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Historic Channel Changes in the Salt River, Arizona 1890-1931

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Introduction

Channel stability and the nature of channel change are important considerations for development along rivers as well as river restoration. Our ability to predict and understand channel change is imperfect, particularly for dryland rivers. An historic, geographical approach to channel change can provide important insights into the dynamic nature of river environments. The Salt River through Phoenix provides a unique setting to combine historic photographs and hydrological data in an effort to better understand channel change.

My research addresses the questions:

- **How stable was the Salt River prior to dam construction?**
- **How are channel stability and instability reflected in vegetation patterns?**

Study site and timeframe

- Hayden Butte: This reach of the river has undergone substantial changes in the past century, and these changes are conveniently documented through photographs taken from the butte.
- 1890-1931: This time period represents the river prior to extensive regulation, and the ground photographs predate earliest available aerial photographs.

Methods

- I collected historic photographs from the Tempe Historical Museum, and chose the subset that best reflected channel change due to the 1891 flood, the largest flood on record.
- I visually analyzed the photographs in conjunction with hydrological data and a collection of historic accounts (Graf et al. 1994) to assess channel stability and vegetation patterns.

Results

Three historic photographs, 1890, 1900, and 1931, captured a view of the Salt River northwest of Hayden Butte from approximately the same orientation and elevation.

Hydrologic data recorded at Granite Reef Diversion Dam (25 km upstream) reflects a large flood event in 1891, followed by a series of much smaller events through 1931.

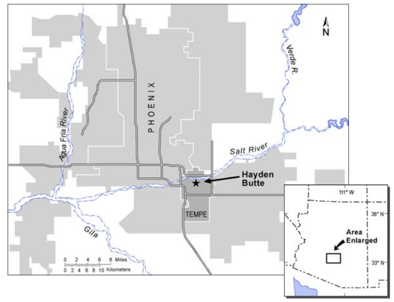
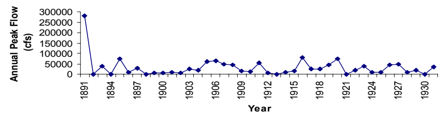


Figure 2: Annual Peak Flow at Granite Reef Dam (cfs) 1891-1931



Results, cont.

•1890: Pre-flood conditions.
Vegetation: Mature cottonwoods, willows and alder grow along banks; floodplain terraces support mesquite greasewood, and palo verde thickets. Channel: Lowflow channel angles across the highflow channel, confined by sand bars. Deep meander bends present downstream from the railroad bridge.

•1900: Post-flood conditions.
Vegetation: Bank vegetation has grown, stringer of vegetation present in 1890 persists. Channel: Meander bends of 1890 are abandoned.

•1931: Conditions after several years with moderate flood events.
Vegetation: Cottonwoods along riverbanks, agricultural fields present north of the river. Channel: Low flow channel of 1900 still visible, marked by parallel bands of vegetation just downstream of the railroad bridge.

Conclusions:

These photographs and hydrological data document the geomorphic and vegetation changes associated with a large flood event. Because this event predates aerial photography and the construction of dams, historical ground photo analysis represents the only visual evidence for channel change.

How stable was the Salt River prior to dam construction?

The Salt River's largest recorded flood event changed the river channel and patterns of vegetation. Subsequent smaller events did not appreciably change the low flow channel, evidence that the Salt River's geomorphology is event-driven. This combination of historic photographs and hydrological data provides unique insight into the nature and degree of channel change in response to a specific flooding event.

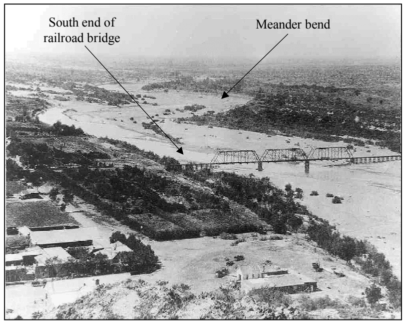
How are channel stability and instability reflected in vegetation patterns?

