Arizona State Land Department
Date, 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

- Speaker Resume

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 (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, 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

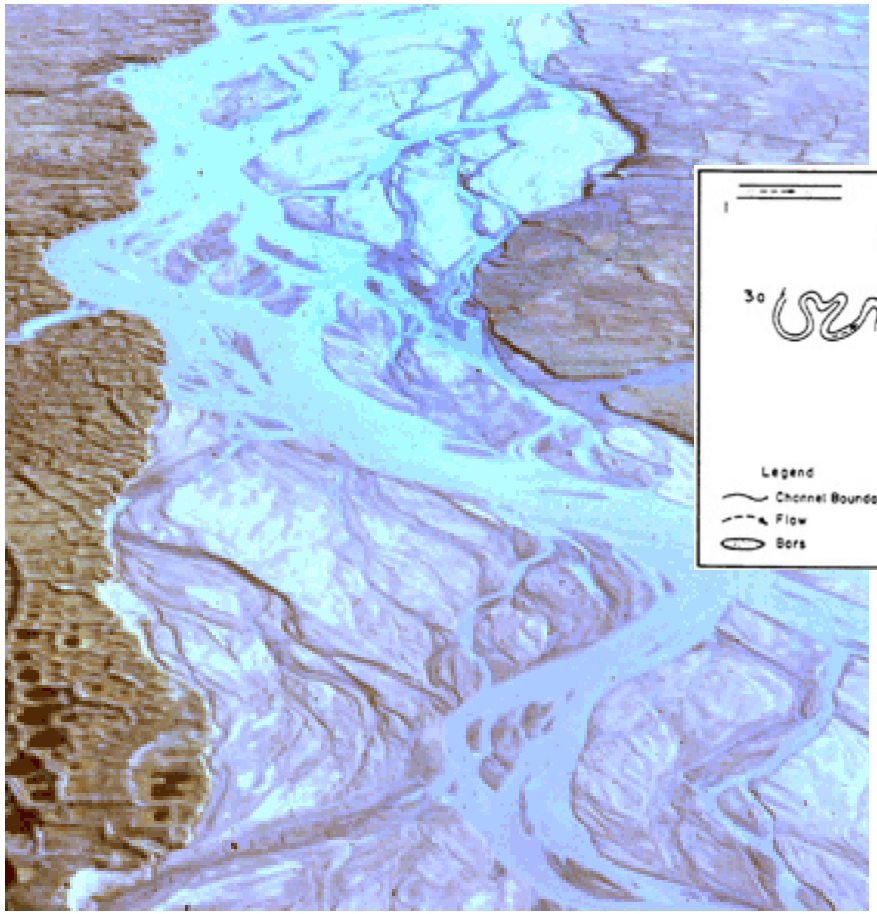
Terminology

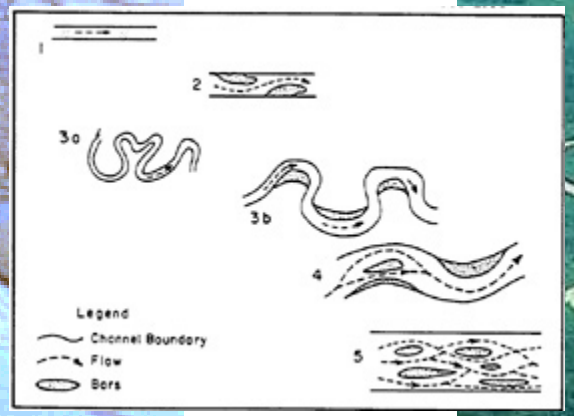
- Example: Burkham, 1972 Study of Gila
  - Phreatophyte study – water use by floodplain vegetation
  - "Stream channel" = area devoid of vegetation
    - Not = boating channel, except in high flow
    - "Active channel" – recent erosion, deposition, water flow
  - "Bottom land" = 1914 flood channel (inclusive)
  - "Flood plain" = outside stream channel, inside bottom land, densely vegetated

Terminology

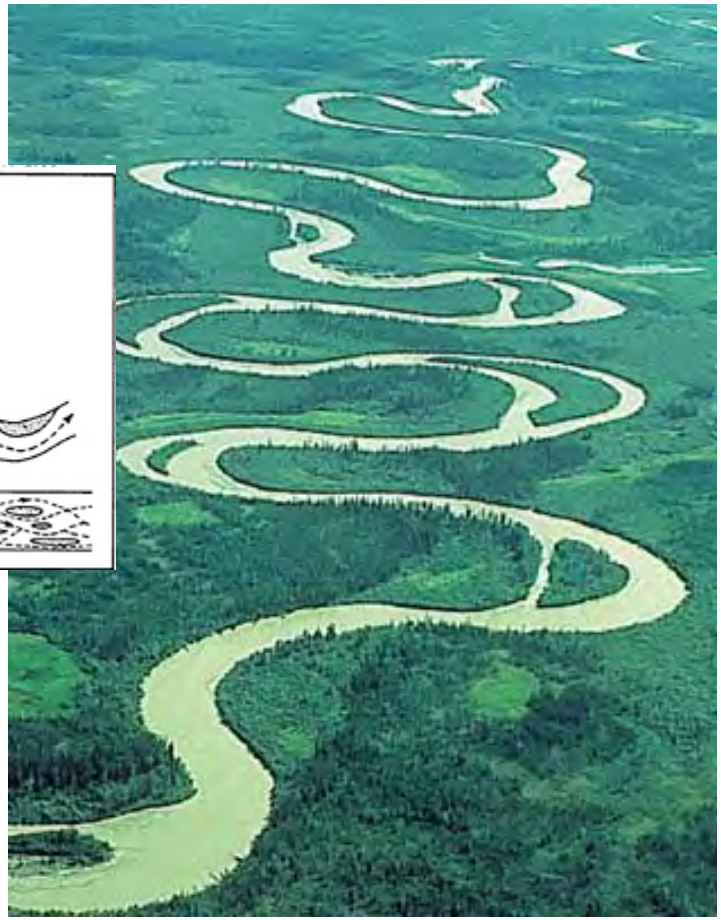
- Common Channel Patterns

Braided





Meandering



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.

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?

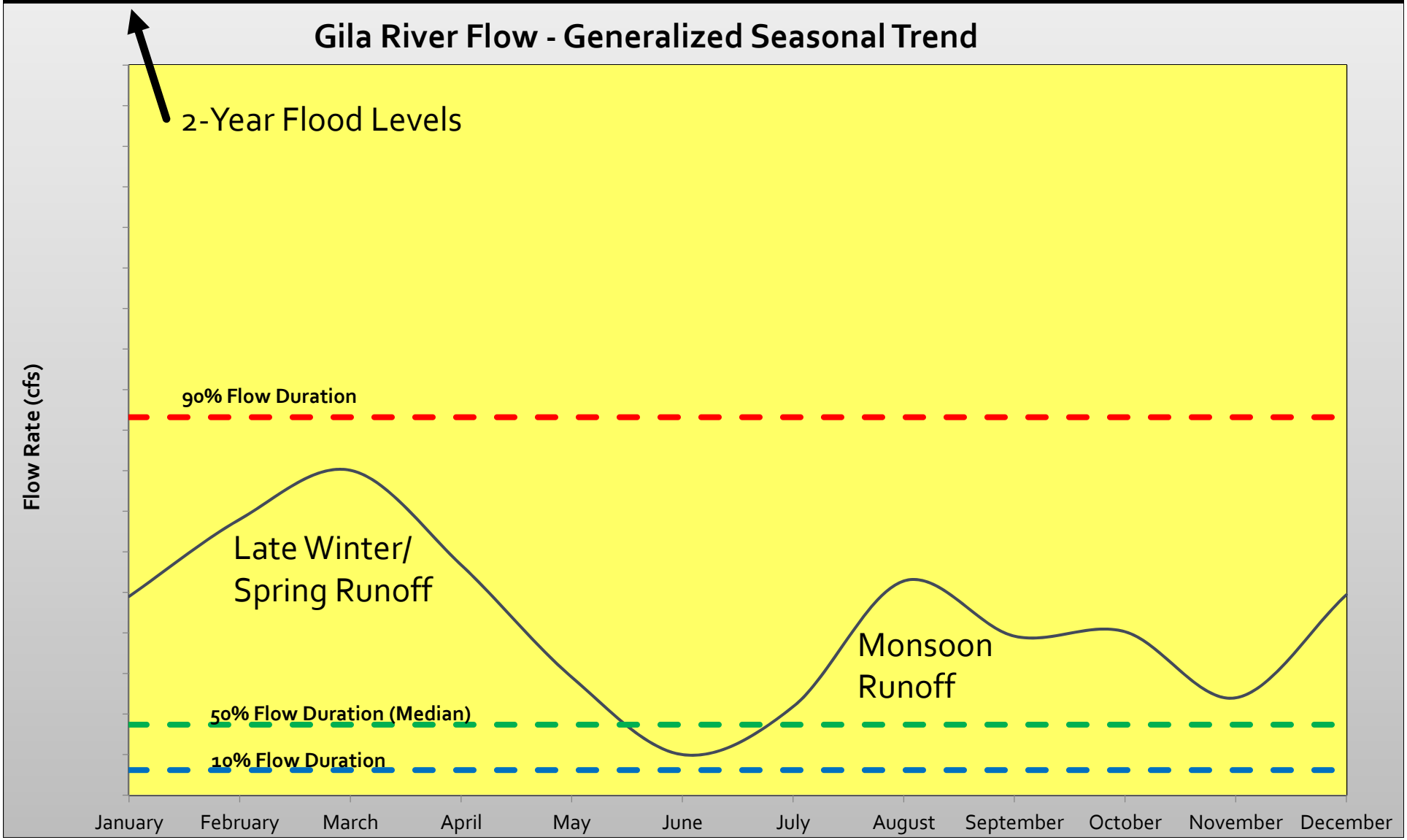
Terminology

- 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."

Terminology: Non-Erratic Seasonal Flow Fluctuation



Terminology

- Unstable
  - Not defined in ARSor 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

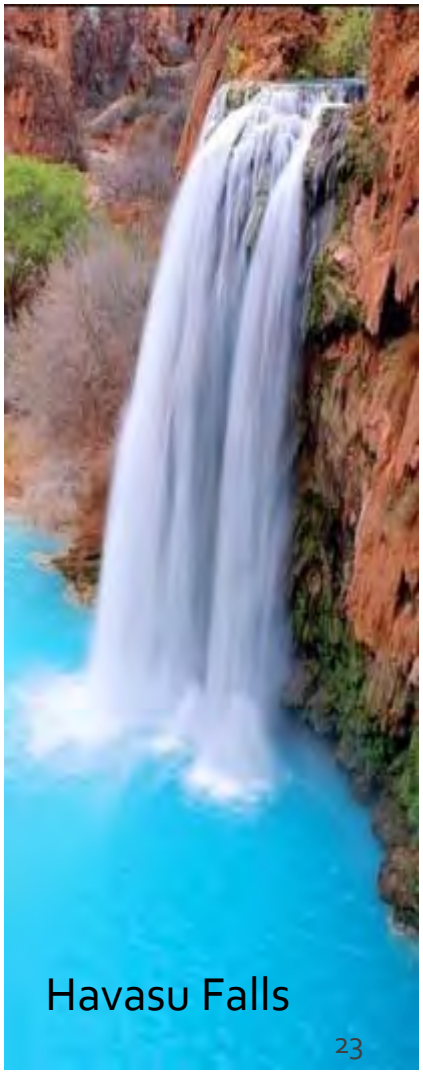
Cimarron River
Oklahoma

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

Verde "Falls"



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
  - 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 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 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.

Presentation Overview: Gila River

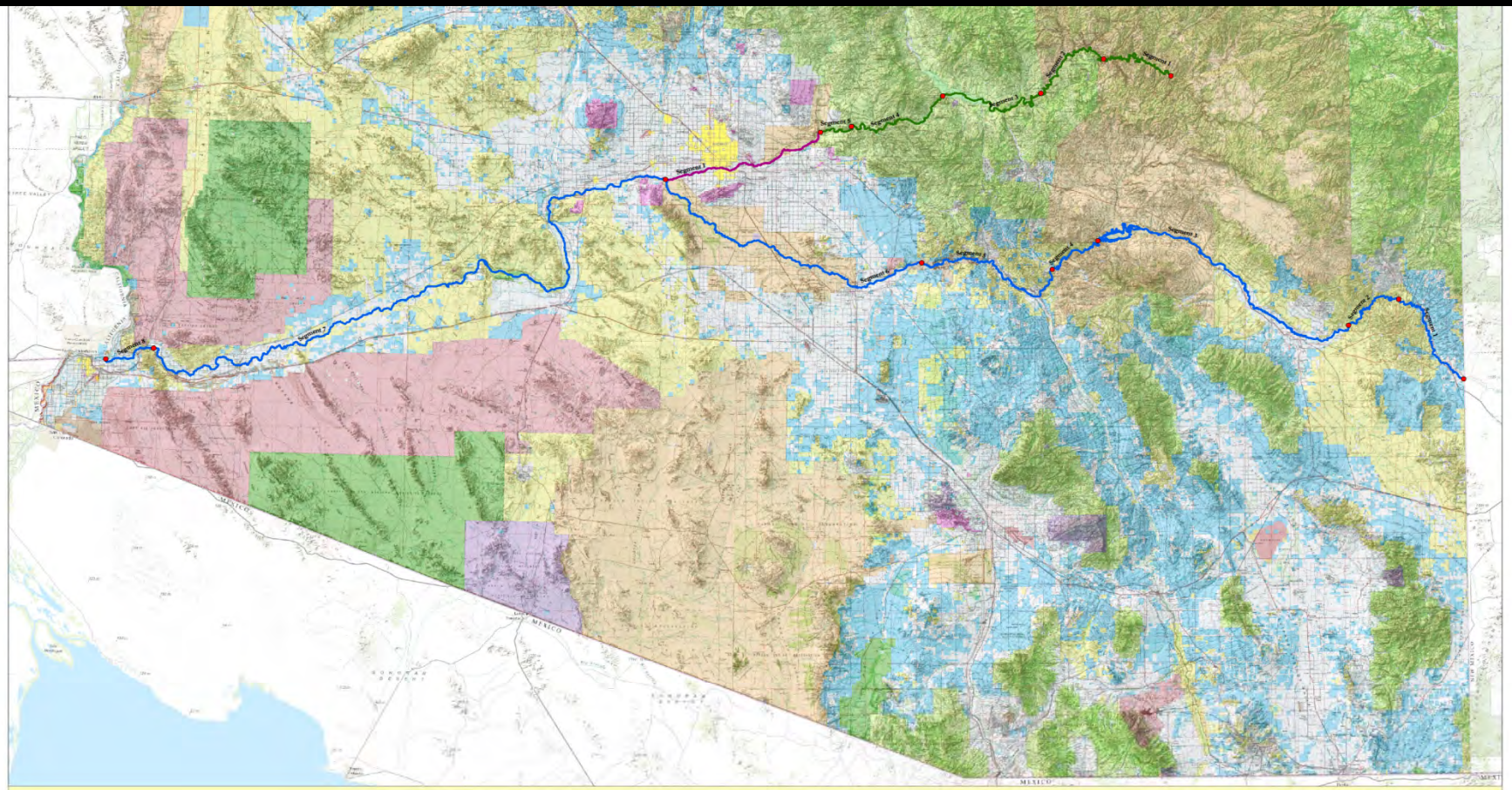
- Arizona/New Mexico Border to Colorado River

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
- Lower Salt River
- Upper Salt River
- Reach Boundary

Public Land Ownership

- Private
- State Trust
- BLM
- Forest Service
- Indian Reservation
- Military
- City or County Parks
- State Parks
- Wildlife Refuge
- Other
- Natl. Parks

Arizona State Land Department

0 5 10 20 30 40 Miles

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

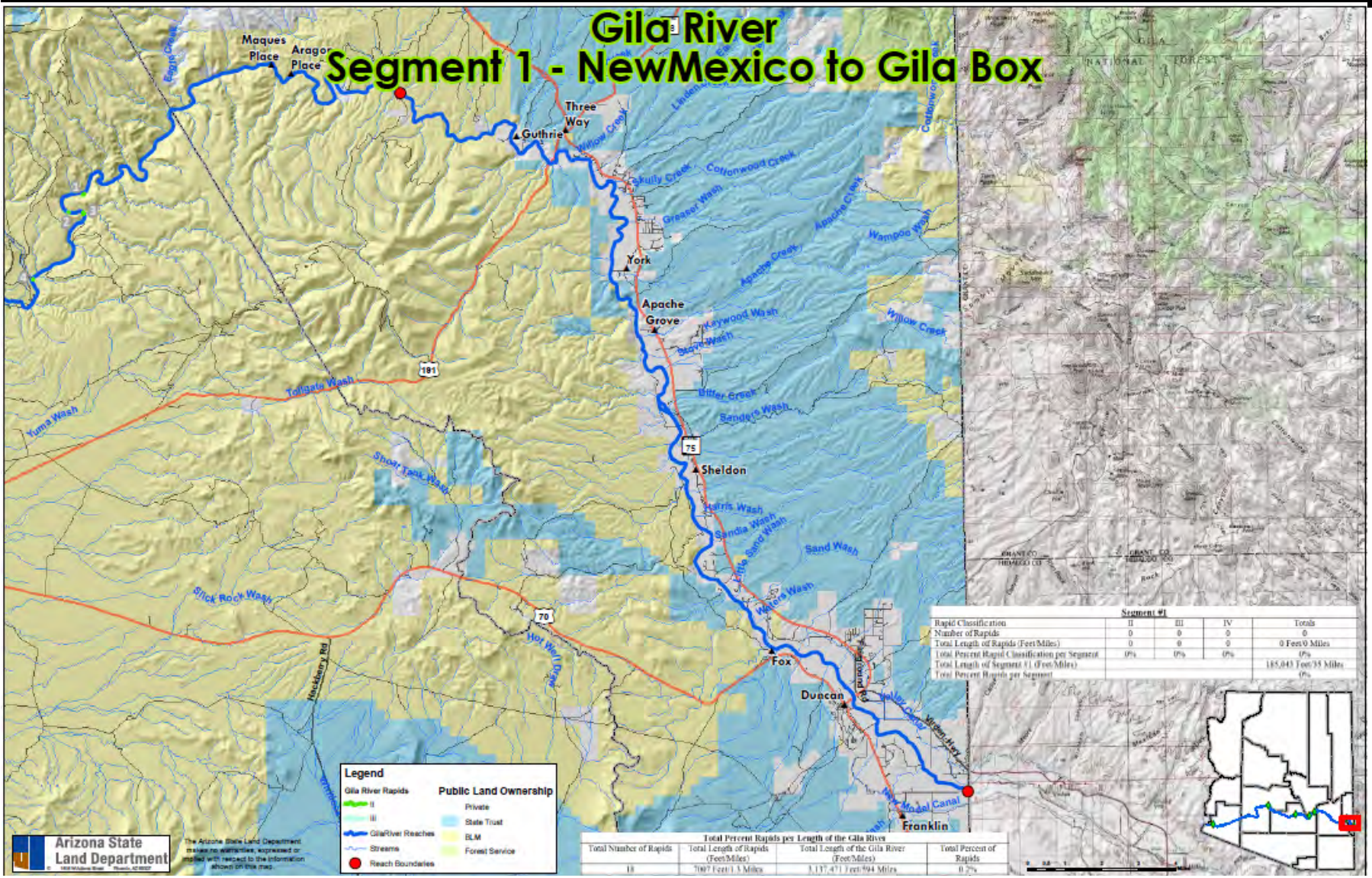
Gila River Segmentation

- 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 Obstructions (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



