NDOT – Highway 12 Niobrara East and West

Midwest Geotechnical Conference Indianapolis, IN

September 2025

Presentation Outline

Introduction

Project History and Overview

Challenges and Lessons Learned

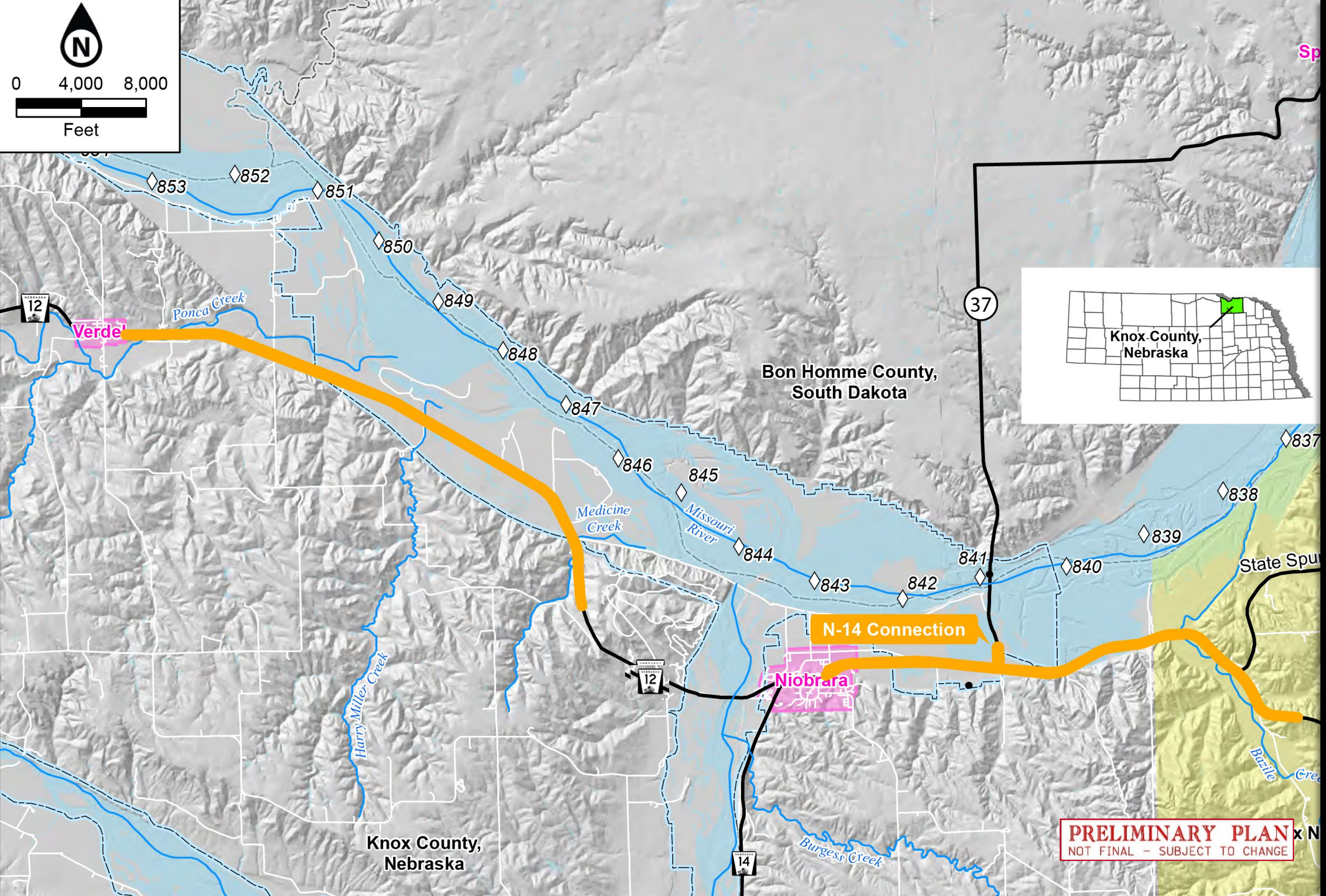
Questions

Project Overview

- **Hwy 12 Location:** 2,000–3,000 feet from Missouri River
- **Project Scope:** Two 6-mile segments (East & West of Niobrara)
- **Key Features:**
  - Roadway elevated 8’ above existing
  - 5 bridges
  - 40 concrete box culverts
  - 23 pipe culverts

Project Purpose/Goals

- Improve Safety & Reliability
- Protect Highway 12 from future flooding
- Maintain Traffic During Construction
- Limit Number of Bridges
- Limit Environmental and Floodplain Impacts



PROJECT AREA

Project History

- **Rising Water Levels:** Missouri River/Lewis & Clark Lake sediment buildup
  - Much of the land between roadway & river now wetlands/underwater
- **Interim Improvements in 1995: Roadway Elevation**
  - 1 mile section 4.7 miles east of Verdel
  - 0.7 mile section 1 mile east of Niobrara
  - 1 mile section 2.4 miles east of Niobrara
- **Continued Flooding Persists:**
  - 1997 – NDOT requests a permanent solution
  - 2000 – USACE authored further repairs based on Adverse Effect ruling (Not Funded)
  - 2002 – NDOT filed suit
- **2002:** Coordination w/ USACE on Alternatives & Permitting

