



# Geotechnical Construction Methods in CCR Impoundment Closures

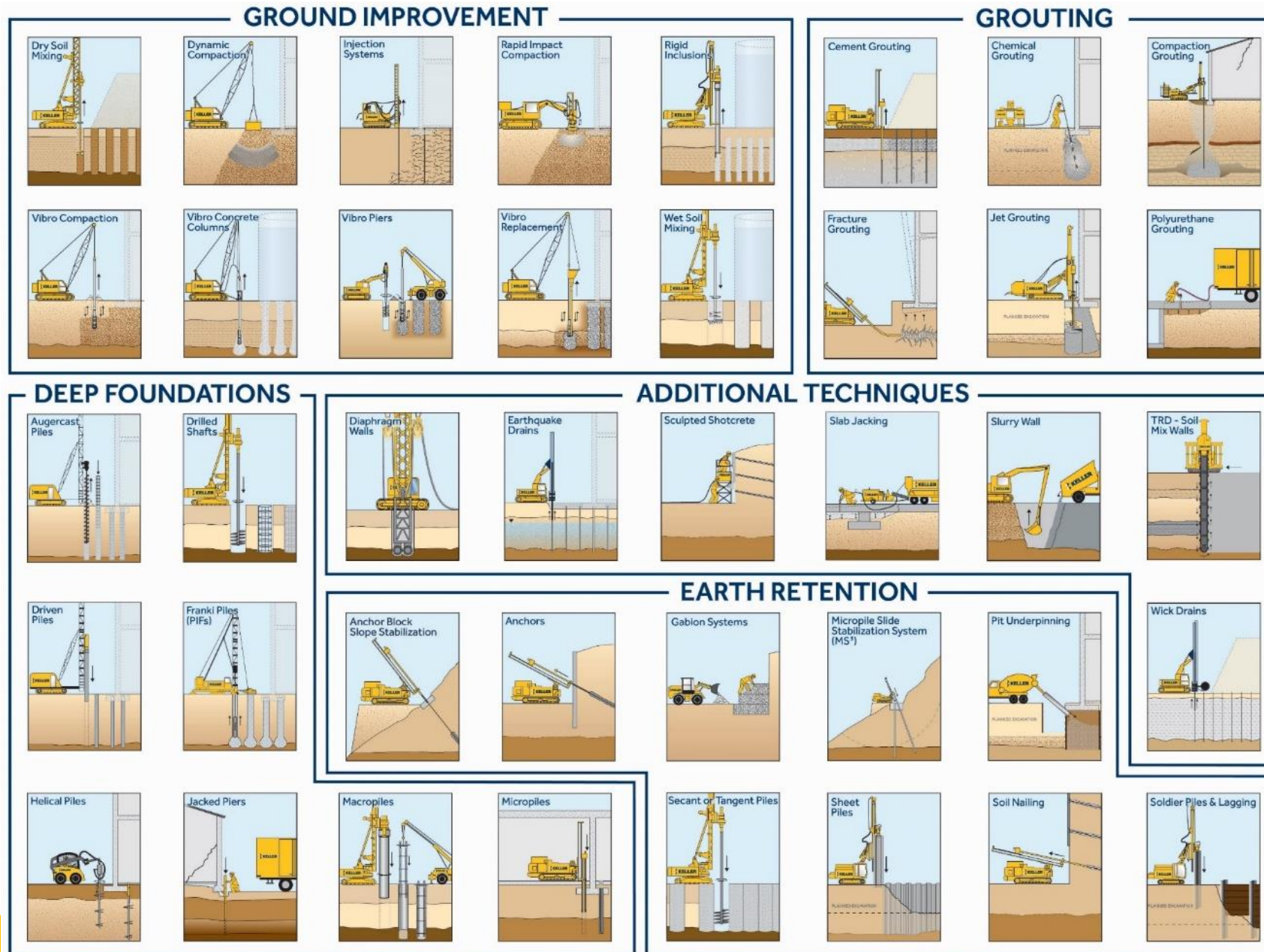
*Presented by:*  
**Anthony Sak, PE**

**USWAG CCR Workshop**  
**Crystal City, Virginia**  
August 8-10, 2022

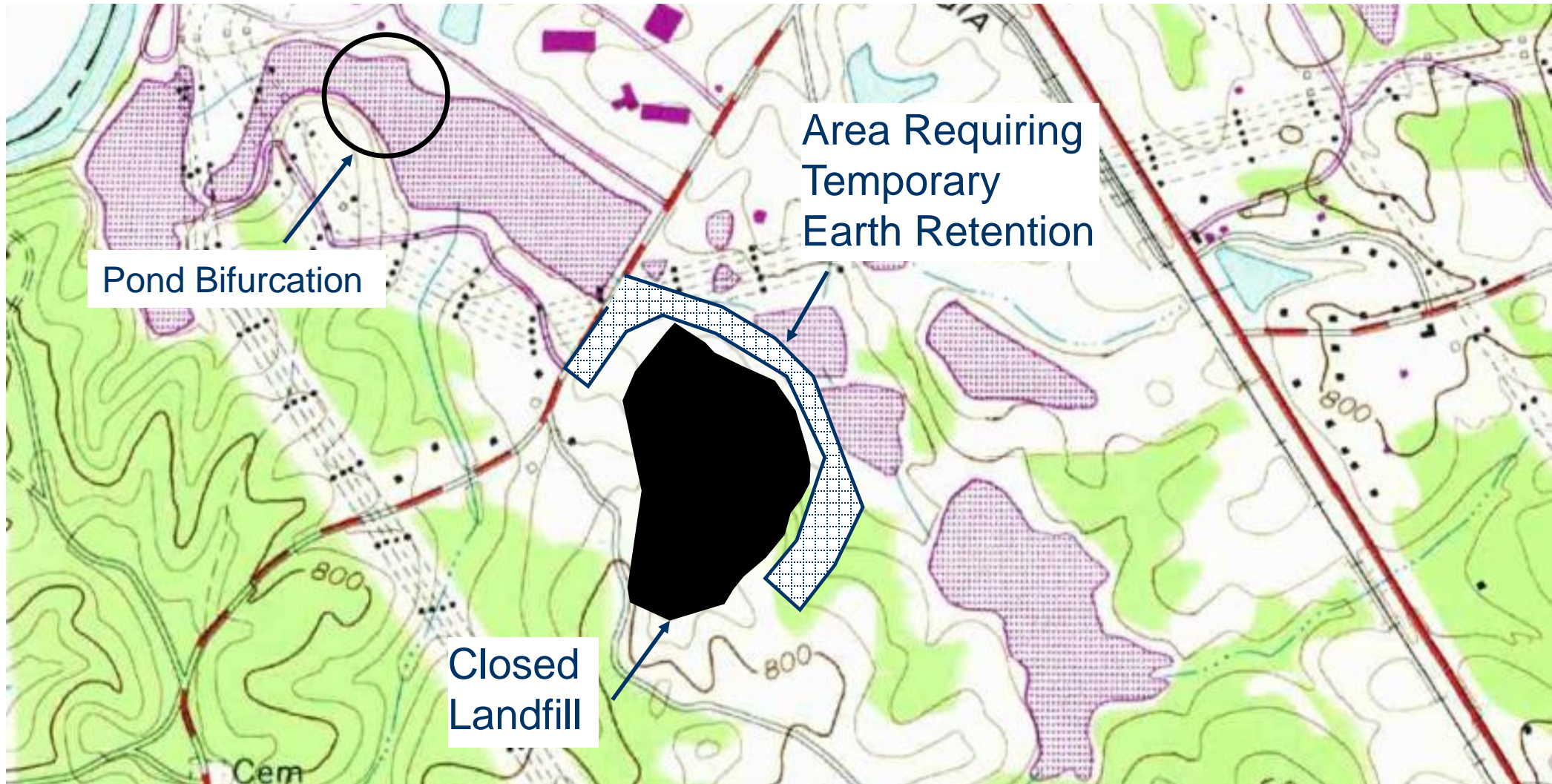
# Outline

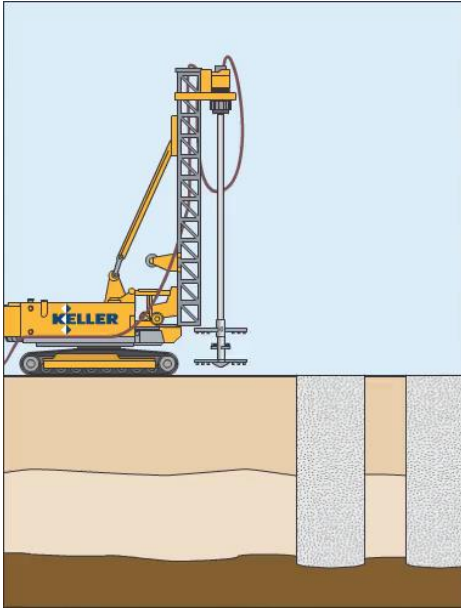
- Geotechnical Construction Techniques
- CCR Pond Complex
  - Temporary Earth Retention
  - Pond Bifurcation
- Seepage Barrier

