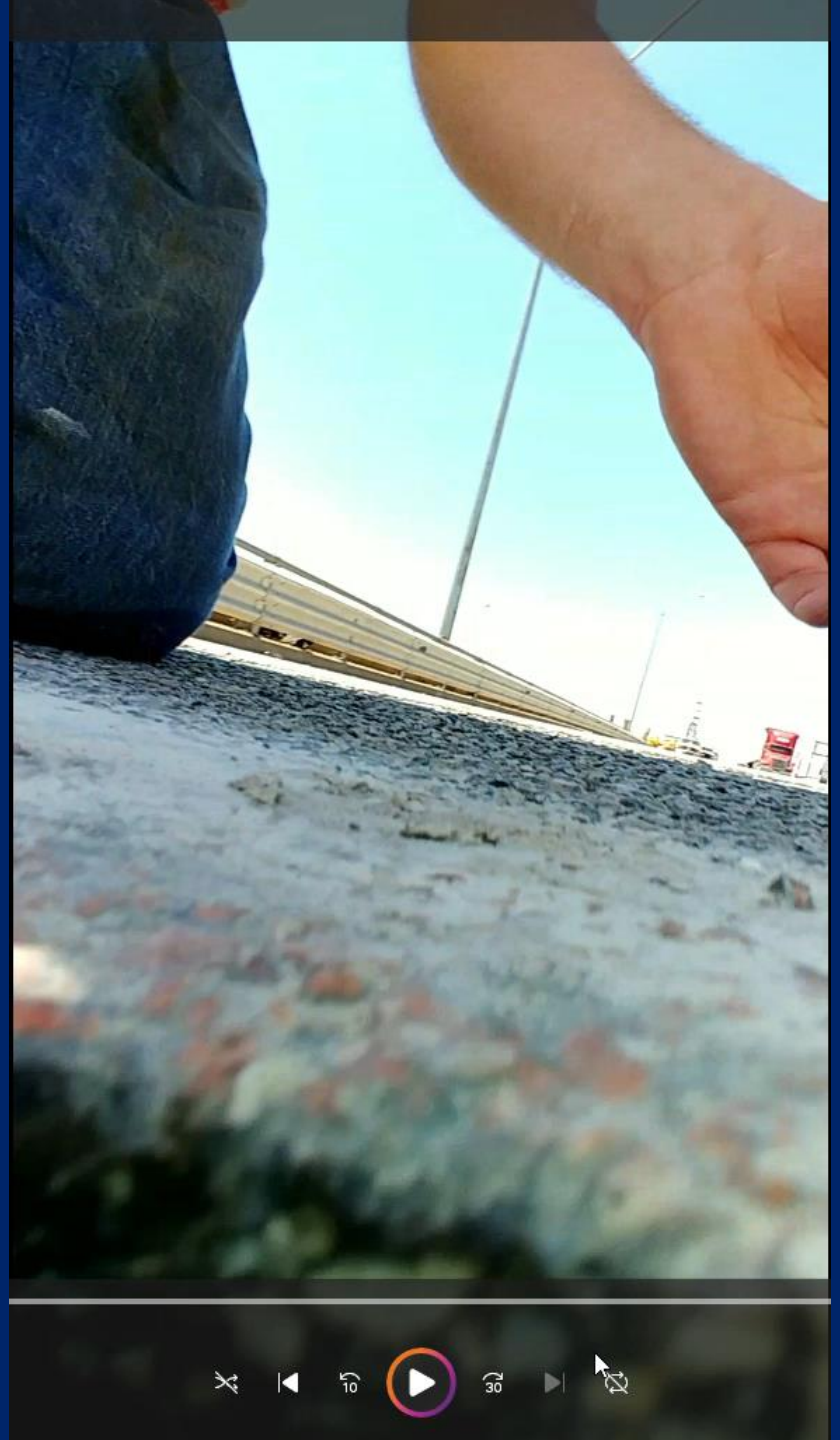
Kansas Department of Transportation

# Geotechnical Investigation Requirements and Scheduling

# What Subsurface Conditions exist?


Kansas Department of Transportation

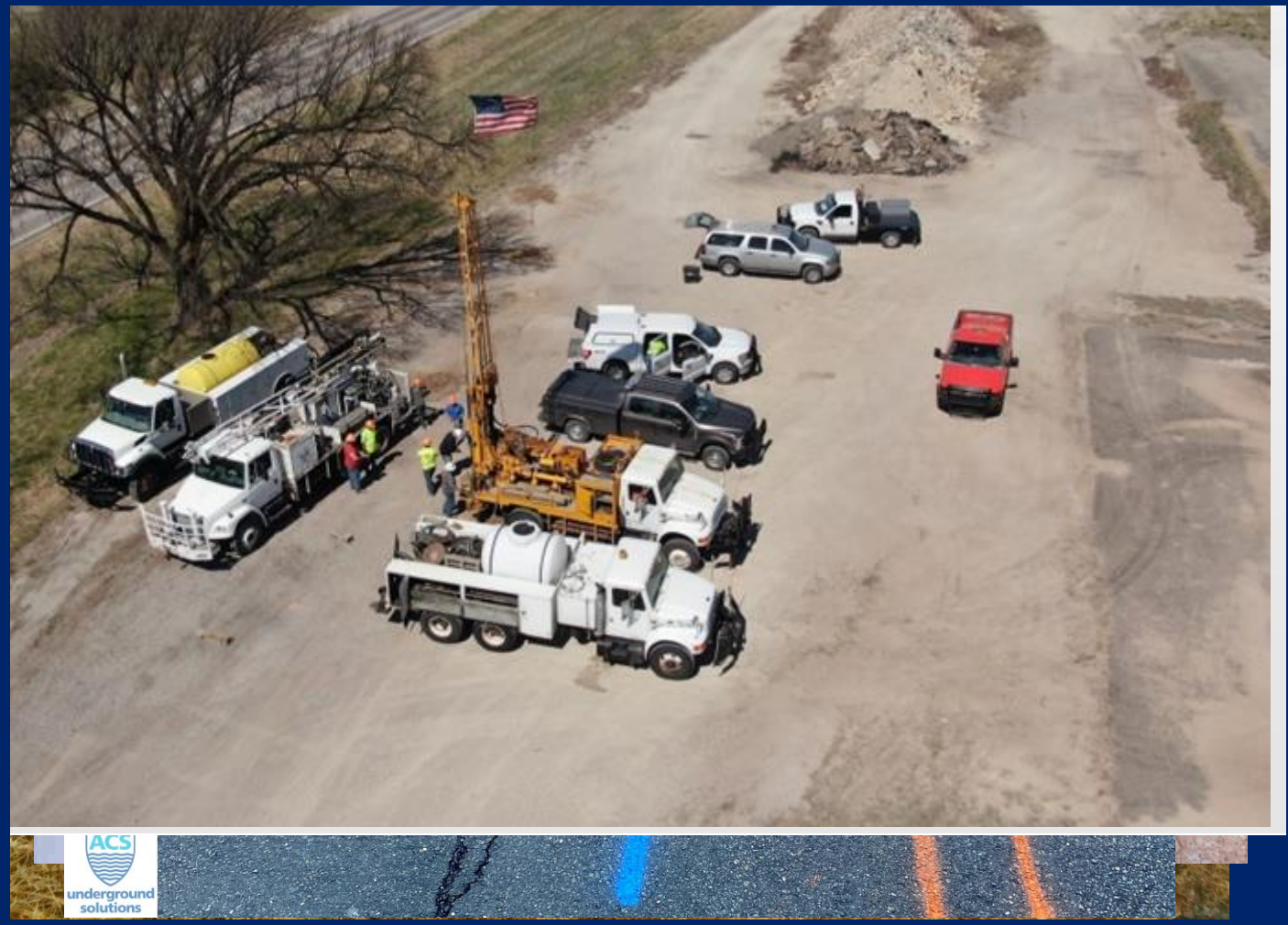

AD ASTRA PER ASPERA
Kansas
Department of Transportation



Kansas
Department of Transportation

# What Impacts an Investigation?

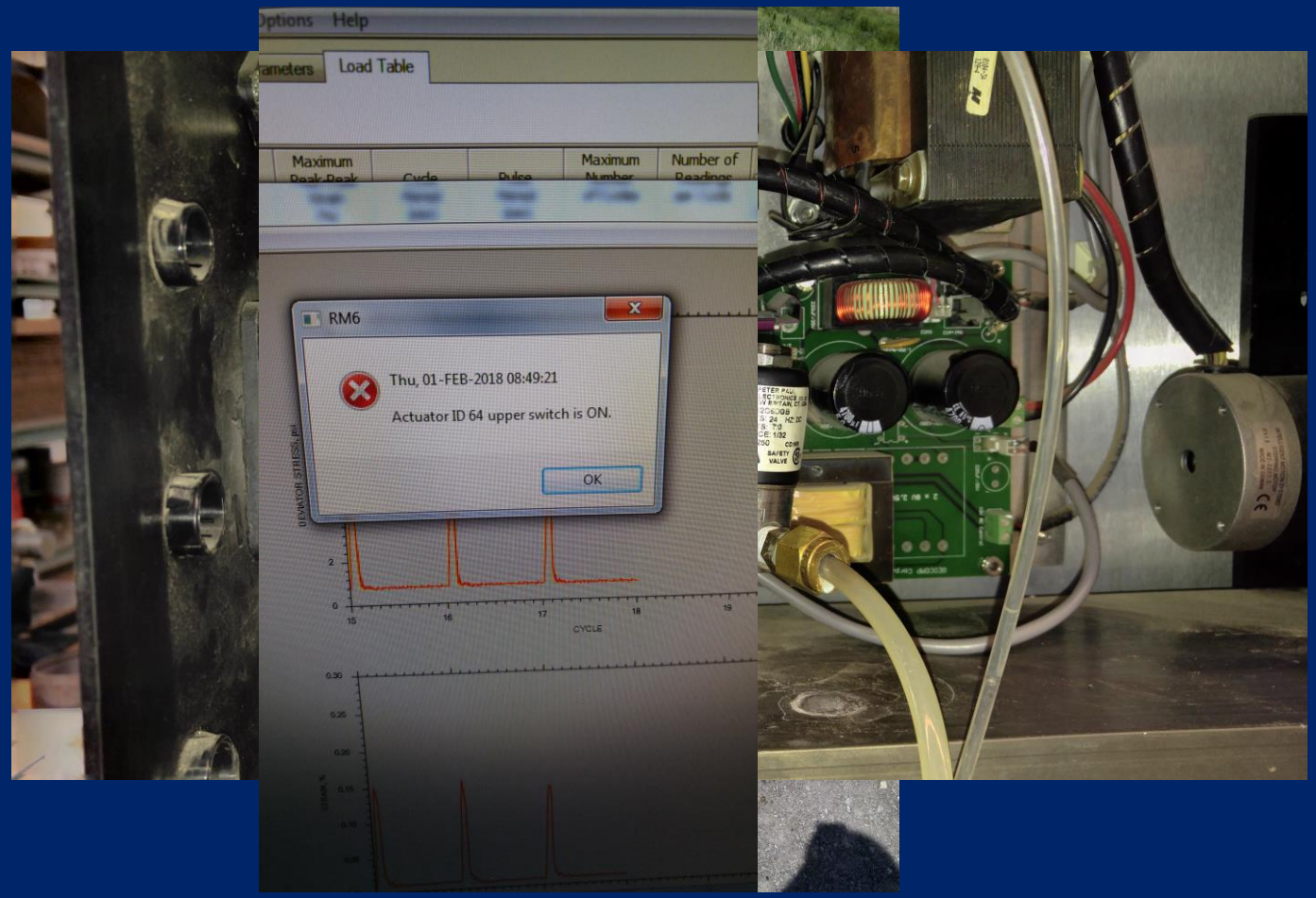
- Access
- Landowner Permission
- Mother Nature
- Railroad
- Utilities
- Personnel
- Equipment




Kansas
Department of Transportation

# Challenges Associated with a Geotechnical Investigation

- Access
- Landowner Permission
- Mother Nature
- Railroad
- Utilities
- Personnel
- Equipment




Kansas Department of Transportation

# KDOT Geotechnical Investigation Procedure

- Determine what the scope of the project is: surface investigation, foundation investigation, wall investigation, slope stability and settlement, temporary shoring, soil survey.

