Lock & Dam No. 7
Upper Approach Outdraft

Mississippi Managers Meeting
February 2021

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St. Paul District

Overview

BUILDING STRONG

- Lock & Dam 7 Upper Approach Hydraulics
  - Dynamic Bathymetry
  - Flow Shifts
- 2018 Fall – Structure Construction
- 2019 Condition Recap
  - Abnormally high, extended flows
- 2020 Recap
  - Weir extension
- Discussion
  - Path forward/feedback

Dynamic Bathymetry

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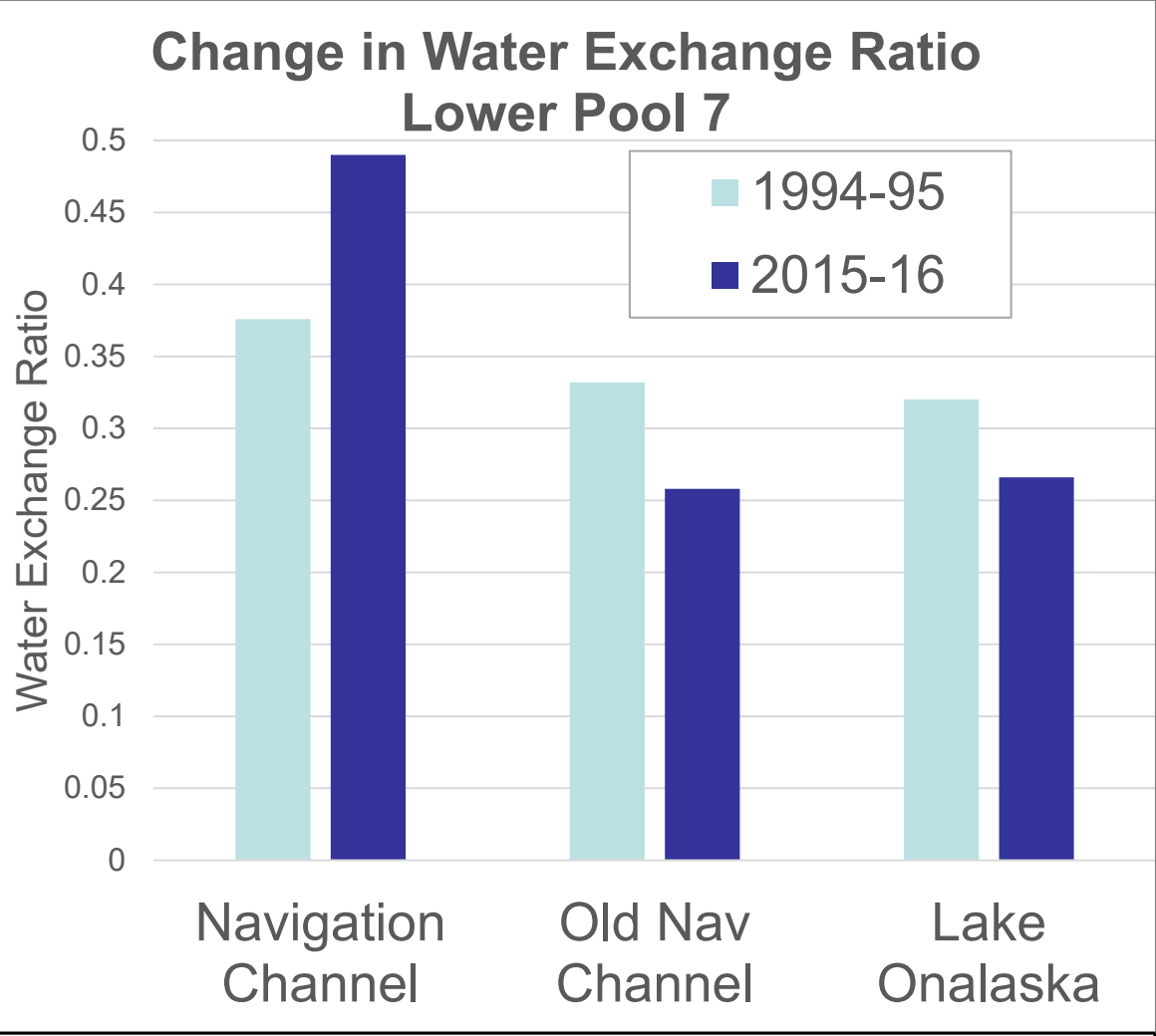
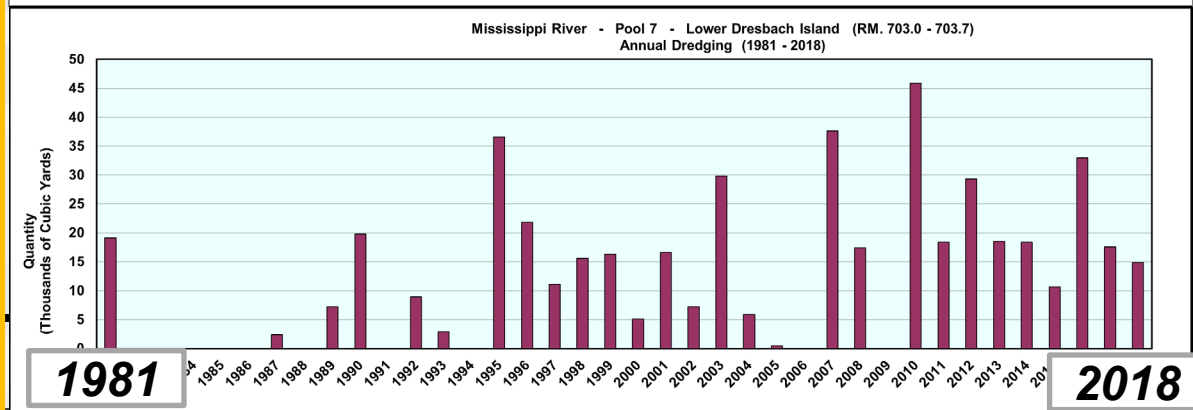
Significant
Flow Changes
Dresbach
Slough
Old
Navigation
Channel
More Flow
No Change
Less Flow
LD7