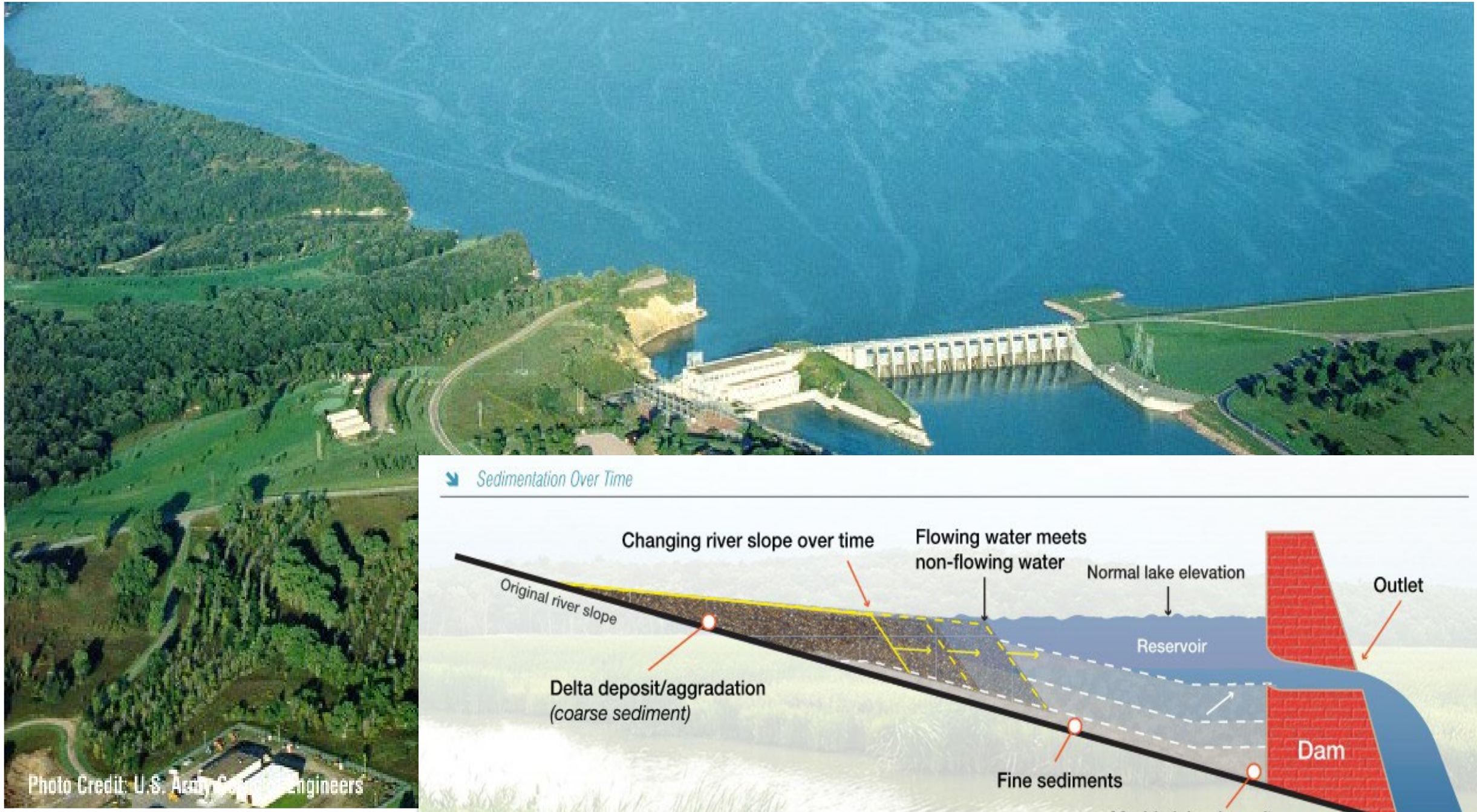
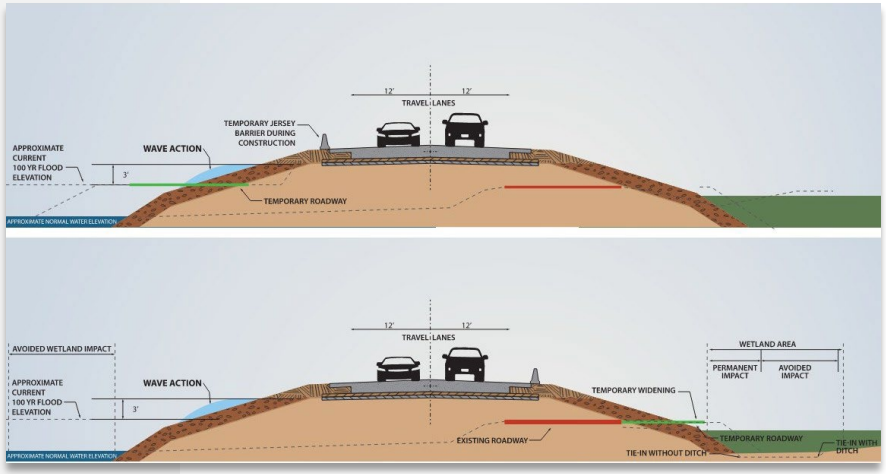


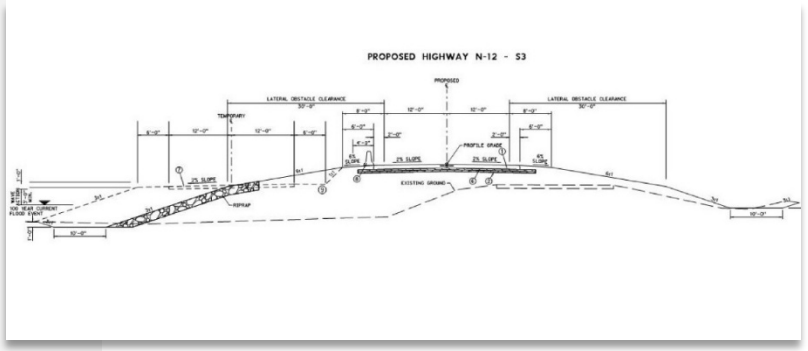
Photo Credit: U.S. Army Corps of Engineers

Sedimentation Over Time
Changing river slope over time
Flowing water meets non-flowing water
Normal lake elevation
Outlet
Original river slope
Reservoir
Delta deposit/aggradation
(coarse sediment)
Dam
Fine sediments
Muddy lake deposit

