Reservoir Sustainability/ Sediment Continuity

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River Engineering and Restoration Section

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US Army Corps of Engineers
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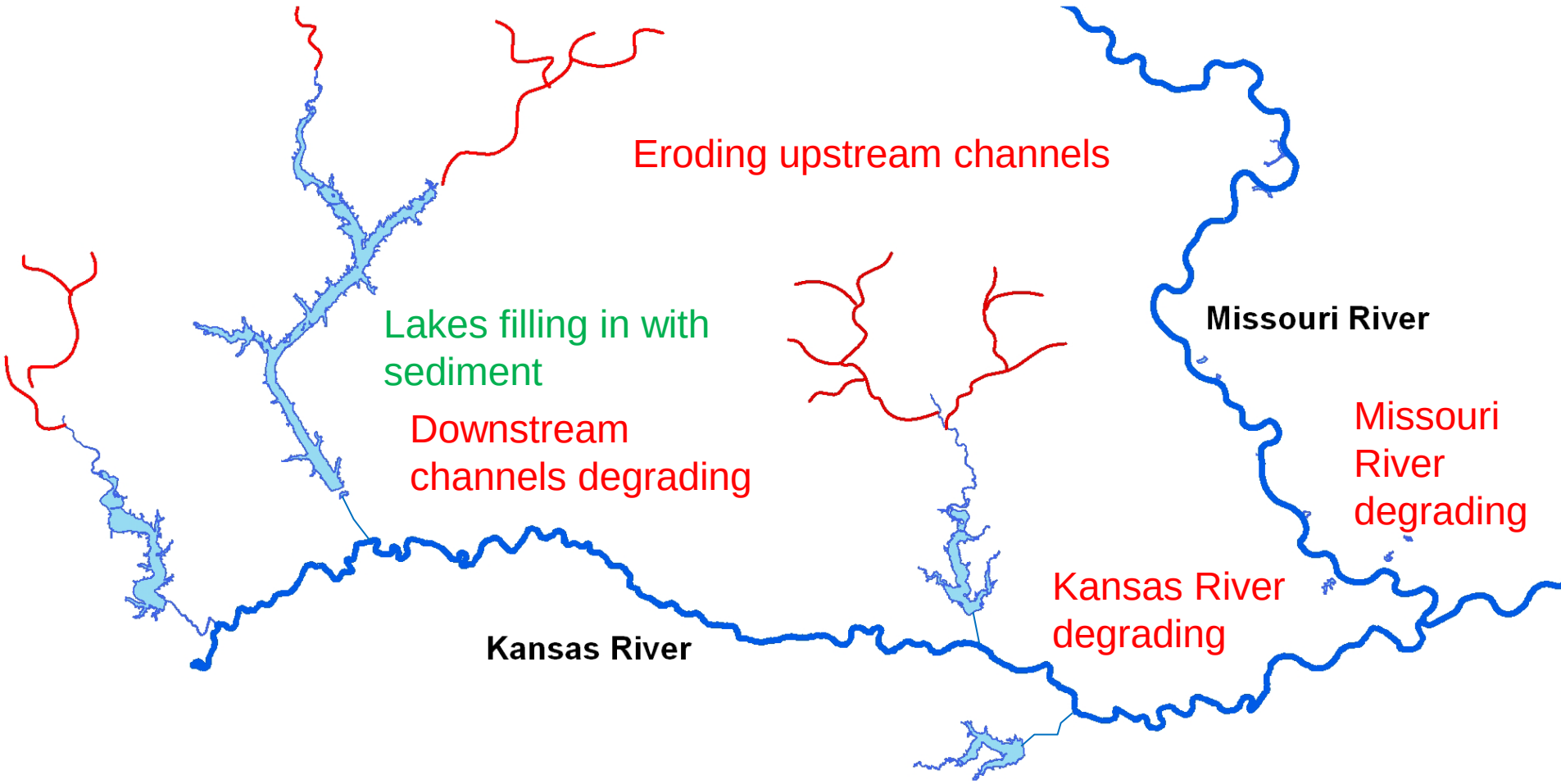