# Geotechnical Construction Techniques

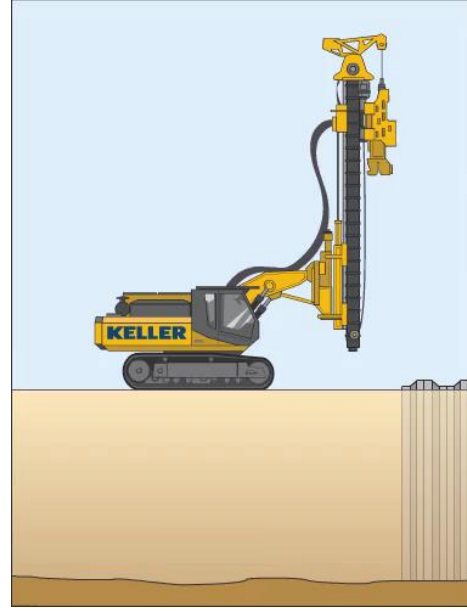


# Ash Complex – Clean Close into On-Site Landfills

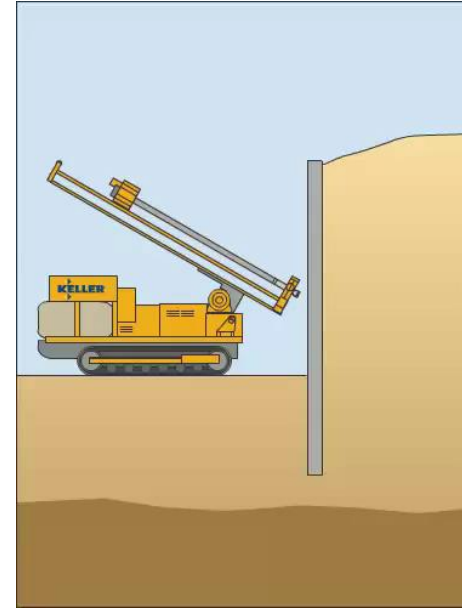




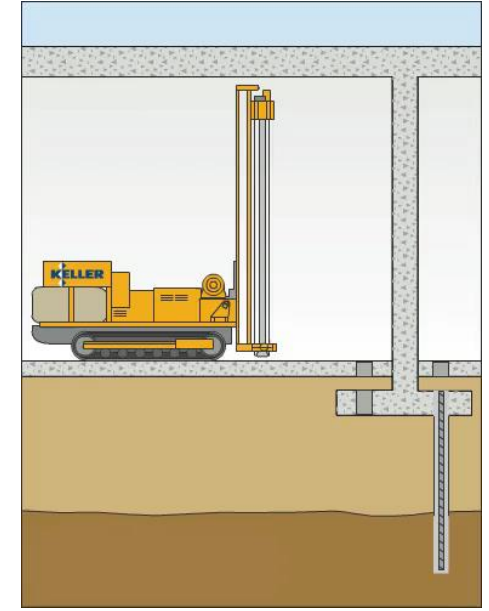
**Deep Soil Mixing**



**Sheet Piles**

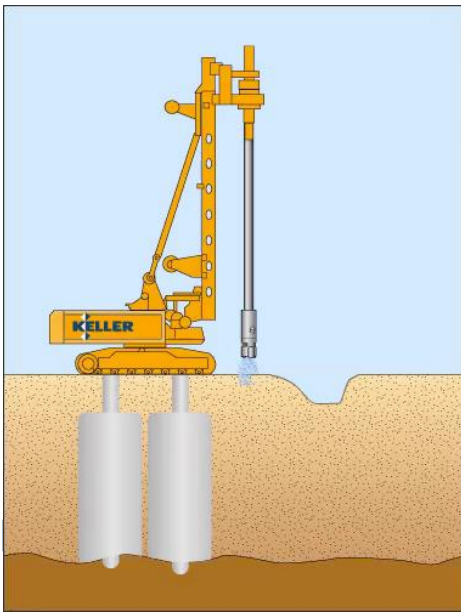


**Anchors**

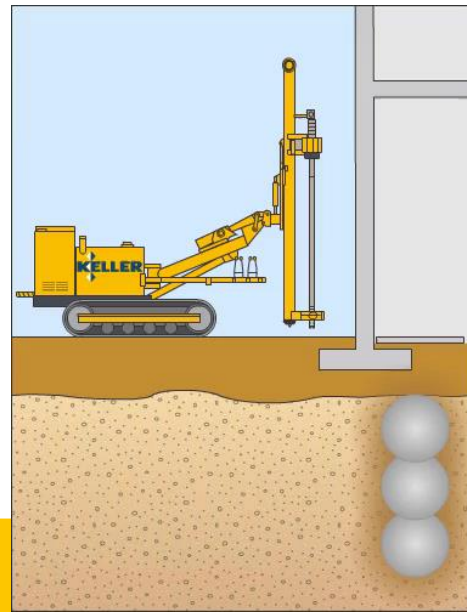


**Micropiles**

**Jet Grouting**



**Compaction Grouting**



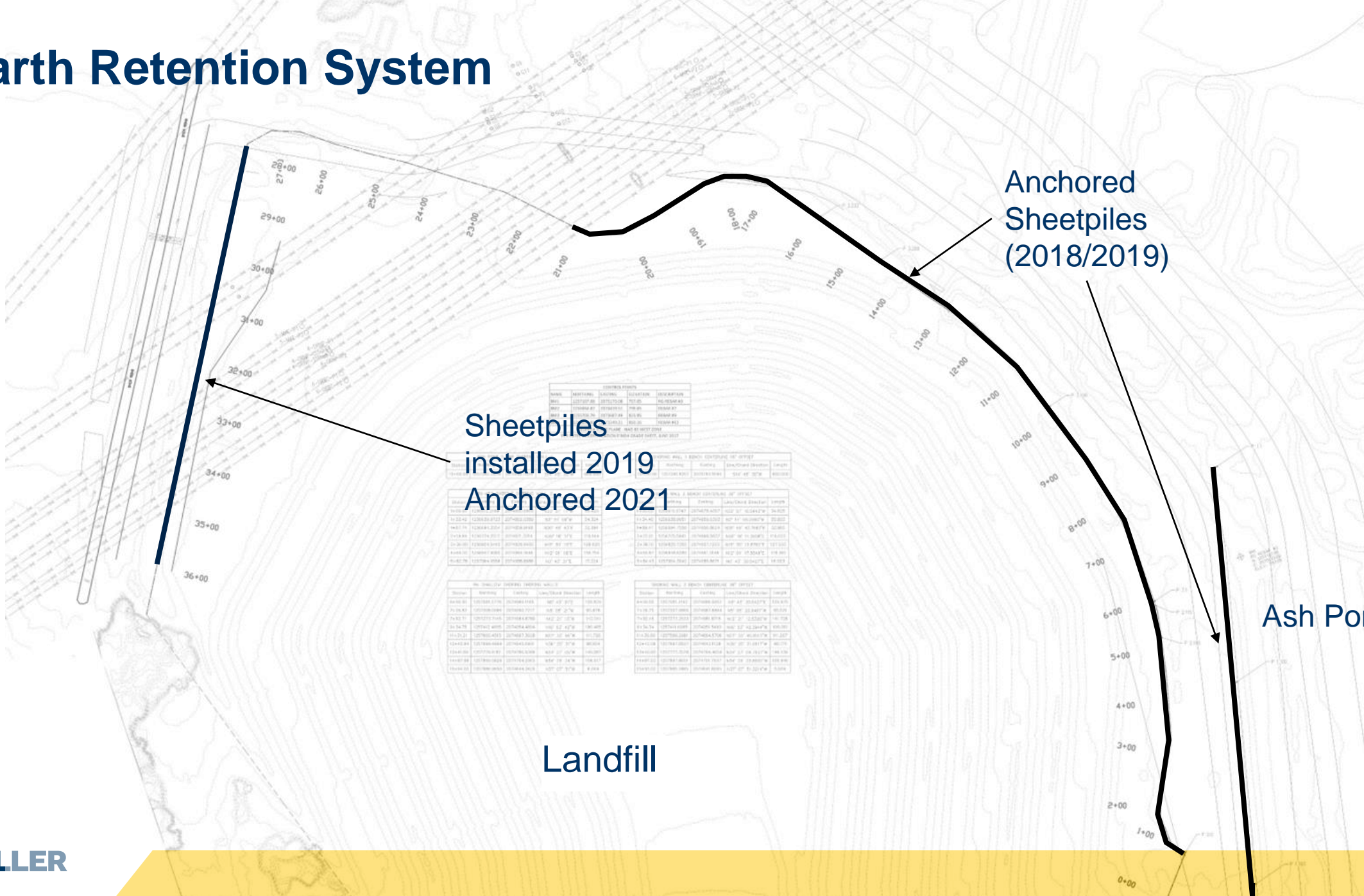
**Mass Soil Mixing**



- Dewatering
- Predrilling (30 and 36-inch diameter)
- Geotechnical Instrumentation
- Geotechnical Investigation



# Earth Retention System



Anchored Sheetpiles (2018/2019)

Sheetpiles installed 2019  
Anchored 2021

Ash Pond Dam

Landfill

# Dewatering

2018/2019

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- Two component dewatering system
  - Work platform stability
  - Well points between rows of sheets (dewater ash for excavation)
  - Well points on retained (landfill) side of sheets (reduce pressure on sheets)

2021

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- Two component dewatering system
  - Work platform stability
  - Vertical well points behind sheetpiles
  - Battered well points drilled through the exposed wall face