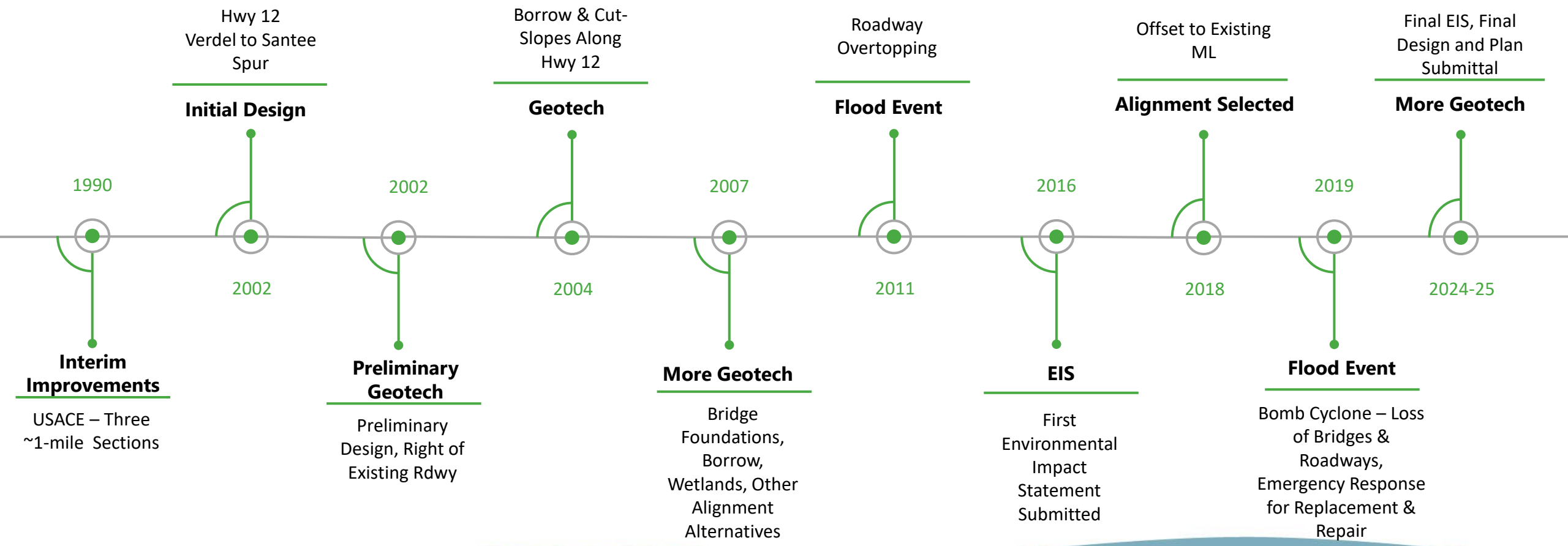
Project Overview

- **Study & Design Timeline:** Began in early 2000s, 17 alignments studied
- **Final Selection:** 2024
  - 8-foot grade raise of N-12 average
  - 24’ max new embankment height at Bazille Creek bridge
- **Permitting & Environmental Considerations:** USACE 404, 408, E011988 (floodplain), Env. Impact Statement
  - ~100 acres of wetland/aquatic impacts
  - Stream impacts
- **Traffic Management:** Essential to avoid 40+ mile detour





Project Schedule



N-12 Niobrara East & West

2011 & 2019 Flood Events

2011 Flooding:

- N-12 (East & West of Niobrara) overtopped
- USACE funds solution to raise above 100-year flood elevation
- 17 alternative alignments studied

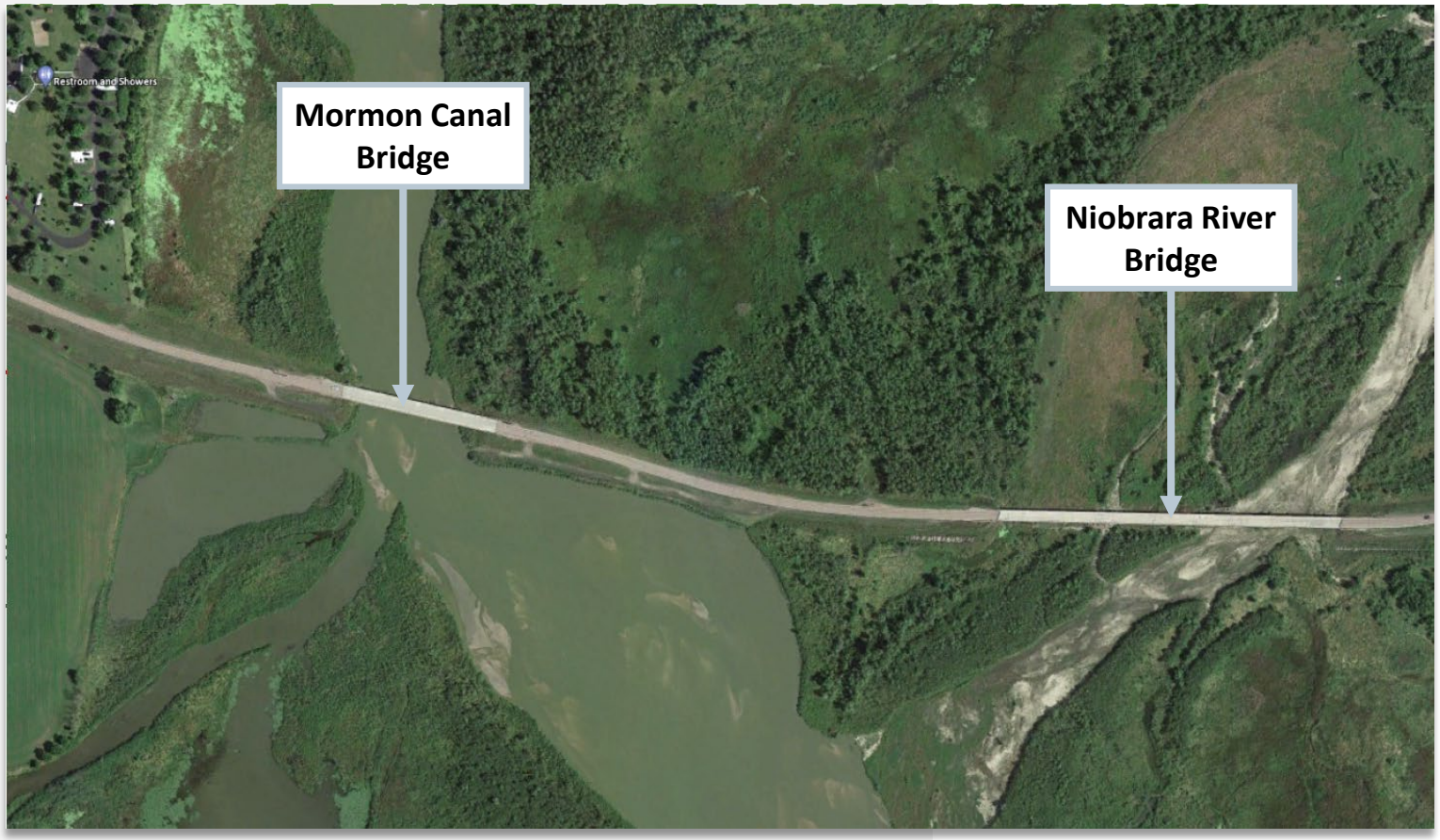
2018: NDOT selects slight offset alignment S-3 as preferred

