Case Study:

I-35W River Bridge Design Build Project

Transportation Construction and Grading Innovations Technology Forum

Tuesday December 3, 2019

10:45 AM - 11:30AM

Tom Villar, MnDOT
Brent Theroux, Barr Engineering
Ryan McShane, Ames Construction
Joe Bentler, American Engineering Testing

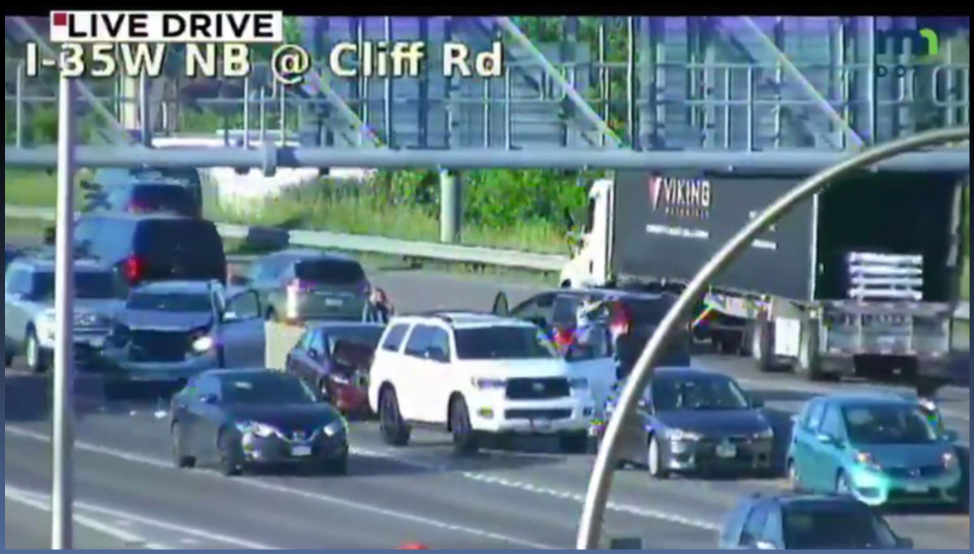
Project Development

- I-35W over MN River
- Original bridges built in 1956-1957.
- Replace existing bridges.
- Add roadway capacity.
- Raise roadway out of the 100yr floodplain.
- MnDOT Design-Build Project S.P. 1981-124.
  - Letting: May 9, 2018
  - Start August 2018
  - Planned Completion Fall 2021
  - Project Value $128,000,000

The Project

Noteworthy Challenges

- Construct the new River Crossing & Approaches off-line of the existing interstate.
- Poor subsurface conditions.
- Historic land slide during original construction of the embankment.
- Contaminated soils and groundwater South of the River
- Work within the Minnesota River Flood Plain
- Maintain six travel lanes during construction.

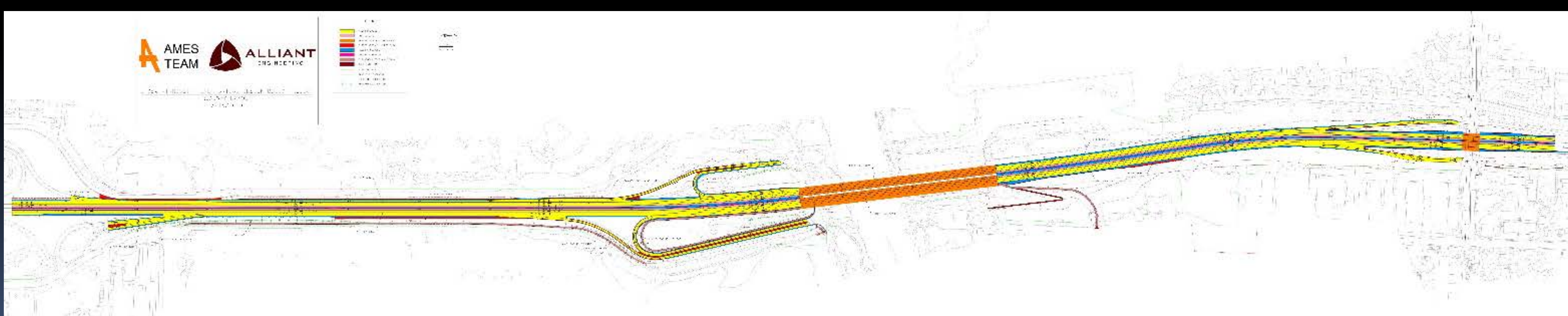


The Project

Existing River Bridge Aerial looking Northeast

The Project

- 2.2 Mile Reconstruction of I-35W.
- Reconstruction of Cliff Road, Black Dog Road, 106th Street Ramps.
- Construction of two new 1,400ft Steel Girder River Bridges.
- Demolition of the Existing Steel Girder River Bridge.
- Demolition and Reconstruction of the 106th St. Interstate Bridge.
- Construction of two MSE Walls, 1,500ft in length.
- Construction of three Reinforced Soil Slopes, 3,800ft in length.