Change in Water Exchange Ratio
Lower Pool 7
Water Exchange Ratio
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1994-95
2015-16
Navigation Channel
Old Nav Channel
Lake Onalaska


Mississippi River - Pool 7 - Lower Dresbach Island (RM. 703.0 - 703.7)
Annual Dredging (1981 - 2018)
Quantity
(Thousands of Cubic Yards)
50
45
40
35
30
25
20
15
10
5
1981
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2018

Hydraulic Model

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- **2D** Model Developed
- ~4 River Miles
- Assess existing conditions/Validate
- Test Alternatives
- ***Goal**: Reduce Velocities around Upper Approach*

Alternatives

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- Unique channel
  - Shallow + Narrow : limits options
- Hydraulic model used to evaluate various alternatives
  - ▶ Simple Non-Structural alternatives
    - Dredging/clearing
  - ▶ Complex Structural
    - Dredging/clearing with structures
- Only one alternative showed potential

Constructed Alternative

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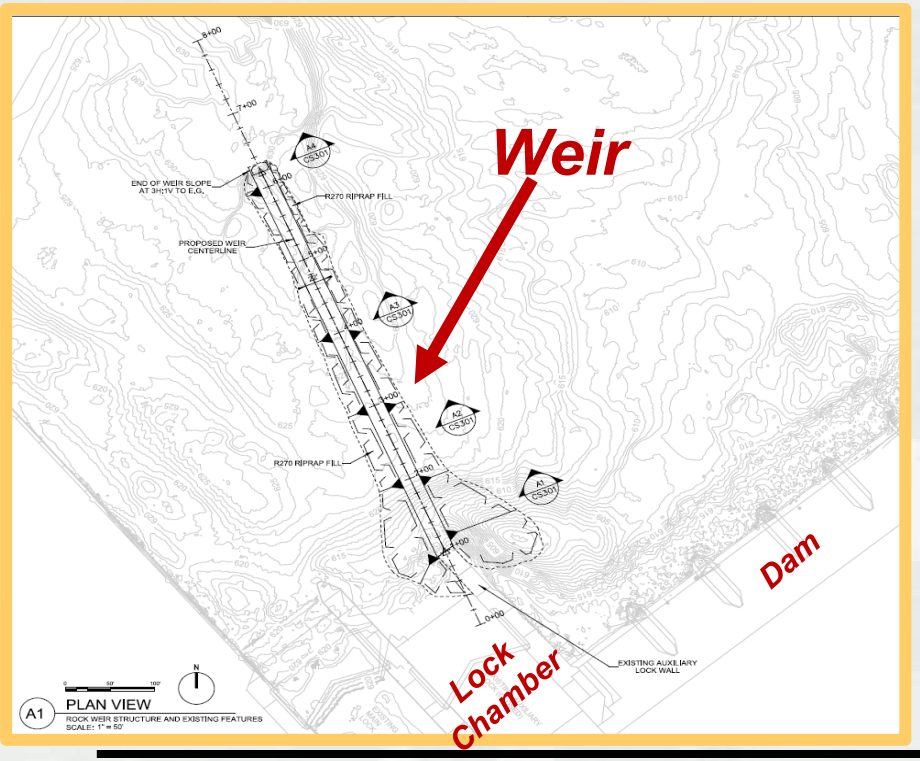
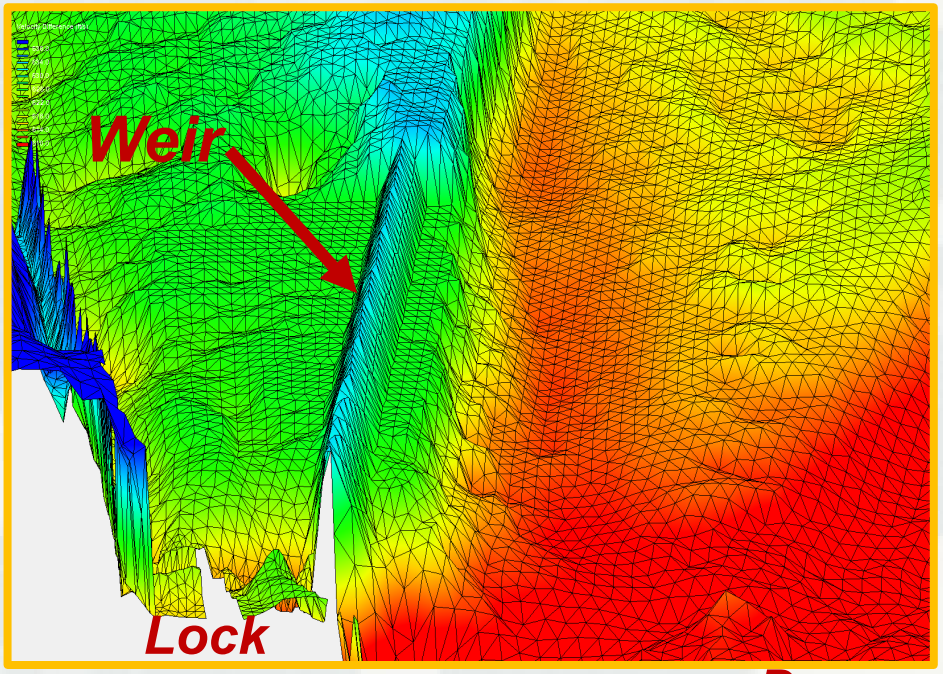
- Rock Weir at **7ft below LCP** (El. 631.45 ft NAVD88)
  - Lowers velocities by 20-50% (near Upper Approach)
    - ▷ “Nudge” in the right direction





Constructed Alternative

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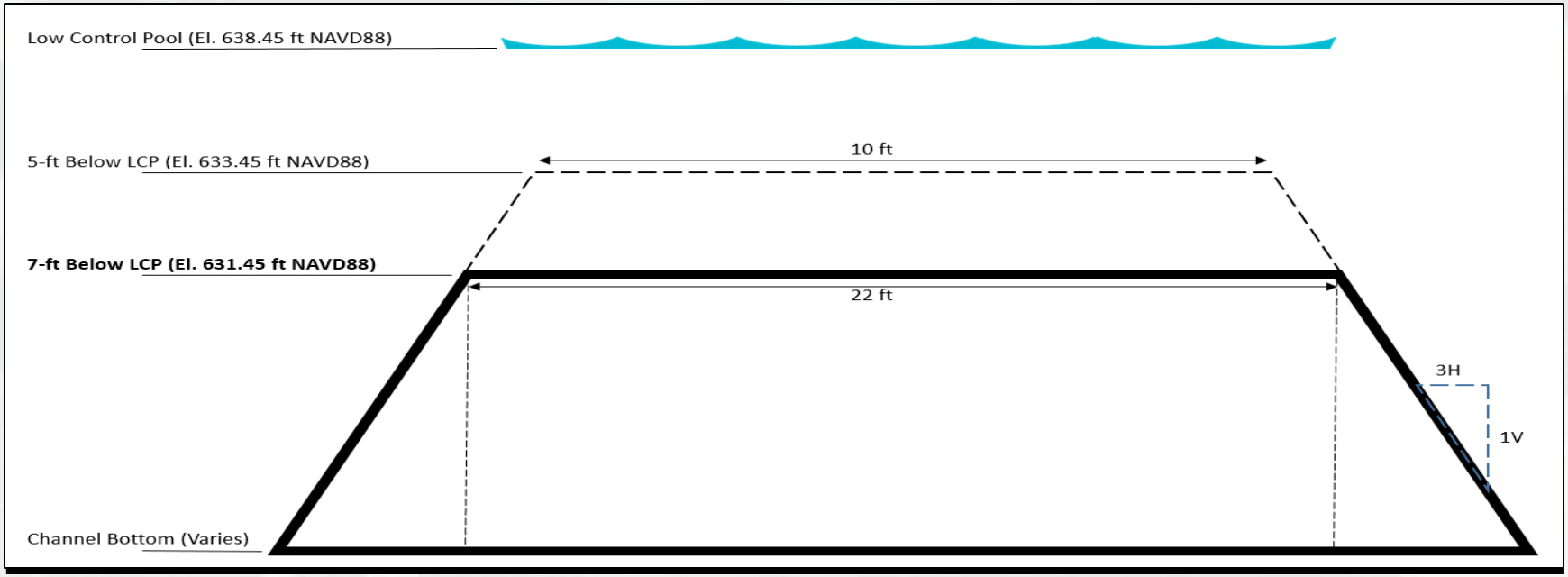
- Adaptive Plan
  - ▶ Constructed to 7ft below LCP with wider top width
    - Monitor sedimentation & navigation feedback



