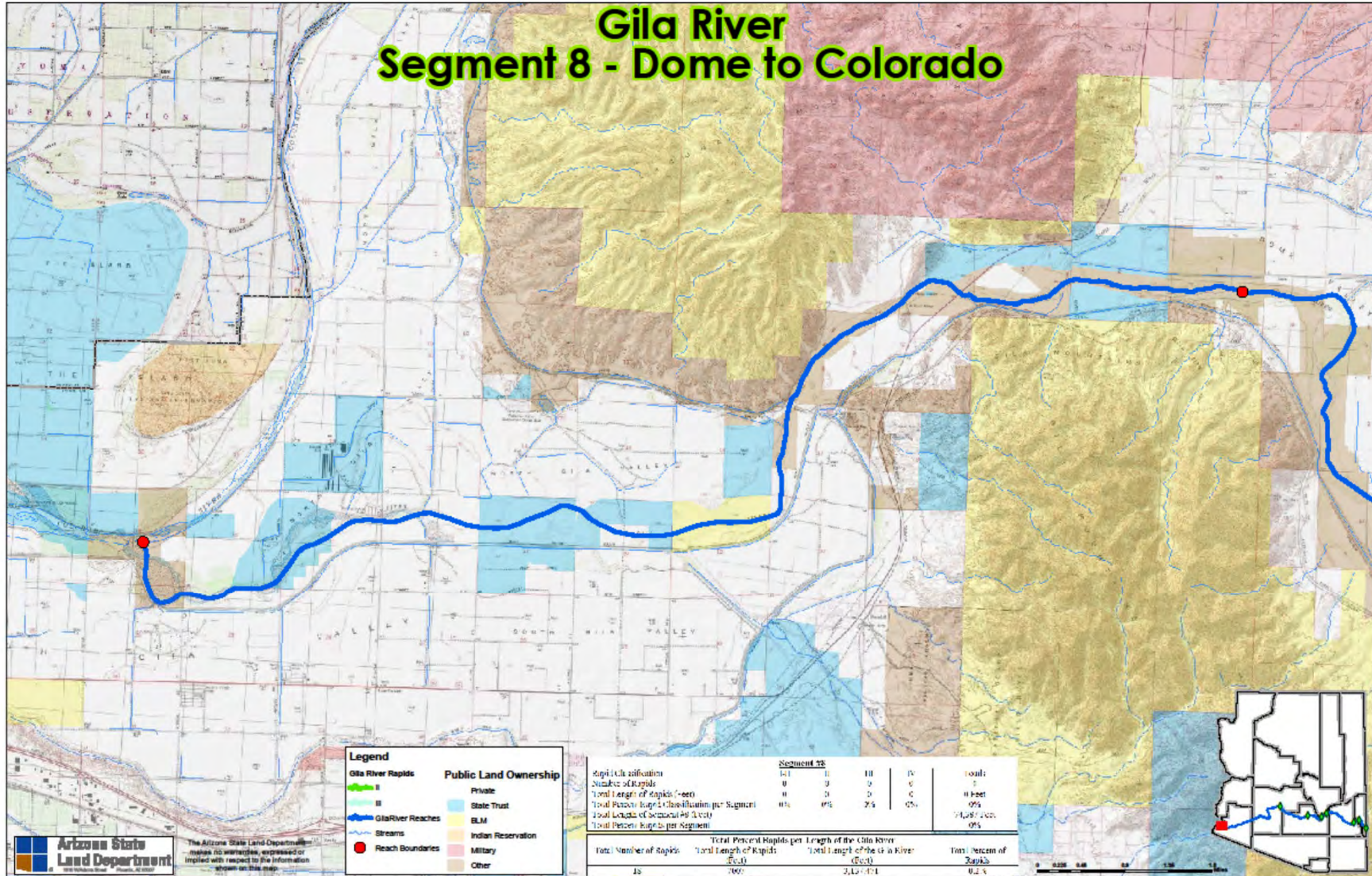
Gila River Segment #7

- Gila River Segment #7
 - Salt River Confluence to Dome
 - Perennial
 - Salt River inflow
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel
 - Sinuous to straight
 - Broad alluvial valley
 - No Rapids
 - Major Tributaries:
 - Salt River, Hassayampa River, Agua Fria River

Google Earth Flyover

- Gila River, Segment 7

Gila River Segment #8



Gila River Segment #8

- Gila River Segment #8
 - Dome to Colorado River Confluence
 - Perennial
 - Compound Channel Pattern
 - Pool & riffle, sand-gravel
 - Sinuous
 - Broad alluvial valley
 - No Rapids
 - Major Tributaries: None

Historical Maps



Source: USGS Topographic Map – Laguna, 1929; Fortuna, 1926

Google Earth Flyover

- Gila River, Segment 8

Navigability of the Gila River

- Information Provided in ASLD Reports
 - Archaeology
 - History
 - River Descriptions
 - Historical Boating Accounts
 - Geology
 - Hydrology
 - Rating Curves (Flow Depths)
 - Modern Boating

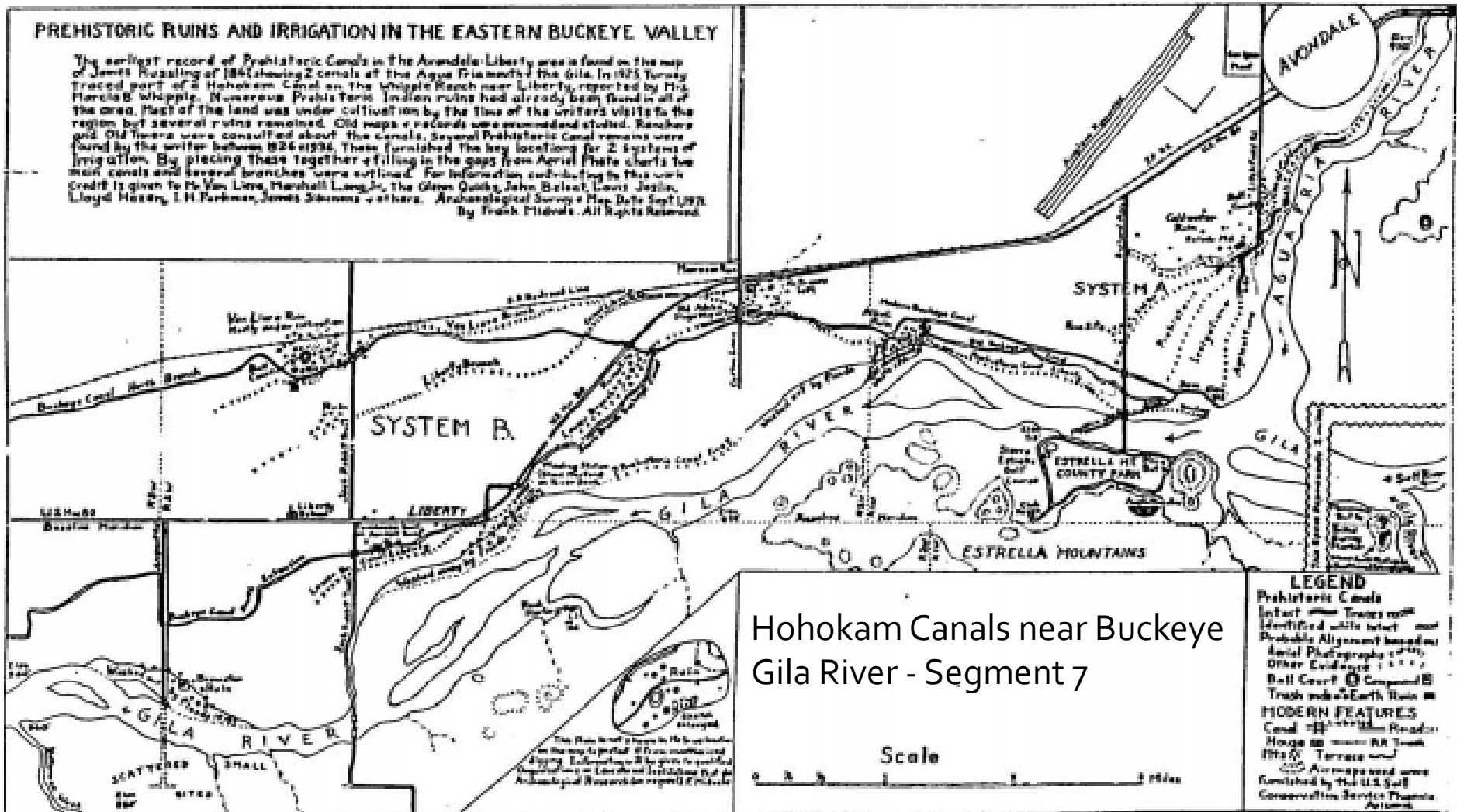
Archaeology: Key Findings

- Reliable & Dependable Flow
 - 1,000+ years of irrigation-based civilization
 - Segments 3, 5, 6, 7, 8
 - River-dependent people
 - All Segments
 - Perennial stream flow
 - Fish, beaver, wildlife, riparian vegetation
 - Non-trivial flow

Archaeology: Key Findings

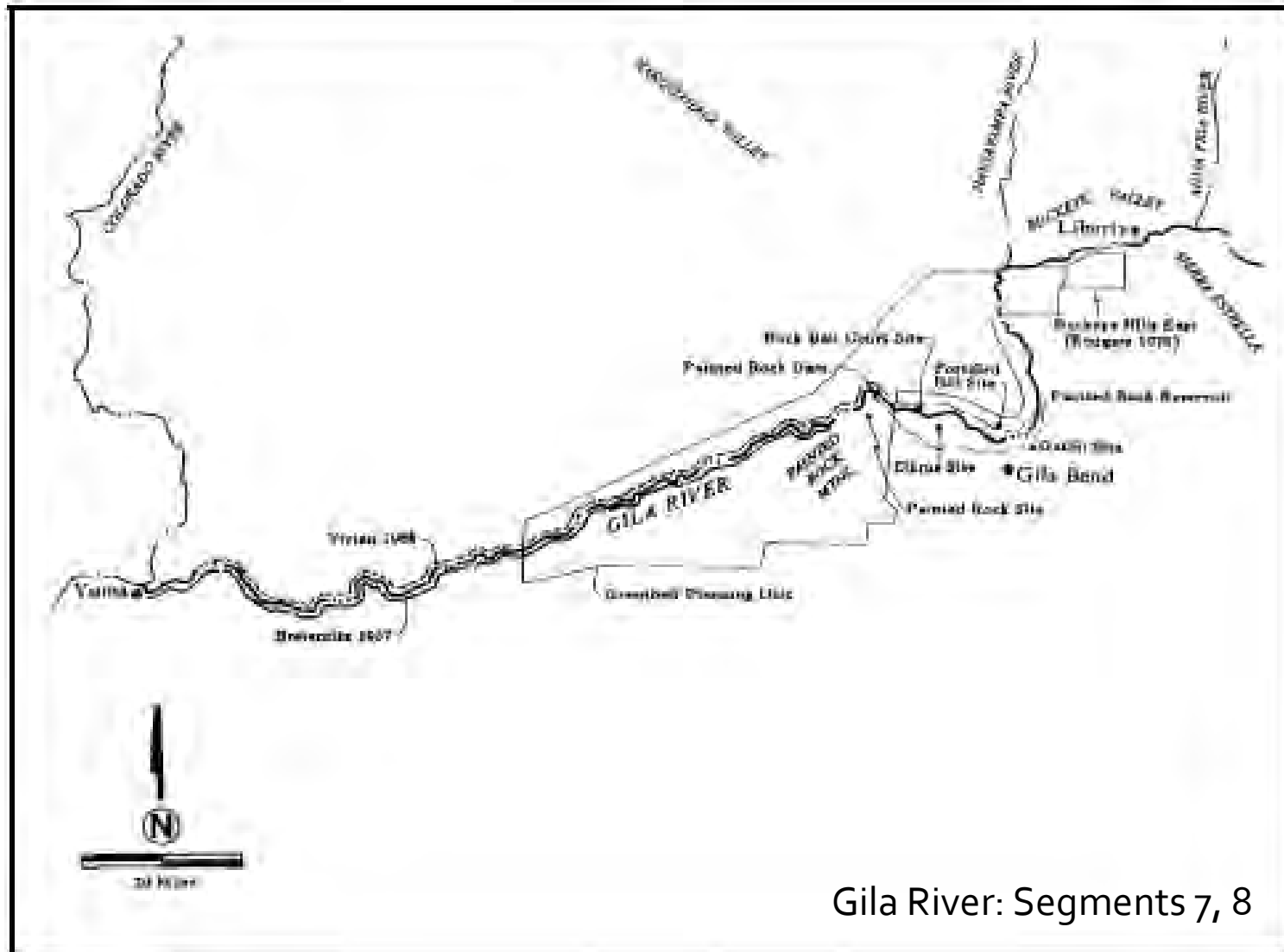
- Native American Canals
 - Segments 3, 5, 6, 7, 8
 - Capacity (individual) up 240 cfs
 - Length – 100's of miles
 - Acreage – 10,000's of acres
 - River Stability – sufficient for diversions