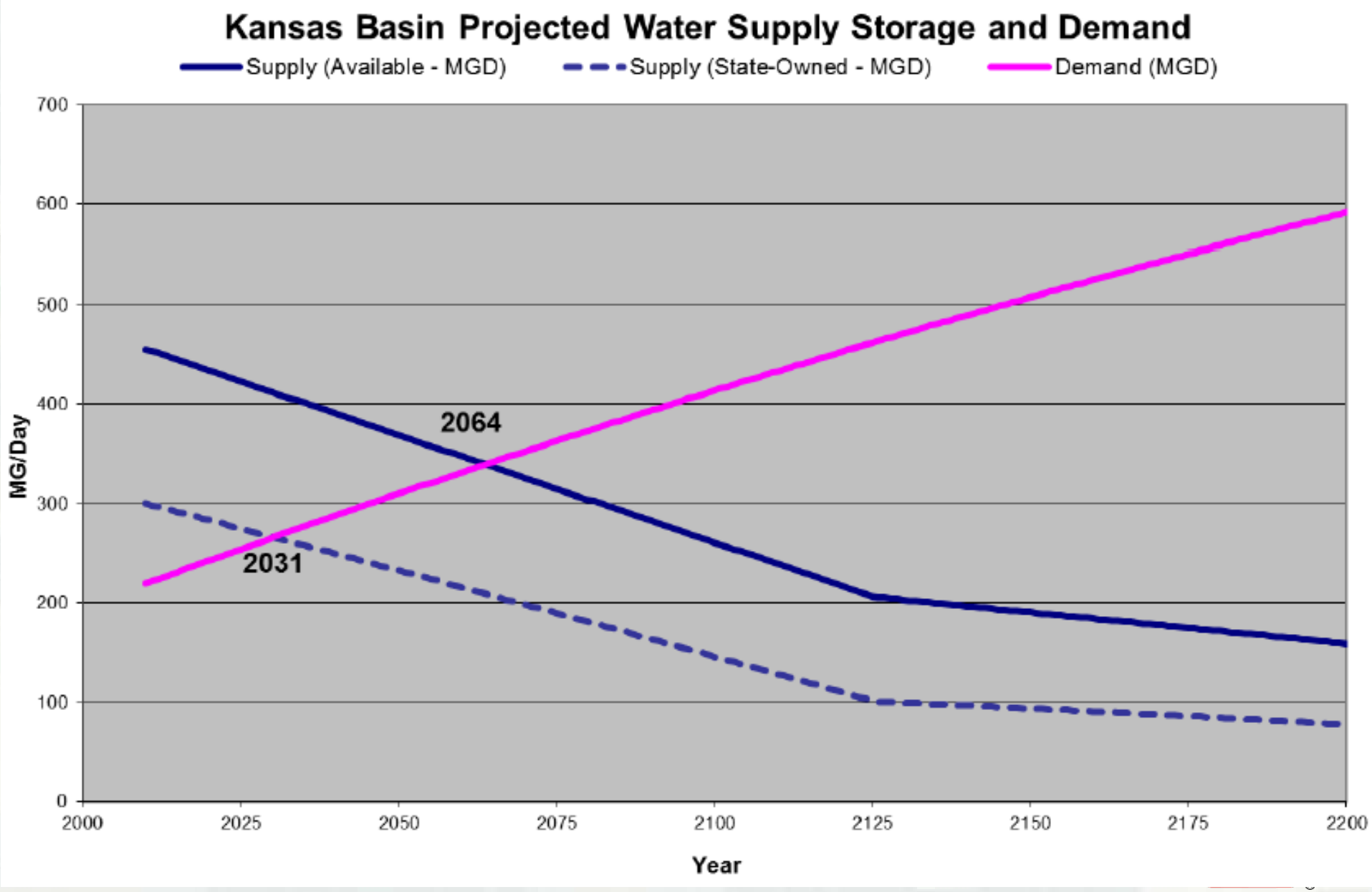
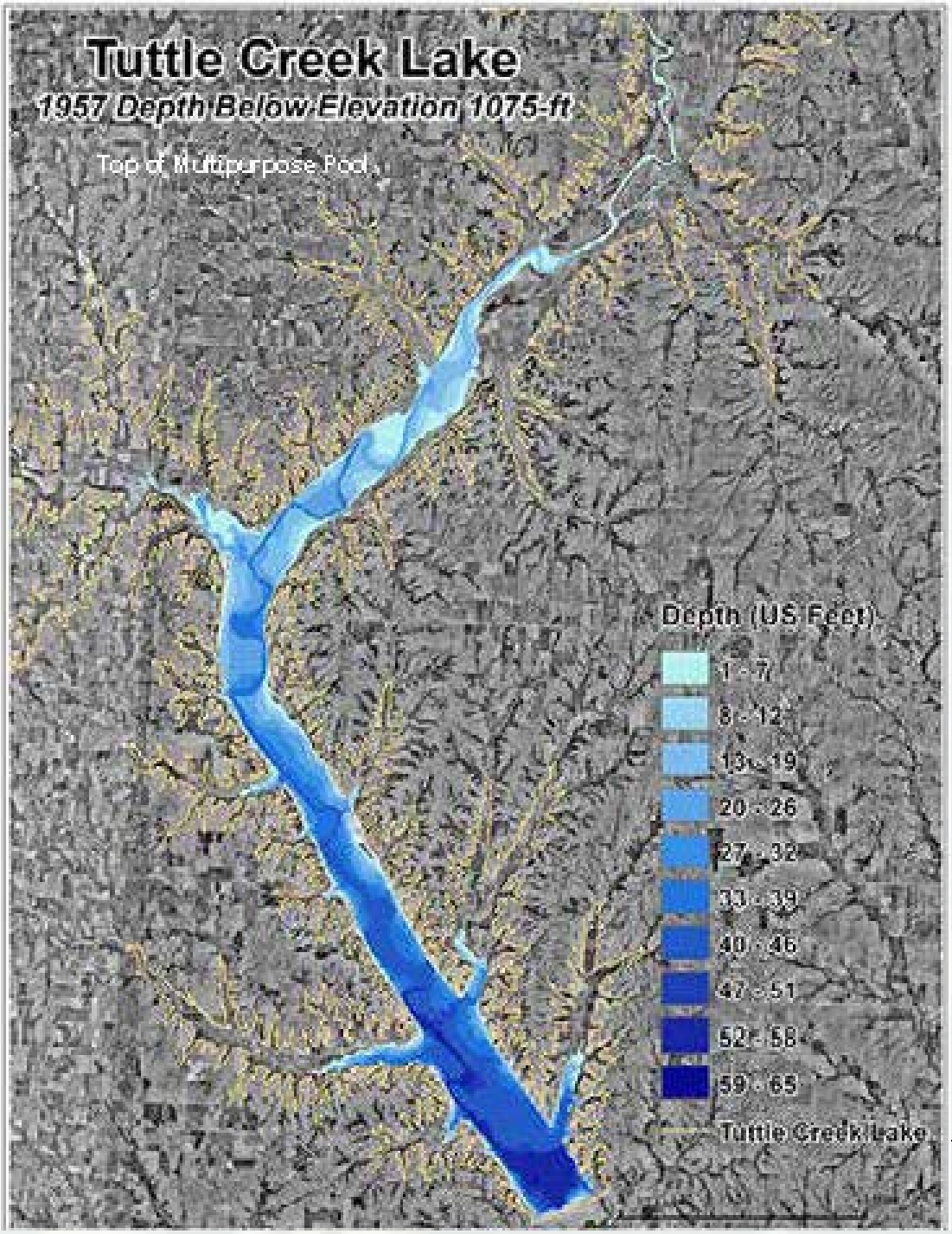
FY14 RSM-EWN IPR
Kansas City District-John Shelley

<u>BLUF:</u> "**…**some scoping work to bridge the gap between the RSM FY13 workshop and a more fully funded implementation project or study."