2019 Flows = Dynamic Year

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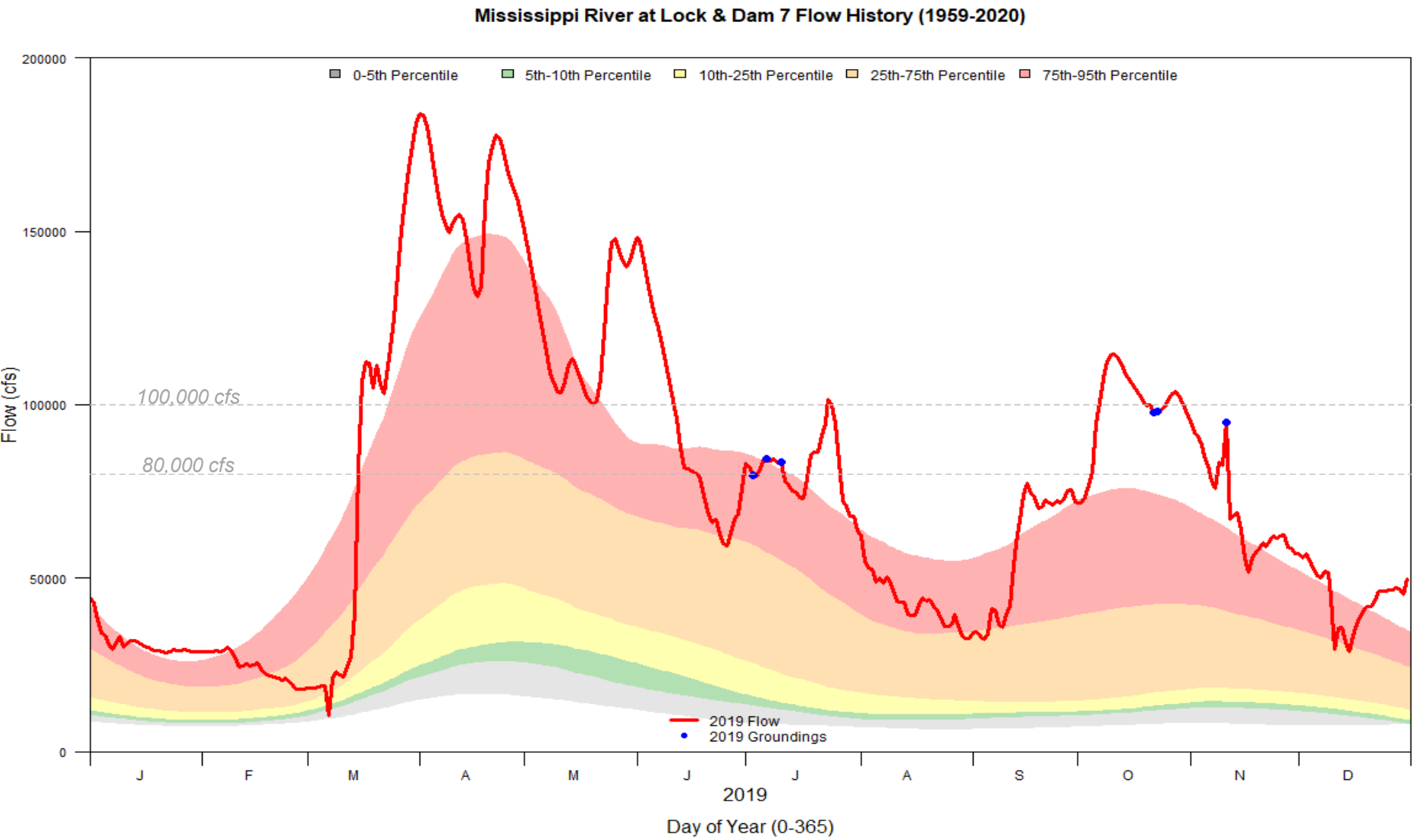
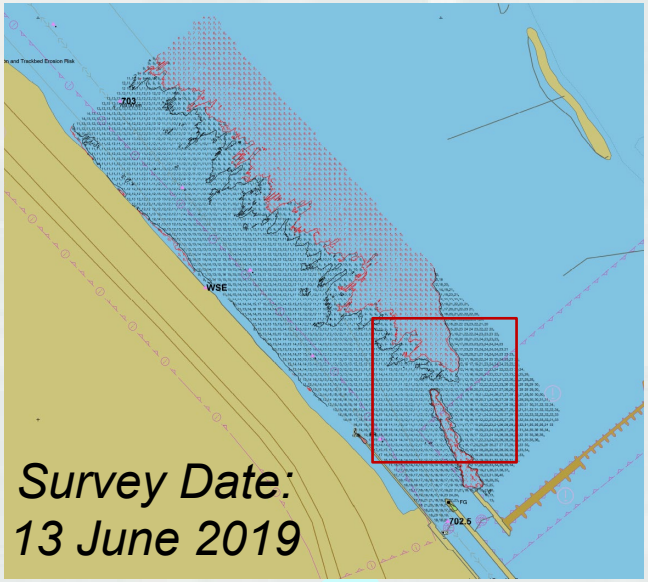
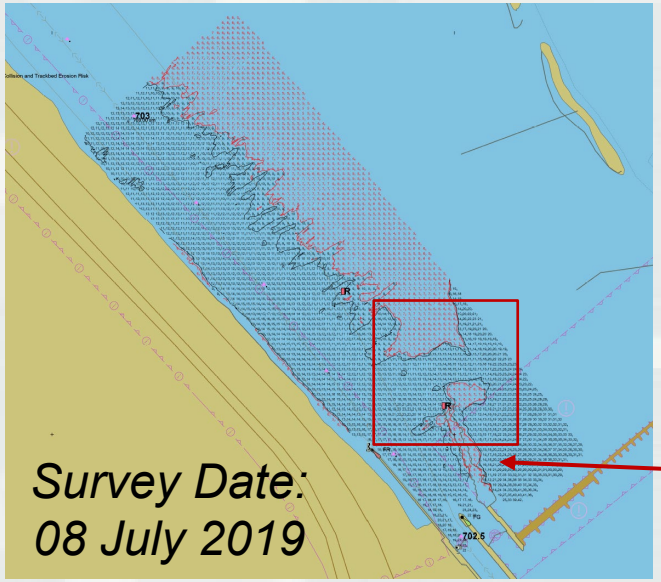