**Table 3-13**

**Guidelines for minimum number of exploration points and depth of exploration (modified after FHWA, 2002a)**

| Application | Minimum Number of Exploration Points and Location of Exploration Points | Minimum Depth of Exploration |
|---|---|---|
| Retaining walls | (1) A minimum of one exploration point for each retaining wall.<br>(2) For retaining walls more than 100 ft (30 m) in length, exploration points spaced every 100 to 200 ft (30 to 60 m) with locations alternating from in front of the wall to behind the wall.<br>(3) For anchored walls, additional exploration points in the anchorage zone spaced at 100 to 200 ft (30 to 60 m).<br>(4) For soil-nail walls, additional exploration points at a distance of 1.0 to 1.5 times the height of the wall behind the wall spaced at 100 to 200 ft (30 to 60 m). | (1) Investigate to a depth below bottom of wall between 1 and 2 times the wall height or a minimum of 10 ft (3 m) into bedrock.<br>(2) Exploration depth should be great enough to fully penetrate soft highly compressible soils (e.g. peat, organic silt, soft fine grained soils) into competent material of suitable bearing capacity (e.g., stiff to hard cohesive soil, compact dense cohesionless soil, or bedrock). |
| Embankment Foundations | (1) A minimum of one exploration point every 200 ft (60 m) (erratic conditions) to 400 ft (120 m) (uniform conditions) of embankment length along the centerline of the embankment.<br>(2) At critical locations, (e.g., maximum embankment heights, maximum depths of soft strata) a minimum of three exploration points in the transverse direction to define the existing subsurface conditions for stability analyses.<br>(3) For bridge approach embankments, at least one exploration point at abutment locations. | (1) Exploration depth should be, at a minimum, equal to twice the embankment height unless a hard stratum is encountered above this depth.<br>(2) If soft strata are encountered extending to a depth greater than twice the embankment height, the exploration depth should be great enough to fully penetrate the soft strata into competent material (e.g., stiff to hard cohesive soil, compact to dense cohesionless soil, or bedrock). |
| Cut Slopes | (1) A minimum of one exploration point every 200 ft (60 m) (erratic conditions) to 400 ft (120 m) (uniform conditions) of slope length.<br>(2) At critical locations (e.g., maximum cut depths, maximum depths of soft strata) a minimum of three exploration points in the transverse direction to define the existing subsurface conditions for stability analyses.<br>(3) For cut slopes in rock, perform geologic mapping along the length of the cut slope. | (1) Exploration depth should be, at a minimum, 15 ft (4.5 m) below the minimum elevation of the cut unless a hard stratum is encountered below the minimum elevation of the cut.<br>(2) Exploration depth should be great enough to fully penetrate through soft strata into competent material (e.g., stiff to hard cohesive soil, compact to dense cohesionless soil, or bedrock).<br>(3) In locations where the base of cut is below ground-water level, increase depth of exploration as needed to determine the depth of underlying pervious strata. |

Kansas Department of Transportation

# KDOT Geotechnical Investigation Procedure

- Determine what the scope of the project is: surface investigation, foundation investigation, wall investigation, slope stability and settlement, temporary shoring, soil survey.

and settlement issues in the geotechnical report.

Sampling and in-situ testing criteria are the same as for bridges.

**3.3.2.3 Retaining Walls**

At retaining wall locations borings should be taken at a maximum interval of one per 100 feet (30 meters) of the wall, as close to the wall alignment as possible. Borings should be extended below the bottom of the wall a minimum of twice the wall height or at least 10 feet (3 m) into competent material. Borings offset behind and in front of the proposed system should be taken in 150 to 200 foot intervals. This applies to all walls, proprietary systems as well as precast and cast-in-place systems. Sampling and in-situ testing criteria are the same as for bridges.



Kansas Department of Transportation

# Geotechnical Investigation Guidelines

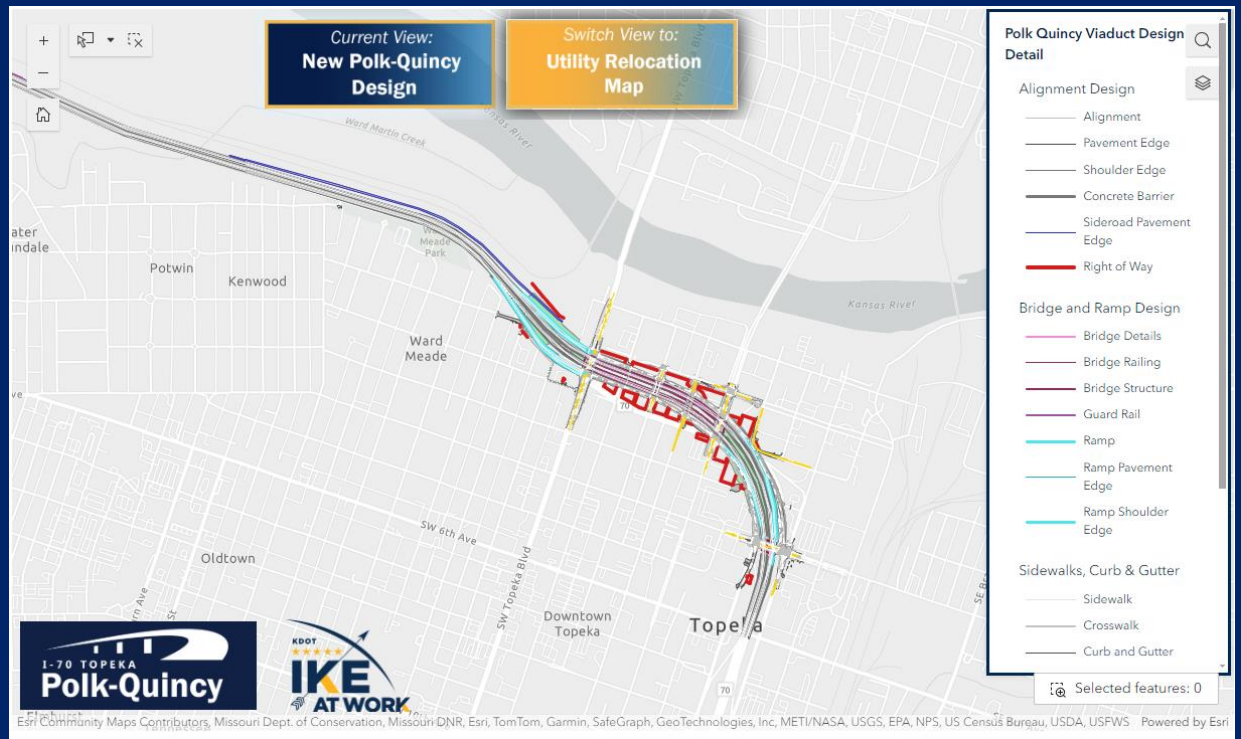
- Arizona DOT: https://azdot.gov/business/engineering-and-construction/bridge/geotechnical-services
- California DOT: https://dot.ca.gov/programs/engineering-services/manuals/geotechnical-manual
- Hawaii DOT: Could not find
- Kansas DOT: https://kart.ksdot.gov/
- Louisiana DOTD: http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Pavement_Geotechnical/Pages/Geotechnical.aspx
- Nevada DOT: https://www.dot.nv.gov/doing-business/about-ndot/ndot-divisions/operations/materials-section/geotechnical-section
- New Mexico DOT: https://www.dot.nm.gov/infrastructure/engineering-publications/design-manual/
- Oklahoma DOT: https://oklahoma.gov/content/dam/ok/en/odot/documents/Geotech%20Specifications.pdf
- Texas DOT: https://onlinemanuals.txdot.gov/TxDOTOnlineManuals/TxDOTManuals/geo/index.htm

- FHWA: https://www.fhwa.dot.gov/engineering/geotech/library_listing.cfm

Kansas Department of Transportation

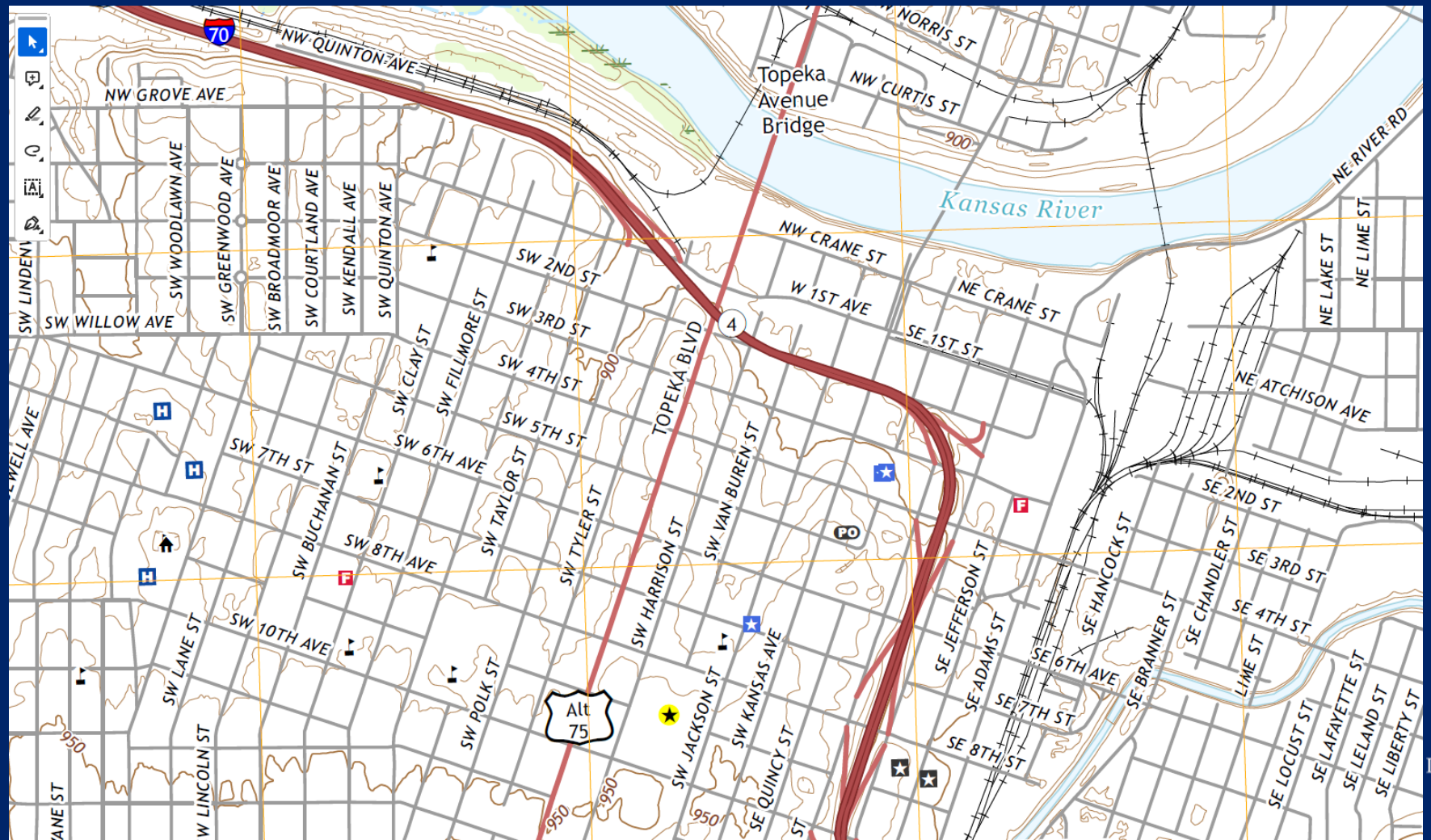
# Example Project

- 70-89 KA-1266-04 Polk-Quincy Viaduct
- Includes a surface geology investigation, bridge foundation geology investigations, slope stability and settlement investigations, temporary shoring investigations, and more!