Site History – North Approach

- Original north approach embankment failed during construction in 1957

Site History – North Approach

First in Area

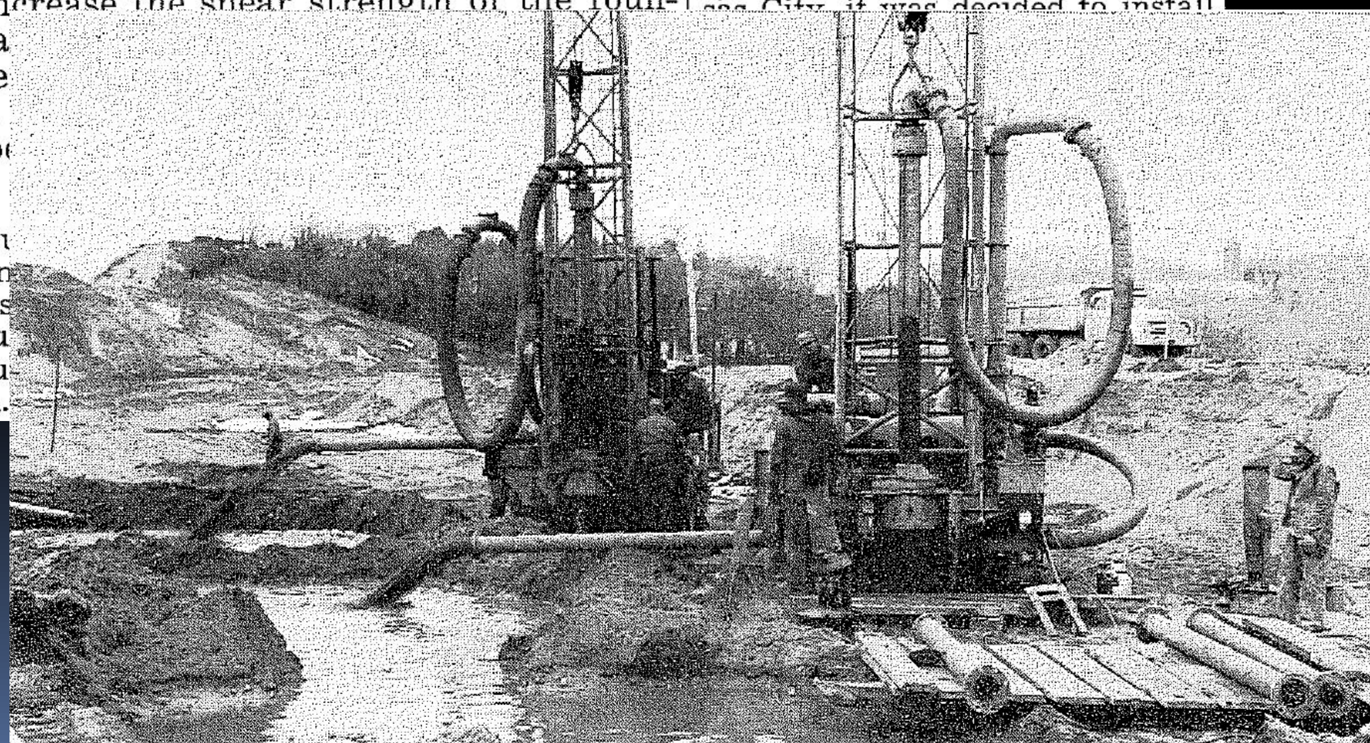
Vertical Sand Drains Used on 700-Foot Slide

By DICK BRAUN
Soils Research Engineer

A type of highway construction new to Minnesota and its surrounding states is being used on T.H. 394, a new interstate route, south of Minneapolis. The method, called vertical sand drains, is a remedial installation to reduce pore water pressure and increase the shear strength of the foun-
dation soil prior to pla
is the excess pressure
placement of the fill.
was not dissipated be
underlying soil.

This new interstate rou
ing south out of Min
which lies west of pres
65 (Lyndale Ave.), requ
siderable grading throu
field and Bloomington.

After consultation with the Bureau of Public Roads' experts in Washington and the consulting firm of Howard, Needles, Tammen and Bergendoff of Kansas City, it was decided to install



