NIOBRARA RIVER BEDLOAD COLLECTOR PROJECT AND RELATED WORK

Paul Boyd, Ph.D. P.E.
Hydraulic Engineer
Omaha District
US Army Corps of Engineers

02 MAY 2024

U.S. ARMY

US Army Corps of Engineers®

PLANNING ASSISTANT TO STATES (SECTION 22) PROJECT BACKGROUND

The study is being conducted in three phases with a 50:50 federal and sponsor cost share for first two phases.

Phase 1: Scoping Effort
- Collaborate to develop the study objectives, constraints, and study scope for Phases 2 and 3
- Output: Project Management Plan with Phase 2 Tasks, Schedule, and Budget, and Phase 3 Framework.
- Budget: Federal Contribution $12,000; Sponsor (MSAC & Partners) Contribution $7,000 cash and Work-in-kind (WIK) $3,680

Phase 2:
- Focus on leveraging existing sediment management studies coupled with the application of economic models to consider the costs and benefits associated with sediment management.
- Developed trend analysis for future impacts
- Hosted Solutions Workshop in June 2021
- Budget: Fed. $107,834; Sponsor $84,434 cash and WIK $24,720
- Completed October 2023

Phase 3:
- Expand the technical analysis to consider emerging technologies
- Integrate the economic and environmental benefits and impacts
- Develop a Sediment Management Plan for Lewis and Clark Lake
- Budget to be developed with scope

LEWIS & CLARK LAKE SEDIMENT MANAGEMENT PLAN STUDY SECTION 22

Reservoir Sediment Management Alternatives (workshop and more)