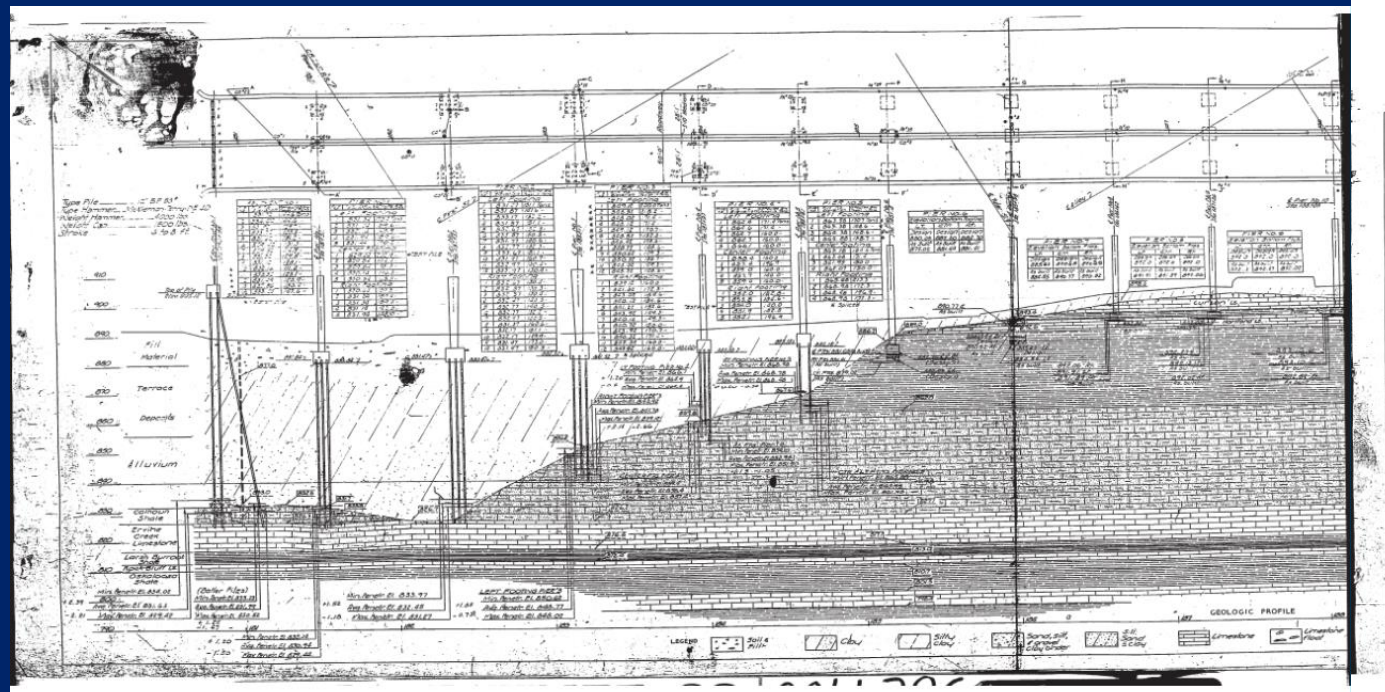

Kansas Department of Transportation

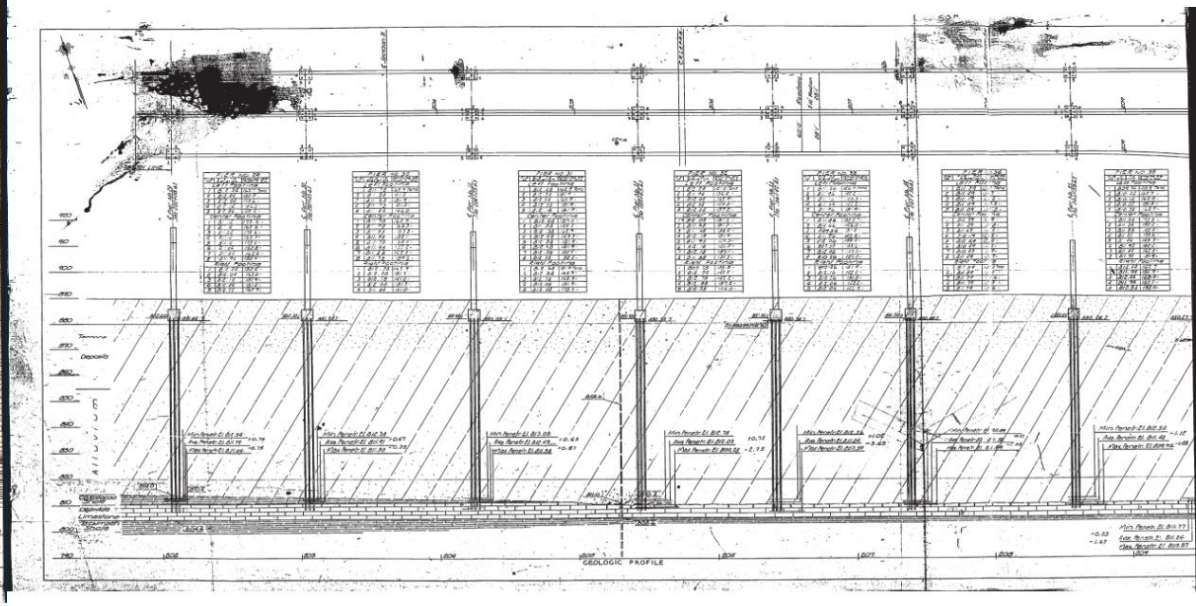
# Pre-Fieldwork




AD ASTRA PER ASPERA
Kansas
Department of Transportation

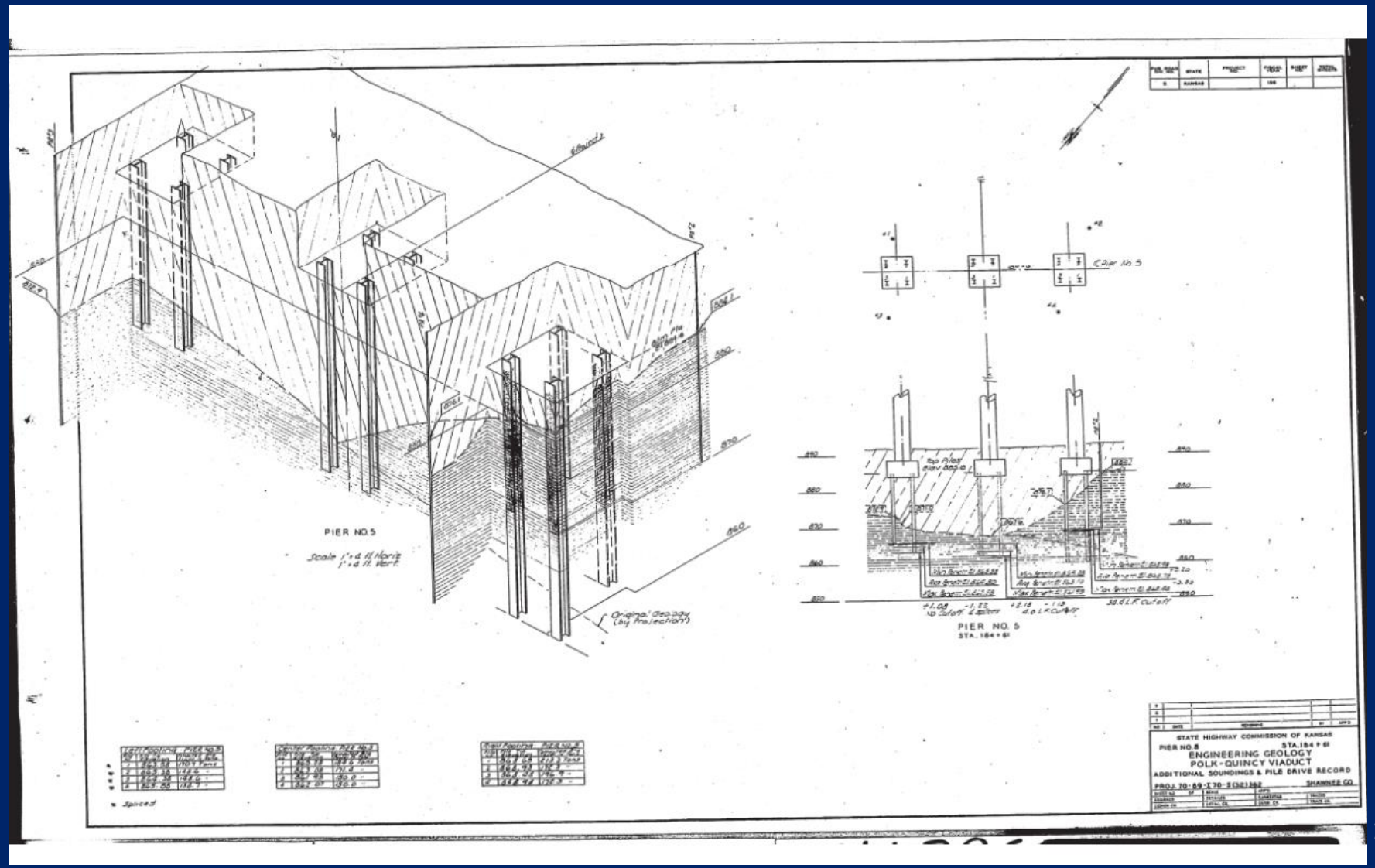
# Subsurface Profile Variability



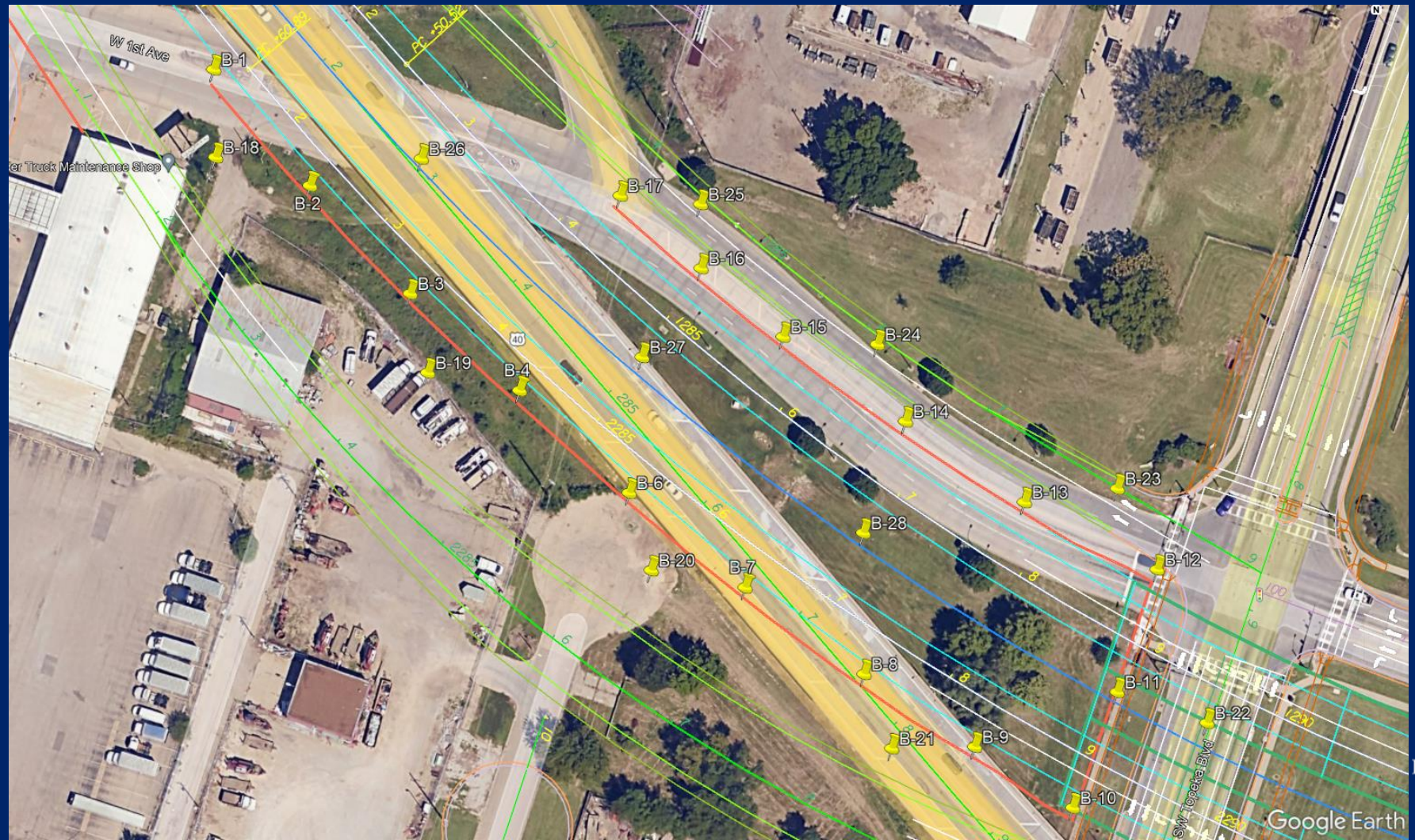

AD ASTRA PER ASPERA
Kansas
Department of Transportation

# Subsurface Profile Variability



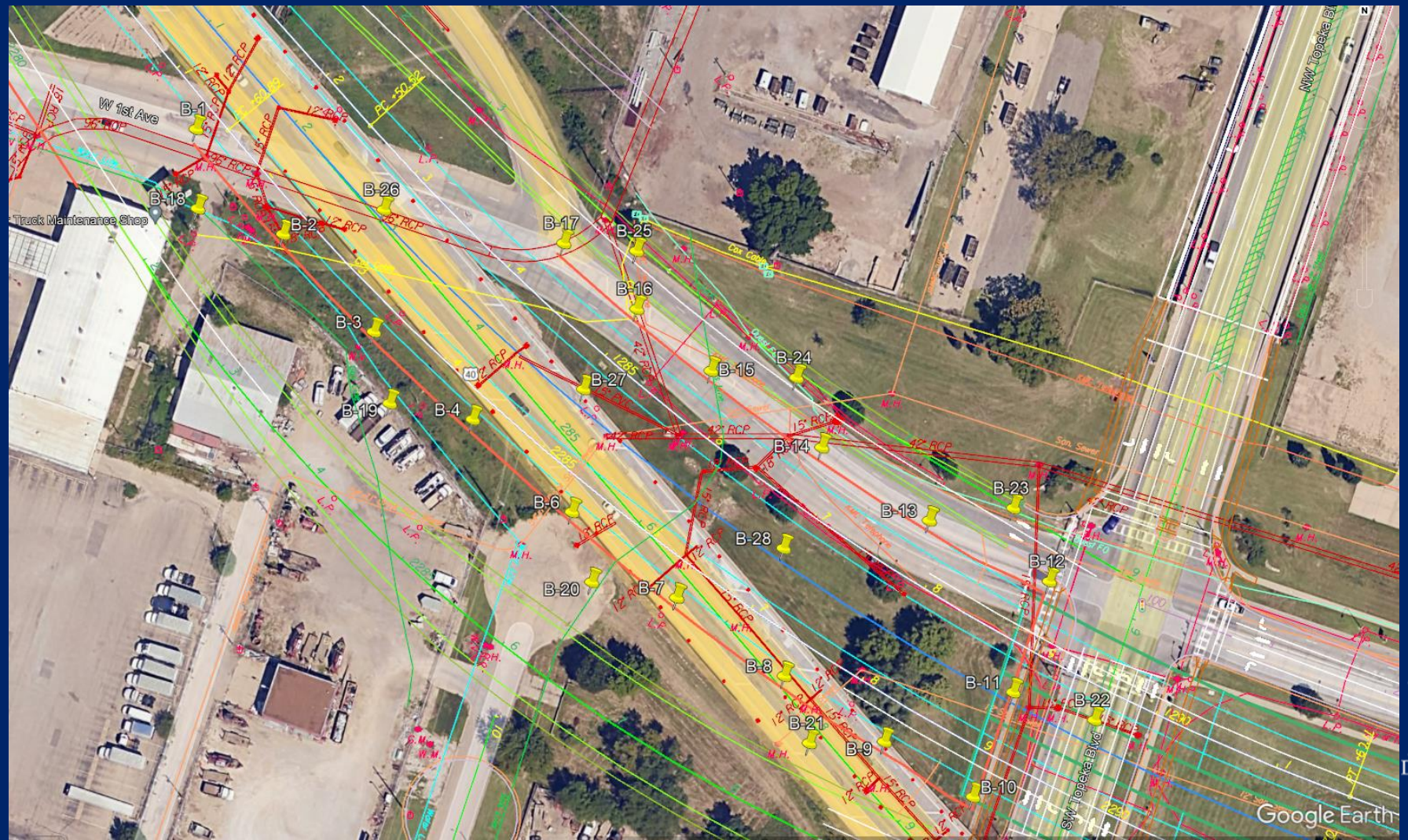

Kansas Department of Transportation