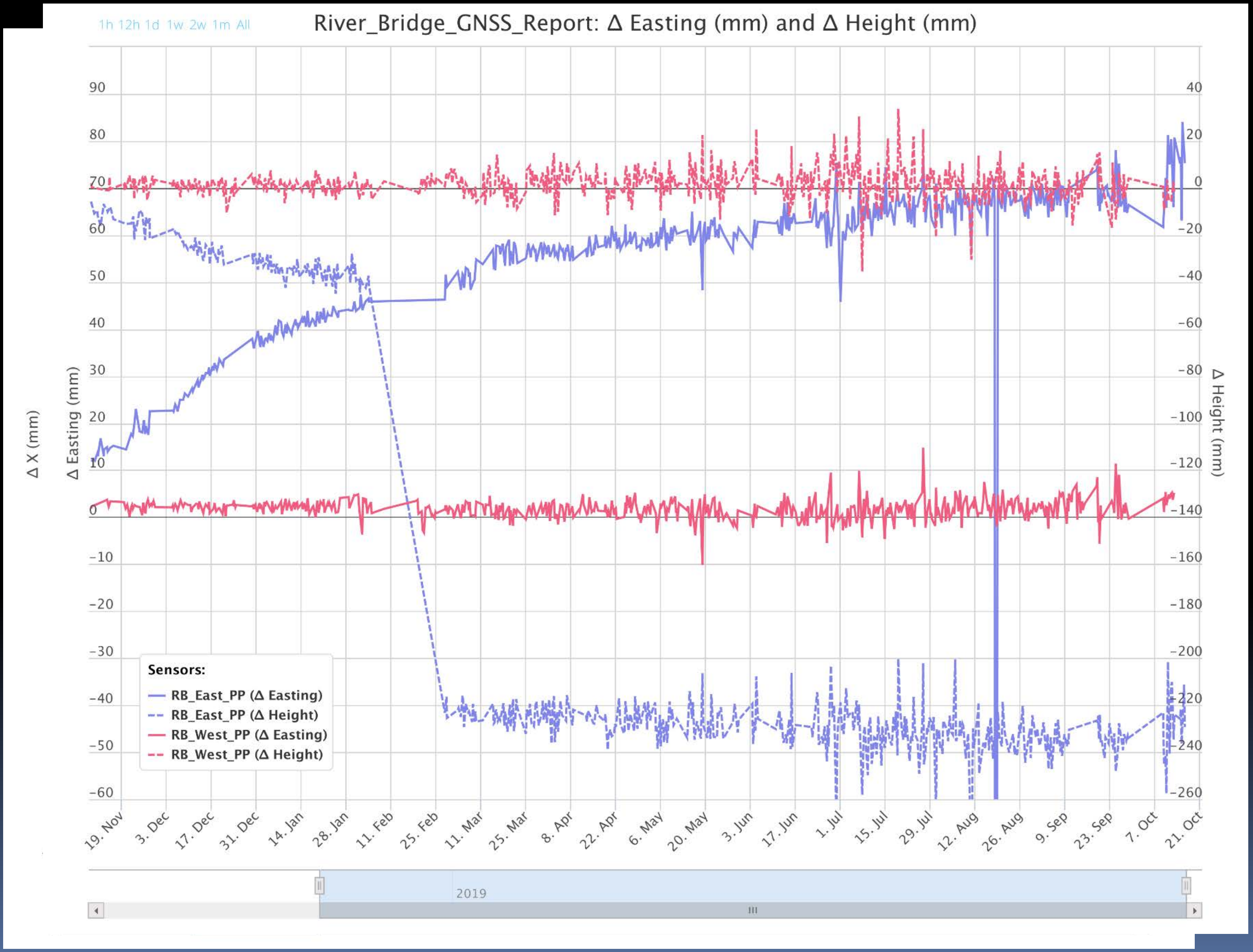
Abutment Monitoring

- GNSS receivers on both north abutments

Abutment Monitoring

- Digital and manual crack meters across gap between footings

Abutment Movement



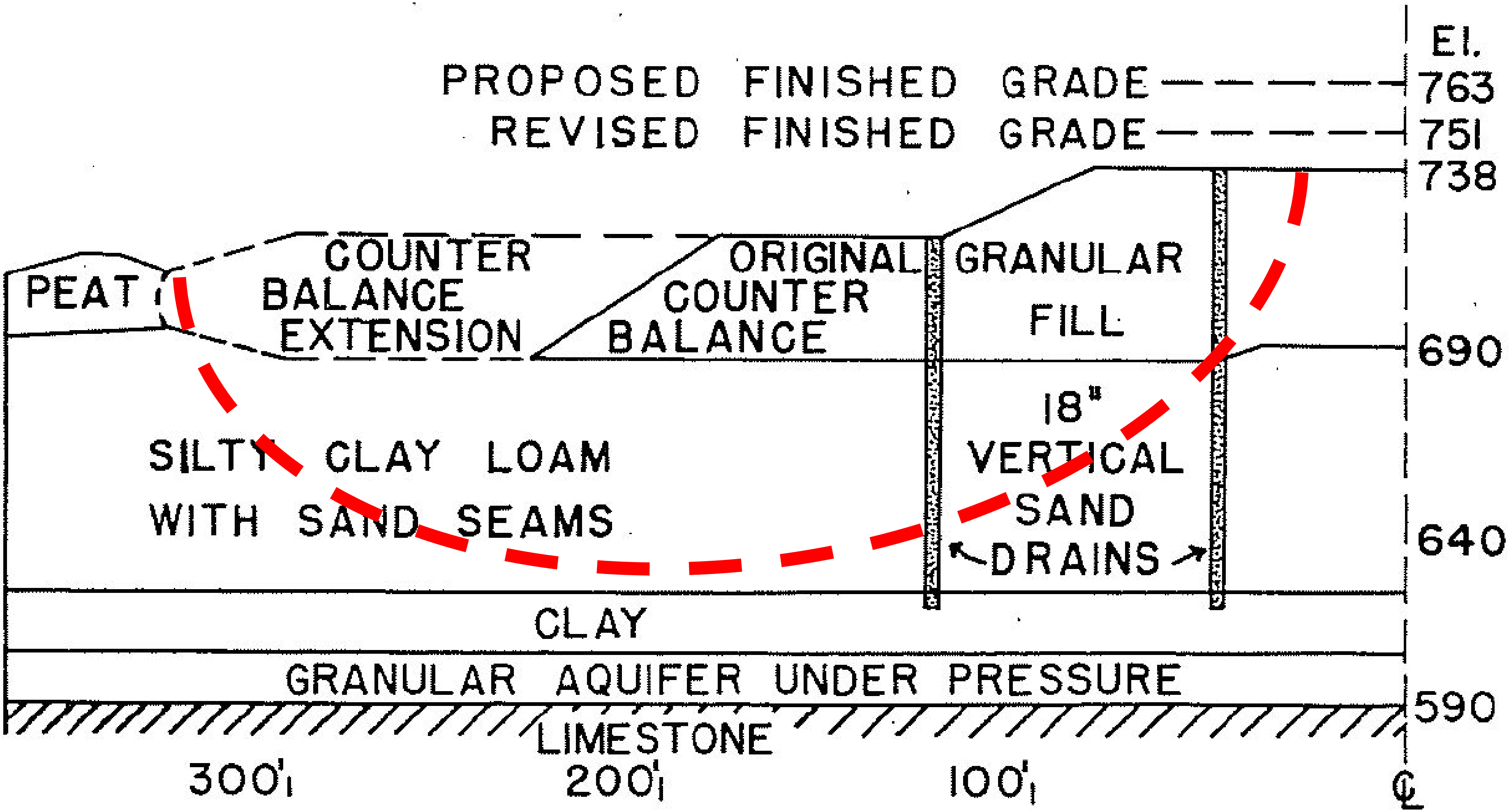
Design - Build Pursuit

Ames Construction: Design-Build Contractor

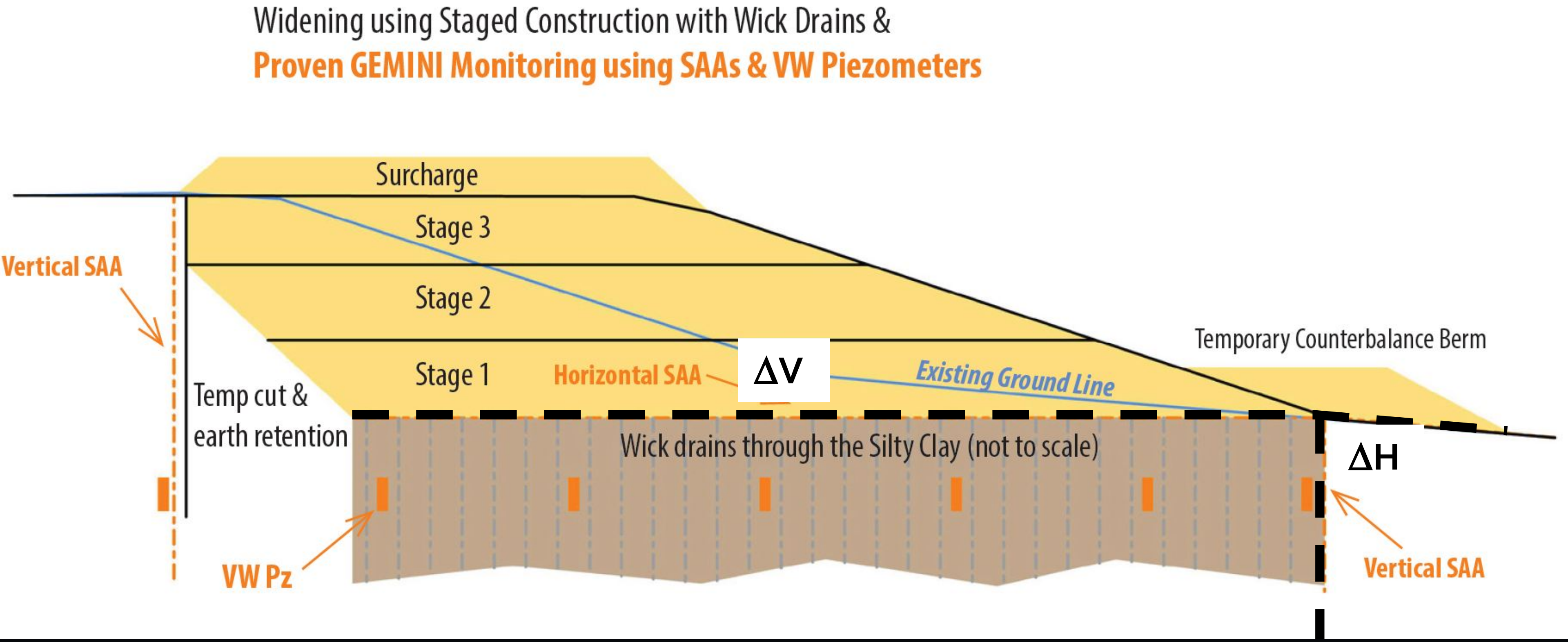
Key Participants

- Parsons
- Alliant Engineering
- TKDA
- American Engineering Testing

Design-Build Pursuit



Design - Build Pursuit



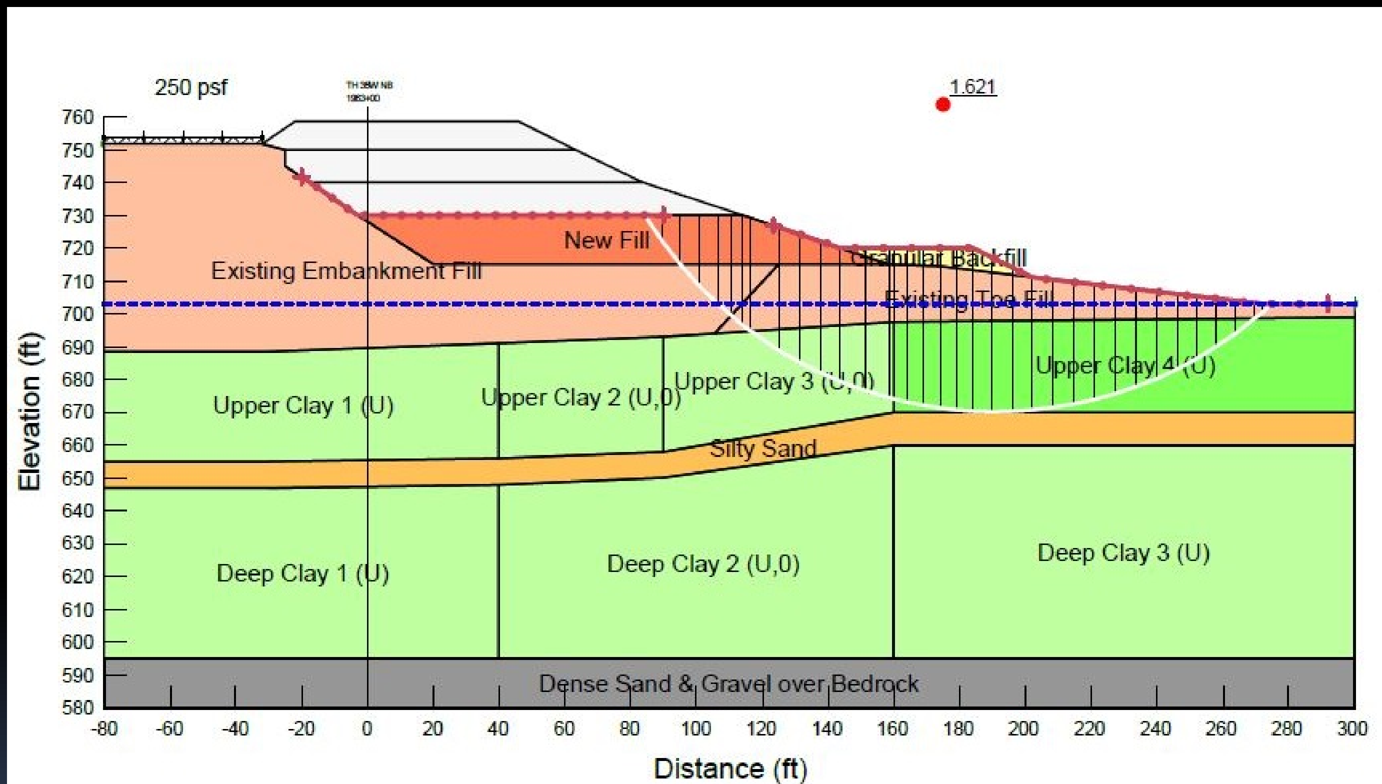