Sediment Imbalances




Kansas Basin Projected Water Supply Storage and Demand
Supply (Available - MGD)
Supply (State-Owned - MGD)
Demand (MGD)
MG/Day
700
600
500
400
300
200
100
0
2064
2031
2000
2025
2050
2075
2100
2125
2150
2175
2200
Year



COE/HNTB

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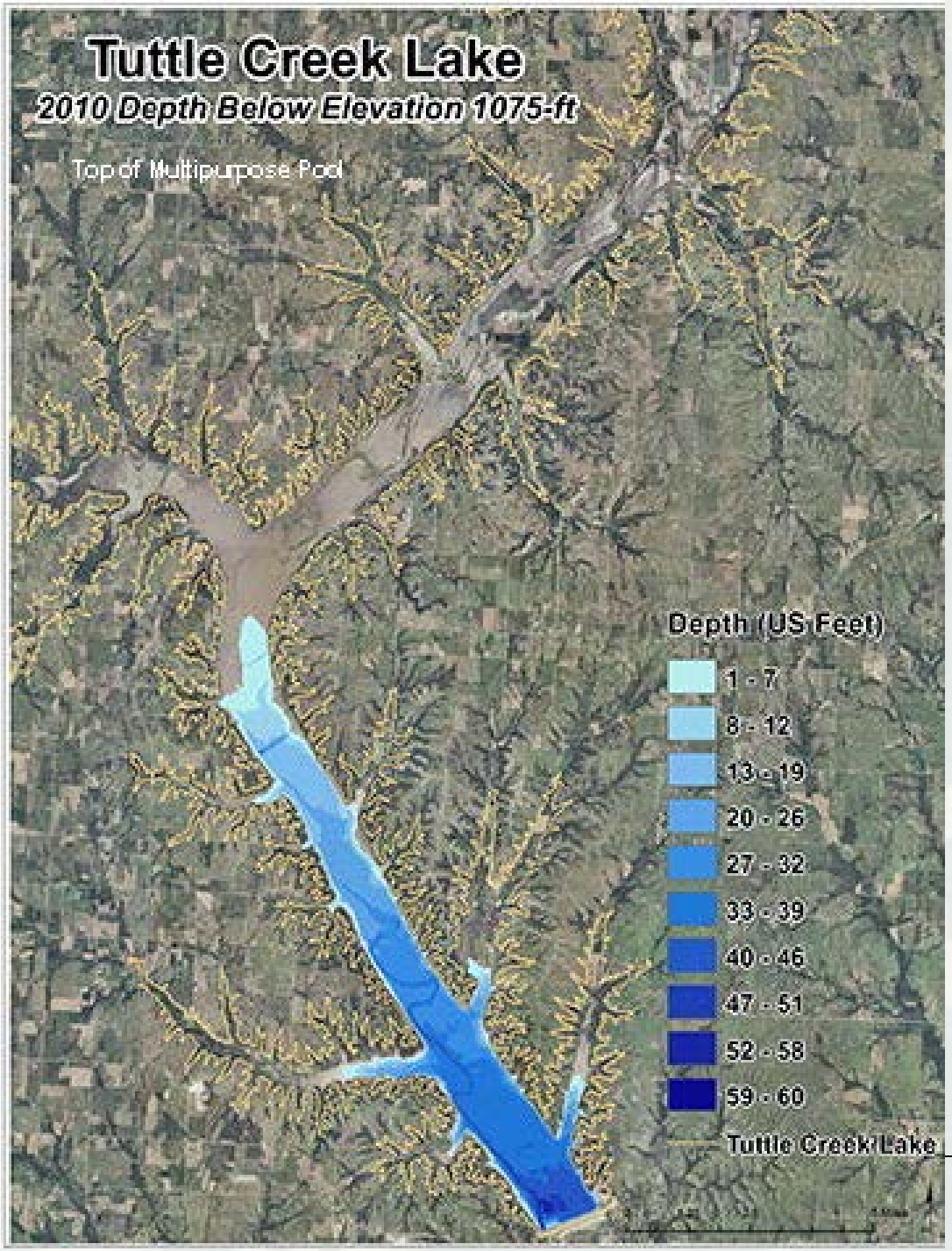