# Minimum Work Requirements



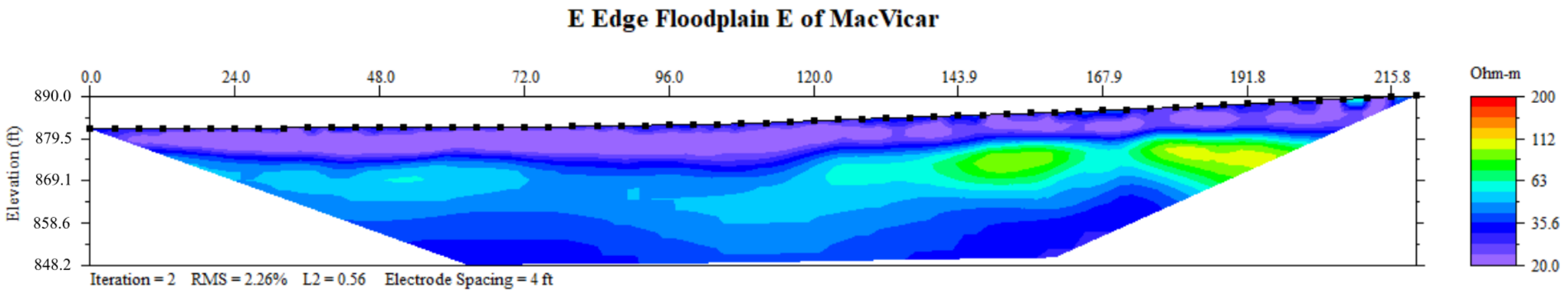

Kansas Department of Transportation

# Minimum Wall Investigation Complications



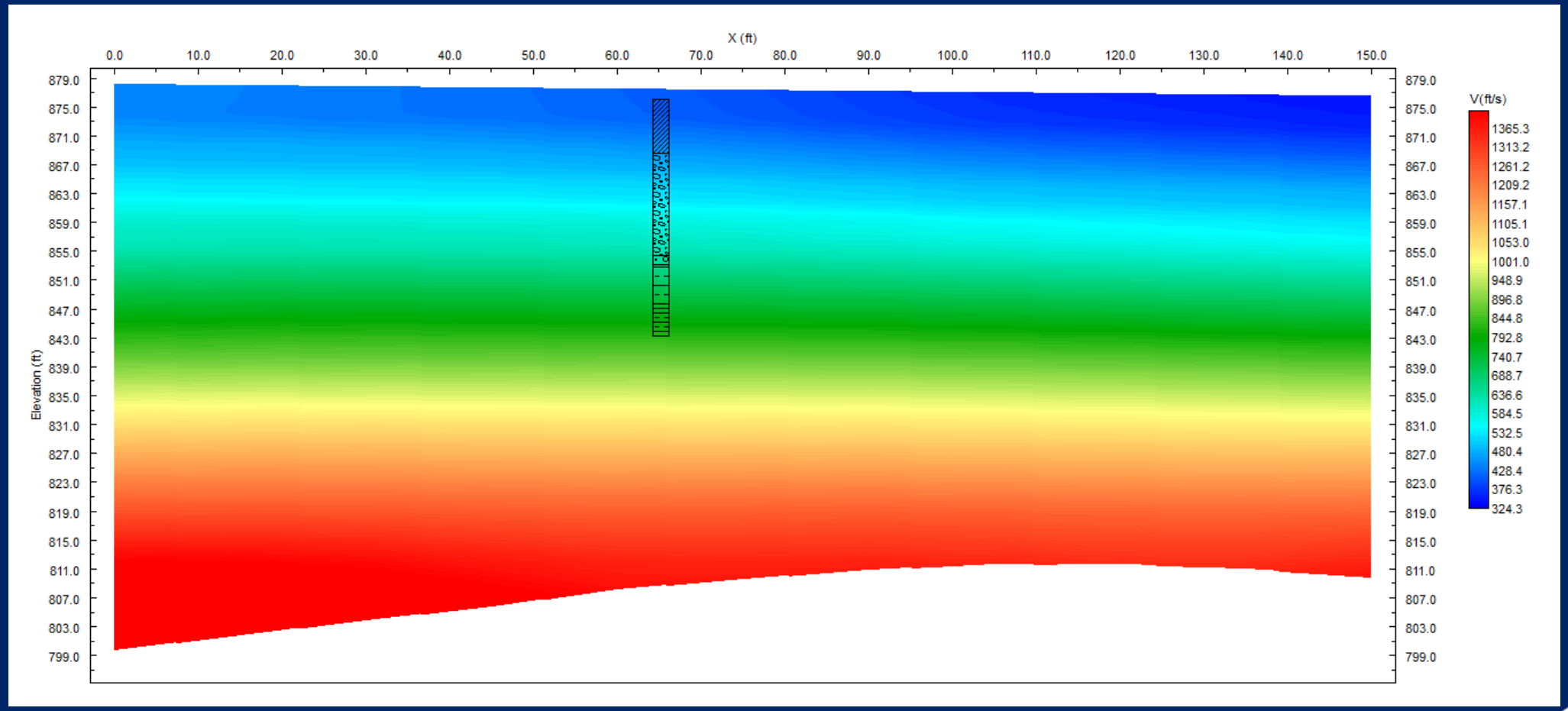

Kansas Department of Transportation

# Subsurface Profile Variability



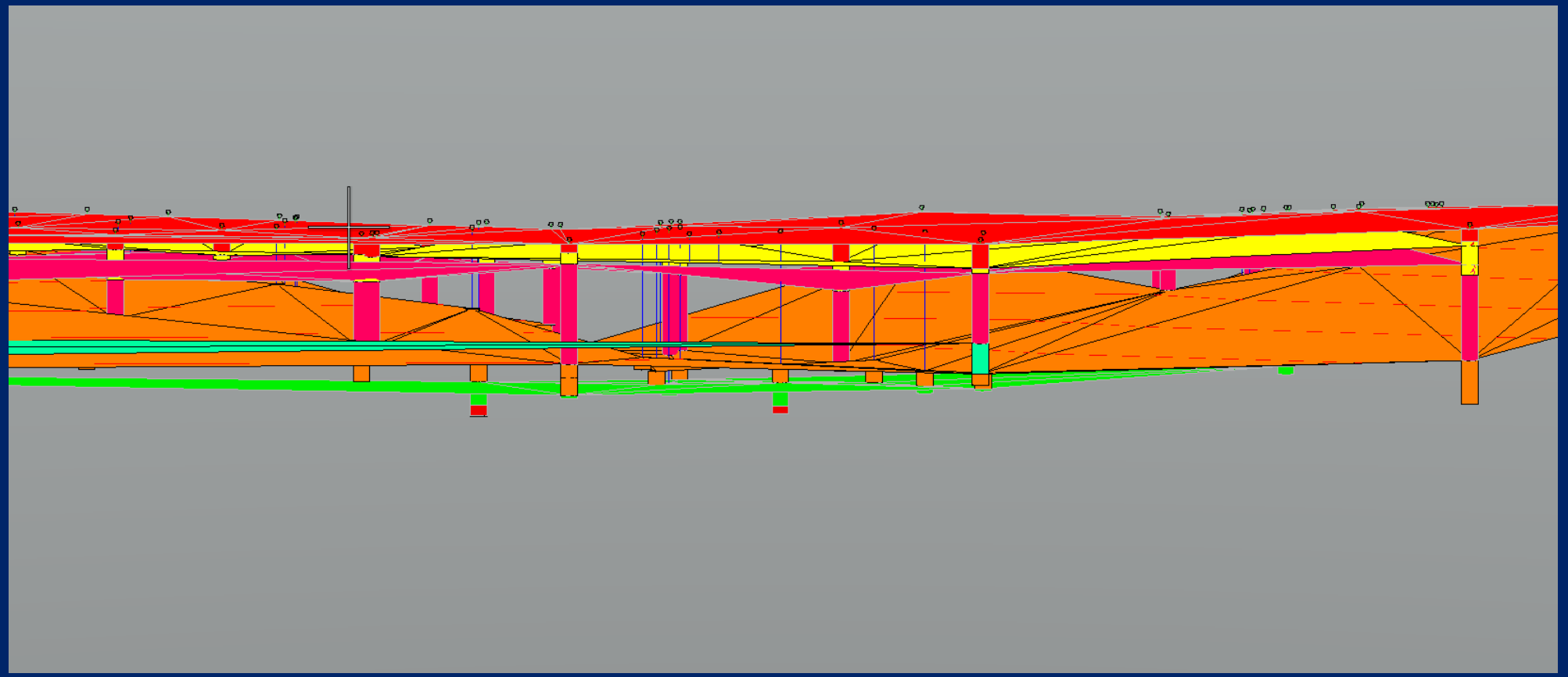

Kansas Department of Transportation

# Subsurface Profile Variability



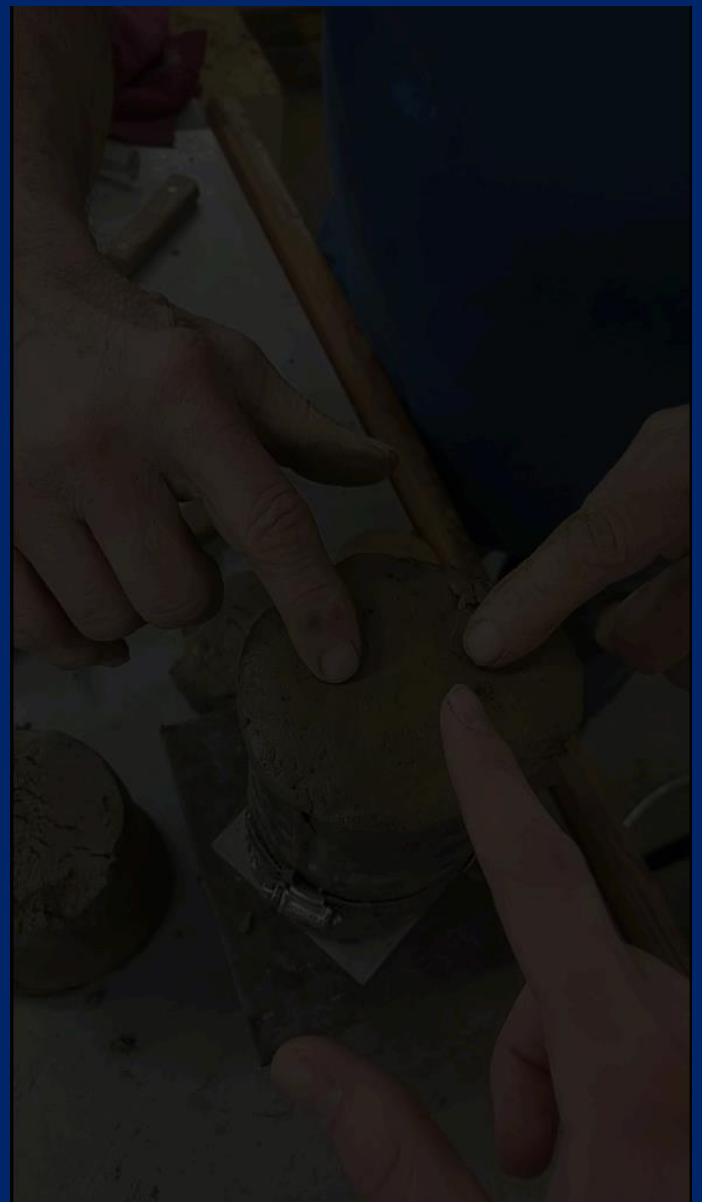

Kansas Department of Transportation

# Subsurface Profile Variability



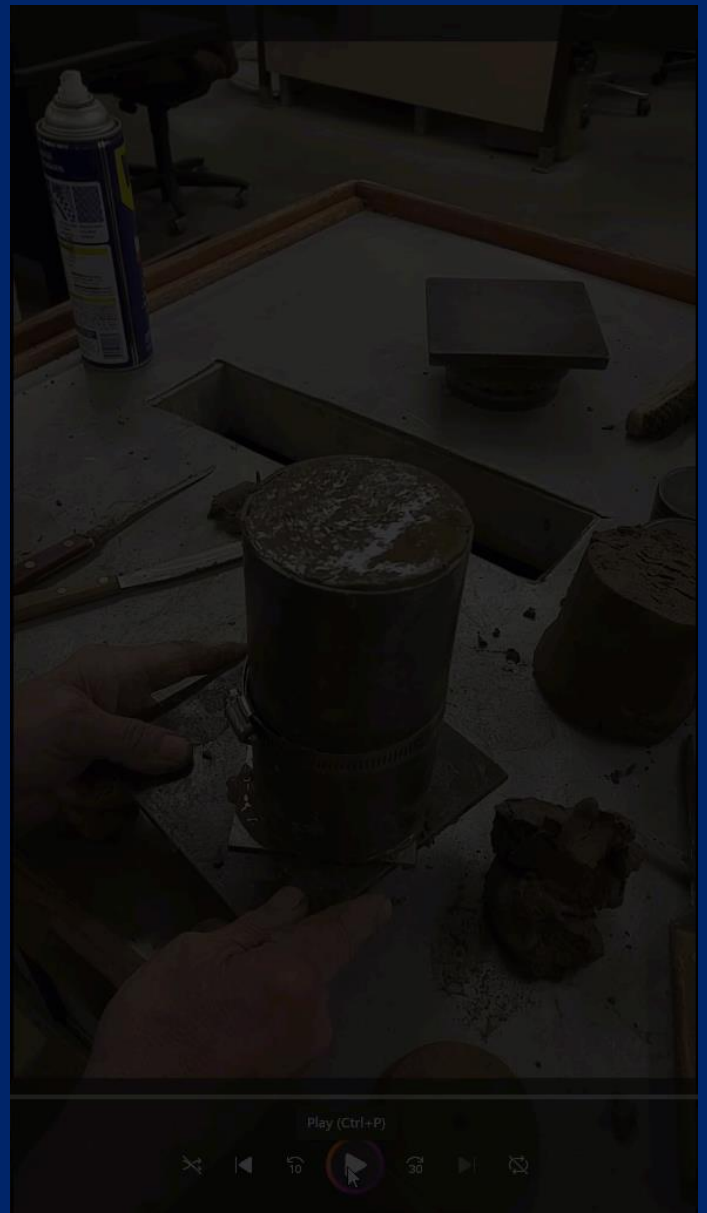