Alternative Technical Concept for lateral movement

- RFP allowed 3-inches maximum of lateral movement for embankment
- With over 1 foot of vertical settlement expected, AET's experience was at least 5 inches lateral movement should be expected
- Ames Team proposed using instrumentation to monitor both vertical settlement and lateral movement in real-time (should remain proportional)

Geotechnical Stability Analyses

Maintain safety factor of 1.3 throughout filling

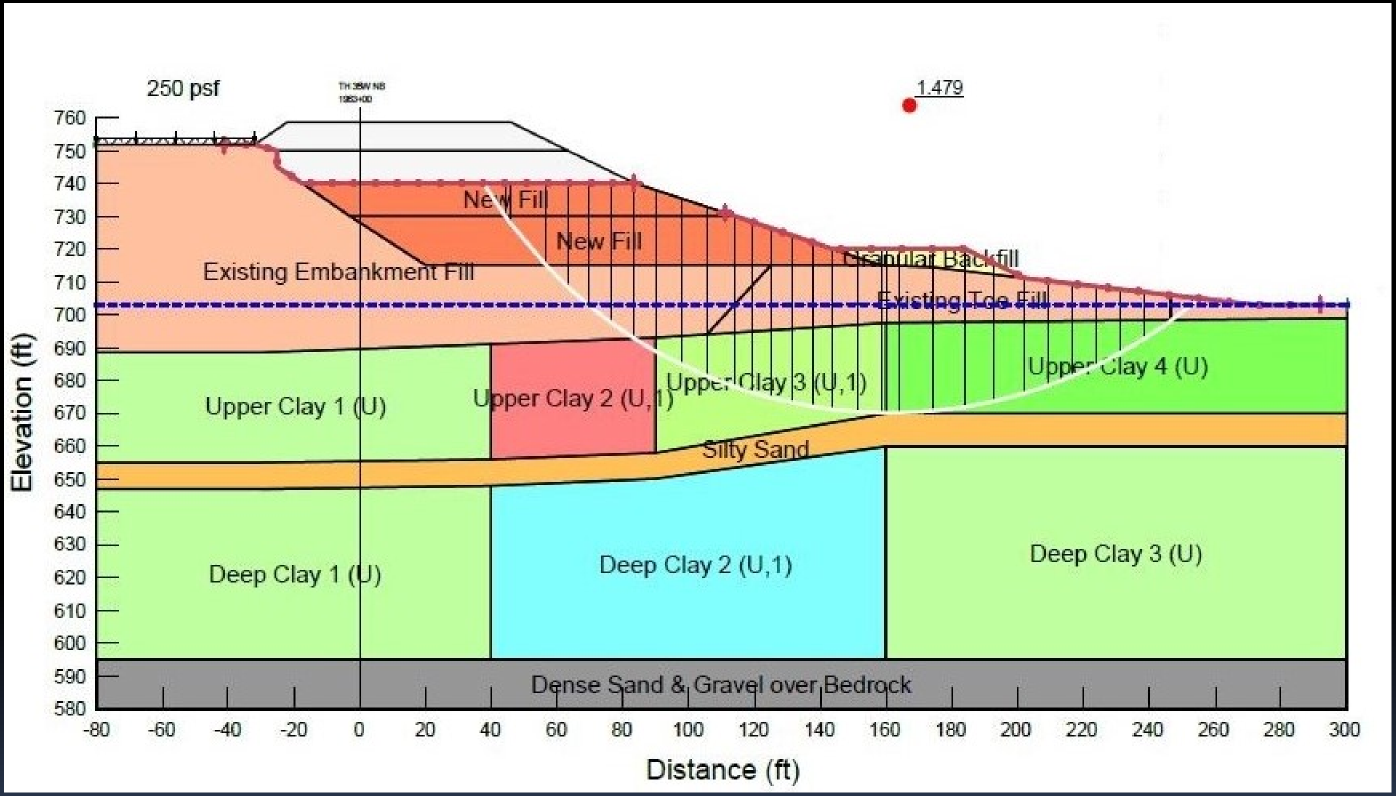
- Needed to predict the strength gain of the clay under the embankment