# Well Points





# Dewatering System



## Drill and Install Anchors

- 3 to 6 strand anchors
- Lengths 85 to 135 ft

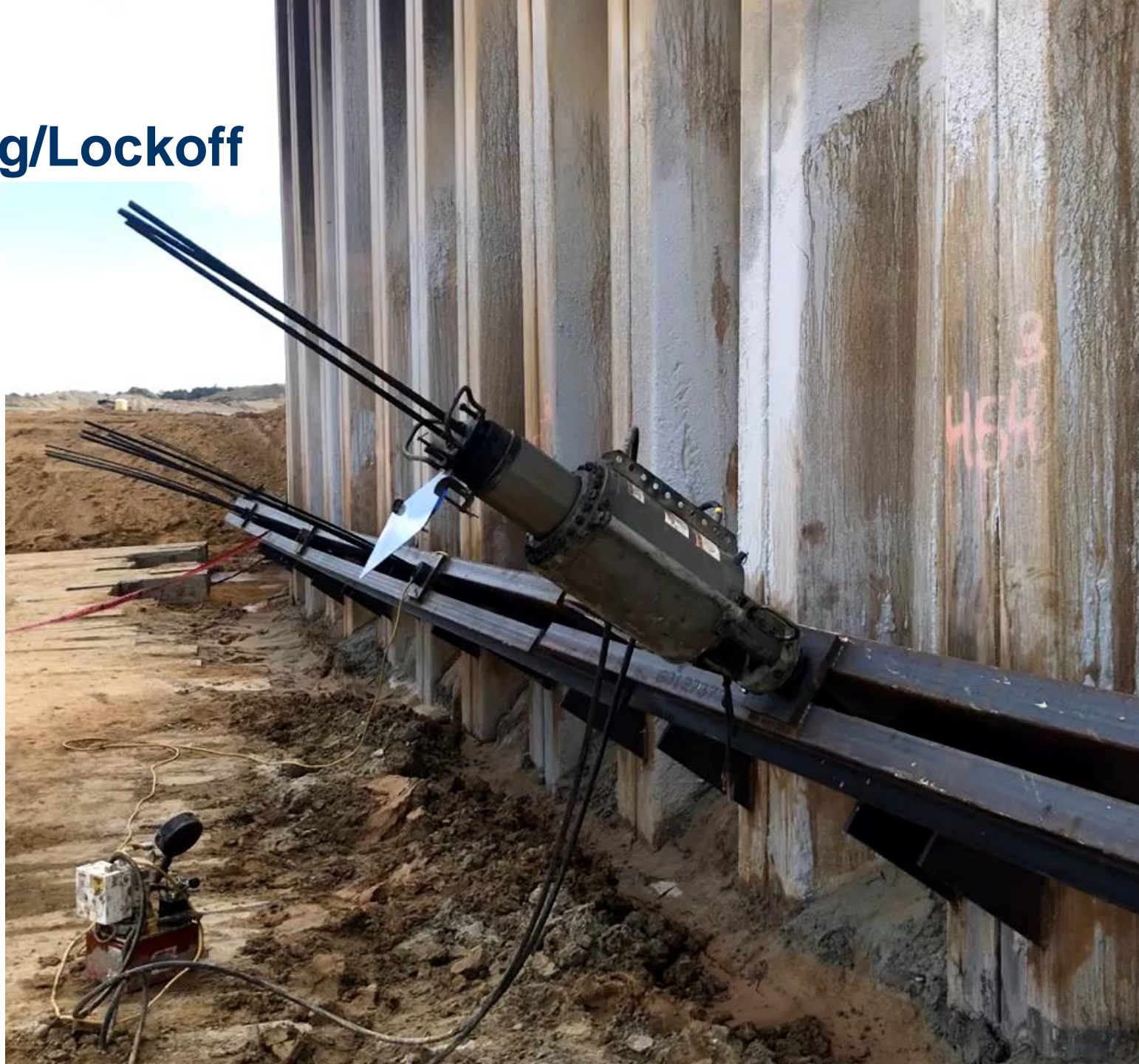


# Install Walers

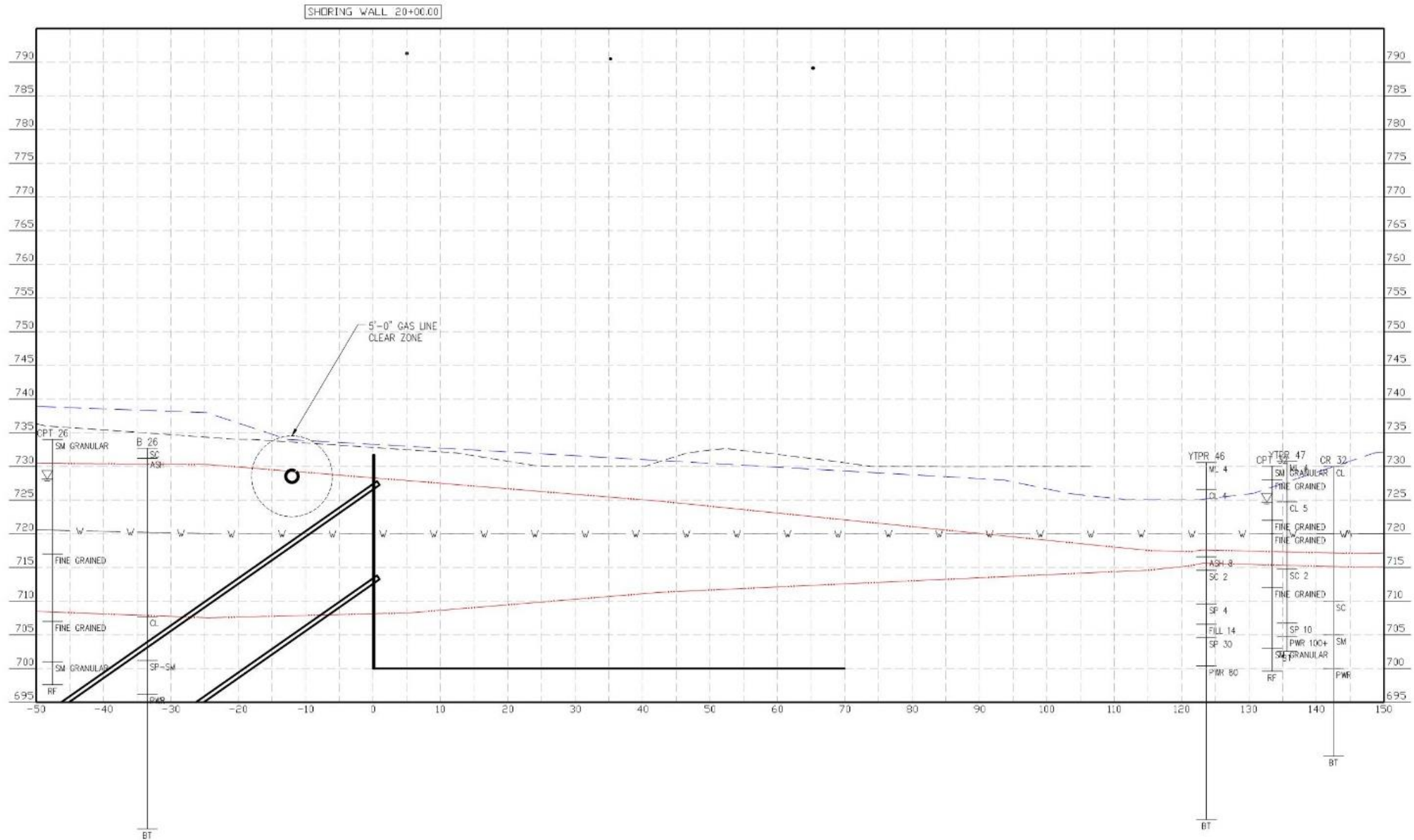


## Setup for Anchor Testing/Lockoff

- Design loads (DL)
  - 105 to 215 kips
- Tested to 133% DL
- Locked off at DL



# 2021 Earth Retention



Other Contractor's  
Sheetpiles (2020)



Keller Sheetpiles  
(2019)