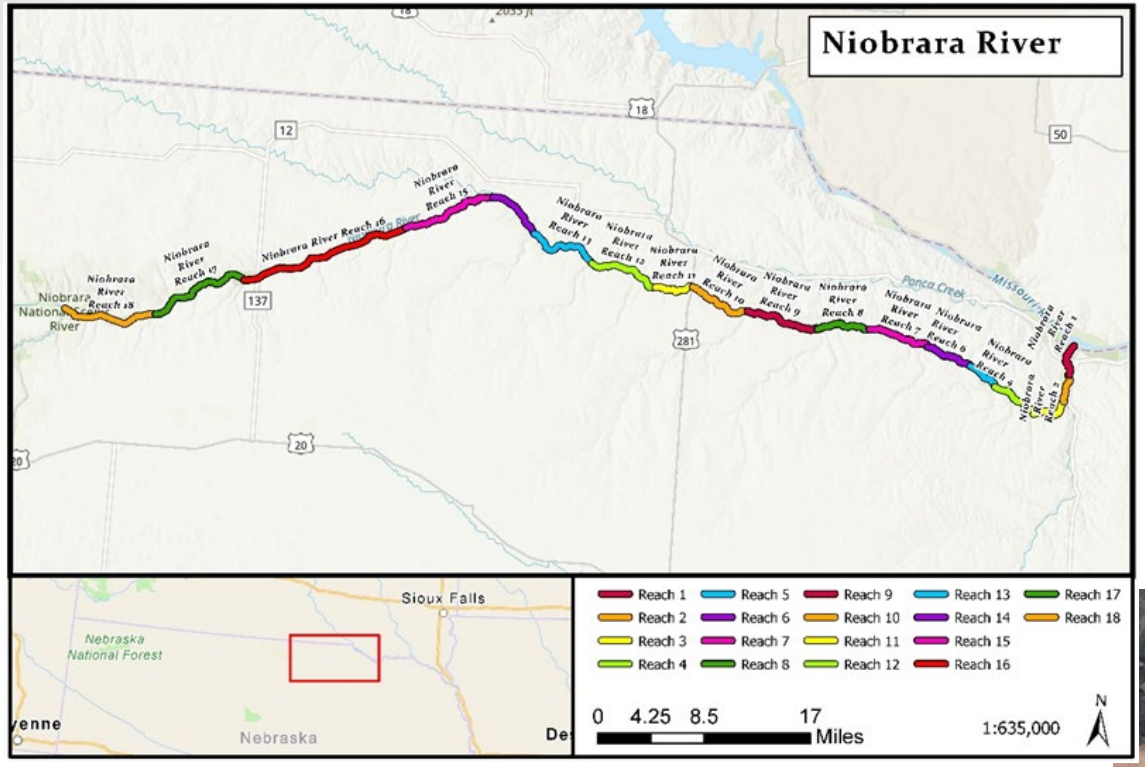
U.S. ARMY

US Army Corps of Engineers®

JUNE 2021 RESERVOIR MANAGEMENT WORKSHOP

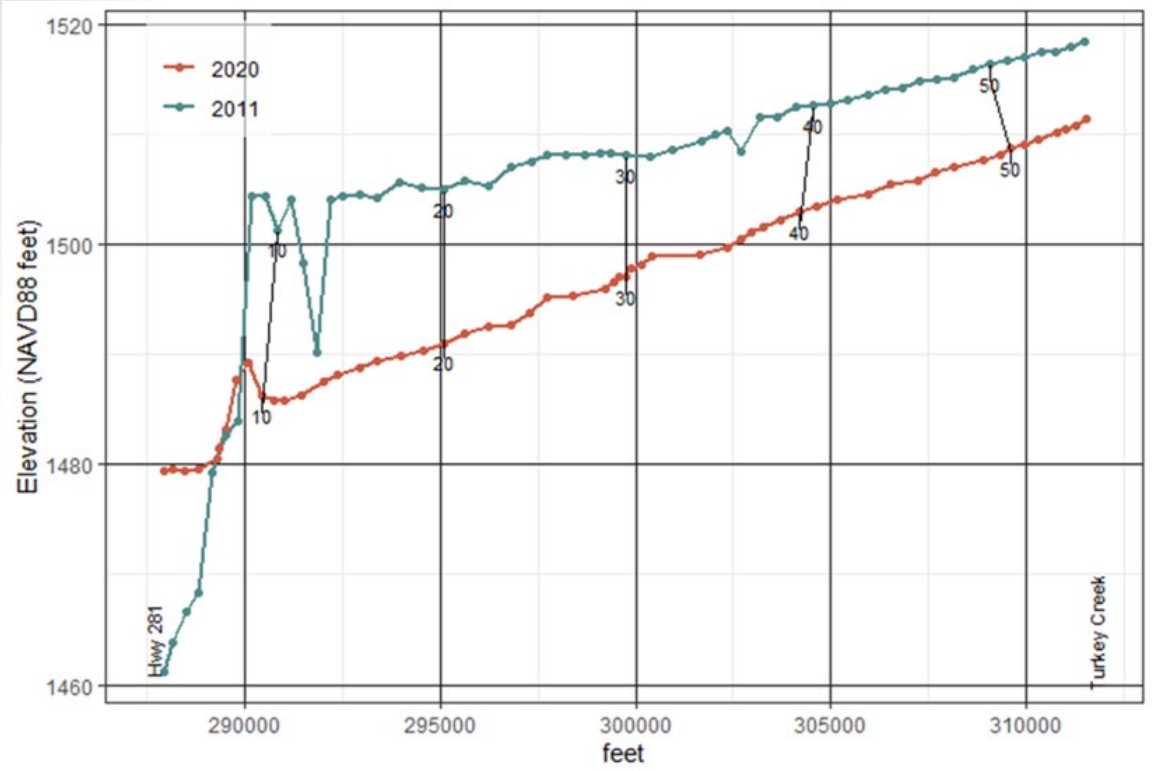
- Dr. Greg Morris
- Dr. John Shelley
- Ms. Meg Jonas
- Mr. Tim Welp
- Provided input on possible reservoir management actions