Bathymetric Changes

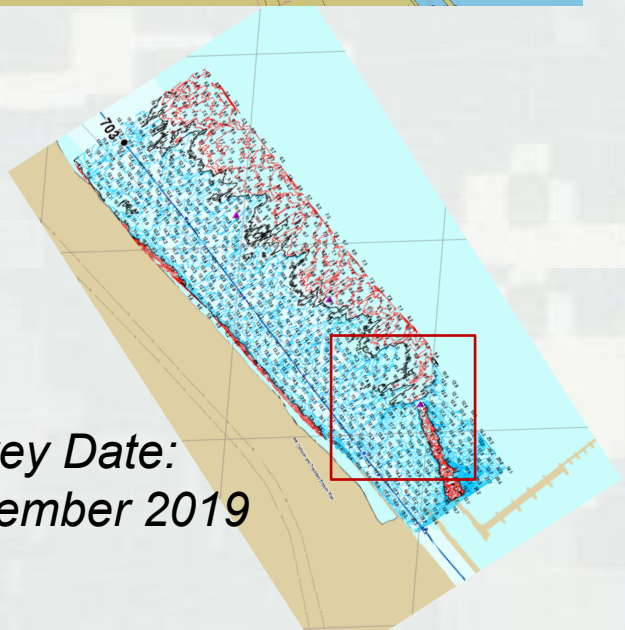


Survey Date:
13 June 2019

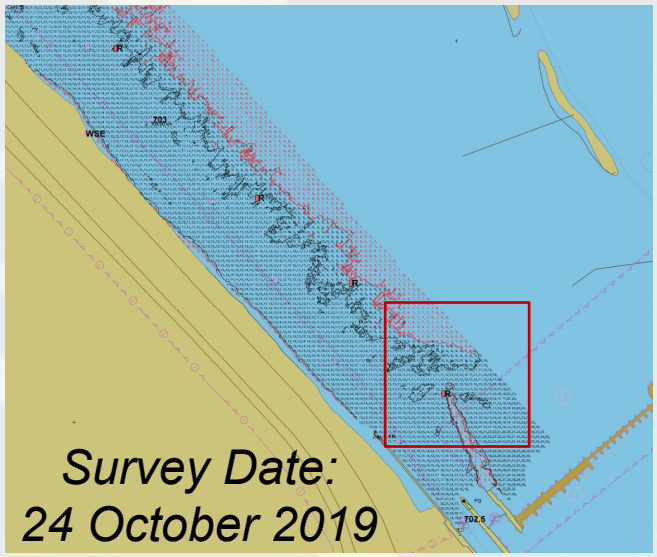


Survey Date:
08 July 2019

Weir



Survey Date:
24 September 2019



Survey Date:
24 October 2019

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February 2020
Mississippi Manager's Meeting