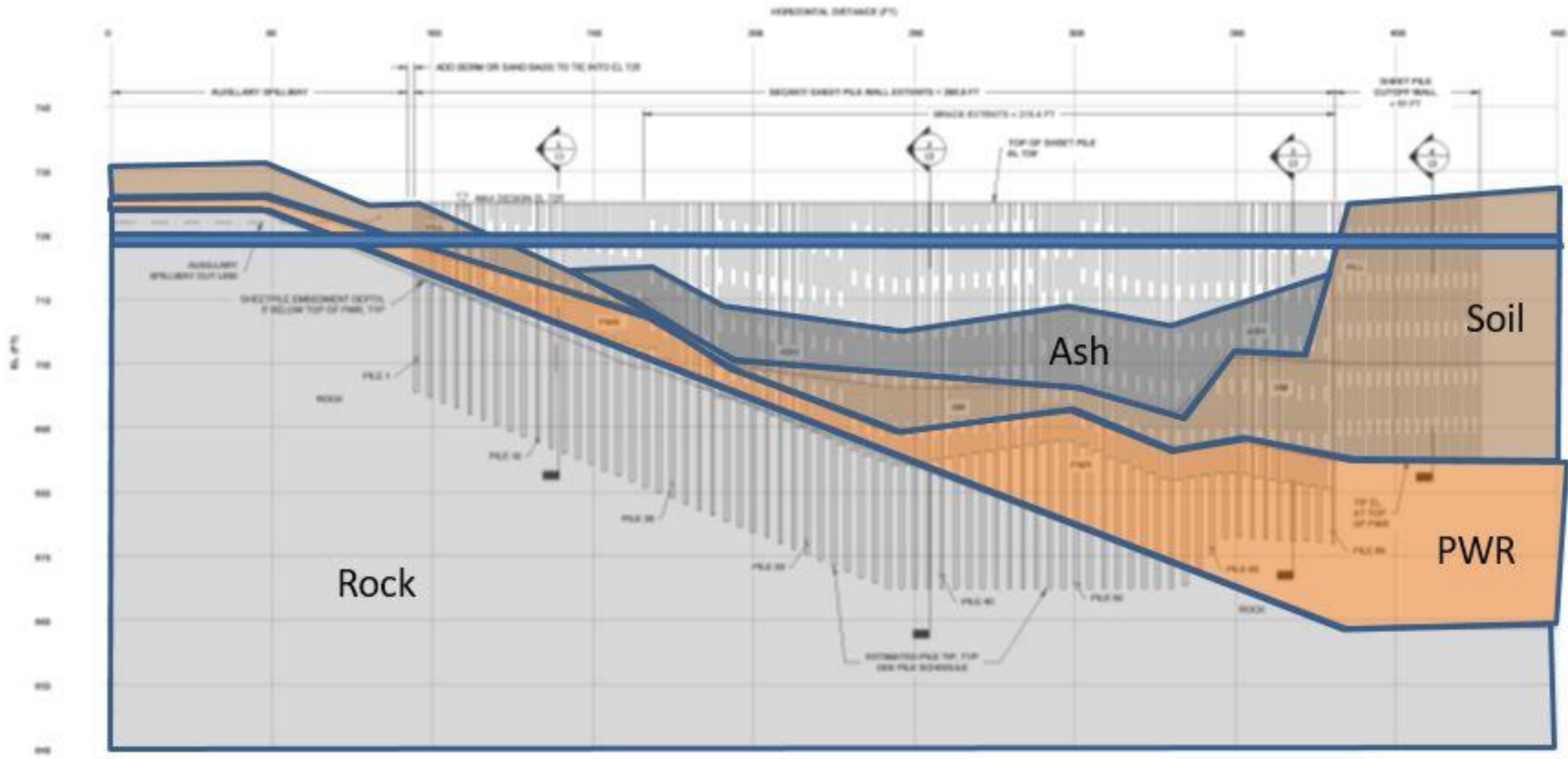
# Excavation Progression



Battered  
Well Header



# Pond Bifurcation - Subsurface Profile



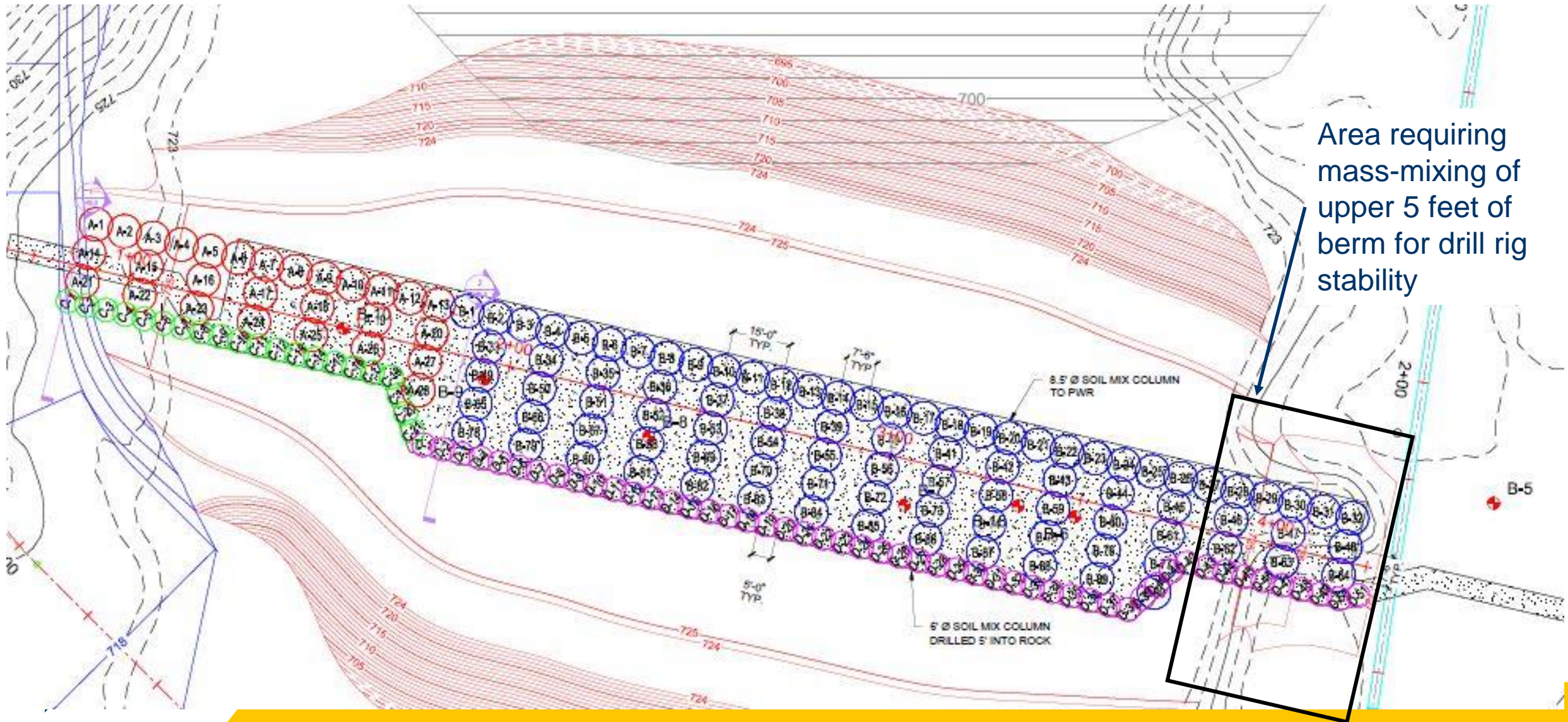
1 SECANT PILE WALL ELEVATION VIEW