WORKSHOP OUTCOME - NIOBRARA RIVER WATERSHED TREATMENT

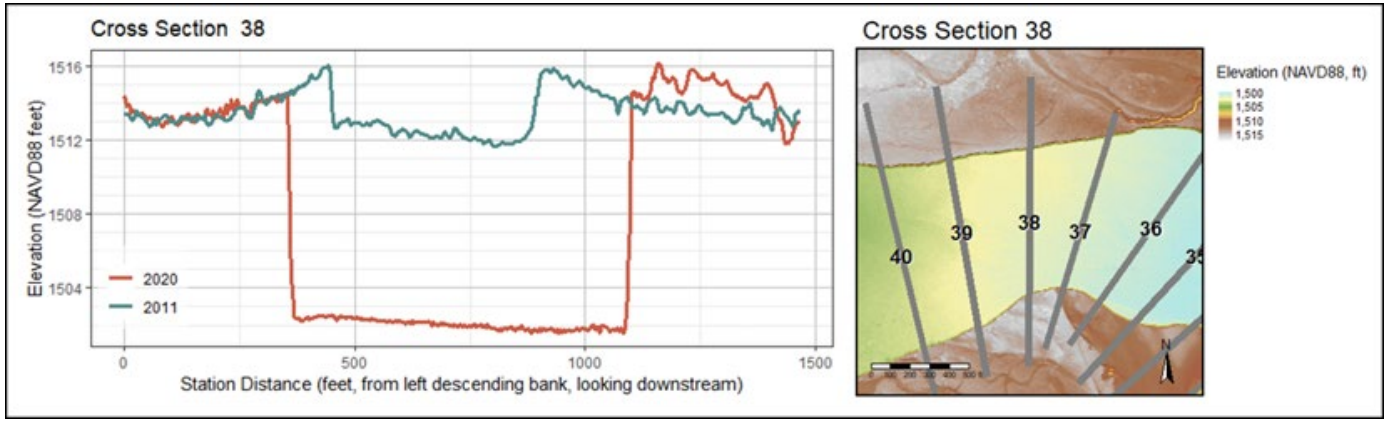


- Initial assessment done as part of a Water Operations Technical Support (WOTS) request
- Many reaches of the Niobrara are actively supplying large amounts of sediment
- Expanded assessment needed to determine what level of sediment reduction could be achieved

CONTRIBUTION FROM SPENCER DAM FAILURE

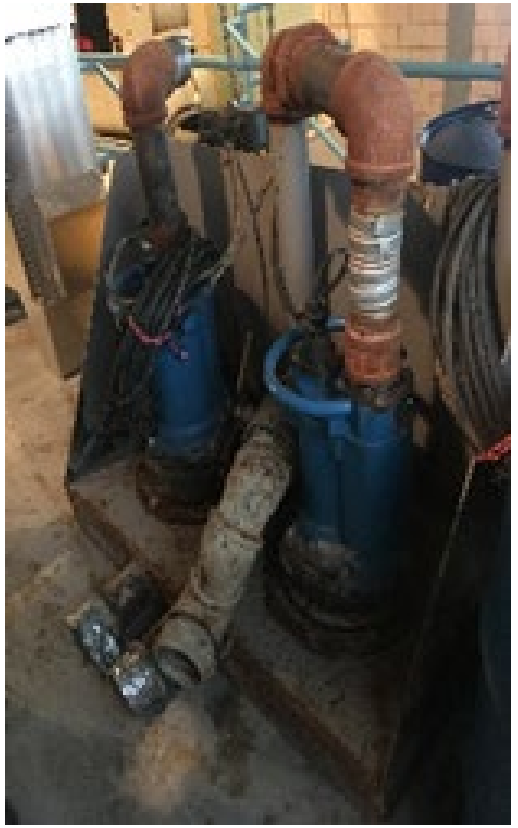


- Initial assessment done as part of a Water Operations Technical Support (WOTS) request
- Volume of sediment above the annual load has not been quantified



NIOBRARA RIVER SEDIMENT COLLECTION

- The Niobrara River produces over 50% of the supply to the Missouri River and Delta
- A significant reduction in delivery from the Niobrara could have a positive impact on reservoir life



ECONOMIC OPPORTUNITIES FOR SEDIMENT

Road Sand

Construction Aggregate

Recreation

Mining/Hydraulic Fracturing

Ash Grove Cement – exploring Circular Economy Concepts with Sediment

- Working with Omaha cement plant, considering sourcing of sediment from Minnesota
- Investigate if L&C sediment would be suitable
- Possible transport pilot project