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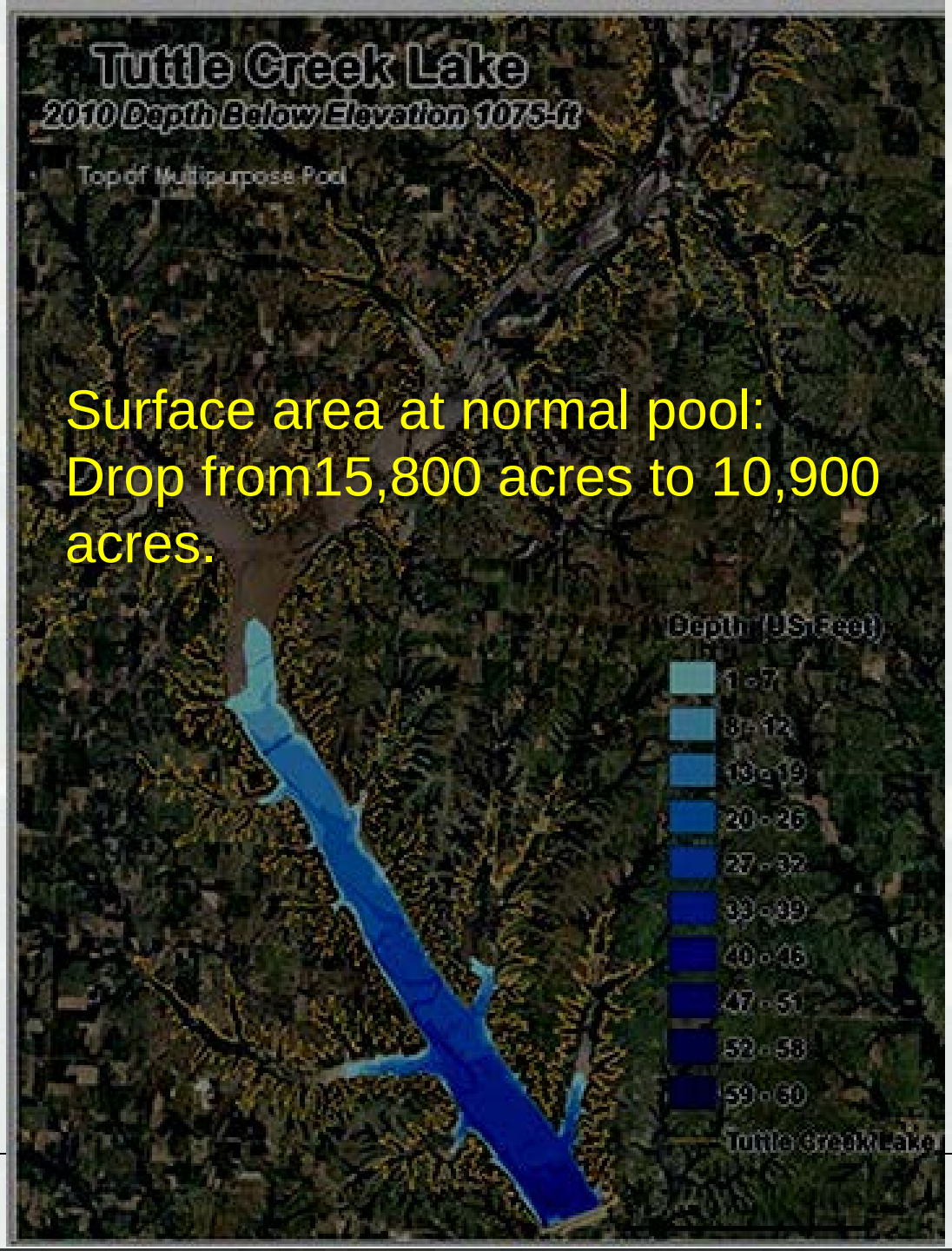
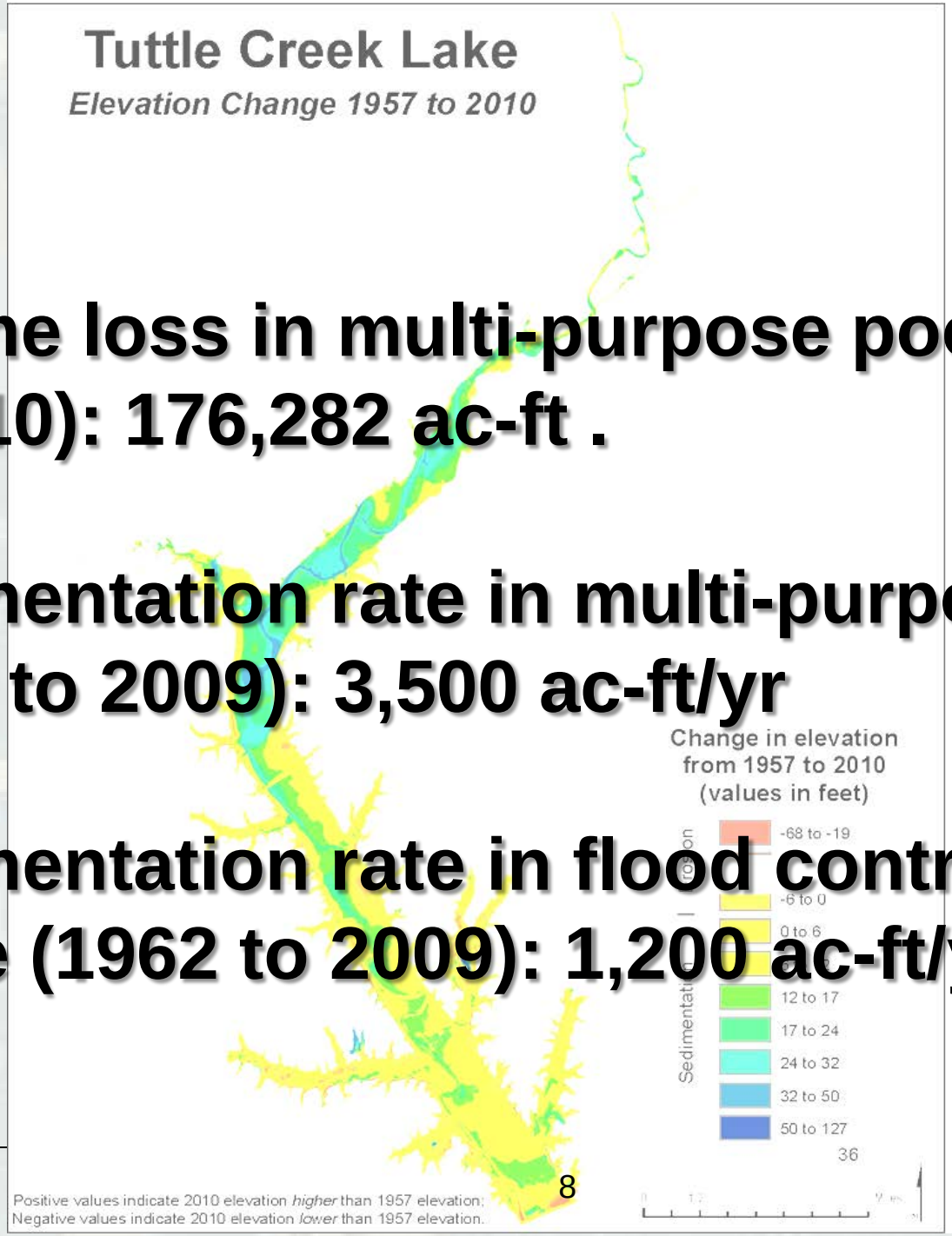


Surface area at normal pool:
Drop from15,800 acres to 10,900 acres.