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- 2019 was *not* a "normal" year
- Outdraft still present, but weir was helping
- Possible updates...
  - Raising structure
  - Dredging upstream of structure
  - Extending structure
- **Decision**: Wait & see how 2020 Nav. Season goes...

2020 Flows

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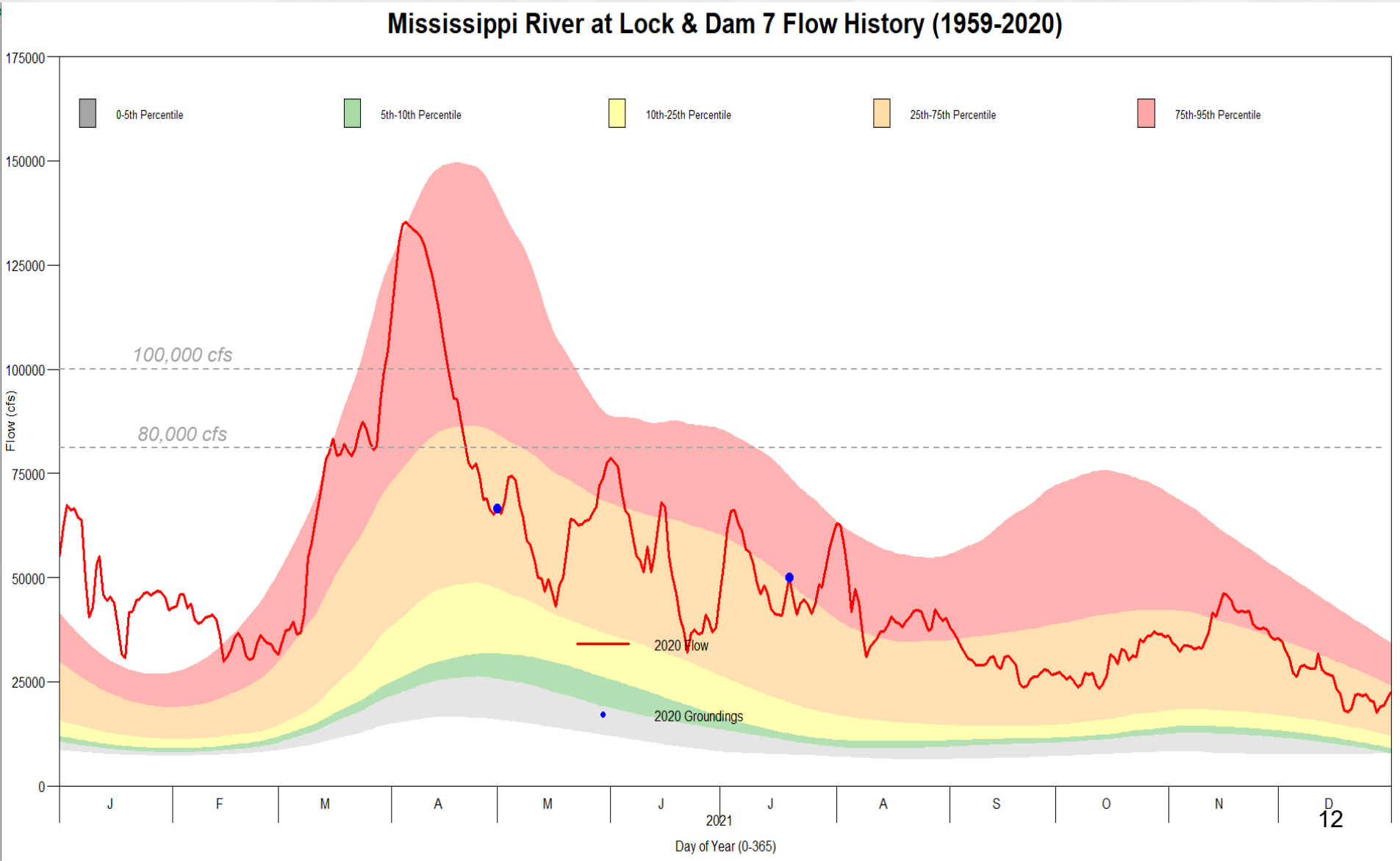