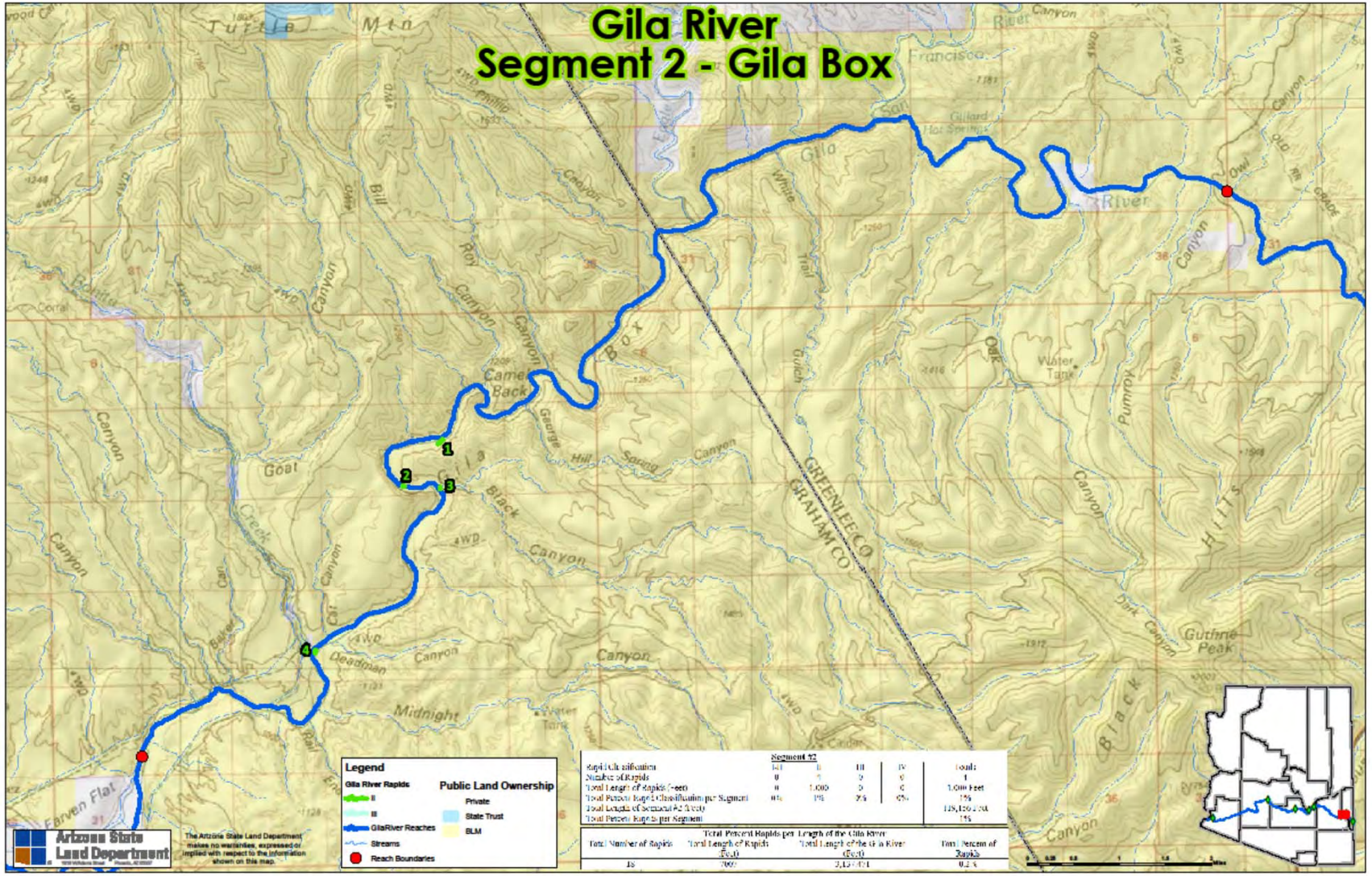
Gila River Segment #1

- 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



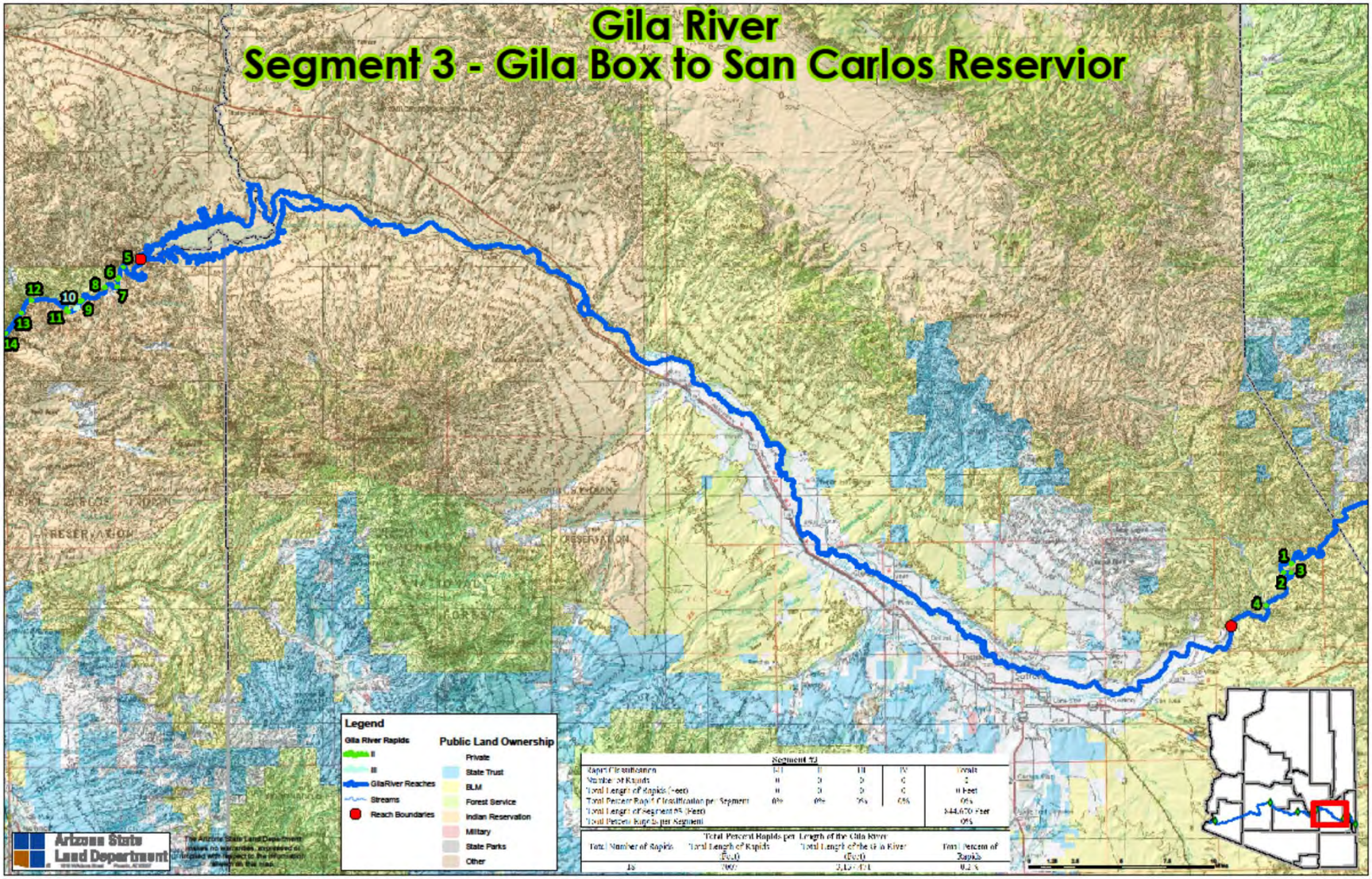
Gila River Segment #2

- 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:
    - Eagle Creek, Bonita Creek, San Francisco River

Google Earth Flyover

- Gila River, Segment 2

Gila River Segment #3



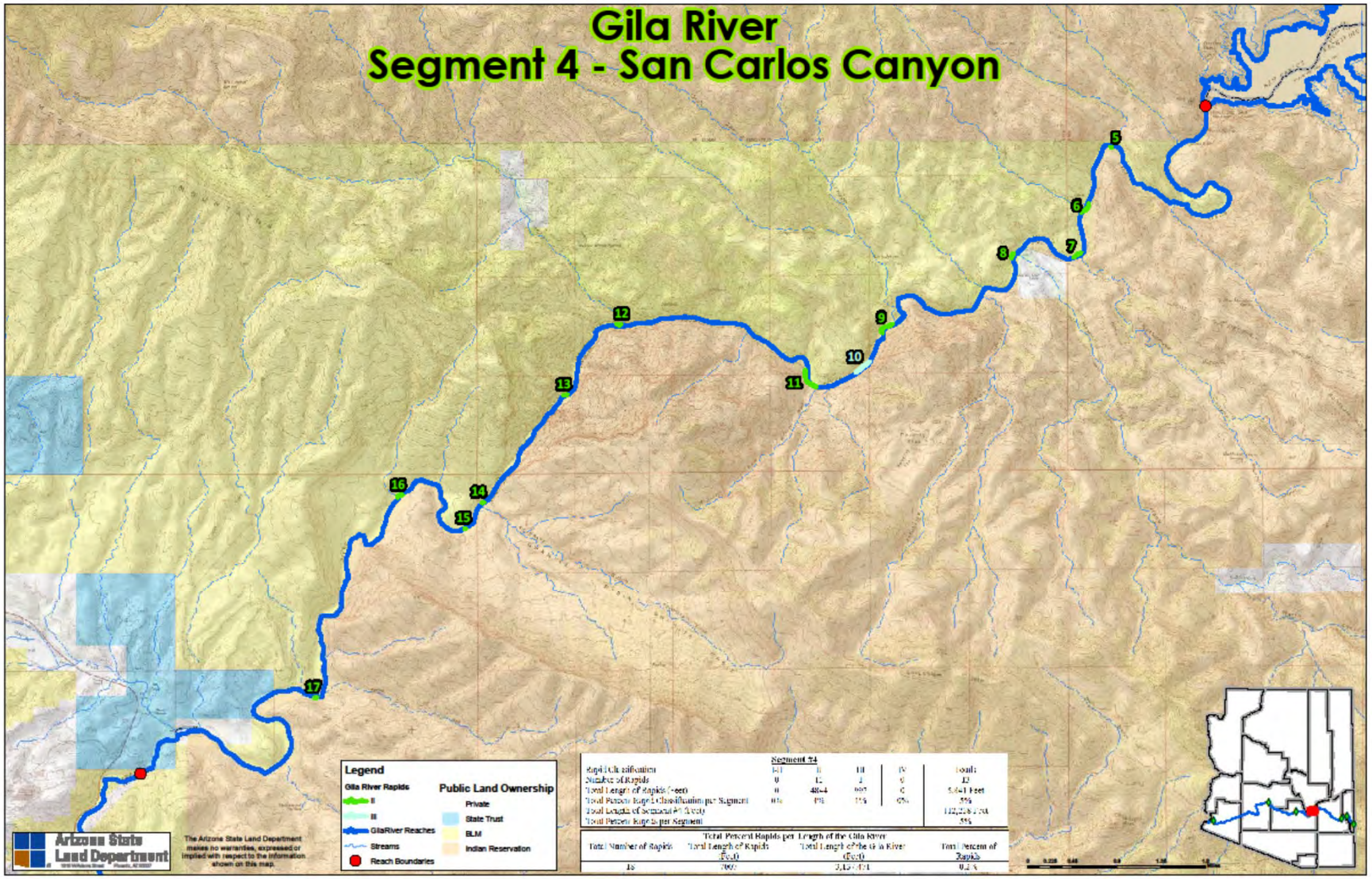
Gila River Segment #3

- 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



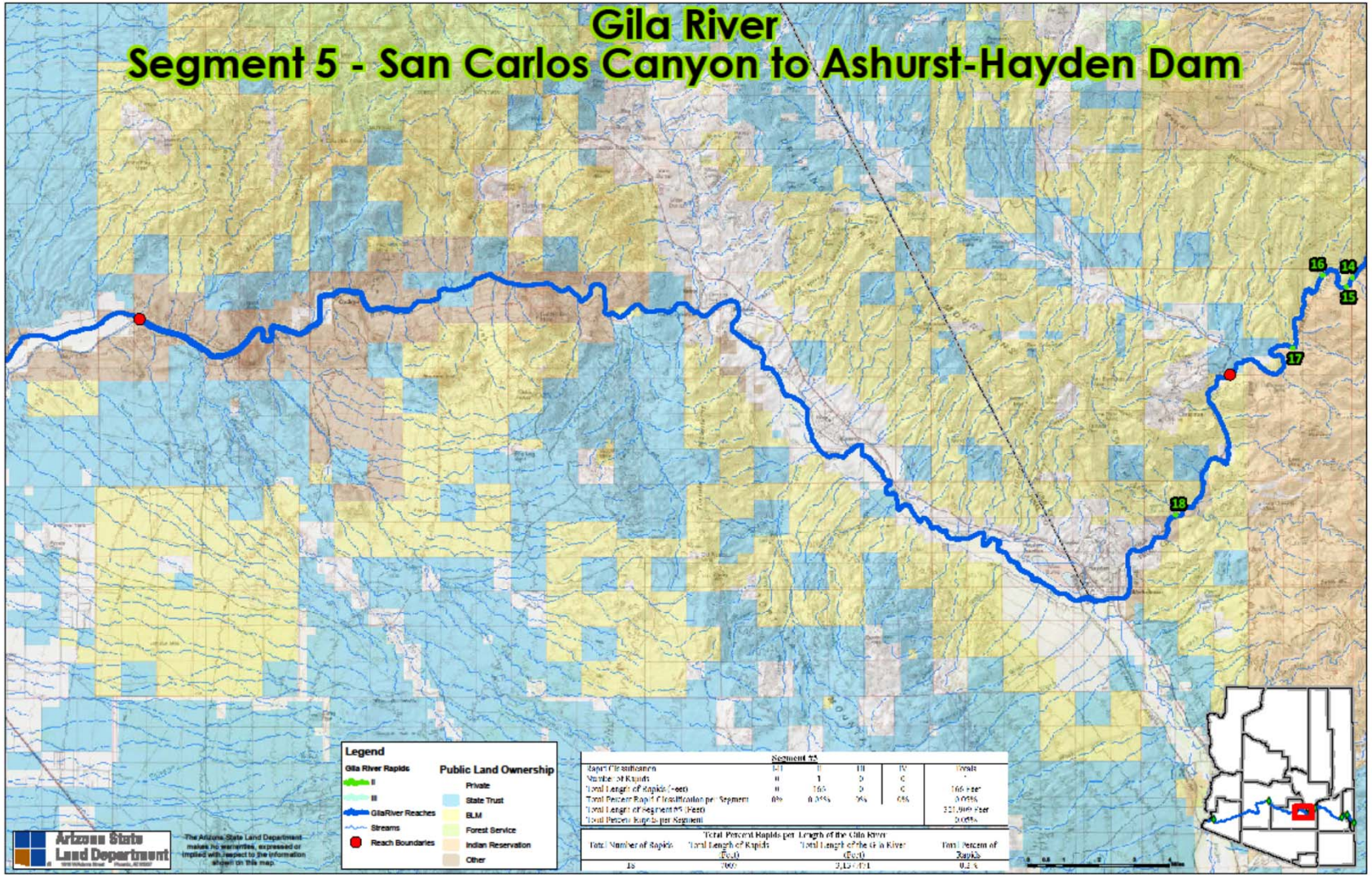
Gila River Segment #4

- Gila River Segment #4
  - San Carlos Reservoir to SR 77 above Winkelman
  - Perennial
  - Compound 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