# Pond Bifurcation - Divider Berm Construction

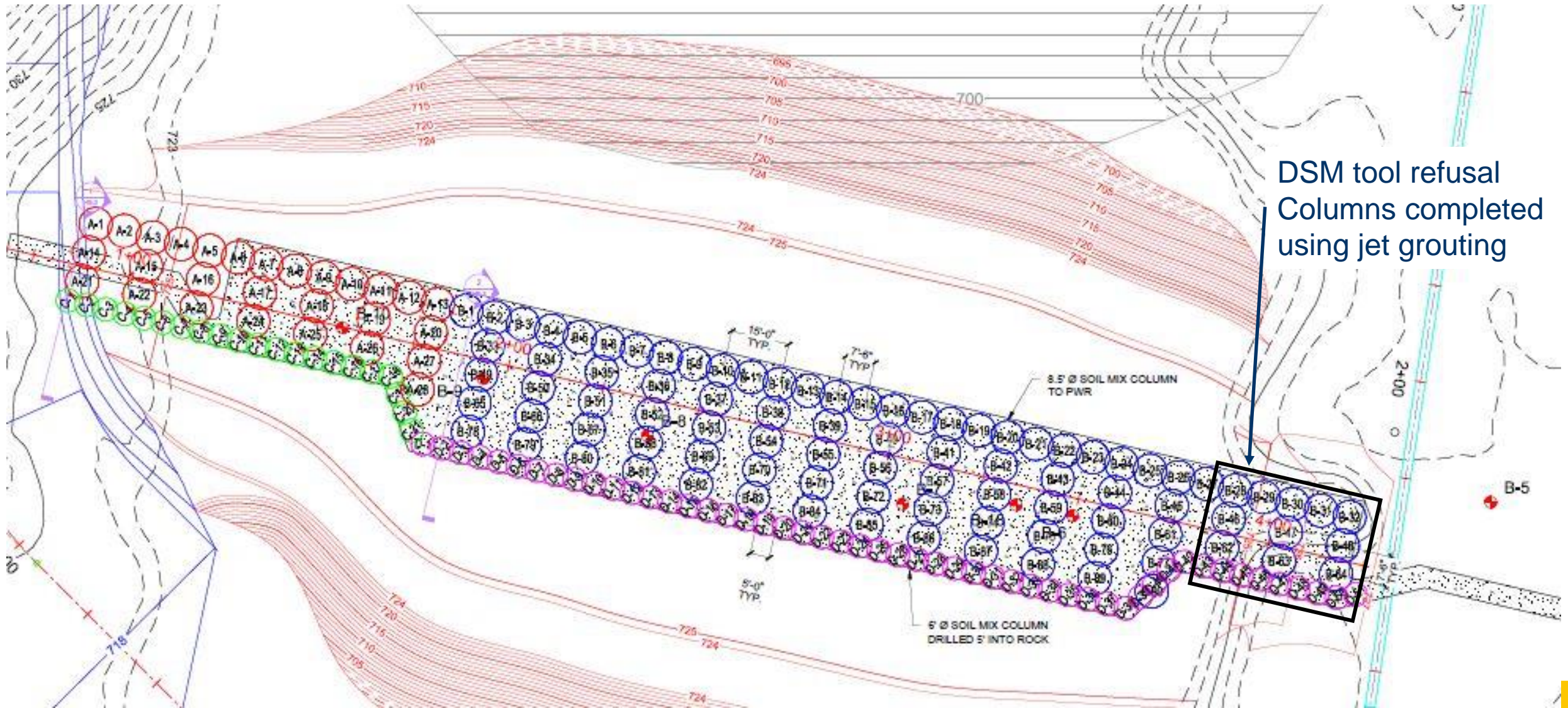


# Divider Berm / DSM Core Solution



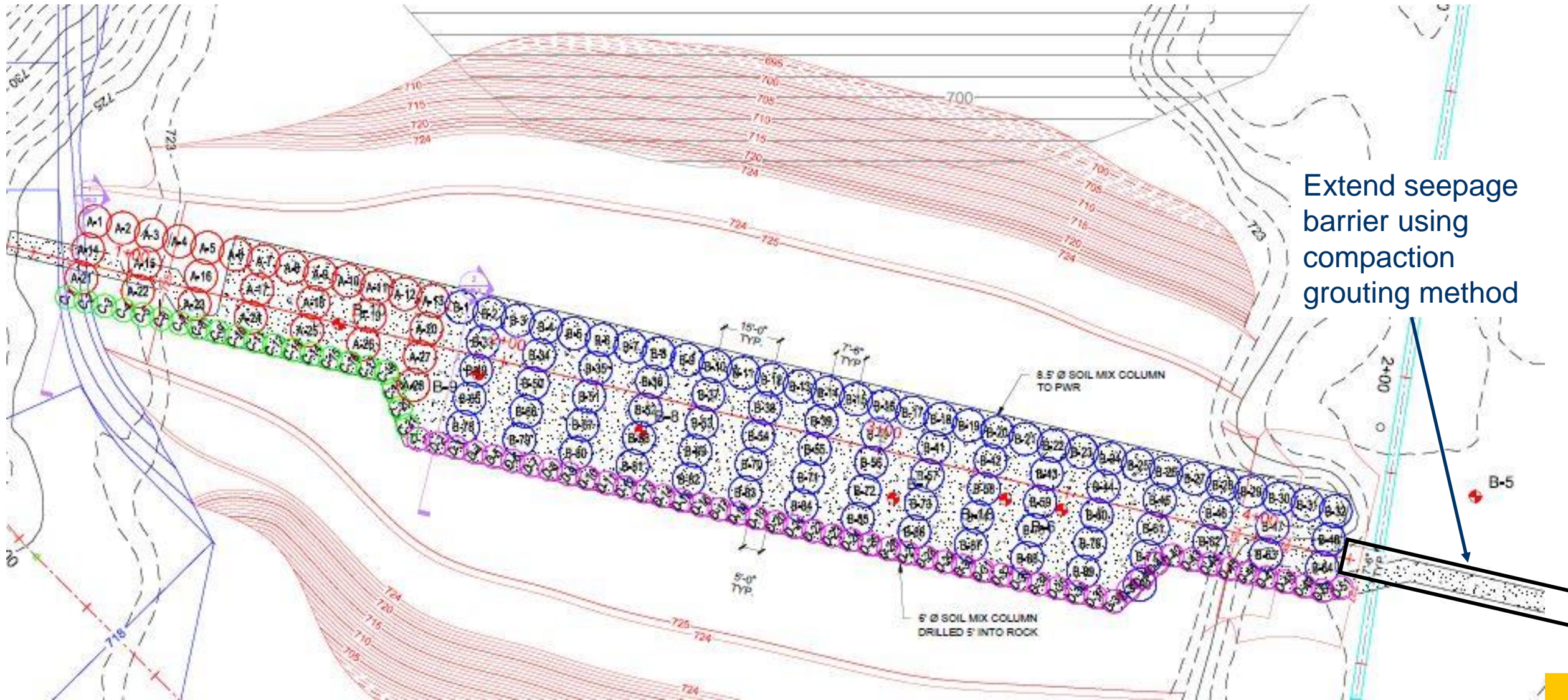
Area requiring mass-mixing of upper 5 feet of berm for drill rig stability