Archaeology: Key Findings



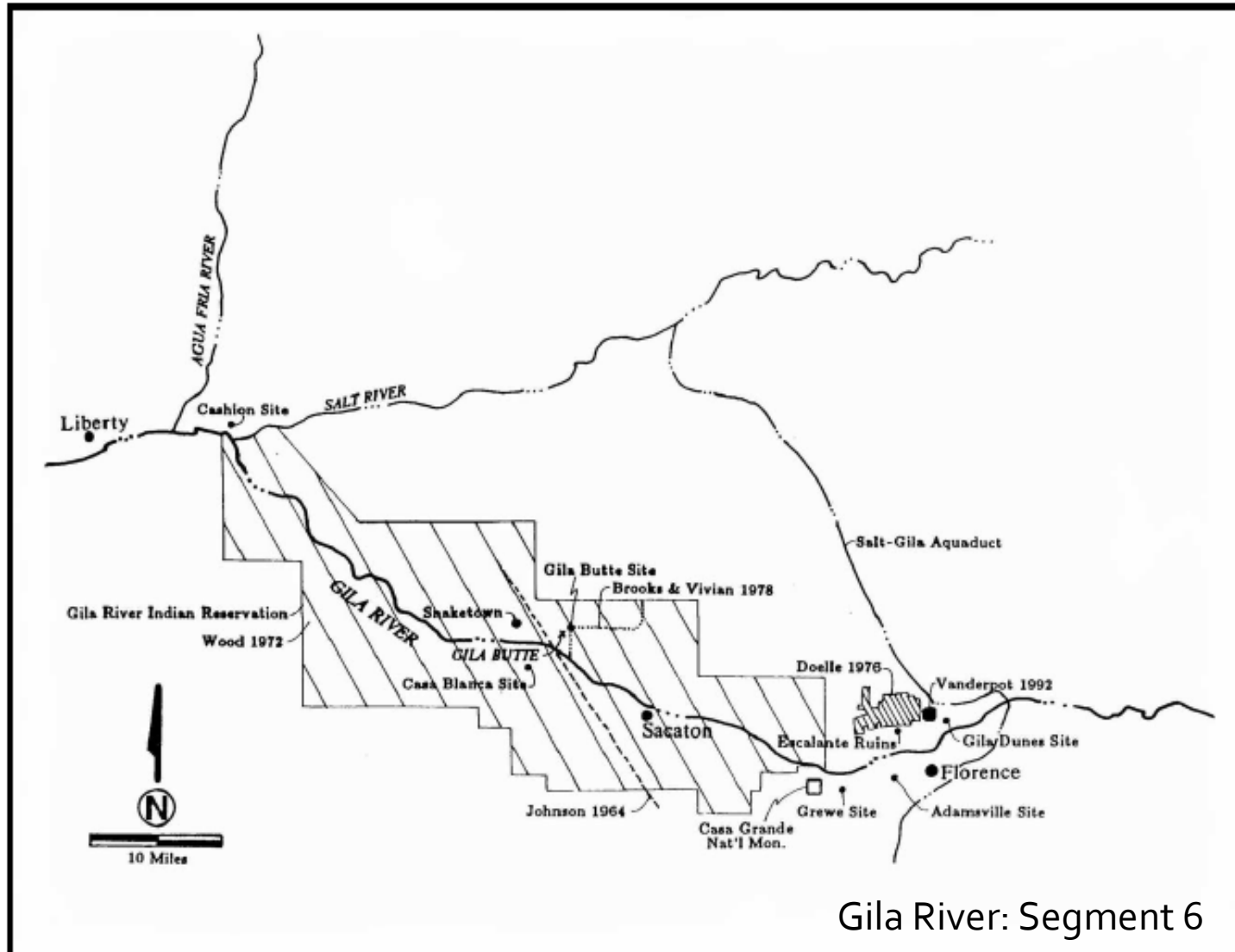
Hohokam Canals near Buckeye
Gila River - Segment 7

Archaeology: Key Findings

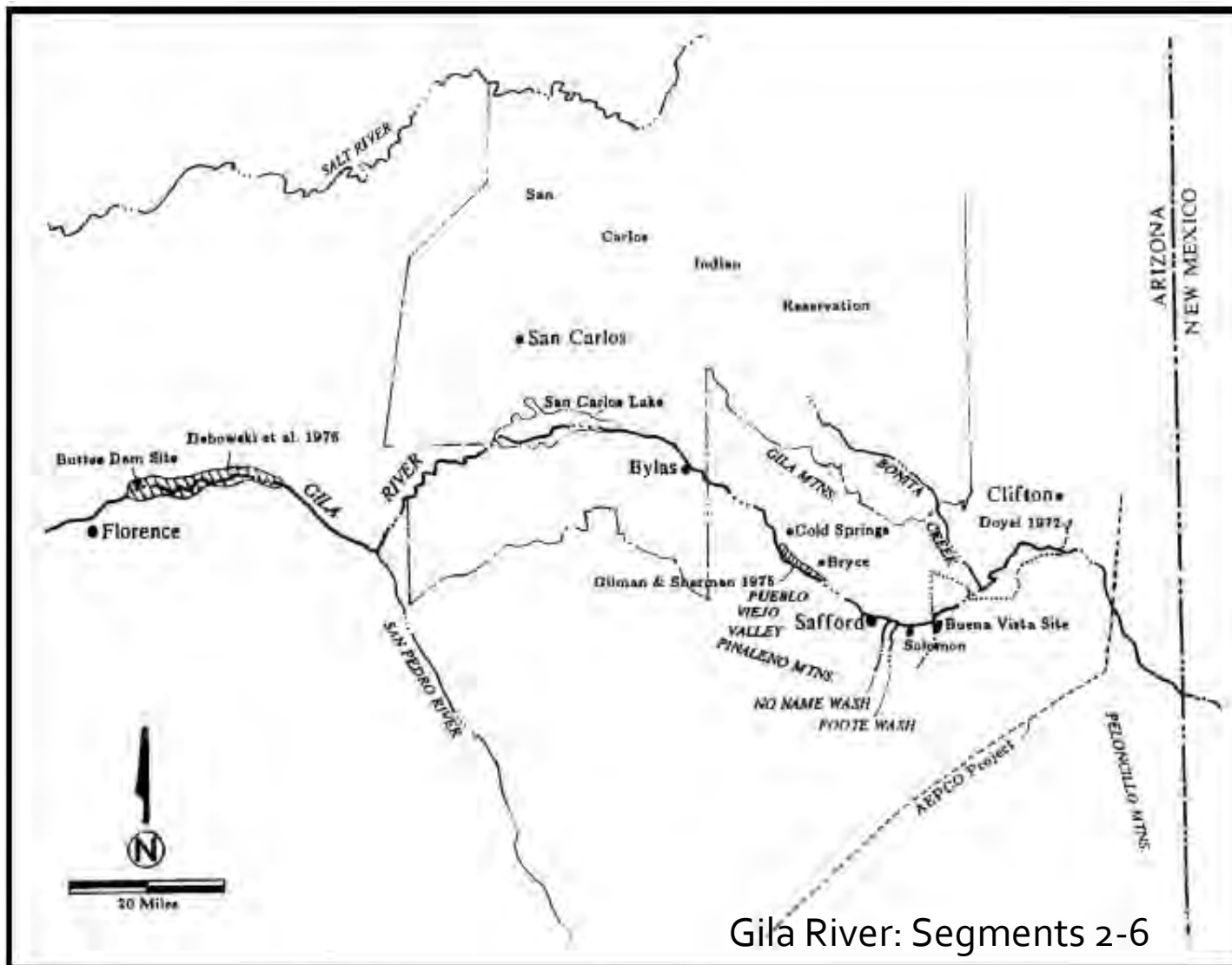


Gila River: Segments 7, 8

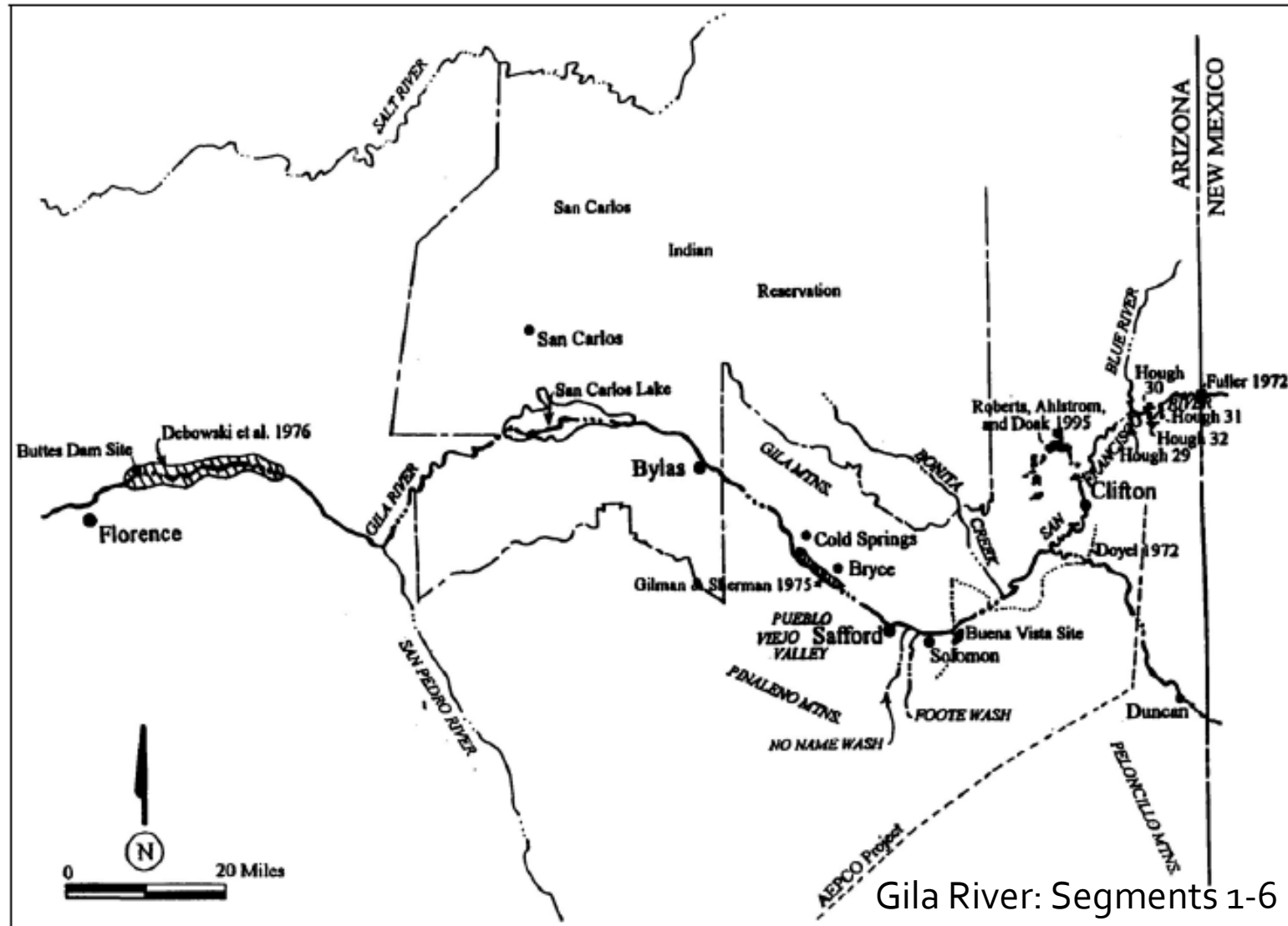
Archaeology: Key Findings



Archaeology: Key Findings



Archaeology: Key Findings



Gila River: Segments 1-6

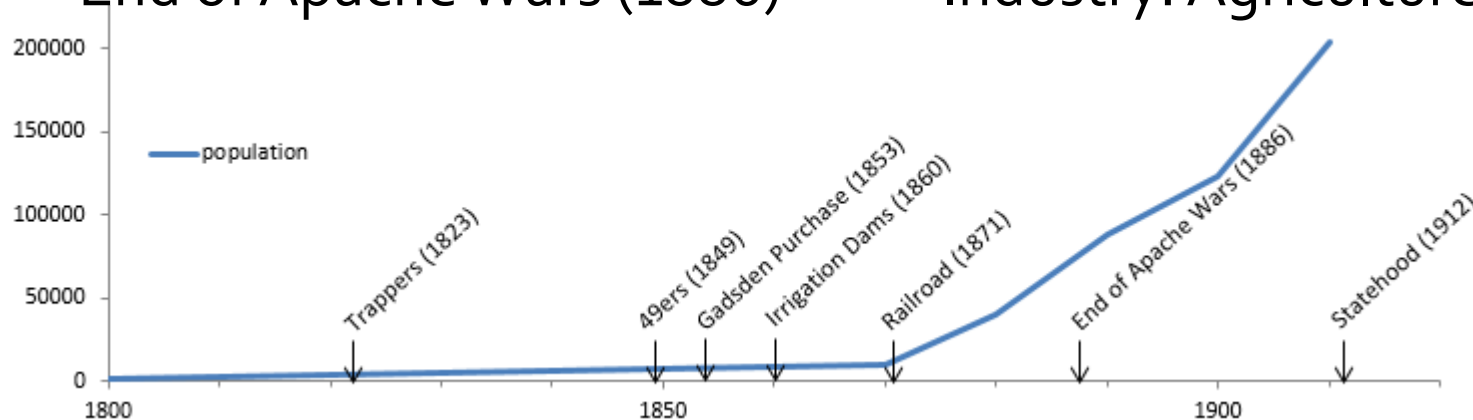
Archaeology: Key Findings

- Native American Boating
 - Tohono Creation Account – Canoe
 - Wooden Rafts on the Lower Gila – Segment 7, 8
 - Possibly on Middle Gila
 - Constructed of Perishable Materials
 - Bullboats – Segment 2, 3
 - Rio de las Balsas (River of Rafts) – Segment 3
 - Granger – Indian use of wicker baskets to cross
 - Not Boat-Dominated Societies