Vegetation, particularly trees, serves as a useful visual clue to the location of the low flow channel. Woody vegetation may play an important role in maintaining channel stability during moderate flood events by restricting and directing flood flow. The flood of 1891 was large enough to destabilize bank vegetation and resulted in channel change.

Reference: Graf, William L., Patricia J. Beyer, and Thad A. Wasklewicz. 1994. Geomorphic Assessment of the Lower Salt River, Central Arizona. U.S. Army Corps of Engineers Contract DACW09-94-M-0494.

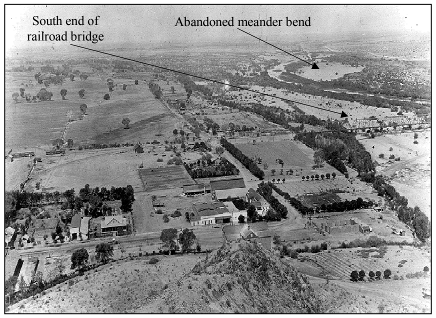
1890

Note groves of trees (cottonwoods, willow and alder according to historic accounts) lining the banks of the high flow channel. Floodplain terraces north of the river support mesquite, greasewood, and palo verde thickets with sagebrush and native grasses in more open areas. Agricultural fields dominate the southern bank in the foreground, with the darkest area possibly native vegetation. The low flow channel is slightly wider than the middle section of the bridge, and sand bars and point bars occur along its length. Stringers of vegetation mid-channel indicate stabilized sand bars and help direct flow.



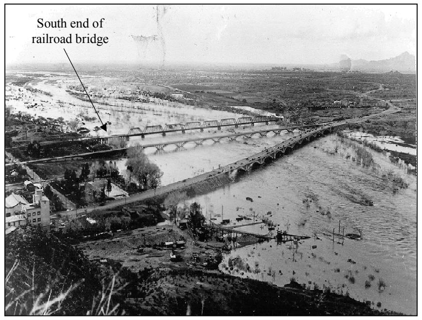
1900

The bank vegetation is taller and more extensive (compare trees near railroad bridge with those in the 1890 photograph), as are the planted rows of trees surrounding the fields. Following a flood in 1891, the low flow channel shifted north, and is delineated by bands of dark vegetation. The most dominant stringer of vegetation in 1890 is still visible, now south of the low flow channel. The trees marking the north bank of the low flow channel in 1890 delineate the south bank of the low flow channel in 1900. The trees closest to the bottom of the photograph mark the Hayden Canal, an irrigation canal out of view (but present) in the 1890 photograph.



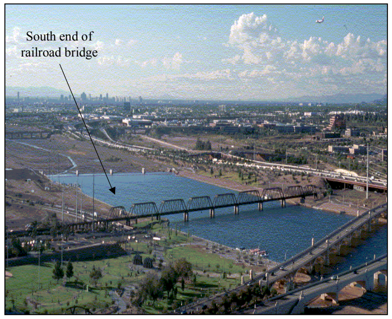
1931

This photograph shows the Salt River in flood, obscuring some vegetation and channel details. The tops of mature cottonwoods are visible between the two automobile bridges, and the low flow channel in the 1900 photograph is still visible in 1931 as parallel bands of vegetation. Agricultural fields replaced native vegetation north of the river. In the center foreground, conveyor belts mark a sand and gravel quarry, and the Tempe Beach Park swimming pool is located south of the river between the two automobile bridges.



2000

This modern view reflects the impacts of urbanization on the Salt River during a period of rapid growth. In 1998, the city of Tempe constructed Tempe Town Lake to stimulate economic growth. The river is entirely channelized and native vegetation is minimal.



All photographs were taken from Hayden Butte facing northwest, with the river flowing towards the west. Tempe Historical Museum provided the 1890, 1900, and 1931 photographs, and the 2000 photograph is by Wendy Bigler. Salt River Project provided the hydrological data.
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