Volume loss in multi-purpose pool (1957 to 2010): 176,282 ac-ft .

Sedimentation rate in multi-purpose pool (1962 to 2009): 3,500 ac-ft/yr

Sedimentation rate in flood control space (1962 to 2009): 1,200 ac-ft/yr

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Decrease in Sediment Load in the Kansas River

"…twelve dams were constructed across the Kansas River basin from 1952 to 1969, with six of the impoundments having water-storage capacities larger than Lewis and Clark Lake behind Gavins Point Dam on the Missouri mainstem (Perry, 1994). Predam discharges of suspended sediment from the Kansas River (based on only a few years of record: 1929-1930, 1949-1950) averaged **30-40 million metric tons per year** (Secretary of War, 1935; USACE, 1957). During the record flood year of 1951, the Kansas River carried 150 million metric tons of sediment into the Missouri River. Following dam construction (data available for 1964-1973), however, annual sediment loads of the Kansas River averaged just **10-12 million metric tons** (USACE, 1970, 1972, 1976)."

National Research Council. Missouri River Planning: Recognizing and Incorporating Sediment Management. Washington, DC: The National Academies Press, 2011. Emphasis added.

Reservoir Sedimentation Workshop

FEDERAL

- USACE (KC):
  - River Engineering
  - Hydrologic Engineering Branch Chief
  - Planning
  - Water Control
  - Regulatory
  - Tuttle Creek Lake Manager
  - Perry Lake Manager
  - Water Quality
- Other USACE: ERDC, HEC, Omaha, Tulsa
- USGS

STATE

- Kansas Biological Survey
- Kansas Water Office
- University of Kansas
- Delaware River Watershed
- Kansas Department of Health and Environment
- Kansas Department of Agriculture-DWR
- Kansas Department of Wildlife, Parks, and Tourism

PRIVATE

- Rollin Hotchkiss
- George Annandale
- HNTB
- The Watershed Institute

Outcomes

- Compilation of brainstorming ideas, presentations, and meeting notes
- Selection of immediate “next steps” for targeting Section 204 funds
  - Operational change model to decrease trapping efficiency
  - Moveable inlet extension pipe for hydrosuction/ pressure flushing
  - Additional meetings/communication with stakeholders, including EPA

Tuttle Creek

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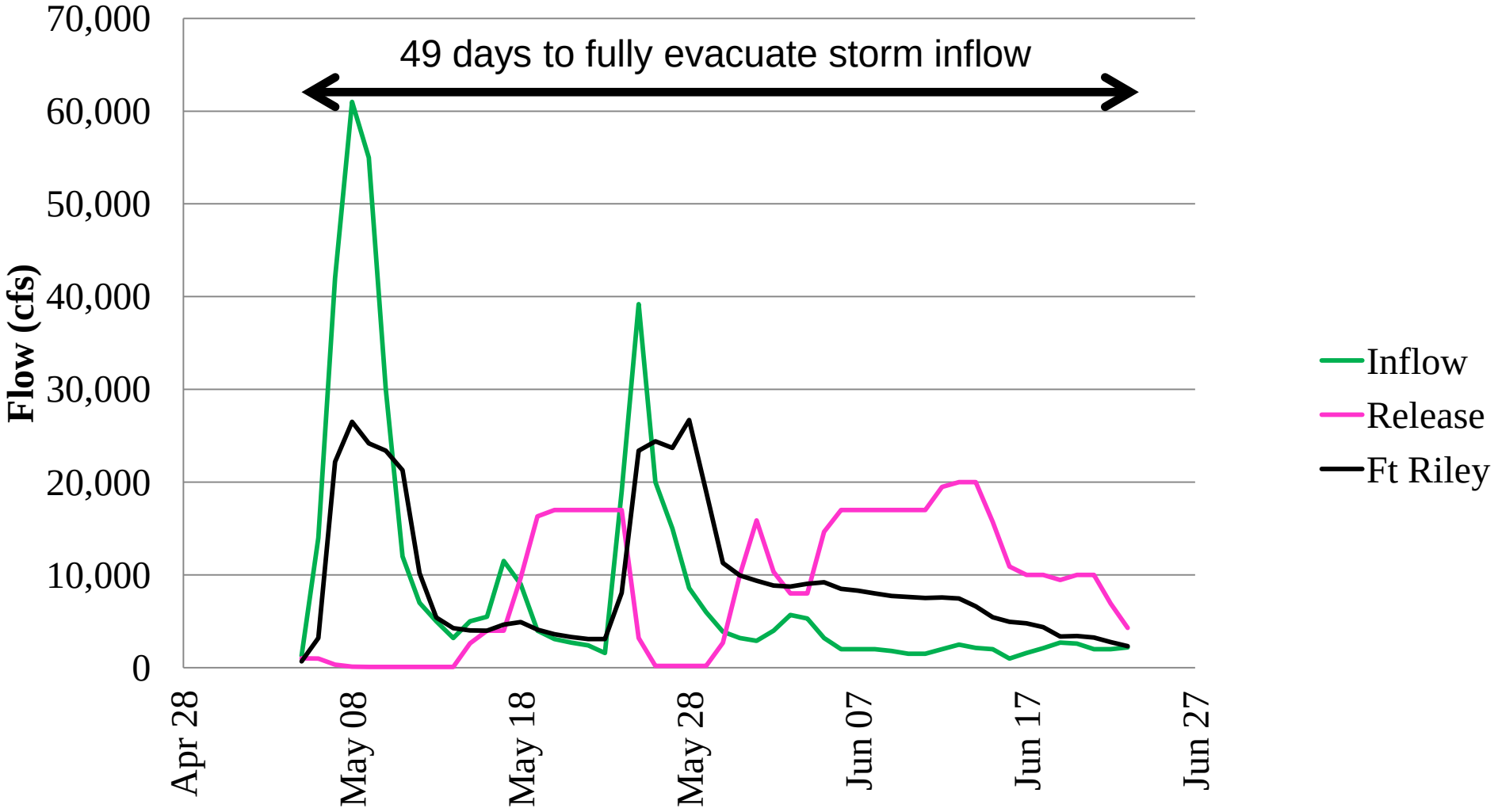
Tuttle Creek