2019 Flooding:

- **Niobrara River & Bazile Creek:** N-12 East overtopped, major damage near Bazile Creek
- **Ponca Creek:** Flooding damaged westbound lanes between Verdel & Niobrara
  - Creek channel expanded toward Hwy N-12
- Additional wetlands created and existing ones expanded

Niobrara West Emergency Response

- Niobrara River flooding & ice floats
- Niobrara River Bridge damaged
- Roadway damage between Mormon Canal & Niobrara River
- Mormon Canal Bridge relocated



Niobrara Bridge - 2019

Niobrara Bridge - 2019

Niobrara Bridge - 2019

Niobrara Bridge - 2019

Niobrara Bridge - 2019

Morman Canal Bridge - 2019

Morman Canal Bridge

Morman Canal Bridge - 2019


Bazile Creek - 2019

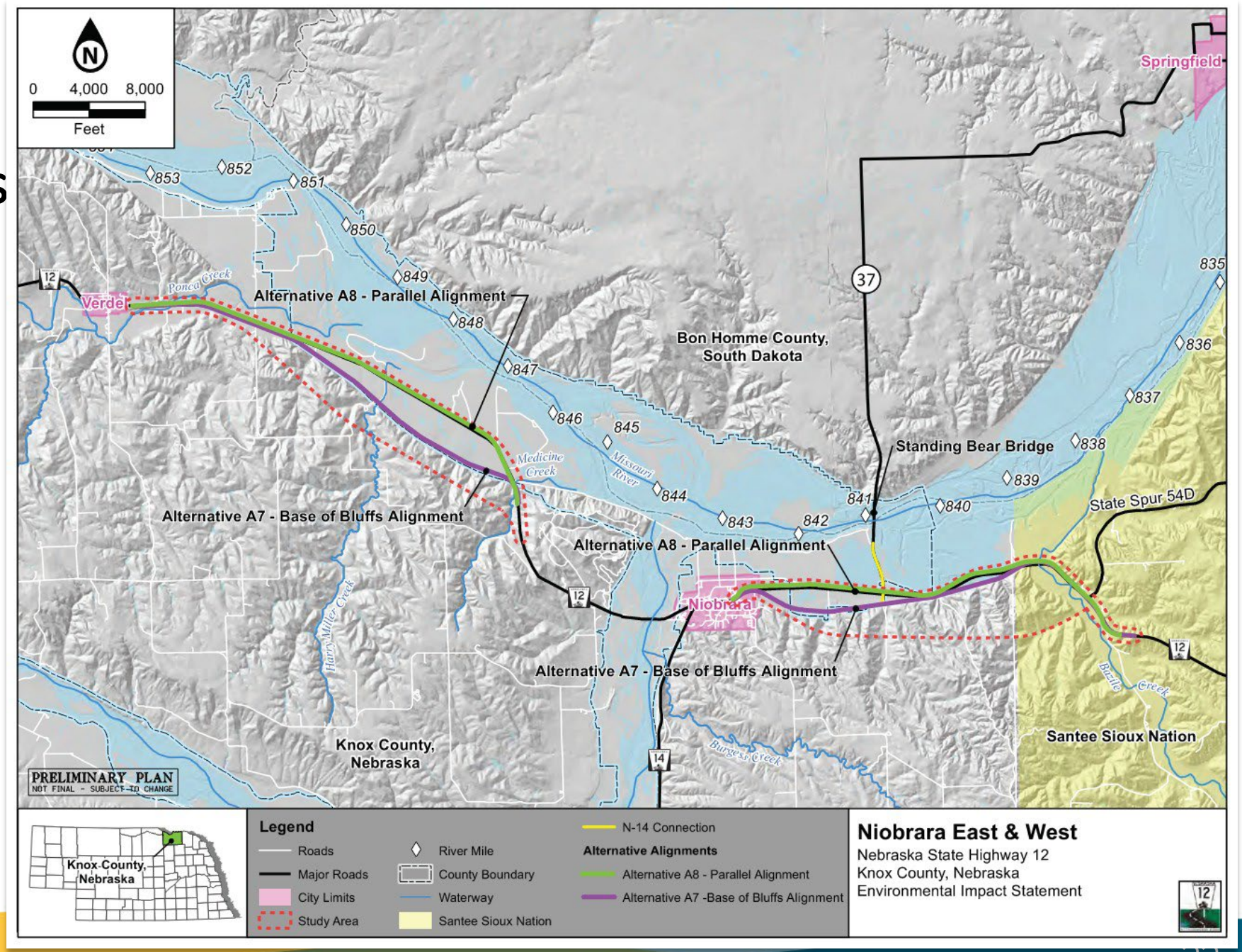
Bazille Creek - 2019

Ponca Creek – 2019

Project Alternatives

Require New Roadway 3-feet Above 100-Year Flood:

- New roadway in bluffs
- New roadway along base of bluffs
- On CL (S1), to the right (S2), or to the left (S3) of existing roadway?