# Divider Berm / DSM Core Solution



DSM tool refusal  
Columns completed  
using jet grouting

# Divider Berm / DSM Core Solution



# Deep Soil Mixing – max depth 40 feet through berm and CCR



# CCR Impoundment Complex Closure Geotechnical Construction Quantities

## Excavation Support Scope

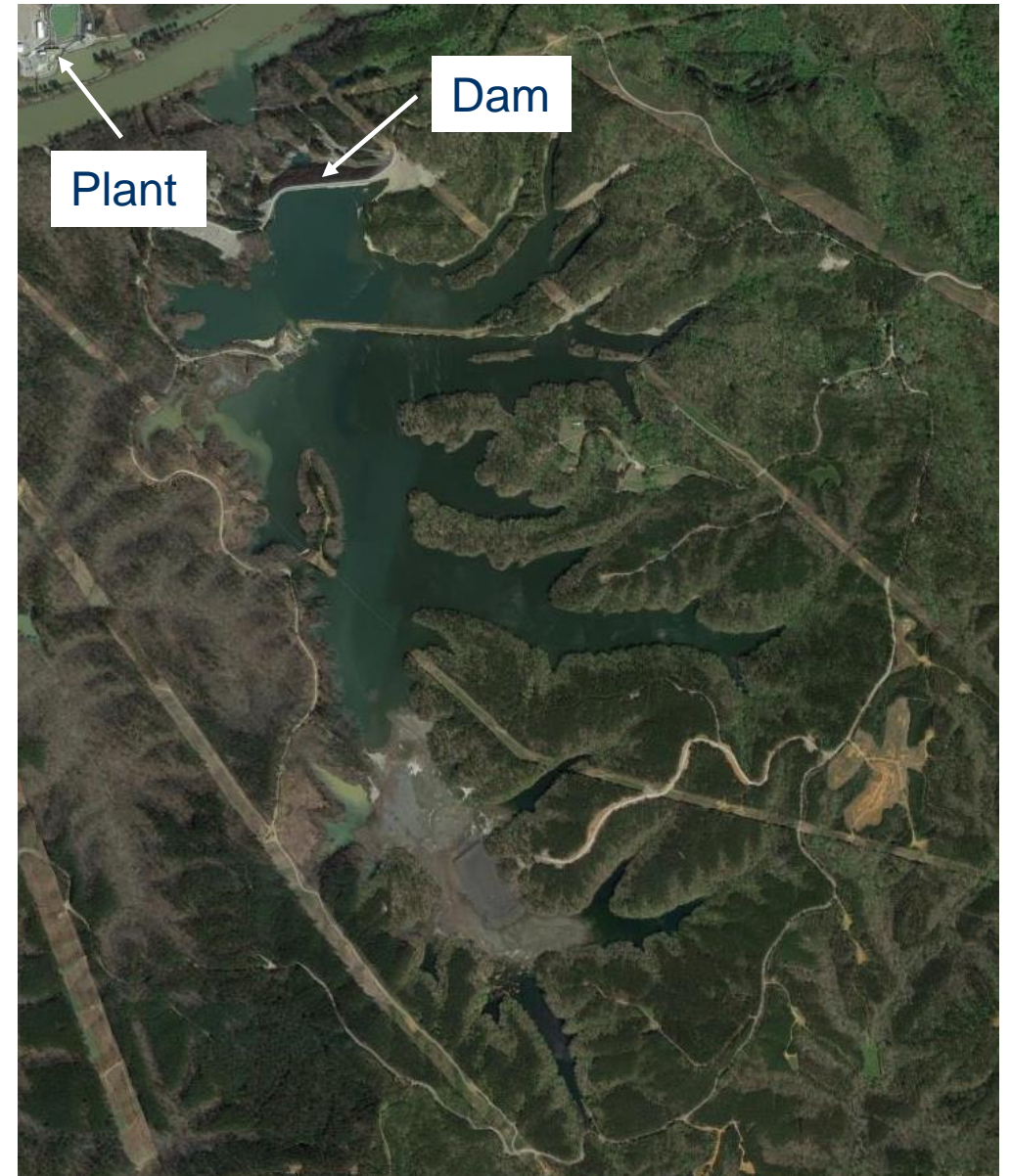
- Sheetpiles installed
  - 3,600 linear feet of wall
  - 130,000 square feet
- Anchors installed - 812
  - Mostly 5 strand anchors at a design load of 175 kips
- Micropiles – 61
- Dewatering wells - 410

## Pond Bifurcation Scope

- Deep soil mixing
  - Ninety-two, 8.5-foot diameter columns
  - Seventy-one, 6-foot diameter columns
  - 19,500 cubic yards
- Mass soil mixing – 4,000 cubic yards treated
- Jet grouting – 600 cubic yards in 64 columns
- Compaction grouting – 385 cubic yards

# Seepage Barrier Project

- Hybrid pond closure
  - Dredge material from behind dam
  - Drain pond
  - Dry stack CCR in upstream fingers
  - Decommission dam