Operational Changes within Existing Flexibilities

Low-hanging fruit: A course of action that can be undertaken quickly and easily as part of a wider range of changes or solutions to a problem (dictionary.com)

Operational Changes



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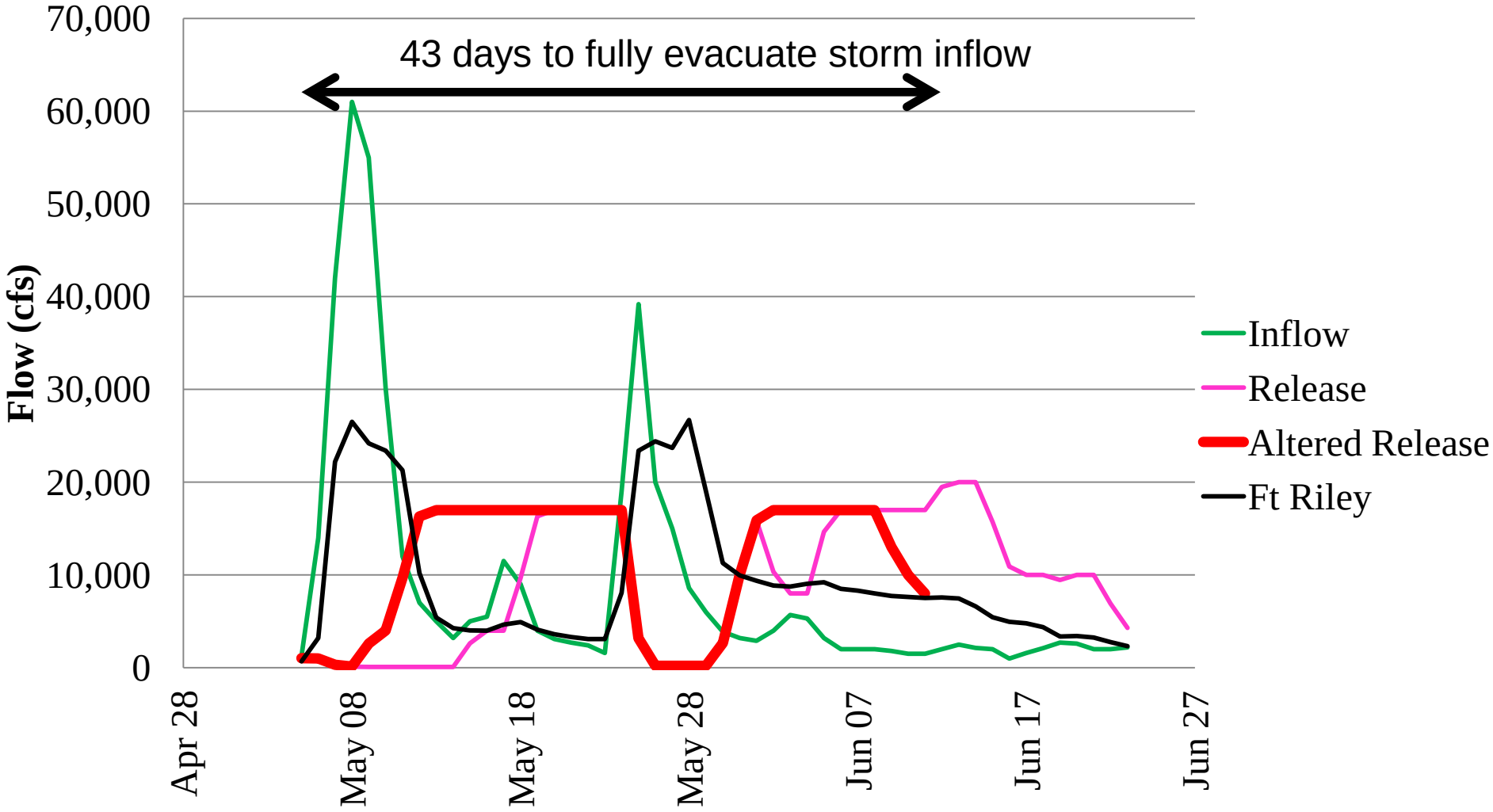
Operational Changes



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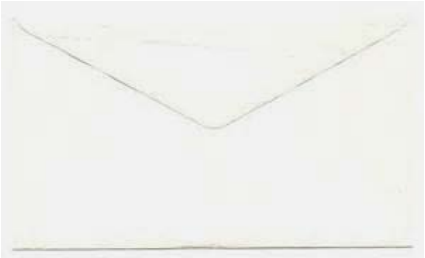
Back of the Envelope



Trap Eff = Tevacuate/Tsettle

(Trap Eff)new = (43 days/49 days) * Trap Eff

(Trap Eff)new = (0.88)*0.98 = 0.86

This is the trapping efficiency if the reservoir were empty. Assuming the water in the reservoir has a trapping efficiency of 100%, and doing a weighted average…

TEnew*StormVolume+ TEstored*StoredVolume / (StormVolume + StoredVolume)

= 0.89

This benefit only applies to trapping of sediment during storm inflows, which bring in 94% of the sediment (USGS 2011)