Summer 2020 Update

- Ops reached out to Navigation Industry again...
  - Interested in adapting the structure
- Options:
  - *Raising structure*
    - Additional grounding/bumping concerns
  - *Dredging u/s of structure*
    - 2D modeling → ineffective
  - ***Extending structure*** *(selected option)*
    - Operators feel flow shift at end of structure
      - Theory: Extending structure pushes flow shift further u/s
    - 2D Model indicates some velocity reduction

Fall 2020 – Weir Extended

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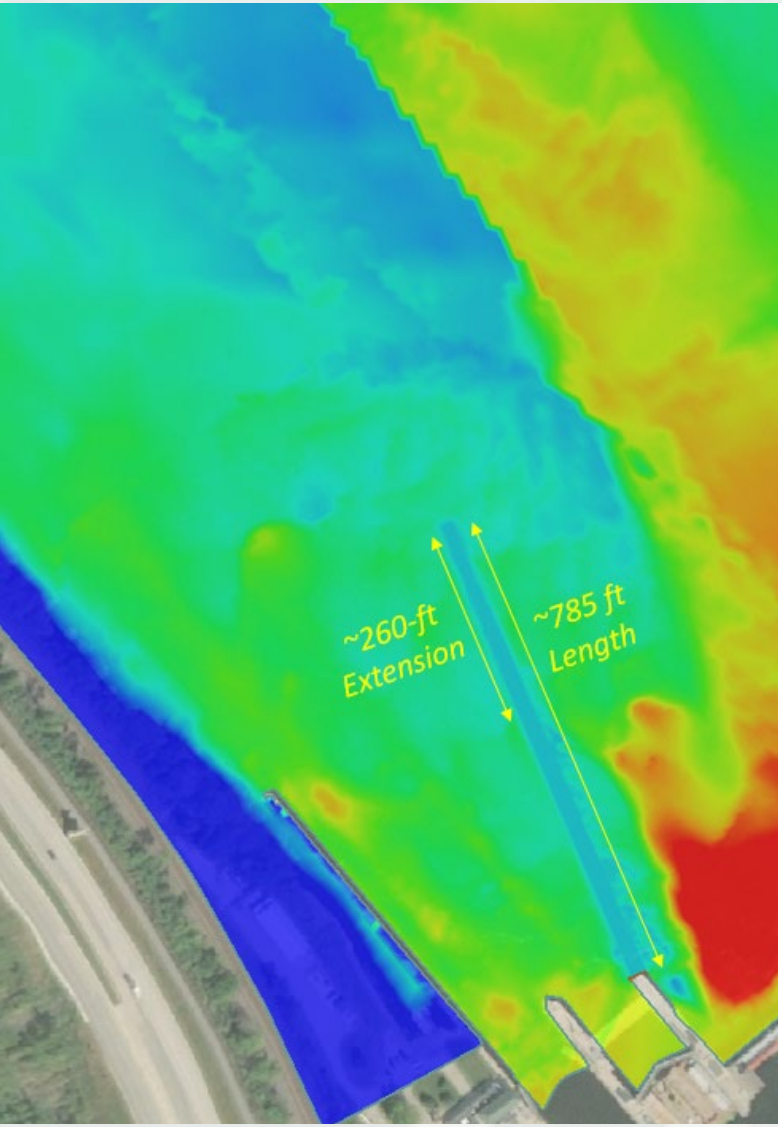