Kansas Department of Transportation

# Subsurface Profile Variability



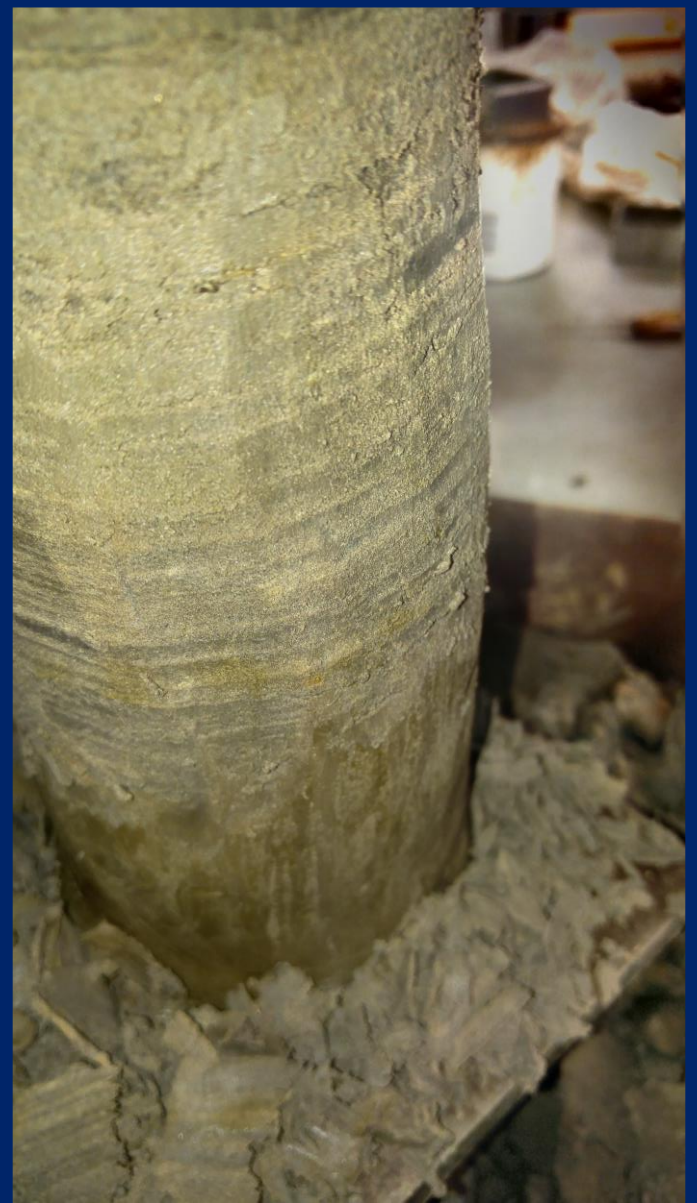
Kansas Department of Transportation

# Subsurface Profile Variability



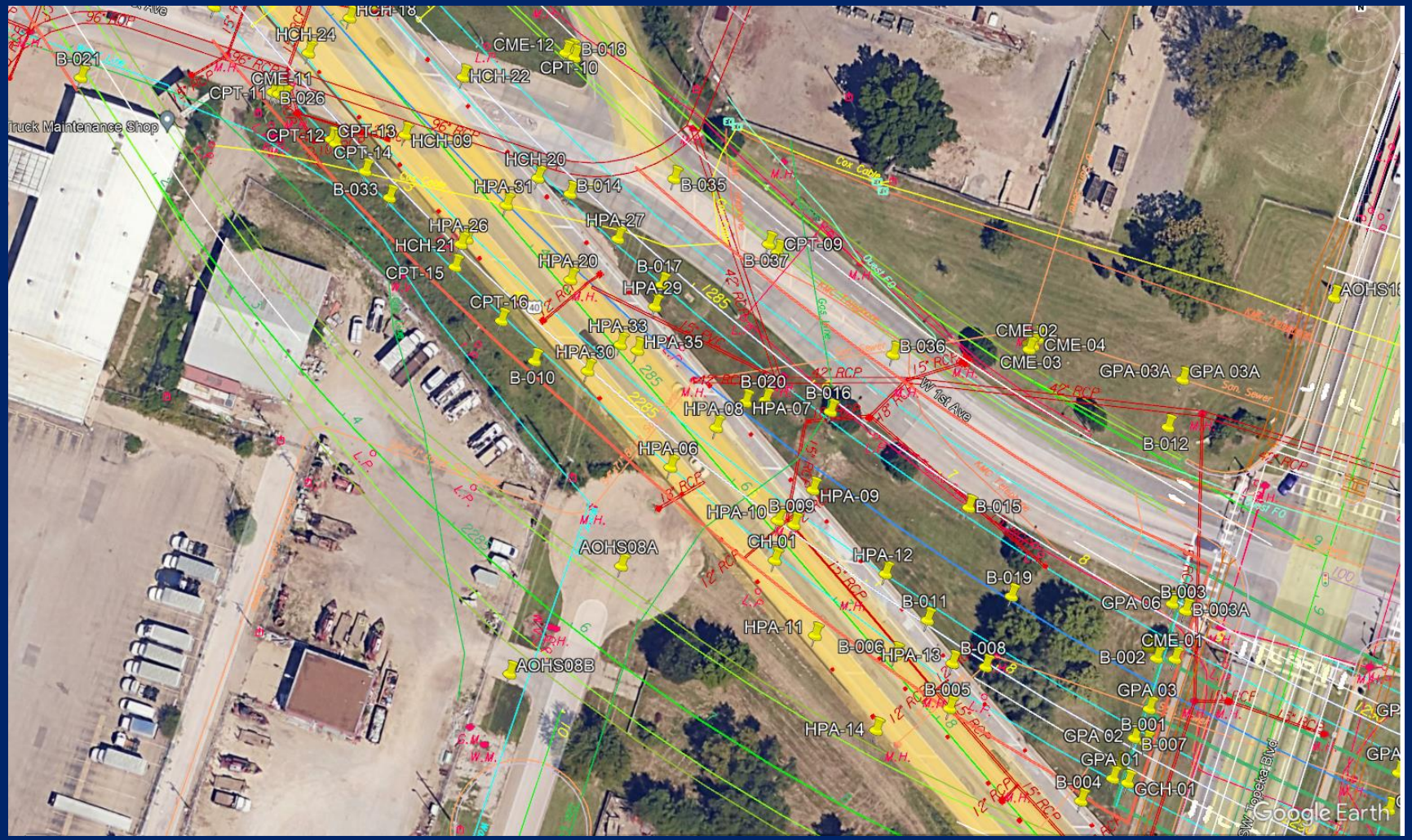

Kansas Department of Transportation

# Subsurface Profile Variability



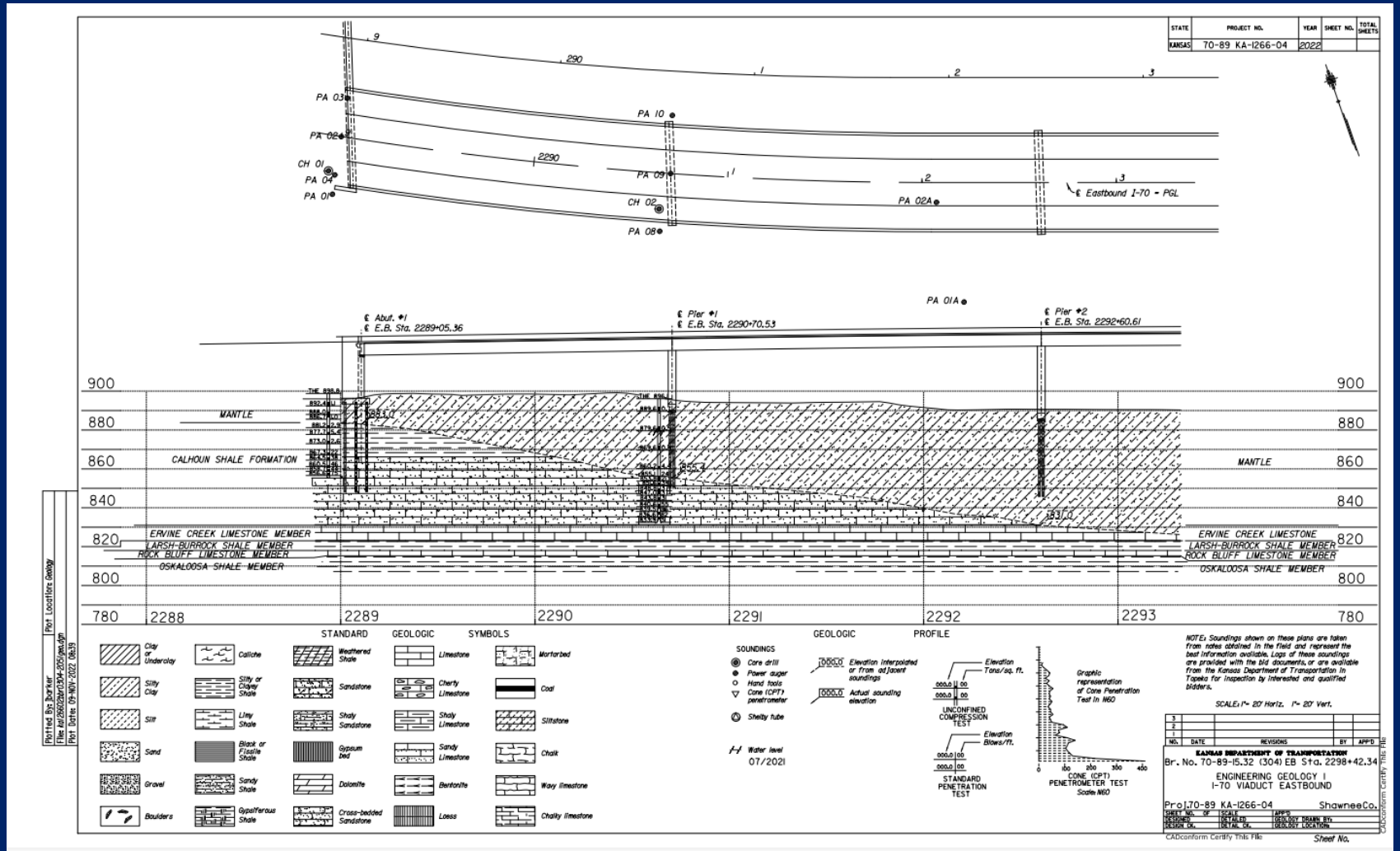
Kansas Department of Transportation

# Subsurface Profile Variability



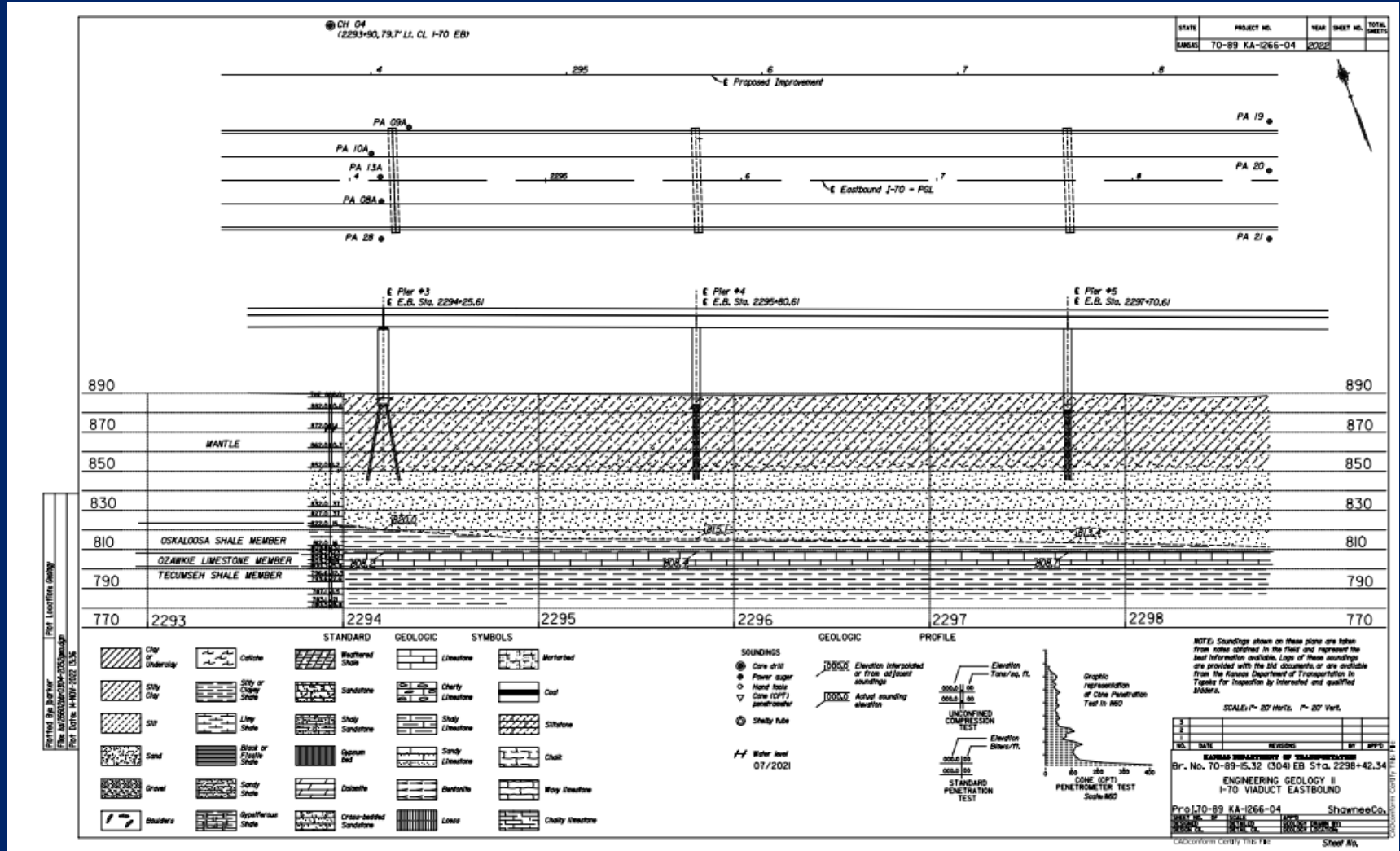