View Of The Bluffs Looking South from South Dakota – Standing Bear Bridge (Hwy 14)

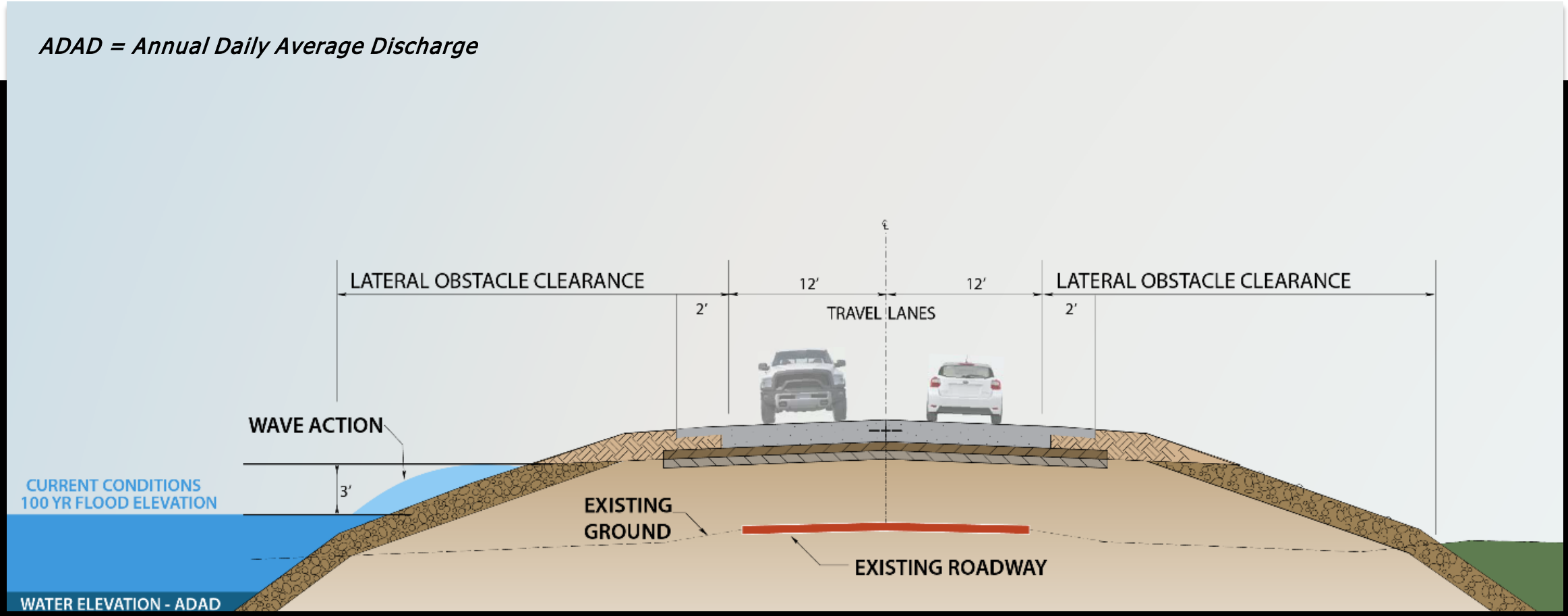
Bluff & Base of Bluffs Alternatives - Eliminated

- ROW needs & public opposition
- Pierre Shale at / near surface
- Cuts & Fill in shale
  - Embankment Stability Concerns
  - Unacceptable for re-use as fill
  - Special Pavement Subgrade Design
  - Drainage Systems
- Long term maintenance concerns
- Base of Bluffs - ~9,300 feet of bridges
- Costs