# Holding Pond

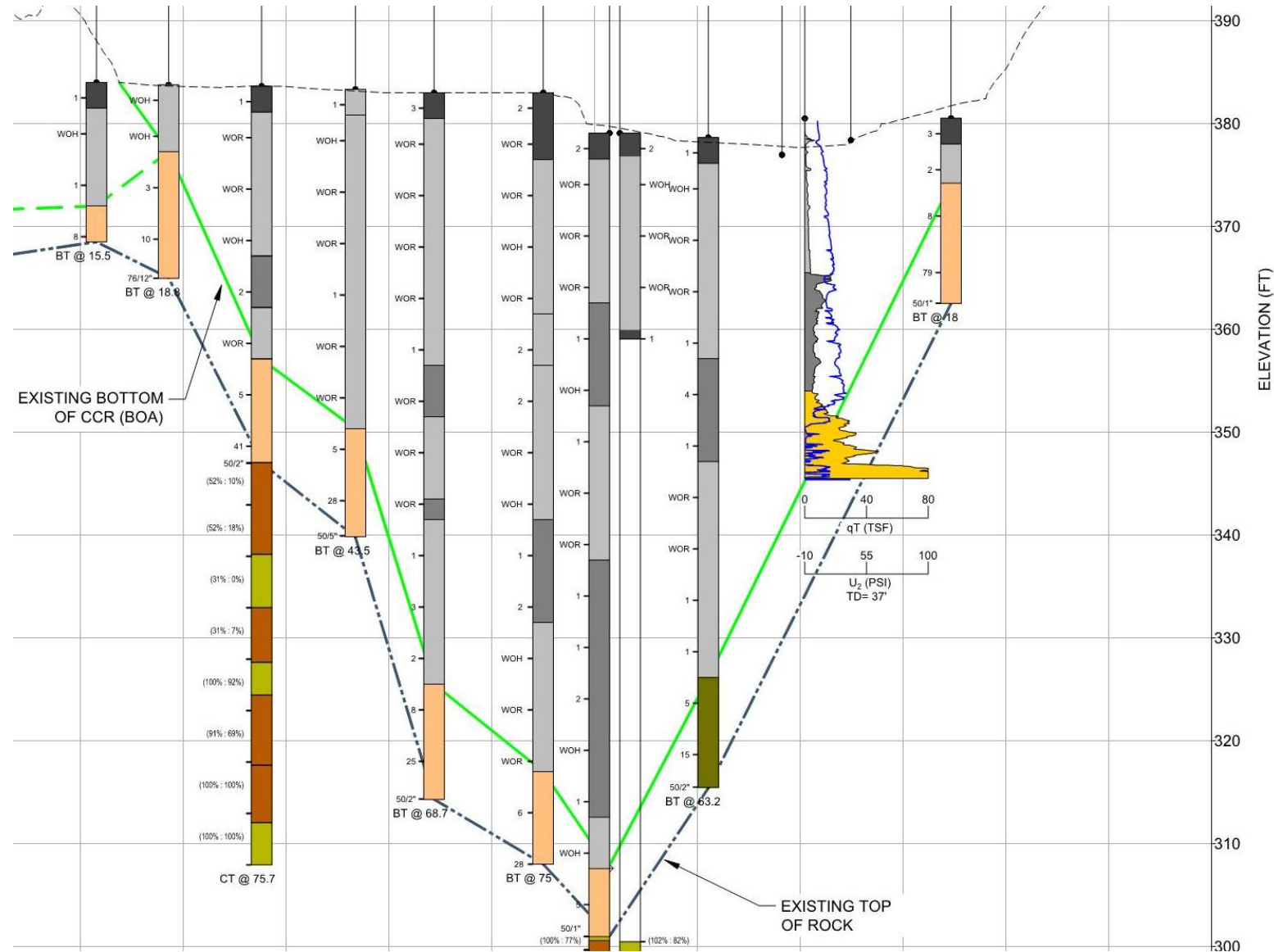
- Dredge operation required a holding pond created in a cove of the CCR pond
- Holding pond must be hydraulically separated from CCR pond, due to draining main pond
- Berm across cove also required
- Other geotechnical techniques were considered to construct a seepage barrier





# Subsurface Profile

- Fly Ash
- Bottom Ash
- Mix of Fly/Bottom Ash
- SPT N-value
  - Weight of Rod
  - Weight of Hammer
  - 1 to 2 blows per foot

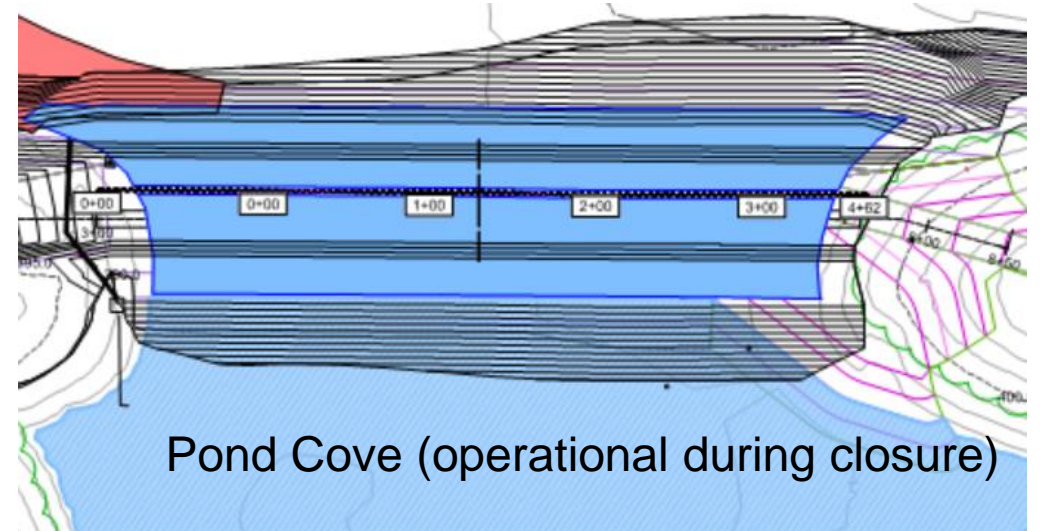


# Keller Scope of Work

- Design geogrid-reinforced berm across pond cove
  - GC constructed using bottom ash
- Install well-point dewatering system
- Geotechnical instrumentation monitoring
- Install 465-foot long sheetpile barrier

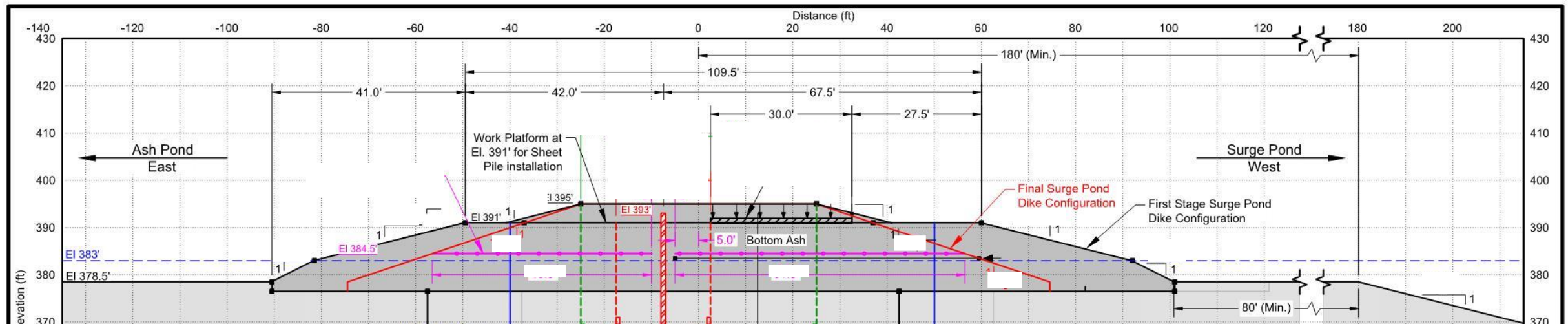
## Main Pond

- remove CCR by dredge
- drain free water



# Berm Design/Construction Sequence

- Place bottom ash bridge lift to design grade
- Multiple layers of geogrid reinforcement with reinforced overlaps (alternate layer roll direction)
- Place/compact 1 to 3 feet of bottom ash fill
- Place/compact bottom ash fill in 12-inch lifts to final grade, let embankment rest
- Cut berm down to sheetpile working grade