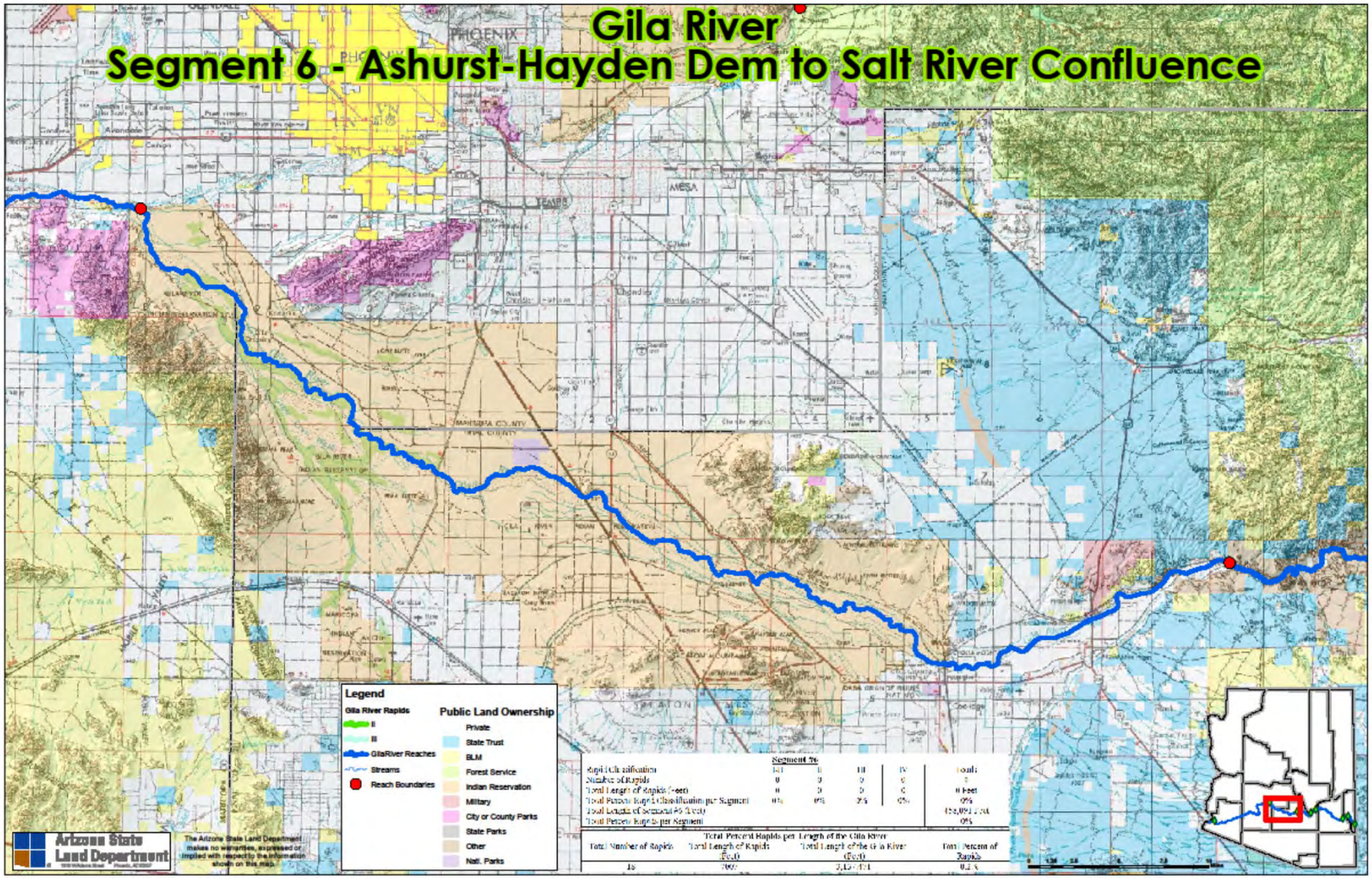
Gila River Segment #5

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

Google Earth Flyover

- Gila River, Segment 5

Gila River Segment #6



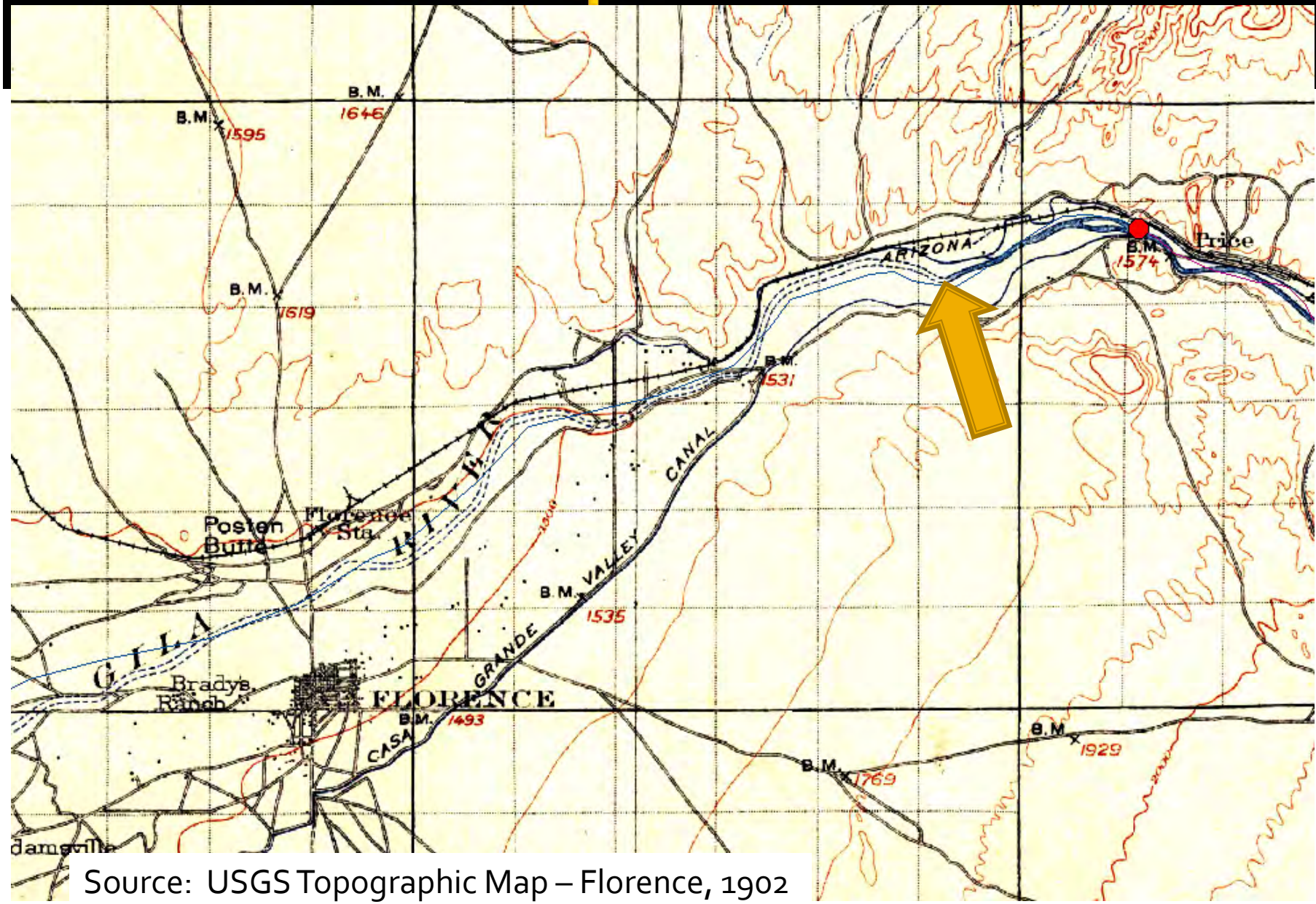
Gila River Segment #6

- 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

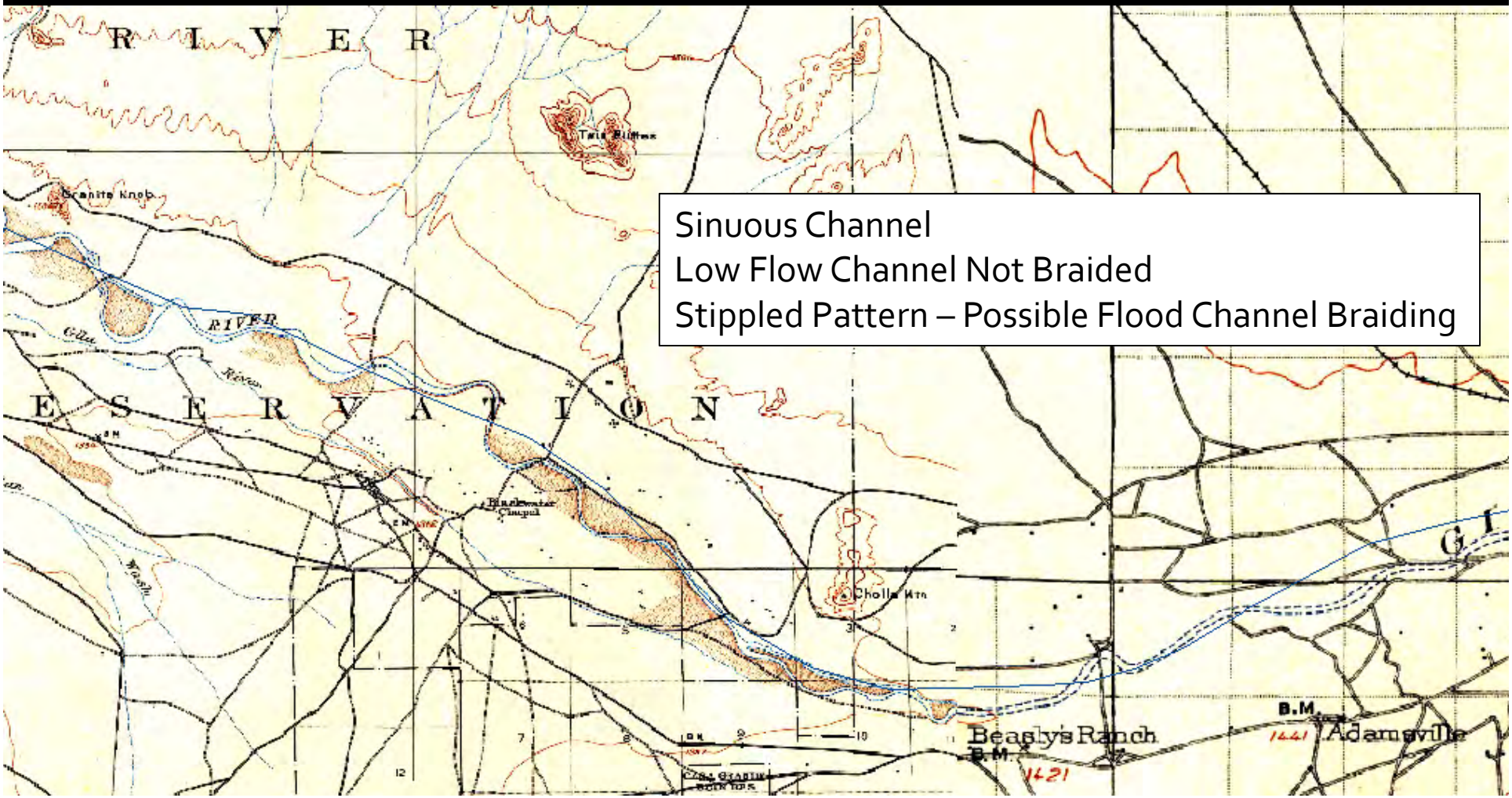
- Gila River, Segment 6

Historical Maps



Source: USGS Topographic Map – Florence, 1902

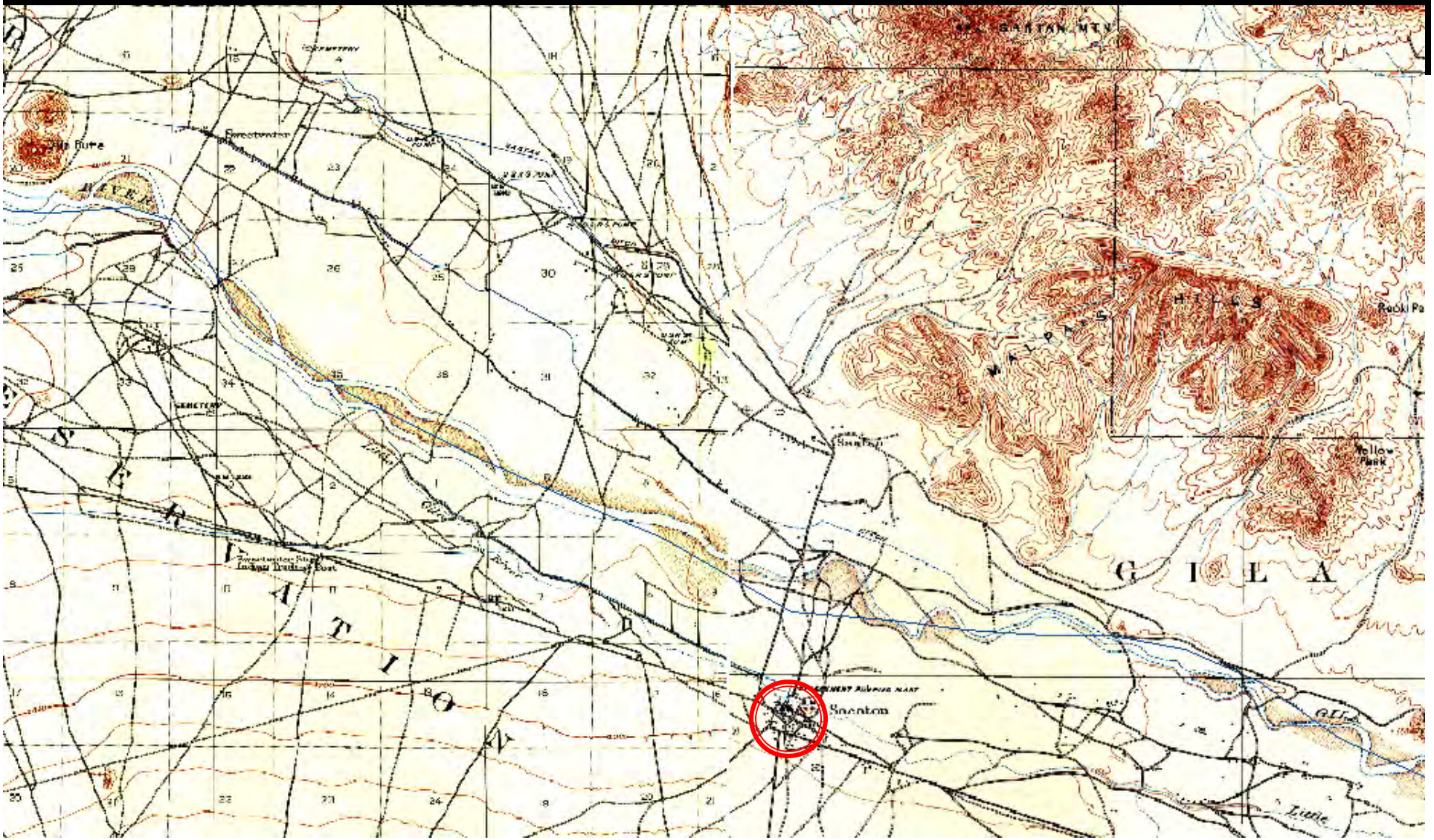
Historical Maps



Sinuous Channel
Low Flow Channel Not Braided
Stippled Pattern – Possible Flood Channel Braiding

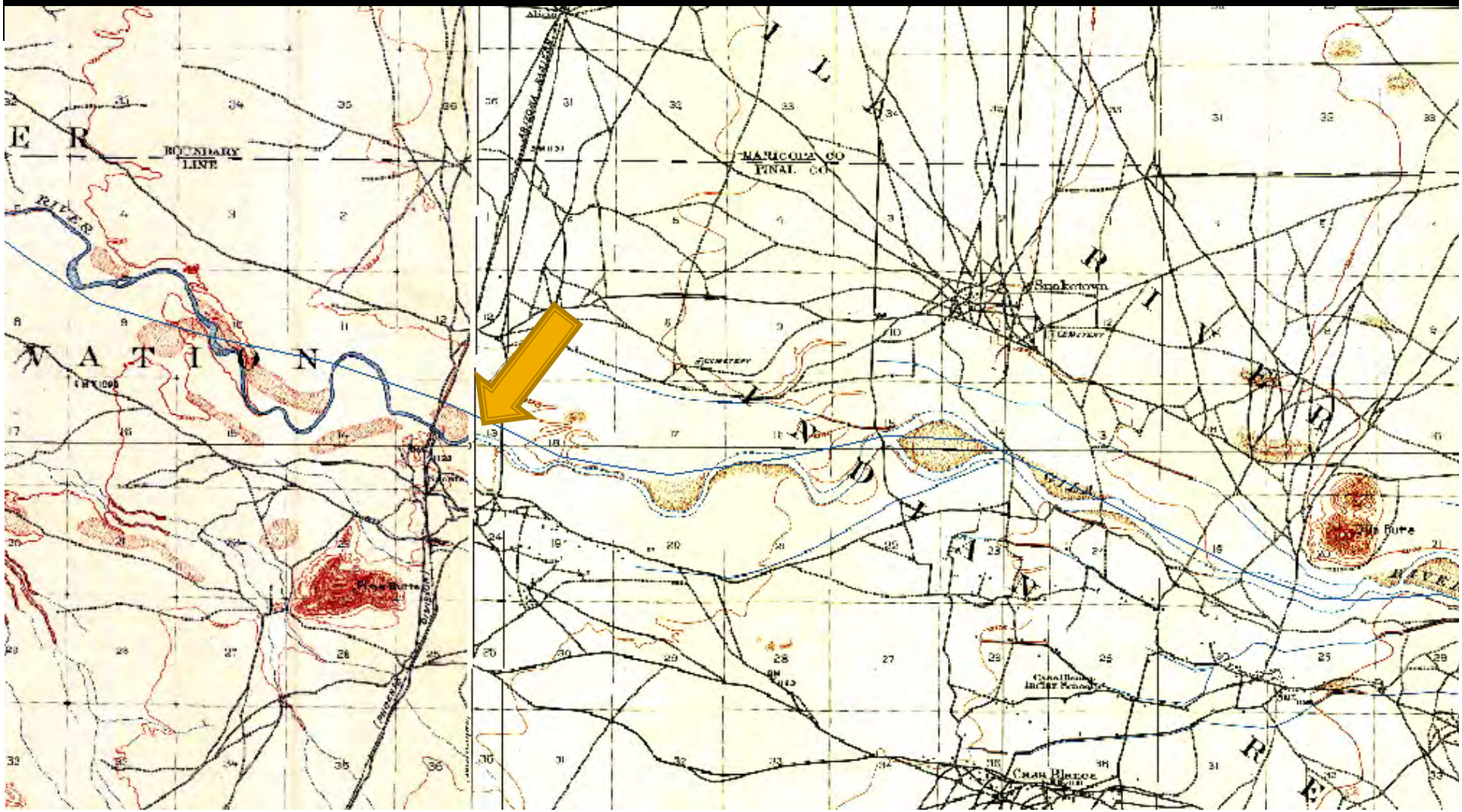
Source: USGS Topographic Map – Florence, 1902; Sacaton, 1907

Historical Maps



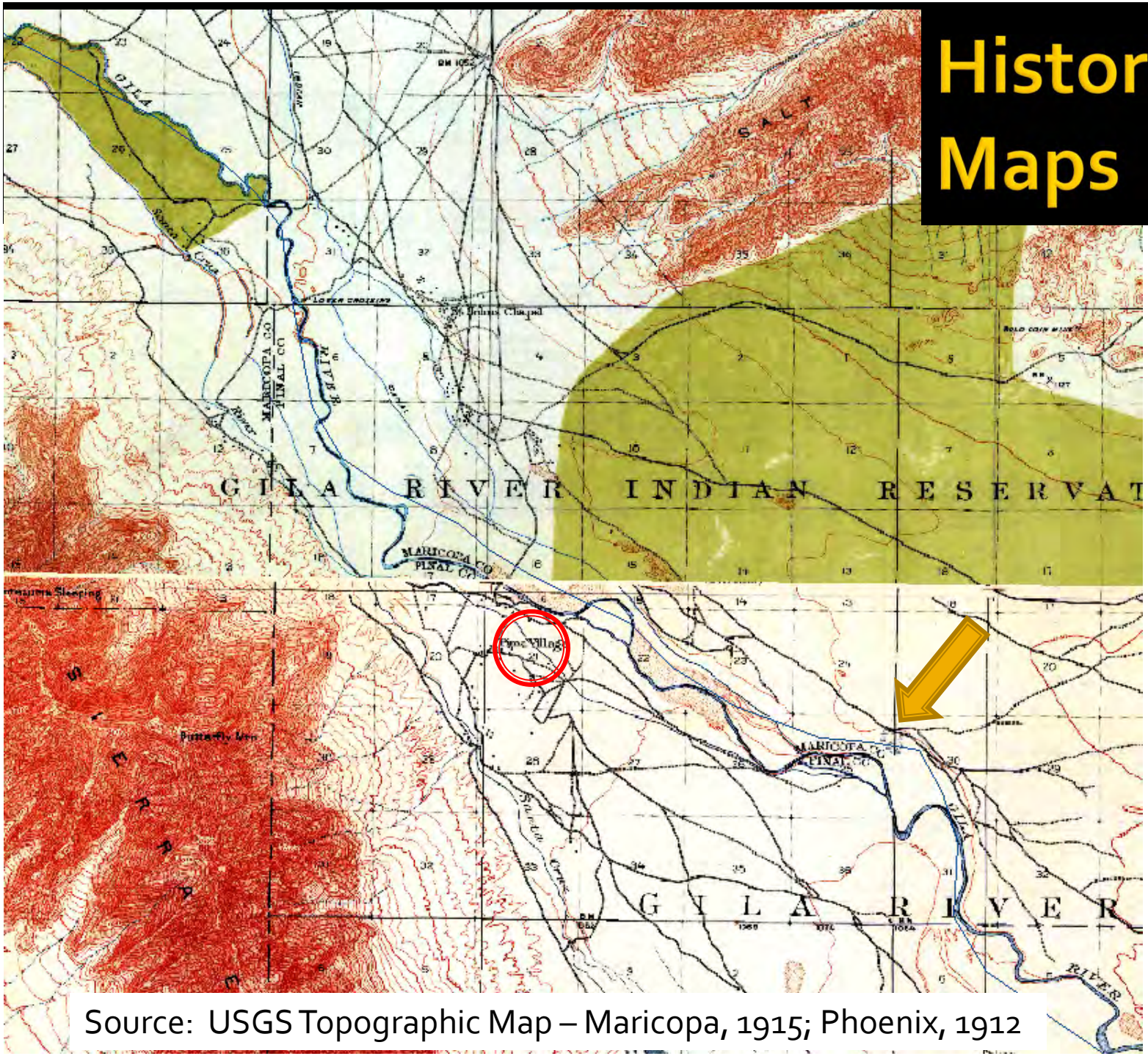
Source: USGS Topographic Map – Sacaton, 1907; Gila Butte, 1914