S1 ALTERNATIVE

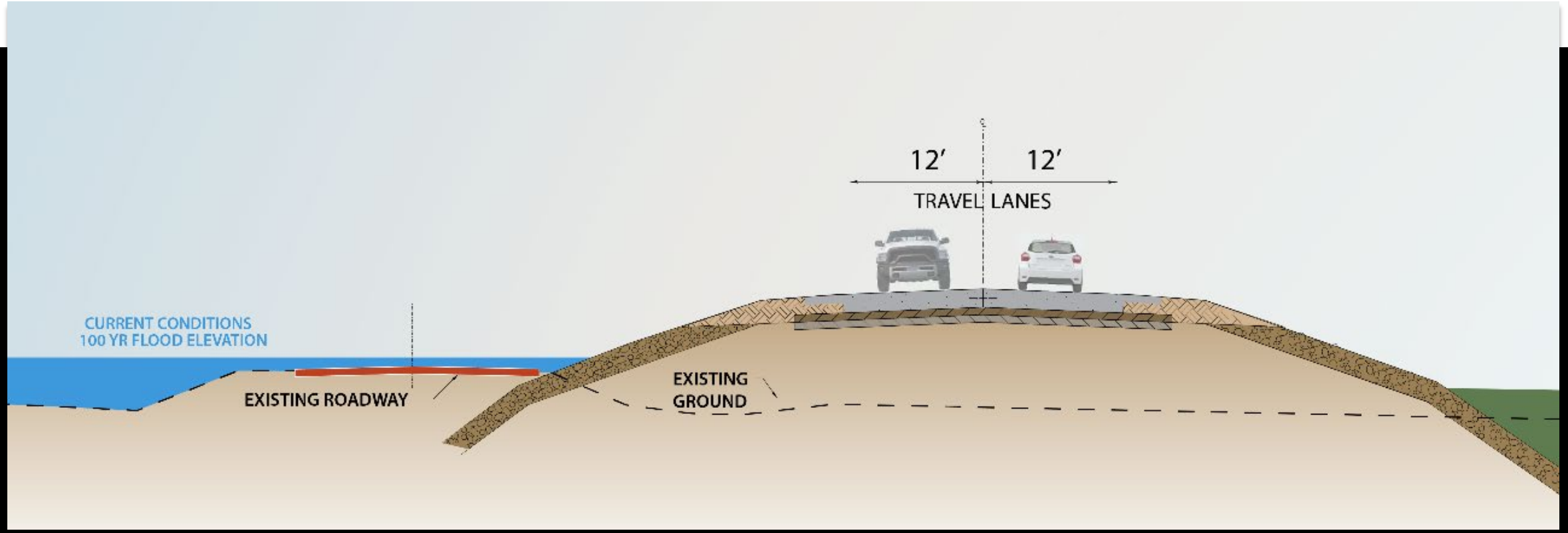
On Existing Roadway Alignment

ADAD = Annual Daily Average Discharge



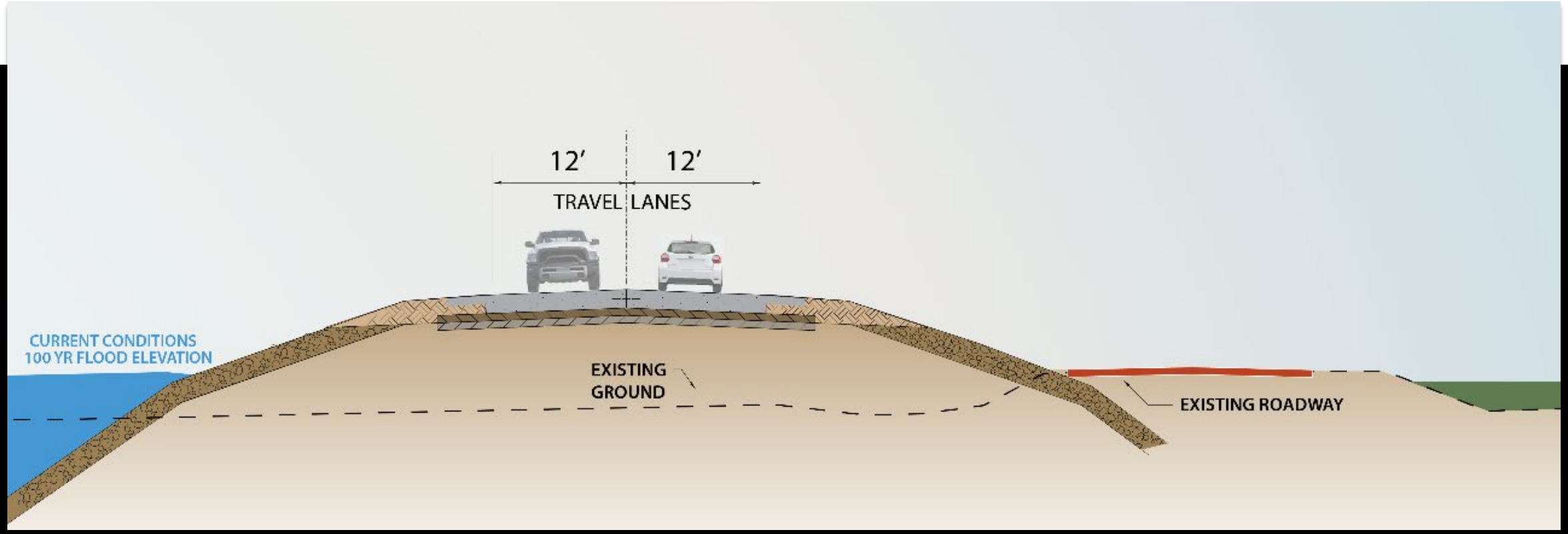
S2 ALTERNATIVE

Roadway Shifted to South of Existing Roadway



S3 ALTERNATIVE

Roadway Shifted to North of Existing Roadway



TYPICAL EXISTING N-12

TYPICAL PROPOSED N-12

Project Overview - Geotech

Geotech Investigations:

- 2002, 2004, 2007, 2024; wetland mitigation (2019, 2023)
- NDOT and consultant investigations (2024)

Drilling & Sampling:

- **Borings:** 4,470’ (CFA, HSA, Mud-Rotary), 2,760’ Dutch Cone, 630’ Hand Auger/Soil Probe
- **Testing:** 175’ Field Vane Shear, 278 Shelby Tubes, 481 SPTs, 200’ Rock Cores
- **Lab Analysis:** 60 Consolidations, 52 Unconfined Soil, 16 UC Rock, 11 CU Triaxial
- **Soil Properties:** 73 PI’s, 66 Hydrometers, 23 Proctor Curves, 5 Permeabilities

Project Challenges

- Impacts to Wetlands (All Alternatives)
- Suitable Borrow (All Alternatives)
- Alternatives Along Existing Roadway
  - Much of existing roadway in floodplain
  - Shallow groundwater
  - Open water (4’ above ground)
  - Organics and compressive soils
  - Change (Increase) in 100-year flood elevation