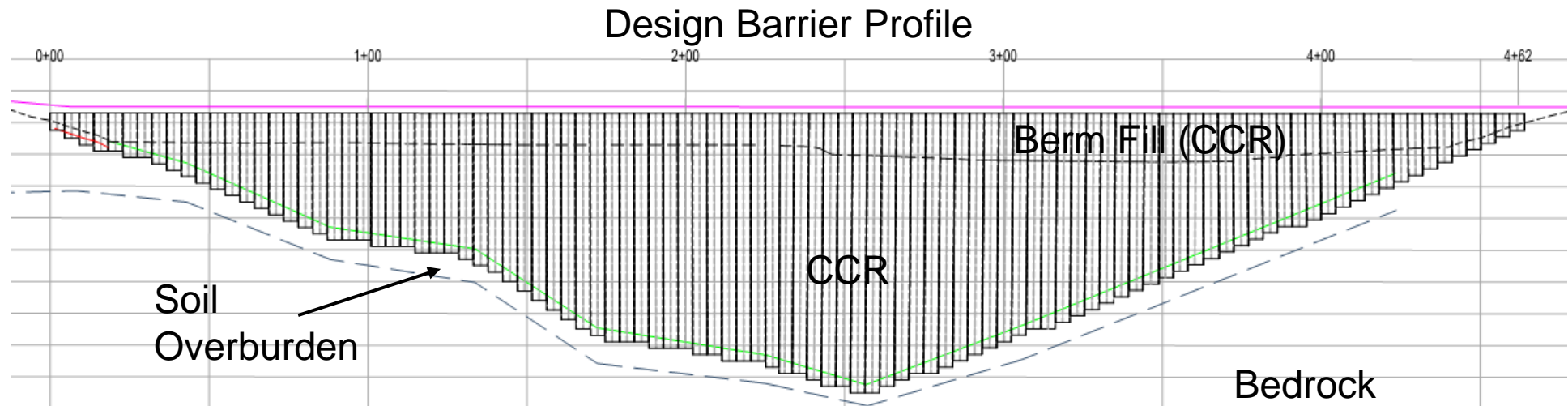


# Instrumentation and Dewatering

- Vibrating wire piezometers – monitor pore water pressure with depth during sheetpile installation
  - Set threshold levels
- Optical survey using automated monitoring total station
- Two lines of jetted well points installed to locally draw down the water in the CCR supporting the berm

# Sheetpile Barrier

- Penetrate through berm and sluiced CCR into natural soil overburden (2 feet)
- No watertightness specification – leaky barrier
- Site access limited delivered pile length to 40 feet (splicing required), maximum length 85 feet



# Crane Operates from Mats



# Use Guide Beams for Layout



# Piles Installed with a Diesel Hammer & Vibratory Hammer





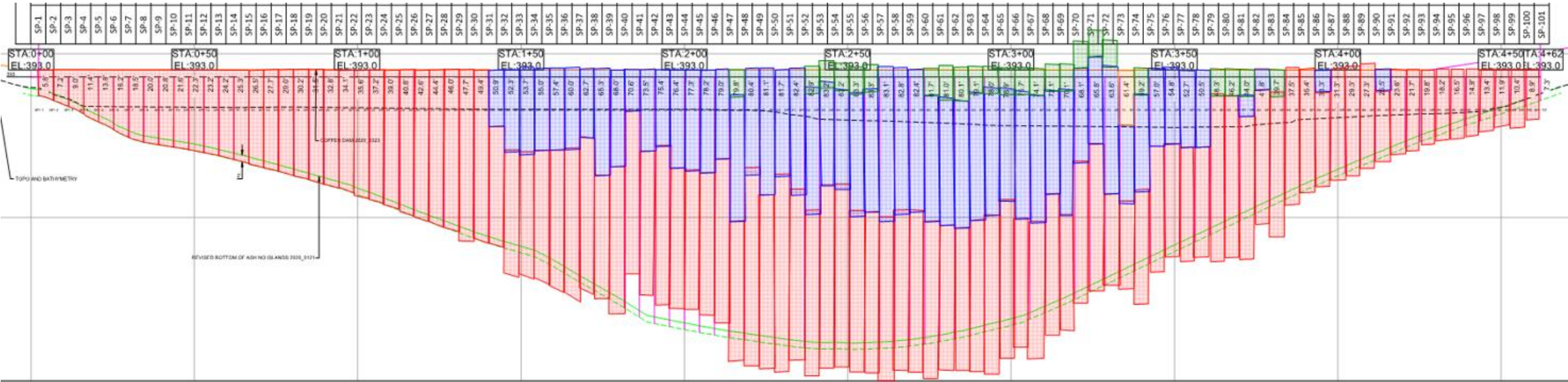
# Sheetpile Splicing



# Completed Sheetpile Barrier



- 101 pairs of sheets
- 465 feet barrier length
- 23,559 sq. ft.



# Instrumentation Monitoring during Geotechnical Construction

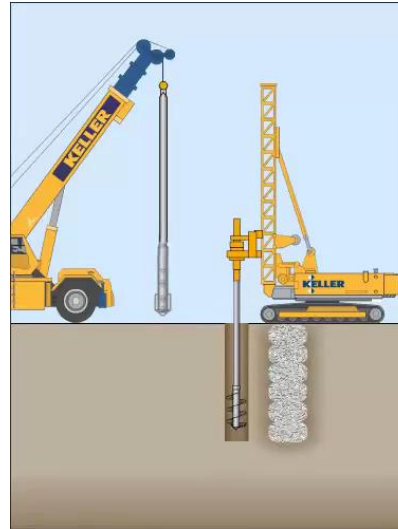
- Geo-Instruments installed a comprehensive system installed:
  - Vibration monitoring
  - Vibrating wire piezometers
  - Inclinometers (SAA)
  - Standpipe piezometers
- Solar powered
- Website Access
- Trigger levels
- Notifications
  - Individual equipment alarms
  - Site alarms (light and siren)
  - Emails/texts



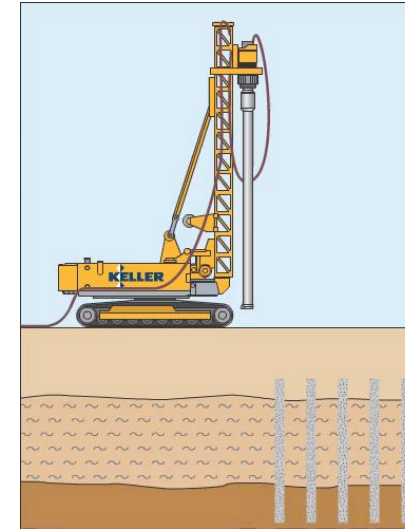
# Other Applications of Geotechnical Construction Techniques Applied to CCR

- Aggregate pier and rigid inclusion ground improvement for foundations of light to moderately loaded structures/tanks/silos on weak ground
- Seepage barriers using conventional slurry wall or TRD
- In-situ stabilization/bottom seals using jet grouting or deep soil mixing

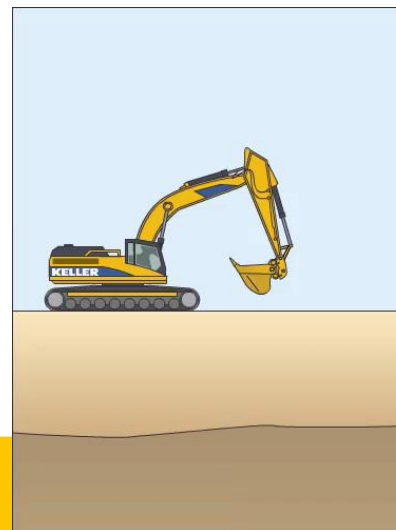
Aggregate Piers



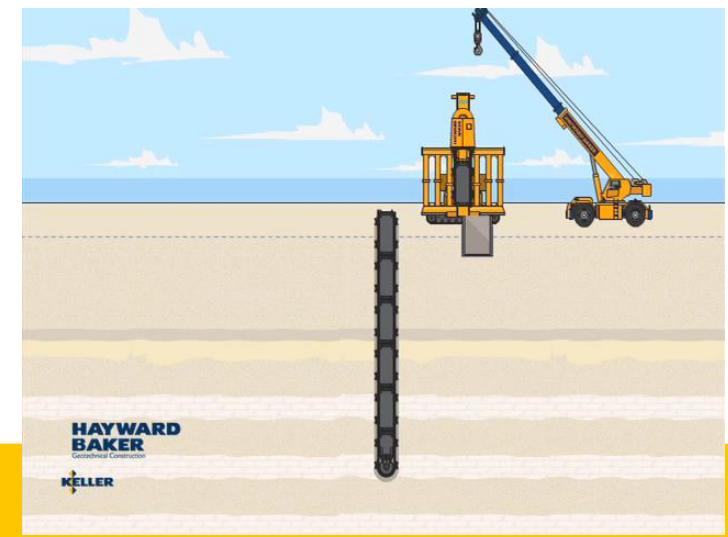
Rigid Inclusions



Slurry Wall



TRD



# Questions

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## Geotechnical solutions for CCR pond closure