Historical Maps



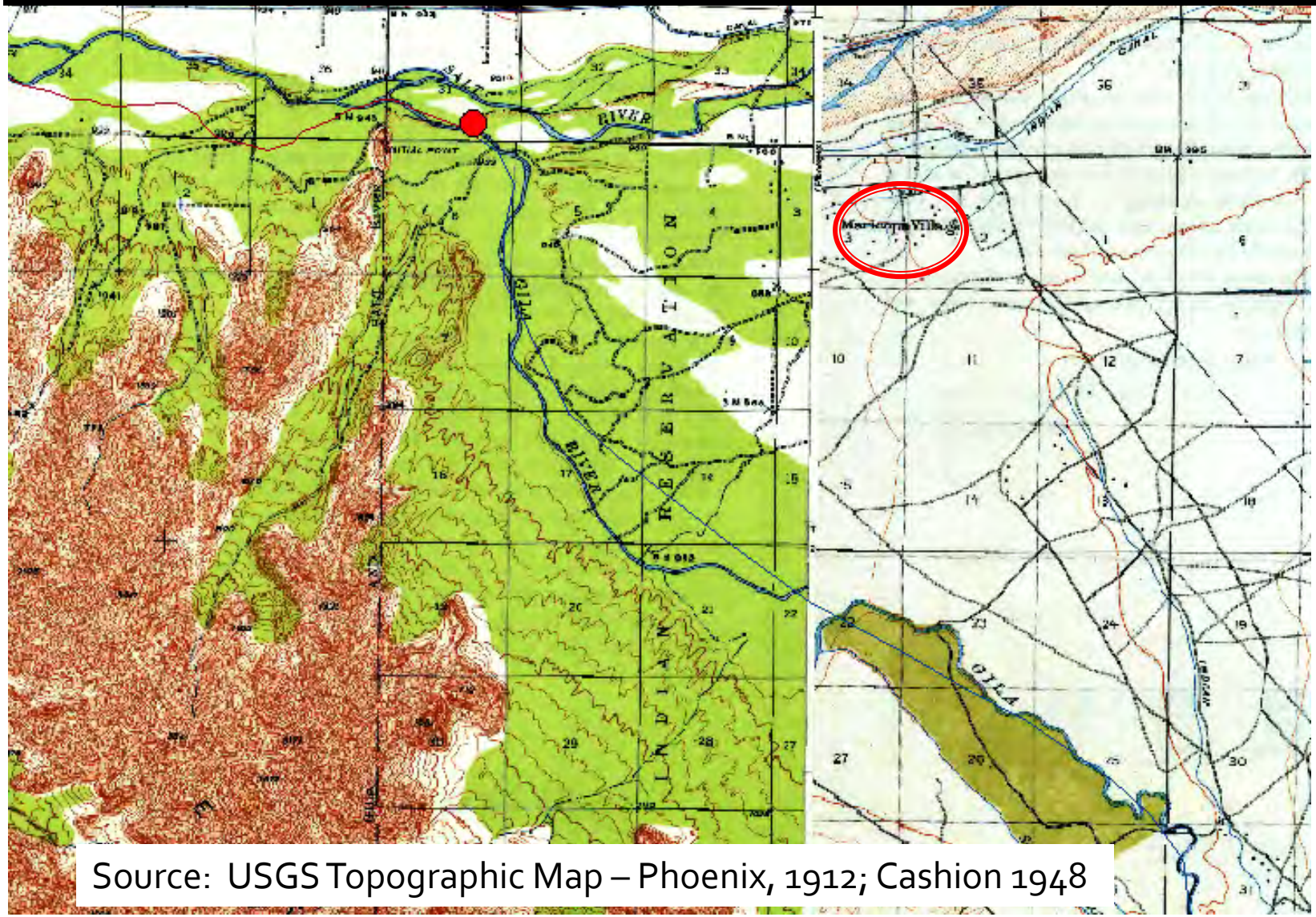
Source: USGS Topographic Map – Gila Butte, 1914; Maricopa, 1915

Historical Maps



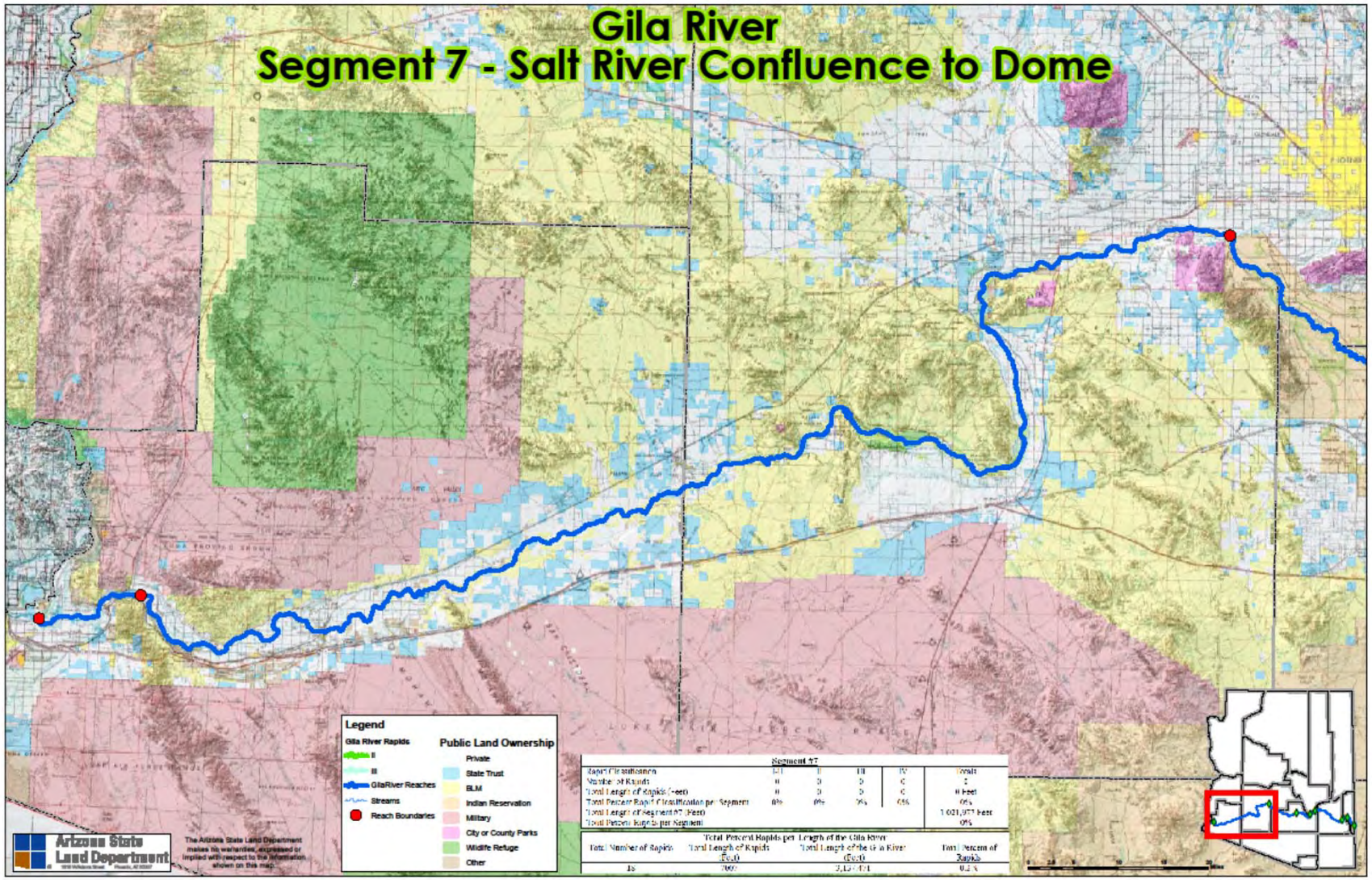
Source: USGS Topographic Map – Maricopa, 1915; Phoenix, 1912