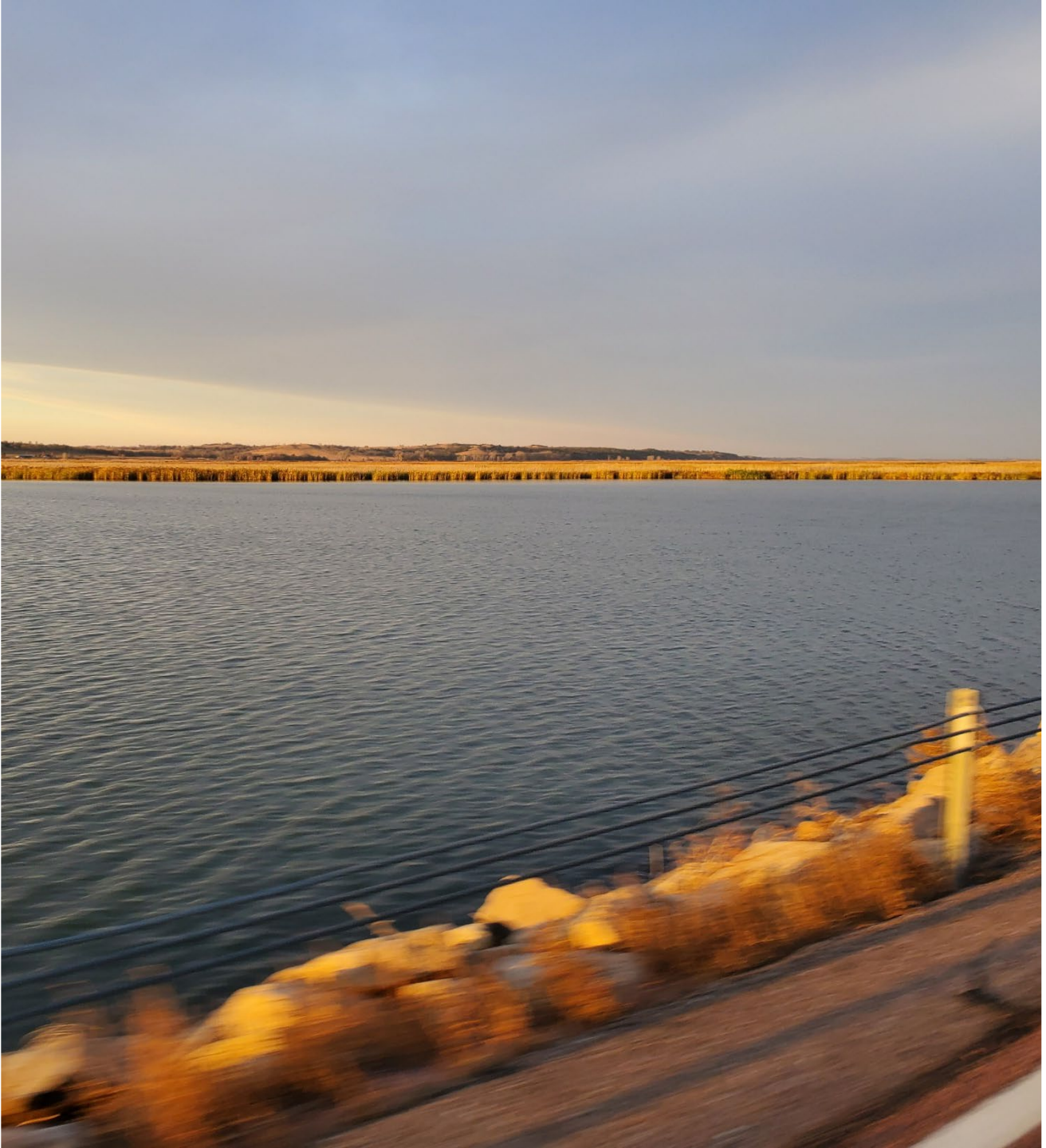
Project Challenges

- Next to Bluffs
  - Same as ex. Alignment Alternatives but difficulty with access
  - Potential for continuous bridge as roadway
- In the Bluffs
  - Rugged Terrain
  - Shale – Stability, drainage, and expansive soils
- Emergency Response Efforts– 2019 (NDOT Geotech)
  - Drilling and Analysis – Statewide
  - Access & Detours
  - Niobrara Drilled Shaft Inspection

View From The Bluffs Looking West

Drilling & Geotech Challenges

- Along Existing Roadway
  - Much of existing roadway in floodplain
  - Shallow groundwater
  - Open water
  - Vegetation, Organics and compressive soils
- Bluff Alignments
  - Rugged Terrain
  - Undisturbed sampling of soft rock (Shale)
- Final Design Timeline: October 2024 to February 2025 – Drilling to Final Plan Set
- Stabilization: Soft, saturated, under-water conditions
- Settlement and Bridge Foundation Delays, Surcharge
- Compiling all the Data from 2003 to 2024



2024 Geotech

Final Alignment (S-3)

Access

- Full-size rig limited to shoulder due to soft/saturated ground
- Hand sampling by hip-waders or boat

Tools

- Rig Borings
- Hand Auger
- Shelby Tubes
- Soil Probe
- Vane Shear
- Chest Waders
- Machete (sharp)
- Aluminum John-Boat
- Trolling Motor
- Trimble Catalyst