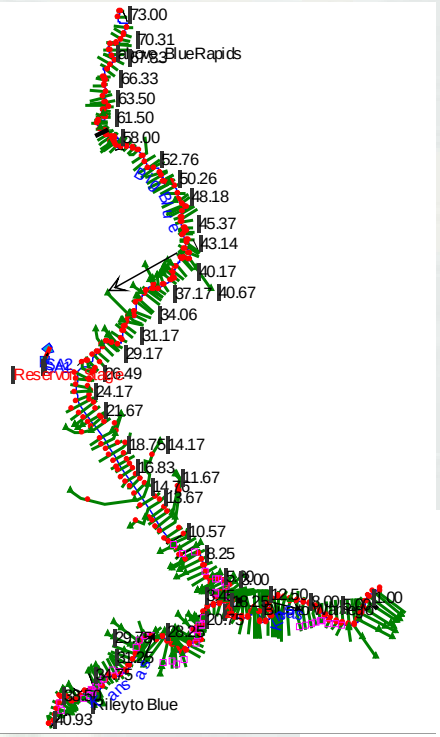
New total Trap Eff = 0.98*0.06 + 0.89*0.94 = 0.90

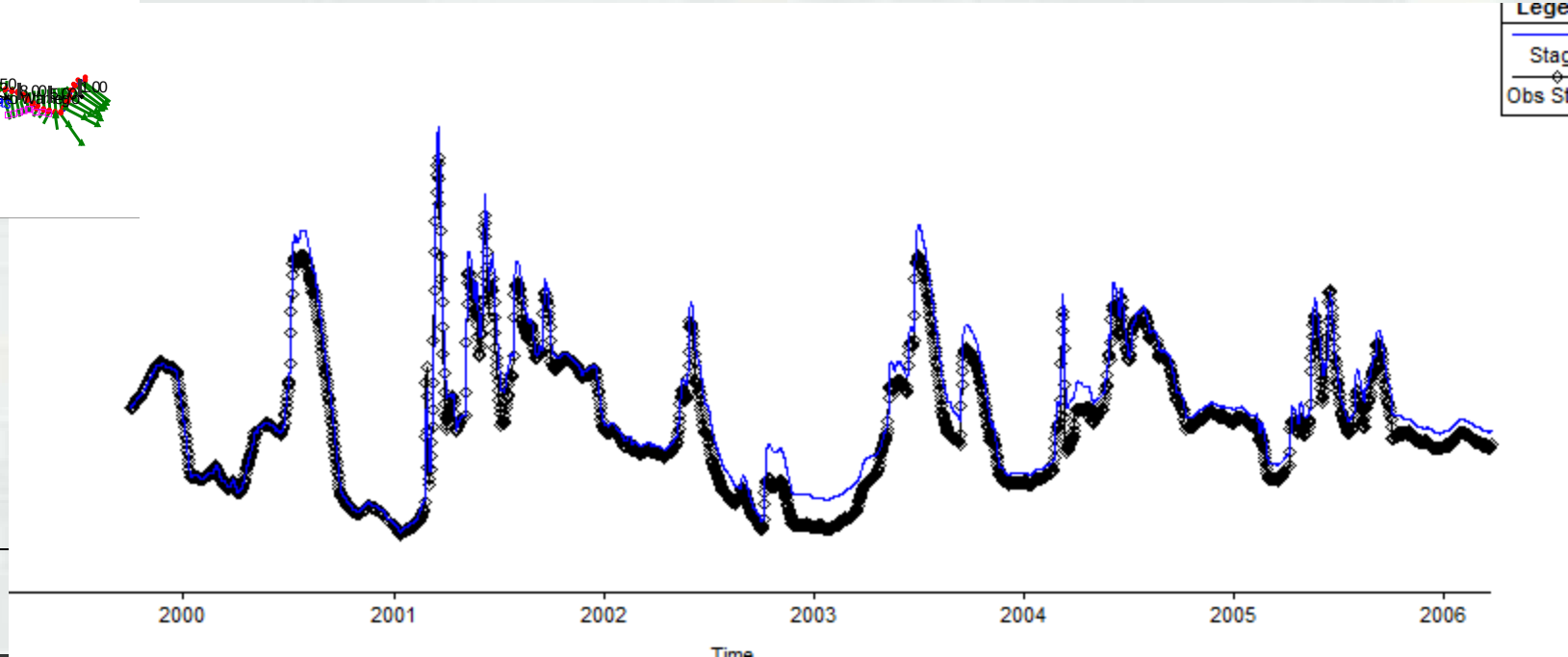
Decrease in sediment accumulation = (1- 0.90/0.98) * 100% = 8%

About **461,000 cu yd/year less accumulation** in the Multipurpose Pool

The assumptions that went into this are numerous and probably represents a maximum efficacy of the “release earlier” approach. A more aggressive strategy for John Redmond reservoir was estimated to decrease accumulation by 8.2% , so 8% is probably too high for Tuttle.