Historical Maps



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

Gila River Segment #7



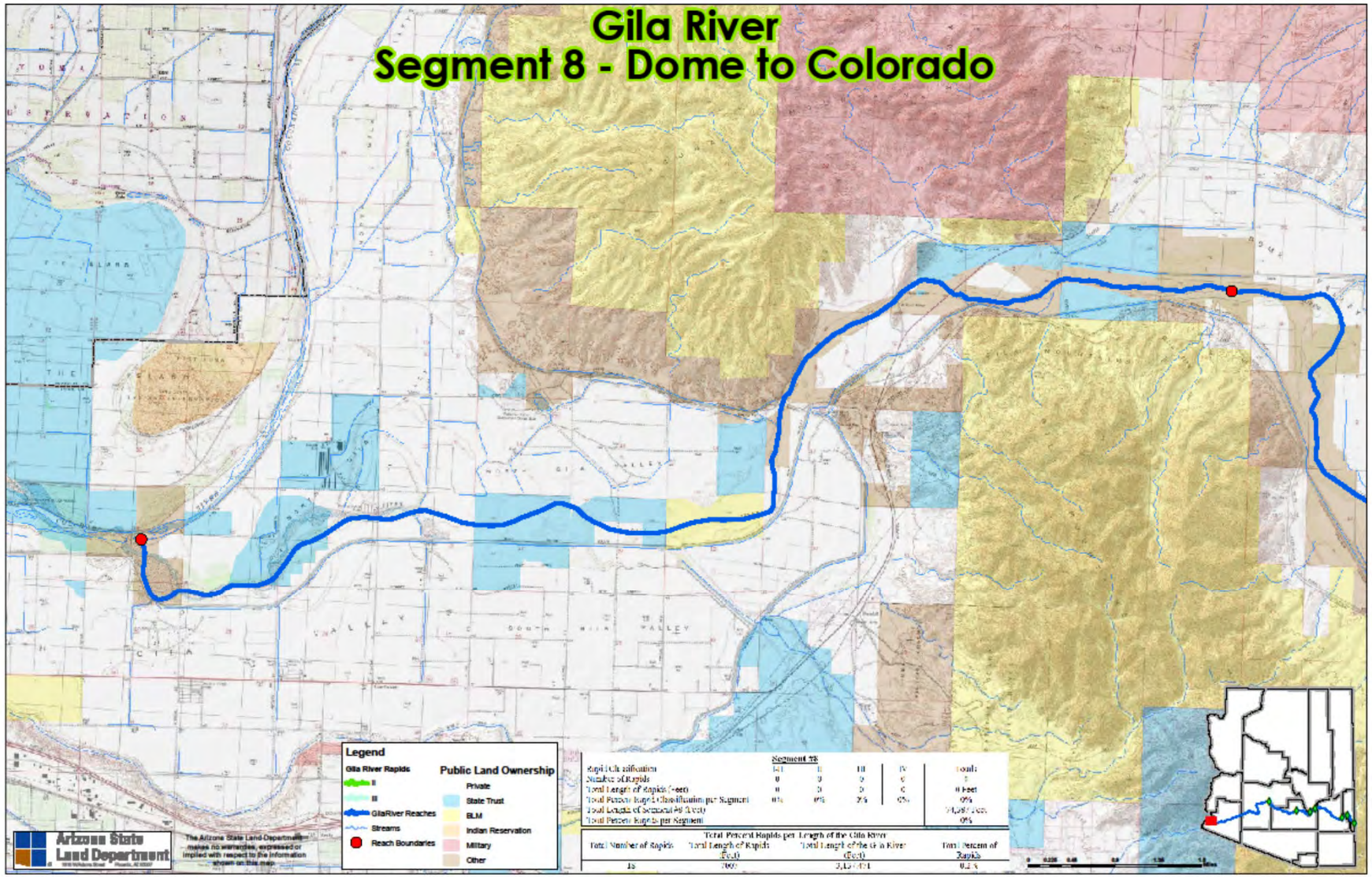
Gila River Segment #7

- 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



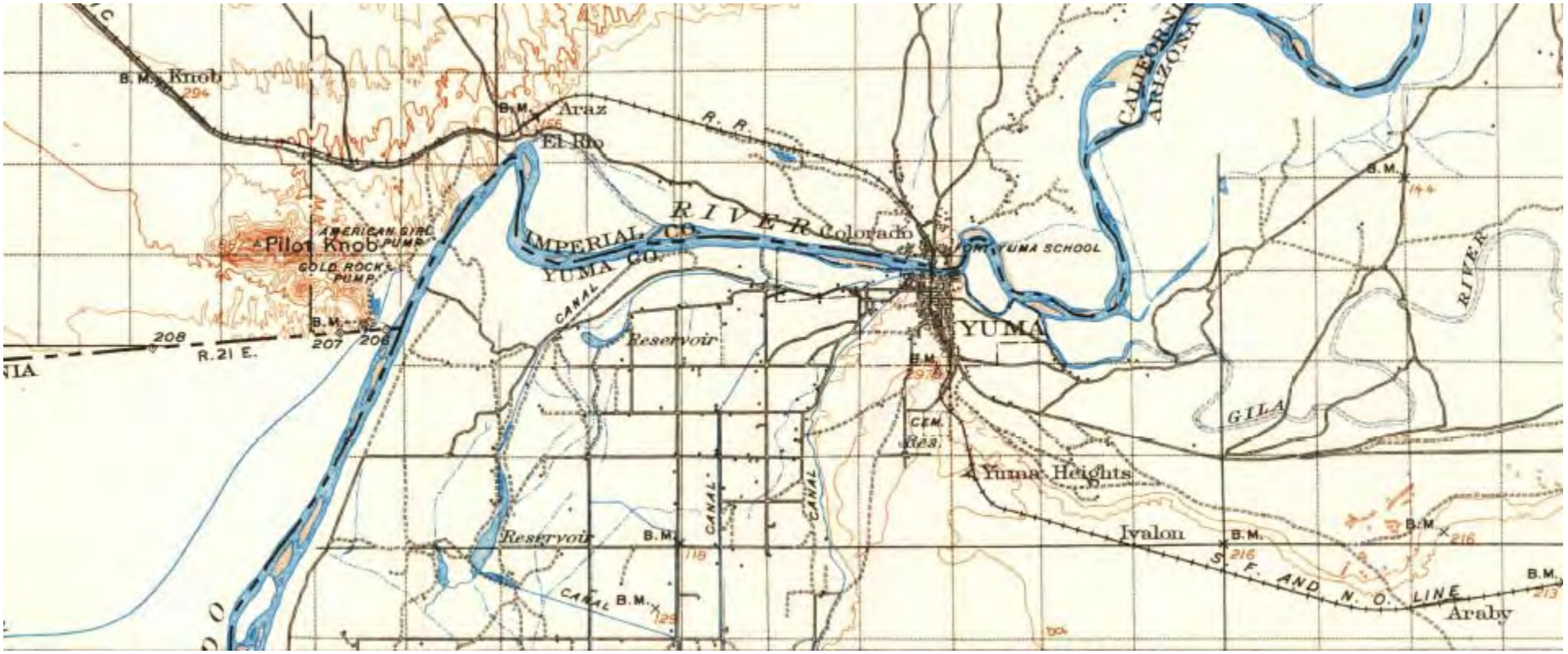
Gila River Segment #8

- 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

Historical Maps



Source: USGS Topographic Map – Laguna, 1929; Fortuna, 1926; Yuma, 1903

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

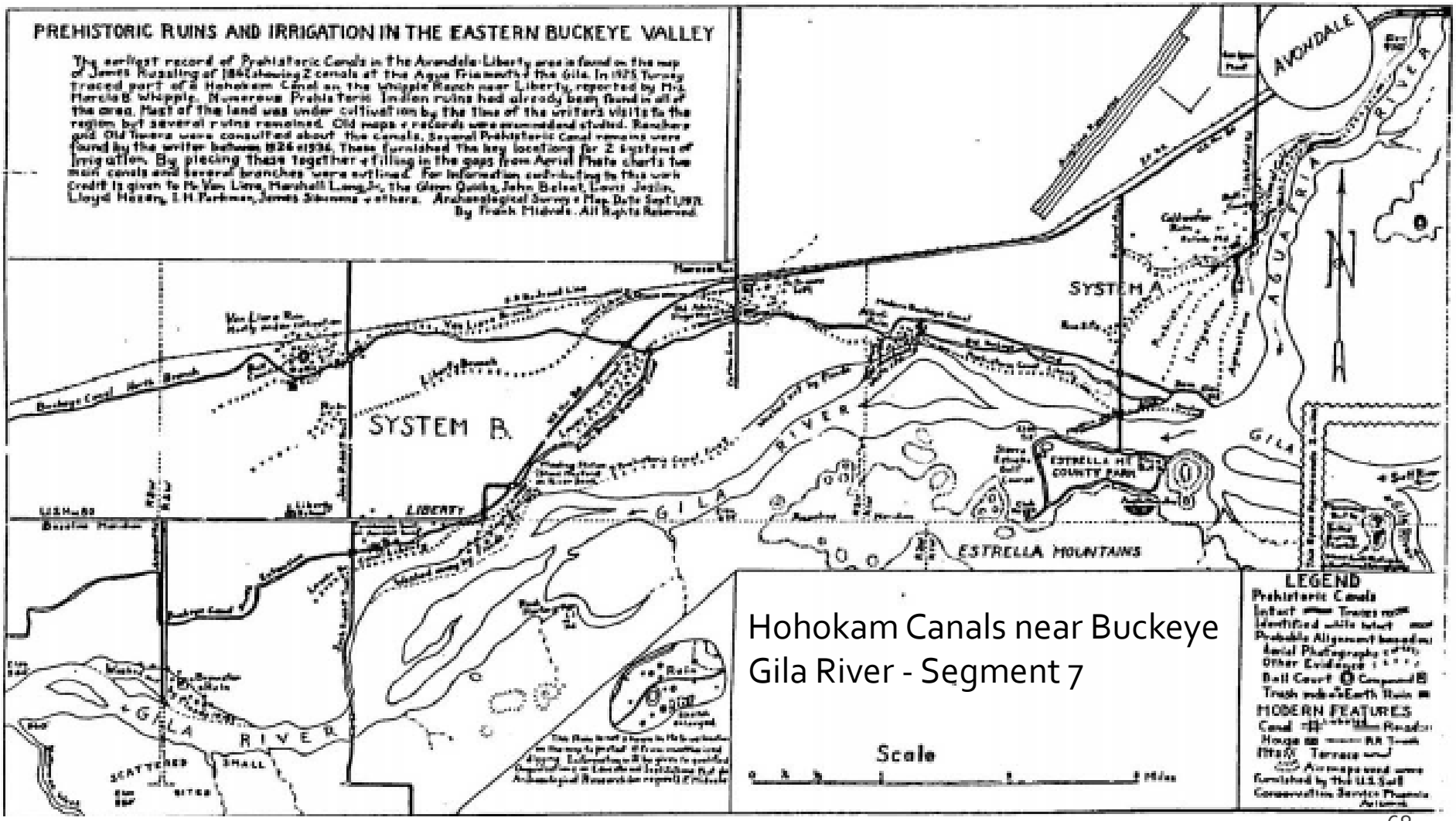
Archaeology: Key Findings

- 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

Archaeology: Key Findings

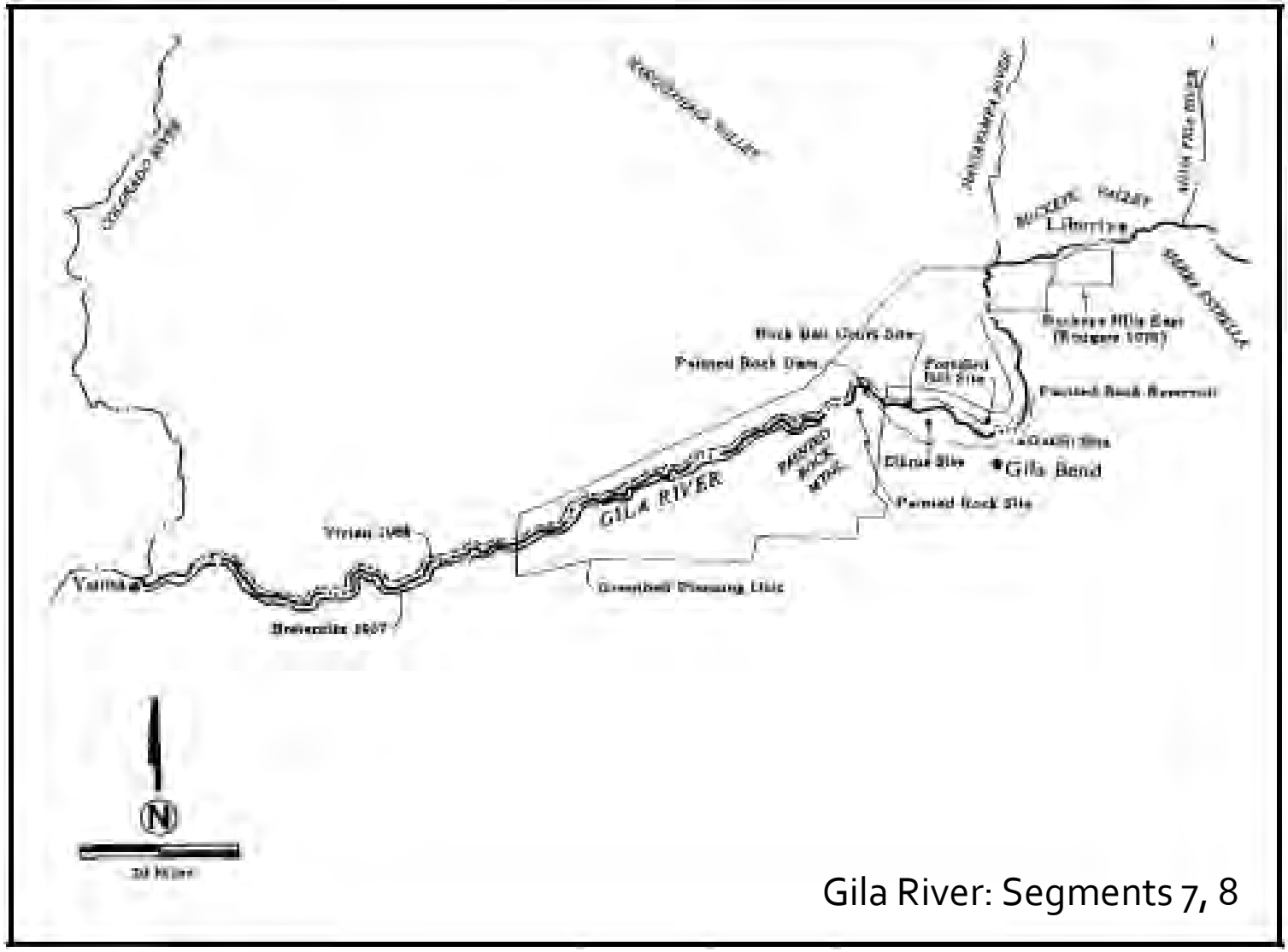
- Canals
  - Segments 3, 5, 6, 7, 8
  - Capacity (individual) up 240 cfs
  - Length – 100's of miles
  - Acreage – 10,000's of acres
  - River Stability – sufficient for diversions

Archaeology: Key Findings

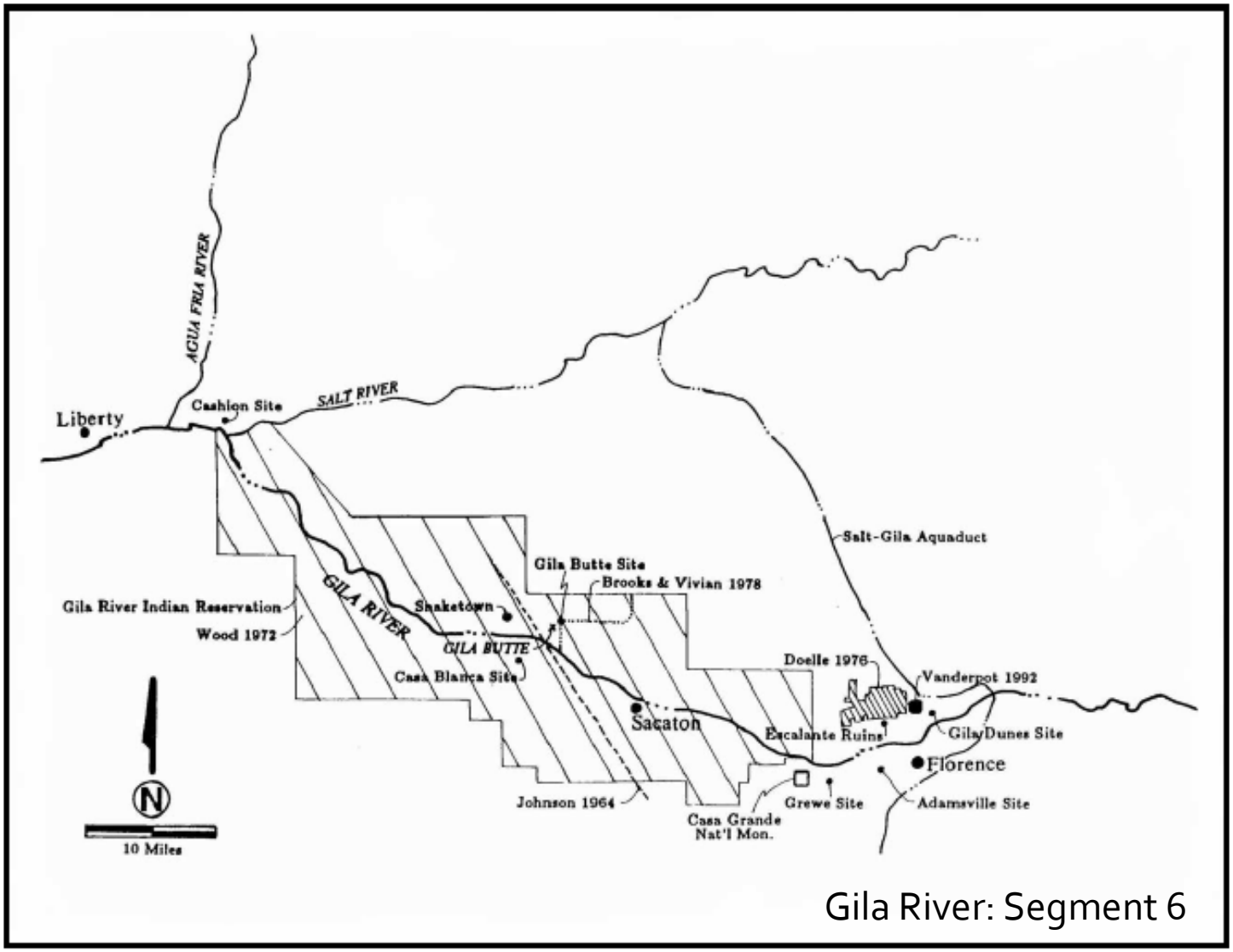


Hohokam Canals near Buckeye
Gila River - Segment 7

Archaeology: Key Findings

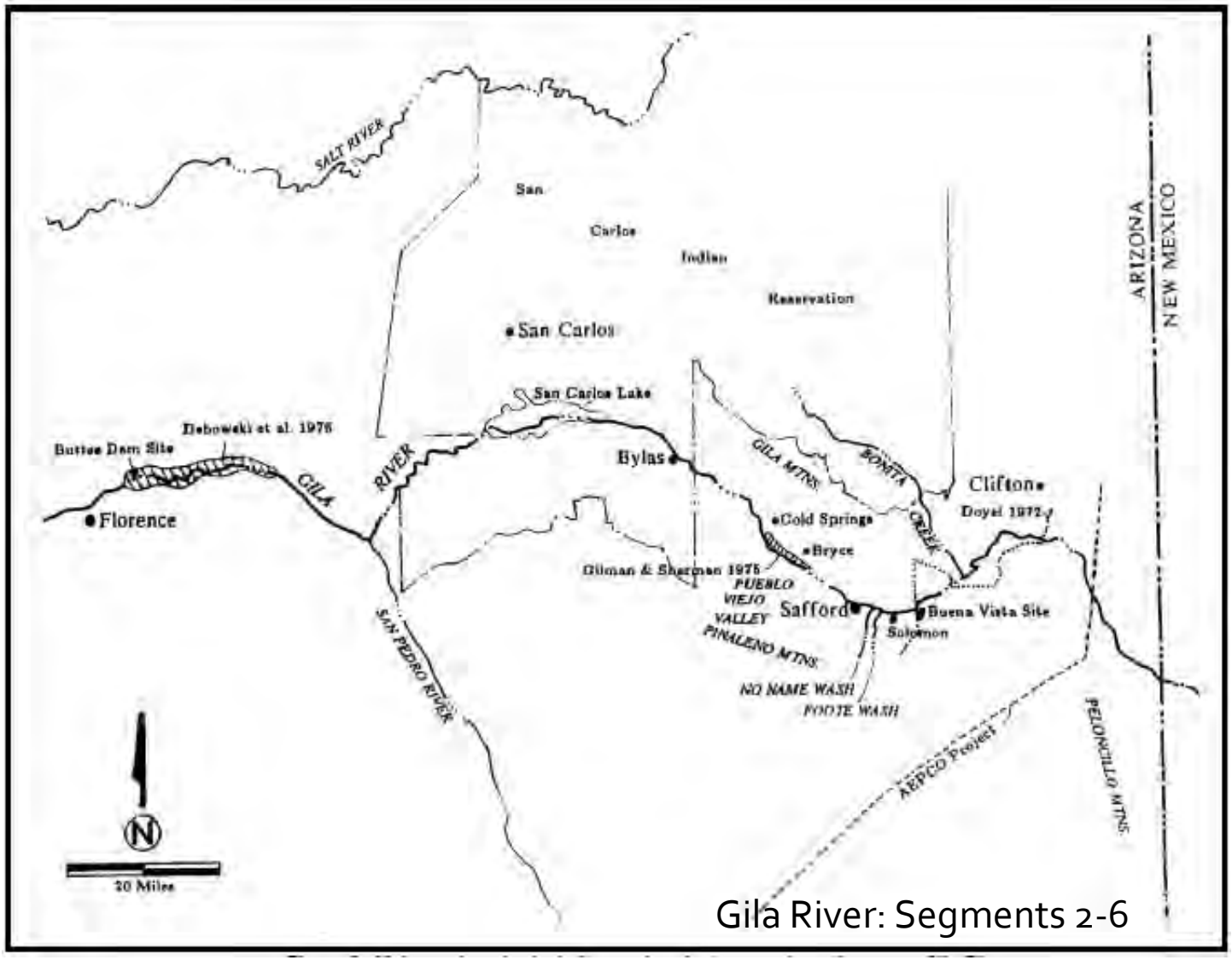


Archaeology: Key Findings



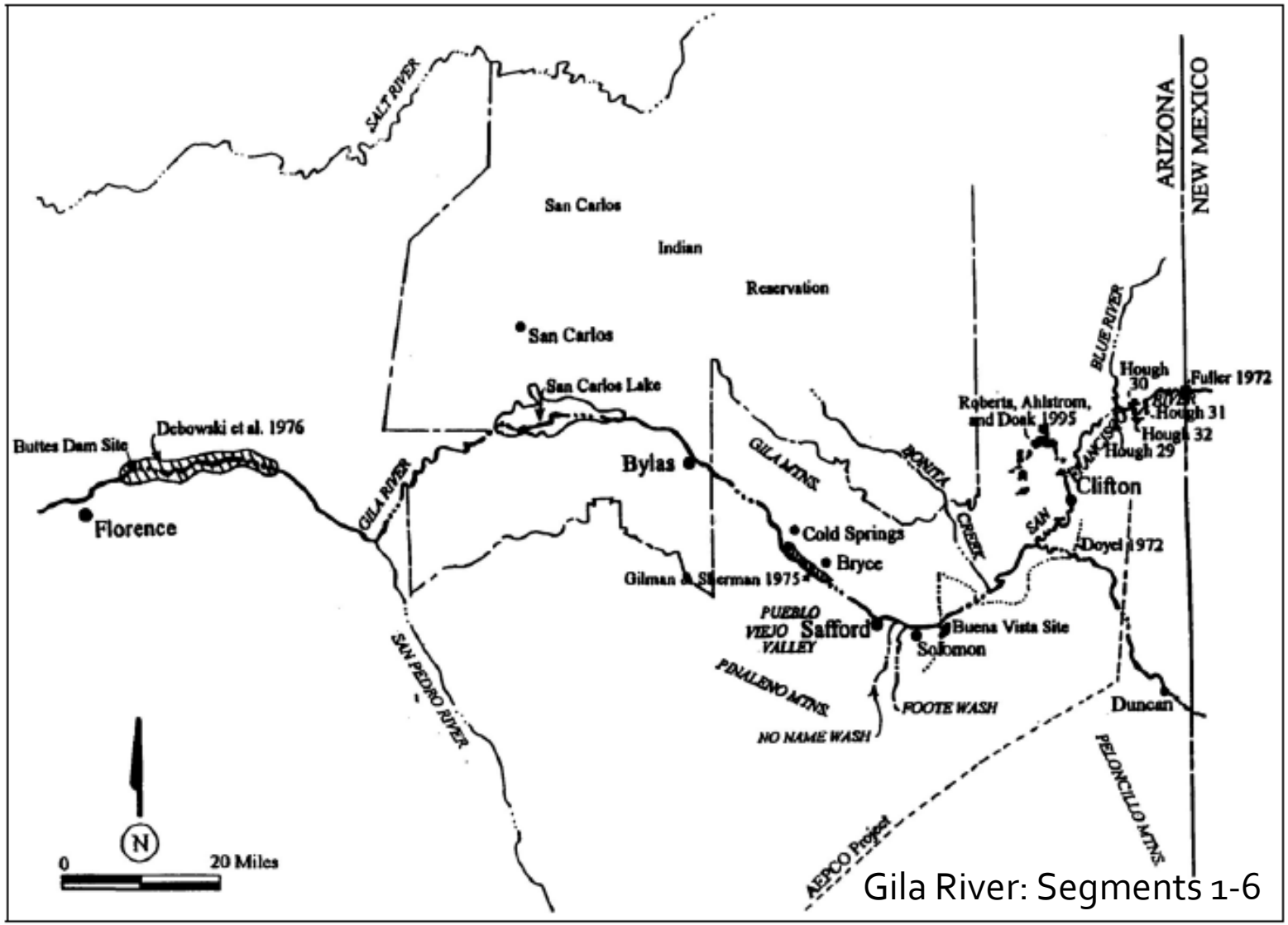
Gila River: Segment 6

Archaeology: Key Findings



Gila River: Segments 2-6

Archaeology: Key Findings



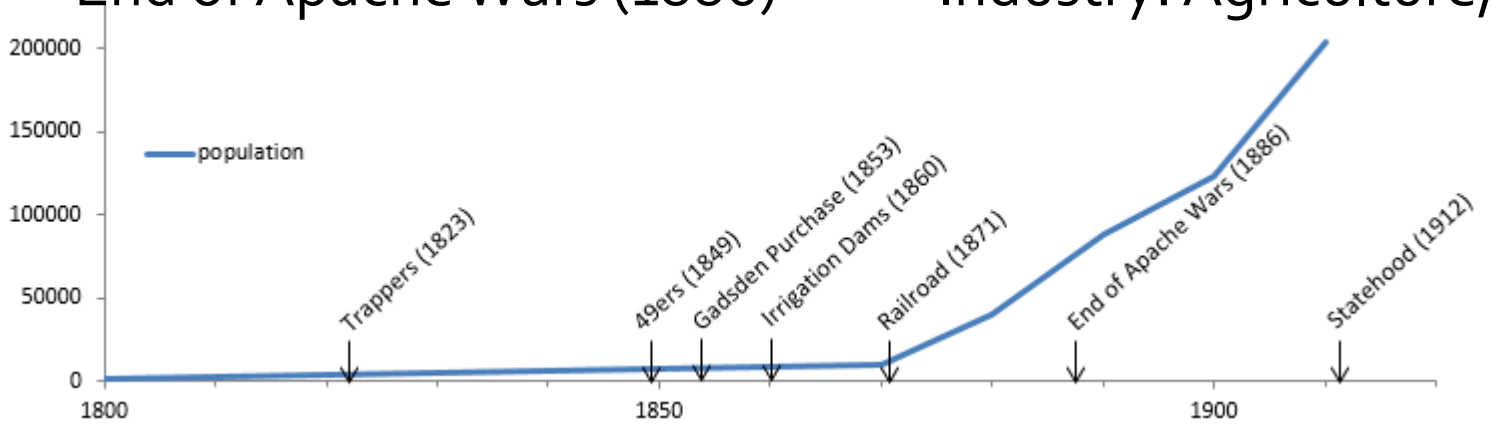
Gila River: Segments 1-6

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
  - Frank Cushing
    - Found remains of canoe at Hohokam site (on Salt).
  - 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 travellers 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 many 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?
  - 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 < ¼ 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 in deep"
  - Parke
    - Segment 5: (July 1855): "20 ft wide, 12 in 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 in to 2 ft deep"