History: Key Findings

■ Key Events in Gila River History

- Trappers 1820's
- Steamboats 1860's
- Explorers 1500's-1800's
- Railroad (1877, 1881)
- Stage Coach Lines (1857)
- Toll Roads (1880's)
- End of Apache Wars (1886)
- Irrigation Diversions (1860's)
- Gadsden Purchase (1853)
- Dams
 - Coolidge (1928)
 - Ashurst-Hayden (1923)*
 - Gillespie (1921)
- Industry: Agriculture, Mining



History: Key Findings

- Early Exploration of Arizona
 - 1846 Kearney Expedition along Gila (Carson, Emory)
 - Most travelers used Cooke's route away from UGR
 - Bartlett Boundary Survey 1850-1853
 - Whipple: "Impracticable" as wagon or canal route – due to narrow canyons.
 - Emory Boundary Survey 1854-1855
 - Treaty of Guadalupe Hildago
 - Navigation of Gila River

History: Key Findings

- Why Didn't the Trappers & Explorers Boat the Gila
 - Some did – built & used canoes
 - The river didn't go where they were going
 - They had horses, wagons
 - They had travelled overland getting to Arizona
 - Skipped other navigable rivers
 - Character of the country – overland travel easier
 - The fur market (sales) was in St. Louis, not to the west
 - There were fords & alternative routes
- Why Did they Canoe the Colorado?
 - There were no land alternatives

Descriptions of the Gila River

- How to Interpret Early River Descriptions
 - What River Segment?
 - What Time of Year?
 - Flood/Drought/Ordinary Condition?
 - Natural or Disturbed Condition?
 - When Relative to Man-Caused Depletion?
 - Point of View & Attitude of Observer

River Descriptions

■ How to Interpret Early River Descriptions

Reports on Explorations and Surveys, . . . Route for a Railroad from the Mississippi River to the Pacific Ocean," ASLD GR Report p. IV-3

- Vol. VII: Reported the Gila was ½ mile wide and up to **12 feet deep**, had wide bottoms and lagoons, and that the Pimas were irrigating field crops in a 6 to 8 mile wide river bottom.
- Vol. II: Reported that the river bed location had changed in a few locations and **dry in mid-February**.
- Vol. I: Reported that **water was not available** during certain seasons, that **logs could probably be delivered** from the Mogoyon (sic) mountains down the Gila, and that the river was approximately **9 feet deep for 35 miles up from the mouth during low water period**

River Descriptions

- Coronado (16th century, late spring)
 - Segment 5:
 - “a deep & reedy stream”
- Father Kino (1699)
 - Segment 6 (Pima Villages):
 - “channel with large cottonwoods...irrigation agriculture”
 - “fisherman...nets...fish all year”

River Descriptions

- de Escalante (Nov, 1697)
 - Segment 6
 - River too deep to ford, crossed by swimming
- de Anza (1775)
 - Segment 6, 7 & 8
 - “dry...half way up legs...reaching horses’ shoulders...very deep...flowing slowly”

River Descriptions

- James Ohio Pattie (1825, Jan-Mar)
 - All Segments: “beautiful, running between banks with tall cottonwoods & willows...plenty of beaver”
 - Segment 7: “200 yds wide”
 - Segment 6: “too deep to ford”
 - Built a canoe to trap both sides of river

River Descriptions

- Kearny Expedition (1846) – Mapping, Roads
 - Segment 7:
 - “80 yds wide...3 ft deep...rapid”
 - Lt. Emory (1846): “Navigable as far as Pima Villages (Segment 6)...possibly with small boats at all stages”
 - Lt. Emory (1853): “Not navigable...a never failing stream...large volume of flow...large fish”
 - Turner: “100-150 yds wide...average depth of 4 ft...deep enough for a steamboat”
 - Segment 1:
 - Johnson: “30 ft wide, 1 ft. deep on the shallows, pebbly bed, fringed with trees.”

River Descriptions

- Mormon Battalion (1847, Jan)
 - Segment 7: "4-5 ft. deep, 150 yds wide"
- US Government (1846-47)
 - Segment 7:
 - "3 ft deep, 60-80 yds wide" (1846)
 - "3-4 ft deep, 150 yds wide" (1847)

River Descriptions

- Forty-Niners
 - Segment 6:
 - “deep, narrow & rapid stream”
 - “whole stream drawn off for irrigation”
 - August, 1849 “deep, narrow, rapid, muddy, tall cottonwoods”
 - Segment 1:
 - “12 yds wide, 1.5 ft deep...abounds in trout”

River Descriptions

- Forty-Niners
 - Segment 7:
 - “300 ft wide...deep enough for swimmers”
 - June 12: “river occupied $< \frac{1}{4}$ of bottom”
 - “broad & shallow”
 - Audubon: “18-20 in deep, 150 yds wide...very deep holes in places”

River Descriptions

- US Army (1853-54)
 - Segment 8: 9 ft deep for 35 miles above mouth during low water
 - Segment 7: 12 ft deep, dry in mid-February
 - Looking for railroad routes

River Descriptions

- Boundary Surveyors

- Bartlett

- Segment 6: (1849, June/July): "low flow, navigation doubtful...completely dry at Pima Villages (due to irrigation)...50 yds wide, 9 inches deep"

- Parke

- Segment 5: (July 1855): "20 ft wide, 12 inches deep"

- Others

- Engalls (Segment 7, June 1868) – "fine stream"
- Foreman (Segment 7, 1871) – "smooth lively current"
- Harris (Segment 7, 1878) – "abundance of water"
- Powers (Segment 7, 1883) – "plenty of water"
- Martineau (Segment 8, Sept. 1890) – 12-15 ft deep.
- Hesse (Segment 7, 1907) – "18 inches to 2 ft deep"

River Descriptions

- GLO Surveyors
 - Segment 7
 - (1890) Too deep to cross except by swimming (Ligurta)
 - (1877) Abundance of water (Agua Caliente)
 - (1871) 16 inches deep & lively current (Arlington)
 - (1883) deep water (Arlington)
 - (1871) at low water, about 100,000 inches (2,500 cfs)
 - (Gila Bend area)
 - (1871) lively current, deep water (Gillespie)
 - (1892) deep & swift channel, ferry (Painted Rock)
 - (1868) fine stream (Agua Fria confluence)

River Descriptions

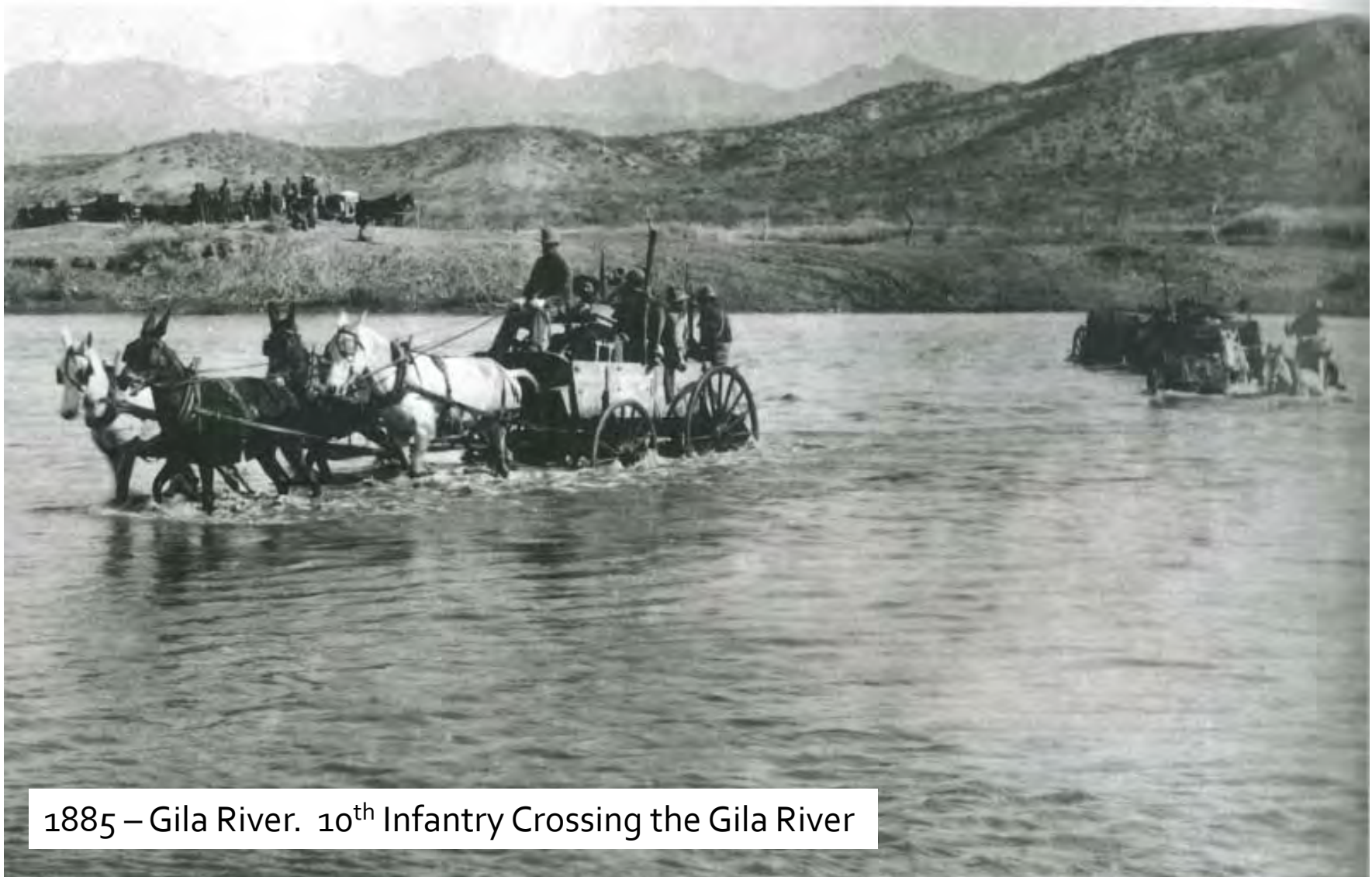
- GLO Surveyors
 - Segment 6
 - (1869, June) dry (Florence)
 - Segment 5
 - (1878) abundance of water (Hayden)