Geotechnical Stability Analyses

Maintain safety factor of 1.3 throughout filling

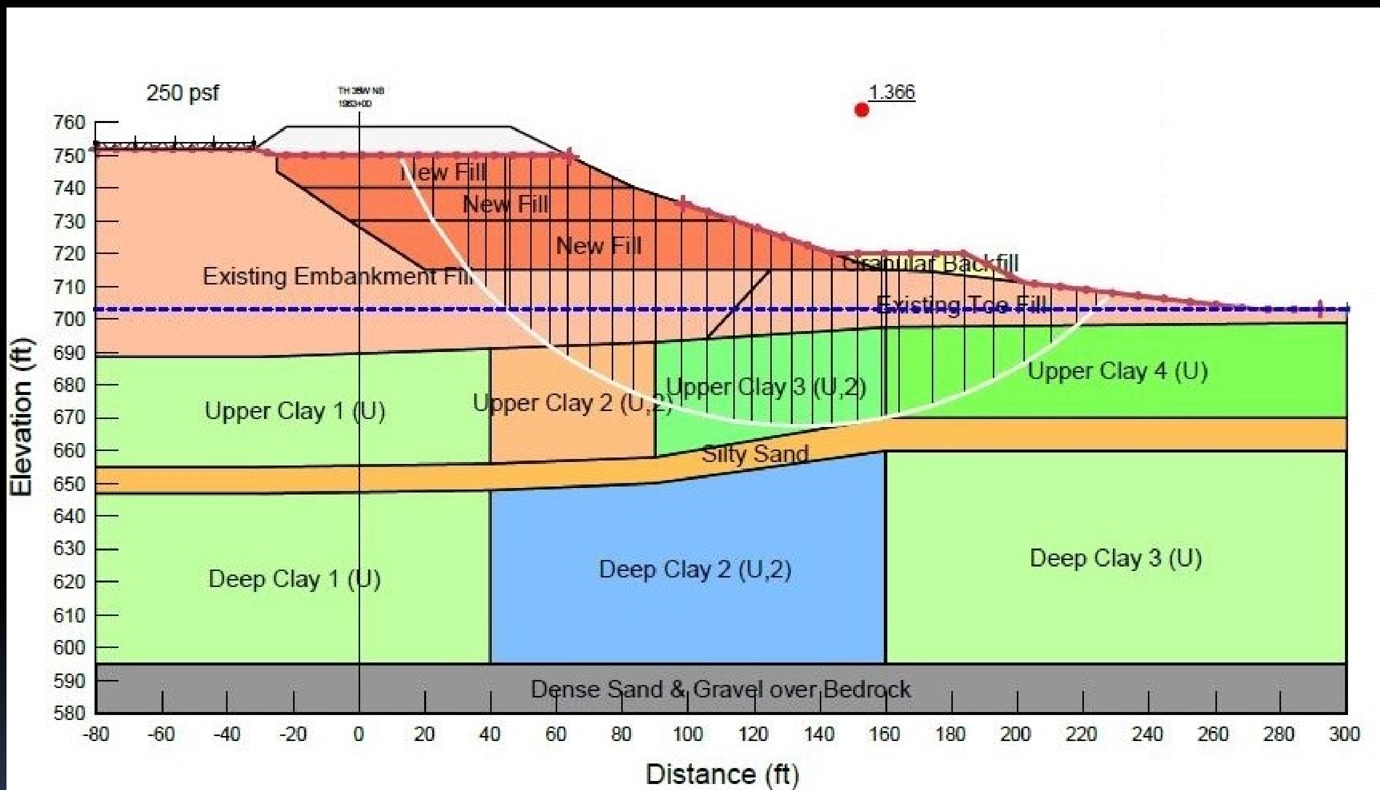
- **Approximately 10% gain in clay strength from Stage 1 to 2**



Geotechnical Stability Analyses

Maintain safety factor of 1.3 throughout filling

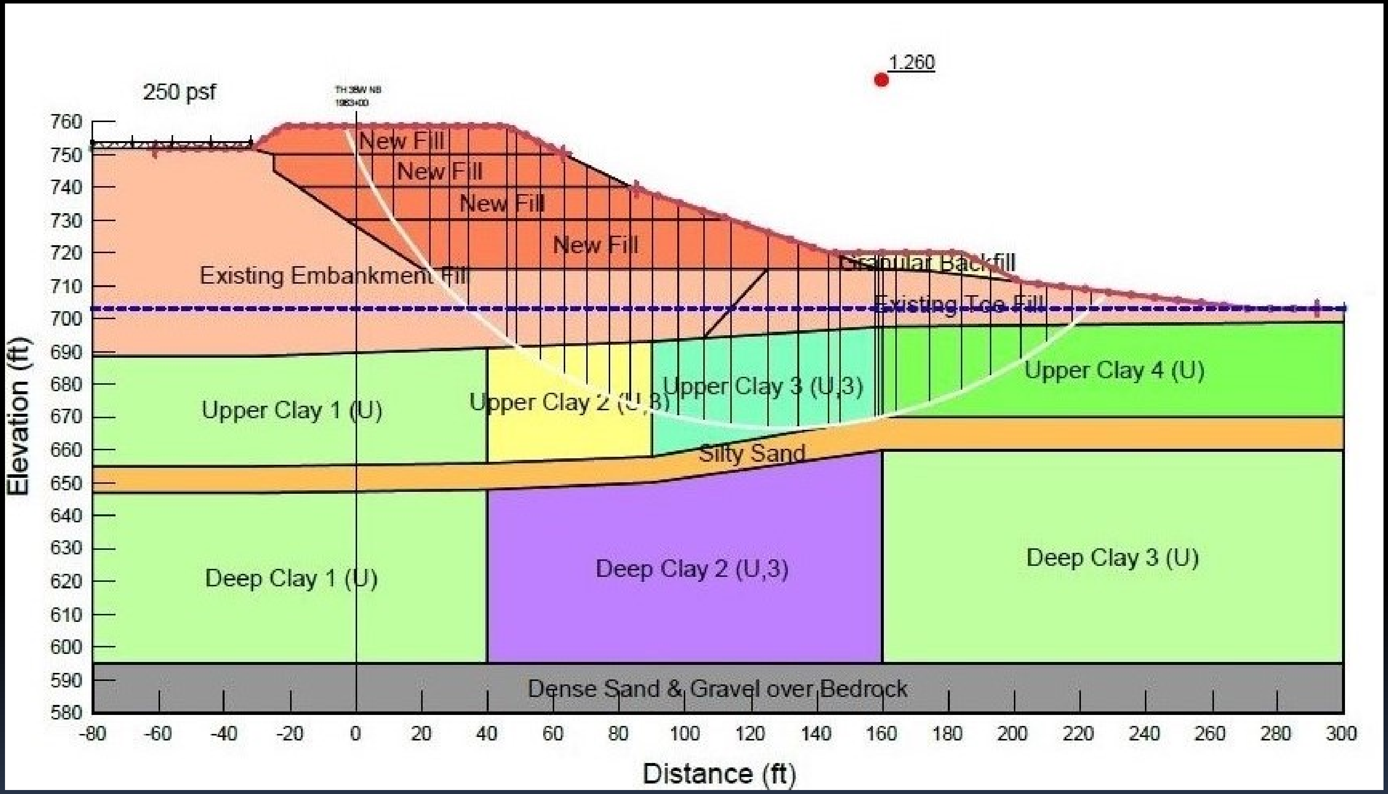
- Approximately 10% gain in clay strength from Stage 2 to 3