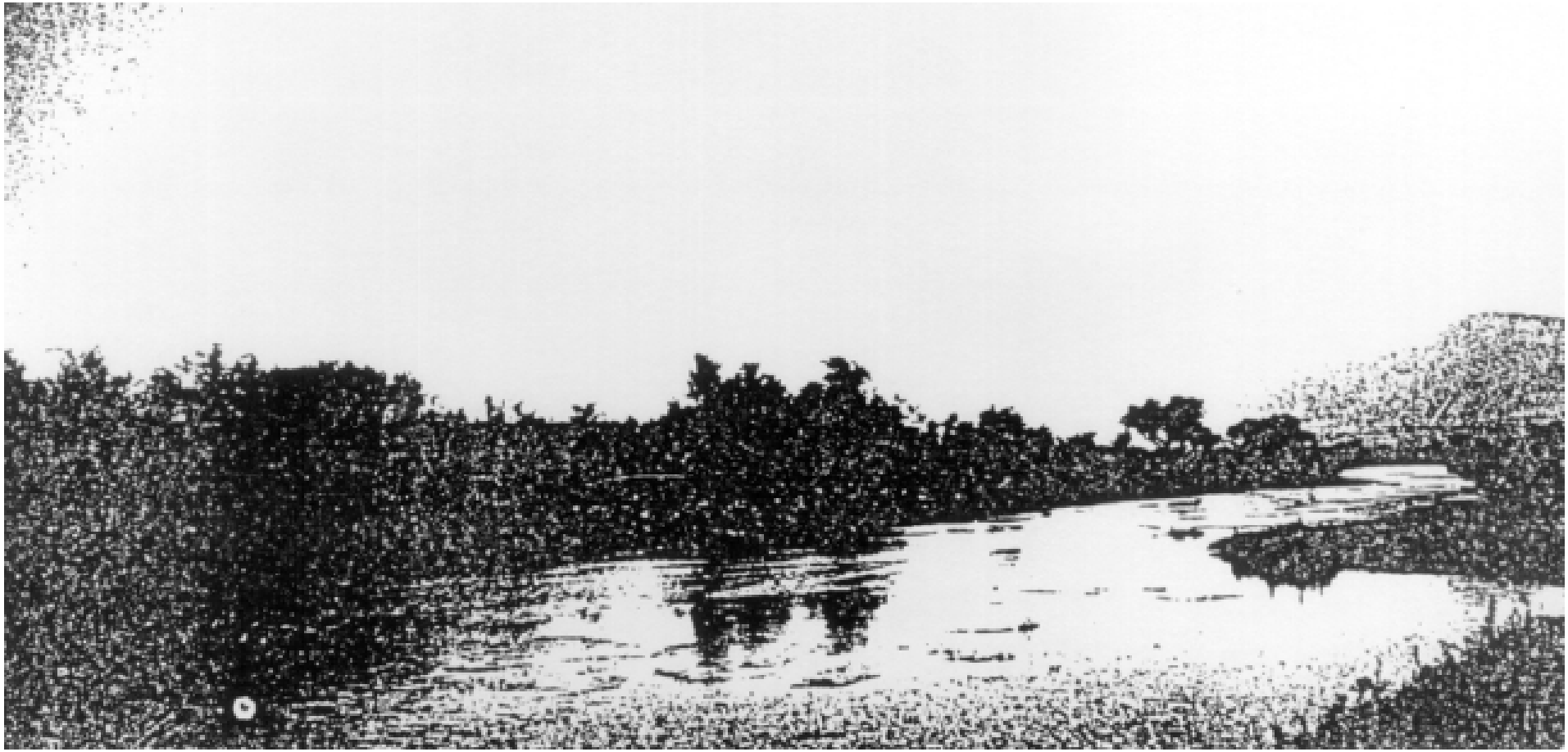
River Descriptions

- GLO Surveyors
  - Segment 7
    - (1890) Too deep to cross except by swimming (Ligurta)
    - (1877) Abundance of water (Agua Caliente)
    - (1871) 16 in 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

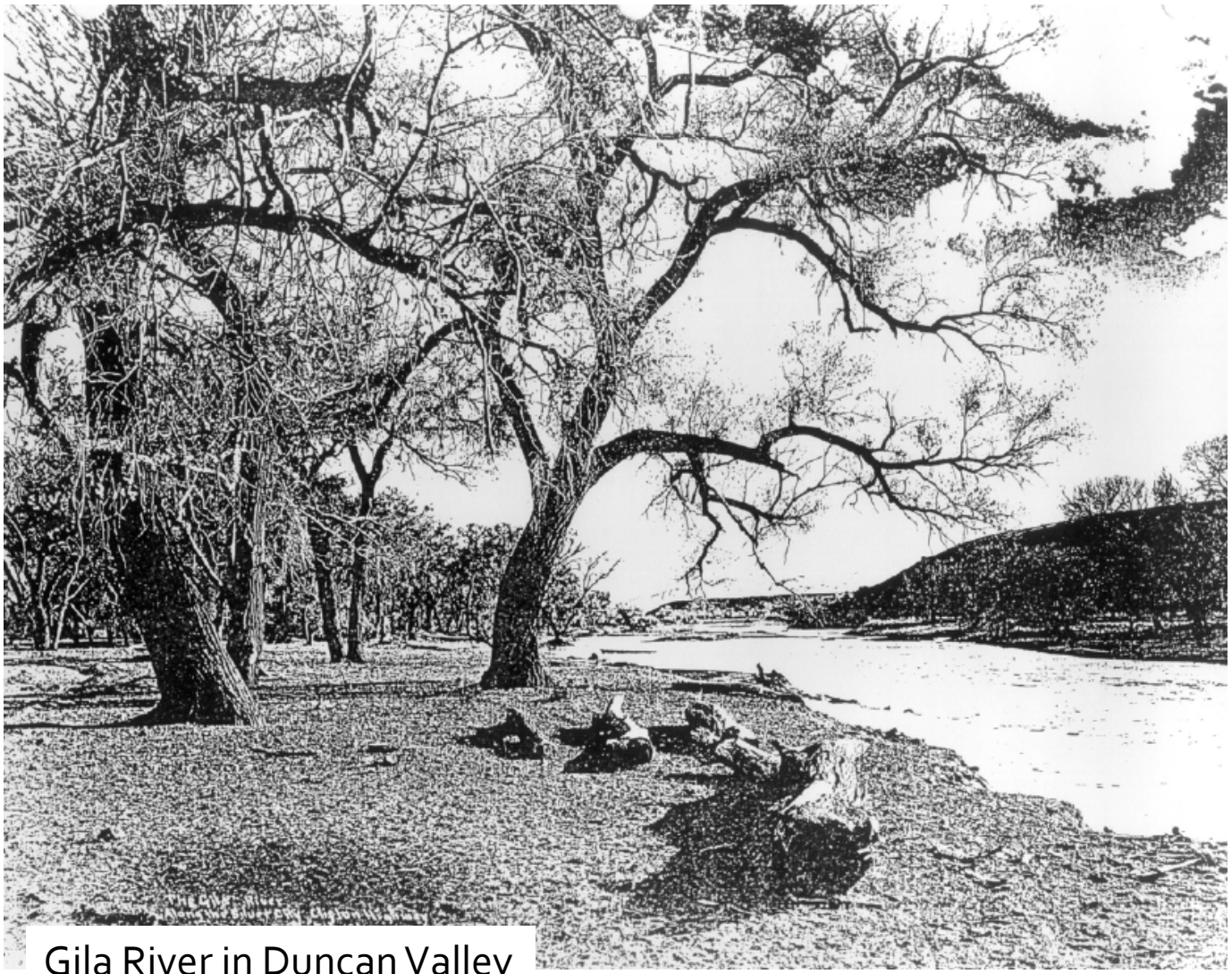
- GLO Surveyors
  - Segment 6
    - (1869, June) dry (Florence)
  - Segment 5
    - (1878) abundance of water (Hayden)

Historical Photographs



October 17, 1885 – Gila River near Ft. Thomas

Historical Photographs



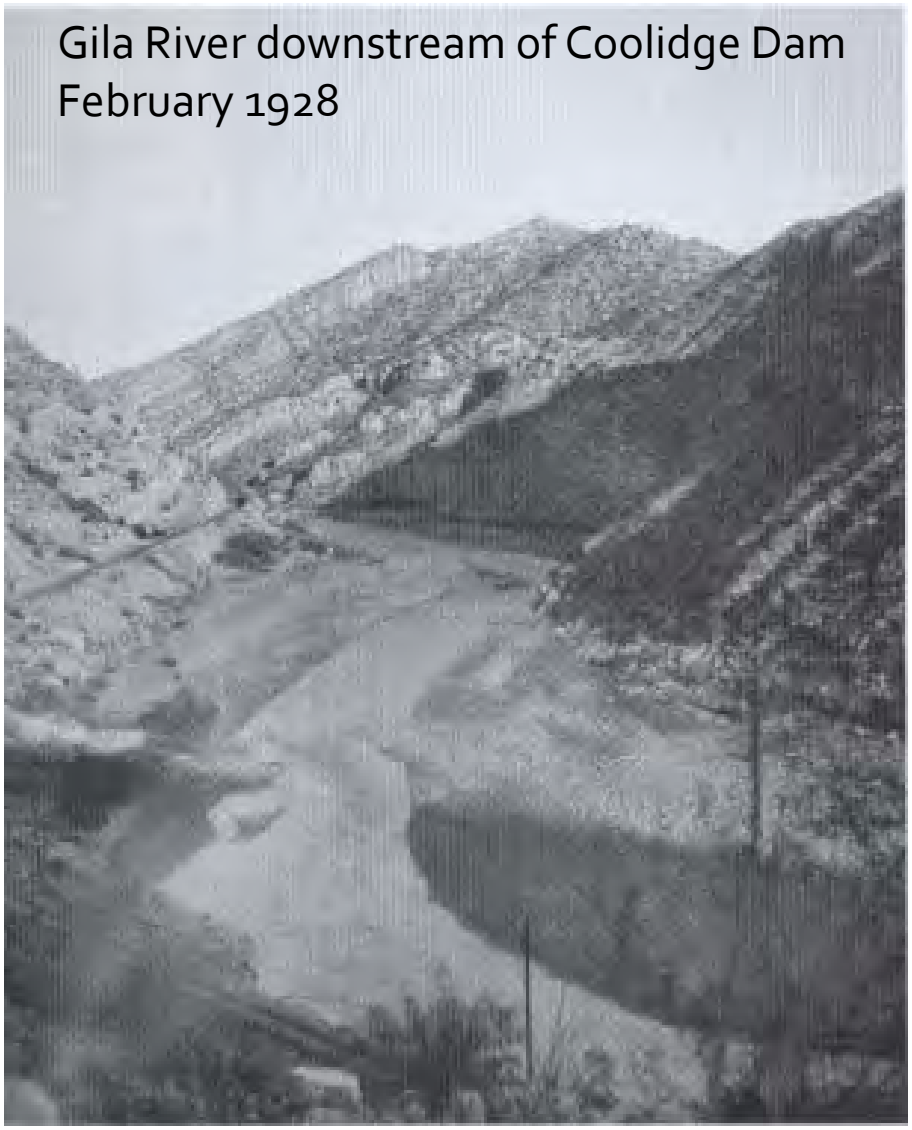
Gila River in Duncan Valley

Historical Photographs

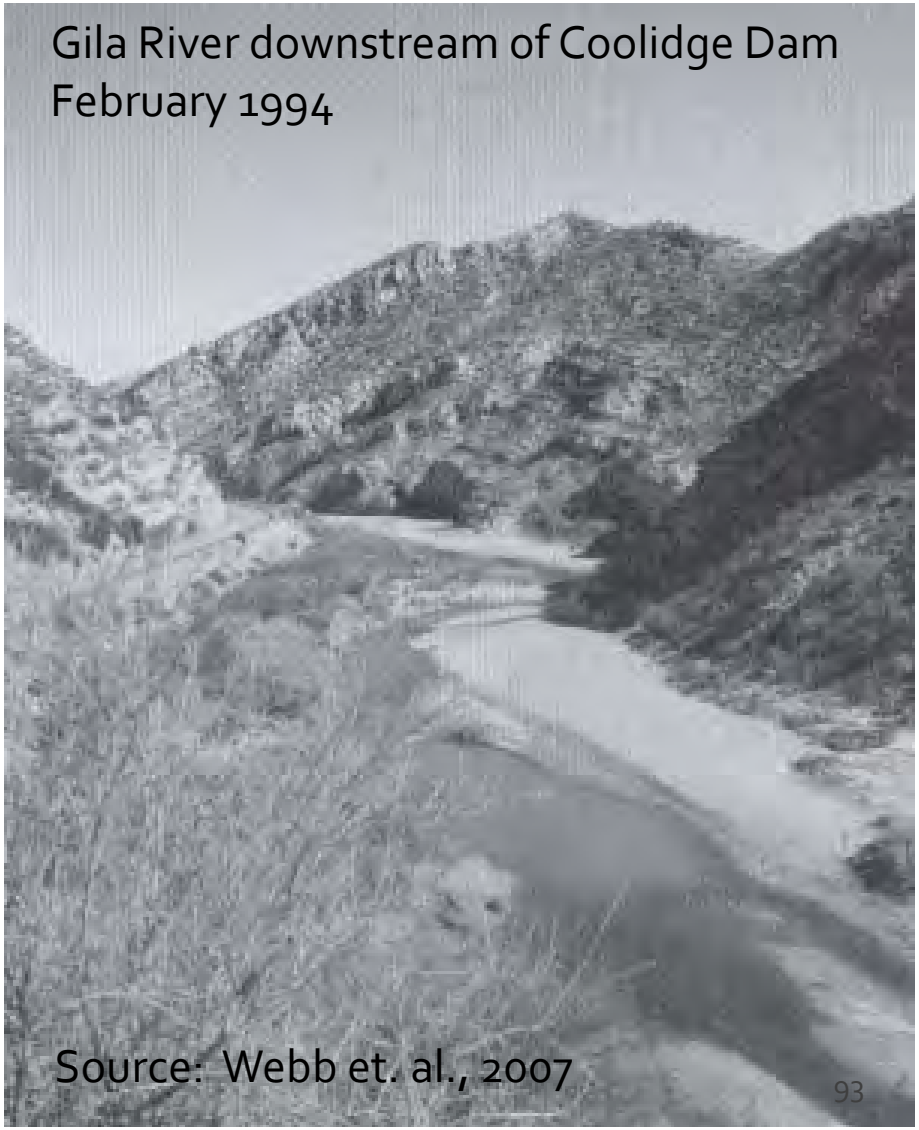
May 1909 – Gila River near Geronimo, AZ (Burkham, 1972)

Historical Photographs

Gila River downstream of Coolidge Dam
February 1928

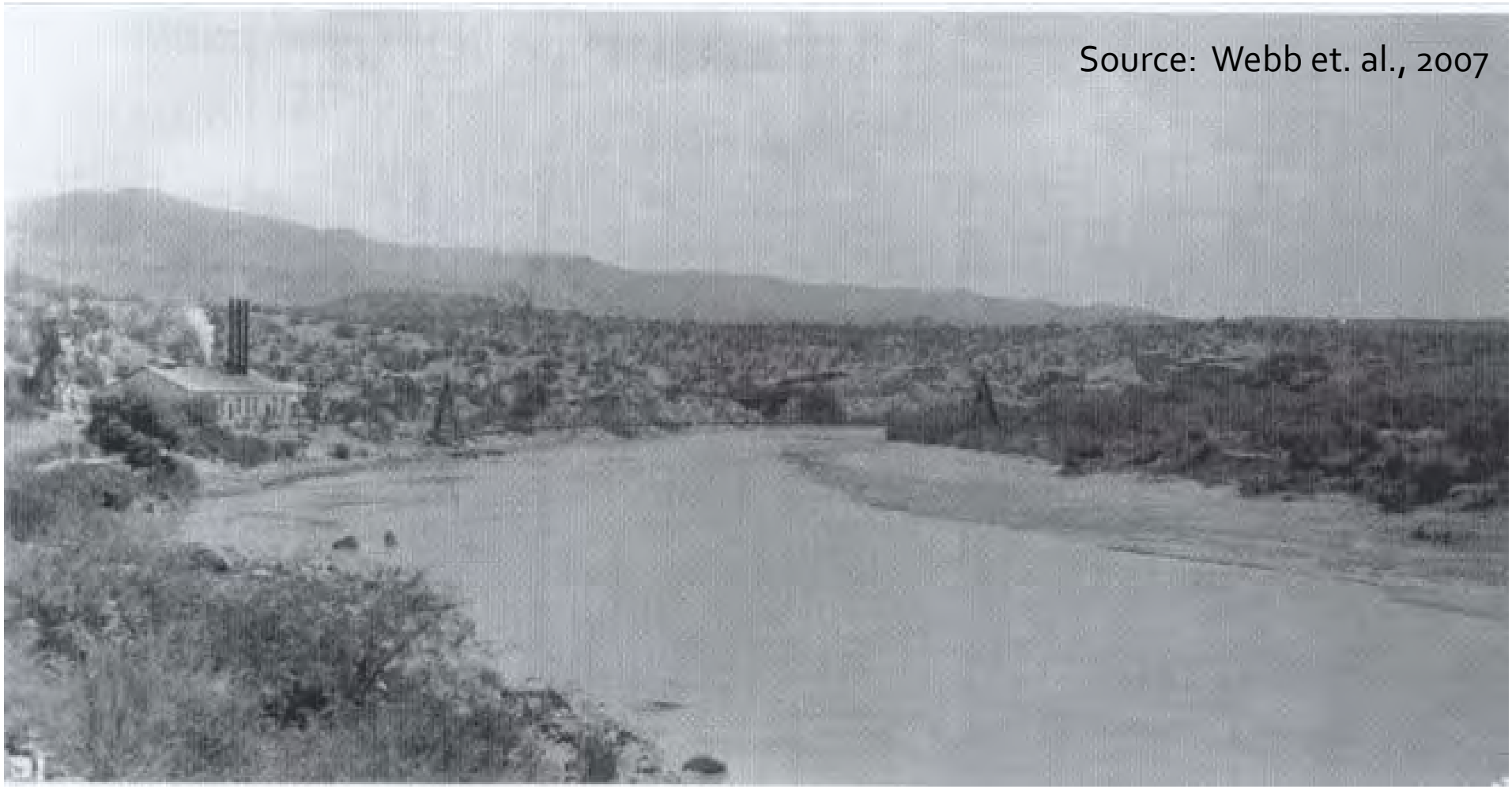


Gila River downstream of Coolidge Dam
February 1994



Source: Webb et. al., 2007

Historical Photographs



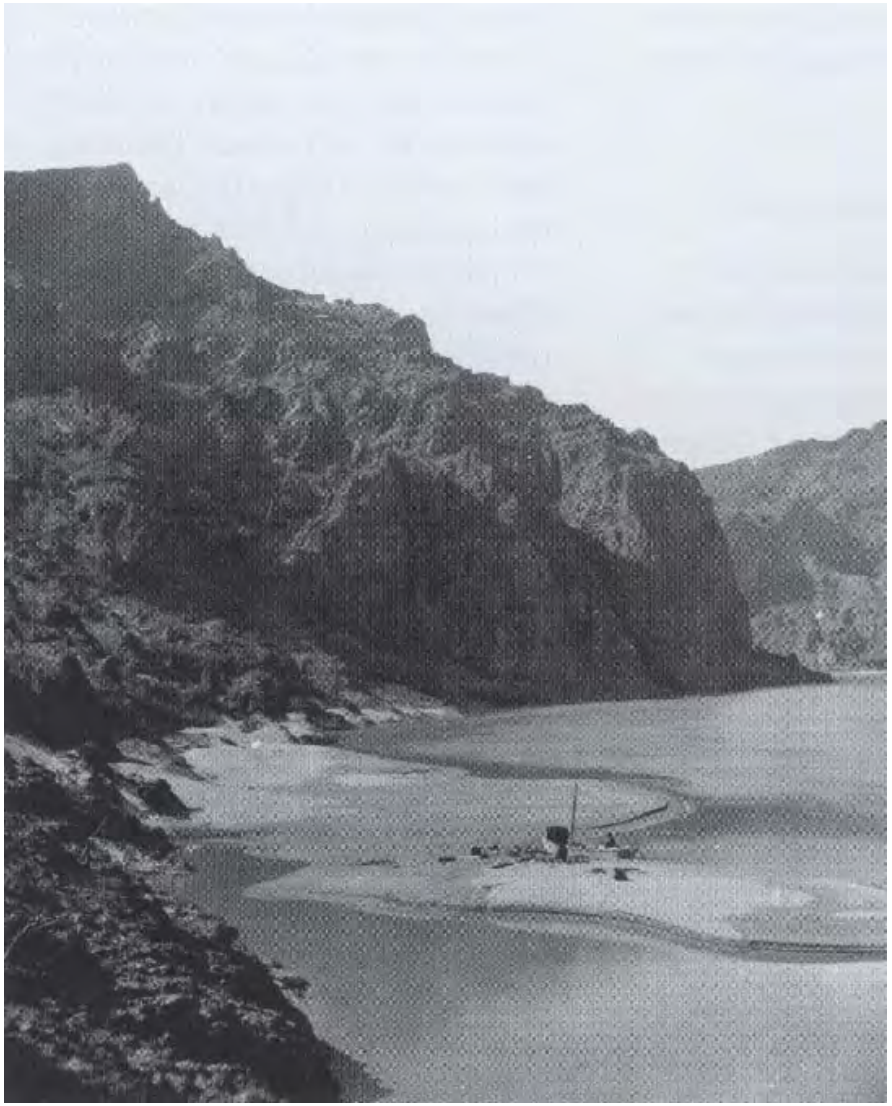
September 2, 1915 – Gila River near Kelvin

Historical Photographs

~1908 – Gila River near Kelvin

Source: Webb et. al., 2007

Historical Photographs



October 1871– Upstream travel on the Colorado River in Black Canyon. Trip extended to Diamond Creek through many large rapids.