Historical Photographs



October 17, 1885 – Gila River near Ft. Thomas

Historical Photographs



1885 – Gila River. 10th Infantry Crossing the Gila River

Historical Photographs



Gila River in Duncan Valley

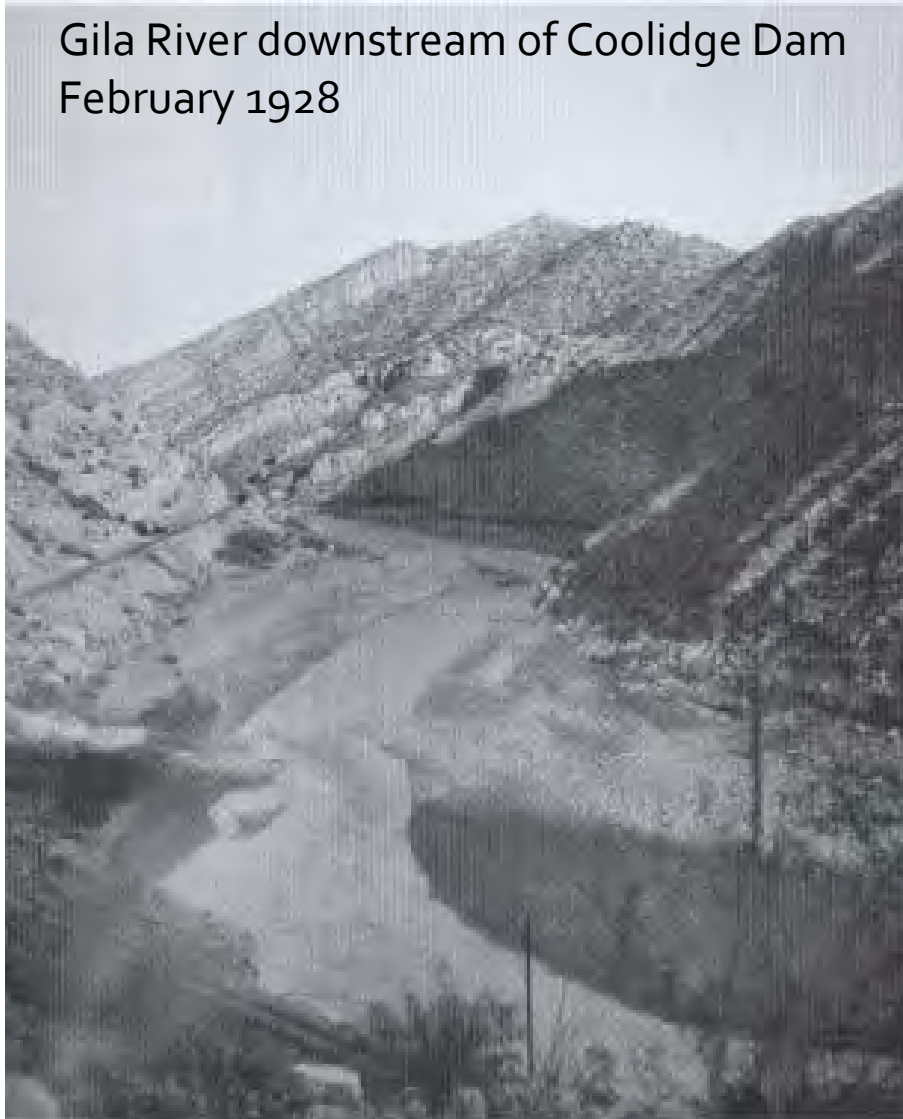
Historical Photographs



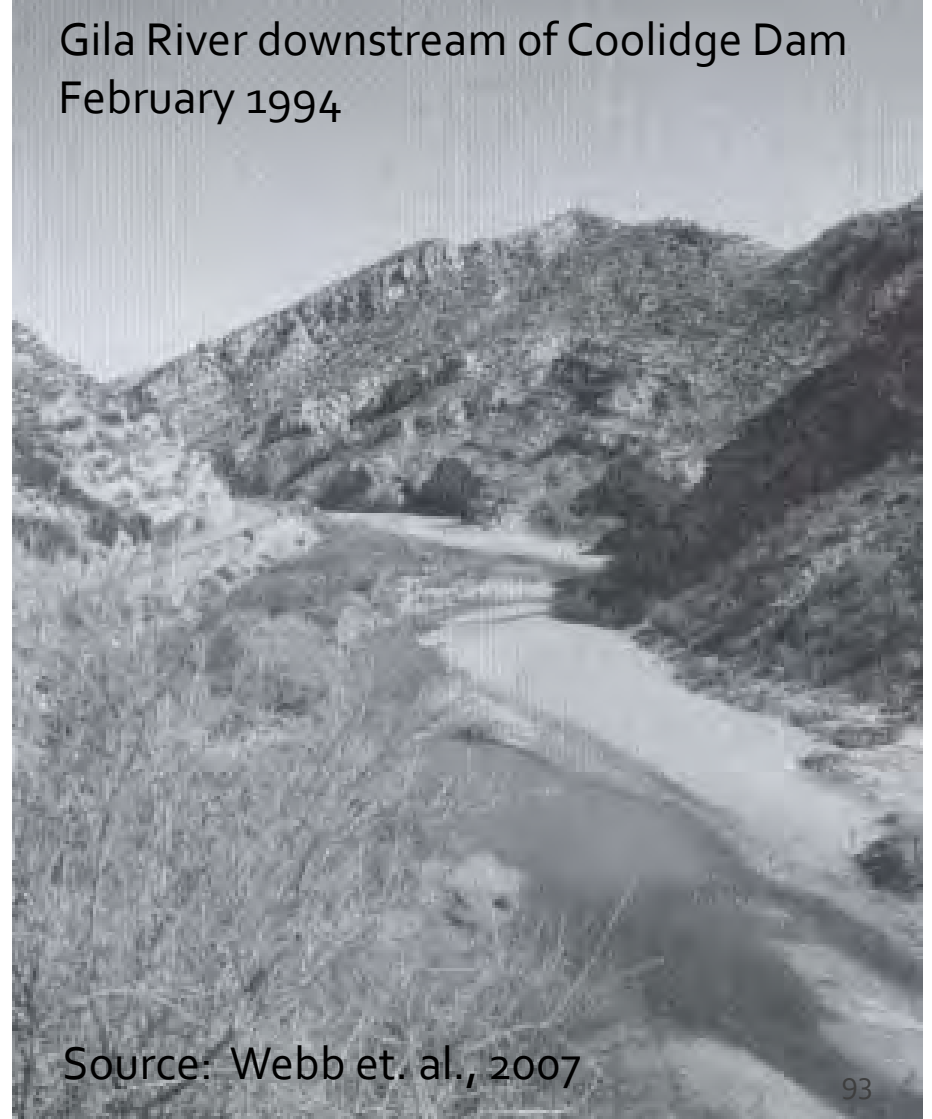
May 1909 – Gila River near Geronimo, AZ (Burkham, 1972)

Historical Photographs

Gila River downstream of Coolidge Dam
February 1928



Gila River downstream of Coolidge Dam
February 1994



Source: Webb et. al., 2007

Historical Photographs



Source: Webb et. al., 2007

September 2, 1915 – Gila River near Kelvin

Historical Photographs



~1908 – Gila River near Kelvin

Source: Webb et. al., 2007

Historical Photographs



Small boat used in repair of Gila River Bridge after 1905 flood.
From Littlefield, 2014

Historical Photographs



Gila River near
Wilton
Crossing, 1910

From:
Littlefield, 2014

River Descriptions

- Summary of Descriptions
 - Single channel
 - Moderate depths (1-4 ft)
 - Some deeper areas
 - Moderate widths (~20-150 yds)
 - Subject to seasonal & annual changes
 - Segment 6 seasonally dry (possibly due to irrigation)
 - All other Segments perennial
 - Corridor of vegetation

Historical Boating Accounts

- Steamboats
 - Explored by steamboat in 1860's after gold discovered around Gila City (Segment 8)
 - Segment 8
 - Ran up to Dome
 - Shipping firewood (ca. 1864)
 - Lingenfelter Declaration:
 - Steamboats ran 5 miles up Gila during high water
 - Use by gas powered steamers in 1890's

Sources:

AZ Sentinel, 1-25-1879

AZ Sentinel, 6-12-1901

Tombstone Epitaph, 5-27-1894

Historical Boating Accounts

- Chiricahua Apaches (Segments 1-3)
 - Bull hide boats used to cross river
 - Wicker baskets
- Spanish Explorers
 - “Rio de las Balsas” (river of rafts – crossing)

Historical Boating Accounts

- James Ohio Pattie (1825)
 - Segment 7-8: Used canoe because river too deep to ford on horseback
 - 1828: Eight dugout canoes, comfortable descent
 - Canoeed from Safford to Yuma several times
 - Made rafts to escape Indian attack
 - Some trappers used horse hide /wood frame boats

Sources: ASLD Reports; Tellman (AZ Changing Rivers); Davis, 1982

Historical Boating Accounts

- Mormon Battalion (Col. Cooke, Lt. Stoneman)
 - Segment 7-8; December 1846
 - Boat
 - Initially: two wagons lashed to two cottonwood logs, loaded with 2500 lbs, plus more logs lashed on
 - Later: detached the logs, wagons – two boats
 - No mention of oars or rudder
 - Ran aground, lightened load & modified, boated on
 - Arrived in Yuma before the rest of the troops
 - “A complete failure” – but faster than troops, arrived, no upsets

Sources: Corle, 1951; Christiansen & Pettes, 1986

Historical Boating Accounts

- Howard Family Trip (October, 1849)
 - Wagon/Boat (built on Lake Michigan)
 - 16 x 5.5 ft wooden, decked
 - Used without serious incident
 - 250 miles in 3 days (Pima Villages to Yuma)
 - Sold boat at Yuma for \$300 and a wagon
 - Segments 6, 7 & 8
 - Baby boy born en route "Gila"

Historical Boating Accounts

- Forty Niners
 - (Segment 7-8) Small boats, successful to Yuma
 - “Many Gila Trail travelers had thus reached the Colorado River” (NY Daily Tribune, 2.18.1850)

Historical Boating Accounts

- Hamilton, Jordan, Halesworth (Jan 1879)
 - Segment 7 & 8 (Phoenix to Yuma)
 - Homemade skiff, paddled
 - “Perfectly practicable for navigation”
 - One obstruction by rocks – 10 mi. above Gila Bend
 - Easy for flatboat loaded with produce
 - Would draw 2 feet

Historical Boating Accounts

- Cotton & Bingham Trip (February 1881)
 - Segment 7-8
 - Phoenix to Yuma (Salt River; Gila Segments 7-8)
 - 18 ft skiff, flat-bottomed

Historical Boating Accounts

- Yuma or Bust, November 1881
 - Segment 7-8 (Phoenix to Yuma)
 - 25 x 5 ft flatboat
 - Shallow flow, sand bars
 - Bucky O'Niell

Historical Boating Accounts

- Stanley Sykes & Charlie McLean (Winter, 1890's)
 - Segment 7-8 (Phoenix to Yuma)
 - Canvas over wood frame, painted
 - Salt River at put in: 15-20 ft wide, 1 ft deep
 - Dry reaches until the Gila Confluence
 - Capsized on an irrigation diversion
 - After the dam, there was more water & they “made pretty good time to Yuma.”

Source: Coconino Sun, 9.7.1945

Historical Boating Accounts

- Entire Gila River (Nov 1890-April 1891)
 - Segments 1-8
 - Two men (unnamed in account)
 - New Mexico highlands to Yuma
 - Homemade wooden boat
 - Boat lost during flood, built new one & continued
 - No special incident except above
 - Hunting, trapped – moderate success

Source: Tombstone Epitaph, reprinting Yuma Times, 4-19-1891

Historical Boating Accounts

- J.K & George Day (Sept 1891-April 1892)
 - Camp Verde to Yuma (Verde-Salt-Gila Segment 7-8)
 - Trapping expedition
 - Large quantity of beaver & otter furs
 - Very profitable
 - No problems reported
 - Planning a repeat trip the following year

Source: AZ Sentinel, 4.2.1892

Historical Boating Accounts

- Adams & Evans (Jan 20-Feb 17 1895)
 - Segments 2, 3, 4, 5, 6, 7, 8
 - 18 x 3.5 ft homemade wooden flat boat with cabin
 - Clifton to Sacaton (Segment 2-6)
 - Tempe to Yuma (Segment 7-8)
 - Below San Carlos “81 miles of rough rapids & falls”
 - Actual mileage = 28 miles to Winkelman, no falls
 - Smooth river below Winkelman
 - Hauled the boat from Sacaton to Phoenix
 - Visited for several days in Phoenix
 - Boated Phoenix to Yuma
 - Difficult in one segment. Successful in all others.
 - Jan-Feb is not usually high water.

Sources: ASLD Report, Phoenix Herald (2.18,25.1895), AZ Sentinel (3.9.1895)

Historical Boating Accounts

- Lt. Gully & Richardson (prior to 1896)
 - Segments 6, 7, 8
 - Pima Villages to Yuma
 - Homemade wooden boat
 - No incidents
 - Hostile Indians along Colorado

History: Key Findings

- Floating Logs (Segment 8)
 - Los Angeles Herald, 1897
 - “Formerly, they were bringing wood down the Gila river on a raft.” Replaced the rafts with a boom to collect floating logs in the “swift current.”

Historical Boating Accounts

- Jacob Shibley (April 1905)
 - Segment 7 (Phoenix to Gila Bend)
 - Homemade wooden boat
 - Capsized once (on Salt River)
 - Reached Gila Bend
 - Determined he needed a bigger boat.
 - Flow in Salt was ~11,000 cfs

Source: AZ Republican, 3.24,29.1905; McCrosky, 1989

Historical Boating Accounts

- Stanley Sykes (1909)
 - Granger (1983) states that Stanley Sykes of Flagstaff canoed the entire length of the Gila in Arizona.

Historical Boating Accounts

- Federal GLO Surveyors
 - 1890. Boat used to complete survey
 - 1911: Used Dougherty's skiff to cross river
 - Skiff was part of rancher's inventory.

Historical Boating Accounts

■ Others

■ HMT Powell (1849)

Source: McCroskey, 1989

- Heavily loaded vessel, trouble with sand bars
- “Navigation only practical for flat boats”
- Advice: send heavy loading by boat from Pima Villages

■ Nathaniel Jones (Mormon Battalion, 1847)

- Boats made of wagons, 12 oxen in each Source: Utah Historical Quarterly
- No indication of success or failure, Segment unknown

Historical Boating Accounts

■ Others

- March 1869 (Military Ferry @ Ft. Goodwin)

- Raft used during high flow

Source: AZ Weekly Miner, 4.10.1869

- 1883: "Gila has been navigated to its junction with the Santa Cruz."