Geotechnical Stability Analyses

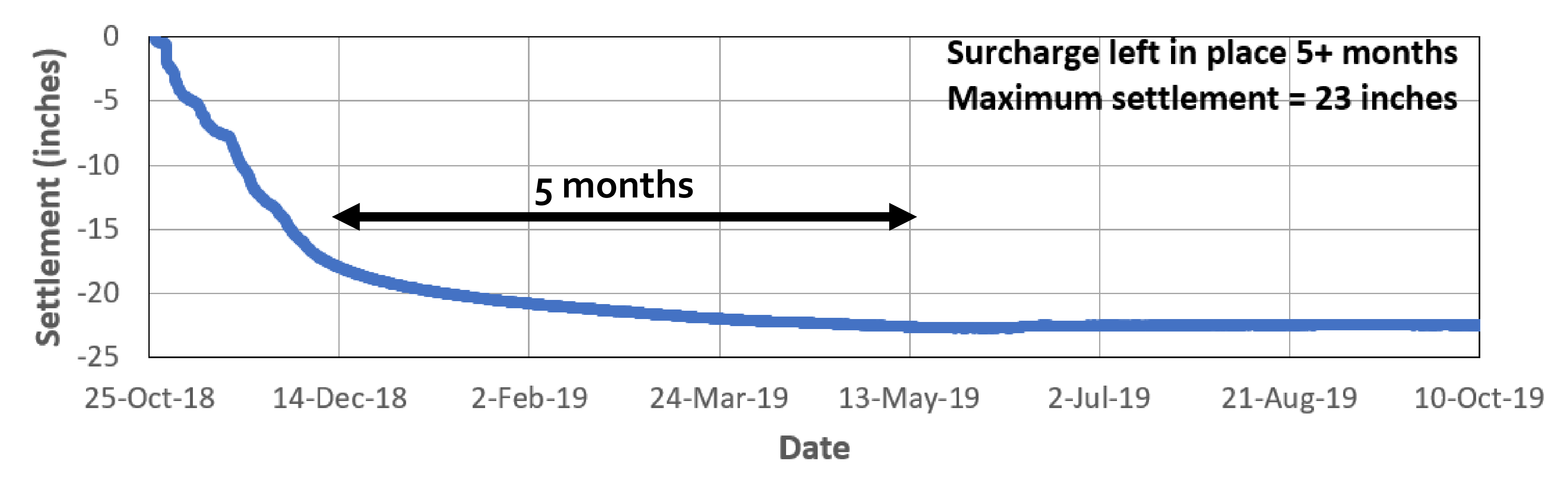
Maintain safety factor of 1.3 throughout filling

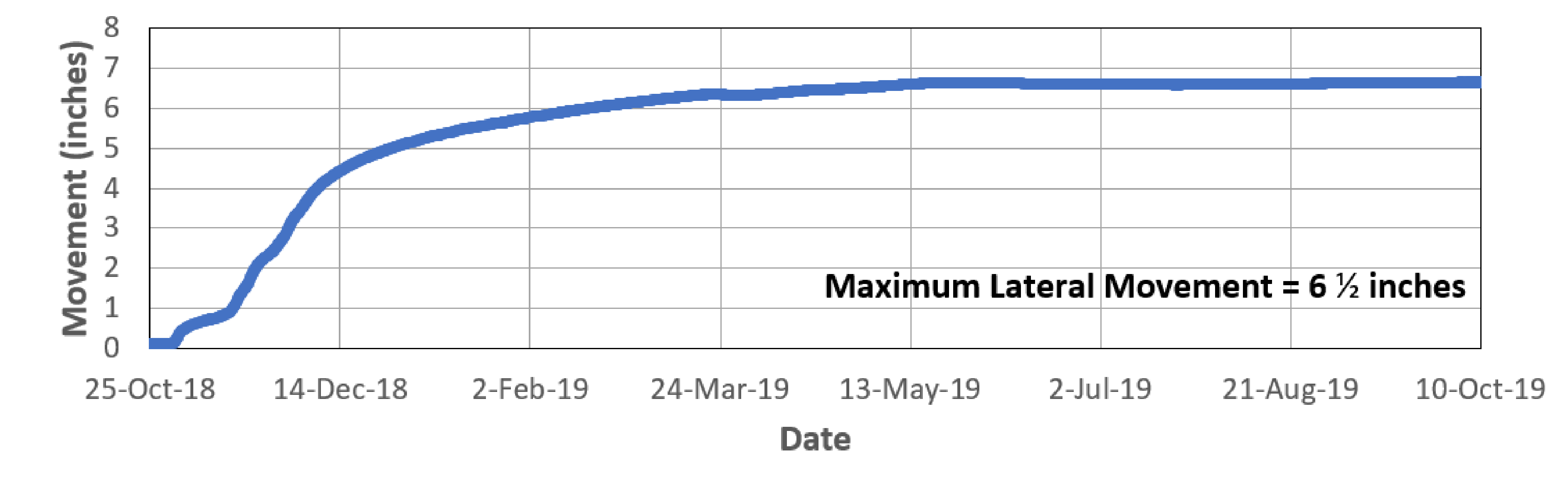
- Approximately 5% gain in clay strength from Stage 3 to 4



To confirm assumptions about strength gain between stages, AET pushed CPT soundings through the fill and into the clay.