HEC-RAS 5.0 Unsteady Sediment Model





Outcomes

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Tuttle Creek

Inlet Extension Pipe

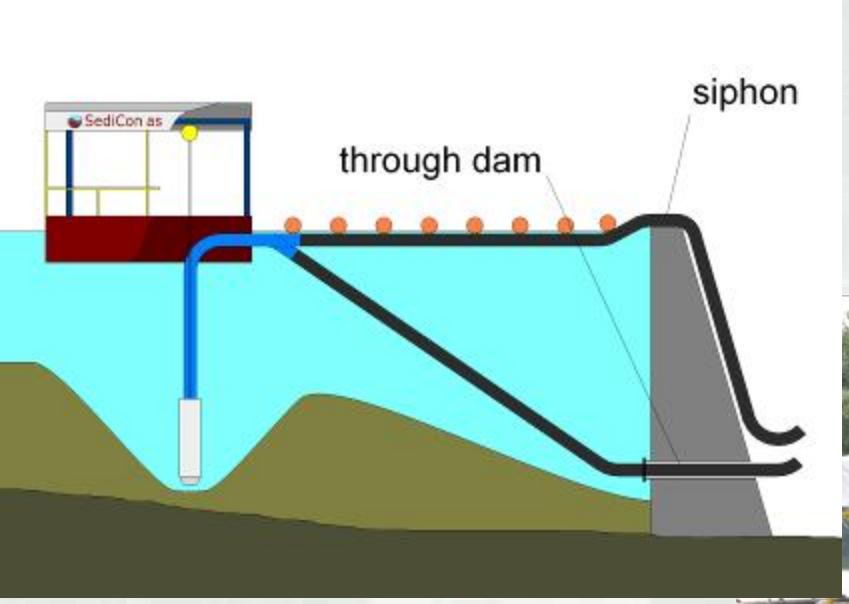
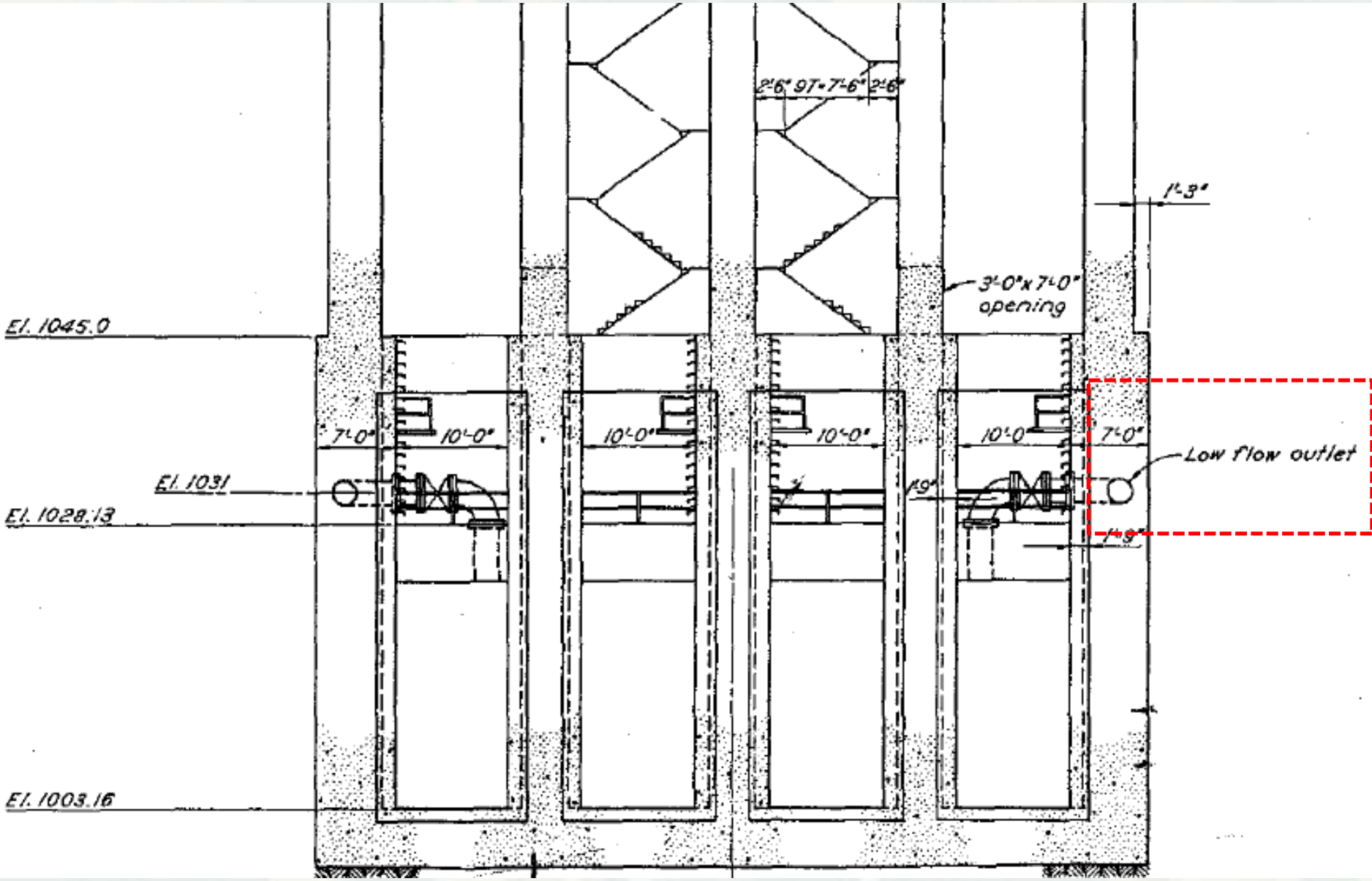


Image source: SediCon.no


2'-6" 9T-7'-6" 2'-6"
1'-3"
3'-0"x 7'-0"
opening
El. 1045.0
7'-0"
10'-0"
10'-0"
10'-0"
10'-0"
7'-0"
Low flow outlet
El. 1031
1'-9"
El. 1028.13
1'-9"
El. 1003.16

Outcomes

- Compilation of brainstorming ideas, presentations, and meeting notes
- Selection of immediate “next steps” for targeting Section 204 funds
  - Operational change model to decrease trapping efficiency
  - Dredging with downstream recharge of sediment
  - Additional meetings/communication with stakeholders, including EPA

Tuttle Creek

ERDC Dredging Analysis

Alternative	Equipment	Suction Length (ft)	Discharge Length (ft)	Removal Rate (yd^3/hr)	Days to Sed Balance
Pipe Over Dam	(1) 600 RPM Pump	6500	1000	1632	351
Pipe Through Dam	(1) 600 RPM Pump	6500	0	2448	234
Pipe Over Spillway	(2) 600 RPM Pumps	10100	10000	2040	281

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Tuttle Creek Technical Questions

1. Economic assessment
2. Environmental analysis
3. Sediment properties
4. Operational changes (HEC-RAS model)
5. Array of alternatives, including hydrosuction / dredging with downstream recharge, upstream bank stabilization, sediment flushing, including an option that creates wetlands
6. Cost estimating for the alternatives

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Summary

- Sediment accumulation a big deal in Kansas
- RSM (FY13) and Section 204 Funds
- Workshop with significant State and Federal involvement
- Promising solutions
  - Operational changes
  - Dredging with downstream disposal

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Questions?