Source: AZ Weekly Citizen, 6-9-1883

- Feb-Mar 1886 (Dugout, Clifton to Florence)

- Prospector

Source: AZ Silver Belt, 4-3-1886

- 1897 – Bringing wood down on a raft (Segment 8)

Source: The Herald, 3.28.1897

Historical Boating Accounts

■ Others

■ Frank Burke & George Davis

Source: Tombstone Epitaph, 4.5.1890

- Segment 7
- Boat with \$15,000 in gold from Harquahala mines
- Overturned the boat, saved the gold

■ Boat Use During Floods

Sources: Various Newspapers

- Not ordinary & natural condition
- Boating in large floods can be dangerous
- Note: always seemed to have boats available when needed

Historical Boating Accounts

- Ferries
 - Dome (Segment 7/8)
 - Gila Bend (Segment 7)
 - Maricopa Wells (Segment 6) – 25 years
 - Maricopa (Segment 6)
 - Kelvin (Segment 5)
 - Florence (Segment 6)

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 Portage
 - 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
 - All but one boat reached destination
 - Dugout, 1886, Segment 5
- Conclusion: Historical boating was successful.

Historical Boating Accounts

- Typical Trade/Travel Uses ca. 1912
 - Hauling Goods
 - Hauling Passengers
 - Exploration
 - Military
 - Ferries
 - Fishing
 - Trapping/Hunting
 - Survey
 - Travel

Boat Types Used		
Steamboat	Flatboat	Canoe
✓	✓	✓
✓	✓	✓
	✓	✓
	✓	
	✓	✓
	✓	✓
	✓	
	✓	✓

Historical Boating Accounts

Segments Boated Historically								
Boat Type	1	2	3	4	5	6	7	8
Steamboat								X
Ferry			X		X	X	X	X
Raft		X	X					X
Flatboat	X	X	X	X	X	X	X	X
Canoe	X	X	X	X	X	X	X	X
Floating Logs								X

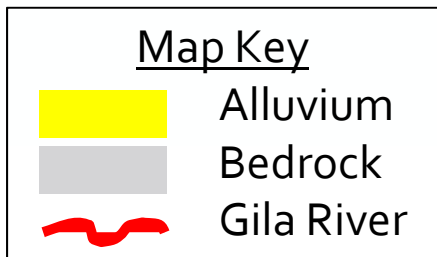
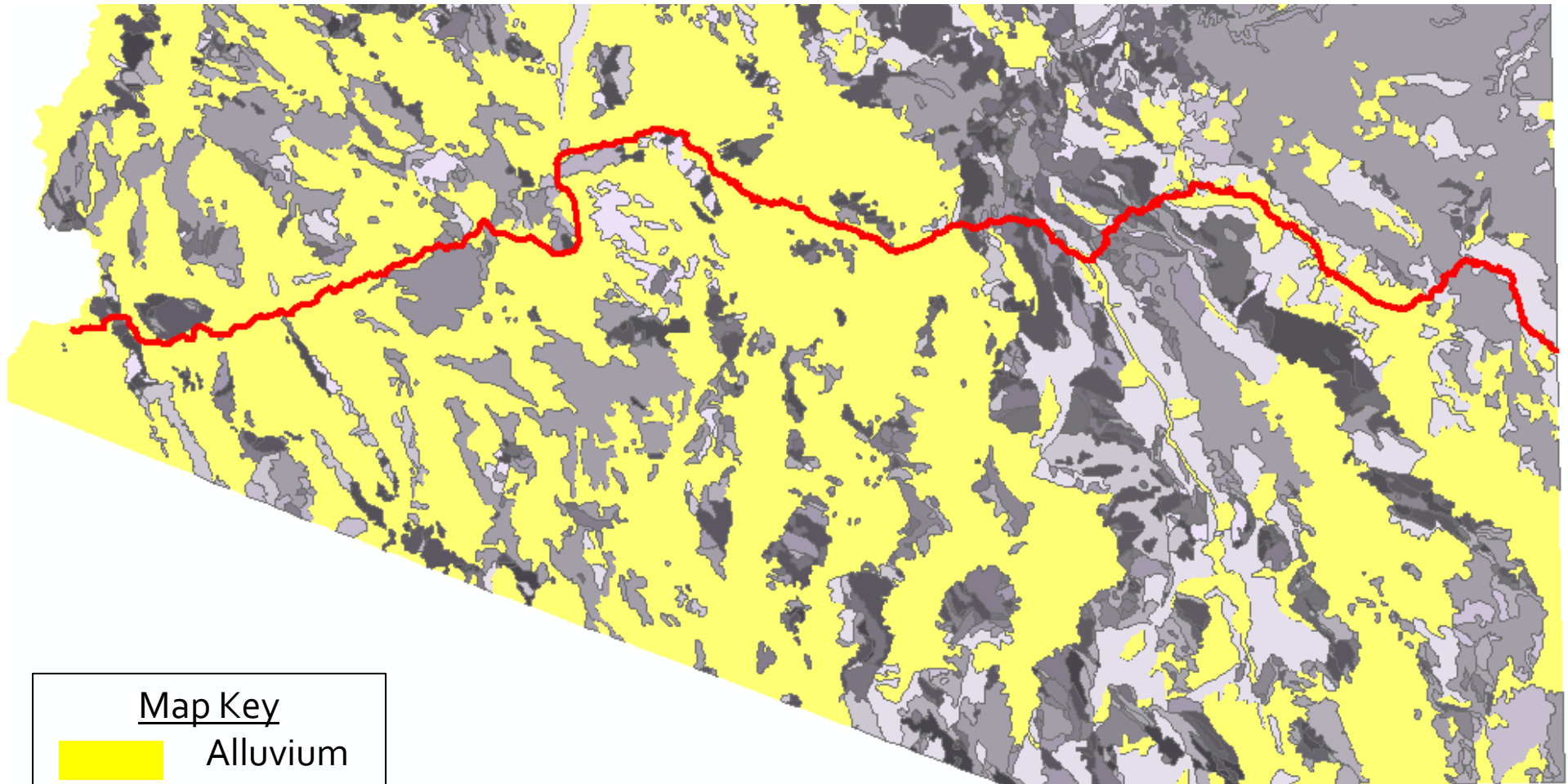
Historical Boating Accounts

- Historical Accounts of Boating: Summary
 - Seasonality (Winter-Spring-Fall)
 - Not August-September
 - Flow Rates: Normal, Expected Range
 - Manmade Obstacles
 - Depleted flows
 - Irrigation diversions
 - Success v. Failure
 - All but one reached destination

Geology: Key Findings

- Variable Geology over Length
 - But channel remains navigable
- Affects of Floods
 - Channels move, but stay the same
 - Floods aren't "ordinary"
- Braided vs. Compound Channel
 - Braided flood channel, not boating channel
 - Braided channels can be navigable

Geology: Key Findings



Geology: Key Findings

- Huckleberry Report (Segments 3-8)
 - Reference to Burkham study
 - Period of unusual flooding
 - Kearny Reach: single, sinuous channel
 - Did not consider canyon reaches
 - Low flow channel within braided channel
 - Notes that GLO channel plots are inaccurate except at section lines. (outside floodplain)
 - Not ordinary & natural condition

Geology: Key Findings

- Geomorphic Response to Altered Hydrology
 - Loss of low flows (Segments 1-3, 6-8)
 - Affects recovery of navigable channel
 - Persistence of flood impacts on river corridor
 - Change in native/invasive vegetation
 - Loss of floods (Segments 4-5)
 - Channel “maintenance”
 - Change in native/invasive vegetation
 - Sediment transport
 - Increase deposition & braiding

Geology – Other Factors

- Waterfalls: None
- Rapids: Minor, rare
- Exotic Stream: Distant primary source
- Water Table: High prior to 1912
- Gaining stream segments (2,4,5)
- Losing stream segments (1,3,6,7,8)
- Sand Bars: many
 - 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

Gila 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
 - Seasonal Variation
 - Occurs Within Predictable, Ordinary Range
 - 90% Range Presented
 - Seasonal Variation Normal on Navigable Rivers
 - Ice, Low/High Flow, Flood Season

Gila 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

Gila 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
 - Other flow estimates submitted by others for ordinary & natural condition are higher

Gila River Hydrology

Flow Estimates Reported in ASLD, 2003; JE Fuller, 2003

Gage Station	Segment	Flow Rate (cfs) Avg Monthly	Flow Rate (cfs) Median	Flow Rate (cfs) 90%	Gage Period
Dome	8/7	455	*	*	1903-1991
Gillespie	7	393	*	*	1921-1991
Kelvin	6/5	491	270 ⁺⁺	26 ⁺⁺	1911-1991
Winkelman	5	332	*	*	1917-1991
Coolidge	4	379	*	*	1899-1991
Calva	3	334	69 ⁺⁺	2 ⁺⁺	1929-1991
Solomon	3/2	433	174	62	1914-1991
Clifton	2/1	206	80	18	1912-1989
Virден (NM)	1	190	91	21	1928-1989

All flow rates shown are for post-ordinary & natural (depleted) condition

* No median flow rate data were reported by ASLD, 2003

++ Flow rates from Pope et. al., 1998

Gila River Hydrology

- Comparison to Other Parties (Burtell)
 - Reconstruction of Undepleted Flow
 - Segment 1:
 - Virden Gage: 80-315 cfs (monthly medians)
 - Segment 2:
 - Clifton Gage: 158-442 cfs (monthly medians)
 - Segment 3:
 - Solomonville Gage: 264-693 cfs (monthly medians)
 - Segments 4:
 - Below Coolidge Gage: 334-845 cfs (monthly medians)
 - Segments 5-8: No estimate

Gila River Hydrology

- Comparison to Other Parties (Gookin)

Gookin Flow Estimates				
Location	Segment	Mean Flow (cfs)	Median Flow (cfs)	Low Flow (cfs)
Kelvin	5/6	755	345	175
Above Salt River	6	637	193	23
Below Salt River	7	2504	774	74

- Comparison to Other Parties (Mussetter)
 - No flow data or estimates submitted

Gila River Hydrology

- Hjalmarson (Segment 7, 8)
 - Average = 2330
 - Median = 1750
 - Base flow = 290 cfs (170 cfs at mouth)

Gila River Hydrology

■ Other Undepleted Flow Rate Estimates

<u>Average Annual</u>	<u>BUREC (1952)</u>	<u>Krug (1989)</u>
■ Virden (Seg #1)	217 cfs	212 cfs
■ Clifton (Seg #2)	233 cfs	177 cfs
■ Solomonville (Seg #3)	551 cfs	494 cfs
■ Coolidge Dam(Seg #4)	588 cfs	*

■ Tree Ring – Segment 3 (Solomonville Gage)

- Meko & Hirshboeck, 2008 - 345 cfs (median annual)
- Meko & Graybill, 1972 – 350 cfs (median)

■ Thomsen & Eychaner - Mean of 610 @ Kelvin (Seg #5/6)

Gila River Hydrology

- Summary
 - Best Available Data
 - Flow is Predictable
 - Flow is Reliable
 - Flow is Perennial
 - Gila River Flow is significant
 - Pre-Development Flows Higher than Modern Flows

Gila River Rating Curves

- Rating Curves: Flow Depth & Width
 - From USGS Rating Curves & Field Sections
 - Representative of Segments
 - Actual Measurements & Observations
 - Consistent with Historical Observations

Gila River Rating Curves: Segment 1

Gila River Near Virden (NM): ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	21	0.6	1.3	27
50% (median)	91	0.9	2.2	45
Mean Annual	190	1.2	1.6	100

Gila River Near Clifton: ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	18	0.7	1.0	26
50% (median)	80	1.0	1.7	47
Mean Annual	206	1.3	2.5	64

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

Gila River Rating Curves: Segment 2

Gila River Near Clifton: ASLD Report Estimates				
Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	18	0.7	1.0	26
50% (median)	80	1.0	1.7	47
Mean Annual	206	1.3	2.5	64

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

Gila River Rating Curves: Segment 3

Gila River Near Solomon: ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	62	0.8	0.5	144
50% (median)	174	1.3	0.9	146
Mean Annual	433	1.9	1.5	150

Gila River Near Calva: ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	2	< 0.5	1	*
50% (median)	69	< 0.5	1	*
Mean Annual	334	1.8	1.5	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

Gila River Rating Curves: Segment 4

Gila River Below Coolidge Dam: ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	*	*	*	*
50% (median)	*	*	*	*
Mean Annual	379	2.7	3	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves: Segment 5

Gila River at Kelvin: ASLD Report Estimates				
Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	26	0.3	1	*
50% (median)	270	1.3	2	*
Mean Annual	491	1.8	3	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves: Segment 6

Gila River at Olberg: ASLD Report Estimates				
Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
*	48	0.5	1.1	*
*	153	1.0	1.5	*
*	302	1.5	1.9	*
*	489	2.0	2.3	*
*	711	2.5	2.8	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves: Segment 7

Gila River at Laveen: ASLD Report Estimates				
Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
*	80	0.5	0.8	*
*	369	1.5	0.9	*
*	763	2.0	1.0	*
*	1219	2.5	1.1	*
*	2158	3.0	1.2	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves: Segment 7

Gila River near Buckeye: ASLD Report Estimates

Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
*	30	1.0	0.6	*
*	90	1.5	0.8	*
*	193	2.0	0.9	*
*	350	2.5	1.0	*
*	479	3.0	1.1	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves: Segment 8

Gila River at Dome: ASLD Report Estimates				
Flow Frequency	Flow Rate (cfs)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Top Width (ft)
90%	*	*	*	*
50% (median)	*	*	*	*
Mean Annual	455	3.2	1.3	*

For post-statehood conditions. Ordinary & natural condition flows would be deeper.