Construction



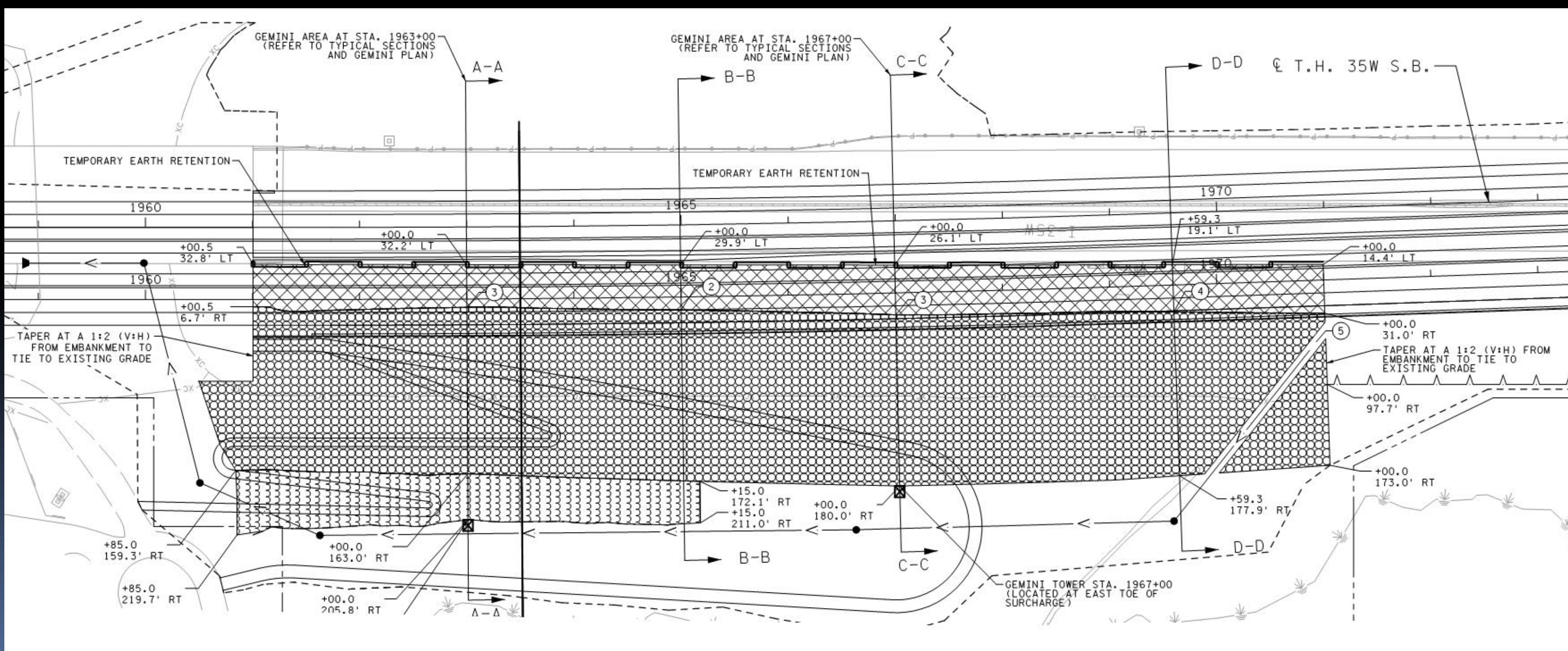


Construction

Clearing & Site Preparation

Construction

- *Temporary Earth Retention*
- *60" RCP Drainage Line*
- *Subgrade Preparation*
- *Wick Drain Installation*
- *Settlement Period*
- *Embankment Construction*
- *Geotechnical Instrumentation*
- *Staged Embankment*



Construction

Temporary Earth Retention

- *39,500 SF Sheet Piling*
- *60 King Pile*
- *35ft Depth @ 9.5 FT Spacing*

Construction

60" RCP Drainage Installation

- *1,572ft 60" RCP Drainage Line*
- *Poor soil conditions*
- *Water infiltration*