Drill Rig to Hand Work

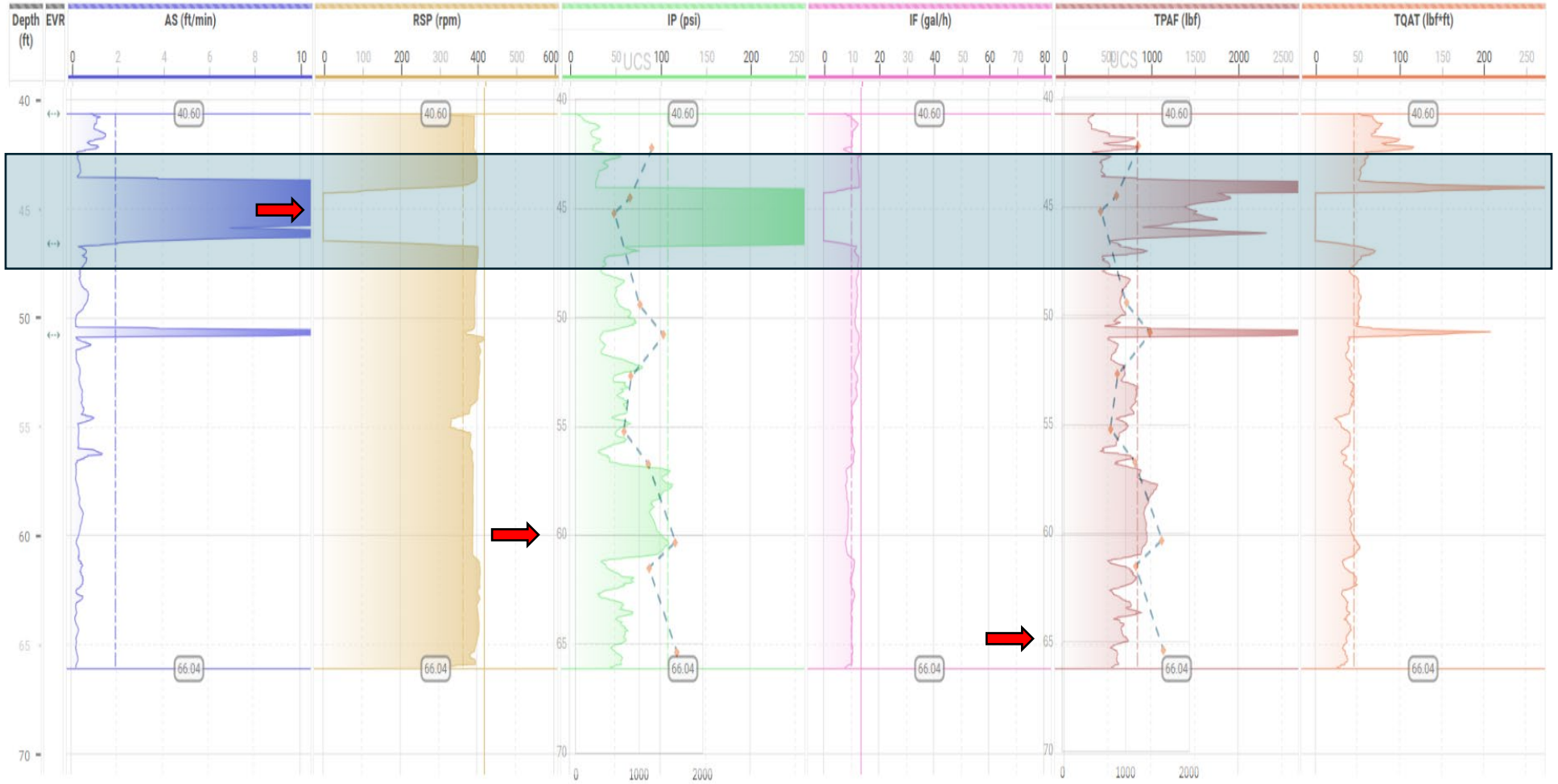

benesch

S012 16603 BR-2

Not Shown | Holdback Pressure | Tool (Down) Pressure

Control | Control

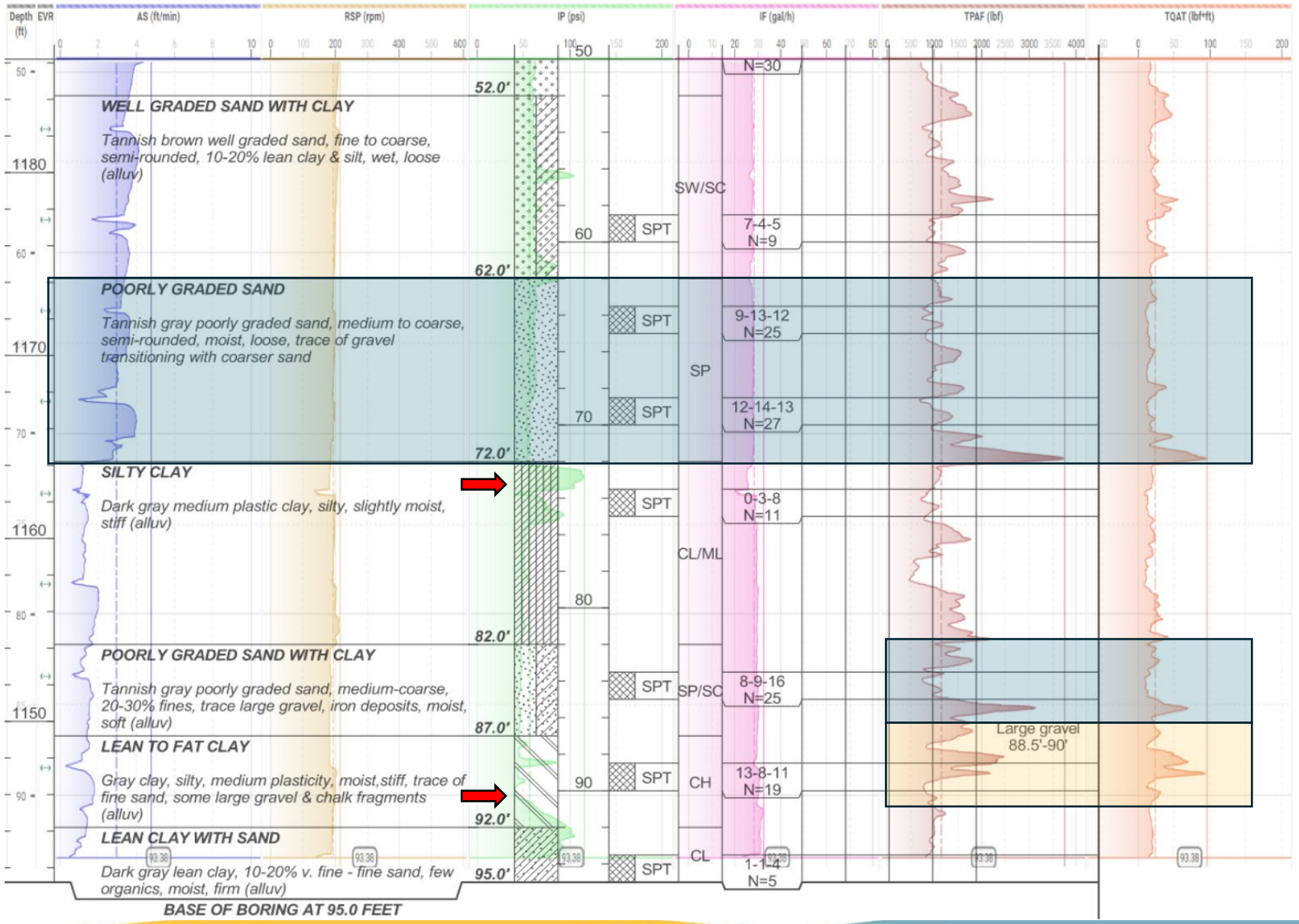
Advancement Rate | Rotation Speed | Inject. Pressure | Inject. Flow | Tool Force (lbf) | Torque (lb-ft)



Control | Control | Not Shown | Holdback Pressure | Tool (Down) Pressure

S012 16603 BR-5A

Advancement Rate | Rotation Speed | Inject. Pressure | Inject. Flow | Tool Force (lbf) | Torque (lb-ft)




Thank you!