* Data not reported in ASLD, 2003.

Gila River Rating Curves

- Comparison to Other Experts' Estimates (Burtell)
 - Segment 1: 1.7-1.8 ft (hydraulic depth) - Virden
 - Segment 1: 1.6 ft (hydraulic depth) - York
 - Segment 2: 1.5-2.5 ft (hydraulic depth) - Clifton
 - Segment 2: 2.5 ft (hydraulic depth) – Bonita Ck
 - Segment 3: 2.0 ft (hydraulic depth) - Solomonville
 - Segment 3: 2.0 (hydraulic depth) - Ashurst
 - Segment 3: 1.8 ft (hydraulic depth) - Calva
 - Segment 4: 1.8-2.0 ft (hydraulic depth) – Coolidge Dam

Gila River Rating Curves

- Comparison to Other Experts' Estimates (Gookin)
 - Based on Modeling Cross Section from Historical Topo
 - Potential Issues with Cross Section/Model

■ Results	Kelvin	Above Salt River
■ Mean	0.70 ft (1.1 ft)	0.98 ft
■ Median	0.55 ft (1.4 ft)	0.74 ft
■ Low Flow	0.44 ft (1.7 ft)	0.24 ft

Gila River Rating Curves

- Comparison to Other Experts' Estimates

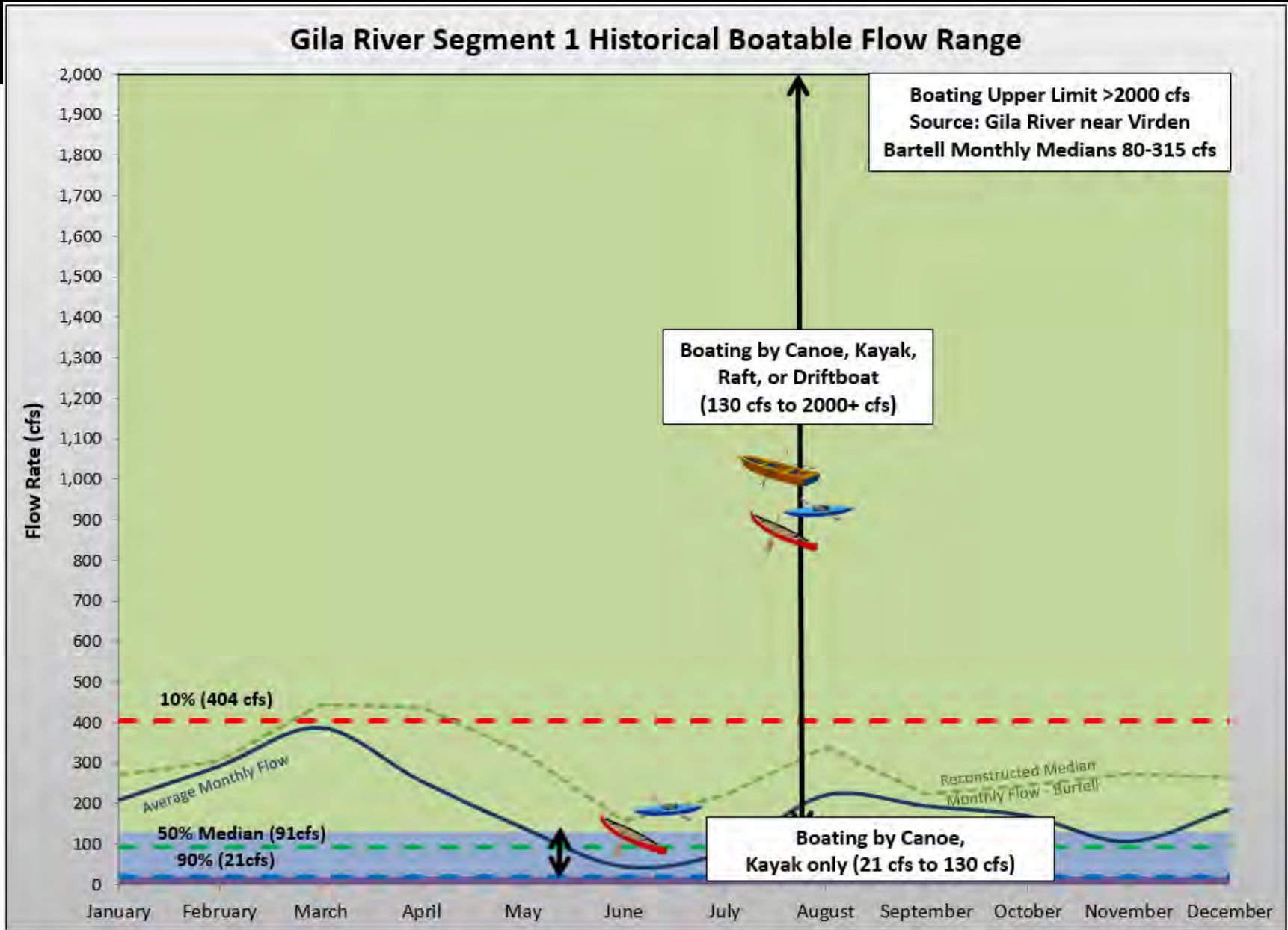
- Hjalmarson/Segment 7

	@ Salt River	@ Colorado River	Depth
■ Mean:	2,330 cfs	2,330 cfs	3.1 ft
■ Median:	1,750 cfs	1,750 cfs	2.9 ft
■ Base:	290 cfs	170 cfs	1.0-2.0 ft

Susceptibility to Boating

- Requirements for Boating
 - In Boating Presentation
- Summarized Below by Segment
 - Flow Data (Seasonal, Median, 10-90%)
 - Boating Range

Gila River Segment #1



Gila River Segment #1

- Modern Boating
 - Rarely boated due to flow removal, diversions, fences, poor scenery, minimal adventure, & distance from major urban centers.
- Changes Since Statehood
 - Flow removed for irrigation
 - Floodplain encroachment (mostly agriculture)
 - Isolated levees
 - Bridges
 - Invasive species (tamarix, etc.), loss of native vegetation
 - Loss of low flow, recovery of main channel

Gila River Segment #1

■ Summary

- Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
- Boatable by flatboats: ~40% of the time
 - Seasonally (Winter, Monsoon) (146 days/yr)
- Modern Boating
 - Some recreational use
 - Not particularly scenic
 - Fences & dams
- Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River Segment #1

- Field photos, February, 2014
 - Gila River @ Duncan: 50 cfs (upstream end)
 - Gila River near Safford: 38 cfs (downstream end)
- Wenonah Rendezvous Solo Canoe
 - 15 ft, 8 in long
 - 59 lbs
 - Minimal load (~300 lbs)

Gila River Segment #2

- Modern Boating
 - Frequently boated by canoes, kayaks, rafts
 - Some commercial recreation
 - Four Class II rapids (< 1% of 23 mile reach)
 - “Gila Descending” by M.H. Salmon
 - Numerous websites & river guides
 - Prime season is late spring, summer monsoon

Gila River Segment #2

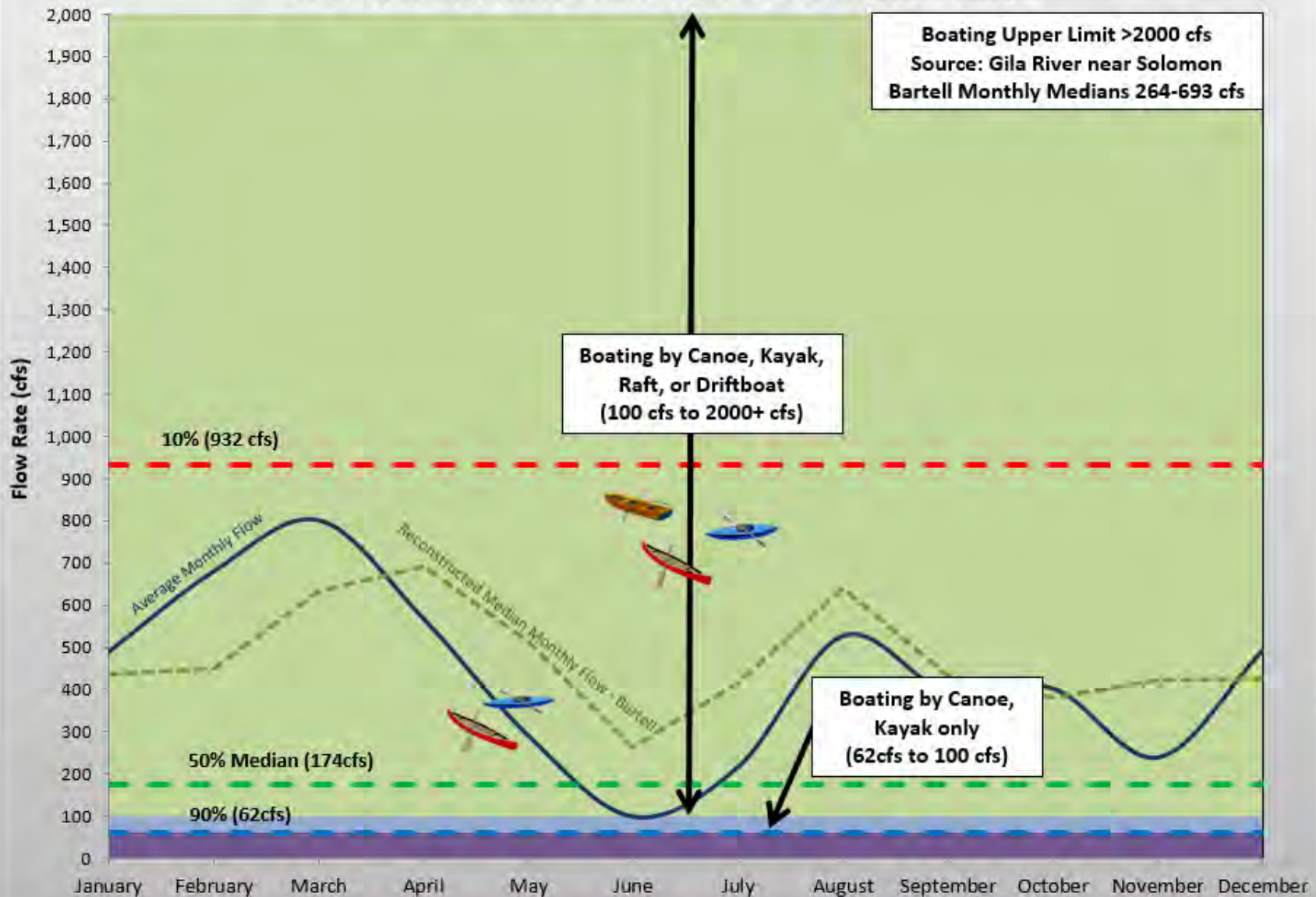
- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~50% of the time
 - Seasonally (Winter, Monsoon) (183 days/yr)
 - Modern Boating
 - Extensive recreational use
 - Fences & dams
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River, Segment #2

- Field photos, June 2014
 - Gila River near Safford: 22 cfs (upstream end)
 - Gila River @ Head Safford Valley : 40 cfs (d/s end)
- Wenonah Rendezvous Solo Canoe
 - 15 ft, 8 in long, 59 lbs
 - Moderate load (~350 lbs)
- Prijon Yukon Expedition Kayak (14.5', 59 lbs)
 - Light load (250 lbs)

