Introduction

https://www.youtube.com/watch?v=HQ-Y8CIEpgw&feature=youtu.be
Outline

- Effect on authorized purposes
- Urgency
Water Supply

If you fill your cup with mud, there’s less room for the water.

You can’t drink mud.
Water Supply Impacts: Tuttle Creek Lake
Tuttle Creek Lake: 1957 to 2010
Tuttle Creek Lake

Distance from Dam (miles)

Elevation (feet)

Open Water

Normal Pool

2010

2000

1983

1962

Dam

Low Flow Gate
Tuttle Creek Lake

![Graph showing elevation and distance from dam](image)
Annual Storage Volume Lost

Sedimentation rate in multi-purpose pool (1962 to 2009):

3,500 ac-ft/yr

5.6 million yd³ / year
Tuttle Creek Lake: At the same annual rate of sedimentation

- Multi-purpose pool will be 88% full in 50 years
- Total storage (multi-purpose + flood control) will be 21% full
Tuttle Creek Lake: 50 years
Flood Control

- **Downstream impacts**
  - Sediment displaces storage in the flood control pool
  - Sediment accumulation in the multi-purpose pool can lead to the need for pool reallocations

- **Upstream impacts**
  - Backwater → Delta → Water surface rise upstream of flood control pool
Flood Control Impact: John Redmond Reservoir Pool Raise

- 2 ft pool raise in 2013
- Reallocation from flood control to water supply
- Deemed in the public’s best interest
Upstream Aggradation Impacts

Increased surface and groundwater stage
Reduction in channel capacity & increased flooding
Environmental Impacts: Kansas River

Pre-dam Sediment Load: 44 million tons per year

Post-dam Sediment Load: 13 million tons per year

A 70% reduction in sediment transport
Turbid-water Fish

- Smaller eyes
- Smaller optic lobes of brain
- Electro-sensory and chemo-sensory organs
- Non-sight feeding
- Thrive in naturally high-turbidity environments

Clear-water Fish

- Larger eyes
- Larger optic lobes of brain
- Site-feed
- Out-compete native Kansas River fish in the current, unnaturally clear Kansas River environment
Shovelnose Sturgeon

- Once abundant in the Kansas River, no longer present in much of Kansas

Imperiled Due to Increased Water Clarity and Predation and Competition from Sight-Feeding Fish

- Formerly found in the lower Kansas River. Not found for 20 years. Considered “extirpated, or nearly so, in Kansas.”

- Significantly reduced in abundance

Imperiled Due to Increased Water Clarity and Predation and Competition from Sight-Feeding Fish

Significantly reduced in range or abundance

Other impacted species showing significant decline or complete extirpation: Silver Chub, Flathead Chub, River Shiner, Carmine Shiner, Sturgeon Chub
Impacts from Lack of Turbidity: Colorado River

- Humpback Chub numbers have decreased substantially and they are now federally protected.

- One primary reason is that the Colorado River used to be usually over 1000 FNU, but after construction of Glen Canyon Dam now is usually below 50 FNU. The small chub become easy prey for trout species in clear water.
Impact on Hydropower

At a 1000 MW power station, Pelton needle valves under 800 meters of head. (A) 10,000 hours normal operations. (B) less than 24 hours passing sand. (Source: Morris, 2016)
Sedimentation and Dam Safety

- Increased sediment within or immediately upstream of an intake tower may
  - Change flow patterns, vibrations within the tower, and potential areas of cavitation.
  - Cause blockages and inability to operate gates resulting in reduced or zero releases.
  - Prevent emergency bulkheads from lowering the pool during a dam emergency.
  - Inability to pass inflows through intake tower could result in higher record pools (untested embankment) or spillway releases resulting in additional risk to populations downstream of dam.
Operations
Reservoir sediment management is important...
...but is it urgent?
Clay Consolidation
Clay Consolidation
Clay Consolidation

Effect of time on sediment erodibility of silts/clays

Erodibility testing in Tuttle Creek Lake
Laboratory Jet Erosion Tester at USDA-ARS
Deeper (older) deposits are up to 200 times less erodible.

The longer we wait, the harder the sediment is to erode.

Orders of magnitude easier (less expensive) to prevent or remove fresh deposits than to recover storage later.
Conclusion

- Effect on authorized purposes
- Urgency