Kansas Department of Transportation

# Subsurface Profile Variability



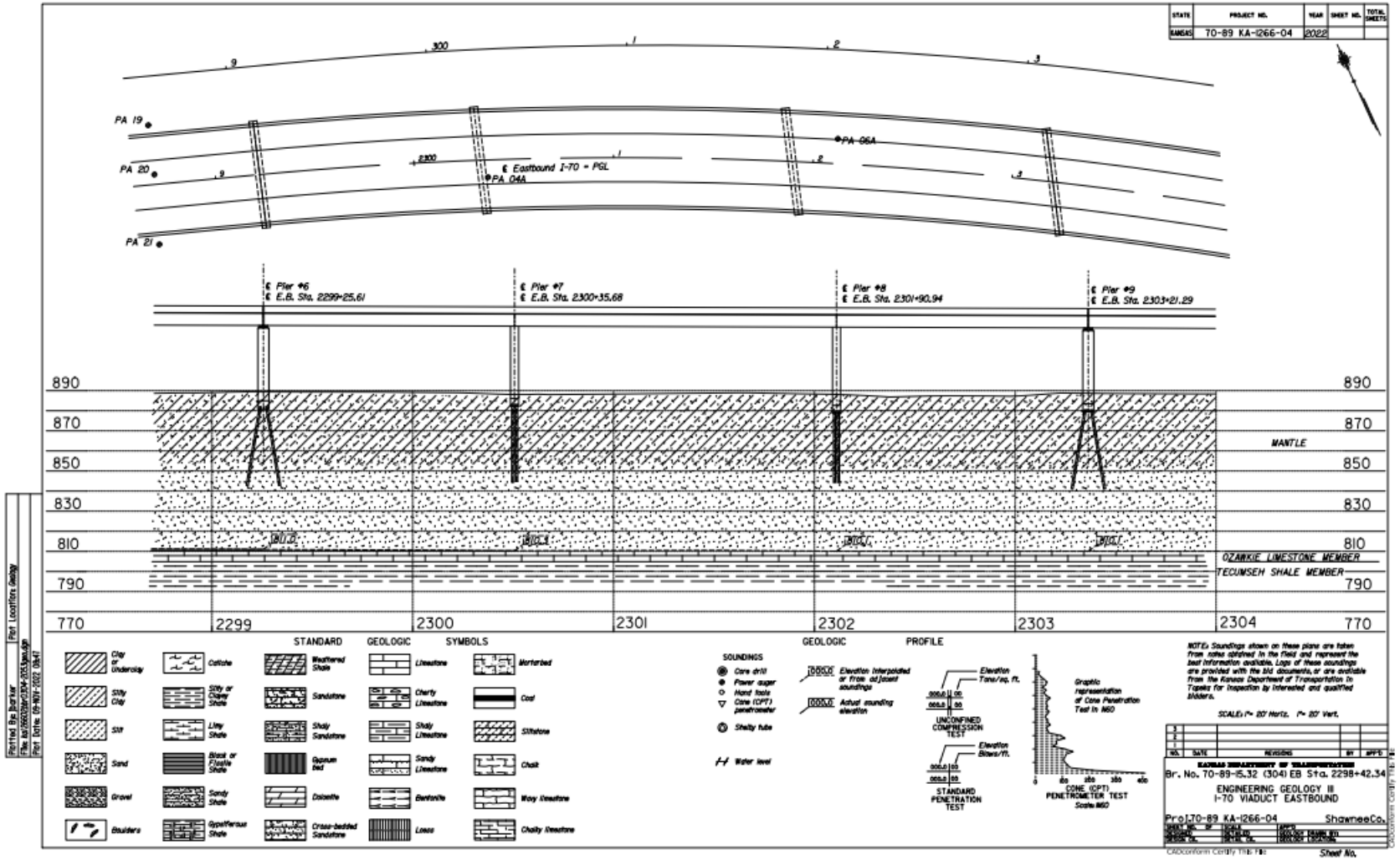

Kansas Department of Transportation

# Subsurface Profile Variability



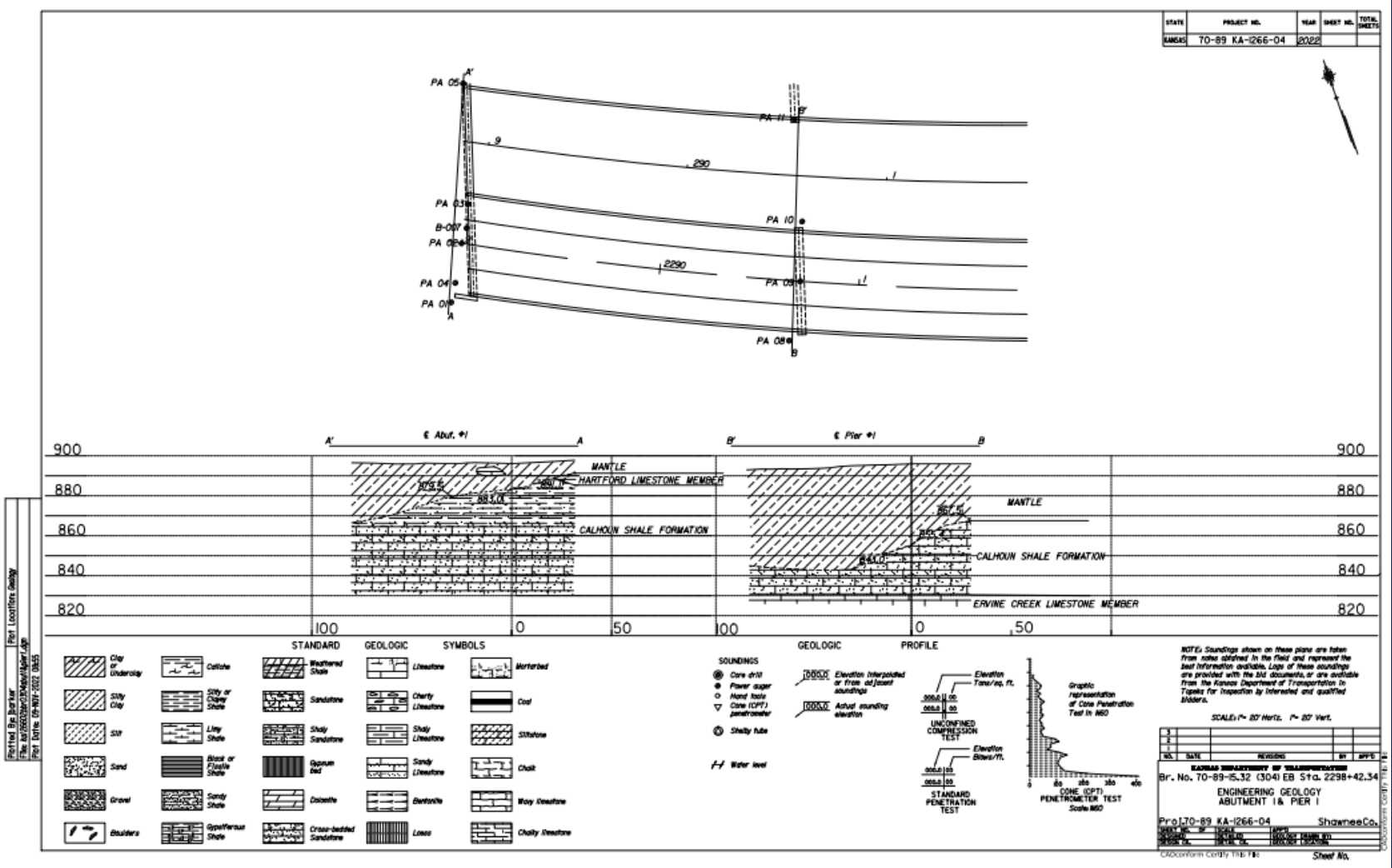

Kansas Department of Transportation

# Subsurface Profile Variability



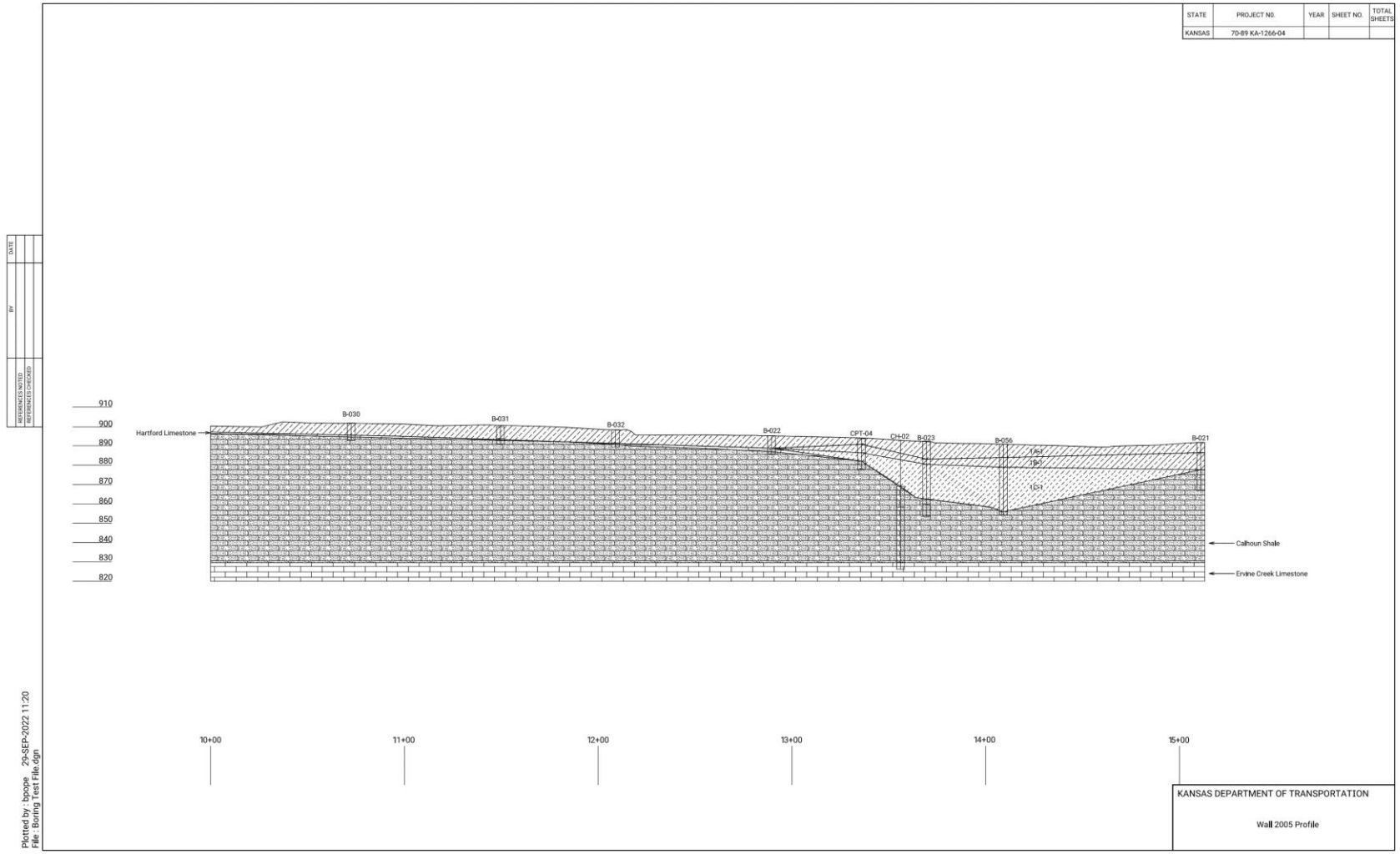

Kansas Department of Transportation

# Subsurface Profile Variability



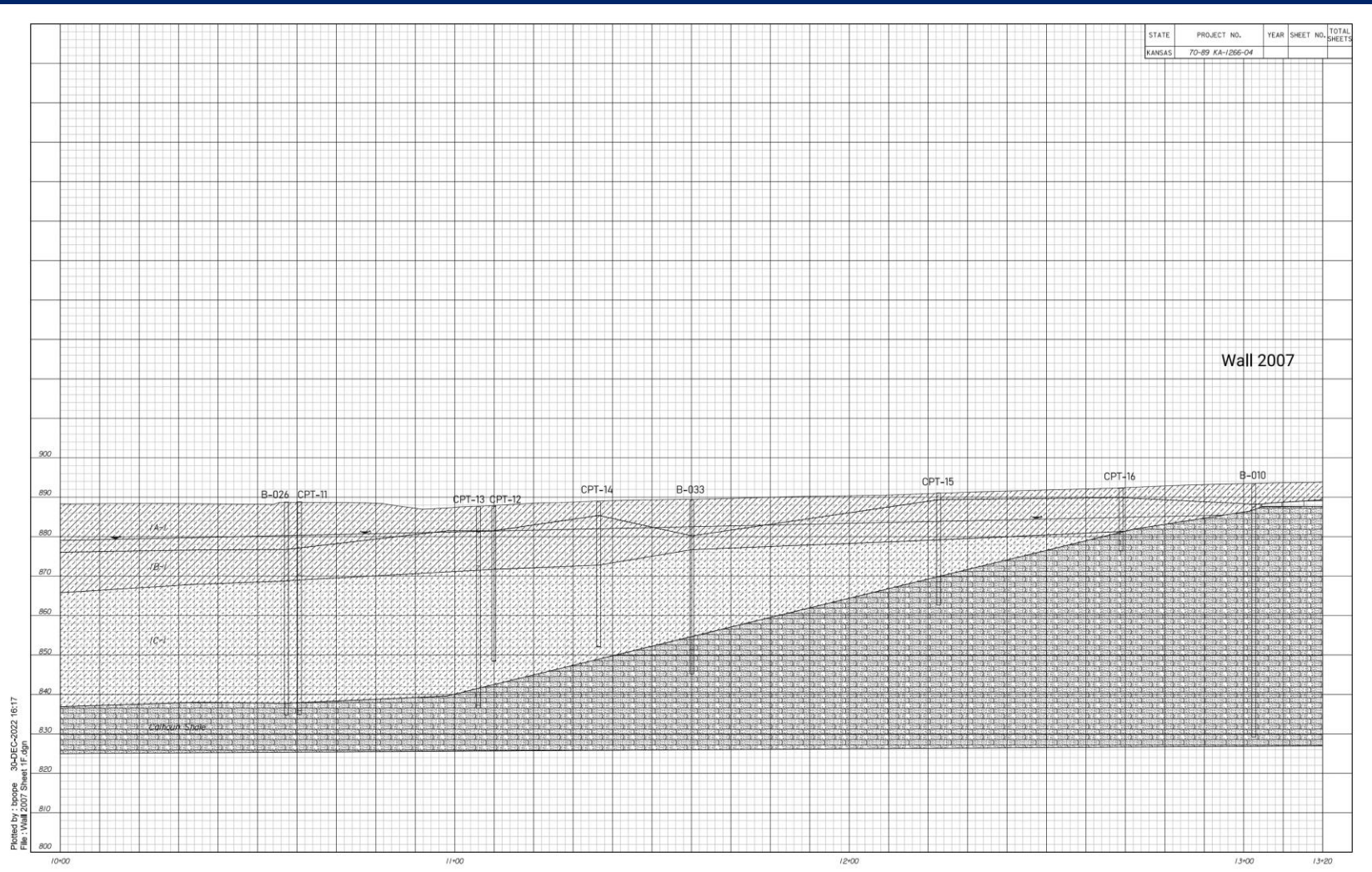

Kansas Department of Transportation