Gila River Segment #3

Gila River Segment 3 Historical Boatable Flow Range



Gila River Segment #3

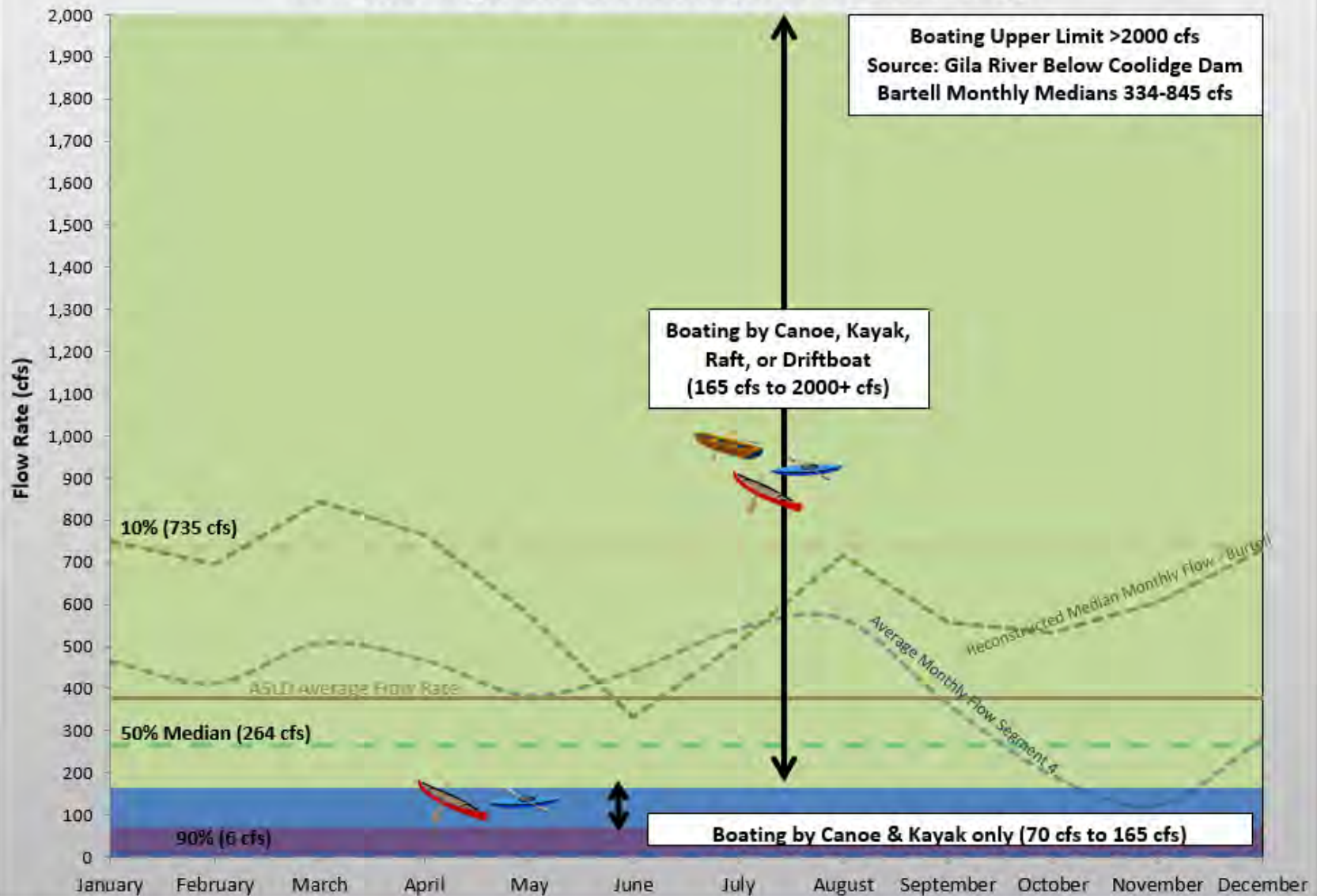
- Modern Boating
 - Rarely boated due to flow removal, diversions, fences, poor scenery, minimal adventure, & distance from major urban centers.
- Changes Since Statehood
 - Flow removed for irrigation
 - Floodplain encroachment (mostly agriculture)
 - Isolated levees
 - Bridges
 - Invasive species (tamarix, etc.), loss of native vegetation
 - Loss of low flow, recovery of main channel

Gila River Segment #3

- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~80% of the time
 - Year Round (292 days/yr)
 - Modern Boating
 - Rare recreational use due to human disturbance
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River Segment #4

Gila River Segment 4 Historical Boatable Flow Range



Gila River Segment #4

- Modern Boating
 - Main canyon is infrequently boated due to flow removal, locked gates on the few access roads.
 - Lower canyon is popular boating reach during dam releases.
 - 12 Class II (< 4%), 1 Class III rapid (<1%) in 21 miles.
 - Several websites with boating guides.

Gila River Segment #4

- Changes Since Statehood
 - Flow releases regulated for irrigation
 - Floods stored, irrigation needs dictate flows
 - Invasive species (tamarix, etc.)
 - Bank vegetation overgrown due to lack of floods.
- Summary: Less navigable today than in past

Gila River Segment #4

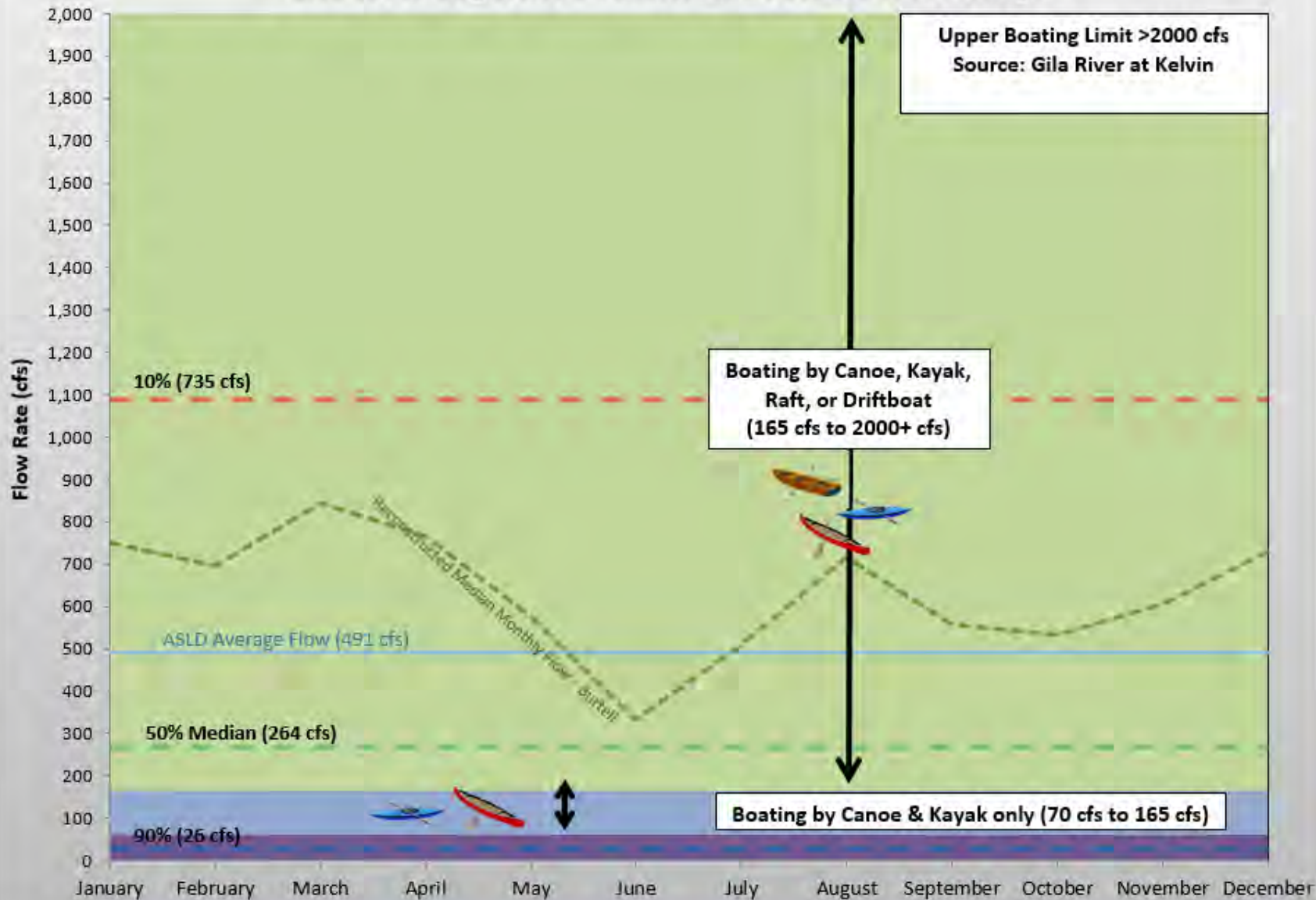
- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~70+% of the time
 - Year Round (256 days/yr)
 - Modern Boating
 - Recreational use limited by gated access
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River Segment #4

- Field photos, April 2014
 - Gila River d/s Coolidge Dam: 220 cfs
- Wenonah Rogue Tandem Canoe
 - 16 ft long, 69 lbs
 - Moderate load (~420 lbs)
- Other Boats Pictured
 - Prijon Kayak, Tandem Canoe, Inflatible Kayak

Gila River Segment #5

Gila River Segment 5 Historical Boatable Flow Range



Gila River Segment #5

- Modern Boating
 - Occasionally boated, mostly canoes and kayaks.
 - Flow removal, diversions, fences, and mining waste limit recreational boating.
 - 1 Class II rapid (<1%) in 61 mile reach.

Gila River Segment #5

- Changes Since Statehood
 - Flow removed for irrigation
 - Floodplain encroachment (mostly mining)
 - Invasive species (tamarix, etc.)
 - Loss of floods, changes in vegetation
- Summary: Less navigable today than in past

Gila River Segment #5

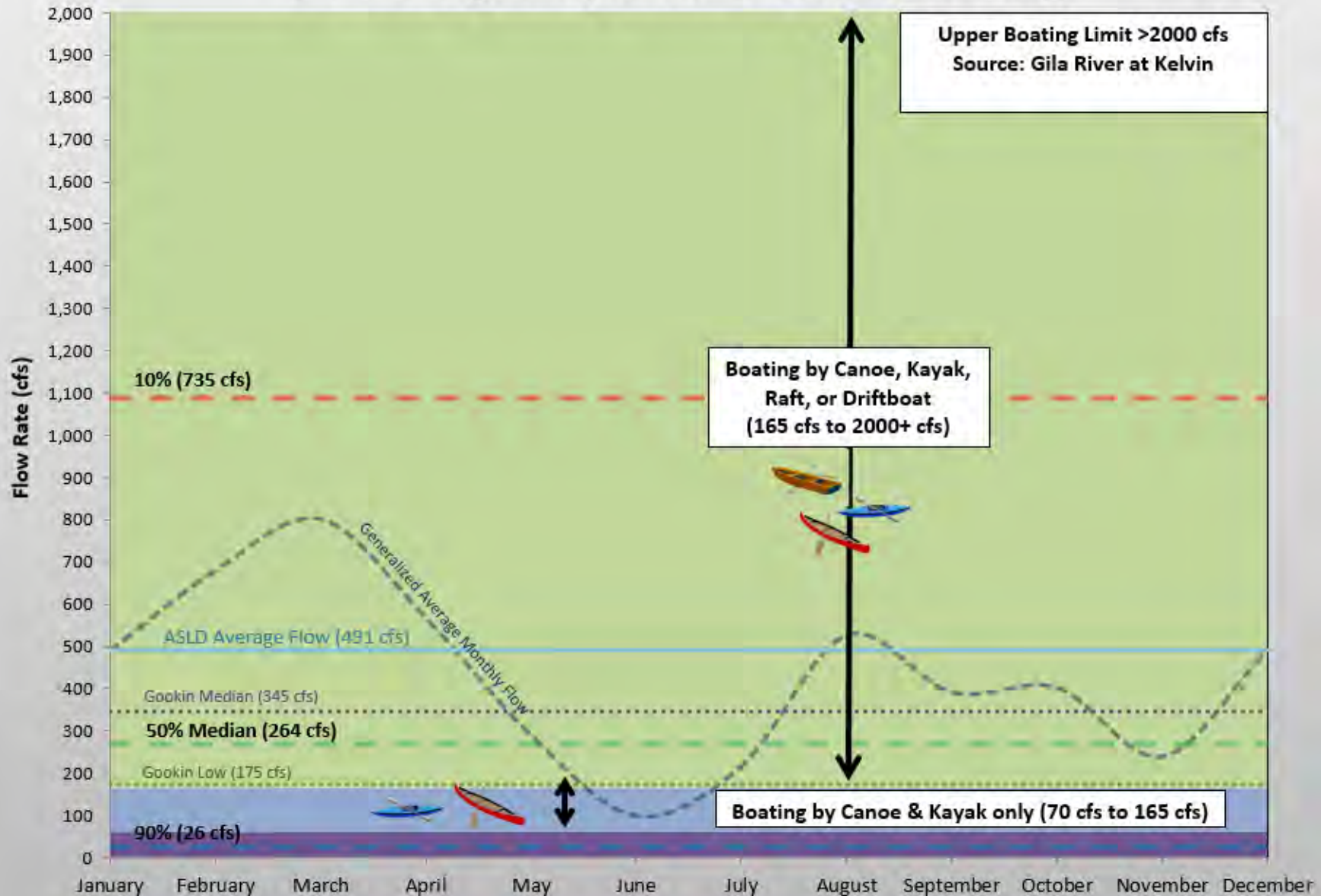
- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~90+% of the time
 - Year Round (329 days/yr)
 - Modern Boating
 - Frequent recreational use in canoes & kayaks
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River Segment #5

- Field photos, May 2014
 - Gila River @ Kelvin: 260 cfs
- Wenonah Rendezvous Solo Canoe
 - 15 ft, 8 in long, 59 lbs
 - Minimal load (~300 lbs)
- Other Boats:
 - Prijon Kayak, Play Kayak

Gila River Segment #6

Gila River Segment 5/6 Historical Boatable Flow Range



Gila River Segment #6

- Modern Boating
 - Rarely boated due to complete flow removal, diversions, fences, poor scenery, minimal adventure, & in-stream mining.