NIOBRARA RIVER BEDLOAD COLLECTOR PILOT PROJECT

Project Plan and Schedule

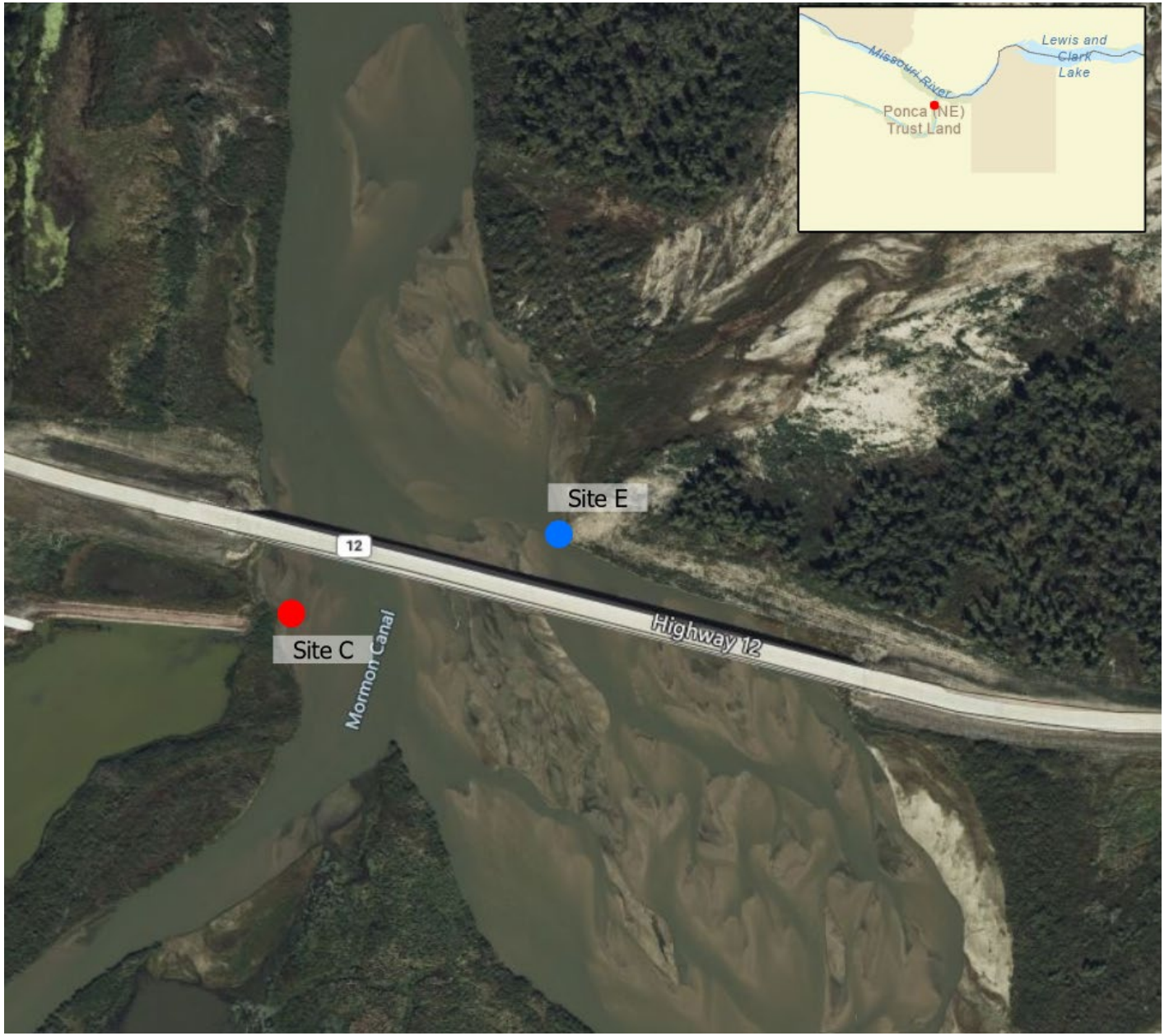
U.S. ARMY

US Army Corps of Engineers®

NIOBRARA RIVER BEDLOAD COLLECTOR PILOT PROJECT

- Requested funding through the USACE Regional Sediment Management Program, proposal built upon MSAC EPA grant proposal
- Study approved in October 2023, fully funded after budget passed in early April 2024
- Pilot Study Plan:
  1. Identify suitable bedload collection location
  2. Complete environmental and real estate approvals
  3. Avoid Pallid Sturgeon spawning season and Piping Plover nesting season
  4. Determine local in-kind resources
  5. Schedule dates for one-week collection
  6. Collect Niobrara sediment and measure collection rate, fill Geotubes for display
  7. Instrument and monitor with USGS collaboration to show impacts at collection site
  8. Host field day at end of pilot to showcase method (and give away some sand)
  9. Report showing benefits of method and applicability

POSSIBLE COLLECTION LOCATIONS



COLLECTION IN EAU CLAIRE, WI
MARCH 2024


Galaxy S23


VOLVO
Galaxy S23

SCHEDULE AND MILESTONES

Tentative dates:

Aug 12-16
Sep 9-13

Schedule:

Mon – equipment delivery and setup
Tues – setup and testing, monitoring installation
Wed – Fri – testing and collection
Fri – field day session
Sat – removal and equipment pickup

Milestones:

May 15	Approval of USGS monitoring funding
May 31	Determine local resources (contract others)
July 30	Environmental and Real Estate approvals
July 1	Set date and start outreach

MSAC FACT SHEET

February 2024

Bottom Line Up Front (BLUF):

Omaha District has been partnering with the Missouri Sedimentation Action Coalition (MSAC) on a multi-phase study to develop a Sediment Management Plan for Lewis and Clark Lake behind Gavins Point Dam. As a result of an SME led workshop in June 2021, bedload collection on tributaries was one of four management methods identified for further examination. In collaboration with the ERDC Environmental Lab, this project will place a 12-ft length bedload collector in the Niobrara River for at least one week to collect and analyze the efficiency of collection in the high-bedload conditions prevalent on the Niobrara River. Our MSAC partners will arrange a field day for stakeholders and elected officials, and results will be used to develop scaled estimates of the effectiveness of the method and its applicability in similar conditions across the USACE reservoir portfolio.