# Subsurface Profile Variability



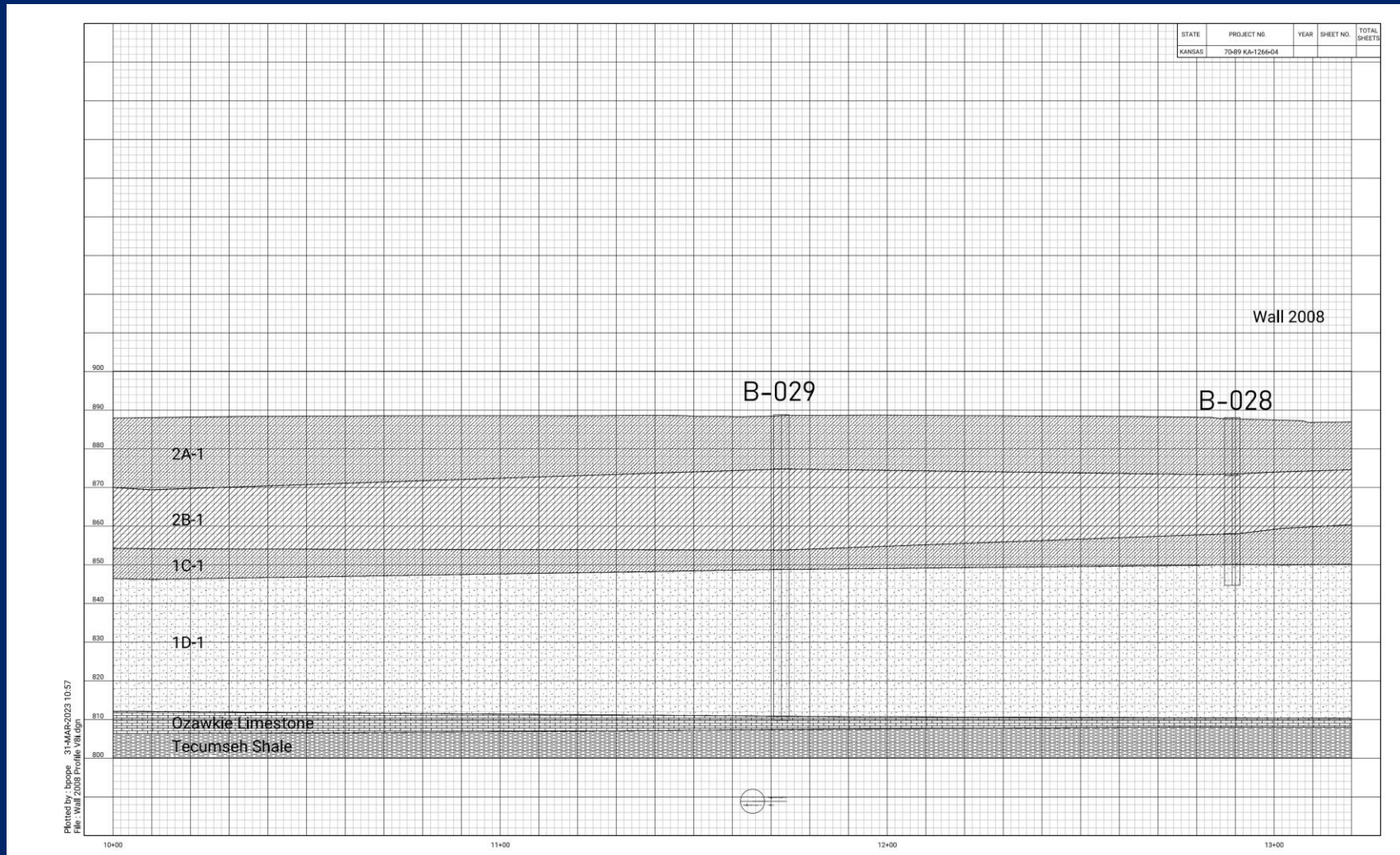

Kansas Department of Transportation

# Subsurface Profile Variability



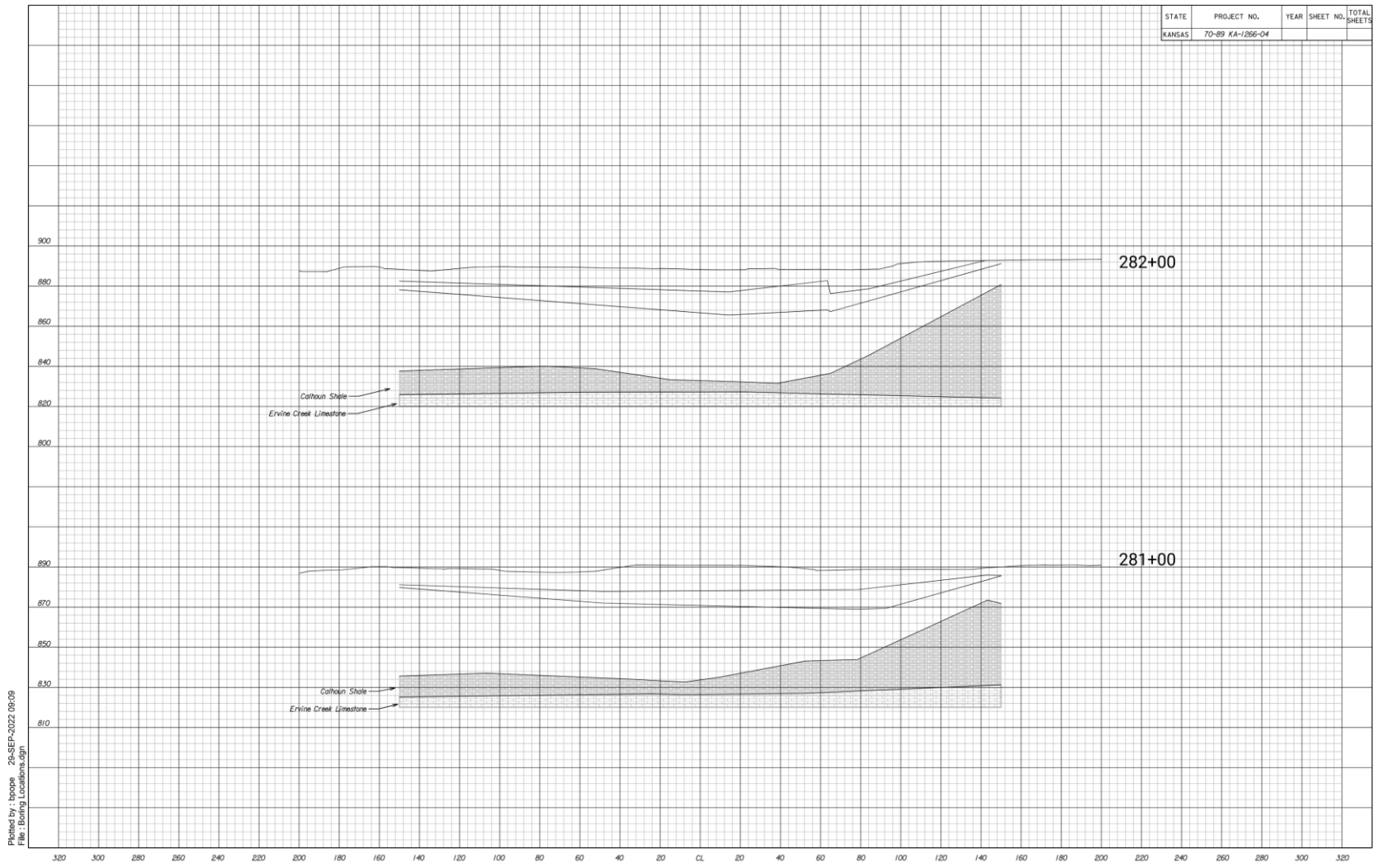

Kansas Department of Transportation

# Subsurface Profile Variability




Kansas Department of Transportation

# Subsurface Profile Variability




Kansas Department of Transportation

# Example Project Summary

- Due to site complexity and variability
  - 11,518.9 linear feet of drilling
  - 245 Shelby tubes taken
  - 66 SPT samples
  - 145 feet of rock cores
  - 182 RTN’s ran
  - 101 Direct Shears
  - 79 UU Triaxial
  - 36 Soil QU’s
  - 147 Rock QU’s
  - 24 CIU Triaxial
  - 40 Consolidation Tests
  - 16 Permeability Tests
  - Over 1 mile of geophysical studies

Kansas Department of Transportation

# Why Do More Than The Minimum?

- Risk Reduction
  - Identify Variability
    - Design/Plan for Variability

Kansas Department of Transportation



AD ASTRA PER ASPERA
Kansas
Department of Transportation


Questions?
487-0031