Gila River Segment #6

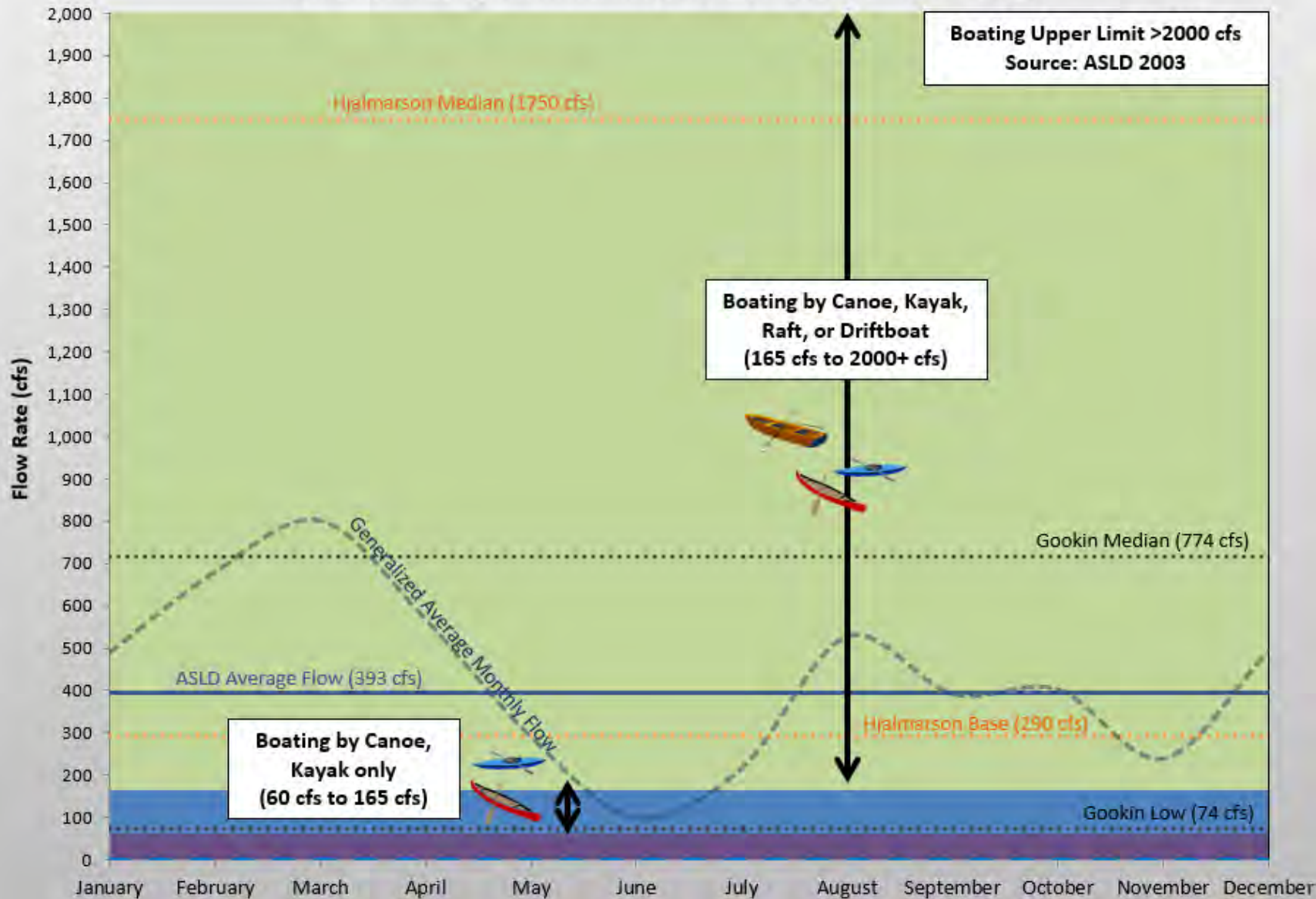
- Changes Since Statehood
 - Flow removed for irrigation
 - Lower water table
 - Floodplain encroachment (mostly agriculture)
 - Isolated levees
 - Bridges
 - Invasive species (tamarix, etc.) .), loss of native vegetation
 - Loss of low flow, recovery of main channel
- Summary: Less navigable today than in past

Gila River Segment #6

- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~90+% of the time
 - Year Round (329 days/yr)
 - Modern Boating
 - None due to human impacts
 - Ordinary & Natural Condition More Boatable
 - Higher flow, Lower reaches may have dried up rarely

Gila River Segment #7

Gila River Segment 7 Historical Boatable Flow Range



Gila River Segment #7

- Modern Boating
 - Infrequently boated due to flow removal, diversions, & minimal adventure.
 - Some recreational boating now occurs on effluent dominated reach between the Salt River and Gillespie Dam.
 - Tres Rios Nature Festival Canoe Trips

Gila River Segment #7

- Changes Since Statehood
 - Flow removed for irrigation
 - Floodplain encroachment (mostly agriculture)
 - Levees, In-stream mining, agriculture
 - Bridges, Utilities
 - Invasive species (tamarix, etc.) .), loss of native vegetation
 - Loss of low flow, recovery of main channel
- Summary: Less navigable today than in past

Gila River Segment #7

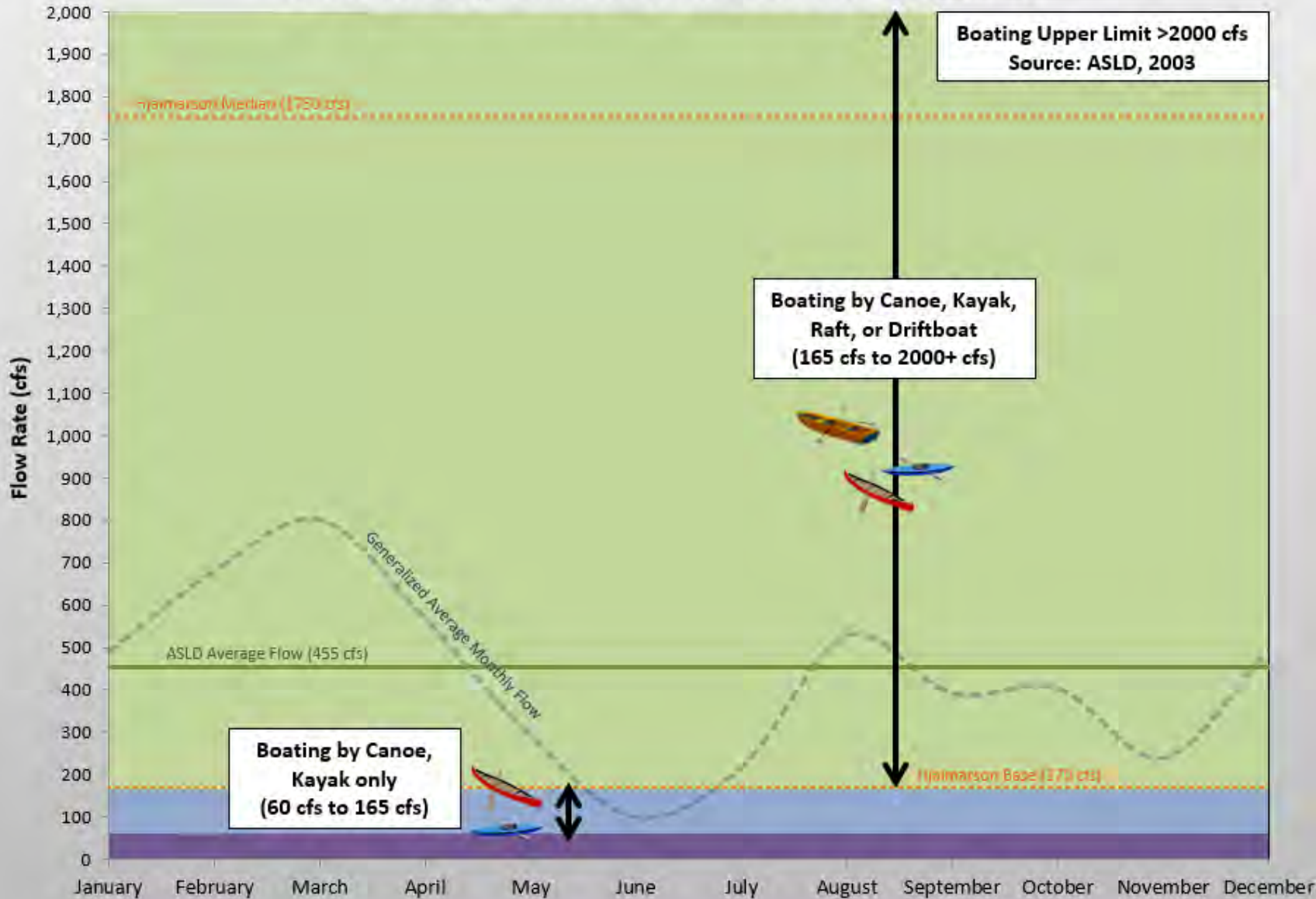
- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~90+% of the time
 - Year Round (329 days/yr)
 - Modern Boating
 - Some recreation boating
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Gila River Segment #7

- Field photos, February 2003
- Boats: Tandem Canoes
 - Wenonah Rogue (16 ft, 69 lbs)
 - Wenonah Cascade (17.5 ft, 75 lbs)
 - Other tandem canoes

Gila River Segment #8

Gila River Segment 8 Historical Boatable Flow Range



Gila River Segment #8

- Modern Boating
 - Rarely boated due to flow removal, diversions, fences, poor scenery, minimal adventure, & distance from major urban centers.

Gila River Segment #8

- Changes Since Statehood
 - Flow removed for irrigation
 - Floodplain encroachment (mostly agriculture)
 - Isolated levees
 - Bridges
 - Invasive species (tamarix, etc.) .), loss of native vegetation
 - Loss of low flow, recovery of main channel
- Summary: Less navigable today than in past

Gila River Segment #8

- Summary
 - Boatable by canoes: ~90% of the time
 - Year Round (329 days/yr)
 - Boatable by flatboats: ~90+% of the time
 - Year Round (329 days/yr)
 - Boatable by streamboats: ~50% of the time
 - Modern Boating
 - Rare modern boating
 - Ordinary & Natural Condition More Boatable
 - Higher flow

Modern Boating on the Gila River

- Recreational
- Commercial Recreation

Modern Boating on the Gila River

- Paddler's Clubs
 - Central Arizona Paddler's Club Poll
 - All of Segment 1 & 2 are boated.
 - Segment 2 (Gila Box) most frequently boated
 - Segment 4-5 boated
 - Gila River Classic – Race on Segment 5
 - Previous ANSAC Testimony (1997, Globe)

Modern Boating on the Gila River

- Websites re. Gila River Boating (Segments 1,2,4,5)
 - GORP: year round, 150-1500 cfs
 - Novice canoeists
 - Paddleon.net:
 - Segments 1-2-4-5 – Trip reports & photos
 - Southwestpaddler.com, year round, 100+ cfs
 - Livingexposed.com, trip reports
 - Adventureplus.com, trip reports
 - BLM.gov

Modern Boating on the Gila River

- Paddling Guides
 - Arizona State Parks Boating Guide
 - Segment 1-2 (Canoe, Kayak, Raft)
 - Southwest Boating Guide
 - Segment 1-2 (Canoe, Kayak, Raft)

Modern Boating on the Gila River

- Commercial Recreation
 - Cimarron Adventures (Jon Colby)
 - Segment 2 (Gila Box)
 - 17 years (recently stopped)
 - Flows 170-3000 cfs
 - Rafts, Canoes, Kayaks
 - Gila Outdoors Store
 - Shuttles, Outfitting, Canoe Rental – Gila Box
 - Segment 5

Modern Boating on the Gila River

- Commercial Recreation in Segment 2 (Box)*
 - AZ River Adventures (1995-2002)
 - Blue Sky (2002) **
 - Cimarron Rafting Co (1990-2002)
 - Mild to Wild Rafting (2000-2001)
 - Rising Wolf Expeditions (1990-1998)
 - Sun Country Rafting (1997)
 - Wolf Spirit Expedition (1997-2002)
 - Desert Voyagers **
 - River Proof Outfitters (guide service)

*Data through 2003

**Also ran trips on Segment 4-5

Modern Boating on the Gila River

- Commercial Use
 - Game & Fish Surveys (Segment 2, 4 & 5) – Canoe
 - BLM Gila Box RNCA
 - Management float trips

Technical Summary

- Hydrology – All Segments
 - Permanent, perennial flow
 - Predictable, reliable flow range
 - Sufficient to float shallow draft boats all year
 - Sufficient for larger, flat bottom boats seasonally
 - Well-defined boating channel that conveys the ordinary, normal flow of the Gila River

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

Ives, 1858: “constantly shifting channel... numerous obstacles”

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: A Little More History

In 1993, ASLD presented a report to ANSAC that concluded that “navigability” Arizona rivers depended on the following:

- The definition of the “Ordinary & Natural Condition.”
- What travel modes constitute a “highway for commerce.”
- The type of boat used to define susceptibility.
- What duration of boatable conditions is sufficient.

Not much has changed in 21 years.

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

- Gila 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)