Construction

Subgrade Preparation

- *80,000 CY Excavation*

Construction

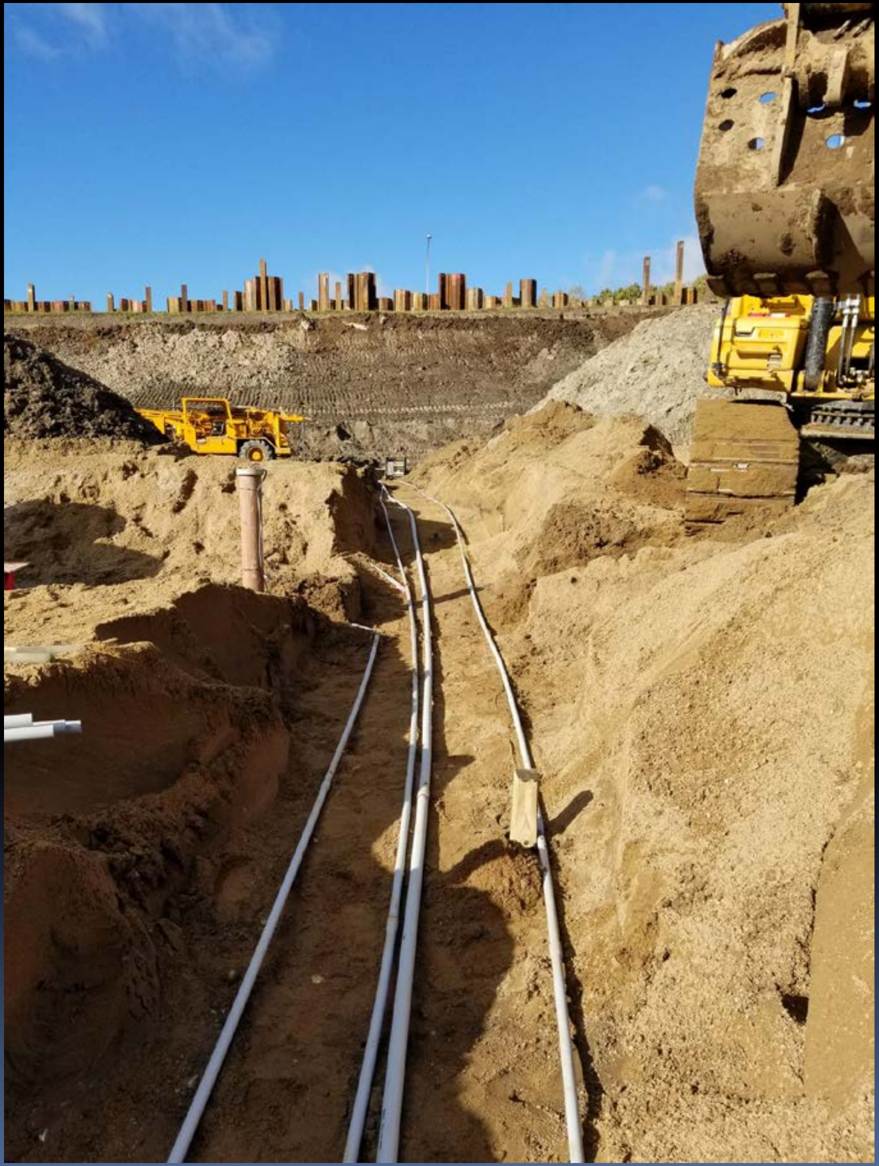
Wick Drain Installation

- *12,500 Wick Drains, 1,129,000ft in length*
- *279,000ft Predrill for Wick Drains*
- *55ft – 120ft Depth*

Construction

Geotechnical Instrumentation

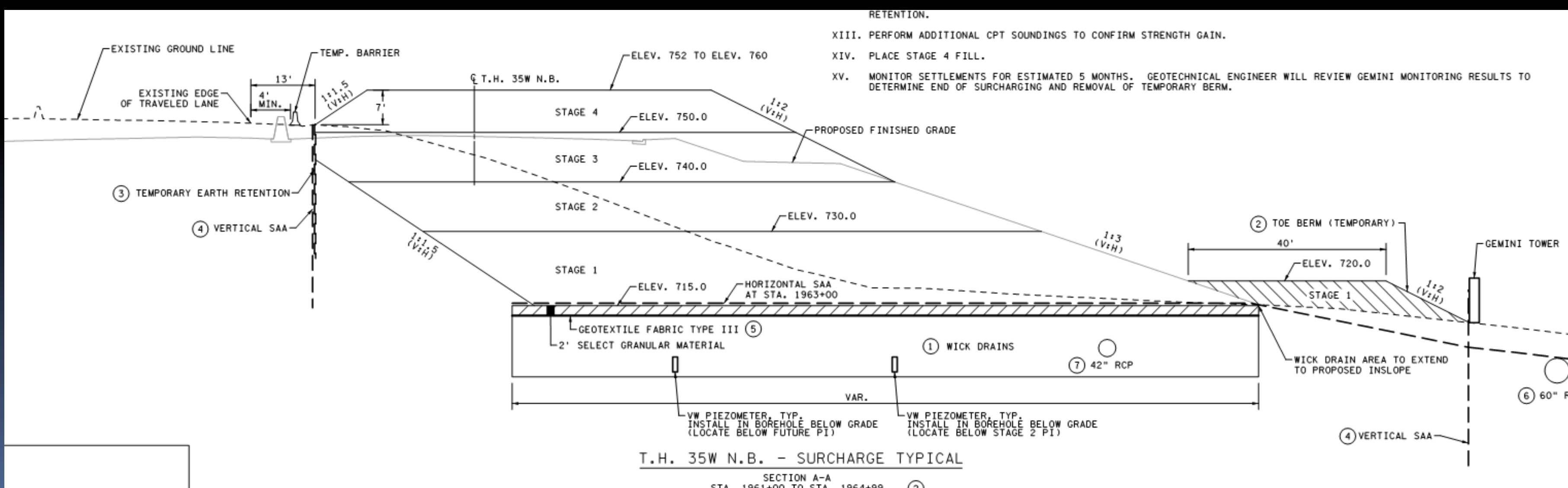
- *Vertical Shape Arrays*
- *Vibrating Wire Piezometers*
- *Earth Pressure Cells*
- *Horizontal Shape Arrays*
- *Settlement Plates*



Construction

Staged Embankment

- *Stage 1: Fill Toe Berm*
- *Stage 1: Fill 15ft*
- *Stage 2: Fill 10ft*
- *Stage 3: Fill 10ft*
- *Stage 4: Surcharge 10ft*
- *20-Day Settlement Period per Stage*



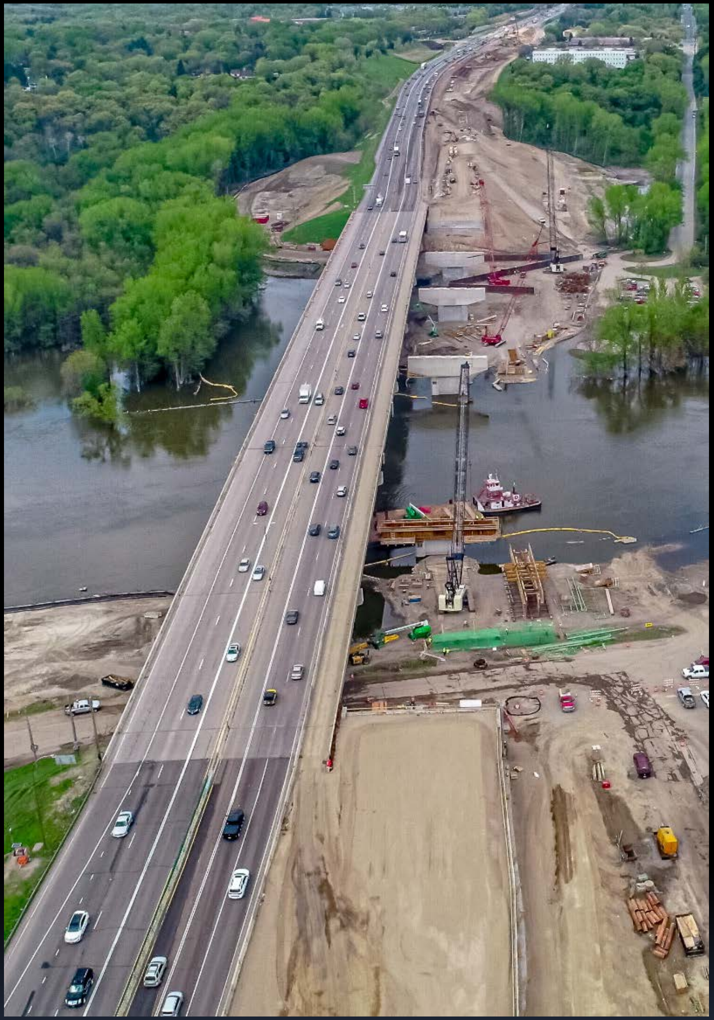
Construction

Staged Embankment

View looking Northeast to Southwest

Construction

NE Embankment Construction



- *226,000 CY of Embankment*

Construction

Embankment Construction

QUESTIONS?