Example shows large sand bars in river.

Source: Webb et. al., 2007

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 (possible irrigation cause)
    - 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
  - Canoed 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, 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"

Sources: AZ Weekly Citizen, 7.18.1885

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

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

AZ Gazette, 2.17.1881

Historical Boating Accounts

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

Source: ASLD Report, Phoenix Gazette (11.30, 12.3.1881)

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

- 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

Sources: AZ Weekly Citizen, 6.20.1896

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

- 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

Source: AZ Sentinel, 1.25.1879)

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

- 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

- Entire Gila River (Nov 1890-April 1891)
  - 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

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

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

- 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
  - 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

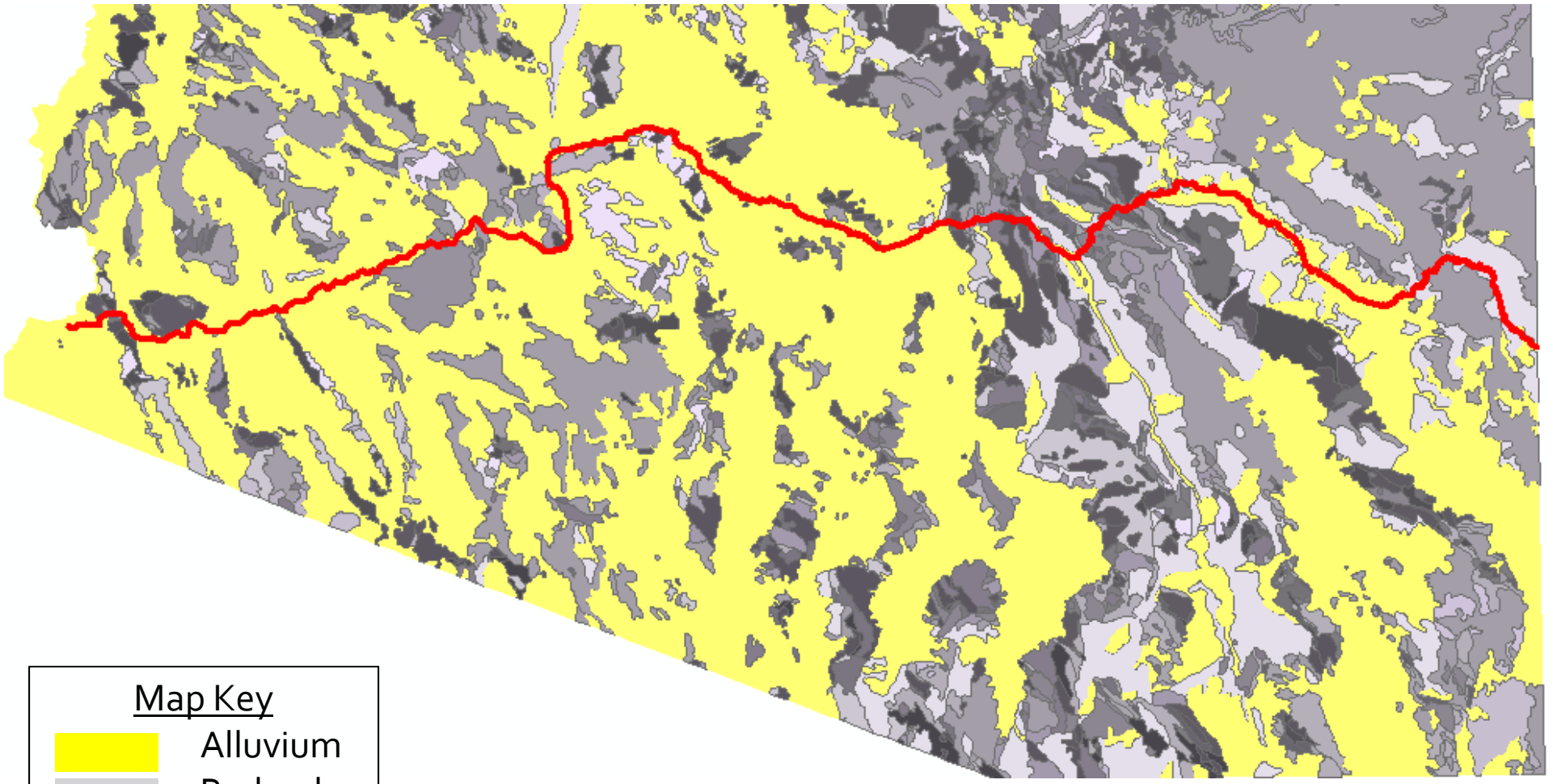
Historical Boating Accounts

- Historical Accounts of Boating: Summary
  - Seasonality (Winter-Spring-Fall)
  - Flow Rates (Low to > 10,000 cfs)
  - Manmade Obstacles
    - Depleted flows
    - Irrigation dams
  - 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)

Geology: Key Findings

- Geomorphic Response to Altered Hydrology
  - Loss of low flows (Segments 1-3, 6-8)
    - Recovery of navigable channel
    - Persistence of flood impacts
    - 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 navigable rivers have them

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 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
Virden (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 (Bartell)
  - 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
  - Average Annual

	BUREC (1952)	Krug (1989)
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 (Bartell)
  - 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

Modern Boating

- Recreational
- Commercial Recreation

Modern Boating

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

Modern Boating

- Websites
  - GORP: Segment 2, year round, 150-1500 cfs
    - Novice canoeists
  - Paddleon.net:
    - Segments 1-2-4-5 – Trip reports & photos

Modern Boating

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

Modern Boating

- 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

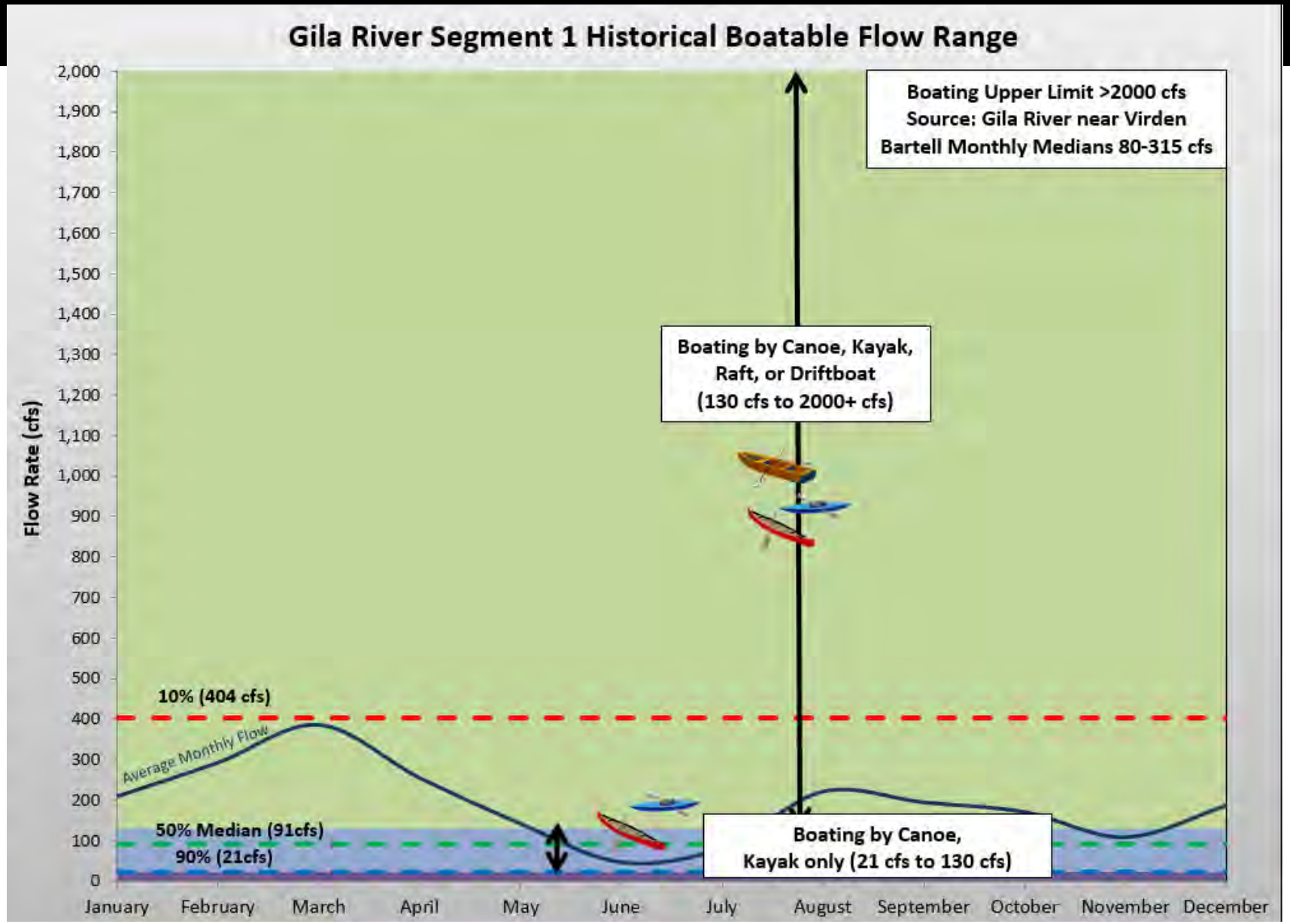
Modern Boating

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

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



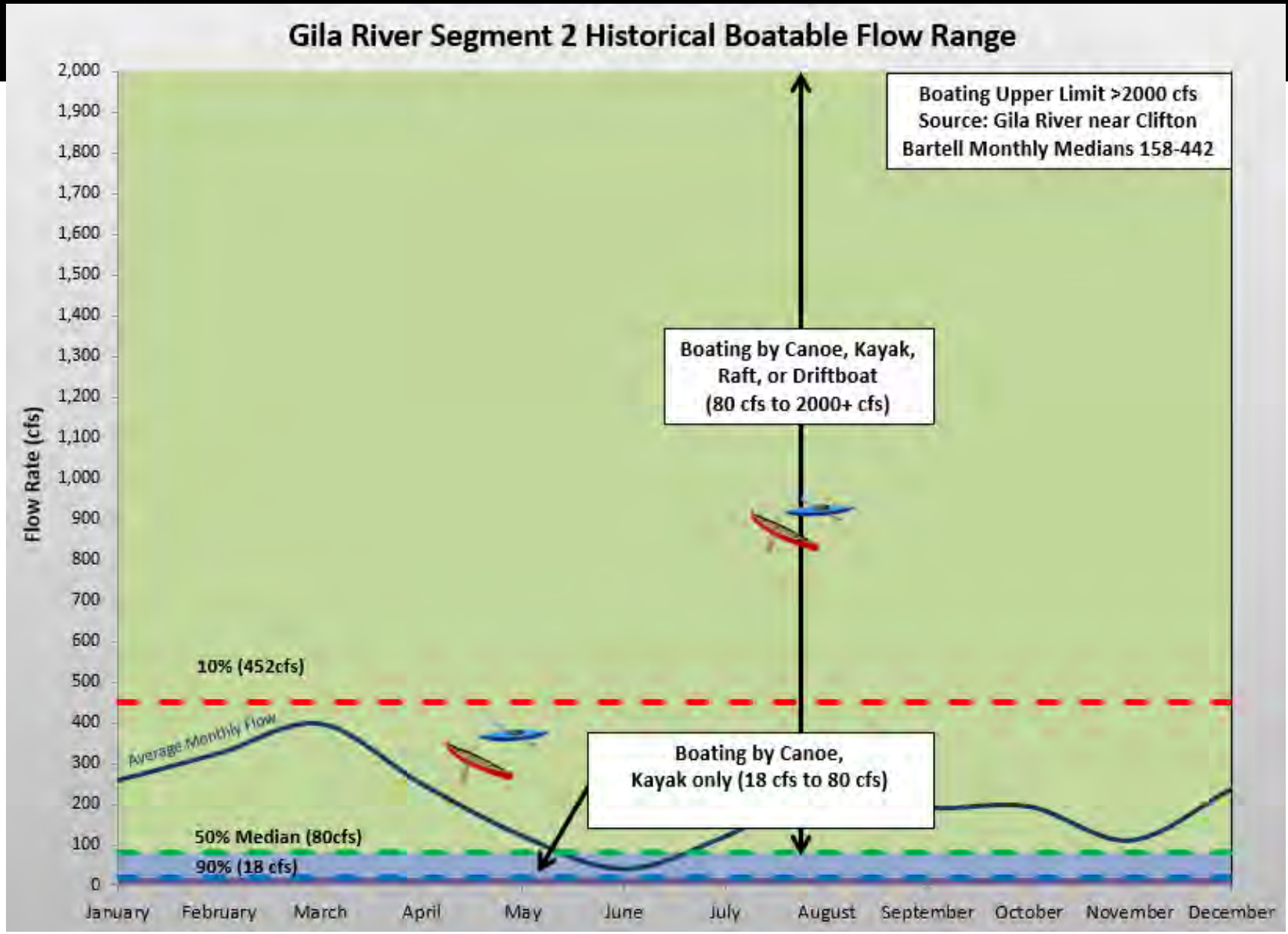
Gila River Segment #1

- Field photos, February, 2014

Gila River Segment #1

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

Gila River Segment #2



Gila River, Segment #2

- Field photos, February/June 2014

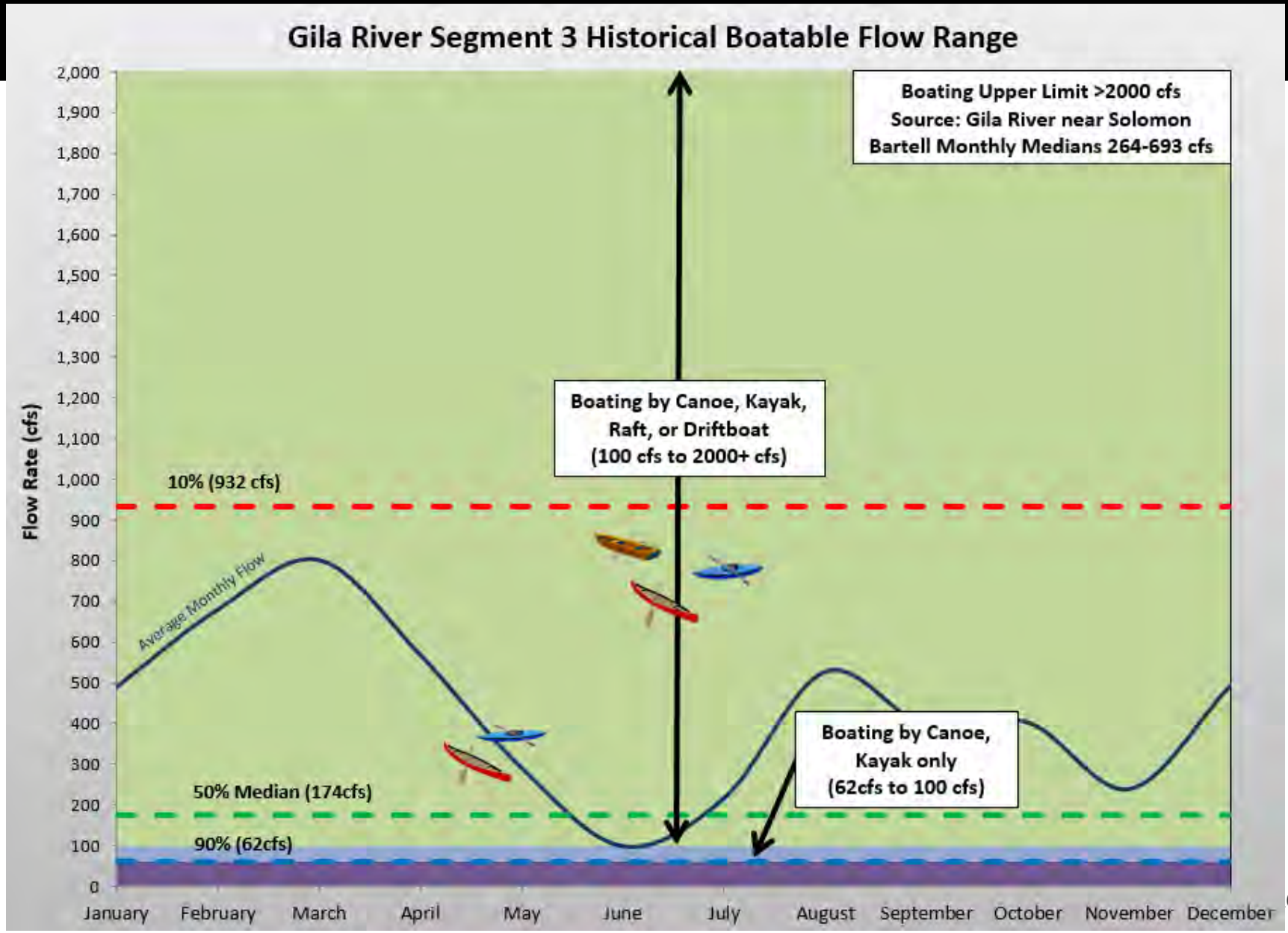
Gila River Segment #2

- 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
  - Boatable by flatboats: ~50% of the time
    - Seasonally (Winter, Monsoon)
  - Modern Boating
    - Extensive recreational use
    - Fences & dams
  - Ordinary & Natural Condition More Boatable
    - Higher flow

Gila River Segment #3



Gila River Segment #3

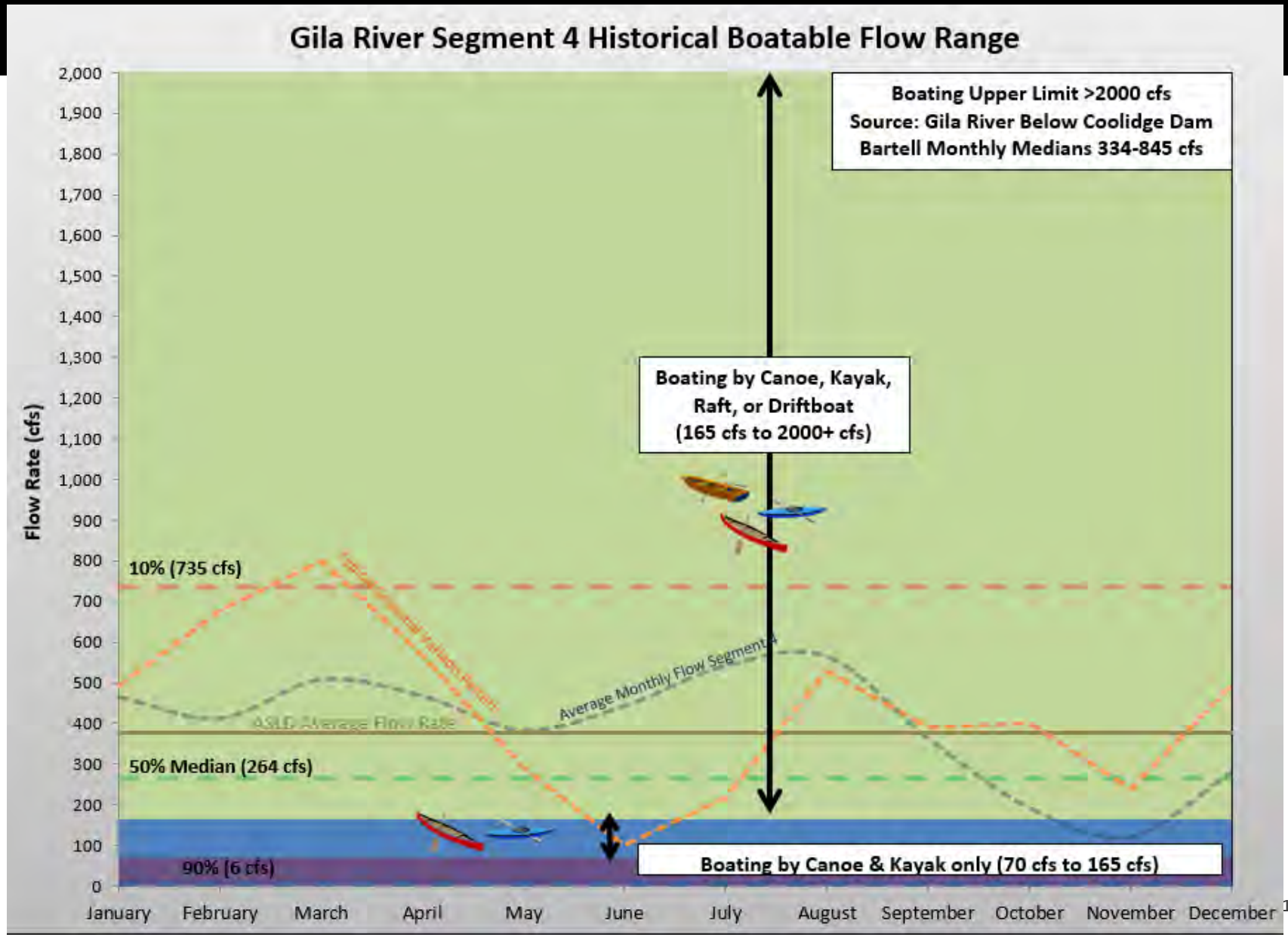
- Modern Boating
  - Rarely boated due to flow removal, diversions, fences, poor scenery, minimal adventure, & distance from major urban centers.