Figure 3. Components of the Sediment Collector™ at the Fountain Creek, CO Install (Tucker et al., 2015)

Missouri Sedimentation Action Coalition

Scott Kostal,
executive director
PH: 605-464-1067
msacdirector@keepitwater.org

Sandy Stockholm,
communications coordinator
PH: 605-661-1594
msacinfo@keepitwater.org

www.keepitwater.org

Figure 4. ERDC-EL 12-foot Sediment Collector™ system for Pilot Project

Pilot Installation on Niobrara River

The Niobrara River has historically contributed just over 50% of the total sediment load to the Missouri River reach that makes up the Lewis and Clark Lake delta (USACE, 2013). The delivery of this sediment is chronic due to nearly unlimited sediment supply and base flow driven by springs through the basin. This makes sediment delivery from the Niobrara a 'chronic' condition, i.e. slow and continuous delivery which increases intermittently during flood events. This condition makes it an excellent candidate for this type of passive collection system that can operate continuously.

In the application case for a pilot on the Niobrara River, where much of the bedload material is in the 0.2-0.4mm range (USACE, 2013), similar to Material 1 tested by Lipscomb, bedload capture efficiency varies between 54 and 74% with velocity and depth of flow. In concept, the collection of bed material from the Niobrara could be scaled to capture the full width of the river channel. If 50% of the bedload could be captured, which can be up to 20% of the total load in the Niobrara that is annually delivering 50% of the estimated 2,600 ac-ft (as of 2011) to Lewis and Clark Lake, an effective 5-15% reduction in delta forming sediment could be extracted. Any reduction in sediment delivered to Lewis and Clark Lake can be expected to slow the progression of the delta face and increase the lifespan of the lake. Whether the percentage rate of sediment delivery reduction equals the same percentage increase in the lifespan of the reservoir is currently unknown.