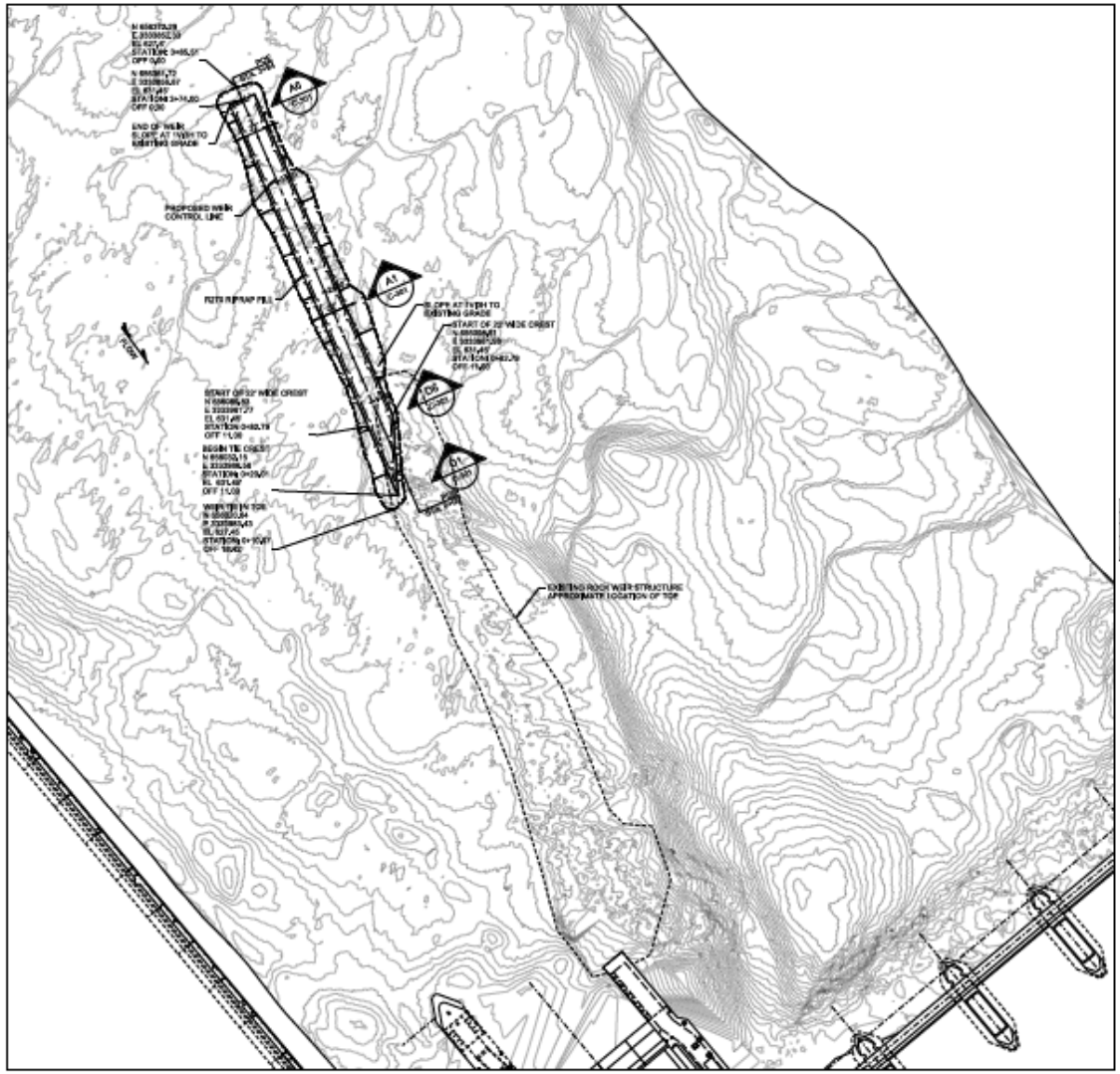

Recap

- Outdraft Issue studied and river conditions modeled
- Evaluated Non-Structural & Structural alternatives
- Constructed Rock Weir Fall 2018
- 2019 Nav Season: High Flows, Difficult Conditions
- 2020 Nav Season: ~“Normal” Conditions, Outdraft still present
- Extended Rock Weir Fall 2020

Path Forward?

- **Feedback**
- Future Adaption Options:
  - Raise weir to 5-ft depth *(currently @ 7-ft depth)*
    - Further reduction in velocities (5-10%)
  - Investigate new structural solutions
    - Time +++
    - Cost +++
  - Others?