- 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
  - Boatable by flatboats: ~80% of the time
    - Year Round
  - Modern Boating
    - Rare recreational use due to human disturbance
  - Ordinary & Natural Condition More Boatable
    - Higher flow

Gila River Segment #4



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

- Field photos, February 2014

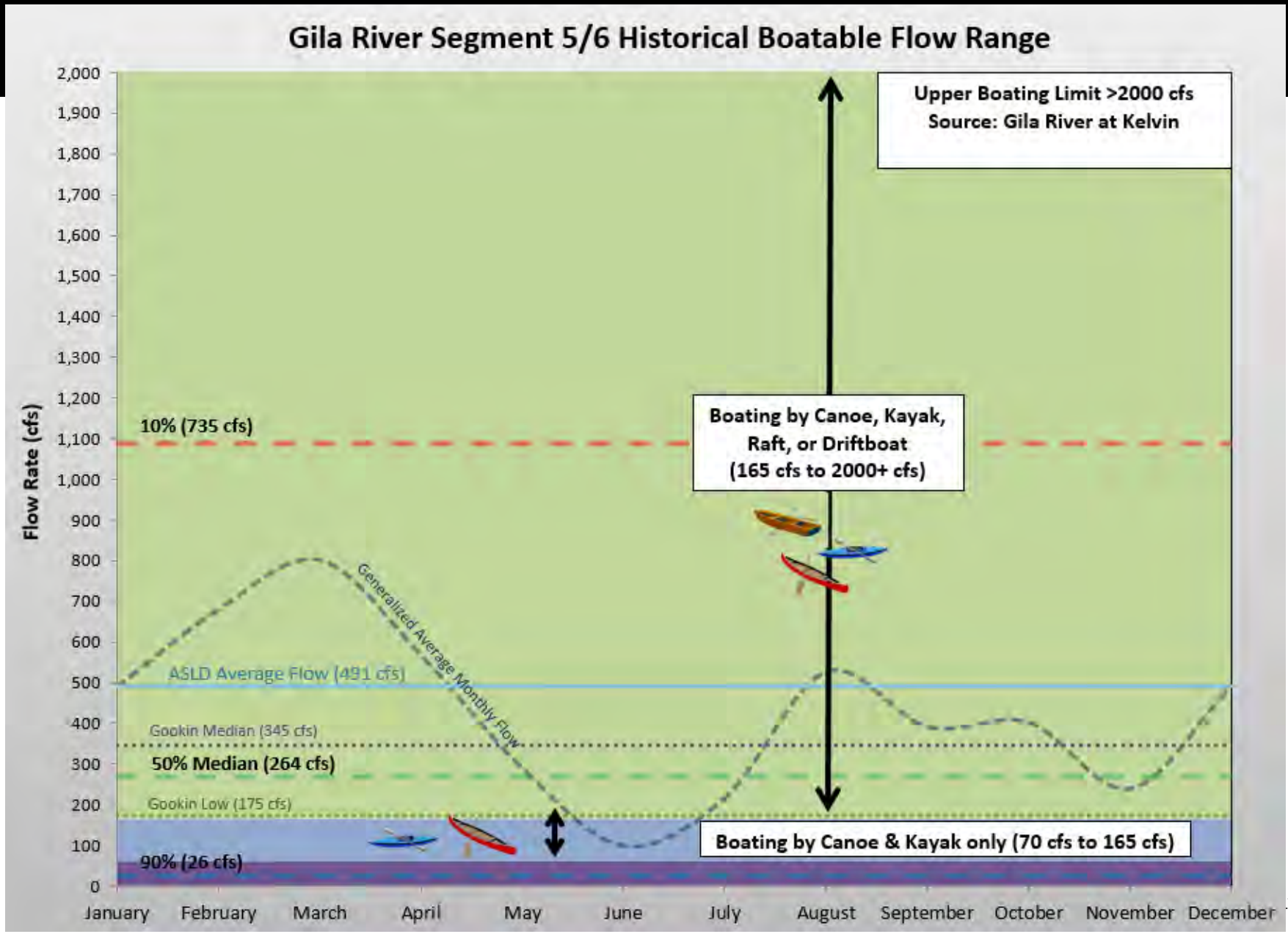
Gila River Segment #4

- Changes Since Statehood
  - Flow regulated for irrigation
  - 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
  - Boatable by flatboats: ~70+% of the time
    - Year Round
  - Modern Boating
    - Recreational use limited by gated access
  - Ordinary & Natural Condition More Boatable
    - Higher flow

Gila River Segment #5



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

- Field photos, May 2014

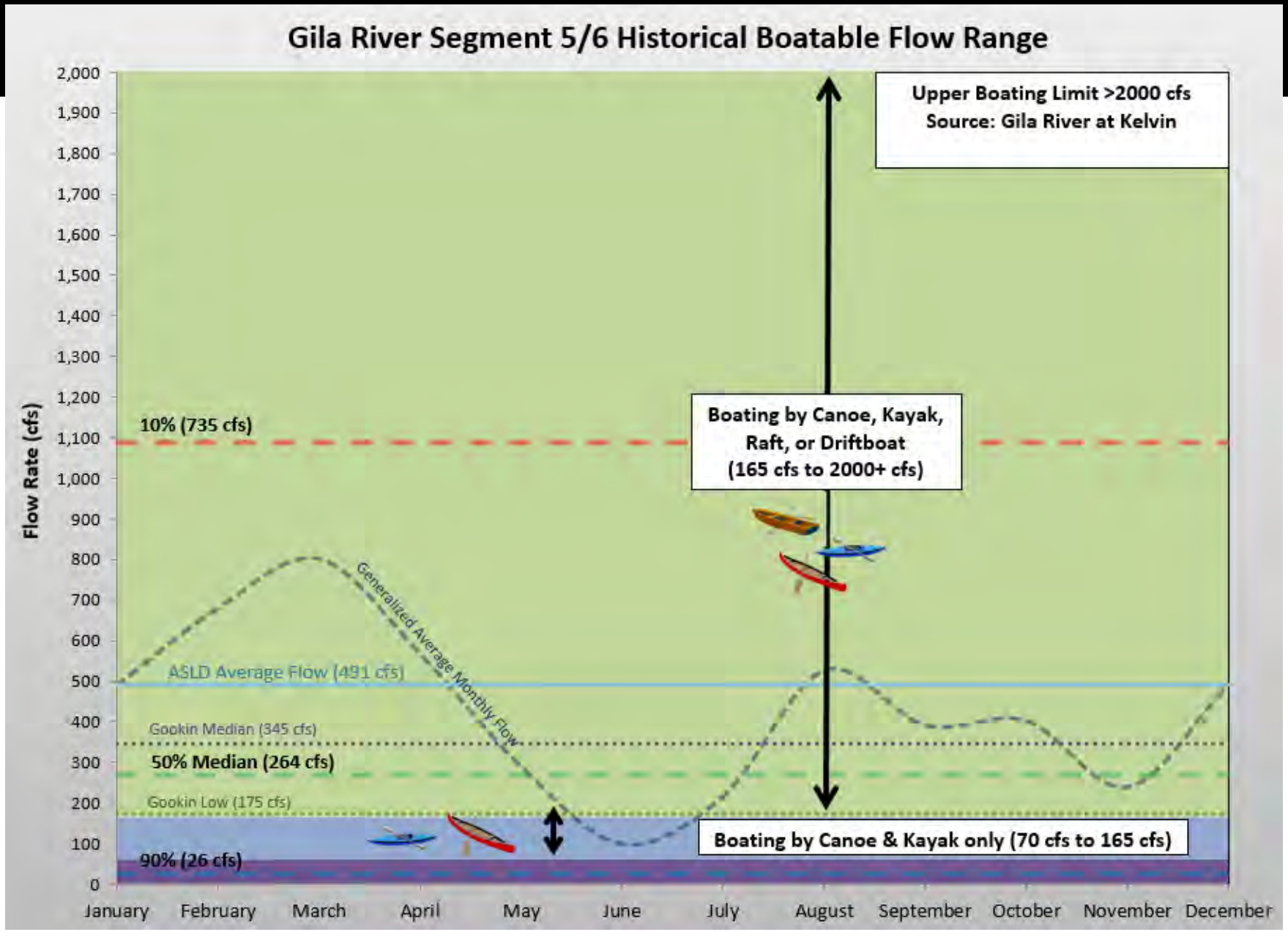
Gila River Segment #5

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

Gila River Segment #6



Gila River Segment #6

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

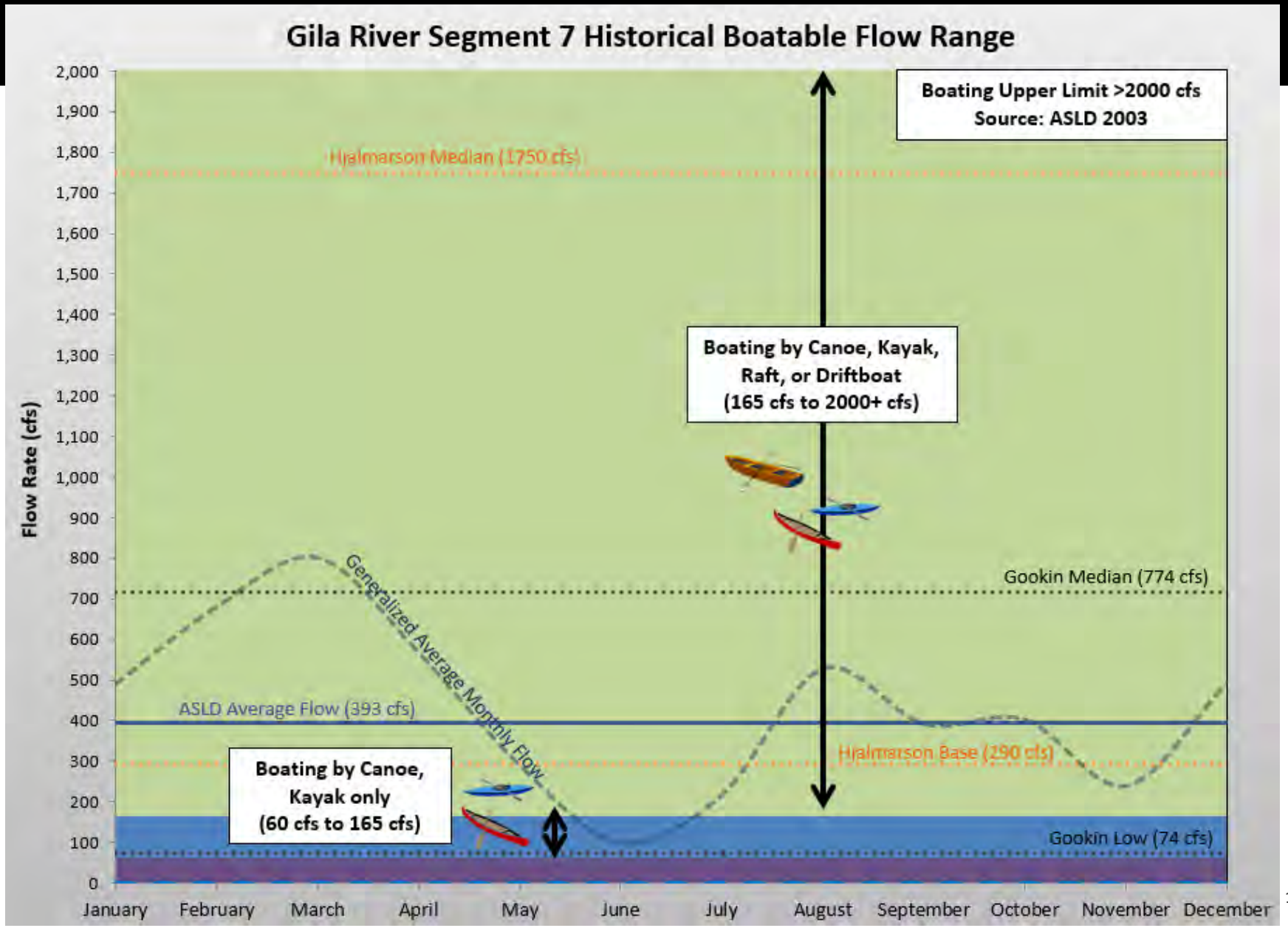
Gila River Segment #6

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

Gila River Segment #7



Gila River Segment #7

- Field photos, February 2003

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

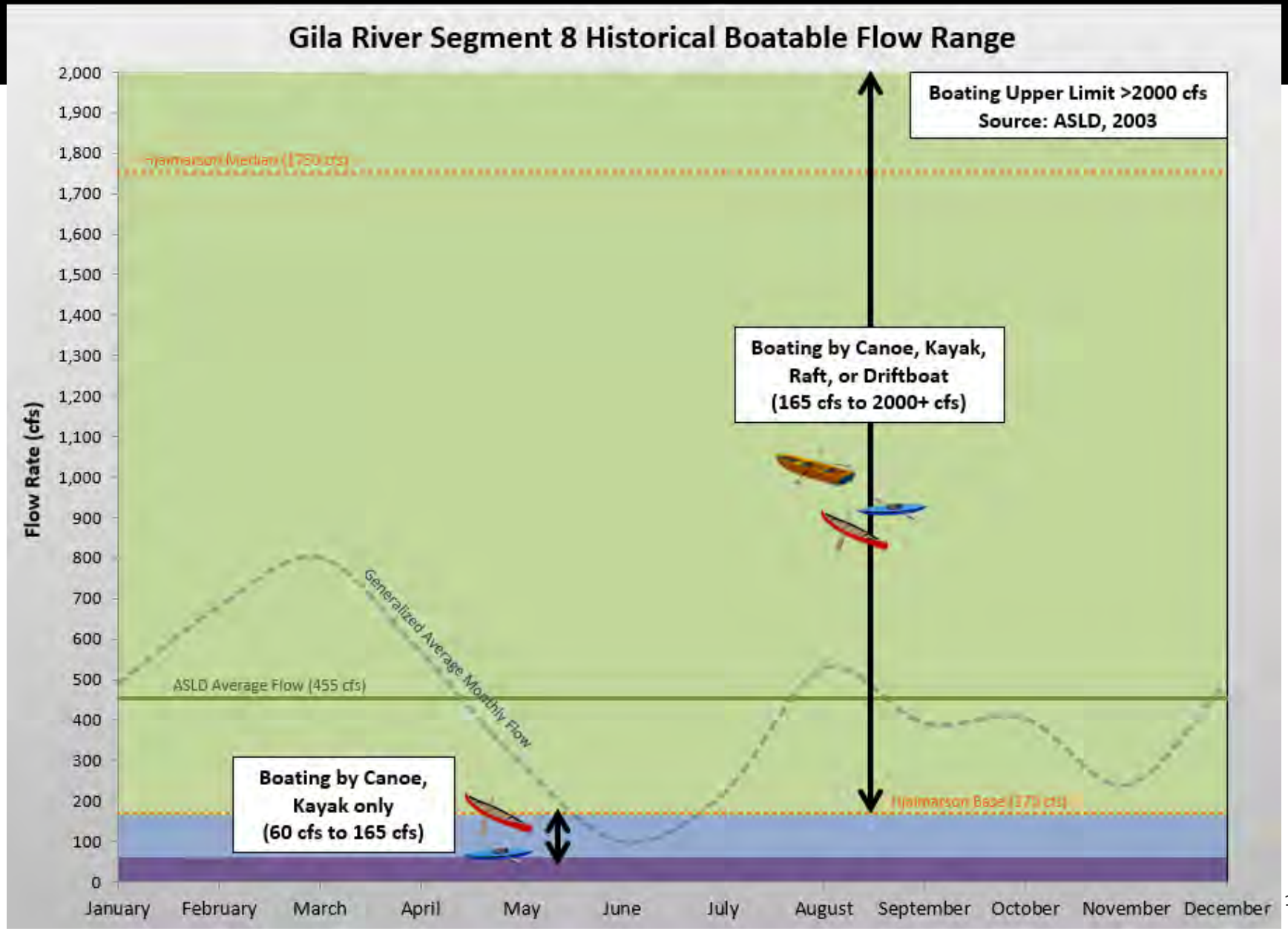
Gila River Segment #7

- 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
  - Boatable by flatboats: ~90+% of the time
    - Year Round
  - Modern Boating
    - Some recreation boating
  - Ordinary & Natural Condition More Boatable
    - Higher flow

Gila River Segment #8



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
  - Boatable by flatboats: ~90+% of the time
    - Year Round
  - Boatable by streamboats: ~50% of the time
  - Modern Boating
    - Rare modern boating
  - Ordinary & Natural Condition More Boatable
    - Higher flow

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:
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)

Conclusions

- 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)**