The USACE Engineering Development and Research Center (ERDC) has been examining and texting bedload collectors for the past twenty years (Mr. Tim Welp – ERDC Coastal and Hydraulics Lab as author on Tucker et. al., 2007). Most of the previous work done by ERDC was with small collectors (2- to 4-ft width), or in conjunction with existing installs up to 30-ft width.

ERDC Environmental Lab (ERDC-EL), under PI Chuck Theiling, has a 12-ft long collector with the necessary connections, pumps, and separators, that could be used for a one-to-two-week sediment collection pilot project. Figure 4 shows the collector and separators of this system. An install of this system would require portable power, approximately one acre of river side access, and a roadway access capable of supporting at least 26T rated equipment haulers.

The production rate of the system is difficult to predict, but the ERDC-EL team expects that up to 1-2 tons/hour could be collected and separated in this pilot with Niobrara River sand. This system requires manual removal of the sediment from the separator tanks. This configuration is therefore separator limited, not collection rate limited. Increases in total sediment removed could be achieved with faster separation methods. A monitoring program during the pilot will provide more specific production and sediment capture rates, which will be necessary to estimate the footprint and cost of larger scale implementation.

While additional collection may not be necessary for the measurement and determination of collection rates, Geotubes™ could be used to collect a larger volume of sediment to increase the visual impact during the field day. This additional collection would also need to be removed or returned to the river as part of site cleanup.

At the scale of the proposed pilot project, the benefit to Lewis and Clark Lake would be negligible, but the value in terms of proof of concept, scaling considerations, applicability to other USACE reservoir projects, and the public outreach and engagement is very high. Local partners including MSAC, Knox County, Village of Niobrara, Nebraska DOT, NE DNR, Isaac Walton League, are excited to partner with USACE on the pilot and are expected to bring some of their agency resources to the project.

Sediment Moved through RSM:

For the first time in the history of RSM, an Omaha District proposal IS identifying that there will be sediment moved through this RSM project. The total to be moved will depend on trap efficiency of the collector and separator, the ability to move and store sediment, and the duration of the pilot. For a weeklong pilot run, 8 hours per day, the total could approach 100 tons (78 CY, or 5-10 truckloads). The sediment will be beneficially used for road maintenance activities in the local area or for other beneficial uses.

Possible Bedload Collector Access Points on Niobrara River

LEWIS & CLARK LAKE SEDIMENT MANAGEMENT PLAN STUDY SECTION 22

Phase 3 Scoping
Other Studies
Research and Pilot Opportunities
Future Funding Streams

U.S. ARMY

US Army Corps of Engineers®

LEWIS AND CLARK SEDIMENT MANAGEMENT PLAN PHASE 3 SCOPING

Considered for Inclusion:

- Engineering analysis of technologies – dredging methods, flushing, bed collector, watershed improvement
- Pilot of bedload collector – DONE!
- Environmental benefits
- Advanced Economic Analysis - Comprehensive benefit analysis (regional economic development)
- Environmental Justice considerations

- MSAC and USACE plan to begin scoping in late FY24 (Aug-Sep)
- Opportunity for more Phase 3 elements to be covered in an FY25 RSM project
- Possibility of full Federal funding

RELATED STUDIES

- Ponca Creek Section 208
- Lewis and Clark Lake Hydrographic Surveys and Analysis
- Updated HEC-RAS numerical model for Reservoir Sluicing
- Missouri River Flow Frequency (June 23) and Stage Frequency
- Upper Missouri River Basin Flow Frequency
- Highway NE12 Update

RESEARCH AND PILOT OPPORTUNITIES

- Tuttle Creek Water Injection Dredging
  - State of KS funding support paired with USACE budget line to get $3M for pilot in 2024

- ERDC request for $10M/5yr Reservoir Sedimentation Work Unit to fund research and pilots starting in FY26 – Reservoir Sediment Management Economics focused

- D-Sediment and 3D Dredger (Guardians of the Reservoir Finalists) interested in pilot partnerships